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NOVEMBER

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Checks identifying harmonics of frequency standard in precision frequency calibration of radio equipment.

Checks natural resonant points of r.f. chokes making sure they are beyond operating range.

Traces resonant absorption trouble in "all-wave" receiver circuits — locating dead spots, etc. Locates resonant points in shorted windings (unused coils) in multi-range oscillators, etc.

Locates resonant frequency of r.f. coupling chokes, making sure of placement to secure enough gain balance over tuning range of r.f. stage.

Checks natural period of antennae and transmission lines. Determines resonant peaks and current loops.

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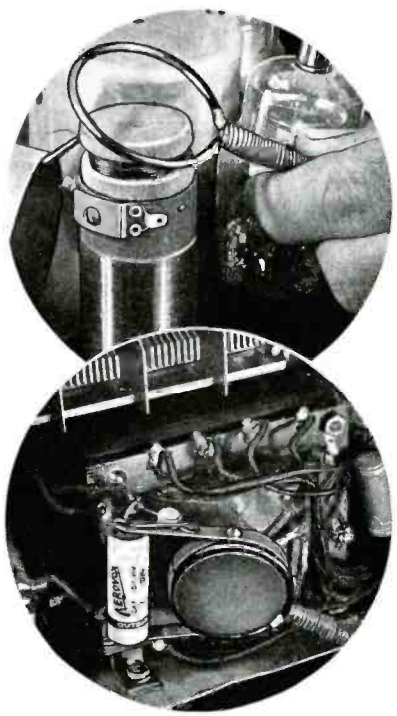

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VOLUME 19
NUMBER 11

RAY D. RETTENMEYER
Editor

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COVER ILLUSTRATION

A unique antenna arrangement (three units) for one of the runway localizer transmitters in the aircraft radio instrument landing system designed and built for the Civil Aeronautics Authority at Municipal Airport, Indianapolis, by International Telephone Development Co., Inc., subsidiary of the International Telephone and Telegraph Corp. See article page 9.

•Editorial Comment•

AN engineering opinion relative to future allocations and operation of television stations has been transmitted to the Federal Communications Commission by the Radio Manufacturers Association. This followed approval by the RMA Board of Directors on October 10. It is expected that the Commission will release soon another report on television in connection with pending applications for commercial licenses.

The RMA engineers' recommendations cover field intensity, service areas, power, separation, according to population, geographical, and other factors.

The engineering opinion transmitted to the Commission was prepared by RMA committees representing technical advice based on experimental operations. However, it was not a formal recommendation by the RMA.

IT is understood that the United States Supreme Court has refused to review the 500-kw case of WLW. The station's application for an extension of a special temporary experimental authorization to operate with 500 kw, unlimited time, on 700 kc was denied by the Federal Communications Commission early this year. This would seem to close the door, at least temporarily, to anything resembling "super power."

DURING the past year there has been an increasing amount of interest shown in frequency modulation. For the benefit of our readers we have secured an up-to-the-minute series of articles on this interesting subject. Part one, devoted to transmitting principles, will be found on page 5 of this issue. The second and concluding part, covering receivers, will appear in our December issue.

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FREQUENCY MODULATION

An up - to - the - minute summary on frequency modulation. This is the first of a series of two articles on this interesting subject.

By CHARLES H. YOCUM

SOMETHING new and vital has come to radio. Wide-band frequency modulation offers the set manufacturer, the seller, and the user of radio the possibility for a new era in which performance will be paramount. The industry welcomed the recent upward trend in prices, small as it was. F-m is a proven system, standing ready to free it from "price" standards, give it instead a "quality" standard.

Fortune magazine, in its October issue, insists that 40,000,000 home receivers and 750 or 800 transmitters became obsolete on the day the f-m system was perfected. Engineers within the industry are more conservative. They know that years may be needed to change two-billion dollars worth of equipment to another system, no matter how superior that system might be.

Those who have not followed the progress of f-m will be amazed at its advancement. Look at the list of stations in Table I. They are on the air or actually under construction. All will be on the air before next spring.

The scientist and engineer has presented this development to us all. Will the public demand the refinements and greater enjoyment promised by f-m? A tremendous replacement volume hangs on the answer.

From the standpoint of the consumer, f-m transmission has two major advantages. First, is its amazing fidelity. Music and speech have a natural sound, you hear a truer duplication of the original program in the studio. High fidelity is commercial, not experimental.

OPERATOR	LOCATION	POWER Kw.
Major Armstrong	Alpine, N.J.	50
WDRC, Inc.	Meriden, Conn.	1
Yankee Network	Paxton, Mass.	2
Yankee Network	Paxton, Mass.	50
Jansky & Bailey	Washington, D.C.	1
Interstate Broad.Co.	New York City	1
Stromberg-Carlson	Rochester, N.Y.	1
Mutual Broad.Co.	New York City	1
Milwaukee Journal	Milwaukee, Wis.	2
WHEC, Inc.	Rochester, N.Y.	2
Worcester Telegram	Worcester, Mass.	1
Travelers Ins.Co.	Hartford, Conn.	1
General Electric	Heidelburg Mt.,N.Y.	10

Table I. A list of f-m stations either on the air or under construction.

noise reduction

The freedom from atmospheric disturbances and local noise, which the buying public group together as static, is equally noteworthy. No longer will it be necessary to turn off your favorite program because a thunder storm is brewing. A bolt of lightning may strike the transmitter and cause only a mild click in your receiver. All interference is reduced. Faults associated with radio since its earliest days are wiped out or reduced far below what is considered acceptable today.

Many technical factors combine to give this vastly improved reception. One advantage of the f-m system is that radio-frequency noise which may occur between the transmitter and receiver is not evenly distributed throughout the audible range when it is reproduced in the speaker. It is a peculiarity of f-m that these noises, due to what we normally call static, are minimized at the lower audio frequencies. They increase steadily as we approach the limit of human hearing at about 15 kc. The noise and interference continue to increase still further up to 75 or 100 kc, and some part of this disturbance may pass through the receiver.

No human ear, however, can detect the part of this distortion which occurs above about 15 kc. The human ear also is much more sensitive to distortion at low pitch. Thus this peculiar distribution, of what we may call the disturbance energy, occurs in such a way that the human ear rejects by far the greatest part of it entirely, and is most sensitive in the region where the f-m system most completely wipes out the disturbing sounds. The amount of advantage accruing to f-m depends, of course, upon the keenness of hearing of each individual. A number of tests, however, show that at least 50% more actual audible distortion may be present in an f-m program than in an a-m program, yet the human ear would rank them both equally acceptable and free from objectionable disturbances. This means that an f-m program may be received with enjoyment in an area where local electrical disturbances, whether natural or man-made, would normally make pleas-

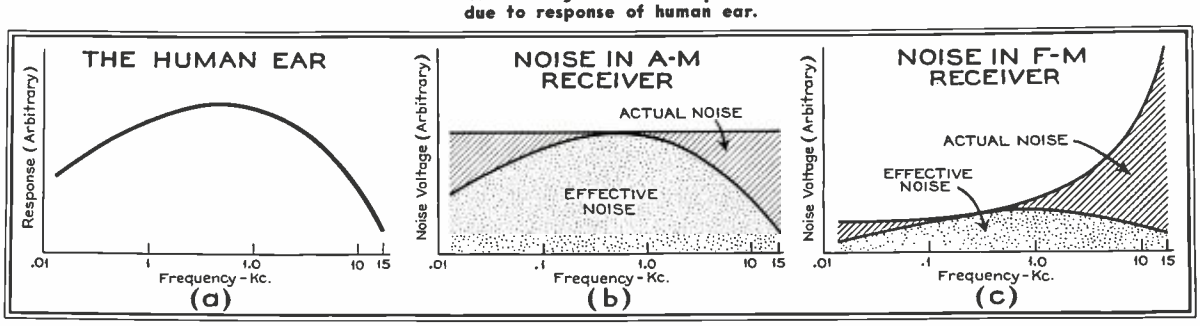


Fig. 1. The reduction in effective noise voltage in f-m reception due to response of human ear.

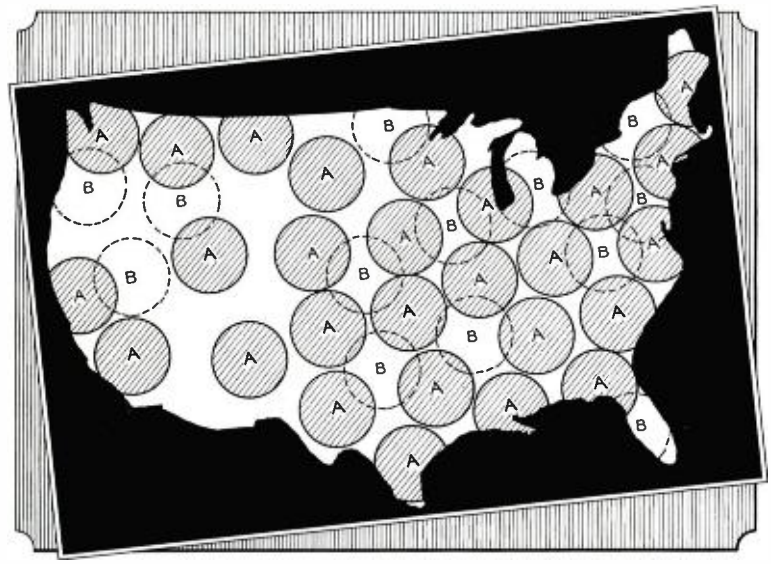


Fig. 3. A possible two-frequency arrangement of f-m stations covering practically the whole country. A frequency, 27 stations —B frequency, 13 stations.

ant listening an impossibility. See Fig. 1.

In addition, some disturbances are themselves of definite band width, or affect only a certain band of frequencies in the transmitted signal. If the program we hear in our receiver is carried to us through a system which is only 10 kc wide, then a disturbance affecting a band 1 kc wide will cause a certain amount of distortion. If, on the other hand, our receiver brings us a program by means of an energy band 100 kc wide, then this 1 kc disturbance will cause less distortion than occurred in the first case. If one f-m system operates with a swing of 50 kc each side of its carrier, and another with a swing of 5 kc each side of its carrier, the first transmitter should show an improvement of at least 10 to 1 as compared to the second in its ability to suppress noise.

The actual figures are astounding. When the peak value of the disturbance is less than 10% of the signal (both measured in the limiter stage of the f-m receiver) then the energy of this disturbance after rectification will be reduced by almost 1100 to 1. For noise voltage upwards of 25% of the signal voltage, the noise reduction in the rectified signal will be about 700 to 1. When the noise is one-half the signal it appears in the output reduced by a factor of about 400 to 1. If the noise and signal become approximately equal, the actual improvement drops to some very low value of 2 or 3 to 1. Although the primary service area would be considerably enlarged if the suppression could be kept up to 400 or 500 to 1 when noise and signal were about equal, let us not forget that high-fidelity a-m reception requires signal to noise ratio of about 100 to 1. This is the region where the f-m system's ability to suppress unwanted noise is a maximum.

inter-station interference

Reference has been made to the efforts of early experimenters who tried to use f-m in order to pack more transmitters in the broadcast band. A big advantage of modern f-m transmitters is that a number of them may be assigned to the same frequency, provided they are several hundred miles or more apart. There will be no cross-modulation or interference. This is due to the fact that the f-m receiver will reproduce only the stronger of two signals, suppressing the weaker one, provided the ratio of the signal voltages in the receiver is 2 to 1 or more. F-m is at present limited by the FCC to frequencies of 40 mc or higher. The limit of satisfactory signal strength for such transmission is somewhere between 100 and 150 miles. We can visualize a large number of transmitters, all on the same wavelength, scattered across the country at distances of approximately 300 miles from each other. Each one covers its own primary service area without being affected by, or interfering with, the other transmitters on the same band. Present experiments indicate that even better results could be had if the assigned frequencies of the stations were separated by amounts as small as 10 or 15 kc. Due to the action of the detecting device in the f-m receiver, the suppression of unwanted signals would be still further increased. It is often possible, however, to pick up the weaker signal with a directive antenna which would increase the amount of desired signal available to the receiver. Map, Fig. 3.

The ability of the f-m transmitter to minimize natural and man-made interference and to magnify the wanted signal gives the system a cumulative advantage over present types. If we calculate the performance of an f-m transmitter and an a-m transmitter, both drawing about the same number of kw from the lines of the local utility, the f-m system with a band width of 150 kc and the a-m system with a band width of 10 kc, we find that a theoretical overall improvement of more than 1000 to 1 may be secured. This improvement is measured by the accepted method: comparing the ratios of signal to signal-plus-noise permissible for high-fidelity reproduction.

Actual comparisons have shown the possibility of approaching this ratio in practical, every-day operations. Some allowance should be made for the circumstances attending the test, since u-h-f transmission of any type has advantages over the same system operated in the broadcast band. The tests would have been more acceptable had they compared a-m and f-m, both at the same high frequency. Sufficient additional improvement exists, however, to convince many investigators.

phase shift

Another operating advantage of f-m rests upon the fact that high audio frequencies are transmitted with the minimum phase shift in output, and low frequencies with the maximum. In a typical case cited by Major Armstrong, 30 cycles per second would be represented by a phase shift of 30 degrees; 10,000 cycles by a shift of but .09 degrees. Even after the series of multiplications required to change this shift to an f-m wave, the highest audio frequencies lie

Table II. Roder's calculations for frequency-modulated amplitude variations. Phase modulation (last column) should be restricted to less than 30° to avoid serious distortion. Note that in phase modulation the phase shift varies inversely as audio frequency; in true frequency modulation the frequency deviation varies directly as the audio frequency.

AUDIO SIGNAL FREQUENCY (Cycles per Sec.)	CARRIER AMPLITUDE	SIDE FREQUENCY AMPLITUDES								CORRESPONDING PHASE SHIFT.
		1st.	2nd.	3rd.	4th.	5th.	6th.	7th.	8th.	
10,000	100	2.5	-	-	-	-	-	-	-	2.9°
5000	100	5.0	-	-	-	-	-	-	-	5.7°
2500	99	9.9	-	-	-	-	-	-	-	11.5°
1000	93.8	24.2	3.1	-	-	-	-	-	-	28.6°
500	76.5	44	11.5	1.9	-	-	-	-	-	57.3°
250	22.4	57.7	35.3	12.9	3.4	-	-	-	-	114.6°
100	17.7	32.7	4.6	36.5	39.1	26.1	13.1	5.3	1.8	286°
Amplitudes are expressed as percent of unmodulated carrier.										

closest to the assigned carrier in phase relationship. Thus, a considerable amount of additional amplification may be given to all the higher audio frequencies without causing interference with adjacent programs. Pronounced amplification of the highs in an a-m transmitter is limited in order to prevent cross-modulation of adjacent channels.

cost factors

Another advantage of the f-m system is that the modulation of even the largest transmitter can be accomplished using the same type of tubes and components found in radio receivers, except for the final stages. A 50-kw modulator bay (Fig. 2—pictures) is reduced to the approximate size of an 8 or 10-tube receiver chassis, although it includes its own power pack.

The maximum voltage (plate supply) applied to any component part of the modulator is only 180 volts. Such voltages are easily handled and filtered and represent an economical design which is reflected in the initial and lower maintenance cost of the complete transmitter. Voltages over 200 are found only in the power stages.

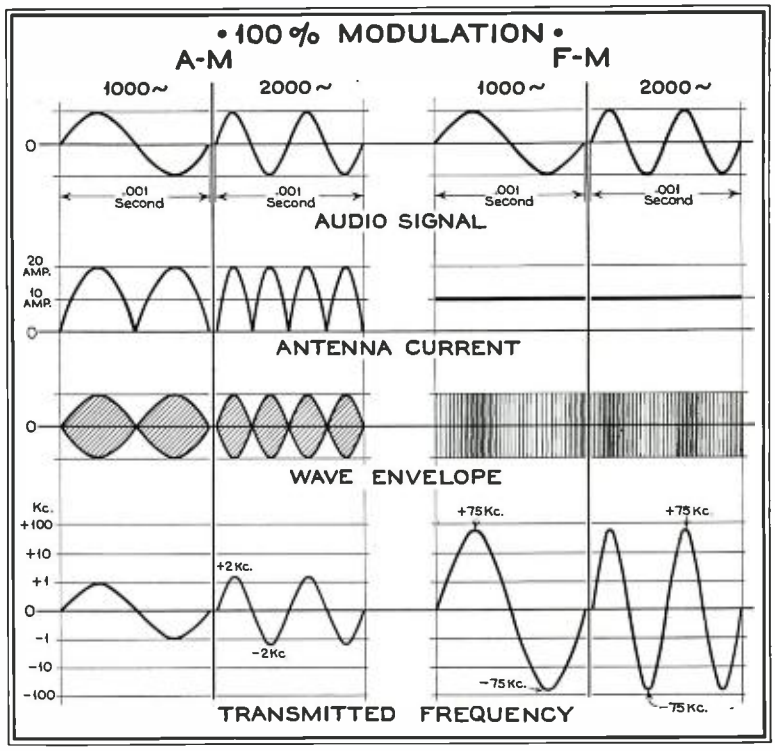
Further economy results from the fact that for equal transmitter power rating only about half the electrical energy is required from the power lines by an f-m system as compared to a-m. This economy is partly due to the fact that f-m lends itself admirably to the use of Class C output stages and also because the antenna current does not vary (during program transmission) from the carrier level.

Some criticism of f-m is voiced because, in its modulating system, a small phase shift of not over 30° must be multiplied, with strict linearity, several thousand times. The answer to this is that the modulator is relatively inexpensive. The carrier is modulated at a low energy level and the majority of the parts used in its construction, both tubes and components, are identical with those used in home receivers. This complexity of parts is merely that of numbers, since the actual circuits are doublers and triplers of a conventional type.

economic status

Reference has been made earlier to an article in *Fortune* which strongly criticizes the FCC and the broadcast industry for their apparent failure to enable the public to enjoy f-m programs. Granting every advantage claimed by the strongest advocates of f-m, how can the industry begin to replace any major part of the a-m transmitters and receivers now in use? Their replacement value runs into billions of dollars. No program has yet been evolved which offers the industry an economically sound way to change to f-m, overnight.

Perhaps an answer is developing at this very moment. Station WABC, for example, is now piping some of its programs to Major Armstrong's transmitter at Alpine (Fig. 4.) The potential buyer of an f-m receiver may compare the quality of the two methods of transmission in the area served by the



Above: Fig. 5-A. 100% modulated signals.

Fig. 5. A comparison of the transmission variables in f-m and a-m.

Below: Fig. 5-B. 50% modulated signals.

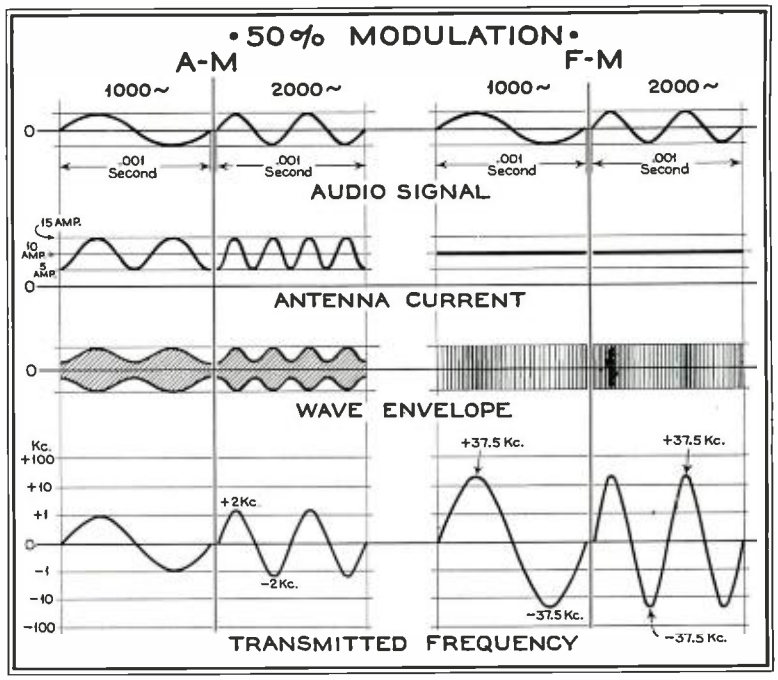


Fig. 4. First 50-kw u-h-f f-m transmitter—W2XMN, Alpine, N. J. (near N. Y. C.). Designed, constructed, operated by Major Armstrong.

