JUNE 1947

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WHEN THE CUSTOMER ISN'T RIGHT

by Eugene A. Conklin

The customer isn't always right, and when he isn't, he's hard to handle... But remember, he's your customer—right or wrong!

Success in the radio service business, as in any other where direct contact is made with the consumer, depends to a great extent on the manner in which the customer is treated. The average layman knows very little about his radio and when his receiver is in need of repair, he more often than not becomes very interested in what must be done to put it back in working order. He or she invariably asks questions of the serviceman. Because the consumer knows so little about radio and radio servicing, these questions are often difficult to answer. Good business practice tells us that they must be answered with an eye toward satisfying the customer and building confidence.

By anticipating the logical questions before they are asked, it is possible to develop a technique which will fulfill the above requirements. The writer went to a number of successful service shops to find out how they met some of the more commonly encountered situations. The following are the questions and answers they gave.

What is the best procedure to follow when a customer calls on the phone and requests that a serviceman be sent to his or her home to repair a radio while the owner is absent?

Answer: Often a customer will call and state that "The key is in the mailbox, nobody will be home, but go right ahead and repair the radio." The serviceman who follows these instructions and enters an unoccupied house is taking the risk of being held responsible for any possessions lost, strayed or stolen from that home at any time during the day the radio is serviced. In fact, we heard of a case where a serviceman was accused of having taken something which later was found to have disappeared a week before the day he entered the house. Ideal Radio Service of Dallas, Texas, has an excellent method of handling requests of this sort. When the customer calls, the following form is dictated over the phone: "I
authorize to enter my home for the purpose of repairing my radio and hereby agree not to hold him responsible for any loss incurred as a result of his entrance." The customer is then asked to make out the form, sign it, and leave it with the key. It provides protection against unpleasant and costly lawsuits. In actual practice, the customer usually realizes that he is not being fair in asking the serviceman to assume responsibility for his property and will request that the serviceman call at a time when someone will be home. The customer almost always respects the business-like way in which the matter has been handled.

What is the best answer to give when a customer complains that a competitor down the street charges less both for components and hourly labor?

Answer: The Ruby Avenue Radio Service has its representatives inform the customer that its service rates are based on the work of skilled servicemen and the best of components from the standpoint of quality. They point out that service charges can only be lowered by using inexperienced help and parts of a poorer quality, and they remind the customer that either procedure often proves more costly in the final analysis. If handled tactfully, the customer will see the logic of the above answer without making it necessary to brand a competitor as unreliable.

What is the best thing to do when a customer insists on conversing with the serviceman when work is being done on a set in the home?

Answer: Jackson Radio Service of Jackson, Mississippi, has its representatives take a full five minutes to demonstrate their service tools and service customers on the following basis: Two references must be provided and the firm allowed to check with the local Credit Bureau. If the results of the investigation are satisfactory, Ann Arbor Sales and Service extends credit for thirty days. If an account is not paid within five days of the termination of the credit period, no future service calls are made except on a strictly cash basis.

Granger Radio Service of Rochester, New York, has a plan whereby customers pay service charges amounting to more than ten dollars on the basis of one-third down and the balance within thirty days.

What can be done when a customer attempts to repair his own radio, succeeds in doing considerable damage, and then sends for the radio serviceman?

Answer: When an examination of the receiver shows that some inex-
MAINTENANCE

Test equipment which is always in tip top shape means dollars in the serviceman's pocket. Many a repair job results in double working time and expense because of instrument breakdown which a regular maintenance schedule could have prevented. This is the first of a series of three articles explaining how to increase the life and efficiency of your equipment.

by John B. Ledbetter

Many radio servicemen who daily encounter delicate and complex electronic equipment are reluctant to service their own test instruments. While it is sometimes desirable to return test equipment and meters to the factory, many items of maintenance may be successfully undertaken in the shop. Ability to service one's own equipment not only saves precious time and money, but usually improves efficiency and self-confidence.

Instrument and test equipment may be preventive or corrective. Preventive maintenance is that performed as a regular routine check-up, whereby abnormal conditions are found and corrected prior to breakdown. Corrective maintenance may be classified as that necessitated by equipment failure, and includes all measures required to restore normal operation.

The source of equipment failures is a defective part, damaged meter, or faulty tube, and can be traced and corrected without difficulty. Often suitable replacement parts may be obtained from a local radio distributor; special or precision parts should be obtained from the manufacturer. Orders for such parts should include the instrument serial and model number and an exact description and number of the defective part.

If the defect or breakdown requires return of the instrument to the manufacturer, a note should include: (1) The exact nature of the complaint, (2) any erratic behavior prior to failure, (3) whether trouble is intermittent, and (4) repairs or observations made by the serviceman. Such information provides the manufacturer's service department with a case history of the instrument. Without this information, the manufacturer might waste time in repeating operations already performed by the serviceman, with resultant increase in time and labor charges.

Preventive Maintenance

Equipment failures and depreciation may be minimized by proper care in handling, by precautions to prevent overload, and by making periodic check-ups on each instrument.

Most failures of meters, copper-oxide rectifiers, and other parts, are due to overload and incorrect scale settings. These are both almost entirely due to carelessness or "human error." Most of us have at one time or other become absent-minded just long enough to touch the test probes across a high voltage with the meter range set on the milliampere or ohms scale. Much time and trouble, to say nothing of service interruption, can be avoided simply by making sure the proper range or scale is being used for each test. When doubt exists as to the approximate value of the current or voltage under test, the highest meter range available should be used before switching to a lower scale. In this way, the meter and resistors are protected against overload. This system is also advantageous in checking low-voltage circuits since there is always the possibility that a shorted tube or component has placed excessive voltage across these points.

Maintenance Requirements

Proper care and operation, coupled with a definite maintenance schedule, will often decrease de-
terioration and breakdown by as much as 90 per cent.

The amount of maintenance required and the manner in which it is carried out depend largely on (1) the type of instrument, (2) the conditions of use, and (3) the care with which it is handled and operated. An instrument in regular operation naturally requires more frequent checking than one used occasionally. This does not mean that equipment infrequently should not be checked at regular intervals. While moving parts of seldom used instruments may not suffer much wear, they are subject to oxidation and corrosion, collection of foreign matter, and exposure to moisture, heat, salt air, and other elements. Heat is responsible for carbonizing lubricants in bearings, shafts, and dial mechanisms. Exposed parts should be cleaned and lubricated regularly as recommended by the manufacturer.

Salt air, humidity, and chemical fumes in industrial areas, are injurious to metal parts, especially switch contacts, coils and wire-wound resistors. Condensers will dry out rapidly when exposed to heat. Although a number of modern test instruments are available with molded resistors, sealed meter cases, and impregnated components which aid in moisture-proofing, most parts are exposed and require occasional cleaning and lubrication. Recommended methods for cleaning and servicing test equipment are outlined in the following discussion.

Routine Maintenance

Preventive maintenance, more generally known as "routine" servicing, is equally important in all types of test equipment. The basic group, including tube tester, volt-ohm-milliammeter, and signal generator, require more attention than most of the others since they are in more constant use. It is to these instruments that first consideration is given.

Efficiency can be increased immensely by first setting up a definite maintenance schedule. In this way, there is less likelihood of overlooking a defect. The exact order in which the various steps are carried out is not important as long as all steps are included. Each serviceman has his own method of performing routine maintenance. It is recommended that, once the serviceman has chosen a desirable procedure, he list the steps in order and follow that order in all tests. By adopting a set method of performing maintenance duties, the serviceman memorizes each step, and, as a result, becomes more efficient and thorough.

