RADIO · TELEVISION · ELECTRONIC

SERVICE

VOL. 24

THE TECHNICAL JOURNAL OF THE TELEVISION-RADIO TRADE

JANUARY 1955

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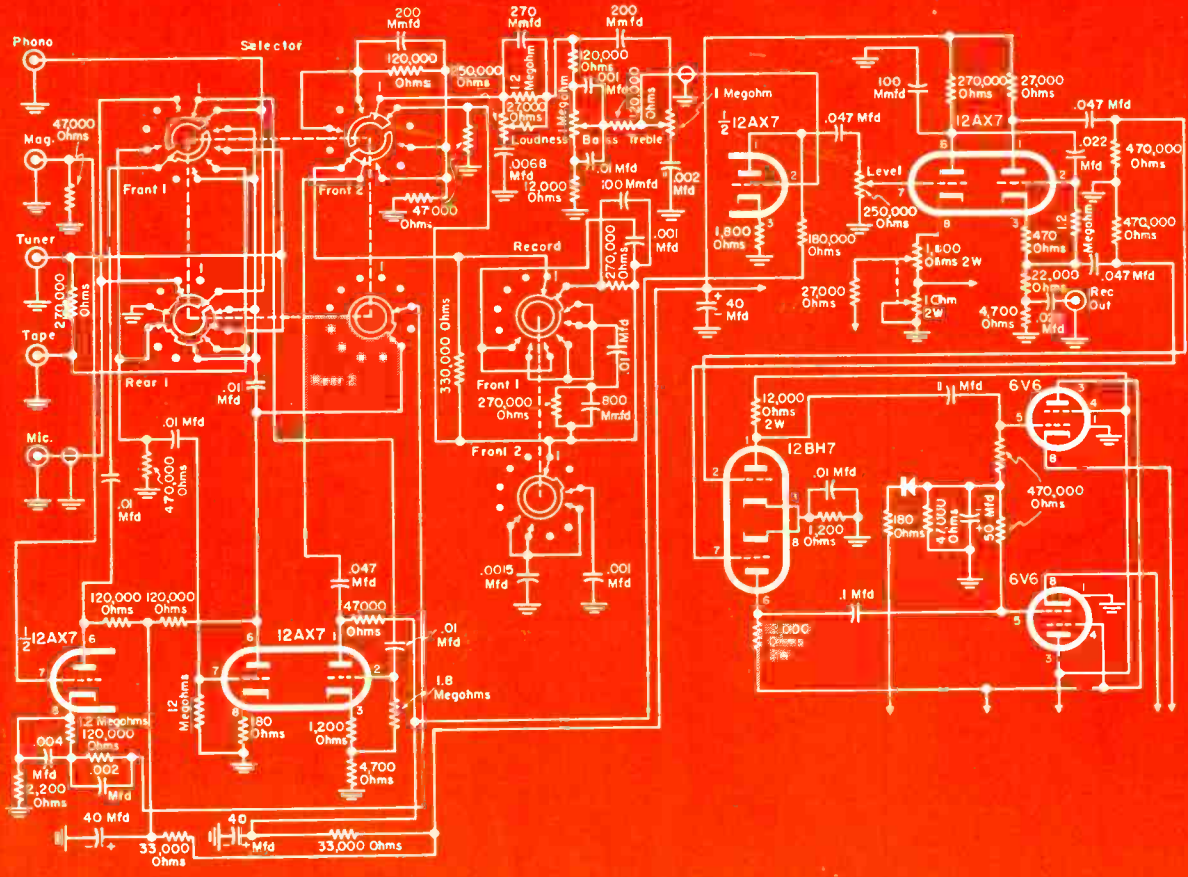

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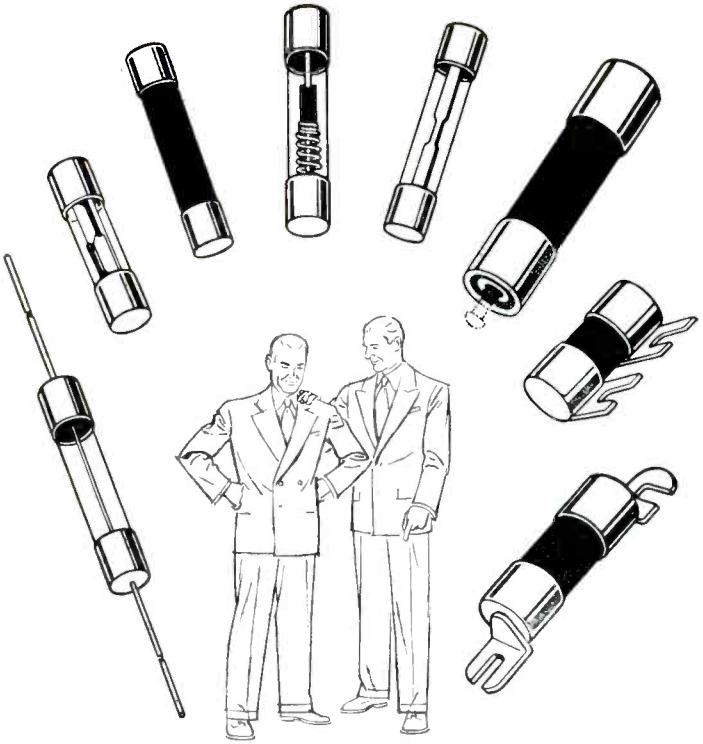

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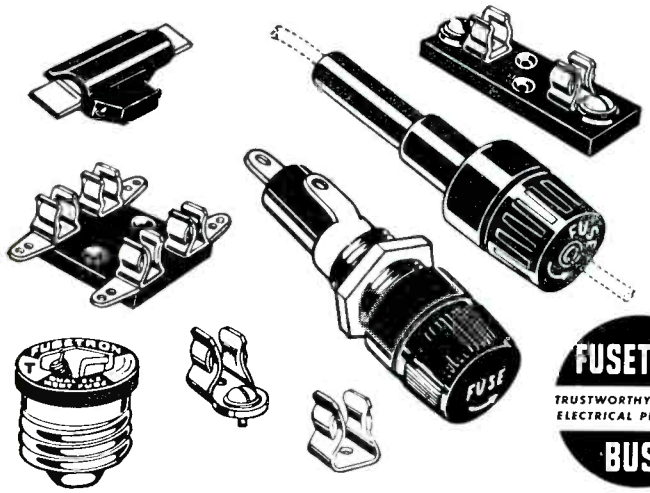

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Vol. 24, No. 1 — January, 1955

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Including SERVICE—*A Monthly Digest of Radio and Allied Maintenance*; RADIO MERCHANDISING and TELEVISION MERCHANDISING. Registered U. S. Patent Office.

Published monthly by Bryan Davis Publishing Co., Inc.

52 Vanderbilt Avenue, New York 17, N. Y. **Telephone: MUrray Hill 4-0170**

Bryan S. Davis, Pres. F. Walen, Sec. John Iraci, Adv. Mgr. A. Goebel, Cir. Mgr.

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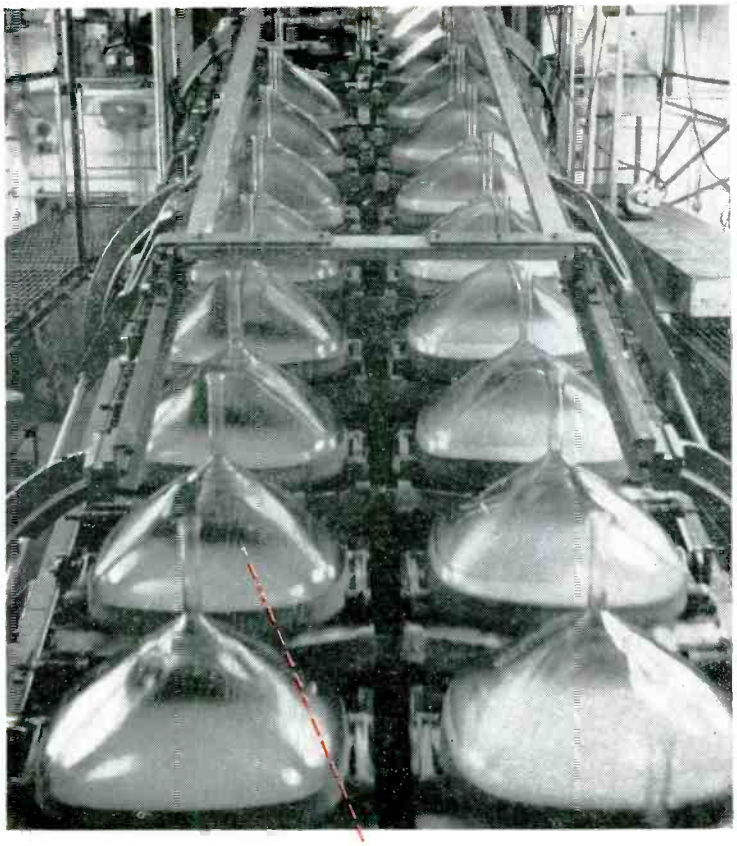
Entered as second-class matter June 14, 1932, at the Post Office at New York, N. Y., additional entry at the Post Office, Norwalk, Conn., Oct. 22, 1954, under the Act of March 3, 1879. Subscription price: $2.00 per year in the U.S.A. and Canada: 25 cents per copy. $3.00 per year in foreign countries; 35 cents per copy.



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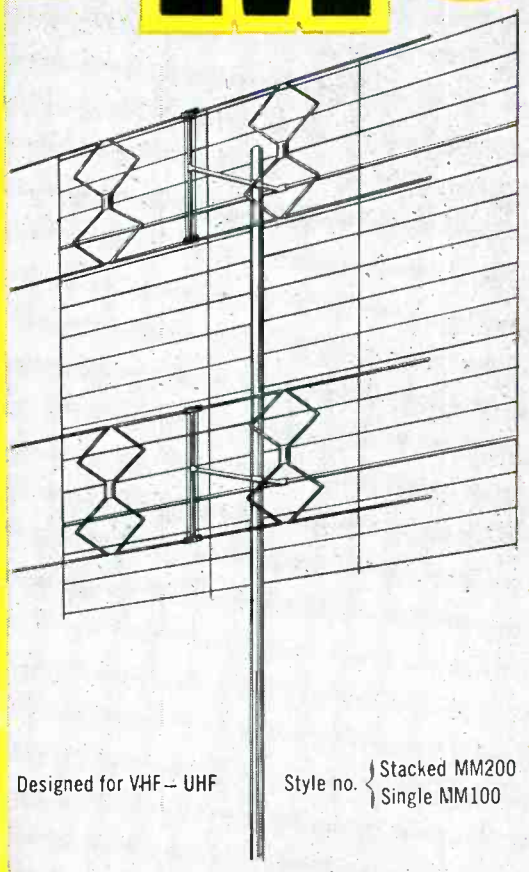

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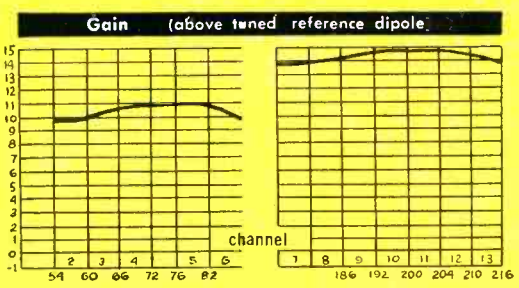

Most uniform gain response ever recorded.
Does not vary more than 1½ D.B. on any channel.
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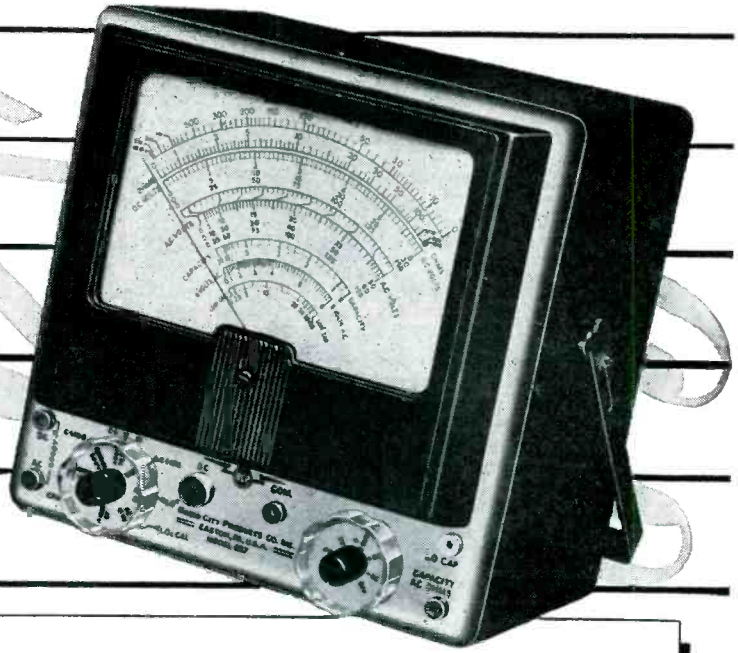
Electronic "DO-ALL" MODEL 657



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Ohmmeter: 8 ranges—0 - 1,000—10,000 - 100,000 ohms. 0—1—10—100—1,000—10,000 megohms. Center Scale 10.
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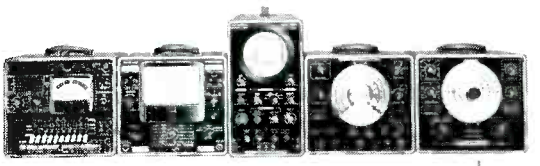

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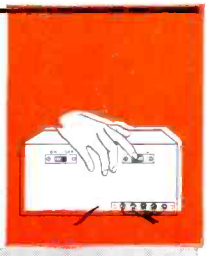

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...CULMINATION OF SIX YEARS RESEARCH AND PRODUCTION

TRIO Manufacturing Co.
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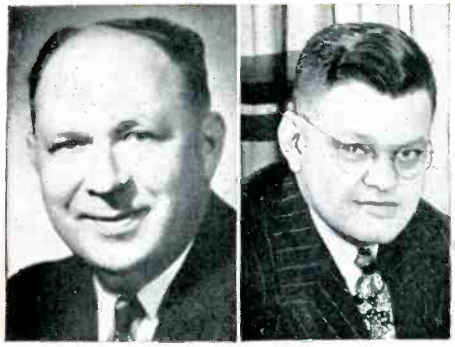

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The Door Is Wide Open

FIELD REPORTS are always impressive. Based on actual experiences, these accounts are packed with sturdy, practical information, genuinely valuable to everyone.

At this time of the year, such reports can be particularly fruitful, providing us with a blueprint for progressive planning.

Members of one association, attending their annual meeting a few weeks ago, received a dynamic illustration of this point, in the reading of a sprightly collection of on-the-scene notes, describing activities of the group's members during the year.

It was disclosed, for instance, that a number of Service Men have found that the simplified electronic organs have now become as popular as the parlor organ was in Grandma's day. No longer, they learned, is this unique instrument confined to churches, mortuaries, theatres and schools. Today, organs are being installed in a growing number of homes across the nation; and organ makers have reported that sales have been running up to forty per cent ahead of that recorded in '53. Current traffic indicates that, this year, there'll be another jump in deliveries.

The renewed interest has opened a bright new frontier for Service Men, association members were told. For in these models, which are moderately priced, and feature streamlined chord operation via compact keyboards, tones and a variety of musical instrument effects are obtained basically through a chain of oscillators whose circuitry is familiar to all. In the past, most organ makers controlled servicing through a network of factory depots. But now, the modern electronic versions and their widespread acceptance have outmoded that policy. And Service Men who can install, service and maintain these electronic gems are being sought eagerly.

The conferees were also told that closed-circuit TV, heretofore considered a complex restricted project, has now blossomed forth as a package, tailor-made for the resourceful and proficient Service Man. Thanks to the development of the vidicon, it has become possible to reduce the size of the chain and provide efficient pickup with nothing more than a compact camera, camera control and sync monitor, using ordinary lighting. Dozens of uses have been found for the new three-unit cable system, and installed on a rental or outright-sale basis, carrying in both instances a service-maintenance contract: As an audio-visual tool in schools for displaying experiments, from a central lab, to a number of rooms. For stockroom supervision, where parts handling and traffic problems can be more efficiently handled through television. In banks to check signatures. Also safety-deposit-box subscribers can be photographed and identified from a central file. In hospitals, too, for the observation of operations and as an aid in the instruction of trainees.

Community antenna system operators have also found that closed-circuit TV is an ideal medium, even though the three basics of the chain must be supplemented by slide and moving picture gear to provide a rounded service to subscribers. In one installation, in the northwest, film and live shows are being piped over the channel-4 frequency, using a pair of cameras, two projectors, a multiplexer, automatic slide machine and remote control gear. Incidentally, for redistribution, modulators are available and so designed that they can modulate the video output at the frequency of any one of the twelve commercial very high channels.