Alpine transmitter. If f-m continues to advance in public acceptance, a double system may be needed, until the public makes a final choice.

The variety and quality of American radio entertainment is admittedly the best in the world. It is paid for by advertisers, who buy time on the radio only because they can thus reach more people for a given expenditure than they can by competitive media. The individual broadcaster or chain cannot change to f-m unless enough f-m receivers are in operation in his primary service area to permit him to charge the sponsor an adequate fee. The maker of receivers can offer f-m sets at attractive prices only if he is assured of a volume of sales. The public cannot be expected to buy an f-m receiver if it means that he must sacrifice the reception of his favorite programs, or if the price is too high.

Since radio broadcasting in this country is a private undertaking, many factors must be weighed before a change can be authorized. Existing contracts with sponsors, competition, stockholders, patents, licenses, are but a few. The remarkable point, in the opinion of many, is that a new and radical departure from the established system can have made the rapid progress which f-m has, in spite of these factors, all nominally opposed to sudden change.

transmission fundamentals

In order to compare the f-m and a-m systems in operation, we must first return to the fundamental problem of transmitting intelligence by radio. There are two variables which must be sent from the transmitter to the receiver, if we are faithfully to reproduce in the latter the program originating in the studio. Each of these variables suffers wide changes independently of the other. They are the pitch or frequency of the program material, and its volume.

In a conventional a-m transmitter the change in pitch is indicated by a change (in cycles per second) from the fixed carrier frequency. Thus, if an a-m transmitter, operating with double sidebands, were assigned a frequency of 42.8 mc, a 1000-cycle note would be broadcast when this transmitter was sending out a wave, the side frequencies of which would be 42.799 and 42.801 mc. Change in volume is signalled by a variation in the amount of current fed into the antenna of the transmitter. For example, if the antenna current is 10 amperes when no signal is being broadcast, this current would be increased to 20 amperes for 100% modulation, or the loudest sound which this system could transmit. An antenna current of 15 amperes would represent a sound about one-half as loud as the first, etc.

The first point of difference between the above system and f-m transmission is that the f-m station broadcasts a signal of constant amplitude whether modulated or not. Zero, 50 or 100% modulation would call for a 10-ampere antenna current in all cases, if we use the carrier power assumed for the a-m transmitter. The loudness of the sound presented to the microphone of the f-m system would be indicated by the frequency deviation of the side frequencies. If this station likewise operated on a carrier of 42.8 mc, 100% modulation would be indicated when the emitted frequency contained side frequencies of 42.725 to 42.875 mc. If 50% modulation was to be indicated, the frequency would vary between the limits of 42.7625 and 42.8375 mc. If no modulation was present, the transmitter would emit a single continuous frequency of 42.8 mc. If a 1000-cycle note is being fed into the microphone at an f-m station, the frequency swing will take place 1000 times in every second. Note that under no circumstances will the antenna current deviate from 10 amperes. We may summarize the comparison by stating that a-m indicates pitch by changing the frequency of the radiated energy; f-m by the *time rate of change* of frequency. The a-m system indicates percentage modulation by proportionate changes in the antenna current; f-m by varying the amount of frequency swing above and below its assigned carrier. See Fig. 5.

Experimenters have tried to apply frequency modulation to solve radio problems since the earliest days. It was tried on both spark transmitters and the early phone sets without success in either case. We can see now that one probable reason for these failures was that the experimenters were trying to compress the normal audio band of 10 kc into one only 2- or 3-kc wide. This, if successful, would have permitted many more transmitters to operate in the broadcast band. As we have seen, f-m has a solution to that problem today. It has achieved its success, however, by an exactly opposite method of attack. Today's f-m transmitter transmits a band 100 or 150 kc wide to reproduce in the home receiver an audio band of 15 kc with fidelity. But there were many other problems which had to be overcome, however, before f-m could reach its present state of development.

(To be concluded)

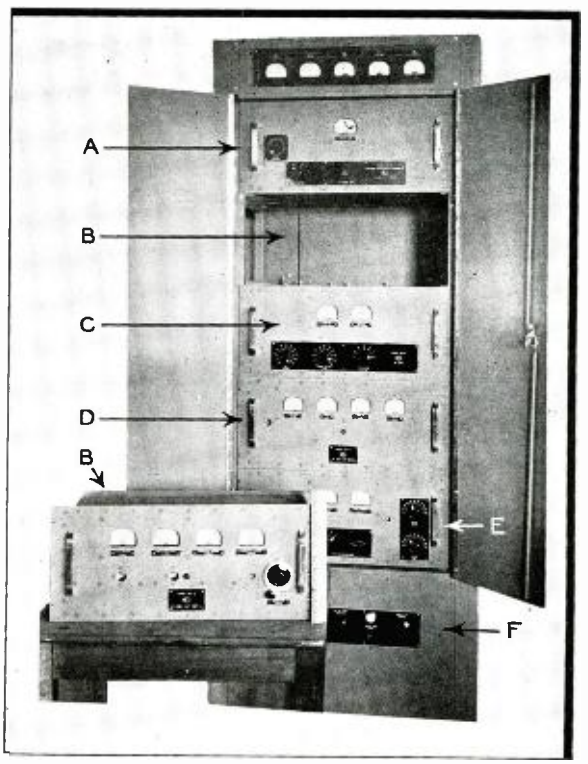
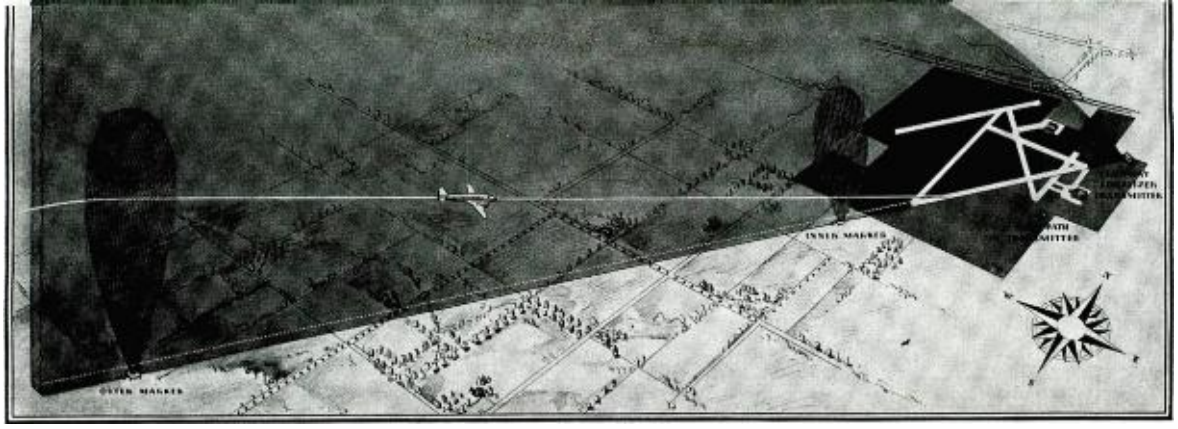


Fig. 2. The standard Radio Engineering Laboratories modulator for all f-m transmitters from 1-50 kw. Between 1 and 5 kw, this unit followed by 2 power stages; between 5-50 kw, one additional, or 3, power stages required. (A) Zero-level input predistorter and corrector; (B) modulator and crystal oscillator; (C) frequency doublers; (D) crystal control and doublers; (E) output stages; (F) power supply.



Showing location of runway localizer and glide path transmitters as well as marker transmitters.

INSTRUMENT LANDING SYSTEM

THE radio instrument landing system for aircraft designed and manufactured to the performance specifications of the U. S. Civil Aeronautics Authority by International Telephone Development Company, Inc., a subsidiary of the International Telephone and Telegraph Corporation, has been accepted by the C. A. A. and installations are planned at ten major airports in 1940 and probably fifteen more in 1941. The C. A. A.-I. T. & T. instrument landing system was installed first at Indianapolis Municipal Airport and demonstrated there for officials of the C. A. A. and the air transport lines, technical experts of the Army and Navy, military and naval attaches of countries in the Americas.

Four Transmitters Per Direction

A set of four radio transmitters correctly arranged with respect to the landing runway produce the necessary space radiations for each landing direction. The runway localizer transmitter, situated in direct line with and approximately 1,000 feet beyond the far extremity of the runway, provides the course indication or lateral guidance for the approaching airplane to insure exact alignment for landing on the runway. The glide-path transmitter, situated to one side of the runway and approximately opposite the far end of the runway, gives the vertical guidance.

Special receiving antenna mounted on pilot's cabin.

The two "marker" transmitters send radio beams directed sharply upward which indicate to the pilot that he has arrived over certain definite points in his approach to the airport. The outer marker, situated approximately two miles from the airport on the line of approach, advises the pilot where to start his glide. When the pilot, flying at a predetermined altitude meets the glide path at this outer marker, he knows that both the ground equipment and his receiving apparatus are in correct adjustment for him to start his glide on the instruments. The inner marker, situated at the edge of the airport on the line of approach, indicates to the pilot when the plane has cleared the boundary of the field and has reached the area within which it is safe to make wheel contact with the ground.

C.A.A. Indianapolis Installation

In this Civil Aeronautics Authority installation at Indianapolis, four complete groups of instrument landing transmitters have been set up permitting radio landings in any of four wind directions: northeast, southeast, southwest and northwest. The group of transmitters for any direction can be turned on from the airport control tower to meet local wind conditions for landing. The airport tower is equipped with an instrument landing control board by which the operator can select directions at will, and the correct operation of the ground equipment is indicated by visual signals on this control board. Should any part of the system fail to operate, the control tower is warned immediately both by visual and aural alarms.

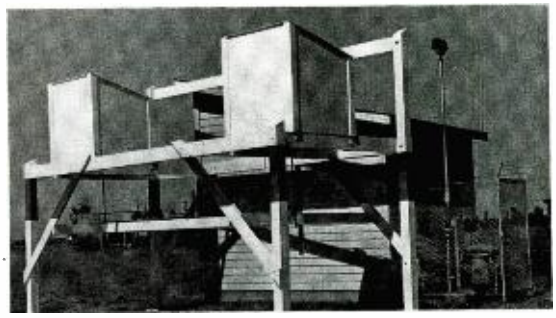
Straight Line Glide-Path

Aviation has long demanded a glide path which would give a straight line of descent to the field. On a straight line glide-path the pilot can set his throttle and the altitude of his ship at the beginning of the glide. Then, he can concentrate completely upon the landing indicator and the small adjustments of his flight controls necessary to center on the localizer and glide-path beams. The I. T. & T. has developed an improved type of glide-path which is

(*Continued on page* 25)

One of the inner marker transmitters.

Housing and antenna arrangement for glide path transmitters.



BOSTON POLICE RADIO

By M. B. KAHN

Transmitter Equipment Mfg. Co.

THE Boston, Massachusetts, Police Department has recently made an important addition to their elaborate communications network[1] which rightfully entitles this department to be generally known as pioneers in the field of ultra-high-frequency two-way duplex communication, as they were among the first to use u-h-f for two-way contacts. The original 1000-watt transmitter which was installed some years ago is now being used to supplement this present equipment.

The newest installation is a Temco 250-C, 250-watt transmitter operating on 35.5 megacycles. The installation of the transmitter and latest type coaxial antenna was made atop the new Federal Courthouse building over 400 feet above the ground level. The original 1000-watt transmitter employed water-cooled tubes in the power-amplifier stage, whereas the new transmitter uses only air-cooled tubes of the latest design, and although the new equipment has only one-fourth of the power output, its signal equals or betters that of the high-powered installation. The department's communication system comprises 78 patrol cars and 4 patrol boats, all equipped with u-h-f transmitters and receivers which are capable of simultaneous operation with one antenna system. Two-way duplex operation is always used, thereby eliminating the necessity of "push-to-talk" operation.

GENERAL DESCRIPTION

The transmitter is a complete unit in itself which necessitates very few external connections being made to complete the installation. In the case of the Boston Police job, the transmitter is located atop the 400-foot Federal Courthouse Building at Pemberton Square, Boston, and is connected by means of telephone lines to the dispatcher's location one mile away. These telephone lines interconnecting the two points make possible the full remote control of the equipment as well as resetting at one time all of the individual overload relays which protect the various component parts of the transmitter. The unit is located in a locked room in the above building, and does not require an operator in attendance. The only connections necessary are the coaxial transmission line feeding the antenna, a source of a-c power, i.e., 110 volts at 20 amperes, and the incoming telephone line which energizes the remote-control relays and carries the audio system. The actual installation of the equipment was only a matter of hours, and the general simplicity of the installation was due to the many mechanical features contained in its design.

MECHANICAL FEATURES

The transmitter is divided into five individual sections housing the following equipment: (1) the final power amplifier consisting of push-pull 806s and the antenna coupling device; (2) crystal oven, 6L6 crystal oscillator, 807 frequency multiplier, 808 driver; (3) audio input stage consisting of a 53 phase inverter into push-pull 2A3s transformer coupled into push-pull 805s operating Class B; (4) low-voltage supply and relay control panel consisting of time-delay relays, underload relays, overload relays, and plate and filament relays; (5) two high-voltage supplies using 872A type rectifiers supplying Class B modulator and final amplifier stages.

A rear view of the transmitter.

As noted from the rear illustration showing the detailed constructional features, each of the first four mentioned units are mounted on a removable chassis with all the interconnecting wires terminating at plugs and jacks. This type of construction makes it extremely simple to remove any particular unit with the minimum amount of effort and time for inspection or servicing. The main portion of the power supply is fastened permanently to the bottom chassis. The female section consisting of the necessary terminating jacks is located in the interconnected channeling which carries all of the cables. Each chassis is removed from the front of the cabinet by simply removing the four screws holding the panels in position. This method eliminates the necessity of bothersome and unsightly binding-post connections. The transmitter is housed in a substantial and attractive cabinet with both front and rear doors. All doors leading into the transmitter's interior are interconnected with switches that effectively remove all high-voltages when opened, thus protecting the operating personnel from accidental contact. The front doors that protect the tuning controls are fitted with locks to further insure freedom from tampering by unauthorized persons. All circuits are individually metered by means of the 10 meters grouped at the top of the transmitter.

Since dependability is the watchword of any police-communication system, great care was taken in the selection of all component parts. All power components are designed for continuous operation, although police transmitters are rarely used under these conditions. This feature eliminates the possibility of any of the power components operating at an objectionable temperature, and reduces to an absolute minimum any chance of a breakdown. All power resistors are chosen to withstand normal overload ratings of at least 100% and the individual tubes are all operated at considerably below their normal ratings. Besides these precautions, a forced-draft system of ventilation is provided which effectively removes all heat generated

[1]See "Boston Police Department's Communications System," p. 15, February, 1937. *Communication & Broadcast Engineering*.—Editor.

Showing the well-planned dispatcher's office of the Boston police radio system.

by the tubes and conducts it outside the building. All sections use transformers especially designed for this installation. Their ratings are twice that actually needed at continuous duty and they are completely dehydrated as a protection against moisture.

ELECTRICAL FEATURES

While the transmitter has a conservative rating of 250 watts output within the range from 30 to 42 megacycles, tubes were chosen having a very high safety factor. The final-amplifier stage employs two 806s in push-pull, operating at a plate voltage of only 1500, whereas the normal rating is 2500 volts.

The intermediate amplifier is an 808 triode operating at 1250 volts. This stage is capable of furnishing the final amplifier with an excess of grid current thereby assuring a good efficiency at all times. The frequency doubler is an 807 beam power tube operating at 500 volts. This section of the transmitter is well shielded to prevent parasitic and spurious oscillations. The oscillator employs a 6L6 with only 250 volts on the plate. Thus the plate current in this circuit is very low, operating normally in the vicinity of 12 milliamperes. Both the grid and plate circuits of the push-pull 806 stage employ split-tank-circuit arrangements, and the final amplifier tank employs a unique design which greatly reduced stray capacity thus permitting the use of an oversized tank coil.

Referring to the photograph, it will be seen that the tank coil fastens directly to the tank condenser and that the neutralizing condensers are a part of the entire assembly. The tank-circuit wiring detail consists of short leads from the end of the tank coil to the top plate cap of the 806s and the grid leads are crossed over directly to the neutralizing condensers. Final amplifier construction of this type greatly contributes to the operating efficiency. The normal input to the final amplifier is 350 watts. Therefore, in order that this stage may be 100% modulated, audio power to the extent of ½ this value, or 175 watts, is provided quite easily by a pair of 805s running Class B driven by a pair of 2A3s and a 53 voltage amplifier. A very elaborate and complete set of relays fully control and protect the entire system.

Relays are furnished for controlling the application of both the filament and plate voltage, and overload relays with electrical resets are provided for protecting both the low and high voltage for the final amplifier and Class B modulator stages and an undercurrent relay located in the Class C power-amplifier stage makes it impossible for modulation to be applied prior to the final amplifier drawing its normal current. Three additional pilot relays are furnished which actuate the filament and plate contactors and the three reset circuits of the overload relays. These pilot relays were necessary to minimize the current handling requirements of the telephone lines, i.e., the pilot relays operating on low voltage and they in turn operate higher current type of relays. There are also provisions on the front panel for the complete control of the equipment at the transmitter itself, and if desired, an operator stationed at this point can take over all controls from the dispatcher's position. This procedure is normally unnecessary, and used only for testing purposes. Two pair of 872As furnish rectification for the two individual power supplies for the final amplifier and modulator stages. Since this type rectifier is capable of normally handling 3000 volts at substantially higher currents, exceptionally long life is to be expected as a result of their working at 1250 and 1500 volts respectively. Another feature that insures long life, is a slight reduction of filament voltages on all tubes employing thoriated tungsten filaments during standby periods. This is accomplished by the insertion of a 15-ohm, 100-watt resistor in the primary circuit. This resistor is shorted out when the plate relay is actuated.

ANTENNA SYSTEM

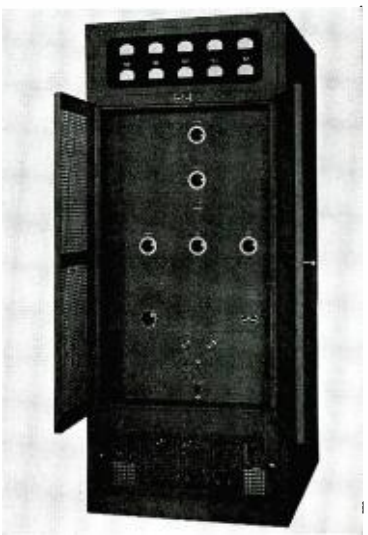
The antenna system is of the coaxial type recently developed by the Bell Telephone Laboratories, and for which claims are made guaranteeing a signal increase of approximately 5 db over that of the standard "J" type matched antenna. It is supported on a steel pole, and the radiating section is 40 feet above the top of the roof. This arrangement provides an antenna system with an effective height above ground of 440 feet, and the excellence of this location has been one of the important contributing factors that has made this latest type installation one of complete satisfaction.

DISPATCHER LOCATION

As the result of the pioneering aspects of this communication system, a great deal of planning resulted in a very elaborate and complete dispatcher's office. A photograph effectively illustrates the magnitude of the dispatcher's function, and it will be noted that each precinct has its own particular section clearly outlined on the board, upon which is kept an instantaneous record of each patrol car and boat and its availability for service when needed.

(*Continued on page* 13)

Front view of the transmitter.



SYNCROSOUND SYSTEM

Synchronized Sound for 8 & 16 mm Motion Pictures

By RALPH C. POWELL
Presto Recording Corp.