Before proceeding with our discussion of maintenance routine, it may be well to review the operating characteristics of the parts which make up the modern tester and their more common failures.

Rectifiers

Common types of rectifiers used in tube testers, volt-ohm-milliammeters, and other equipment employing DC meters to measure AC voltages, are (1) vacuum tube and (2) copper-oxide. The vacuum tube is usually a 30, 80, 6H6 or similar type connected as a diode or half-wave rectifier. Trouble with this type of rectifier is usually low emission or burned-out filaments. Internal shorts or leakage between the cathode and the heater sometimes occur; filament-to-plate shorts seldom are encountered except in cases of broken filaments. Indicative of rectifier trouble is an error or zero reading on all the AC scales. Low readings indicate a weak rectifier; no reading points to a burned-out tube, or, occasionally an open rectifier.

Rectifier tubes should be tested for shorts, leakage, and intermittent heaters or filaments, and replaced if necessary. Occasionally, it will be necessary to readjust the line rheostat to compensate for the difference in rectifier output. A small rheostat adjustable with a screwdriver will be found in most good tube testers. The line voltage should be checked with an accurate voltmeter and the rheostat adjusted to give the same reading on the tester meter. Some testers employ a shadowgraph or similar indicating device in conjunction with a rheostat controlled from the front panel. With these testers, it is not necessary to compensate for rectifier changes.

To avoid confusing rectifier trouble with other failures, check the meter action on DC voltage scales with a battery or other source of known voltage, or check meter

Fig. 1 Internal view of a typical volt-ohm-milliammeter, showing copper oxide rectifier (A.), precision resistors (B,) and push-button switch assembly (C,) Proper care of these and other parts is explained in the text.

To Following Page
readings on the ohmmeter scales. Low readings on all scales may be due to internally shorted turns on the meter coil, or to a low-resistance short in the range switch or test lead circuit.

Remember that most troubles are simple. Tracing the defect becomes difficult usually because the obvious causes are overlooked in the search for “complicated” failures. An example is offered from a recent experience in which the author was called upon to service a Hickok “Jumbo” volt-ohm-milliammeter which gave only a very slight indication on any scale. The meter was checked first by disconnecting it from the circuit and checking for resistance with an ohmmeter. (When using this method, an external resistor of several thousand ohms should be used in series to prevent “pegging” a sensitive meter.) The input and range circuits were then checked with the meter in the circuit, but only for continuity. The series resistors were checked. Then it was decided to check the circuit with a low-range ohmmeter for shorts. Immediately, the “C” battery was found to be shorted to the case by a sharp corner on the mounting strap which had punctured the battery insulation. Had the circuit been checked first, the trouble would have been found at once. The obvious was overlooked simply because the owner and several other servicemen had “checked” the instrument and assumed it presented a complicated service job.

A copper-oxide rectifier is composed of a series of oxide coated copper plates in which current will flow more easily from oxide to bare copper than in the opposite direction. While it has certain frequency and voltage limitations, it is useful for practical service work and is inexpensive, simple, and rugged. Common types are half-wave, double half-wave, and full-wave, examples of which are shown in Fig. 3. Types A and C are of the full-wave (bridge) type shown in schematic diagram 1. Type B is the double half-wave, shown in diagrams 2 and 3.

The following precautions should be observed when copper oxide rectifiers are installed or replaced:

1. Never expose the rectifier to temperatures above 45° C. Keep your soldering iron clear when making connections.
2. Avoid contact with acid or perspiration. When handled, the unit should be wrapped in tissue.
3. Only exact replacements or carefully checked substitutes should be installed.
4. Always mark all connecting wires as this will prevent mistakes such as wrong polarity.

Variable Controls

Potentiometers and rheostats found in tube testers and volt-ohm-milliammeters are usually wire-wound. A common fault is erratic operation, particularly on the low-ohms scale. Where erratic performance is due to dirty wiper arms and contacts, the control may be cleaned by flushing it with a mixture of half alcohol and half ether. Loose controls should be disassembled, the arm bent to provide better contact, and reassembled. After cleaning, contact surfaces of the arm and resistance element should be coated with a very thin film of vaseline, fine clock oil, or Lubrico MD (manufactured by Master Lubricants Company, Philadelphia, Pa.) Avoid applying an excess which will collect dirt, grease, and other foreign matter. Corrosion may be removed with a fine grade of sandpaper, brushing away the residue with a small brush or flushing with carbon tetrachloride and lubricating. Occasionally, a drop of oil should be applied to the bearings and shaft bushing.

In the majority of cases, the control as furnished by the manufacturer is built too lightly for rough use. The contact arm loses tension. The resistance element and the shaft and bearings become worn or loose, resulting in wobbly action and faulty operation. When space allows, worn controls should be replaced with 2-watt wire-wound units.

Switches

When operation of toggle switches becomes erratic, the logical solution is replacement. Wafer-type rotary switches may be cleaned by removing oxidation with very fine sandpaper and flushing with a mixture of ether and alcohol. Tension may be increased by disassembling and springing the contact jaws.
together with a pair of long-nose pliers.

Many test instruments are equipped with gang-type push button switches for selecting ranges and positions. Locking notches on shafts often become worn so that buttons will not stay in a locked position. In most cases, the edge of the notched side of the shaft is found to be rounded instead of straight. This can be remedied by filing. A broken contact blade can be repaired by cleaning, tinning and soldering at the break, applying enough solder over and around the broken area to hold the blade firmly without allowing a bend in the soldered area. Soldering is done with the push buttons in the release or “out” position to relieve strain and to allow tension when the button is pushed in. Cleaning of the contact surfaces is done in the same manner as outlined above.

**Wiring**

All connections should be checked for rosin joints, cold-soldered or loose connections, and broken leads. Corded cables are particularly subject to leakage effects due to moisture or fumes, and lacing should be removed when instrument is used in seashore and industrial areas. The wires can then be spaced to prevent leakage effects.

**Condensers**

Capacitors used in test equipment are usually good for the life of the instrument. They are subject to the usual troubles, however, and should be checked when symptoms appear. If subjected to long periods of use or extreme heat and humidity, they may become leaky, dried-out, lose capacity, or become intermittent. Rarely is a shorted condenser found.

Faulty condensers are indicated by abnormal readings in one or more of the AC ranges, including the “output.” The defective condenser is identified when only one AC range is incorrect and all others provide accurate readings. Where all ranges are inaccurate, the rectifier tube or unit should be inspected.

If replacement is necessary, a condenser whose value is near that of the original unit should be used. Values may be changed or several condensers connected in parallel or series-parallel until the meter readings correspond with a known voltage or with a calibrated instrument.

**Resistors**

Resistors, like condensers, rarely give trouble since most units are of the precision wire-wound type. The greatest strain to which they are subjected is accidental overload, and, in certain locations, corrosive effects from chemical fumes and humid or salt air.

In the cheaper test equipment, several carbon resistors may often be found in a cluster. An inaccurate range may be due to leakage between adjacent resistors. They should be spread apart slightly to avoid such possibility. No meter reading may be due to an open multiplier resistor. In like manner, an open or partially shorted shunt or series resistor will result in inaccurate readings of the range in whose circuit it is connected.

