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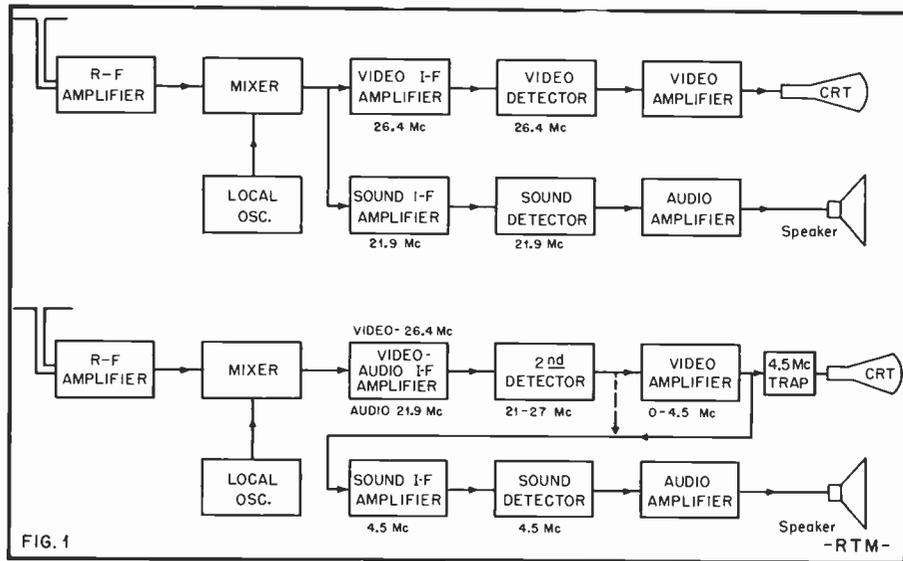
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181-JA6

By **MORTON G. SCHERAGA**
Contributing Editor



Block diagrams comparing stage relationships of conventional TV receivers and intercarrier sound receivers.

THE INTERCARRIER SOUND SYSTEM IN TV RECEIVERS

Tube complement reduced, tuning simplified by use of system on low-cost sets

MANY of the new television receivers employ the intercarrier sound system for receiving the audio signals of TV programs. This new method of sound reception was proposed several years ago as a means of reducing the number of IF stages in a video set and to simplify tuning of the TV signal for best sound and picture.

Adoption of this system was at first slow because it can not be used with every type of tuning arrangement and because its performance depends to a great extent upon the stability of the transmitter's sound and picture carriers and the degree of modulation of the video carrier. While these problems still exist, they have been reduced to a great extent and there is a definite trend towards wider use of the system.

The primary difference between conventional sound circuits and the intercarrier system is in the method of de-

tecting the audio signal. Fig. 1 compares the two systems. In both receivers, sound and video carriers are fed to the RF amplifier and then to the mixer, where the two signals beat with the local-oscillator signal. Two beat frequencies are thus obtained, one at the sound IF carrier level and the other at the video IF carrier frequency. Up to this point the receivers are identical, but now they begin to differ. In the conventional circuit, the carriers are separated and fed to respective IF amplifiers. In effect, there are separate video and FM receivers in such a system.

IF Stages Combined

In the intercarrier circuit, however, the functions of the separate video and sound IF stages are combined in a common IF amplifying system. The result is generally a saving of at least one IF stage. The reduction in cost thus ob-

tained is the first important advantage of the system. In this type of circuit, the audio and video IF signals are fed to the same IF amplifier, the bandwidth of which is 6 Mc—wide enough to pass the two carriers (which are 4.5 Mc apart) and their sidebands. The signals are amplified together and fed to the second detector, which also has a broader bandwidth than conventional receivers so as to accept both carriers.

In some commercial receivers the carriers are separated at this point. In others, they remain together and are amplified in the video stages. In either case the method of separation is the same. The detected video signal, which is amplitude modulated, is fed directly to the picture tube. The frequency modulated sound signal produces no signal at the output of the AM second detector and no audio signal appears at the output or at the grid of the picture tube. It would

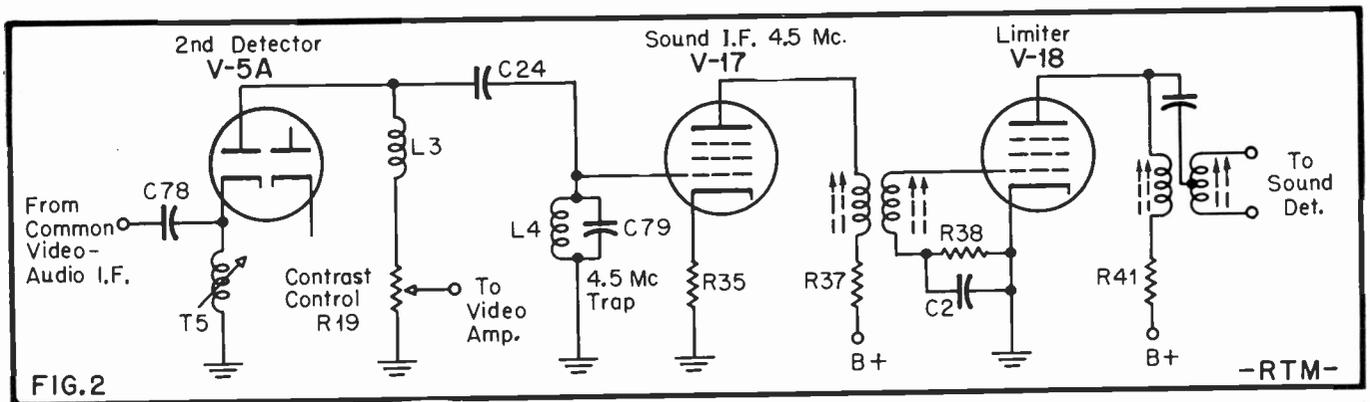


FIG. 2
Sound trap take-off circuit in the Emerson Model 609 intercarrier sound receiver. The video signal is taken from the output of V_{5A} and is coupled to the contrast control, R_{19} , through the inductance L_3 . The signal reaches the grid of the picture tube through the video amplifiers. A 4.5 Mc beat signal is developed across the trap L_4C_{79} and fed

to the sound IF stage V_{17} . The center frequency of this stage is tuned to 4.5 Mc. The limiter stage, V_{18} , is included in this circuit to eliminate any AM remaining in the signal. The output of V_{18} is a constant-amplitude FM signal, with sidebands of plus and minus 25 Kc. Detection of the audio information is done by a discriminator stage.

appear that the audio signal is lost in this system, but it is here that the function of the intercarrier sound system takes place and accounts for the name of this type of circuit.

Two Frequencies Beat

Because the second detector is a non-linear circuit element, like a mixer, the audio and video frequencies passing through it beat with each other just as the RF and local oscillator signals beat in a mixer to produce an IF value. The FM sound IF carrier acts as a local oscillator for the AM video IF carrier and produces a beat signal which is exactly 4.5 Mc, the difference frequency between the two carriers. The 4.5 Mc signal is frequency modulated and contains all the audio information. It has a slight amount of amplitude modulation due to the AM character of the video IF carrier, but this small amount of AM on the 4.5 Mc FM signal is later eliminated in a limiter stage or by a

ratio detector.

The second important advantage of the intercarrier sound system can now be appreciated. The sound and picture carriers of each television channel are exactly 4.5 Mc apart, this difference frequency being precisely controlled at the transmitter according to requirements set down by the FCC. Therefore in an intercarrier receiver there can be no drift between the picture and sound signals. When the set is tuned in for best picture, the sound will always be exactly 4.5 Mc away. Should the picture carrier drift because of the change in frequency of the local oscillator, the sound carrier will drift an equal amount. The precise 4.5 Mc beat frequency will still appear at the output of the second detector and the audio signal will not be distorted.

Trap Keeps Beat from CRT

Returning to the block diagram of the intercarrier receiver, note that a 4.5 Mc

trap prevents the beat signal from going to the grid of the picture tube. At the same time the 4.5 Mc FM voltage developed across this trap is fed to a 4.5 Mc sound IF amplifier, and then to an FM detector, audio amplifier and loud-speaker. The design of the 4.5 Mc trap and the point in the circuit at which it is inserted to separate the beat signal varies in commercial receivers.

Commercial Circuits

Fig. 2 shows the 4.5 Mc sound trap take-off circuit in the Emerson Model 609. The video signal is obtained at the output of the second detector, V_{5A} , and is coupled through L_3 to the contrast control R_{19} . The signal is then fed to the video amplifiers and finally to the grid of the picture tube. At the same time, a 4.5 Mc beat signal is developed across the parallel-tuned trap made up of L_4 and C_{79} . This audio signal is fed to an IF amplifier stage, V_{17} , whose center frequency is tuned to 4.5 Mc. In

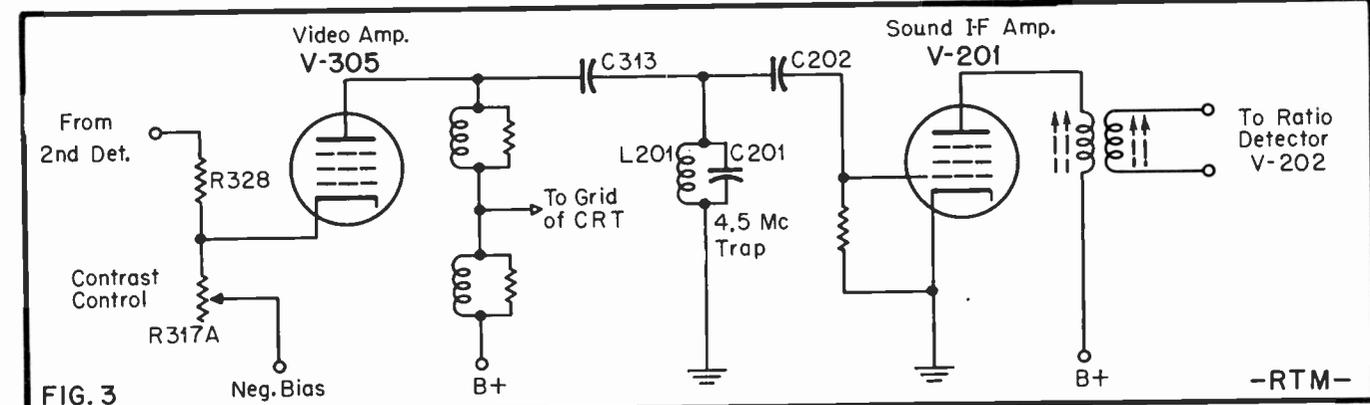


FIG. 3
Sound separation circuit in Admiral 20XI receiver. Unlike the circuit shown above, this variation takes the sound signal from the video amplifier rather than from the second detector. A strong 4.5 Mc signal in the trap $L_{201}C_{201}$ is fed to the sound IF stage V_{201} . The trap also prevents any of the 4.5 Mc signal from working into the grid of the

picture tube. One of the possible reductions in the number of stages, the elimination of the limiter, is utilized here, since the extra amplification of the sound signal by the video amplifier gives a sufficiently strong signal to cause limiting action in the radio detector stage.

this receiver a limiter stage, V_{18} , is included to remove any remaining AM. The output of V_{18} is a constant amplitude FM signal with a center frequency of 4.5 Mc and sidebands of ± 25 Kc containing the audio information. The FM signal is detected in a discriminator circuit and is passed on to the audio amplifier.