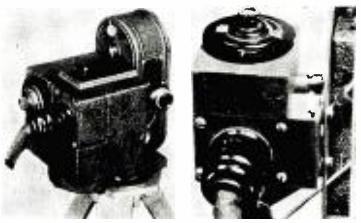
THE sound recording and reproducing system shown in the accompanying illustrations can be added to any standard make of silent 8 or 16 mm camera and projector. It consists of a portable sound recorder, an electric motor drive for the camera and a small attachment for the projector. The latter units can be easily installed and they can be quickly detached if desired to make silent films.

The entire sound recording and reproducing equipment is contained in a single carrying case that weighs less than 50 lbs. The synchronization is automatic requiring no supervision or adjustment once the picture is started. And it is simple to operate. Anyone with sufficient mechanical ability to handle a camera and projector should have no difficulty with the sound equipment.

Synchronizing Equipment

Synchronization is accomplished by the use of three rotating commutators. Each commutator has six segments or contacts and a rotating brush. The master commutator, which controls the speed of the camera or projector, is attached to the center shaft of a recording turntable. It revolves at standard phonograph speed, slightly less than 80 revolutions a minute. Thus the rotating brush makes 480 contacts a minute with the segments.

Secondary commutators are attached to the camera and projector. The camera drive unit consists of a small electric motor, a commutator and a shaft and gear which engages with the spring gear of the camera.



Closeup of the camera and projector attachments.

The drive system may be permanently attached to the camera or the two may be held together by the tripod screw so that the camera may be removed from the electric drive unit and operated on the spring drive at any time. A worm-and-gear system in the drive unit drives the camera commutator at 80 revolutions a minute, the same as the turntable, and the camera at silent picture speed, 16 frames a second.

The projector unit consists of a commutator and a worm and gear which couples to the shutter shaft of the projector so that the commutator will revolve at 80 rpm when the projector is running at proper speed. The synchronizer unit has a bracket by which it is attached to the projector frame. A coupling is provided to attach the unit to the shutter shaft. The commutator connects in series with one of the power supply leads to the motor.

Principle of Operation

The commutator on the recording turntable is connected to the commutator on the camera drive by means of a flexible seven wire cable. This cable may be made as long as desired and permits the camera to be moved freely. The contacts are connected in rotation and as the brushes revolve the camera motor receives 480 power impulses a minute. The duration of each impulse depends upon how closely the camera commutator keeps in step with the turntable commutator. If it is exactly in step it receives full power. If the camera commutator becomes a full segment behind the turntable, the camera motor loses power altogether until the turntable has completed a full revolution and catches up with it again. If this happens synchronization is lost. Therefore in practice, the camera motor is adjusted by means of a rheostat so that it has a tendency to run slightly fast. But as the camera begins to creep ahead of the turntable, it receives progressively shorter power impulses through the commutators which causes it to slow down. These two tendencies balance out during the first revolution of the turntable and thereafter the turntable and camera are held in synchronism. While the camera and turntable are running, no adjustment or supervision is required. They either run in synchronism or not at all.

The operation of the projector is the same. It is set to run slightly fast and is brought into synchronism by the turntable commutator. The same cable connects either the camera or projector to the recorder.

Making a Talking Picture

The procedure for making a talking picture is as follows. The camera and lights are set up in the usual way. The microphone is suspended above and in front of the actors so that it is just outside the frame of the picture. It is desirable to place the microphone as closely as possible to the actors but a satisfactory voice pickup can be obtained with the microphone as much as 6 feet away from the speaker.

A blank disc is placed on the recording turntable. If the complete picture is to run less than 3 minutes, a 10-in. disc may be used; if it is to run 5 minutes a 12-in. disc will be required. After the camera is loaded the turntable is run for a few seconds to take off the film exposed during loading. Then the actors go through a few of their lines

Making a talking picture with a sound recorder and an 8 mm camera equipped with the syncrosound system. Note microphone suspended above subject just outside the frame.

while you adjust the amplification to give the proper recording level.

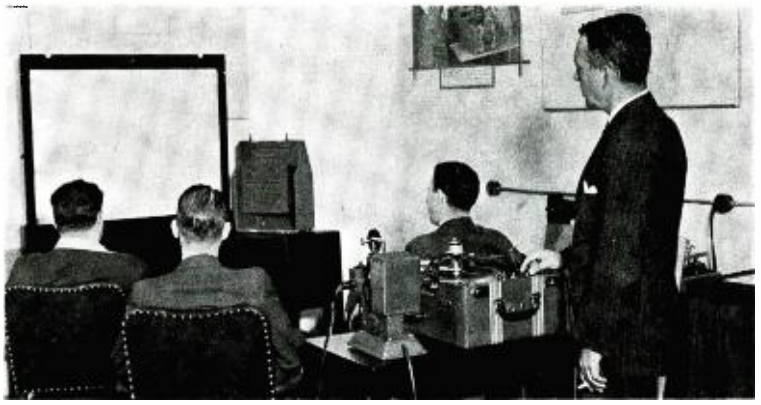
With a red china marking pencil, a radial line is drawn at the edge of the recording disc, and the cutting needle lowered on the line. After adjusting the position of the brushes on both the recorder and camera commutators to the starting mark, the turntable switch can be thrown and the action started.

When the scene has been completed, the turntable is stopped leaving the cutting needle on the disc. When making several takes on the same reel of film, the following procedure should be observed: Note the position on the scale at which the camera commutator has stopped. The turntable will coast a little further than the camera when the power is cut off. Lift the cutting needle and carefully move the turntable backwards until the turntable commutator is in the same position as the camera commutator. For example, if the camera commutator has stopped at 3 on the scale, the turntable must be moved back until the commutator is at the same number. Then lower the cutting needle gently back into the groove. You are now ready for the next shot which is made in the same way. Regardless of the number of interruptions during the filming of the picture, both the film and the record will run continuously when the picture is being shown and the sound for each scene will be in synchronism.

At the completion of the filming, the record is ready for use and you may play it if you wish to check the sound.

Projecting the Picture

After the film has been processed the starting point of the film must be matched with the record. The projector is threaded so that the first picture is properly in frame at the aperture. Using the red pencil a mark is made across the film at a place which can be matched with a similar mark on the top of the aperture plate. This will give an experimental point to work from. Then set the playing needle carefully in the first groove of the record at the starting mark made when the picture was taken.



Projecting the picture. The loudspeaker (right of screen) is mounted in recorder's removable cover.

Set the commutators on both the turntable and projector to the starting mark and throw the turntable switch which also starts the projector motor. Watch carefully for the first lip movement of the actors and note whether it comes before or after the sound on the record. If the picture has been filmed and processed properly, the sound should be in exact synchronism. If the sound is behind the lip movement, it shows that the picture has started too soon and that your starting mark must be placed nearer the beginning of the film. In some cases a few feet of leader must be added to thread the projector properly. If the sound is ahead of the picture, the starting mark must be moved a few frames further along on the film. When making these adjustments, remember that the film moves 12 frames for each revolution of the turntable. Improper synchronization will become noticeable if the picture is cut more than 2 frames. With a little practice it becomes possible to determine the exact starting point within a few minutes. Once the starting point has been found and marked, the picture and record will always run in synchronism whenever they are shown.

Synchronized Narratives

In addition to making talking pictures, the synchronizer may also be used to add narrative comment, sound effects and introductory or theme music to silent pictures. The titles are removed from the film and a script is written to describe the action in the picture. The narrative is then timed by reading it while the picture is projected. When the timing has been perfected, the narrative is recorded while the narrator watches the picture.

• • •

POLICE RADIO

(*Continued from page* 11)

Directly in front of the operating position, are eight small meters in a direct line which are connected across the telephone lines, terminating at the remote-receiver location. Each receiver is in continuous 24-hour-a-day operation, and when a patrol car desires to call headquarters, the patrolman lifts the microphone handset from the control box and presses the identifying tone signal button and the volume-level meter on each receiver circuit indicates the relative strength of the incoming signal at each remote point, thereby simplifying the dispatcher's selection of the circuit producing the loudest signal. By pressing the proper switch, a loudspeaker is connected across this circuit and may be immediately changed if a different circuit produces a stronger signal during any transmission. When a given car is instructed to carry out an order, colored panel lights indicate its status and this system eliminates the necessity of having the dispatcher's refer to a third party who would have to keep a record of this fast changing situation.

Syncrosound system in use with projector and recorder. The master commutator is mounted on the center shaft of the turntable. The projector commutator is coupled to the shutter shaft.

FUNDAMENTALS OF FREQUENCY CORRECTION

Brief Fundamentals of Frequency Correction Without the Use of Filters

By H. C. LIKEL
Consulting Engineer

ENGINEERS working with audio-frequency circuit are often confronted with the task of giving the circuit some special response characteristic. Such problems arise from the need to compensate for deficiencies, intentional or otherwise, in some part of the circuit or to compensate for the action of the ear response at other than normal volume.* Herewith is a short qualitative exposition of some of the means of accomplishing this.

Of course, any circuit which shows frequency discrimination must contain one or both of the two electrical quantities which are inherently discriminating in their behavior to various frequencies, inductance and capacitance. Both of these quantities are useful and sometimes necessary in obtaining a desired frequency correction. However, when it is possible to obtain the desired characteristics through the use of capacitance alone it should be done, not only because it is usually much less expensive, but because inductances are susceptible to induced hum from stray magnetic fields from which it is difficult to shield them. Resonant circuits should also be avoided for this reason which becomes particularly troublesome in resonant bass accentuation circuits and also because resonant circuits tend to sustain the frequency to which they are tuned and detract from the accuracy of the system's reproduction.

*See "New High Fidelity Receiver," by L. G. Pacent and H. C. Likel, p. 14, May (1939) COMMUNICATIONS.

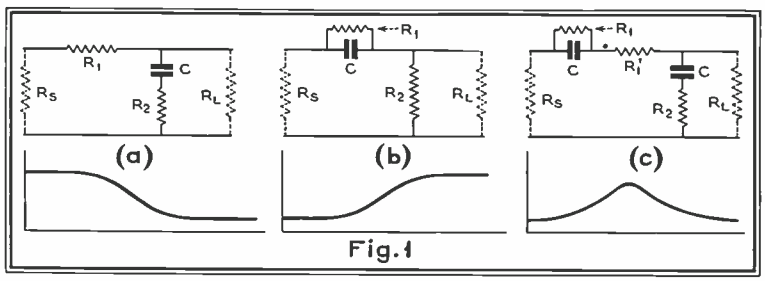


Fig. 1

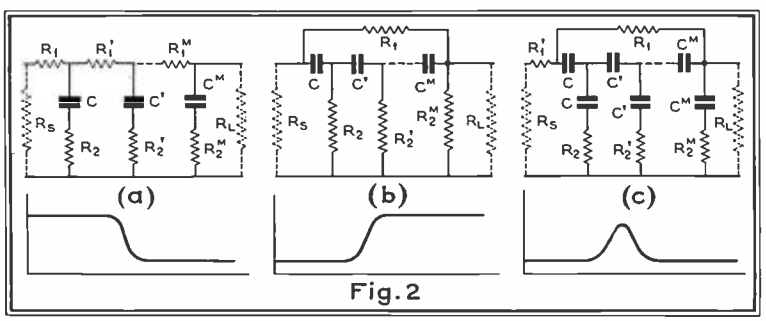


Fig. 2

NOTE: *In Fig. 2 replace all superscripts M with N.*

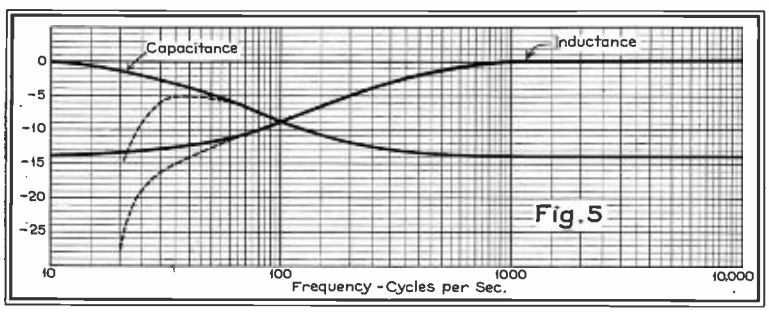


Fig. 5

Unless very sharp breaks in the characteristics are needed, the desired results can be obtained through the use of resistance and capacitance networks alone. The three basic circuits for obtaining frequency discrimination with these components are shown in Fig. 1 together with their particular type of response.

The sharpness of the cut-off of any of these types may be increased by adding sections as shown in Fig. 2.

The behavior of the circuits shown in Fig. 1 is simple. In A, it is the resistor R_1 across which the unwanted part of the signal is lost. Assuming that R_L is large compared to R_1, it is readily seen that at low frequencies where X_C is also large compared to R_1 the voltage across R_L will be substantially that across R_s. At high frequencies, however, where X_C is small compared to R_1 and R_2 the voltage across R_L will be the voltage across R_2, that is

$$E_{R_L} = \frac{E_s \times R_2}{R_1 + R_2}$$

Between these two extremes of frequency the voltage across the load will be

$$E_{R_L} = \frac{E_s}{\sqrt{(R_1 + R_2)^2 + \omega C^2}} \sqrt{R_2^2 + \omega C^2}$$

The maximum correction obtained in

$$\text{db} = 20 \log_{10} \frac{R_1 + R_2}{R_2}$$

assuming R_L is a voltage-operated device. The middle of the correction in db will occur when E_{R_L} is the geometric mean between E_{R_s} and E_{R_L} at the maximum correction.

If a residual high-frequency response is not desired the resistor R_2 should be omitted. Then the voltage supplied to the load will be that across C and will decrease constantly with increasing frequency.

In Fig. 1-B, the unwanted part of the signal is lost across R_1-C. At low frequency where ωC is large compared to R_1 the approximate reduction in the signal in

$$\text{db} = 20 \log_{10} \frac{R_1 + R_2}{R_2},$$

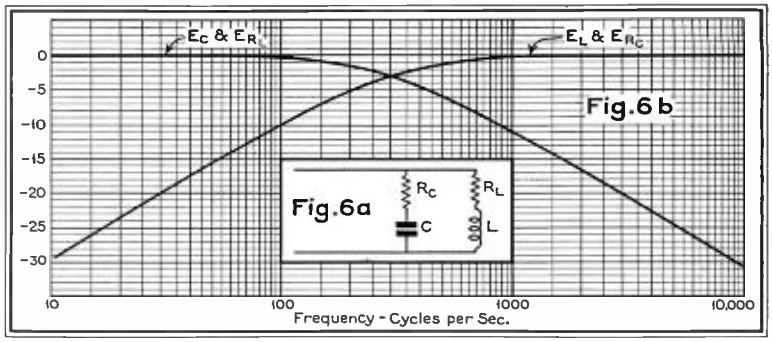
again assuming R_L to be large compared to R_2 and the load a voltage-operated device. Of course the midpoint in the cor-

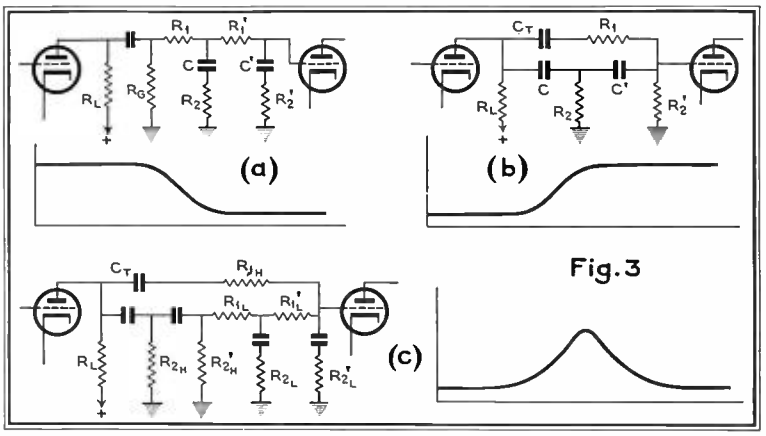
rection in db will again occur when E_{R_L} is the geometric mean between E_R maximum to E_R minimum. When using this circuit R_1 must be left out if the residual low-frequency response is not wanted.

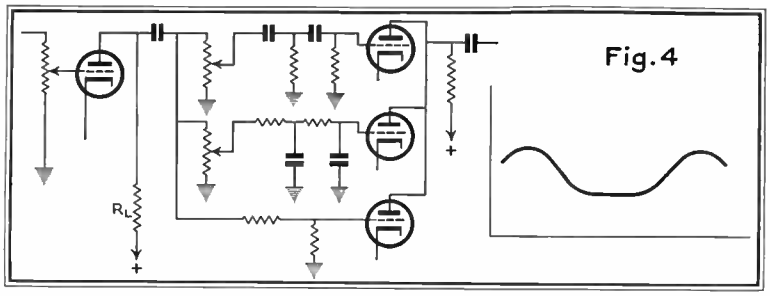
Fig. 1-C is a combination of Fig. 1-A and Fig. 1-B and the data relative to them may be applied to it. The curve shown is obtained by overlapping the pass portion of the two characteristics.

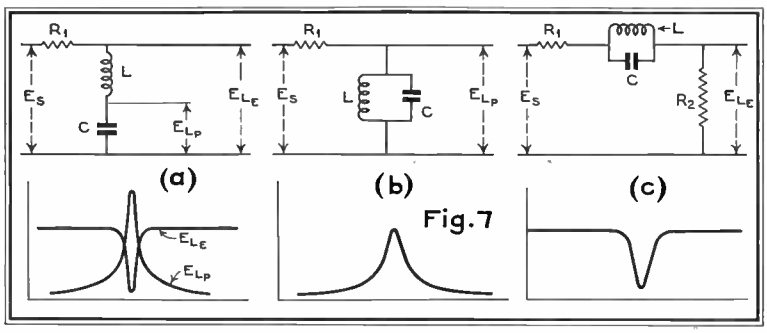
Assuming laboratory facilities will be available to those wishing to design circuits similar to the above it does not seem advisable to go into the mathematics of these circuits more deeply than has been done here. The equations given are sufficient for the selection of approximate values for constants. Exact ones may be quickly determined from a few tests whereas the mathematical solution, taking all factors into account, would be a laborious task. This is even more true of the circuits of Fig. 2. To arrive at values for such circuits it is well to select and test values for the simple circuits of Fig. 1. When proper values have been found but a sharper line of demarcation between the high and low-frequency response of the circuit is wanted these constants may be used as a guide in selecting constants for the more complicated circuit. For example, if the circuit of Fig. 1-A is most nearly satisfactory when $R_1 = 40{,}000$; $R_2 = 10{,}000$; $C = 0.1$ then suitable constants for Fig. 2-A using two sections would be $R_1 = R_1' = 20{,}000$; $R_2 = R_2' = 20{,}000$; $C = C' = 0.05$. This solution is the result of a little arithmetic relative to the resistance part of the network alone, that is with the network simplified as it would be at a high frequency where the capacitive reactances are negligible. Since the curvature in the characteristic will now be sharper than before, other values than those suggested for C and C′ may be more desirable. In any event satisfactory values for any of these circuits should be arrived at, once their behavior is thoroughly understood, after a few trials have been made.

Such arrangements as have been discussed are usually not applicable to line circuits because of the variation in impedance which they present with frequency. They are best applied between the anode circuit of one tube and the grid circuit of another tube. When used in this way the effect of the variation in impedance of the circuit upon the load circuit of the first tube and the consequent variation in gain by that tube must be taken into account. It is possible to design the circuit so that this effect is minimized. To do it, it is necessary either to design the compensating circuit so that its lowest impedance will be large as compared to the tube load resistance or have the load







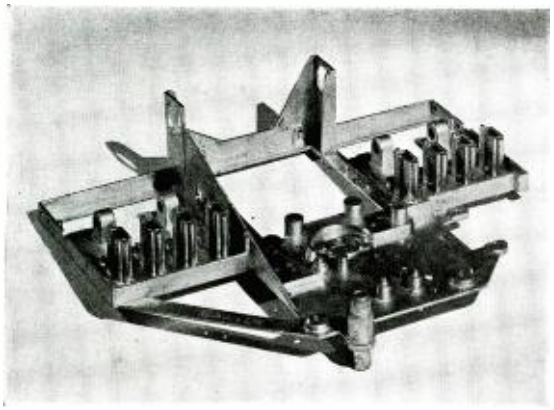


impedance, as represented by the combination of the load resistance and the compensating circuits, always large as compared to the plate resistance of the tube. If the first thing is done the load impedance of the tube will not vary much so the gain will remain proportionately constant. In the second case it must be remembered that

$$\text{gain} = \mu \frac{R_L}{R_L + R_P}.$$

If R_L is four times R_P the gain will already be 80% of μ. Thus R_L can vary between 4 R_P and infinity and only result in a change in gain due to the tube of a little less than 2 db. For accurate

(*Continued on page 29*)



Frame for a Wells-Gardner automatic tuning device die cast in one piece.