Replacement resistors should be checked for overall circuit accuracy by comparing meter readings with known values or checking against a laboratory standard. (Most high schools and university physics laboratories have precision voltmeters and ammeters; it is relatively easy to have a friend or faculty member check the instrument—usually they are glad to do so as a class demonstration or project.)

Part 2 will continue our discussion of routine maintenance procedure, meter repair, vacuum-tube voltmeters, oscillographs, and other shop equipment.
This article completes the discussion of the seven sections of the television receiver. Articles to follow will cover the new circuit designs and components.

Television receiver power supplies are more complex than those found in the usual radio receiver, for they must supply a multiple of voltages over a wide range. For example, in one commercial receiver now on the market, 400 volts are applied to the sweep circuits; 300 volts are applied to the RF, video, and sound circuits; a negative voltage of 10 volts supplies the beam positioning circuits; and the cathode-ray tube is driven at a potential of 12,000 volts.

Usually two separate supplies are employed as the most economical means of producing these voltages. Since the picture tube requires a very high voltage at low current, one of the supplies is used to perform only this function. The maximum beam current drawn by the picture tube is about 200 microamperes. On the other hand, the sweep circuits of a magnetically deflected tube draw as much as 200 ma at around 400 volts, while the rest of the receiver usually requires an additional 100 to 150 ma at about 300 volts. These currents and voltages are, therefore, drawn from a second supply, with the various voltages tapped from a bleeder.

The type of cathode-ray tube used in the receiver will determine the operating voltages of the power supply. Present day seven-inch, direct view tubes use from 3 to 6 kv accelerating potentials. Ten-inch tubes operate at 8 to 10 kv, and the large fifteen-inch and twenty-inch tubes are driven at voltages sometimes as high as 15 and 18 kv, respectively. Another factor which affects the design of the supply is the focus and deflection system. Magnetically focused and deflected tubes require large currents, whereas electrostatic-
Magnetic Deflection

Let us consider first the television receiver supply designed around a magnetically deflected tube. Fig. 1 is a simplified diagram of the various voltages that control the tube's operation, while Fig. 2 shows a typical power supply in greater detail. The filament is heated from a 60-cycle low voltage source. The filament ratings in modern tubes are 6.3 volts at 600 ma. The tube shown in Fig. 1 is operated with a cathode at low potential so that the filament winding connected to it does not have to be insulated against high voltage breakdown. Sometimes, the cathode is run up to several thousand volts negative, in which case the filament winding is insulated accordingly.

It will be noted that a positive voltage is applied to the cathode. This is done in order to maintain the control grid at a negative potential with respect to the cathode, for in some circuits, the grid is directly connected to the plate of the video amplifier which is at positive potential. Thus, the cathode must be raised to a higher positive value than the grid in order to keep the latter negative with respect to ground. The cathode voltage is usually made variable to change the grid bias, and hence the beam current. This variable voltage is the brightness control of the receiver and is set by the user when tuning the set.

Following the grid in the order of elements in the tube is the first accelerating electrode. In magnetically deflected tubes it is operated at several hundred volts and is connected to a tap on the bleeder of the lower of the two power supplies.

The next element usually found in the gun structure is the focus electrode. However, manufacturers are now making most magnetically deflected television tubes for magnetic focusing which gives more uniform spot size and a sharper image than that obtained with electrostatic focusing. The tube in Fig. 1 lacks the focus electrode; instead, there is shown the focus coil, located over the tube neck and behind the deflection coil.

Two types of focus coils are found in receivers today: One of high resistance which draws about 30 ma, and another of low resistance requiring approximately 250 ma. In the first type, the current is low and the coil can be connected.

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Fig. 1 The above illustration shows where the various power supply voltages are applied to a magnetically deflected and focused cathode-ray tube.

Fig. 2 A schematic diagram of a high voltage and low voltage supply for a television receiver which uses a magnetic cathode-ray tube.

RADIO MAINTENANCE • JUNE 1947
Radio Maintenance is presenting a number of short articles describing various pieces of commercially available equipment. All of the units described will be put through their paces on the bench before being presented. It is hoped that the information given will prove helpful when choosing from the great variety of instruments available.

**Crystal Controlled**

**Signal Generator**

by J. R. James

The use of a crystal controlled signal generator for alignment of receivers is becoming increasingly popular. We present the Bliley "CCO" as a good example of the several types of crystal controlled generators now available. There are two main advantages in the use of this type of equipment:

1. Instead of having to set a range switch and then carefully adjust a tuning dial to the frequency to be used, one must only turn the selector knob immediately to the desired frequency.

2. Since the frequencies are crystal controlled, they are very accurate and will remain so since such an oscillator cannot operate on any but its designated frequency.

As can be seen in the illustration, the unit is very compact. Controls and leads are all available from the front panel and calibrations are clear and distinct. The circuit is the AC-DC type; the B minus lead is kept above ground (chassis) potential, but a good RF ground is pro-

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Fig. 1  The Bliley CCO with the case removed. The seven crystals are mounted around the rotary switch and held in place by the large round plate.
vided by a 0.1 uf condenser (C8). The chassis and cabinet are thus an effective shield and at the same time allow external grounding without danger of short circuiting the power line. A 35Z5GT tube is used for power rectification. The RF oscillator is a 12SK7 and audio modulation power is generated by means of a neon bulb. The circuit arrangement is given in Fig. 2.

A rather novel feature of this circuit is the use of a neon bulb as an audio oscillator, which provides the 400 cycle modulation voltage. The oscillator is the "Pierce" type which has the advantage of not requiring any tuned circuits. This means that frequency can be changed by simply switching from one crystal to another, and that external crystals can be used without any tuning adjustments.

Controls are as follows:

1. Frequency Selector Knob (center of panel). This control selects one of seven internal crystals or an external crystal.

2. Operation Selector (left center). This switch turns on the power and permits the selection of a pure RF signal, a 400 cycle modulated signal, or a signal modulated by an external audio signal.

3. Attenuator (center right). This is the decimal type of attenuator such as is usually found on signal generators.

4. Output Control (below Frequency Selector Knob). Provides smooth control of output voltage from zero to maximum for the particular attenuator setting being used.

As shown in the photograph, separate jacks are provided for RF and audio output signals. These are located at right and left sides respectively, near the bottom of the panel. The external crystal socket and pilot lights are located to the right and left of the frequency selector knob.

With ordinary broadcast receivers, alignment procedure is about the same as with conventional signal generators, except that harmonics of some of the crystal frequencies are used. We select the IF frequency with the knob in the center of the panel, feed the signal into the receiver in the usual way and align the IF section.

Since we now require the two tracking frequencies, 600 kc and 1400 kc, we make use of harmonics. We select the 200 kc crystal; the third harmonic will now be on 600 kc, and the seventh harmonic will appear at 1400 kc. There will, of course, be other harmonics at 800, 1000, 1200 and 1600 kilocycles. If we should have any trouble identifying these, we can select the 1000 kc crystal which has only one signal in the broadcast band. Once on 1000 kc, we can count harmonics from that point. When the set is aligned, dial readings at the harmonic points can be checked.

Short wave bands of receivers can be aligned by means of the 1000

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Let us start this month's analysis of circuit diagrams with the Philco battery operated Model 46-132. This is a superheterodyne and uses a 1LA6 converter, ILN5 IF amplifier, 1LH4 detector AVC-AF amplifier, and two 1A5GT power output tubes. The power supplies are a 90 volt B battery and a 1.5 volt filament battery pack.