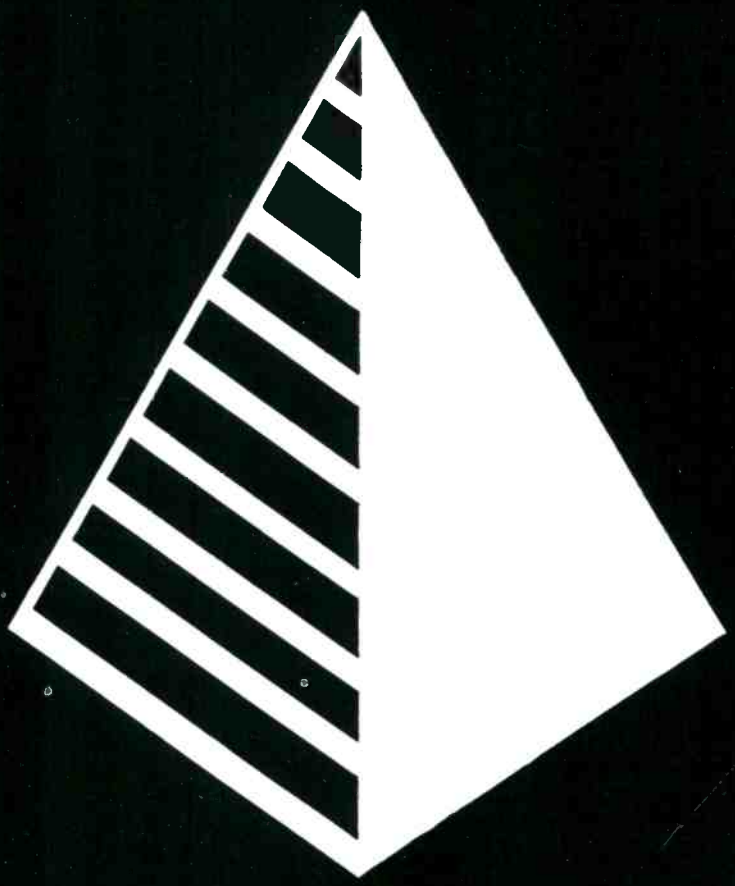
The field notes of another association member underlined the spreading popularity of drive-in shops, specially designed for those who want to bring their receivers in for repair. Wherever possible these shops provide one-day service; it was noted that receivers brought in before 10 in the morning receive priority for same-day attention, in most of the drive-ins.

The subject of tubes was highlighted in another portion of the year-end commentary. One association member revealed that he had found a dual use for tube checkers; on his bench and up front for self-service checking. To save time, those who come in to check tubes only, (and there are countless who seem to enjoy bringing in shopping bags loaded with 'em) are directed to the checker, told how the instrument works and permitted to make their own checks. This practice, it was found, saves manpower, eliminates sour debates that often follow a tube-checking session, and most important, sells tubes.

Continuing, the tube memo disclosed that picture-tube sales and installations have grown to be an extremely profitable part of the service operation. The large number of aging sets about have not only boomed the need for replacements, but modernization, too, through the use of improved, wide-angle, brighter picture types.

Concluding, the survey said that the deep interest exhibited by Service Men and intense activity of industry have truly brightened the scene, providing soaring opportunities for all. Surely, the door is wide open for those who are willing to look ahead, and take advantage of the avalanche of new ideas and trends that are being created almost daily.—L. W.

*See National Scene, this issue, pages 13 and 16, for additional year-end comments on in-the-field activities.



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SERVICE...The National Scene

BRISK PROSPECTS FORECAST FOR '55--New and improved products, across the board, coupled with continued vigor in research, development and merchandising that proved so successful during '54, should spark an outstanding sales volume in the next twelve months: So predicted the prexy of one of the nation's leading tube and set makers recently in a year-end progress report. . . . Audio, it was stressed, will continue its astonishing pace. In the next five years, the statement said, about 20-million record players of all types are expected to be produced and sold. The vastness of this potential can be gleaned from the fact that today there are more than 25-million turntables in use, many of them equipped to handle the three phono speeds, compared with only 16-million phonos in operation at the end of World War II.

ACCORDING TO THE CHIEFTAIN of the phono makers' association, '55 will be a banner year for discs, topping the $60-odd million marks reached during '53 and '54. The advent of hi-fi, he said, has made the average consumer sound conscious, while a year or two ago only enthusiasts or musicians demanded fine reproduction from recordings. Whether the new phonos are called hi-fi or not, they do offer better audio, it was noted, for reproduction fidelity has been greatly improved in all price-range models, over the past years. Competition has forced phono component makers to improve continually their product, the association head emphasized. It was felt that the recent 40% slice in disc costs was a boon that would certainly boost phono interest. Those who were reluctant to come into the hi-fi camp and discard their 78 libraries because of the replacement expense, will now think differently, it was noted. Many have begun to ask Service Men to convert their amplifiers and install new changers, pickups and speaker systems to permit use of the new wide-range recordings. . . . The growing impact of high-fi in home entertainment and recorded music, all agree, will be a major factor in stimulating industry activity during '55.

THE PICTURE TUBE front for '55 is bright indeed, too. Over 5½-million new picture tubes will be required as replacements during the year, the market barometer shows. Surveys have revealed that about one in every six sets will need a new big tube; this is based on approximately 33-million receivers now in use. . . . Besides the 5½-million replacements, industry is expected to make about 6-million more for new sets. The total 11½-million will top, it is said, the previous record year of '53 by about a half-million tubes.

THE NEW YEAR will also see the use of improved electrostatic gun picture tubes, which it is felt will lower picture tube costs and still afford the performance of the more expensive electromagnetic types. The new guns, lab experts say, offer improved picture detail and good focus across the face of the screen.

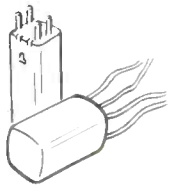
AS DISCLOSED editorially some months ago, the antenna business will also boom in '55, because of technical and mechanical obsolescence. Describing this trend in a year-end statement, the prexy of an antenna producer (with plants in upper New York State) said that older types of antennas, designed to receive a limited number of channels, will in many cases have to be replaced by all-channel antennas, so that set owners can receive all of the stations now available in their area. Furthermore, he added, more powerful types of antennas are constantly being developed, and the best antenna that was available just two or three years ago, is now far surpassed in performance by the newer types. Thus, those who have had to be content with poor or marginal pictures will now be able to expect much better reception by replacing older antennas with newer models. . . . Commenting on mechanical obsolescence, the antenna manufacturer said that because antennas are constantly exposed to the elements and their destructive forces, they eventually deteriorate to the point where picture quality is seriously affected. The replacement of these, particularly in those areas that have antennas four and five years old, was large in '54, and in '55 this will be a major source of antenna sales.

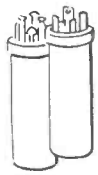

SPEAKERS

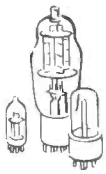

AUTO RADIO AERIALS

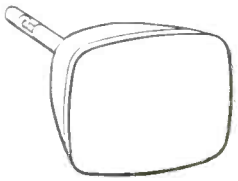

VIBRATORS

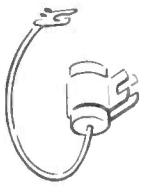

CONTROLS

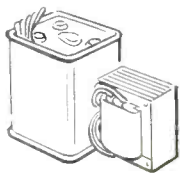

COILS


CAPACITORS


RECEIVING TUBES


PICTURE TUBES


CONDENSERS


TRANSFORMERS

SERVICE...The National Scene

COVERAGE UPPED IN CONN. BY CHANNEL-53 SATELLITE--In an official review recently submitted to the FCC, recording the results obtained from satellite station KC2XFF, retransmitting signals of WATR-TV, Waterbury, Conn., it was disclosed that the booster, a low-powered unit, provided an improvement in signal strength equivalent to that obtainable from nearly a 200-fold power increase at the main transmitter. . . . The Commission was told that although the antenna site of the mother station was on top of one of the highest peaks in the state, it was found that field strengths over much of the town of Waterbury were far below predicted values. This condition obtained because the town lies in a valley some 300 to 400 feet below the elevation of the ground. . . . The satellite provided gain increases from 64 to 80 dbu; it was estimated that areas with a population of about 50,000 profited by the signal boost. . . . The report also noted that considerable attention was paid to locating and determining the extent of the region often known as the zone of interference, or zone of confusion, and sometimes called the mush zone. This is the area where it was believed the signal strengths of the satellite and the main transmitter would be so nearly equal, that viewers would be unable to receive a clear single image picture, but instead would see two images, one displaced from the other by a distance on the screen equivalent to the difference in time between arrival of the main signal and the amplified and retransmitted one. Thus a new region would presumably be created in which reception would have been destroyed in an attempt to extend coverage to zones which hitherto had not been receiving a usable signal at all. . . . However, during the study, it was found possible to receive one clear picture from either the satellite or main transmitter. Where ghosts or a displaced image effect was noted, because the fields were about equal, rotating of the antenna solved the problem; the pattern thus fell midway between the signal sources and further movement one way or the other caused one signal to disappear. . . . Discussing channel spacing, the report said that operation of a satellite does not affect any allocations, actual or proposed, since the improvement provided by the booster is confined to a small area, of about 4 to 5 square miles, contained entirely within the normal grade A contour of the base transmitter. Therefore, it was felt, no interference can be created to other ultrahigh channels.

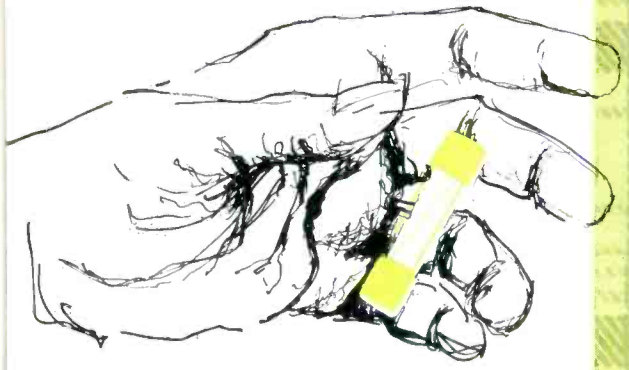
ASSOCIATIONS LAUNCH DRIVES AGAINST BAIT ADVERTISING--Three associations in N.Y., N.J. and Minn., have begun swinging away at those who continue to prey on set owners by wilfully misleading in ads, handouts and mail. . . . In Buffalo, a group is pounding hard in a newspaper campaign, asking viewers if they have been victims of hidden service costs. "To eliminate unethical advertising and TV service practices, "the association ads say, "we need your assistance. We need to hear from you; we want a complete record of your complaint. These complaints will be referred to our legal department for investigation and necessary action." . . . And in New Jersey, the push against bait spielers is being championed by the association and local trade groups. "We feel that the public should be told what it is getting when a company advertises 'free estimates'," the association president said. "There are many kinds of estimates in service work," he added, "and any advertising of "free estimates' should state exactly what is meant." . . . In Minnesota, the attack against bait peddlers has been initiated by a newly formed group who plan to invoke the state's fraudulent advertising law, established to prevent untrue, deceptive or misleading advertising. Violation of this ordinance is a misdemeanor; injunction rights are also provided.

GALA PLANS ANNOUNCED FOR NATIONAL SALUTE TO SERVICE MEN--A TV Service Men's week, paying tribute to those who install, service and maintain TV receivers, has been planned for the week of March 7 to 12. The week, registered* with the U.S. Chamber of Commerce, will be marked by an ad and promotion campaign designed to focus consumer and industry attention on the nation's Service Men. . . . Prizes totaling more than $10,000 will be awarded. . . . The event, a company spokesman said, has been established as a long-overdue gesture of appreciation to the skilled Service Men who played so vital a role in the quick transformation of TV from a lab development to a truly national service, and have continued to serve set owners so effectively.--L.W.

*By R.C.A.

THE RIGHT FUSE

AT HAND : TIME SAVED : YOUR PROFIT



YOUR BENCH BOX
For the average TV-radio service operation this box provides the perfect container for the right number of fuses you should keep on hand. Supplied to you as a service by your distributor. The cover lists the fuses most widely used in TV, radio and communications service. You or your distributor salesman can replenish your stock quickly by checking what is in the box against the listing on the lid.

Ask your distributor today for full information on these time-saving money-making service aids. Littelfuse also provides illustrated price sheets, cross-reference sheets and fuse guides. For your convenience Littelfuse products are listed and cross-referenced in all Howard Sams Photofact folders.

Des Plaines, Illinois

LITTELFUSE

FUSE DISPENSER
Ideal where your service turnover is greater. A revolving drum with self-dispensing channels to hold the individual boxes of fuses. No time lost in looking for the proper fuse—no time lost taking inventory of your stock—no time lost because you do not have the right fuse

ONE CALL KIT
One call is all. This kit provides the fuse you need for 94% of all TV fuse service calls. A real service, the perfect assortment in the perfect container for your portable tool box.

Community TV Antenna

by T. C. MASTERS

Chief Engineer

Television Signal Service

THERE ARE two major factors to consider when contemplating the installation of a community TV antenna system, and both are equally important. One revolves about the size and the economic status of the community, which determines the TV set potential and the number of possible subscribers. Obviously, a community of 500, with a low income level, would offer a small possibility of success. Item two involves the technical considerations; this includes the number of TV stations available, and their field strength. A community situated close to powerful TV stations, but completely remote from other transmitters, would also offer small possibilities because solid pictures would be available from the local telecast centers, using standard antennas.

The ideal location would be a medium-sized average-income town, located in a valley, shaded or walled in by high, nearby mountains, so that the antennas required for perfect reception would be expensive and difficult to maintain. The prospective community-antenna system operator faces the rugged task of finding the ideal location for an antenna in these signal-hole areas.

Thus, it becomes necessary to first, test for the presence of signals, and then, after the other factors have been considered, proceed with necessary legal arrangements. One must obtain a franchise from the City Council, granting the operator the exclusive right to install and maintain a *c-t* system.‡

Such a franchise must be issued before any contract can be drawn up with the local utilities, such as the light, power, and telephone companies for the use of their poles to support the network of cables needed. Most utilities have standard contracts now available covering the leasing of poles for community antenna systems.

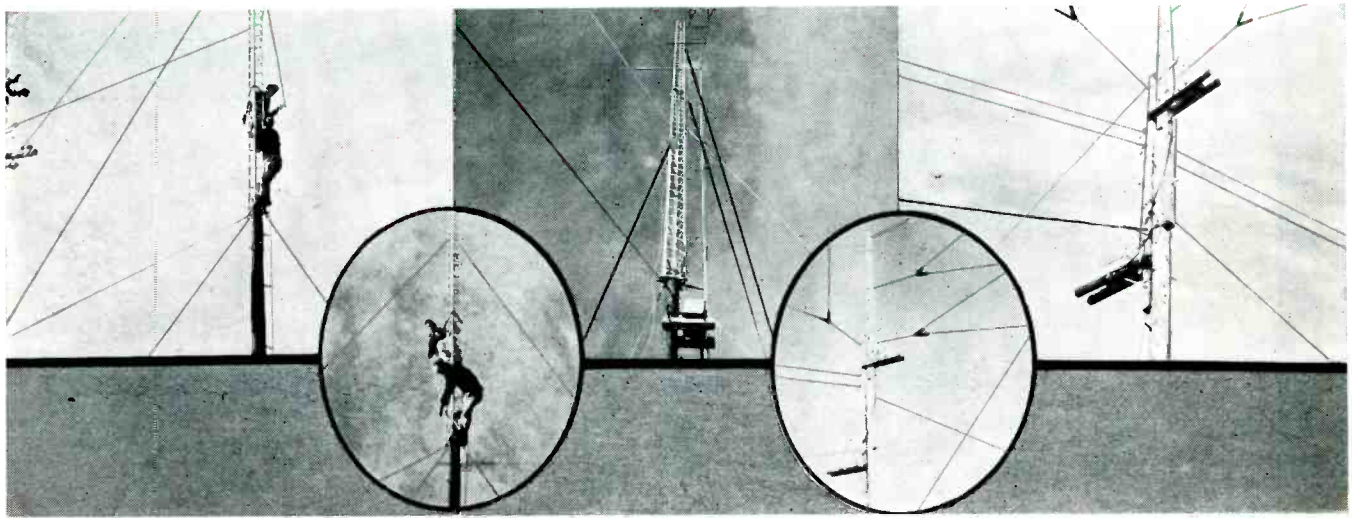
While these legal activities are underway, and by the way as in all governmental proceedings, whether Federal or municipal, action will not be swift, field testing for possible antenna sites should be carried on. This is an extremely important operation, and great care should be exercised in selecting the pickup point.

A variety of equipment should be ready for site testing: Portable antennas, usually yagis cut to each channel (with short masts), a field-strength meter, a small 7-inch TV receiver, and a power supply for these and other gear. The latter should be, preferably, a gasoline-driven *ac* generator furnishing 60-cycle *ac*, at 110 *v*. Also absolutely essential is an accurate *ac* voltmeter for checking line voltage when making measurements. Several long, heavy-duty extension cords will also be found very useful, as a number of sites are usually entirely inaccessible for motor vehicles. All of this equipment, together with climbers, ropes, tools, and other accessories, can be mounted on the back of a pickup truck, or, if the terrain warrants, in four-wheel-drive cars of the *Jeep* type. Many of the best community TV antenna sites are in very mountainous country. Therefore, it might not always be easy to transport equipment to a test site, and a detailed study of the most practical approach to the area will be necessary.

One of the handiest survey aids is a terrain *profile* map, showing the area to be covered by the system and revealing the TV stations from which signals are to be received, their air-line distance, and any obstacles to the signal path, such as mountains, forests of tall trees, or metal-sheathed silos. The ideal location would be one that is but a short distance to the town to be served, has an auto lane and offers enough height to insure a line-of-sight path for all signals that will be fed to the cable. Unfortunately, the ideal is rarely attained; therefore, each site selected must be a compromise of each of the foregoing features.