In the Admiral 20X1 receiver, the signal take-off is from the video amplifier stage rather than from the second detector. As shown in Fig. 3, the 4.5 Mc trap C_{201} - L_{201} is connected to the plate of the video amplifier, V_{305} , through capacitor C_{313} . A strong 4.5 Mc signal is developed across the trap and is fed to V_{201} , a 4.5 Mc IF amplifier. By virtue of its position in the circuit, the sound trap also prevents any 4.5 Mc signal from passing on to the grid of the picture tube. The output of V_{201} is fed to V_{202} , a ratio detector. Because of the additional amplification of the 4.5 Mc audio signal which is obtained in the video amplifier and the use of a ratio detector, no limiter is required in this circuit. The 4.5 Mc signal is sufficiently strong to cause limiting action under most conditions in the ratio detector circuit.

Limiter Usually Omitted

In the foregoing circuits, one receiver employed a limiter and the other did not. Since one of the advantages of using intercarrier sound systems is to reduce the number of stages, and hence the cost of the receiver, the limiter is usually eliminated. The question arises as to when a limiter is necessary in such a system. Actually the use of a limiter is optional and depends on how the circuit has been designed. If the video IF carrier is amplified sufficiently so that it is much greater than the sound IF carrier before the two beat with each other in the second detector, practically no amplitude modulation occurs on the 4.5 Mc FM sound carrier, even though the video carrier is amplitude modulated.

This is because of the heterodyne characteristic that when two RF signals are mixed with each other, the resultant beat signal has an amplitude equal to that of the smaller signal and a frequency equal to the difference.

Since only the FM sound signal is varying in frequency while the video signal is of constant frequency, the resultant 4.5 Mc is also frequency modu-

lated and contains the audio information. By keeping the sound IF signal very small as compared to the video IF signal, the resultant beat has the amplitude of the original sound IF signal and contains very little of the amplitude modulation of the video carrier. If the receiver is designed so that there is practically no AM in the 4.5 Mc signal, the small amount which is present can usually be eliminated by a discriminator or ratio detector. If the AM is too great, then a limiter is employed.

Curve Shapes Important

The relative amplitudes of the sound and picture carriers are controlled, before they are mixed, by the shape of the IF response curve. It is important when aligning an intercarrier receiver that the response curve of the combined video and sound IF amplifiers agree closely with that called for by the manufacturer. The response curve of a typical intercarrier sound receiver is shown in Fig. 4. Curve A shows that there is a small

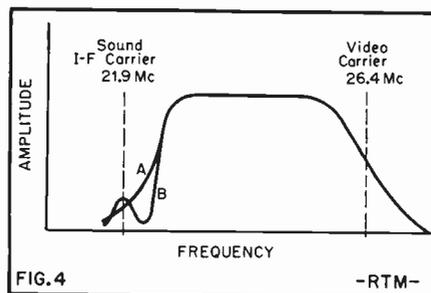


FIG. 4 Modified IF response curve of typical intercarrier receiver.

amount of signal response at the sound carrier frequency. On the other hand, note the large amplitude of the video IF carrier at the "50 per cent down" point on the right side of the curve. When tuning the IF amplifiers, the bandwidth of the response curve is increased only slightly more than in conventional IF systems in order to produce a small amount of signal at the sound IF carrier level. The only disadvantage of a response giving this curve is that it is not symmetrical around the sound IF point, so that slope-detection of the FM signal occurs and results in slight distortion of the sound. This is overcome by tuning the sound traps in the common IF amplifier so that there is a maximum dip slightly above the sound IF value. This results in curve B, which has a small peak centered around the sound IF carrier. This peak is sufficiently broad to pass the 25Kc sidebands of

the FM signal uniformly. No slope-detection occurs and the amplitude of the sound signal can be increased slightly more than in curve A without becoming so large, with respect to the video carrier, as to cause amplitude modulation of the 4.5 Mc signal. If the amplifiers are tuned according to curve B, a stronger sound signal can be obtained with no additional distortion.

Qualities of System

When properly designed, an intercarrier receiver has the previously mentioned advantages of lower cost, freedom from oscillator drift, and simplified tuning. The simplified tuning comes with the elimination, in many receivers, of a fine tuning control which is incorporated to adjust for oscillator drift.

The intercarrier system also has disadvantages, however. Since it depends upon the beating of a video carrier with an audio carrier in order to produce a 4.5 Mc signal, it cannot be used in TV receivers which use the TV sound circuit for reception of the FM band. When receiving only an FM station, there is no video carrier to beat with, and no 4.5 Mc sound signal is produced.

Two other disadvantages of the system are due to faulty transmission of TV stations. It is very difficult to control the carrier frequency of an AM transmitter so as to prevent all shifting in phase or frequency. This shifting is more pronounced on the high-band television channels than the lower ones. Any frequency or phase shift of the video carrier that occurs does not affect the performance of receivers employing conventional sound systems because the video detector responds only to amplitude and not to frequency changes. With intercarrier sound, the phase or frequency modulation of the video carrier adds an undesired frequency component to the 4.5 Mc beat signal and distorts the sound.

Overmodulation Produces Buzz

According to standard FCC practices, the video signal is supposed to modulate the RF carrier to a maximum of 15 per cent. Very often, however, a station will overmodulate the carrier, particularly when a bright scene produces large amplitude video signals. During the time that the video carrier is over modulated,

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Some Tips on a Ticklish Job:

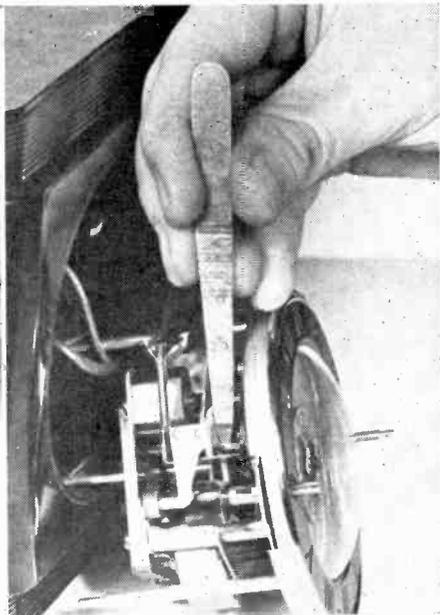
ALARM CLOCK RADIO SERVICE

by HARRY F. LEEPER

WHEN you have to repair an alarm-clock radio, you're faced with an entirely different problem, in most cases, than with an ordinary radio, because the trouble very often lies in the clock mechanism or wiring, rather than in the radio circuits you are most familiar with.

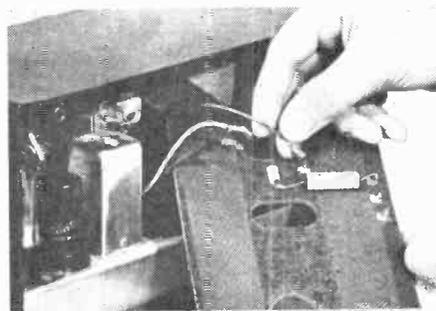
You don't need to take a course in clockmaking, though, to be able to fix these sets. All you need is common sense, and careful attention to what you're doing.

The first thing to look for when the clock hands move normally, but don't



A common clock radio item, a knob that screws onto the shaft, is shown at left. Filing switch contacts with a fingernail file (right) will often cure set difficulties. In removing clock-radio set back (below) watch out that leads to the built-in antenna are replaced in correct order. Best procedure is to make a note of which wire goes to each tie-point.

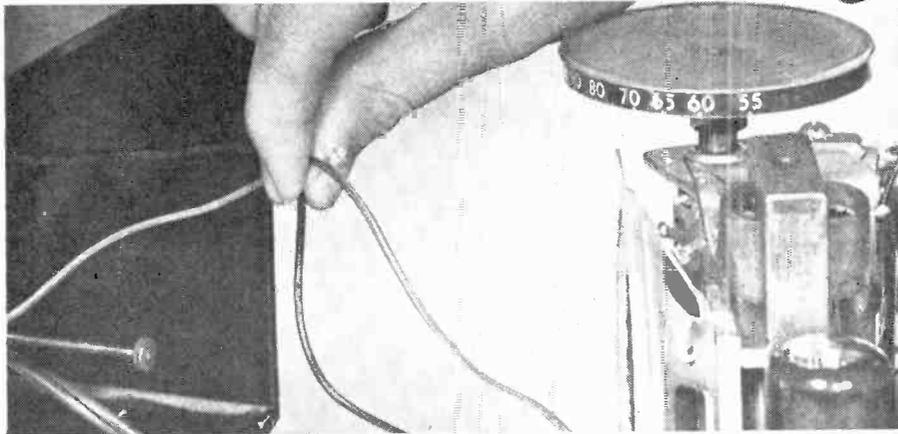
close the radio power circuit, is trouble in the clock switch. Since this switch is mounted in a cam arrangement, there



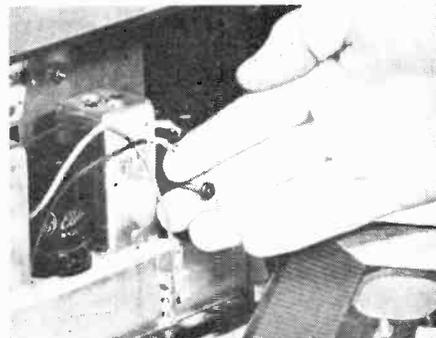
are several ways of attacking the problem. One is to loosen the wires leading to the switch and short them to-

gether. The trouble may simply be a little dirt or grease on the contact points. If that's all it is, cleaning the points with a fingernail file will probably do the trick.

In all work on clock radios, extreme care must be taken in removing the mechanism from the cabinet. On the model shown, for instance (a G-E Model 60) the upper knob of the clock is unscrewed, not pulled off in the usual way. At the rear of the set, it is best to make sure you note the lead connections on the cabinet back when you remove it, to make sure they are replaced in the same way. In replacing the back, avoid tangling any wires with the long shaft of the clock-setting mechanism.