The phase inverter used in this circuit is rather unusual. Fig. 1 shows this portion of the circuit in simplified form. Notice that there is a resistor (R1) in series with the screen supply to output tube No. 1; whereas the screen of output tube No. 2 gets its DC directly from B plus. The screen of V1 is not bypassed, but decoupling condenser C1 bypasses the screen of V2. This means that the first screen has a signal voltage on it, built up across the resistor tl. This voltage is in phase with the voltage on the plate of this tube, which in turn is 180 degrees out of phase with the grid of V1. Signal voltage is coupled from this screen through C2 to the grid of V2 which is thus fed 180 degrees out of phase with the grid of V1. Phase inversion has thus taken place in the output stage itself.

Another interesting feature of this set is the tone compensator which is placed between the high side of the volume control and the grid coupling condenser as shown in Fig. 2. Condenser C3 and resistor R2 form a total impedance which varies with frequency due to the change in the reactance of C3. Since this impedance is lowest at the highest frequencies, it feeds more of the "highs" through to the grid of the first audio stage. It can be seen that this effect is greater when the volume control is in a low position since this compensator is shunted between the variable arm and the high side of the volume control.

The RCA Victor Model 56X is an AC-DC type of receiver with several interestingly different features. It uses six tubes of the 12 and 35 volt series; and, instead of the usual one-tube arrangement, a separate mixer and oscillator are used. The circuit for these two tubes is shown in Fig. 3. The oscillator is of the electron-coupled type usually used with a single tapped coil in which the grid, cathode, and screen are the oscillating elements and the plate is simply run at positive DC potential to maintain the electron stream in the tube. In this circuit, however, the single coil has been split up into two separate portions. The cathode returns to
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RADIO MAINTENANCE • JUNE 1947
G. G. Costantino, Secretary of the **Rhode Island Radiomen's Business Association**, gives us the following information about the activities of his organization:

"On March 24th, the first major lecture in the series being sponsored by the R.I.R.B.A. was given by Mr. Leon Rensicow, Chief Engineer of the Electronic Instrument Co., whose subject was 'Signal Tracing.' The lecture and demonstration were very interesting to the many assembled. The sponsor was the Wm. Dandretta Co."

"On April 28th, Mr. Freeman Spindell, Chief Engineer of the Browning Laboratories, lectured on FM and demonstrated the Browning tuner before a gathering of 150 technicians. Mr. Spindell covered the subject so completely and answered questions so intelligently that he won the admiration and respect of all present to such an extent that we want him back for a repeat performance on some other subject. The sponsor for this lecture was the DeMambro Radio Supply Co."

"New officers were elected on April 14th and the installation will take place at a dinner dance on May 12th."

G. G. Costantino, Secretary

We are happy to report the following information about the **Associated Radio Technicians of British Columbia, Canada**.

"The Vancouver Associated Radio Technicians of B. C. held their annual meeting in the genial surroundings of the Piccadilly Cafe on April 9th, with President Wilf Munton in the chair. A good majority of the members were present.

"After a most appetizing meal, served by the charming hostesses, all made themselves comfortable by loosening their belts and leaning back to listen to a very informative address by Mr. Dick Diespecker, radio commentator of station C.J.O.R., on the non-technical aspects of radio broadcasting. In his opening remarks he expressed the opinion, based on his associations with the species, that it was not necessary to be slightly 'off the beam' to be a radio technician, as is so often stated, but that it did require a lot of hard work with long hours—everyone silently agreed.

"In describing some of the difficulties encountered in putting on a radio program, Mr. Diespecker referred to the book 'The Hucksters' but said that fortunately there were not many sponsors of this type.

"He stressed the important part radio technicians can play in fostering public acceptance of and demand for cultural and educational programs, but that at present they had the lowest sponsor rating; however, if the listening audience were large enough and made their desire for the more educational programs known in the proper places, this would be partly overcome.

"Following Mr. Diespecker's address, the regular business of the meeting commenced; the minutes of the previous meeting were read and adopted, followed by the nominations for the slate of candidates: Al Johns was elected president to spark the association activities for the next year; Fred Stucky, vice-pres.; Barney Jensen, sec.; Monty Lennox, treas.; Ed. Mullen, recording sec.; the remaining 5 nominations on the slate, John Haldom, Cyril Helliar, Bill Brakes, Jim Baird and Sam Beyer, were automatically considered chairmen of the various committees.

"Many prizes were drawn for during the evening. We thank the many generous jobbers who donated them.

"Two A.R.T. members from distant points were introduced, C. L. Mathews of Rosedale and John Pearson, Past President Victoria Branch.

"Before handing the gavel to his successor, retiring president Wilf Munton spoke briefly on the accomplishments and activities of the past year as well as pointing to some of the unfinished business for the newly elected officers to begin their labors. The meeting adjourned after a few well chosen words by President Al Johns."

Sam Beyer, Publicity 
Associated Radio 
Technicians of B.C.

"At the regular monthly meeting of the **Associated Radio Service Men of Central Pennsylvania** on Tuesday, May 6th, in the Brown Library in Williamsport, Pa., the guest speaker was Mr. Fred L. Bartley, Field Service Supervisor of the Radio Div. of Westinghouse in Sunbury, Pa. He prefaced his talk with some pertinent remarks on associations.

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RADIO MAINTENANCE • JUNE 1947

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**NEW DOUBLE TRIODES**

Two new double triodes providing single-ended operation for cascade amplifiers at frequencies up to 400 mc have been announced by Sylvania Electric Products Inc., New York City. The high mutual conductance tubes have independent elements with the exception of heaters, permitting a saving in space and number of tubes required. Circuit applications include grounded grid, cathode follower and push-pull amplifiers and converters in the new FM and television bands where low equivalent noise resistance obtained with triode converters is desirable.

The tubes are supplied with lock-in RMA bases, 88W-L-O and measure 2-9/32” overall, a seated height of 1-1/4”. They may be mounted in any position.

**NEW INTERCOM SYSTEM**

RCA’s first postwar intercommunication system, with speaker stations as small as an ordinary desk clock, has been announced by the RCA Sound Equipment Section. The reduced speaker station size is possible in this two-station intercom since the amplifier and speaker station are separate units, permitting off-the-desk location of the amplifier.

Conversation at normal voice level requires only a flick of the two-position switch. Releasing the switch returns it to “listen” position. This intercom is easily installed and plugs into any 110 volt AC or DC outlet. Additional stations up to five can be connected to the amplifier.

**DYNAMIC MICROPHONE**

With the new Acoustalloy Diaphragm, the Electro-Voice Model 630 dynamic microphone now provides high fidelity pick-up and reproduction, and is suitable for a great variety of applications. Frequency response is substantially flat, 40–9000 cps. It withstands high humidity, extremes of temperature and severe mechanical shocks, hence is especially rugged for indoor and outdoor use. Built-in cable connector permits vertical tilting of microphone head in a 90° arc. For complete information, write for Catalog No. 101 to Electro-Voice, Inc., Buchanan, Michigan.