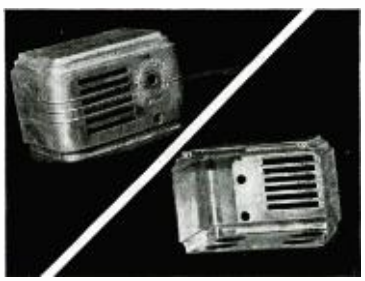
Die Castings In

By HERBERT CHASE

IT requires no more than a superficial study of modern radio receivers and other communication equipment to make it apparent that die casting is finding important and increasing uses in this field. Reasons for this soon become evident to the designer and production man who gives the matter attention, but may require some study to those not familiar with the facts. Although the art of die casting is not new, it is constantly opening new possibilities and many of these are hardly more than beginning to be discovered.

When the production of instruments and light machines in moderate to large quantities is under consideration, four major processes stand out as holding. perhaps, the major possibilities of economy in construction, namely, stamping. screw-machine, die casting and plastic molding. We will only be concerned with die-casting here.

Specific instances need to be examined to make the advantages apparent to those not already familiar with die casting, but before this is done, a few facts about the types of die castings available should be mentioned. Alloys of five or more base metals are available for die casting, but, for practical purposes, only those of zinc and aluminum will be given attention here.



Left: Front and rear view of Silvertone midget housing.

Below: A die-cast microphone housing.

The zinc alloys have a tensile strength averaging around 40,000 lb. per sq. in. and an impact strength usually above 15 ft. lb. (Charpy), which is above that for most of the common low-cost cast metals. Of primary importance, however, is the fact that these alloys can be cast in complex shapes of thin section and usually within 0.001 in. per in. of drawing dimensions. Each part coming from the die as a substantially exact duplicate of preceding and subsequent castings and in general requires little or no machining. Complex core work can be done, when required and surface finish can be made so smooth that grinding or polishing is rarely required even for exposed parts.

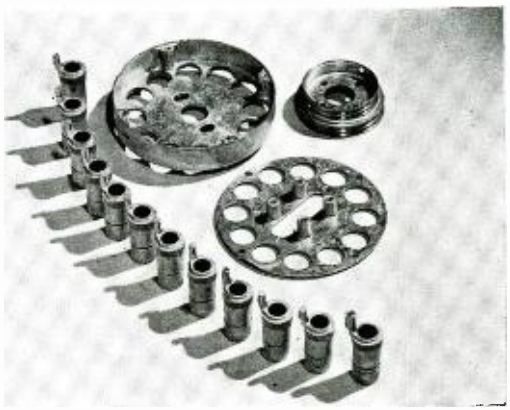
Zinc alloys are non-rusting, of course, and seldom require any finish, unless exposed to view, in communication applications. Accurately cast gears, cams, mounting bosses and the like are readily provided, making it possible in many instances to produce parts in one piece which would require two or more pieces and assembly operation if other means of production were used. It is this last consideration, along with the matter of dimensional accuracy, which makes the die casting so useful in many radio and similar parts.

Some of the parts which are assembled on Wells-Gardner frame (above). Some of the parts and gears are die cast.

This becomes apparent when some typical die castings are studied. Take, for example, the frame for the automatic tuning device shown. Here, in one complex piece, but easier to produce than many die castings, are bosses for supporting many parts, bearings for

PARTS PRODUCTION

Engineer



Parts for a Philco tuning device involving accurately sized die-cast elements.

shafts, pivots for other members, eight cored-out T-slot guides for tuning plungers, and a motor bracket, among other elements, forming a complete frame with adequate stiffness. Accuracy in dimensions is such that little or no machining aside from drilling, reaming or tapping holes and possible spotfacing of bosses is needed. Similar results might be secured by building up an assembly of stamped and screw-machine parts, but only at the expense of numerous manufacturing, handlings and assembly operations.

Subsequently assembled on this frame are several small die-cast parts, including flanged hub members for setting disks, gears of irregular shape, clutch parts, and at least one bracket. With

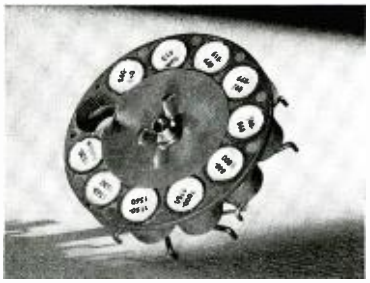
Right: Emerson semi-automatic tuning device.

Below: Auto remote control device by Star Machine Co.

these go several stamped and screw-machine parts, but the chief reliance is in the die castings, clearly effecting marked savings in the cost of units and of assembly.

Several other tuning devices, some of which might be classed as semi-automatic, employ die castings for similar reasons, as accompanying illustrations indicate. These include small gears of accurate tooth profile, and plungers with toothed serrations. Some of these plungers have inserts of other metal and some have added integral elements or odd-shaped projections hard to produce in any but die-cast form.

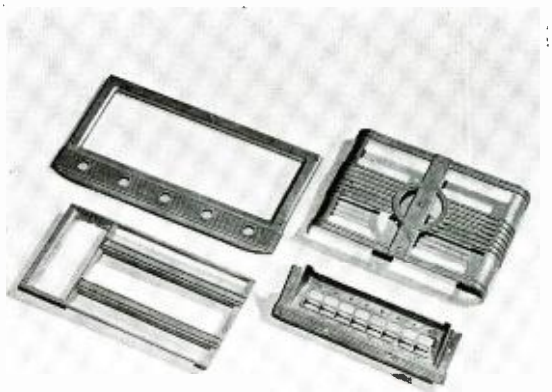
In the automobile-radio tuning device, there are a pair of accurate, free-turning die-cast bevel gears in a die-



cast zinc-alloy housing having integral support and threaded projections. Assembled with these parts are some screw-machine products, a stamping and a molded knob. All four of the high-production processes mentioned above are involved in this unit.

Such examples make it clear that die casting is suited for small mechanical parts, but its utility does not end there. For larger parts, including some in which appearance is a primary consideration, the die casting again plays an important role. This is well illustrated in the midget radio case shown in another illustration. The fine appearance of this case is immediately obvious. It is a one-piece zinc-alloy die casting measuring 6¾ in. wide, 4¾ in. high and 4⅜ in. deep, yet the section thickness averages about 1/32 in., making a cabinet as thin as if made in sheet metal. Finish is in antique ivory, Chinese red or walnut and only one lot of cases need be purchased and stocked to turn out a case in these or in any other color. All the holes and openings seen in the front view are cored and the dial markings are debossed in the die and hence are embossed on each casting, as are also the decorative moldings carried around the corner and side. Convenient mounting bosses are integral and the

(*Continued on page 19*)



A number of die-cast grilles and bezels. Surfaces are smooth and readily plated or enameled.

TIMING CARRIER BREAKS

By HILTON REMLEY

Engineering Staff
WJJD, Inc.

FOR the station engineer who visits his brothers in the industry once in a while, it is truly amazing the various little tricks and pieces of equipment that are used to improve the service. No two engineers have the same ideas nor the same problems, but when a problem is solved at most stations, the idea gets no further than the confines of that one engineering staff. From time to time we do see some practical ideas in print, but they are few and far between. This is an attempt to bring out two ideas that have been in use here for some time and have been very helpful. (COMMUNICATIONS welcomes practical "tricks" that may be of interest to other engineers.—*Editor.*)

It has always been a practice to record on the transmitter log the exact time and duration of any break in the carriers. It was necessary for the operator to quickly glance at the clock, both at the time of a break and after all the excitement was over. That, at best, was but a guess and there were large errors, we were certain.

Therefore, it was decided that something should be done, along the mechanical-electrical line, to correct the situation. That decision resulted in an interesting and inexpensive piece of equipment.

We started out with the idea that a set of clocks would do very nicely. The transmitter plant was already supplied with accurate time by means of a bichronous clock (one which continues to run for an hour or more after the a-c supply has been disconnected), and this formed the basis of our idea. If we would manage to have two synchronous clocks running when the carrier was on, connected in such a manner that when the carrier was on both would run but when the carrier was off they would stop, then if it could be arranged that only one of the last two clocks would start when the carrier came back on, we would have all the information that we needed.

When it came time to build the unit, it was decided to build it on a standard panel to match the remainder of the speech and monitor equipment and to install it on the monitor rack. After a little concentration on the trigger work for the most simple system to use with the relays, the equipment was wired as shown in Fig. 1.

The resonant circuit, L C, will be tuned so as to supply a voltage to the 1v rectifier, such that the rectified current will operate both relay 1 and relay 2 when they are in series. Then when the carrier first comes on, the current through the diode flows through Sw_3, through resistor R_1 (which is same resistance as that of relay 1), through the contacts of relay 1 and through the winding of relay 2 to ground. Contacts on relay 2 will then start clock 2. Now, in order to start clock 1, we push Sw_3 (momentary contact type switch). This shorts R_1, takes the short off relay 1 and allows the current to flow through the windings of both relays, thus causing both clock 1 and clock 2 to run. Then, by means of Sw_1 and Sw_2 the clocks are set exactly with clock 3 (bichronous) and all clocks are now running together.

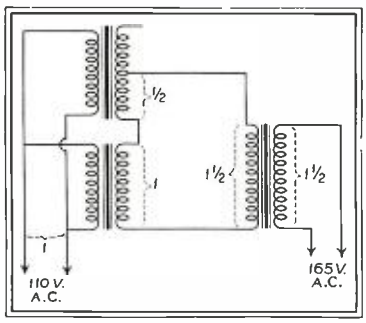


Fig. 5. Circuit for stepping up the voltage from 110 to 165 volts.

When the carrier goes off, both relays release, relay 1 automatically shorting its winding as before and locks out clock 1.

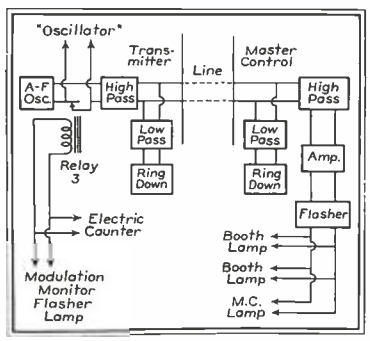
Then: Clock 1 goes off with carrier and stays off until re-set manually. Clock 2 comes back on with carrier, after having stopped as long as the carrier was off. Clock 3 is always running.

The difference in time between clock 3 and clock 2 is the total time the carrier was off. Time on clock 1 shows the exact second when the carrier went off. With this information at hand we can compute any time we need for the log, and we have not had to bother about time while the carrier was off!

It will be noted that an extra contact on relay 2 is taken off to terminals marked "oscillator." This will be used on the following equipment and will be dealt with later.

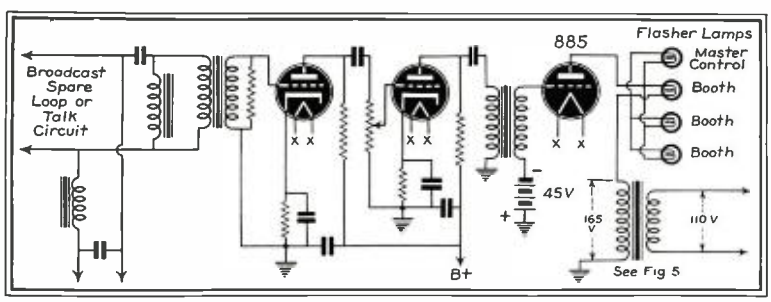
The equipment mentioned above is just another solution of the old problem of feeding the peak flash from the modulation monitor back to the master control from the transmitter. This little trick has been done by many operators before, by use of either simplex or duplex, but we think we have another solution. The distance and type of circuit at WJJD were such that we had to find some other way to handle this situation. We went about it from an entirely different angle.

Fig. 2. Block diagram of the system to feed back peak flashes.



We decided to key an audio-frequency oscillator with a relay connected in parallel with the peak flasher lamp on the modulation monitor, send this impulse to the studio on the talk circuit, there

Fig. 4. Showing connection of equipment at master control point.

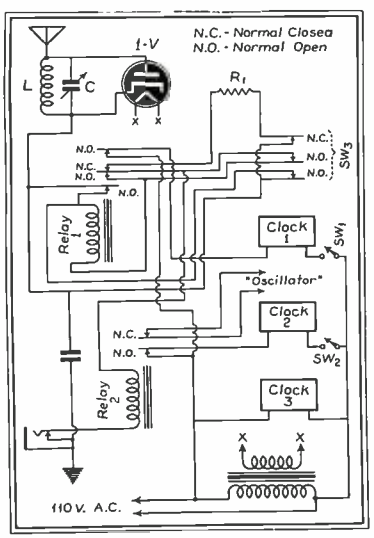


to have it operate another flasher circuit for indication to the control operator. The choice of frequency is a matter of no importance in itself, with the exception of the filter requirements. About 4,000 cycles was used in this case as we were able to make use of simple filters which could be reasonably built in our own shop. A high-class filter located on the output of the oscilator at the transmitter and on the input of the amplifier at the master control point tends to filter the speech and ringing current from the oscillator and amplifier. We should also filter the pulse frequency out of the talk circuit just ahead of each ringdown set so that the pulse will not bother the normal use of the talk circuit. Here is another reason for the 4,000-cycle frequency, as the natural filtering of the ringdown set itself will not pass much above 3,000 cycles, and our task is just that much more simple. With the use of the filters, we do not interfere with normal use of the circuit in any way. Fig. 2 shows a block diagram of the entire system.

Any type of audio-frequency oscillator may be used at the transmitter end of the line, while the amplifier at the master control point will depend upon the loss in the line. This amplifier is arranged to feed an 885 or 884 gas triode which in turn flashes the lamps.

To give some idea, we have shown the type of oscillator in use and the entire connection of apparatus at this end of the line. Fig. 3 shows all this. There is very little of interest in this except the coil 1, which is about three pounds of No. 22 d.c.c. with no iron and mounted off of any metal panel. Fig. 4 shows the connection of equipment at the master control point. The only point

Fig. 1. Showing the equipment wiring.



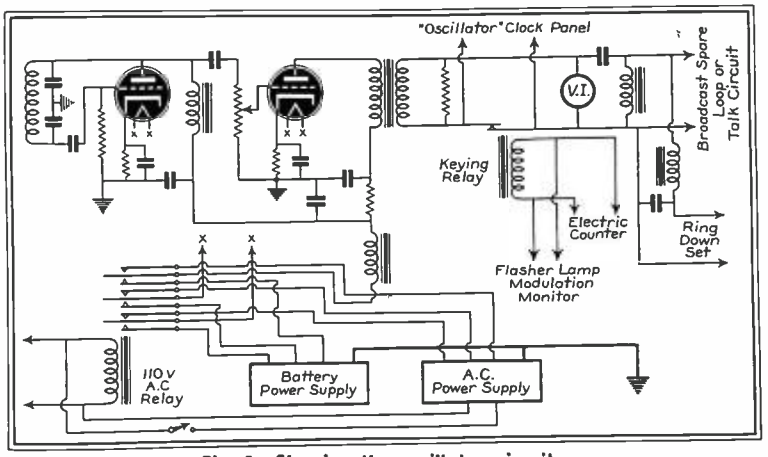


Fig. 3. Showing the oscillator circuit.

of interest here is the isolation transformer T_{1a}. Although 110-volt lamps are used in the flasher sockets, it was found that far better operation will result if the voltage on the lamps (6 watts each) is raised to about 165 volts. This is a ratio of 1:1½ and can be done with the aid of three cheap filament transformers as shown in Fig. 5.

Now the extra contacts on relay 2 of the clock panel comes in. This set of contacts will be seen to parallel the contacts on the keying relay of the oscillator output. These contacts will close if the carrier goes off and thereby shorts the keying relay, sending a continuous signal to the master control, which in turn lights all lamps brightly. This gives indication to the control operator that the transmitter is off the air and will indicate the time the carrier is back on the air when the lamps all go out again. It will be noted that a means of automatically switching from a-c to battery power supply is provided in case of a power-supply failure at the transmitter. Otherwise, the failure of power at the transmitter would stop the oscillator altogether and there would be no energy fed to the master control, and no indication that the carrier was off.

A few notes on the operation of the peak flasher equipment might prove to be of some help. A setting of the flasher at the transmitter of less than 100 percent is necessary if the control operator is to make use of the system. For normal use, it has been found that when peaks flash at an average of about one peak every 2 to 5 seconds at 85 percent modulation, we will find that average level is a little over that point, but under 100 percent. This should be checked carefully after the system is put into use and it is found how the control operator will use the flashes, there being no hard and fast rules to follow. The level can be lowered at any time by reducing the flash point of the lamp on the monitor. The control operator will then automatically reduce gain when he finds that he is reading too many peaks. A telephone type of electric counter, read every half hour or so, connected across a lamp somewhere in the circuit, will be of great help in checking the operation.

These notes have been given to show what can be done to improve the operation of a station and to assist the engineering staff to operate in an orderly manner. Each engineer will have his own ideas and variations of those given. No two installations are the same and, as a result, the problems and their solution will never be the same every place. We only hope that we have provided a working basis for other ideas.

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IRE CONVENTION

Tentative dates have been announced for the National IRE Convention in 1940—June 27, 28, 29. The place is the Hotel Statler in Boston, Mass.

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DIE CASTINGS

(*Continued from page 17*)

only machine work required is to tap these holes and punch those in the base.*

Similar advantages are gained in the two-piece streamlined housing for the microphone shown, and in the attractive radio grilles or bezels also illustrated. When plating is required, the die casting does not go out of shape or show draw marks or ripples when buffed.

If space permitted, further examples might be cited, but those mentioned show conclusively that the die casting has found a deserved position in the communication industry's products, as it has done long since in other classes of equipment.

*Base holes could be cored if desired, but this would increase die cost and probably would leave fins requiring subsequent removal and so yielding no net gain. The thin die-cast wall is easily punched in an inexpensive operation and with low-cost tools.

OVER THE TAPE . . .

NEWS OF THE COMMUNICATIONS FIELD

PURCHASING DIRECTORY OMISSION

In our purchasing directory section of the October, 1939, issue of COMMUNICATIONS, the following company was unintentionally omitted from the listing devoted to "Laboratory and Test Equipment," page 27: *Cornell-Dubilier Electric Corp.*, South Plainfield, N. J.—capacitor bridge, capacitor analyzer.

BLILEY CATALOG

A new catalog has just been made available by Bliley Electric Co., manufacturers of quartz crystals. Catalog G-11 covers general communication frequency quartz crystals, holders and ovens for frequencies from 20 kc to 30 mc. This catalog will be of interest to radio engineers, station operators, purchasing agents and experimenters. Copies may be secured from the above organization at Union Station Bldg., Erie, Pa.

LITTELFUSE TAKES BIGGER SPACE

For the fifth time in twelve years, Littelfuse has had to enlarge its manufacturing facilities, increase its plant capacity, and move to enlarged quarters. The new plant address is 4757 Ravenswood Avenue, Chicago, Illinois.

Littelfuse Laboratories, now known as Littelfuse, Incorporated, was organized in 1927 by Mr. E. V. Sundt. The company was founded with an idea and total capital of $150.00. Year by year the business has had a steady growth. From the smallest beginning, today Littelfuse has thousands of active accounts, over 250 domestic distributors, and distribution in practically every country of the world. Mr. Sundt reports that business is up over 35% above the same period last year.