In many cases, difficulty in the clock-radio's cam switching device can be detected by shorting the leads from the switch. In G-E Model 60 pictured, clock housing is removed from the rear, while clock mechanism comes out from the front of the set. Individual replacement parts for clock motor are available.



Clock setting shaft protrudes from rear of cabinet. Care must be taken not to tangle the shaft with wires in the rear of the set when replacing the antenna back.

The Smallest Service Business Can Afford

SIX million television sets have made changes. They have changed America's living room, her school room and the neighborhood theater. They have also changed the serviceman. Like it or not, he has had to become a bigger businessman. To service TV, his inventory has become greater, his equipment more costly, his know-how broader, his charges higher. His profits should have grown, too. If they haven't, he must look at his *advertising program* or lack of it.

With the stakes higher, the service-

tising program is the toughest. It's the decision to *spend for advertising*. Apparently, this money could go into the serviceman's pocket as profit. He asks himself, "Why throw it away on advertising?" To answer this question, the serviceman need only look at his successful business neighbors—large and small, and—by all means—at his competitors. Are they spending for advertising? Is it paying off? The answer in 90 per cent of the cases will be "Absolutely!"

year's campaign for my \$300?" Typical store identification and "point of sale" advertising for a service dealer should include seasonal window and counter displays and window streamers, permanent store signs and daily eye-catchers such as thermometers and clocks advertising "Radio and Television Service." Most important items in a serviceman's advertising campaign are the means of directly soliciting prospects' business—advertising postal cards and mailing pieces, mailed regularly. In addition, a well-rounded program should include telephone directory listing, occasional newspaper ads and a varied group of sales promoting reminders, such as stationery, bill heads, business cards, service stickers, advertising match books, and door-knob hangers.

GOOD ADVERTISING

By FREDERICK P. HARVEY

*Supervisor of Advertising and Sales Promotion
Radio Tube Division, Sylvania Electric Products, Inc.*

man can no longer afford to advertise only when business is bad or when the whim strikes him. His program must be planned on an annual basis. Its cost must bear a direct relationship to desired service business. It must consider *all* the practical means of reaching prospects in his trading area—store identification material, newspaper and telephone directory ads, direct mail postal cards and mailing pieces, radio spot announcements, and the many forms of "reminder" sales promotion.

Consistent Program Needed

All of these means must be used by the service dealer constantly and consistently to accumulate an impression on the prospect's mind. If such an advertising program is planned and executed properly, there should be no need for frantic last-minute selling at that critical moment when the prospect's set needs service. The impression—and the sale—will be made . . . and so will the profit.

The first step in drawing up an adver-

Five Percent of Gross

Both large corporations and smaller businesses spend varying amounts on their advertising programs, depending on their marketing problems. A good rule of thumb for the radio or television serviceman, however, is, "Set aside five per cent of your gross service income for advertising." Suppose a service shop owner plans to do a \$6,000 service business during the coming year. Five per cent of that is \$300—let him set it aside on paper and budget his program around that figure.

Once the decision to spend that \$300 has been made, the big problem is "How can I plan a complete and adequate

For an average radio serviceman to try to design and have printed even a minute fraction of this material would consume more than his \$300 overnight.

Manufacturers Help

Fortunately, the manufacturers of radio and television parts are as interested as the serviceman himself in increasing radio and television service business. It means more sales for them. Consequently, many of them, particularly radio tube manufacturers, maintain a complete line of expertly-created and proven advertising material for the service dealer, buying it in huge quantities and reselling it to the serviceman at cost

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Producers Are Anxious To Supply Your Ad Needs

SERVICEMEN NEED PROTECTION



Have You Insured for a Debt-free Hole in the Ground? How Would Your Business Stand If Hit by a Lawsuit?

By HERBERT S. BRIER

IT is safe to say that the majority of independent radio men carry insurance, but too often it is inadequate to cover losses; here are some of the problems involved in insuring a radio business against all potential dangers.

Because insurance agents are naturally more aggressive in selling where their commissions are larger, and because a lender usually insists that property offered as security for a loan be insured, larger shops and those with mortgages or them are generally better insured than the rest. Now, if your shop is small, you aren't any better able to afford an uninsured loss, nor are all your insurance problems solved simply because part of your mortgage payment is earmarked "insurance." Some insurance could leave you with a debt-free hole in the ground after a fire or tornado!

Two Types of Coverage

For our purposes, insurance may be divided into two broad general classifications. First, there is insurance against actual property loss, as from fire, windstorm, boiler explosion, automobile collision, and dishonesty, as well as health, accident, and life insurance. Secondly, there is liability insurance in all its forms, including workmen's compensation insurance.

Fire Insurance, the basic property insurance, protects against losses from fire and lightning, and from losses caused by water and other agents used in fighting

fires. An extended coverage endorsement adds protection against losses caused by smoke from faulty heating and cooking devices with chimneys, windstorm, tornado, cyclone, explosion (except from boilers and pressure or vacuum devices), hail, vehicles other than your own, aircraft, riot, and riot attending strike.

While buildings and their contents are considered separate matters for insurance, and take different rates, they should be insured in the same policy for maximum convenience and protection whenever possible. In fact, there are so many advantages to combining all insurance coverages in as few policies as possible, preferably all written by the same company, that insurance authorities recommend it emphatically. They frown especially on the common practice of buying insurance in dabs and dabs, here and there, in an effort to make every agent a customer in return, because it makes it almost impossible to obtain satisfactory insurance protection at reasonable cost. Insurance adjusters report that they are forced to disallow many claims under such circumstances, simply because the several policies duplicate protection on some risks and give none at all on others.

Unfortunately, not all insurance companies sell all types of insurance, and it is sometimes inconvenient to place all insurance on the same property with one company. When this is true, it is extremely important to describe the property exactly the same way in all policies and to make very sure that a policy ex-

clusion does not eliminate the coverage for which you purchased the insurance.

Proper Amount of Insurance

Equally important in buying property insurance is buying the proper amount. Buying too much is a waste of money, because no company will pay more than the property value after a loss, no matter how heavily the property was insured. On the other hand, neither will it pay more than the face value of the policy no matter how great the loss, and it may pay less. Paying less than the loss even when the policy is apparently sufficient may come about through a *co-insurance* clause in the policy. This clause, which is optional in many policies, gives the insured a reduced rate, in return for which he agrees to carry insurance equal to a certain percentage (usually 80 per cent) of the property value. If, however, he carries less than the required percentage, *he is not fully covered on any loss.*

Company May Pay Only Part

Suppose a property is valued at \$5,000 and is insured under an 80 per cent co-insurance policy. If the policy is for \$4,000 (80 per cent of \$5,000), all losses up to the face value of the policy will be covered fully. But if the policy is for \$3,000 (75 per cent of that required by the co-insurance clause), the company will pay only 75 per cent of any loss, with a maximum of \$3,000.

As insurance values are computed at the time of loss, a co-insurance clause is as potentially as dangerous as making a

habit of working on 5,000-volt power supplies with the power on. Because the risk is so great and the saving so small, co-insurance is never recommended by responsible authorities for policies under about \$2,500. The clause may save appreciable amounts on large policies, but should only be accepted with a definite plan for adjusting the insurance periodically to fit changing property values. Buildings are, of course, valued by appraisal, while stock held for resale, such as parts, radios and television sets, are valued at wholesale cost. Tools and service equipment are valued at their replacement cost, modified by depreciation.

Exclusions

All insurance policies are subject to "exclusions." Two of the more important ones to radio men holding standard fire insurance policies are that all of them exclude losses caused by artificially-generated electrical currents, unless a fire results, and most of them exclude damages to external radio and TV antennas, unless specifically mentioned in the policy.

Vandalism and malicious mischief insurance may be added to Extended Coverage Fire Insurance. Its importance depends a great deal on your shop's location and on the experience of neighboring merchants. As with all extended coverage endorsements, it must be written on the same items and for the same amounts as the basic policy to be fully effective.

Boiler and pressure heating plant insurance covers most of the explosion hazards excluded in regular fire insurance. Sometimes more important than the actual insurance is the boiler inspection service that goes along with it.

Business Interruption Policy

Business interruption insurance, as usually written, pays a stipulated sum per day when fire or other loss makes business impossible. This protection might save your business after a serious loss.

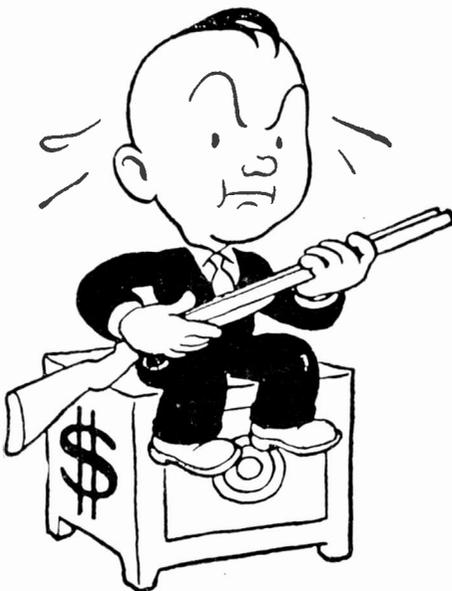
Improvements and betterments insurance protects a tenant's investment in "permanent" improvements he makes in rented property. When possible, it is usually cheaper to obtain it as part of the owner's building insurance, rather than under the more expensive contents insurance.

There is a saving of 10 to 20 per cent

in buying insurance for three to five years; however, most casualty policies specify that when a large claim is paid, the insurance is automatically reduced by the same amount. Consequently, when the property is repaired, it must be re-insured to value, thereby nullifying the saving gained by the long-term purchase. Unearned premium insurance will protect you against such loss, but also reduces the savings obtained by buying long-term insurance.

Floater

Often considered "luxury" insurance, because their premium rates are quite high, and because similar, although more



If you have plenty of spare time, don't need sleep, and have a well-oiled shotgun, you may not need burglary insurance.

restricted, protection can usually be added to other casualty policies by paying a small additional premium, "floaters" give broad protection to certain types of property. Probably of the greatest interest to radio men are scheduled property floaters, repair charge floaters, and deferred payment floaters. The first one affords almost "all risk" coverage to specified items, such as test equipment and meters, when taken from the shop, a time when standard policies do not apply. The latter two protect against loss through failure of customers to pay legitimate bills.

Automobile collision insurance is so clearly a necessity to anyone operating automobiles or trucks that it is unnecessary to dwell on it.