**NEW VTVM**

Model 210 Vacuum Tube Voltmeter and Visual Signal Tracer, manufactured by the Electronic Instrument Company, Inc., has broad ranges which permit its use on AM, FM and television receivers. DC readings up to 5000 v. are made with a single specially designed high voltage test probe. Four simple linear scales and two colors provide for easy, accurate reading. All multiplier resistors are matched to 1% accuracy, giving a maximum error of 2% on both AC and DC voltage ranges. The instrument has 29 separate ranges for AC, DC resistance and decibel readings. A new type of UHF diode is used for AC rectification and is designed for visual signal tracing on all frequencies from 20 cycles to 100 mc.

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TITLES OF ARTICLES IN RECENT ISSUES — These articles are typical of the ones you'll find in "The Capacitor" every month: How to Use Audio Oscillator and Signal Generator to Simplify Tests — New Requirements of FM and Television Servicing — Hum Elimination — Aligning Superhet. Think how such articles will help you — mail coupon NOW.

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When the Customer isn't Right!

From Page 5

experienced person has been attempting repairs, the Houston Radio Service of Houston, Texas, immediately advises the customer. Their representative informs the customer that repairs will probably cost him an additional ten to twenty per cent in replacement parts and labor. He further points out that with television receivers coming, extremely high voltages will be present in radios and the owner who attempts self-service is very apt to be severely injured. By notifying the customer immediately upon discovering that the set has been tampered with, charges for the extra work caused by the customer’s tinkering will be accepted without question.

If a comparatively unknown customer attempts to pay for service activities with a personal check, how should the serviceman proceed?

Answer: The Peerless Radio Service of Jacksonville, Florida, instructs its representatives to have all personal checks made out to cash rather than to the service firm. The representative then cashes the check for the customer and the customer, in turn, pays for the service charges. Although this procedure is somewhat involved, it is safer since checks made out to cash are usually collectible with the aid of the law, while checks made out to the service firm which will not clear through the banks must be handled through time-consuming collection methods.

What is the most effective method of turning a transient customer into a constant one?

Answer: The Thomas Ayer Radio Service of Albuquerque, New Mexico, has its representatives mark the date of service and also the date ninety days from the date of the service transaction on the top of each duplicate service invoice. The invoices are inspected daily and the customers are called after ninety days and reminded that “quarterly” radio inspections save the radio owner a conservative fifteen per cent on yearly service bills.”

The Richard Budlong Radio Service of Detroit, Michigan, advises its customers to “see your invoice billing. Their representatives explain to the customer that the cost of delivery truck maintenance and time consumed traveling to and from the shop are barely covered by the charge. This firm charges a flat one dollar service fee over and above invoice billings on home service transactions and explains to its customers that the dollar reflects the time spent traveling to and from the radio owner’s home.

What is the best thing to do when several days after a service call has been made, a customer requests a follow up call and refuses to pay for it?

Answer: Troubles of this type should be anticipated before they take place. The John H. Raglan Radio Service of San Antonio, Texas, presents its customers with a detailed service invoice at the conclusion of every transaction. The invoice lists all repairs made, components installed, and the reason the set was inoperative. Raglan, when making his second call, determines whether or not the trouble is in any way due to components or repairs made on the initial call. If it is, no charge is made. If the trouble is totally unconnected with the first inspection, regular labor and component charges are made. If the customer knows what was wrong with his radio the first time and a
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RADIO MAINTENANCE • JUNE 1947

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The Power Supply

From Page 11

directly across the lower voltage power supply. If the second type were shunted across the supply, the current drain would be excessive and needlessly increase the size of the power supply. In practice, the coil is placed in series with the filter network in much the same manner as is the field coil of a speaker in conventional radio receivers. Another point in the circuit for the focus coil is the negative or ground return of the power supply. In Fig. 2, the focus coil is connected in this manner. A rheostat is placed in parallel with the coil to vary the amount of focus current. This variable resistor is the focus control found generally on the front of the receiver.

If the tube is electrostatically focused, this electrode is operated at about 1200 volts. The focus electrode is negligible so that the voltage is tapped from the high voltage supply bleeder. The focus voltage can be varied with a potentiometer in series with the bleeder as shown in Fig. 2.

The intensifier voltage is generated by the high voltage supply which consists of a high voltage transformer, a half-wave rectifier, and 60 cycle filter. Full-wave high voltage rectifier are seldom found in television receivers because of the added expense and increased size of a transformer with twice as many turns. Besides, the very low current drain permits the design of filters for 60 cycle ripple to be just as inexpensive as those for the 120 cycles produced with full-wave rectification. Except for the higher ratings of the components, the supply is conventional. (See Fig. 2.) Ordinary 5 volt rectifier tubes cannot withstand the high inverse peak voltages; instead, tubes like the 2X2, 2V3, and 8013 are used.

In addition to providing the proper voltages to the picture tube, the power supplies must perform several other functions. The positive voltages for the plates of the RF, video, and audio tubes are generally operated from a 300-350 volt supply. This power is taken from the low voltage, high current supply. The sweep circuits can be operated at the same voltages, but usually a higher B voltage is desirable to be able to obtain ample deflection amplitude on the new 50 degree wide angle tubes. The higher voltage is tapped across the full bleeder.

There may also be needed a source of low negative voltages, as for example a variable grid bias (for contrast control) in the video amplifier. The vertical and horizontal positioning circuits also need about 5 to 10 volts of negative bias. A simple means of developing this negative voltage without resorting to an extra winding on the power transformer and a separate rectifier is shown in Fig. 2. Instead of the center tap of the secondary of the power transformer being directly grounded, it is grounded through the focus coil (or a resistor). Thus, the entire receiver current flows through the coil, furnishing it with the necessary current. At the same time, a negative voltage is developed at the tap, equal to the potential drop across the focus coil (the receiver current multiplied by the resistance of the coil).

Electrostatic Deflection

The power supply required for receivers with electrostatically deflected tubes has several variations from those discussed above. The low voltage supply is the same for the RF, video, and sound circuits. But now the sweep amplifiers require high plate voltages rather than high currents in order to be able to deflect the plates of the cathode-ray tube. This reduces the current required from the low voltage supply, but another higher voltage winding and rectifier must be added for the sweep circuits. For example, a 12-inch electrostatically deflected tube, operating with an intensifier voltage of 5000 volts, requires about 1400 volts peak-to-peak sawtooth voltage to deflect the beam. The sweep amplifier plate must then have a B voltage of at least 1400 volts. Fig. 3 shows the power supply circuit used with electrostatically deflected tubes.

Electrostatically deflected television tubes are all electrostatically focused. The focus electrode voltage is obtained from a tap on the high voltage supply as discussed previously.

Whereas positioning is accomplished in magnetic deflection by varying the DC current in the deflection coil, electrostatic deflection requires a variable DC voltage on the plates. The deflection plates and centering controls must be at a potential near that of the second anode. Otherwise any large difference in voltage between the plates.

Fig. 3 A circuit diagram of a high voltage and low voltage power supply for a television receiver using an electrostatically focused and deflected tube.
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Circuit Analysis

From Page 14

ground through one of these windings and the other provides the tuned grid circuit. It should be noted that, instead of the usual grid coupling condenser, the grid RF connection is made by means of the coupling coil, L1. As has been pointed out previously in this column, there is a tendency toward the use of this method in many of the new sets. This oscillator is exactly the same electrically as the electron-coupled type which uses a single tapped coil.

