WOR OFFICE MESSAGE

DATE Apr. 1 1942 19

TO Chas. Singer FROM S. Gamblin

Re: Method of Putting Screws in Plaster Wall

Have discovered by trial and error, that the best method of securing wood screws in the plaster walls of the station is as follows.

Drill a hole in the plaster, using high speed electric drill, the same size as the screw to be used. If the hole is smaller than the screw, the plaster will crack and flake off around the hole. Also wobbling of the drill, as in using a hand drill, will break the plaster.

Using a tube of Carron Fabric Cement, or the equivalent, inject a small quantity into the hole. Roll up a piece of rag the size of a match stick and insert in hole. Apply cement to the screw before inserting it.

This method has been used successfully several times, and the information is passed along for future reference.

Mr. Singer: Is this any merit for Routine Book - Rob 4/2/42

Yes in book II 15 — Gantoal —

INSTRUCTIONS

IDEAL VOLTMETER TESTER #41
For Use With
Ideal Storage Battery #44

A resistor of 4.3 ohms (the equivalent in resistance to the 1.93 Volt Lamp), is connected in parallel to this voltmeter so that with the following known values, the condition of an IDEAL Storage Battery, #44, can be easily determined.

A FULLY CHARGED BATTERY should read approximately 2 Volts or better. If read immediately upon being removed from the Charger, it may show a somewhat higher reading for a brief period. Battery is not completely charged if reading is below 1.98 Volts.

A reading of 1.94 to 1.96 indicates 3/4 charge; 1.85 to 1.87, 1/2 charge; 1.76 to 1.78, 1/4 charge. This charge is based on a recommended cutoff point of 1.7 volts, although the Cell will continue to give a diminishing light down to 1 volt.

Approximate readings are given here as allowance is made for slight variation between Cells and in the meter.

IMPORTANT

If, after proper charging time, a Battery fails to show full charge, clean the Charging Clip. Due to the low charging voltage, 2.3 volts, a very slight film on the contact clip can sometimes prevent the Battery from receiving full charging current.

IDEAL COMMUTATOR DRESSER CO.
Sycamore, Illinois

FORM BTI-1041

#62

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IDEAL COMMUTATOR DRESSER CO.
Sycamore, Illinois

FORM BTI-1041

#62

GENERAL USE OF THE IDEAL FLASHLIGHT STORAGE BATTERY

The following should be of interest to anyone running tests or handling a large quantity of Batteries.

For heavy use such as meter reading, inspection service, etc., the IDEAL Storage Battery is not only much more economical than other cells, but it also provides a more uniform light. However, its handling must be approached from a fresh viewpoint and should not be confused with previous methods established for dry cells.

Actually, its care is simple and if correctly understood, takes little time, but the fact that it is different from dry cells must be considered when Batteries are first being put into service. Satisfied customers are enthusiastic because they have learned how to secure the benefits claimed for the Cell, but those who have tried to use it as they did dry cells have frequently failed to obtain these advantages.

The 1.93 Volt (#195) Special Screw Base Mazda Lamps are compared generally with the #14 standard dry cell lamp. In heavy service, all efforts in the past have been directed to getting the longest possible use commensurate with good light out of one set of dry cells. The Bureau of Standards recommends a cut off point of 1.8 Volts for two industrial dry cells(size D). At closed circuit voltage on the #14 Lamp, this is an approximate drop of .9 Volt. Discharge recommended for the IDEAL Cell on closed circuit with 1.93 Volt #195 Lamp, starts at 2 to 2.1 Volts and runs to a suggested cut off of 1.7 Volts. At these latter voltages, the rated candle power output of the #195 Lamp used with the IDEAL Cell is greater than the #14 with dry cells. This is a drop of .4 Volt for the IDEAL Battery against .9 Volt for the 2 dry cells.

But - there is no reason why the Storage Cell should be run down even to 1.7 volts. Recharging the Battery frequently when the charge is only partly used has a tendency to keep it at a high state of efficiency as well as providing the user with bright and uniform light. Therefore, routine should be worked out to take advantage of this important quality. There are no specific number of charges in a Storage Cell. History shows many heavily used Batteries have not only given excellent service, but have lasted well in the matter of time. A routine using up a set of dry cells every 4 days may be replaced by charging the Storage Cell every 3 days or possibly every 2 days. This means the user has a fresh battery with consequent bright light and large reserve.

Within a short time, the storekeeper handling a quantity of Cells learns to obtain the best results, and to pick up a naturally easy and quick system of care. The instructions accompanying each Battery do not have to be strictly followed

so long as the Battery is charged enough and has sufficient saturation. A Battery charged frequently does not necessarily have to be checked for saturation each time, even when free liquid does not show. The directions merely provide a basis from which to start.

There will be some small variation in capacity between Cells, part of it due to charging. The conditioning charge is recommended to offset possible under saturation and undercharging. It brings back Cells which have remained too long in a discharged or semi-discharged condition. The directions are intended to give an understanding of the simple but necessary essentials in the Battery's care.

A volt meter reading to .05 of a Volt and connected to a 1.93 V. lamp or 4.3 ohms resistor can be of much aid to the storekeeper in charge of Batteries, as after a short time, he will be able to tell at a glance the condition of each Cell before it is put into service.

IDEAL has available a Battery Tester consisting of a small 3 (DC) Volt Meter in parallel with 4.3 ohms resistance and provided with convenient connections. It is recommended wherever a quantity of Cells are in use.

See Instruction Sheet attached.

Storage Battery Division
IDEAL COMMUTATOR DRESSER CO.
Sycamore, Illinois

FORM-FBI-342

#234

DIRECTIONS

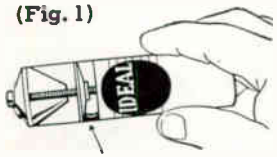
IDEAL (Quirk Rechargeable) BATTERY

FIRST–

Before Putting Your Ideal Battery Into Service Do These Four (4) Things:

1. Check Saturation

(Fig. 1)

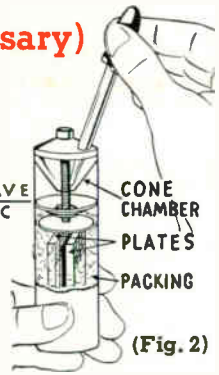


A FEW DROPS only of Free Running Liquid Indicates CORRECT SATURATION.

Correct saturation is indicated by a **few drops of free running liquid** in bottom chamber (Fig. 1) when Battery is inverted and gently shaken. If "check" does not show this free liquid (few running drops only), add distilled water. DO NOT OVERFILL or spill-proof device may become ineffective.

2. Add Distilled Water (if necessary)

To add water, unscrew filler cap and insert medicine dropper **(half full)** as far as possible. Press bulb gently forcing water through cone chamber (Fig. 2). If water collects on concave disc, tip Battery sideways until water runs into bottom chamber. Allow a few seconds for water to settle through packing surrounding Battery plates and again check saturation as above. Add more water if necessary until free drops show, but — DO NOT OVER SATURATE.



(Fig. 2)

3. Charge

After your check-up shows proper saturation, then charge the Battery in an IDEAL Charger for 48 to 60 hours before using and thereafter always follow instructions on right hand page under the heading "SECOND".

4. Use Recommended LAMPS

Only Mazda Lamps designed for this Battery should be used. Either a 1.93 V., .45 ampere Screw Base Lamp or a 1.90 V., .6 ampere Flanged Base (Pre-focussed or Fixed Focus type) is available. DRY CELL LAMPS ARE NOT RECOMMENDED for they do not burn brightly with the IDEAL Battery.

SECOND–

To Maintain Your Ideal Battery At High Efficiency Follow Instructions Below:

Charge Frequently with "NORMAL CHARGE"

(Daily or Weekly Routine—dependent upon use).

With Battery in constant service, it should be charged frequently to assure a bright, uniform light. **A "Normal Charge" is as follows:**

1. **Charge with IDEAL Charger for 12 to 16 hours.**
2. ✻ **After Charging, CHECK SATURATION and add water if necessary (as shown on left hand page).**

Charge Every 30 Days with "CONDITIONING CHARGE"

Whether in use or not, the IDEAL Battery should have a CONDITIONING CHARGE of 48 to 60 hours at least **every 30 days** to keep the Battery up to top capacity. **A "Conditioning Charge" is as follows:**

1. ✻ **BEFORE CHARGING, CHECK SATURATION and add water if necessary (as shown on left hand page).**
2. **Charge on IDEAL Charger for 48 to 60 hours.**

✻ Liquid increases on short charging periods, but decreases on long charges. Therefore, add water only after charging for "NORMAL CHARGE" and before charging for "CONDITIONING CHARGE".

NOTE: If liquid collects in cone chamber during charging (from overfilling) force liquid back to lower chamber with dropper.

Battery should not be allowed to remain in a discharged condition.

LONG OVERCHARGING on IDEAL Charger does not injure the Battery, but the Battery must be kept properly saturated (Fig. 1) otherwise, it will have a short discharge life and give poor light. Charger may be left continuously connected as practically no current is used. But, do not leave Battery in Charger with current "off" as it will slowly discharge.

Keep top and bottom charging clips clean. Always wipe off top of Battery after charging.

D.C. CHARGING RATE—Correct charging rate on D.C. supply is 200 milliamps. **Positive Pole is on bottom.**

See Other Side for Causes and Correction of Poor Light

FACTS YOU SHOULD KNOW

How long can the IDEAL Battery last?

Up to several hundred cycles or more of discharge (one to three years average service) with proper care.

How long does a charge last?

In heavy service, a single discharge of a properly conditioned IDEAL Battery is equal to the practical use of two ordinary commercial dry cells (1¼" size D) which it replaces.

Does the Battery have to be discharged before charging?

No — charging the IDEAL Battery frequently keeps it in excellent condition. Just be sure of correct saturation.

Does care of Battery take much time?

No — little time is required and then only at convenient periods. Storeroom keeper can easily service a large number of Batteries on an allowance of about ½ minute each per charge.

Does free liquid always have to be visible?

No — it is only necessary that packing around plates be saturated. The way to be sure of correct saturation is the visual test of a few running drops.

What causes poor light or short discharge capacity?

(a) Improper lamp — or lamp may need to be replaced as it gradually loses efficiency with long use.
(b) Improper charging and insufficient saturation.
(c) Poor charging contact. Even a slight film of dirt on the Charger clips can prevent the Battery from getting full charging current because the voltage is low.

How can the efficiency of this Battery be checked?

In proper condition and using a 1.93 volt, .45 amp. lamp, it should burn continuously for approximately four hours or more with good light, or if voltmeter is available, from 2 to 2.1 volts down to a recommended cut off point of 1.7 volts, closed circuit. To increase light and capacity, check saturation and give "CONDITIONING CHARGE". For handling a quantity of Cells, we recommend a Battery Tester which tells at a glance the condition of the Battery.

If Battery is out of service for months without charging or water, is it permanently damaged?

In most cases, it can be brought back to serviceable capacity. Give "CONDITIONING CHARGE" (see directions) and then burn continuously in flashlight for about three hours using the 1.93 volt lamp. Again give "CONDITIONING CHARGE". Repeat if necessary to bring the Battery back to proper capacity.

How long will the A.C. Charger last?

It is a transformer with rectifier plates and should last for years.

NOTE: The IDEAL Battery contains diluted sulphuric acid which is harmful to most materials. If liquid leaks out due to overfilling, apply at once, ammonia or baking soda with water to the material affected to prevent damage.

Storage Battery Division
IDEAL COMMUTATOR DRESSER CO.
SYCAMORE, ILLINOIS, U.S.A.

PRINTED IN U.S.A.

Form BI-8

CAUTION!

Follow These IMPORTANT DIRECTIONS

Your IDEAL Storage Battery is a permanent and valuable piece of flashlight equipment. *It is rechargeable*, and therefore, requires a different method of handling than other types of flashlight cells.

Your IDEAL Battery has the potential of hundreds of hours of bright light. Do not use until light is dim, but *charge frequently* at convenient intervals to obtain full benefit of its natural advantages. Enjoy the pleasure of a fresh Battery and a bright light — ALWAYS!

Storage Battery Division
IDEAL COMMUTATOR DRESSER CO.
SYCAMORE, ILLINOIS, U.S.A.

KEEP FOR PERMANENT REFERENCE

INSTRUCTIONS

Installing *and* Operating

Exide
BATTERIES

In Aircraft Service

Type XT Battery

THE ELECTRIC STORAGE BATTERY CO.

PHILADELPHIA, U. S. A.

FORM 2754 Fifteenth Edition JANUARY, 1940

RATINGS

Based on electrolyte temperature of 80° F. at beginning of discharge and on full charge specific gravity of 1.300. See Par. 7.

TYPE OF CELL*	Plates Per Cell*	CHARGE RATE (Par. 10)	DISCHARGE CAPACITY (Paragraph 8)					Max. Water (Par. 11) Pints Per Cell Per Month
			5-Hour		20-Minute	3-Minute	75 Amps. For	
		Amperes	Ampere Hours	Approx. Points in Gravity	Amperes	Amperes	Minutes	
Double Chamber Non-Spillable Types								
AC	7	1	10	135	15	36		.04
	11	1¾	17	176	25	60		.07
TS	7	1¾	19	113	30	75	3½	.08
	13	3½	38	180	60	150	14	.16
TX	9	3	29	160	50	133	10	.12
	19	6½	65	162	112	300	33	.27
XT	13	5½	65	150	100	275	30	.27
Shielded†, Non-Spillable Vent Plug Types								
6-ACS-7	7	1	10	135	15	36		.05
6-TAS-9	9	3½	34	180	54	144		.15
6-TAS-17	17	7	68	200	108	288		.30
Heavy Duty Aircraft Transport Type								
FHM	13	7½	88	190	140	360	46½	.36
Limiting Volts per Cell (approx.)				1.75	1.50	1.20	1⅔	

* To identify type and plates per cell, note the marking molded on container or on the nameplate. For example, 6-XT-13 means 6 cells type XT, 13 plates. Look for XT 13 in table.

† Shielded against electrical interference of radio circuits, see page 16.

In addition to the above batteries installed on aircraft, Exide supplies ground-cranking batteries to be installed on small carts. Instructions for the care of ground-cranking batteries are covered by Form 2399.

HOW TO INSTALL

(For Shielded† Batteries, also see Special Notes, Page 16)

1. Unpacking—Freshening Charge

Exide batteries are shipped fully charged and with electrolyte in the cells.* Upon arrival, examination may show that electrolyte has accidentally spilled. In this situation, fill with electrolyte of same gravity as in surrounding cells.

During transit the battery may have lost some of its charge. If specific gravity of electrolyte is below 1.250, give a freshening charge.

2. Battery Location

The battery compartment should be ventilated, dry and clean. The battery should not be near apparatus that will unduly heat it; its temperature should be kept below 110° F. Its location should be accessible to permit inspection, adding water, and removal.

The battery should be seated evenly, firmly. It should be fastened down by suitable holding devices for a *snug* fit, not necessarily the tightest fit. Do not put much pressure on the rubber containers.

If holddowns are used on batteries equipped with handles, apply holddown inside hole of handle. Do not apply to top of handle.

U. S. Department of Commerce requirements for the installation of aircraft batteries are in Civil Air Regulations, amended to May 31, 1938, paragraph 04.5821, which reads:

"Batteries shall be easily accessible and adequately isolated from fuel, oil, and ignition systems. Adjacent parts of the aircraft structure shall be protected with a suitable acid-proof paint if the battery contains acid or other corrosive substance and is not completely enclosed. If the battery is completely enclosed, suitable ventilation shall be provided. All batteries shall be so installed that spilled liquid will be suitably drained or absorbed without coming in contact with the airplane structure."

* If shipped without electrolyte for special reasons, a tag is attached to the battery giving instructions for filling and charging.

† Shielded against electrical interference of radio circuits.

3. Connections to Battery

Battery cables must be flexible and sufficiently long to prevent a pull on the battery terminals and they should be anchored and protected where they pass through the battery compartment walls to prevent chafing of insulation. Any special terminals for connecting to the battery should be clean and in good mechanical condition.

If two or more battery trays are to be connected in series, the positive terminal of one should connect with the negative terminal of the other. The positive terminals are painted red on top or are marked POS or +; the negatives are painted black or are marked NEG or —.

Connections from the generator or regulator are made by connecting the positive lead to the positive terminal of the battery and the negative side of the system with the negative terminal of the battery. If one side of the electrical system is grounded, the ground connection should be accessible and examined occasionally.

4. Greasing Bolted Connections

For permanently clean bolted connections, the surfaces to be in contact should be cleaned by scraping lightly. Then apply a film of No-Ox-Id grease or vaseline to the cleaned surfaces, also to the bolt studs. After tightening, wipe off the surplus grease.

OPERATION AND MAINTENANCE

5. Condensed Maintenance Information

Exides are easily kept in good condition for a long time of trouble-free service if the following four simple rules are followed:

1. Maintain battery in a healthy state of charge. The method varies. See par. 10.
2. Add water at regular intervals. Par. 11.
3. Keep battery clean outside. Par. 13.
4. Keep a written record on the above items. Par. 17.

Exides have no moving parts; therefore, require no lubrication as a machine. If kept fully charged, they cannot freeze, therefore requiring no anti-freeze solution. The little care for

the large amount of work that they do makes Exides economical to operate.

There are some general characteristics of Exides which should be understood by all maintainers and these are discussed in paragraphs 6 to 9.

6. Hydrometer Readings—Specific Gravity

The specific gravity of the electrolyte in Exide batteries lowers on discharge and rises again on charge.*

Consequently if we know the specific gravity or hydrometer reading we can tell if the battery is fully charged or the amount it is discharged. The specific gravity is easily determined by allowing a hydrometer to float in the electrolyte. When the specific gravity is high or strong, the hydrometer will

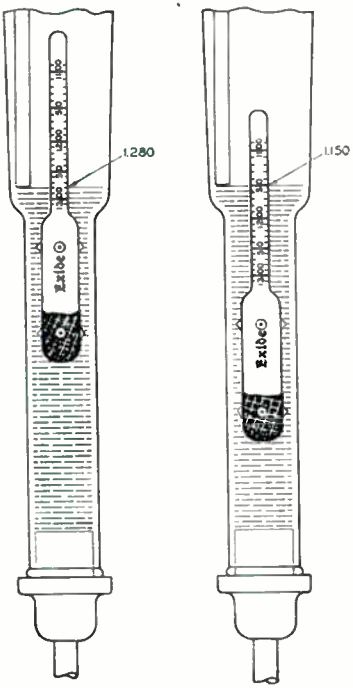


Fig. 1
Hydrometer Reading 1.280

Fig. 2
Hydrometer Reading 1.150

*Exide's booklet, "Fundamentals of a Storage Battery," Form 2480, explains this and will be supplied upon request.

not sink as far into the liquid or electrolyte as when the specific gravity is low or weak. See Figs. 1 and 2.

To take a hydrometer reading, insert the nozzle of the hydrometer syringe (Fig. 3) in the electrolyte, squeeze the bulb and slowly release it, drawing up enough electrolyte to float the hydrometer freely. It may be necessary to tilt the cells to obtain sufficient electrolyte for readings. Holding the syringe vertically, the reading on the stem of the hydrometer at the surface of the electrolyte is the specific gravity of the electrolyte. Then return the electrolyte to the same cell.

Fig. 3. Aircraft Battery Hydrometer Syringe Exide Type AS-2

Wash and clean hydrometers and barrels frequently. Dirty hydrometers read inaccurately.

Do not take hydrometer readings immediately after adding water. Allow a day or so for the water to mix with the electrolyte, otherwise the reading is false. If the battery is on charge and gassing, the water will be mixed within an hour.

Do not use the same cell each time to take the gravity readings. Change around to the various cells. This recommendation is made to avoid lowering the gravity of one cell due to possible loss of a small amount of electrolyte in taking gravity readings. Using all cells spreads the possible loss over all cells rather than have the loss taken by one cell.

7. Full Charge Specific Gravity

For the types shown on page 2, the specific gravity of the electrolyte with the cells fully charged and electrolyte at the high level (Par. 11) should be as shown in the table below for the temperatures indicated.

47° F.	**77° F.**	107° F.
1.285 to 1.310	**1.275 to 1.300**	1.265 to 1.290

This table shows the effect of temperature on the specific gravity reading. A change of 30° F. changes the gravity reading .010, or 10 points.

It is adjusted within the above limits at the factory and will not require adjusting during the life of the battery unless electrolyte is actually lost out. If it is necessary to adjust the specific gravity to bring it within the above limits, see paragraphs following.

To adjust low specific gravity, charge battery (for rate in amperes see page 2) until it is gassing and until specific gravity rises no higher over a 3-hour period. Then remove some electrolyte and replace with 1.325 electrolyte, repeating this step if, after an hour's charging, the specific gravity has not reached the desired value. Never adjust on a cell that does not gas.

To adjust high specific gravity, charge until battery is gassing and until specific gravity rises no higher over a 3-hour period. Remove some electrolyte and replace with water, repeating this step if, after an hour's charging, the gravity is too high.

8. Discharging Rates and Capacity

The capacity of a storage battery is measured in units of ampere hours, which is the product of the electrical current in amperes multiplied by the time in hours. For example, on page 2 an XT-13 battery has a capacity at the 5-hour rate of 65 ampere hours, or 5 hours x 13 amperes = 65 ampere hours. Although current may be obtained after the end of this time, the voltage of the battery has dropped to a point beyond which it is not very useful. For instance, in lighting service, because the lamps would become dim.

In an emergency, little if any permanent harm will result if the battery is discharged to the full amount that it will give, provided it is promptly recharged.

The ampere hours which may be obtained from a battery are greater for a long, low-rate or intermittent rate discharge than for a short high rate. This is because the voltage drops faster at the higher discharge rates (amperes).

High discharge rates (amperes) should not be confused with overdischarge (too many ampere hours taken out). An Exide battery may be discharged, without any injury to the

plates, at any rate of current it will deliver. The maximum permissible rate of discharge is limited only by the current-carrying ability of the wiring, motor or other apparatus to which the battery is connected or by the current-carrying ability of the cell terminals and connectors and not by the plates themselves.

Another indication which may be used in ascertaining when the discharge should stop is the drop or difference between the full charge specific gravity and the discharge specific gravity. This drop varies with the type of cell and the rate of discharge and is given on page 2 for the 5-hour rate. For example, if the full charge gravity of an XT-13 cell is 1.300, after discharging the 5-hour capacity, the gravity should be 1.300 minus .150 or 1.150. The values shown are averages and may differ from that of a particular cell by as much as 10 per cent. A point is considered equal to .001 specific gravity, in the example the difference between 1.300 and 1.150 being 150 points.

9. Charging—in General

Direct current only must be used, never alternating.

Connect positive of battery with positive of charging circuit, and negative of battery with negative of charging circuit. If connected reverse, serious injury results. Battery positive terminal is marked POS or +, or painted red; negative is marked NEG or —, or painted black.

Ventilate the battery compartment when charging, in order to dispose of gas generated by battery. Never bring a flame, spark, or lighted cigarette or cigar near the battery when charging or shortly after.

Keep the vent plugs in the cells. Do not remove them at any time except to take specific gravity or temperature readings or to add water.

If the cells flood or sputter electrolyte, the level is too high and should be lowered by withdrawing electrolyte.

Never add special solutions, powders or jellies to the battery. A great many are injurious, having a corrosive or rotting action on the battery plates, reducing the voltage and capacity of the cells.

10. Charging Methods

For convenience in discussing, we have grouped charging under two methods:

I. *System Governed.* Batteries charged in this way are permanently connected in the electrical system. They are discharged and charged automatically and as governed by the schedule and adjustment of the system. For example, batteries in autos and some aircraft services. Here the battery supplies current (discharges) to crank the engine, and takes care of lighting and other accessories until a certain engine speed is reached, when the control throws the load off the battery and onto a generator, which then also charges the battery.

II. *Manually-Cycled.* These batteries are usually connected to the electrical system until they become discharged to a certain extent. By starting a charge manually, the batteries are restored to their full charge gravity in several hours, when the charge is stopped. The batteries again carry the load and become discharged, and the cycle of charge and discharge is repeated. Examples are in farm lighting service and in some airplane services.

I. System-Governed Charge Method

The system should be adjusted to obtain a balance between the amount taken from the battery and the amount put back into the battery. If too little current is put back into the battery, it will become discharged, and the specific gravity reading will be below 1.225. If too much current is put into the battery, it will use more than the allowable amount of water and will cause unnecessary wear on the plates.

The allowable amount of water is shown on page 2 for a hard worked battery. Example, for one XT-13 cell it is 0.27 pints per month. For 6 cells, multiply 6 x 0.27 = 1.6 pints for a 6-cell battery. Keeping a written record of the amount of water added from time to time and comparing from year to year is useful. As a battery ages, the amount of water necessary to add increases.

Before adding water at intervals, take a hydrometer reading to check that the specific gravity is above 1.225. Use different cells from time to time.

The exact setting to use for the generator and regulator depends on the type of generator and control. A brief discussion on settings follows in the next few paragraphs, but in all cases the manufacturer's detailed directions should be followed.

Straight Third Brush Generators

On third brush generators without voltage control it is a case of striking a rate by trial and error settings which will keep the battery charged, and yet not overcharge it. A setting of two or three amperes above the steady load is sometimes satisfactory.

Voltage Regulated Generators

Third brush generators equipped with voltage regulators, and shunt generators with current and voltage control units, may be started off with the current output setting just under the maximum of the generator, and with a voltage setting for a first trial at 2.37 volts per cell (14.2 volts for a 6-cell battery). The voltage setting cannot be definitely given because it is governed somewhat by the type of generator and the voltage drop in the cable between the generator and battery; usually the voltage setting is between 2.33 and 2.50 open circuit volts per cell (14.0 to 15.0 volts for 6 cells). The current setting will be between the maximum of the generator and the steady load.

Since the generator should keep the battery charged, operate for several days with the above settings to see if it does. If it does, the current setting may be reduced a little and the system operated further to see if the battery is still kept charged. If it is, the current setting may be reduced a little again. This trial method should be continued, but do not set below the steady load value, until the generator does not keep the battery charged, after which the settings of the previous trial which kept the battery charged should be used.

The current setting protects the generator, and the voltage setting protects the battery—both should be as low as consistent with the manufacturer's and operating limits to avoid waste of current and promote long battery life. Generator output settings should be adjusted in small steps as suggested above.

After the setting is determined, it should be checked from time to time with other routine inspection of equipment. Use accurate meters and read fractions of a volt.

II. Manually-Cycled Charge Method

The battery may be charged at any rate in amperes that will not produce gassing or bubbling of the electrolyte or a cell temperature in excess of 110° F. As soon as gassing starts, or before, if the temperature reaches this limit, the rate should always be reduced, and the charge should be completed at not higher than the charging rate given on page 2. Do not charge at a higher rate than this while the cells are gassing. If charging at constant current is more convenient, the entire charge may be given at the rate shown on page 2 or at a lower rate.

The best procedure for charging will depend on the number of cells in the battery, the time available for charging and the voltage and capacity of the charging apparatus. Wherever possible the charging equipment should be permanently arranged so that the rate of charge is automatically (and not manually) tapered to the rate shown on page 2, or to less, by the time the charge is completed. Usually, this is not only possible but very easy and simple to arrange. If the charge rates used and the type of cell is advised, we will furnish a charging shedule showing length of time to charge for various specific gravity readings or the amount discharged.

Charge the battery at least frequently enough to keep it from falling below the discharge limits referred to in Paragraph 8.

If the battery requires less than one charge a week, make every charge an equalizing charge. This is a continuation of a regular charge at a low rate (not higher than the charge rate on page 2, and lower if possible). Charge until all cells gas or bubble freely and until half-hourly readings of the specific gravity and voltage both show no further increase over one hour.

If the battery requires more than one charge a week, charge until the cells are gassing and until the specific gravity of the pilot cell is within 10 to 15 points of the maximum

obtained on the last equalizing charge. Then stop the charge. Once a week give an equalizing charge.

In this charging method the amount of water necessary to add at intervals is a guide to the amount of charge. If the battery is charged about twenty-five times per month, the water data on page 2 will apply. For instance, the allowable shown is 0.27 pints for one XT-13 cell. For 6 cells this is 6 x 0.27 = 1.6 pints. If more than this amount is added, and battery is charged less than twenty-five times per month, unnecessary and harmful overcharging is indicated. Much less water will be required for less frequent charging.

11. Adding Water

Approved water must be added regularly to each cell. Keep the level between the high and low points shown below.

Battery Type	*High Level*	*Low Level*
Double Chamber	At splash cover on inside. (Fig. 4)	Top of Separators
Others on page 2	3/8" above protector on top of separators.	Top of Separators

The time of adding water is important in the winter time if the battery is not in a heated room. When it is cold add water just before charging the battery in order to mix the water with the electrolyte by the charging current. If water is added and the battery left standing in freezing temperatures, the water will freeze just the same as though it was outside the battery.

Nothing but water is required to be added to storage batteries. Never add acid, electrolyte or any special powders, solutions or jellies.

A great many special powder solutions or jellies are injurious, having a corrosive or rotting action on the battery plates, reducing the voltage and capacity of the cells.

Electrolyte loses some of its water by charging of the battery and a little by evaporation, but acid is never lost in this manner. Therefore, no acid or electrolyte will need to be added unless some electrolyte should be spilled or lost from the cell, which loss is usually the result of carelessness in not

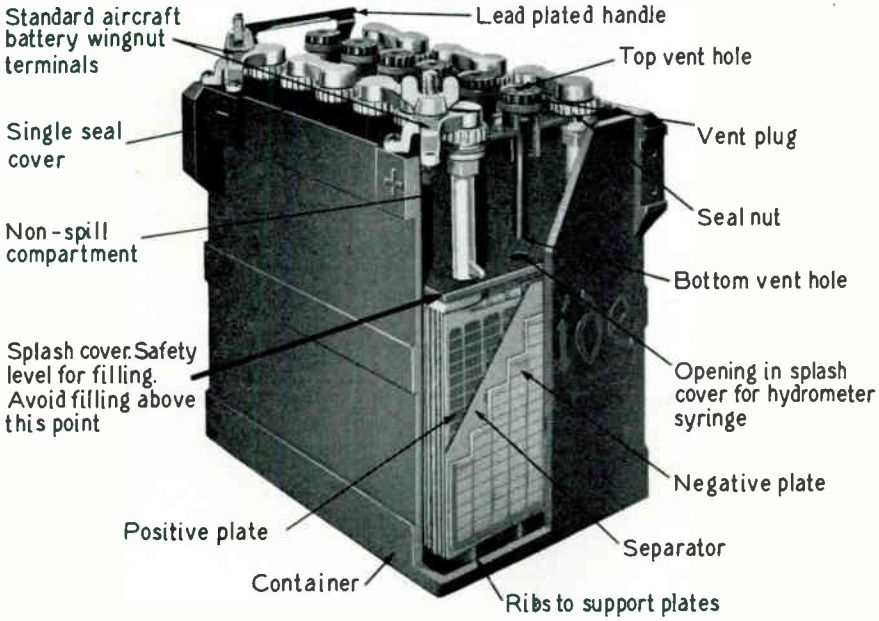


Fig. 4

Type 6-XT-13-1 Double Chamber Non-Spillable Battery

keeping the vent plugs tight or in adding water too high. Add only distilled or other approved water.

If the cells flood or sputter electrolyte, the level is too high and should be lowered by withdrawing electrolyte. Keep vent plugs tight in the cells.

All the cells in the battery should take the same amount of water. If one cell takes more than the others, examine it for leakage.

Keep a written record of the amount of water added from time to time. The allowable amount is shown on page 2 for a hard worked battery. If the allowable amounts are exceeded, unnecessary overcharging is indicated. For example, for 6 cells XT-13, the allowable amount is 6 x 0.27 = 1.6 pints per month.

12. Kind of Water

The quality of water to add is distilled (not merely boiled) or other approved water. By approved water is meant that of which The Electric Storage Battery Co. has analyzed a sample and found safe for Exide Batteries. The local source of water is usually suitable, but before using it The Electric Storage Battery Co. should be consulted. Without charge we will analyze, and report on quart samples received at our works, Allegheny Ave. and 19th St., Phila., Pa., if transportation charges are prepaid and if sample is marked for identification.

If water is drawn from a tap it should be allowed to run a few moments before using. Water should not be transported or stored in any metallic vessel except lead. Glass, earthenware, rubber or wooden receptacles that have not been used for any other purpose are satisfactory.

Fig. 5
Type AC Battery

13. Keeping Battery Clean

Brush dirt off with a stiff bristle (not metal) brush. Wiping with a cloth wet with ammonia or bicarbonate of soda solution (one pound of soda to a gallon of water) will neutralize any electrolyte sprayed or spilled out. Then wash battery with water, making sure vent plugs are tight in place. Examine vent plugs to make sure the gas escape holes are clear.

If any corrosion is experienced, scrape or brush off. Then washing with ammonia or soda solution will neutralize any

electrolyte remaining on the metal surfaces. After rinsing in water and drying, a thin coating of No-Ox-Id grease or vaseline should be applied. Lead does not corrode. Lead-plated parts on which the lead coating is worn or scraped off should be replaced.

14. Battery Freezing

The freezing point of the battery electrolyte depends upon its specific gravity, the table below showing how this varies.

Specific Gravity	Freezing Point
1.275	— 85° F.
1.250	— 62° F.
1.225	— 35° F.
1.200	— 16° F.
1.175	— 4° F.
1.150	+ 5° F.
1.125	+ 13° F.
1.100	+ 19° F.

From this table it can be seen that there is little danger of freezing in a temperate climate zone except with a completely discharged battery. Moreover, at these freezing points the solution is slushy and does not become hard until the temperature goes still lower.

If water is added (Par. 11) to a battery in freezing temperatures and the battery let stand in the cold and not charged to mix the water with the electrolyte, the water will remain on top and freeze.

15. Low and High Temperatures

Low electrolyte temperatures temporarily reduce the battery capacity, the battery performing as though it were numbed by the cold.

Continued or frequent high temperatures above 110° Fahrenheit will shorten the life of the plates. The battery compartment ventilation should provide for maintaining the battery below 110° F.

16. Battery Repairs

Only in case of accident is it necessary to repair an Exide. It is so designed that both positive and negative plates and separators wear out together, making it poor economy to replace any of these parts with new ones. Complete new batteries are the cheapest replacement for worn out ones. Low cost users find that if attention is given to taking care of the battery, as outlined in this book, long life is obtained from the batteries and extensive repairs eliminated.

17. Written Records

A written record should be made of the date and amount of water added from time to time. (Par. 11.) Depending on the charge method (Par. 10), records should also be kept on the generator or regulator settings and their adjustments on the System-Governed Method. On the Manually Cycled Method, the time charge is started and stopped, the charge rate, and specific gravity at start and end of charge should be noted.

Special Notes for Shielded Batteries

18. Location

a. Cable connections in shielding conduit are to be made to the positive and negative terminals as shown in Fig. 6. The body of the terminal box is reversible so that the opening in one end for the cables can be placed most conveniently for the approach of the cables.

b. Two vent tubes are provided, one on each end of the container, for ventilation and drainage of any possibly spilled electrolyte. Ordinarily the vent plugs prevent spilling of electrolyte when the battery is inverted, but as a precaution the vent tubes are provided.

c. Attach flexible rubber tubing securely to the lower vent tube, that is, to the tube through which liquid would normally drain when the airplane is on the ground. The outlet of this rubber tubing should be located on the land-

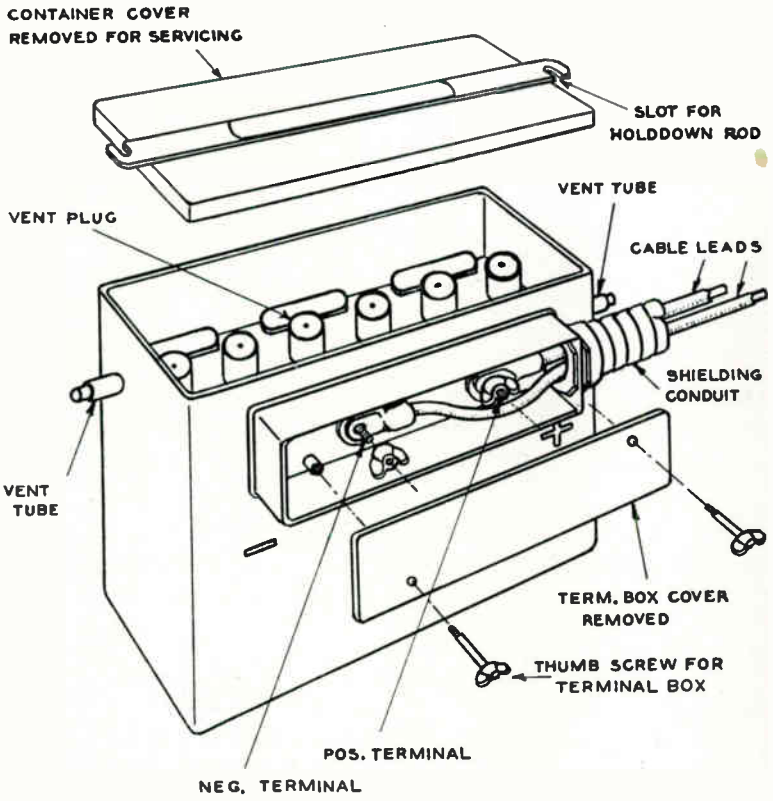


Fig. 6—Illustration of Typical Exide Aircraft Shielded Battery, Non-Spillable Vent Plug Types

ing gear or connected to a short, hard rubber tube projecting several inches through the fuselage. Any drainage should not come in contact with the ship.

d. The tubing attached to the upper vent tube should lead through the side of the airplane above the battery as a forced ventilator. As an option to this, if the installer prefers, the front tube can be sealed off by a rubber cot.

e. After seating the cover, the hold-down rod, one at each end, should be located in the cover slot provided, Fig. 6. Make a snug fit—not necessarily the tightest fit. Avoid tightness

that will distort the hold-down bar that extends across the top of the cover.

19. Non-Spillable Vent Plugs

a. The battery is made non-spillable by a vent plug design. Each vent plug, therefore, should always be securely seated on the cover hole and should not be opened for internal examination unless it allows electrolyte to leak out when the battery is inverted for very short periods. The vent plugs will last the life of the battery.

20. Handling of Container

a. The containers for these batteries are made of sheet aluminum, protected outside with a special acid resisting lacquer, and inside with a soft rubber lining.

b. To prevent corrosion from acid, do not scratch the lacquer because it is difficult to relacquer properly, and do not loosen the rubber lining inside the container, as it is impossible to repair satisfactorily.

c. When removing the cover, lift vertically by grasping the ends of the hold-down bar that extends across the top. Do not pry off the cover as the top of the container may be distorted permanently and the shielding effect reduced.

d. Handle all parts carefully. Avoid putting a dent in the container. Do not draw cover too tight and distort with hold-down bolts.

INSTRUCTIONS

Installing *and* Operating

Exide
BATTERIES

In Aircraft Service

Type XT Battery

THE ELECTRIC STORAGE BATTERY CO.

PHILADELPHIA, U. S. A.

FORM 2754 Fifteenth Edition JANUARY, 1940

RATINGS

Based on electrolyte temperature of 80° F. at beginning of discharge and on full charge specific gravity of 1.300. See Par. 7.

TYPE OF CELL*	Plates Per Cell*	CHARGE RATE (Par. 10)	DISCHARGE CAPACITY (Paragraph 8)					Max. Water (Par. 11) Pints Per Cell Per Month
			5-Hour		20-Minute	5-Minute	75 Amps. For	
		Amperes	Ampere Hours	Approx. Points in Gravity	Amperes	Amperes	Minutes	
Double Chamber Non-Spillable Types								
AC	7	1	10	135	15	36		.04
	11	1¾	17	176	25	60		.07
TS	7	1¾	19	113	30	75	3½	.08
	13	3½	38	180	60	150	14	.16
TX	9	3	29	160	50	133	10	.12
	19	6½	65	162	112	300	33	.27
XT	13	5½	65	150	100	275	30	.27
Shielded†, Non-Spillable Vent Plug Types								
6-ACS-7	7	1	10	135	15	36		.05
6-TAS-9	9	3½	34	180	54	144		.15
6-TAS-17	17	7	68	200	108	288		.30
Heavy Duty Aircraft Transport Type								
FHM	13	7½	88	190	140	360	46½	.36
Limiting Volts per Cell (approx.)				1.75	1.50	1.20	1⅔	

* To identify type and plates per cell, note the marking molded on container or on the nameplate. For example, 6-XT-13 means 6 cells type XT, 13 plates. Look for XT-13 in table.

† Shielded against electrical interference of radio circuits, see page 16.

In addition to the above batteries installed on aircraft, Exide supplies ground-cranking batteries to be installed on small carts. Instructions for the care of ground-cranking batteries are covered by Form 2399.

HOW TO INSTALL

(For Shielded† Batteries, also see Special Notes, Page 16)

1. Unpacking—Freshening Charge

Exide batteries are shipped fully charged and with electrolyte in the cells.* Upon arrival, examination may show that electrolyte has accidentally spilled. In this situation, fill with electrolyte of same gravity as in surrounding cells.

During transit the battery may have lost some of its charge. If specific gravity of electrolyte is below 1.250, give a freshening charge.

2. Battery Location

The battery compartment should be ventilated, dry and clean. The battery should not be near apparatus that will unduly heat it; its temperature should be kept below 110° F. Its location should be accessible to permit inspection, adding water, and removal.

The battery should be seated evenly, firmly. It should be fastened down by suitable holding devices for a *snug* fit, not necessarily the tightest fit. Do not put much pressure on the rubber containers.

If holddowns are used on batteries equipped with handles, apply holddown inside hole of handle. Do not apply to top of handle.

U. S. Department of Commerce requirements for the installation of aircraft batteries are in Civil Air Regulations, amended to May 31, 1938, paragraph 04.5821, which reads:

"Batteries shall be easily accessible and adequately isolated from fuel, oil, and ignition systems. Adjacent parts of the aircraft structure shall be protected with a suitable acid-proof paint if the battery contains acid or other corrosive substance and is not completely enclosed. If the battery is completely enclosed, suitable ventilation shall be provided. All batteries shall be so installed that spilled liquid will be suitably drained or absorbed without coming in contact with the airplane structure."

* If shipped without electrolyte for special reasons, a tag is attached to the battery giving instructions for filling and charging.

† Shielded against electrical interference of radio circuits.

3. Connections to Battery

Battery cables must be flexible and sufficiently long to prevent a pull on the battery terminals and they should be anchored and protected where they pass through the battery compartment walls to prevent chafing of insulation. Any special terminals for connecting to the battery should be clean and in good mechanical condition.

If two or more battery trays are to be connected in series, the positive terminal of one should connect with the negative terminal of the other. The positive terminals are painted red on top or are marked POS or +; the negatives are painted black or are marked NEG or —.

Connections from the generator or regulator are made by connecting the positive lead to the positive terminal of the battery and the negative side of the system with the negative terminal of the battery. If one side of the electrical system is grounded, the ground connection should be accessible and examined occasionally.

4. Greasing Bolted Connections

For permanently clean bolted connections, the surfaces to be in contact should be cleaned by scraping lightly. Then apply a film of No-Ox-Id grease or vaseline to the cleaned surfaces, also to the bolt studs. After tightening, wipe off the surplus grease.

OPERATION AND MAINTENANCE

5. Condensed Maintenance Information

Exides are easily kept in good condition for a long time of trouble-free service if the following four simple rules are followed:

1. Maintain battery in a healthy state of charge. The method varies. See par. 10.
2. Add water at regular intervals. Par. 11.
3. Keep battery clean outside. Par. 13.
4. Keep a written record on the above items. Par. 17.

Exides have no moving parts; therefore, require no lubrication as a machine. If kept fully charged, they cannot freeze, therefore requiring no anti-freeze solution. The little care for

the large amount of work that they do makes Exides economical to operate.

There are some general characteristics of Exides which should be understood by all maintainers and these are discussed in paragraphs 6 to 9.

6. Hydrometer Readings—Specific Gravity

The specific gravity of the electrolyte in Exide batteries lowers on discharge and rises again on charge.*

Consequently if we know the specific gravity or hydrometer reading we can tell if the battery is fully charged or the amount it is discharged. The specific gravity is easily determined by allowing a hydrometer to float in the electrolyte. When the specific gravity is high or strong, the hydrometer will

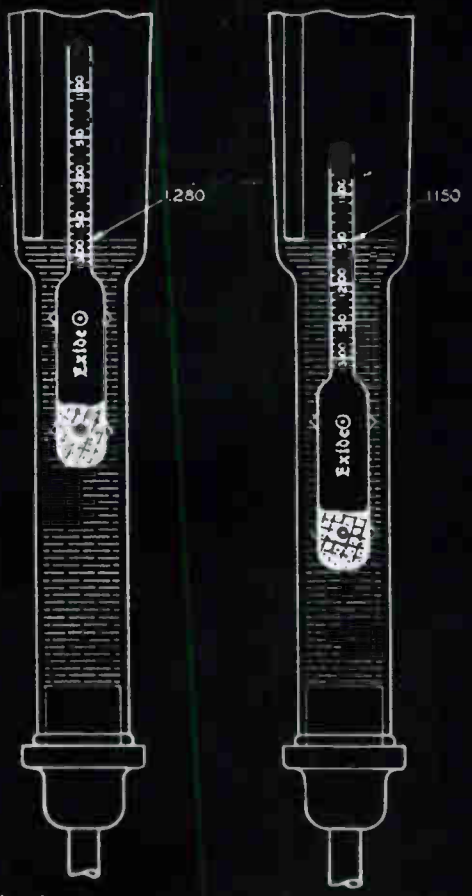


Fig. 1
Hydrometer Reading 1.280

Fig. 2
Hydrometer Reading 1.150

*Exide's booklet, "Fundamentals of a Storage Battery," Form 2480, explains this and will be supplied upon request.

not sink as far into the liquid or electrolyte as when the specific gravity is low or weak. See Figs. 1 and 2.

To take a hydrometer reading, insert the nozzle of the hydrometer syringe (Fig. 3) in the electrolyte, squeeze the bulb and slowly release it, drawing up enough electrolyte to float the hydrometer freely. It may be necessary to tilt the cells to obtain sufficient electrolyte for readings. Holding the syringe vertically, the reading on the stem of the hydrometer at the surface of the electrolyte is the specific gravity of the electrolyte. Then return the electrolyte to the same cell.

Fig. 3. Aircraft Battery Hydrometer Syringe Exide Type AS-2

Wash and clean hydrometers and barrels frequently. Dirty hydrometers read inaccurately.

Do not take hydrometer readings immediately after adding water. Allow a day or so for the water to mix with the electrolyte, otherwise the reading is false. If the battery is on charge and gassing, the water will be mixed within an hour.

Do not use the same cell each time to take the gravity readings. Change around to the various cells. This recommendation is made to avoid lowering the gravity of one cell due to possible loss of a small amount of electrolyte in taking gravity readings. Using all cells spreads the possible loss over all cells rather than have the loss taken by one cell.

7. Full Charge Specific Gravity

For the types shown on page 2, the specific gravity of the electrolyte with the cells fully charged and electrolyte at the high level (Par. 11) should be as shown in the table below for the temperatures indicated.

47° F.	77° F.	107° F.
1.285 to 1.310	**1.275 to 1.300**	1.265 to 1.290

This table shows the effect of temperature on the specific gravity reading. A change of 30° F. changes the gravity reading .010, or 10 points.

It is adjusted within the above limits at the factory and will not require adjusting during the life of the battery unless electrolyte is actually lost out. If it is necessary to adjust the specific gravity to bring it within the above limits, see paragraphs following.

To adjust low specific gravity, charge battery (for rate in amperes see page 2) until it is gassing and until specific gravity rises no higher over a 3-hour period. Then remove some electrolyte and replace with 1.325 electrolyte, repeating this step if, after an hour's charging, the specific gravity has not reached the desired value. Never adjust on a cell that does not gas.

To adjust high specific gravity, charge until battery is gassing and until specific gravity rises no higher over a 3-hour period. Remove some electrolyte and replace with water, repeating this step if, after an hour's charging, the gravity is too high.

8. Discharging Rates and Capacity

The capacity of a storage battery is measured in units of ampere hours, which is the product of the electrical current in amperes multiplied by the time in hours. For example, on page 2 an XT-13 battery has a capacity at the 5-hour rate of 65 ampere hours, or 5 hours x 13 amperes = 65 ampere hours. Although current may be obtained after the end of this time, the voltage of the battery has dropped to a point beyond which it is not very useful. For instance, in lighting service, because the lamps would become dim.

In an emergency, little if any permanent harm will result if the battery is discharged to the full amount that it will give, provided it is promptly recharged.

The ampere hours which may be obtained from a battery are greater for a long, low-rate or intermittent rate discharge than for a short high rate. This is because the voltage drops faster at the higher discharge rates (amperes).

High discharge rates (amperes) should not be confused with overdischarge (too many ampere hours taken out). An Exide battery may be discharged, without any injury to the

plates, at any rate of current it will deliver. The maximum permissible rate of discharge is limited only by the current-carrying ability of the wiring, motor or other apparatus to which the battery is connected or by the current-carrying ability of the cell terminals and connectors and not by the plates themselves.

Another indication which may be used in ascertaining when the discharge should stop is the drop or difference between the full charge specific gravity and the discharge specific gravity. This drop varies with the type of cell and the rate of discharge and is given on page 2 for the 5-hour rate. For example, if the full charge gravity of an XT-13 cell is 1.300, after discharging the 5-hour capacity, the gravity should be 1.300 minus .150 or 1.150. The values shown are averages and may differ from that of a particular cell by as much as 10 per cent. A point is considered equal to .001 specific gravity, in the example the difference between 1.300 and 1.150 being 150 points.

9. Charging—in General

Direct current only must be used, never alternating.

Connect positive of battery with positive of charging circuit, and negative of battery with negative of charging circuit. If connected reverse, serious injury results. Battery positive terminal is marked POS or +, or painted red; negative is marked NEG or —, or painted black.

Ventilate the battery compartment when charging, in order to dispose of gas generated by battery. Never bring a flame, spark, or lighted cigarette or cigar near the battery when charging or shortly after.

Keep the vent plugs in the cells. Do not remove them at any time except to take specific gravity or temperature readings or to add water.

If the cells flood or sputter electrolyte, the level is too high and should be lowered by withdrawing electrolyte.

Never add special solutions, powders or jellies to the battery. A great many are injurious, having a corrosive or rotting action on the battery plates, reducing the voltage and capacity of the cells.

10. Charging Methods

For convenience in discussing, we have grouped charging under two methods:

I. *System Governed.* Batteries charged in this way are permanently connected in the electrical system. They are discharged and charged automatically and as governed by the schedule and adjustment of the system. For example, batteries in autos and some aircraft services. Here the battery supplies current (discharges) to crank the engine, and takes care of lighting and other accessories until a certain engine speed is reached, when the control throws the load off the battery and onto a generator, which then also charges the battery.

II. *Manually-Cycled.* These batteries are usually connected to the electrical system until they become discharged to a certain extent. By starting a charge manually, the batteries are restored to their full charge gravity in several hours, when the charge is stopped. The batteries again carry the load and become discharged, and the cycle of charge and discharge is repeated. Examples are in farm lighting service and in some airplane services.

I. System-Governed Charge Method

The system should be adjusted to obtain a balance between the amount taken from the battery and the amount put back into the battery. If too little current is put back into the battery, it will become discharged, and the specific gravity reading will be below 1.225. If too much current is put into the battery, it will use more than the allowable amount of water and will cause unnecessary wear on the plates.

The allowable amount of water is shown on page 2 for a hard worked battery. Example, for one XT-13 cell it is 0.27 pints per month. For 6 cells, multiply 6 x 0.27 = 1.6 pints for a 6-cell battery. Keeping a written record of the amount of water added from time to time and comparing from year to year is useful. As a battery ages, the amount of water necessary to add increases.

Before adding water at intervals, take a hydrometer reading to check that the specific gravity is above 1.225. Use different cells from time to time.

The exact setting to use for the generator and regulator depends on the type of generator and control. A brief discussion on settings follows in the next few paragraphs, but in all cases the manufacturer's detailed directions should be followed.

Straight Third Brush Generators

On third brush generators without voltage control it is a case of striking a rate by trial and error settings which will keep the battery charged, and yet not overcharge it. A setting of two or three amperes above the steady load is sometimes satisfactory.

Voltage Regulated Generators

Third brush generators equipped with voltage regulators, and shunt generators with current and voltage control units, may be started off with the current output setting just under the maximum of the generator, and with a voltage setting for a first trial at 2.37 volts per cell (14.2 volts for a 6-cell battery). The voltage setting cannot be definitely given because it is governed somewhat by the type of generator and the voltage drop in the cable between the generator and battery; usually the voltage setting is between 2.33 and 2.50 open circuit volts per cell (14.0 to 15.0 volts for 6 cells). The current setting will be between the maximum of the generator and the steady load.

Since the generator should keep the battery charged, operate for several days with the above settings to see if it does. If it does, the current setting may be reduced a little and the system operated further to see if the battery is still kept charged. If it is, the current setting may be reduced a little again. This trial method should be continued, but do not set below the steady load value, until the generator does not keep the battery charged, after which the settings of the previous trial which kept the battery charged should be used.

The current setting protects the generator, and the voltage setting protects the battery—both should be as low as consistent with the manufacturer's and operating limits to avoid waste of current and promote long battery life. Generator output settings should be adjusted in small steps as suggested above.

After the setting is determined, it should be checked from time to time with other routine inspection of equipment. Use accurate meters and read fractions of a volt.

II. Manually-Cycled Charge Method

The battery may be charged at any rate in amperes that will not produce gassing or bubbling of the electrolyte or a cell temperature in excess of 110° F. As soon as gassing starts, or before, if the temperature reaches this limit, the rate should always be reduced, and the charge should be completed at not higher than the charging rate given on page 2. Do not charge at a higher rate than this while the cells are gassing. If charging at constant current is more convenient, the entire charge may be given at the rate shown on page 2 or at a lower rate.

The best procedure for charging will depend on the number of cells in the battery, the time available for charging and the voltage and capacity of the charging apparatus. Wherever possible the charging equipment should be permanently arranged so that the rate of charge is automatically (and not manually) tapered to the rate shown on page 2, or to less, by the time the charge is completed. Usually, this is not only possible but very easy and simple to arrange. If the charge rates used and the type of cell is advised, we will furnish a charging shedule showing length of time to charge for various specific gravity readings or the amount discharged.

Charge the battery at least frequently enough to keep it from falling below the discharge limits referred to in Paragraph 8.

If the battery requires less than one charge a week, make every charge an equalizing charge. This is a continuation of a regular charge at a low rate (not higher than the charge rate on page 2, and lower if possible). Charge until all cells gas or bubble freely and until half-hourly readings of the specific gravity and voltage both show no further increase over one hour.

If the battery requires more than one charge a week, charge until the cells are gassing and until the specific gravity of the pilot cell is within 10 to 15 points of the maximum

obtained on the last equalizing charge. Then stop the charge. Once a week give an equalizing charge.

In this charging method the amount of water necessary to add at intervals is a guide to the amount of charge. If the battery is charged about twenty-five times per month, the water data on page 2 will apply. For instance, the allowable shown is 0.27 pints for one XT-13 cell. For 6 cells this is 6 x 0.27 = 1.6 pints. If more than this amount is added, and battery is charged less than twenty-five times per month, unnecessary and harmful overcharging is indicated. Much less water will be required for less frequent charging.

11. Adding Water

Approved water must be added regularly to each cell. Keep the level between the high and low points shown below.

Battery Type	*High Level*	*Low Level*
Double Chamber	At splash cover on inside. (Fig. 4)	Top of Separators
Others on page 2	3/8" above protector on top of separators.	Top of Separators

The time of adding water is important in the winter time if the battery is not in a heated room. When it is cold add water just before charging the battery in order to mix the water with the electrolyte by the charging current. If water is added and the battery left standing in freezing temperatures, the water will freeze just the same as though it was outside the battery.

Nothing but water is required to be added to storage batteries. Never add acid, electrolyte or any special powders, solutions or jellies.

A great many special powder solutions or jellies are injurious, having a corrosive or rotting action on the battery plates, reducing the voltage and capacity of the cells.

Electrolyte loses some of its water by charging of the battery and a little by evaporation, but acid is never lost in this manner. Therefore, no acid or electrolyte will need to be added unless some electrolyte should be spilled or lost from the cell, which loss is usually the result of carelessness in not

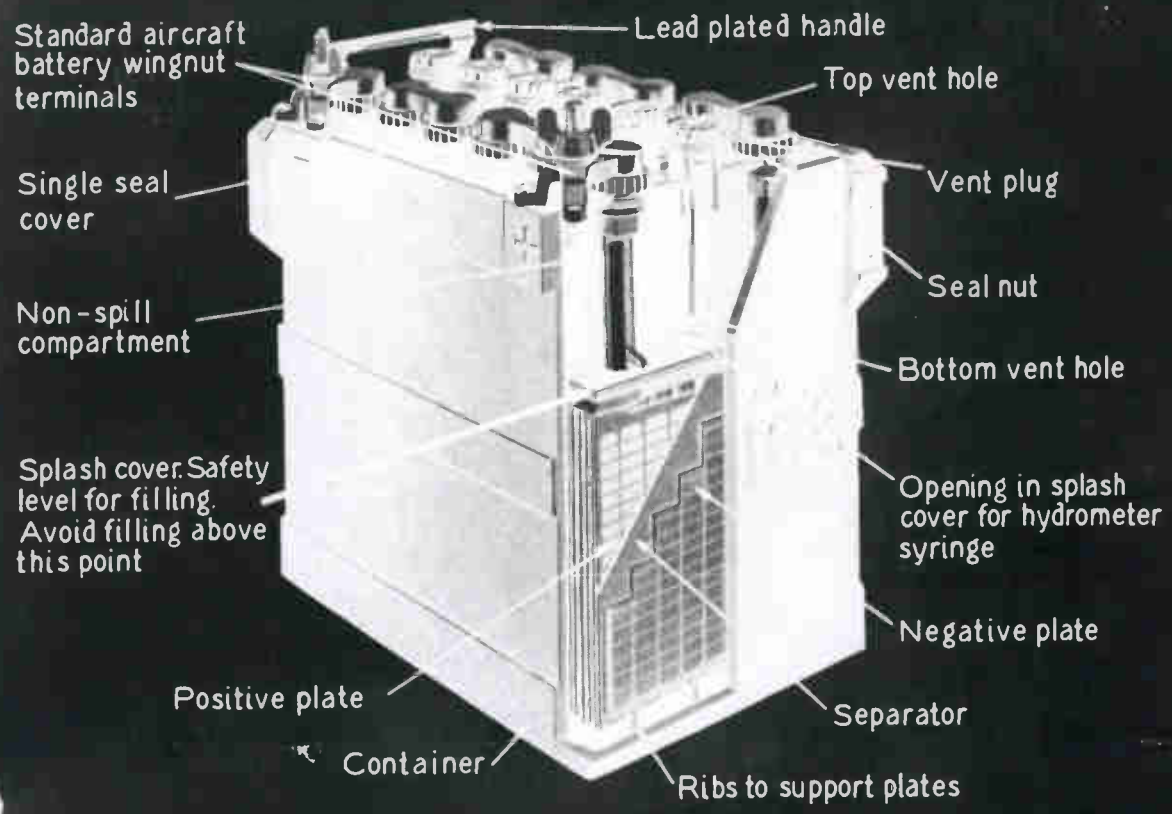


Fig. 4

Type 6-XT-13-1 Double Chamber Non-Spillable Battery

keeping the vent plugs tight or in adding water too high. Add only distilled or other approved water.

If the cells flood or sputter electrolyte, the level is too high and should be lowered by withdrawing electrolyte. Keep vent plugs tight in the cells.

All the cells in the battery should take the same amount of water. If one cell takes more than the others, examine it for leakage.

Keep a written record of the amount of water added from time to time. The allowable amount is shown on page 2 for a hard worked battery. If the allowable amounts are exceeded, unnecessary overcharging is indicated. For example, for 6 cells XT-13, the allowable amount is 6 x 0.27 = 1.6 pints per month.

12. Kind of Water

The quality of water to add is distilled (not merely boiled) or other approved water. By approved water is meant that of which The Electric Storage Battery Co. has analyzed a sample and found safe for Exide Batteries. The local source of water is usually suitable, but before using it The Electric Storage Battery Co. should be consulted. Without charge we will analyze, and report on quart samples received at our works, Allegheny Ave. and 19th St., Phila., Pa., if transportation charges are prepaid and if sample is marked for identification.

If water is drawn from a tap it should be allowed to run a few moments before using. Water should not be transported or stored in any metallic vessel except lead. Glass, earthenware, rubber or wooden receptacles that have not been used for any other purpose are satisfactory.

Fig. 5
Type AC Battery

13. Keeping Battery Clean

Brush dirt off with a stiff bristle (not metal) brush. Wiping with a cloth wet with ammonia or bicarbonate of soda solution (one pound of soda to a gallon of water) will neutralize any electrolyte sprayed or spilled out. Then wash battery with water, making sure vent plugs are tight in place. Examine vent plugs to make sure the gas escape holes are clear.

If any corrosion is experienced, scrape or brush off. Then washing with ammonia or soda solution will neutralize any

electrolyte remaining on the metal surfaces. After rinsing in water and drying, a thin coating of No-Ox-Id grease or vaseline should be applied. Lead does not corrode. Lead-plated parts on which the lead coating is worn or scraped off should be replaced.

14. Battery Freezing

The freezing point of the battery electrolyte depends upon its specific gravity, the table below showing how this varies.

Specific Gravity	Freezing Point
1.275	— 85° F.
1.250	— 62° F.
1.225	— 35° F.
1.200	— 16° F.
1.175	— 4° F.
1.150	+ 5° F.
1.125	+ 13° F.
1.100	+ 19° F.

From this table it can be seen that there is little danger of freezing in a temperate climate zone except with a completely discharged battery. Moreover, at these freezing points the solution is slushy and does not become hard until the temperature goes still lower.

If water is added (Par. 11) to a battery in freezing temperatures and the battery let stand in the cold and not charged to mix the water with the electrolyte, the water will remain on top and freeze.

15. Low and High Temperatures

Low electrolyte temperatures temporarily reduce the battery capacity, the battery performing as though it were numbed by the cold.

Continued or frequent high temperatures above 110° Fahrenheit will shorten the life of the plates. The battery compartment ventilation should provide for maintaining the battery below 110° F.

16. Battery Repairs

Only in case of accident is it necessary to repair an Exide. It is so designed that both positive and negative plates and separators wear out together, making it poor economy to replace any of these parts with new ones. Complete new batteries are the cheapest replacement for worn out ones. Low cost users find that if attention is given to taking care of the battery, as outlined in this book, long life is obtained from the batteries and extensive repairs eliminated.

17. Written Records

A written record should be made of the date and amount of water added from time to time. (Par. 11.) Depending on the charge method (Par. 10), records should also be kept on the generator or regulator settings and their adjustments on the System-Governed Method. On the Manually Cycled Method, the time charge is started and stopped, the charge rate, and specific gravity at start and end of charge should be noted.

Special Notes for Shielded Batteries

18. Location

a. Cable connections in shielding conduit are to be made to the positive and negative terminals as shown in Fig. 6. The body of the terminal box is reversible so that the opening in one end for the cables can be placed most conveniently for the approach of the cables.

b. Two vent tubes are provided, one on each end of the container, for ventilation and drainage of any possibly spilled electrolyte. Ordinarily the vent plugs prevent spilling of electrolyte when the battery is inverted, but as a precaution the vent tubes are provided.

c. Attach flexible rubber tubing securely to the lower vent tube, that is, to the tube through which liquid would normally drain when the airplane is on the ground. The outlet of this rubber tubing should be located on the land-

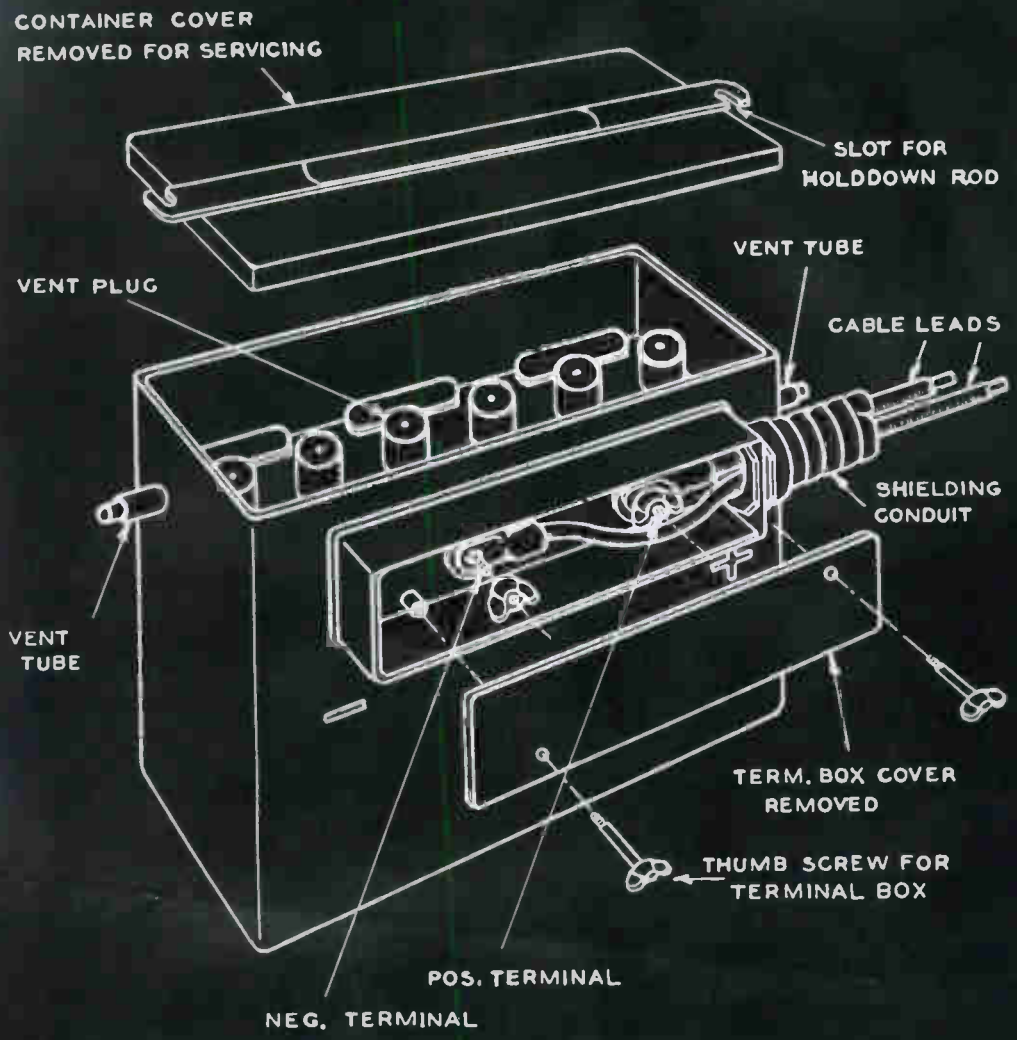


Fig. 6—Illustration of Typical Exide Aircraft Shielded Battery, Non-Spillable Vent Plug Types

ing gear or connected to a short, hard rubber tube projecting several inches through the fuselage. Any drainage should not come in contact with the ship.

d. The tubing attached to the upper vent tube should lead through the side of the airplane above the battery as a forced ventilator. As an option to this, if the installer prefers, the front tube can be sealed off by a rubber cot.

e. After seating the cover, the hold-down rod, one at each end, should be located in the cover slot provided, Fig. 6. Make a snug fit—not necessarily the tightest fit. Avoid tightness

that will distort the hold-down bar that extends across the top of the cover.

19. Non-Spillable Vent Plugs

a. The battery is made non-spillable by a vent plug design. Each vent plug, therefore, should always be securely seated on the cover hole and should not be opened for internal examination unless it allows electrolyte to leak out when the battery is inverted for very short periods. The vent plugs will last the life of the battery.

20. Handling of Container

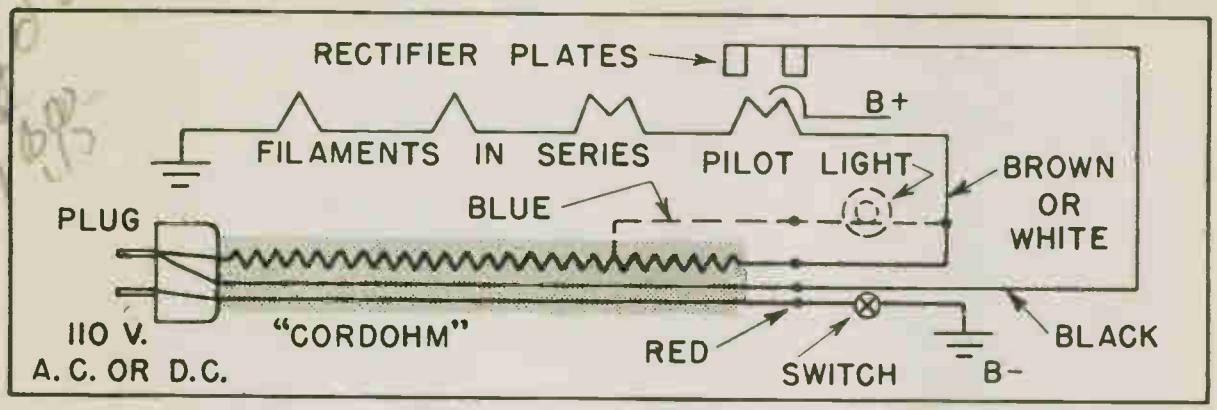
a. The containers for these batteries are made of sheet aluminum, protected outside with a special acid resisting lacquer, and inside with a soft rubber lining.

b. To prevent corrosion from acid, do not scratch the lacquer because it is difficult to relacquer properly, and do not loosen the rubber lining inside the container, as it is impossible to repair satisfactorily.

c. When removing the cover, lift vertically by grasping the ends of the hold-down bar that extends across the top. Do not pry off the cover as the top of the container may be distorted permanently and the shielding effect reduced.

d. Handle all parts carefully. Avoid putting a dent in the container. Do not draw cover too tight and distort with hold-down bolts.