The field strength of the received signals should be a major criteria in the final selection of the site. It has been found that a minimum of six weeks of testing are required to judge accurately a site; misleading readings, caused by atmospheric conditions, *freak* weather, are avoided in such a careful check. Often, the choice of sites is narrowed down to two or three possibilities within the first week; and

‡This subject was thoroughly covered in a series of articles published in the March and April, '53 issues of SERVICE.



Design and Installation

Site Testing . . . Signal Measurement Methods Selecting Best Antenna

then daily checks are required until the site offering the most reliable signal can be definitely selected.

Test runs must be made at each site, noting and recording the reliability of the signals. Line voltages furnished by the portable power supply also must be carefully checked to avoid any misleading readings. The antennas used can be yagis, mounted on short masts for portability. For final tests an antenna can be set up at each test site while the measuring equipment is moved about. The antennas can be repositioned on the site to locate possible high-signal points. When the choice has been narrowed down to two sites, it will be found wise to run comprehensive tests over at least a two-week period, checking each site several times daily, to determine the difference in signal levels, if any. Very little attention need be paid to excessively high signal levels; *agc* action of the line amplifiers will remove these. What must be checked is the presence of a *minimum* signal *at all times*. No amplifier yet constructed will *make* a picture out of a signal that is not there! Certain sites tested during surveys showed very high maxima on some stations, yet the signal at times dropped far below usable levels, due to terrain conditions, reflections or other unknown factors, rendering the sites unusable. Dips in the signal will not only cause snow in the pictures but complete fading.

If two sites of practically equal signal levels are discovered, it then becomes necessary to consider distance from the town, accessibility to ac lines and for motor vehicles. All other things being nearly equal, the town-distance factor is important, as this affects the length of run of the main cable and the size of amplifier that will be required; it will have a great bearing on the total cost of the completed system. Presence of roads on or near the site will affect the construction cost to a great extent, and determine the type of equipment used. If roads are available, lumber for houses, heavy equipment and, in addition, large wooden poles of the type used by utilities, may be trucked to the site and erected. If the site is inaccessible for motor vehicles, all equipment must be *back-packed* up; in this instance sectional metal towers will have to be used. Ease of access is also important for maintenance purposes.

The wooden poles are often more costly than equivalent metal towers. Of course, in some instances, metal towers will require more guying, and therefore the cost of anchors, wire and fittings must be taken into consideration. However, the lessened wind-resistance, ease of climbing, and longer potential service life of the metal towers represent impressive advantages that have underscored their value on location.

Final testing of the site must be planned carefully; actual signal levels available from the different stations must be evaluated. Signals must be checked over a period of several days when reception conditions in the town below are poor; when even those receivers operating on selected antennas are unable to produce clear pictures. If your site can show good pictures on the test receiver consistently under such conditions a highly favorable situation obtains, and you will be able to proceed with the installation with confidence. It must be remembered though, signal levels should be solid on all days; if they're clean on one day and snowy, the next, an investigation must be made to determine the cause. It's better to check at this

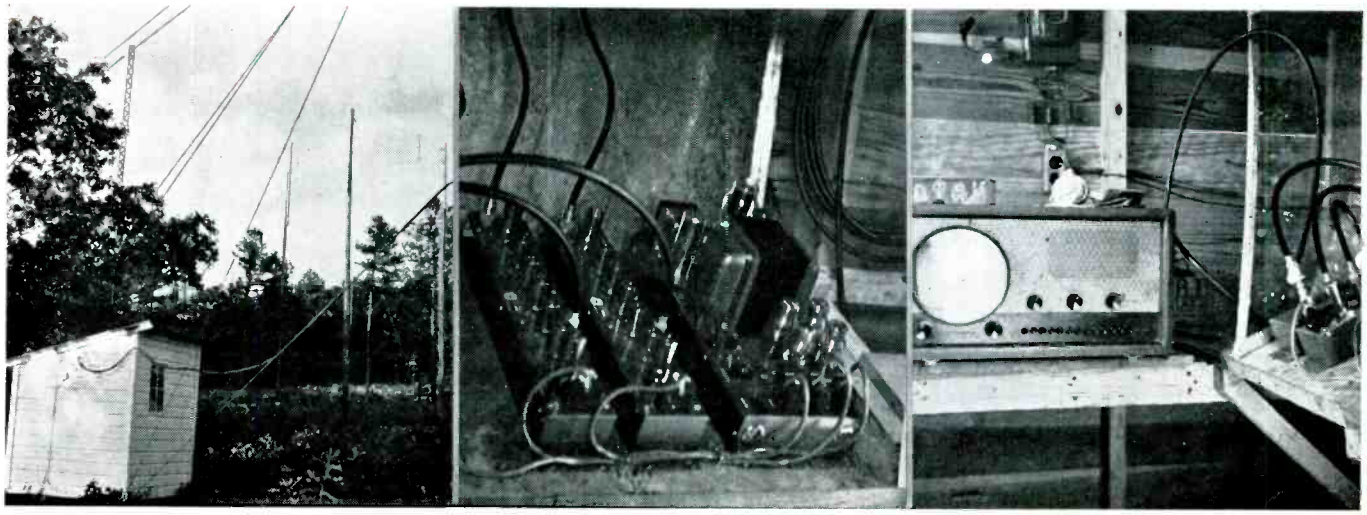
(*Continued on page* 56)

(Below, left)

Community antenna installation atop pole-tower mount using a rhombic: View at left shows author and associate Jack Darr positioning tower atop pole. View in center shows tower, rhombic terminations and amplifier housing. At right is view of the channel 7 rhombic (right) and channel 6 section (left) on pole mount.

(Below)

Equipment house and gear included for amplifying, monitoring, etc.: At left is view of shack and main cable feed. At left rear, behind shack, is section of tower used to support channel 4 rhombic. Poles in foreground support channel 6 rhombic. Individual channel amplifiers with power supply are shown in center. At right is an interior view of the equipment shack, showing TV receivers used for monitoring.



Beat-Frequency Oscillators In Communications Receivers

by RONALD L. IVES

THE FUNDAMENTAL difference between amusement and communications receivers is that the latter is equipped to receive continuous wave (*cw*) signals, whereas the former will receive *cw* signals only if it is out of order. Reception of *cw* signals is usually accomplished by use of an oscillator-mixer combination near the detector end of the *if* channel; the oscillator being the beat frequency oscillator, and the mixer being an *if* tube, usually the last.

Cw signals can be received by a procedure known as audio modulated detection[1], in which a local audio oscillator is keyed by the rectified and filtered *cw* output of the *if* amplifier. This system, which is basically a squelched audio-oscillator, performs quite well, but has not been incorporated into any popular brand of communications receiver.

BFO Functions

A block diagram of a conventional superhet receiver is shown in Fig. 1*a*. When this is adapted for continuous wave reception, by addition of a beating oscillator, we then have the arrangement shown in *b* of Fig. 1. With this connection, the *avc* must be disabled, usually by grounding the *avc* line, so that the receiver sensitivity is not reduced to nearly zero by the rectified *bfo* output. This leads to serious overloading of the receiver by strong signals, making necessary or desirable a manual sensitivity control.

In some advanced type communications receivers,‡ the *avc* voltage is produced by rectifying the output ot a branch amplifier tapped into the *if* system on the antenna side of the *bfo* input. Mixing in this specific instance is in the diode second detector. In some military receivers, a second mixer, such as a 6SA7, is used, as in *c* of Fig. 1. In most installations, the second mixer is more nearly a dual-input *if* amplifier, as its plate circuit is usually tuned to the *if* frequency, and not to the difference between the intermediate and beating frequencies. When this tube is used as a true mixer, with inputs at two relatively high frequencies, and output at an audio frequency, the stage is usually called an audio converter.

It is entirely possible to heterodyne a signal at any radio frequency by a steady oscillation at nearly that frequency, and to get an *af* output from the mixer. This procedure is seldom used at frequencies above about 300 kc because of the difficulty of keeping the local oscillator exactly on frequency.

Variety of Settings

Regardless of the exact method used to combine the *if* signal and the beating oscillator output, the audio signal perceived will be the difference between the frequencies. This permits several *bfo* settings, some of which, skilfully used, increase the workable selectivity of the receiver, either alone, or in conjunction with either crystal or *af* filters.

When the *bfo* frequency is identical with that of a steady *if* signal, there is no audio output, and the condition is known as zero beat. If the incoming signal is keyed, make and break clicks will usually be heard, and can be read, in the same manner as land-line Morse signals. Some of these make and break clicks are key clicks in the transmitter; others are due to the transient response of the receiver.

With an *if* signal of 455 kc (table 1, *a*) and a *bfo* setting of 456 kc, the audible output, which is the difference frequency, will be 1,000 cycles (1 kc). Similarly, with a *cw* signal of 455 kc and a *bfo* setting of 454 kc, (*b* in table 1) the audible signal will again be 1,000 cycles, which is the difference frequency. When operating in a reasonably clear channel, it mikes no difference whether the *bfo* operates above or below the signal frequency.

Let us now assume that there are two signals in the *if* system, one at 455, and one at 457 kc. If the *bfo* is set at 456 kc the difference frequency for the 457-kc signal will be 1,000 cycles (*c;* table 1). As the difference frequency produced by interaction of the 455-kc signal and the 456-kc *bfo* is also 1,000 cycles, we have an excellent example of interference. The 457-kc interfering signal can be eliminated only by use of many tuned circuits of high *Q*, a combination that will ring like a carillon, making the signal hard to read; or by use of a crystal filter, the conventional method

[1]Griffin, D. A., and Waller, L. C. *Audio-Modulated Detection*, QST; July, 1946. *Applying AMD to the Communications Receiver*, QST; August, 1946.

‡Such as the National NC-183D.

Functions of BFO Systems . . . Basic Circuits . . . Reducing or Preventing Pulling . . . Commercial Circuit Problems and Solutions . . . General BFO Servicing . . . Improving BFO Performance

of increasing the selectivity of communications receivers; or by use of a Villard *tunable slot* circuit[2], a relatively new device which has not as yet been incorporated into commercial communications receivers.

It is possible, however, to isolate the desired and interfering signals by proper adjustment of the *bfo;* and later to eliminate the undesired signal completely by use of an audio filter. With a desired *if* signal at 455 kc, and an interfering signal at 457 kc, we have seen that a *bfo* setting of 456 kc produces a beat note of 1,000 cycles from each signal, so that they cannot be separated by the operator. If, now, with these same signals, we set the *bfo* at 454 kc, the difference frequency produced by combination with the desired signal is 1,000 cycles, while that of the interfering signal is now 3,000 cycles. A highly skilled operator can now read either signal at will; and the undesired signal can be completely eliminated by use of a high grade *af* filter[2a]. The frequency ratio of the interfering to the desired signal here is *3* (*a* and *d;* table *1*). This frequency ratio can be greatly improved by tuning the *bfo* to 454.5 kc (*e;* table *1*), producing an *af* output at 500 cycles for the desired signal; 2,500 cycles for the undesired signal, and a ratio of *5*. Further decrease in the *bfo* frequency to 454.75 kc (*f;* table *1*), gives an audio output at 250 cycles for the desired signal, and 2250 cycles for the undesired signal, with a ratio of *9*. The two signals can now be separated by a crude *af* filter. Quite obviously, if the interfering signal is steady, it can be eliminated by tuning the *bfo* to its exact frequency, so that there is (or should be) no output from that signal, as in *g*, in table 1, and the *af* output frequency then is the difference in the frequencies of the desired and undesired signals. This procedure works better on paper than it does in practice, because a frequency drift of only a fraction of one per cent in either the *bfo* or the undesired signal produces a beat note which makes readjustment necessary. Also, keying transients in the undesired signal, whether produced as key clicks at the transmitter or as surge responses in the receiver, will usually be present in the receiver output, even though a steady signal at the undesired frequency cannot be heard. An elaboration of this general principle, using a *locked in* local oscillator, is called a synchrodyne, and has received much attention in Europe, but not in this country.

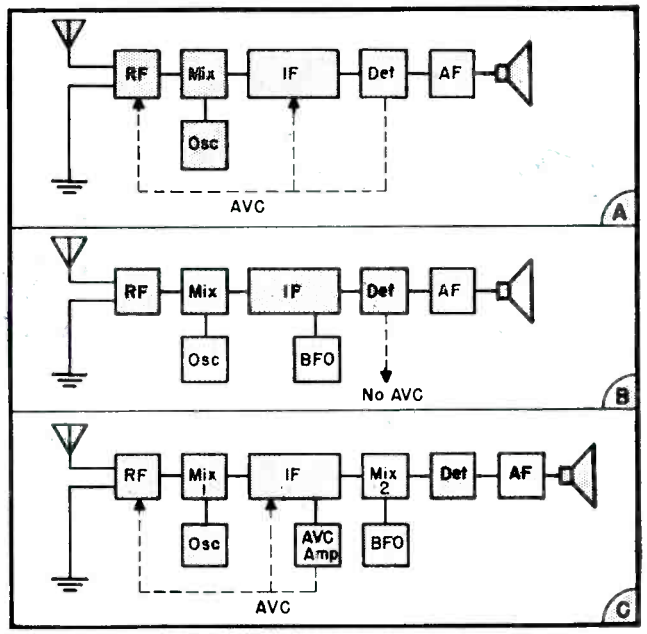


Fig. 1: Block diagrams showing superhet receiver (a); common variety of communications receiver (b); and advanced-type communications receiver c), in which the avc is not influenced by the beat-frequency oscillator.

Basic Circuits

Almost every conceivable oscillator circuit has been used, and successfully, as a beat-frequency oscillator. Because almost anything that will oscillate in the desired frequency range will function, after a fashion, as a *bfo,* many manufacturers have equipped their receivers with inadequate, balky, or unstable beat frequency oscillators.

Circuits in common use as beat-frequency oscillators include the Hartley (Fig. 2*a*), the Colpitts (Fig. 2*b*), the tuned grid-tickler (Fig. 2*c*), and the Pierce crystal oscillator (Fig. 2*d*). Outputs of these oscillators are coupled to the receiver *if* system by means of a very small capacitor, usually a gimmic, and the point of beat frequency injection may be the grid or plate of the last *if* stage, or the plate of the diode second detector. Because the *if* signal is strong at this point, the *bfo* output must also be strong; but too much coupling leads to circuit interaction (*pulling*), so that the tightness of the coupling, and the point of beating-frequency injection, are usually arrived at by a series of compromises, none of them entirely satisfactory.

To reduce or prevent pulling, coupling between the *bfo* and the *if*

(*Continued on page 57*)

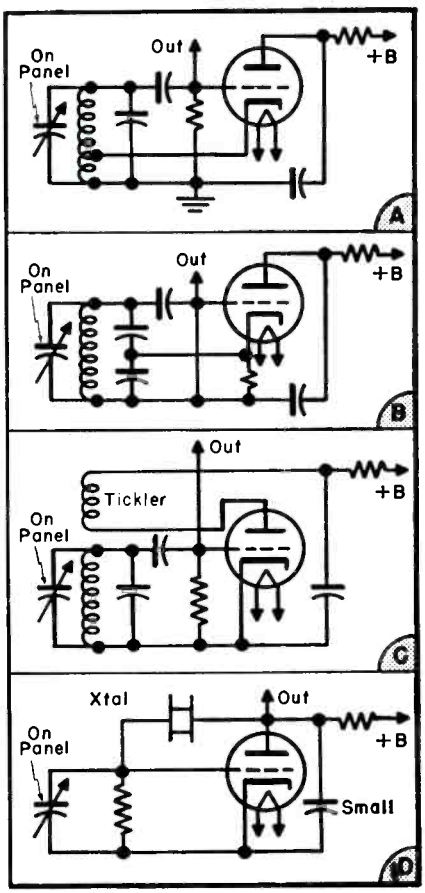


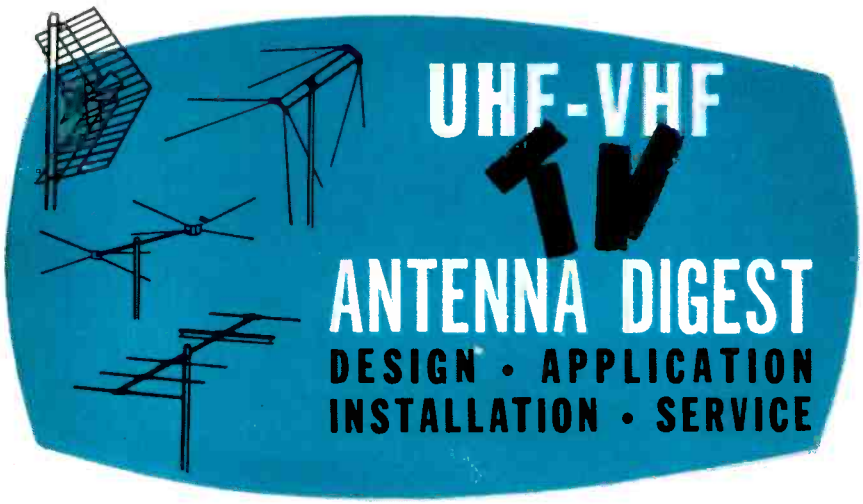
Fig. 2. Basic circuits commonly used in beat frequency oscillators: a—Hartley; b—Colpitts; c—tuned grid-tickler; d—Pierce crystal oscillator.

Reference	*IF Signal (kc)*	*BFO Frequency (kc)*	*Output (kc)*	*Ratio*
A	455	456	1	
B	455	454	1	
C	457	456	1	
D	457	454	3	3
	455	454	1	
E	455	454.5	.5	5
	457	454.5	2.5	
F	455	454.75	.25	9
	457	454.75	2.25	
G	455	457	2	infinity
	457	457	0	

Table 1: Typical examples of bfo outputs for various above-below frequencies.