NEW OFFICES FOR ALLIED RECORDING

On November 1st Allied Recording Products Co. moved to their new offices and plant at 21-09 43rd Ave., Long Island City, N. Y. The telephone number is STillwell 4-2318. According to the manufacturer, the change was made necessary by increased business.

MALLORY CATALOG

The new 1940 Mallory-Yaxley Catalog is now available from P. R. Mallory & Co., Inc., Indianapolis, Indiana. This 40-page catalog contains considerable technical data on their line of controls, switches, potentiometers, special switches, dial plates, jacks, plugs, cable connectors, terminal strips, dial lights, knobs, resistors, condensers, vibrators, vibrapacks, dry disc rectifiers, grid bias cells, etc.

BLAW-KNOX APPOINTMENT

At the last meeting of the Board of Directors of Blaw-Knox Company, Lawrence E. Joseph was elected a Director and Vice-President of the company. Mr. Joseph was recently appointed Executive Head of the Blaw-Knox Division.

MAAS & WALDSTEIN BULLETIN

A comprehensive review of the various methods of applying lacquers and enamels to metal products has just been published by Maas & Waldstein, 438 Riverside Avenue, Newark, New Jersey. Copies of this review, which was presented by G. Klinkenstein, Vice-President and Technical Director of Maas & Waldstein, before the recent annual convention of the American Electroplaters Society, are available on request.

TRIUMPH REPRESENTATIVE

Triumph Mfg. Co., 4017-19 W. Lake Street, Chicago, Ill., manufacturers of commercial radio testing apparatus, announces the recent appointment of Fry & Roberts, 2412 W. Seventh Street, Los Angeles, California, as West Coast representatives for the states of California, Arizona, Nevada and Utah. Plans were completed for opening a San Francisco office November 1st.

OXFORD-TARTAK BULLETIN

Oxford-Tartak Radio Corporation, 915 West Van Buren St., Chicago, Illinois, have just issued a new bulletin covering their line of speakers for various applications. Rather complete technical data is given. Copies may be secured from the above organization.

J. R. BEEBE IN NEW POST

The Thordarson Electric Mfg. Co. announce the appointment of J. R. Beebe, well known sales representative, as Assistant Sales Manager. Jack Beebe has been representing Thordarson in the Middle Western States since 1934.

ULRICH RECEIVES APPOINTMENT

The Hytron Corporation announce the promotion of Vinton K. Ulrich to the position of Renewal Tube Sales Manager. Mr. Ulrich joined Hytron in May of this year as Sales Manager of the Hytronic Laboratories Division and will continue handling those duties.

"TELEVENTS"

The Allen B. DuMont Labs., Inc., 2 Main Ave., Passaic, N. J., are issuing their "Televents" each week to DuMont dealers. Printed in attractive green and black, "Televents" are illustrated television programs on heavy card stock, for use in the dealer's window or on his walls. All programs to be transmitted by Station W2XBS (Empire State Tower) in New York City are listed day by day for the forthcoming week.

RME BULLETIN

Radio Manufacturing Engineers, Inc., 111 Harrison St., Peoria, Illinois, have recently issued a booklet covering their line of communication receivers, pre-selectors, band expanders and associated communication receiving equipment. Copies are available from the above organization.

BRUCE BURLINGAME APPOINTED BY I.R.C.

Bruce O. Burlingame, well-known manufacturers' representative with headquarters at 69 Murray Street, New York City, has been appointed by the International Resistance Company, 401 North Broad Street, Philadelphia, to handle IRC fixed and variable resistance products to the jobber and industrial trade. His territory will comprise parts of Eastern Pennsylvania, Maryland, Delaware, New Jersey and the District of Columbia.

EISLER ELECTRIC APPOINTMENTS

The Callite Products Division, Eisler Electric Corporation, have announced the appointments of Mr. J. Kurtz to the position of Director of Research and Development and Mr. Daniel R. Donovan to the position of Sales Manager. Mr. Kurtz will co-ordinate and expand the company's present activities in the form of a new department of research and development.

AEROVOX BULLETINS

Two colorful bulletins just issued by Aerovox Corporation, New Bedford, Mass., cover the Aerovox L-C Checker and the Aerovox Capacity & Resistance Bridge. Just introduced to the trade, the L-C Checker is designed for use by service men, manufacturers, laboratories, engineers, aircraft radio workers, communication companies and others as a means of checking condensers, coils and circuits under actual working conditions. The Aerovox bridge has been on the market over a year. Although intended primarily for service men, the bridge is useful to laboratory workers and engineers as well.

V. O. ALLEN RECEIVES APPOINTMENT

Victor O. Allen has been named Technical Director of the Wilbur B. Driver Company, Newark, New Jersey. For the past five years Mr. Allen has been associated with the Radio Corporation as consulting and research engineer. Educated at King Edward School VI, England, F. & M. Academy, and F. & M. College, he comes to the Wilbur B. Driver Company with broad experience in development and research. Starting with Carnegie Steel Company during college vacation, Mr. Allen has previously been connected with Union Carbide and Westinghouse. From 1932 he was Assistant Chief Engineer with De Forest-Radio until absorbed by R.C.A., in 1932, and from that date to 1934 he was in charge of power tube development and research for Hygrade Sylvania Corporation.

GENERAL CERAMICS CATALOG

The General Ceramics Company, 30 Rockefeller Plaza, New York, N. Y., has recently released a fully-illustrated 24-page catalog containing complete and concise information on General Ceramics Steatite and Ultra-Steatite Insulators. Copies of this booklet (Catalog 100) may be obtained by writing to the company at the above address.

OAK MFG. CO. ACQUIRES RELIANCE DIE & STAMPING CO.

Edw. F. Bessey, President of the Oak Manufacturing Company, Chicago, has announced the purchase by Oak of the Reliance Die & Stamping Company, also of Chicago. The Oak Manufacturing Company, with plants at 711 West Lake Street, Chicago, and Crystal Lake, Illinois, manufactures wave band and selector switches, vibrators, mechanical tuners, special switches, solenoids and similar gadgets for radio sets. The Oak company in taking over the Reliance Die & Stamping Company, 1260 Clybourn Avenue, Chicago, acquires a modern factory and office of approximately 125,000 feet. The Reliance plant has one of the best equipped tool rooms in the middle west and has long been known for its tool work.

The facilities of the Reliance tool room will be primarily used for Oak's own requirements and will enable the Oak company to expand its operation and also to accept contract manufacturing business. It is planned to enlarge upon and improve the Condenser Department.

The Oak company will move only its Chicago offices and plant to the Clybourn Avenue address. The business will be carried on as the Oak Manufacturing Company. Officers: Edw. F. Bessey, President and Treasurer; Elof Sandstrom, Vice-President; Geo. D. Sullivan, Secretary; R. A. O'Reilly, Sales Manager.

NEW POST FOR BOHLKE

W. H. Bohlke, whose activities in the Service Division of the RCA Manufacturing Company have contributed much to the development of radio and television servicing methods during the past eleven years, has been appointed Director of Test Equipment and Service Merchandising. The announcement was made by L. W. Teegarden, Manager of the RCA Radio Tube and Parts Division.

PORCELAIN ENAMEL APPOINTMENT

The Porcelain Enamel and Manufacturing Co. has announced the appointment of Mr. Harold G. Wolfram as Vice-President. Mr. Wolfram has been with Pemco for the past fifteen years and has served as laboratory technician, Director of Research, and more recently as Factory Manager. In his new position he will have charge of all engineering and technical activities of the company.

SOUTH BEND LATHE CATALOG

The South Bend Lathe Works, South Bend, Indiana, has just issued a new catalog which is said to be one of the most complete lathe catalogs ever published. This catalog contains 112 pages with over 250 illustrations and shows 75 different sizes and types of South Bend back-geared screw cutting lathes for production manufacturing, tool room and general shop work. A copy will be mailed on request.

LITTELFUSE CATALOG

Littelfuse Incorporated, have just issued a new catalog covering the complete line of Littelfuse products. This catalog, No. 8, contains several new products, including Bakelite enclosed aircraft fuses, fuse extractor posts up to 300 amps, Slo-Blo fuses, Video Littelfuses and Vacuum 4AG fuses. Copies of the catalog may be secured by writing to the above organization at their new address, 4757 Ravenswood Ave., Chicago, Ill.

N. U. SERVICE ENCYCLOPEDIA

National Union Radio Corporation, 57 State St., Newark, N. J., released this month a service equipment encyclopedia for use by N. U. distributors throughout the country. The compilation is 8½ by 11 page size and includes, in addition to listings of National Union tubes, condensers and panel lamps and information on N. U. gift merchandise, the complete catalogs of leading instrument manufacturers, such as, Jackson, Precision, Supreme, Triplett, Webber, and Weston. The book is provided with tabbed index sheets for ready reference.

G-E APPOINTMENTS

T. F. Hall, associated with General Electric appliance activities in various capacities for the past nine years, and more recently Manager of Radio Sales in General Electric's southwestern district at Dallas, has been transferred to Bridgeport as a member of the merchandising services section of the G-E radio and television department, it has been announced by Perry Hadlock, Manager of the Receiver Division. Simultaneously it was announced that Jack J. Broderick had been named Manager of Order Service for the same division.

CORNELL-DUBILIER CATALOG

"Industrial Capacitors for Motor Starting and Other A. C. Applications" is the title of a 36-page catalog just published by the Cornell-Dubilier Electric Corporation. A 1939-40 edition, and therefore up-to-date, the book contains a complete description of a-c electrolytic capacitors and a-c dykanol capacitors for motor starting and other a-c applications. Copy of Catalog No. 164 can be obtained free on request by writing to the main office of the Cornell-Dubilier Electric Corporation, South Plainfield, New Jersey.

RADIO CITY PRODUCTS CATALOG

Radio City Products Company has just issued the new 1939-40 edition of its catalog. The book encompasses the complete RCP line of test equipment—tube testers, combination tube and set testers, analyzer units, signal generator and special instruments. Under each model illustrated the performance specifications and price are listed. Copy of new 12-page Catalog No. 121 can be obtained on request from Radio City Products Company, Inc., 88 Park Place, New York City.

WOR TO CONSTRUCT F-M STATION

Official approval by the Federal Communications Commission has given WOR a full go-ahead in its plans to construct a new frequency-modulated broadcasting station to service the metropolitan area, according to an announcement made by J. R. Poppele, Chief Engineer of WOR. The new station will operate with a power of 1,000 watts on an ultra-high-frequency channel of 43.3 magacycles under the call letters W2XW1. Employing the Armstrong system of frequency modulation this new station's site is to be selected by WOR engineers within the next few weeks at the conclusion of extensive field tests.

WIRE BROADCASTING APPOINTMENTS

Appointment of Leo A. Pollock as director of public relations has been announced by J. R. West, President of Wire Broadcasting Corporation of America. Pollock, who will make his office at 250 West 57th Street, New York City, was with the public relations department of the New York World's Fair, where he was assignment editor.

Announcement was also made of the appointment of C. W. Bunn, one of the pioneers in the development of talking pictures, as General Manager of Wire Broadcasting. Mr. Bunn, formerly General Manager of Electrical Research Products, Inc., has also taken up his duties at 250 West 57th Street, New York City.

PATENT LICENSE AGREEMENT

Radio Corporation of America and Farnsworth Television & Radio Corporation announce that they have entered into patent license agreements whereby each party has acquired the right to use the inventions of the other in the fields of television and in other fields of their respective businesses. Radio Corporation of America acquired a non-exclusive license under the patents of the Farnsworth Corporation for television receivers, for television transmitters and other radio and sound recording and reproducing apparatus. The Farnsworth Corporation acquired a standard, non-exclusive license for broadcast and television receivers and electrical phonographs under the patents of Radio Corporation of America, and also other non-exclusive licenses for television and broadcast transmitters and for its other fields of business. Neither Corporation acquired any right to grant sub-licenses to third parties under the patents of the other Corporation.

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BOOK REVIEWS

TESTING TELEVISION SETS, by J. H. Reyner, published by Chapman and Hall, Ltd., 11, Henrietta Street, W.C.2, London, England, 1938, 128 pages, price 9/6.

Hitherto, information regarding the servicing of television receivers has only appeared in scattered articles or in a single chapter of a book. Accordingly, Reyner's "Testing Television Sets" is a valuable addition to the television engineer's library, since it is, thus far, the one and only book devoted exclusively to a compilation of television receiver faults.

Among the subjects covered are: apparatus required, location of trouble, cathode-ray-tube faults, time-base faults, synchronising faults, receiver faults, interference, and laboratory technique.

One precaution must be observed while reading this book. British television practice differs in a few minor respects from that employed in America. Accordingly, some of the statements and tests will not apply to American television receivers. The occurrence of such cases which are inapplicable to American receivers is of sufficient rarity, however, as not to detract from the value of this excellent book.

R. L.

RADIO-FREQUENCY ELECTRICAL MEASUREMENTS, second edition, by H. A. Brown, published by McGraw-Hill Book Company, Inc., 330 West 42 Street, New York City, 1938, 384 pages, price $4.00.

The scarcity of books devoted to radio-frequency measurements is so great that the appearance of another book on this subject is always eagerly awaited. In one sense, Professor Brown's *Radio-Frequency*

(Continued on page 29)

VETERAN WIRELESS OPERATORS ASSOCIATION NEWS

W. J. McGONIGLE, President | RCA Building, 30 Rockefeller Plaza, New York, N. Y. | H. H. PARKER, Secretary

15TH ANNUAL

THE Fifteenth Annual Dinner-Cruise of the Veteran Wireless Operators Association will be held at the Hotel Astor, New York City, on Wednesday evening, February 21st, 1940. The change to the 21st from the 11th is made because of the eleventh being a Sunday. Remember this is the one great event of the year that you cannot afford to miss. The day following is Washington's Birthday so the festivities will continue on into the wee sma' hours. Many highlights are planned for the celebration of the Fifteenth Anniversary of our Association. All of our Chapter groups are urged to arrange some sort of feature program for that evening and join with us in a night of good cheer. We will be pleased to include the details of Chapter plans so long as they arrive in time to be of value to your planned activity. The details should be in our hands before the first of the new year for inclusion in the January issue of COMMUNICATIONS. Let us all join, then, in making the Fifteenth Anniversary program one long to be remembered.

At the Astor on the 21st of February there will be a grand dinner, dancing, entertainment, Association awards to deserving recipients and a full evening of camaraderie and good fellowship with your associates of days gone by. Tickets are available and the subscription is $4.00 and dress is optional. Please let us hear from you soon as to your ticket requirements. Tables of ten may be reserved and the choice locations go to the early birds. So be one!

BOSTON

Bart McCarthy, energetic Secretary-Treasurer of the Boston Chapter, reports all prospects for a most successful VWOA season in the Boston area. At a meeting held at the Statler Hotel on October 21st, 1939, the following nominations were made: Jim Barnes, of Boston Edison Company, for Chairman; Arthur Stockellburg for Vice-Chairman and Bart McCarthy for Secretary-Treasurer. The nominations will be confirmed at the next general meeting of the Boston group on the 16th of November. Bart reports much interest in Association pins. And he will receive a supply of them. Pins may be obtained from the Secretary for one dollar.

HONOLULU

We are deeply sorry to hear of the recent passing of the Secretary of the Honolulu, Chapter, H. F. McIntosh. He was ever cooperative and an enthusiastic booster of VWOA. Through his efforts together with a few other key men the Honolulu Chapter was built up to one of our largest in membership. Our sincere condolences to his family and his fellow members in Honolulu.

George Street sends some interesting information from Hawaii. He is Chairman of the Honolulu Chapter and will be pleased to hear from all interested in VWOA activities in that part of the world. George has run some bang-up affairs out there and anyone who can attend and misses them surely misses something worth while. We're sure he'll have something good for the 21st of February. Let's know the details, George.

DUES

Our Secretary, H. H. Parker, will be glad to shoot along a 1940 membership card to all sending in the necessary. If you are not sure whether you paid for 1939 just send it along and he will properly credit your account. Your cooperation will be gratefully appreciated. Thank you.

PERSONALS

Pleased to learn of the appointment of "Bill" Simon, our hard working Treasurer, as Marine Radio Superintendent of the Tropical Radio Telegraph Company covering all radio marine activities of that company on the Atlantic and Gulf coasts. Congratulations and best of luck, Bill. . . . Heard Hal Styles of our Los Angeles group on the "Strange as it Seems" program the other night. He told an interesting story of losing his voice while on a ship running up to the far North-Russia and Alaska way. On his own account he has a program on a Pacific coast network titled "Help Thy Neighbor" which has been extremely successful. . . . Glad to see John V. L. Hogan and Lloyd Espenschied at the de Forest dinner. J. V. H recently received an OK for raising the power of his station WQXR to 5000 watts. The station specializes in classical music and has enjoyed great popularity. Lloyd is an executive in the Bell Labs. . . . Arthur Cohen, well known to all oldtimers, writes in accompanied by the necessary. . . . An interesting note from D. K. de Neuf, Superintendent of Operations of Press Wireless, Inc. . . . If some of the rest of you wrote in more frequently it would be a simpler job to fill this page each month. Let us hear from you re your new job, past experiences or just anything that might interest your fellow members. . . . George Clark, editor of the *RCA Family Circle*, did a fine job on the 20th Anniversary number. Many interesting pictures and notes re the early days and later developments in the past twenty years of radio progress. . . . New Orleans and adjacent territory will soon be well represented in VWOA ranks. "Steve" Wallis, one of our Directors, was recently appointed District Manager in New Orleans for the Mackay Radio Telegraph Company. All interested in VWOA activities in that area should contact him there. Thanks, Steve, for your fine telegram (Postal) to Dr. de Forest on "De Forest Day." . . . Pleased to see "Bill" Steadman and party at the de Forest dinner. . . . Paul K. Trautwein, Chairman of our Finance Committee, called re plans for our Fifteenth Annual Cruise. See item on this page and we'll see you there, Paul, and gladly.

NEW MEMBERS

We welcome among new members: Frank E. Fisher, an executive in the Skelly Oil Company in Pawhuska, Oklahoma. Mr. Fisher was in the Signal Corps of the U. S. Army some years back. . . . E. E. Rackle, assistant to the Vice-President of the Waterman Steamship Company at Mobile, Ala. Mr. Rackle has spent the past ten years aboard ships of the Southern Pacific, Waterman Steamship and Pan Atlantic Lines and at shore stations for the Mackay Company. . . . Leroy Bremmer, continuously active in radio since 1918 as ship operator, broadcast engineer, shore stations, ship and shore wireless installation engineer, design engineer, associate radio editor and other branches of the industry. He is now in Los Angeles. . . . We are glad to welcome each of the above and hope their affiliation with us will be mutually beneficial.

BYRD

A most interesting communication from Amory H. Waite, Jr., a member of the Second Byrd Antarctic Expedition: "I have indeed been anxious to join your fine organization ever since I heard the broadcasts on the air telling how Carl Peterson received the VWOA medal for flying in the Antarctic. As it happens I was one of the three men who rescued Admiral Byrd at his lonely outpost, and also was the operator of most of the Tractor Radio Equipment in the Expedition."

Mr. Waite's interest in radio dates back to 1912 and he was an operator in the Navy for four years, starting in 1919. Then with the Electric Storage Battery Company for two years and completed a course in electrical engineering at Lowell Institute in Boston—M. I. T. night school. He then worked with Mark McAdam at the Fore River Shipyard installing radio transmitters aboard ships. Spent some time in the Massachusetts National Guard. A trip to China as electrical engineer aboard the *M. S. Triumph*, an electric drive vessel. With Hollis Baird at station W1XAV, Television, W1XAU, Sound, and then helped build and operate from 1931 to 1933, W1XAL, which is still on the air with fifteen kilowatts on short wave.

Joined Byrd Expedition as Chief Operator of *Bear of Oakland* to Little America and operating there for over a year and operated aboard *Bear of Oakland* on return trip. Now operates amateur station W3HKO as Official Relay Station of ARRL and in the Army Amateur Radio System and does considerable lecturing on his experience with Byrd Expedition and particularly his trip with two others to rescue Admiral Byrd at his lonely outpost.