CORDOHM LINE CORD RESISTORS



STOCK NUMBER	TOTAL VOLTAGE DROP IN FILAMENTS	RESISTANCE OF CORDOHM
C-350	12.0 to 17.0	350 ohms
C-330	18.0 to 24.0	330 ohms
C-290	23.0 to 31.5	290 ohms
C-250	32.0 to 44.5	250 ohms
C-220	45.0 to 52.0	220 ohms
C-180	53.0 to 61.0	180 ohms
C-160	62.0 to 68.9	160 ohms
C-135	69.0 to 75.2	135 ohms
LIST PRICE, Any Cord Above-------$0.75		
C-165P	For 5 tube sets using three 6.3 volt tubes, two 25 volt tubes and one brown bead, 0.15 ampere, pilot light.	165 ohms tapped at 22.5 ohms.
C-187P	For 4 tube sets using two 6.3 volt tubes, two 25 volt tubes and one brown bead, 0.15 ampere, pilot light.	187.5 ohms tapped at 22.5 ohms.
C-190P	For 4 tube sets using two 6.3 volt tubes, two 25 volt tubes and one blue bead, 0.25 ampere, pilot light.	190 ohms tapped at 40 ohms.
LIST PRICE, Tapped Cords Above --$1.00		
X-320	220 V. to 110 V. Line Dropping Cord for sets drawing 0.32 amps. to 0.36 amps.	320 ohms
LIST PRICE, Line Dropping Cord --$1.50		

USE

The CORDOHM is intended to replace the voltage dropping resistor and the line cord in AC-DC radio receivers. It consists of a three conductor cable which furnishes both 110 volts for the tube plates and a reduced voltage for the filaments; and it may also have a fourth conductor to supply pilot light voltage. It eliminates the generated heat from the set and insures longer life for the component parts as well as giving more satisfactory operation.

DIRECTIONS FOR INSTALLING THE CORDOHM

To install the CORDOHM, disconnect the old resistor and also remove the old line cord. Connect the red wire of the CORDOHM to one side of the filament circuit and the white (or brown) resistance lead to the other. Connect the plate circuit to the red and black leads of the CORDOHM; these furnish the needed 110 volts.

On tapped cords the blue lead is connected to the pilot light (the other side of which should be connected to the white (or brown) lead).

DETERMINING THE CORDOHM REQUIRED

To determine the correct CORDOHM for any set, add up the voltages of the various tube filaments and then select a CORDOHM of corresponding Total Voltage Drop. For instance, if a set has four tubes which operate at 6.3 volts, the total drop over the four tubes is four times 6.3 or 25.2 volts and the 290 ohm CORDOHM should be used. Other values may be found in the table.

FLUORESCENT LAMP RESISTORS

CORDOHMS and other types of resistors are available for operating fluorescent lamps on direct current circuits. Further details on request.

OHMITE MANUFACTURING COMPANY
4835 W. Flournoy Street Chicago, Illinois, U. S. A.

Westinghouse

Types F-11 and F-22 Oil Circuit-Breakers Manually Operated

Westinghouse

Types F-11 and F-22 Oil Circuit-Breakers

Manually-Operated

INSTRUCTION BOOK

Westinghouse Electric & Manufacturing Company

East Pittsburgh Works East Pittsburgh, Pa.

I. B. 5229-J

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Westinghouse

Types F-11 and F-22 Oil Circuit-Breakers

Manually-Operated

General Information

The types "F-11" and "F-22" oil circuit-breakers comprise a line of low capacity oil circuit-breakers. The design of this line of oil circuit-breakers is unique in that the breaker unit, the hand operating mechanism and all auxiliaries are unit assemblies. These unit assemblies are carried in stock packed ready for shipment. Upon the receipt of an order, the unit assemblies necessary to make up the particular breaker which the customer orders, together with the necessary auxiliaries, are shipped in separate packages. This facilitates shipment and enables the Westinghouse Company to render better service to their customers.

Before shipment, all breakers, operating mechanism and auxiliaries are given thorough testing to determine that they are adequate, and that their operation is correct.

Shipping

The circuit-breakers with auxiliaries are shipped in unit assemblies, that is, the breaker unit will be in one box, the coverplate with handle will be in another box, the bell cranks will be in still another box, and so on. Each package or box will be plainly marked as to its contents.

Installing

There is a method of procedure for each circuit-breaker set-up which, if followed, will greatly facilitate the work of installing the breaker, and will avoid troubles which otherwise might be encountered during the installations of breakers.

Unpacking—Care should be used in unpacking the circuit-breakers so that the porcelain insulators and small mechanical parts will not be damaged or broken. All of the excelsior and dirt should be blown or cleaned from all operating parts. A careful inspection should be made to see that none of the parts are broken during shipment, and that all the details are in good operating condition.

Mounting of Switchboard Breaker (on Panel or on Panel Bracket)

Before mounting the coverplate and the breaker to the panel, first assemble the signal switch and bell alarm, if they are ordered, to the coverplate as shown in Fig. 4. Then place the 5 ampere tripping coils or series coils from the overload attachment, if supplied, in the coil box of the coverplate, and then mount the coverplate and the breaker to the panel, using the same mounting bolts for mounting both. The breaker should be mounted as nearly level as possible. The nipple supplied with the breaker units can then be screwed into the rod end on the rear of the operating handle and the mechanical set-up will then be complete. By adjusting the amount by which the nipple is screwed into the rod end, it is possible to vary the contacts in the breaker. This adjustment should be made in such a way that full contact is obtained in the breaker when the handle is latched closed. See Fig. 2. With the Type F-22 breaker it is necessary to observe that good contact is secured on the main contact as well as the arcing tips, as the arcing tips make contact before the main contacts. With this adjustment correct, the signal switch should make good contacts in both the open and closed position of the breaker. It should be observed that proper contact in the breaker is necessary in order to get proper contact on the signal switch.

In adjusting the breaker special care should be taken to see that the toggle lever is from one thirty-second to one sixteenth of an inch away from the stop in the closed position. On the 2 and 3-pole breakers the stop is the end of the slot on the side of the frame, and on the single-pole and 4-pole breakers, the stop is a rib on the inside of the frame

If this adjustment is not correct, the latch load on the cover plate will be excessive and the tripping attachments may not function promptly.

When the adjustment of the breaker and signal switch is correct and operating properly, then the tripping cores can be put in place, and the nuts put on which hold them. If direct trip attachment or an under-voltage release is supplied, it may now be mounted on the coverplate and the leads thrust through the clearance between the coverplate and the panel, and then drawn back through the holes drilled in the panel for the leads. After this, the necessary electrical connections can be made as described later.

For mounting other auxiliaries on the switchboard mounting breaker, see description under the heading of "Mounting of the Auxiliaries", page 6.

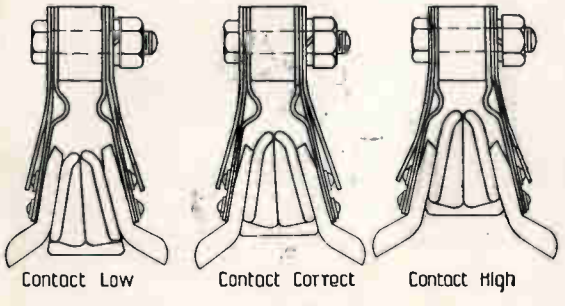


FIG. 2—CONTACT ADJUSTMENT FOR TYPE F-11 OIL CIRCUIT-BREAKER

FIG. 3—REMOTE-CONTROL WALL-MOUNTED TYPE F-11 OIL CIRCUIT-BREAKER

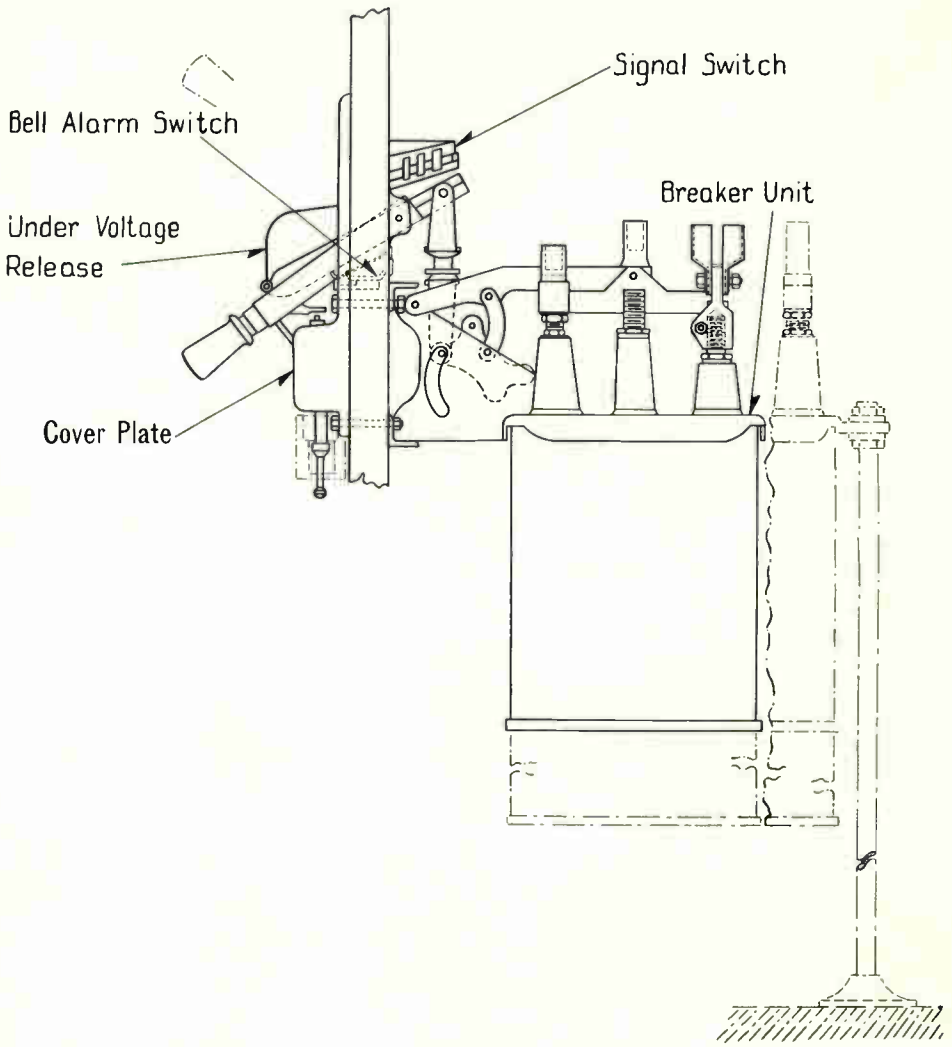


FIG. 4—SWITCHBOARD MOUNTING TYPE F-22 OIL CIRCUIT-BREAKER

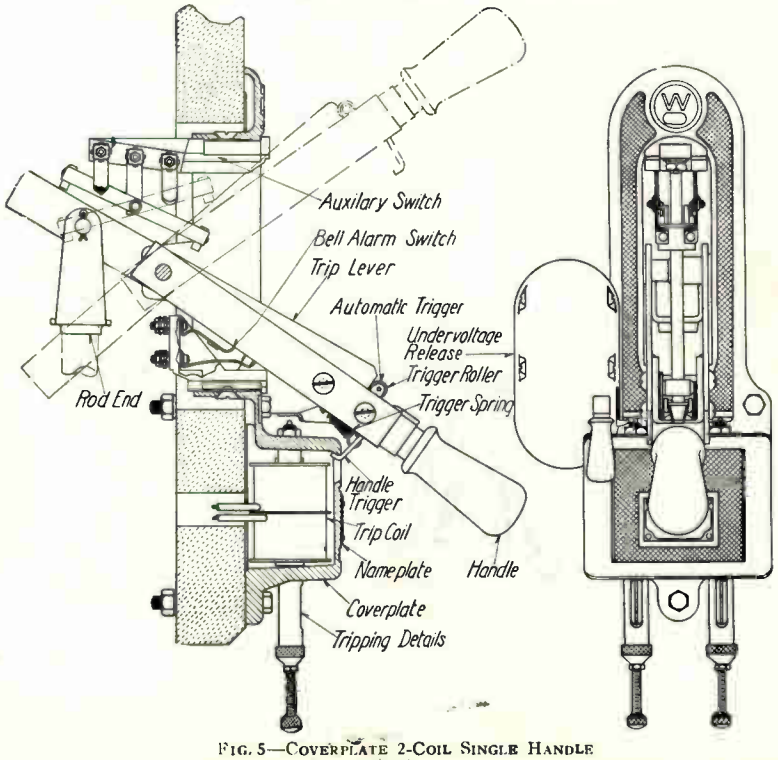


FIG. 5—COVERPLATE 2-COIL SINGLE HANDLE

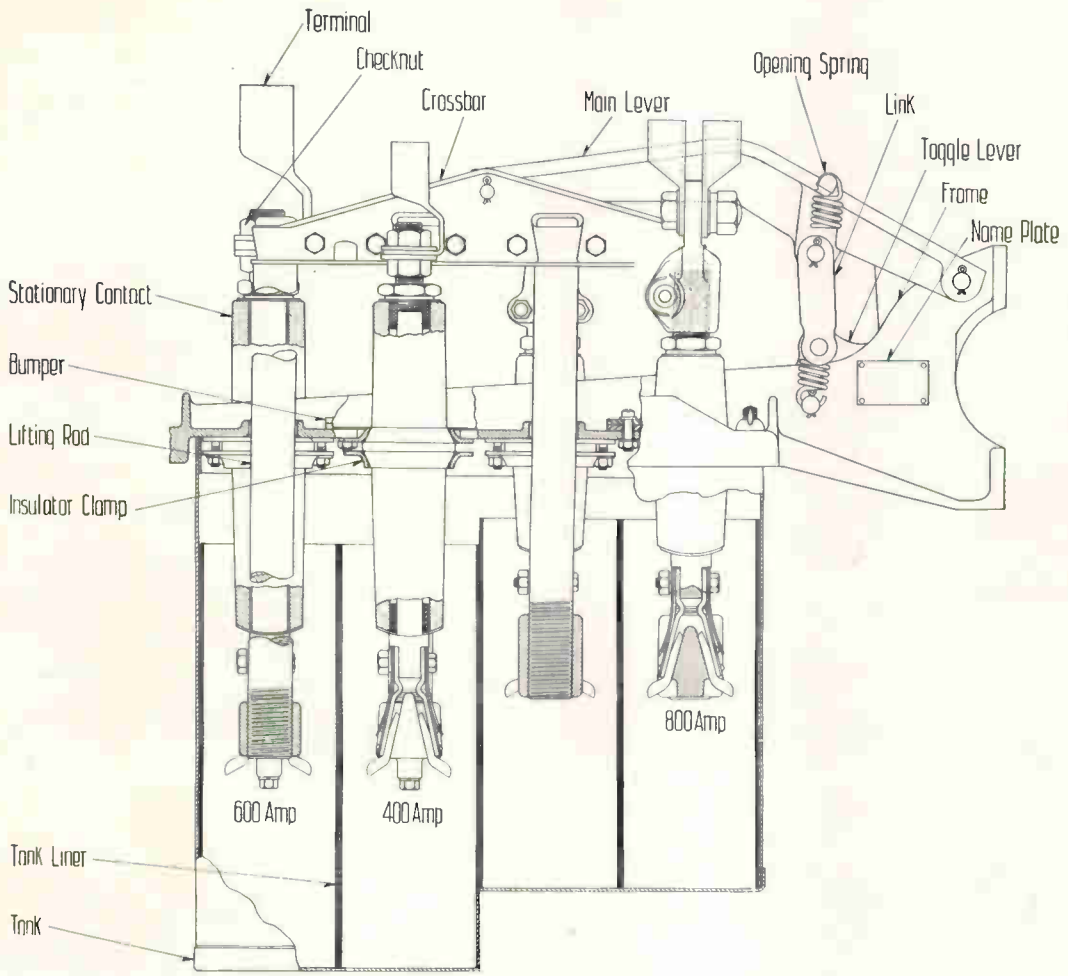


FIG. 6—TYPE F-22, 4 P.S.T. OIL CIRCUIT-BREAKER

Mounting of Remote Control Breaker

The remote control breaker unit should be mounted in place upon the wall or pipe as nearly level as possible. The auxiliary switch and bell alarm contacts, if supplied, should be mounted in the coverplate before the coverplate is mounted on the panel or on the panel bracket. The coverplate can then be mounted as shown in Fig. 5, with the coils in place in the coil box. The tripping cores can then be put in place on the coverplate and tightened up. Here again, if direct trip attachments or undervoltage release are used, they may be placed on the coverplate after it is assembled to the panel by pushing the leads through the clearance between the coverplate and the panel, and pulling them back through the drilled holes in the panel. All connections should be made after the mechanical assembly is complete. The coverplate and breaker units should then be connected up with operating rods through the bell cranks as shown in Fig. 3.

The connecting pipes are ¾ inch wrought iron, and should be cut 4 inches shorter than the distance between fulcrums of the levers to be connected. These pipes should be threaded 2¾ inches on each end with a 1.041-14 (¾ inch straight pipe thread) die. A ¾ inch pipe lock nut should be put at one end or the other of each pipe. The length of the pipe should be adjusted so that the travel of each bell crank lever is approximately equal on each side of the horizontal or vertical center line. The last length should be adjusted so that with the handle in the latched position, the contacts in the breaker are making full contact. With proper adjustment on the breaker contacts, it will be observed that proper contact is secured on the signal switch if one is used. The bell cranks as supplied are for mounting above the floor. If it is desired to mount the bell cranks below the floor, it is necessary to reverse them. To reverse the bell cranks, remove the fulcrum pin and replace it in the lower hole. To reverse the accelerating device, it is necessary to remove the fulcrum pin and to replace it in the upper hole. It is also necessary to change the accelerating spring on the accelerating device. See Fig. 7 and Fig. 8.

Any length of pipe exceeding 12 feet should have an intermediate support. The operating rods should all be in tension except the one next to the breaker, and in applications where this vertical rod is long enough, to cause buckling under the strain of closing the

breaker, it will be necessary to reverse the accelerating device and also to reverse the toggle in the breaker so that this rod will be in tension instead of compression. To reverse the toggle in the breaker, the pin between the toggle lever and the toggle link should be moved to the hole farther back. This will cause the toggle to close the breaker with a downward motion of the operating rod. See Fig. 9.

Mounting of the Auxiliaries

Mounting of the Electric Lock-out Device

The electric lock-out device mounts on the rear of the panel, and is attached to the coverplate as shown in Fig. 25. It is necessary to take out the fulcrum pin of the coverplate and remove the two washers which space the handle on either side from the lugs on the coverplate. The steel piece of the electric lock-out device occupies space left by the removal of the washer. The lock-out device can then be mounted as shown, and the set screws tightened so that it is held rigidly in place. It should be observed that the armature moves freely, and that with the armature closed, the handle has clearance to pass; while with the coil de-energized, and the armature open the lug is over the trip lever of the handle, and successfully prevents it from closing.

Mounting of the Mechanical Interlock

When two single handle coverplates, or the two handles of a double handle coverplate, are to be interlocked so that only one can be closed at a time, the mechanical interlock is used. See Fig. 26. When two handles are used to operate a double-throw F-11 Breaker an interlock is provided as an integral part of the breaker. In any other case the interlock as here described should be used. In order to mount this attachment, it is necessary to remove the fulcrum pin from the coverplate handle, and to take off the spacing washer for the handles on the side next to the coverplate with which it is to be interlocked. Then

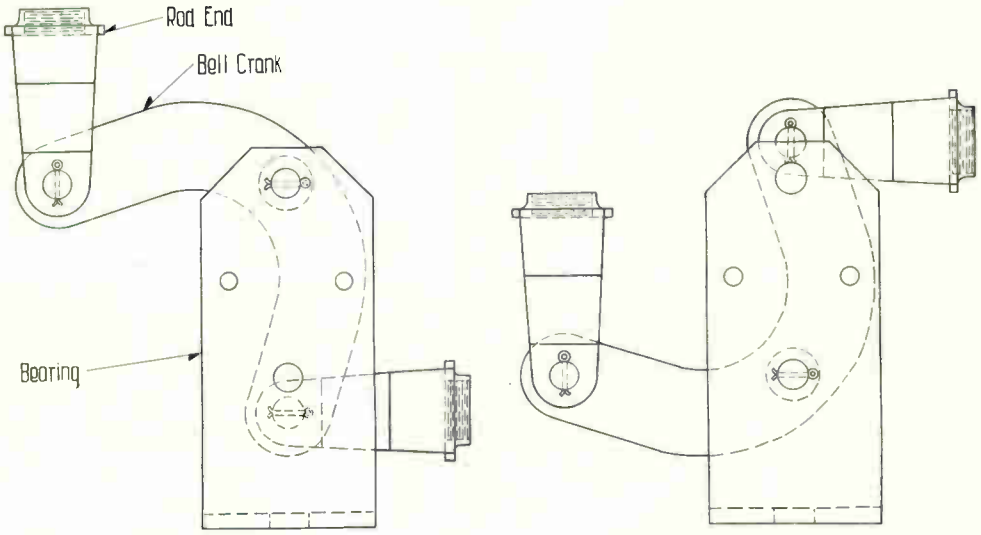


FIG. 7—BELL CRANK SHOWING ASSEMBLIES FOR ABOVE AND BELOW FLOOR MOUNTING

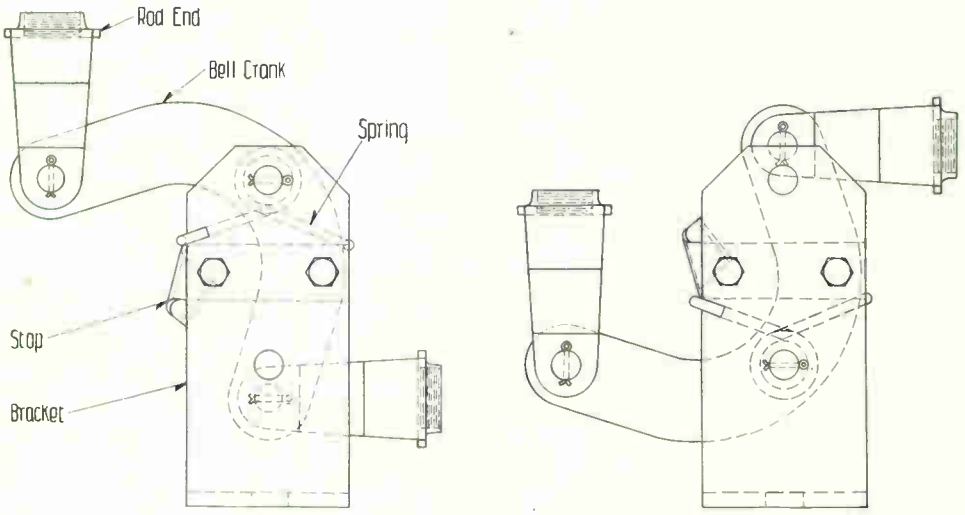


FIG. 8—ACCELERATING DEVICE SHOWING ASSEMBLY FOR ABOVE AND BELOW FLOOR MOUNTING

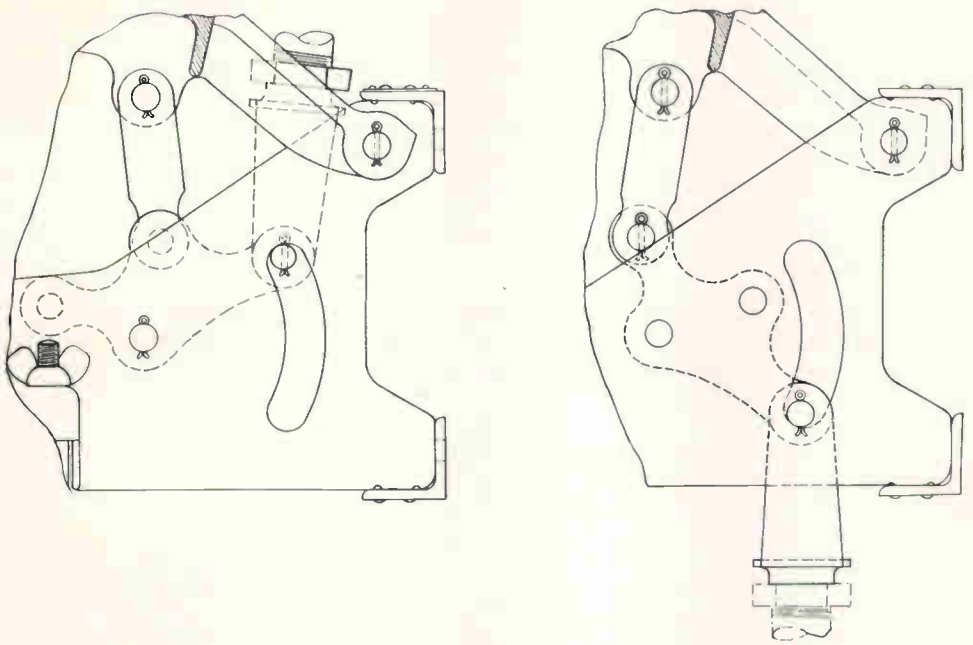


FIG. 9—SHOWING ASSEMBLY OF BREAKER MECHANISM FOR UPWARD AND DOWNWARD PULL

the mounting brackets of the interlock may be placed on the coverplate as shown in the picture, and all screws tightened. It will be found that to put the brackets on first and to insert the interlock bar in place after the brackets are lined up will make the assembly easy. It should be observed that the interlock bar moves freely and is returned to the neutral position by the spring when the handle releases it. The movement of one handle to the close position should move the bar over the other handle so that it locks on the straight part of the bar and not the beveled part. Adjustment is provided so that length may be altered when assembling. When this interlock is used in addition to a lock-out device on one of the handles, a hole in the mounting bracket of the electric lock-out device takes the interlock bar and one of the interlock mounting brackets should be omitted. If for any reason the interlock bar does not move freely, it will be necessary to more properly line up the holes in which it is supported. This can be done by loosening the coverplate mounting bolt and moving the coverplate bodily to alignment. In very extreme cases it may be found necessary to file the top lug of the mounting bracket to line up.

Mounting the Mechanical Sequence Interlock—The mechanical sequence interlock can be mounted on a double handle coverplate only. The brackets for the sequence interlock are held in place by a special pin which replaces the fulcrum pin of the handles, omit spacing washers for handle on one side of each handle only. The adjusting screws at top and bottom should be adjusted so that there will be no binding between the cam shaped slot and the interlock pins on the coverplate lever. The interlock pins replace the standard pins for the rod ends. See Fig. 27.

Mounting of the Undervoltage Release Attachment

The hand retrieved undervoltage release attachment mounts on the left hand mounting bolt for the coverplate. It is necessary to take out this bolt and to put it in from the rear of the panel, and thus screwing it into the undervoltage cover, tightening this bolt clamps the undervoltage release tightly in the proper position. After it is completely mounted, operate it a few times by hand to see that the movement is free and that it operates properly. See Fig. 17.

The automatic retrieve undervoltage release mounts on the right hand side of the coverplate in a similar manner. It is necessary to put a pin in the trip lever of the coverplate to operate this device. See Fig. 18.

Mounting of Other Tripping Devices

The overload trip, the shunt trip, and the overload trip with dash-pot, as well as the direct trip attachment, mount on the coverplate by passing the core up through from the bottom into position in the coverplate and then securing it there by means of one nut. With the direct trip attachment, it is necessary that the leads from the lower coils be put through the clearance provided between the coverplate and the panel and drawn back through the drilled holes in the panel. The coil should be put in the coil box of the coverplate, before the coverplate is mounted on the panel. However, the tripping cores with the dash-pot or direct trip below, should not be mounted on the coverplate until the mechanical installation is complete. This is necessary in order that all the bolt heads will be easily accessible

Mounting of Signal Switch and Bell Alarm

As indicated above, it is necessary to mount the signal switch and bell alarm in position on the coverplate as shown in the picture before the coverplate is put on the panel, otherwise it

would be very difficult to tighten the screw which clamps it in position.

Connections

When the breaker has been assembled with its operating handle and auxiliaries as described above, then the connections should be made in accordance with the diagram furnished for the complete installation if covered by a complete diagram, or according to the diagram furnished with this instruction book. The main leads should be carefully soldered into the cable terminal furnished with the circuit-breaker. In case copper strap connections are to be used, they should be carefully grained before putting on and the contact nut should be drawn down so as to bear evenly over their entire area on the strap. The lower contact nutshould not touch the upper clamping nut of the insulator. The connection should have an area of not less than that given by the National Electric Code, in the tables on allowable carrying capacity for wires and cables. After fastening in the main leads, the terminals should be insulated with tape or insulating tube, so that any gas expelled from the circuit-breaker in opening heavy short circuit, will not cause a short circuit outside of the circuit-breaker. Good engineering practice demands that all terminals on circuit-breakers of 2200 volts and above, be insulated.

As a safety measure the frame of the circuit-breaker should be grounded.

Caution—Before connecting power to the circuit, remove the tank from the breaker and after thoroughly cleaning and drying, fill with clean dry insulating oil. Clean the oxide from the contacts so that they are clean and bright. It is also recommended that the breaker be operated several times by hand to see that all the parts are free to move and operating properly.

Maintenance

Circuit-Breaker Unit—Wherever possible, periodic inspection should be made of circuit-breakers, at which time the tank should be removed and the contacts inspected. Any pitting of the contacts which has been caused by arcing should be cleaned off and the contacts put in good condition. If the contacts are too badly burned to be repaired so as to give good contact, new parts should be put on. If the oil is very much carbonized, it should be replaced by new clean dry insulating oil.

Coverplate and Handle—The mechanical part of the coverplate and handle should be kept in good condition in order that the tripping function will be properly performed. A little oil on the bearings at intervals will keep the parts in good operating condition.

Other Devices—Though there is nothing about the construction of the other auxiliaries and tripping devices which would require the attention of the operator periodically, yet it is recommended that the tripping devices be given a casual inspection to see that

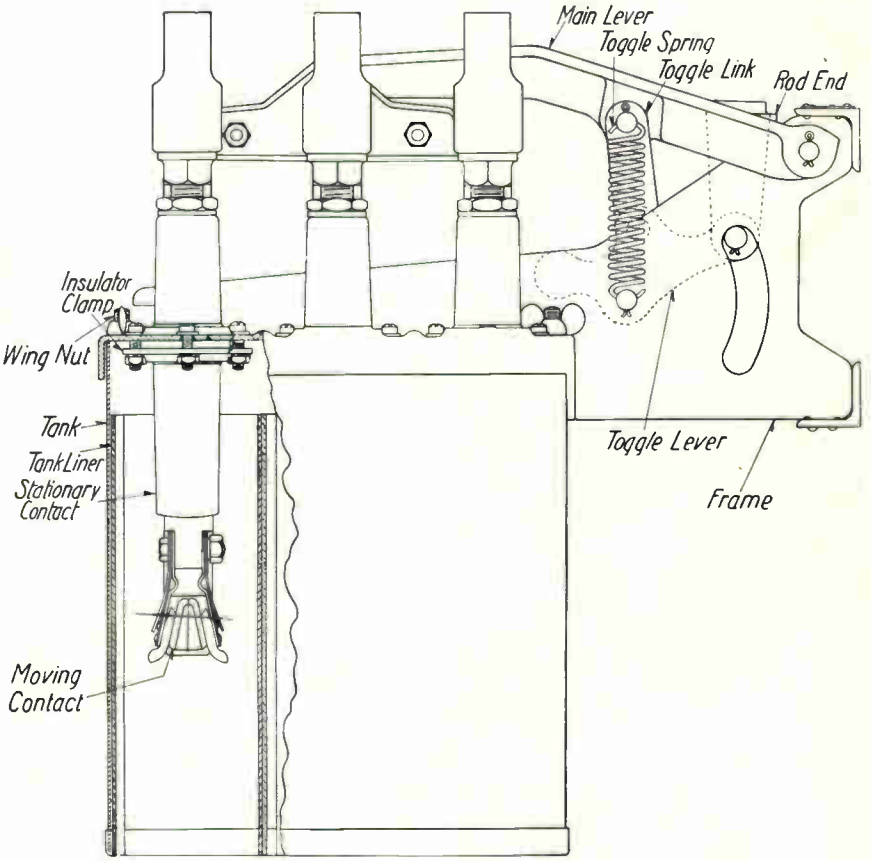


FIG. 10—TYPE F-11, 3 P.S.T. CIRCUIT-BREAKER UNIT

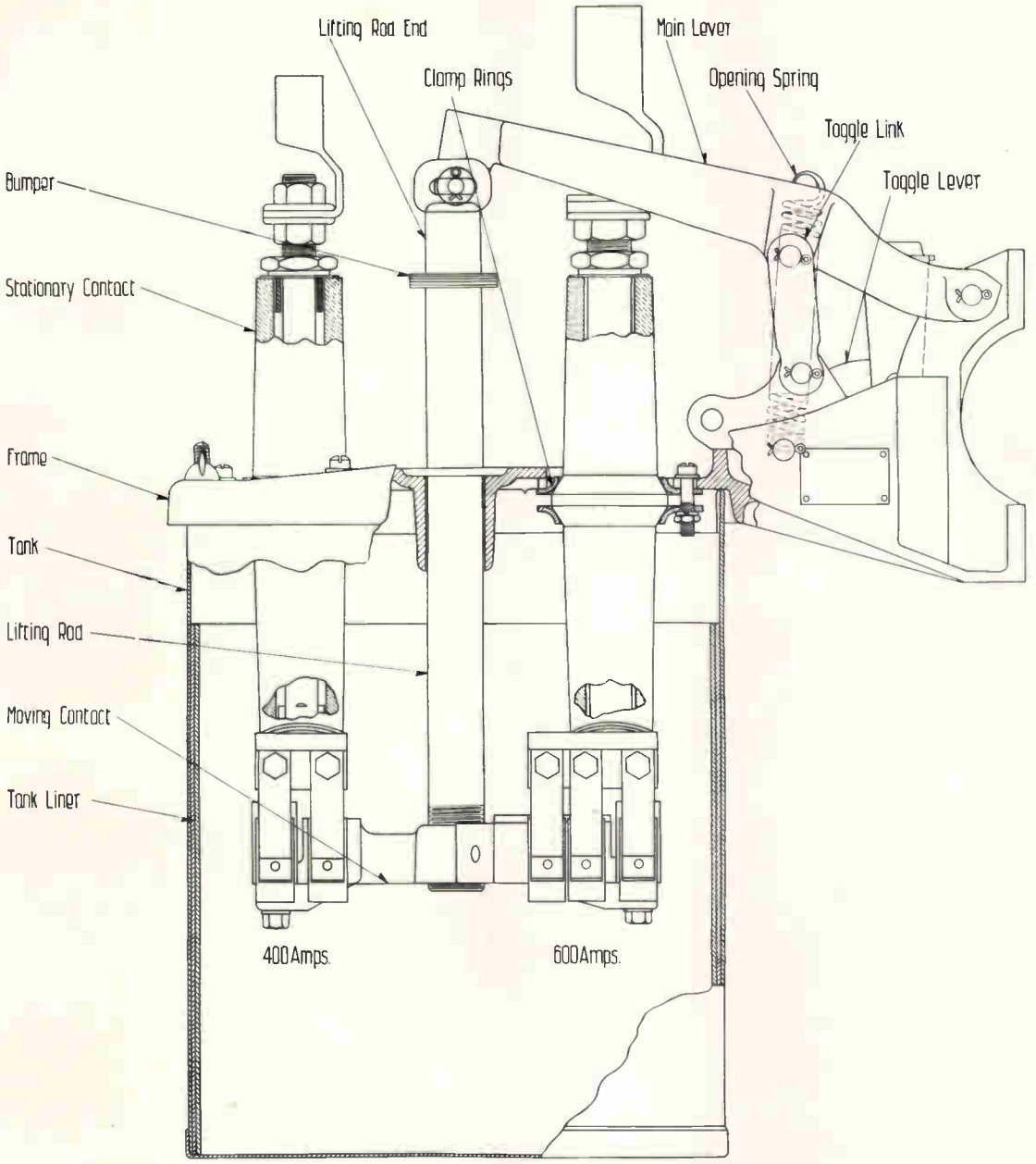


FIG. 11—TYPE F-22, SINGLE-POLE OIL CIRCUIT-BREAKER

cotter pins have not become lost and that screws and bolts are tight. Moving parts should be operated by hand to see that they are free on their bearings and do not bind.

Description of Breakers and Auxiliaries

Breaker Unit and Contacts—The circuit-breaker units include the main current carrying parts and operating details. See Fig. 10. The two and three-pole "F-11" and "F-22" have frames of punched steel, while the double throw "F-11" and the single and four-pole "F-22" breakers have frames of heavy cast iron. The stationary contacts are clamped to these frames by clamping rings which have bolts spaced 120 degrees apart. This makes it easy to swing the contacts so that the moving contacts will enter exactly between the fingers. At the lower end of the stationary contact stud, the contact fingers are bolted. These may be renewed when badly burned by removing the bolt which holds them in place. The moving contact of the Type "F-11" breaker is a punched piece of copper, which is clamped rigidly to the wedged end of the wood lifting rod. The moving contact of the Type "F-22" breaker is a heavy copper casting with a renewable arcing tip of solid copper,

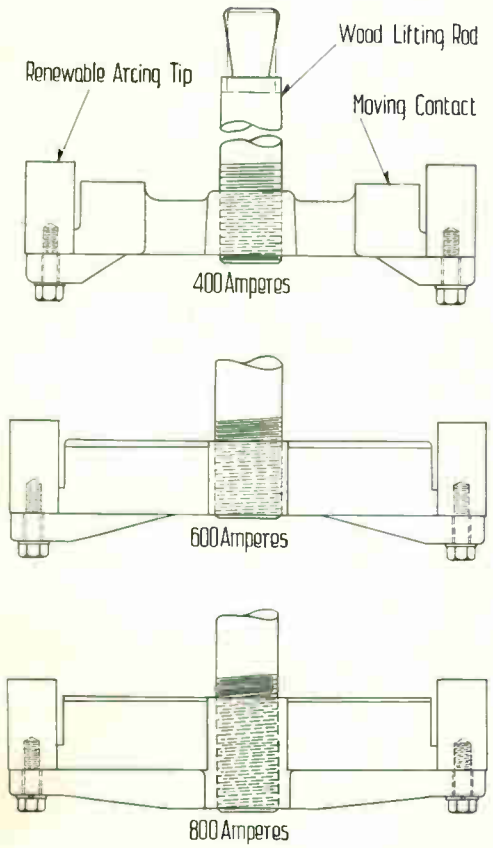


FIG. 12—TYPE F-22, MOVING CONTACTS

which has a very high thermal capacity, which reduces the burning due to arcing to a minimum. All of the arcing on the Type "F-22" breaker takes place on this arcing tip and when it has become badly pitted, due to opening very heavy short-circuits, it should be replaced by a new arcing tip and the pair of fingers which make contact on it should also be renewed.

Coverplate—The coverplate contains the operating handle with space for overload coil, auxiliary switch, bell alarm, undervoltage and other auxiliaries. The operating handle is in two parts. The trip lever is attached to the breaker unit through a rod at the rear of the panel and engages the trigger in the handle lever on the front of the panel. The handle trigger holds the handle lever down after the circuit-breaker has been closed by pushing the handle. The auxiliaries all operate to disengage the trigger from the trip lever. Raising the handle disengages the handle trigger and permits the breaker unit to open.

The coverplate is made in three arrangements, the two-coil single handle coverplate is used on non-automatic or automatic single-throw breakers unless special requirements demand the three-coil single handle coverplate.

The double handle coverplate is used with all automatic and non-automatic double-throw breakers or motor starting combination of breakers.

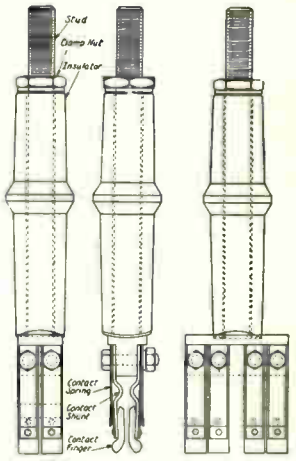


FIG. 13—TYPE F-11, STATIONARY CONTACTS

A special assembly of this double handle coverplate is used with motor starting combinations. It is provided with a pin to operate the automatic retrieve undervoltage release and latches are removed from starting side so that it is impossible to leave the motor running on starting voltage.

Undervoltage Release—The hand retrieve undervoltage release must be connected so as to leave the coil de-energized when the circuit-breaker is open. This may be done by energizing from the dead side of breaker or wiring through the signal switch. The undervoltage device is designed with a closed magnetic circuit. Upon the reduction of the voltage across the coil to approximately 50 percent of the normal voltage, the armature will be drawn downward by

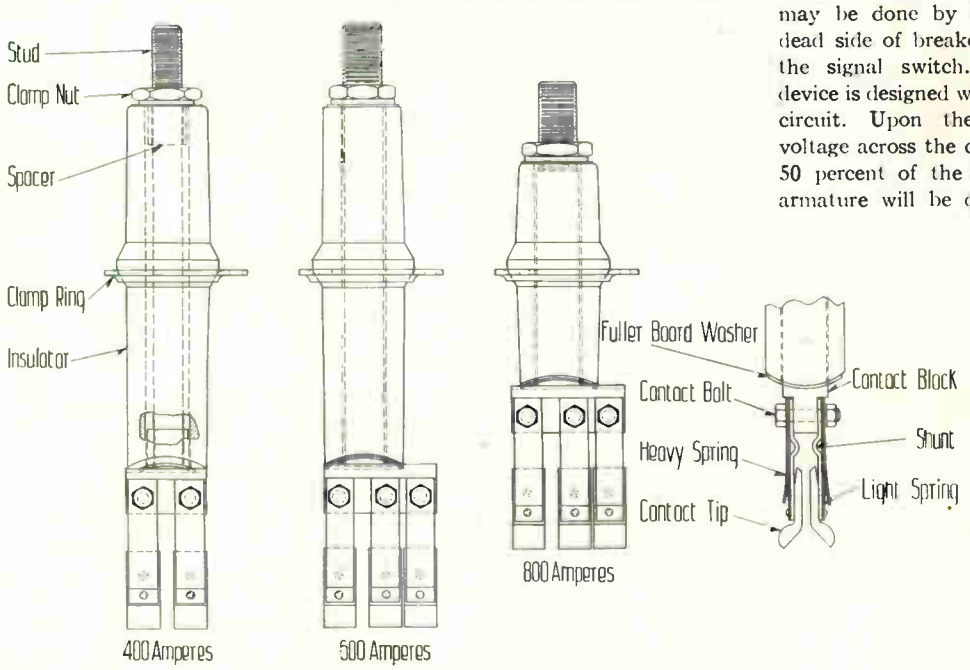


FIG. 14—TYPE F-22, STATIONARY CONTACTS

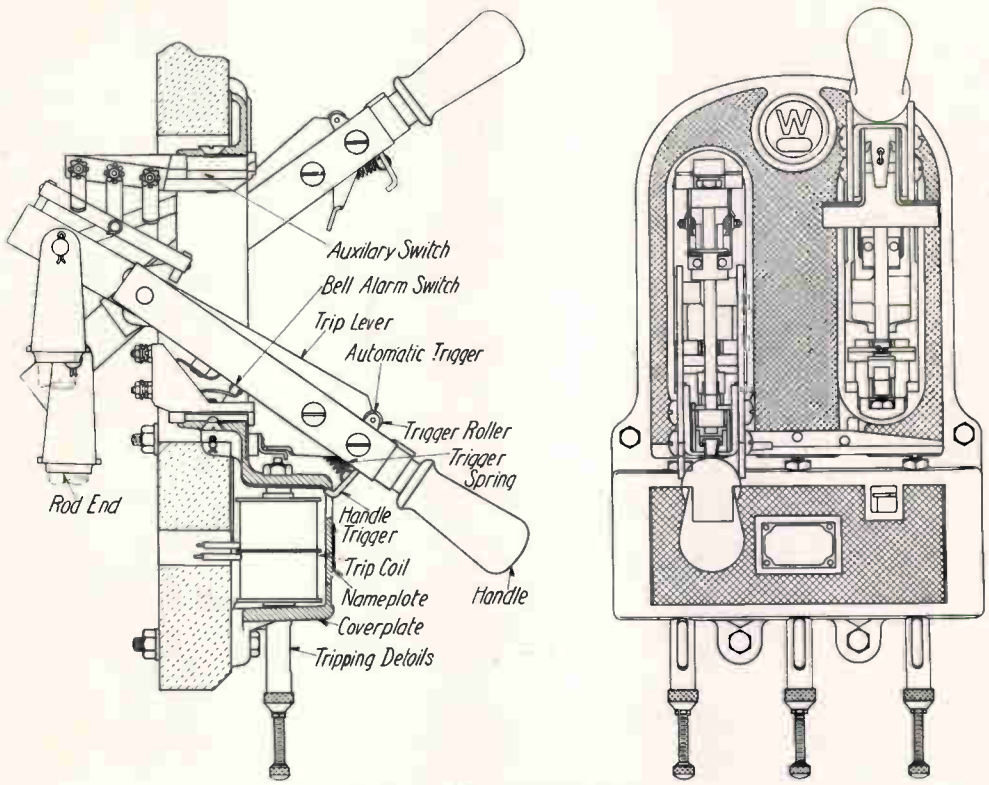


FIG. 15—DOUBLE HANDLE COVERPLATE

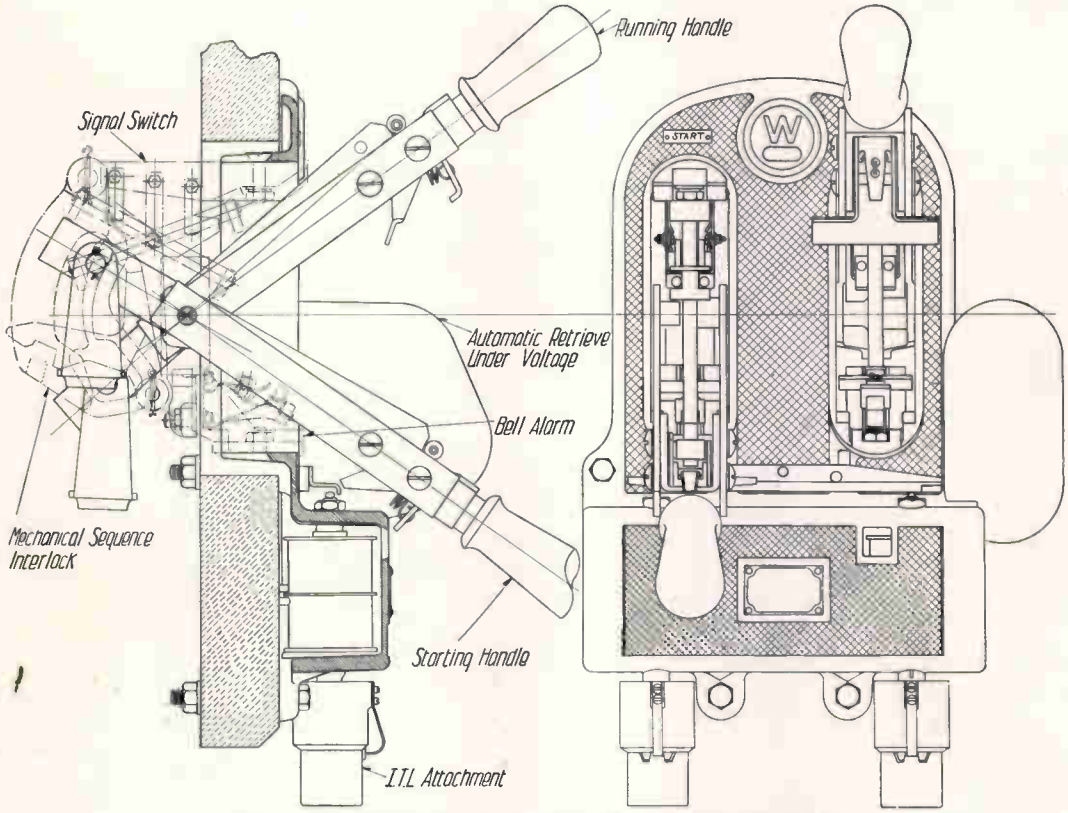


FIG. 16—DOUBLE HANDLE COVERPLATE FOR MOTOR-STARTING EQUIPMENT

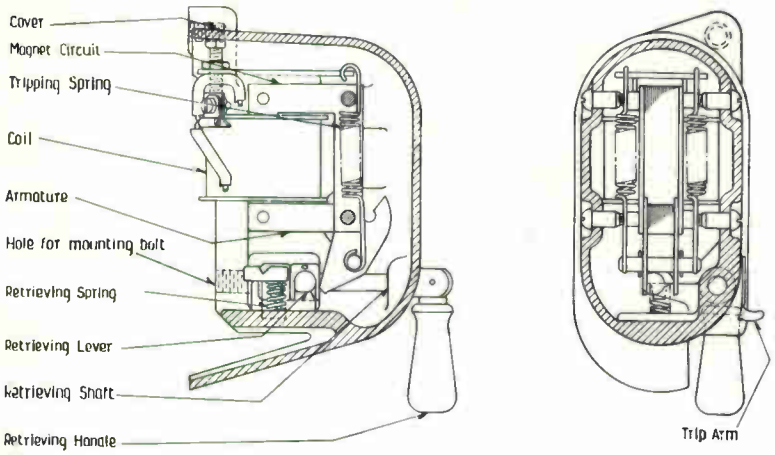


FIG. 17—HAND RETRIEVE UNDERVOLTAGE

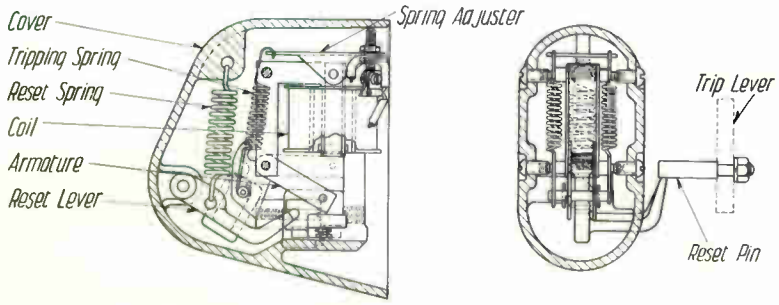


FIG. 18—AUTOMATIC RETRIEVE UNDERVOLTAGE RELEASE

the spring. The armature will strike the tripping arm which will raise the trigger on the coverplate and allow the circuit-breaker to open. The armature is not reset by the circuit-breaker in opening and must be reset by rotating the retrieving handle to the left before the coil is re-energized. The coil will burn out if the current is flowing in the coil when the armature is not in the retrieved position.

If noise develops, the face of the armature and magnetic circuit should be inspected to see that a good clean seat is obtained when they are together. If necessary to clean this seat be careful to leave it bearing over its entire area. The coils are marked with their style number, the style number of the series resistor and the voltages and frequencies on which they may be used. Reference to these should be made in all correspondence regarding the device. The device is made for use with or without resistor, depending upon whether it is desired to trip the breaker by short circuiting the undervoltage coil. When this is done it is necessary to have a resistor in circuit in order that a short circuit on the control wiring will not be obtained.

A screw adjustment is provided for the opening springs by which it is possible to alter the drop-out point over a considerable range.

The automatic retrieve undervoltage is intended primarily for use with the double handle coverplate for use with motor starting equipments, but may also be used on single handle coverplates. It mounts on the right hand side of the coverplate. Its operation is identical with that of the hand retrieve device except that an additional lever and spring is provided which will retrieve the armature to the closed gap position when the breaker opens. When the breaker closes, a pin on the trip lever engages this lever and holds it back so that the armature is free to trip the breaker. This undervoltage release may be energized from either the live or the dead side of the breaker.

Overload Release (Fig. 19)—The overload release consists of the part shown in the picture. The moving core is drawn by the magnetic pull up against the trip pin which is pushed up against the trigger. The calibration is varied by

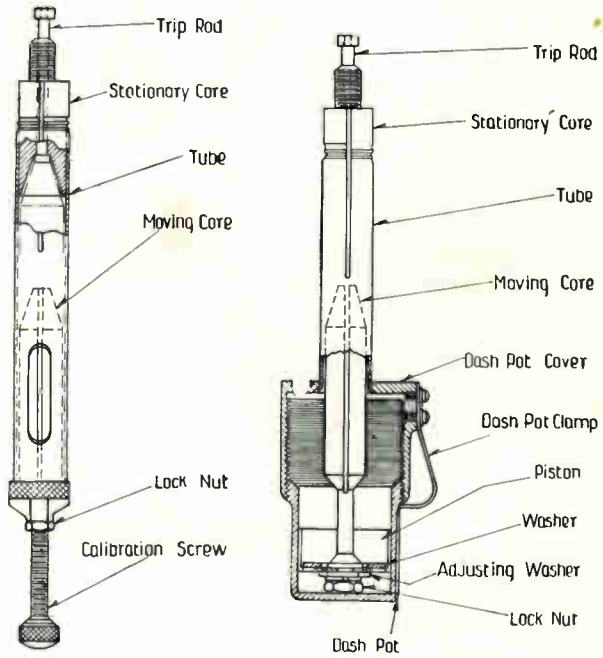


FIG. 19—OVERLOAD RELEASE CORES

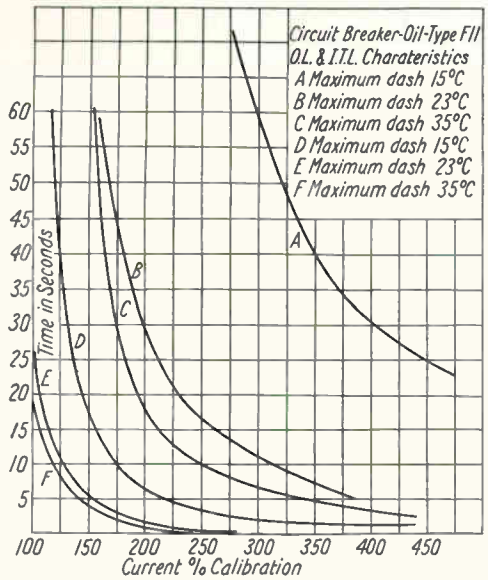


FIG. 20—CALIBRATION CURVE

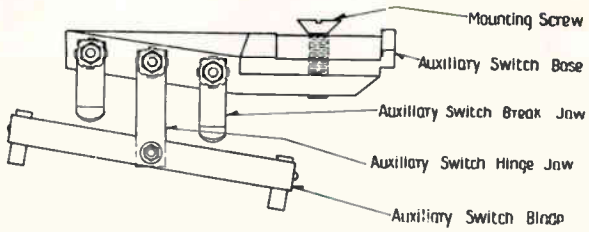


FIG. 22—AUXILIARY SWITCH

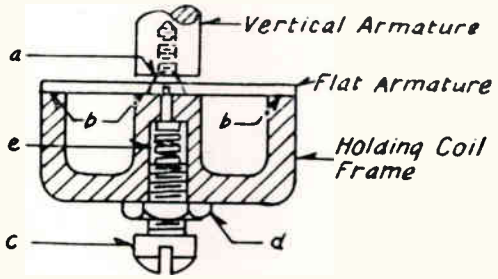


FIG. 23—DIRECT TRIP ARMATURE

changing the air gaps between the moving and stationary cores by raising and lowering the calibration screw. The lock nuts to be drawn tight after changing calibration. The calibration setting is indicated by figures on the tube opposite the line on the moving core. For series trip coils, the calibration is directly in ampere. For current transformer trip coils, the calibration corresponds to amperes in the secondary of the current transformer.

If the opening of the circuit-breaker is not desired unless the overload continues, an oil dash pot is attached to the end of the moving core. The calibration is then inscribed on the dash pot and is varied by screwing the pot into the cover. The time is varied by changing the number of holes in the bottom of the piston uncovered by the diaphragm. Instantaneous resetting is possible because the check valve action of the washer at the time of tripping varies inversely with the amount of overload and directly with the variation in the viscosity of the oil. Fig. 20 shows approximate variations of the time with the variations of the overload and the effect of changed temperature on the standard dash pot oil as supplied with the dash pot.

The values given in figure 20 are approximate and will vary somewhat with changes in temperature, and changes in viscosity of the oil. Where a definite time delay is required the delay should be obtained by the use of suitable relays. The oil in the dash pots should be renewed periodically to obtain the best service.

Fill with oil to ¾ inch above the inside bottom surface of the pot, with the plunger removed.

Direct Trip Attachment (Fig. 21)—Two opposed trip coils are added below the overload trip coil when a definite delay time in tripping is desired. The holding coil, the terminals of which are marked 3 and 4, retains the armature which is fastened to the moving core until the terminals to the relay coil are short-circuited. The terminals are marked 1 and 2. The adjusting screw pushes on the balance spring which balances the weight of the moving core and armature and allows the armature to drop just far enough to touch the magnetic yoke when no current is flowing.

All dust and excelsior from packing must be removed from between the magnetic poles in order to permit the

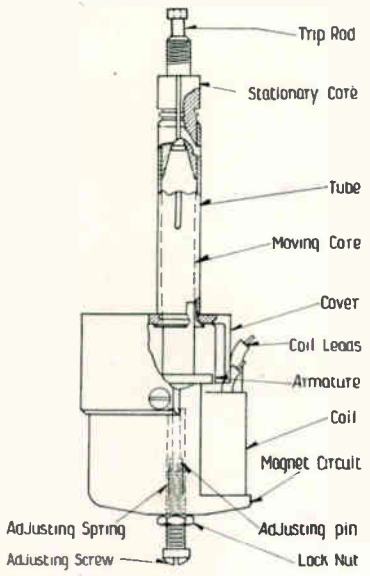


FIG. 21—DIRECT TRIP ATTACHMENT

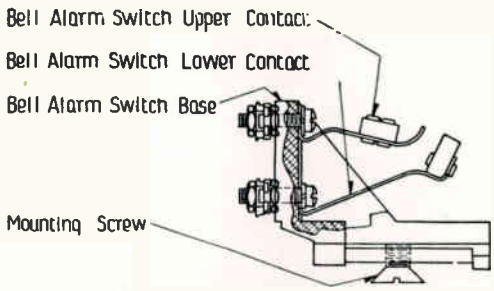


FIG. 24—BELL ALARM SWITCH

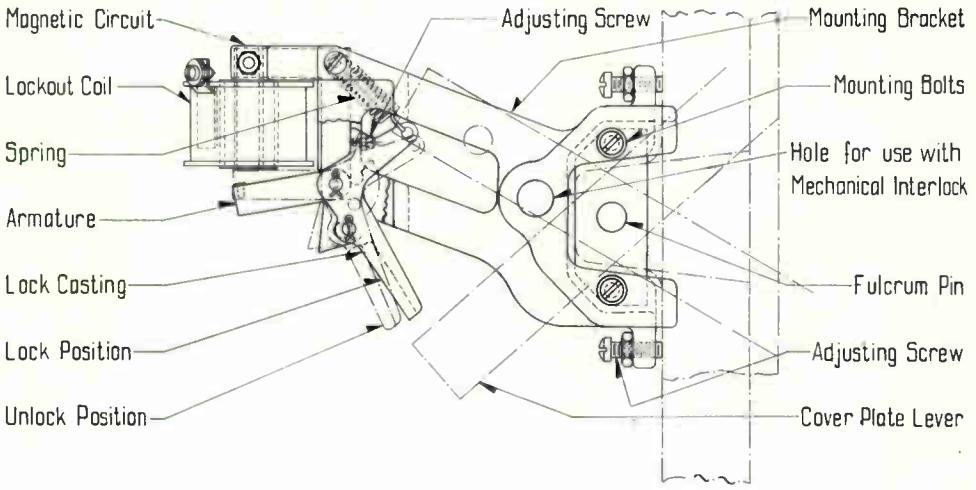


FIG. 25—ELECTRICAL LOCKOUT DEVICE

armature seating properly. Figure 23 shows the points that should be inspected to detect trouble.

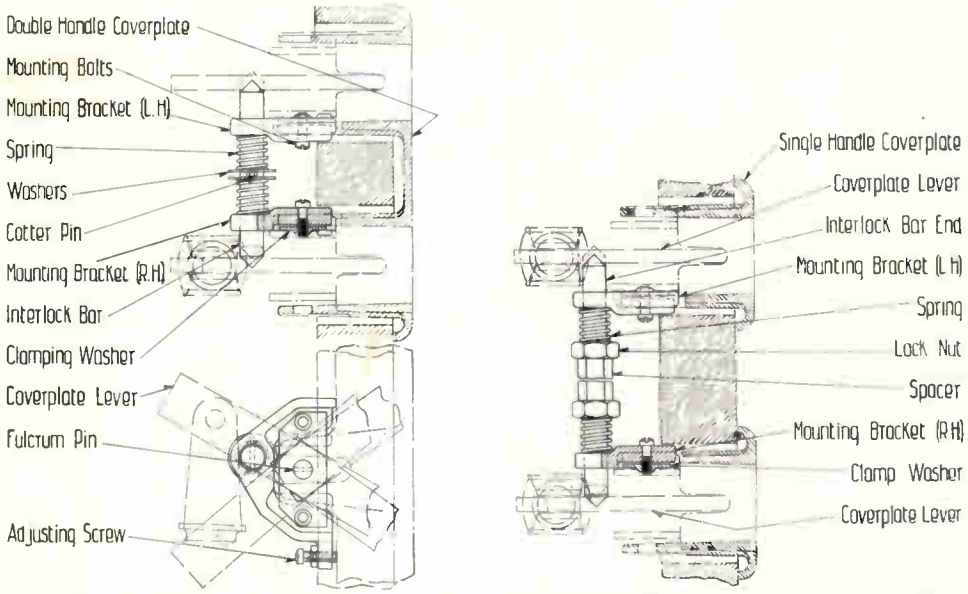
Be sure that the flat armature is making good contact with the holding coil frame at point (b). If surfaces are dirty they should be cleaned off by rubbing lightly with a fine piece of emery cloth.

The flat armature must be able to move freely on the screw at point (a). Do not draw the screw up tightly, as it is purposely left free to provide alignment of armature. If the setting of the adjusting screw (c) has been disturbed it should be readjusted until the proper pressure is put on the spring (e). This pressure is determined by the point at which the armature will remain seated when the breaker closes and it will trip when the secondary of the holding coil is short circuited. After this setting is made and adjusted properly then the lock nut (d) should be tightly fastened

Auxiliary Switch (Fig. 22)—The auxiliary switch is mounted in the coverplate by a flat head screw. It is operated by the trip lever striking the fiber block in between the blades. The switch should be examined occasionally to be sure that the blades are making firm contact in the jaws, that the connections are on tight and that the nuts are drawn up tight on the clip washers at the hinge jaw.

Bell Alarm Switch (Fig. 24)—The bell alarm switch only makes contacts when the handle is drawn down with the circuit-breaker open as would be the case if tripped by any attachment. The upper block is depressed by the handle side bars and the lower block by the tripping lever. It should be examined occasionally to make sure that the contacts and all connections are secure.

Electrical Lockout Device (Fig. 25)—The electrical lockout device is used in various schemes where it is desired to in-



FOR DOUBLE HANDLE COVERPLATE

FOR TWO SEPARATE COVERPLATES

FIG. 26—MECHANICAL INTERLOCK

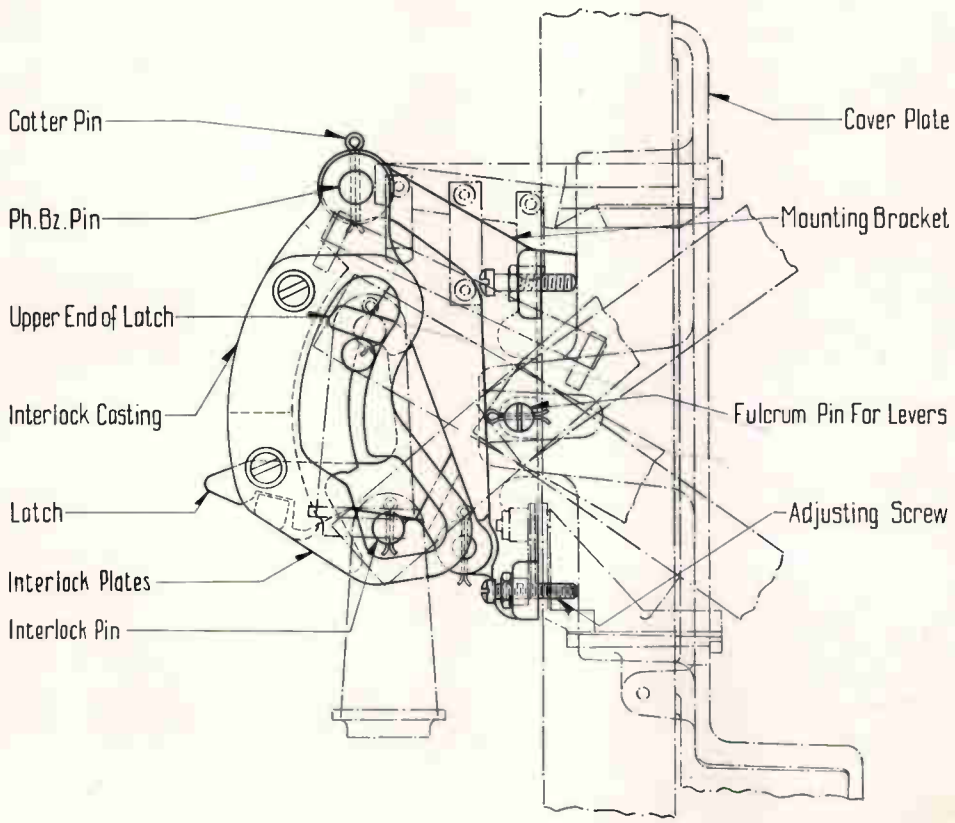


FIG. 27—MECHANICAL SEQUENCE INTERLOCK

terlock the breaker so that it cannot be closed unless predetermined conditions exist. The device consists of a magnetic circuit with a moving armature to which is attached a lever. When the coil is de-energized the armature is open and the lever is interposed over the trip lever so that it is impossible to close the circuit-breaker. When the coil is energized the lever is drawn away from the trip lever and allows the circuit-breaker to be closed.

Mechanical Interlock (Fig. 26)—The mechanical interlock consists of a bar and centralizing springs so arranged that it is impossible to close but one of two levers at a time. This may be used on two single handle coverplates on various center lines or on the two handles of a double handle coverplate. Its chief application is a double-throw breaker made of two single-throw units operated from two handles of the coverplate. The double-throw F-11 breaker has an equivalent interlock which is an integral part of the breaker unit. See Fig. 26.

Panel Brackets—The panel bracket is an iron casting with U bolts to mount it to pipe structure and provided with holes so that the coverplate and breaker or the coverplate alone may be mounted on this bracket. It is especially adaptable to mounting the breaker on pipe structure where no panel is required, or where it is desirable to mount the breaker separate from the panel.

Pipe Bracket—The pipe mounting bracket for the breaker consists of pieces of angle iron provided with standard pipe fittings and holes so that the breaker unit is bolted to the angle iron and the angle iron is held to the pipe.

Pipe Structure—The pipe structure as supplied is a simple arrangement made of 1¼ inch pipe and standard switchboard clamps arranged to support the breaker by means of a panel bracket installation where panels are not desired for other equipment than the breaker. It should be assembled with 12 inches of vertical pipe protruding above the top horizontal pipe. This projection is for mounting transformers. When transformers are not used this pipe may be cut off.

Panel Frame Mounting Bracket—This bracket is designed for mounting the breaker 4½ inches back of the panel on a pipe structure, with the coverplate mounted on the front of the panel.