Dishonesty Insurance

Losses through dishonesty can be just as disastrous as "destruction" losses. Luckily, they are also eligible for insurance protection. Outside losses are covered by various forms of robbery, burglary, theft, and open stock insurance; and employee dishonesty is covered by fidelity bonds.

Fidelity bonds are usually available in two forms. In one, each employee is bonded, and in the other, one bond covers all employees. With individual position bonds, losses caused by the collusion of several employees are covered up to the sum of their bonds. But with one blanket bond, protection extends only to the amount of the bond, no matter how large the loss or how many are involved; but in that case it is not necessary to prove that a bonded employee is guilty. An indirect advantage of bonding employees is that insurance companies investigate those they bond and may save you from hiring a dishonest one.

Comprehensive Policies

Here again it is courting disaster to spread dishonesty insurance among several companies, because *robbery*, *burglary*, and *theft* are rather closely defined in insurance policies. The least that should be done is buy all dishonesty protection from one company. It is even better to buy "Three-D," or comprehensive dishonesty, disappearance, and destruction insurance, which provides the broadest protection in the field, and then to add any additional coverages that are necessary.

Liability Insurance

In some ways, liability insurance is the most important insurance of all to a business firm. Casualty losses are definitely limited to the monetary value of the property, but it is anybody's guess how much a jury will award in a liability case.

Suppose a customer trips over a loose board in the shop and wrenches her back, or a lad watching you repairing receivers sticks his hand into a television set and is severely burned, or a toddler pulls a receiver on top of himself. There is a good chance that suit will be brought in each accident, but premises and operations liability insurance will protect you.

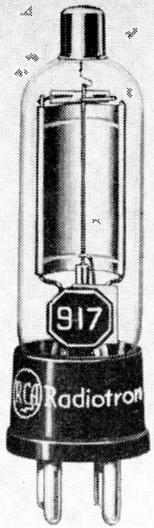
While working in a customer's home,

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Tubes, Circuits, and Operation of

Photoelectric Devices

By ED BUKSTEIN



INDUSTRIAL electronics has long outgrown its role of "little brother" to radio and television. It is a growing, expanding field involving an ever increasing variety of applications, and employing an ever increasing number of technicians. The radio servicing profession has begun to realize that the repair of industrial electronic devices constitutes a good sideline, if not steady work. By acquainting himself with certain basic circuits and concepts, the radio technician can avail himself of this source of income.

Phototubes Versatile

Of the many types of electronic devices which industry has adapted to its needs, photoelectric equipment is perhaps the most representative and the most widely employed. Photoelectric devices are used in a large variety of applications. They are used to count and inspect objects passing on a conveyor belt and to reject automatically those items which do not meet with the standard. They are used for color matching operations in the paint and textile industries. They serve as burglar alarms and smoke and fire detectors. They control the filling of bottles to a predetermined level and then inspect filled bottles for the presence of foreign particles. They control the register of successive colors in multicolor printing presses. They judge the temperature of a flame or a heated body by its color.

So flexible in application are these photoelectric devices, that industrial plants, factories and shops use them in an almost endless variety of tasks. Most of these plants and factories do not employ full-time electronic technicians. Instead, they relegate the repair and maintenance of the equipment to local radio servicemen.

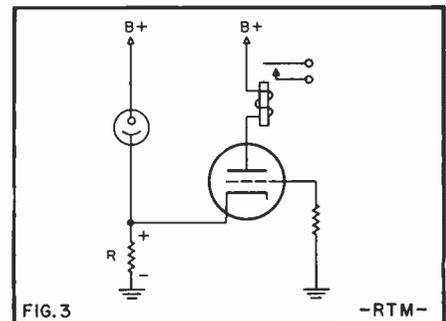
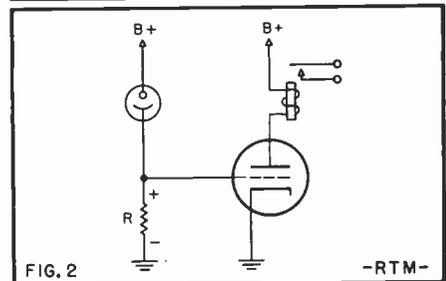
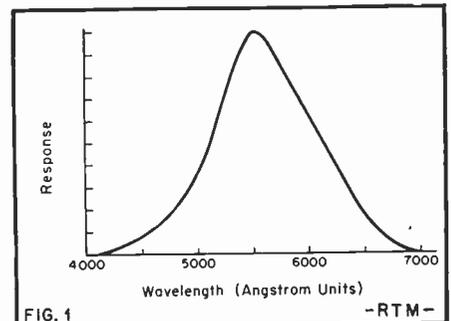
Perhaps no other member of the large family of electron tubes has received as much publicity as the phototube. Newspapers and magazines have referred to photoelectric equipment by such sensational names as the magic eye, the electric eye and black light. The public has been fascinated by the "miracle" of the drinking fountain which automatically turns itself on when the drinker approaches, and doors which mysteriously open when approached.

Design of Tubes

As shown in the illustration, the physical structure of the phototube is extremely simple. Basically, it is a diode employing a photocathode rather than the conventional thermionic cathode. The photocathode is a curved metal plate covered with some photosensitive chemical such as sodium, barium, rubidium or caesium. The property of these chemicals is that they will emit electrons when light is allowed to fall upon them.

The anode of the phototube is gen-

erally a straight piece of wire. In some tubes, this wire is bent around to form



Spectral sensitivity curve (Fig. 1) of a typical phototube. Basic operating circuits of photoelectric control devices, for closing relay when light is turned on and when light is cut off are shown in Figs. 2 and 3.

a loop. The anode is made physically small so that it will not obstruct the passage of light to the cathode. In practice, a positive potential is applied to the anode so that it will attract the electrons emitted when light strikes the cathode. This flow of photocurrent produces an I_R drop in the load resistor connected in series with it. The I_R drop is then fed into an amplifier or other circuit and ultimately operates a motor, relay, alarm bell or other device.

Light Wave Measurements

Light is a form of electromagnetic radiation similar in nature to heat, radio waves, X-rays, and cosmic rays, differing only in wavelength. The wavelength of light is extremely short as compared to the length of radio waves, and the meter is too large for a practical unit of light measurement. The micron, one millionth of a meter, is a unit of measurement often used to indicate the wavelength of light. The millimicron, one thousandth of a micron, and the Angstrom unit are also employed here. The Angstrom unit equals one-tenth of a millimicron.

The range of visible light extends from 4000 to 7000 Angstrom units. When a wavelength of 7000 Angstrom units acts upon the eye, a red color is seen. A wavelength of 4000 Angstrom units is perceived as violet. All other color wavelengths are between these two limits. Ultraviolet rays are shorter than 4000 Angstrom units and cannot be seen. Infra-red rays are longer than 7000 Angstrom units, and are also invisible.

Color Sensitivity

The phototube is sensitive not only to variations of light intensity but also to color variations. Some tubes are most sensitive to blue-violet, while other have their peak response in the red region of the spectrum. The color sensitivity of a phototube depends upon the type of chemical used as the cathode. A curve showing the relative response of a typical phototube to various wavelengths, the spectral sensitivity curve, is shown in Fig. 1. By proper choice of cathode chemicals and the use of filters, the spectral response of the phototube may be made to approach that of the human eye.

Some phototubes are designed to respond to ultraviolet or to infra-red radiations. Since these wavelengths cannot be seen by the eye, the term black light

has been used to describe them. In some applications, burglar alarms for instance, it is desirable to use a phototube which will respond to the black light wavelengths. No burglar is sufficiently stupid to deliberately walk through a visible beam of light. By using an ultraviolet light source, this difficulty is overcome; the burglar cannot see the beam, but the phototube can. A phototube designed to respond to ultraviolet radiation uses a quartz or Corex window. These materials readily pass ultraviolet rays, while ordinary glass does not.

Gas-filled Photo Tubes

Some phototubes are vacuum types, while others are gas filled. In the gas filled phototube, electrons traveling toward the anode collide with gas molecules and knock electrons out of these molecules. The additional electrons from the gas contribute to the total plate current. This increase of current, called *gas amplification*, makes the tube more sensitive. The degree of ionization in the gas phototube must be limited, however. Under no circumstances must a glow discharge be allowed to occur. When glow discharge takes place, the cathode is subjected to bombardment by positive ions, and the photosensitive coating may be damaged. To prevent glow discharge, the plate voltage is generally kept to a low value (about 90 volts). The rate of response of a gas phototube is limited. If the light variations are too rapid, the tube may be unable to follow the variations. This limiting feature of the gas phototube is called *fatigue*. The vacuum phototube has a more linear response than the gas type and is therefore employed when extremely accurate measurements are required.

Control Circuits

The circuit in Fig. 2 illustrates the basic operating principle of photoelectric control devices. When light falls upon the photocathode, electrons are emitted and attracted to the anode. The flow of current through R produces a voltage drop which makes the triode grid positive. The resultant increase of triode plate current causes the relay to close. This circuit arrangement is useful for opening garage doors at the approach of auto headlight, turning off the light of a billboard at sunrise, and similar applications. If a milliammeter is included in the triode plate cir-

cuit, it becomes useful for light measurement applications.

In the circuit shown in Fig. 2, the relay closes when light falls upon the phototube. Fig. 3 shows a circuit in which the relay closes when the light is cut off. Here, the cathode of the triode is held at a positive potential as long as photocurrent flows through R. A positive voltage on the cathode is, of course, equivalent to a negative voltage on the grid. When the light beam is interrupted, no photocurrent flows through R, and the positive potential is removed from the cathode of the triode. The resultant increase of triode plate current causes the relay to close. This circuit arrangement is useful for burglar alarms, drinking fountains, counters.

When the circuit is to be used as a counter, for instance, counting the number of automobiles passing over a bridge, the relay is replaced by an electro-mechanical counter. The counter consists of an electromagnet which operates a series of numbered disks similar to the mileage indicator used in automobiles.

Use of Thyatron

In commercial photoelectric controls, a gas filled triode is generally used instead of a vacuum triode. The gas filled tube, the thyatron, is comparable to a switch. It has only two modes of operation: on and off. Its plate current is either zero or maximum; there are no intermediate points. In the vacuum triode, a gradual change in grid voltage produces a gradual change in plate current. In the thyatron, as the grid voltage is varied, the plate current remains at zero until a critical value of grid voltage is reached. At this time, the tube fires (ionizes) and plate current jumps to its maximum value. The thyatron and phototube constitute a sensitive combination for light controlled devices. Types 2050, 2051 and 2D21 are small thyatrons commonly used in photoelectric devices.