Mr. Waite received the Congressional Medal of Honor from Governor Hoffman of State of New Jersey in 1937. We heartily welcome "Bud" Waite to membership in our organization.

TELEVISION ENGINEERING

Registered U. S. Patent Office

TELEVISION ECONOMICS

Part X

By

Dr. ALFRED N. GOLDSMITH

Consulting Industrial Engineer

J-4 Costuming

REGARDLESS of whether a play be of the period (historical) or modern type, considerable special costuming is generally required. The wardrobe mistress is usually in charge of costumes in active use. Storage facilities for costumes must be provided, as well as convenient dressing rooms and lavatories. In television, with its rapid changes, specially adequate provision must be made in this regard. Costume colors should be selected to reproduce satisfactorily, considering iconoscope color sensitivity and the color of the studio illumination.

J-5 Make-up

Iconoscope chromatic sensitivity and color of studio illumination both affect correct make-up. As far as possible, television make-up should be minimized since the proper use of stage make-up requires skill and experience and takes considerable time. Nevertheless, a certain amount of make-up will always be required in order to remove blemishes or wrinkles, to create a photographic contrast between the complexion and the hair, and to enhance or reduce shadowing. The durability of make-up under the intense lighting conditions found on the television stage must be given consideration.

It has been found that the color sensitivity of the camera pick-up tube may change from time to time. This may require slight alterations in make-up during the day as the color sensitivity of the camera noticeably changes. Glare in the image can frequently be reduced by the avoidance of whites, and substitution therefor of yellow tinting.

J-6 Set Design

The sets used for television purposes will probably be far less extensive, as a general rule, than those used for motion-picture purposes. These sets are usually designed by artists and draftsmen working together. Many problems arise in their construction. Sometimes cameras and microphones must pass through doorways or other openings. Space must be provided for all properties, lamp supports, catwalks, and other adjuncts. Attention is given to the use of suitable upholstery.

There is a tendency toward background projection as a substitute for actual outdoor scenes or unusually elaborate sets, a motion picture or lantern slide being projected against a translucent screen toward the camera. Various lighting and electrical requirements (shielding of screen from direct light, synchronizing of projector and camera) must be observed which need not be here considered. In television, painted backgrounds or "flats" have been found widely usable.

Miniature sets may prove quite important in certain television applications particularly since picture definition is such that the accuracy of the model need not be excessive. As previously mentioned, it is also possible to inject backgrounds electrically by methods which are both flexible and economic and which may be expected in due course to find increasing favor.

Television will also do well to depend to a considerable extent on special effects, backgrounds consisting of blended shadings, and fading and dissolves, either for artistic reasons or to bridge gaps in the action. Titles can be handled conveniently in a set-up where controlled illumination and dissolves of captions on cards placed before the iconoscope camera are available.

J-7 Set Decoration

The usual complement of painters and plasterers may be required in this connection. The use of sound-transmitting material, thin veneers, and the like which simulate the appearance of wood or marble (and which can be obtained in sheets or rolls) sometimes proves convenient in economic set construction and also enables acoustic control.

J-8 Set Construction

An adequate carpenter shop is necessary for this purpose. In television it will be particularly desirable to use adaptable sets repeatedly. For example, different portions of the same set may be used in different shots. Sets may be reversed back to front in different scenes, if properly constructed, and thus serve a double purpose. At suitable intervals, interior sets can be used again, with difference in lighting and properties, and without the audience becoming aware of the repeated use. It is possible that television will develop construction units for sets, to be readily assembled in various arrangements as required.

Adequate studio size is an economy in this connection since crowding in the construction, erection, or removal of sets is a costly or at least inconvenient procedure.

J-9 Electrical Requirements

The studio must have an adequate power supply for the intense lighting

required on the sets. Experienced electricians are necessary in connection with the determination of the number and placement of the lights. An electrician who is accustomed to working with a given director, can frequently save a great deal of time by pre-lighting the set in a manner satisfactory to the director or nearly so. In television, there is a tendency to simplify studio lighting along semi-standardized lines. It is as yet uncertain whether such simplicity can be maintained when television productions become more numerous and presumably more elaborate. Unit directional overhead light groups, mounted for remote control of their output from the floor of the studio, are a convenience.

At present, an abundance of general or keylighting is provided, but lighting for special effects and modelling lighting are kept at economical minima. Some European studios use a series of overhead racks carrying 100-watt lamps and reflectors. This arrangement provides a really uniform lighting service and avoids "dazzling" effects. Such lighting, however, may tend to become monotonous or uninteresting. Heat radiation from the lamps is reduced by 80% through the use of special glass filters. There are provided in one studio stage a group of 10 rolling bridges controlled from the side galleries. These support lamp racks and accessories, thus leaving the stage floor entirely clear.

J-10 Picture and Sound Staff

Probably the most busy people in a television studio will be the camera men and the sound men.

The cameras in a television studio are highly mobile, shifting from position to position between takes. That is, at the termination of a scene, the outgoing camera is moved to a new location and carefully set up in preparation for the next take in which it becomes active. Similarly, the sound man may have to move his microphone correspondingly. It is even necessary at times that lights be shifted or made ready during a scene in preparation for the next scene or take. All of these operations must be conducted according to a rehearsed schedule, rapidly, accurately, *and quietly*. It will be appreciated that the corresponding personnel must be highly trained and thoroughly competent and that the equipment must be silenced. In addition, it is likely that film camera men will be in the studio sooner or later since the recording of studio presentations is in some cases a desirable and economic measure enabling, as it does, the inexpensive repetition of the performance and the film syndication of the presentation at any later date. A film library is thus established, the possession of which would naturally give any organization an advantage over its competitors. Since the cost of any but the simplest production is considerably greater than the cost of incidentally filming it during its presentation (for example, on 16-mm. negative stock), serious consideration should be given in the future to the film recording of programs.

In addition to the camera and sound men, it will be necessary to have control-room staffs for picture and sound made up of men who are not only skilled technicians but who have sufficient artistic sense to be able to collaborate with the director as required.

Studio experience has indicated a definite lack of depth of focus under present conditions. One television authority in Europe makes the following instructive statement:

"The producer's concern with his actors is largely due to the camera. The sensitivity factor of the mosaic . . . is still considerably below the sensitivity of a good film on an ordinary camera. As a result the depth of focus obtainable is less and so the producer is vitally concerned with all his artists being in such a position that a sharp picture will result. When it is realized that a matter of a foot is going to make all the difference between a clear-cut picture and a blur, it will be understood that the chief difficulty is in arranging the movements of the actors to appear natural and at the same time restricting them to the plane of focus of the camera. For example, in certain plays, we had six people of necessity in vision at the same time. How would they stand? They would not normally stand in a straight line, but we had to put them like that as it was the only way, otherwise there would have been a good view of the back of somebody's head and no face, or vice versa."

The ideal television picture in the home would of course be one of which all parts were in sharp focus. Not only would this most effectively utilize the television screen, but it would also afford the actors that freedom of motion and expression which would add greatly to spontaneity of acting and would give marked realism and naturalness to the performance. Television pictures are costly to produce both for the broadcaster and the receiver owners; accordingly their delineatory capabilities must be fully utilized by sharply focused depiction. Fortunately methods are available to produce these results. Any methods whereby the depth of focus in films used for television, or the depth of focus in direct television studio pick-up can be increased, constitute an essential and economic element in television, a notable addition to picture quality, and a factor in audience satisfaction.

Television will also develop a technique of special shots much like those used in motion pictures, though on a simpler scale. Zooming shots (where the focal length of the camera lens is optically increased or decreased while shooting from a fixed point, so that the effect of an approach or receding shot is obtained), an ddoly shots (where the camera is mounted so that it may follow mobile action), or follow shots (where the camera pans or tilts to follow a moving subject), or approach shots (where the camera moves toward or away from the actors) will all have dramatic value under certain conditions. Occasionally the action can be moved toward a fixed camera, with a zooming effect by a follow-focus shot. Accordingly the studio must be provided ultimately with perambulators (mobile camera supports), booms or camera cranes (which can as well elevate or depress the camera), and dollies; all of the foregoing being particularly carefully silenced for television purposes through mounting on rubber wheels, provision of elastic buffers, and the like.

J-11 Film Projection

Inasmuch as film will be used for some program transmissions, for optical background projection, for electrical background injection, and the like, a projectionist staff will be required in the studio. The handling of film for television must necessarily be even more precise as to its timing (starting and stopping) than in theater projection, since it will, in general, be associated with accurately timed programs or conjoint and related studio action. In addition, there may be required control room or studio men concerned with special lighting, changeover effects, and the like in a manner somewhat analogous to the sound-effect men now active in audio broadcasting.

J-12 Rehearsals and Presentations

A suitable group of producers or directors and actors will be required for television presentations. Actors who are most desirable for television programs may not be of the same types as those who would be particularly successful either in the legitimate theater or in motion pictures. The atmosphere of the home, in which television programs will be presented, is so different from that of the theater that only considerable experience will establish the criteria by which to judge the suitability of any given actor for television purposes. It may even prove necessary to establish training schools for such actors and to maintain them in stock companies. It may be mentioned that one European television producing organization has used as many as 32 actors in

one program. If television programs occupy any considerable portion of the available time for broadcasting, it will be necessary to have available a wide variety of different types of directors and producers, as well as actors, in order to avoid monotony resulting from repetition of a given type of presentation.

European authorities state that studio equipment required for a single television channel is about five times as expensive as that for a sound channel. For outside pick-ups, the present ratio rises to the rather astonishing value to 100-to-1. It is believed that about 4.7 times as many people are now required for the studio engineering staff of a television channel as are needed for a sound channel. A sound program requires for adequate rehearsal about 5 times the length of the actual performance. For television, even higher ratios are desirable in view of the numerous additional requirements of such programs. In fact, American practice both for sound and television tends not infrequently toward even higher ratios.

The number of rehearsals required for television performances will obviously exceed that required for sound broadcasting. All parts and action must be perfectly memorized so that they can be faultlessly presented the first time, retakes in the broadcast being obviously impossible. As a result, the rehearsal studio facilities for television must be extensive, and due allowance must be made for the rehearsal factor in establishing base costs of television programs. In this connection it may be mentioned that the addition of even a few hours of program operation per week, beyond a certain minimal point (of about 2 or 3 hours per week) requires additional studios and substantially increased program costs. Program costs thus tend to jump upward stepwise, particularly since each added and necessary studio carries in its train a whole group of added and related equipment, facilities, and maintenance costs.

In addition to all the staff members previously mentioned, the motion-picture producers employ dressmakers, script girls, historical research men, etc. Many of these elements can be minimized or avoided in television, at least in the early development stages.

The general procedure in the "shooting" (that is, photography) of a scene may be either of the following, among others. The scene may be started on a "key" shot which gives an indication of the purpose of the scene, for example, a close-up of some significant object or motion. Thereafter the camera may pan or tilt to the principal character or characters, and afterward go to a longer shot during the significant action. A second method of presentation involves "establishing the set" by means of a long shot which shows the surroundings and the main actors who are on the set, thereafter playing the major action of the scene during a medium shot, and using close-ups principally at significant points or for any climax in the action. Such close-ups may be either the "bighead" type (showing a single face) or they may be a "two-shot" (showing two heads in close-up, generally side by side). In television studios, these methods may be combined. In any case, the rapid changes from one camera to the next, and the shifting of cameras, actors, microphones, and even lights from one set to the next practically instantaneously is a hectic procedure requiring unusual skill and energy. It might facetiously be described as almost requiring that a number of people shall do several different things at the same time in various separated places.

It is to be expected that evolution in television methods, if controlled by considerations of studio economy, will lead to the use of semi-standardized arrangements of the sets and lighting, with control of the latter from portable switchboards to reduce operation costs.

In general, television programs will probably be compared by the public with those in a motion-picture theater in two principal respects, namely as to quality and cost. It must be admitted that effective presentation is easier under the controlled conditions of the theater than under the relatively friendly and informal conditions of the home. The existence in the theater of comfortable chairs, large-screen pictures (sometimes in color), supervising ushers, and the psychological atmosphere surrounding a large audience all add to the emotional appeal or effective presentation of the program. These factors are largely missing in home presentation but, on the other hand, the lack of effort required from the home audience and certain other factors may partly compensate for the theater advantages. There is some reason to believe, for example, that dramatic effects will be heightened in the home and that a performance of a given length in the home seems to correspond in entertainment value to a relatively longer performance in the theater. As to relative costs, it is difficult to compute these until a specific number of hours per week of television programs become available. Even then there will be differences of opinion as to whether the cost of the television receiver should be included in the cost of the entertainment (in addition to power and tube replacement), any more than the owner customarily includes a write-off of the cost of an automobile in the expense of a motor trip (rather than limiting the cost items to gasoline, oil, tires, hotel bills, and the like). The public will probably be inclined to regard maintenance cost only as the full price of admission to a television program.

There are a few additional economic problems in connection with television programs which may be briefly mentioned. The production cost levels which have been built up in the motion-picture field are manifestly far beyond the financial range of television. For this reason many motion-picture standards of elaboration and expense must be modified or discarded. In fact, it seems possible to adapt the present economical and high-speed methods of direct television pick-up to motion-picture recording of the performance at greatly reduced cost. Further, and particularly in its early stages, television must seek the sympathetic cooperation of organized labor groups. It is not likely to be possible for television to employ men on either the numerical or wage scales of the motion-picture industry. After all, the final criterion of television success will be what the advertiser can afford to pay for the program. While undoubtedly the advertiser will pay more than he now believes he can, particularly if television advertising demonstrates its persuasive selling capabilities, yet there must be some economic upper limit to advertising appropriations. The sensible and equitable adjustment to each other of the preceding factors will spell in large measure the future of television.

(To be continued)

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INSTRUMENT LANDING

(*Continued from page 9*)

straight from the airport to 600 feet above the outer marker.

Localizer Beam

In meeting the C. A. A. requirements for a stable runway localizer beam, the engineers found the elimination of multiple courses, crooked or bent courses, and the effect known as "pushing the beam," to be one of their most serious problems. Research determined that pure horizontally polarized radiation, entirely free of vertically polarized waves, was essential to overcome the troubles enumerated above. To satisfy these requirements they developed a new and unique design of basic antenna element (see front cover). They also devised an arrangement of these elements for controlling reradiation from structures, pole lines, trees, etc., near the airport. The result has also been a localizer system which provides the pilot

with two reciprocal courses giving him definite orientation when approaching the airport from any direction, and this has been accomplished with a complete absence of spurious or false courses to the sides. Further, this new antenna system is adaptable to airport conditions and can be adjusted to eliminate wave interference peculiar to any particular airport.

A new type of receiving antenna has also been developed for the airplane. This antenna is fundamentally the same as the transmitting antennas and it is receptive to horizontally polarized waves only. The basic field pattern is essentially circular in the horizontal plane. In order that a single antenna may be used for reception of both the localizer and glide path waves, a special network was designed to be connected between both receivers and the one antenna.

Designed to Pilot's Viewpoint

The Civil Aeronautics Authority system has been designed throughout to make the pilot's indication as simple as possible to follow. He switches from the radio range, which is giving him his general directional guidance, to the instrument landing receiver when he is about ten miles from the airport. The pilot is guided by a single indicator with two cross pointers. The pointers, one vertical and one horizontal, are actuated by two constant beams of radio energy sent out by the transmitters at the airport. The vertical pointer, actuated by the runway localizer beam, shows the pilot whether he is to the right or the left of the correct line of approach to the runway. The horizontal pointer, actuated by the glide-path transmitter, gives him his exact line of descent to the runway.

The pilot receives the signals of the inner and outer markers as pulsating flashes in small electric lamps adjacent to the cross pointer indication—slower pulsations at the outer marker, rapid pulsations at the inner marker. He also receives these marker signals in his earphones—a low pitched tone when he passes over the outer marker, a high pitched tone when over the inner marker.

The Localizer Transmitter

The localizer transmitter is a unit 76 inches high, 30 inches wide and 20 inches deep weighing approximately 900 pounds. The frequency of transmission is stabilized by a 4579.17-kc quartz crystal. A series of multiplier stages produces a final frequency of 109.9 mc. The tube lineup is as follows: R. C. A. 802 crystal oscillator and multiplier, R. C. A. 807 first multiplier, W. E. 304-B second multiplier, W. E. 304-B third multiplier, Eimac 100th (2 tubes) first amplifier, Eimac 250th (2 tubes) final amplifier.

The rated output power, unmodulated, is approximately 300 watts, with a total power input of approximately 2,000 watts at 220-volt single-phase alternating current. An important feature of this unit is its compactness. All r-f circuits and power supply (exclusive of line voltage regulator) are contained in the single cabinet. The unit also contains control relays so that it may be remotely operated from the control tower.

A monitoring arrangement is provided in this transmitter which operates in conjunction with a field monitor. The field monitor is situated in front of the localizer house on a line between the localizer and the landing runway. The monitor is directly on course and receives the signals in much the same way as the receiver in the approaching airplane. The monitor output is returned to the transmitter where it operates the course indicator meter which shows the position of the course at all times. There is also a similar instrument in the control tower for observation purposes from that point, and this is operated from the same field monitor.

The modulator unit is considered part of the localizer transmitting system. It is situated adjacent to the transmitter and modulates the transmitter output. The r-f output of the transmitter is divided into two equal parts and is modulated separately at 90 cycles and 150 cycles before being delivered to the antenna system.

The Glide-Path Transmitter

The glide-path transmitter is 76 inches high, 30 inches wide and 20 inches deep, and weighs 900 pounds. The crystal frequency is 3912.5 kc and the output frequency is 93.9 mc. The rated output power is approximately 300 watts modulated at 60 cycles. The total input power is approximately 2,000 watts at 220 volts single-phase a-c. The tube lineup is the same as in the localizer transmitter. All r-f and power-supply components (excepting line-voltage regulator) are contained in a single cabinet as well as control relays necessary for remote operation from the control tower.

The transmitter contains a monitoring circuit for indicating the transmitter operation. This monitor also serves as a tuning aid during the transmitter adjustment. The monitor output is carried to the control tower for operation of instruments which indicates the position of the glide-path at any time. In addition, if the monitor output shall fall below a predetermined level, an alarm is sounded as an indication of trouble.

The Marker Transmitters

The marker transmitters are approximately 18 inches high, 27 inches wide and 15 inches deep, and they weigh 150 pounds each. The crystal frequency is 4166.7 kc and the output frequency is 75 mc. The tube lineup is as follows: 1—807 crystal oscillator and frequency multiplier, 1—807 multiplier, 1—807 mutiplier, 1—807 amplifier.

The rated output power is five (5) watts modulated at 400 cycles for the outer marker and at 1300 cycles for the inner marker. The 400-cycle modulation is keyed at the rate of two pulses per second and the 1300 cycles at six pulses per second.

The entire transmitter is contained in a single portable unit. All radio frequency and power supply circuits, modulator, keying and monitoring equipment are contained in the single unit. The transmitter and its associated line voltage regulator are installed in a small weatherproof house suitable for outdoor installations in positions where the unit will be unattended for long periods of time.

The transmitters are mounted on sliding shelves so that they may be easily pulled out of the small housings for servicing. While in this position, complete access may be had to all parts of the transmitter.

The transmitters are intended for remote operation and monitoring from the airport control tower. The transmitter monitor returns a signal to the tower, where correct operation may be observed.

Monitor and Control Desk

The monitor and control desk permits remote control of all equipment in the system as well as observation of the operation of all transmitters. The control tower operator may select the runway on which the plane may land in accordance with the prevailing wind direction. Selection of any given runway automatically places in operation the proper localizer glide-path and marker transmitters for the approach from that direction.

Calibrated instruments and signal lamps give quantitative and qualitative indications of the various transmitters. These indicators are operated by the transmitter monitors and indicate the position of the glide-path, alignment of the runway localizer course and correct operation of the marker transmitters. If the output of any transmitter falls below a predetermined level, visual and aural alarms indicate the trouble. The alarms also operate if the runway localizer course should shift sufficiently to cause an airplane following the course to land off the runway.