Motor Starting Breaker—Combination of "F-11" and "F-22" oil circuit-breakers may be used in connection with auto transformers for the starting of 3 phase squirrel cage induction motors and self-starting synchronous motors. When used for this kind of service two handles are provided so that the throwing of one handle imposes partial voltage upon the motor to bring it to speed and then throwing the other handle throws full voltage on the motor for running duty. For this type of service the handles are provided with a mechanical sequence interlock. This sequence interlock provides first that both handles cannot be closed at the same time; second, the running handle cannot be closed until the starting handle has been completely closed and completely opened; third, if the running handle is not thrown in within a very limited period of time after the starting handle is opened, it will be impossible to close the

FIG. 28—VIEW OF STARTING SIDE WITH BOTH HANDLES OPEN

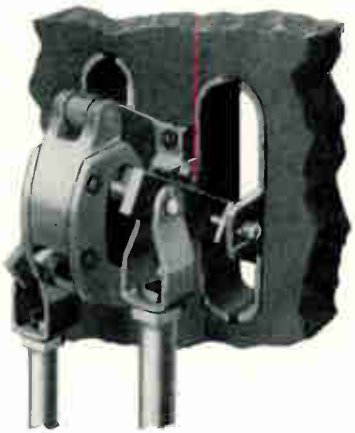


FIG. 29—VIEW OF STARTING SIDE WITH STARTING SIDE CLOSED

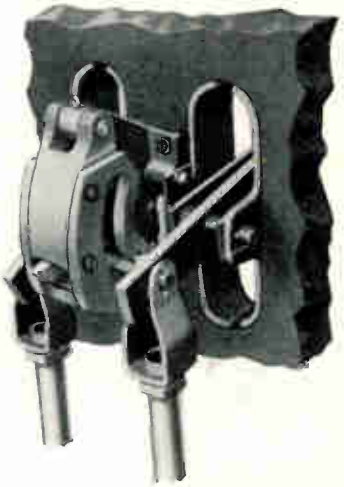


FIG. 30—VIEW OF STARTING SIDE JUST AS STARTING HANDLE IS REACHING ITS OPEN POSITION

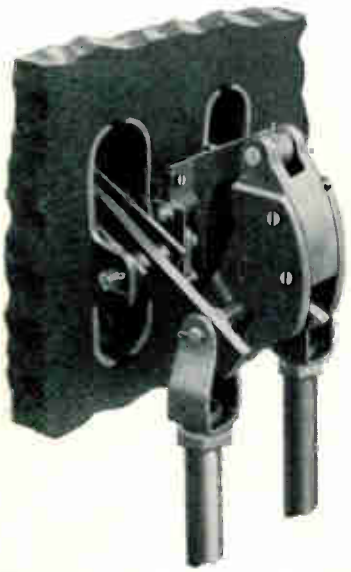


FIG. 31—VIEW OF RUNNING SIDE WITH BOTH HANDLES OPEN

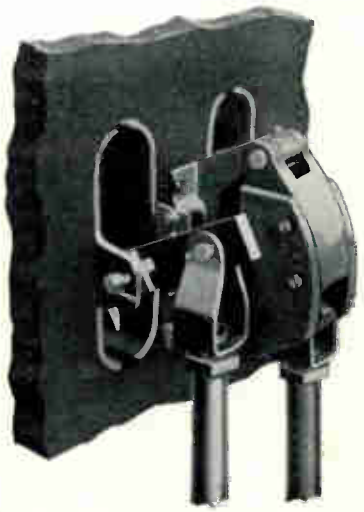


FIG. 32—VIEW OF RUNNING SIDE WITH RUNNING SIDE CLOSED

running side without first throwing in the starting side again. A special automatic undervoltage release is used with these combinations to facilitate operation.

Operations of the Mechanical Sequence Interlock

(Fig. 27) With both sides of the circuit-breaker in the open position, the following operation should take place in putting the motor on the line with full voltage across the terminal. First, the starting handle is closed applying reduced voltage across the terminal on the motor. The upward motion of the starting handle at the upper end of its travel touches the upper projection of the unlocked lever and releases the interlocking casting. The interlocking casting then rotates on its axis to such a position that when the starting side of the circuit-breaker is open, the starting handle will then strike the unlocking surface of the interlocking casting and withdraw it from in front of the running handle pin and allows the running handle pin to raise, as would occur if the running side of the circuit-breaker had started to close. Thus it is easy to see that it is impossible to start to close the running side of the circuit-breaker until the starting side has been fully closed and has reached its full open position. At the opening of the circuit-breaker the interlock castings return to their original position. The operation of the device can readily be seen by reference to the illustration. Figures 28 to 32.

Number of Starts

Auto transformers are designed to start the motor from rest twice in succession with an interval of 45 seconds before the cycle is repeated. Auto transformers built on this basis have demonstrated their ability to meet operating conditions where more than

two starts are made in rapid succession, without allowing the machine to come to rest.

Under abnormal operating conditions, requiring a number of starts the auto transformer should be kept under observation to prevent their coming to destructive temperatures.

Care of Insulating Oils

Deterioration in Use—All insulating oils are subject to carbonization. This carbonization forms a deposit on the bottom of the tank or any part of the mechanism located in the oil. The contacts and the interior of the tank should be cleaned at regular intervals depending upon the service. The carbonization reduces the dielectric strength of the oil. It is necessary, therefore, that the tank be emptied and refilled with oil from time to time. Deteriorated insulating oil can be filtered and dried by the use of Westinghouse Oil Drying and Purifying Outfits.

Storage—All Westinghouse insulating oil for oil circuit-breaker use is kept either in soldered tin cans or steel drums provided with steel bungs which are sealed before shipment, or in tank cars made exclusively for that purpose. All oil in steel drums, which have been stored exposed to weather, and all oil shipped in tank cars should be tested before using by taking a sample from each container. Drums stored out of doors should always be laid on their side with bungs turned down, never turned up on end; and when storing drums out of doors, protection against direct precipitation should be provided.

Handling—Extreme precautions are required to insure that all containers and any apparatus therein are absolutely dry when oil is transferred to them from a drum, soldered tin or tank car. A drum of cold oil when taken into a warm room will sweat and the resulting moisture on its outer surface may mix with the oil in drawing it from the drum. The container should always be allowed to stand long enough to reach room temperature before breaking the seal. Tank cars should never be emptied during wet weather. Any vessel used in transferring oil should be absolutely dry and free from any foreign matter, especially metallic or carbonation particles.

Filtering—Although the drums are thoroughly washed and dried at the Refinery before filling, a certain amount of scale is generally loosened inside the container. This must be removed by passing the oil through two layers of ordinary finely woven cotton cambric, which has been thoroughly washed to remove the sizing and then dried. The cloth may be stretched across a funnel of large size. The oil will pass through the cloth more rapidly if slightly warm. If the funnel does not discharge directly into the tank of the circuit-breaker, the oil should not be returned to an empty drum unless it is known to be thoroughly clean and dry. The thoroughness of filtering should be determined by a dielectric test.

Detection of Moisture—It is impossible to over-emphasize the effect of relatively small amounts of moisture in oil in circuit-breakers and the serious effect which such moisture may have on breaker operation from breakdown on voltage surges or on interrupting short circuits. The amount of moisture which will seriously lower the insulating value of oil is of the order of 1 part in 20,000. This is too small to be detected by settling out or by the well known hot metal test. It can only be done by a dielectric test. The Westinghouse Electric & Manufacturing Company manufactures a special device for this purpose and furnishes instructions for its use.

Removal of Moisture—Moisture may be entirely removed by passing the oil through a Westinghouse Oil Drying and Purifying Outfit, or a Sharples Transformer Oil Purifier and Dehydrator. When this outfit is not available the oil may be dried in a fairly satisfactory, although slow, and inconvenient manner, by passing it through a bag of clean, dry lime and filtering it afterwards to remove particles of suspended matter. It is not advisable to use various other methods, such as passing hot dry air through the oil on account of the difficulty of entirely removing all moisture from the air, or heating the oil for a considerable length of time on account of the liability of injuring the oil during the heat treatment.

Renewal Parts

For renewal or spare parts refer to Part Catalogue No. 6186 for F-11 Circuit-Breakers and to Catalogue No. 6195 for F-22 Circuit-Breakers.

In case renewal parts are required, consult the nearest Sales Office, as shown in list given on the inside back cover of this book. In all cases give the following information and give a description of parts. First, nameplate reading complete on breaker unit and coverplate. Second, normal voltage frequency applied to all coils. Third, refer to parts by name as given in this book.

Recommended Stock of Renewal Parts

The following is a list of the renewal parts and the minimum quantities of each that should be carried in stock. These are the parts most subject to wear in ordinary operation and damage or breakage due to possible abnormal conditions. The maintenance of such stock will minimize service interruptions due to breakdown.

Recommendations for stocking Renewal Parts for your complete equipment will be supplied upon request to the nearest District Office.

Ordering Instructions: When ordering renewal parts, give the nameplate reading. Always give the name of the part wanted, also the stock order number or the style number of the apparatus on which the part is to be used. For list of parts refer to the tables on the following pages and the illustrations in the preceding pages.

Type F-22 Oil Circuit-Breaker Unit

SINGLE-THROW
400–600 AMPERES—7500 VOLTS
800 AMPERES—2500 VOLTS

Name of Part	Style No.	Single Pole				2 Pole				3 Pole				4 Pole			
		No. Per Unit	Recommended for Stock			No. Per Unit	Recommended for Stock			No. Per Unit	Recommended for Stock			No. Per Unit	Recommended for Stock		
Breaker units in use up to and including	.....	..	2	5	15	..	2	5	15	..	2	5	15	..	2	5	15
Breaker unit complete	.....	1	0	0	1	1	0	0	1	1	0	0	1	1	0	0	1
Bumper	329459	3	1	3	6	..	..	..	..	..	..	..	..	..	..	..	..
Bumper	545683	..	..	..	..	1	0	1	2	1	0	1	2	..	..	..	..
Bumper	329474	..	..	..	..	..	..	..	..	..	..	..	..	4	4	8	12
Front bumper	545684	..	..	..	..	1	0	1	2	1	0	1	2	..	..	..	..
Lifting rod—400-600 Amp.	329465	1	0	1	1	..	..	..	..	..	..	..	..	..	..	..	..
Lifting rod—400-600 Amp.	328471	..	..	..	..	2	0	1	2	3	1	2	3	..	..	..	..
Lifting rod—400-600 Amp.	372311	..	..	..	..	..	..	..	..	..	..	..	..	4	1	2	4
Lifting rod—800 Amp.	329466	1	0	1	1	..	..	..	..	..	..	..	..	..	..	..	..
Lifting rod—800 Amp.	328473	..	..	..	..	2	0	1	2	3	1	2	3	..	..	..	..
Lifting rod—800 Amp.	372312	..	..	..	..	..	..	..	..	..	..	..	..	4	2	4	8
Moving contact—400 Amp.	328467	1	0	1	2	2	1	2	4	3	1	3	6	4	2	4	8
Moving contact—600 Amp.	328468	1	0	1	2	2	1	2	4	3	1	3	6	4	2	4	8
Moving contact—800 Amp.	328469	1	0	1	2	2	1	2	4	3	1	3	6	4	2	4	8
*Arcing tip	328470	2	4	8	16	4	8	16	32	6	12	24	48	8	16	32	64
Stationary contact—400 Amp.	328459	2	0	1	2	4	1	2	4	6	1	3	6	8	2	4	8
Stationary contact—600 Amp.	328460	2	0	1	2	4	1	2	4	6	1	3	6	8	2	4	8
Stationary contact—800 Amp.	328461	2	0	1	2	4	1	2	4	6	1	3	6	8	2	4	8
*Porcelain insulator—400-600 Amp.	328479	2	0	1	2	4	1	2	4	6	1	3	6	8	2	4	8
*Porcelain insulator—800 Amp.	328480	2	0	1	2	4	1	2	4	6	1	3	6	8	2	4	8
*Contact finger—400 Amp.	328455	8	8	16	32	16	16	32	64	24	24	48	96	32	32	64	128
*Contact finger—600-800 Amp.	328455	12	12	24	48	24	24	48	96	36	36	72	144	48	48	96	192
*Contact finger spring—400 Amp.	328478	8	4	8	16	16	8	16	32	24	12	24	48	32	16	32	64
*Contact finger spring—600-800 Amp.	328478	12	6	12	24	24	12	24	48	36	18	36	72	48	24	48	96
Opening spring	328466	1	0	1	1	2	0	1	2	2	0	1	2	2	0	1	2
Tank—400-600 Amp.	329163	1	0	0	1	..	..	..	..	..	..	..	..	..	..	..	..
Tank—400-600 Amp.	328487	..	..	..	..	1	0	0	1	1	0	0	1	..	..	..	..
Tank—400-600 Amp.	329477	..	..	..	..	..	..	..	..	..	..	..	..	1	0	0	1
Tank—800 Amp.	329464	1	0	0	1	..	..	..	..	..	..	..	..	..	..	..	..
Tank—800 Amp.	328154	..	..	..	..	1	0	0	1	1	0	0	1	..	..	..	..
Tank—800 Amp.	329478	..	..	..	..	..	..	..	..	..	..	..	..	1	0	0	1
Tank liner—400-600 Amp.	364636	1	0	1	1	3	1	2	3	3	1	2	3	4	1	2	4
Tank liner—800 Amp.	377519	1	0	1	1	3	1	2	3	3	1	2	3	4	1	2	4

Parts indented are included in the part under which they are indented.
*Not indicated on illustration.
Illustrated on Pages 9 and 10.

Type F-22 Oil Circuit-Breaker Unit

DOUBLE-THROW
600-800 AMPERES—2500 VOLTS

Name of Part	Style No.	2 Pole				3 Pole				4 Pole			
		No. Per Unit	Recommended for Stock			No. Per Unit	Recommended for Stock			No. Per Unit	Recommended for Stock		
Breaker units in use up to and including	.....	..	2	5	15	..	2	5	15	..	2	5	15
Breaker unit complete	.....	1	0	0	1	1	0	0	1	1	0	0	1
Leather bumper	496019	8	4	8	16	8	4	8	16	8	4	8	16
Opening spring	315770	4	1	2	4	4	1	2	4	4	1	2	4
Lifting rod—600 Amp.	478670	4	1	2	4	6	1	3	6	8	2	4	8
Lifting rod—800 Amp.	472855	4	1	2	4	6	1	3	6	8	2	4	8
Moving contact—600 Amp.	472856	4	2	4	8	6	3	6	12	8	4	8	16
Moving contact—800 Amp.	478669	4	2	4	8	6	3	6	12	8	4	8	16
*Arcing tip	328470	8	16	32	64	12	24	48	96	16	32	64	128
Stationary contact—600 Amp.	439157	4	1	2	4	6	1	3	6	8	2	4	8
Stationary contact—800 Amp.	439158	4	1	2	4	6	1	3	6	8	2	4	8
Stationary contact—center—600 Amp.	439159	2	0	1	2	3	1	2	3	4	1	2	4
Stationary contact—center—800 Amp.	439160	2	0	1	2	3	1	2	3	4	1	2	4
*Porcelain insulator	328180	6	1	3	6	9	2	4	9	12	3	6	12
*Contact finger	328455	48	48	96	192	72	72	144	288	96	96	192	384
*Contact finger spring	328478	48	24	48	96	72	36	72	144	96	48	96	192
Tank	439096	1	0	0	1	1	0	0	1	1	0	0	1
Tank liner with barrier slot	472853	3	1	2	3	3	1	2	3	3	1	2	3
Tank liner without barrier slot	478671	1	0	1	1	1	0	1	1	1	0	1	1
Tank liner—barrier	472854	1	0	1	2	1	0	1	2	1	0	1	2

Parts indented are included in the part under which they are indented.
*Not indicated on illustration.
Illustrated on Pages 9 and 10.

Type F-11 Oil Circuit-Breaker Unit

SINGLE THROW
200 AMPERES—4500 VOLTS
400 AMPERES—2500 VOLTS

Name of Part	Style No.	2 Pole				3 Pole				4 Pole			
		No. Per Unit	Recommended for Stock			No. Per Unit	Recommended for Stock			No. Per Unit	Recommended for Stock		
Breaker units in use up to and including	.....	..	2	5	15	..	2	5	15	..	2	5	15
Breaker unit complete	.....	1	0	0	1	1	0	0	1	1	0	0	1
*Bumper	315915	2	1	2	4	2	1	2	4	..	..	..	..
Bumper	326474	..	..	..	..	..	..	..	..	4	2	4	8
Toggle spring	315770	2	0	1	2	2	0	1	2	2	0	1	2
*Lifting rod	300752	2	0	1	2	3	1	2	3	..	..	..	..
*Lifting rod	472816	..	..	..	..	..	..	..	..	4	1	2	4
Moving contact	300751	4	2	4	8	6	3	6	12	8	4	8	16
Stationary contact—200 Amp.	300730	4	1	2	4	6	1	3	6	..	..	..	..
Stationary contact—200 Amp.	439161	..	..	..	..	..	..	..	..	8	2	4	8
Stationary contact—400 Amp.	300732	4	1	2	4	6	1	3	6	..	..	..	..
Stationary contact—400 Amp.	439162	..	..	..	..	..	..	..	..	8	2	4	8
*Porcelain insulator	300725	4	1	2	4	6	1	3	6	8	2	4	8
*Contact finger—200 Amp.	424123	8	8	16	32	12	12	24	48	..	..	..	..
*Contact finger—200 Amp.	300727	..	..	..	..	..	..	..	..	16	16	32	64
*Contact finger—400 Amp.	424123	16	16	32	64	24	24	48	96	..	..	..	..
*Contact finger—400 Amp.	300727	..	..	..	..	..	..	..	..	32	32	64	128
*Contact finger spring—200 Amp.	300726	8	4	8	16	12	6	12	24	16	8	16	32
*Contact finger spring—400 Amp.	300726	16	8	16	32	24	12	24	48	32	16	32	64
Tank	300736	1	0	0	1	1	0	0	1	..	..	..	..
Tank	439163	..	..	..	..	..	..	..	..	1	0	0	1
Tank liner	424041	3	1	2	3	3	1	2	3	4	1	2	4

Parts indented are included in the part under which they are indented.
Illustrated on Page 5.
*Not indicated on illustration

Type F-11 Oil Circuit-Breaker Unit

DOUBLE THROW
200 AMPERES—4500 VOLTS
400 AMPERES—2500 VOLTS

Name of Part	Style No.	2 Pole				3 Pole				4 Pole			
		No. Per Unit	Recommended for Stock			No. Per Unit	Recommended for Stock			No. Per Unit	Recommended for Stock		
Breaker units in use	.....	..	2	5	15	..	2	5	15	..	2	5	15
Breaker unit complete	.....	1	0	0	1	1	0	0	1	1	0	0	1
Bumper	300743	8	4	8	16	8	4	8	16	8	4	8	16
Toggle spring	315770	4	1	2	4	4	1	2	4	4	1	2	4
Lifting rod	300752	4	1	2	4	6	1	3	6	..	..	..	..
*Lifting rod	472816	..	..	..	..	..	..	..	..	8	2	4	8
*Moving contact	300751	8	4	8	16	12	6	12	24	16	8	16	32
Stationary contact—200 Amp.	300730	4	1	2	4	6	1	3	6	8	2	4	8
Stationary contact—400 Amp.	300732	4	1	2	4	6	1	3	6	8	2	4	8
Stationary contact—center—200 Amp.	300731	2	0	1	2	3	1	2	3	4	1	2	4
Stationary contact—center—400 Amp.	424124	2	0	1	2	3	1	2	3	4	1	2	4
*Porcelain insulator	300725	6	1	3	6	9	2	4	9	12	3	6	12
*Contact finger—200 Amps.	424123	16	16	32	64	24	24	48	96	32	32	64	128
*Contact finger—400 Amps.	424123	32	32	64	128	48	48	96	192	64	64	128	256
*Contact finger spring—200 Amps.	300726	16	8	16	32	24	12	24	48	32	16	32	64
*Contact finger spring—400 Amps.	300726	32	16	32	64	48	24	48	96	64	32	64	128
Tank	424121	1	0	0	1	1	0	0	1	..	..	..	..
Tank	439095	..	..	..	..	..	..	..	..	1	0	0	1
Tank liner—side	424119	2	0	1	2	2	0	1	2	..	..	..	..
Tank liner—bottom	424120	1	0	1	1	1	0	1	1	..	..	..	..
Tank liner—barrier	424044	1	0	1	2	1	0	1	2	..	..	..	..
Tank liner—barrier	472818	..	..	..	..	1	..	..	..	1	0	1	2
Tank outer poles	593119	..	..	..	..	..	..	..	..	2	0	1	2
Tank liner, inner poles	593118	..	..	..	..	..	..	..	..	2	0	1	2

Parts indented are included in the part under which they are indented.
Illustrated on Page 5.
*Not indicated on illustration.

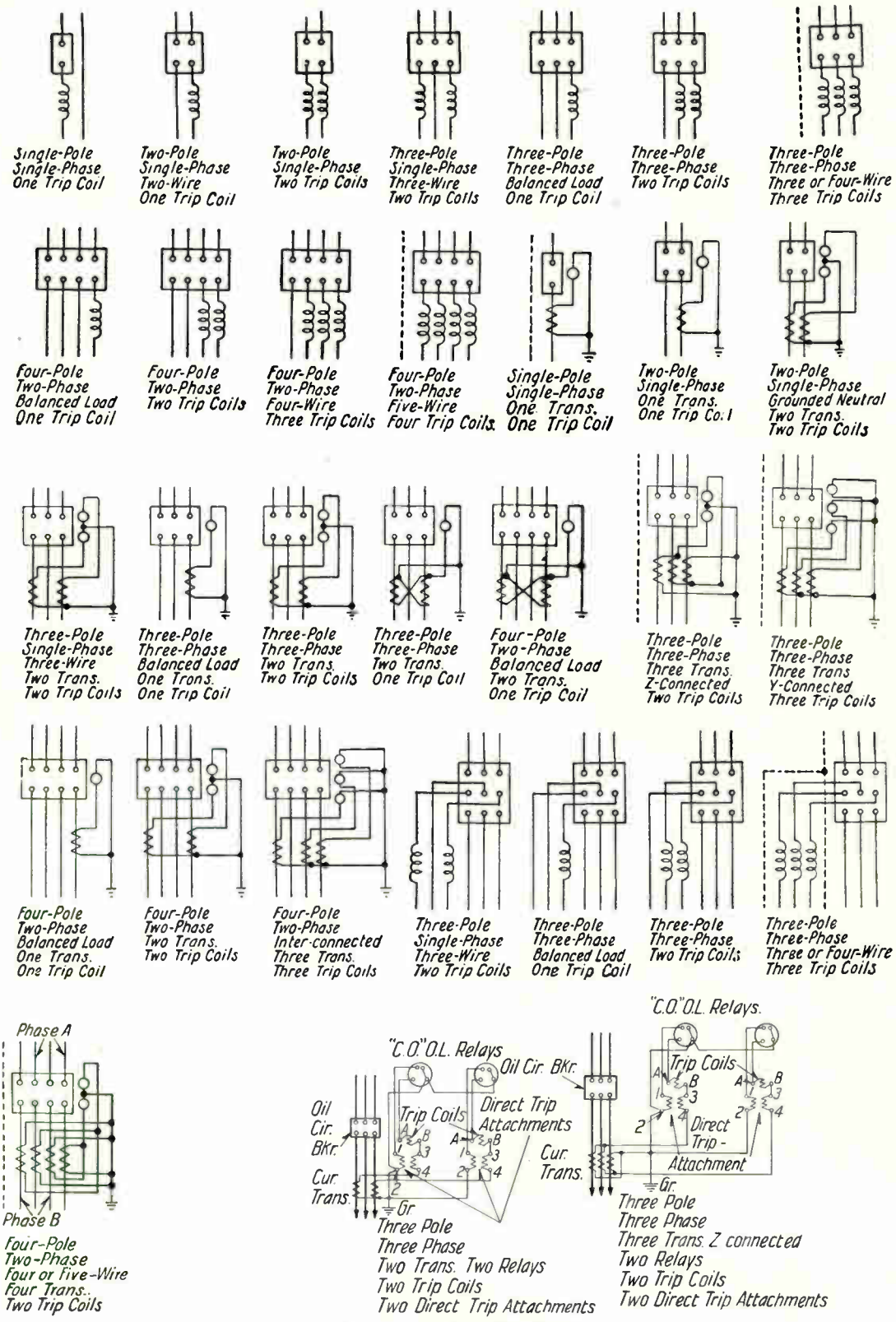


FIG. 33—DIAGRAMS OF CONNECTIONS

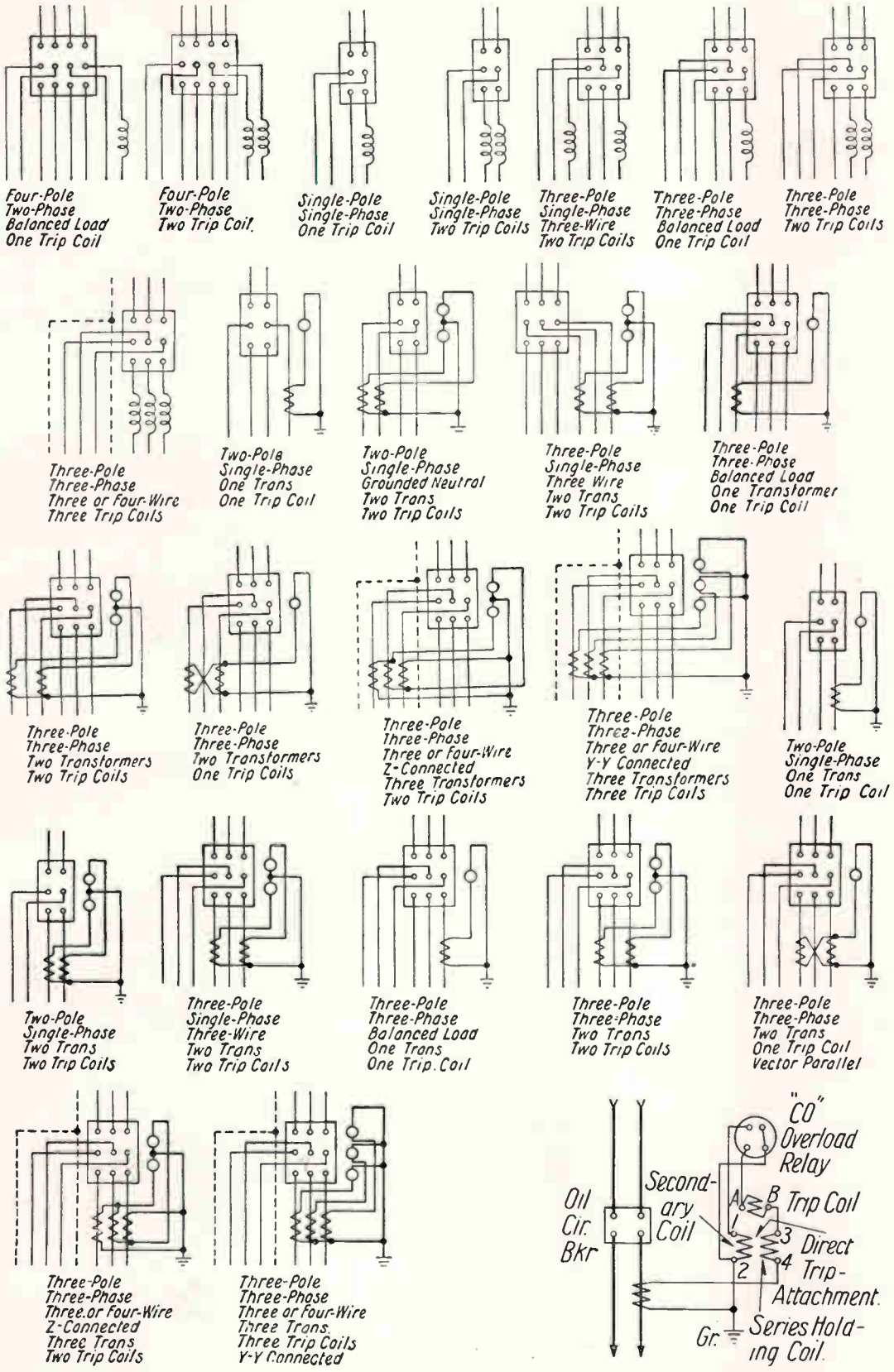
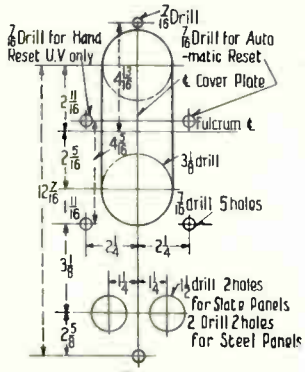


FIG. 34—DIAGRAMS OF CONNECTIONS

(SCHEMATIC DIAGRAM OF CONNECTIONS)

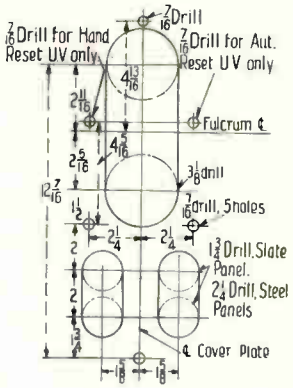
Drilling Dimensions in Inches

FOR INSTANTANEOUS AND INVERSE TIME LIMIT ATTACHMENTS



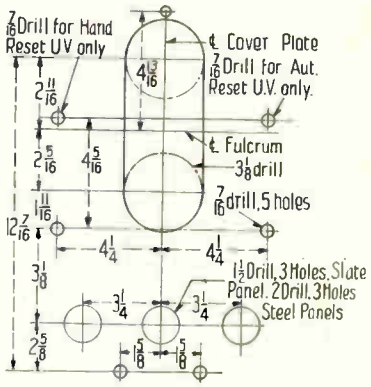
Dwg. No. 390982

S. T., 2-5 Amp., or Shunt Coils, Swbd. Mtg. or Remote Control.



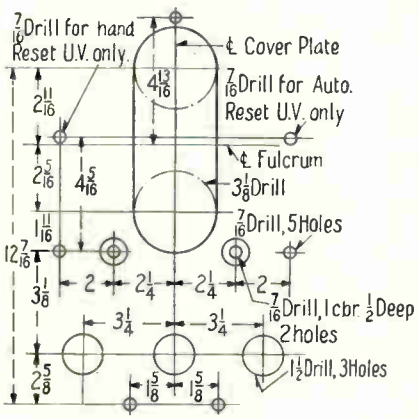
Dwg. No. 390988

S. T., 2 Series Coils, Swbd. Mtg. or Remote Control.



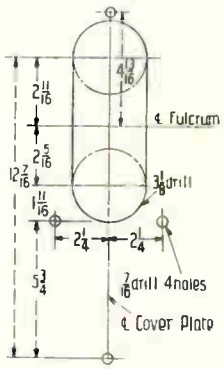
Dwg. No. 390945

S. T., 3-5 Amp. or Shunt Coil. Remote Control.



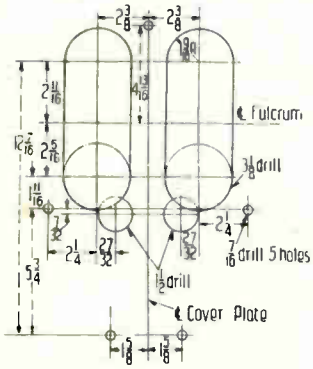
Dwg. No. 390946

S. T., 3-5 Amp. or Shunt Coils, Swbd. Mtg.



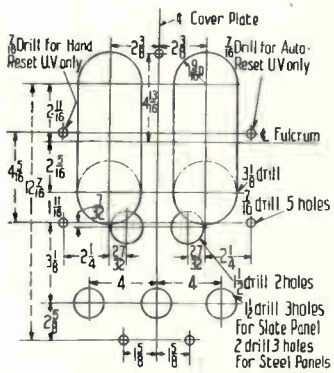
Dwg. No. 394579

S. T., Non-Auto. Swbd. Mtg. or Remote Control.



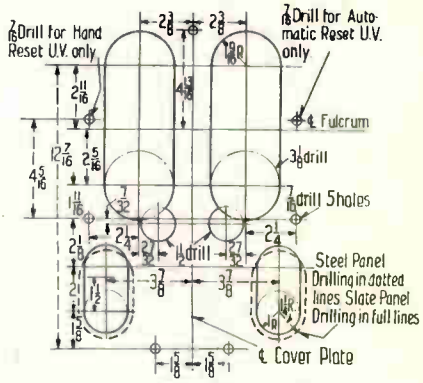
Dwg. No. 394583

D. T., Non-Auto. Swbd. Mtg. or Remote Control.



Dwg. No. 390968

D. T., 3-5 Amp. or Shunt Coils, Swbd. Mtg. or Remote Control.

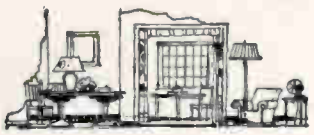


Dwg. No. 390969

D. T., 2 Series Coils, Swbd. Mtg. or Remote Control.

Fig. 35—Drilling Plans

Westinghouse Products



Homes—Farms

- Air Heaters
- Auto Engine Heaters
- Automatic Irons
- Automatic Percolators
- Automatic Ranges
- Cozy Glow Heaters
- Curling Irons
- Fans
- Hot Plates
- Light and Power Plants
- Lighting Equipment
- Mazda Lamps
- Motors for
  - Buffers and Grinders
  - Ice Cream Freezers
  - Ironers and Washers
  - Refrigerators
  - Sewing Machines
  - Vacuum Cleaners
- Newel Posts
- Panelboards
- Radio Equipment
- Rectigon Chargers for Automobiles and Radio Batteries
- Rectox Trickle Charger
- Refrigerators, Electrical
- Safety Switches
- Sollaire Luminaires
- Sol-Lux Luminaires
- Solar Glow Heaters
- Table Stoves
- Tumbler Water Heaters
- Turnover Toasters
- Vacuum Cleaners
- Wall-Type Heaters
- Waffle Irons
- Warming Pads
- Water Heaters

Buildings

- Arc Welding Equip.
- Circuit-Breakers
- Elevators and Control
- Glue and Solder Pots
- Instruments and Relays
- Kitchen Equipment
  - Bake Ovens
  - Hot Plates, Ranges
- Lighting Equipment
  - Brackets, Newels and Lanterns
  - Reflectors & Lamps
  - Sol-Lux Luminaires
- Lightning Arresters
- Micarta Trays
- Meters
- Meter Service Switches
- Motor Generators
- Motors and Control for:
  - Coal and Ash-Handling Equipment
  - Compressors
  - Elevators
  - Fans and Blowers
  - Laundry Equipment
  - Refrigerating Equip.
  - Vacuum Cleaners
  - Water & Sump Pumps
- Panelboards
- Radio Equipment
- Synchronous Converters
- Safety Switches
- Solar Glow Heaters
- Stokers
- Switchgear
- Transformers

City Improvements

- Airport Floodlights
- Automatic Substations
- Constant Current Regulators
- Control Apparatus
- Elec. Railway Equip.
- Lighting Units
- Mazda Lamps
- Ornamental Standards
- Parkway Cables
- Street Brackets
- Streethoods

Offices and Stores

- Air Heaters
- Bread-baking Oven
- Elevators and Control
- Fans, Desk and Exhaust
- Fuses
- Lighting Equipment
- Mazda Lamps
- Meters
- Micarta Desk Tops
- Motors for
  - Adding Machines
  - Addressing Machines
- Motors for
  - Coffee and Meat Grinders, etc.
  - Dictaphones
  - Envelope Sealers
  - Fans and Blowers
  - Pumps
  - Refrigerating Machines
- Panelboards
- Safety Switches
- Switches
- Tumbler Water Heaters

Aviation

- Approach, Boundary, Hangar, and Obstruction Lights
- Arc Welding Equip.
- Floodlight Projectors
- Motor-Generators
- Reflectors
- Transformers
- Mazda Lamps
- Micarta
  - Cabin-lining Plate
  - Fairleads
  - Hinge Bearings
  - Propellers
  - Pulleys
  - Tailwheels
- Radio Equipment

Ships

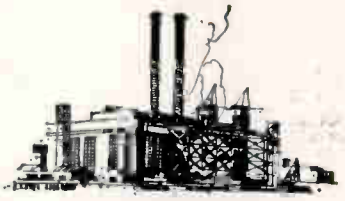
- Circuit-Breakers
- Condensing Equipment
- Deck Winch Motors
- Elec. Heating Appar.
- Eng. Room Auxiliaries
- Fans and Blowers
- Fuses
- Generating Equipment
- Instruments
- Light and Power Plants
- Lighting Equipment
- Micarta Trays
- Motors and Controllers
- Ovens, Ranges and Galley Equipment
- Panelboards
- Propulsion Equipment
  - Diesel-Electric
  - Geared Turbine
  - Turbine Electric
- Radio Equipment
- Safety Switches
- Switchgear

Electric Railways

- Arc Welding Equip.
- Automatic Substations
- Babbitt, Solder & Pots
- Baking Ovens
- Circuit-Breakers
- Elec. Trolley Coaches
- Fans
- Gas Electric Coaches
- Gears and Pinions
- Generators
- Insulating Material
- Insulators
- Lighting Fixtures
- Lightning Arresters
- Line Material
- Manual Substations
- Mazda Lamps
- Meters
- Motors and Control
- Panelboards
- Portable Substations
- Relays
- Signal Equipment
- Supervisory Control
- Switchgear
- Synchronous Convert's
- Transformers
- Trolley Poles

Railroads

- Arc Welding Equipment
- Automatic Substations
- Babbitt, Solder & Pots
- Baking Ovens
- Battery Charging Equip.
- Cars—Multiple-Unit, Gas Elec., Oil Elec.
- Circuit-Breakers
- Control Apparatus
- Elec. Heating Apparatus
- Fans
- Gears and Pinions
- Generators
- Headlight Equipment
- Instruments
- Insulating Materials
- Insulators
- Lighting Equipment
- Lightning Arresters
- Line Material
- Locomotives—Electric Gas Elec., Oil Elec.
- Manual Substations
- Mazda Lamps
- Micarta Gears
- Motors and Control
- Outdoor Substations
- Panelboards
- Power House Apparatus
- Radio Equipment
- Safety Switches
- Signal Equipment
- Stokers
- Supervisory Control
- Switchgear
- Transformers
- Yard Lighting Equip.

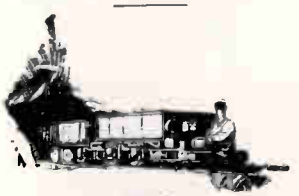


Electric Service Companies

- Automatic Switching Equipment
- Circuit-breakers
- Condensers
- Cutouts
- Fans
- Frequency-converters
- Fuses
- Generators
- Instruments & Meters
- Insulating Material
- Insulators
- Line Material
- Lighting Equipment
- Lightning Arresters
- Micarta
- Motors and Control
- Motor-Generators
- Network Protectors
- Network Transformers
- Oil Testing and Purifying Equipment
- Outdoor Substations
- Panelboards
- Porcelain Insulators
- Relays
- Safety Switches
- Steam Turbines
- Stokers
- Supervisory Control
- Switchgear
- Synchronous Conden'rs
- Synchronous Conv'ters
- Transformers
- Turbine Generators
- Voltage Regulators

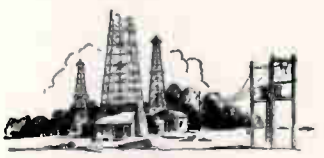
Mills and Factories

- Arc Welding Equip.
- Automatic Starters and Controllers
- Babbitt & Babbitt Pots
- Capacitors
- Circuit-Breakers
- Condensers
- Fans, Desk and Exhaust
- Furnaces and Ovens
- Fuses
- Generating Equipment
- Insulating Materials
- Knife Switches
- Larry Car Equipment
- Lighting Equipment
- Lightning Arresters
- Locomotives—Electric Gas-Elec., Oil Elec.
- Mazda Lamps
- Meters and Relays
- Micarta Gears
- Motors and Controllers
- Panelboards
- Pipe Fittings (Struct'al)
- Power House Apparatus
- Safety Switches
- Solder & Glue Pots
- Space Heaters
- Stokers
- Switchgear
- Transformers
- Turbines



Mines

- Arc Welding Equip.
- Auto. Feeder Equip.
- Automatic Starters and Controllers
- Automatic Substations
- Battery Charging Equip.
- Circuit-Breakers
- Clamps
- Elec. Heating Apparatus
- Fans
- Gears and Pinions
- Headlights
- Insulating Materials
- Insulators
- Larry Car Equipment
- Lightning Arresters
- Line Material
- Locomotives
- Manual Substations
- Mazda Lamps
- Meters & Instruments
- Micarta
- Motor Generators
- Motors for Hoists, Pumps, Tipples, and Breakers
- Panelboards
- Portable Substations
- Relays
- Safety Switches
- Switchgear
- Synchronous Conv'ters
- Transformers
- Ventilating Outfits



Oil Fields

- Arc Welding Equip.
- Change House Heaters
- Floodlight Projectors
- Gear Units
- Insulators
- Mazda Lamps
- Motors and Control
- Panelboards
- Reflectors
- Rig Lighters
- Safety Switches
- Small Light Plants
- Transformers
- Vapor Proof Fixtures

Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa.

WESTINGHOUSE SALES OFFICES

ABILENE, KAN., 300 Cedar St. N.
ABILENE, TEX., 774 Butternut St.
AKRON, OHIO, 11 S. Main St.
ALBANY, N. Y., 90 State St.
*ATLANTA, GA., 426 Marietta St. N. W.
BAKERSFIELD, CALIF., 2224 San Emedio St.
BALTIMORE, MD., 39 W. Lexington St.
BEAUMONT, TEX., 2008 McFadden St.
BIRMINGHAM, ALA., 2030 Second Ave.
BLUEFIELD, W. VA., 525 Bland St.
*BOSTON, MASS., 10 High St.
*BRIDGEPORT, CONN., Bruce Ave. and Seymour St.
*BUFFALO, N. Y., 814 Ellicott Square Bldg.
BURLINGTON, IOWA, 320 N. Third St.
*BUTTE, MONT., 52 E. Broadway
CANTON, OHIO, 120 Tuscarawas St.
CEDAR RAPIDS, IOWA, 1400 Second Ave.
CHARLESTON, W. VA., 101 Capitol St.
*CHARLOTTE, N. C., 210 E. Sixth St.
CHATTANOOGA, TENN., 536-540 Market St.
*CHICAGO, ILL., 20 N. Wacker Drive
*CINCINNATI, OHIO, 207 W. Third St.
*CLEVELAND, OHIO, 2209 Ashland Rd. S. E.
COLUMBUS, OHIO, 209 S. Third St.
*DALLAS, TEX., 108-116 S. Akard St.
DAVENPORT, IOWA, 206 E. Second St.
DAYTON, OHIO, 30 Main St. N.
*DENVER, COLO., 910 15th St.
DES MOINES, IOWA, 604 Locust St.
*DETROIT, MICH., 5757 Trumbull Ave.
DULUTH, MINN., 408 Bradley Bldg.
ELMIRA, N. Y., 338-42 E. Water St.
*EL PASO, TEX., Oregon and Mills St.
EMERYVILLE, CALIF., 5815 Peladeau St.
ERIE, PA., State and Tenth St.
EVANSVILLE, IND., 14-16 N. W. Sixth St.
FAIRMONT, W. VA., 602 Cleveland Ave.
FERGUS FALLS, MINN., Kadatz Hotel
FORT WAYNE, IND., 1010 Packard Ave.
FORT WORTH, TEX., 2426 Tierney Rd.
GARY, IND., 1514 W. Fifth Ave.
*GRAND RAPIDS, MICH., 507 Monroe Ave. N. W.
HAMMOND, IND., 403 Waltham St.
*HOUSTON, TEX., 218 Main St.
*HUNTINGTON, W. VA., 209 Ninth St.
INDIANAPOLIS, IND., 20 N. Meridian St.
JACKSON, MICH., 212 W. Michigan Ave.
JACKSON, MISS., 519 Hemlock St.
JACKSONVILLE, FLA., 719 W. Forsyth St.
JOHNSTOWN, PA., 47 Messenger St.
*JOPLIN, MO., 420 School St.
*KANSAS CITY, MO., 2124 Wyandotte St.
KNOXVILLE, TENN., 612 S. Gay St.
*LOS ANGELES, CALIF., 420 San Pedro St. S.
LOUISVILLE, KY., 332 W. Broadway
MADISON, WIS., 508 Edgewood Ave.
MEMPHIS, TENN., 130 Madison Ave.
MIAMI, FLA., 82 N. E. Twentieth St.
MILWAUKEE, WIS., 735 N. Water St.
*MINNEAPOLIS, MINN., 2303 Kennedy St. N.E.
NASHVILLE, TENN., 309 Fourth Ave. N.
*NEWARK, N. J., 17-25 Academy St.
NEW HAVEN, CONN., 152 Temple St.
*NEW ORLEANS, LA., 333 St. Charles St.
NEW YORK, N. Y., 150 Broadway
NIAGARA FALLS, N. Y., 205 Falls St.
*OKLAHOMA CITY, OKLA., 128-32 W. Grand Ave.
OMAHA, NEB., 409 17th St. S.
PEORIA, ILL., 104 State St.
*PHILADELPHIA, PA., 3001 Walnut St.
*PHOENIX, ARIZ., 11 W. Jefferson St.
PINE BLUFF, ARK., 2103 Linden Ave.
*PITTSBURGH, PA., 310 Grant St.
PORTLAND, ME., 61 Woodford St.
*PORTLAND, ORE., 83 Sixth St.
PROVIDENCE, R. I., 393 Harris Ave.
PUEBLO, COLO., 1309 Claremont Ave.
QUINCY, ILL., 506 Main St.
RALEIGH, N. C., 803 Person St. N.
READING, PA., 438 Walnut St.
RICHMOND, VA., 700 E. Franklin St.
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SPRINGFIELD, MASS., 395 Liberty St.
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TERRE HAUTE, IND., 701 Wabash Ave.
TEXARKANA, ARK., 503 E. Sixth St.
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*TULSA, OKLA., 602 S. Main St.
*UTICA, N. Y., 258 Genesee St.
WASHINGTON, D.C., 1434 New York Ave. N.W.
WATERLOO, IOWA, 305 W. Fourth St.
WICHITA, KAN., 918 N. Lawrence St.
WILKES-BARRE, PA., 267 Pennsylvania Ave. N.
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WORCESTER, MASS., 54 Commercial St.
YOUNGSTOWN, OHIO, 16 Central Square
The HAWAIIAN ELECTRIC CO., Ltd., Honolulu, T. H.—Agent

*Warehouses located in these cities and also in Marshall, Texas.

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NEW YORK, N. Y., 460 West 34th St.
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PITTSBURGH, PA., 6905 Susquehanna St.
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SALT LAKE CITY, UTAH, 346-A Pierpont Ave
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WILKES-BARRE, PA., 267 N. Pennsylvania Ave.
WORCESTER, MASS., 54 Commercial St.

WESTINGHOUSE ELECTRIC INTERNATIONAL CO.
150 BROADWAY, NEW YORK, U. S. A.

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CANADIAN WESTINGHOUSE CO., Limited
HAMILTON, ONTARIO

INSTRUCTIONS GEH-768A

CR2810 A-C. LOW-VOLTAGE SHUNT CONTACTORS

600 VOLTS MAXIMUM

150 Amperes	300 Amperes
CR2810-1551	CR2810-1561
CR2810-1552	CR2810-1562
CR2810-1553	CR2810-1563
CR2810-1554	CR2810-1564
CR2810-1555	CR2810-1565
CR2810-1557	

INSTALLATION

The sealing surface on the magnet frame and the armature should be kept clean. A coat of oil is spread over the sealing surface to the magnet frame and armature to prevent rusting and should be removed when the contactor is put in service.

Unless the contactor is located in an extremely dusty atmosphere the magnet faces may be wiped occasionally with a very light machine oil to prevent rusting.

ADJUSTMENTS

Failure to Open

If the contactor does not open when its operating coil circuit is open, see that the contact tips are clean and free from blisters and that no movable parts are binding.

A gap of 0.015 in. is intentionally left between the armature and the middle pole face of the 1551 to 1557 contactors to prevent the contactor holding closed when the coil is deënergized, due to residual magnetism. On the 1561 to 1565 contactors, this gap is 0.005 in.

Contact Tip Pressure

It is very important that the compression of the springs for the contact tips be kept at its proper value. If the pressure is too low the tips may overheat; if too high the magnet may be prevented from completely closing or may be noisy. The compression of the spring should be tested occasionally as follows:

Initial Tip Pressure

With the contactor open and the coil deënergized, insert a strip of thin paper between the contact tip support and contact tip, just back of spring A in Fig. 1 and 2. Attach the hook of a spring balance to a string fastened around the tip at the line of final contact. The pounds pull at the instant the paper can be moved is the initial tip pressure.

Final Tip Pressure

Final tip pressure should be taken only with new tips. The contactors should be closed by mechanical means rather than by energizing the coil. A strip of thin paper should be placed between the tips and the pounds pull at the instant the paper can be moved is the final contact tip pressure.

The contact limits of the initial and final tip pressures are given below for each contactor.

When renewing tips, the contact surfaces between the tips and the shunts must be cleaned with a fine file to insure a good contact and to reduce the heating at this point.

Care of Contact Tips

In general, the tips do not require attention during their normal life, but if prominent copper beads form on the surfaces, or if the tips turn a dark color due to overheating, the contact faces should be dressed with a fine file.

GENERAL ELECTRIC COMPANY
SCHENECTADY, N. Y.

January, 1931 (4600)

Superseding GEH-768

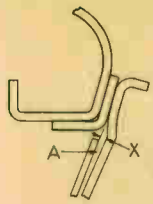


Fig. 1. CR2810-1551 to 1557

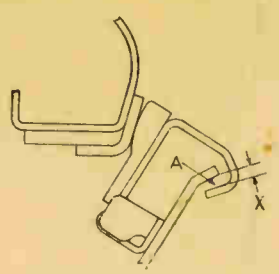


Fig. 2. CR2810-1561 to 1565

Contactor Symbol	Amp.	CONTACT TIP PRESSURE IN POUNDS				DIMENSION "X", FIG. 1 AND 2, IN INCHES WITH CONTACTOR CLOSED	
		Initial		Final			
		Min.	Max.	Min.	Max.	New Tips	* Worn Tips
CR2810-1551 to CR2810-1557	150	3¾	4¼	7	9	2/64	1/16
CR2810-1561 to CR2810-1565	300	7½	8½	15	17	3/8	3/16

* Renew tips when worn to "Worn Tip" dimension.

RENEWAL PARTS

Contactor CR2810-	CONTACT TIPS		ARC CHUTE SIDE		Shunt Cat. No.	Spring Cat. No.
	Stationary Cat. No.	Movable Cat. No.	Right Cat. No.	Left Cat. No.		
1551-A	2457337	2457351	3671036	3671035	3667564G1	2411332
1552-A	2457337	2457351	3671036	3671035	3667564G1	2411332
1552-B*	2457337	2457351			3667564G1	2411332
1553-A	2457337	2457351	3671036	3671035	3667564G1	2411332
1553-B*	2457337	2457351			3667564G1	2411332
1554-A	2457337	2457351	3671036	3671035	3667564G1	2411332
1555-A	2457337	2457351	3671036	3671035	3667564G1	2411332
1555-B	2457337	2457351	3671036	3671035	3667564G1	2411332
1557-A	2457337	2457351	3671036	3671035	3667564G1	2411332
1557-B*	2457337	2457351	3671036	3671035	3667564G1	2411332
1557-C	2457337	2457351	3671036	3671035	3667564G1	2411332
1561-A	2447762	2447778	3827466	3827465	3849732G1	149815
1562-A	2447762	2447778	3827466	3827465	3849782G1	149815
1562-B*	2447762	2447778			3849732G1	149815
1563-A	2447762	2447778	3827466	3827465	3849732G1	149815
1563-B*	2447762	2447778			3849732G1	149815
1564-A	2447762	2447778	3827466	3827465	3849732G1	149815
1565-A	2447762	2447778	3827466	3827465	3849732G1	149815

* Contactor has no arc chutes.
Order Coils by the winding specification number. If this is not available give complete nameplate rating of contactor.

For renewal part information not given in the above table, refer to the nearest office of the General Electric Company, giving the complete nameplate rating, and describing the part in detail.

247501D

Westinghouse

Types F-11 and F-22 Oil Circuit-Breakers

Manually-Operated

General Information

The types "F-11" and "F-22" oil circuit-breakers comprise a line of low capacity oil circuit-breakers. The design of this line of oil circuit-breakers is unique in that the breaker unit, the hand operating mechanism and all auxiliaries are unit assemblies. These unit assemblies are carried in stock packed ready for shipment. Upon the receipt of an order, the unit assemblies necessary to make up the particular breaker which the customer orders, together with the necessary auxiliaries, are shipped in separate packages. This facilitates shipment and enables the Westinghouse Company to render better service to their customers.

Before shipment, all breakers, operating mechanism and auxiliaries are given thorough testing to determine that they are adequate, and that their operation is correct.

Shipping

The circuit-breakers with auxiliaries are shipped in unit assemblies, that is, the breaker unit will be in one box, the coverplate with handle will be in another box, the bell cranks will be in still another box, and so on. Each package or box will be plainly marked as to its contents

Installing

There is a method of procedure for each circuit-breaker set-up which, if followed, will greatly facilitate the work of installing the breaker, and will avoid troubles which otherwise might be encountered during the installations of breakers.

Unpacking—Care should be used in unpacking the circuit-breakers so that the porcelain insulators and small mechanical parts will not be damaged or broken. All of the excelsior and dirt should be blown or cleaned from all operating parts. A careful inspection should be made to see that none of the parts are broken during shipment, and that all the details are in good operating condition.

Mounting of Switchboard Breaker (on Panel or on Panel Bracket)

Before mounting the coverplate and the breaker to the panel, first assemble the signal switch and bell alarm, if they are ordered, to the coverplate as shown in Fig. 4. Then place the 5 ampere tripping coils or series coils from the overload attachment, if supplied, in the coil box of the coverplate, and then mount the coverplate and the breaker to the panel, using the same mounting bolts for mounting both. The breaker should be mounted as nearly level as possible. The nipple supplied with the breaker units can then be screwed into the rod end on the rear of the operating handle and the mechanical set-up will then be complete. By adjusting the amount by which the nipple is screwed into the rod end, it is possible to vary the contacts in the breaker. This adjustment should be made in such a way that full contact is obtained in the breaker when the handle is latched closed. See Fig. 2. With the Type F-22 breaker it is necessary to observe that good contact is secured on the main contact as well as the arcing tips, as the arcing tips make contact before the main contacts. With this adjustment correct, the signal switch should make good contacts in both the open and closed position of the breaker It should be observed that proper contact in the breaker is necessary in order to get proper contact on the signal switch.

In adjusting the breaker special care should be taken to see that the toggle lever is from one thirty-second to one sixteenth of an inch away from the stop in the closed position. On the 2 and 3-pole breakers the stop is the end of the slot on the side of the frame, and on the single-pole and 4-pole breakers, the stop is a rib on the inside of the frame

If this adjustment is not correct, the latch load on the cover plate will be excessive and the tripping attachments may not function promptly.

When the adjustment of the breaker and signal switch is correct and operating properly, then the tripping cores can be put in place, and the nuts put on which hold them. If direct trip attachment or an under-voltage release is supplied, it may now be mounted on the coverplate and the leads thrust through the clearance between the coverplate and the panel, and then drawn back through the holes drilled in the panel for the leads. After this, the necessary electrical connections can be made as described later.

For mounting other auxiliaries on the switchboard mounting breaker, see description under the heading of "Mounting of the Auxiliaries", page 6.

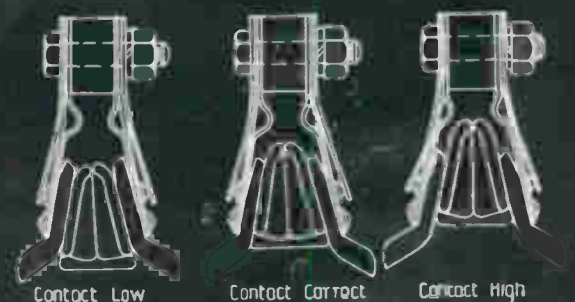


FIG. 2—CONTACT ADJUSTMENT FOR TYPE P-11 OIL CIRCUIT-BREAKER

FIG. 3—REMOTE-CONTROL WALL-MOUNTED TYPE P-11 OIL CIRCUIT-BREAKER

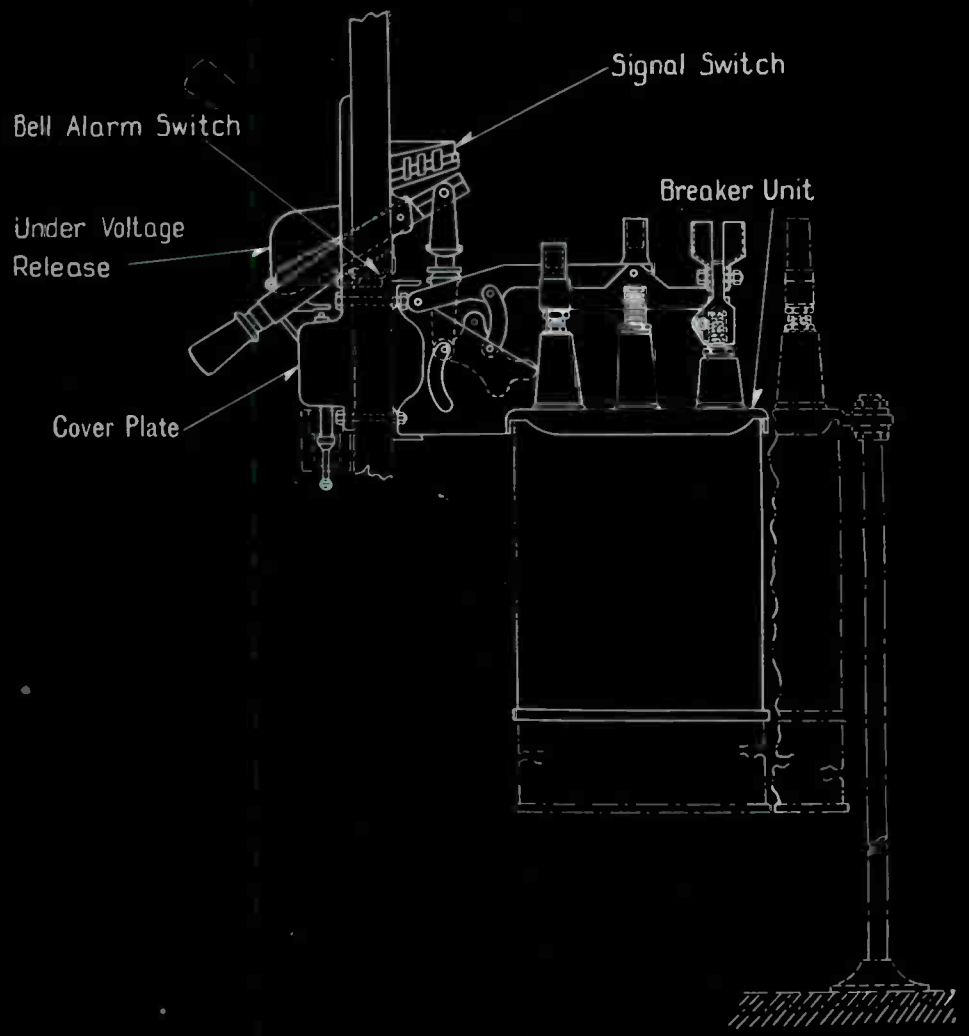


FIG. 4—SWITCHBOARD MOUNTING TYPE F-22 OIL CIRCUIT-BREAKER

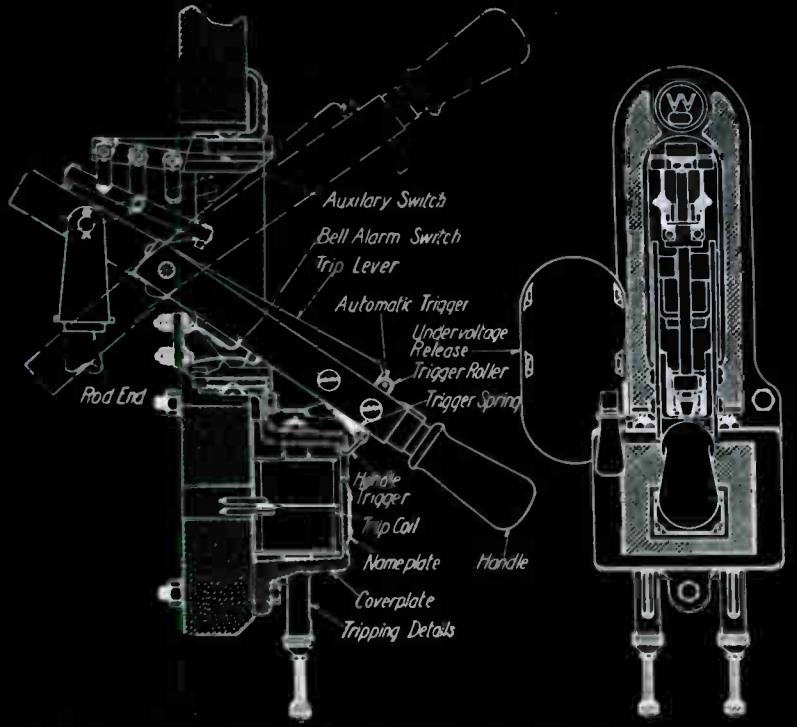


FIG. 5—COVERPLATE 2-COIL SINGLE HANDLE

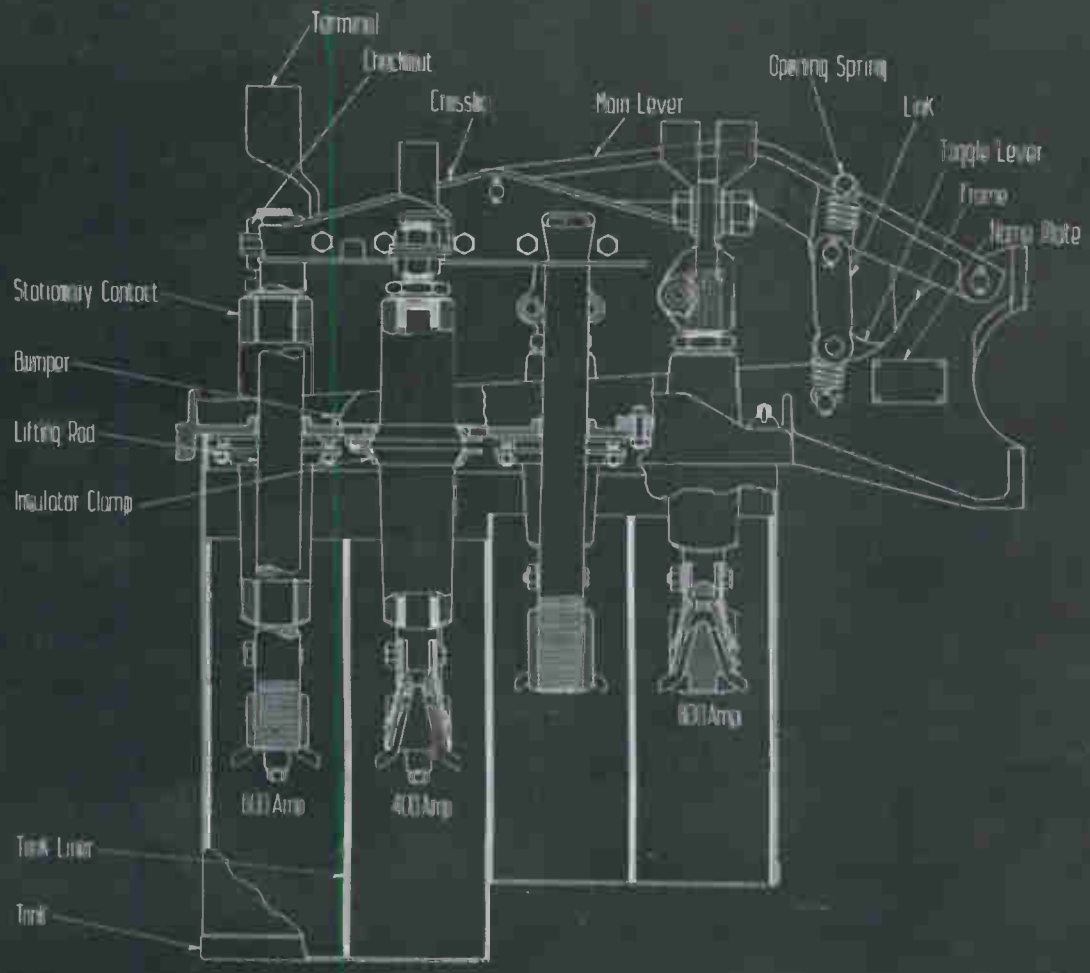


FIG. 6—TYPE F-22, 4 P.S.T. OIL CIRCUIT-BREAKER

Mounting of Remote Control Breaker

The remote control breaker unit should be mounted in place upon the wall or pipe as nearly level as possible. The auxiliary switch and bell alarm contacts, if supplied, should be mounted in the coverplate before the coverplate is mounted on the panel or on the panel bracket. The coverplate can then be mounted as shown in Fig. 5, with the coils in place in the coil box. The tripping cores can then be put in place on the coverplate and tightened up. Here again, if direct trip attachments or undervoltage release are used, they may be placed on the coverplate after it is assembled to the panel by pushing the leads through the clearance between the coverplate and the panel, and pulling them back through the drilled holes in the panel. All connections should be made after the mechanical assembly is complete. The coverplate and breaker units should then be connected up with operating rods through the bell cranks as shown in Fig. 3.

The connecting pipes are ¾ inch wrought iron, and should be cut 4 inches shorter than the distance between fulcrums of the levers to be connected. These pipes should be threaded 2¾ inches on each end with a 1.041-14 (¾ inch straight pipe thread) die. A ¾ inch pipe lock nut should be put at one end or the other of each pipe. The length of the pipe should be adjusted so that the travel of each bell crank lever is approximately equal on each side of the horizontal or vertical centerline. The last length should be adjusted so that with the handle in the latched position, the contacts in the breaker are making full contact. With proper adjustment on the breaker contacts, it will be observed that proper contact is secured on the signal switch if one is used. The bell cranks as supplied are for mounting above the floor. If it is desired to mount the bell cranks below the floor, it is necessary to reverse them. To reverse the bell cranks, remove the fulcrum pin and replace it in the lower hole. To reverse the accelerating device, it is necessary to remove the fulcrum pin and to replace it in the upper hole. It is also necessary to change the accelerating spring on the accelerating device. See Fig. 7 and Fig. 8.

Any length of pipe exceeding 12 feet should have an intermediate support. The operating rods should all be in tension except the one next to the breaker, and in applications where this vertical rod is long enough, to cause buckling under the strain of closing the

breaker, it will be necessary to reverse the accelerating device and also to reverse the toggle in the breaker so that this rod will be in tension instead of compression. To reverse the toggle in the breaker, the pin between the toggle lever and the toggle link should be moved to the hole farther back. This will cause the toggle to close the breaker with a downward motion of the operating rod. See Fig. 9.

Mounting of the Auxiliaries

Mounting of the Electric Lock-out Device

The electric lock-out device mounts on the rear of the panel, and is attached to the coverplate as shown in Fig. 25. It is necessary to take out the fulcrum pin of the coverplate and remove the two washers which space the handle on either side from the lugs on the coverplate. The steel piece of the electric lock-out device occupies space left by the removal of the washer. The lock-out device can then be mounted as shown, and the set screws tightened so that it is held rigidly in place. It should be observed that the armature moves freely, and that with the armature closed, the handle has clearance to pass; while with the coil de-energized, and the armature open the lug is over the trip lever of the handle, and successfully prevents it from closing.