AC Operation

Commercial photoelectric devices are small and compact. This compactness is achieved by operating the device directly from AC power lines without the use of rectifiers. A representative circuit is shown in Fig. 4. As long as no

→ to page 20



Fix on the Facts

by Frye

Don't Keep Your Customers Guessing—It's Good Policy To Let Them Know What's Up

WE are always being told what the radio serviceman should know, but believe me it does not hurt anything if the customer knows a few things, too! Evidence to the contrary, the average "unreasonable" customer is not that way simply because he enjoys being mean and cantankerous. He expects and demands the impossible only because he does not realize that it *is* impossible.

Long ago I found that the time spent in explaining a few of the electronic facts of life to my customers paid good dividends. They were pleased and flattered at the attention given them, and their increased knowledge of what they had a right to expect in the way of performance from their radio or TV sets made my work easier. Naturally, there are certain special bits of information that I try, sooner or later, to put across to all of my customers. Some of the items are offered casually when a repaired set is returned; other bits are given in answer to questions.

Here are some of the points I try to make clear:

A radio or television receiver *has more than one condenser*. In fact, even a small set will have twenty or thirty condensers that vary in size and shape from a postage stamp to a good-sized flash-hundred or more of these capacitors, light; and a typical TV set will have a

When this fact is understood, it follows that when a customer's receiver needs a new condenser, that does not necessarily mean that the one that was replaced last month or last year has gone bad again.

Running a radio at full volume will not appreciably increase its consumption of electricity, but such a practice is hard on the speaker cone, some of the tubes and condensers—and, above all, on one's neighborhood popularity! Better tone quality is usually had at a lower volume level.

Grounding a radio antenna, or depending upon the lightning arrester on the TV lead-in for complete protection against damage, is poor practice. Much damage is done to these sets by surges, that come in over the power line and jump the switch contacts, even if the set is turned off. Pulling the plug from the wall socket during thunderstorms is the only safe insurance against this type of damage.

Keep Children Away from Sets

Allowing small children to play with radios and record-changers is fine for the service business, but it is quite hard on the customer's pocketbook. No delicate electronic device will stay in repair long when subjected to the treatment that children give it, and the little folks are absolute poison to complicated automatic record-changer mechanisms. Any radioman who has recovered toys, erector-set parts, etc., from the cabinets of receivers knows that children will poke and probe about the insides of a set in a manner never anticipated by either the manufacturer or the underwriters. There is a very live danger that such behavior will result in serious, or

even fatal burns or shocks. Many cheaper and safer toys are to be had.

Loop Antennas Directional

All loop antennas are directional. It is absolutely amazing how a customer will use a set for years and never discover that the built-in loop will receive a given station much better in one position than it will in another. A demonstration of this fact with the customer's own set will quite often amaze and delight him. It is always pleasant to discover you have a feature that you didn't know you had.

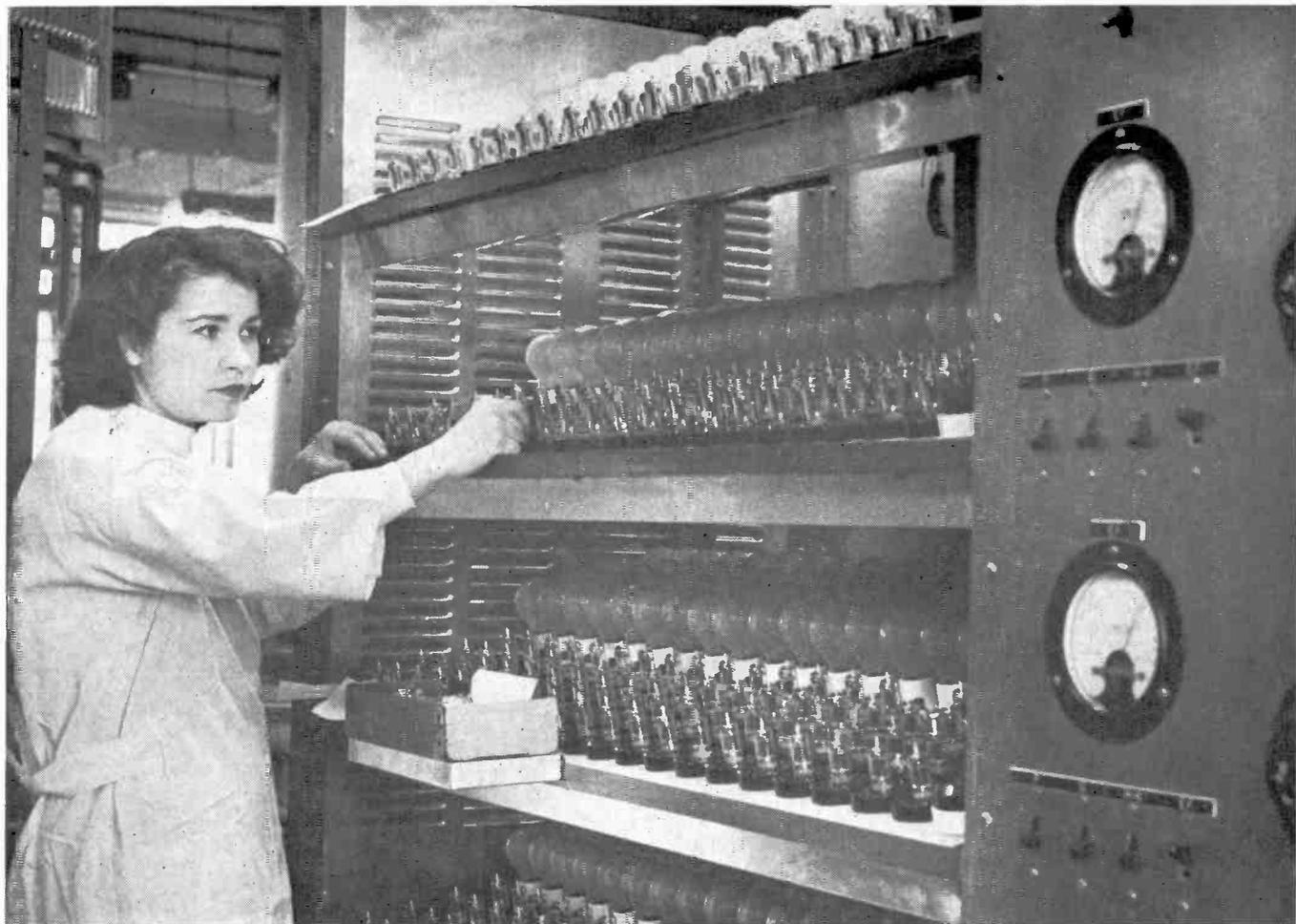
AM Static Almost Inevitable

There is no way to remove summer static from an AM set—all claims of "static-remover" salesmen to the contrary. A strong local station will usually override all but the worst of static, though, and a good FM receiver will provide static-free reception of the FM stations in the listening area.

Some fading at night from a distant station is to be expected, but if a radio fades in the daytime, there is something the matter with it. This is true of the AM band only.

When two stations share the same frequency and come in with about equal strength, there is little that a serviceman can do to the receiver that will help. Sometimes using the directional properties of the loop antenna will get rid of interference from the unwanted station. When interference is had between stations on adjacent channels, though, this is a different matter. Realignment

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A pretty tube plant worker watches miniatures being aged on a rack. The ageing process, which stabilizes tube characteristics and eliminates

rejects, is a necessary step in tube production. After tubes have been aged, they are ready to be packed and shipped.

MINIATURES BY THE MILLIONS

SHOTS OF RECEIVING TUBE PLANT SHOW HOW RECORD PRODUCTION FIGURES ARE ACHIEVED

THE many stages in the production of miniature receiving tubes, from tiny, almost invisible elements and glass envelope blanks, through to complete, delicate instruments, ready for use in hundreds of different applications, involve an incredible amount of fine assembly work, welding, heating, checking, and other operations.

In the RCA plant illustrated, where part of this year's record tube production originates, miniatures of many types are put together, subjected to tapping, boiling, and electronic measurement tests before they are shipped to customers.

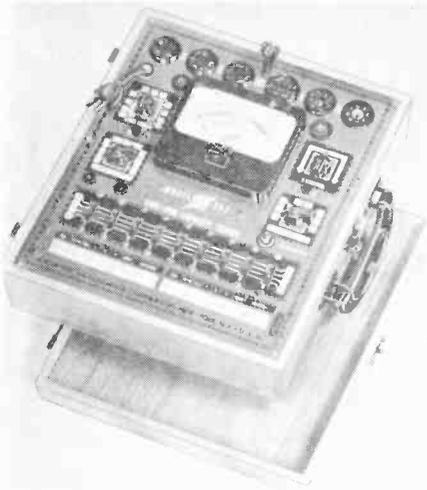
Starting with tube pins, fused into glass base slugs, the tubes are built up from the bottom before they are slipped into their envelopes. Dozens of different processes on each element of the tube are completed before the many pieces can be assembled in "cage" form on the pin leads. Filaments or heaters are put in first, then cathodes, grids, plates, and shields are carefully put into position on mica spacers and secured with miniature spotwelding equipment.

In most of the operations, work is so delicate that only women have enough manual dexterity to assemble the pieces without smashing the fragile components. Filament and grid wires, often so fine that they are scarcely visible, must not be even slightly out of line, or the tubes will not measure up to specifications.

Finally, the cages on their bases are inserted into glass envelopes. In automatic operations, bases are fused to the sides of the tubes, the air is exhausted, and exhaust pipes, at the top of most miniatures, are sealed off. Then capacitances, transconductances, and other values are accurately checked, the tubes are aged, other checks are made, and the finished products are at last prepared for delivery.

TUBE TESTER

A new tube-ohm-capacity tester has been put out by Electronic Measurements Corp., it was announced recently. The tester will handle all tubes, including noval and subminiature types, the announcement said. Testing is done by the standard emission method. Individual sockets for each type of tube base are included, permitting testing of cold cathode, magic eye, voltage regulator, and ballast tubes.



A flexible switching arrangement, a fine voltage control compensating for variations between 105 and 135 volts, and a check for shorts and leakages are provided, the report said.

Resistance can be checked to four megohms, and capacity from .01 to 1 mfd.

The tester is housed in a hand-rubbed oak case with a removable hinged lid and a carrying handle. The built-in roll chart is protected by non-breakable transparent plastic.