(*Continued on page 29*)

RCA TELEVISION INSTRUMENTS

Three new pieces of television test equipment, a piezo-electric calibrator, a 5-inch wide-range oscillograph, and a television alignment oscillator, have been announced by the *RCA Manufacturing Company*, Camden, N. J. All three have been carefully designed in accordance with present-day television receiver development, and in addition include provision for future television progress.

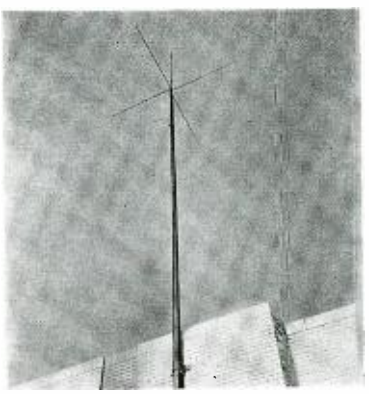
The calibrator is a small crystal-oscillator unit having fundamental frequencies at 250 and 2000 kilocycles. Harmonics of these frequencies are such as to provide calibrating frequencies for use in all high-frequency work. It is accurate to the degree of plus or minus .05%. The unit is complete with its own power supply and acorn type oscillator tube. Selection of either fundamental frequency is obtained by a two-way switch. An output jack has been included for ease of connection.

The 5-inch oscillograph gives a large image. All controls are located on the front panel, and a special step-attenuator (plus a fine control to cover between steps) is provided to prevent changes in frequency characteristics at various input levels. Provision is made for synchronization on positive or negation peaks, an important feature because in certain television tests it is desirable to choose which is to be used. In television servicing, this capable oscillograph is suited for viewing synchronizing and blanking impulses, horizontal and vertical saw-tooth waves, and grid and plate voltages on the horizontal and vertical oscillators. A special input cable having high input resistance and low capacity is provided.

When the new alignment oscillator is used with a cathode-ray oscillograph, the selectivity curve of the circuits under test is produced on the television screen. Operation of the new instrument is surprisingly simple. There are only four highly-accurate, easily read controls: the power selector switch for i-f or r-f operation; two range switches for selecting the desired i-f and r-f channels; and the phase control and switch for adjusting the oscillograph horizontal deflection to provide single image operation. The output frequency sweeps through the r-f and i-f bands at a rate of 60 times per second, providing a steady, non-flickering pattern on the oscillograph screen. R-f and i-f coaxial transmission lines with proper terminating loads are included.

U-H-F ANTENNA

A new ultra-high-frequency radio transmitting and receiving antenna which is



custom-built for each installation, and thus requires no adjustments when it is erected, has been announced by RCA. Low in cost, the new antenna is already in operation in more than score of widely scattered localities throughout the country. It has been installed at W3XIR, Philadelphia, and WBNS, in Columbus, and by a number of police radio stations, including St. Paul's new 500-watt installation. It has also been purchased by New York City for use on radio-equipped harbor launches. Developed under the direction of Dr. G. H. Brown, the antenna has a simplicity of design and construction. When installed, the unit appears to consist of four horizontal rods at right angles to each other, and a vertical rod above them, all of the same length. The latter is the antenna, while the others are ground rods.

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Employed by .....
Nature of business .....
(State if Manufacturer, Broadcast Station, etc.)
Product .....

Name .....
Street .....
City-State .....
Occupation or title .....
Employed by .....
Nature of business .....
(State if Manufacturer, Broadcast Station, etc.)
Product .....

Name .....
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Occupation or title .....
Employed by .....
Nature of business .....
(State if Manufacturer, Broadcast Station, etc.)
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Name .....
Street .....
City-State .....
Occupation or title .....
Employed by .....
Nature of business .....
(State if Manufacturer, Broadcast Station, etc.)
Product .....

INSTRUMENT LANDING

(*Continued from page* 26)

The top of the desk is a pictorial map of the airport showing clearly the position of the various runways and transmitters. Colored signal lamps represent each transmitter and are lighted when the corresponding transmitters are in operation. At the head of each runway is located a translucent miniature airplane which is lighted to show the direction of approach.

A pen recorder incorporated in the unit supplies a permanent record of the operation of the system. This instrument records the elapsed time a runway has been in operation, the output of each transmitter, and the localizer course alignment. This multiple function is accomplished with a single pen by recording successive short intervals of the operation of each unit.

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BOOK REVIEWS

(*Continued from page* 21)

Electrical Measurements is not a new book, for the first edition which appeared in 1931 has been widely used. Nevertheless, the revision of this older book has been so extensive that the present second edition may be considered a new book.

The field covered by this book is quite wide in scope and practically all types of radio-frequency measurements are discussed. In fact, the title is somewhat misleading for many of the measurements are directly applicable to low electrical frequencies.

This book is replete with alternative methods of making a particular measurement. This is a useful feature for it enables the choice of that particular measuring technique to be employed for which the necessary equipment is available. The limitations of each of the alternative methods are carefully pointed out and the numerous sources of errors which might occur in the course of the measurement are brought to the attention of the reader. D. B.

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FREQUENCY CORRECTION

(*Continued from page* 15)

calculations the phase angle of the combined load must be taken into consideration as well as the grid resistor, if any, and tube input and output capacitances.

Fig. 3 A-B-C show two section networks as connected in tube circuits together with the type of amplifier response in which they result. Fig. 4 shows a circuit for using this type network for complete control of bass, middle and treble response relative to one another. It will be noted that the limiting resistors shown in Fig. 2, R_2 in A and R_1 in C, have been omitted in this circuit, the middle frequencies being supplied through a separate linear voltage-division circuit. This voltage divider must incur a loss at the middle frequency which is roughly equal to the greatest gain which the high or low frequencies are to have above the middle register, plus whatever loss exists in the high or low-pass network at its pass frequency. If it is desired to have the response cut off at definite points at the high and low ends when the bass and treble boost are set at zero it is necessary to replace the linear voltage divider with a circuit similar to Fig. 2-C.

Sometimes in order to maintain d-c continuity or for other reasons inductances must be substituted for capacitances in the circuits which have been described. When this is done the frequency response characteristics of the circuits are reversed, those having high-pass characteristics with capacitance having low-pass characteristics with inductances, etc. Fig. 5 shows the response characteristics of a circuit similar to that of Fig. 1-A. When $R_1 = 40{,}000$; $R_2 = 10{,}000$; $C = 0.1$ mfd and when C is replaced with an inductance which has the same reactance as C at 100 cycles. As the usual audio system does not have linear response at the extreme low-frequency end of the spectrum, actual curves would not be as shown. Due to falling off of the characteristics elsewhere in the system the overall response would probably be in the nature of that shown by the dotted curves.

When it is necessary to adjust frequency response external to an amplifier and particularly at a line termination the circuit of Fig. 6 is sometimes useful. It is well known that the impedance presented by such a circuit is resistive, constant with frequency and equal to the resistance of one of its branches if at some frequency $R_L = R_C = X_L = X_C$.

Any amplifier whose input impedance is high compared to R_L and R_C may be bridged across any of the components of this circuit without seriously affecting the characteristics of the circuit. If such an amplifier were bridged across C or R_L it would have very little voltage impressed upon it at high frequencies and practically the line voltage at low frequencies. The converse of this would be true of a connection across R_C or L. The curves shown at Fig. 6-B are the actual curves for a circuit in which $R_C = R_L = X_C = X_L = 500\Omega$ at 300 cycles. Such a circuit would be suitable to terminate a 500Ω line. The output of an amplifier bridging R_C would be suitable for driving a recording head at approximately constant velocity above 300 cycles and constant amplitude below 300 cycles. If a more exact adherence to this rule is desired a circuit of the type of Fig. 1-C inserted somewhere in the system will give it. This circuit would have to be so designed that its maximum response would be at 300 cycles and approximately equal to the

deviation of the actual curve from the desired one.

When resonance is used to obtain gain or loss the effect may be much more pronounced than that given by such circuits as have been discussed so far. The use of resonant-circuit arrangements for this purpose, with the exception of the parallel case already mentioned, have been rather thoroughly discussed in various published articles by J. G. Aceves and others. Therefore it will be touched on but briefly here. Since such circuits, whether of the parallel or series type, are inherently either of the band-pass or band-rejection type, it seems best to reserve them for this purpose. The more effective a circuit of this type is, that is, the higher its Q, the narrower the band of frequencies which it affects. Because of this when it is required that the circuit be highly effective over a considerable band of frequencies it is necessary either to use several resonant circuits tuned to slightly different frequencies in conjunction with one another or to resort to the use of more complicated types of filters. Of course coupled-resonant circuits would also serve in some instances but their use is not within the scope of this paper. When more than one series-resonant circuit is used in order to broaden the band of frequencies affected they must be use in parallel or in successive stages. When several parallel-resonant circuits are used they must be connected in series or applied in successive stages. Either the series or parallel type of circuit may be used for band-pass or band-elimination purposes. Fig. 7-A shows a single series type circuit which will give either band-pass or band-elimination results. In this case R_1, which, as in B and C also, may be the plate resistance of a tube, should be kept as low as possible for band-pass results and high for band elimination. Fig. 7-B shows a parallel circuit arranged to give band-pass results. In this circuit R_1 should be of the same order as the resonant impedance of the parallel circuit. Fig. 7-C shows a parallel circuit arranged for band elimination. Here, if possible, R_2 should be large compared to R_1 but small compared to the resonant impedance of the parallel circuit. Because of the high impedances encountered in these circuits it may be necessary when R_1 is the plate resistance of a tube to add additional resistance in series with it. In all of the above circuits the load impedance must be large compared to the other impedances involved if pronounced effects are to be had.

All of the circuits described herein may be used as a part of the feed-back circuit of a negative feed-back amplifier. In this way much greater effects may be obtained. When so used their functions will be reversed, the low-pass circuit giving low-frequency elimination effects.

When analyzing the results obtained from a system, negative feed-back or otherwise, which employs these circuits, it must be remembered that except at resonance whenever reactive components are part of a circuit phase shift may and must at some frequencies take place. This is not important in final result insofar as listener is concerned, as it is said that the ear cannot detect any change in sound due to shift in phase relationship of its components. However, particularly in feed-back circuits, it may result in different amplitude characteristic from that expected and must be considered.

THE MARKET PLACE

POWERSTAT

A line of "Powerstat" variable transformers is now available for transmitter line-voltage and power-supply control and for use in electrical test equipment requiring variable voltages. Design features are high efficiency, good regulation, smooth operation, and low weight. All cast parts

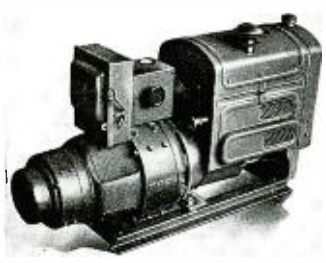
are of aluminum alloy and units above 2 kva are wound with glass insulated wire. Standard types are available for single and three-phase operation on 115, 230, and 440-volt circuits in capacities up to 25 kva. Bulletin 148 gives descriptive data and performance characteristics. Address Superior Electric Co., 58 Harrison Street, Bristol, Conn.

AEROVOX CONDENSER CHECKER

A radically new means of testing condensers and coils in the r-f range under actual operating conditions is offered in the Aerovox Model 95LC checker, it is claimed. The instrument determines the effectiveness of a condenser or coil without disconnecting it from the circuit in which it is used. It is self-powered. Additional information may be obtained directly from Aerovox Corp., New Bedford, Mass.

5-KW POWER PLANT

The Pioneer Gen-E-Motor Corporation, 466 West Superior Street, Chicago, has just developed a new five-kilowatt power plant. This all-purpose unit is a part of this manufacturer's present line of Pincor Gold Crown heavy-duty units. It is adapted for general light and power use for industrial and construction work, as well as a stand-by electric plant for radio stations, etc., where uninterrupted power service is a necessity.



The engine on this new Pincor Gold Crown is completely enclosed in a sheet metal housing to protect it against the elements, dirt, etc. A four-pole generator is employed—1800 rpm. It is of the single, grease sealed ball-bearing type. Rheostat, voltmeter and switchbox are standard equipment. Filter and shielding available for radio operation. Remote control and other accessories also available.

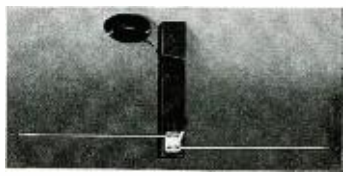
POLYSTYRENE CO-AXIAL CABLES

New co-axial cables insulated with Amphenol "912" pure polystyrene beads. Offers low line loss. Used as transmitter transmission line, receiver antenna leadin, patch cords, test leads on v-t voltmeters on h-f oscillators, etc. Available in impregnated double cotton braid covered, weatherproof synthetic resin covered and copper tubing types. Surge impedance 72 to 78 ohms. Special sizes and types to

order. Made by American Phenolic Corporation, 1250 Van Buren Street, Chicago, Illinois.

TELEVISION ANTENNA

A new dipole type television antenna has two telescoping brass rods (shown in the closed position) which allows for adjustment to the exact frequency to be picked up by the television receiver. Chromium finished fittings give an attractive appearance to the unit. Low-loss transmission

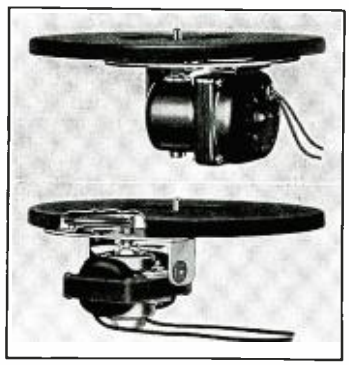


line is used. The impedance of this will match the input of television receiver which is approximately 100 ohms. The unit comes with 75 feet of transmission line. *Consolidated Wire & Associated Corps.*, 522 S. Peoria St., Chicago, Ill.

PHONO-MOTORS

The two phonograph motors illustrated are the new "even-speed" models 60 and 70 just announced by Alliance. The specifications are as follows:

Model 60: Available for operation on 110 or 220-volt, 50 or 60-cycle source at 14 watts input. Self-starting—maintains constant record speed. Designed for good



speed regulation under wide variations of voltage, load and temperature. Large bearings, ample oil reserves.

Model 70: Available for use on 110 or 220-volt, 50 or 60-cycle source at 15 watts input. Simple in operation—no gears—smooth friction rim drive. Good regulation characteristics for reasonable uniformity of table speed. Available with 9" turntable top only.

Further information may be secured from the *Alliance Mfg. Co.*, Alliance, Ohio.

POLICE RADIO EQUIPMENT

Doolittle & Falknor are offering a complete line of radio equipment for law enforcement agencies consisting of station transmitters from 50 to 550 watts power, mobile transmitters of 15 and 25 watts power, receivers for both stations and cars, and other accessories such as concentric

transmission line and antennae. The 15-W mobile transmitter is illustrated above. Complete details can be secured by writing. *Doolittle & Falknor, Inc.*, 7421-23 South Loomis Boulevard, Chicago, Illinois.

BEAT-FREQUENCY GENERATOR

The Boonton type 140-A beat-frequency generator is shown in the accompanying illustration. It provides frequencies from 20 cycles to 5 megacycles in two ranges: 20 to 30,000 cycles; 30 kc to 5 mc. Two large scales are provided reading directly in cycles, kilocycles and megacycles. Total scale length is about 23 inches. The accuracy is said to be plus or minus 2 cycles up

to 100 cycles, plus or minus 2% above 100 cycles. Voltage range is from 1 millivolt to 32 volts. Literature is available from *Boonton Radio Corporation*, Boonton, N. J.

CARTER GENEMOTOR

A new high power lightweight genemotor for use on aircraft, marine and police radio has just been announced by the Carter Motor Company of 1608 Milwaukee Avenue, Chicago, Illinois. The high efficiency, small size and light weight is said to be due to a new type one-piece field

ring and armature design. Available in two sizes, 150 and 250 watts, output up to 1000 volts, input from 5.5 volts up. Weight of 150 watt size, only 13½ lbs.

A-C RELAY

The type A alternating-current relay is a new member of the Clare line of sensitive and control relays. Some of the features of this new unit are said to be: low-loss magnetic circuit; quick action; no contact bounce; quiet operation; numerous contact arrangements; long life; low current consumption. Contacts are available in silver, palladium, platinum-iridium and tungsten. Literature may be obtained from *C. P. Clare and Company*, Lawrence and Lamon Aves., Chicago, Illinois.

MOBILE TRANSMITTER-RECEIVER

A mobile unit of unique and advantageous design has just been announced for police, fire and forestry service. Mounted upon three separate chassis which "plug-in" to mechanical fastenings in a shock-mounted weather-proof case are a 15-watt crystal-controlled transmitter, a crystal-controlled, noise-suppressed superheterodyne receiver and a receiver power supply. "Plug-in" connecting cables permit the changing of either chassis, without tools in a very few minutes. The entire top and front of outer case removes for accessibility. The line also consists of 15, 50, 100, 250 and 500-watt main stations for police, fire and forestry communication with mobile units. *Radio Engineering Laboratories, Inc.*, 35-54 36th St., Long Island City.

VELOCITY MICROPHONE

Universal Microphone Co., Inglewood, Calif., is now producing its new M4 series, a new 4-magnet velocity microphone that was formerly catalogued as RH. This model is an all-purpose unit for p-a, amateur and semi-professional use. Frequency range is said to be from 40 to 10,000 cycles, output level —64 db. It is furnished in standard output impedances. Further information may be secured from the manufacturer.

AMPEREX TUBES

Amperex Electronic Products, Inc., 79 Washington Street, Brooklyn, N. Y., has announced a new 5-kw air-cooled transmitting tube. Amperex has also announced FCC approval of the following tubes for use in the last radio stages of broadcast transmitters—high-level or plate modulation:

Type	Power
892-R	5000 watts
343A	5000 watts
542A	10000 watts

Low-level modulation or last radio stage operating as linear power amplifier:

Type	Power
892-R	2500 watts
343A	2500 watts
342A	8500 watts

Further information on these and other Amperex tubes may be obtained from the above organization.

R-F MICROVOLTER

The Televiso standard r-f microvolter is shown in the accompanying illustration. The frequency range of 100 kc to 32 mc is covered in 6 steps by a rotating switch.

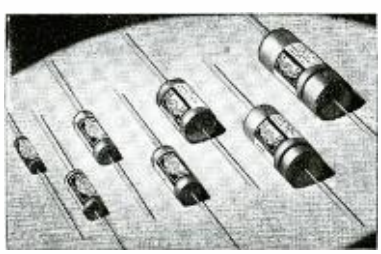
The output voltage is variable from .1 microvolt to 1 volt. This calibration is checked by a built-in vacuum-tube voltmeter. The modulation voltage is continuously variable and is available for external use. A special feature of the unit is a band-spread dial. Complete information may be secured from Televiso Company, 337-345 N. Crawford Ave., Chicago, Ill.

RECORDERS

A recent entry in the field of recorders is the David Bogen Co. A complete line of recorders has been put into production. The Model 212 RP recorder shown comes complete in a carrying case finished in brown leatherette with handle for easy portability. Literature and technical data may be obtained from the manufacturer. Write to the *David Bogen Co., Inc.*, 663 Broadway, New York City.

HIGH-VOLTAGE TUBULAR PAPER CAPACITORS

Designed for television receivers, test equipment and amateur transmitter applications are the Cornell-Dubilier Type MD Dykanol impregnated tubular paper capacitors. With rated work-voltages up to 1600 volts they are said to meet substantially all requirements of the above services in this respect and are available in a wide variety of capacity values ranging from .0001 to .15 mfd at 800 volts; .001 to .1 mfd at 1200 volts; and .001 to .05 mfd at 1600 volts. Catalog No. 175A describing these capacitors in detail available on request at main office of the Cornell-Dubilier Electric Corporation, South Plainfield, New Jersey.