Mounting of the Mechanical Interlock

When two single handle coverplates, or the two handles of a double handle coverplate, are to be interlocked so that only one can be closed at a time, the mechanical interlock is used. See Fig. 26. When two handles are used to operate a double-throw F-11 Breaker an interlock is provided as an integral part of the breaker. In any other case the interlock as here described should be used. In order to mount this attachment, it is necessary to remove the fulcrum pin from the coverplate handle, and to take off the spacing washer for the handles on the side next to the coverplate with which it is to be interlocked. Then

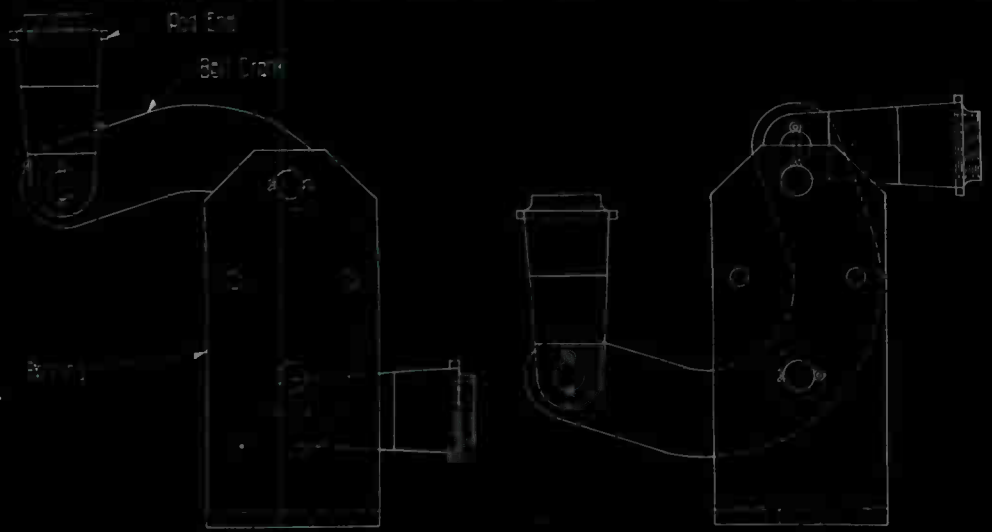


Fig. 7. Bell Crank Showing Assemblies for Above and Below Floor Mounting

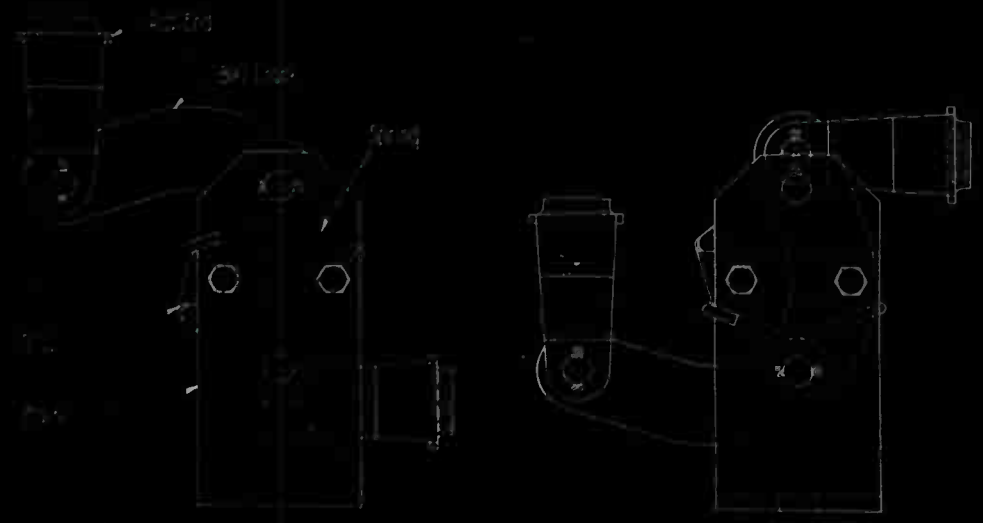


Fig. 8. Accelerating Device Showing Assembly for Above and Below Floor Mounting

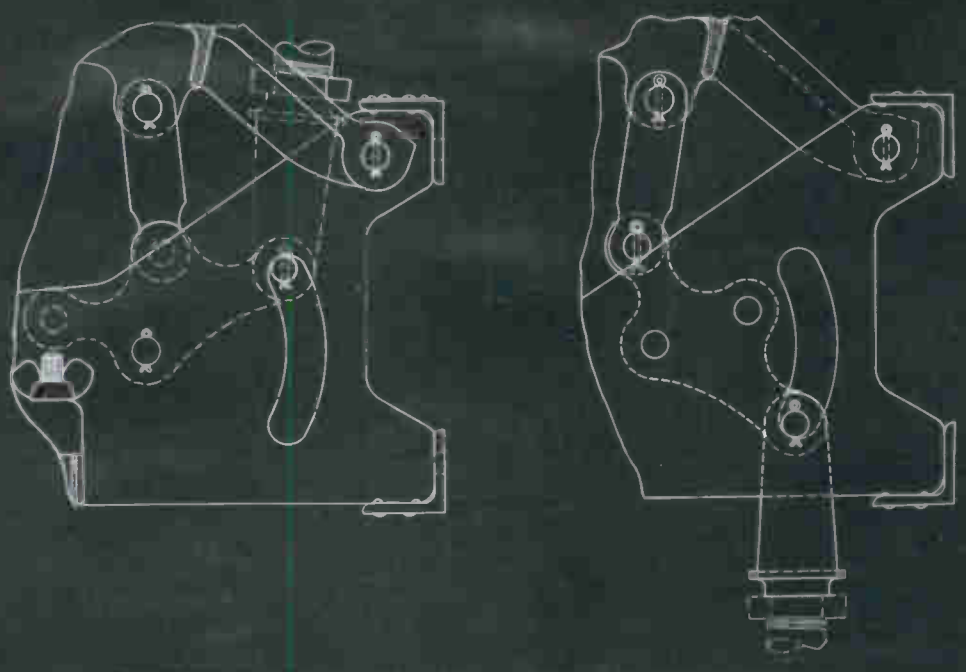


FIG. 9—SHOWING ASSEMBLY OF BREAKER MECHANISM FOR UPWARD AND DOWNWARD PULL

the mounting brackets of the interlock may be placed on the coverplate as shown in the picture, and all screws tightened. It will be found that to put the brackets on first and to insert the interlock bar in place after the brackets are lined up will make the assembly easy. It should be observed that the interlock bar moves freely and is returned to the neutral position by the spring when the handle releases it. The movement of one handle to the close position should move the bar over the other handle so that it locks on the straight part of the bar and not the beveled part. Adjustment is provided so that length may be altered when assembling. When this interlock is used in addition to a lock-out device on one of the handles, a hole in the mounting bracket of the electric lock-out device takes the interlock bar and one of the interlock mounting brackets should be omitted. If for any reason the interlock bar does not move freely, it will be necessary to more properly line up the holes in which it is supported. This can be done by loosening the coverplate mounting bolt and moving the coverplate bodily to alignment. In very extreme cases it may be found necessary to file the top lug of the mounting bracket to line up.

Mounting the Mechanical Sequence Interlock—The mechanical sequence interlock can be mounted on a double handle coverplate only. The brackets for the sequence interlock are held in place by a special pin which replaces the fulcrum pin of the handles, omit spacing washers for handle on one side of each handle only. The adjusting screws at top and bottom should be adjusted so that there will be no binding between the cam shaped slot and the interlock pins on the coverplate lever. The interlock pins replace the standard pins for the rod ends. See Fig. 27.

Mounting of the Undervoltage Release Attachment

The hand retrieved undervoltage release attachment mounts on the left hand mounting bolt for the coverplate. It is necessary to take out this bolt and to put it in from the rear of the panel, and thus screwing it into the undervoltage cover, tightening this bolt clamps the undervoltage release tightly in the proper position. After it is completely mounted, operate it a few times by hand to see that the movement is free and that it operates properly. See Fig. 17.

The automatic retrieve undervoltage release mounts on the right hand side of the coverplate in a similar mannèr. It is necessary to put a pin in the trip lever of the coverplate to operate this device. See Fig. 18.

Mounting of Other Tripping Devices

The overload trip, the shunt trip, and the overload trip with dash-pot, as well as the direct trip attachment, mount on the coverplate by passing the core up through from the bottom into position in the coverplate and then securing it there by means of one nut. With the direct trip attachment, it is necessary that the leads from the lower coils be put through the clearance provided between the coverplate and the panel and drawn back through the drilled holes in the panel The coil should be put in the coil box of the coverplate, before the coverplate is mounted on the panel. However, the tripping cores with the dash-pot or direct trip below, should not be mounted on the coverplate until the mechanical installation is complete. This is necessary in order that all the bolt heads will be easily accessible

Mounting of Signal Switch and Bell Alarm

As indicated above, it is necessary to mount the signal switch and bell alarm in position on the coverplate as shown in the picture before the coverplate is put on the panel, otherwise it

would be very difficult to tighten the screw which clamps it in position.

Connections

When the breaker has been assembled with its operating handle and auxiliaries as described above, then the connections should be made in accordance with the diagram furnished for the complete installation if covered by a complete diagram, or according to the diagram furnished with this instruction book. The main leads should be carefully soldered into the cable terminal furnished with the circuit-breaker. In case copper strap connections are to be used, they should be carefully grained before putting on and the contact nut should be drawn down so as to bear evenly over their entire area on the strap. The lower contact nutshould not touch the upper clamping nut of the insulator. The connection should have an area of not less than that given by the National Electric Code, in the tables on allowable carrying capacity for wires and cables. After fastening in the main leads, the terminals should be insulated with tape or insulating tube, so that any gas expelled from the circuit-breaker in opening heavy short circuit, will not cause a short circuit outside of the circuit-breaker. Good engineering practice demands that all terminals on circuit-breakers of 2200 volts and above, be insulated.

As a safety measure the frame of the circuit-breaker should be grounded.

Caution—Before connecting power to the circuit, remove the tank from the breaker and after thoroughly cleaning and drying, fill with clean dry insulating oil. Clean the oxide from the contacts so that they are clean and bright. It is also recommended that the breaker be operated several times by hand to see that all the parts are free to move and operating properly.

Maintenance

Circuit-Breaker Unit—Wherever possible, periodic inspection should be made of circuit-breakers, at which time the tank should be removed and the contacts inspected. Any pitting of the contacts which has been caused by arcing should be cleaned off and the contacts put in good condition. If the contacts are too badly burned to be repaired so as to give good contact, new parts should be put on. If the oil is very much carbonized, it should be replaced by new clean dry insulating oil.

Coverplate and Handle—The mechanical part of the coverplate and handle should be kept in good condition in order that the tripping function will be properly performed. A little oil on the bearings at intervals will keep the parts in good operating condition.

Other Devices—Though there is nothing about the construction of the other auxiliaries and tripping devices which would require the attention of the operator periodically, yet it is recommended that the tripping devices be given a casual inspection to see that

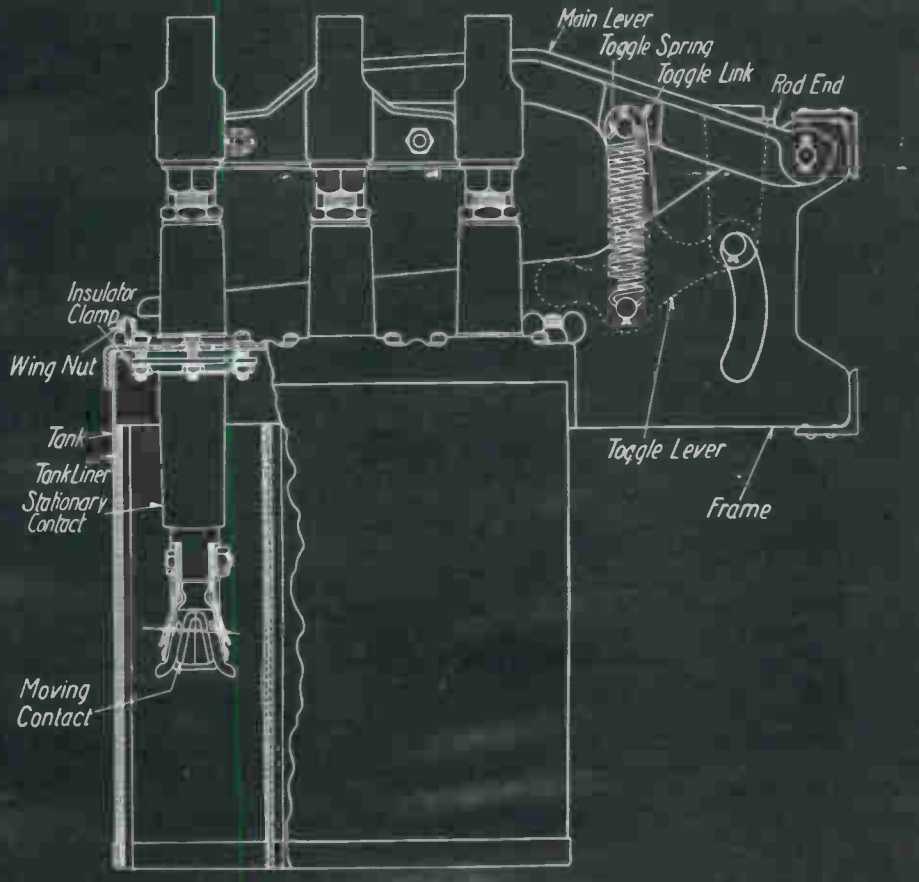


FIG. 10—TYPE F-11, 3 P.S.T. CIRCUIT-BREAKER UNIT

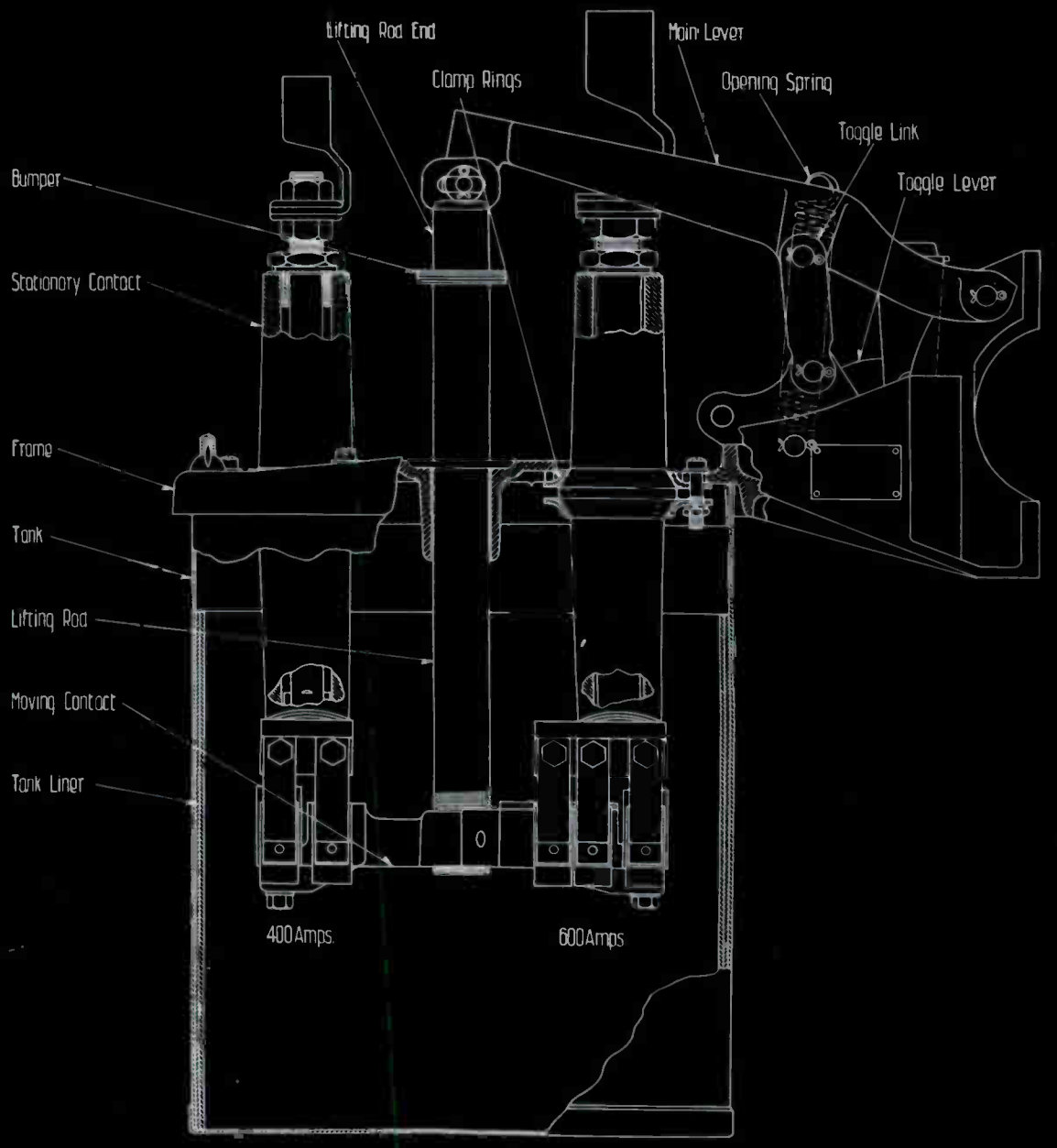


FIG. 11—TYPE F-22, SINGLE-POLE OIL CIRCUIT-BREAKER

cotter pins have not become lost and that screws and bolts are tight. Moving parts should be operated by hand to see that they are free on their bearings and do not bind.

Description of Breakers and Auxiliaries

Breaker Unit and Contacts—The circuit-breaker units include the main current carrying parts and operating details. See Fig. 10. The two and three-pole "F-11" and "F-22" have frames of punched steel, while the double throw "F-11" and the single and four-pole "F-22" breakers have frames of heavy cast iron. The stationary contacts are clamped to these frames by clamping rings which have bolts spaced 120 degrees apart. This makes it easy to swing the contacts so that the moving contacts will enter exactly between the fingers. At the lower end of the stationary contact stud, the contact fingers are bolted. These may be renewed when badly burned by removing the bolt which holds them in place. The moving contact of the Type "F-11" breaker is a punched piece of copper, which is clamped rigidly to the wedged end of the wood lifting rod. The moving contact of the Type "F-22" breaker is a heavy copper casting with a renewable arcing tip of solid copper,

two starts are made in rapid succession, without allowing the machine to come to rest.

Under abnormal operating conditions, requiring a number of starts the auto transformer should be kept under observation to prevent their coming to destructive temperatures.

Care of Insulating Oils

Deterioration in Use—All insulating oils are subject to carbonization. This carbonization forms a deposit on the bottom of the tank or any part of the mechanism located in the oil. The contacts and the interior of the tank should be cleaned at regular intervals depending upon the service. The carbonization reduces the dielectric strength of the oil. It is necessary, therefore, that the tank be emptied and refilled with oil from time to time. Deteriorated insulating oil can be filtered and dried by the use of Westinghouse Oil Drying and Purifying Outfits.

Storage—All Westinghouse insulating oil for oil circuit-breaker use is kept either in soldered tin cans or steel drums provided with steel bungs which are sealed before shipment, or in tank cars made exclusively for that purpose. All oil in steel drums, which have been stored exposed to weather, and all oil shipped in tank cars should be tested before using by taking a sample from each container. Drums stored out of doors should always be laid on their side with bungs turned down, never turned up on end; and when storing drums out of doors, protection against direct precipitation should be provided.

Handling—Extreme precautions are required to insure that all containers and any apparatus therein are absolutely dry when oil is transferred to them from a drum, soldered tin or tank car. A drum of cold oil when taken into a warm room will sweat and the resulting moisture on its outer surface may mix with the oil in drawing it from the drum. The container should always be allowed to stand long enough to reach room temperature before breaking the seal. Tank cars should never be emptied during wet weather. Any vessel used in transferring oil should be absolutely dry and free from any foreign matter, especially metallic or carbonation particles.

Filtering—Although the drums are thoroughly washed and dried at the Refinery before filling, a certain amount of scale is generally loosened inside the container. This must be removed by passing the oil through two layers of ordinary finely woven cotton cambric, which has been thoroughly washed to remove the sizing and then dried. The cloth may be stretched across a funnel of large size. The oil will pass through the cloth more rapidly if slightly warm. If the funnel does not discharge directly into the tank of the circuit-breaker, the oil should not be returned to an empty drum unless it is known to be thoroughly clean and dry. The thoroughness of filtering should be determined by a dielectric test.

Detection of Moisture—It is impossible to over-emphasize the effect of relatively small amounts of moisture in oil in circuit-breakers and the serious effect which such moisture may have on breaker operation from breakdown on voltage surges or on interrupting short circuits. The amount of moisture which will seriously lower the insulating value of oil is of the order of 1 part in 20,000. This is too small to be detected by settling out or by the well known hot metal test. It can only be done by a dielectric test. The Westinghouse Electric & Manufacturing Company manufactures a special device for this purpose and furnishes instructions for its use.

Removal of Moisture—Moisture may be entirely removed by passing the oil through a Westinghouse Oil Drying and Purifying Outfit, or a Sharples Transformer Oil Purifier and Dehydrator. When this outfit is not available the oil may be dried in a fairly satisfactory, although slow, and inconvenient manner, by passing it through a bag of clean, dry lime and filtering it afterwards to remove particles of suspended matter. It is not advisable to use various other methods, such as passing hot dry air through the oil on account of the difficulty of entirely removing all moisture from the air, or heating the oil for a considerable length of time on account of the liability of injuring the oil during the heat treatment.

Renewal Parts

For renewal or spare parts refer to Part Catalogue No. 6186 for F-11 Circuit-Breakers and to Catalogue No. 6195 for F-22 Circuit-Breakers.

In case renewal parts are required, consult the nearest Sales Office, as shown in list given on the inside back cover of this book. In all cases give the following information and give a description of parts. First, nameplate reading complete on breaker unit and coverplate. Second, normal voltage frequency applied to all coils. Third, refer to parts by name as given in this book.

Recommended Stock of Renewal Parts

The following is a list of the renewal parts and the minimum quantities of each that should be carried in stock. These are the parts most subject to wear in ordinary operation and damage or breakage due to possible abnormal conditions. The maintenance of such stock will minimize service interruptions due to breakdown.

Recommendations for stocking Renewal Parts for your complete equipment will be supplied upon request to the nearest District Office.

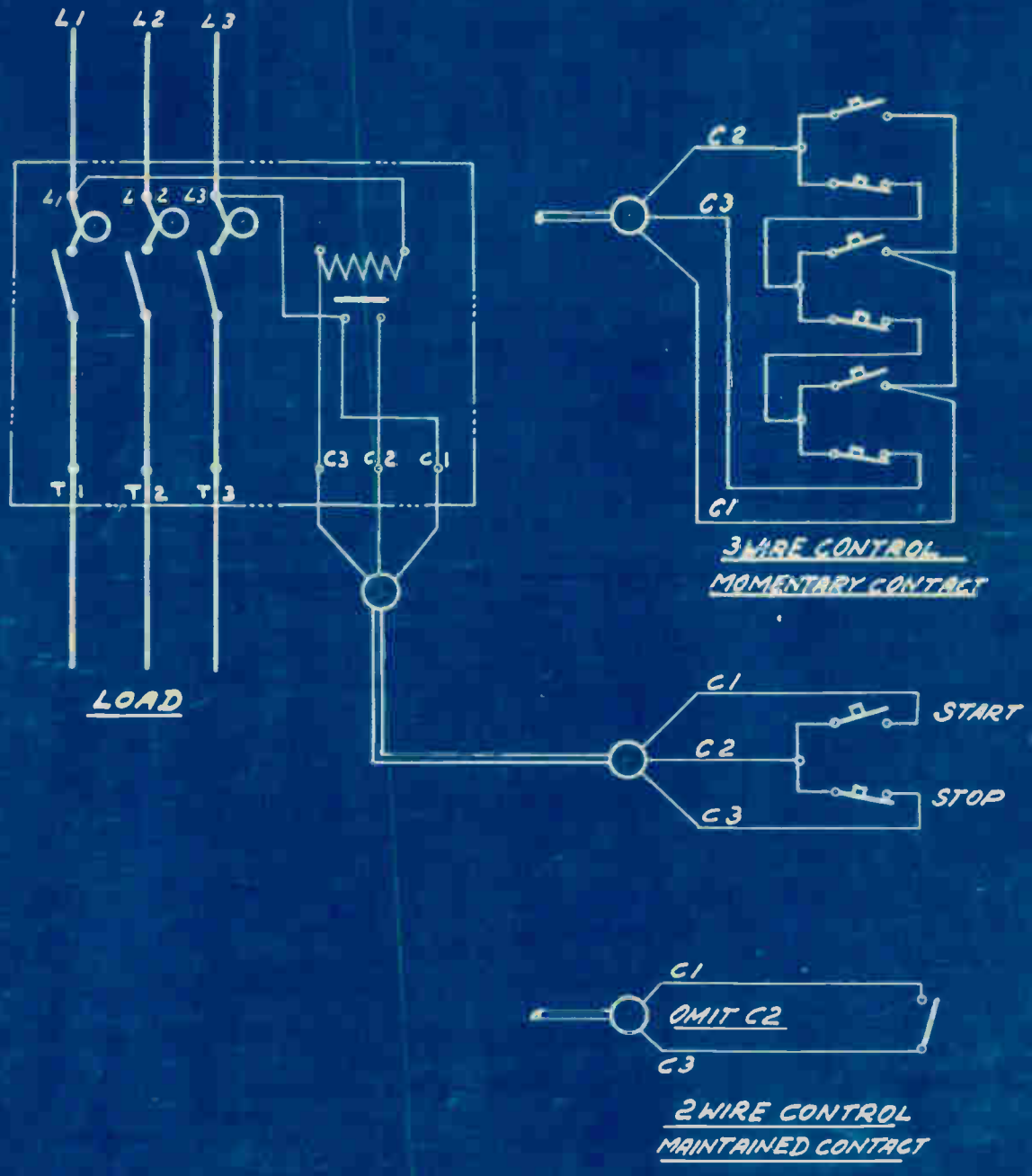
Ordering Instructions: When ordering renewal parts, give the nameplate reading. Always give the name of the part wanted, also the stock order number or the style number of the apparatus on which the part is to be used. For list of parts refer to the tables on the following pages and the illustrations in the preceding pages.

SQUARE D COMPANY

INDUSTRIAL CONTROLLER DIVISION — MILWAUKEE, WIS.

DRAWN	A.C. MAGNETIC CONTACTOR - 3 POLE	TYPE
CHECKED	2 & 3 WIRE CONTROL	CLASS 8502
APPROVED	WIRING DIAGRAM	FILE

FRONT 1294-C7-G1

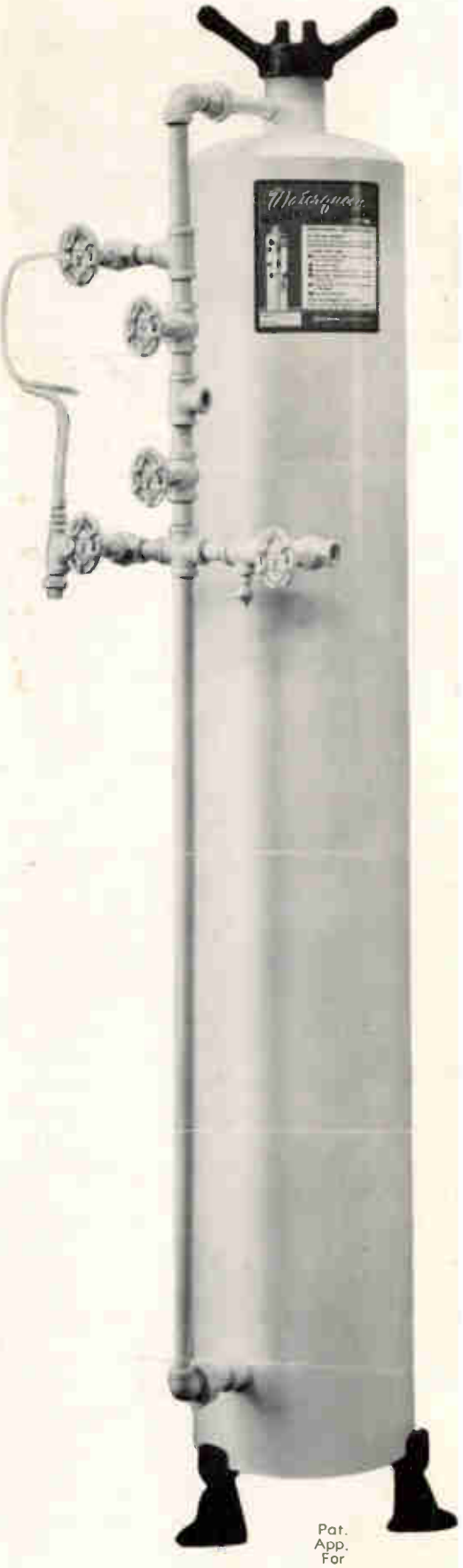


DATE	5-4-32							DRAWING NO.	1294-D14
REVISION	R.0								

Waterqueen

WATER SOFTENER

Trade-Mark Registered



The LIFETIME appliance

- HOMES
- RESTAURANTS
- BARS
- GRILLS
- DINERS
- FARMS
- BEAUTY SALONS

FOR PLANTS and INSTITUTIONS

The Waterqueen Water Softener eliminates lime deposits and scale from boilers used in heating systems. Schools, public buildings, factories, office buildings, apartment houses, hospitals, laundries and dry cleaning plants are able to have a perfectly-functioning, longer-lasting, more economical heating plant because of this feature.

Easy to install • Easy to operate

Waterqueen is law priced . . . easy to install . . . easy to aperate. The unit can be installed in your hame, plant ar affice building by any plumber.

This new, madern device is simple to recharge . . . na mare complicated than defrasting an electrical refrigeratar. The easy-ta-fallaw directians far recharging Waterqueen are permanently affixed to each unit . . . impassible to lase ar misplace. (Recharging means washing aut the undesirable minerals which Waterqueen has remaved fram ardinary water that is piped into yaur hame, office, or plant.)

Waterqueen is a single tank, and is easily installed in the kitchen ar in the basement. Finished in lustraus white enamel, a testing kit, funnel and three cast iran feet are supplied with each unit. Waterqueen saftening material is af highest quality (called "white synthite zealite") and will last far years if praperly and regularly regenerated.

Pat. App. For

MANUFACTURED BY

WATERQUEEN CO. • 119 S. MCBRIDE ST. • SYRACUSE, N. Y.

4 YEAR GUARANTEE!

...es ... date ... be replaced free of ... f.o.b. factory.

Waterqueen

WATER SOFTENER CO.

119 S. McBRIDE ST.
SYRACUSE, N. Y.

Specifications

MODEL No.	GRAIN GALLONS CAPACITY BETWEEN REGENERATIONS	FLOW RATE GALLONS PER MINUTE	FLOOR SPACE REQUIRED DEPTH	WIDTH	HEIGHT	SHIPPING WEIGHT
W-30	35,000	12	12½"	22"	66"	250 lbs.

Average re-charge in homes is approximately every three or four weeks, depending upon amount of water used.

HOW TO USE WATERQUEEN WITH PRIVATE WATER SUPPLY SYSTEM

When softener is to be used with private water supply system, the pump with such private water system must have a pumping capacity of not less than 250 gallons per hour for satisfactory regeneration of softener.

When water pressure is more than 75 pounds, a pressure regulator, set at 75 pounds or lower, must be installed ahead of the softener on the incoming water line. The pressure regulator can be supplied by the local dealer making the installation.

GUIDE FOR PROPER APPLICATION OF *Waterqueen Water Softener*

Where hardness of water is not known, we recommend that a quart sample bottle of the water be sent to the factory to be analyzed. This analysis is made without charge. To determine gallons of soft water between regenerations, divide gallons capacity (35,000) by hardness of water. For example, if water is 20 grains hard . . . 35,000 grain gallons capacity, divided by 20 grains hardness equals 1,750 gallons of soft water between regenerations.

WATERQUEEN GIVES YOU RAIN-WATER SOFTNESS AND ACTUALLY PAYS FOR ITSELF

Waterqueen double action filters as it softens . . . removes impurities, minerals and iron to supply soft water as clean and gentle for laundry, bath and cleaning as rain water. The figures below show how Waterqueen actually pays its way. Typical home operations will have expenses as follows.

HARD WATER

Soap, $67.00 yearly.
Fuel for cooking, $31.70 yearly.
Heat loss from lined pipes, $11.50 yearly.
Laundry wear on clothes, $100.00 yearly.

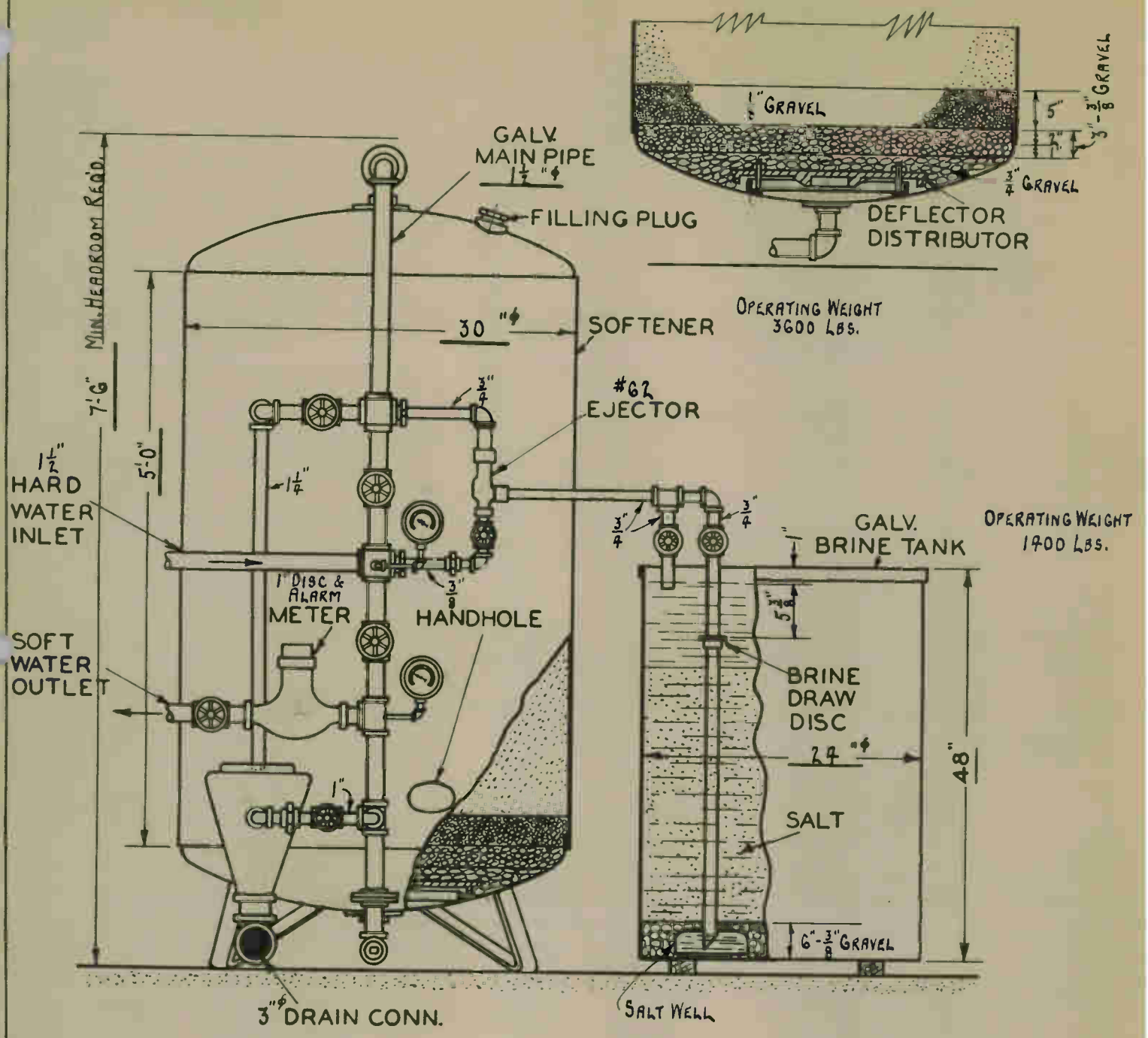
SOFT WATER

Soap, $21.80 yearly.
Fuel for cooking, $15.50 yearly.
Heat loss, none.
Wear on clothes, none.

Count the Savings in Money

A SAVINGS OF $172.90 YEARLY FOR A FAMILY OF FIVE . . . AND THIS INCLUDES ONLY PART OF THE EXPENSE ITEMS AFFECTED BY WATER

Manufactured by **WATERQUEEN *Water Softener* COMPANY**
119 S. McBRIDE ST. SYRACUSE, N. Y.



WARLO INDUSTRIAL SOFTENERS
30" [redacted] DIAM.

WOR BROADCASTING STATION,
CARTERET, N.J.
*W-3069

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WARLO CORPORATION
NEW YORK CITY

SCALE ——— DATE 12-27-39.

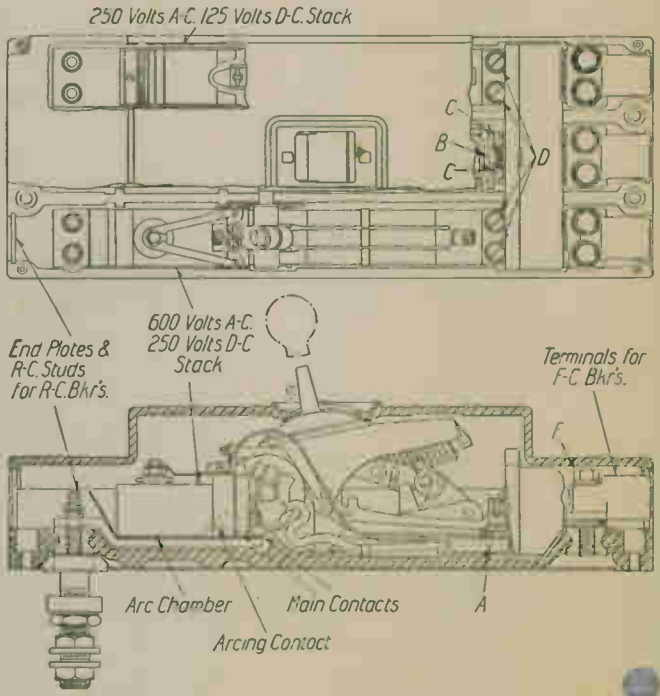
W-3810-A

MADE ... CHECKED R.T.P. ...

Westinghouse

Trip Units for Type AB "De-ion" Circuit-Breakers 2 and 3 Pole

250, 275, 300, 325, 350, 400, 450, 500, 525, 550 and 600 Amperes



This trip unit should be installed in circuit-breaker frames Style No. 807011 or Style No. 807012 if 2 pole and in frames Style No. 807013 or Style No. 807014 if 3 pole. It includes a thermal trip to give time delay on overload and an instantaneous trip to give instantaneous protection against short-circuits. The rating of the instantaneous trip indicates its minimum tripping current.

Important—This trip unit has been calibrated at the factory specific current rating. The cover is sealed to prevent tamper- with the adjustments.

To Install—Place the trip unit in the frame as shown in Figure, making sure the locating lug (A) of the trip unit bracket projects into the hole (B) provided for it, then screw (C) and (D) firmly in place. Each screw (C) is provided with a lock washer only and each screw (D) is provided with a lock washer and a plain washer.

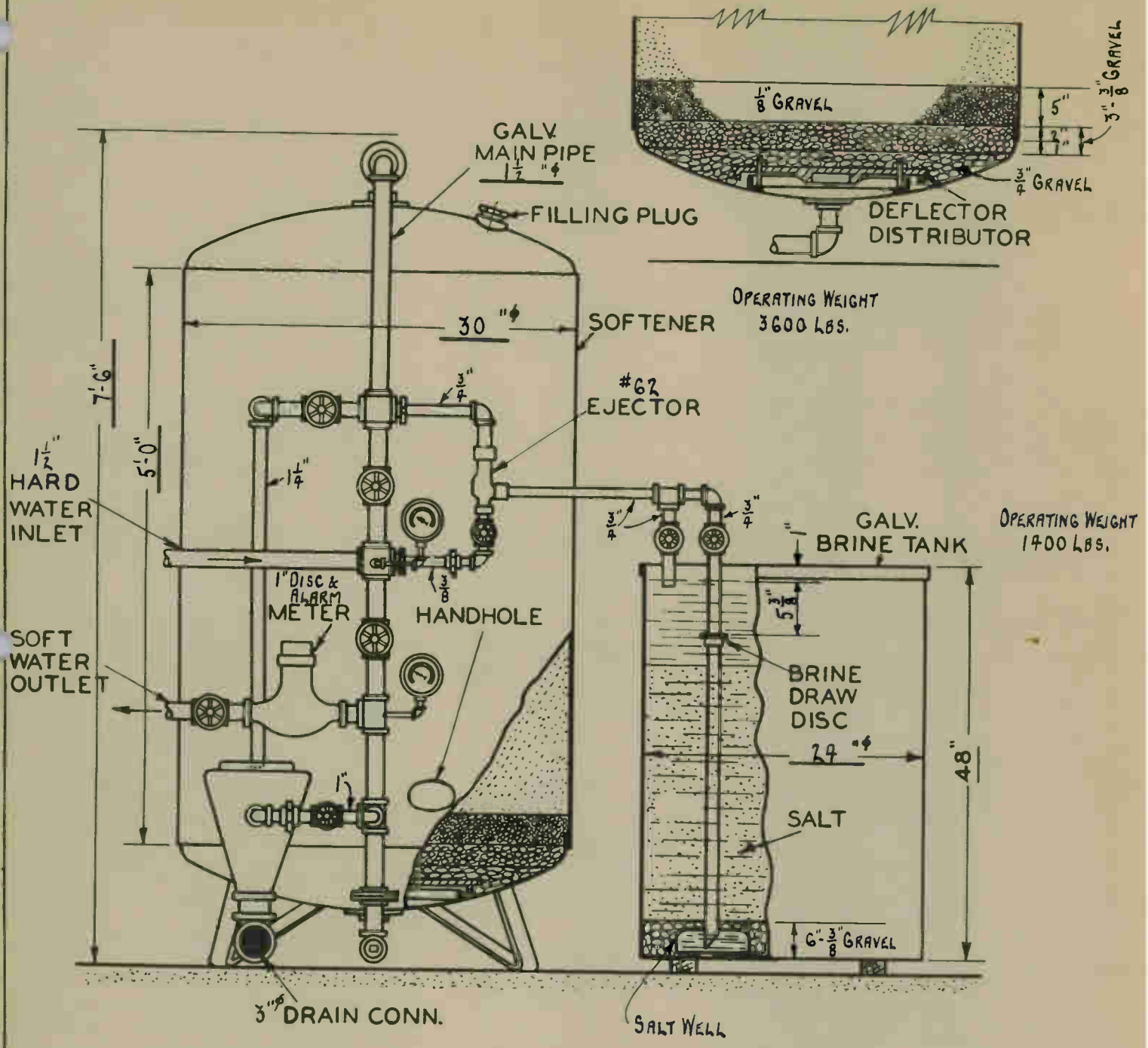
To Change Trip Units—Throw the breaker to open position and remove the load terminal studs (F) and screws (C) and (D) then lift trip unit out of circuit-breaker frame.

The style numbers of the standard trip units are listed below. All trip units of a given number of poles are interchangeable.

Poles	Style No.	Thermal Trip Amps.	Instantaneous Trip Amps.
2	807163	225	2250
2	807374	250	2000
2	807378	275	2200
2	807382	300	2400
2	807386	325	2600
2	807390	350	2800
2	807394	400	3200
2	807398	450	3600
2	807402	500	4000
2	807406	525	4200
2	807410	550	4400
2	807414	600	4800
3	807164	225	2250
3	807375	250	2000
3	807379	275	2200
3	807383	300	2400
3	807387	325	2600
3	807391	350	2800
3	807395	400	3200
3	807399	450	3600
3	807403	500	4000
3	807407	525	4200
3	807411	550	4400
3	807415	600	4800

WESTINGHOUSE ELECTRIC & MFG. COMPANY

East Pittsburgh Works Printed in U.S.A. **East Pittsburgh, Pa.**



WARLO INDUSTRIAL SOFTENERS
30" [redacted] DIAM.

WOR BROADCASTING STATION,
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WARLO CORPORATION
NEW YORK CITY

SCALE ~ DATE 12-27-34.

W-3810-A

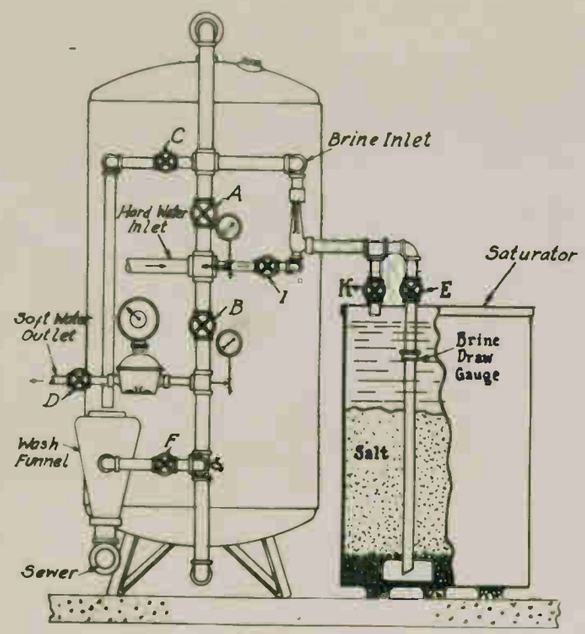
MADE J.S. CHECKED R.T.P.

WOR Broadcasting Station,
Carteret, N.J.

DIRECTIONS FOR OPERATING

WARLÓ CORPORATION
330 W. 42ND STREET
NEW YORK. N. Y.

1-30"ø5'-0" Str. Simplex Zeo-Dur Unit



B-10127

DESIGNATION OF VALVES

A Hard Water Inlet	E Brine Inlet
B Wash Water Inlet	F Drain
C Wash Water Outlet	I Water to Ejector
D Soft Water Outlet	K Water to Saturator

IMPORTANT

Open and close valves slowly.
Do not apply undue force.
Keep valve B closed tight when softener is in operation.
The Softener Must Not Be Run Beyond Its Total Capacity.

SPECIFICATIONS FOR EACH UNIT

1. Capacity 5000 gals. in 4 hrs. based on City water having an actual hardness as $CaCO_3$ of 10 grains per U. S. gallon and a *Compensated hardness of 10 grains per U. S. gallon.
   *Compensated hardness includes addition for sodium salts.
2. Per minute rate of softening 30 gals. max.
3. Wash rate 30 gallons per minute.
4. Salt required to regenerate softener 26 pounds; equivalent to 5 3/8 inches of saturated brine from 24" dia. tank.

I. TO OPERATE:

Open valve A and set valve D at rate (see No. 2). All other valves remain closed.

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II. TO WASH:

With all valves closed, first open wide valve C; then open valve B slowly until wash water in wash funnel rises nearly to the top of the funnel. Wash at the full funnel rate for approximately 10 minutes or until the wash water is clear. If coarse zeolite grains appear in the wash water effluent, lower the water level in the wash funnel slightly by throttling valve B.

III. TO REGENERATE:

With all valves closed tight, open valves F, E and I, in order named. When 5 3/8 inches of brine have been drawn from the saturator, close valves F, E and I in the order named, and proceed to rinse as described below under IV.

IV. TO RINSE:

Open valve A wide and when the softener is under normal pressure, as indicated by the pressure gauge, open valve F slowly, allowing water to flow at the full funnel rate without splashing. The endpoint of this rinse is reached when the water passing to waste through valve F is free from any salty taste and is free from hardness as indicated by the soap test. Samples for testing may best be obtained from the brine sampling cock. When rinsing is completed, close valve F and place the softener in operation. (See I. "To Operate.")

Refiill saturator with water through valve K, being careful always to fill to the same level.

V. CHARGING SATURATOR:

(a) Initial Charge.

Open valve K and admit water to saturator tank until there is between 9" and 12" of water above the gravel. Load clean, coarse, easily soluble salt into the tank to within 15" from the rim of the tank. If salt level is too high, the brine draw gauge will be buried in the salt bed and not measure correctly the brine drawn during regeneration.

To insure full strength of brine, the layer of undissolved salt should not be less than 12" deep.

(b) Recharging.

The saturator must be recharged whenever the minimum salt depth is reached (see V (a)). To provide space for the salt charge, allow brine level in saturator to drop by regenerating a few times without refilling saturator with water. During these drawdowns, use a rule for measuring brine depth per regeneration. Fill the saturator with salt to within 15" of the rim of the tank, and refill the saturator with water through valve K.

VI. SOAP TEST:

Draw sample to be tested from Soft Water Sampling Cock, filling test bottle to the 30 cc mark; add 4 drops of soap solution. Shake the bottle well. If a good lather results, the water is soft.

VII. GENERAL:

(a) **Temperature:** The temperature of the water entering the softener must not exceed 100° F. The pressure must not exceed 100 lbs. per square inch. ***If the soft water passes directly to a hot water heater or any heat producing apparatus, a swing check valve must be installed in this line to prevent hot water from backing into meter, and to protect shell place a pop valve between check valve and heater.***
The softener must be housed properly to protect it against freezing.

(b) **Capacity:** Care must be taken that the output per minute is not exceeded. When the compensated hardness of the raw water exceeds that specified, the volume of water softened between regenerations will be decreased. In any case the softener must be regenerated as soon as the effluent requires more soap solution to form a lather than is specified above (see Par. VI, Soap Test). If the softener is run beyond its capacity, it must be thoroughly washed, then regenerated several times in succession without softening any water between these regenerations.

(c) **Washing:** Air must be kept out of the softener during washing. Be sure that pump glands, pipe joints, etc., are tight. Air will cause gravel hills. Too sudden opening or closing of wash water inlet valve will do likewise.

(d) **Water Hammer:** Wherever water hammer or a rapid pulsation of water pressure occurs, e. g. from reciprocating pumps or from quick closing valves, the purchaser is to provide a properly designed air chamber or other suitable means to protect the pressure vessels from fracture. This applies even though the pressure change due to pulsation is small.

(e) **Hard Water Supply:** The water entering the softener should be clear, neutral and practically free from iron, color, turbidity, plankton (microscopic organisms), acidity, oil and free alkali. Should the raw water occasionally contain slight amounts of plankton and suspended matter, then additional washings of the softener units between regenerations may suffice to properly maintain the softener without the installation of a filter. If however, the amount of plankton and suspended matter becomes excessive, a filter should be installed to remove them.

(f) **Pretreated Water:** Water pretreated by lime and soda ash should be neutralized by alum or acid, or CO_2, so that the neutralized water entering the sand filters (which precede the softeners) will be free from phenolphthalein alkalinity and will contain 1—10 ppm free CO_2, in order to prevent after-reactions from coating the zeolite.

(g) **Boiler Blowoff Control:** When the soft water is used for boiler feed purposes, the concentration of the boiler salines (water inside the boiler) must be kept within certain limits which depend upon the demands on the boiler and its design. In general the boiler should be blown off frequently enough to keep below the concentration corresponding to a density of about 0.5 degrees Beaumé.
Boilers operating at very high ratings may require densities as low as 0.2 degrees Beaumé. The safe maximum density should be determined for each boiler and the blowoff regulated to maintain the density below this maximum. To determine the density, use the patented "Permutit Boiler Blowoff Hydrometer" which conveniently corrects for temperature.

(h) **Prevention of Corrosion:** Boiler feed water should be deaerated to prevent corrosion. Closed heaters do not deaerate the water. Sufficient deaeration for protection of boilers proper can be accomplished in the usual open mixing heater, provided the heater is sufficiently large, well vented and live steam is introduced into the heater (in addition to exhaust steam) to keep the feed water temperature practically at the boiling point. A thermostatic valve on the auxiliary live steam line should be installed to prevent waste of steam. If steel tube economizers are used, the water must be completely deaerated and special equipment should be added to the ordinary open heater to accomplish that purpose.

(i) To prevent hot water supply piping corrosion, deaeration should also be employed. If corrosion occurs and deaeration cannot be adopted, feeding of sodium silicate solution into the inlet of the heater for hot water supply (not boiler feed) will be found efficacious.

(j) **Idle Periods:** If there are seasonal periods wherein soft water is not required for a week or more, the softener should, at the start of the idle period, be run to exhaustion (until effluent is no longer soft) and then drained. When ready to resume operation, ***very slowly*** fill the softener with water through valve B until it overflows through valve C. Then regenerate in the usual manner.
However, if softener is subject to freezing temperature even for short periods, it should be run to exhaustion and completely drained as described above.

24"

2 $ CRANE

2 "

1½"x1½"x1"

← 1½"x1½"x1" TEE

5

24"

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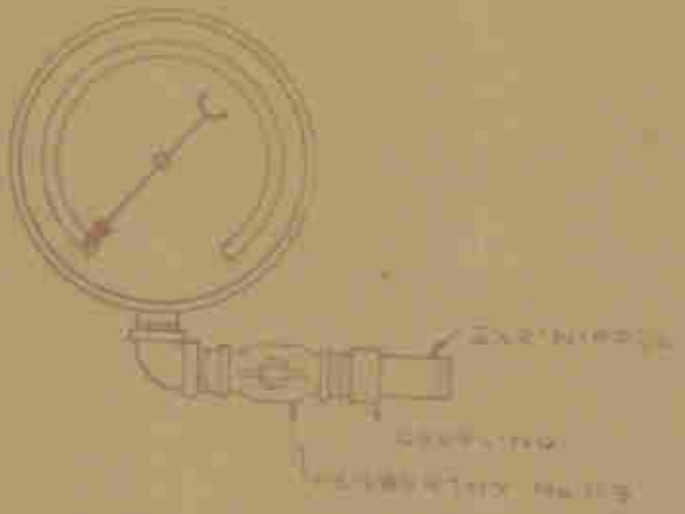


BILL OF MATERIAL

REQ	CLASSIFICATION	SIZE	LENGTH	REMARKS	MAT'L
	SINGLE PRESSURE GAUGE ASSY.				
	NIPPLE Y&C	¼"	2"	IPS	BR
	ELBOW ILR	¼			B-
	BUSHING	½		REDUCING IPS	BR
	COUPLING	½		IPS	BR

PRESSURE GAUGE PIPING

WARD CORPORATION

W- 3819-A

WARLO CORP.
NEW YORK, N.Y.

BILL OF MATERIAL

172

30" INDUSTRIAL WARLO SOFTENER

#W-3069

WOR BROADCASTING STATION, CARTERET, N.J.

SHEET 1 OF 2

	DRAWING	NO. REQ'D	DESCRIPTION	SIZE	LENGTH	MAT.	REMARKS
	W-3810-A		LAYOUT				
	B-10909		ASSEMBLY				
		1	METER SCR	1" Disc	AND ALARM-REG No.	4015	
	W-3812-A	1	SHELL WELDED COMPLETE WITH DEFLECTOR DISTRIBUTOR	30"ø x 5'-0 SIR ST.	W.P.	100#	
			ZEOLITE	Zeo-Dur	18	CU. FT.	INSIDE SOFTENER
			GRAVEL 3/4"		65	LBS.	" "
			GRAVEL 3/8"		130	LBS.	" "
			GRAVEL 1/8"		220	LBS.	" "
	W-3811-A	X 1	SET MAIN PIPING	1½"			SEE LAYOUT
	W-3819-A	2	SETS PRESSURE GAUGE	¼"		BR	" "
			PIPING WITH PRESSURE GAUGES 0# TO	100#			WITH CRANE AIR COCKS #708
		1	RECORD BOOK				
		1	TEST SET	#W-7	4 DROPS - 30 cc.		
		1	WATER CARTON				
	W-3818-A	1	WASH FUNNEL USING	Zeo-Dur		C.I.	
		1	ELBOW SCR	¼"		YEL. BR.	PRESSURE GA.
		1	NIPPLE TBE.	¼"	1½"	YEL. BR.	" "
		1	PIPE TOE	½"	14½"	GALV. W.S.	FUNNEL VENT
		1	NIPPLE TBE	½"	4"	GALV. W.S.	" "
		1	ELBOW SCR	½"		GALV. C.I.	" "
		1	BUSHING HEX	1½"	K1"	GALV. C.I.	"
	W-3813-A	1	FILLING PLUG	2½"		BR	
	W-3814-A	1	FILLING FUNNEL				

W[illegible]CO CORP
[illegible]W YORK N.Y.

BILL OF MATERIAL

173

BRINE EQUIPMENT FOR
30 # SOFT & 42 "
INDUSTRIAL WATER SOFTENER

JOB #W-3069

SHEET 2 OF 2

	DRAWING	NO. PCS	DESCRIPTION	SIZE	LENGTH	MAT.	WHERE USED
1	W 3823-A	1	SATURATOR TANK	24"ϕ	x 4'-0"	GALV ST.	
2	W 3041-A	1	SALT WELL			C.I.	
3			GRAVEL 3/8" ϕ	165	LBS.		
4							
5		1	HYDRAULIC EJECTOR	#62	PERS & LOW	BR	
6	W 3820-A	1	BRINE DRAW DISC & COLLAR FOR 3/4" PIPE				
7							
8		2	GATE VALVES SCR	3/4"	CRANE	BR	EJECTOR BRINE LINE
9		2	ELBOWS SCR	3/4"		GALV C.I.	" " "
10		1	TEE SCR	3/4"		GALV C.I.	" " "
11		1	BUSHING HEX.	1 1/4"	x 3/4"	GALV C.I.	" " "
12		2	COUPLINGS	3/4"		GALV W.I.	" " "
13		3	NIPPLES TOE	3/4"	2 1/2"	GALV W.I.	" " "
14		1	NIPPLE 24" TOE	3/4"	6"	GALV W.I.	" " "
15		1	PIPE [illegible] TOE	3/4"	4'-2"	GALV W.I.	" " "
16		1	PIPE CUT TO SUIT TOE	3/4"	6'-0"	GALV W.I.	" " "
17							
18							
19		1	GATE VALVE SCR	3/8"	CRANE	BR	EJECTOR SUPPLY
20		1	ELBOW SCR	3/8"		GALV C.I.	" "
21		1	BUSHING HEX	1 1/2"	x 3/8"	GALV C.I.	" "
22		1	UNION CHICAGO	3/8"		GALV M.I.	" "
23		1	PIPE CUT TO SUIT TOE	3/8"	2'-0"	GALV W.I.	" "
24		2	NIPPLES TOE	3/8"	2 1/2"	GALV W.I.	" "

DIRECTIONS FOR INSTALLING

30" and 36" "WARLO" WATER SOFTENING- SIMPLEX

WITH AERATOR

I The softener shell is constructed for a working pressure of 100 lbs per sq inch

II Drawing W-3810-A is a general drawing covering this installation

1. The operating weight of the softener and saturator are given on the assembly and general drawing, and supporting floor or foundation must be strong enough to sustain these weights without settlement

2 Provide and place under each of the softener tank legs steel bearing plates not less than 3/8" thick and not less than 8" square

I SOFTENER TANK:

The softener tank may be set so that the manhole will be on either side of the main piping as convenient to the installation; but, the softener tank must be set so that the piping from the bottom of it will pass between the tank legs. The tank must be set plumb in both directions

II DETAILS OF ASSEMBLY:

(a) Main Piping: Assemble to the softener tank the piping as shown on the assembly drawing and on the detail drawing W- 3811-A-X.

Set Wash Funnel Plumb- Install 1/2" Funnel Vent.

Place Suitable Support Under It To Carry Weight.

III LOADING THE SOFTENER:

(a) The gravel is shipped in bags, labeled according to size. Through the manhole, place in the bottom of the softener tank a layer of 3/4" gravel so that the deflector distributor is completely covered by this layer of 3/4" gravel. The top of this gravel layer must be level. On top of the 3/4" gravel, place a layer of 3/8" gravel and level it off. On top of the layer of 3/8" gravel, place a layer of 1/8" gravel and level it off. Close manhole

(b) Open valve B not more than a turn or two and slowly fill the softener tank about half full of water. With the water still flowing into the bottom of the softener tank, load it through filling hole the zeolite, allowing the zeolite to fall through the water. When all of the zeolite has been placed in the tank, open valve C, and close the filling hole with the brass filling plug. Continue to run the softener tank through valve B at the same low rate until water begins to overflow through valve C.

(a) Gradually increase the opening of valve B. If zeolite tends to come over with the wash water, throttle valve B until there is no loss of zeolite in the wash water. During the first wash a small amount of very fine zeolite dust will be lost in the wash water. This is normal, but the softener should not be washed at such a high rate that coarse grains are lost. Continue the washing until the wash water is fairly clear.

IV. SATURATOR:

1. The saturator tank must be set plumb.

2. Assemble the internal and external piping that connects the saturator to the main piping on the softener. Make sure that the brine draw gauge is on the brine suction pipe before assembly.

3. Place in the bottom of the saturator the 3/8" gravel, being certain that the gravel completely covers the salt well on the brine suction pipe.

4. Admit water to the saturator through valve K until the gravel is submerged to a depth of 12". Load clean, coarse, easily soluble salt into the saturator tank until it is within 15" of the rim of the tank. Continue filling the saturator with water through valve K until the level of the water in the saturator is about 1" from the top of the tank. The brine draw gauge should be set from the water level in the tank. (See assembly drawing or Operating Directions.)

V. PLACING SOFTENER IN OPERATION:

Regenerate and rinse according to paragraphs III and IV of the Directions for Operating, and place in operation according to paragraph I. of the Directions for Operating.

WARLO CORPORATION
New York, N. Y.

INSTRUCTIONS

FOR INSTALLING AND OPERATING

STOKES ELECTRIC WATER STILLS

MODELS 171, 000 and 1

FJ STOKES MACHINE COMPANY

Pharmaceutical Equipment Since 1895

TABOR ROAD PHILADELPHIA 20, PA.

Representatives in New York and Chicago

STOKES ELECTRIC WATER STILLS

MODELS 171, 000 and 1

1. Unpacking

Remove the contents of the packing case being careful not to break, damage or lose any of the parts.

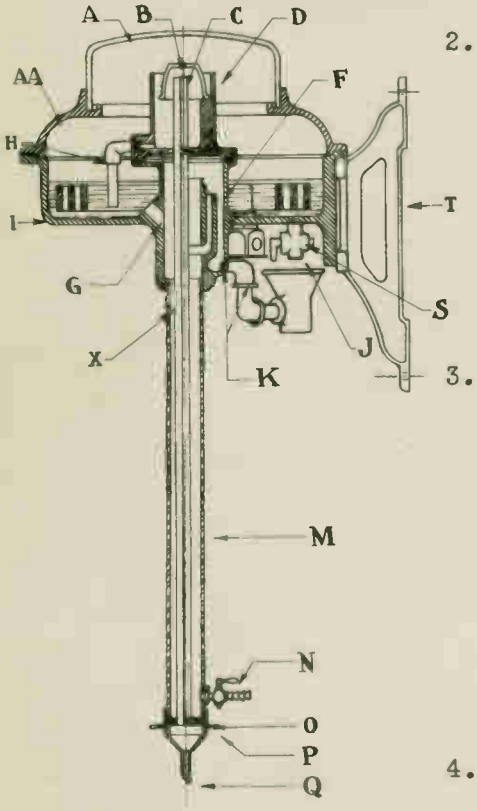


Figure 1

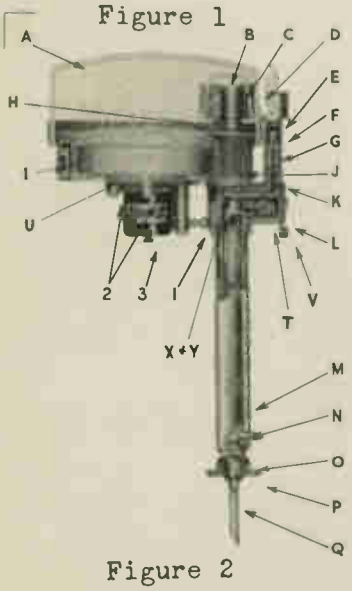


Figure 2

2. Mounting

Fasten the still to a wall or a post and carefully level it to be sure that the water seal will be a uniform depth around the base of the glass dome. Mount the still sufficiently high to drain into a Stokes Storage Tank or other suitable container with at least 3 feet of headroom to remove the dome for inspecting and cleaning the boiling chamber. Floor stands are available for 171 models.

3. Assembling

With the still mounted insert the nozzle (Q) against the rubber washer (O) with the copper washer (171 only) on top and tighten the holder (P) as tightly as possible by hand. The copper washer prevents the rubber washer from being pushed too far into the condenser housing (M). On models #1 the nozzle is already mounted. Next mount the pyrex glass cup and dome referring to Figs. 1 or 2. Turning the metal baffle holder on 171 models (D) if necessary, so that the dome (A) seats firmly.

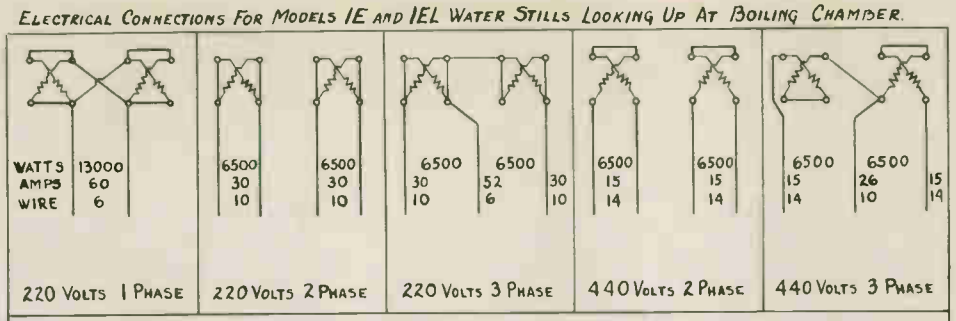
4. Water Supply

A constant supply of water (8 to 9 gallons for every gallon of distilled water produced) is required at uniform pressure and temperature to maintain the condenser at even temperature and supply water for the boiling chamber. Thermostatic controls are available to maintain a uniform temperature of the distillate regardless of fluctuations in the water supply.

Although rubber tubing connections are provided for on some models, permanent piping is better and is recommended. The valve (N) is removed and replaced with a standard water pipe line equipped with a suitable control valve. It is also recommended that a "T" be installed between the still and the adjusting valve, and one leg be fitted with a second valve leading to a drain. This allows the still to be drained by opening this second valve and closing the supply valve.

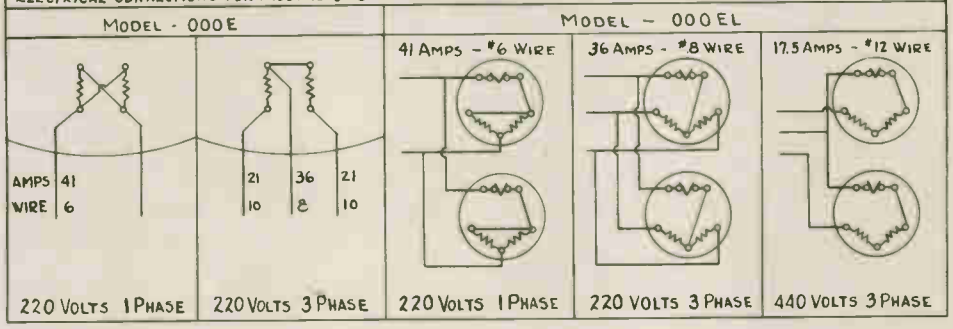
WIRING DIAGRAMS

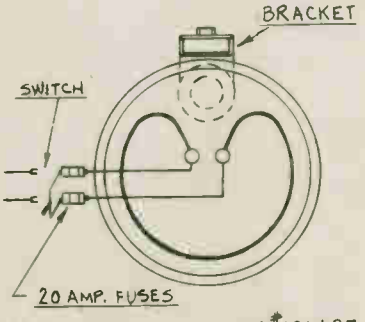
Electrical Connections For Models IE and IEL Water Stills Looking Up At Boiling Chamber.



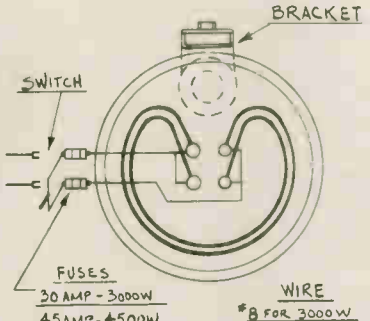
NOTE: Each Terminal Box Contains 1-3100 Watt Heater & 1-3400 Watt Heater - Total Per Box 6500

Electrical Connections For Models 000-E and 000-EL Water Stills Looking Up At Boiling Chamber

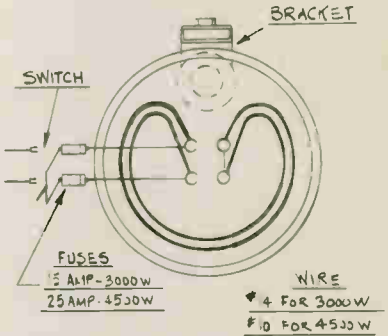




171-H 2000 WATTS - ½ GAL. PER HR.



171-J 3000 WATTS - 1 GAL PER HR.
171-L 4500 WATTS - 1½ GAL. PER HR.

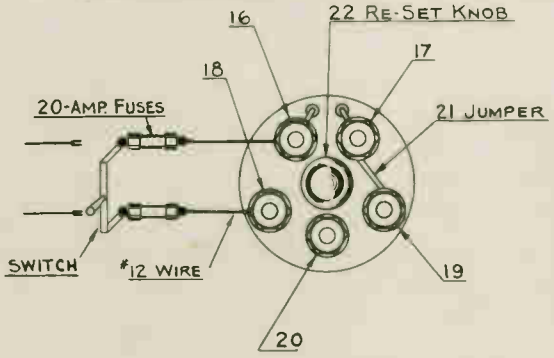


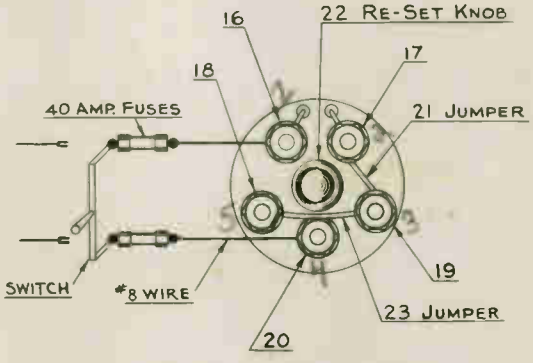
171-J 3000 WATTS - 1 GAL PER HR.
171-L 4500 WATTS - 1½ GAL. PER HR.

110 VOLTS - 1 ELEMENT

110 VOLTS - 2 ELEMENTS

220 VOLTS - 2 ELEMENTS





(Terminals 16 & 17 connected to thermal cut-off switch. Terminal 20 common to both heaters)

220 VOLTS ← MODELS 171 HL & 171E → 110 VOLTS

440 VOLTS ← MODEL 171F → 220 VOLTS

Any restriction in the overflow will flood the still and cause water to spill over the sides of the bracket and therefore the drain (K) must be piped directly to an open drain through piping no smaller than that provided for at (K).