[2]Villard, O. G., Jr., and Rorden, W. L., *Flexible Selectivity for Communications Receivers,* April, 1952, Electronics. [2a]Such as the National *Selectoject.*

Fringe Area Installation Notes . . . Eliminating Channel Interference



by HARRY CHANEY

Chief Engineer, In Charge of Development Lab, Kay-Townes Antenna Company

THE BATTLE to obtain snow-free pictures from greater distances is still going on. There is a relentless search for the highest gained antenna, or any other means that will insure the best results.

There are many precautions or measures which, if used during the installation, will help attain the best possible picture with less snow or interference. The following general precautions have been found very effective; they are aimed at not only taking advantage of all of the signal strength obtainable under any one condition, but reducing pickup of man-made noises, and minimizing losses.

A: One should, of course, first select a high-gain antenna, that is well constructed and employs metals or other materials that are known for their rust and corrosion-resistant properties. Antennas using steel-based elements (even if zinc, copper or cadmium plated) can create many noise problems. It has been found that sometimes this condition can be improved by spraying with a protective coating.

B: All nuts and bolts must be tightened firmly and one must be sure all connections are good; the wire that grounds the mast should be fast.

C: To remove the antenna from obstacles and man-made noises, the antenna should be hoisted high.

D: One should never depend on guesswork in orienting; a field-strength meter is a vital tool for this purpose. An auxiliary set can be used or an aide can watch the picture while the antenna is being adjusted.

E: In mounting one should search for the best signal location, particularly on high channels; moving the antenna two or three feet toward or away from the direction of the station often will place the antenna in or out of a space loop.

F: Grounding of the mast is important; this not only serves to increase lightning protection, but aids in elimination of interference.

G: A low-loss leadin and lightning arrester are musts. Losses in some types of flat twin-lead can be up to 4 db on channel 13, even when dry.

H: To reject pickup of noises by the leadin proper, and eliminate picture jumping when the wind whips the leadin, one should twist the leadin one to two complete turns per foot *all* the way down between antenna and the set.

I: Leadin should be routed as direct and short as possible. It is usually better to come up through the floor than around the room. The wire mesh behind plaster can cause trouble, so try to avoid it. In tacking, use small-headed tacks or staples in line between the two wires, *not across them.*

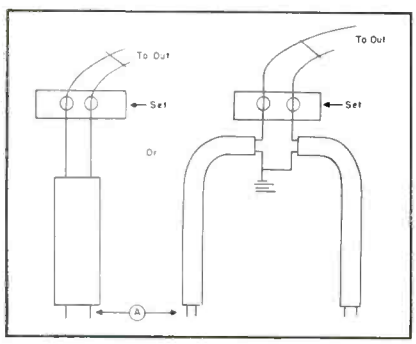
J: It's wise to use long stand-off insulators, generously, to help reduce losses by absorption; never tape the leadin to the mast.

K: Sharp bends in leadin should be avoided, and no loops should be permitted; especially coiled-up sections behind the receiver to enable set to be moved. It is best to recommend, instead, the use of extension arrangements.

L: To help reduce losses caused by mismatch, the following steps can be taken: One should tune to the highest channel, grasp leadin and run hand up and down for a few feet, while looking at picture. If a point is found where an improvement is noticed, a piece of foil should be taped around the leadin at that point. This procedure should be repeated for other stations. If open line is used, the same procedure can be applied, using paper backed foil, facing paper against the wire to prevent shorting; foil should be either taped on the wire or a 3 to 30-mmfd trimmer should be soldered between the two wires at that point, adjusting trimmer for best picture. This procedure sometimes aids in reduction of ghosts. There are a number of impedance matching devices that can be installed to eliminate mismatch problems.

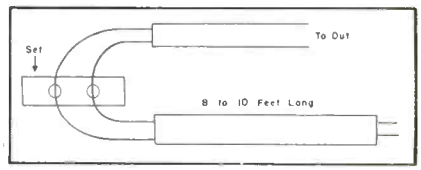
Fringe Antennas

In the fringe zones, the yagi-type antenna has been a standard for many. It has good forward gain with a narrow forward lobe, and good rejection



(Left)
Fig. 1. Simple trap to suppress interference. Terminals at A are cut to ¼ wavelength and left open at end.

(Right)
Fig. 2. Another trap arrangement, in which an 8' piece of twin lead is used. In this setup, the twin leads must be shorted first; the interfering signal will disappear at the half wavelength point. Then the lead should be cut to produce a ¼-wavelength open stub.



from the rear and sides for the channel or channels it has been designed to cover. This feature does help to eliminate ghosts caused by reflected signals. However, the yagi's front-to-back ratio on an adjacent channel is not too good; this can allow co-channel interference. Also, since basically the yagi is a narrow-band antenna, it has narrow horizontal polarization; thus when horizontally-polarized incoming signals tend to roll off the horizontal plane, or become elliptical, signals fade.

In an effort to solve the problem, the yagi has been combined with a fan-dipole,[1] and proportioned to take advantage of the most desirable features of both. The yagi section has been found to provide the necessary gain, while the fan, a double conical, serves to increase gain further and prevent fading on aberrated signals; those that are bent around or over a hill or other obstacle.

The use of two tilted conical sections (placed one in front of the other) has been found to provide a capture area in a forward direction of several feet, allowing at least some portion of the driven elements to be in the maximum signal location of the space loop on the high channels, thereby minimizing the need to *place* the antenna by hunting for best signal.

Eliminating Interference Other Than Noise

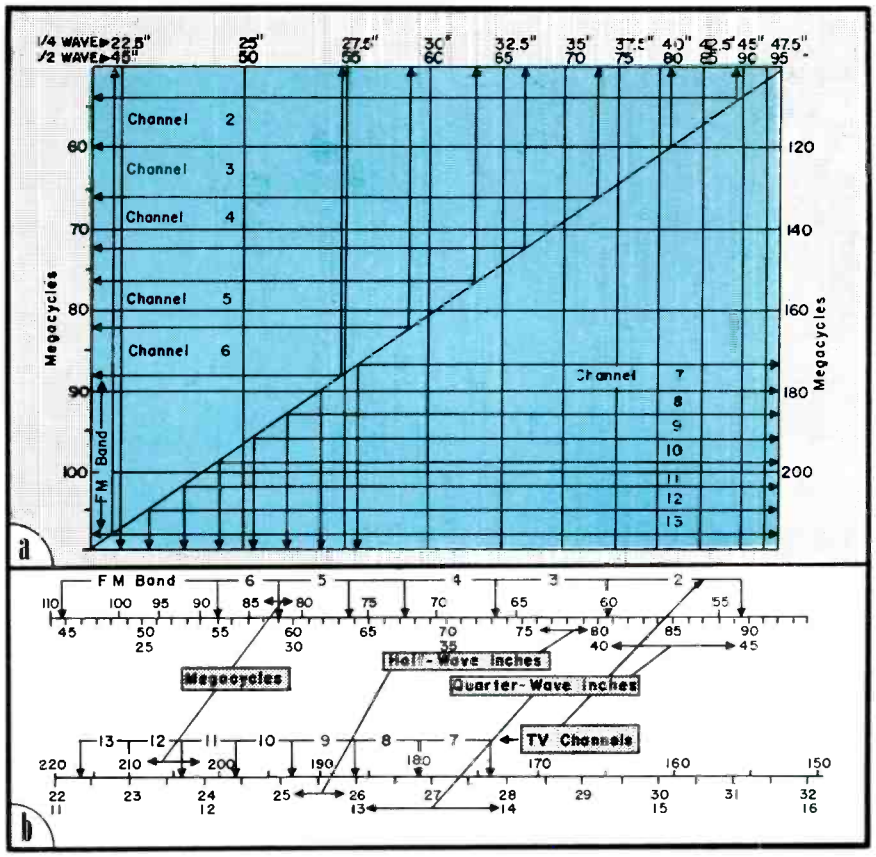
To eliminate interference from another station on the same channel, but from a different direction, one must install an antenna which offers a better front-to-back ratio, narrower forward lobe, or both. This is also sometimes the remedy for trailing ghosts, when caused by reflected signals. However, a leading ghost is usually picked up by the leadin; twisting the lead one turn per foot often cures this difficulty.

When the interfering signal is on an off-channel frequency, then filters can be effective; there are available high-pass filters that will reject any signal below 50 mc. This unit is simply inserted at the set's antenna terminals.

Perhaps the most difficult interference to remove is that which is almost on the same frequency of the desired station, particularly if it happens to be a powerful local station on the adjacent channel. Use of a trap tuned to the unwanted signal frequency and inserted at the antenna terminals, either in series or parallel, can be used for this situation. Most traps usually consist of a coil and capacitor in series with each other, and connected from each antenna terminal to chassis or ground.

[1]Kay-Townes *Big Jack*

Fig. 3. Charts that will provide correct length of stubs (300-ohm flat twin lead) for curbing interference on vhf channels. To obtain wavelength in inches, following formula is used: L (inches) = 11811 V (V = .82 average for twin lead)/Mc or 9684/Mc.



Some TV sets, using a tuned-input circuit, will give better results with this trap if the coil and capacitor are connected in parallel with each other and then inserted in series with each antenna lead, rather than across each to chassis.

Often one finds himself without the necessary trap. A section of 300-ohm twin lead cut to the resonant frequency, can be used in such an emergency; Fig. 1. There are two methods that can be used to determine the proper length of the twin lead section. The lead can be cut to the lengths in-

(*Continued on page* 51)

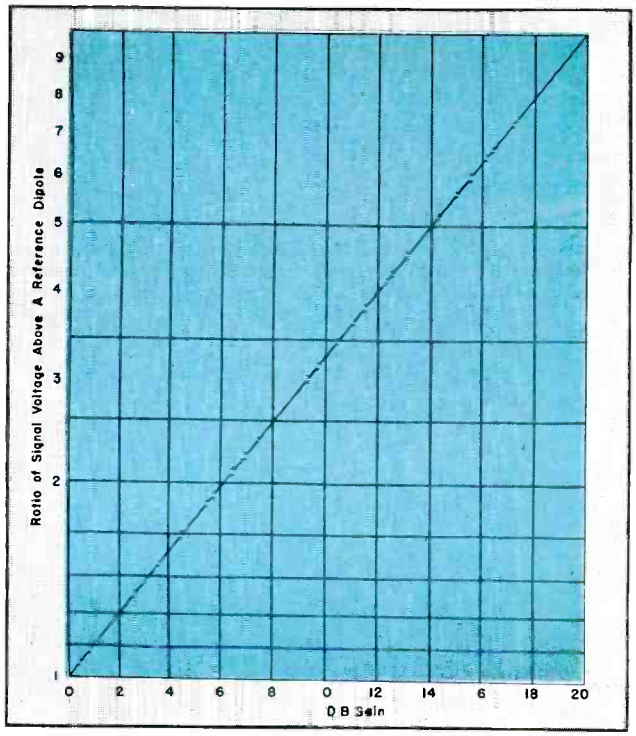
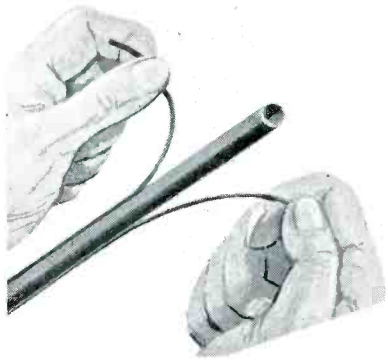


Fig. 4. Gain chart, showing relation of the signal voltage, above a reference dipole, to db gain.

UHF/VHF Antenna-Accessory Review

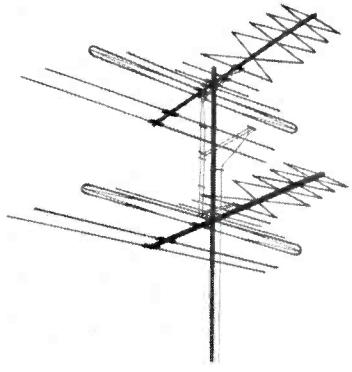
Broadband TV amplifier with auxiliary agc. Includes cascode circuits said to deliver more than 37 db gain on vhf channels. Four tubes operate on the high band and three on low band. Maximum output is 1.25 v rms on each band. Has 75-ohm input and output coax fittings, and separate high and low-band gain controls. (Model MLA; Blonder-Tongue Labs, Inc., 520 North Ave., Westfield, N. J.)

Elliot March, president of Tescon T-V Products Company, Springfield Gardens, N. Y., inspecting Mighty Mo antennas as they come off production line. Antenna incorporates a double-diamond phasing principle. Other antenna features are screen area of over 70 square feet with screen elements spaced less than 1/10 wavelength apart. Half-wave spaced on the low vhf channels, and 3/2-wave spaced on the high vhf channels.



Strip-Ease 300-ohm twin lead; to strip, wire is slit down about 1" on both sides of the wire inside indicated groove and lead is ripped to the desired length. Contains 7-strand 20-gauge copper conductors. Center tubular section, it is said, stays intact as the wall covering is never cut. To keep out moisture, the center section can be sealed by heating end with a match and closing tightly with a pair of pliers. (The Radix Wire Co., 26260 Lakeland Blvd., Cleveland, O.)

Indoor antenna, designed for metropolitan and suburban area reception, with a built-in, electronic rotating and tuning control. Tuning control changes directivity, by automatically selecting the correct combination of elements. (Star; Walsco Electronics Corp., 3602 Crenshaw Boulevard, Los Angeles 16, Calif.)



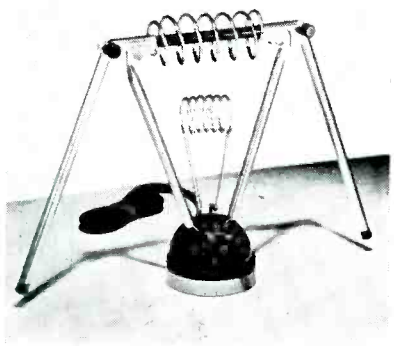
Antenna with a flat plane microwave type helical section composed of individual non-linear additive collectors, each said to be tuned separately. Folded dipole-design is claimed to transform the low band collector into three half-wavelength antennas that develop high in-phase current on the high band. Entire dipole length is said to act as an effective capturing device, because it operates totally on fundamental. Hi-tension brackets lock elements into place. (Star Helix Rainbow, models SX 711 (single bay) and SX711S (stacked); JFD)

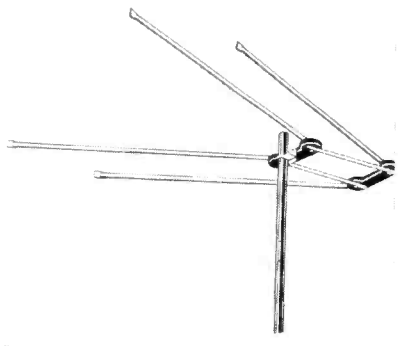
Antenna rotator with control box featuring a fingertip bar which rotates antenna in one direction when pressed on one end and in the opposite when pressed on the other end. Model consists of a rotator unit, enclosed in split die-cast zinc housing. Automatic center disk signal light indicates when limit of travel in either direction is reached. Speed of the new unit is approximately 2 rpm. Has magnetic brake to prevent drifting. (Model K-22 Tenna-Rotor; Alliance Manufacturing Co., Alliance, O.)

Counter display carton which contains polyethylene tubular TV twin-lead. Carton packs 5 coils, each 100'. (Cornish Wire Co., 50 Church St., N. Y. 7, N. Y.)

Indoor TV antenna with 6-position impedance switch. Has adjustable dipoles and double coil. (Model 6A; K-G Electronics Corp., 2738 N. Sheffield, Chicago 14. Ill.)

Adjustable uhf-vhf all-aluminum antenna. Twin elements are adjustable 60° to 90°. (Mity-V model A-9098; Television Hardware Mfg. Co. (Division of General Cement Mfg Co.), 919 Taylor Avenue, Rockford, Ill.





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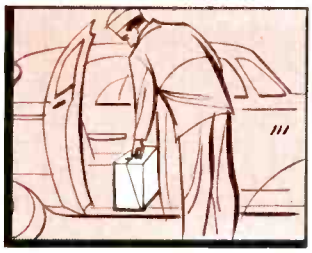

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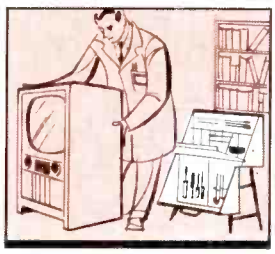

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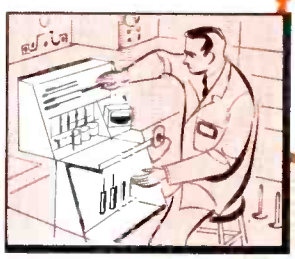

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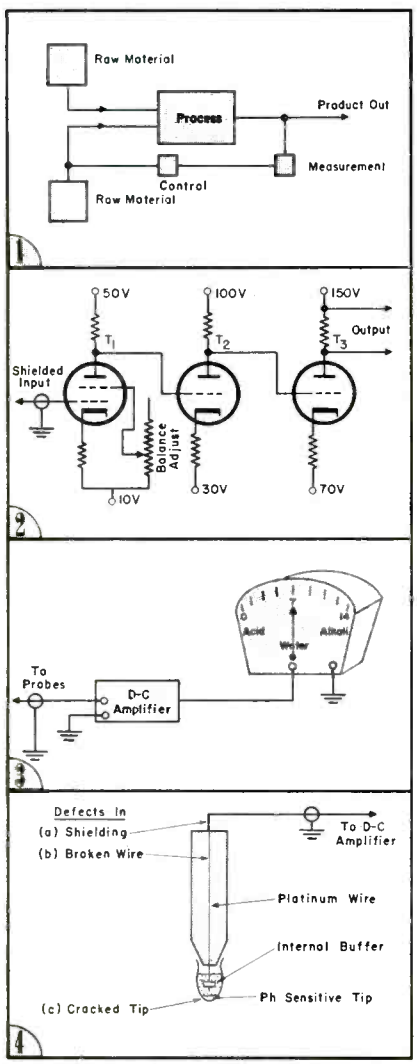
Service Engineering — field and shop notes

by
HENRY A. SCHWARTZ

Servicing Industrial Electronic Equipment

ELECTRONICS has become a major factor in the industrial world serving as a primary means of control of assorted devices employing gears, cams, linkages, and pneumatic and hydraulic mechanisms. Service Men must be familiar not only with the electronic circuitry, but with the mechanical and hydraulic counterparts that exist in the circuit.