SMALL WIRE-WOUND RESISTORS

A new and compact design of Ohiohm ceramic-insulated wire-wound resistors is now being manufactured by The Ohio Carbon Company, 12508 Berea Road, Cleveland, Ohio, in addition to their line of carbon resistors. The wire-wound units are applicable to a wide range of uses, such as original and replacement equipment for radio sets, broadcasting station apparatus, railroad block signaling systems and general industrial plant uses such as motor-starters and relays and on photo-electric safety and counting devices. Standard units are from 5 watts to 20 watts in a range of resistance values; all being guaranteed accurate to plus or minus 5%.

MIDGET ELECTROLYTICS

Aerovox announces the addition of several dual-section numbers to its Dandee line of midget metal-can electrolytics. These are the 8-8 and 8-16 mfd, 450 v; 8-8, 8-16 and 16-16 mfd, 200 v; and the 20-20 mfd, 150 v; and 10-10 25-volt. The 10-10 mfd, 50-volt, previously included in the line, rounds out the dual-section numbers. *Aerovox Corporation,* New Bedford, Mass.

RHEOSTAT

The construction of the 50-watt all metal rheostats IRC type PR-50 is said to result in a reduction of operating temperatures. Operation of the rheostat at full load in any portion of the resistance winding down to 25% of full rotation is made possible without exceeding the normal temperature rise by more than 30 degrees C. The 50 watt rating is based on a hottest spot temperature rise of 140 degrees C. when unit is mounted on a metal panel and power dissipated over the entire unit. IRC Type PR-50 rheostat is only 2⅜" in diameter. Depth behind panel is 1⅜". It is available in a full range of values from 0.5 ohms to 10,000 ohms. *International Resistance Co.,* 401 N. Broad St., Philadelphia, Pa.

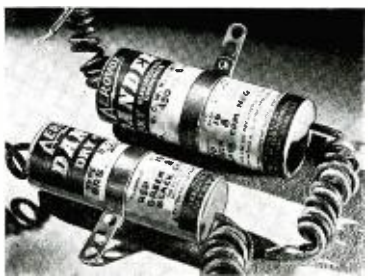
CLOUGH-BRENGLE 1940 LINE

The Clough-Brengle Co., 5501 Broadway, Chicago, have introduced their latest line of test instruments. Included in the line are the Model 220 Unimeter and the Model 230 a-c bridge. The former is a volt-ohm-milliammeter with d-c voltage ranges to 10,000 volts at 20,000-ohms-per-volt, and corresponding a-c volts, decibels, ohms, d-c microampere and milliampere scales. The latter is an a-c bridge with capacity ranges from 2 mmfd to 200 mfd with corresponding inductance, resistance, power factor and turns ratio scales. Additional information on this and other Clough-Brengle test equipment may be obtained directly from the manufacturer.

TUBE TYPE & LINE-CORD RESISTOR TESTER

A handy means of testing resistor tubes and line-cord resistors is presented in the Clarostat Model 160 tester just introduced. Enclosed in a steel case, the tester has a panel carrying the meter, the prong-selector switch, an octal socket and a UX socket, for testing resistor tubes with any type of base. There is also an a-c outlet receptacle for plugging in a resistor line cord, as well as a pin jack for testing the different cord leads. A resistor tube characteristic chart is supplied with the instrument. *Clarostat Mfg. Co.,* 285-7 N. 6th St., Brooklyn, N. Y.

Above: General Radio condenser.
Below: Ohio Carbon resistor.



Above: Aerovox condensers.
Below: International Resistance rheostat.

Above: Harvey Radio transmitter.

TELEVISION ANTENNA

A television antenna with universal joint mounting, permitting adjustments in all directions, is now offered by Technical Appliance. The di-pole antenna is constructed of heavy duraluminum rods held together with a center insulator. Two extension rods screw into the center rods for attaining the correct length of the di-pole. Mounting straps are provided for mounting to an iron pipe or wooden mast. Adjustments are possible in both the horizontal and the vertical planes, simply by loosening a nut and tightening after the correct position is obtained. A reflector is available wherever needed. *Technical Appliance Corp.,* 17 E. 16th St., New York City.

TYPE 755-A CONDENSER

The new Type 755-A variable air condenser is designed for use in high- and ultra-high-frequency circuits. Small, compact and ruggedly constructed, it has low dielectric losses, low inductance and low metallic resistance. A precision worm drive with 30:1 reduction drives the rotor plates. Total scale length is 1500 worm divisions. Ball bearings are used on the main shaft, and backlash is practically eliminated through the use of a spiral spring on the main shaft. Both rotor and stator plates are of soldered brass, heavily copper plated. Plates are shaped to spread out the frequency scale. The condenser is shielded by the cast aluminum frame and a removable base plate. Both rotor and stator are insulated from the frame. The range of direct capacitance is 5 mmfd to 142 mmfd. Rotor-to-ground capacitance is 7 mmfd; stator-to-ground capacitance is 6 mmfd. The equivalent series inductance is approximately 0.0055 μh at minimum capacitance setting. This condenser can be used in conjunction with a coil switching system at frequencies as high as 350 mc. The mounting frame is drilled and threaded for a three-hole mounting. Threads are 10-32. General Radio Co., 30 State Street, Cambridge, Mass.

FERRIS INSTRUMENTS

Two new instruments added to the Ferris line are the 118 external modulation coupling unit and the 218 audio oscillator.

The 118 is designed to couple the 18B signal generator to external sources of modulation. Meters are provided to allow adjustment of the external voltage. By means of a panel switch the input of the 118 may be adjusted to 50, 500, 5000 and 10,000 ohms. A second switch permits the lower values to be used with balanced lines. The case is designed to allow the unit to be placed directly on top of the 18B signal generator, the handle of the 18B fitting a recess in the bottom of the 118. Connection between the two units is made by means of patch cord and ground strap.

The 218 is an audio oscillator of from 3 to 8 fixed frequencies for use with the 18B where other than 400 cycles modulation is required. Two output circuits are provided. The output circuit for the 18B is adjusted for 30% modulation. The second output for external circuits is adjustable by means of a potentiometer. Any combination of 8 frequencies between 200 and 10,000 cycles are available. The 218 is designed for operation from the 115-volt 60-cycle lines as in the case of the 118 and may be placed directly on top of the 18B signal generator.

Further information may be secured from the Ferris Instrument Corp., Boonton, N. J.

POLICE TRANSMITTER

The unit shown in the accompanying illustration is the new Harvey PF-25 central station police radio equipment. Both transmitter and receiver are self-contained in a single cabinet. The 25-watt unit is comprised of two deck sections easily accessible through the top and rear covers for servicing or adjustment. All transmitting controls are locked in place on the top deck chassis. Interlock switches are provided on both covers. Complete information may be secured from *Harvey Radio Laboratories, Inc.,* 25 Thorndike St., Cambridge, Mass.

STATEMENT OF THE OWNERSHIP, MANAGEMENT, CIRCULATION, ETC., REQUIRED BY THE ACTS OF CONGRESS OF AUGUST 24, 1912 AND MARCH 3, 1933, OF COMMUNICATIONS

Published monthly at New York, N. Y., for October 1, 1939.

County of New York, } ss.:
State of New York, }

Before me, a Notary Public in and for the State and county aforesaid, personally appeared B. S. Davis, who, having been duly sworn according to law, deposes and says that he is the Business Manager of COMMUNICATIONS, and that the following is, to the best of his knowledge and belief, a true statement of the ownership, management, etc., of the aforesaid publication for the date shown in the above caption, required by the Act of August 24, 1912, as amended by the Act of March 3, 1933, embodied in section 537, Postal Laws and Regulations, to wit: 1. That the names and addresses of the publisher, editor, managing editor, and business manager are: Publisher, Bryan Davis Publishing Co., Inc., 19 East 47th Street, New York, N. Y.; Editor, Ray D. Rettenmeyer, New York, N. Y.; Managing Editor, None. Business Manager, B. S. Davis, Ghent, N. Y. 2. That the owners are: Bryan Davis Publishing Co., Inc., 19 E. 47th St., New York, N. Y.; B. S. Davis, Ghent, N. Y.; J. C. Munn, Union City, Pa.; J. A. Walker, St. Albans, L. I., N. Y.; A. B. Goodenough, New Rochelle, N. Y.; S. R. Cowan, Brooklyn, N. Y.; P. S. Weil, Brooklyn, N. Y. 3. That the known bondholders, mortgagees, and other security holders owning or holding 1% or more of the total amount of bonds, mortgages, or other securities are: None. 4. That the two paragraphs next above, giving the names of the owners, stockholders, and security holders, if any, contain not only the list of stockholders and security holders as they appear upon the books of the company, but also, in cases where the stockholder or security holder appears upon the books of the company as trustee or in any other fiduciary relation, the name of the person or corporation for whom such trustee is acting, is given; also, that the said two paragraphs contain statements embracing affiant's full knowledge and belief as to the circumstances and conditions under which stockholders and security holders who do not appear upon the books of the company as trustees, hold stock and securities in a capacity other than that of a bona fide owner; and this affiant has no reason to believe that any other person, association, or corporation has any interest direct or indirect in the said stock, bonds, or other securities than as so stated by him.

(Signed) BRYAN S. DAVIS, Business Manager.

Sworn to and subscribed before me this 29th day of September, 1939.

(Seal) J. A. WALKER, Notary Public.

Queens Co. Clk's No. 1991, Reg. No. 5650.
New York Co. Clk's No. 199, Reg. No. 1-W-176.
Commission expires March 30, 1941.

SOLDERLESS FITTINGS FOR RADIO AND TELEVISION ANTENNAS

A new complete line of solderless fittings for small copper tube coaxial transmission lines for both radio and television antenna systems, has just been placed

on the market by Isolantite Inc., 233 Broadway, New York, N. Y. The new fittings, which employ the Raybould patented coupling, include end seals and couplings for both ⅜-inch and ⅞-inch diameter lines, and junction boxes for ⅞-inch lines.

The use of these solderless fittings is expected to eliminate most of the potential sources of trouble occurring with soldered fittings, according to the manufacturer, since failures of transmission lines have been found to result most frequently from imperfectly soldered joints. With the solderless fittings a gas-tight electrical joint is made simply by tightening a single nut. It is said that the use of these couplings simplifies alterations and repairs.

Illustrated are typical fittings from the new line, including two types of end seals, couplings, and junction boxes.

All the fittings are of solid cast bronze, equipped with specially designed Isolantite insulators or internal copper connectors.

Complete details of the solderless fittings are contained in Bulletin No. 101-D, copies of which may be obtained on request from Isolantite Inc.

TURNER CRYSTAL MIKE

The Turner Model 22X is a satin-chrome plated crystal mike with a comparatively flat output from 30 to 7,000 cycles and a level of —52 db, it is said. The 90° tilting-head range allows semi and non-directional pick-up. Additional information and prices may be obtained directly from Turner Co., Cedar Rapids, Iowa.

EXAM-ETER

The Exam-eter, new circuit-and-components-analyzer introduced by Solar Mfg. Corp., Bayonne, N. J., is claimed to be a rapid and effective trouble-shooter. Exam-eter is an output indicator, dual-range peak-voltmeter, r-f circuit alignment indicator, capacitance bridge, resistance bridge, power-factor indicator, leakage indicator and continuity checker. For detailed information, write the manufacturer.

BRUSH PRODUCTS

New products recently announced by Brush include the Models QO and QOM microphones, and the Type BJ headphones.

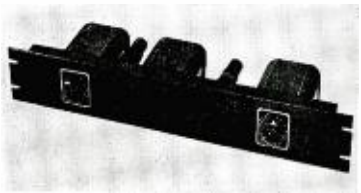
Both the QO and QOM microphones have a fidelity response of 30 to 9000 cycles per second. For close speaking the outputs are sustained in the lower register without booming, it is said. Output levels are —54 db.

The BJ headphones feature: a soft rubber jacket encasing the cartridge to assure ruggedness, comfort, good ear seal and safety from shock; a hermetically sealed aluminum cartridge construction to protect the phones against adverse climatic conditions; a yokeless cord design to allow more freedom and comfort to the operator.

Additional information may be secured from the Brush Development Co., 3311 Perkins Ave., Cleveland, Ohio.

PEAK LIMITING AMPLIFIER

Construction data for a peak-limiting line amplifier for police work is given in a recent issue of Thordarson's "Police Communications Bulletin." This peak-limiting amplifier was developed primarily



for use between remote receivers and the input of telephone lines. The amplifier permits the transmission of a higher average level without exceeding the permissible line level. Copies of the above bulletin may be secured by writing to the Thordarson Electric Mfg. Co., 500 W. Huron Street, Chicago, Ill.

500-, 1,000-WATT RESISTORS

Shown is one of the big resistors recently introduced by Ohmite for heavy-duty service. It is 12" long, 12½" in diameter, and is rated at 500 watts. But it is second in size to the 2½"x20" 1000-watt Ohmite resistor. These are two of more than 50 Ohmite resistor sizes which range from 1 to 1000 watts in a single unit, from 5/16" diameter x 1" long to 2½" diameter x 20" long. These big Ohmite resistors are also furnished in Corrib Type with corrugated ribbon winding. Ohmite Manufacturing Co., 4835 W. Flournoy St., Chicago, Ill.

CRYSTAL PICKUP

The Astatic Model AB-8 crystal pickup has just been made available. This unit features spring-axial cushioning, Astatic type B cartridge with ebonite water-proof coated crystal element, Tru-Tan offset head to reduce tracking error, threaded

stud base for single hole mounting and a new die-cast arm. Response of the AB-8 may be altered according to requirements by a slight modification of the input circuit or by the use of Astatic's E4P tone equalizer. Astatic Microphone Laboratory, Inc., Youngstown, Ohio.

PLATE-CIRCUIT RELAY

Allied Control is now producing a new plate-circuit type of relay. The coil of this unit has a resistance of 2,500 ohms and contains 13,400 turns, layer wound with .001" condenser paper between layers. This single-pole, double-throw unit is rated up to 5 amps but is normally adjusted to 8 mils pull in, 5.5 mils pull out. Additional information may be secured from *Allied Control Co., Inc., 227* Fulton St., New York, N. Y.

LAFAYETTE CONSOLE

The Lafayette Model BB-7 radio-console has just been introduced by *Radio Wire Television Inc.* (formerly Wholesale Radio Service Co., Inc.) of 100 Sixth Avenue, New York City. Contributing to installation convenience are built-in broadcast and short-wave loop antennas which eliminate external connections to antenna and ground and thus permit the console to be placed anywhere in a room.

Operating features are: (1) push-button tuning of any six stations, (2) a large and fully calibrated "slide-rule" dial to facilitate manual tuning of short-wave and other broadcast stations, (3) horizontal positioning of both the record player and radio control panels at table height inside the console top to allow good visibility and avoid stooping to operate, (4) inclusion of a fully automatic record player which plays up to eight 10 or 12-inch records without attention.

WESTERN ELECTRIC HORN

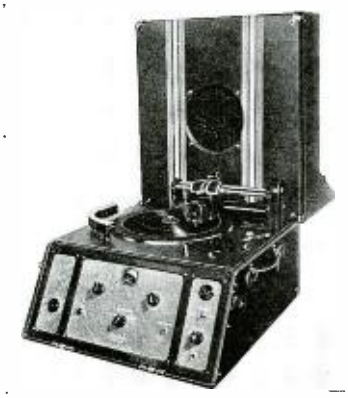
A single horn which does the work of four trumpet type loudspeakers in distributing upper register sound in the horizontal plane has been announced by the Western Electric Company, 195 Broadway, New York City. Because of its novel design, sound radiation from the new horn is substantially uniform over 120 degrees horizontally and 40 degrees vertically. This distribution characteristic enables sound engineers to provide uniform coverage in auditoriums and to eliminate such disagreeable conditions as "overlap." The relatively narrow vertical beam tends to reduce reflection from the ceiling.

REMOTE AMPLIFIER

The Collins 12Z remote amplifier is shown in the accompanying illustration. This unit is completely battery-operated, thirty hours of service being obtained from one set of batteries. This unit has three mixing positions with a switch arranged to select either of two inputs to the third mixer . . . there are four microphone receptacles. The volume indicator is the new Weston type 30 instrument calibrated in VU, used for reading output level and battery voltages. The 12Z with tubes, case and batteries weighs 28¼ pounds. It is 14" wide, 10½" high and 8" deep. Complete information may be secured from Collins Radio Co., Cedar Rapids, Iowa.

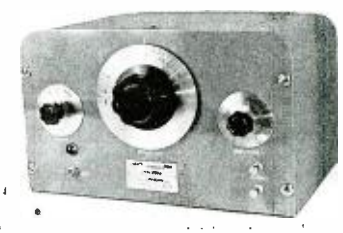
PORTABLE RECORDERS

Radiotone announces the addition of four new portable models to their 1939 line of recording machines. Two of the models feature built-in radio and two models feature instantaneous speed change from 78 rpm to 33 1/3 rpm. Descriptive literature will be mailed upon request. Write to *Radiotone, Inc.*, 7356 Melrose Ave., Hollywood, Calif.



RESISTANCE-TUNED OSCILLATORS

The new Hewlett-Packard resistance-tuned oscillators are suitable for many types of work. Their low distortion is said to make them valuable in making distortion measurements on audio amplifiers, broadcast transmitters, and other equipment. They are also said to provide a good source of voltage for accurate bridge measurements. The output is sufficient to drive signal generators and other equipment requiring considerable power. Their frequency range also makes them suitable for work in the super-sonic region. Two standard models are supplied in a cabinet mounting. The Model 200A (shown) has a frequency range of 35 to 35,000 cps. It is smaller and lighter than the Model 200B which has a frequency range from 20 to 20,000 cycles. Complete information may be secured from Hewlett-Packard Co., 367 Addison Ave., Palo Alto, California.



Index to Advertisers

for ROUTINE MEASUREMENTS

OF

- RESISTANCE
- INDUCTANCE
- CAPACITANCE

•

ALWAYS READY TO OPERATE

RANGES

RESISTANCE
1 milliohm to 1 megohm

INDUCTANCE
1 microhenry to 100 henrys

CAPACITANCE
1 micromicrofarad to 100 microfarads

TYPE 650A
Impedance Bridge $175.00

IN ANY LABORATORY where measurements of inductance, resistance or capacitance have to be made this bridge has become as invaluable as an ohmmeter or voltmeter.

Completely self-contained with built-in 1,000 cycle and d-c power sources, it is always connected and ready to measure these constants over an extremely wide range. Its logarithmic dial is direct-reading with an accuracy suitable for all but the most precise measurements.

Measurements of the dissipation factor of condensers and the storage factor of inductors can be made directly over these wide ranges: R/X from .002 to 1 and X/R or Q from .02 to 1000.

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● WRITE FOR BULLETIN 513

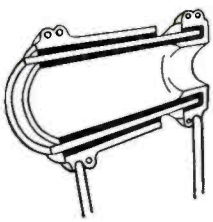
GENERAL RADIO COMPANY

CAMBRIDGE, MASSACHUSETTS

Branches in New York and Los Angeles

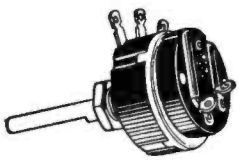
Millions of attentive ears are glued to radio receivers as bulletins are relayed from the various capitals of Europe.

No longer just a "sales argument" . . . these are the days when "Short Wave" has come into its own. Europe clears through Centralab, as in millions of receivers Centralab parts guide and project the signals clearly, smoothly, surely.



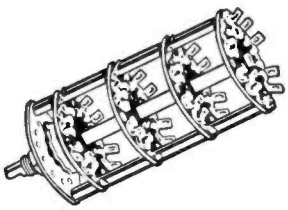
Ceramic Capacitors

Where permanence of temperature compensation insure and retain stability of frequency in oscillator circuits.



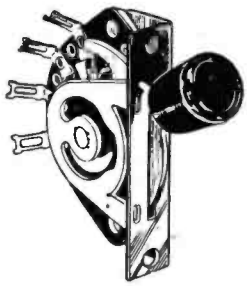
Volume Controls

In standard or midget . . . a low noise level and smooth attenuation insure reception of faint signals.



Wave Change Switches

Multi-point switching for wave change or tone control . . . with positive low resistance contact.



Toggle Switches

In communication receivers . . . with crystal filters and wherever delicate supplemental tuning is involved.

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