5. Electrical Supply

Wire the heating elements using the recommended sizes of wires and fuses according to the diagrams above which show the connections at the heater terminals when looking up at the bottom of the boiling chamber. All models equipped with a built in thermal cut-off switch can be reset by pushing up the reset knob (3). Model 1EL cut-off switch consists of a float switch and relay. Both switches cut off the current to the heaters should the water supply become low or fail. Gradually scale forms on the heating elements and even thin layers form a very effective insulation which will accumulate heat and eventually cause the elements to burn out. We therefore strongly recommend that the elements be cleaned at regular intervals and that the scale never be allowed to build up thicker than 1/64 of an inch. The heating elements in all of these stills are designed to operate under water and will burn out quickly if operated in the atmosphere. Therefore always fill the boiling chamber first then turn on the current to the heaters. A relay must be used in Direct Current installations for all models with a low water cut-off. Write us for details.

6. Operation

The raw, cold water enters the condenser column and surrounds the condenser tubes. As this cold water rises in the column it condenses the water-vapor descending in the condenser tube from the boiling chamber, the resulting distilled water being discharged at (Q). The temperature of the feed water rises to about 190°F as it ascends the column. Preheating in this manner not only conserves heat, but it also expels dissolved gases and volatile impurities from the feed water before actual distillation begins, these escaping to the atmosphere. A portion of this preheated water automatically feeds into the boiling chamber through the passage (G). The remainder overflows through the passage (F) and goes to the drain through (K). In the boiling chamber the preheated water is boiled gently, with but little tendency for spray to be formed and carried along in the rising water-vapor or steam. The steam slowly rises to the top of the boiling chamber where it enters an efficient baffling system which separates and returns to the chamber any such light particles of spray as may have become entrained by the vapor. The vapor continues down the condenser tube issuing as pure distilled water at (Q).

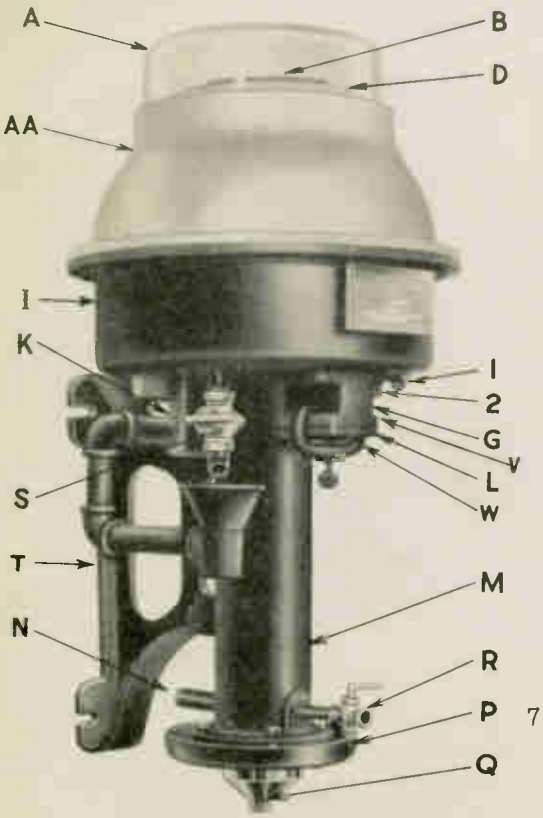


Figure 3

7. To Operate

a. Open the water supply line to fill the condenser and the boiling chamber, then after the heating elements are covered turn on the

current for the heaters. After the still has started to operate adjust the valve at (N) to keep the condenser cool about 1/3 of the way up. The distilled water will be approximately 110°F under these conditions. If more water is admitted the water entering the boiling chamber will be cooler with a resultant drop in efficiency.

b. If absorbed gases are present in the distilled water, slightly decreasing the flow of water at (N) will make the condenser run hotter permitting a small amount of steam to escape with the water and carry off the absorbed gases. Under these conditions the capacity will drop slightly and the water will issue at about 175°F.

c. The distilled water coming from the nozzle should be allowed to flow freely into a vented storage container. The water may have a slightly oily taste which will disappear after a few days of operation. The still must be drained after each day's run, or more frequently if necessary, to help reduce the accumulation of impurities in the boiling chamber which eventually form a scale reducing the efficiency of the still.

8. Maintenance and Cleaning

a. To operate efficiently the still should be flushed out daily and cleaned at regular intervals depending upon the condition of the feed water. The still may be drained through the valve inserted in the "T" at the bottom of the condenser column. In very hard water districts we recommend draining every 4-8 hours and we will be glad to supply automatic drain valves and timers to automatically start, stop and drain the still periodically.

b. Scale gradually builds up on the heating elements. A very thin layer forms such an effective insulation that heat is prevented from passing into the water eventually causing the elements to burn out. Although the thermal cutout provided on some models may automatically turn the current off before the elements are damaged, it is recommended that the elements of all models be cleaned at regular intervals and the scale never be allowed to build up over 1/64" in thickness. If the cutout operates due to accumulation of scale it is necessary to remove the scale before operation can be resumed.

c. Some varieties of scale containing carbonate may be removed by using Pennsalt PM90 or by boiling commercial hydrochloric acid, diluted with four times their volume of water, in the distilling chamber. Remove the still cover so that the acid fumes can escape, and cork up the feed water inlet in the bottom of the chamber so the acid will not run down into the condenser. The acid should not be allowed to remain too long in the still and both the Pennsalt and the acid must be thoroughly rinsed out with soda or other alkaline solution before operating again. Sulphate scale usually must be removed mechanically be scraping the elements with a tool and polishing with emery cloth. If necessary the elements can be removed by unfastening the electric connection and unscrewing the four bolts at 2. In order to make the boiling chamber watertight it is recommended that both sides of the gasket be painted with shellac and the elements replaced before this has dried.

d. The passages in F, G and K may become clogged after a time and should be cleaned with a brush or tool inserted through the opening provided by the removal of the plate (L). (Remove D on #000 models and the pipe plugs above K on #1 models.)

e. If the feed water is muddy, sediment will collect in the bottom of the condenser. This sediment should be flushed out from time to time by means of the "T" drain valve, if the still has been connected with permanent piping or otherwise by removing the rubber hose at (N).

9. Ordering Parts

When ordering parts give model & serial numbers (found on the nameplate) of your still as well as the part number and description. We must have this information to fill your order promptly and correctly.

PARTS LIST FOR STOKES ELECTRIC MODEL WATER STILLS

Part Name	Part No. 171H	171J	171L	171HL	171E	171F	000E	000EL	1E	1EL
Cast Iron Dome	-	-	-	-	-	-	AA	AA	AA	AA
Glass Dome	A	A	A	A	A	A	A	A	A	A
Glass Baffle Cup	B	B	B	B	B	B	B	B	B	B
Condenser Tube)	C	C	C	C	C	C	C	C	C	C
Baffle Cup Holder)*	D	D	D	D	D	D	D	D	D	D
Entrainment Return)	H	H	H	H	H	H	H	H	H	H
Boiling Chamber	I	I	I	I	I	I	I	I	I	I
Deconcentrator Tube or Valve	J	J	J	J	J	J	S	S	S	S
Overflow Connection	K	K	K	K	K	K	-	-	-	-
Clean-out Plate	L	L	L	L	L	L	-	-	L	L
Condenser Housing	M	M	M	M	M	M	M	M	M	M
Water Inlet Valve	N	N	N	N	N	N	N	N	-	-
Outlet Nozzle Gasket	O	O	O	O	O	O	O	O	O	O
Outlet Nozzle Holder	P	P	P	P	P	P	P	P	P	P
Outlet Nozzle	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q
Condenser Drain Valve	-	-	-	-	-	-	-	-	R	R
Water Still Bracket	T	T	T	T	T	T	T	T	T	T
Heating Element	T20	/T30	/T45	/BL20	/BL30	/BL45	**T45	MCB2	θT325	θT325
Heating Element Gasket	U	U	U	U	U	U	U	U	U	U
Low Water Cut-off	-	-	-	-	-	-	-	-	-	W89
Clean out Gasket	V	V	V	V	V	V	-	-	V	V
Clean out Plate Clamp	-	-	-	-	-	-	-	-	W	W
Boiling Chamber Gasket	X	X	X	X	X	X	X	X	-	-
Boiling Chamber Gasket Washer	Y	Y	Y	Y	Y	Y	-	-	-	-
Condenser Tube Plate	-	-	-	-	-	-	Z	Z	Z	Z

/ Specify whether upper or lower element. / Furnished with thermal cut-out switch. * Supplied as unit only on 171 models. ** Specify right or left unit. θ Specify long or short necks.

These stills can be easily equipped with a storage tank and full automatic controls that automatically turn on the electricity and water supply when the tank is nearly empty and shut the still down again and flush it when the tank is filled. Write for prices and full information.

F. J. STOKES MACHINE COMPANY

PHILADELPHIA 20, PA.

PARTS LIST FOR MODEL #171F Water Still

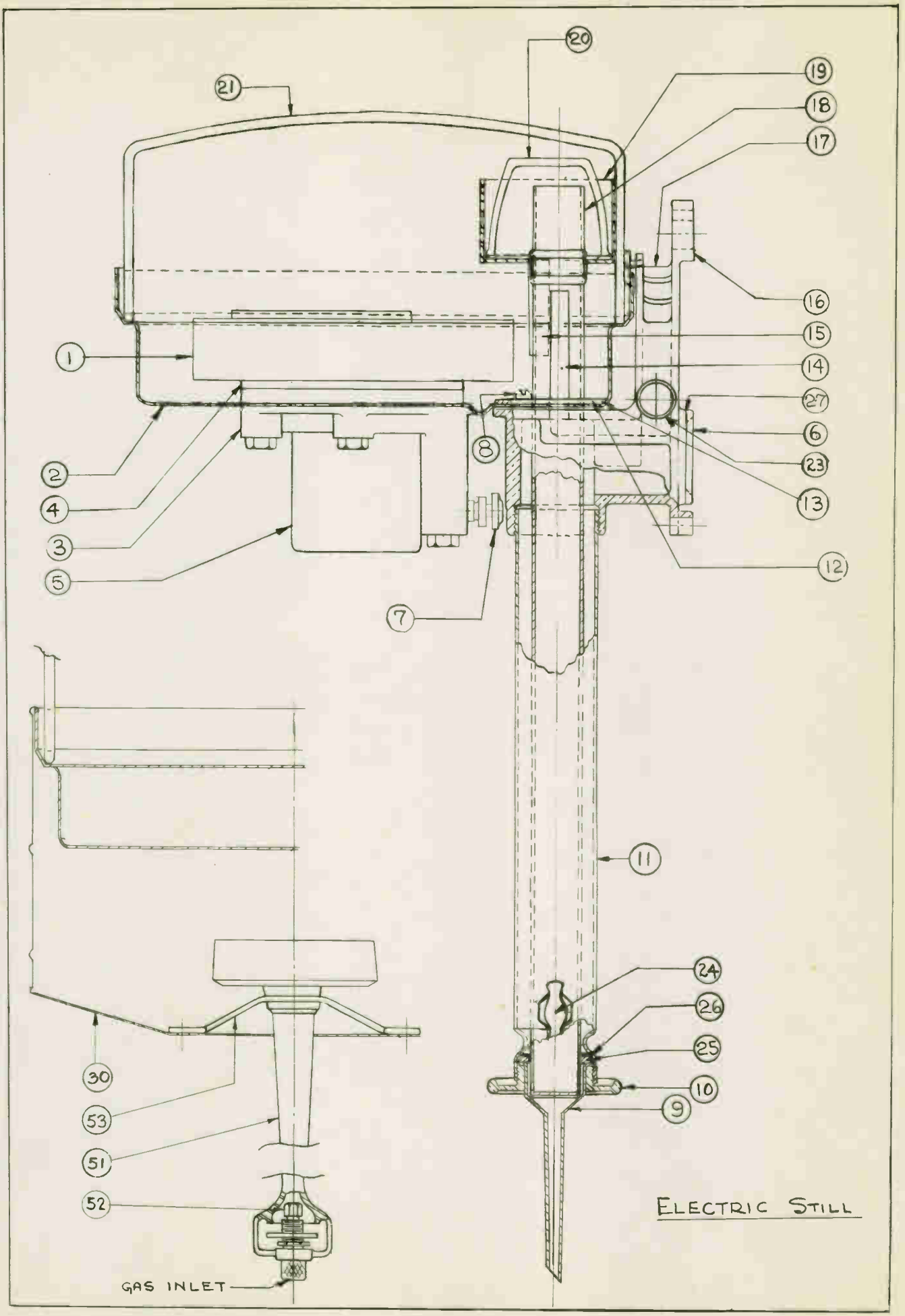
TO AVOID DELAYS AND MISTAKES ALWAYS STATE INDEX NUMBER, PART NUMBER, PART NAME, MODEL, LOT AND SERIAL NUMBERS OF EQUIPMENT

INDEX NO.	PART NO.		PART NAME	PRICE EACH
12	171-202	S	Gasher for 171-203	
8		S	1/4" x 5/8" round head screws for 171-202	
13	171-203	S	Gasket (between Boiling Chamber & Mounting bracket)	
	171-204	S	Clamp Screw for rim of Boiling Chamber	
	171-205	S	Eyelet for 171-203	
16	171-301	S	Mounting Bracket with 171-302 & 171-303 & 171-401	
6	171-302	S	Clean-Out Plate for 171-301	
27	171-303	S	Clean-Out Plate gasket for 171-302	
16	171-3A01	NS	Mounting Bracket (double distillation only) (manual control)	
16	171-3B01	NS	Mounting bracket for automatic control (double distillation unit)	
16	171-3001	NS	Mounting bracket for use with Watts low water cut off or automatic control (single distl.)	
11	171-401	S	Condenser Column - see 171-301	
18	171-404	S	Condenser Tube with 171-406 and 171-407	
25	171-405	S	Gasket for 171-403	
19	171-406	S	Cup Holder - see 171-404	
15	171-407	S	Cup Holder Drain Tube see 171-404	
14	171-408	S	Foam Drain Tube	
24	171-410	S	Inlet Valve	
26	171-412	S	Gasher for 171-405	
10	171-4A02	S	Nozzle Holder	
9	171-4A03	S	Nozzle	
21	171-501	S	Glass Dome	
20	171-502	S	Glass Baffle Cup	
23	171-811	S	Hose Connection for 171-301	
9	171-1201	S	Nozzle (double distillation only)	
7	171-3001	S	Brace screw for 171-3003	
		S	Cap Screws 3/8"(for heating element) x 1"	
		S	Cap Screws 3/8" x 3-1/4" long for heating element	
3	171-3003	S	Clamp ring for heating element	
4	171-3004	S	Gasket for heating element	
	171-3005	S	Thermostatic Switch for heating element	
5	171-3006	S	Terminal cover for 171-3003	
2	171-201	S	Boiling Chamber	
1	171-216	S	Heating Element - 4500 Watts with 171-3005	

DATE

PRICES SUBJECT TO CHANGE WITHOUT NOTICE

CODE:



ELECTRIC STILL

SERVICE AND MAINTENANCE CHARTS

STILL NOT DELIVERING RATED CAPACITY

Cause	Remedy
a. Insufficient heat.	a. Check voltage on line and connections to the still (see par. 5). Also check operation of low-water cut-off.
b. Insufficient water in boiling chamber to cover heating elements.	b. Check for variations in water pressure - install thermostatic regulator or constant head device. Clean out scale at entrance to boiling chamber (G) (See par. 8c).
c. Condenser at incorrect or fluctuating temperatures or pressure.	c. Adjust feed water flow or install a constant head device or thermostatic regulator (See pars. 4, 6, 7a & 7b). Also check and clean overflow passage (F) and see that overflow pipe is large enough and unrestricted.
d. Flow of steam and/or distillate restricted.	d. Flow distillate into an open or vented container. Place baffle cup correctly and turn entrainment return tube downward.
e. Water seal breaks and steam escapes.	e. Level still carefully so water seal is uniform.

STILL FOAMING, SPILLING OR BOILING OVER

f. Water boiling too violently.	f. See a. above.
g. Water seal breaks and water spills over side of still.	g. See e. above. Also check for any restrictions as in d.
h. Water foams excessively.	h. Flush still more frequently. (See pars. 8a, b and c). Use treated water for boiling chamber. At certain times of the year water high in organic content causes foaming. Slow down operation of still.
i. Water spills over side of condenser column or down the side of the boiling chamber due to restricted overflow.	i. Clean out overflow passages at (K) and (F). Also see that overflow line is sufficiently large and drops at least 3 feet before going horizontal.

DISTILLATE CONTAMINATED

j. Water boiling too violently carrying entrained droplets into the condenser.	j. See a. above and par. 5. Also check variations in water temperature and/or pressure. Install constant head device or thermostatic regulator. Clean out scale in entrance to boiling chamber.
k. Still foaming excessively.	k. See c. above under "Still Foaming."
l. Vapor baffles displaced.	l. Level baffle cup in correct position and turn entrainment pipe down.

DISTILLATE CONTAMINATED (Continued)

Cause	Remedy
m. Improper or fluctuating condenser temperature - all dissolved gases not expelled.	m. See c. above under "Still Not Delivering Capacity."
n. Cooling water leaking into distillate funnel.	n. Tubes are rolled into lower tube plate and may need re-rolling. If proper tools are not available it may be desirable to return still to us for re-rolling or replacement of tubes. Check for leaks by admitting water without turning on heat. If water issues at Q there is a leak. Re-roll or replace condenser tube.
o. Distillate coming into contact with soluble materials.	o. Block tin, aluminum, pyrex glass and quartz are most suitable materials for storage containers. Bakelite, rubber, ordinary glass and so-called stainless steel are all slightly soluble and should not be used.

SUPPLEMENTARY INSTRUCTIONS FOR OPERATING MULTIPLE DISTILLATION UNITS

Note that the Stills are marked #1, #2 etc. and must be mounted as directed to function properly.

The Stills should be mounted one above the other as indicated on the blueprint supplied and should be connected to the necessary water, steam, gas, or electric supplies according to the standard instructions. In the case of electrically-heated models, install the electric resistors furnished with the Stills in accordance with the wiring diagram. The resistors are used only on the #2 and #3 (or lower) stills. Their purpose is to slightly reduce the capacity of the lower stills in order that the upper still will furnish sufficient distillate to keep the lower ones from running dry. In the case of gas and steam heated stills, the gas or steam supply to the lower stills must be throttled down slightly to assure that they do not operate faster than the upper one, and thereby run dry.

Do not start operating Still #2 until Still #1 above has delivered sufficient distillate to fill the boiling chamber to the proper level. Do not start operating Still #3 until Still #2 above has delivered sufficient distillate to fill the boiling chamber to the proper level. To get distillate of the greatest purity Stills #1 and #2 should be operated to deliver distillate to #3 at a temperature as near the boiling point as possible. This means that the instructions regarding the coolness of the condenser column should be disregarded for the #1 still and no notice be taken of the HOT/COLD line of the condenser. Allowing a small amount of steam to issue from the distilled water outlet of #1 and #2 stills will aid in removing any gases not eliminated in these stills.

If water of single distillation is desired, only still #1 should be operated. This single distilled water can be drawn off at the overflow in connecting piping between the two stills.

INSTRUCTIONS
FOR INSTALLING AND OPERATING
STOKES AUTOMATIC WATER STILL No. 171
(Electrically-Heated Model)

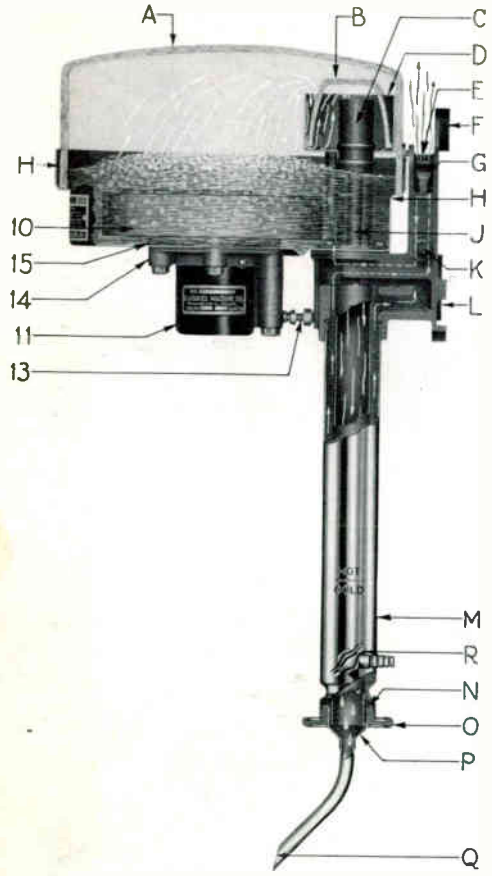


Fig. 1

LOCATING AND MOUNTING

1. The Still should be fastened to the wall or post sufficiently high to permit the outlet "Q" to drain into a carboy or other container. We recommend placing the Still so that the distance to the top screw hole in bracket "F" is about 46 inches from the floor. With the Still at this height the action can be observed at all times and the boiling chamber conveniently examined and cleaned without taking the Still down. For convenience in mounting, screws of the proper size are furnished in an attached envelope.

Showing Still (gas-heated) mounted on Stokes Floor Stand with container in place.

2. The most convenient way to mount the Still is on a *Stokes Floor Stand.* This is shipped knocked down in the carton and should be assembled first. Assemble the pipe sections and screw them tightly into the floor plate. Bolt the floor plate down at the desired location and mount the Still on the adjustable bracket.

ASSEMBLING

3. Carefully remove the Still and its parts from the carton. The box containing the glass dome can be lifted out and the Still itself can be removed after unscrewing the nozzle holder "O." Put the needle valve in place at "R" screwing it up tightly. The Still may now be mounted and care should be taken to see that the bracket "F" is vertical. If necessary, washers or other packing may be placed under the screws holding the bracket to the wall or stand. As the electric heating element is of considerable weight a brace is provided

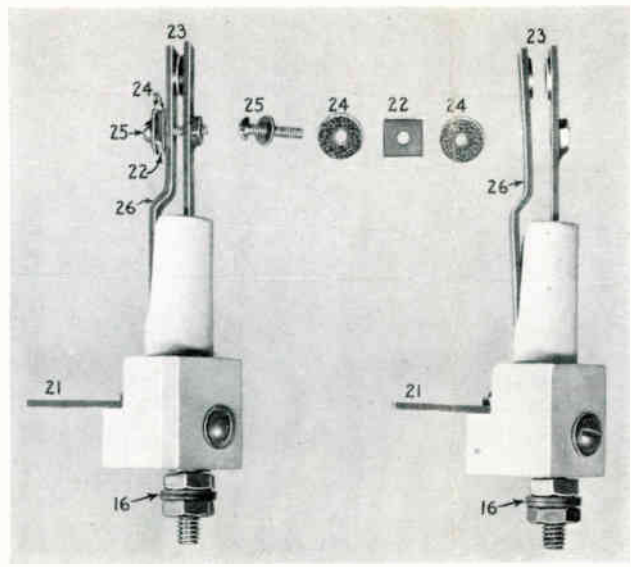


Fig. 2

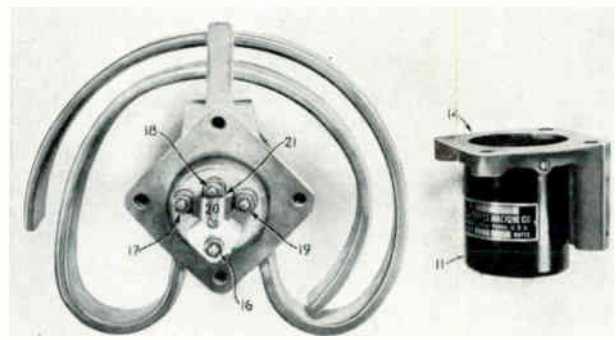
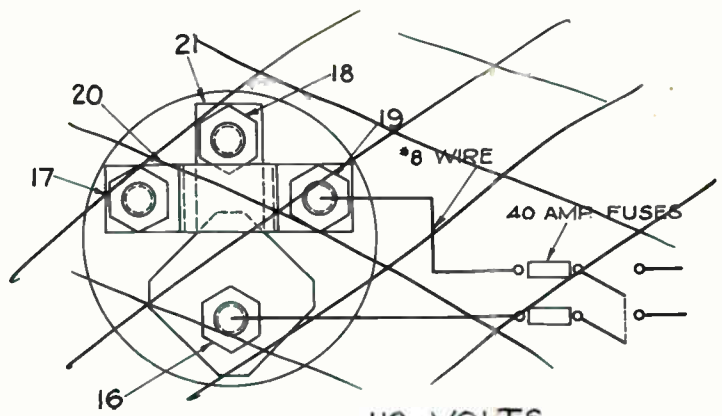
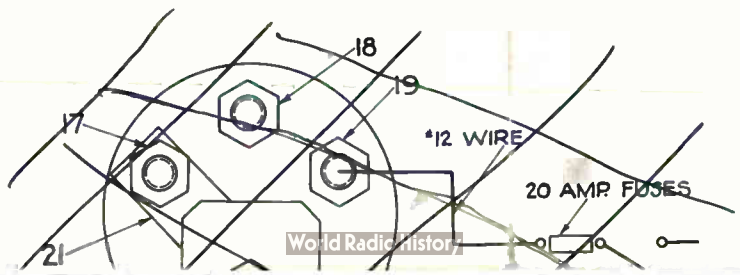


Fig. 3



~~110 VOLTS~~
SEE BLUEPRINT SK. 171-16



SAFETY FUSE *(See Fig. 2)*

7. A safety fuse is contained in the terminal block which operates when the heating element is over-heated, due either to lack of water or the accumulation of scale on the surface of the heating element. When such over-heating occurs fusible washer (22) melts and contacts (23) spring apart, breaking the circuit. The fuse can be removed after turning off the current and disconnecting arm (21) and terminal (16). When replacing a new fusible washer (22) see that mica discs (24) are placed each side of it before inserting screw and washer (25). After tightening screw (25) see that it does not touch the side of the hole in fuse arm (26). Clean off all old fuse metal.

8. If the fuse operates on account of accumulation of scale this should, of course, be removed before putting the Still in operation again. See paragraph 14. The heating element can usually be cleaned in position in the Still. Should it be necessary to take it out, loosen the four screws in flange (14) and remove the flange and cap, then lift the element out. If gasket (15) is no longer serviceable a new one should be inserted in its place when replacing the heater.

OPERATING STILL

9. With water running through the Still and with current on, regulate the flow of water through the needle valve "R" so that the distillate coming out at "Q" will be about 110° F. The condenser will then be hot up to the HOT/COLD line on the condenser casing "M," the temperature in the hot well "E" approximately boiling and the overflow "K" about 195° F.

10. Dissolved gases in the distillate can be practically eliminated by cutting down the flow of feed water and allowing a little steam to issue with the distilled water. The temperature of the distillate under these conditions will be between 170° and 180° F. and the tendency for liberated gases to redissolve in this distillate is reduced to a minimum. With a constant pressure water supply the position of needle valve "R" need not be changed after once regulated, the supply of water being admitted and shut off by a valve in the water supply line.

11. Should fluctuations in water pressure seriously interfere with regularity of the operation of the Still, it is advisable to purchase and install a Stokes constant head device, which will entirely eliminate the fluctuations. Instructions for attaching and operating are furnished with the device.

CONTAINERS

12. For most uses the distillate may be received in ordinary clean glass bottles or carboys. These may be set immediately beneath the distilled water outlet "Q" which can be bent to suit requirements. If the small amount of solids dissolved from the glass is objectionable, tin-lined copper storage tanks should be used. Containers made of Jena Glass or Pyrex or acid-proof stoneware are also sometimes used.

CLEANING

13. A deconcentrator or bleeder "J" is provided to keep down the concentration of impurities which accumulate in the boiling chamber as the distillation proceeds. As the water boils a small amount passes down through the tube and into the overflow. This amount automatically increases as the concentration increases. Trouble with foaming is usually eliminated entirely and the rate of scale formation is greatly

SUPPLEMENTARY INSTRUCTIONS
STOKES AUTOMATIC WATER STILL NO. 171-E.

NOTE: These instructions are to take the place of paragraphs of the corresponding numbers in our regular instruction sheet. Blueprint SK 171-16 shows new revised wiring diagram for improved heating element replacing Fig. 4 on the printed sheet.

CONNECTING ELECTRIC CURRENT (See photograph and B/P 171-16).

5. A competent electrician should hook up this apparatus.

For protection of the heating element all Stills are wired and shipped ready for operation on 220 volt current. For 110 volt current several simple changes must be made to the wiring at the terminals of the heating element as shown on the blueprint and described below. The current must be connected through fused switches.

For 220 volt current use 20 ampere fuses in the line and connect with No. 12 copper wire to terminals #16 and #17. Copper connectors should be soldered to the wire ends to insure a good contact.

For 110 volt current use 40 ampere fuses and connect the terminals #16 and #17 with No. 8 copper wire having copper connectors soldered to the wire ends. Wire #21 must be shifted from terminal #19 to the center of terminal #18, and terminals #17 and #19 must be joined with an insulated No. 8 copper wire or jumper, as shown in the blueprint. A suitable wire jumper for changing the Still for operation on 110 volt current is enclosed in the instruction envelope.

6. Do not switch on current until the boiling chamber is filled with water to the proper level.

SAFETY CUT-OUT (See blueprint SK 171-16).

7. A safety cut-out is contained in the terminal block of the heater and this operates when the element is over-heated, due either to lack of water or the accumulation of scale on the surface of the heating element. When such over-heating occurs the catch (24) moves outward and the two contacts spring apart breaking the circuit. The cut-out can be quickly reset by pushing on reset lever #22 which is accessible from the outside of the cap (11). A few minutes are necessary to allow for the heater and the cut-out to cool before resetting is possible. If the cut-out operates when the Still is running with the water in the boiling chamber at the normal level, it will be necessary to adjust the small screw (25) slightly. Turning this screw to the left with screw driver or small pliers or unscrewing it, allows the heater to run at a higher temperature without cutting off the current. When properly set this screw should be adjusted so that the cut-out operates when the water level is about 1/8" to 3/4" below the top of the heater.

SUPPLEMENTARY INSTRUCTIONS
STOKES AUTOMATIC WATER STILL NO. 171-E.

8. If the cut-out operates on account of the accumulation of scale this scale should, of course, be removed before putting the Still in operation again. See paragraph 14. The heating element can usually be cleaned in position in the Still. Should it be necessary to take it out, loosen the four screws in the flange (14) and remove the flange and cap, then list the element out. If gasket (15) is no longer servicable a new one should be inserted in its place when replacing the heater. When reassembling, paint each side of the gasket with standard shellac and alcohol mixture.

JAS/H
2/8/35
4/8/36

• Other Models Available

In addition to the new one-gallon still a complete line of laboratory and commercial stills (single and multiple effect) is available. Sizes ½ to 100 gallons per hour are carried in stock.

Storage tanks and automatic controls furnished, if desired.

Write for literature and quotations.

• Through Dealers or Direct

Stokes stills are available through dealers or direct.

FJSTOKES MACHINE COMPANY

Chemical Engineers and Equipment Manufacturers Since 1895

TABOR ROAD, OLNEY P. O., PHILADELPHIA, PA.

New York Office—103 Park Avenue

Los Angeles Office—1231 E. 7th Street

Chicago Office—307 N. Michigan Avenue

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Printed in U. S. A.

STOKES

444

New One Gallon Automatic Water Still

BULLETIN No. 171

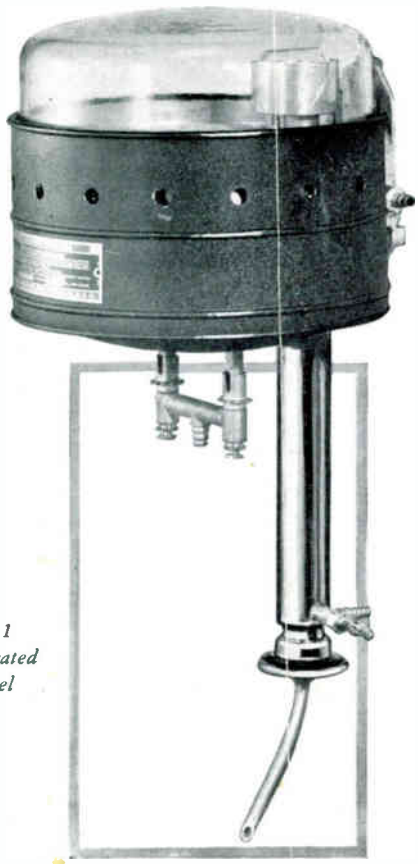


Fig. 1
Gas-Heated Model

THE new STOKES one-gallon Automatic Water Still has the following important features which safeguard the exceptional purity of the distillate as well as increase convenience and automatic operation:

★ PYREX GLASS COVER.
★ TRIPLE VAPOR BAFFLE.
★ SOLID BLOCK-TIN CONDENSER TUBE.
★★ GAS ELIMINATOR (Hot Well).
★★ DECONCENTRATOR or "BLEEDER" — Especially vital in hard water districts.
★ FUSE-PROTECTED HEATING UNIT — In electrically-heated still.

★ *Found solely in the new STOKES Still.*
★★ *Standard Equipment in the new STOKES Still.*

• Pyrex Glass Cover

THE dome covering the boiling chamber of this still is made of pyrex, which permits observation of the operation of the still at all times. It is easy to clean, is unaffected by heat and, when in place, rests on a rim beneath the water level of the boiling chamber so that it is "water-sealed." No gasket is necessary. No vapor or steam can escape from beneath it, yet it can be lifted off readily for cleaning.

• Triple Vapor Baffle

Figs. 2 and 3 show clearly the design of the triple vapor baffle which acts as an effective entrainment separator. It is made of heavy tinned copper and pyrex and forces the steam to reverse direction completely ***three*** times before it enters the condenser tube. Any entrainment is automatically returned to the boiling chamber beneath the water level.

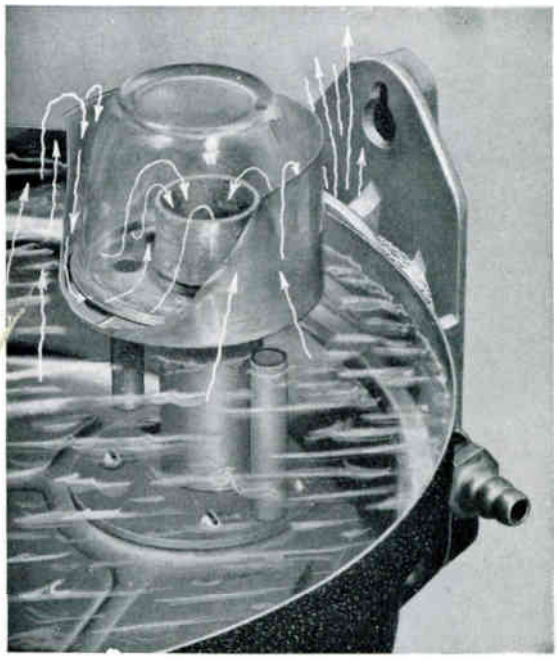


Fig. 2
Close-up view of Triple Vapor Baffle and Deconcentrator Pipe

• Solid Block-Tin Condenser Tube

The condenser tube is made of *solid* block-tin —not merely tin-coated. The funnel and tube which conduct the distillate to the container or storage tank are also solid block-tin.

• Gas Eliminator

This still is so designed that before the feed water enters the boiling chamber it is raised to a temperature approximating 212°. This hot water passes into an open hot well where the high temperature causes most of the dissolved gases and volatile impurities to escape before the actual distillation begins.

• Deconcentrator

Loss of efficiency and failure of any still to continue to produce pure water are results of scaling and foaming which are caused by impurities accumulating in the boiling chamber. In this still excessive foaming is prevented entirely and scaling is reduced to a minimum by a deconcentrator or "bleeding" device. As the water in the distilling chamber boils, a small amount, which increases with the tendency to foam, overflows and thus automatically prevents the accumulation of impurities.

This feature safeguards the exceptional purity of the distillate and lengthens the intervals at which cleaning is necessary. ***It is especially important when the still is to be used in a hard water district.***

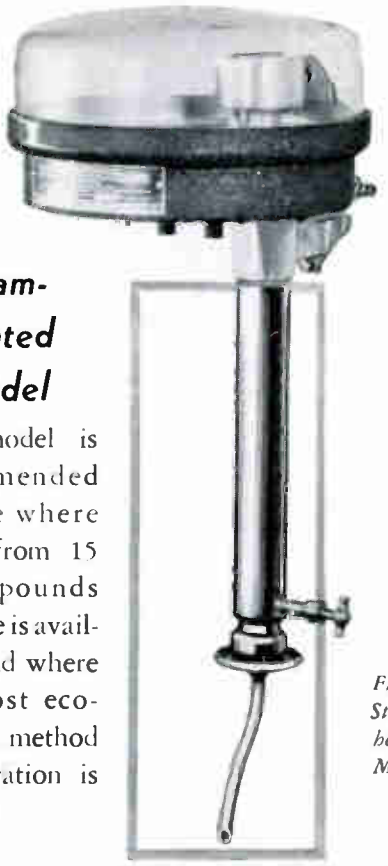


Fig. 4 Steam-heated Model

• Steam-Heated Model

This model is recommended for use where steam from 15 to 25 pounds pressure is available, and where the most economical method of operation is desired.

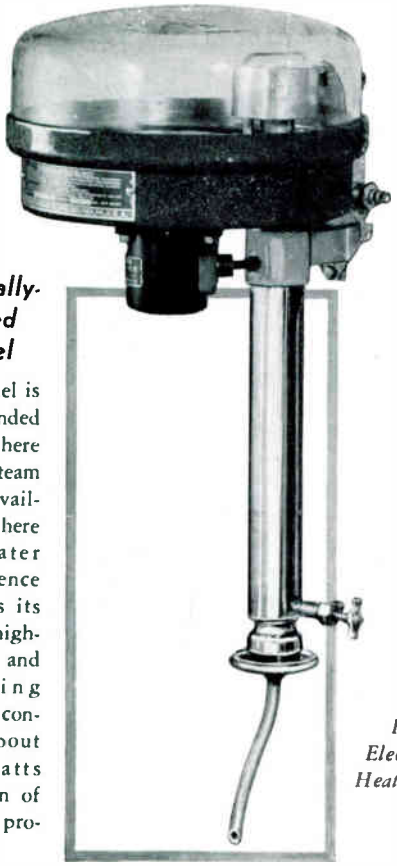
• Exceptional Purity of Distillate

As the analysis shows, the distillate produced by this still is of the highest quality. The residue of solids, for example, is only 0.28 parts per 100,000 while the U.S.P. standards allow 1 part per 100,000.

*Typical Analysis of Distillate

	Parts per 100,000
Total Solids	0.28
Volatile Solids	0.16
Inorganic Solids	0.12
Nitrogen as	
Free Ammonia	0.0035
Albuminoid Ammonia	0.0000
Nitrites	0.0000
Nitrates	0.0000
Chlorine	0.00
Dissolved Oxygen	0.06
Free Carbon Dioxide	0.12
pH Value at 20° C.	5.7
Total Bacteria per cc	None

*Made and certified by Arthur D. Little, Inc.



Electrically-Heated Model

This model is recommended for use where gas and steam are not available or where its greater convenience outweighs its slightly higher initial and operating costs. It consumes about 3 kilowatts per gallon of distillate produced.

Fig. 5 Electrically-Heated Model

• Fuse-Protected Heating Unit

The electrically-heated still has as standard equipment a new, patented, embedded type heating unit. This unit is exceptionally rugged. It has a large, easily cleaned heating area of low watt density which reduces its operating temperature and lengthens its life. A simple and inexpensive dual-purpose fuse, easily replaced, prevents damage to the heating element either from a shutting off of the water supply or, more important, from overheating due to the element's becoming heavily scaled. The fuse is controlled by temperature alone and does not carry any current.

• Other Features

Attractive Appearance. The copper basin of the steam and electric models, and the burner shield of the gas-heated still, have a black "crackle" finish. The condenser column and other exposed fittings are chromium plated, giving the still a permanent finish in keeping with modern laboratory standards.

Durability. The boiling chamber is made of extra heavy cold-rolled pure electrolytic copper drawn and ribbed for strength and rigidity and lined with a heavy coating of pure block-tin. The condenser column is also heavy copper, chromium plated, and the cover is Pyrex Glass.

Easy to Install and Operate. The still weighs only 18 to 32 pounds, depending on the model. It is easily assembled without special tools. Wall-bracket and floor-stand types are available. Rubber tubing can be used for gas and water connections if desired. Gas and water inlets and outlets are clearly marked. A needle valve facilitates adjustment of the raw water flow. Essential directions are found on the instruction plate.

Easily Cleaned. The Pyrex cover lifts off readily and exposes the entire boiling chamber for cleaning. All passages are also accessible.

Constant Water Level. The water level in the boiling chamber is constantly and automatically maintained by a visible weir overflow.

Special Gas Burners. Double gas burners of a new design afford easy regulation of gas and air. Burners are available for artificial gas, natural gas and mixtures, and are easily adjustable for variable pressure.

Interchangeable Parts. All parts are interchangeable so that replacements, if necessary, are inexpensively and easily made by the user. ***Meets Fire Underwriters' Requirements.***

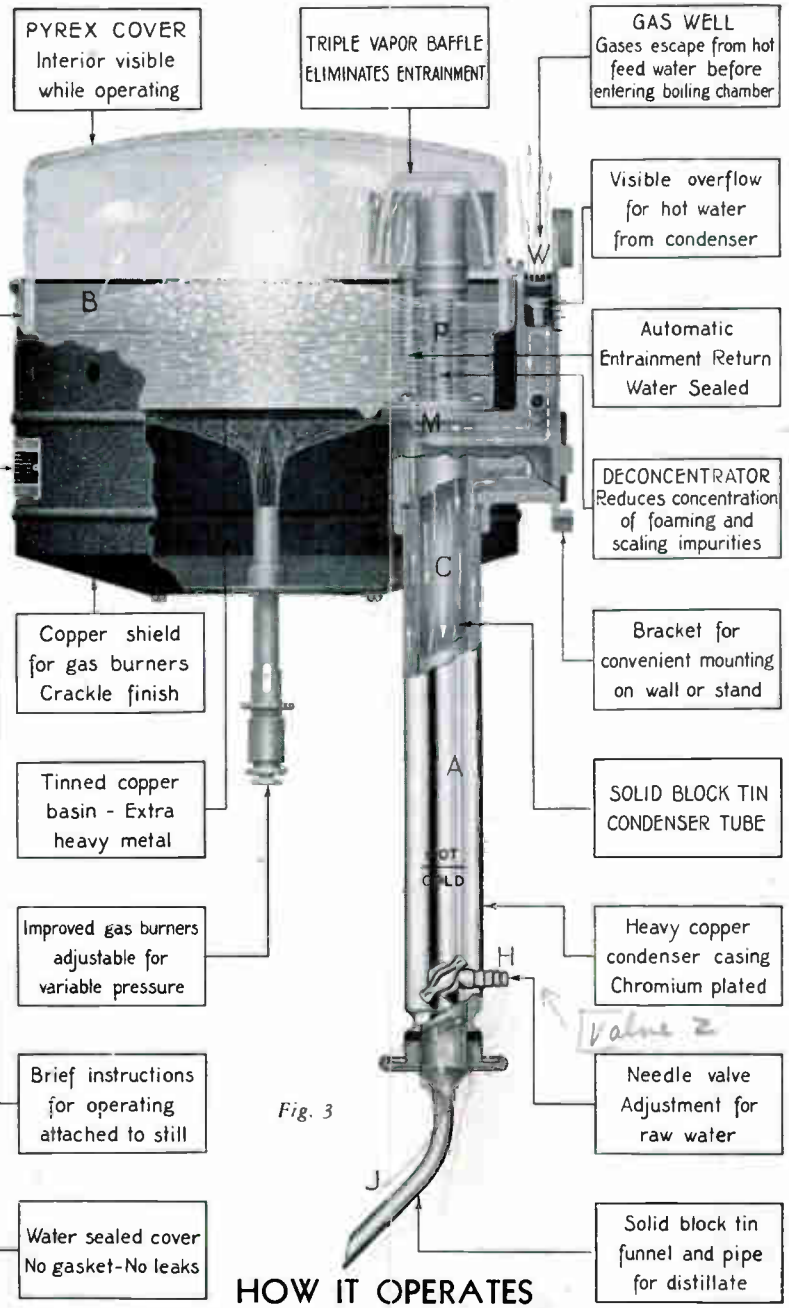


Fig. 3

HOW IT OPERATES

The feed water enters the still at "H" (see illustration) and rises around the condenser tube "C" in the condenser column "A." The water condenses the steam coming down the tube from the boiling chamber "B" and the resulting distilled water comes out at "J." As this steam condenses it serves to heat the raw water rising in "A" practically to 212° before it passes through the hot well into the boiling chamber. A portion of the feed water entering the still passes through passage "M" to maintain the level of the water in the boiling chamber and the remainder flows away through "E." Of the water entering the boiling chamber a small portion overflows into the deconcentrator pipe "P" and runs to waste.

•Floor-Stand Type

Standard Stills are of the wall-bracket type. The floor-stand type illustrated affords a most convenient method of mounting. It is designed to permit easy observation and cleaning and makes the still, stand and container a compact unit. The height of the still on the stand is adjustable.

• For Hospitals

For intravenous injections double distilled water of the highest quality can be produced by mounting two stills in tandem. These stills mounted with a special chromium-plated storage tank can be supplied as a self-contained unit which harmonizes in appearance with modern hospital requirements. Steam, gas and electrically-heated models are available.

• For Drug Stores

This still, besides insuring the quality of distilled water used for prescription work, enables the druggist to make "aqua distillata," an item of considerable profit. With this still the druggist can make his supply of distilled water for a few cents a gallon and sell it for use in radio and automobile batteries, for drinking purposes, for use by physicians, for household use, etc.

• Other Uses

Schools, institutions, hotels, garages, battery service stations, auto fleet owners, photographic studios and other users of distilled water will find this still well adapted to their needs for quantities within its capacity of one gallon per hour.

• Cost of Operation

The cost of operation is low. For a steam-heated still it is about ¼ cent per gallon; for a still heated by artificial gas between 2 and 3 cents per gallon, depending on the price of the gas; and for an electrically-heated still slightly more, depending on the local rate for electricity.

• Specifications and Prices

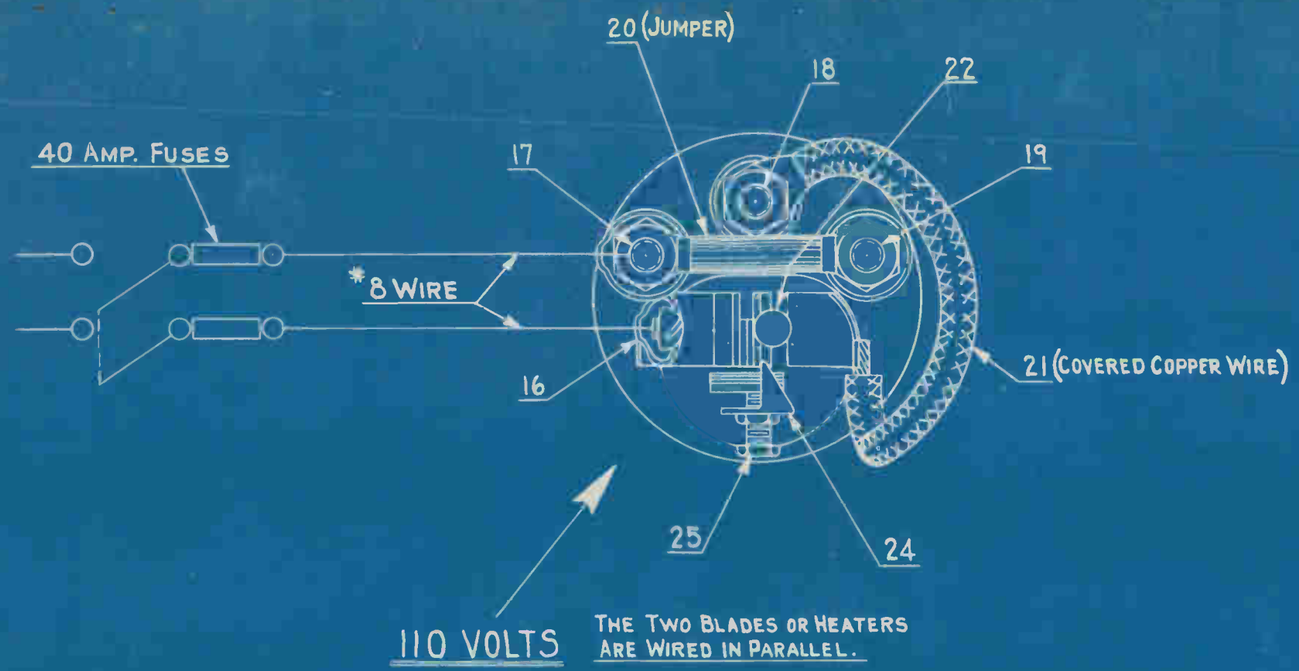
Number	Method of Heating	Height	Weights Net	Weights Boxed	Cu. Ft. Boxed	Prices
171 M	Man. Gas	30"	22 lbs.	29 lbs.	3⅓	$[illegible] 60.
171 N	Nat. Gas	30"	22 "	29 "	3⅓	[illegible] 60.
171 S	Steam	30"	18 "	27 "	3¼	[illegible] 65.
171 E	Electricity	30"	32 "	41 "	3¼	[illegible] 95.
Stand	———	4'	17 "	19 "	...	8.

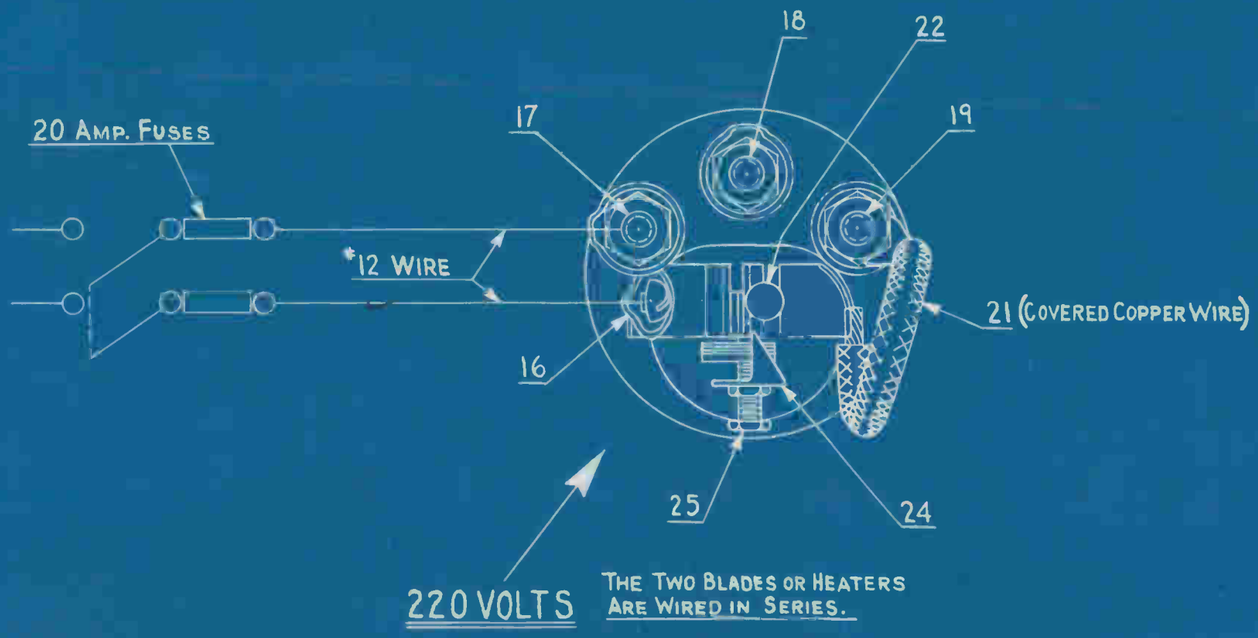
*Includes automatic protective device as standard equipment.
All prices for wall-bracket type; F. O. B. Philadelphia

All models consume about 8 gallons of feed water for each gallon of distilled water produced.

All stills are packed in cardboard cartons suitable for shipment by parcel post, express or freight. Complete instructions for assembling and operating accompany each still.

When ordering specify type wanted by number and letter as on page 11 and give voltage in addition if electric still is required.





WIRING DIAGRAM FOR ELECTRIC HEATER AND THERMAL CUTOUT.

ALTERATIONS			
A			
B			
C			
D			

THIS SKETCH SUPERSEDES SKETCH OF SAME NUMBER DATED 9-26-34

F. J. STOKES MACHINE CO.
PHILADELPHIA

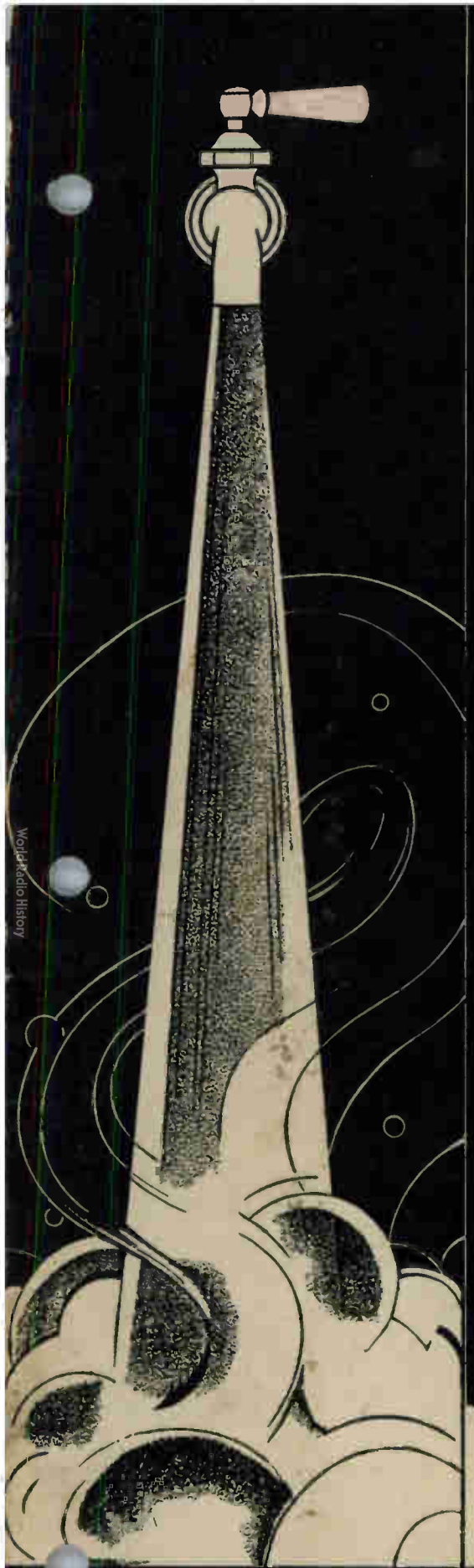
Drawn by E.A.SWOPE Checked by

Traced by J.F.K. Date 3-22-35

Scale FULL Order No.

Name WATER STILL

Sk. No. 171-16

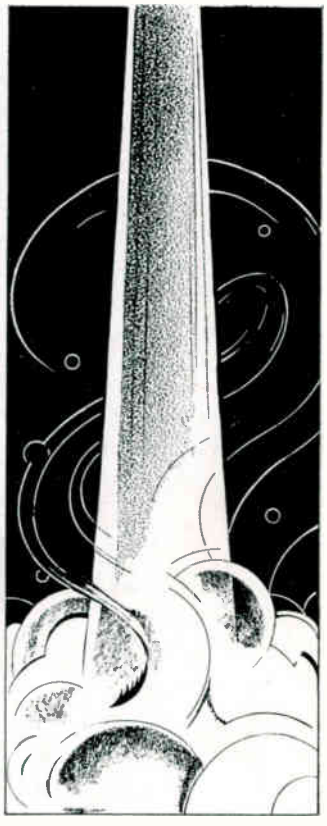


Westinghouse

Electric Water Heaters

Westinghouse

Electric Water Heaters



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WESTINGHOUSE ELECTRIC & MANUFACTURING CO.

Merchandising Department

Mansfield Works • • • Mansfield, Ohio

Westinghouse *Electric Water Heaters*

Westinghouse Electric Water Heaters are designed in types and sizes to meet every central station load condition and the great variety of applications required by home-owners and other users. The complete line includes storage tank heaters, strap-on heaters, and heaters of the side-arm circulation and immersion types. For the central station, Westinghouse Water Heaters make possible easy installation at low cost and quick servicing, if necessary. From the customer's point of view the complete line offers a selection of heaters, any one of which will always provide an ample supply of hot water economically, with minimum attention. Made of the finest materials available for the purpose and manufactured and factory-tested to the exacting standards of Westinghouse quality, these water heaters give long years of efficient, trouble-free service in all kinds of applications, when installed and operated as recommended.

The Complete Line

Storage Heaters—Westinghouse storage tank heaters are made in sizes ranging from 10 to 80 gallons. They are of three distinct types: Automatic, Adapt-o-matic, and Adjust-o-matic. The Automatic heater, in 10-, 30-, 52-, and 80-gallon sizes, has one heating element installed through the side at the bottom of the tank and is equipped with adjustable-automatic control. In the 18-gallon Automatic the heating element is installed through the bottom of the tank and Built-in Watchman thermostat controls at approximately 155° F. The Adapt-o-matic is available in 30-, 52-, and 80-gallon sizes. This heater has two heating elements, one of which is near the top of the tank, each separately controlled by an adjustable thermostat. The Adjust-o-matic heater, with a capacity of 18 gallons, may be controlled at 180°, 155°, and 135° by turning the switch to high, medium, or low. Westinghouse Heaters of the storage type may be operated with or without time-switch control.

Side-Arm Circulation Heaters—are of two types, automatic and non-automatic. The CA heater is automatic and comes equipped with a three-temperature control. The CX heater is non-automatic but is equipped with a standard 3-heat switch. Casings can be supplied for DX heaters.

Immersion Heaters—The DX and CX immersion heaters, without casing, in capacities ranging from 600 to 6000 watts, are available for range boiler and special tank installations, meeting the varied requirements for commercial and industrial applications as well as hot water needs in the home.

Strap-on Heaters—These heaters are designed to convert standard range boilers to automatically-controlled electric storage-type water heaters. They are easy to install. With an asbestos cover, these heaters provide efficient service with minimum heat loss through radiation.

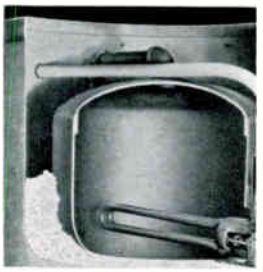
Thermal Regulators—Westinghouse thermal regulators are an efficient, economical means of controlling automatically, by Built-in Watchman thermostat, the temperature of circulation and immersion heaters of the non-automatic type.

Features of Design and Construction

Corox Heating Element—Corox heating elements are manufactured by an exclusive Westinghouse process that assures a longer, more efficient life. The heating coil is within a seamless copper tubing and insulated from it by crystalline magnesium oxide, an excellent insulator and heat conductor. The element heats to a temperature slightly higher than that of the water in which it is immersed. It expands and contracts slightly in operation, flaking off scale formations.

Thermostat—The Spencer thermostat, the Built-in Watchman, is designed for both adjustable and non-adjustable temperature control and automatically safeguards Westinghouse Heaters in emergencies. On the adjustable type, a convenient lever allows for heat regulation within temperatures of approximately 130° and 190° F. This exclusive Westinghouse heat control has established an enviable record for satisfactory, trouble-free performance through years of service on all kinds of heating

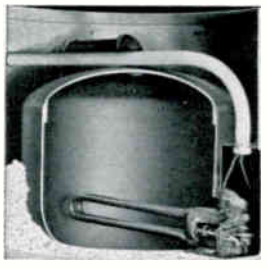
appliances for the home. It has the fastest make and break of any thermostat on the market today. In action on electric water heaters, the Built-in Watchman control breaks the circuit at six points, thereby minimizing arcing and eliminating radio-interference.



Insulation—All Westinghouse storage tank heaters are protected against heat losses with high quality balsam wool insulation. The low heat transfer, low moisture absorption, light weight, and resilient characteristics of this material make it ideal for insulating water heaters. Moreover, balsam wool contains no life-giving properties attractive to rodents or vermin.

Low Conduction Heat Losses—In Westinghouse Water Heaters every precaution is employed to minimize conducted heat losses. The inner tank or water chamber is securely fastened to the base and legs through wood blocks. Heat losses occurring where pipe connections and outer casing meet on ordinary heaters, are minimized through the application of fibre washers.

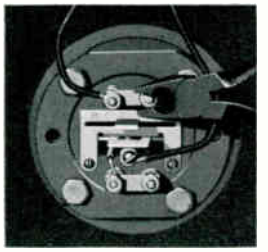
Heat Trap—Heat losses from circulation of hot water within the pipe are greatly reduced because of the heat trap built into the hot water outlet pipe. By constructing one-half of this trap within the casing, it is impossible to omit this essential part when the storage tank is connected to the hot water system.



Wiring and Connections—All wiring and connections are made and tested to meet the stringent specifications of the National Board of Fire Underwriters. Within the casing, all wire is protected by rigid conduit and special switch box construction around the heater terminals. Each element is separately wired. The wire is of the impregnated asbestos, slow-burning type recommended by Westinghouse experts and other electrical authorities. For ease in making line connections, a standard 3¼-inch outlet box is attached on the back of the heater near the top.

Cold Water Baffle—Westinghouse storage tank heaters are constructed with an effective cold water baffle to eliminate excessive mixing of cold and hot water when cold water enters the tank. This feature adds materially to the efficiency of the unit.

SERVICING: *Heaters*—The special flange construction employed in Westinghouse storage tank and CA heating units has a decided advantage over the "screw in" method used on ordinary electric water heaters. This feature makes possible a change of heating elements with maximum speed and minimum of labor. *Thermostats*—The Built-in Watchman thermostat on the storage tank models is readily accessible by removing the heater cover plate. It may be changed or removed without inconveniencing the user by interrupting the hot water service.



Variable Wattage Feature—Each heating element in Westinghouse storage tank heaters, with the exception of the eighteen-gallon type, permits wattage adjustments from the rated wattage by connecting the two heater hairpins of each heating element in series or multiple or leaving one heater hairpin disconnected. Thus adaptation to specific requirements—¼-, ½-, or full-rated wattage—may be obtained as desired.

Finished in Durable Cordovan—All storage tank heaters in the Westinghouse line, except the eighteen-gallon sizes, are finished in ivory and grey Cordovan. This finish has all the desirable qualities of enamel, lacquer, and varnish and can be cleaned easily and quickly with a soft damp cloth.

Heaters Easily Convertible—The 30-, 52-, and 80-gallon Westinghouse storage tanks may be converted from Automatic or single-heater tanks to two-unit Adapt-o-matic type by installing an additional unit near the top, if such is desired.

Constructed for Maximum Safety—Westinghouse tank-type heaters have the patented feature of construction that makes it possible to install the thermostat in the head of the heating element. This design provides an extra safeguard against burn-outs should the tank be temporarily operated without water. This exclusive Westinghouse development also minimizes the possibility of the thermostat being "grounded" or "shorted" out of the circuit with the heating element remaining in the circuit.

10-GALLON . . . . *Automatic*

Type AU

This complete tank heater has one Corox heating element, at the bottom of the tank, controlled by the famous Built-in Watchman adjustable-automatic thermostat, at temperatures of approximately 130 to 190 degrees. The heating element and thermostat are inserted through the side near the bottom—easily accessible for thermostat adjustment and for servicing, if necessary. All piping and wiring connections are at the back of the heater. A built-in U trap in the hot water line prevents circulation of water in the pipe. Thick balsam wool insulation provides efficient protection against heat losses. Durable Cordovan finishes, in ivory and grey, give this heater lasting beauty.

The 10-gallon Automatic is ideal for intermittent operation. In small bungalows, summer camps, roadside stands, gas stations, and so on, where only small quantities of hot water are required, this heater provides efficient and reliable service.

SPECIFICATIONS

Catalog Number	Capacity Gallons	Wattage	Voltage	Overall Dimensions Height	Overall Dimensions Diameter	Insulation Top	Insulation Side	Insulation Bottom	Shipping Wt. Lbs.
AU-128	10	3000	230	34¾″	18¾″	1″	3″	3¾″	155

The 10-gallon Automatic can be supplied with copper tank and brass fittings, on special order. Heater elements of special wattage and voltages are also available on special order. Prices on request.

All Westinghouse hot water tanks are rated at 250 pound test pressure. All pipe connections ¾″.

For maximum safety, an approved relief valve should be included on every water heater installation. Consult your local plumbing inspector or electric service company.

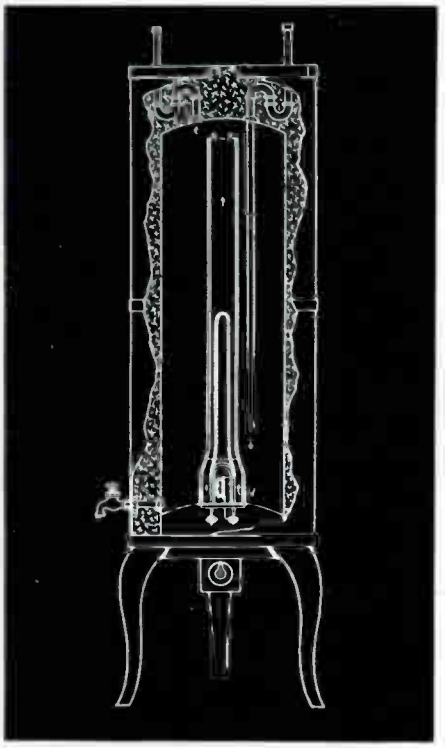
18-GALLON . . . *Adjust-o-matic*

Type WT

This Adjust-o-matic heater provides hot water at approximately 180° F. on "high," 155° F. on "medium," and 135° F. on "low" through a snap switch attached to the base. Once the switch is set, no further attention is required as the Built-in Watchman thermostat automatically controls the water temperature. The heating element is inserted through the bottom of the tank and is surrounded by an internal circulation tube. Both hot and cold water pipes have built-in U traps to minimize circulation in the pipe. Thick insulation on top and sides of the tank seal in the heat. The tank is finished in attractive grey lacquer, with all exposed metal parts heavily nickeled. A convenient drain cock is installed near the base of the heater.

Automatic

The 18-gallon Automatic is of the same construction and design as the Adjust-o-matic, except that water is provided at only one temperature, approximately 155° F. A single-heat switch is provided for manual operation.



SPECIFICATIONS

Adjust-o-matic

Catalog Number	Capacity Gallons	Wattage	Voltage	Overall Height	Dimensions Diameter	Insulation Top	Insulation Sides	Shipping Wt. Lbs.
WT-38	18	3000	240	*72″	19″	5″	3″	302
WT-58	18	5000	240	*72″	19″	5″	3″	302

Automatic

Catalog Number	Capacity Gallons	Wattage	Voltage	Overall Height	Dimensions Diameter	Insulation Top	Insulation Sides	Shipping Wt. Lbs.
WT-138	18	3000	240	*72″	19″	5″	3″	302
WT-158	18	5000	240	*72″	19″	5″	3″	302

*Including 18″ legs illustrated on this page.

This 18-gallon model can be supplied with copper tank and brass fittings, on special order. Heater elements of special wattage and voltage are also available on special order. Prices on request.

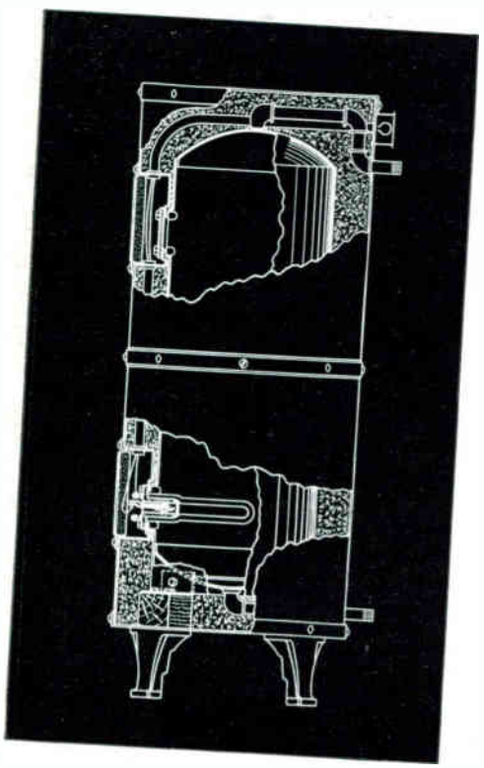
All Westinghouse hot water tanks are rated at 250 pound test pressure. All pipe connections ¾″.

For maximum safety, an approved relief valve should be included on every water heater installation. Consult your local plumbing inspector or electric service company.

30-GALLON . . . . Automatic

Type AU

The 30-gallon Automatic provides a complete electric water heating service. It is equipped with an immersion-type Corox heating element, automatically controlled by Built-in Watchman thermostat. This thermostat is adjustable to provide a selection of temperatures ranging from approximately 130° F. to 190° F. As a safeguard against circulation of hot water in the pipe, a built-in heat trap is provided in the hot water outlet pipe. The force of the incoming cold water is broken by an efficient baffle at the bottom of the tank, thus minimizing the mixing of hot and cold water. Thoroughly insulated with the highest grade balsam wool and finished in ivory and grey Cordovan, this heater combines efficiency and economy with beauty.