A block diagram of a typical industrial process chain employing electronics is shown in Fig. 1. Here we have a process block where a certain quantity of raw material is fed and then a certain quantity and quality of finished product is produced. Linking the incoming raw material and the outgoing finished product lines are the measurement and control steps. The former measures quantity, quality, or both of the finished product. A voltage, developed by this measuring device, is transmitted to the control device. Upon receipt of this information (in voltage form), the control device applies corrective control to the incoming raw materials.



Let us now assume that the setup in Fig. 1 represents a chemical process of making muriatic acid (a very mild form of hydrochloric acid), wherein a strong solution of hydrochloric acid is mixed with water. Since the muriatic acid must have a definite amount of water and a definite amount of acid in it, the outgoing quantitative value of the acid must be known. In this instance we must control the amount of water, one of the incoming raw materials.

To measure the acidity of any substance a meter and pickup electrode must be used. Muriatic acid can be measured with an instrument known as a *ph meter*. The chemist in charge, normally knows from experimentation what reading the *ph* meter should reveal for proper composition; thus we have a base *ph* reading to follow. Therefore, if too much acid appears in the final mixture, an operator can turn on a valve to permit more water to flow and mix with the strong acid until the *ph* reading is in order. And, similarly, if the finished product produced a reading which indicated insufficient acid, then the valve could be turned again *manually* to increase the amount of acid being fed. The valve-control operator can be replaced by an electronic control device in the form of a relay network, to actuate meterized valves.

The foregoing analysis is, of course, highly simplified, but it does represent a basic approach to the problem. The methods of control and measurement vary widely with the quantity and quality of the finished product. The same basic electronic circuit may be applied to various processes in a different manner in each case. The Service Man must not only be aware of the function of the electronic device, but be able to analyze the process to which it is applied; he must know what is actually going on within the process block, and he must have a knowledge of the equipment and its application to the process. He must also know what is being measured and how it is being measured. He must know what is being controlled and how it is being controlled, before he can ever attempt to service the equipment in the field.

Prior to servicing any equipment involved it is necessary to analyze first whether the trouble is within the equipment or whether the fault exists in some other part of the process.

Direct-Coupled Amplifiers

The direct coupled amplifier is an important item in the industrial control chain; it appears in various types of recording, measurement, and control equipment. The amplifier may be used in association with equipment to provide a combination of measuring, recording and control. In itself, the amplifier is relatively simple and provides voltage amplification in the first stages and power amplification in the last stages; Fig. 2. A negative voltage applied to the grid of the first tube will cause a greater resistance to the flow of electrons in that tube, and therefore less conduction and less electronic flow through the plate-load resistor. Since a small current will flow through the tube the plate voltage will increase. The grid of tube *2* is con-

(*Continued on page* 51)

(Left)

Figs. 1, 2, 3 and 4 (top to bottom): Block diagram, illustrating typical processing procedure using electronic control, is shown in Fig. 1. A direct-control amplifier, used in industrial electronic equipment, is diagrammed in Fig. 2. How a ph meter can be connected to a d-c amplifier is illustrated in Fig. 3. And in Fig. 4 appears a cross-sectional view of a sensitive glass probe and defect points.

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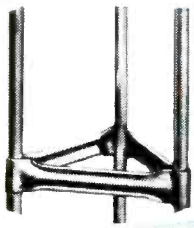

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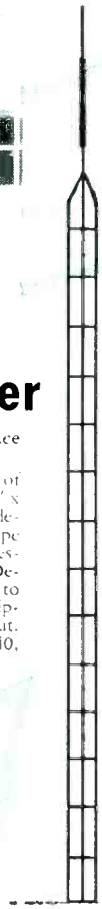

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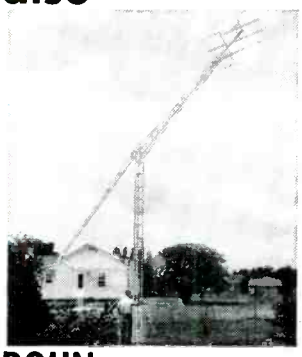

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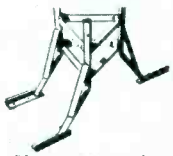

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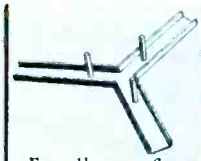
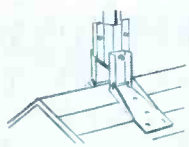


FLAT ROOF MOUNT

For all types flat surfaces. 3–1" solid steel projections permit first section of tower to be mounted directly on roof mount by inserting usual ⅜" bolts.



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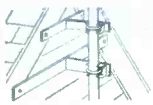

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TELEVIS

Circuitry Developments*

by CHRIS STORMLEY

IN THE COLOR CHASSIS the 3.58-oscillator and reactance tube are extremely important elements.

The purpose of the reactance tube is to control the phase and frequency of the local 3.58-mc color oscillator, as dictated by the *dc* voltage produced by the phase detector; a *dc* voltage is produced in the phase detector when the phase of the local oscillator is not correct. The 3.58-color oscillator is basically a tuned-plate tuned-grid type of circuit, using a shunt-fed plate tank. The oscillator is stabilized by a crystal in the grid circuit which replaces the usual *l-c* tuned tank. The crystal acts as a high *Q* tuned circuit and will operate within a few-hundred cycles of the correct frequency, or not at all.

The reactance tube is connected across the crystal circuit of the oscillator and operates as an electronic capacitor tuning the resonant crystal circuit to the correct frequency.

In the 19-inch Motorola color chassis, the oscillator signal voltage is fed, in reverse manner, to the plate of the reactance tube through a 100-mmfd capacitor and arrives at the grid of the reactance tube through the internal plate to grid-tube capacity; in some chassis, a 2-mmfd capacitor is connected externally from the plate to the grid of the tube. The oscillator signal voltage arriving at the grid of the reactance tube leads the oscillator signal applied at the plate, due to the capacitor action. This leading voltage, at the tube's grid, produces a leading plate current through the reactance tube, which makes the entire reactance tube circuit appear as a capacitor to the crystal oscillator. If the reactance tube's plate current and output signal are increased by a positive voltage on the control, the tube acts as a larger value capacitor and tunes the crystal to a lower frequency. But if the reactance tube's plate current and output signal are decreased by a less positive (negative) voltage at its control grid, the tube then acts as a smaller value capacity and tunes the crystal to a higher frequency. Thus we find that the apparent capacity presented to the crystal circuit is determined by the reactance tube's output signal, and this *ac* signal can be controlled by the voltage applied to the reactance tube's grid. The frequency of the crystal oscillator can therefore be controlled by a *dc* voltage; as applied to the control grid of the reactance tube. A phase detector serves to produce a *dc* output voltage when the phase or frequency of the local oscillator is not exactly that of the burst sync signal sent from the transmitter. Therefore, it becomes possible to control the frequency of the 3.58 oscillator automatically.

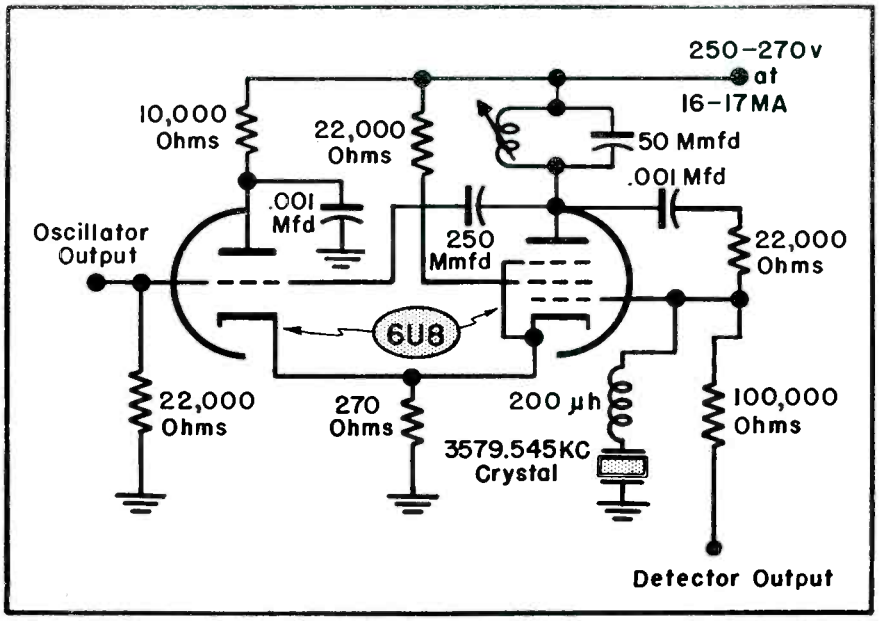
The plate current and output signal of the reactance tube determines the apparent value of capacity that is tuning the crystal to resonance. Accordingly, if the reactance tube plate current is cut off by sufficient grid bias, it produces no capacity effect. If the minimum capacity of the tube (as produced by minimum plate current) does not tune the oscillator to the correct frequency before the reactance tube is completely cut off, the reactance tube will lose control of the oscillator. To insure sufficient range of the reactance tube's capacitor action, a tunable inductor is incorporated in the plate circuit. This arrangement makes it possible to tune the crystal to resonance and still have the reactance tube operate over its most desirable range of voltages and currents.

Packaged Oscillator Assembly

To simplify control in this portion of the color system, crystal experts recently designed a packaged crystal-controlled reactance tube oscillator using a 6U8 triode pentode; the unit is 2⅜" long and 1⅝" wide and can fit into a standard 9-pin noval socket.[1] This setup, it is claimed, assures maximum performance of the crystal control in the synchronization of the color subcarrier.

According to the circuit designers, the system offers a sensitivity of 200 cycles per volt minimum, and the *rf* output is in excess of 20 volts rms. Power requirements are 6.3 *v* at 450 milliamperes, and 250 to 270 *v* at 17.5 milliamperes.

Fig. 1. Schematic of Midland MC-103C crystal-controlled reactance-tube oscillator assembly.



*Based in part on notes prepared by **Motorola** for their 19-inch color chassis: TS-902A-03 and BP-902A-01.

[1]MC-103C, Midland Manufacturing Co.

...oulous VHF-UHF antenna that actually ...lls itself with performance!

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"Just what our customers have been waiting for -- a powerful, sturdy, economical antenna."

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LOOK at the RAINBOW'S unique design, so deceptively simple, yet so unbelievably efficient. ***LOOK*** at its advanced features: New *Spacing Formula*, new *Triple-Section* High Band elements, new full-efficiency *Intermix Design*, and the brilliant triple-power TRI-POLE! ***LOOK*** at its remarkable Yagi performance on every channel, its sharp single lobe. ***LOOK*** at its rugged, durable 100% aluminum construction, reinforced at all stress points. ***LOOK*** at its trigger-fast "Snap-Lock" Action, Channel Master's fabulous preassembly that snaps open, *locks* open, without hardware or tightening.

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	1-Bay SUPER RAINBOW	+1 DB	+1 DB	+1.5 DB	+2.5 DB	+3.5 DB	+3.5 DB	+3 DB	+2 DB	+1.5 DB	+2 DB	+3.5 DB	+4.5 DB
	CHANNEL	2	3	4	5	6	7	8	9	10	11	12	13
Gain Over Stacked Champion	Stacked RAINBOW	+1.5 DB	+2 DB	+1.5 DB	+1.5 DB	+2 DB	+.5 DB	+.5 DB	+0 DB	+0 DB	+0 DB	+1 DB	+1.5 DB
	Stacked SUPER RAINBOW	+2 DB	+2.5 DB	+3 DB	+3 DB	+4 DB	+.5 DB	+1 DB	+1 DB	+2 DB	+2 DB	+2.5 DB	+3.5 DB

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stocked Super RAINBOW model no. 331-2, $75.70 list

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Champion *RAINBOW model no. 330,* $23.60 list

stocked **Champion** *RAINBOW model no. 330-2,* $48.60 list

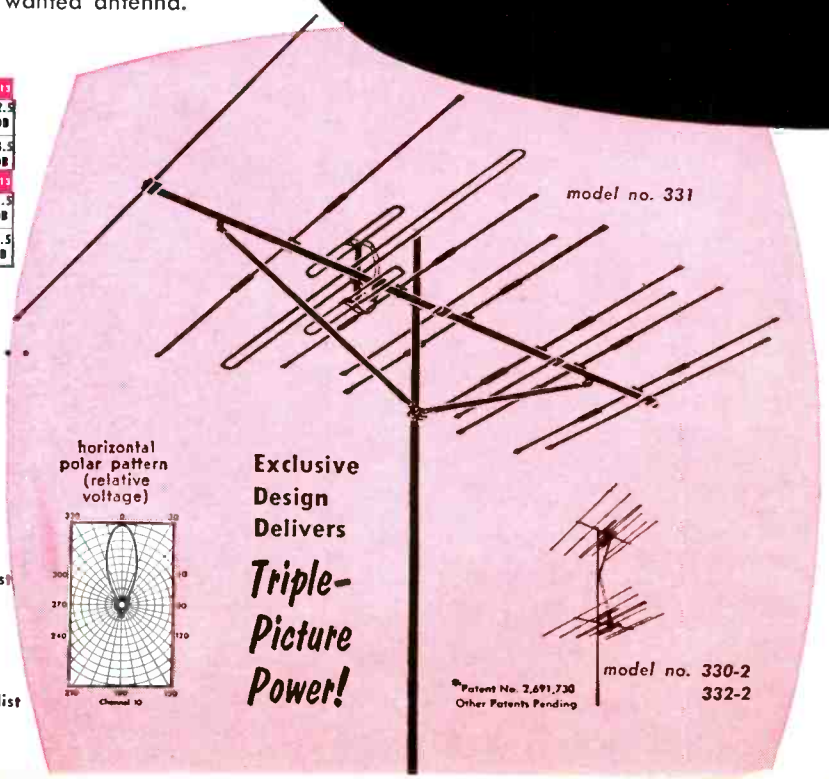
For economy installations:
(featuring butted tubing)

Challenger *RAINBOW model no. 332,* $18.06 list

stocked **Challenger** *RAINBOW model no. 332-2,* $37.50 list

don't kid me!

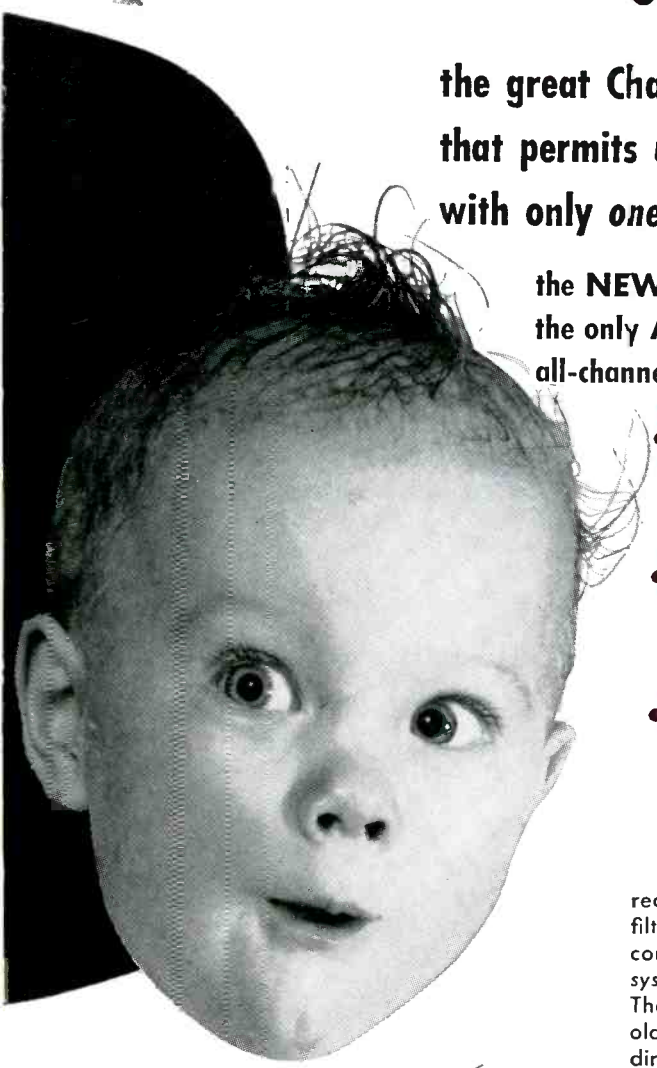
NOTHING outperforms CHANNEL MASTER



a major step forward in installation procedures —

CHANNEL MASTER'S SELECTENNA coupling system

the great Channel Master development that permits *unlimited antenna combinations* with only *one* transmission line to the set!