— RTM —

NEW 300-OHM LINE TYPE

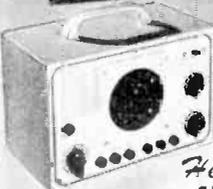
A new variation in antenna feed line, the "Goodline Airlead," incorporates removal of 80 per cent of the plastic web



between the conductors of a 300-ohm line. The manufacturer, Don Good, Inc., states that the line permits maximum practical transfer of the signal from the

→ to page 21

Anyone Can build a HEATHKIT



**Heathkit
SIGNAL
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\$24.50



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**Heathkit
BATTERY
ELIMINATOR KIT**
\$22.50

Heathkits are beautiful factory engineered quality service instruments supplied unassembled. The builder not only saves the assembly labor cost but learns a great deal about the construction and features of the instrument. This knowledge aids materially in the use and maintenance of the equipment. Heathkits are ideal for and used by leading universities and schools throughout the United States. Each kit is complete with cabinet, 110V 60 cycle transformer (except Handitester), all tubes, coils assembled and calibrated, panel all ready printed, chassis all punched, formed and plated, every part supplied. Each kit is provided with detailed instruction manual for assembly and use. Heathkits provide the perfect solution to the problem of affording complete service equipment on a limited budget. The basic three instruments — an Oscilloscope, Vacuum Tube Voltmeter, and Signal Generator can be purchased in Heathkits for \$83.50, about the cost of a factory-built VTVM alone. Write for complete catalog



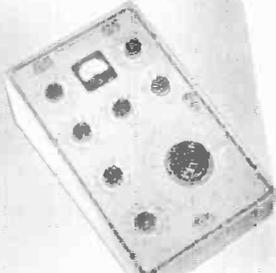
**Heathkit
CONDENSER
CHECKER KIT** \$19.50



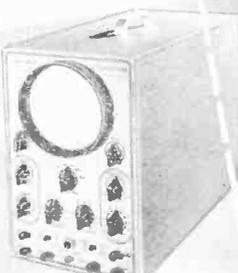
**Heathkit
AUDIO GEN.
KIT** \$34.50



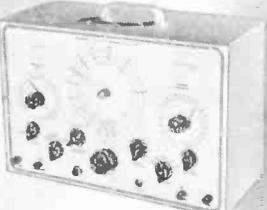
**Heathkit
ELECTRONIC
SWITCH KIT**
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BRIDGE KIT** \$69.50



**Heathkit 5"
OSCILLOSCOPE
KIT**
\$39.50



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R. F. SIGNAL
GEN. KIT . . .**
\$19.50



**Heathkit
HANDITESTER
KIT . . .** \$13.50

HEATH COMPANY

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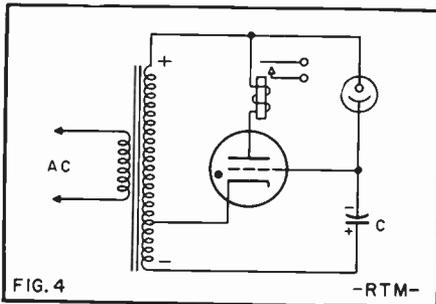
EXPORT DEPT. 13 E. 40th ST. NEW YORK 16, N.Y. • CABLE ARLAB - N.Y.

Operation of Photoelectric Devices

→ from page 14

light reaches the phototube, the thyatron remains cut-off by the negative voltage of capacitor C. If light is now allowed to reach the phototube, it conducts current and discharges C, the thyatron fires and the relay closes. The relay may have normally-open or normally-closed contacts, depending upon the application. In one case, the action will occur when light reaches the phototube, and in the other case when the light is interrupted.

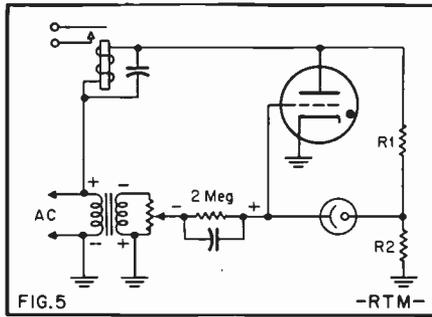
Since the circuit of Fig. 4 is AC operated, it will be operative only during the time when the transformer polarity is as shown in the diagram. During the opposite alternations, the transformer applies a negative voltage to the plate of the thyatron and causes it to deionize.



Basic AC operated photoelectric circuit. Capacitor, C, prevents relay chattering when polarity is reversed.

ize. Since the thyatron deionizes during each negative alternation, the relay tends to chatter. To prevent such chattering, a capacitor of about 10 or 20 microfarads is connected across the relay winding. On the positive alternations, when the thyatron is ionized, this capacitor charges. On the negative alternations, the charged capacitor keeps the relay closed.

Another circuit arrangement for an AC operated photoelectric control is shown in Fig. 5. In this circuit, R_1 and



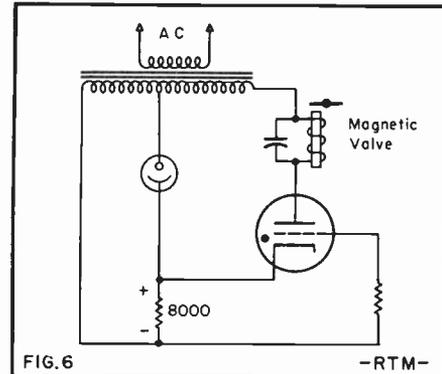
AC operated circuit with voltage divider supplying anode voltages for phototube.

R_2 serve as a voltage divider to supply plate voltage for the phototube. When the polarity of the transformer is as shown in the diagram, the grid of the thyatron is negative, preventing ionization. If light is now allowed to reach the phototube, the flow of photocurrent produces an I_R drop across the 2 megohm resistor. This I_R drop makes the thyatron grid positive, ionization

occurs and the relay closes. Here again, the relay may have either normally-closed or normally-open contacts. The capacitor across the relay winding prevents chattering.

Flame-failure Control

Fig. 6 shows the circuit diagram of a flame-failure control. Flame-failure controls are used in conjunction with gas and oil heating installations. A pilot light burner is kept lit in the furnace at



Flame-failure control circuit. Phototube "watches" pilot light of gas or oil burner and closes valve if pilot is extinguished, preventing dangerous accumulation of unignited fuel.

all times. When the temperature drops, a thermostatic control element turns on the fuel supply. If, by accident, the pilot burner should become extinguished, unignited fuel would accumulate in the furnace. To prevent this dangerous situ-

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Intercarrier Sound System for TV

→ from page 8

there is no video IF signal to beat with the sound IF signal in the second detector. If this overmodulation persists for a period of time, it will occur during each field, or at a repetition rate of 60 cps. The momentary hole in the video carrier results in a 60-cycle component being added to the 4.5 Mc signal. It is demodulated by the FM detector along with the audio signal and is the familiar 60-cycle buzz that is characteristic of intercarrier receivers. The buzz is not the fault of the receiver and cannot be eliminated. The fault lies with the transmitter and becomes especially noticeable when maximum white is transmitted. On the other hand, certain misadjustments of the receiver will cause the buzz even when the transmission is not faulty.

If more than one station is in operation at the time, tuning in another station will indicate where the fault lies. If only one station is on the air, a check with another receiver known to be operating properly should be made.

Other Causes of Buzz

Should the fault prove to be in the receiver, one or more of the following misadjustments can cause buzz:

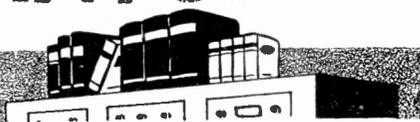
1. The fine-tuning control, if present, may be misadjusted or the contrast control may be advanced too far, thus overloading the video amplifier. The fine-tuning control should be tuned for the most clearly defined picture with best sound. If no definite sound peak is obtainable with rotation of the fine-tuning control, it may be necessary to realign the oscillator. Overloading caused by improper setting of the contrast control should normally disappear when the con-

trol is backed off.

2. If buzz remains after adjustment of the oscillator, it may be due to misalignment of the ratio detector so that it does not provide sufficient limiting action. It may be necessary to realign the oscillator after the ratio detector is adjusted. If oscillator adjustment is required for other channels, it will not be necessary to readjust the FM ratio detector after having correctly made the alignment on one channel.

3. Buzz is also caused by overloading of the video stages with a very strong television signal. Insertion of an attenuation pad between the transmission line and the receiver should decrease the incoming signal strength to normal level.

4. Another fault in the receiver which may cause buzz is misalignment of the common IF stages so that too large a sound IF carrier beats with the video IF carrier.



RCA TUBE BOOKLET

A completely revised edition of the tube characteristics booklet, "RCA receiving tubes for AM, FM, and Television Broadcast," is now available from RCA tube distributors. Labeled the "most comprehensive tube reference of its kind" by RCA spokesmen, the booklet covers more than 450 RCA receiving tubes and kinescopes, including 50 new tube types.

Characteristics and base diagrams are given, as well as a comprehensive classification chart, which permits quick determination of type designations, according to tube functions and filament or heater voltages. Miniature and octal tube types having similar characteristics and similar heater or filament voltages are grouped together on the chart.

— RTM —

SPEAKER CATALOG

A new radio and television replacement speaker catalog has been put out by Cletron. It lists a complete line of auto, TV, radio, and other speakers in both PM and dynamic types. Cletron weatherproof speakers and TV lightning arresters are also included. Available free from Bill Allen, Cleveland Electronics, Inc., 6611 Euclid Ave., Cleveland 3, Ohio.

— RTM —

BASE DIAGRAM GUIDE

The "Triple Pindex," a quick-reference guide to tube base diagrams, is in a new edition, it has been announced by RCA's tube department, publishers of the guide.

The booklet, which consists of three identical sections bound next to each other, each containing base diagrams of more than 600 types, including 60 picture tubes, permits simultaneous study of two or three base diagrams at once. To use the booklet, the serviceman looks up the diagram of one tube in the top section. If he wishes to compare the diagram of another tube, he locates it in the second section. A third diagram in the bottom section may be examined without turning pages of the other two divisions.

VIBRATOR BOOK

An entirely new replacement guide for vibrators in communications equipment is now available on request from the James Vibrapowr Co., 3224 W. Armitage Ave., Chicago. The guide shows the correct type of all vibrators in nationally-used communications equipment, it is stated by the company.

— RTM —

ANTENNA CATALOG

A new catalog of 12 pages on television antennas and accessories has been put out by JFD. The book covers many different models and types of antennas, installation hardware, lightning arresters, ground and guy wires, test leads, knobs and other parts and tools. It is available from JFD Manufacturing Co., 6101 16th Ave., Brooklyn, N. Y., or from the company's representatives and distributors.

Operation of Photoelectric Devices

→ from page 20

ation, a phototube is used to "watch" the pilot burner. In Fig. 6, as long as the pilot burner is lit photocurrent will flow and an I_R drop is produced across the 8000 ohm resistor. This I_R drop makes the thyatron cathode positive and prevents ionization. If the pilot burner should become extinguished, no I_R drop would be produced across the 8000 ohm resistor and the thyatron would ionize. In this application, a magnetic valve is used in place of a relay. When the thyatron ionizes, the valve closes and shuts off the fuel supply.