SPECIFICATIONS

Catalog Number	Capacity Gallons	Wattage	Voltage	Overall Dimensions Height	Diameter	Insulation Top	Side	Bottom	Shipping Wt. Lbs.
AU-408	30	1000	230	60⅛″	20¾″	4″	3″	4″	298
AU-418	30	1500	230	60⅛″	20¾″	4″	3″	4″	298
AU-428	30	2000	230	60⅛″	20¾″	4″	3″	4″	298

The 30-gallon storage heater can be supplied with copper tank and brass fittings, on special order. Heating elements of special wattage and voltage are also available on special order. Prices on request.

All Westinghouse water tanks are rated at 250 pound test pressure. All pipe connections ¾″.

For maximum safety, an approved relief valve should be included on every water heater installation. Consult your local plumbing inspector or electric service company.

The cut-away view at the left shows the construction of the Automatic. Note the thickness of the balsam wool insulation and the location of the heating element near the bottom of the tank.

30-GALLON . . . *Adapt-o-matic*

Type AD

The 30-gallon Adapt-o-matic storage heater embodies all the features found in the Automatic type, plus a second Corox heating element near the top of the tank. This extra element provides more rapid recuperation than is found in the 30-gallon Automatic. Each heating element of the Adapt-o-matic is equipped with an adjustable thermostat, the world-famous Built-in Watchman control. This thermostat may be adjusted easily and quickly to obtain water temperatures ranging from approximately 130° F. to 190° F. by shifting from right to left a convenient little lever that protrudes from the heating element mounting. The finish is beautiful lasting ivory Cordovan with grey trim.

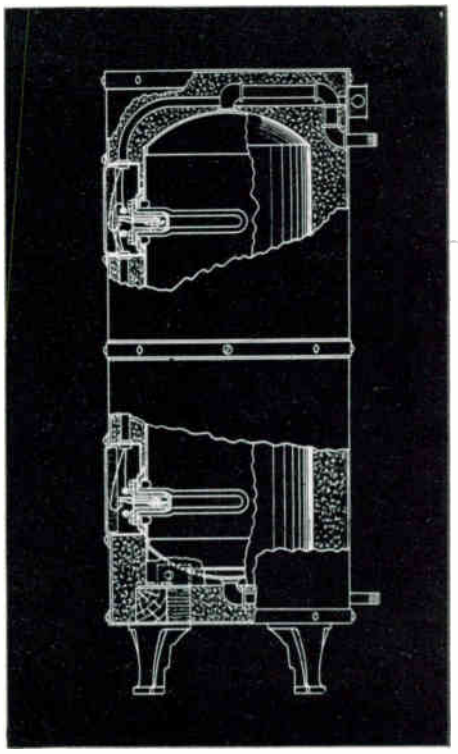
SPECIFICATIONS

Catalog Number	Capacity Gallons	Wattage Bottom	Wattage Top	Voltage	Overall Dimensions Height	Overall Dimensions Diameter	Insulation Top	Insulation Side	Insulation Bottom	Shipping Wt. Lbs.
AD-518	30	500	1000	230	60⅛″	20¾″	4″	3″	4″	300
AD-528	30	500	1500	230	60⅛″	20¾″	4″	3″	4″	300
AD-538	30	750	1500	230	60⅛″	20¾″	4″	3″	4″	300
AD-548	30	1000	1000	230	60⅛″	20¾″	4″	3″	4″	300
AD-558	30	1000	1500	230	60⅛″	20¾″	4″	3″	4″	300

The 30-gallon storage heater can be supplied with copper tank and brass fittings, on special order. Heating elements of special wattage and voltage are also available on special order. Prices on request.

All Westinghouse water tanks are rated at 250 pound test pressure. All pipe connections ¾″.

For maximum safety, an approved relief valve should be included on every water heater installation. Consult your local plumbing inspector or electric service company.

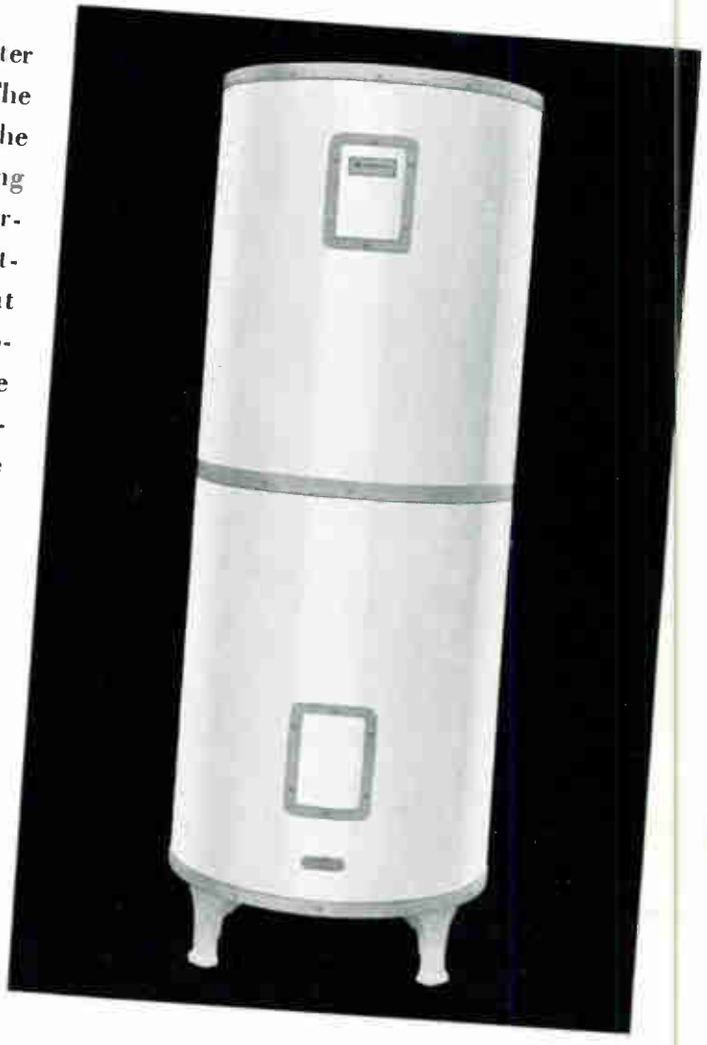


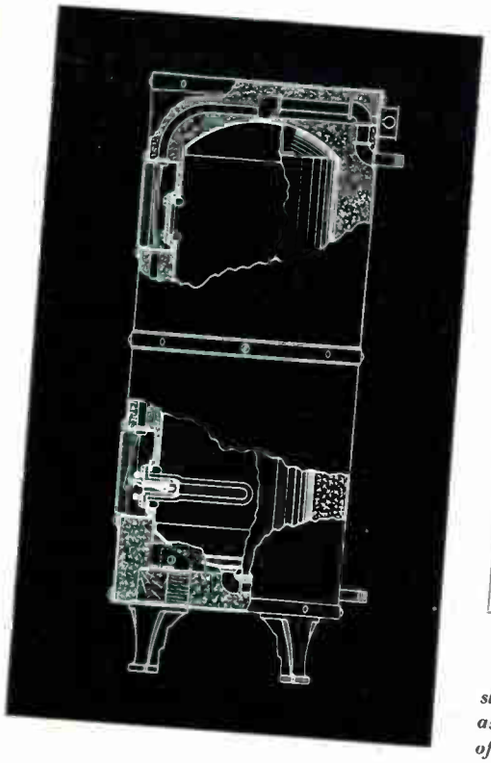
The illustration at the right shows the position of the heating elements in the Adapt-o-matic. The U trap at the top prevents circulation of hot water within the hot water pipe.

52-GALLON . . . . Automatic

Type AU

The 52-gallon Westinghouse Automatic heater is well-adapted for controlled service. The Corox heating element is inserted through the side near the bottom. This patented heating element expands and contracts slightly in operation, flaking off scale formations. An adjustable-automatic Built-in Watchman thermostat permits heat control at temperatures from approximately 130° to 190° F. Easily removable cover plates minimize the time and labor necessary to set the thermostats for the temperature desired. Complete insulation is effected by the use of balsam wool at top, sides, and bottom. The 6-inch cast iron legs are fastened through wood blocks to insulate the inner tank from the base and reduce conducted heat losses. Finished in durable ivory and grey Cordovan for greater beauty.





SPECIFICATIONS

Catalog Number	Capacity Gallons	Wattage	Voltage	Overall Dimensions Height	Diameter	Insulation Top	Side	Bottom	Shipping Wt. Lbs.
AU-608	52	1000	230	61¼″	26¾″	4½″	4″	4¼″	406
AU-618	52	1500	230	61¼″	26¾″	4½″	4″	4¼″	406
AU-628	52	2000	230	61¼″	26¾″	4½″	4″	4¼″	406

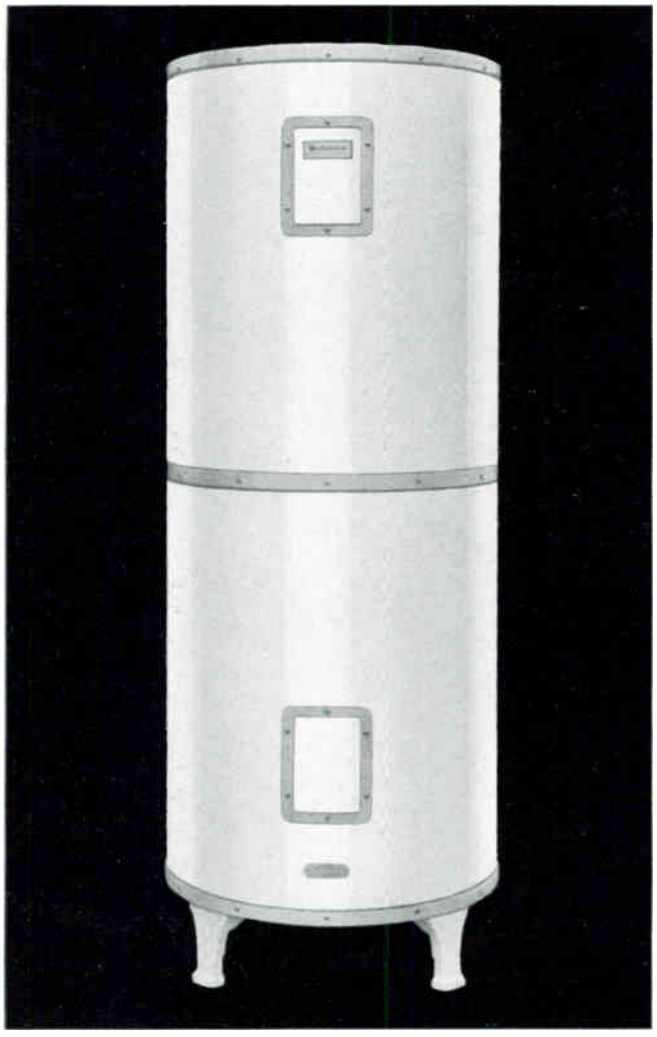
The 52-gallon storage heater can be supplied with copper tank and brass fittings, on special order. Heating elements of special wattage and voltage are also available on special order. Prices on request.

All Westinghouse hot water tanks are rated for 250 pound test pressure. All pipe connections ¾″.

For maximum safety, an approved relief valve should be included on every water heater installation. Consult your local plumbing inspector or electric service company.

Rigid conduit incases the wiring inside the Westinghouse storage tank heaters. The wire itself is of the impregnated asbestos, slow-burning type approved by the National Board of Fire Underwriters.

52-GALLON . . . *Adapt-o-matic*



Type AD

This storage heater is exactly like the 52-gallon Automatic except that faster heat recovery is provided by a second Corox heating element inserted through the side near the top. Exclusive Westinghouse Built-in Watchman thermostat control with an adjustable feature makes possible a selection of water temperatures ranging from approximately 130° F. to 190° F. The heater cover plates are easily removable by releasing six sheet metal screws. Only two screws contact the conduit box, thus minimizing conducted heat losses. The heater can be used on continuous or controlled service, as desired. Cordovan finishes of ivory and grey add a note of distinctive beauty that is much appreciated no matter where the Adapt-o-matic is installed.

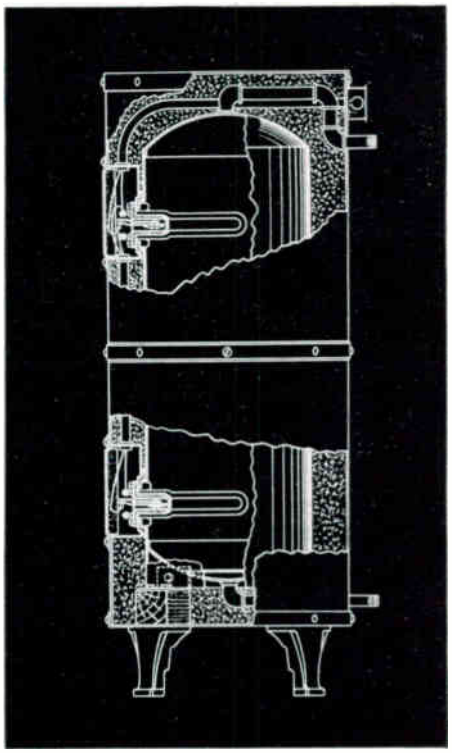
SPECIFICATIONS

Catalog Number	Capacity Gallons	Wattage Bottom	Wattage Top	Voltage	Overall Dimensions Height	Overall Dimensions Diameter	Insulation Top	Insulation Side	Insulation Bottom	Shipping Wt. Lbs.
AD-718	52	500	1000	230	61¼″	26¾″	4½″	4″	4¼″	408
AD-728	52	500	1500	230	61¼″	26¾″	4½″	4″	4¼″	408
AD-738	52	750	1500	230	61¼″	26¾″	4½″	4″	4¼″	408
AD-748	52	1000	1000	230	61¼″	26¾″	4½″	4″	4¼″	408
AD-758	52	1000	1500	230	61¼″	26¾″	4½″	4″	4¼″	408
AD-768	52	1000	2000	230	61¼″	26¾″	4½″	4″	4¼″	408

The 52-gallon storage heater can be supplied with copper tank and brass fittings, on special order. Heating elements of special wattage and voltage are also available on special order. Prices on request.

All Westinghouse hot water tanks are rated at 250 pound test pressure. All pipe connections ¾″.

For maximum safety, an approved relief valve should be included on every water heater installation. Consult your local plumbing inspector or electric service company.

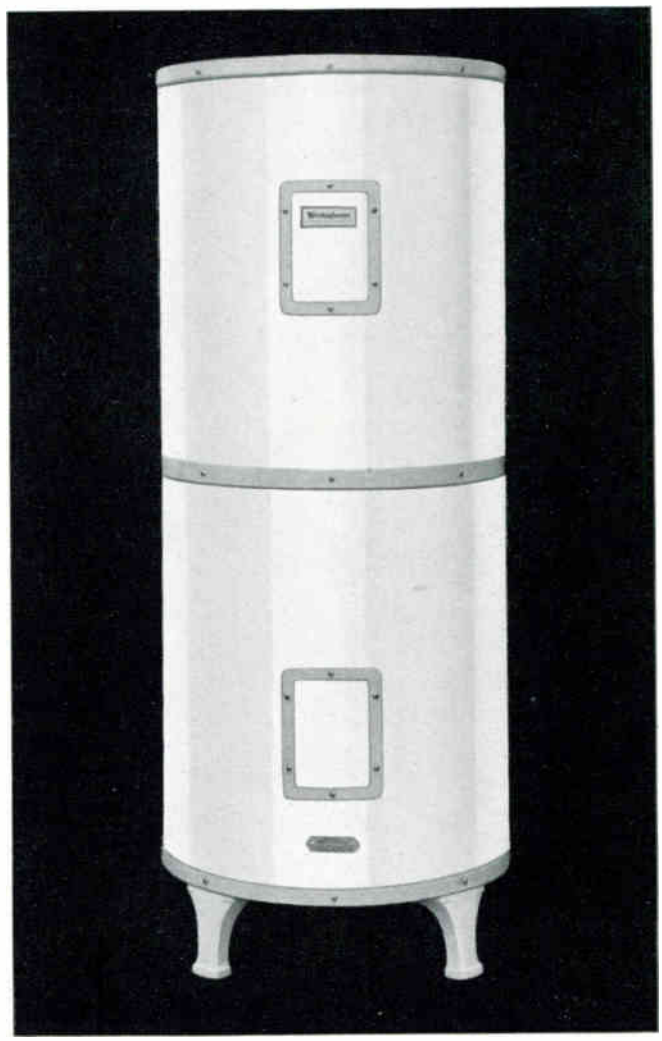


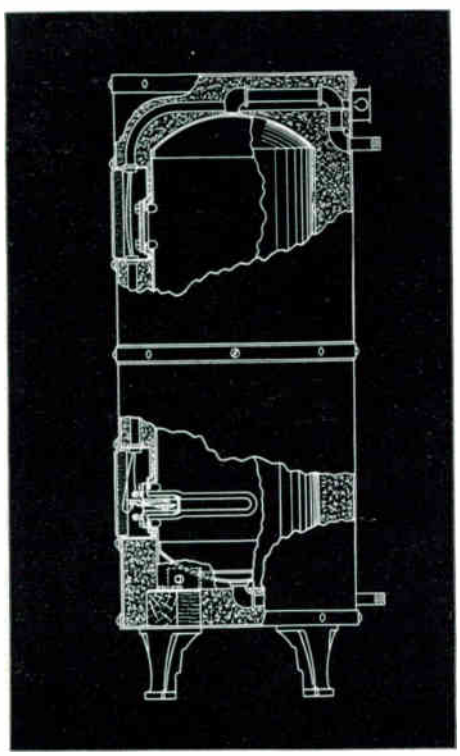
The design and construction of Westinghouse storage heaters makes it possible to keep hot water available for hours after the current has been shut off.

80-GALLON . . . . *Automatic*

Type AU

The 80-gallon Westinghouse storage heater is recommended for use where a large volume of hot water must be available at all times. The tank can be operated automatically at temperatures ranging from approximately 130° to 190° F. The unit is suitable for continuous or controlled service, as desired. All wiring within the outer casing is of the impregnated asbestos, slow-burning type, protected by rigid conduit. The heating element terminals are housed in a 16-gauge steel conduit box. In addition to thick balsam wool insulation at top, sides, and bottom, the water tank is still further safeguarded against heat losses by wood block insulators at the base. The finish is beautiful durable ivory and grey Cordovan like that used on the other tanks in this group.





The Corox heating element in the Automatic is inserted through the side near the bottom of the tank.

SPECIFICATIONS

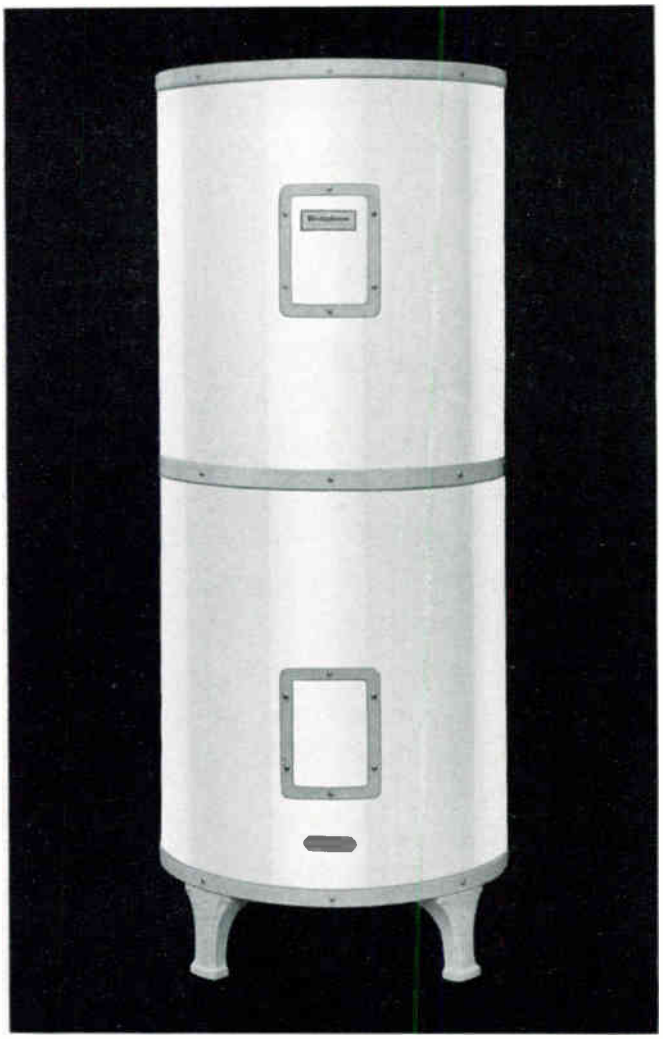
Catalog Number	Capacity Gallons	Wattage	Voltage	Overall Dimensions Height	Diameter	Insulation Top	Side	Bottom	Shipping Wt. Lbs.
AU-818	80	3000	230	75″	28¾″	4½″	4″	4¼″	598

The 80-gallon storage heater can be supplied with copper tank and brass fittings, on special order. Heating elements of special wattage and voltage are also available on special order. Prices on request.

All Westinghouse hot water tanks are rated at 250 pound test pressure. All pipe connections ¾″.

For maximum safety, an approved relief valve should be included on every water heater installation. Consult your local plumbing inspector or electric service company.

80-GALLON . . . *Adapt-o-matic*



Type AD

Like the 30- and 52-gallon Adapt-o-matic Storage Heaters, this 80-gallon model has two heating elements and two adjustable Built-in Watchman thermostats that control the water temperature from approximately 130° to 190° F. Adjustment is made easily and quickly by moving a convenient little lever that extends through the end of the heating element. The hot water outlet pipe and fittings are hot galvanized. The pipe comes directly off the top of the tank, thus delivering the hottest water at all times. The pleasing design of the heater is augmented by ivory and grey Cordovan finish. Its speedy recuperating power makes the 80-gallon Adapt-o-matic particularly useful where large quantities of hot water must be on hand constantly.

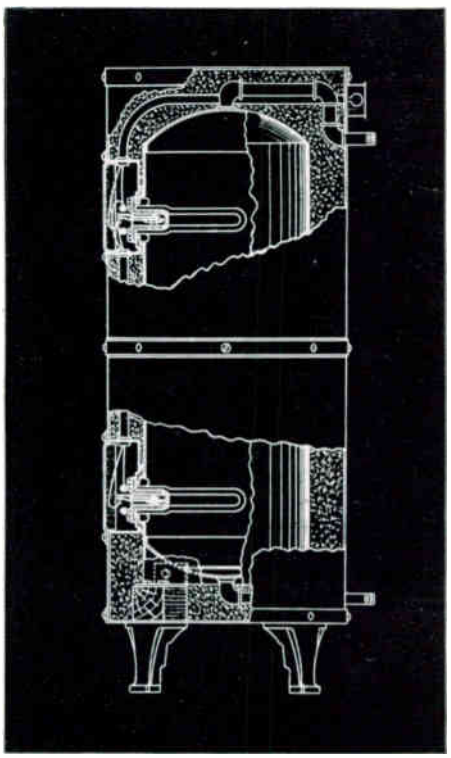
SPECIFICATIONS

Catalog Number	Capacity Gallons	Wattage Bottom	Wattage Top	Voltage	Overall Height	Dimensions Diameter	Insulation Top	Insulation Side	Insulation Bottom	Shipping Wt. Lbs.
AD-878	80	3000	1500	230	75″	28¾″	4½″	4″	4¼″	604

The 80-gallon storage heater can be supplied with copper tank and brass fittings, on special order. Heating elements of special wattage and voltage are also available on special order. Prices on request.

All Westinghouse hot water tanks are rated at 250 pound test pressure. All pipe connections ¾″.

For maximum safety, an approved relief valve should be included on every water heater installation. Consult your local plumbing inspector or electric service company.



All water and electrical connections can be made quickly and with a minimum of labor as the piping and outlet box are exposed at the back of the heater.

Side-Arm CIRCULATION HEATERS

Type CA

Side-arm circulation heaters are attached to the side of a storage tank. Water circulates from the tank, through the heater and back to the tank. The CA side-arm circulation heater offers a selection of three temperatures, approximately 180°, 155°, 135°, by turning the conveniently located switch button to high, medium, or low. The temperature is controlled automatically by a Built-in Watchman thermostat specially adapted for this unit. Designed for automatic or manual operation, this heater provides efficient, trouble-free water heating service wherever installed. A drain plug at the bottom of the unit permits removal of sediment with a minimum amount of labor. The CX heater with three-heat switch and casing (listed on page 13) is available for non-automatic side-arm heater applications.

SPECIFICATIONS

Catalog Numbers	Wattage	Voltage	Distance Between Pipe Connections	Overall Length	Shipping Wt. Lbs.
CA-24	2000	120	13¼″	25″	35
CA-28	2000	240	13¼″	25″	35
CA-44	3000	120	18¼″	30″	38
CA-48	3000	240	18¼″	30″	38
CA-88	5000	240	29½″	41¼″	47

Equipped for ¾″ pipe connections.

(See CX and DX Heaters on page 13.)

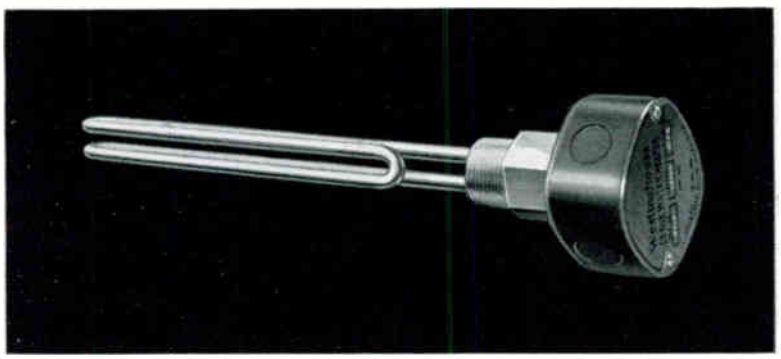
The CA side arm heater shown at the right can be installed as illustrated above. It is finished in buffed nickel for attractive appearance.

IMMERSION HEATERS

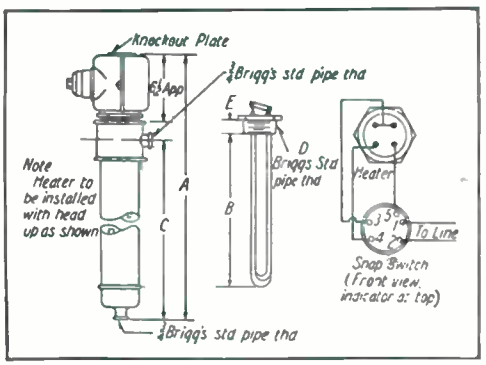
Types CX and DX

Westinghouse CX and DX heaters without switch or casing are available in wattages ranging from 600 to 6000. The DX model is designed for one-inch pipe connection. Casings can be supplied for DX heaters, if desired. CX heaters are supplied with two-inch pipe thread head casting. When inserted in range boilers or special tanks, these heaters provide efficient, reliable heating. Both are used extensively in commercial and industrial applications for heating non-corrosive liquids as well as water.

CX heater with and without switch and casing.



The DX heating element.



SPECIFICATIONS

CX Heaters With Switch and Casing

Catalog Numbers 120 volts	Catalog Numbers 240 volts	Wattage	Dimensions (see drawing) A	Dimensions (see drawing) C	Shipping Wt. Lbs.
CX-214	CX-218	2000	26⅛″	18″	22
CX-4	CX-8	2500	30⅛″	22″	24
CX-64	CX-68	3500	35⅛″	27″	25
	CX-128	4500	39¾″	31⅝″	30
	CX-188	6000	48″	39⅞″	35

CX Heaters Without Switch or Casing

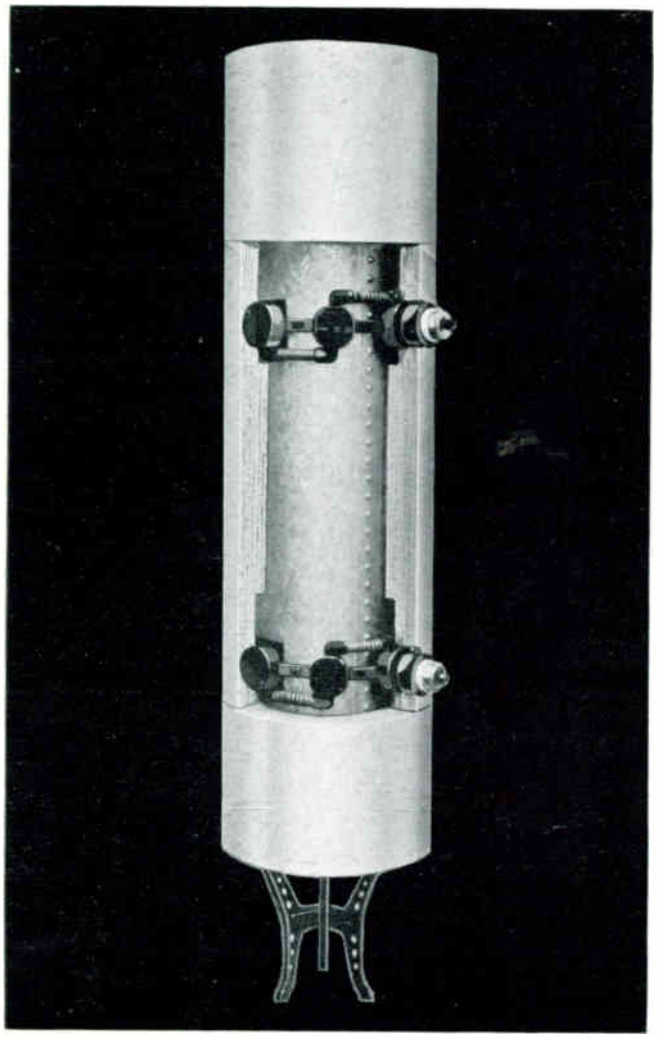
Catalog Numbers 120 volts	Catalog Numbers 240 volts	Wattage	Dimensions (see drawing) B	Dimensions (see drawing) D	Dimensions (see drawing) E	Shipping Wt. Lbs.
CX-234	CX-238	2000	13⅞″	2″	1¼″	6
CX-24	CX-28	2500	16⅞″	2″	1¼″	7
CX-84	CX-88	3500	23⅜″	2″	1¼″	9
	CX-148	4500	27⅞″	2″	1¼″	9
	CX-208	6000	36⅞″	2″	1¼″	12

DX Heaters

Catalog Numbers 120 volts	Catalog Numbers 240 volts	Wattage	Tube Length	Pipe Thread	Shipping Wt. Lbs.
DX-4	DX-8	600	9 13/16″	1″	4
DX-14	DX-18	750	9 13/16″	1″	4
DX-24	DX-28	1000	9 13/16″	1″	4
DX-44	DX-48	1500	11½″	1″	4½

(Casings can be supplied for DX heaters.)

STRAP-ON HEATERS



Type SA Automatic

Strap-on heaters are designed for installation on existing water tanks and are applicable for standard 30-gallon range boiler* of 12-inch diameter. They have the advantage of providing a completely automatic electric hot water service at a very low initial cost. The complete installation consists of two 1000-watt heating elements, with mounting clamps and automatic thermostatic control,† and an asbestos cover, properly cut to receive the heaters. The terminals are in outlet boxes, one of which serves as a switch support. An "on-and-off" switch is mounted on each heating unit so that the switch projects through the tank covering, providing easy manual control of the heater, and providing for conduit or BX connections to the service line. The illustration at the left shows a typical installation, with the tank cover cut away to show the arrangement and location of the heaters.

*SA Heater can be applied to range boiler of 14-inch diameter. Special asbestos covers and clamping straps can be supplied for 14-inch boiler on special order.

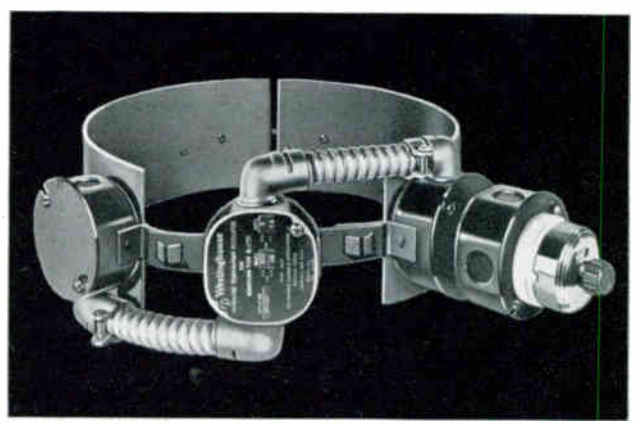
†Not supplied with SB Heaters.

SPECIFICATIONS

Catalog Numbers	Wattage	Voltage	Shipping Wt. Lbs.
SA-23	1000	110	19
SA-26	1000	220	19
SB-23 (Non-automatic)	1000	110	19
SB-26 (Non-automatic)	1000	220	19

Asbestos tank cover, S#590339 for use with SA and SB heaters on 30-gallon 12-inch diameter range boilers.

For maximum safety, an approved relief valve should be included on every water heater installation. Consult your local plumbing inspector or electric service company.



View of the Strap-on Heater Unit, showing connections, terminal boxes, thermostat mounting and method of mounting switches.

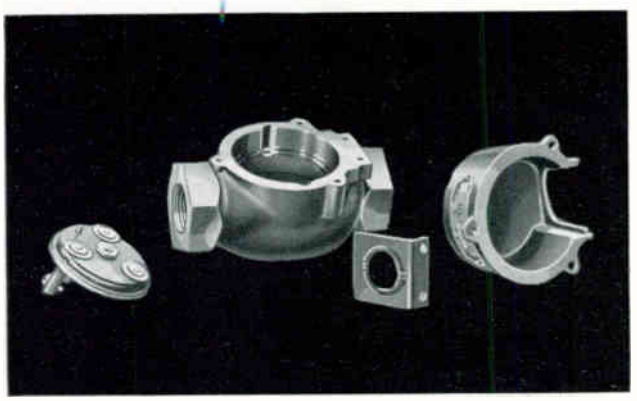
TEMPERATURE CONTROLS

RG-10 and RG-30 Automatic Thermal Regulators

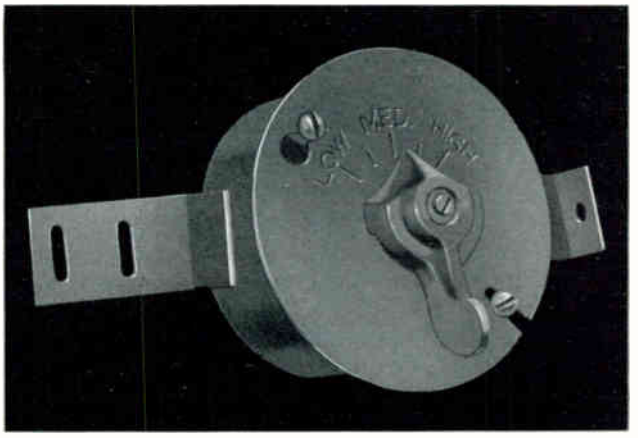
These thermal regulators are non-adjustable Built-in Watchman thermostats designed for installation in the hot water pipe line directly above the non-automatic heater to be controlled. They are set to keep the water temperature at approximately 160° F. when installed in accordance with instructions packed with each regulator. No attempt should be made to change the setting, as Westinghouse cannot guarantee satisfactory operation of the unit at temperatures other than approximately 160° unless adjustment is made at the factory.

Strap-on Thermostats

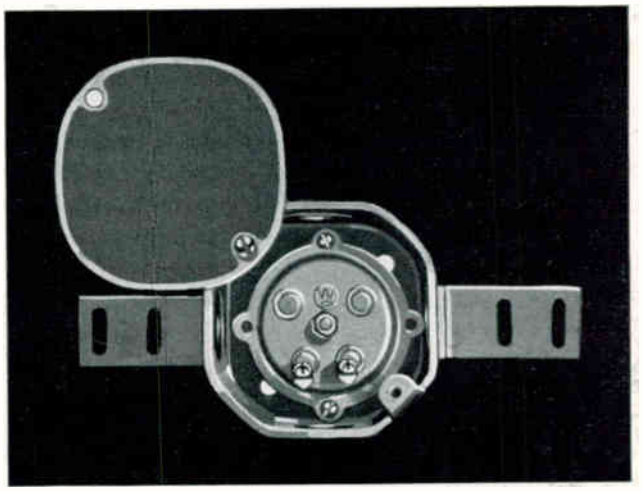
Strap-on thermostats are designed for controlling Westinghouse heating elements clamped to or inserted in boilers or tanks. When installed in accordance with instructions, the non-adjustable type shown at the right will control at approximately 160° F. The adjustable strap-on thermostat illustrated at the upper right offers a range of water temperatures from approximately 130° to 190° F.



The Automatic Thermal Regulator adapts the Built-in Watchman Thermostat to existing side-arm or circulation heaters. Above is a disassembled view of thermostat and mounting.



The adjustable strap-on thermostat controls temperatures between 130° and 190° F.



Westinghouse strap-on or immersion heaters can be converted from non-automatic to automatic operation by applying the thermostat shown above.

SPECIFICATIONS

Automatic Thermal Regulators

Catalog Numbers	Ampere Rating	Voltage	Shipping Wt. Lbs.
RG-10	15	115 AC	2
	7	115 DC	2
	7	230 AC only	2
RG-30	40	115 AC	5
	25	115 DC	5
	20	230 AC only	5

Strap-on Thermostat

Catalog Numbers	Ampere Rating	Voltage	Shipping Wt. Lbs.
521775	15	115 AC	1
	7	115 DC	1
	7	230 AC only	1

Adjustable Strap-on Thermostat

Catalog Numbers	Ampere Rating	Voltage	Shipping Wt. Lbs.
763166	10	115 AC	1
	5	115 DC	1
	5	230 AC only	1
798083	25	115 AC	1
	13	115 DC	1
	13	230 AC only	1

CHECK THESE FEATURES

1. Casing, No. 19 gauge casing steel. Lacquer finish inside; ivory Cordovan outside.

2. Trim band of steel finished in grey Cordovan.

3. Top cover has wide flange to balance with bottom and center trim band. Finished in grey Cordovan.

4. Sheet metal screws anchor top cover and casing and provide greater rigidity.

5. Bottom casing cover No. 13 gauge sheet steel for greater strength and rigidity.

6-7. Heater cover plate easily removable by releasing six sheet metal screws. Only two screws contact conduit box, thus minimizing heat losses.

8. Inner tank welded steel, heavily galvanized by hot zinc dip process, 250 pound test pressure.

9. Baffle breaks force of cold water and minimizes mixing of hot and cold water in tank.

10. Brackets and bolts fasten tank to legs through wood blocks and bottom casing. Side walls of tank extended and bolted to brackets for greater rigidity.

11. Legs and base fastened to wood blocks to insulate inner tank from base and reduce heat losses.

12. Six-inch legs of cast iron, artistically designed, and finished in grey Cordovan.

13. Hot water outlet pipe and fittings hot galvanized. Pipe comes directly off top of tank, delivering hottest water to outlet pipe.

14. Heat trap minimizes pipe heat losses by stopping circulation within pipe.

15. Cold water inlet pipe brings water in at lowest point of tank.

16. No. 12 asbestos-covered, impregnated wires meet Underwriter's specifications.

17. Rigid conduit houses wiring.

18. 16-gauge steel conduit box houses terminals.

19. Lock nut fastens rigid conduit to heating element housing.

20. Standard 3¼" outlet box with knock-outs for rigid conduit or BX circuit connections.

21. Brass composition heating element flange casting. Houses thermostat.

22. Corox heating element hairpin consists of heating coil within seamless copper tubing. Coil insulated from copper tubing by crystalline magnesium oxide, an excellent insulator and heat conductor.

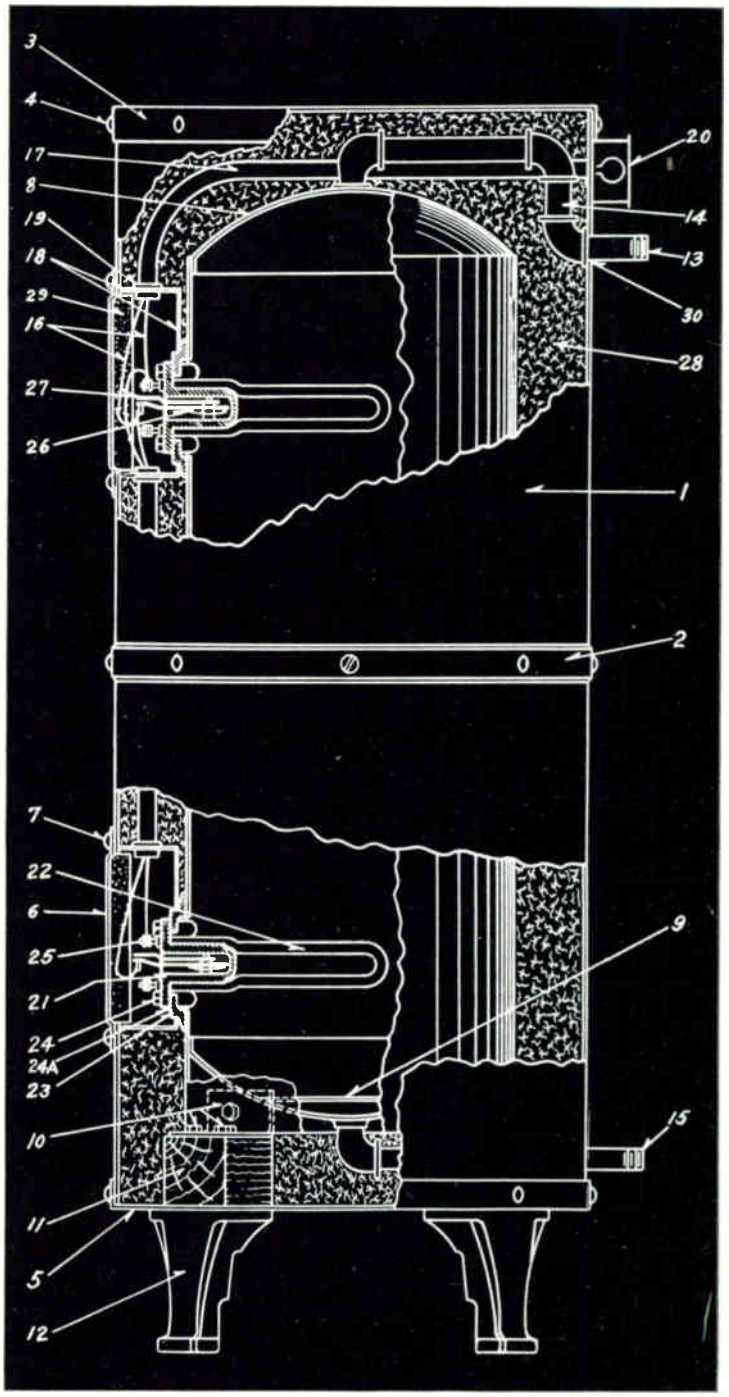
23. Adaptor steel casting welded to tank side wall.

24. Four $\frac{3}{8}$-16 standard bolts hold flange casting.

24-A "Durabla" gasket effects water-tight connection between flange and adaptor castings.

25. Four heating element terminals accessible after removing heater cover plate. Connections may be changed to procure different wattages.

26. Adjustable-automatic Built-in Watchman thermostat controls water at temperatures ranging from approximately 130 to 190 degrees.



27. Thermostat adjustment lever readily accessible after removing heater cover plate.

28. Balsam wool insulation, unqualifiedly endorsed by National Board of Fire Underwriters.

29. ¾-inch air cell block under heating element cover plate minimizes heat losses at this point.

30. Fibre washer at inlet and outlet pipes reduces heat losses.

INFORMATION FOR ORDERING

To avoid delays and misunderstandings, note carefully the following points:

1. Send all correspondence and orders to the nearest office of the Company or the nearest jobber.

2. When ordering, give style or catalog number, voltage, type of system and complete description. If modification of standard apparatus is desired, order "Similar to Style No. . . . . except (state modification)."

3. In ordering duplicate of apparatus not listed, order by style number or shop order (S. O.) number (one of these numbers is cast or marked on the apparatus), and give full description.

4. State whether shipment is to be made by freight (and name the route), express, or by parcel post. In the absence of definite instructions, goods will be shipped at our discretion. Shipments ordered by parcel post will be insured only on request. All shipments are made at the purchaser's risk.

5. If damage occurs in transit, it should be reported to the transportation company immediately, inspected by their representative, and copy of inspection report procured. All claims should be adjusted with the transportation company as we are not responsible for breakage after goods are delivered by us to the carrier. If notified of such claims, we shall be glad to assist in securing adjustment providing we are furnished a copy of the carrier's inspection report.

6. All claims for shortage must be made within five days after receipt of shipment.

7. Do not return goods to us for credit or exchange without first obtaining written approval, with shipping directions, from the office through which the order was placed. Notification of such shipment, with copy of the shipping receipt, must be sent to the district office. The shipment must bear the name and address of the sender: otherwise, we cannot accept responsibility for credit.

8. When referring to an order, always mention the number and date of your order and the name of the consignee.

9. Small orders should be combined so as to amount to a value of at least $1.00 net, as no invoice will be rendered for an amount less than $1.00. Where the total of the sale is less than this, the material will be invoiced at $1.00.

10. The Company will not be responsible or liable for any loss, damage, detention or delay caused by fire, strike, civil or military authority, or by insurrection or riot, or by any other cause which is unavoidable or beyond its reasonable control; nor in any event for consequential damages.

11. In ordering parts, give style number with complete description, and style number with description of the complete apparatus. Ask the nearest Westinghouse representative for catalog of parts.

Shipping Weights Shown in this Catalog are Approximate and Given for Single Units

Always order by style number and specify exact voltage.

WESTINGHOUSE SALES OFFICES

ABILENE, KAN., 300 N. Cedar St.
AKRON, OHIO, 7 S. Main St.
ALBANY, N. Y., 90 State St.
ALLENTOWN, PA., 433 Green St.
*ATLANTA, GA., 426 Marietta St. N. W.
BAKERSFIELD, CALIF., 2224 San Emedio St.
BALTIMORE, MD., 30 W. Lexington St.
BAY CITY, MICH., 816 N. Sheridan St.
BEAUMONT, TEX., La Salle Hotel
BIRMINGHAM, ALA., 2030 Second Ave.
BLUEFIELD, W. VA., 525 Bland St.
*BOSTON, MASS., 10 High St.
BRIDGEPORT, CONN., Bruce Ave. and Seymour St.
*BUFFALO, N. Y., 814 Ellicott Square
BURLINGTON, IOWA, 320 N. Third St.
*BUTTE, MONT., 52 E. Broadway
CANTON, OHIO, 120 Tuscarawas St., West
CHARLESTON, W. VA., 100 Capitol St.
*CHARLOTTE, N. C., 210 E. Sixth St.
CHATTANOOGA, TENN., 536 Market St.
*CHICAGO, ILL., 20 N. Wacker Drive
*CINCINNATI, OHIO, 207 W. Third St.
*CLEVELAND, OHIO, 2209 Ashland Rd. S. E.
COLUMBIA, S. C., 912 Lady St.
COLUMBUS, OHIO, 209 S. Third St.
*DALLAS, TEX., 209 Browder St.
DAVENPORT, IOWA, 206 E. Second St.
DAYTON, OHIO, 32 N. Main St.
*DENVER, COLO., 910 Fifteenth St.
DES MOINES, IOWA, 604 Locust St.
*DETROIT, MICH., 5757 Trumbull Ave.
DULUTH, MINN., 10 East Superior St.
ELMIRA, N. Y., 338 E. Water St.
EL PASO, TEXAS, 303 N. Oregon St.
EMERYVILLE, CALIF., 5815 Peladeau St.
ERIE, PA., 1003 State St.
EVANSVILLE, IND., P. O. Box 457
FAIRMONT, W. VA., 602 Cleveland Ave.
FORT WAYNE, IND., 1010 Packard Ave.
FORT WORTH, TEX., 501 Jones St.
GARY, IND., 524 Roosevelt St.
*GRAND RAPIDS, MICH., 507 Monroe Ave. N. W.
GREENVILLE, S. C., P. O. Box 1591
HAMMOND, IND., 403 Waltham St.
*HOUSTON, TEX., 218 Main St.
*HUNTINGTON, W. VA., 209 Ninth St.
INDIANAPOLIS, IND., 539-549 Madison Ave.
ISHPEMING, MICH., Third and High Sts.
JACKSON, MICH., 212 W. Michigan Ave.
JACKSONVILLE, FLA., 37 S. Hogan St.
JOHNSTOWN, PA., 47 Messenger St.
*KANSAS CITY, MO., 2124 Wyandotte St.
*LOS ANGELES, CALIF., 420 S. San Pedro St.
LOUISVILLE, KY., 322 W. Broadway
MADISON, WIS., 508 Edgewood Ave.
MEMPHIS, TENN., 130 Madison Ave.
MILWAUKEE, WIS., 735 N. Water St.
*MINNEAPOLIS, MINN., 2303 Kennedy St. N. E.
MONROE, LA., c/o Monroe Hardware Co.
NASHVILLE, TENN., 219 N. Second Ave.
*NEWARK, N. J., Haynes Ave. & Lincoln Highway
NEW HAVEN, CONN., 152 Temple St.
*NEW ORLEANS, LA., 333 St. Charles St.
NEW YORK, N. Y., 150 Broadway
NIAGARA FALLS, N. Y., 205 Falls St.
*OKLAHOMA CITY, OKLA., 130 W. Grand Ave.
OMAHA, NEB., 409 S. Seventeenth St.
PEORIA, ILL., 104 State St.
*PHILADELPHIA, PA., 3001 Walnut St.
*PHOENIX, ARIZ., 11 W. Jefferson St.
PINE BLUFF, ARK., 1715 Linden Ave.
*PITTSBURGH, PA., 435 Seventh Ave.
PORTLAND, ME., 61 Woodford St.
*PORTLAND, ORE., 83 Sixth St.
PROVIDENCE, R. I., 393 Harris Ave.
RALEIGH, N. C., 803 N. Person St.
READING, PA., 438 Walnut St.
RICHMOND, VA., 700 E. Franklin St.
ROCHESTER, N. Y., 410 Atlantic Ave.
ROCKFORD, ILL., 130 S. Second St.
SACRAMENTO, CALIF., 1107 Ninth St.
*SALT LAKE CITY, UTAH, 10 W. First South St.
SAN ANTONIO, TEX., 105 S. St. Marys St.
SAN DIEGO, CALIF., 863 Sixth St.
*SAN FRANCISCO, CALIF., 1 Montgomery St.
*SEATTLE, WASH., 603 Stewart St.
SIOUX CITY, IOWA, 2311 George St.
SOUTH BEND, IND., 107 E. Jefferson St.
SPOKANE, WASH., 428 Riverside Ave.
SPRINGFIELD, ILL., 607 East Adams St.
SPRINGFIELD, MASS., 395 Liberty St.
*ST. LOUIS, MO., 411 N. Seventh St.
SYRACUSE, N. Y., 224 Harrison St.
TACOMA, WASH., 1021 Pacific Ave.
TAMPA, FLA., 417 Ellamae Ave.
TEXARKANA, ARK., 811 Olive St.
TOLEDO, OHIO, 245 Summit St.
*TULSA, OKLA., 602 S. Main St.
*UTICA, N. Y., 113 Genesee St.
WASHINGTON, D. C., 1434 New York Ave. N. W.
WATERLOO, IOWA, 328 Jefferson St.
WICHITA, KAN., 110 N. Estelle St.
WILKES-BARRE, PA., 267 N. Pennsylvania Ave.
WILMINGTON, CALIF., 305½ Avalon Blvd.
WORCESTER, MASS., 54 Commercial St.
YORK, PA., 143 S. George St.
YOUNGSTOWN, OHIO, 25 East Boardman St.
The HAWAIIAN ELECTRIC CO., Ltd., Honolulu. T. H.—Agent.

*Warehouses located in these cities and also in Marshall, Texas.

INSTRUCTIONS FOR INSTALLATION AND OPERATION OF WESTINGHOUSE AUTOMATIC HOT WATER TANK

INSTALLATION

The outlet pipe is marked with a metal identification tag and this is to be connected to the hot water riser. The other pipe is to be connected to the cold water supply. Both pipes are capped to protect the threads and to prevent dirt from getting into the tank. Remove the caps and connect directly to the hot and cold water pipes. The Westinghouse tank is equipped with traps in both hot and cold water lines inside of the cover of the tank and therefore none need be supplied in external piping.

Covering the hot water pipes between the tank and faucets with a commercial pipe covering will materially increase the efficiency of any electric hot water system.

In cases where a circulating system of piping is already installed it is recommended that a check valve be put in a horizontal section of the return line to prevent a reverse flow from the bottom of the water tank to the hot water line, with the resultant mixing of the hot and cold water before it reaches the faucets. An even better scheme would be to put a shut-off valve in the return line which would completely stop the circulation and materially cut down the radiation losses, besides giving hotter water at the faucets.

THIS TANK MUST NOT BE INSTALLED IN CONJUNCTION WITH A FURNACE COIL OR OTHER AUXILIARY HEATING SYSTEM. A special tank can be supplied for this type of installation if required.

OPERATION

The Westinghouse Water Tank is equipped with a thermostat which automatically controls the water temperature. By means of the three-heat switch is is possible to obtain three distinct water temperatures. The approximate temperatures are 180° on "High", 155° on "Medium", and 135° on "Low". The low heat will supply plenty of hot water for the ordinary demands and is the most efficient at which to operate the tank as the radiation or standby losses are a minimum. However, in cases where there is a greater demand for hot water, the switch can be turned to Medium. Very few families will require the tank to be on high heat except on wash days, or at such other times as an extra large amount of hot water is needed.

CLEANING

When the heater is used with hard water it will deposite scale. In case it becomes necessary to clean out this scale it can be done by removing the heating element and flushing the tank. Remove the bottom cover and disconnect the

INSTRUCTIONS FOR INSTALLATION AND OPERATION
OF WESTINGHOUSE [illegible] HOT WATER TANK

[illegible]

The [illegible] pipe is marked with a [illegible] [illegible] to be connected to the hot water [illegible] the cold water supply. [illegible] threads and [illegible] remove the caps and [illegible] into [illegible] pipes. The Westing- [illegible] hot and cold water [illegible] and therefore [illegible]

[illegible] pipe between the tank and faucets [illegible] externally [illegible] system.

In case there a circulating system of piping [illegible] it is [illegible] that a check valve [illegible] return line to prevent a [illegible] bottom of [illegible] tank to the hot water line, [illegible] hot and cold water before it [illegible] An even better scheme would be to put a [illegible] valve [illegible] return line which would [illegible] stop the circula- tion and [illegible] down the radiation [illegible] hotter water [illegible] the faucets.

THIS TANK [illegible] NOT BE INSTALLED IN CONJUNCTION [illegible] OR OTHER AUXILIARY HEATING SYSTEM. A [illegible] type of installation is required.

OPERATION

The [illegible] Tank is equipped with a thermostat [illegible] the water temperature [illegible] it is possible to obtain three [illegible] temperatures, [illegible] "High", 135° on "Low" [illegible] the ordinary [illegible] supply plenty of hot water [illegible] the tank [illegible] the most efficient at which [illegible] radiation [illegible] are [illegible] However, in case [illegible] demand for hot [illegible] the switch [illegible] medium. [illegible] require the tank [illegible] wash days, or such other times [illegible] amount of hot water is needed.

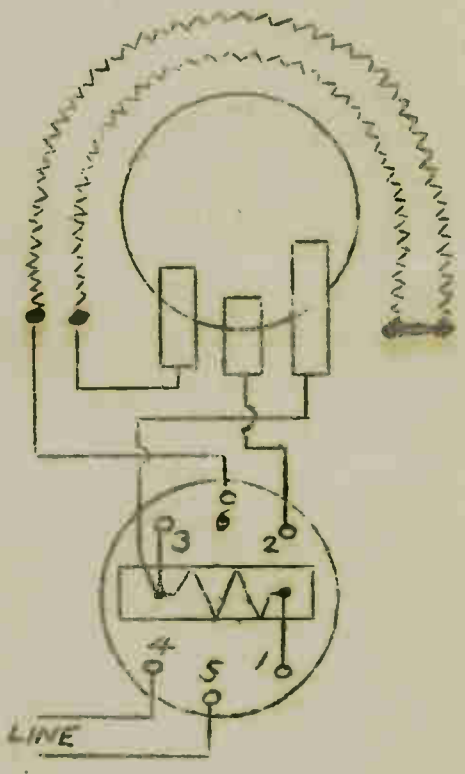
CLEANING

When the [illegible] it [illegible] In case it [illegible] be done by [illegible] flush [illegible] Remove the bottom [illegible]

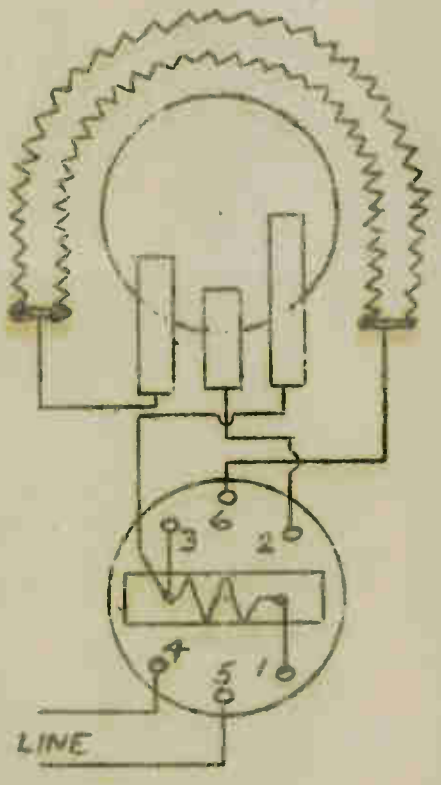
[illegible] #2403-1A.

two wires to the thermostat and the wire to the heater. Then remove the four bolts with a socket wrench and withdraw the heater. CAUTION: When removing the heater do not take out the thermostat, only disconnect the two wires from it. Fig. 1 shows the wiring diagram of the thermostat, element, shunt and switch.

A 50% solution of muriatic acid may be used to dissolve the scale from the heater tubes but the tubes must be thoroughly rinsed in water after the scale is removed.



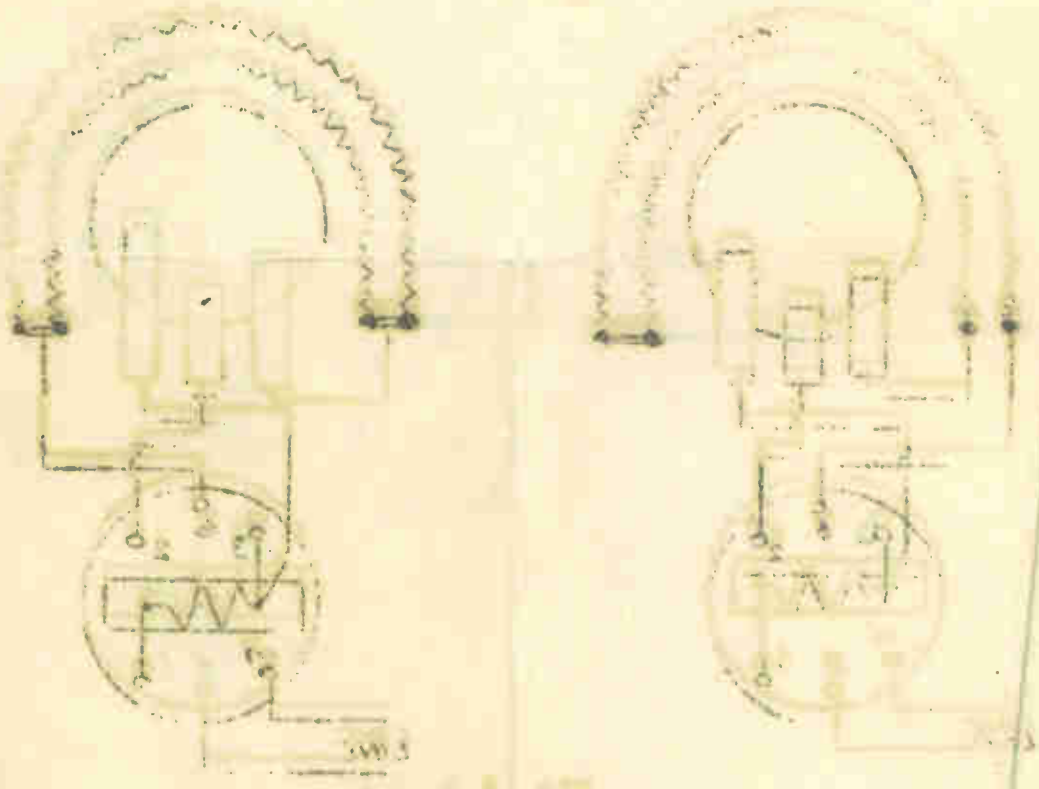
Wiring Diagram for
WT-38 and WT-238



Wiring Diagram for
WT-34, Wt-58, Wt-234
and WT-258

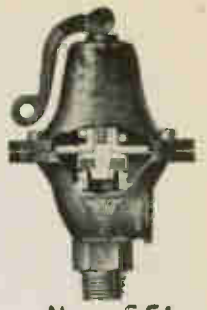
FIG. # 1

Stencil #3403-2
JHR:9-12-29
GE



INSTRUCTIONS FOR INSTALLING WATTS DIAPHRAGM TYPE RELIEF VALVES
PRESSURE RELIEF - TYPES 28L, 30, 55L, 300
PRESSURE AND TEMPERATURE RELIEF - TYPE 31
VACUUM - TYPE 32

No. 28L



No. 55L

Calibrated Top

No. 30L

No. 30A-30C

POSITION

TYPES 28L-55L - PRESSURE RELIEF ONLY. FOR TANK-IN-BASEMENT HOT WATER HEATING SYSTEMS. REGULARLY FURNISHED WITH TEST LEVER AND SET AT 25-30 LBS. TYPE 28L HAS ½" I.P.S. FEMALE INLET, OUTLET AND DRAIN CONNECTIONS. TYPE 55L HAS ¾" I.P.S. MALE INLET AND FEMALE DRAIN. INSTALL IN WATER SUPPLY PIPE TO BOILER, NEAR AND SLIGHTLY ABOVE THE BOILER.

TYPES 30-300 - PRESSURE RELIEF ONLY. THE VALVE MUST BE INSTALLED AS NEAR AS POSSIBLE TO THE RANGE BOILER OR STORAGE TANK. IT MAY BE INSTALLED IN EITHER THE HOT OR COLD WATER LINE. THE TYPES 30 AND 300 ARE MADE WITH I.P.S. MALE INLET AND FEMALE DRAIN AND MUST BE INSTALLED IN A FITTING AS SHOWN IN FIGS. 1,2,3,4,5.

TYPE 31 - PRESSURE AND TEMPERATURE RELIEF. "NEVER INSTALL A TEMPERATURE RELIEF VALVE ABOVE A NON-BY-PASS TEE OR VALVE." TEMPERATURE RELIEF VALVES MUST BE INSTALLED EITHER - DIRECTLY IN THE TANK - IN THE HOT WATER OUTLET WITHIN 3" OF THE TANK (FIGS. 2-3-5) - OR IN THE CIRCULATING LINE BETWEEN HEATER AND TANK (FIG. 4).
VALVES ARE MADE WITH I.P.S. MALE INLET FOR INSTALLING IN FITTINGS AS SHOWN. DRAIN HAS I.P.S. FEMALE CONNECTION.

TYPES 32-68 VACUUM RELIEF. INSTALL IN TEE IN COLD WATER LINE NEAR TOP OF BOILER. I.P.S. MALE INLET. NO. 68 HAS FEMALE DRAIN CONNECTION.
PRESSURE AND VACUUM RELIEF - USE NOS. 30 OR 300 AND NO. 32 OR 68.
PRESSURE, TEMPERATURE AND VACUUM RELIEF - USE NO. 31 AND NO. 32 OR 68.

INSTALL AS INSTRUCTED FOR EACH RESPECTIVE TYPE.

NEVER INSTALL A VALVE OF ANY KIND BETWEEN A RELIEF VALVE AND THE BOILER OR TANK WHICH IT IS TO PROTECT.

THE OUTLET OR DRAIN CONNECTION OF ANY RELIEF VALVE MUST NEVER BE PLUGGED. RUN THE DRAIN PIPE TO AN OPEN FLOOR DRAIN OR SINK, NEVER OUTSIDE THE BUILDING. NEVER INSTALL A VALVE OF ANY KIND IN THIS DRAIN LINE.

STYLE AND PRESSURE MARKINGS.

CALIBRATED - ½" SIZE ONLY, TYPES NO. 30 AND NO. 31. FIGURES ARE STAMPED ON THE TOP OF THE SPRING CAGE REPRESENTING PRESSURE SETTINGS. ARROW ON THE HEXAGON SCREW POINTS TO THE SET PRESSURE.

ADJUSTABLE - ALL SIZES AND TYPES. THE SET PRESSURE AND THE MAXIMUM PRESSURE TO WHICH VALVE CAN BE ADJUSTED ARE STAMPED ON THE TOP OF THE SPRING CAGE (TYPES 28L, 30, 31 AND 300).

LEVER - ALL SIZES AND TYPES EXCEPT NOS. 55L AND 300 ARE ADJUSTABLE. NOS. 55L AND 300 ARE NOT ADJUSTABLE. THE SET PRESSURE AND THE MAXIMUM PRESSURE TO WHICH THE VALVES CAN BE ADJUSTED ARE STAMPED ON THE TOP OF THE SPRING CAGE.
OPERATING THE TEST LEVER LIFTS THE VALVE DISC FROM ITS SEAT AND FLUSHES THE VALVE, SHOWING WHETHER OR NOT THE WATERWAYS ARE CLEAR.
VALVES SHOULD BE SET TO RELIEVE AT 20 TO 30 POUNDS ABOVE THE NORMAL SERVICE PRESSURES IN THE TANK.

No. 300A

No. 300L

READJUSTMENT - TO RESET CALIBRATED VALVES (TYPES 30-31). TURN ADJUSTING SCREW UNTIL ARROW POINTS TO REQUIRED PRESSURE SETTING. IF ADJUSTMENT HAS BEEN TAMPERED WITH, TURN SCREW CLOCKWISE AS FAR AS IT WILL GO. THE ARROW WILL POINT TO 125. THEN TURN THE ARROW TO THE DESIRED PRESSURE SETTING.
TO RESET ADJUSTABLE VALVES, (TYPES 30, 31 AND 300) AND LEVER VALVES (TYPES 30 AND 31), TURN THE HEXAGON SCREW COUNTER-CLOCKWISE UNTIL VALVE JUST DRIPS AND THEN TURN CLOCKWISE THE NUMBER OF TURNS SHOWN IN CHART BELOW.

SIZE	½	¾	1	1¼	1½	2
	1 TURN	1 TURN	2 TURNS	2 TURNS	2 TURNS	2 TURNS

TEMPERATURE RELIEF IS BY MEANS OF A FUSIBLE PLUG WHICH MELTS AT 212°. (TYPE 31)

TO REPLACE A FUSIBLE PLUG, PROCEED AS FOLLOWS:
TYPE NO. 31 - REMOVE PLUG WHICH IS OPPOSITE THE DRAIN OUTLET. INSERT NEW FUSIBLE PLUG (ON BRASS HOLDER) INTO THE TAPERED HOLE AND DRIVE IT FIRMLY INTO PLACE. REMOVE THE BRASS HOLDER AND REPLACE PLUG.

No. 31A-31C

No. 31L

VACUUM RELIEF, TYPES 32 OR 68, NOT ADJUSTABLE. NO. 32 SETTING EQUIVALENT TO 7" OF MERCURY. NO.68 OPENS ON SLIGHTEST VACUUM.

TYPE 62, WATTS CONVERSION CROSS, IS DESIGNED AND RECOMMENDED FOR TEMPERATURE RELIEF VALVE INSTALLATIONS ON SYSTEMS SHOWN IN FIG. 3. TAPPINGS PROVIDED IN THE CROSS FOR RELIEF VALVE INSTALLATION AND FOR CONNECTION. -

No. 68

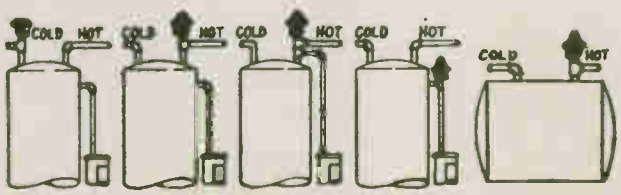
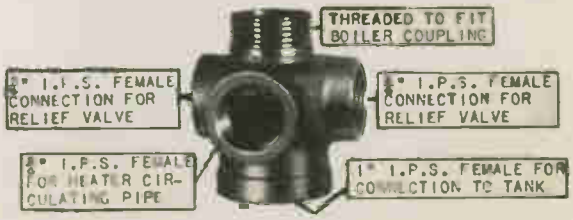
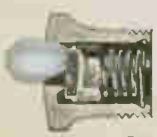


Fig. 1 Fig. 2 Fig. 3 Fig. 4 Fig. 5



No. 62



No. 32

MERCOID RISERTHERM

Redesigned and Fully Perfected
SURFACE TYPE CONTROL

Side View of Control Mounted on Vertical Riser

A temperature limiting control designed to be clamped on risers of hot water heating systems or the surfaces of hot water tanks to control the temperature of the water.