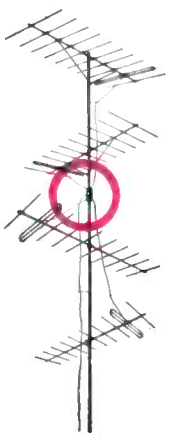
the NEW WAY, the BEST WAY, the only AUTOMATIC WAY to get all-channel, all-direction reception . . .

- ***Without rotators!***
  SelecTenna means: no extra control unit on the set; no moving parts to get out of order; antennas are always in perfect orientation.
- ***Without switches!***
  SelecTenna means: no manual switches to bother with; better performance because couplers have less insertion loss than switches.
- ***Without multiple lead-in wires!***
  SelecTenna means: neater, more professional installations, because no complicated wiring enters the home. Only *one lead* connects to the set.

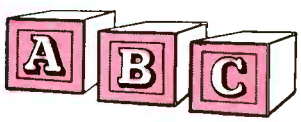
This modern way to obtain multi-directional reception — with its individual band-pass filter networks — offers the consumer great convenience advantages possible *in no other system*. There's never been anything like it! The SelecTenna System is rapidly replacing all older methods. Use it on your next "multi-direction" installation!

FREE TECHNICAL ADVISORY SERVICE

Our engineers will tell you the correct hook-up for your area. Merely list the channels you expect to receive, as well as the different antennas you would like to hook up. No charge or obligation.



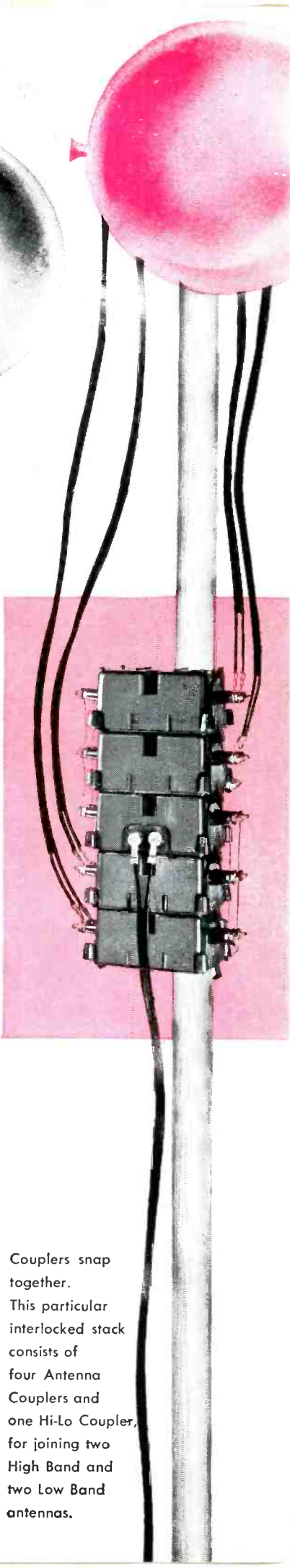
Simple as:



Simply select your channel on the set--- the right signal is always there!

list price: $5.42 each

including mounting hardware and connecting wire.



Couplers snap together. This particular interlocked stack consists of four Antenna Couplers and one Hi-Lo Coupler, for joining two High Band and two Low Band antennas.

CHANNEL MASTER CORP. ELLENVILLE, N. Y.
The World's Largest Manufacturer of Television Antennas and Accessories.

COLOR TV TUBES

by G. C. CHURCH

Technical Data Section, Receiving Tube Sub-Department, General Electric Company

Concluding Installment: Operation of the 6BJ7 (Triple Diode) In the Color TV Receiver

IN THE TV CHASSIS, the coupling capacitor, which is usually used between the plate of the video amplifier and the picture tube, results in the loss of the *dc* component of the composite video signal. In b-w receivers, it has been found that *dc* restoration may be omitted without serious effects to the picture. The result of omitting *dc* restoration in b-w receivers is that black elements in the picture are not correctly black, but rather a dark gray. For color TV, it is believed necessary to restore the *dc* component because any differential change in the average signal content will produce a predominantly red, blue, or green background.

6BJ7 Operation

In the color set one section of the 6BJ7 (the miniature triple diode) is used as a *dc* restorer for one of the signal channels. In operation, for a negative-going signal, whenever the cathode of the 6BJ7 becomes more negative than the plate, it conducts and charges a coupling capacitor. The magnitude of the voltage developed across this capacitor depends upon the level of the *ac* axis of the signal. This axis is a line that divides the signal so that there is just as much positive signal as there is negative and is therefore the line that makes the area above it equal to the area below it. The level of the *ac* axis depends upon the brightness of the background of the scene. For a bright scene, the *ac* axis will be much nearer zero than for a dark scene.

The only time when the 6BJ7 can conduct is when the instantaneous signal level is greater than the *ac* axis. The voltage developed across this capacitor is therefore (for a negative-going signal) proportional to the difference between the peak negative swing of the signal (normally the sync pulse tips) and the negative level of the *ac* axis. The voltage impressed upon the picture-tube grid will be proportional to the sum of the *dc* voltage across the coupling capacitor and the *ac* voltage output of the video amplifier tube.

The *dc* restorer, therefore, inserts a *dc* voltage in series with the *ac* signal, which is proportional to the difference between the sync pulse tips and the *ac* axis of the signal. As the *ac* axis level changes, the *dc* voltage across this capacitor also changes in proportion to the change in the *ac* axis. This will cause the sync tips to be lined up at a common reference, regardless of whether the background of the scene is predominantly bright or predominantly dark.

1- and 3-Gun Circuits

The foregoing discussion has been limited mainly to a consideration of a receiver using a 3-gun picture tube. This was done largely because at present more is known about this type receiver. Several one-gun picture tubes are presently under active development or study by different companies, together with an investigation of the circuits to be used in conjunction with them. It appears that only time will tell which system proves to be best. Regardless of the outcome, however, it is believed that most, if not all, of the tubes discussed (the 5AU4, 2V2, 6BU5, 6AR8 and 6BJ7) will find use in the same or similar circuits described in this report.

(Left)

Table 1. Stages unique to the color receiver and their function.

Stage	Function
(1) Chrominance Amplifier	To pass and amplify the chrominance signal frequencies.
(2) Color Killer	To disable the chrominance channel when a monochrome signal is being received.
(3) Burst Gate	To allow only the 8 to 10 cycles of the *burst* signal to reach the 3.58-mc oscillator.
(4) 3.58-Mc Oscillator	To furnish a reference signal for the *I* and *Q* sync detectors. This oscillator is controlled by the *burst* with an *apc* (automatic phase control) network.
(5) *I* and *Q* Synchronous Detectors	To demodulate the chrominance signal and separate the *I* and *Q* signals.
(6) *I* and *Y* Delay Lines	To enable the *I* and *Y* signals to arrive at the matrixing system at the proper time with respect to the *Q* signal.
(7) Matrixing System	To combine the correct portions of the *I*, *Q* and *Y* signals, and thereby recover the original voltages (E_R, E_G, and E_B), which are proportional to the red, green, and blue in the scene being telecast.
(8) Red, Green, and Blue Amplifiers	To amplify the red, green, and blue video signals to drive the three guns of the picture tube.
(9) *DC* Restorers	To restore the *dc* component that is lost by capacitive coupling.
(10) Focus Rectifier	To provide the *dc* focus voltage.
(11) Dynamic Focus and Convergence	To keep the three electron beams properly focused and properly converged as the beams are swept across the face of the picture tube.
(12) High-Voltage Regulator	To regulate the high voltage supply and prevent, for instance, picture size and picture registration* from being functions of picture tube beam current or picture brightness.

*In a 3-gun color picture tube the phosphor is usually arranged in dots either on a screen placed directly on the inside surface of the face plate or on a phosphor-dot plate just behind the face plate. This so-called phosphor-dot plate or screen contains thousands of phosphor dots set up in trios, with a red, a green, and a blue phosphor dot contained in each trio. Between the phosphor-dot plate or screen and the electron guns is an aperture mask which contains one hole for each trio of phosphor dots. The picture has proper registration when the three beams from the three electron guns pass through each aperture mask hole at essentially the same time and each beam strikes the proper phosphor dot.

Introducing the B-T LABS **Masterline** SERIES

For BETTER, MORE POWERFUL MASTER TV SYSTEMS

Blonder-Tongue research and development have had one objective in mind: to enable local TV technicians to plan, install and maintain master TV systems of any size. As a result, the B-T program has succeeded in producing economical, easy-to-install, and easy-to-maintain equipment. A noteworthy example is the B-T 'Add-A-Unit' System with its complement of broadband amplifiers, distribution amplifiers and accessories.

Now comes our greatest achievement in this field . . . the MASTERLINE Series. Three units are now ready — more will follow — with the result that the TV technician will now be equipped, better than ever, to undertake any task involving TV signal distribution.

MASTERLINE AMPLIFIER — *Model MLA*

A more powerful, cascode, all-channel VHF Amplifier with variable gain control for equalizing high and low bands. When used with AGC unit (Model MAGC) maintains non-varying output signal.

Features:

- Gain: 37db (70x)
- Impedance: 75 ohms input and output.
- Flat response.
- Input and output coax connectors.
- Self-contained power supply.
- Hammertone metal chassis with easily removable cover plate.
- Weight—6½ lbs. Dimensions—9 x 6 x 5".
- UL-approved.

List Price **$119.50**

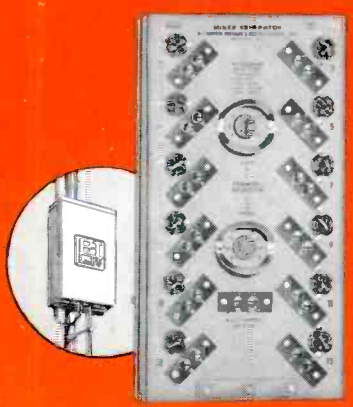
MASTERLINE AUTOMATIC GAIN CONTROL *Model MAGC*

A plug-in AGC unit designed for use with the MLA amplifier. Maintains constant output level, yet permits independent regulation of each band.

Features:

- Separate high and low band gain settings.
- Acts as positive protection against overload.
- Impedance: 75 ohms, input and output.
- Input and output coax connectors.
- Obtains power from MLA.
- Hammertone metal chassis and cover.
- Weight—3 lbs. Dimensions—6 x 4 x 5".
- UL-approved.

List Price **$59.50**



MASTERLINE MIXER-SEPARATOR — *Model MMS*

A complete network unit employing no tubes and requiring no power. **As a Mixer** the MMS permits up to 12 VHF Yagis, each to be individually equalized, mixed and fed into one output line. **As a Separator** the MMS divides the output of a single line or broadband antenna into separate channels with an output (up to 12) provided for each channel. Each channel can then be individually attenuated, filtered or otherwise equalized.

Features:

- Has 12 tuned VHF channel terminals (input or output)—requires no adjustment.
- Impedance: 75 ohms input and output.
- Employs at least 4 resonant circuits for each channel.
- Low mixing loss—1 to 3db.
- Supplied with channel attenuator plugs—0 to 24db.
- Has strain-relief clamp bars for cables.
- Housed in Lead-coated chassis and mast mounting bracket with Aluminum weather-proof cover.
- Weight—4 lbs. Dimensions—12 x 6½ x 4".

List Price **$59.50**

Manufacturers of TV Amplifiers, Boosters, Converters, Accessories, and Originators of the B-T 'Add-A-Unit' Master TV System.

B-T LABS

For complete specification data and operating instructions, write Dept. ZA-8

BLONDER-TONGUE LABORATORIES, INC.

WESTFIELD, NEW JERSEY

Part VI of a Series of System-Component Evaluation and Progress Reports

Cartridge Design Factors*

MODERN CARTRIDGES must meet a number of requirements to insure high quality reproduction:

(*1*) A full frequency range; not less than 40 cps to 15 kc.
(*2*) Not more than 3-db variation, when measured under constant velocity driving conditions.
(*3*) Minimum harmonic distortion.
(*4*) A critically-damped moving system, adequately controlling transient response and mechanical resonances.
(*5*) A minimum degree of reproduced scratch, hiss and ticks.
(*6*) Minimum mechanical noise at the pickup.
(*7*) Adequate tracking ability.

In developing the variable reluctance type of cartridge, these factors served as a design base. This cartridge consists of two coils wound on nylon spools and impregnated; two laminations and two yokes, made of high permeability alloy and heat treated; and an Alnico 5 magnet. These parts are assembled in a molded phenolic base and covered with a casing made of the same permeability material as the laminations.

Two models are available; one with a single styli and another with a dual styli.

The dual-styli assembly consists of a pivot pin, bronze guide, six damping blocks, two cantilevers and two styli. The single-stylus assembly consists of a pivot pin, pole piece, three damping blocks, stylus guide, and a stylus.

The single stylus is held in the cartridge by tension between the pivot pin and its socket. The dual stylus is held in the cartridge by a spring between the selector knob and a retaining washer.

This reproducer is unique in that all parts that wear, move, or are subject to any change in characteristics are included in the stylus assembly and are automatically renewed when the stylus assembly is changed. Thus, a new stylus assembly means, in effect, a new pickup.

When the stylus assembly is inserted in the dual cartridge, it may be rotated so that either a one or three-mil radius stylus is in playing position. When in playing position, the chosen cantilever lies with one end near the magnet extremity and the other end centered in the air gap formed by the laminations. A steady magnetic flux path then exists through the magnet, the cantilever, dividing from the cantilever to each lamination, combining in the yokes and returning by air path to the magnet. The cantilever acts as an extension of the magnet.

When reproducing, the stylus engages the record groove and is driven in conformance with the lateral undulations of the groove. This causes that portion of the cantilever lying in the air gap to approach and depart alternately to and from each lamination. Flux density is thus varied through the core of each coil; the coils connected in such a manner as to develop, across the terminals, an alternating current which is the electrical equivalent of the lateral mechanical motion of the stylus.

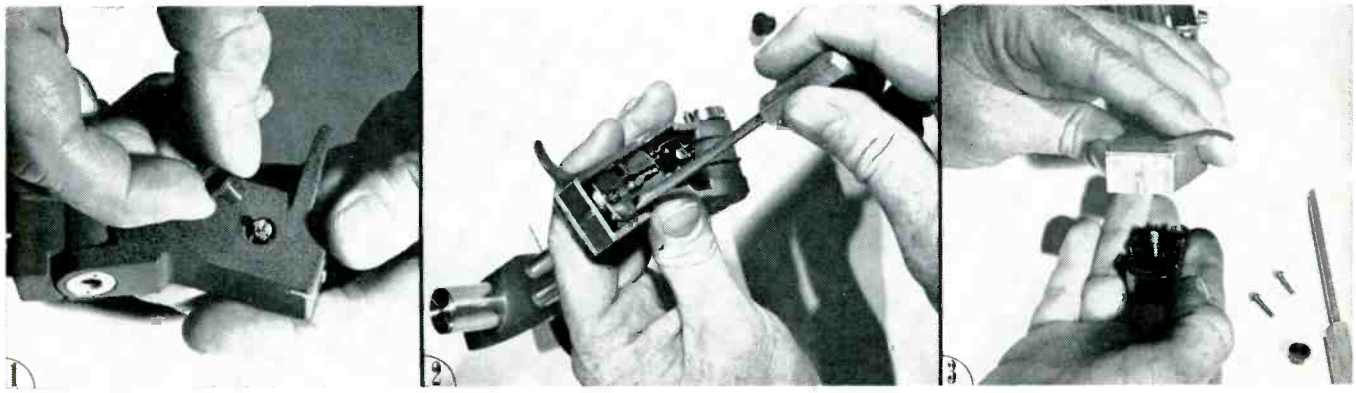
The damping blocks are proportioned and positioned carefully so that mechanical resonances, that would otherwise exist in the cantilever when in motion, are effectively damped out over the reproduced frequency range.

**From a report prepared for* SERVICE *by the components section of the electronics division of General Electric.*

Stylus Assembly Removal and Installation

Single Stylus: To remove the stylus assembly, a straightened paper clip or equivalent tool should be inserted into the stylus stud pin from the top of the cartridge and the assembly then pressed out. To replace the stylus assembly, the cartridge is placed with the bottom side facing up. The stylus

(*Continued on page 44*)



Figs. 1, 2 and 3 (left to right): In removing dual stylus from v-r cartridge selector knob is first pulled off with fingers. Then a screwdriver is used to remove mounting screws. With selector knob and mounting screws removed, cartridge is dropped from tone arm. (See pp. 49 and 50 for additional stylus-removal photos.)

Mr. Dealer,

NOW YOU CAN MAKE MONEY IN HIGH FIDELITY WITH Jensen

You can sell high fidelity equipment to your customers at prevailing catalog prices and make your normal profit.

Jensen's 2-step Distribution Plan allows you to take full advantage of the terrific market potential of widely publicized component high fidelity . . . the only way to get all the music from today's superb recordings.

Jensen hi-fi wholesalers are establishing stocks of Jensen high fidelity loudspeakers for your convenience—and are selling only to dealers at dealer discount. They can supply you with changers and amplifiers too. Many have sound room facilities for your exclusive use—you may take or send your customers to hear equipment you do not stock.

Get in touch with your nearest wholesaler now—he can start you on the road to making money in high fidelity.

One...Two...Three it's TRUE HIGH FIDELITY!