The circuits shown in Figures 2, 3, 4, 5 and 6 are the basic photoelectric control circuits. Variations and modifications may be encountered in practice, but the basic operating principles are identical. If these circuits are properly understood, the variations can be coped with successfully.

the maintenance mill

by Ghysels



"Since we've adopted this new test pattern we haven't heard a single complaint about servicemen's alignment of receivers!"

NEWSLETTER

→ from page 3

ZENITH SILENCED ON PHONEVISION

a video voltage. The system makes possible a relatively compact, inexpensive TV camera for closed-circuit applications. It is reported to be especially suitable for record identification systems.

Zenith Radio Corporation, now working on Phonevision, stated to the FCC that it will not promote the subscription television system until the federal group okays such activity. The company also said it will withdraw the "contingent credit plan" begun this spring in an effort to induce other set makers to include in their new sets "decoder" units for the Phonevision system. The Zenith action brought approval by the FCC of an application for extra time to test Phonevision.

30-INCH, DIRECT VIEW TV RECEIVER PRODUCED

What is said to be the largest direct-view TV receiver, a 30-inch DuMont, was introduced last month. The company, catering to what it calls "public taste," includes no set in the new fall line smaller than 17 inches. The huge 30-inch set is designed for use mostly in group TV showings, it was announced, but will also be suitable for home use.

NEW LINE OF TV SETS SOLD OUT IN 20 HRS.

The complete production of the 1951 line of Sylvania TV receivers was sold out last month within 20 hours, giving some indication of the constantly increasing popularity of television. The big sale was made at the Chicago convention of the National Association of Music Merchants.

FM NOT DYING YET, NAB TO MAKE STUDY

"The obituary supposedly written for FM can very definitely be considered unlikely ever to reach print," said Ben Strouse, chairman of the National Association of Broadcasters' FM committee recently. Strouse based his statement on what he called an "amazing response" to an invitation sent to all broadcasters and their legal representatives to attend the meeting of the FM committee in Washington this month. The conference will discuss many problems of FM broadcasting.

PRICES RISE 10 PC. ON DUMONT SETS

Price increases of 10 percent on current models of DuMont television sets will go into effect September 1. In announcing the price hike, Walter L. Stickel, national sales manager for DuMont receivers, said "rather critical shortages" in components are responsible. Increased government buying of component parts, he said, forces further restrictions.

FIRST-HALF REPORT ON RADIO, TV PRODUCTION

TV sales, continuing to boom, have fulfilled most expectations for the first half of the year. RTMA compilations of figures show that member companies produced nearly 2,500,000 sets during the six-month period. More than five million radio sets were manufactured during the period, including home radios, portables, and auto sets.

NEW RECORD SET IN TUBE OUTPUT

RTMA reports that receiver tube sales for the first half of 1950 were more than double those of the corresponding period in 1949. The output for January-June of this year, a record, was more than 170 million tubes.

MOVIES SUFFERING FROM TV SUCCESS

Television may not kill the movie industry, but if a recent Chicago survey shows the trend correctly, TV will at least cripple motion picture business. The sample, taken by an advertising agency in 600 Chicago homes, shows that in the families interviewed, TV cut adult movie attendance by three-fourths, and reduced child attendance by more than half. According to the agency's report, box-office loss is about \$41.20 per year per TV family. Many of the families interviewed (64 percent) said they still like movies, but would prefer to see them at home, even if they had to pay for them through a system such as Phonevision.

THE

LOUDSPEAKER

BABY those television service contracts!

They mean more than bucks in the bank today . . . they're part and parcel of your business's good will . . . they're your bulwark against future competition . . . they're your guarantee of profitable operation. In short, the service contract can be your greatest business asset next to your own technical skill.

Here's what the service contract means to you in the operation of your shop:

You know in advance how much regular work you are to handle.

You get an excellent basis for estimating required inventory.

You have working capital to buy new equipment and promote your business.

You have a guaranteed minimum income!

In the face of these facts, you can see that it's to your advantage to keep your customers happy, and to make sure you get repeat contracts. But it is too easy to slip into a habit of not keeping up your end of the bargain. And some servicemen have done just that. They already have their money for the contract in the bank—why should they knock themselves out trying to get sets repaired in a few days, the way the customers always want, or even to do a complete job at all?

The answer is simple. The radio and TV serviceman, like any other businessman, has got to think of next year's business and continuing work for years after that.

"All right," says the wise guy, "but what do I care? The war is on, millions of TV sets are being sold this year, and

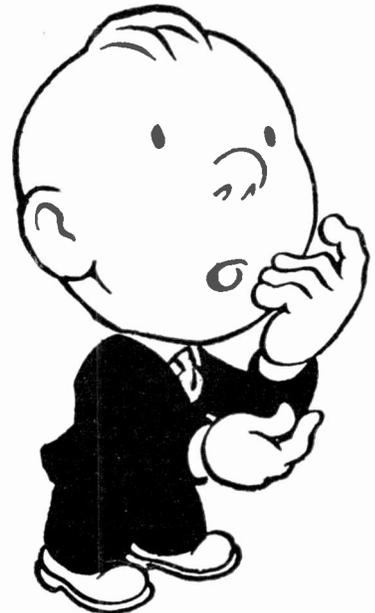
servicemen are hard to find. I'm in demand!" And so he is in demand . . . now.

But the emergency won't last forever. Even if you're doing a customer a favor by fixing his set in the near future, you have to remember that some day there will be a leveling-off, we'll return to competitive conditions, and the wise guy will be crying the blues because he can't sell service work. He probably won't even know who turned his customers against him.

We have to face the fact that no matter how much receiver sales climb, they'll eventually reach their peak. We have to realize that competition for the post-boom business began a long time ago, when radiomen new to TV found out how much more attention a TV receiver needs than a radio set does, and found out that set owners were happy to get a guarantee that for a flat rate, they wouldn't have to worry about keeping the set in shape.

When contracts for service began to be popular with consumers, of course there were chiselers who saw that the wording of the agreements could be loose, and that they didn't really have to promise much in the way of prompt service during the year, and could still get paid to provide careful attention to the receiver. Some of them, knowing that the customer nearly always has to trust the technician because he himself doesn't understand the first thing about TV operation, began to invent excuses for keeping sets in the shop for two or three months, and to forget what they advertised.

**got a
tough one?**



There's one sure way of getting an answer to your problem . . . ask somebody who knows! That's just what the new "What's Your Problem" feature is going to help you do.

Look for "What's Your Problem" . . . coming soon. It's a brand new feature that will print your problems in servicing so that the entire readership can ponder your dilemmas and work out the answers.

Cash will be given for the best answers which will appear in the issue following the publication of the problem.

You can start writing today to get your problem into an early issue of *Radio and Television Maintenance*, which will be running this feature especially geared to the technician.

Send your problems to: Problem Editor, *Radio and Television Maintenance*, P. O. Box 867, Atlantic City, N. J.

The servicemen who don't deliver what they promise in contracts, though, will run into the same trouble as tight-fisted insurance companies that don't pay off. It looks like easy money at first, but the customers will wise up after a while, and when it's too late to do anything about it, they'll find themselves without business. Don't try to get in on the "easy money." It's an easy way to lose your business! M. deA.

Good Advertising

→ from page 10

or giving it to him free. Much of this material is available with the individual service dealer's name, address and phone number prominently printed on it.

The service dealer will find that his \$300 or 5 per cent of gross sales will buy a complete and adequate advertising program if it is budgeted against a parts manufacturers' catalog of advertising aids. One tube manufacturer, Sylvania Electric Products, Inc., not only provides its radio and service dealers with a complete local advertising campaign, but backs up these campaigns with thousands of dollars of advertising in popular national magazines. These ads urging set owners to "call the dependable serviceman who displays this sign" and reproduce in the ads the store identification decals Sylvania provides free to its dealer customers.

Complete Campaign Available

Also free to dealers is a complete four-month advertising campaign con-

taining two large four-color three dimensional window displays, two four color counter cards, two large window streamers, two sets of two and four column ad mats for telephone directory and local newspaper use, sets of four different imprinted three-color advertising postal cards and four booklets of radio spot announcements. All of the material ties in with the national ads by utilizing the same Russell Patterson cartoons of humorous radio servicing situations and the same "Authorized Dealer" decals as appear in the ads. Servicemen have to pay only a penny apiece for the postage on the advertising postal cards. All the rest of the campaign material is provided free.

Utilizing such a manufacturer's offer, the \$6000 service dealer with a \$300 advertising budget for the year can circularize a mailing list of 400 prospects 12 times a year for only \$48 for the year. If he does not care to take the time to address the cards himself he can have the work done by a local typist for approximately \$5 per thousand or \$25 for the year. If the serviceman is located in a village or small city, he can buy

space to run his newspaper ads and reserve spot announcement time from local radio stations at similarly reasonable fees.

With the money remaining, the technician can again go to the parts manufacturer for business stationery at \$5 per thousand for both letterheads and envelopes; business cards at \$2 a thousand—all of which are imprinted with store name, address and phone number. He can get from many parts manufacturers or their distributors a complete professional window valance installed on all his shop windows with his own store name in permanent three-color display for \$10. He can buy three-color fluorescent hanging signs for \$7.50, electric clocks for \$9.50, metal signs for \$1.25 and uniforms, tool kits, or service kits for less than \$10.00 each. In short, he can find an answer to every one of his advertising needs at prices far below what it would cost him to do the job independently.

Thus spent, the serviceman's \$300 advertising budget will give him a complete advertising campaign expertly designed to bring him increased business.

— RTM —

Products for the Trade

→ from page 21

switch, which provides choice of pickup characteristics for crisp voice, general voice, or music.

The Synabar, a high impedance microphone, has an output level of -54 Db. The crystal element is protected with a metal seal. The unit is furnished with 20 feet of single conductor shielded cable and a concentric connector. It is available with or without an on-off switch.

— RTM —

SELF-HEALING MIDGETS

A line of molded paper tubular and electrolytic capacitors produced by the Astron Corp. includes a midget, self-healing condenser. Excess voltages will



not destroy the usefulness of the capacitors, the manufacturer reports, although the dielectric may be punctured many times. Because of its small size and low

ELECTRONICS TECHNICIANS For RADAR, COMMUNICATIONS, TELEVISION RECEIVERS

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A Radio Corporation of America Subsidiary
For U. S. and Overseas

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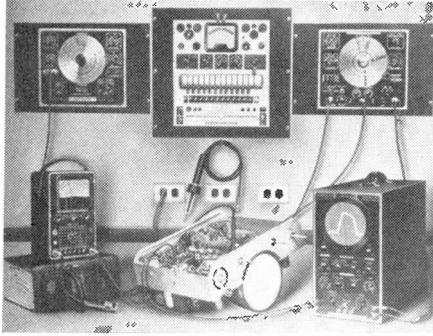
RCA SERVICE COMPANY, INC.
Camden 2, New Jersey

RF impedance, the midget type is recommended for use in high-frequency filters.