Another different feature in this oscillator circuit, however, is the method of obtaining bias. Ordinarily, the oscillator grid is self-biased, that is, the bias is obtained from a grid-to-ground resistor through which the grid current flows. In this case, however, the bias is obtained from the AVC line through isolating resistor R3, as well as in the ordinary way through resistor R4.

A pentode (12SG7) is used as the mixer and cathode injection of the oscillator voltage is used. The cathodes of the two tubes are connected together and since the oscillator cathode runs "hot" with some RF, this RF voltage is applied to the cathode of the mixer. Mixer bias is supplied by R5 which is bypassed to RF by C4.

The volume control on this set has a total resistance of 500,000 ohms, but has a stop at a point where there is still a resistance of 50,000 ohms between the arm and the high end. It is well to remember this in checking control as this might otherwise appear to be a defect in a control which is really still in good condition. It is possible to use a separate 50,000 ohm resistor in series with the top of a 500,000 ohm pot for replacement if an exact duplicate is difficult to obtain.

Hum-bucking is also provided in this set. Fig. 4 shows how this is accomplished. Resistor R6 acts both as a screen-dropping and power supply filter resistance. Some ripple current from the power supply
THE Radio Industry Parts Coordinating Committee in conjunction with the Radio Manufacturers Association and local parts distributors plans to sponsor a merchandising and market research program. According to Herb Clough, Chairman of the Committee, the plan is based on the broad general premise that the progress of the electronic industry is dependent upon the availability of replacement parts and competent service personnel. He stated that "Any program that tends to help the serviceman deserves the support of the industry, and I believe the program being developed by our sub-committee on merchandising is the first step in a constructive activity that should be carried on and allowed to develop in the way in which it will be most beneficial to the serviceman and the industry."

As a result of the committee's report, Mr. Clough indicated that a serviceman's "Code of Ethics" program is being readied to build public confidence in local radio repairmen, and that a series of service-dealer clinics, sponsored by local NEDA distributors will probably be arranged. He emphasized that the program will not be carried out until approved by the four groups sponsoring the Industry Parts Coordinating Committee which are the Radio Manufacturers Association, National Electronic Distributors Association, Electronic Parts and Electronic Manufacturers Association of Chicago, and the Sales Managers Club of New York. The merchandising committee preparing this program is made up of members from each of these four groups.

There are in use today a number of ways of representing tubes in schematic diagrams. The existence of these variations irrespective of their individual merits tends to be confusing and industry authorities have recognized the desirability of a determined effort to establish a uniform industry standard.

In service manuals, the function of the schematic diagram is to assist the service engineer in making repairs quickly, economically, and with the minimum of effort. Viewed in this light, it is apparent that service engineers should have the privilege of indicating their preference. Howard W. Sams & Co., Inc., is cooperating in this program by giving you an opportunity to express your desire.

We urge that you read the following carefully and send in your vote as soon as possible. The results of your voting will be forwarded to the RMA service committee for their guidance.

Seven different methods of tube representation have been used by manufacturers. Each of these methods is described and examples given by reference to recent PhotoFact Folders. In general, these methods fall into two classes: Symbolical (showing the tube elements) and Pictorial (showing the bottom view of the socket).

Please study the schematic diagrams listed together with your choice, attention should be paid to such factors as the manner in which legibility is affected by a reduction in size of the tube symbols which occurs when large set schematics are presented on a single page, the clarity of the diagram, the effect of circuit cross-overs, etc.

Place an X in one box only to indicate that it is your choice. Pick out the whole column and mail it to Howard M. Sams & Co., 2924 East Washington Street, Indianapolis 6, Indiana.

Method 1. The tube elements are shown enclosed in a circle and arranged for clarity of circuit presentation. No pin numbers are shown. Elements of the tube are not identified.

Method 2. The tube elements are shown enclosed in a circle and arranged for clarity of circuit presentation. The elements are illustrated to show name, i.e.: G-grid, P-plate. Pin numbers are not shown.

Method 3. The tube elements are shown enclosed in a circle. Base pin connections are numbered to conform to RMA basing standards. Sequence of the pins is arranged for clarity of circuit presentation and not in same order as the tube socket.

Method 4. The tube is represented by a bottom view of the tube socket. Tube elements are not shown. The type number of the tube is given inside the circle. Base pins are arranged in proper order but are not numbered. The locating key position is shown. The tube elements are installed to show name, i.e.: P-plate, G-grid.

Method 5. The tube is represented by a bottom view of the tube socket with the tube elements shown in the center of the circle. Base pins are arranged in proper order and are not numbered. The locating key position is shown. The tube elements are installed to show name, i.e.: P-plate, G-grid.

Method 6. The tube is represented by a bottom view of the tube socket with the tube elements shown in the center of the circle. Base pins are arranged in proper order and are numbered. The locating key position is shown. The tube elements are installed to show name, i.e.: P-plate, G-grid.

Method 7. The tube is represented by a bottom view of the tube socket with the tube elements shown in the center of the circle. Base pins are arranged in proper order and are numbered. The locating key position is shown. The tube elements are installed to show name, i.e.: P-plate, G-grid. This treatment is the same as used in the tube manuals.

Method 8. The tube is represented by a bottom view of the tube socket with the tube elements shown in the center of the circle. Base pins are arranged in proper order and are numbered. The locating key position is shown. The tube elements are installed to show name, i.e.: P-plate, G-grid.
The Power Supply

-- From Page 22

and second anode would cause defocusing of the electron beam. The circuit arrangement in Fig. 3 shows how this potential difference is kept small, at the same time providing DC centering controls for the plates.

Troubleshooting the Power Supply

When attempting to troubleshoot or service any part of the television receiver, the serviceman should observe extreme caution and make certain that there can be no bodily contact with the high voltage supply. Most receivers have interlock switches which break the AC input circuit when the chassis is removed from the cabinet. Before closing the interlock switch again in order to be able to work on the set, remove the fuse from the high voltage supply; or if this cannot be done because the low and high voltage supplies are built around one transformer, unsolder the high voltage secondary winding lead, and wrap the end with friction tape to prevent its shorting to the chassis or touching the body.

If any trouble is suspected with the high voltage supply, first make continuity and resistance measurement checks with an ohmmeter while the set is off. Most faults like open leads or shorted condensers can be located in this manner. Should it be desirable actually to measure the high voltage (and if a voltmeter of sufficient range is available) connect the meter across the supply while the set is off. Then turn it on for a reading. Also, be sure to turn it off again and allow ample time for the condensers to discharge before removing the meter lead from the high voltage terminal.

Another safety precaution to observe is to have a good ground connection to the chassis. Otherwise, a breakdown of the insulation on the high voltage winding may cause severe shock if contact is made with the “hot” chassis. High voltage supplies, particularly the 60 cycle AC type, are dangerous and the wise serviceman is the one who is always cautious when servicing a receiver.

The following are the usual faults found in high voltage supplies:

No picture on the tube. If the cathode-ray tube filament is lit, but no beam current is flowing, there is probably an open in the high voltage circuit. Check the rectifier tube, and check for shorted or open filter condensers and resistors.

Excessive ripple in high voltage supply. This fault will show up in the picture as in Fig. 4, and is usually due to an open filter condenser.

Breakdown at intensifier terminal. If there is poor contact at the intensifier terminal caused by a loose connector or dirt between the high voltage connector and the terminal, there will be intermittent breakdown, resulting in picture “blop.” The trouble is easily cured by cleaning the terminal and making a secure connection.