Yes, true high fidelity is an easy one-two-three. All it takes is a hi-fi changer, amplifier and Jensen loudspeaker, for the basic hi-fi phono system you'll sell most. There's no mystery, no complications for you or the customer. He sees and hears just what he'll buy. Step up in performance and price tag with a better speaker—from compact Duette Treasure Chest ($76.50) to the incomparable Imperial ($525).

The RDU-1 Display illustrated sets up your compact hi-fi system with Duette Treasure Chest, a true two-way speaker with special 8-inch woofer and compression driver horn-loaded tweeter. Takes less than 4 square feet of floor space. You'll make sales easily as you demonstrate. Your Jensen hi-fi wholesaler has these displays now—ask him for information.

Model CT-100

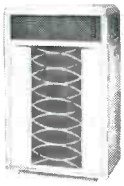
True, two-way "tweeter" and "woofer" system in attractive, compact enclosure. Incomparable reproduction except at far greater cost.

ST-915 Selected Mahogany....$164.50
ST-914 Blonde Korina..... 168.00

Model TP-200

Unsurpassed performance at moderate price; true, evenly balanced tonal quality. Three way system in beautiful new Bass-Ultraflex enclosure.

ST-909 Selected Mahogany....$312.70
ST-908 Blonde Korina..... 316.80



Model PR-100

The finest reproduction you've ever heard! Custom built, specially laboratory tested three-way system, with new trilateral horn enclosure in superb cabinetry.

ST-919 Selected Mahogany....$525.00
ST-918 Blonde Korina..... 535.00

Model DU-300

Finest hi-fi loudspeaker in low price field. Embodies expensive, true two-way horn-loaded "tweeter," and "woofer" principle for natural and thrilling, life-like reproduction.

ST-861 (Mahogany) or ST-860 (Blonde Oak).....$76.50
ST-862 Wrought Iron Leg Set... 4.25

Model G-610

Three independently driven elements give highest quality reproduction attainable in a unitary speaker. Mounts in any cabinet for 15" speaker.

ST-900.....$252.75

JENSEN OFFERS THE MOST *COMPLETE* LINE OF HIGH FIDELITY LOUDSPEAKERS, CABINETS AND ACCESSORIES IN THE ENTIRE AUDIO FIELD.

WORLD'S QUALITY STANDARD FOR MORE THAN A QUARTER CENTURY

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NORFOLK, Va.—Radio Supply Co.
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OKLAHOMA CITY, Okla.
Johnson Wholesale Electronics
ORLANDO, Fla.—Goddard-Orlando
OWENSBORO, Ky.—Peerless Electronic Eqpt. Co.
PASADENA, Calif.—Electronic Supply Corp.
PEORIA, Ill.—Klaus Radio & Electric Co.
PHILADELPHIA, Pa.—Radio Electric Service Co.
PHOENIX, Ariz.—Radio Parts of Arizona
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RICHMOND, Va.—Radio Supply Co.
ROANOKE, Va.—Radio Supply Co.
SALEM, Ore.—Lou Johnson Co.
SALT LAKE CITY, Utah—Standard Supply Co.
SAN DIEGO, Calif.—Western Radio & TV Supply
SAN FRANCISCO, Calif.
Pacific Wholesale Co.
Zack Radio Supply Co.
SAN JOSE, Calif.—Frank Quement, Inc.
SANTA ANA, Calif.—Radio & Television Eqpt. Co.
SCRANTON, Pa.—General Radio & Electronic Co.
SEATTLE, Wash.
Western Electronic Supply
Seattle Radio Supply
SPOKANE, Wash.—Columbia Electric & Mfg. Co.
SPRINGFIELD, Mass.—Soundco Electronic Supply
ST. LOUIS, Mo.—Interstate Supply Co.
ST. PAUL, Minn.—Lew Bonn Co.
TACOMA, Wash.—C & G Radio Supply Co.
TOLEDO, Ohio—Warren Radio Co.
WASHINGTON, D. C.
Electronic Wholesalers, Inc.
Silberne Radio & Electronics Co.
WEST PALM BEACH, Fla.
Goddard Distributors, Inc.
WHITE PLAINS, N.Y.
Westchester Electronic Supply Co.
WICHITA, Kan.—Interstate Electronic Supply
WILKES-BARRE, Pa.
General Radio & Electronic Co.
WORCESTER, Mass.—DeMambro Radio Supply
YOUNGSTOWN, Ohio—Ross Radio Co.

***WRITE TO JENSEN**

Additional hi-fi wholesaler appointments have been made since this ad was released. If the list does not include one serving your area, write for his name and address. We'll include a free copy of "How to Make Money in Customized High Fidelity."

Jensen

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Division of the Muter Co.
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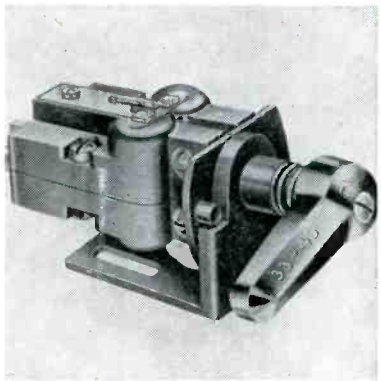
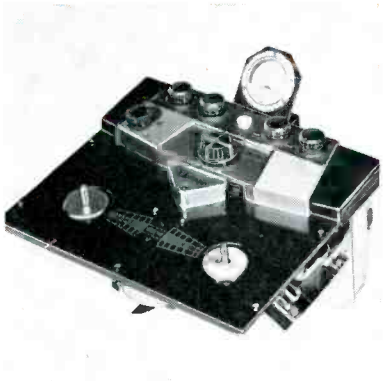
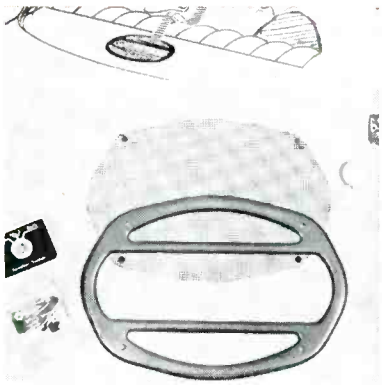
Latest in Audio



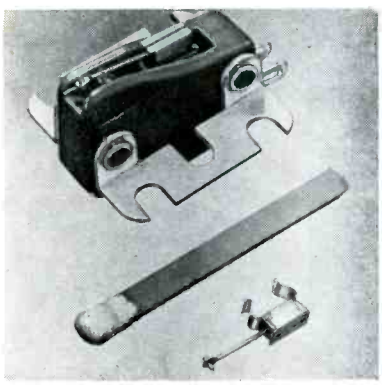
Magnetic cartridge of the turnover type, using separate stylus for 78's and 33's. May be installed in standard tone arm equipped with half-inch-center mounting holes. Has a push-pull coil assembly said to cancel out hum originating in turntable motors; additional protection against hum pickup is afforded by a Mu-metal shield around pole-piece assembly. Features high compliance and low moving mass for tracking at 6 to 7 grams. Each stylus may be replaced independently. (Model 500; Recoton Corp., 147 W. 22 St., N. Y. 11, N. Y.)



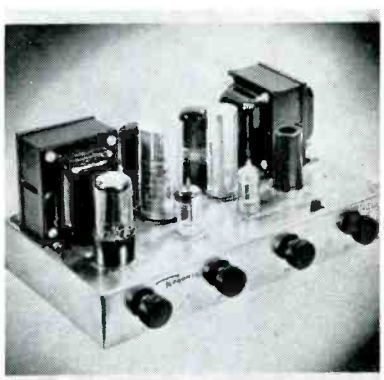
Tape recorder mechanism designed for custom installations. Consists of a two-speed record-playback mechanism; plays and records at 3¾ and 7½ ips with a twin-track recording head. Has a frequency response of 40 to 13,000 cps at 7½ ips speed. One control selects tape direction; fast forward, standard forward, fast rewind and stop. Other controls select playing speed, record/playback, volume, recorder on and off, and cut out for speaker during recording when desired. (Model 212; Sound Sales Division of Webster Electric Co., 1900 Clark St., Racine, Wisc.)



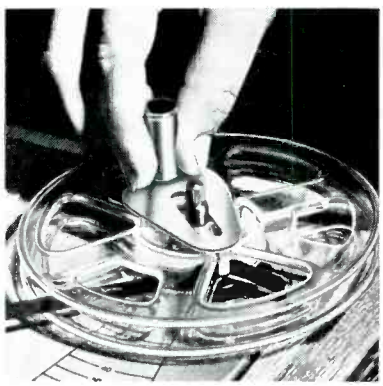
Rear seat speaker baffle kit, which includes a perforated metal grille, said to be both fade-proof and tamper-proof to protect the speaker cone from any damage. Three position switch, mounted on dashboard, permits choice of either speaker or both simultaneously. Colors available are either gray or brown, harmonizing with all car interiors. (Models 9180-bronze, and 9181-gray; General Cement Mfg. Co., 919 Taylor Ave., Rockford, Ill.)



Single-needle ceramic cartridge available in two versions; one for 33's and 45's, and the other for 78's. Does not require either equalizers or preamp. Output voltage is one volt on microgroove records. Replacement needle (model N1P) snaps into place and is available with either diamond or sapphire tip. (Model 1P; Sonotone Corp., Elmsford, N. Y.)



High-fi amplifier assembly; 10-watt amplifier, pre-amp and power supply unit. (Model HF-80; Regency Division of I.D.E.A., Inc., 7900 Pendleton Pike, Indianapolis, Ind.)

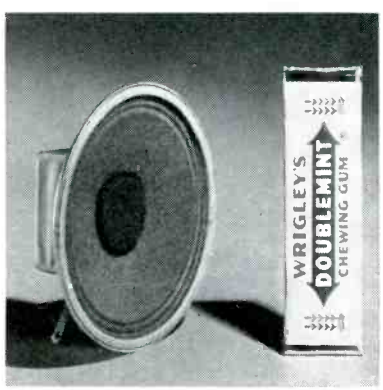


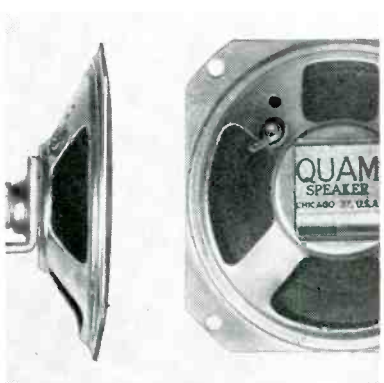
Tape threader; a metal device which holds tape to reel for the first few turns to get winding started, and then can either be slipped off or left in position to serve as a reel crank. Can be used on any size reel up to 7"; for standard reel spindles. (The Flahan Co., 7517 Pelham Drive, Cleveland 29, O.)

Miniature loudspeaker designed for transistorized pocket radios. Speaker is 2¾" in diameter, 1 3/32" in depth, and weighs less than 2¾ ounces. Nominal voice coil impedance at 1,000 cycles is 16 ohms. (Model P275-Y; Jensen Mfg. Co., 6601 S. Laramie, Chicago, Ill.)

Diamond needles packaged in white leatherette-covered boxes. Needles are set off on a black flocked panel insert to simulate the velvet lining of a jeweler's diamond display. (Jensen Industries, Inc., 7333 West Harrison, Forest Park, Ill.)

Four-inch pm speaker of shallow construction. Has RETMA standard rim mounting holes and Alnico V magnet with U shaped pot. Maximum watts input is 2.5. Voice coil impedance 3.2 ohms. (Model 4A06; Quam-Nichols Co., Marquette Rd. and Prairie Ave., Chicago, Ill.)





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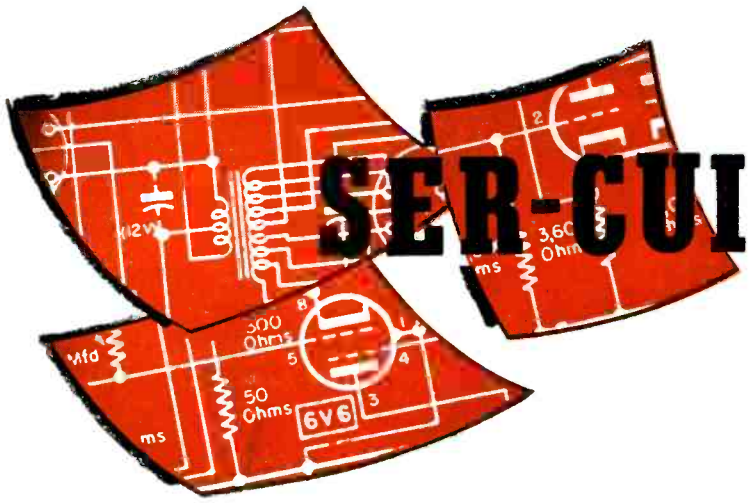
We carry a few of the more popular types of diamond needles along on every service call and always remind the customer to replace his needle. Incidentally, any serviceman can learn to install a diamond stylus in a matter of minutes."



Unity-Coupled Power Amplifier

[*See Front Cover*]

by CULLEN H. MACPHERSON

Assistant Manager, Reproducing Components Division
Electro-Voice, Inc.

ELECTRONIC DEVELOPMENTS in the course of the last decade have made audio power amplifiers the strongest link in the chain of components of a reproducing system. Recent efforts have been directed toward increasing the band pass and decreasing the internal impedance of the amplifier. Although the specifications resulting from this research have been a technical *tour de force,* the operational performance often leaves something more to be desired.

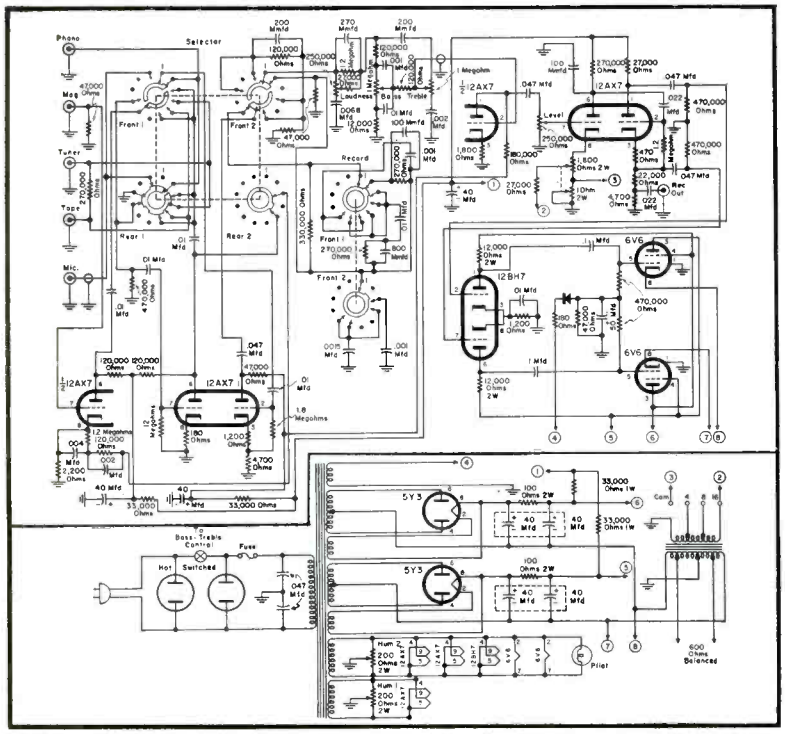
Many reports in current issues of technical journals have been concerned with the problem of supersonic oscillation, switching transients and output stage transient instability. Little comment, however, has been made on the effect of power amplifier internal impedance upon load operation. Recently, it was found possible to produce an amplifier‡ that is free from all circuit instability, offers a high overload safety factor, and provides for varying the amplifier internal impedance.

One of the more important limiting factors in contemporary audio-amplifier design is the output transformer. Through the use of strip wound grain-oriented cores and careful interleaving of primary and secondary windings, leakage reactance and distributed capacity have been radically reduced. By comparison with examples of ten years ago, the modern output transformer is a shining accomplishment. The transformer, however, remains a magnetic device, and as such leakage reactance and distributed capacity may be minimized, but not eliminated.

A very satisfactory method of reducing the limitations imposed by the output transformer is to design an output stage requiring less transformer primarily inductance, thus allowing a reduction in distributed capacity and leakage reactance. The aforementioned amplifier features a circuit which fulfils this requirement because the output tubes operate in series for *dc* and are effectively in parallel for *ac* signals. Because of the parallel-output configuration, it has been found that the primary reactance requirement for the amplifier has been reduced to one-quarter that of conventional designs. This reduction satisfies the requirements for a transformer with reduced leakage reactance and distributed capacitance and, with no further alteration, the output circuit provides four times the phase-margin stability of conventional designs.

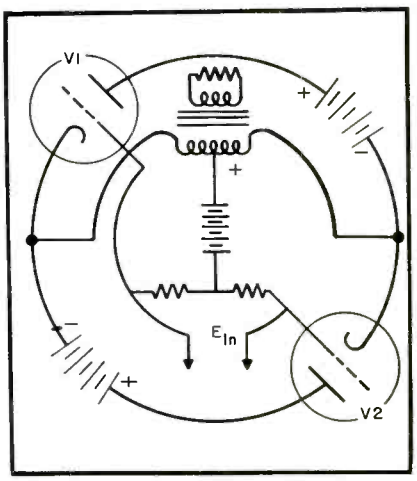
The amplifier's basic circuit, showing the series arrangement of the out-

‡*E-V Circlotron.*



(Left)
Fig. 1A. Complete schematic of the 20-watt E-V Circlotron (model A-20C) **amplifier, containing integral preamp and tone controls.** (See cover)

(Below)
Fig. 1. Basic Circlotron circuit.