— R T M —

PANEL INSTRUMENTS

A panel-mounting combination of test instruments has been announced by Precision Apparatus Co. The group includes a signal and marker generator, a tube and battery tester and a sweep generator, set in standard matching



panels, with portable VTVM and five-inch oscilloscope, as well as a high voltage probe.

Available separately or as a set, the instruments are an outgrowth of the company's earlier set of basic instruments made for bench use.

— R T M —

Servicemen Need Protection

→ from page 12

suppose a child suddenly snatches at your soldering iron, burns himself, and drops it on the rug. In your wild lunge to catch the iron, you knock him down, shaking him up and frightening his mother. You might be sued, not only for all the actual physical losses, but also for the mother's mental anguish! This form of liability risk faces even servicemen who do no sales work, because they may be considered to be working under an implied contract, even if there is none in writing.

Product Injury Claims

It is standard practice in many businesses for dealers to execute "hold harmless" agreements with manufacturers that the manufacturer alone is responsible for any liability claims against his products. This often results in customer ill will when a valid claim is voided through legal inability to prove who is

at fault. Also, such an agreement might not protect the technician from claims arising from custom-built installations, antenna installations, or cases where manufactured equipment was modified.

A recent occurrence in the home of a friend of mine shows how a product liability claim could arise. He and some guests were watching a television movie. Suddenly, one of the children snatched up a toy hammer and began belaboring the face of the kinescope. He got in a few good wallops before the hammer was wrenched from him, and he explained that he was just "hurting the bad man." If he had smashed the tube

and been cut by flying glass, it would have posed an interesting legal question as to who was responsible. Juries are prone to decide such cases in favor of injured minors, especially when an "attractive" danger is involved.

Medical Liability Coverage

Suppose you, your shop, or your automobile is involved in an accident, and you say to the injured party, "I have liability insurance; I will take care of your doctor bills," but later the insurance adjuster determines that you were

→ to following page

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Fix on the Facts

→ from page 15

the receiver will usually eliminate the trouble.

Give Non-technical Answers

When a customer asks you a question, he is usually sincere in wanting information. To answer him in technical jargon, however, sheds no light on his ignorance. Simple analogies will do more towards making him understand than anything else.

For example, when he wants to know why none of the tubes or even the dial light will light up when only one tube is bad in his AC-DC set, I simply explain that all of the tubes and the pilot lamp are connected in series, "just like Christmas tree bulbs." Even women can grasp this fact.

When he asks why the tubes in his portable do not seem to last as long as do those in his console, I explain that the tube filaments in the portable set are made very fine, so that they will take less current from the batteries; consequently, they are more fragile. What is more, they get more jarring and bumping. Once I remind him that light bulbs in an often-moved floorlamp do not last nearly so long as those employed in fixed sockets, he quickly understands

why the same thing is true of tube filaments.

Predict Possible Troubles

Often I warn a customer in whose set I have replaced very weak filter condensers, that he may encounter a little bypass condenser trouble, although I always submit such a set to a few minutes' run on 125 line volts to try to forestall such difficulty. When he wants to know why, I explain that the new condensers have restored the "power" of the set to what it should be, just as would a new engine in an automobile. This restored power places added strain on other parts that have become weakened somewhat but have been able to stand up under the reduced power of the old filter condensers. Just as the renewed zip of the new motor might cause a breakdown of the clutch, transmission, or differential, so might the new filter condensers cause weak bypasses to show up in a few days.

This business of trying to predict possible trouble is not a bad idea. For example, experience has taught me that when a set is dropped, trouble is likely to show up in two or three of the tubes over a period of a few weeks. If you mention this when you are replacing the first tube that goes out, the customer will be in a better humor when another goes out shortly thereafter, and he will

have a higher regard for you for your ability to predict such a possibility.

Effects of Storage

In the same way, it is a good practice to mention to a customer whose set has been in storage for an extended length of time that storage is harder on a set than constant use. Tell him that moisture is the big enemy of electronic equipment and that moisture has little chance to collect in a radio that is used a lot. In a stored set, though, even if the storage place is comparatively dry, dampness can seep into the parts and cause different kinds of trouble to show up in the first few weeks after the set has been put back into use.

But there is no necessity for continuing to pile up examples. You can see, I am sure, the value of telling your customer those things that will enable him to get more out of his radio and to appreciate the honest service you give him. Being human, he will want to display his new knowledge; and the little lectures he will deliver that start, "My serviceman says—" are the very best form of advertising you can secure.

If you try this "customer-education" system, do not be surprised when an increasing number of your customers tell you: "I like to bring my work here because you will talk to a fellow."

There is a lot more to radio and TV servicing than just slinging solder!

not legally responsible for the accident and disallows any claim against the insurance company, leaving you holding the bag. If you have medical liability insurance, it will pay medical, surgical, nursing, ambulance, and even funeral expenses, up to the policy limit, of the injured party whether or not you are legally responsible for the accident. This makes it unique in being the only liability insurance that covers anything but legal liability.

These and many other liability protections may be purchased in separate policies. Many of them may be combined in a general or comprehensive liability policy. As always, the disadvantage of making individual purchases is the danger of being unprotected in borderline cases. Besides, the net cost of full protection may be much greater than in a general policy. The main difference between a *general* and a *com-*

prehensive liability policy is that the general policy covers only those liabilities specifically mentioned in the policy and no others, while a comprehensive policy covers every liability not specifically excluded. In the opinion of many, this universal coverage is necessary for true protection.

Company Assumes Suit Charges

Before discussing exclusions, one feature of liability insurance should be clarified. Probably it is most frequently valuable because the insurance company contracts to defend, in the insured's name, any liability suit, whether groundless or not, brought against him, and pay all expenses incurred in so doing. The value of this is that although the danger of large judgments is always present, many suits are decided in favor of the sued party, and the award in most of the rest is comparatively small, making the

main loss the cost of defending the suit.

Unquestionably the most important exclusion in any liability policy is the standard one that the insurance company will not pay claims for which the insured is liable under workmen's compensation laws. As every state and territory of the United States, with the exception of Mississippi, have such laws, the importance of the exclusion can be readily seen. Unfortunately, the laws are different in every state. One state requires every firm with over two employees engaged in specified businesses to carry workmen's compensation insurance, while in another only firms with over sixteen employees are affected. Because the laws are so varied, and because the courts are constantly liberalizing their interpretations of them in the employee's favor, it is imperative that all radio dealers and servicemen employing others investigate their responsibilities

under the law and purchase workmen's compensation insurance accordingly.

Health, Accident Insurance

Many insurance companies are prepared to write these forms of insurance on all employees of a firm under plans in which the employer acts as the collection agent and pays all or a part of the premium. If you are interested in one, the many factors involved in setting up such a program can only be discussed intelligently on an individual basis by you, an employee representative, and an informed insurance man.

Business Life Agreements

If your partner should suddenly die, you might be faced with the alternatives of continuing in business with his heirs, buying their interest, or selling your own, with disadvantages in every case. One use of business life insurance is to solve such problems ahead of time. Joint owners of a business set a value on each one's share of the business, and the firm buys life insurance on each for that amount. At the same time, they sign an agreement that, in the event of one's death, his share of the business will be automatically transferred to the surviving partners, and that the insurance will be paid to the deceased one's estate or specified heir.

The point where more insurance is financially impossible may easily be reached before the prudent minimum of protection has been purchased; therefore compromises must be made, but before doing so, you should check carefully to be sure you are not paying more than necessary for your insurance.

Reducing Premiums

Buying insurance for three to five years and co-insurance to reduce costs have already been mentioned, but there are other ways to reduce premiums. Eliminating a fire hazard or installing a few fire extinguishers may reduce the cost of fire insurance. A burglar alarm, better locks, or removing valuable papers and money from your shop to a bank safety deposit box may reduce dishonesty insurance premiums. Proper safety devices and a good accident prevention record will save money on workmen's compensation insurance. And accepting a higher deduction clause in automobile

→ to following page

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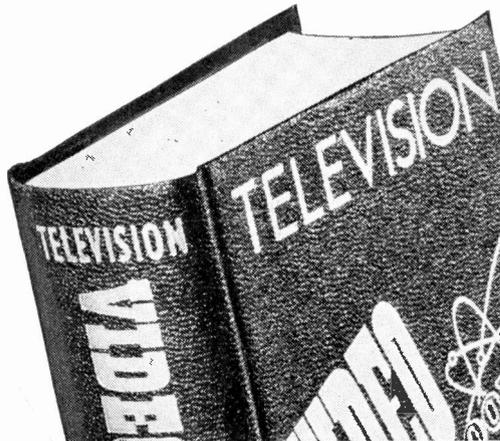
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collision, and similar policies written with a "deductible" clause will reduce premiums there, but will require you to absorb small losses yourself, while protecting you from the large losses that might otherwise be disastrous.

Any attempt to reduce premiums by willfully concealing a condition that would increase your insurance rate, however, is definitely unsafe, because it is a valid reason for the company to cancel your insurance at any time. If necessary it is better to pay the full premium or less insurance than to risk being entirely unprotected at the time of a loss, because you tried to outsmart the insurance company.

Company Type Unimportant

Whether to buy insurance from a mutual or a stock company, a large one or a small one is not, in itself, important. A company's financial rating, its premium rates, its record on claims settlements, and the experience of other merchants in your community with it are more important than size or type. In evaluating these points, several conflicting requirements must be reconciled. For example, a company with a high financial rating may charge high premiums and be notoriously harsh in its claims settlements, while another company with a slightly lower rating is more liberal in its adjustments and its premium charges. Many would consider that the second company was the one to do business with; however, it is wise to be somewhat doubtful about a company that is too generous in claims adjustments. If it pays out too many of its assets now, it may be unable to pay claims at all later! In any case, the financial rating of insurance companies can be obtained by writing to the state insurance board at your state capital.

It should be apparent that it is no more possible to buy satisfactory insurance protection by telling an agent to "Write me up a couple thousand dollars worth of insurance and send me the bill," than it is to call up your wholesaler and saying, "Sam, I'm a little short on parts. Send me a hundred dollars worth." Rather, you must choose a competent agent or broker with great care, and make him responsible for your entire insurance program. Doing so will pay dividends by giving you knowledge that your insurance will actually give you the protection you are paying for.