Easily mounted on either vertical or horizontal pipes.

Fig. 35-L. Mounted on Horizontal Pipe

Fig. 35 Mounted on Hot Water Tank

FIGURE 35

The new model Mercoid Risertherm is meeting with popular favor everywhere.

This control incorporates features which make it positive in action and very sensitive to changes in temperature. It is guaranteed to give satisfactory service.

The Mercoid Risertherm is provided with an interchangeable and simple mounting mechanism so that it can be readily applied on pipes that are either in a vertical or horizontal position.

The instrument is furnished with an outside adjustment and a graduated scale to facilitate a quick and easy setting for any required operating temperature. The binding posts are located inside of the case and simplify the wiring at the time of installation. A connector is provided at the bottom so that it may be easily wired into the line by means of a BX or conduit.

The new model Risertherm is equipped with a Figure 9-51 Tipless Mercoid Switch, which is the latest development in sealed mercury contact switches. This switch is constructed in such a manner that its action is equivalent to the Mercoid Snap Action mechanism, which results in a positive and instantaneous make or break in electrical contact.

There is no open arcing or corrosion of the contacting surfaces. The switch will operate indefinitely within its rated capacity without any indication of deterioration.

The Mercoid thermal element contains a highly expansive liquid which is the actuating power of the mechanism. This thermal element is carefully seasoned at a high temperature which insures positive performance for many years. The thermal element is located at the back of the instrument and connects, by means of an adjustable clamping arrangement, directly on any size pipe. It may also be applied to the surfaces of large diameter tanks by the use of extra length straps. One five foot length of perforated steel strap is regularly supplied which may be cut to the desired size. Special lengths furnished where specified.

The standard range of the Mercoid Figure 35 Risertherm is between 110° F. to 200° F. with an approximate operating differential from 6° F. to 25° F., according to the size of pipe and the operating conditions of the installation.

FIGURE 34

This instrument is identical with Fig. 35, except that the Mercoid Switch is in reverse position and closes the circuit when the temperature rises to a predetermined point and opens the circuit when the temperature falls.

It is used in connection with a thermostat for dual control of unit heaters to prevent operation of the fan until the coils are heated, thereby insuring economical operation.

The standard range of the Mercoid Figure 34 Risertherm is between 140° F. and 230° F., with the same approximate operating differential as Figure 35.

Both instruments can handle current up to 10 amperes at 110 volts or 5 amperes at 220 volts.

FIGURES 34A and 35A

These instruments are the same as Figures 34-35 respectively, except that they are equipped with the Mercoid Figure 9-61 Switch, which operates on current up to 3 amperes at 110 volts and 1½ amperes at 220 volts A. C. or D. C.

FIGURES 34L and 35L

These controls are also identical with Figures 34-35 respectively, except that they are supplied with the two circuit arrangement for 3 wire or low voltage requirement.

LIST PRICES

For Automatic Heating Equipment Standard Range 110° F. to 200° F.			*For Unit Heaters Special Range 140° F. to 230° F.*		
Figure 35	Single Pole 10 amperes	$18.00	Figure 34	Single Pole 10 amperes	$20.00
Figure 35	Two Pole	22.00	Figure 34	Two Pole	24.00
Figure 35-A	Single Pole 3 amperes	16.50	Figure 34-A	Single Pole 3 amperes	18.50
Figure 35-L	Low Voltage 3 wire	19.00	Figure 34-L	Low Voltage 3 wire	21.00

Shipping Weight, 5 lbs., 11 oz.

THE MERCOID CORPORATION

Sole Manufacturers of The Mercoid Switch

4201 BELMONT AVENUE CHICAGO, ILLINOIS

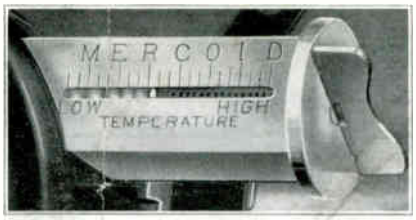
INSTALLATION INSTRUCTIONS

FOR MERCOID RISERTHERM

Element Housing

Mercoid Thermal Element

Element Cap

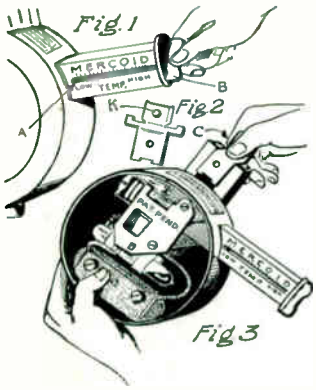


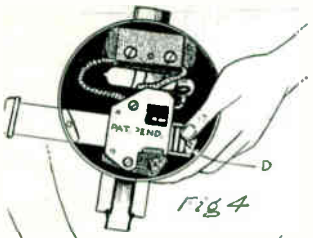
TEMPERATURE ADJUSTMENT

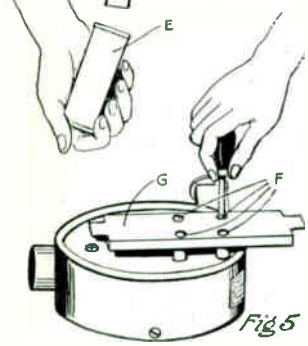
Illustration above shows the simple external adjustment provided for setting the cut-in and cut-out points. Due to variations encountered on installations, the scale is marked in letters instead of figures. The setting in all cases should be checked with thermometer on boiler.

The operating differential of the Risertherm is accurate in itself, but in actual service the performance may vary according to the size of pipe to which it is attached, the condition of the surface of the pipe, and the contact between the element housing and pipe.

Carefully follow instructions below.

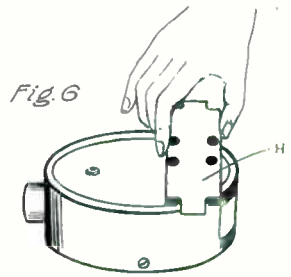


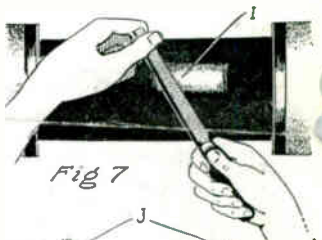




MOUNTING POSITIONS

THE Risertherm, as furnished, is set for vertical mounting position. To change over for horizontal, first remove cover, then turn the temperature adjusting wing nut ("B" Fig. 1) to the left until the indicator is all the way back under "M" in word Mercoid. See ("A" Fig. 1). Remove element cap (Fig. 2) from one end of element housing by pressing it back and pulling out ("C" Fig. 3). Remove element by pressing at section "D" (Fig. 4) and hold instrument in downward position to permit element to drop in hand ("E" Fig. 4). Take off element housing "G" (Fig. 5) by loosening all four screws ("F" Fig. 5) a little at a time until the housing is released. Do not remove screws entirely as bushings and screws remain attached. Place housing in horizontal position ("H" Fig. 6), and reassemble as before. Be sure screws are tight.



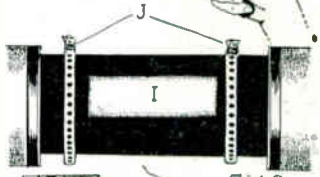


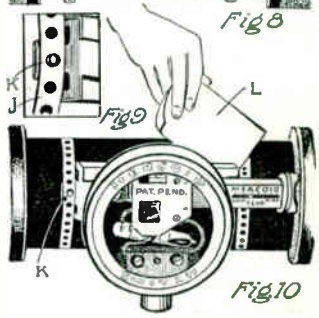
ATTACHING TO PIPE

The element housing must contact the pipe from end to end to insure correct operation. Select a location where the pipe is straight.

Clean pipe with file ("1" Fig. 7) at section where housing comes in contact with it. Remove all scale, rust and humps Place the two perforated straps in loose position ("J" Fig. 8). Put Risertherm in place. See that the studs of the two element caps fit in the holes of the strap. See "K" Figures 2, 9 and 10. Tighten securely screws which clamp the straps. Test contact with a thin piece of paper ("L" Fig. 10) to see that there is no space between the element housing and pipe.

The performance may be considerably improved, especially at lower temperatures, by applying a thick paste of aluminum radiator paint at the section where the element housing touches the pipe and clamping instrument while paint is still wet.





WIRING INSTRUCTIONS

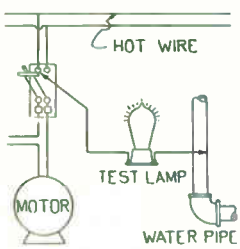


Figure 11

On a straight wire hook-up be sure controls are connected in hot side of line. If in doubt as to which is the hot wire connect one wire of a test lamp to a water pipe, or some othe suitable ground. The lamp will light when the other wire (of test lamp) is connected to the "hot" wire. See illustration 11.

The wires should be scraped and cleaned, and carefully placed around the terminal screws and in the groove provided as shown in Fig. 12.

Fuses installed in line switch should not exceed 10 amperes at 110 volts or 5 amperes at 220 volts. When used as a pilot control to an automatic motor starter, wire in accordance with motor starter manufacturer's diagram.

Figure 12

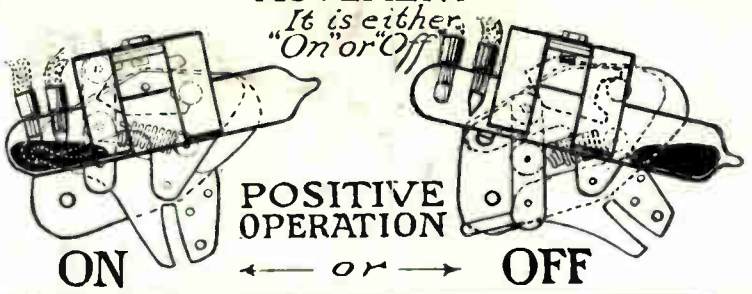
FORM P-15
10-31 3M D

PRINTED IN U. S. A.

MERCOID "SNAP-ACTION" MOVEMENT

It is either "On" or "Off"

Mount Switch in A Vertical Position, so that Points of Electrodes Dip into Mercury.



DONT'S

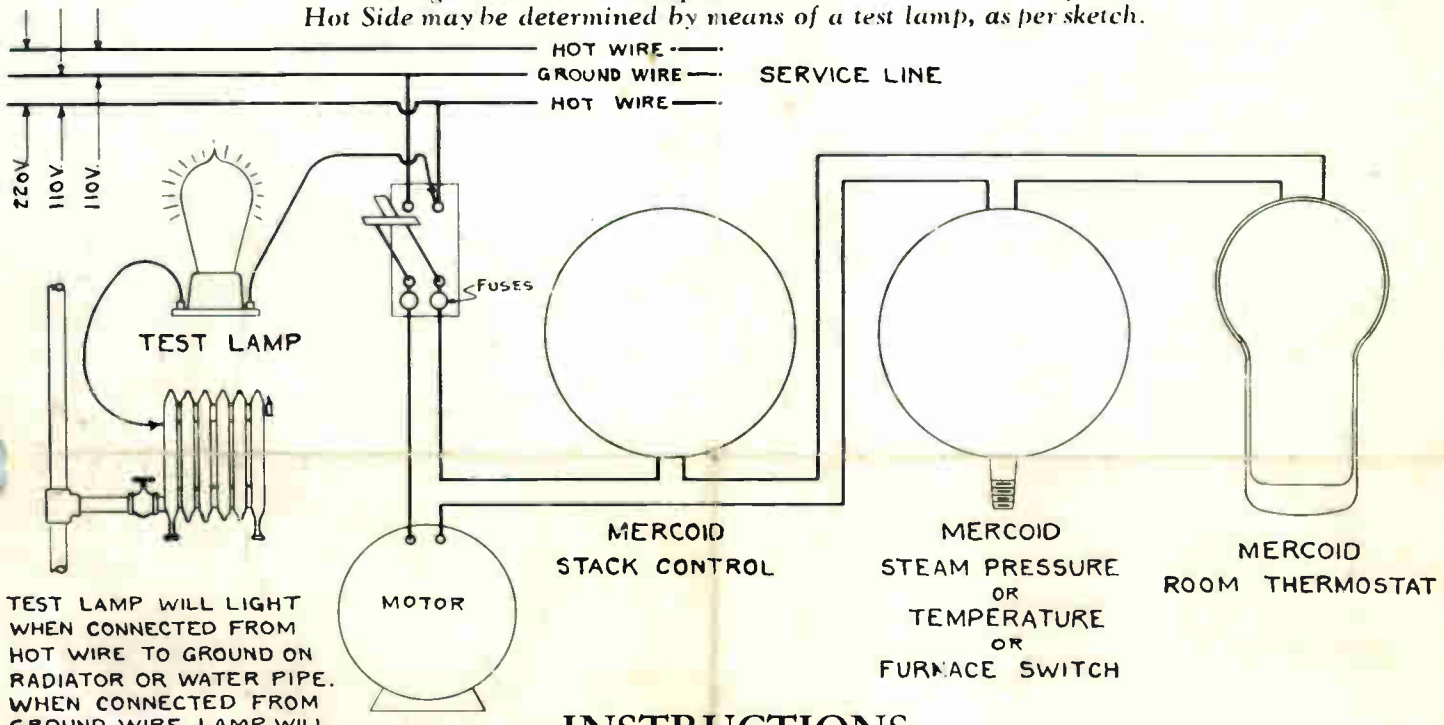
Movement must not be oiled.

Rigid conduit must not be attached to outlet box.

Use flexible conduit or BX to guard instrument from excessive strain.

WIRING INSTRUCTIONS

On a straight two-wire hook-up be sure to break Hot Side of line. Hot Side may be determined by means of a test lamp, as per sketch.



TEST LAMP WILL LIGHT WHEN CONNECTED FROM HOT WIRE TO GROUND ON RADIATOR OR WATER PIPE. WHEN CONNECTED FROM GROUND WIRE, LAMP WILL NOT LIGHT.

INSTRUCTIONS

To Make Mercoid Terminal Joints

1. 

Strip the outer braid two inches from the end with a sharp knife. Take care not to cut so deep as to injure the insulation beneath the rubber.

3. 

Pull back the green cotton covering exposing the tubular braided copper wire.

5. 

Prepare end of rubber covered wire as shown, by stripping and scraping.

7. 

Slide green braid back over joint.

2. 

Peel the rubber off leaving the green cotton covering exposed.

4. 

Open the tubular braided wire with a small wire nail or other pointed object for a distance of a half inch or more.

6. 

Insert same into opening in braided wire and solder this joint carefully, using a non-corrosive flux.

8. 

Apply rubber tape over same and finish with friction tape as a final protection.

Do Not Fail to Carry Out These Instructions

THE MERCOID CORPORATION

564 WEST ADAMS STREET, *Chicago, Illinois, U. S. A.*

25 CHURCH STREET
New York, N. Y.

THE MONADNOCK
San Francisco, Calif.

Cable Address "Mercoid, Chicago"

MERCOID System of DIRECT CONTROL

THE MERCOID CORPORATION

MERCOID IMMERSION TYPE CONTROLS

For Hot Water and Vapor Vacuum Systems

PAT. ISSUED
1521638 1598874
1640869 1658013
OTHERS PENDING

Fig. 36

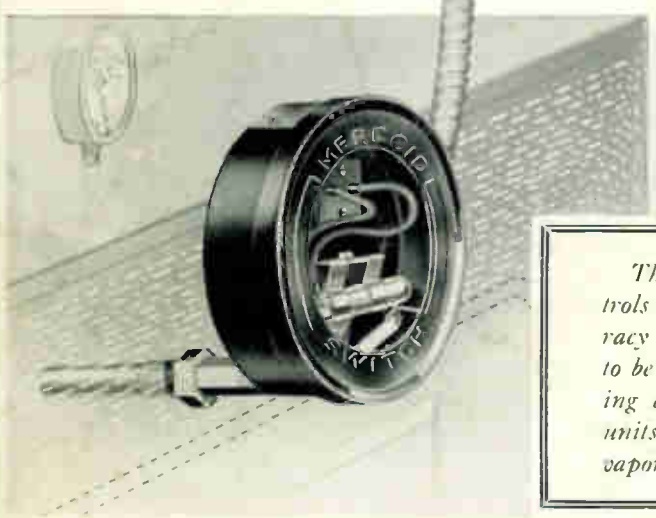


Fig. 37

The Mercoid Immersion Type Controls have proven by their unfailing accuracy and durability over years of service to be the correct type of automatic limiting device for control of motor driven units on hot water boiler installations and vapor-vacuum heating systems.

MERCOID Immersion Type Controls are recommended where positive and dependable control of boiler temperature is necessary. They are especially suitable for overloaded installations to guard against exceeding boiling point, yet permitting normal operation at temperatures just below.

All Mercoid Immersion Type Controls are equipped with Mercoid "Snap-Action" Movement and are intended for direct control where the normal working loads do not exceed 10 amperes at 110 volts or 5 amperes at 220 volts A. C. or D. C. They are furnished fully automatic, or, where so specified, semi-automatic with hand reset. Equipped with either ½" connection 3" stem or ¾" connection 1¾" stem.

Fig. 36

Straight stem. Furnished with simple adjustment for raising or lowering the cut-in and cut-out points.

Fig. 37

Furnished for hot water storage tanks and for installations in the sides of boilers, below the water line, where a straight stem cannot be used. Particularly adapted for positive control on vapor vacuum systems with special range 220° to 214° F. adjustable up to 214° to 226° F.

Fig. 36-L and 37-L

These controls are identical in design with Figures 36 and 37 respectively excepting they are arranged for 3-wire or low voltage requirements.

Fig. 36-A and 37-A

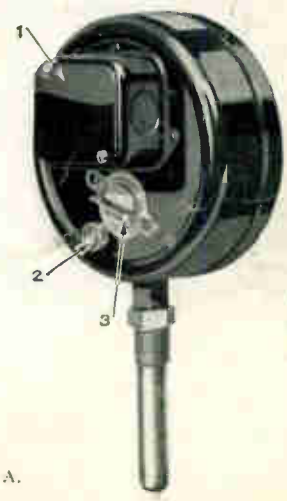
Equipped with Fig. 17 Mercoid tube for applications where the current requirements do not exceed 3 amperes at 110 volts A. C. or D. C.

There seems to be an erroneous impression with some dealers that it is necessary to drain the system to install Immersion type controls. This is not a fact. All immersion controls can be installed without draining by first filling the expansion tank until it overflows and plugging the overflow so as to prevent entering of air. Also close all radiator vents and valves so as to completely seal the system after which the plug in the boiler may be removed and the stem inserted. The plug on the overflow should then be removed and the valves in the radiators opened.

The immersion stem must be installed in the circulation in such a manner as to prevent forming an air pocket. It must be fully immersed in the water at all times to insure proper operation and must not under any circumstances touch the inner walls of the boiler—check for proper clearance before insertion.

Do not use a nipple where stem will not go all the way into top of boiler. On such jobs use a back angle stem control, mounted in elbow on riser or in the side of boiler. Do not run conduit pipe to switch; use a length of BX coming out of either side conduit. Be sure that tapping in boiler is full size—do not force stem into undersized hole—check with drill or rod of $^{23}/_{32}$" diameter for ½" stem and $^{29}/_{32}$" diameter for ¾" stem.

All Mercoid hot water boiler controls have a simple adjustment for raising or lowering cut-in and cut-out points. Note illustration to right. (1) Improved type outlet box with outside screws for making quick electrical connections. (2) Knurled hand reset button furnished on both fully automatic and semi-automatic types of instruments. (3) Hand adjustment for raising or lowering boiler control setting.



STANDARD RANGES

140-160° adjustable up to 165-180° F. **140-180° adjustable up to 175-200° F.** 160-180° adjustable up to 190-200° F.

For Vapor-Vacuum Control:
With back angle stem (Figure 37)
200-214° adjustable up to 214-226° F.

LIST PRICES

Figure 36	Single Pole 10 amperes	$22.00	Figure 37	Single Pole 10 amperes	$23.00
Figure 36	Two Pole	28.00	Figure 37	Two Pole	29.00
Figure 36-A	Single Pole 3 amperes	19.00	Figure 37-A	Single Pole 3 amperes	20.00
Figure 36-L	Low Voltage 3-wire	22.00	Figure 37-L	Low Voltage 3-wire	23.00

Shipping Weight 4 lbs.

Write for information on Double adjustment types of hot water boiler controls.

Printed in U. S. A.
5-8-28

READ CAREFULLY BEFORE INSTALLING

FORM 541 E

INSTRUCTIONS FOR

INSTALLING and OPERATING

FOXBORO
REG U S PAT. OFF

INDICATING THERMOMETERS

Calibration

This instrument has been calibrated and checked for accuracy against the highest standards and finest equipment available for such purposes.

Class II (Vapor Tension) Thermometers are calibrated to an accuracy within plus or minus one per cent of the linear length of the scale.

Class III (Gas-Filled) Thermometers are calibrated to an accuracy within plus or minus one per cent of total scale reading.

Length of scale for 5″ Dial Type Indicating Thermometer is 12″.

Length of scale for 8″ Dial Type Indicating Thermometer is 18″.

Foxboro Indicating Thermometers may be identified as follows:

Class II (Vapor Tension) — increasing dial graduations.

Class III (Gas Filled) — uniform dial graduations.

Guarantee

This instrument has been thoroughly inspected for calibration, workmanship, and material, and delivered to the transportation company in first-class condition.

There are no warranties by the Company after acceptance; but the Company will, free of charge, repair or replace, after receipt F. O. B. its factory, any part of an instrument or other apparatus which, under normal or proper use and on such receipt within one year from shipment by it, proves not to be within the specified limits of calibration or to be defective in workmanship or material. In no event shall the Company be liable for consequential damages.

THE FOXBORO COMPANY,
FOXBORO, MASS., U. S. A.

(over)

INDICATING THERMOMETERS

Caution

The action of an Indicating Thermometer depends upon a closed system composed of the sensitive bulb, the bourdon tube in the instrument case and the capillary tubing connecting the two. If this system is broken the instrument must be returned to The Foxboro Company for repair and recalibration. Workmen, especially electricians, who may have occasion to work around the instrument or tubing should be warned that *The Capillary Tubing Must Never Be Cut or Broken.*

Lift a Thermometer by the instrument itself, not by the tubing or bulb.

Do not kink either plain or protection tubing.

Installing

Set Thermometer up plumb, fasten securely to a solid support reasonably free from vibration.

Stem Type. (Sensitive bulb at end of metal stem attached to case at back or bottom.) Always use a wrench to tighten or loosen union connection. Do not screw into position by the case, as strain might damage the instrument. To obtain the best service, the case should not be subjected to temperatures in excess of 120° Fht.

Long Distance Type. (Sensitive bulb connected to case by tubing.) Capillary tubing must never be cut or broken. Even though encased in flexible bronze, lead or steel protection, tubing should not be bent on less than a 3 inch radius, and care should be exercised to prevent twisting or straining. Fasten tubing in place by cleats or staples.

Elevation. The correct vertical distance between a Class II Vapor Tension bulb and the case, and for which the instrument has been calibrated, is specified on the name plate. A variation of one foot may be allowed.

The temperature along tubing must not exceed the temperature of bulb, unless instrument is made to fit a special condition.

A Class III Instrument is not affected by elevation.

Bulb Immersion. The distance that the bulb must be immersed in the heat zone is specified on the name-plate as Bulb Immersion and is at least equal to or greater than the sensitive length. The bulb *must* be immersed to this distance or the accuracy of the instrument cannot be guaranteed. Bulbs should not be immersed in liquids or gases that will cause erosion or corrosion unless specially ordered and constructed of proper material to resist this action.

Sockets

Sockets are used as follows:

To protect bulbs against the corrosive and erosive action of liquids or gases.

To protect bulb against mechanical damage.

To make possible the removal of the bulb when the container or pipe is filled or under pressure.

Types of Sockets

1. Union seated (pressure tight).
2. Plain open end, particularly for Flue Gas Applications.

To Install Union Seated Separable Sockets

Install the socket in equipment or apparatus so that the sensitive length of the bulb will be completely immersed in the heat zone as explained under Bulb Immersion. Insert the bulb into socket and tighten jam nut. The bulb may be removed by simply unscrewing jam nut and withdrawing.

To Install Plain, Open End Socket

Install the socket in equipment bearing in mind the proper length to immerse as explained under Bulb Immersion. Insert the bulb into socket.

Caution:— Sockets are made from various materials and of various designs according to the conditions of the application. They should be used only under the conditions for which they were ordered. Sockets should never be filled with mercury, or oil, or used for higher pressure than ordered. If through accident or long service, the socket becomes worn out, a replacing socket should be installed.

Serial Number

In any correspondence on this instrument, please refer to the SERIAL NUMBER which is found on the name-plate.

The Foxboro Company will cheerfully and promptly answer any questions relating to the installation, operation and application of this instrument not covered by these instructions.

THE FOXBORO COMPANY, FOXBORO, MASS., U. S. A.

Form 541-E

Printed in U. S. A.

2-34 3M

OIL COOLERS AND WATER COOLERS

SCHUTTE & KOERTING COMPANY
Main Office and Works, Philadelphia

BRANCH OFFICES AND SALES AGENTS IN ALL LEADING CITIES

Heat Transfer Catalog
Pages 12001 to 12016

BULLETIN NO. 12-C

December, 1933

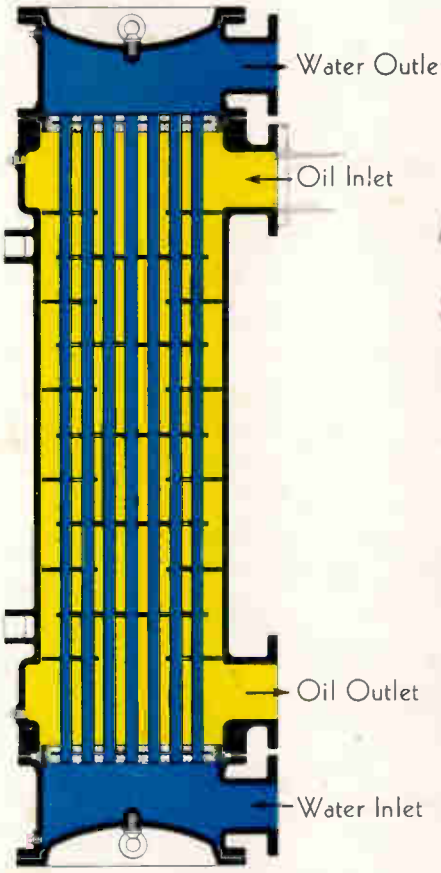


FIG. 1230. SECTIONAL VIEW OF OIL COOLER.
Yellow is used for oil, blue for water.

THE oil used for lubricating steam engine and turbine bearings, and for reduction gears, is circulated over and over again, and it must therefore be re-cooled in order to dissipate the heat adequately and to maintain the proper temperature. This requirement is also encountered in the use of oil for cooling the pistons and lubricating the bearings of internal combustion engines, for cooling electric transformers, and for various other machines used in power plants and in industrial processes.

The simplest method of dissipating the heat in this coil is by the use of properly designed Coolers, in which the oil circulated by suitable pumps is brought continuously into intimate contact with the cooling surfaces. Water is generally used as the cooling medium, the standard arrangement being to pass this water through tubes around which the oil is circulated.

NOTES ON LUBRICATION

IF THE oil supplied to a bearing is relatively cold, the turbulence is not vigorous, and consequently a particle of oil that is in contact with the bearing and that has absorbed its share of the heat, does not move away fast enough and therefore is not rapidly replaced by another colder particle of oil. The result is that the greater part of the circulating oil during its travel through the bearing does not come into contact with the metal surfaces, but passes along without absorbing any heat. Under these conditions, the bearing becomes heated to a point where the temperature difference between it and the oil film in direct contact is great enough to transfer the heat by conduction from the bearing to the oil film. This comparatively small portion of hot oil intermixes with the remaining larger quantity of cold oil, establishing at the outlet of the bearing a low oil temperature which by no means indicates the temperature of the bearing itself.

The temperature of the oil may be surprisingly low, whereas the temperature of the bearing itself may have reached the allowable maximum. The bearing is kept cool, not by establishing a low outlet oil temperature, but by bringing into contact with the surfaces of the bearing as many particles of oil per unit of time as possible.

The best practice is to circulate the oil energetically and to recool it to a temperature below the normal operating temperature of the bearing. According to tests conducted by the General Electric Company, this bearing temperature is about 160°F.

It is a mistake to refer the outlet temperature of the oil to the outlet temperature of the cooling water. The particular oil temperature at which the turbine operates most efficiently should be maintained irrespective of cooling water temperature. The latter can be regulated at will by controlling the amount of water passing through the cooler.

In a test on a standard ℏ No. 7 Cooler, in which 60 gallons of heavy Texaco Ursa oil were to be cooled per minute with 160 gallons of cooling water per minute, the results given in Table 2 were obtained.

In all instances, the difference between the water inlet and oil outlet temperatures was 33°F. Furthermore, the temperature drop of the oil decreased with a decrease in the initial oil temperature. This is primarily due to the oil temperature and to the fact that as the temperature of the oil diminishes, the oil becomes thicker, and more viscous, (see Fig. 1230-P) and its movement along the cooling surfaces sluggish.

TABLE 2. TEST OF NO. 7 COOLER

Inlet Temp. of Water, Deg. Fahr.	Inlet Temp. of Oil, Deg. Fahr.	Outlet Temp. of Oil, Deg. Fahr.	Temp. Drop of Oil, Deg. Fahr.
85	156	118	38
70	140	103	37
60	128	93	35
50	116	83	33
40	104	73	31

A large quantity of oil circulating at a small temperature drop has been found to give better results than a small amount of oil at a large temperature drop. The oil should not be passed through the bearings at too low a temperature, since cold oil, because of its greater viscosity does not absorb the heat of a bearing as well as oil at a higher temperature. See Table 3 and Fig. 1230-P.

TABLE 3. VARIATION OF SPECIFIC HEAT OF TEXACO URSA OIL WITH TEMPERATURE

Temperature of Oil, Deg. Fahr.	Specific Heat of Oil B.t.u. per lb. per. Deg. Fahr.
100	0.437
120	0.450
140	0.462
160	0.474
180	0.486
200	0.497
220	0.508
240	0.518
260	0.527

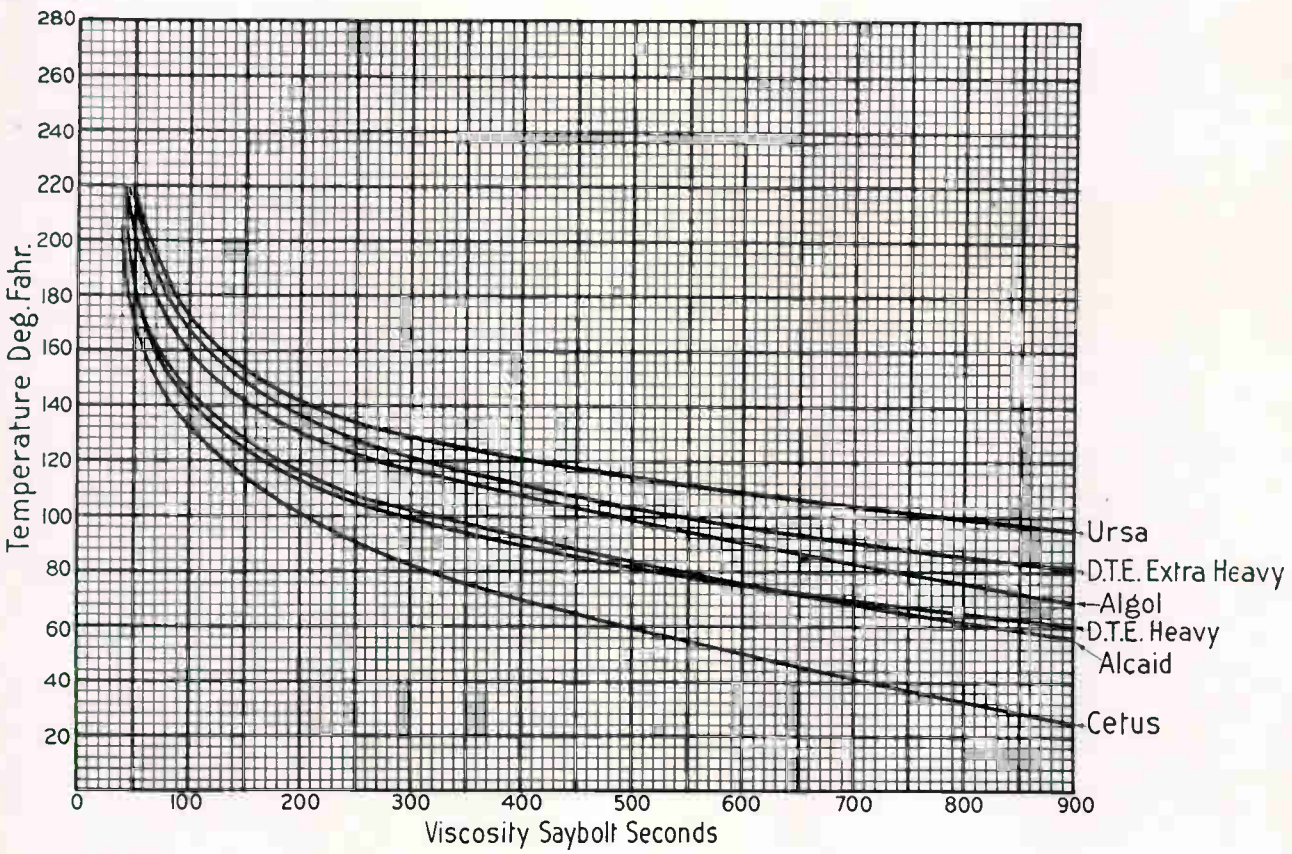


FIG. 1230-P. VISCOSITY AS A FUNCTION OF TEMPERATURE.

FIG. 1230-N.

ƙ OIL COOLER

THE ƙ Oil Cooler consists of a smooth bore cylindrical cast iron shell to the ends of which are attached cast iron headers. Within the shell is a bundle of straight brass or copper tubes through which cold water passes from one header to the other. The headers are separated from the cylinder by the tube sheets.

The hot oil flows into the shell at the top, as shown by Fig. 1230, passes transversely across the tubes and around the annular baffles, and leaves the shell at the bottom. During its travels through the shell, the oil strikes the tubes approximately at right angles, thereby splitting into a great many fine streams.

The water flows through the tubes in an opposite or countercurrent direction to the oil and effects the maximum cooling.

The tube sheets are built of a composition metal, into which the tube ends are cast. Thus it is possible to choose the number, shape, size and spacing of the tubes so that the greatest cooling effect is obtained. The shape or size of tubes is not determined or limited by requirements of manufacturing, as is the case with coolers using drilled tube sheets. In the latter the spacing is restricted, since the metal between the holes must be sufficiently strong to withstand the operation of expanding, rolling or threading the tubes into the sheets.

The upper tube sheet is rigidly secured to the shell; the lower one forms a floating head construction. Thus ample provision is made for the expansion and contraction of the tubes. Each tube experiences the same expansion and for this reason there is no tendency for the tubes to become loosened or for the tube sheets to be strained.

APPLICATIONS

In some cases electric transformers are operated in connection with oil coolers in which air is utilized as the cooling medium. This arrangement involves the use of a Cooler of different construction than the type described in this bulletin, and for air-cooled coolers the reader is referred to Bulletin 12-G.

Oil Coolers are extensively used in the preparation of gasoline and other oils, and various types are employed to meet the special operating conditions encountered in the Oil Industry. One of the standard applications for ƙ Oil Coolers in plants of this kind is in connection with the Mineral Seal Oil Absorption System. Further details covering the use of these Coolers and similar heat exchange apparatus in the Oil Industry will be found in Bulletin 12-H.

In the manufacture of sheet metal automobile bodies, fenders, hoods and other parts, and in the preparation of many other classes of sheet metal pieces, the enamel coating is applied in large dip tanks which are operated in connection with drying chambers. In many cases the enameling and drying take place in several stages and the heat absorbed by the sheet metal parts while in each drying chamber, is transferred to the enamel bath into which the piece is next immersed. A continued addition of heat has a tendency to thin the enamel and interfere with proper coating, and for this reason it has been found advisable to circulate the enamel through a cooler in which the heat can be dissipated. The ƙ Cooler, using water as the cooling medium, is being used for such service with excellent results.

Other applications for ƙ Oil Coolers:

1. When test is required on oil pumps for a long period of time in a closed system, the oil becomes heated and this heat must be removed, so that the test can be continued without interruption.
2. In hydraulically operated presses or rams, using oil to convey the pressure.
3. Thrust bearings.
4. In connection with speed reducers where oil is used as transfer medium.

Customers are requested to present their problems to the Schutte and Koerting Company's Heat Transfer Department, as standard Coolers of the type covered by this bulletin or of special types illustrated in other bulletins can usually be adapted to meet the operating conditions specified.

SINGLE PASS OIL COOLERS

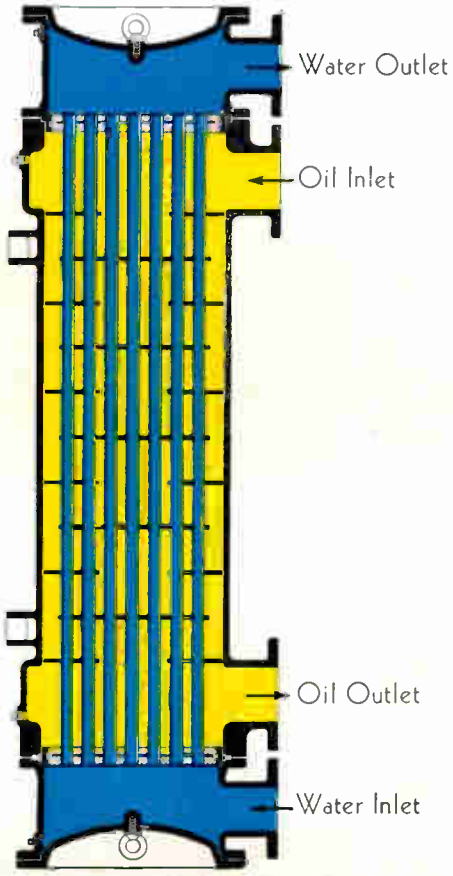


FIG. 1230. SECTIONAL VIEW OF OIL COOLER. Yellow is used for oil, blue for water.

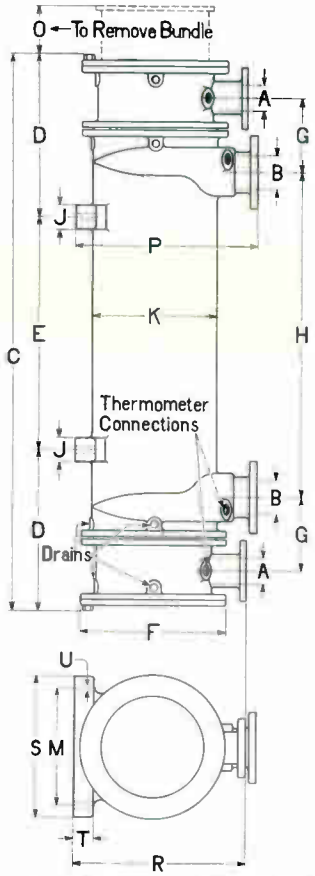


FIG. 1230-F. ESSENTIAL DIMENSIONS OF OIL COOLER.

TABLE 1. OIL COOLER

No.	Water A	Oil B	C	D	E	F	G	H	J	K	M	O	P	R	S	T	U	Wt. in lbs.
000	1	1	41 3/16	12 13/16	15 3/16	8	5 5/8	23 3/16	2	5 3/16	5 1/2	25	9 3/4	9 3/4	7	1 1/2	13/16	160
00	3/4	1	43 7/8	11 5/16	21 1/4	8 1/2	4 3/4	27 7/8	2	5 11/16	6	31 3/4	10 1/2	10 1/2	7 1/2	1 1/2	13/16	215
0	1	1 1/4	46 1/4	13 7/16	23 3/8	9 5/8	4 7/8	30	2 1/4	6 7/8	7 3/4	34	11 5/8	11 5/8	9 1/4	1 1/2	1 1/16	295
1	1	1 1/2	46 1/4	11 5/8	23	10 1/4	5	29 3/4	2 1/2	8 1/8	7 3/4	34	13	13	9 1/4	1 3/4	13/16	350
2	1 1/4	2	50 3/8	12 3/4	21 7/8	11 3/4	5 5/8	32	2 1/2	9 1/2	8 3/8	36 3/4	14 7/8	14 7/8	10 1/8	2	1 1/16	550
3	1 1/2	2 1/2	51 1/2	14 3/16	26 1/8	13	6 9/16	33 5/8	2 1/2	10 7/8	9 1/2	39 1/4	16 3/8	16 3/8	11 1/2	2	1 1/16	625
4	2	3	59 1/4	16	27 1/4	14 7/8	7 5/8	35 1/8	2 1/2	12 3/8	11 1/2	41	18 1/2	18 1/2	13 1/4	2 1/4	13/16	850
5	2 1/2	3 1/2	61 1/2	18 5/16	27 7/8	16 1/4	8 7/8	37 7/8	3	13 7/8	12	43	21 1/4	19 5/8	14	2 1/2	13/16	1025
6	3	4	68 3/8	19 13/16	28 3/4	17 3/4	9 1/16	40	3	15 1/8	13	45 1/2	22 1/4	21	15	2 1/2	13/16	1175
7	3 1/2	4 1/2	73 1/4	20 1/2	32 1/4	19	9 1/2	43	3	16 5/8	14 1/2	47 1/4	24	22 1/2	17	2 1/2	13/16	1680
8	4	5	77 3/8	21 15/16	33 1/2	20 1/2	10 1/4	45 1/8	3	18	16	50	24 1/2	24 1/2	18	2 1/2	13/16	1750
9	5	6	82 3/8	23 5/8	35 1/8	21 7/8	11 1/8	47 3/8	3 1/2	19 3/8	17 1/4	52 1/2	27 3/4	26 3/8	19 1/4	3	13/16	2190
10	5	6	82 3/8	21 5/8	34 1/8	22 3/4	11 1/4	47 1/8	3	20 1/2	19 1/2	52 1/2	28 1/2	28 1/2	21 1/2	2 1/2	13/16	2850
11	6	6	99 1/4	32 1/8	35	27 1/2	13 3/4	53	4 1/2	23 1/4	21	55	32 7/8	32 5/8	24	2 3/4	1 1/8	4350
12	6	6	99 3/4	32 1/2	34 3/4	30	13 3/4	53 1/4	5	25 3/4	23	56	35	35	26	2 3/4	1 1/8	5200

ƙ TWO-PASS OIL COOLERS

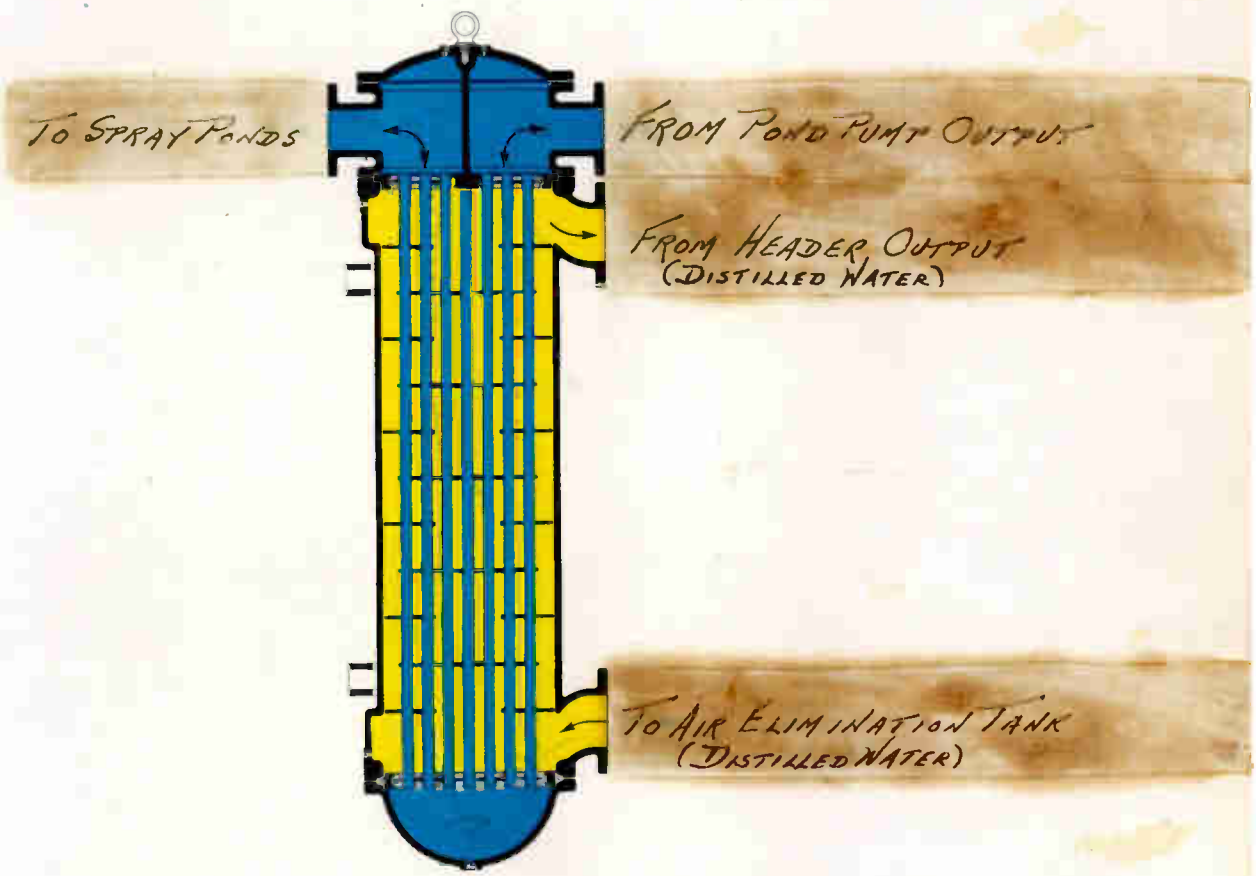


FIG. 1231.

Yellow is used for oil, blue for water.

THE ƙ two-pass Oil Coolers are used where the terminal difference between oil and water is not close and a minimum amount of cooling water is available. As you will observe from the sectional cut the oil and water flows are not true counter-current. therefore a small terminal difference means a greater amount of surface, hence a larger cooler than is necessary with the single pass design. Inspection of water side of tube bundle is readily made by removal of simple cover.

TWO-PASS OIL COOLER "K" TYPE

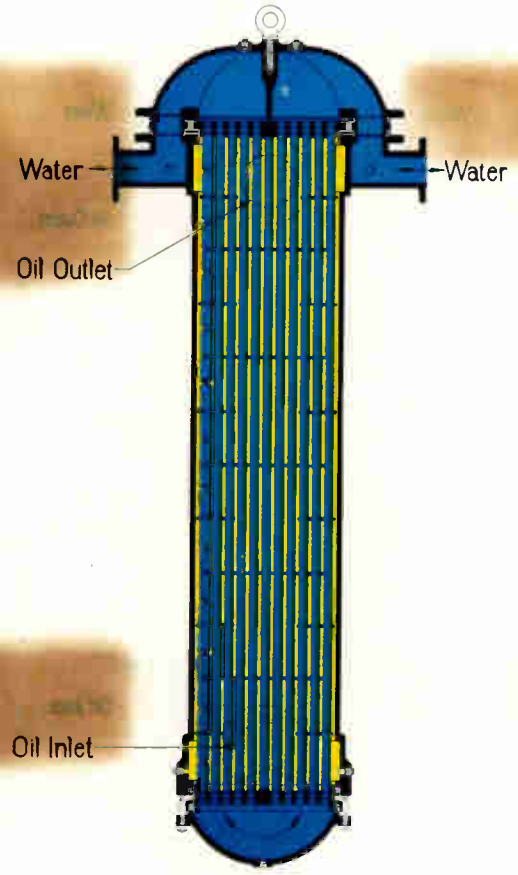


FIG. 1231-K.

Yellow is used for oil, blue for water.

THE two-pass "K" type Oil Coolers are designed so that tube bundle can be removed without breaking any pipe joints in either water or oil. However, in this design it is necessary to break the internal water joints to remove the top head for inspection of the water side of the tube nest. This construction is original with us. The double gland stuffing box on floating tube sheet can be furnished on any of our two-pass coolers.

℔ TWO-PASS "MIDGET" OIL COOLERS

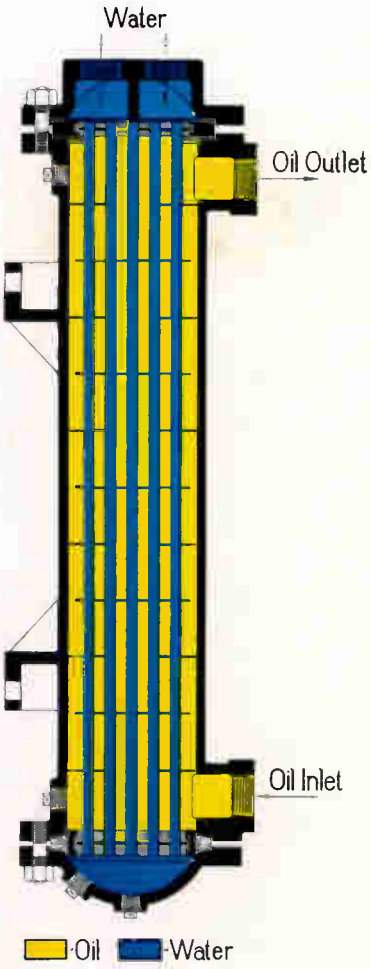


FIG. 1231-M.

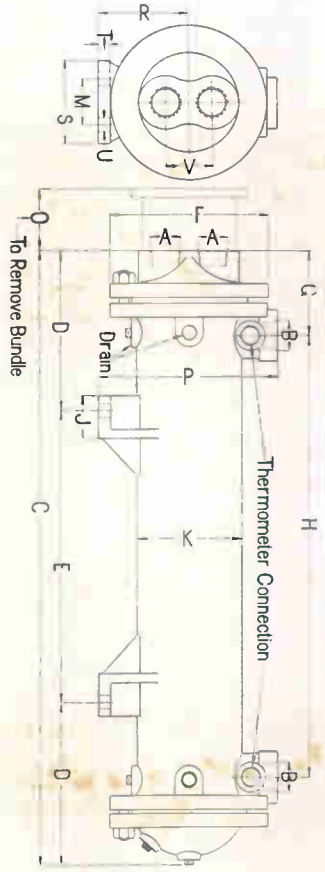


FIG. 1231-A.

PRINCIPAL DIMENSIONS OF ℔ "MIDGET" OIL COOLERS.

TABLE 1. ℔ "MIDGET" TWO-PASS OIL COOLERS, FIG. 1231

Size No.	Oil Capacity, G. P. M.	Wt., Lbs.	DIMENSIONS, INCHES																	
			Water A	Oil B	C	D	E	F	G	H	J	K	M	O	P	R	S	T	U	V
000	5	140	1	1	35 1/16	8 1/2	18 1/16	8	4 1/2	26 1/16	1 7/8	5 3/16	2 5/8	29 1/2	9	4 1/2	4 1/2	9/16	5/8	2 1/2
00	8	205	1	1	38 1/2	8 1/2	21 1/2	8 1/2	4 1/2	29 1/2	2 1/4	5 11/16	2 1/2	33	9 5/8	4 7/8	4 1/2	5/8	3/4	2 1/2
0	14	270	1 1/4	1 1/4	41 5/8	8 7/8	23 7/8	9 5/8	4 7/8	31 7/8	2 1/2	6 7/8	2 7/8	35 1/2	10 11/16	5 3/8	5	11/16	3/4	2 5/8
1	24	330	1 1/2	1 1/2	42 1/4	9 7/8	22 1/2	10 1/4	5 3/8	31 1/2	2 1/2	7 5/8	2 7/8	35 1/2	11 7/8	6 1/4	5	1/16	3/4	3 1/8

HEAT TRANSFER IN ƙ OIL COOLERS

THE heat transfer rate in oil coolers depends upon the viscosity and velocity of the oil, the velocity of the water, and the arrangements of the cooling surface, and for this reason it is impossible to use any fixed heat transfer rate in designing these coolers. For example, a cooler that will handle 100 gallons per minute of a certain grade of oil having a viscosity of 250 Saybolt seconds at 120° F., will cool about 75 per cent as much, or 75 gallons per minute of another grade of oil having a viscosity of about 750 Saybolt seconds at 120° F. through the same temperature range and with the same water conditions.

In the design of Oil Coolers the following factors must be considered:

The velocity and friction drop of the oil.
The velocity and friction drop of the water.
The heat transfer rate.

An increase in velocity increases the heat transfer rate but also increases the friction drop of the oil and water. Since a high transfer rate reduces the amount of surface required for a specified cooling, Oil Coolers should be designed with as high velocity of oil and water as permissible without causing excessive friction drop. In the ƙ Oil Cooler the heat transfer rate varies from 50 to 100 B.t.u. per hr. per sq. ft. of surface per degree Fahrenheit mean temperature difference between the oil and the water.

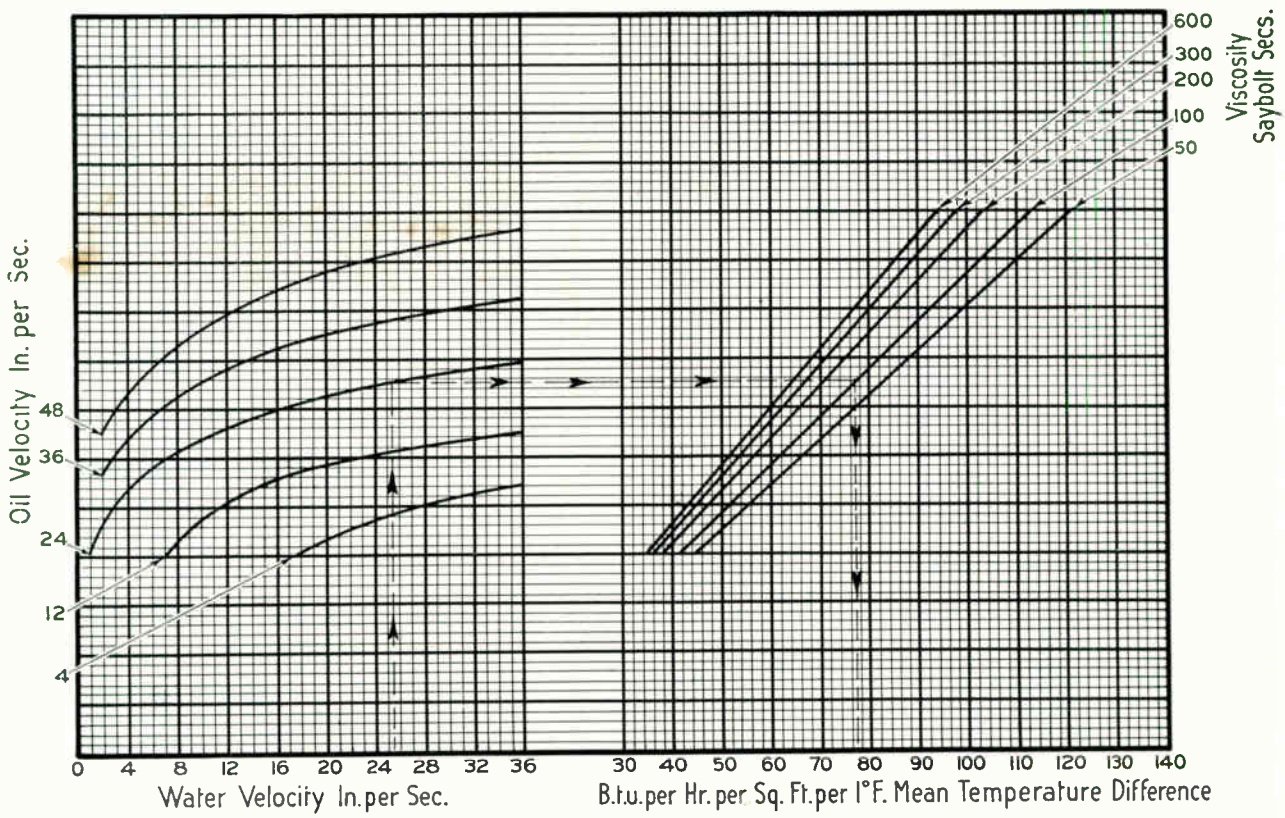


FIG. 1230-B. HEAT TRANSFER RATE WITH VISCOSITY CORRECTIONS FOR OIL COOLER.

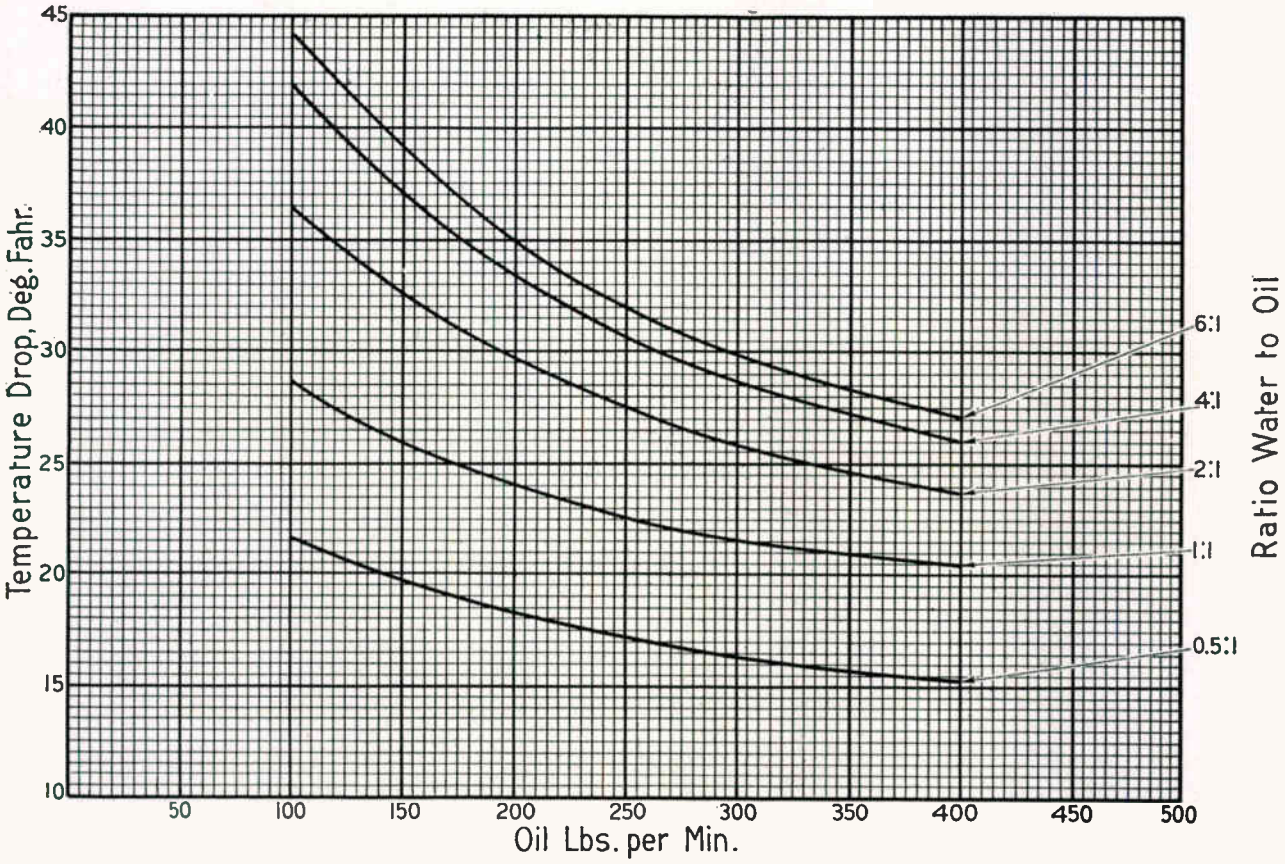


FIG. 1230-C. WATER-TO-OIL RATIOS AND COOLING EFFECTS FOR NO. 2 OIL COOLER.

Fig. 1230-B gives the heat transfer rates (in B.t.u. per hr. per sq. ft. of heating surface per 1°F., mean temperature difference between oil and water), corrected for oil viscosities corresponding to different oil and water velocities expressed in inches per second. For example, given a water velocity of 25.5 in per sec., and an oil velocity of 24 in. per sec., the viscosity of the oil being 100 Saybolt seconds, the correct heat transfer rate is determined from the right-hand section of the chart to be 77 B.t.u. per hr. per sq. ft. per 1°F., mean temperature difference.

Fig. 1230-C is drawn for a No. 2 oil cooler with inlet water at 80°F. and inlet oil at 160°F. When, for example, 300 lbs. of oil are passed through the cooler per minute, the temperature drop in deg. Fahr. is 16.5°, 21.5°, 26°, 28.5° and 30°F. for water-to-oil ratios respectively of 1:2, 1:1, 2:1, 4:1, and 6:1. In other words, there is a practical limit beyond which it is not advisable to increase the water-to-oil ratio since the temperature drop gained is not commensurate with the increase in the quantity of water circulated. As the data show, increasing the water-to-oil ratio 12 times corresponds only to a 14° increase in temperature drop, or about twice the temperature drop for a 1:2 ratio.

APPLICATIONS FOR S&K OIL COOLERS

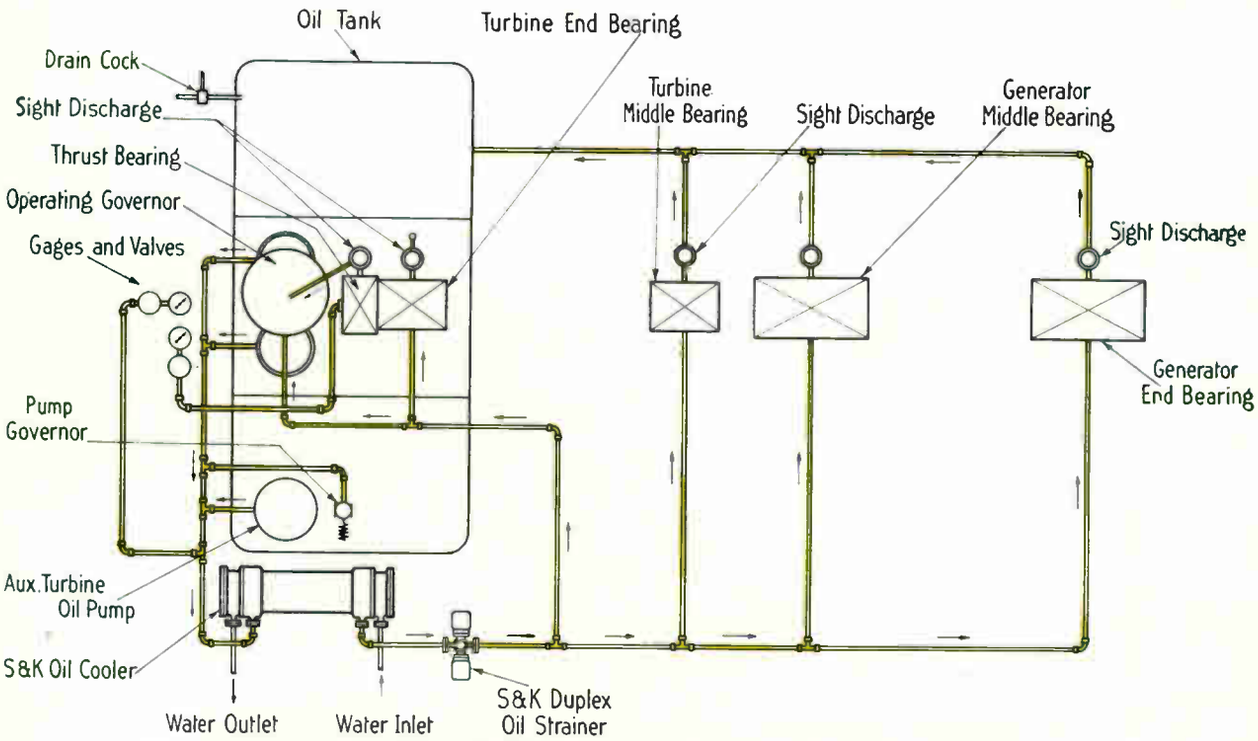


FIG. 1230-G. LUBRICATING SYSTEM FOR A STATIONARY TURBINE. Yellow is used for oil.

Different designs of turbines and gears will differ as to the amount of heat developed. For the average installation without reduction gears, it is sufficient to assume that the heat generated in the bearings will be 1.5 per cent of the total turbine horsepower. For installations with both bearings and gears, about 3 per cent of the total power will be lost as heat.

For example, for a 2500 H.P. turbine of average design, without reduction gears, the heat equivalent of the power is 6,362,500 B.t.u. per hour. Of this amount, 1.5 per cent is 95,437 B.t.u. per hour. Therefore the cooler should be designed to absorb from the oil 95,437 B.t.u. per hr., or 1,591 B.t.u. per minute.

If the oil has a viscosity of 150 Saybolt seconds at 120°F., and if an oil circulation of 30 gallons per minute or 233 lb. per minute is required, we have the following heat balance, assuming the specific heat of oil to be 0.5:

$$233 \times 0.5 \times X = 1591 \text{ B.T.U.'s}$$

Oil Temp. Drop X=13.7°F.

The cooler should therefore be designed to cool 30 gallons per minute of specified oil 113°F., that is, from about 127°F. to about 113° F. We recommend for stationary service an oil temperature drop of 30°F., namely, from 150 to 120°F., since from the experience of most engine and turbine builders, this range gives the best operating results. Under these conditions a high rate of oil flow in the bearings is provided, as well as a thin oil film that insures a vigorous movement and rapid efficient absorption of heat in the bearings.

OIL COOLING SYSTEM FOR QUENCHING TANK

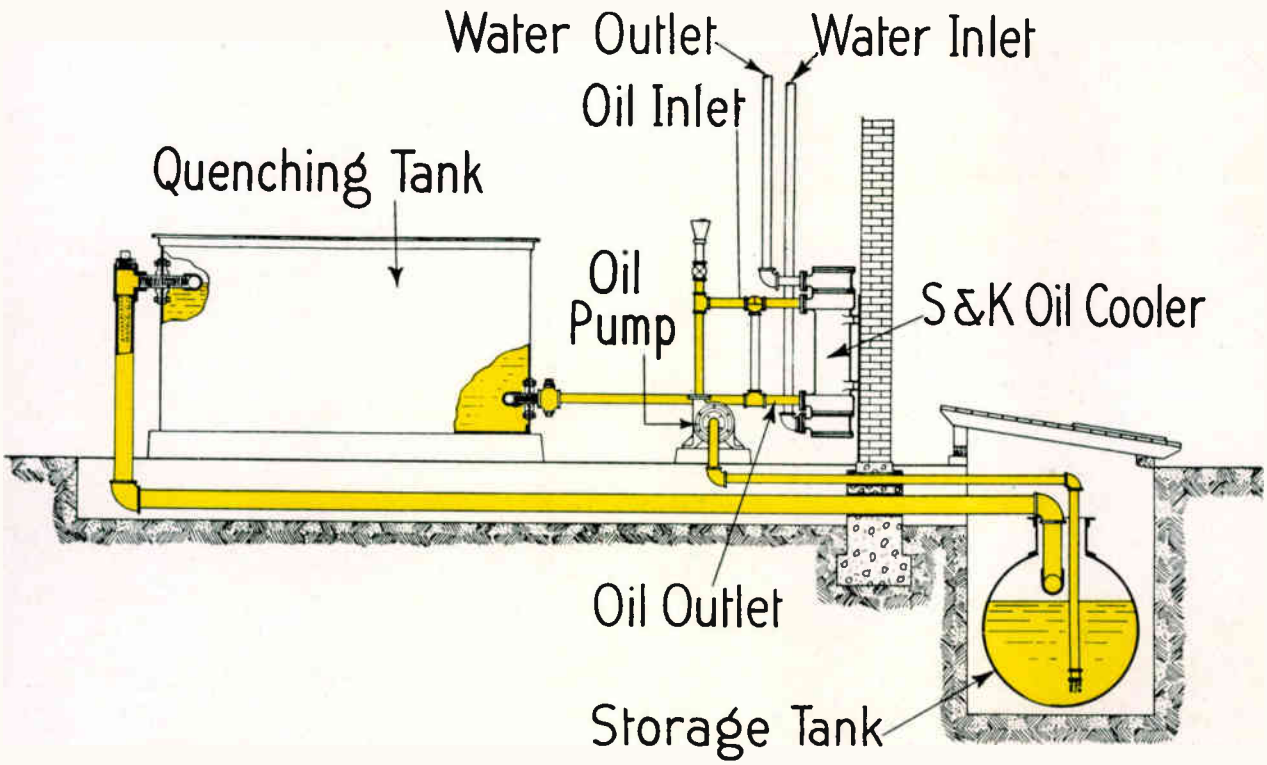


FIG. 1230-K. OIL COOLING SYSTEM FOR QUENCHING TANK. Yellow is used for oil.

For keeping constant the temperature of the oil in steel quenching tanks, ducts or coils through which cold water circulates are sometimes placed in the bottom of the oil tank. On account of the poor circulation of the oil either before or after the hot metal is plunged into it, this method is inadequate and inefficient.