Faults in the low voltage supply generally can be detected in the picture. Excessive ripple because of a shorted filter choke or open condenser will produce the same type of hump in the picture as that shown in Fig. 4, only in this case the ripple comes through the video amplifier. If 60 cycle hum also gets into the sweep circuits, the sides of the picture will take on a wavy shape and the vertical linearity will be distorted. All such faults can be cleared up by completely checking the components and wiring in the low voltage supply.

The foregoing description of high voltage supplies dealt only with those of the 60 cycle type which are inherently quite dangerous for use in the home. In a later article, we will discuss the safer, newly developed high frequency, high potential power supplies that are being employed in post-war receivers.
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YOU'RE ON THE AIR! A sensational new one minute spot announcement to boost service business has just been released by IRC through IRC Distributors. Listen in and cash in on this promotion!
While at first it may seem a quick and easy way of reaching some destination... experience shows that it is not alone risky... but often dangerous... to accept help from a stranger. When you have a phonograph pickup cartridge to replace, you'll be playing it safe to duplicate the original cartridge... the one you know... the cartridge selected by the engineers and manufacturers of such equipment for the most satisfactory results. Cartridge characteristics, ideal for one instrument, may be entirely unsuitable for another. For exact, duplicate replacements in a majority of Phonographs now in use, Astatic Crystal Pickup Cartridges are available at your Radio Parts Jobber's.

The Astatic Corporation
Conneaut, Ohio

Astatic Crystal Devices Manufactured under Brush Development Co. patents.

Circuit Analysis

→ From Page 24

passes through this resistor and through filter C5 to ground. On the way, this current passes through a small portion of the primary of the output transformer in such a direction as to "buck" against any hum current which may exist in the plate circuit.

This means that output hum is reduced to a minimum and the plate of the 35L6GT/G can operate on the higher DC voltage side of filter resistor R6 giving higher output.

When the Customer Isn't Right!

→ From Page 20

detailed invoice is available, it is much easier to convince him that the trouble is not connected with the original repairs, if such is the case. The invoice also provides trouble-shooting leads on the follow-up call.

These are only a few of the questions which the serviceman is asked continually. The procedures followed by these organizations have been proven to be effective. If you have a better answer or have found a particularly effective way to handle other problems such as these, the editors of Radio Maintenance would like to hear about them for possible inclusion in a future article.
I am convinced, Gentlemen, that the automobile is here to stay. Yes, I shall go even further than that: I am also convinced—we may as well face it—that the automobile radio is here to stay, too.

I can almost see your wry faces when you read that; for I am quite sure that automobile radio servicing does not top the hit parade with the brethren of the soldering iron. In fact, I am fairly confident that it is very near the bottom of the popularity list—not quite down to the level of the camera-type portables, perhaps, but only a cut or so above them. Oh, of course, I have heard a scattered few say that they like to work on auto sets; but I have always dismissed these strange creatures as being of the same stripe as those who say that they do not mind the taste of castor oil.

It is not hard to see why this is so. The automobile radio is subject to every ill that a house radio suffers, and then it has a whole flock of other ailments peculiarly its own. Vibrator power supplies are quite a bit more cranky than the old familiar full- or half-wave rectifier and brute-force filter combinations of the house sets. Moreover, operating a radio in a car is just asking for trouble. Not only do you have your static built right in—what with the ignition system, etc.—but the set is subjected to terrific abuse in the way of vibration and extreme changes in temperature and moisture. Add to this the very limited antenna facilities, and you are beginning to wonder how auto sets work at all; yet the customer expects his auto radio to function as well as, if not better than, his house receiver.

Working on the sets is no picnic, either. Getting them out of the car and putting them back is hard on the back, neck, knuckles, and patience. On the other hand, trying to make adjustments with the set still in the car is a job for an expert midget contortionist. An exasperating feature is the fact that often a set will play to perfection on the bench and then refuse to let out a squawk when it is installed in the car; or perhaps it will work all right until the motor is started, or the brakes are applied, or until a right-hand turn is made, or the headlights are turned on, or the driver shifts his chewing gum from port to starboard, etc., etc. In fact, anyone who has been cutting a hole in the firewall to install a set and has had the hole-saw in his half-inch electric drill suddenly jam and has made two or three complete revolutions in the cramped quarters of the front seat before he could release the trigger of the drill is likely to feel little enthusiasm for automobile radio servicing.

Nonetheless, servicemen who are not going in for auto radio servicing are making a grave and costly mistake. There is gold in them there hills, boys. Car radios are almost as common as Studebaker jokes. The young bucks buy a car radio before they buy a spare tire. (They have to have something to fasten those squirrel tails to, don’t they?) Anyone who owns a car is accustomed to paying well for any service performed on the machine; consequently, the serviceman can charge for extra inconvenience of working on auto sets without hearing a complaint. What is more, most servicemen are still loath to work on these sets; therefore, the radioman who does will be building up good will and will be making val-

Another Cunningham technical aid... this handy reference bulletin gives you the data you want on RCA’s 48 miniature tube types. Its classification chart, comparative-type and application information, electrical characteristics, and socket diagrams will keep you up to date on these tubes. Authoritative technical data and Cunningham tubes keep you ahead of the field. GET BOTH FROM YOUR CUNNINGHAM DISTRIBUTOR.

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Over the Bench

From preceding page

table contacts that will swing his
house radio business.

Like any other kind of work,
radio servicing is not so bad
if you are adequately prepared
for it. The first requirement is a
place to work. This means a
place that is warm and dry during all
seasons of the year—a place into
which the car can be driven. Working
at the curb is no good. It is
unhealthy and makes a poor
impression on the customer.
An "annex" built onto
the shop, the installation of an
overhead door at the rear, or even
a lowered drive into a basement
may solve the problem if you are
already established; if you are not,
be sure to select a shop site that will
permit you to do auto radio servicing.
I remember that several years ago
Supreme Instruments made a
national survey to determine the
best place for locating a radio service
business, and they decided that a
garage was the first choice. You
might give that a little thought if
you are not permanently located.

Of course, you will need storage
batteries for your test bench, and a
trickle charger is a good investment,
too. A good set of end and socket
wrenches is another "must," and a
sturdy half-inch electric drill, to-
gether with a set of adjustable hole-
cutters or hole saws are also a
necessity. Vibrators, suppressors,
metal-cased condensers, car
antennas, and various other items
will have to be carried in stock.

Probably the handiest thing you
can have around a shop doing auto
radio service, though, is a smart boy
of high school age. To secure one
of these handy little jiggers, go down
to the high school and have a talk
with the teacher in charge of auto
mechanics. Ask him to recommend
a boy who is good at automobile
work and who would like to learn
something about radio as well. Tell
the teacher what you can afford
to pay and explain that you expect
to teach the boy the elements of
radio.

Do not forget this promise, either.
Encourage the boy to ask questions,
and answer these questions to the
very best of your ability. You will
be helping yourself as well as the
kid, for you will find that you have
to know a thing very thoroughly
before you can explain it to someone
else.

Let the boy do the removing of
the sets and the replacing of them.
When he is not doing that, he can
be cleaning chassis, brushing out
consoles, doing deliveries, or even
doing supervised service at the
bench. The cramped quarters and
awkward positions that are so trying
to your old bones will not bother
him in the least. During the school
term, you can probably arrange
your work so that he can help with
the auto sets. Many of these jobs
are two-man affairs, anyway, so it
will pay to put off the installations
and removals until he is with you.

Do not be afraid to charge a good
price for your auto radio work for
you cannot turn out auto radio jobs
as fast as you can AC-DC midgets.
Do not be surprised, either, if you
soon discover that you are making a
very fine living out of this auto
radio service that the other service-
men are letting slip through their
fingers.
Each month the reader sending in the best suggestion receives a crisp ten dollar bill. For all others published, RADIO MAINTENANCE will pay five dollars. Let's hear from you.

Signal Generator

Many servicemen acquire small four-tube TRF receivers as trade-ins. These sets can be modified for use when setting up automatic push buttons in locations where signal strength is low. The antenna coil is converted into a tuned grid plate feedback oscillator tank circuit. The cathode of the input tube is grounded. The receiver will then operate as a signal generator covering the broadcast frequencies. It can be carried to the customer's home and employed to aid in setting push buttons.

Soldering

A piece of flannel tacked to the service bench near the soldering iron holder comes in handy for keeping the iron clean and tinned. The pad is folded neatly and held in place with carpet tacks. Every time a joint is to be soldered, the iron is rubbed quickly across the face of the pad. If the pad and iron are always kept in the same place, the action will become automatic and will take place without conscious thought. You will be surprised how long the iron will remain clean and unpitted.

Edward T. Johnson
Lindhome and Johnson Service Dept.
Mt. Jewett, Pa.

James Mutari
1641 72nd St.
Brooklyn, N. Y.

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The Organizations

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in and prepare for the future. For another, they pave the way for open discussion of all sorts of problems. With the coming of Television, the serviceman will have to know his circuits more than ever. And most manufacturers are willing to let qualified servicemen take over the service end of this development. Associations such as yours can play a major part in helping the serviceman attain the necessary competence.'

"Mr. Bartley then proceeded to present what was, in effect, a complete course in FM, illustrated with projection slides. He started with the antenna, then analyzed the circuits in an FM receiver, and concluded with FM receiver alignment and trouble shooting. Always he kept in mind our angle—the angle of the man who has to service the equipment. Hence he drew on his wealth of practical experience to highlight the theoretical parts of the talk. Mr. Bartley described some of the practical difficulties in FM servicing. One example was the case of 'flutter' interference due to nearby airplanes, another was on how to overcome customer objections to dipoles.

"And so the talk proceeded with similar practical information on alignment and trouble shooting. Mr. Bartley told us what to check when running into excessive noise and hiss; distortion and poor tone quality; poor reproduction, lack of highs; amplitude distortion during high audio signal levels; in short, quite a gamut of troubles peculiar to FM circuits.

"Concluding his talk, Mr. Bartley promised to be back in the Fall, with data on the new circuits, as well as a more advanced FM course.

"During the business part of the meeting, our chairman, Mr. Gordon A. Phips, of Williamsport, Pa., appointed a Nomination Committee to select candidates for next month's election of officers."

John Barsophy, Secretary
RADIO on each nearest the megacycle work tests wave These harmonics extend through which Crystal BAND

Fig. RADIO TELEVISION Get Ready From Page

Crystal Controlled Signal Generator

-- From Page 12

ke crystal. This produces harmonics which are spaced every megacycle. These harmonics extend through the range of all the ordinary short wave bands (to 25 mc). In fact our tests on one of these units show that output is still sufficient for alignment work at 50 mc and higher. Choose the megacycle points which come nearest to the tracking frequencies on each band and proceed with the

alignment. On the higher frequency short wave bands, megacycle points come quite close together and identification becomes a little more difficult. In that case, we can switch to another crystal whose harmonics will only coincide with megacycle points at certain frequencies. Fig. 3 shows how this can be done with the 175 kc frequency. At 7, 14, and 21 mc, 175 kc crystal harmonics will coincide with those of the 1000 kc crystal. Then, if a signal is heard using either crystal, we know it must be one of these multiples of 7 mc.

To align the IF section of an FM receiver, an external crystal is used. This crystal should be one which oscillates at one-half of the IF frequency of the receiver. For instance, the latest RMA standard IF is 10.7 mc. Thus, we would need a 5.35 mc crystal. The second harmonic then provides the proper alignment frequency. In the same manner, other special alignment frequencies can be obtained by using the correct crystal.

For alignment of the RF and mixer sections of FM receivers, a 5 mc crystal will provide harmonics up to 200 mc which are strong enough to use.

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For expert guidance—TURN THE PAGE
Our first announcements of the availability of back numbers of RADIO MAINTENANCE brought a response much greater than we anticipated. As a result we are continuing to comply with the demand of radio servicemen for these back issues. We don’t know how long we may be able to fill orders for the earlier issues as the supply is dwindling fast, and some are already sold out. Only those listed are now available, so if you are anxious to get them, send in your request as soon as possible.

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JOHN RIDER SAYS . . .
It pays to keep informed

To believe that elaborate test equipment and the availability of service data eliminate the need by the serviceman for an up-to-date understanding of radio theory is tantamount to hanging one’s hopes on a plume of smoke.

There was a time when the simplicity of receiver construction made maintenance and repair work a fairly easy task. Today, modern mass production methods, extended frequency ranges, and improved designs, have multiplied the complexity of radio servicing.

The serviceman who has an adequate technical background will have no difficulty in recognizing or understanding new circuit modifications. Without such knowledge, however, servicing must be a costly “trial and error” procedure, no matter how good and versatile the test apparatus. Servicing “know-how” is one of your most valuable assets—upon it rests the success of your business.

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NEXT MONTH
IN
RADIO MAINTENANCE

Servicing FM Receivers
By popular demand of our readers, RADIO MAINTENANCE has prepared a new series of articles on FM, the first of which appears in the July issue. Every phase and detail of this rapidly expanding development are explained and discussed by one of the most competent authorities on the subject. Complete servicing, trouble-shooting, and alignment will be covered, as well as the theory of operation and a thorough description of all components of an FM receiver. You will enjoy and value these articles and keep them as permanent reference.

Speaker Matching
A complete article on how to divide the output of an audio amplifier among several different speakers at scattered locations in order to obtain suitable volume levels. How to do the job with optimum efficiency and minimum amplifier output. Every P A installation requires special planning for proper results and a serviceman who knows how to achieve the tight balance in distribution will save himself a lot of time and realize greater profits.

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The Notebook
receivers of the type that bolt to the fire wall, trouble is sometimes encountered when replacing the front cover on the metal box housing the set. This is due to the fact that fire walls on most automobiles are not flat, causing the box to become sprung. If the nuts that hold the box are loosened, it will straighten up and the cover can be easily put back on.
Fred Stolze
141-23 Cherry Ave.
Flushing, N. Y.

IF Transformers
In many IF transformers, the adjusting screw is made of soft brass which breaks easily. When broken, adjustment is difficult. A simple remedy is to solder a nut onto the screw as shown in the accompanying diagram.
C. Demeter
1148 Fairmount Ave.
Elizabeth, N. J.

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1. Portion of audio amplifier of typical set. It is required to examine correctness of cathode bias of VI as well as to determine maximum signal it can amplify without distortion. So...
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3. Note output due to grid cut-off, with flattened waveform at upper part of cycle. Again...
4. Here's the distorted output due to driving grid too high. Note flattened waveform at lower part of cycle.
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