The advantages derived are uniform hardening, saving in time, saving in oil, and elimination of fire risk.

When the oil is circulated, the temperature of the bath can be controlled closely and kept sufficiently low, thereby preventing the formation of vapor bubbles and soft spots on the surface of the hot steel.

ƙ TWO-PASS WATER COOLERS

COOLING WATER HEAT EXCHANGERS

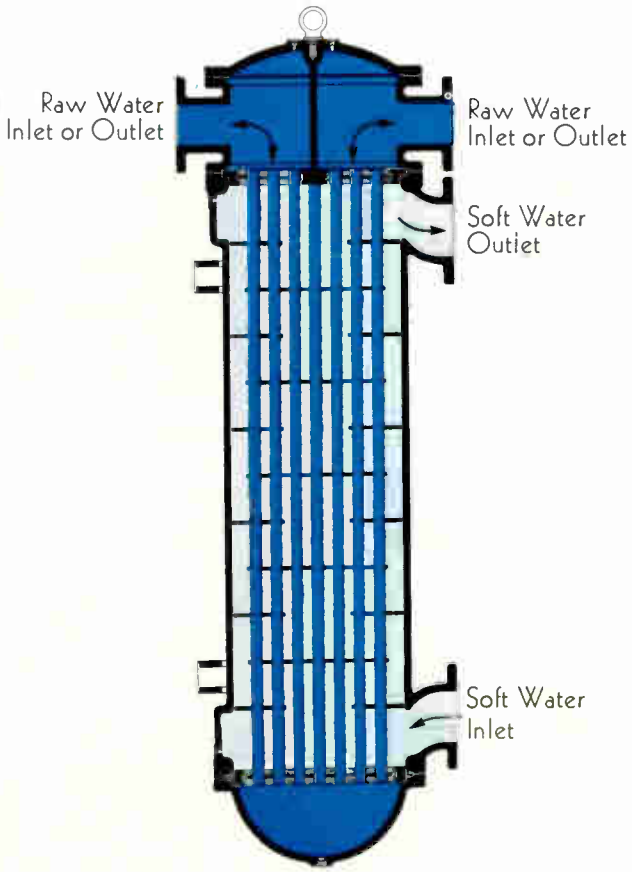


FIG. 1231.

On board ships or in plants where the supply of fresh water for cooling the jackets of internal combustion engines is insufficient, it is necessary to use the same clean jacket water over and over again, and for this reason, to recool the water.

This can be done to advantage in the ƙ Water Cooler, wherein the same principles of construction are employed, as in the ƙ Oil Cooler, and the same exceptionally high heat transfer, low weight and small space requirements are obtained.

Since there is no necessity of replenishing the jacket water, the same water is used over and over again. Thus, due to the continual circulation, the possibility that any sediment in the water will settle in the passes of the cooling jacket is reduced to a minimum, and cleaning of the jackets is unnecessary. All clogging of the passes is avoided, as are strains and cracked cylinders caused by uneven distribution of heat.

The cooling water in the cooler must be capable of carrying off from an ordinary commercial Diesel engine an amount of heat,—including that abstracted from the lubricating oil,—equal to about 35 per cent of the total heat in the fuel consumed.

For example, an engine consuming per B.H.P. hr. (horsepower hour actually delivered at the coupling end of the crank shaft), 0.40 lb. of fuel oil of 18,000 B.t.u. per lb. or 7200 B.t.u. per B.H.P. hr., will require sufficient cooling water to carry off 2520 B.t.u. per B.H.P. hr.

If the water has a temperature of 70°F., and the discharge temperature is limited to 100°F., the quantity of cooling water required will be 84 lbs. or about 10 gal. per hr. per B.H.P.

If the total heat of the engine amounts to about 775.000 B.t.u. per hr., about 260,000 B.t.u. per hr. would be transformed into mechanical work. This means a heat loss (total heat loss = total heat available minus heat transformed into mechanical work) of 775,000 minus 260,000, or 515,000 B.t.u. Of this amount, about one-half must be absorbed by the jacket water. One-half equals 257,000 B.t.u. per hr., the amount of heat to be absorbed by the jacket water, and to be surrendered to the water in the cooler.

If 250 B.t.u. are to be transferred per hr. per sq. ft. of heating surface per 1°F. mean temperature difference between the hot and cold water, and if the hot water is circulated around the tubes at a velocity of 18 in. per sec., then from Fig. 1230-D the velocity of the cooling water through the tubes must be about 19 in. per sec. For a heat transfer of 275 B.t.u. this velocity must be 23 in. per sec.

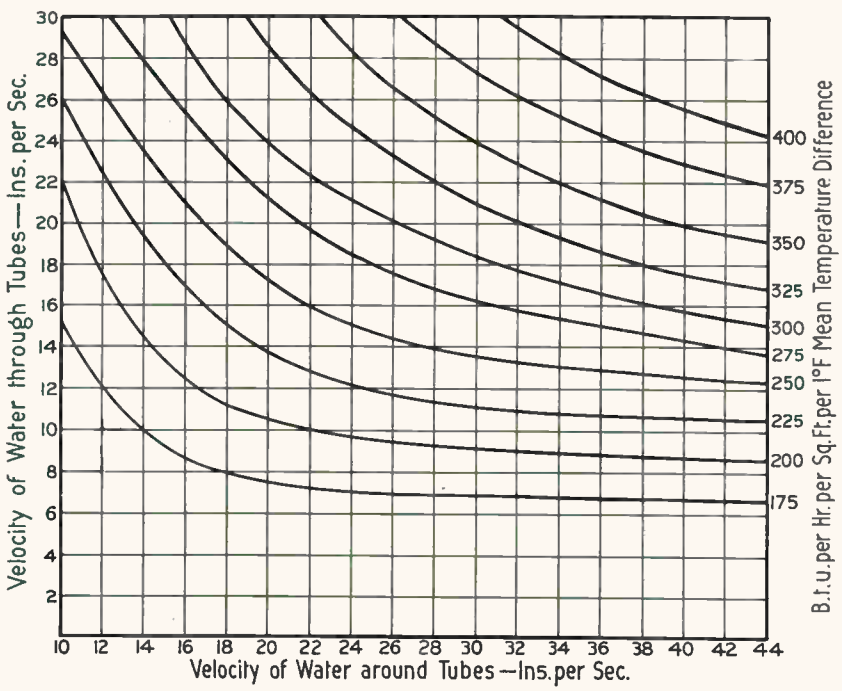


FIG. 1230-D. HEAT TRANSFER RATE FOR WATER COOLER.

MISCELLANEOUS APPLICATIONS

The hot waste water from dye tubes in dyeing and cleaning establishments, and in the dyeing departments of textile mills, and from washtubs in laundries and similar plants, can be utilized to heat boiler feed water or to recharge the tubs, thus effecting a considerable saving in fuel. A typical arrangement of an ƙ Water Cooler used as a heater for the above service is shown in Fig. 1230-M. The cold water flows from a tank on the roof through the heater in counter current with the hot waste dye water or wash water.

As an illustration of the saving effected by an arrangement of this kind, it can be estimated that in a plant having 17,000 gallons of waste water at 210 degree F. in 10 hours, 18,450 gallons of fresh water can be heated from 75 deg. F. to 170 deg. F. in the same time, the heated fresh water being used as boiler feed or for re-charging the tubs. This transfer of heat to the fresh water represents an actual saving in coal amounting to 272 tons per year.

In paper machines considerable heat is contained in the hot waste water leaving the felt washers. This heat can be utilized to raise the temperature of the fresh water going to the top felts by passing the waste water and the fresh water through an ƙ Cooler functioning as a Heat Exchanger. The cold, fresh water is circulated around the tubes while the hot waste water flows through the tubes.

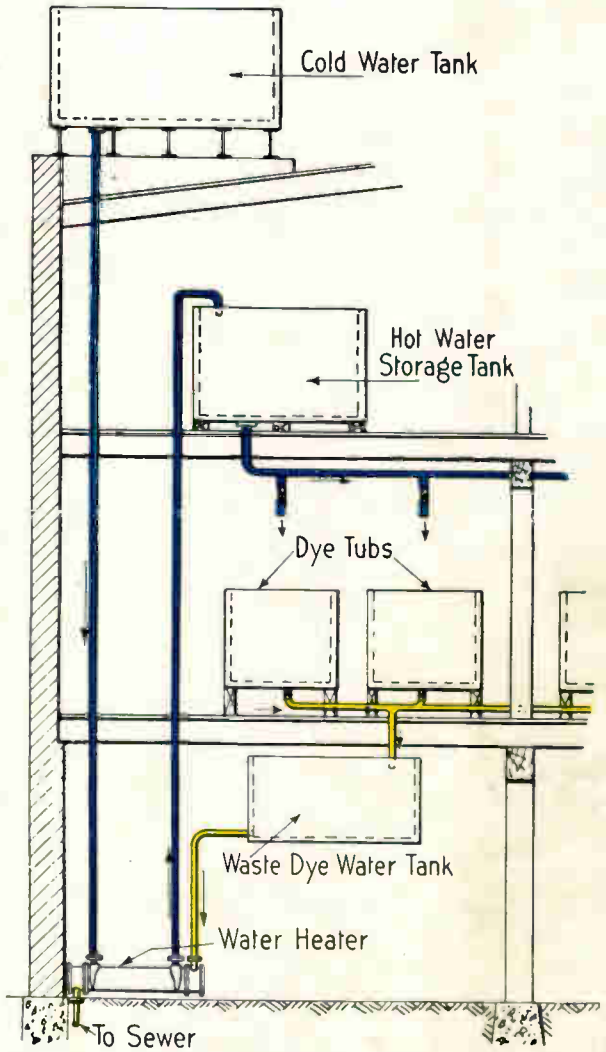


FIG. 1230-M. WATER HEATING WITH WASTE WATER.

Where the discharge from a process consists of water or other liquid at a high temperature considerable economy can be produced by extracting the heat from such discharge before it is allowed to run to waste. ƙ Heat Exchangers offer the simplest method of transferring this heat to the incoming water, oil or other liquid.

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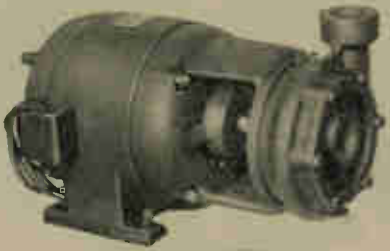
WORTHINGTON

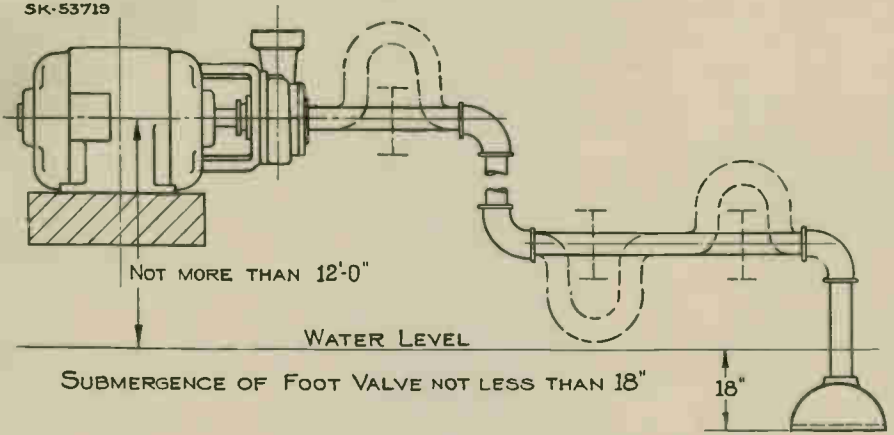
CENTRIFUGAL PUMPING UNITS

FOR GENERAL SERVICE
Type D (Monobloc)



INSTRUCTIONS FOR INSTALLATION AND OPERATION

WORTHINGTON PUMP AND MACHINERY CORPORATION



AVOID LOOPS IN SUCTION LINES AS SHOWN BY DOTTED LINES

DIAGRAM SHOWING ARRANGEMENT OF SUCTION PIPING

INSTRUCTIONS FOR
INSTALLING AND OPERATING

WORTHINGTON CENTRIFUGAL PUMPS AND MOTOR UNIT

Type D (Monobloc)

A motor pumping unit should be located so as to be easily accessible during operation, as close to the water supply as possible and with as short and direct suction and discharge pipe lines as conditions will permit.

Do not install the unit in a damp or moist place unless this condition has been especially provided for and do not set the machine close to furniture or goods that could be damaged by slight moisture or stuffing box leakage. Consult your dealer in regard to this point.

Both pump and motor are ruggedly built for continuous service and will require only reasonable attention.

MOTOR

The base or framing to which the motor is secured should be reasonably rigid and the upper surface fairly level. Supports, leveling or make-up pieces which may be required must be placed directly under, or close to, bolt holes so as to guard against possibility of cracking the base when tightening foundation bolts.

PUMP

Suction Piping. Measure length of screw thread on suction pipe and check when screwed into place to make certain that end of pipe does not contact with pump impeller. Turn shaft by hand after pipe

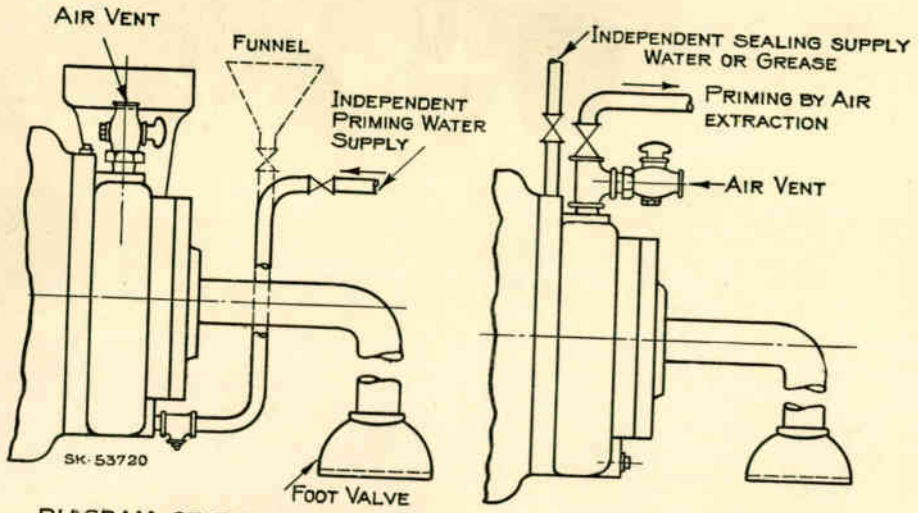


DIAGRAM OF PIPING AND VALVES REQUIRED FOR PRIMING

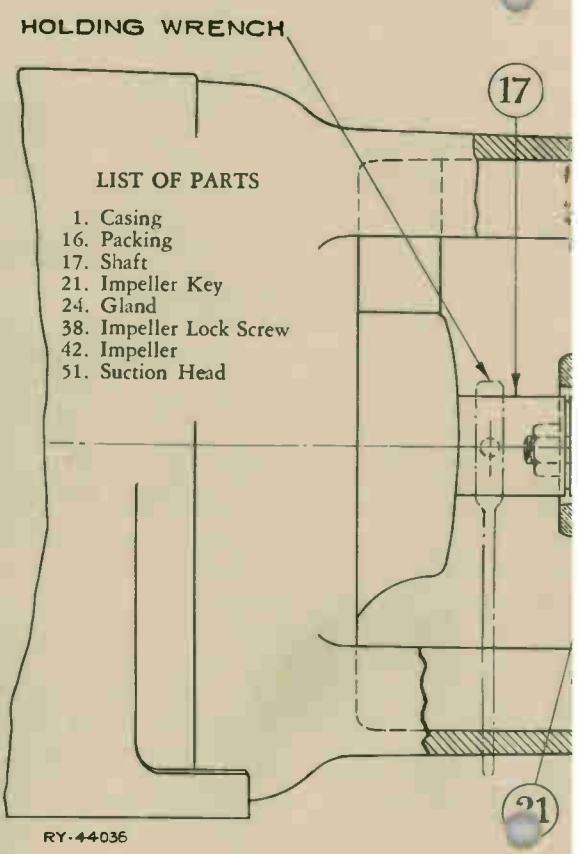
screwed home, to make sure that impeller turns freely. This pipe, after a generous application of compound to the threads, does not require to be tightened more than enough to insure an air and water tight joint. Violent straining is unnecessary.

While tightening pipe, screw a short piece of pipe into the discharge nozzle and use this as a brace. This will prevent bringing undue strains on the pump parts of the unit. The suction pipe should never be less than full size of suction opening and should be as short and direct as possible. The pump will operate satisfactorily under suction *heads* not exceeding 100 feet (43½ lb.) above pump.

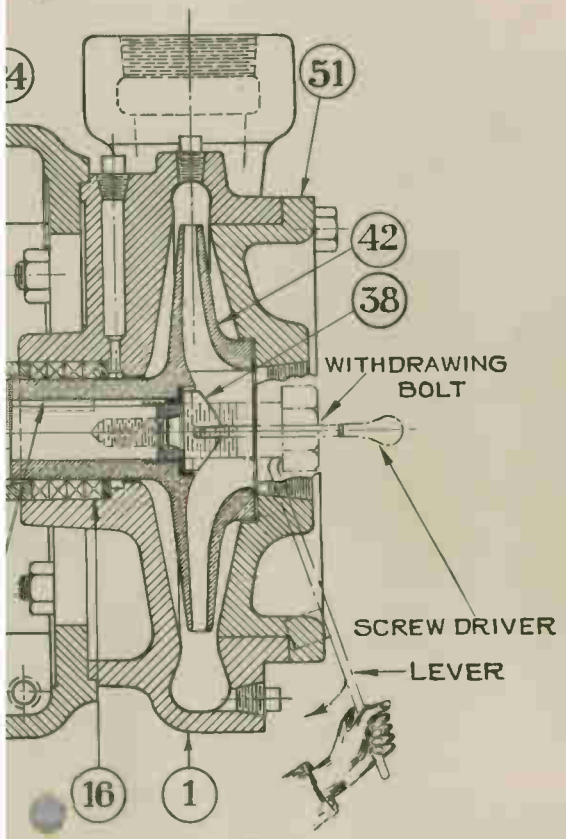
Where there is a suction *lift* the pump should be located as close to the surface of the water as conditions will admit and not more than 12 feet above this level. In cases where the suction pipe is long the total suction lift including pipe friction must not exceed 15 feet. The suction pipe should be laid with a rise toward pump and on no account must loops or air pockets occur in the length of the line. (See diagram on page 2.) The suction pipe should project into the well or source of water supply at least 18″ below its lowest level.

Discharge Piping. When connecting the discharge piping to the pump it is well to counteract strains, due to screwing up, with a large Stillson wrench held on the discharge nozzle. It is good practise to place a non-return check valve in the discharge piping close to the pump, although this is not essential when a foot valve is used in the suction pipe.

Both suction and discharge piping must be so made up and supported that pump and motor parts



SECTIONAL ELEVATION, PARTS LIST AN



METHOD OF WITHDRAWING IMPELLER

will not be under strain due to weight of pipe. It is recommended that unions or flanges be used close to the pump so that the pipes can be conveniently disconnected for the purpose of checking pipe alignment.

Priming. The pump should always be filled with water before starting. When the water level is below the center line of pump, it must be primed in order to start a flow of water through the pump. This is usually done by filling suction pipe and pump with water and for this method it is necessary to install a foot valve on the end of the suction pipe. This foot valve should have a clear area of at least one pipe size larger than suction pipe and, when necessary, should be combined with a strainer. The end of the pipe should be submerged at least 18". While this foot valve is needed primarily for filling the pump and pipe, it is an advantage always to use a foot valve when the water level is below center of pump.

When an external supply of water is available, a permanent pipe connection, carrying a shut off valve, may be made from the supply to the 1/8" pipe tap at the bottom of the pump volute, for filling suction pipe and pump. The vent cock (supplied with pump) is screwed into the 1/8" pipe tap on top of the volute. (See diagram on page 4.) This cock is opened when pump is being filled so as to allow the air to escape. When water overflows from the vent, both vent cock and valve in filling pipe should be closed and the motor started. When no external supply of water is available, a priming funnel, with shut off valve, is used in place of the connected

ater pipe. (See diagram on page 4.) Water is poured into pump through funnel, vent cock of course being left open while filling. When pump is full, close vent and funnel valve and pump is ready to start.

Instead of the preceding methods of filling pump, one of a number of types of air removal apparatus may be used, depending on the facilities available, the apparatus being piped to the 1/8" pipe tap at the top of the volute. (See diagram on page 4.) When using an air removal primer on a pump with high suction lift, it may be necessary to provide additional sealing for the stuffing box. This may be accomplished by piping an independent water supply to the stuffing box seal, by filling a funnel on this opening or by packing the funnel with grease before priming. (See diagram on page 4.)

Dismantling for Inspection or Repairs. The pump will operate satisfactorily for a long period of time when handling ordinarily clear water but if water is impure or gritty the life of the parts will be correspondingly reduced and when replacements are found to be necessary the usual and most satisfactory repair is to renew the entire pump end of the unit.

To remove the impeller of the pump, release impeller lock washer and lock screw then back off impeller by using the forcing off bolt and holding wrench (pin spanner), both furnished with pump, the spanner pin being inserted in the hole provided for it in the motor shaft. When replacing impeller be sure to secure lock washer; lock screw must not

be used in this operation, its function being only t lock impeller in place. (See diagram on pages 6 and 7.)

These pumps will positively do the work for which they are sold. If difficulties are encountered, and time is an important factor, personally investigate all possible sources of trouble both within, and external to, pump. The following suggestions are offered:—

1. Note if foot valve is sufficiently submerged.
2. Examine suction strainer, foot valve and suction pipe for obstructions.
3. Remove suction head (part 51) and run a piece of wire through impeller passages.
4. Test speed of motor.
5. Make certain that total head (discharge head plus suction *lift* or discharge head minus suction *head*) against which pump operates is not greater than that specified in the pump order. Use calibrated gauges, where possible, in checking. Note especially that suction and discharge piping should be as free as possible from short bends. Allowance should be made for friction losses in piping when selecting a pumping unit and where unduly long, piping should be increased in size to keep these losses at a minimum.

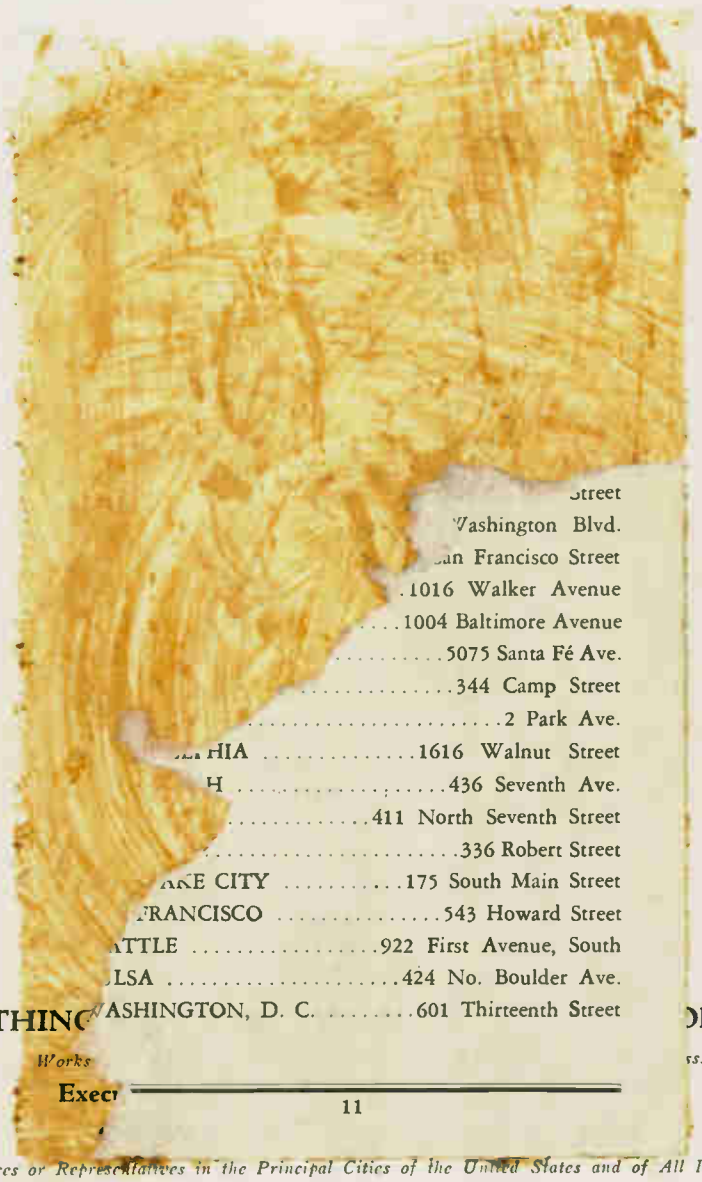
If additional suggestions are required communicate with nearest district office or with dealer whose tag is attached to motor frame. In ordering repair or writing for information always give pump serial number and size as stamped on name plate.

W-300-E1B 6-31
(Superseding W-300-E1A)

WORTHINGTON

CENTRIFUGAL PUMPS

INSTRUCTIONS FOR INSTALLATION AND OPERATION



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...1016 Walker Avenue
...1004 Baltimore Avenue
...5075 Santa Fé Ave.
...344 Camp Street
...2 Park Ave.
...HIA ...1616 Walnut Street
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THE INSTALLATION AND OPERATION OF CENTRIFUGAL PUMPS

INTRODUCTION

1. These instructions cover the general points in erecting, operating and maintaining Worthington Centrifugal Pumps.

The information contained herein is of a general character and will be supplemented upon request by specific instructions applying to the particular type of centrifugal pump being operated. It is requested that these instructions be placed in the hands of those directly charged with the installation and operation of equipment furnished by us. Satisfactory service can be realized only upon strict adherence to these instructions.

CHECKING EQUIPMENT

2. As soon as shipment is received, inspect and check with shipping manifest and report any damage or shortage to transportation company's local agent.

SELECTING LOCATION

3. The pump should be so placed that it is easily accessible for inspection during operation, at the same time giving due attention to the desirability of simplifying the suction and discharge piping arrangement. In general, a pump should be located as close to the water supply as possible, so as to make the suction piping short and direct. On pumps of larger size there should be ample head room to allow the use of an overhead crane or supporting structure, sufficiently strong to lift the heaviest part of the unit. Motor driven units should not be located in damp or moist places, unless this condition has been especially provided for.

SUCTION LIFT

4. In an ordinary pumping installation it is recommended that the suction lift should not exceed 15 ft. If the water is warm this must be reduced. Water at 212° F. must flow to the pump under a net head of from 10 to 20 feet, depending on the capacity at which the pump is operating. At higher altitudes the lift must be decreased or the head increased one foot for every 1,000 feet above sea level.

FOUNDATION

5. The foundation may consist of anything sufficiently heavy to afford permanent rigid support at all points of the bedplate and to absorb any normal amount of vibration that may develop from any cause.

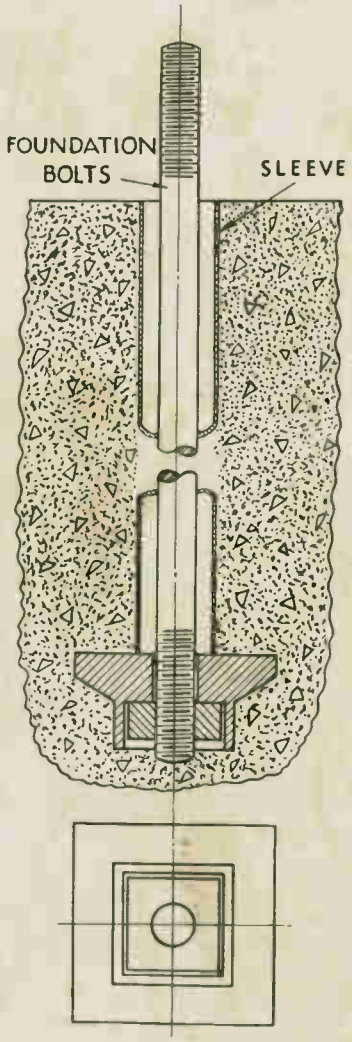


Fig. 1

6. Concrete foundations built up from solid ground will prove the most satisfactory. In building the foundation an ample allowance for grouting should be made.

7. Foundation bolts of the specified size should be accurately located according to drawings or templates and each bolt should be surrounded by a pipe sleeve, shown by Fig. 1, three or four diameters larger than the bolt. After the concrete is poured the pipe is held solidly in place while the bolts inside of it may be moved around to conform to the holes in bedplate.

8. When a unit is mounted on steel work or other structure, it should be set directly over, or as near as possible to the supporting beams and walls and be so supported that the baseplate cannot be distorted and alignment disturbed by any yielding or springing of the structure.

ERECTION

9. **Alignment.**—Correct alignment is absolutely essential to successful operation. A flexible coupling is no excuse for misalignment. Centrifugal pumping units should be aligned just as accurately as if the flexible coupling were solid. The flexible coupling will then serve its purpose, i.e., eliminate the transmission of end thrust from one machine to the other and compensate for slight changes in alignment which may occur during normal operation.

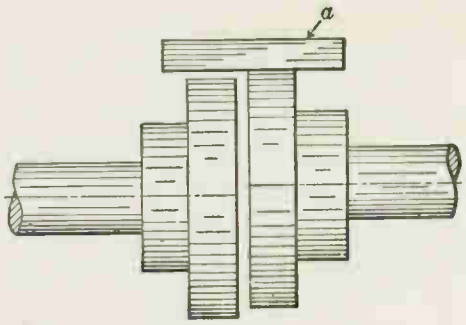


Fig. 2

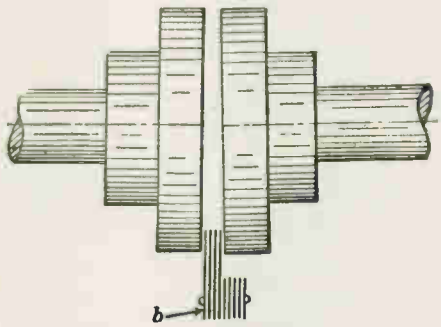


Fig. 3

10. **Factory Alignment.**—Every unit that is assembled at our works is accurately aligned by placing the baseplate on a surface plate, levelling the machined pads and then shimming where necessary under the feet of the pump and driver to obtain perfect alignment. However, all baseplates are elastic no matter how deep or heavy they may be and on account of this fact we cannot assume responsibility for the proper mechanical operation of a unit unless the shop alignment is reproduced after the unit is erected on its foundation.

11. **Field Alignment.**—Pumps are, with few exceptions, shipped on their bedplates and it is usually unnecessary to remove the pump and driver from the bedplate while levelling up. The pumping unit should be placed on the foundation, supported by plates and wedges placed near the foundation bolts, allowing from three-quarters to two inches opening between the bottom of the baseplate and the top of the foundation for grouting.

Do not fail to remove coupling bolts before proceeding with levelling and aligning the unit. Clean the projections of the baseplate pads upon which the pump feet are supported. Place a small spirit level on these pads and adjust the wedges under the bedplate to bring the pump shaft level and the pump nozzles into a true vertical plane. On pumps of the sleeve bearing type the top half bearing caps and bushing may be removed and the unit leveled with the spirit level resting on the shaft.

During the above procedure very little attention will have been given the driver half of the unit and in most cases it will be found that the coupling halves may be out of alignment by an appreciable amount. In any event, the alignment must be checked and corrected by adjusting the wedges under the driver end of the baseplate to bring the driver half coupling in perfect alignment with the pump half coupling. The checking of alignment can be accomplished by the use of a straight edge across the top and sides of the coupling, at the same time checking the faces of the coupling halves for parallelism by means of a thickness gauge or set of feelers as shown in Figs. 2 and 3.

12. When the couplings are perfectly true on both the faces and outside diameters, exact alignment will show that the distance between the faces is the same at all points and a straight edge will lay squarely across the rims at any point. If the faces are out of parallel the thickness gauge or feelers will show a variation at different points. If one coupling is higher than the other the amount may be determined by the straight edge and feelers.

13. It may sometimes be found that the couplings are not perfectly true and not the same diameter. In checking the trueness of either coupling half, revolve it, holding the other coupling half stationary and checking alignment at each quarter turn of the half being rotated. Next revolve and check alignment of the half previously held stationary. If any variation is found in either of the half couplings, proper allowance must be made in aligning the unit.

14. In cases where pumps are driven by steam turbines which are subject to temperature changes in operation, final alignment should be made with the driver heated to its operating temperature. Where this is not possible at the time of alignment, proper allowance should be made. Similarly, where the pump element is subject to expansion in service due to handling hot liquids, allowance must be provided for expansion. In any case the cold alignment should be checked when hot and adjusted as required before the unit is placed in service.

15. The clearances between the faces of the couplings should be set so that they cannot strike, rub or exert pull on either pump or driver. The amount of

this clearance may vary with the size and type of coupling used. The best rule to follow is to allow sufficient clearance for unhampered endwise movement of the shafts of the driving element to the limit of its thrust bearing clearance. On motor driven units the magnetic center of the motor will determine the running position of the motor half coupling. It is well to check this point by operating the motor light before the coupling bolts are replaced. If electric power is not available to operate the motor light, move motor shaft in both directions as far as bearings will permit then adjust shaft centrally between these limits, assembling the unit with the correct gap between coupling halves.

16. Do not put coupling bolts in until the piping is complete and the driver has been tried out for correct direction of rotation.

17. **Important.**—Alignment must be checked after the pump has been completely piped up for the reason that pumps are easily sprung and pulled out of position by drawing up the bolts in the piping flanges where these flanges are not brought squarely together before the bolts are tightened. Particular care must be taken to properly support the suction and discharge piping so that they can not exert a strain or pull on the pump. Pipe strains are a common cause of misalignment, hot bearings, worn couplings and vibration.

18. **Grouting.**—The bedplate is ordinarily grouted in before the piping connections are made. However, in some special cases, the reverse procedure is permissible. The usual mixture for grouting a machine is composed of one part pure cement and two parts sand with sufficient water to cause the mixture to flow freely under the bedplate. A wooden form should be built around the outside of the bedplate to contain the grout and provide sufficient head to assure a flow of the mixture underneath the entire bedplate. After grouting, the unit should be allowed to set for 48 hours.

PIPING CONNECTIONS

(See page 7)

19. **Suction Piping.**—Experience has shown that by far the greater number of troubles with centrifugal pumps, outside of misalignment, can be traced to a faulty suction line. We would emphasize that attention be given to this point when installing a pump. The suction piping should never be less in diameter than the full size of the pump suction opening. It should be as short and direct as possible. In cases where a long suction line can not be avoided, the size of the piping should be increased. Air pockets or high spots in a pump suction line will invariably cause trouble. The piping must be laid so as to provide a continual rise without high spots from the source of supply to the pump. See sketches, page 7.

20. The suction pipe should project into the well or source of supply a sufficient amount to insure that the pipe is well submerged when the water is at its lowest level, with the pump operating. Large pipes are usually submerged four times their diameter while small pipes require from two to three feet submergence. The suction pipe should be blanked off and hydrostatically tested for air leaks before starting up.

21. **Discharge Piping.**—The discharge pipe should be installed with a check valve and gate valve near the pump outlet. The check valve provides protection from excessive pressure or water hammer. On units having no suction foot valve, the check valve eliminates the possibility of the pump running backward if for any reason the driver ceases to function.

22. **Foot Valve**—A foot valve may be installed on the end of the suction pipe for convenience in priming or where the pump is subject to intermittent service. Care should be used in the selection of the size and type of foot valve in order to avoid excessive friction loss through the valve. We emphatically discourage the use of an ordinary swing check valve as a foot valve. See sketches, page 7.

23. **Strainer.**—A strainer should be placed in the suction pipe to prevent lodgment of foreign material in the impeller. It is very important to take every possible precaution to protect the pump from becoming clogged up, as serious damage may ensue. A strainer with a net area of from three to four times the area of the suction pipe should be selected. The net area is understood to mean the clear and free opening through strainer. If the strainer is likely to become frequently clogged, an accessible place should be selected for the suction pipe. For large pumps, removable screens should be placed at the entrance to the suction well.

24. **Jacket Piping.**—If a thrust bearing is supplied, make sure that the jacket cooling water pipe is connected so that the supply enters at the bottom and discharges from the top. For the purpose of observing whether the jacket water is flowing, and for the regulation of the amount, it is good practice to pipe the discharge jacket water so that it will have an open flow into a funnel connected to a drain.

25. **Drain Piping.**—All drain connections should be piped to a pump pit or suction well so that the drain water will be properly carried away.

26. **Gland Piping.**—Piping to each gland should have a valve to control the amount of water necessary to feed and seal each gland and to permit enough seepage to lubricate the gland.

STUFFING BOXES

27. **Packing.**—We recommend the use of Worthington square, soft, asbestos graphited packing, or equal, for either hot or cold water service. Do not use flax packing under any circumstances on centrifugal pumps having bronze shaft sleeves as rapid wear of the sleeves may result. To properly pack a centrifugal pump, the packing rings should be cut slightly short so as to prevent butting of the ends and buckling. Each ring should be inserted separately and pushed as far into the stuffing box as possible by means of the gland. The split of successive packing rings should be placed 90 degrees apart. After two or three rings are inserted, the water seal cage should follow so as to bring the cage directly under the water pipe connection as shown in Fig. 4 at A. Next insert enough additional packing to allow the gland to be loosely drawn up.

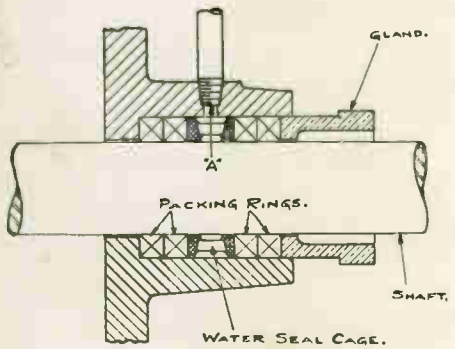


Fig. 4

28. **Water Seal.**—The stuffing boxes are water sealed to prevent air from leaking in and also to keep the packing wet. For this purpose a composition cage in halves is inserted in the middle of the packing space and is supplied with water through a pipe connected to the box. If the pump handles clear, cold water, the supply for the water seal may be taken directly from the discharge.

29. **Independent Water Sealing** should be provided from an independent source of cold, clean water, at a pressure of 15 to 40 lb., under the following conditions:

a. On suction lift from 20 ft. to 25 ft. (Ordinarily operation above 15 ft. is not recommended.)

b. When the discharge pressure is less than about 10 lb., or 23 ft. head.

c. When pumps are handling hot water over 200° F.

d. When the water is muddy, sandy or gritty.

e. In general, when the liquid handled is other than water, such as acid, juice, molasses and sticky substances.

f. On all hot well pumps.

PRIMING

30. A centrifugal pump should never be operated unless first filled with water, as in addition to the impossibility of the pump delivering water when operated dry, the wearing rings are likely to seize and cause serious damage. The only exception to the above rule is in the case of pumps specially designed to start dry, and provided with water lubricated wearing rings with the water supply coming from a source external to the pump.

31. With a foot valve installed on the suction pipe, the pump can be primed by opening a vent cock or valve at the high point of casing and admitting water from some outside source until the suction pipe and pump casing are completely filled with water. Care must be taken to exhaust all air from the suction pipe and pump casing, as any air that remains entrapped will interfere with operation or hinder the pump from lifting its water.

32. If a foot valve has not been installed on the suction pipe, an ejector of some good design, and of ample size, should be connected to the high point on pump casing. Ejectors can be operated with either air, steam or water. If water is used, the supply must be of sufficient pressure to give a high velocity through the ejector.

33. Priming is of course unnecessary on pumps having a suction supply under sufficient head to fill the pump casing. Under this condition it is only necessary to open a vent cock at the high point of the casing in order that the water may expel any entrapped air.

34. Another very satisfactory method of priming a centrifugal pump is by the use of a motor driven rotary vacuum pump. There are several types of these units procurable which will handle both air and

water successfully. If a dry vacuum pump is used for priming purposes care must be taken to protect the vacuum pump from drawing over any water.

STARTING AND OPERATING

35. Before starting up the first time, try out the prime mover for correct direction of rotation with the coupling bolts removed from the coupling. The arrow on pump casing shows the correct rotation.

36. Wash out all bearings thoroughly with kerosene. When the pump is equipped with ball bearings, remove the small plug in the grease chamber and fill with a good grade of soft grease of the same consistency as is used on automobile links and shackles. When pumps are furnished with ring oiled sleeve bearings, the bearing should be filled with clean dynamo oil. Check the jacket cooling water piping on thrust bearings to make sure the inlet enters at bottom and discharges from top, and then turn on the supply, allowing an ample amount of water to flow to keep the bearing cool. The water seal supply to glands may then be turned on and the pump primed. *Do not run pump unless primed and full of water as there is danger of injuring some of the interior parts which depend on water for lubrication.*

37. Final inspection should be carefully made of all parts of unit before starting up to make sure every part is ready for operation. Bring the pump up to speed. After a pressure is built up on the discharge, open the discharge gate valve slowly.

38. A compound gauge connected to the suction of the pump and a pressure gauge connected to the discharge, and mounted at a convenient place, will be a great help to the operator.

39. During the routine operation of pumps the bearings should be occasionally inspected to determine whether the lubrication is satisfactory. On ball bearings lubricated by grease cups it will usually be found that a few turns of the cup once every week will be all that is necessary. Ring oiled sleeve bearings should be inspected periodically to determine whether the oil rings are turning freely and supplying enough oil to the shaft and bearings. We recommend draining, washing out and removal of the lubricant at regular intervals, particularly during the first month of operation.

40. The stuffing box glands must be so adjusted as to permit a slight seepage of water out of the stuffing box at all times during operation, otherwise the packing will cause excessive wear on the shaft sleeves, as the stuffing boxes are dependent upon water for lubrication as well as for sealing.

LOCATING TROUBLES

41. The troubles which may occur with a centrifugal pump, and their causes, are listed below. We would suggest that the operator can often avoid unnecessary expense by careful consideration of the points outlined.

42. Failure to Deliver Water
- (a) Pump not primed.
- (b) Insufficient speed.
- (c) Discharge head too high.
- (d) Suction lift too high (over 15 feet), check with vacuum gauge.
- (e) Impeller plugged up.
- (f) Wrong direction of rotation.

43. Insufficient Capacity
- (a) Air leaks in suction or stuffing boxes.
- (b) Speed too low.
- (c) Total dynamic head higher than that for which pump is rated.
- (d) Suction lift too high (over 15 feet), check with vacuum gauge.
- (e) Impeller partially clogged.
- (f) Insufficient suction head for hot water.
- (g) Mechanical defects.
  - Wearing rings worn.
  - Impeller damaged.
  - Casing packing defective.
- (h) Foot valve too small or restricted by trash.
- (i) Foot valve or suction pipe not immersed deep enough.

44. Insufficient Pressure
- (a) Speed too low.
- (b) Air in water.
- (c) Mechanical Defects.
  - Wearing rings worn.
  - Impeller damaged.
  - Casing packing defective.

45. Pump Loses Water After Starting
- (a) Leaky suction line.
- (b) Waterseal plugged.
- (c) Suction lift too high (over 15 feet).
- (d) Air or gases in water.

46. Pump Overloads Driver
- (a) Speed too high.
- (b) Total Dynamic Head lower than rating,—pumping too much water.
- (c) Liquid pumped of different specific gravity and viscosity than that for which pump is rated.
- (d) Mechanical defects.

47. Pump Vibrates
   (a) Misalignment.
   (b) Foundation not sufficiently rigid.
   (c) Impeller partially clogged, causing unbalance.
   (d) Mechanical defects.
      Shaft bent.
      Rotating element binds.
      Worn bearings.

ORDERING REPAIRS

48. When ordering repair parts or writing for any information not given in the foregoing instructions, always state the pump serial number and size as stamped on the nameplate. Give name and number of each repair part as shown on the attached part list.

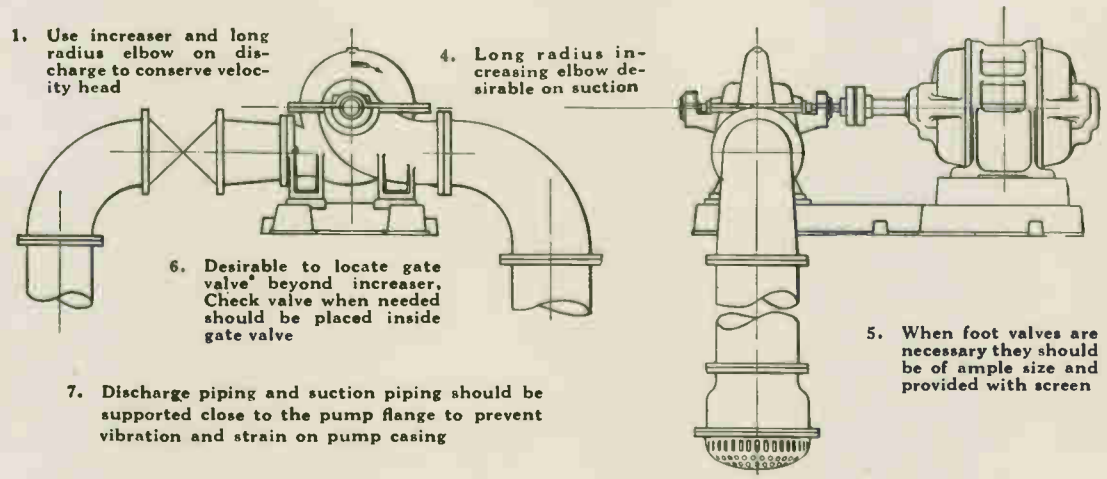
TYPICAL INSTALLATION POINTS TO REMEMBER

The diagram on this page suggests a typical arrangement for piping connection to a double suction volute pump.

External losses resulting from excessive velocity in pipe lines and short radius bends close to pump nozzles materially affect the overall plant efficiency. This is particularly so for pumps of the larger size for operating at high heads, as the velocity in high head pumps is greater.

Elbows located close to suction nozzle and turned at right angle to center line of pump will cause an unequal flow to each side of impeller. This tends to reduce capacity and excessive thrust frequently results.

Increasers should have a gradual taper. When located on suction side of pump an offset increaser is preferable, to prevent high spot in suction for accumulation of air.



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FOREIGN

EUROPE

AUSTRIA, Worthington Pumpen-und Maschinenbau Ges. m. b. H., Reichsrats-Strasse 7, Vienna.

BELGIUM, Ste. Francaise des Pompes et Machines Worthington, 22, Rue de l'Autonomie, Bruxelles.

FINLAND, Maskin-Aktiebolaget E. Gronblom, Abo and Helsingfors.

FRANCE, Ste. Francaise des Pompes et Machines Worthington, 1, Rue des Italiens, Paris.

GERMANY, Worthington Pumpen-und Maschinenbau, Ges. m. b. H., Quitzow Strasse, 3-7, Berlin-Hohenschönhausen.

GREAT BRITAIN, Worthington-Simpson, Ltd., Queen's House, Kingsway, London W. C. 2, England.

GREECE, Papayaonnou Bros., 15-A Rue Edward Law, Athens.

HOLLAND, N. V. Ing. Bu. C. P. Stieltjes, Keizersgracht 745, Amsterdam.

HUNGARY, Worthington Szivattyugep Reszvenytarsasag, V., Vaczi-ut 4, Budapest.

ITALY, Societa Anonima Worthington, Via Boccaccio No. 21, Milan 117.

ROUMANIA, Mr. A. Rotter, Engineer, Casuta Postala No. 384, Bucharest.

SPAIN — Sdad. Española de Bombas y Maquinaria Worthington, S.A., Marques de Cubas 8, Madrid. Sdad. Española de Bombas y Maquinaria Worthington, S.A., Plaza Universidad, 2, Barcelona. Sdad. Española de Bombas y Maquinaria Worthington, S.A., Don Juan de Austria, 25, Valencia.

AMERICA

ARGENTINA, PARAGUAY — Agar, Cross & Co., Ltd., Buenos Aires, Argentina.

BRAZIL, The Worthington Company, Inc., Caixa Postal 600, Rio de Janeiro.

CANADA — Fraser & Chalmers of Canada, Ltd., Canada Cement Bldg., Montreal, Province of Quebec. Storey Pump & Equipment Co., 510 King Street, West Toronto 2, Ontario. Kipp-Kelly Limited, Winnipeg, Manitoba. Ferguson Supply Co., Ltd., Calgary, Alberta. Pumps & Power Limited, Vancouver, B. C.

CUBA, The Worthington Co., Inc., 104 Aguiar, Havana.

CHILE — Carr, Haynes y Cia. Ltda., Santiago, Valparaiso. Concepción.

ECUADOR, Gonzalez Rubio & Co., Guayaquil.

GUATEMALA, HONDURAS, SALVADOR — Emilio Selle, Guatemala City.

MEXICO — Worthington Pump & Machinery Corporation, W. Leigh, General Agent, Avenida 16 de Septiembre, 5 Mexico, D. F.

PERU, Emilio F. Wagner y Cia., Lima.

PORTO RICO, H. Glyde Gregory, Inc., San Juan.

TRINIDAD, Hardware & Electric Supplies, Ltd., Port of Spain and San Fernando.

AFRICA

EGYPT, Anglo-Egyptian Engineering, Cairo.

SOUTH AFRICA, Guest, Sykes Ltd., 88 Fox Street, Johannesburg.

ASIA

PHILIPPINE ISLANDS, The Edward J. Nell Co., Manila.

CHINA, Andersen, Meyer & Co., Ltd., Shanghai, other cities.

INDIA — Worthington-Simpson Limited, 10 Clive Street, Calcutta. Worthington-Simpson Limited, Asian Buildings, Nicol Road, Ballard Estate, Bombay.

JAPAN — Ryobi Denki Shokai, Ltd., Tokio and Osaka. Asano Bussan Co., Tokio, Osaka and other cities.

OCEANIA

AUSTRALIA, Worthington-Simpson Limited, Lawson House, 49 Clarence Street, Sydney.

HAWAII, W. A. Ramsay, Ltd., Honolulu.

JAVA, N. V. Ing. Bu. C. P. Stieltjes, Societeitstraat 22, Soerabaja.

PRODUCTS

PUMPS

Steam Pumps, direct-acting, simplex and duplex, horizontal and vertical.
Flywheel Steam Pumps, horizontal and vertical.
Power Pumps for gear, belt, motor or engine drive; vertical and horizontal; single, duplex and triplex cylinder.
Centrifugal Pumps for belt, motor or engine drive; single and multistage; horizontal and vertical.
Deep Well Pumps, reciprocating and rotating shaft.

AIR COMPRESSORS

Air Compressors, single or duplex cylinder; one, two, three and four stage; power, steam or oil engine drive, for air or gas service.
Ammonia Compressors. Air Lifts.

STEAM CONDENSERS

Surface Condensers, Barometric Condensers, Jet Condensers.
Condensing Systems, including all vacuum auxiliaries.
Steam-Air Ejectors.

FEEDWATER HEATERS

Locomotive Feedwater Heating Equipment.
Open Stationary Feedwater Heaters.

DIESEL ENGINES

Diesel, Double-Acting, Two-Cycle, Air Injection, Vertical, Stationary and Marine.
Diesel Single-Acting, Two-Cycle, Direct Injection, Vertical, Stationary and Marine.
Diesel Single-Acting, Four-Cycle, Air or Direct Injection, Vertical, Stationary and Marine.

GAS ENGINES

Horizontal, four-cycle double acting, for natural and blast furnace gas; power and compressing units.

METERS

Water, Oil and Gasoline.

MULTI-V-DRIVES

A new combined development by Worthington and Goodyear. Rubberized cord belts running in grooved pulleys, suitable for a wide range of equipment.

CHROMIUM PLATING

Plating of machine parts where resistance to wear, abrasion, corrosion or high temperature is important.

DRILL STEEL SHOP EQUIPMENT

Automatic Heat Treating Machines. Oil or electric fired, automatically heat, harden, and temper the cutting end of rock drill steel.
Forging Furnaces. Oil fired, for heating drill steel preparatory to forging.

ROCK DRILLING EQUIPMENT

Rock Hammers, Wet and Dry Patterns.
Drifters, Wet and Dry Patterns.
Pneumatic Self-Feeding Drifters for Line Drilling and Broaching.
Plug and Feather Drills.
Pavement Breakers.
Finished Drill Steel for all purposes, also drill steel bar stock.
Hose and Couplings.

Worthington patterns and products comprehensively cover the complete range for each line of manufacture as well as the special service requirements of each industry.

WORTHINGTON PUMP AND MACHINERY CORPORATION

Works—Harrison, N. J., Cincinnati, O., Buffalo, N. Y., Holyoke, Mass.

Executive Offices: 2 Park Avenue, New York, N. Y.

GENERAL OFFICES: HARRISON, NEW JERSEY

Printed in U. S. A.

INSTRUCTIONS

For Installing and Operating Westco Pumps

The Westco Pump Corporation will be responsible for the operation of this pump only when the following precautions for setting up and operating are followed:

ALIGNMENT

This pump has been carefully aligned and tested at the factory. The alignment should be checked however at the time of installing as the bedplate will frequently warp in transit, but can readily be brought back to the original alignment by the use of wedges and foundation bolts. Place unit on rough foundation and drive wedges under edge of bedplate until alignment is secured. To check alignment place a straight edge across the coupling which should be in full contact with both rims at top, bottom, and sides. Grouting should then be poured under the bedplate and permitted to set perfectly before pulling down on foundation bolts. Any mis-alignment now apparent must be corrected by means of shims under pump or motor. Final alignment should be checked under the conditions of operation.

PIPING

PIPES MUST LINE UP AND NOT BE FORCED INTO PLACE AS THIS WILL FORCE PUMP OUT OF ALIGNMENT. Heavy pipes should be supported independent of the pump to relieve strain on pump casing.

Suction piping must be absolutely air tight and short as possible, avoiding bends and elbows. Also, from one to two sizes larger than suction opening to pump is recommended and care should be exercised in laying to eliminate air pockets. If possible, check with water pressure for leaks. When source of supply is below pump a foot valve is necessary on end of suction pipe for priming. A suitable strainer should be attached to the foot valve to prevent foreign matter from entering pump. Piping system gate valve should be installed on the suction and discharge lines as near pump as possible. In case it becomes necessary to inspect or repair pump these valves can be closed, making it unnecessary to drain system.

PRIMING

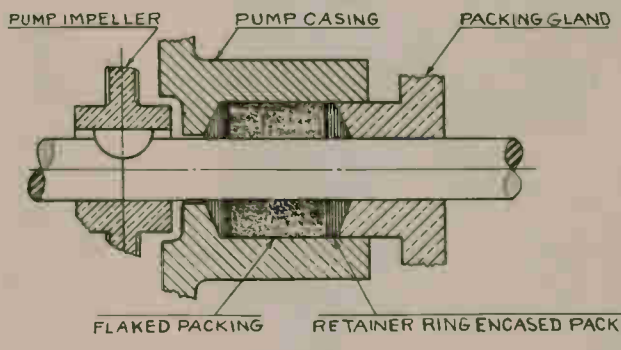
(Westco Pumps are Not Self-Priming)

The pump casing and suction line must be completely filled with water before pump will operate. To prime, open air cock on top of pump to permit the air to escape and fill completely with water, fill slowly to allow the air to escape, then close air cock and pump is ready to operate.

STUFFING BOXES

A high grade metallic flaked packing or lubricated fabric packing is recommended. Glands should be drawn up while pump is in operation, but not too tight. To secure best operation, and to keep the packing in good condition a slow dripping of water from the stuffing box is best. Means are provided to catch this water and carry it to the bedplate from which it can be piped to a drain, or it may be piped directly from bearing bracket. When using a flaked packing, a retainer ring of encased packing should be inserted in the stuffing box first to keep packing from working into the inside of the pump; also a retainer ring, shipped with the pump, should be put in after the flaked packing has been inserted to keep it from working out around the packing gland. Below is given a sketch showing proper method of packing stuffing boxes when using flaked packing.

DIAGRAM SHOWING METHOD OF PACKING STUFFING BOXES WHEN USING FLAKED PACKING



A can of this flaked packing can be secured from us or from most any mill supply house. All supply houses handle lubricated fabric packing if you desire to use this kind.

DIRECTION OF ROTATION

Arrows cast on pump casing designates the direction of rotation. Unless otherwise specified all Westco Pumps operate in a clockwise direction when viewing pump from coupling end. Furnished to operate counter-clockwise on special order.

GENERAL INSTRUCTIONS

1. Hot water cannot be raised by suction. It must always flow to the pump. Viscous liquids should also flow to pump under a head.

2. When there is danger of freezing remove drain plugs at bottom of pump casing and drain thoroughly.

3. Keep grease cups filled.

4. Do not disassemble pump unless absolutely necessary as bearings and rotor are accurately adjusted and tested before leaving factory.

5. Pump should always turn freely by hand.

6. Ask for information or help if trouble is experienced that cannot be rectified as this pump is guaranteed to operate as recommended.

7. *Do not throttle gate valve in discharge* line to decrease capacity as this builds up excess pressure. Westco resembling piston type pump in this respect. Don't start a Westco pump with the discharge valve closed. When desired to decrease capacity use by-pass with valve from discharge to suction or throttle gate valve in suction line.

8. If pumps are to be idle for a very long period of time they should be taken apart, cleaned and oiled. This prevents parts rusting together and assures a longer period of satisfactory operation.

9. When pump is driven by electric motor, the motor should be protected against overload and undervoltage. Such control devices can be had at a very low cost. It's cheap insurance.

Useful Hints in case pump does not perform satisfactorily. Try them before you call for Service.

If pump will not deliver water, note carefully each of the following points:

1. Is pump primed?
2. Is suction pipe absolutely air tight?
3. Is pump rotating in the direction indicated by the arrows on pump casing?
4. Is suction lift too high? Check up by means of vacuum gauge.
5. Is suction line or strainer clogged?

If pump does not deliver full capacity, look carefully for the following:

1. Small air leaks in suction line or stuffing boxes.
2. Discharge head higher than anticipated.
3. Suction lift too high.
4. If hot water, is there sufficient positive suction head?
5. Is pump running up to speed?
6. Mechanical defects.

Should pump appear to be overloading motor or taking excess power the following points should be noted:

1. Discharge head higher than anticipated.
2. Liquid heavier than water. Note viscosity and specific gravity.
3. Packing too tight.
4. Rotor out of adjustment and rubs casing. To detect rotate by hand and simultaneously pull or push in direction of the shaft.

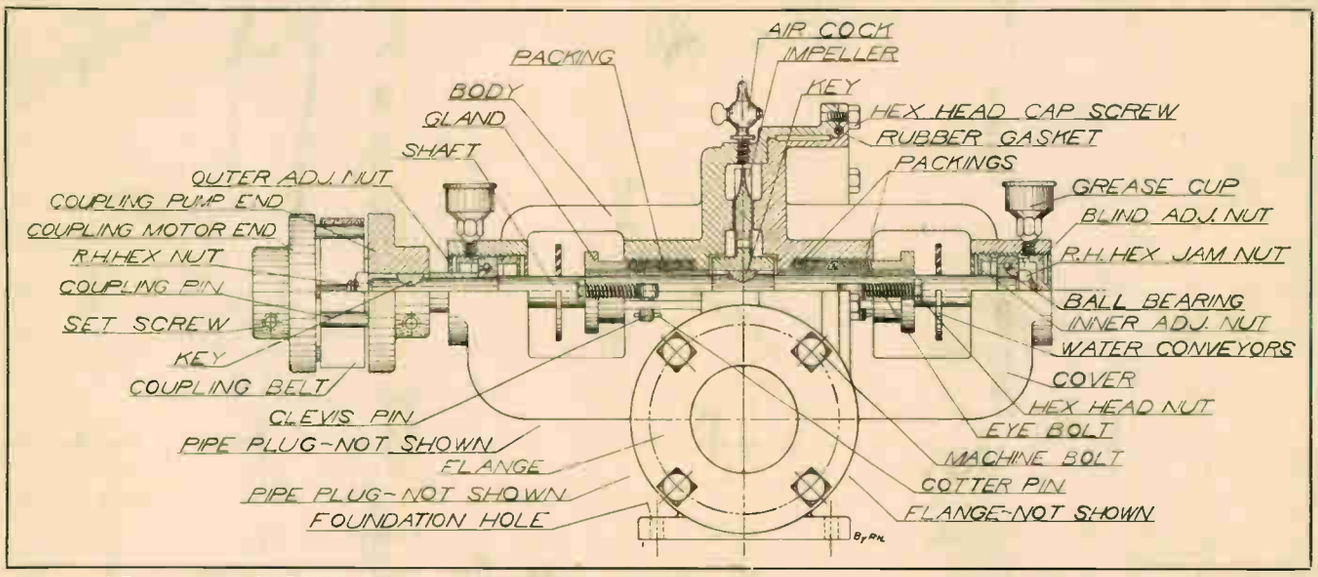
DISASSEMBLY and ASSEMBLY of PUMP

TO OPEN PUMP FOR INSPECTION OR REPAIR, remove cap screws from around pump case, also adjusting nut and jam nut on cover end of shaft. The cover may stick slightly, but this can be loosened by tapping around the edges.

TO COMPLETELY DISMANTLE PUMP, proceed further as follows: Remove nut and pump half coupling from body end of shaft. You can now pull out the impeller and shaft.

TO ASSEMBLE PUMP, reverse the above operations, making certain that impeller is centered between the two halves of the pump casing, otherwise it will rub, wear, and take excess power.

The impeller is centered by means of the adjusting nuts located in the bearing arms. When assembled properly, the impeller should turn very freely by hand. Do not tighten adjusting nuts too much, as it will impose excess load on ball bearings.



Sectional Drawing of WESTCO Pump showing Names and Location of parts. When writing us regarding any Pump be sure to give Pump Serial Number.

WESTCO PUMP CORPORATION

Factory and General Offices:

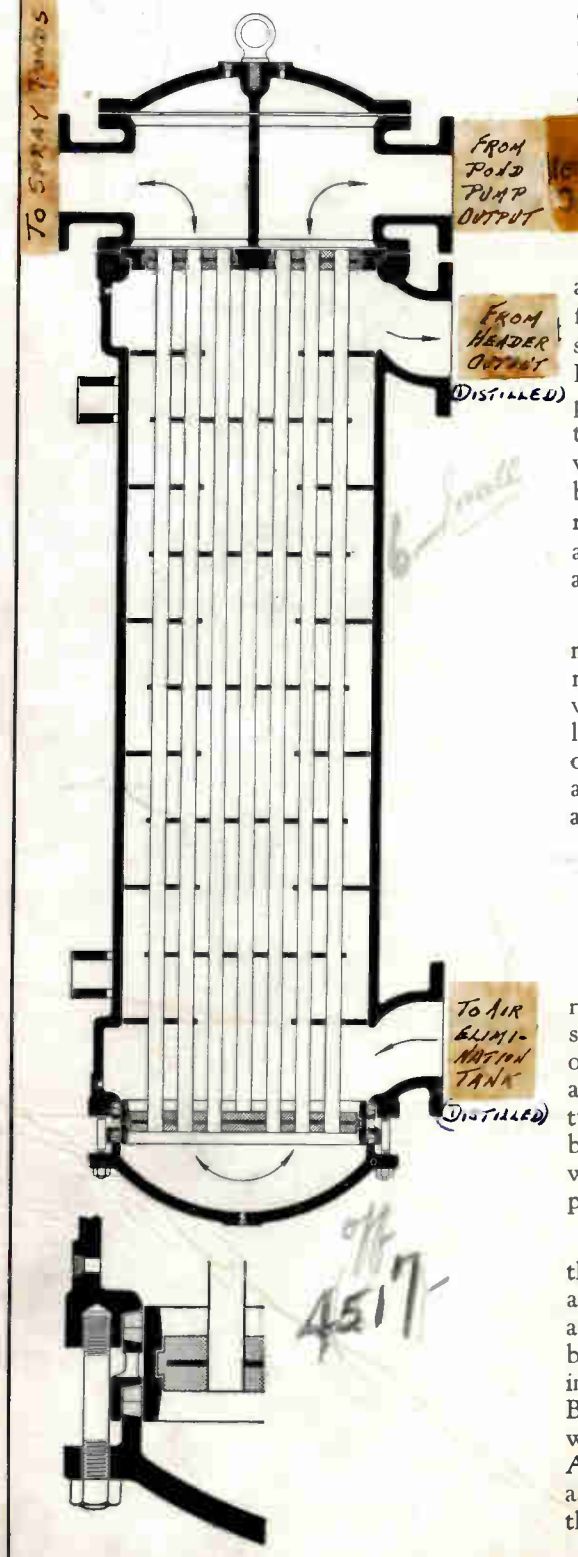
DAVENPORT, IOWA

CHICAGO **NEW YORK** **SAN FRANCISCO**

Distributors in Principal Cities

S&K Two Pass Oil Cooler

Schutte & Koerting Two Pass Water Oil Coolers of the type illustrated in cut, are made up of the following parts: Shell, main head, main cover, packing rings and tube bundle. The tube bundle consists of tubes, tube sheets, tube spacing plates, large baffle plates (with hole in center), small baffle plates (without hole), and distance pieces. These names should be used in sending for repair parts or in referring to the cooler construction for any other reason.



Installation

In locating the cooler, provision should be made to allow space to withdraw the bundle in a straight line from main head end of the cooler. This free space should be about equal to the length of the cooler. If, owing to local conditions, this space cannot be provided, the entire cooler must be removed from the line, after which the tube bundle can easily be withdrawn. When used vertically, the cooler should be placed at least 6" above the floor in order to permit removal of the cover. When used horizontally, the above precautions should be observed with respect to adjacent walls or other obstructions.

When used horizontally, either water connection may be used as the inlet, and either oil connection may be used as the inlet. When used vertically, either water connection may be used as the inlet, but the lower connection on the shell should be used as the oil inlet. The vertical arrangement is recommended, as this position gives slightly better cooling performance and facilitates withdrawal of the tube bundle.

Removal of Bundle

First, remove main head, return cover and packing rings. If the bundle is to be taken from a cooler installed in the vertical position, pass a ⅜" rope through one of the tubes, then around a piece of wood placed across the lower tube sheet and up through another tube. This loop may be used in pulling out the bundle. Rotation of the bundle while it is being withdrawn will greatly facilitate removal, as it will prevent binding of the baffle plates in shell.

If bundle is to be taken from a cooler installed in the horizontal position, the main head, return cover and packing ring should be removed as described above. To force bundle out, the main cover should be placed against the floating tube sheet, convex side in, the bolt-holes fitting over studs in flange of shell. By screwing down evenly on the stud nuts, the cover will force the bundle out without any hammering. A rope fastened around projecting end of bundle assists withdrawal. Care must be taken to withdraw the bundle in a straight line to prevent binding.

Cleaning Tube Bundles

A tank of suitable size should be used and live steam coils provided, these heating coils being arranged in some convenient manner. The tank should be located under a hand hoist and a rope sling should be used in handling the tube bundle.

"Oakite," "Wyandotte" and "Nocolite" have been used with satisfactory results in cleaning off oil which has caked on tube bundles. Oakite is made by the Oakley Chemical Company, No. 22 Thames Street, New York City; Wyandotte Metal Cleaner is made by the J. B. Ford Company, of Wyandotte, Michigan, and Nocolite is made by the National Oil and Chemical Company, Lafayette Building, Philadelphia, Pa. The descriptive booklets issued by these concerns contain much valuable information.

About eight ounces of cleaner solution should be used to each gallon of water. In making up a new batch of solution, the water should be heated to boiling point before the cleaner is mixed in. The full quantity should not be put in at one time, better results being obtained by introducing the cleaner in four installments. The mixture should be agitated and cleaner thoroughly dissolved before bundle is immersed; this preparation takes about an hour. The solution will last a long time, depending on the number of bundles handled. Cleaner should be added from time to time to maintain strength of solution.

The tube bundle should be lowered horizontally into the bath and surged up and down, and, occasionally, endwise. The solution is kept in agitation by the steam coils. The bundle should be examined from time to time to note progress of cleaning, and while thorough cleaning usually requires about an hour, the exact time depends on condition of the bundle.

After bundle is cleaned, it should be rinsed in clear cold running water in a tank provided with overflow. For quick drying, a hot rinse should follow. The inside of the tubes can further be cleaned by passing through them a round wire brush.

Replacement of Tubes

Tubes can be readily removed in the following manner:

1. With a drill 1/16″ larger than the outside diameter of the tube, drill away both ends of the tube to a depth slightly greater than the thickness of the tube sheet. This will permit removal of the loose tube through the enlarged opening.

2. A new tube is now inserted, care being taken that the ends are thoroughly cleaned with emery paper and treated with soldering fluid (concentrated solution of zinc in hydrochloric acid).

3. With new tube in place, solder the ends by means of soldering copper, using a small torch to pre-heat the metal around the tube ends. In order to prevent tension caused by heating of one tube while the others are cold, fill shell with water as high as top neck on shell.

Reassembling

In replacing tube bundle in cooler shell, care should be taken to keep the bundle rotating to prevent binding of the baffle plates. Cooler should be tested before being put back in service, test pressure not exceeding 125 pounds per square inch.

SCHUTTE & KOERTING COMPANY

Heat Transfer Department

12th and Thompson Streets, Philadelphia, Pa., U. S. A.