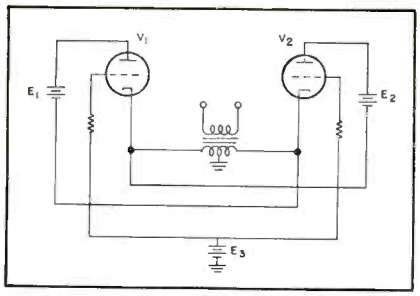
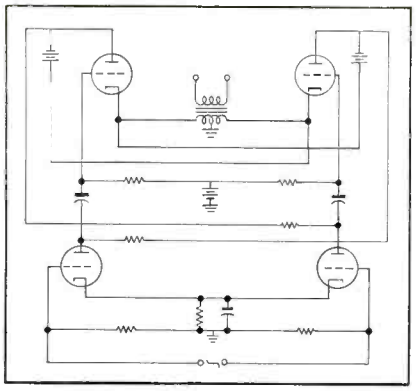
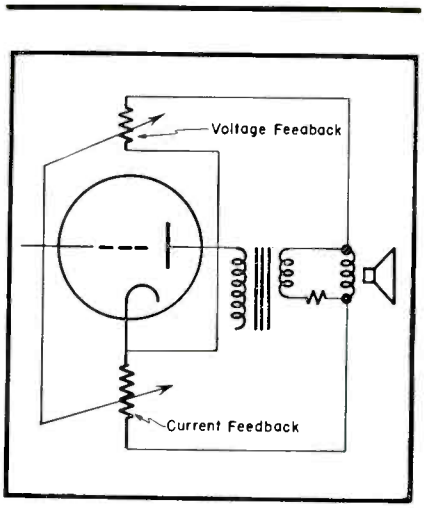


Fig. 2. Transposition of Fig. 1 into more conventional format, showing circuit in simplified form with batteries in place of power supplies.



(Right)
Fig. 3. Circuit of driver stage found to permit higher undistorted voltage without increased plate voltage.



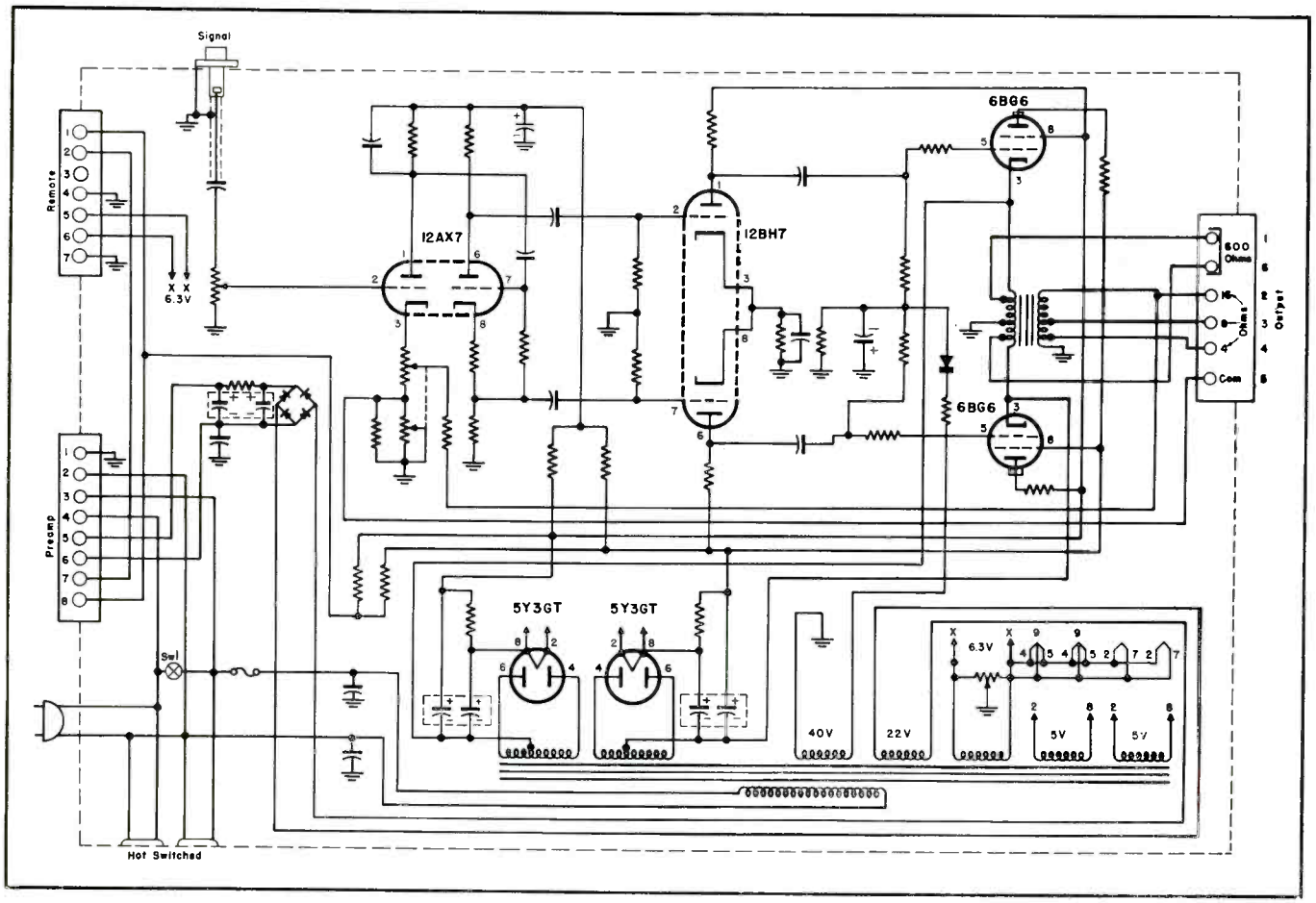
(Right)
Fig. 4. Feedback-proportioning circuit in Circlotron.

put tubes and power supplies, is shown in Fig. 1. The circular arrangement in which the output stage is most easily drawn gave rise to the name for this new circuit. Fig. 2 is a transposition of the circuit into more conventional format, showing the circuit in simplified form with batteries in lieu of power supplies. Two power supplies are used in this circuit, each supply being connected from the plate of one tube to the cathode of the other. The plate current of each tube circulates through both power supplies without traversing the windings of the output transformer. Although two power supplies are necessary, each must furnish only half the usual current demand, and thus no increase in power transformer size is necessary.

Analyzing Fig. 2, it can be seen that the circuit is a balanced bridge under no signal conditions. The bridge consists of two tubes, V_1 and V_2, and the two power sources, E_1 and E_2. Since the cathodes of V_1 and V_2 are equipotential, the output transformer can be placed across this section of the bridge and provided with a center tap, without having power supply current circulate through it. Circuit continuity is established between the grounded center tap of the transformer and the bias return for supply E_3. The grid bias for the amplifier is supplied by a simple half-wave selenium rectifier

(*Continued on page* 42)

Fig. 5. Circlotron (model A 30) **line amplifier with remote control and preamp powered from chassis. Amplifier is rated at 30 watts and 60-watts peak output.**



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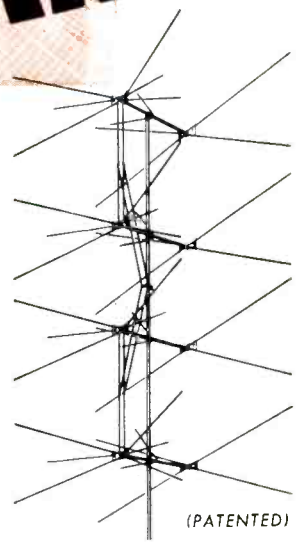

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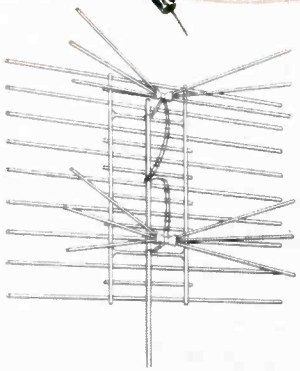

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Converting Audio Amplifiers to Provide Hi-Fi Results

by MARK VINO

Practical Steps to Take in Modifying Amplifiers to Achieve Improved Wide-Range Reproduction: Changing Contact Potential Bias to Cathode Bias . . .

THE CONVERSION of older radio-phonos to accommodate modern program sources, such as FM broadcasts, microgroove records, etc., is an old story to seasoned Service Men. Such a conversion may include the substitution of a new speaker, revamping of the speaker enclosure, and the installation of the latest types of motors, superior pickup cartridges and needles, since higher quality program material calls for higher quality reproduction.

The substitution of a new audio amplifier is not as common a practice, and this leaves the original audio amplifier stages as a possible weak link in the chain of reproducing components. Fortunately, there is usually quite a bit that can be done in the way of improving amplifier quality. Often the amplifier changes can produce a change in the sound quality at least as dramatic as that produced by a new speaker or cartridge.

Checking the Original Circuit

The first step prior to making any changes is to clean up the original amplifier stages, replacing any parts that are slightly defective. For example, coupling capacitors to the output tubes may be a little leaky, causing a few volts of positive potential to be applied to the output grids. While this positive potential may not have an immediately obvious result on reproduction, the lowering of the correct bias can increase harmonic distortion by a significant amount. The offending voltage will register on a *vtvm* (with an input impedance of about 10 megohms or more) connected between grid and ground.

If the output stage uses cathode bias, as is usually the case, the cathode-to-ground bias voltage should be checked and compared with the manufacturer's or tube manual specifications. A change in the value of the cathode resistor, or *dc* leakage in the cathode bypass capacitor, will affect the correct bias voltage.

When the set is an old one it is probably safest to replace all audio coupling and cathode bypass capacitors. As indicated, *dc* leakage in either of these will upset bias conditions and increase distortion, while loss of capacitance will result in bass losses.

Tubes should be checked, taking care to look for noise, hum, or intermittent trouble by generous tapping with a pencil.

Contact Potential Bias

The basic circuit illustrated in Fig. 1*a* is often used as the input voltage amplifier of inexpensive radios. This circuit, which supplies *contact potential* bias, has the disadvantage of allowing relatively high distortion levels. The distinguishing feature of the circuit is the use of a very high value of grid resistor, of the order of ten megohms.

Figure 1*b* illustrates a simple conversion which provides a changeover to *cathode* bias. All values are shown except that of the cathode resistor itself; this must be determined on the basis of the plate and following grid resistors (R_b and R_g) and the value of

(*Continued on page 42*)

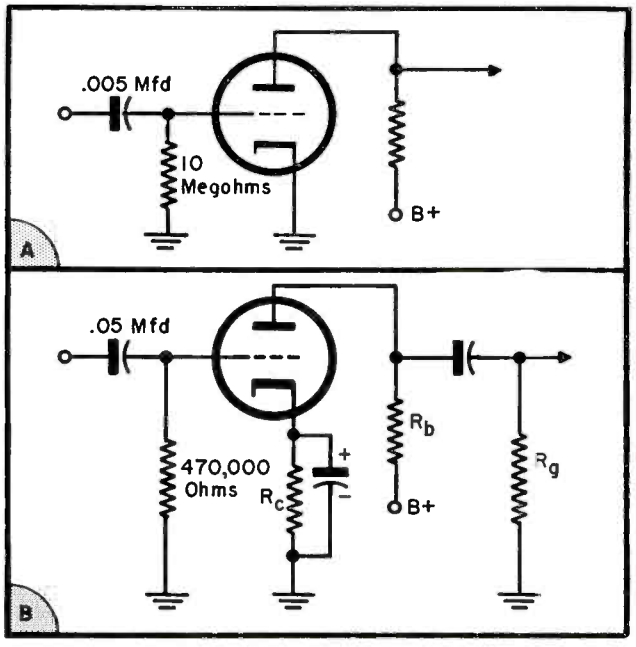


Fig. 1 a and b. In a appears a contact potential bias circuit; conversion of a to cathode-bias circuit is shown in b.

(Right)

Fig. 2. Sample of data from a section of a resistance-coupled amplifier chart for 6SQ7 tube types. (From RCA tube manual)

B+ Voltage	Plate resistor	Following grid resistor	Cathode resistor
90	0.1	0.1	6300
		0.25	6600
		0.5	6700
	0.25	0.25	10000
		0.5	11000
		1.0	11500
	0.5	0.5	16200
		1.0	16600
		2.0	17400
180	0.1	0.1	2600
		0.25	2900
		0.5	3000
	0.25	0.25	4300
		0.5	4800
		1.0	5300
	0.5	0.5	7000
		1.0	8000
		2.0	8800

Converting Amplifiers

(*Continued from page 41*)

the *B*-supply voltage. The resistance-coupled amplifier charts in tube manuals will readily yield the correct values of bias resistor, given the particular plate and grid resistors and the approximate *B*+ voltage.

Data from a section of resistance-coupled amplifier charts of one tube manual‡ are shown in Fig. 2 (p. 41). From this chart it may be seen that, for a *B* supply of 180 volts, a 6SQ7 plate resistor of .5 megohm, and a following grid resistor of .5 megohm, the required bias resistor is 4800 ohms. This value is not too critical, so that variations of 10% will not make any difference. The use of the diode sections of the 6SQ7 for detection is not affected if the load resistor (usually the volume control) is returned to cathode rather than ground, as illustrated in Fig. 3.

Negative Feedback

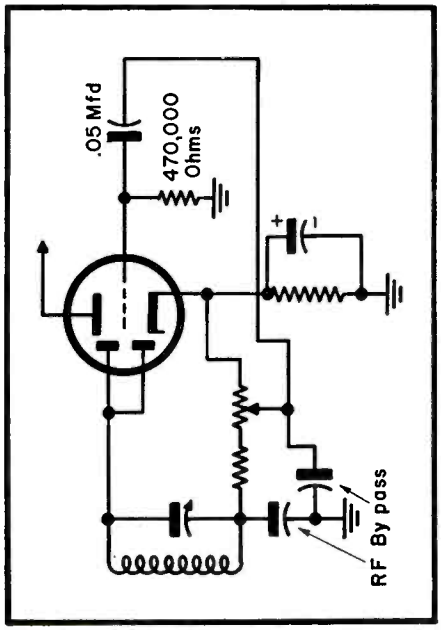
There are many misconceptions about negative feedback, both as to its seemingly magical powers, and the price that must be paid for its benefits. Probably one of the most popular of these misconceptions is the idea that negative voltage feedback reduces the power capability of an amplifier. Actually negative feedback reduces the *gain* of the amplifier, which means that more driving signal voltage is required for the same power output, but a ten-watt amplifier remains a ten-watt amplifier, and will have lower distortion. (As a matter of fact, if the power rating is based on the old, no-feedback distortion level, the power output capability is probably increased by a watt or two.)

Another misconception about negative feedback relates to the range of frequency response. Negative feedback improves the *uniformity* of frequency response, smoothing out peaks and valleys in the response curve such as the peak associated with speaker resonance, but should not be used to *extend* the frequency range.

[To Be Continued]

‡RCA.

Fig. 3. Cathode bias used in a duo-diode-triode detector and amplifier.



Audio Ser-Cuits

(*Continued from page 39*)

and filter operating from a low-current transformer winding.

In the interests of simplicity, the tubes shown in Fig. 2 (p. 39) are illustrated as triodes, although pentodes, tetrodes and beam-power tubes may be used as well. In the case of multi-grid tubes, the screen grid is returned to the opposite tube plate and in the case of pentodes, the suppressor grid is returned to the cathode.

The total primary winding is presented as a load to each tube, one-half appearing in the cathode circuit, and the other half in the plate circuit. Since each tube looks into the same

load, there is perfect coupling between V_1 and V_2. Because of the configuration of this circuit, no switching transients can occur if either of the tubes is driven past cutoff, since both halves of the primary have the same signal current flowing through them. Thus, switching transients which place extremely severe requirements on the output transformer, when the output stage is operated in class *AB* or *B*, are eliminated.

The unity-coupling between the two output tubes allows the tubes to be operated with low quiescent current approaching class *B* operation. Operation of tubes under these conditions enables the amplifier to produce more power than conventional circuitry, while still staying below ½% harmonic distortion and within the established dissipation ratings of the tubes.

Although great flexibility of design is possible with this amplifier, it was decided to employ operation similar to class *B* with *rc* coupling, taking advantage of maximum cathode degenerative feedback, thus reducing distortion products as well. The circuit under these conditions is essentially a cathode follower having a voltage gain less than unity. A cathode follower has the advantage of a large amount of degenerative feedback with resultant low distortion and low output impedance, while still producing a large power gain. Because the output stage voltage gain is less than unity, a higher drive voltage is required compared to a conventional circuit. Although the driver stage has heretofore been a major pitfall in the design of high-power amplifiers, simple circuitry has allowed higher undistorted voltage to be obtained, without increasing the plate voltage of the drivers, by means of the arrangement shown in Fig. 3 (p. 39). In this circuit, the B+ of the driver tubes is taken from the opposite plate of the output tube, resulting in an increase in the *B*+ supplied, by adding one-half of the output signal to the supply voltage. This has been found to permit the driver tube to operate linearly over a greater range than would be possible with a fixed *B*+ supply of lower value. This arrangement is similar to *boot strapping*, as used in TV high-voltage power supplies.

Variable Damping Factor

To obtain optimum speaker performance at low frequencies, it is desirable to have the amplifier present the correct impedance to the load. The value of the required speaker critical-damping resistance is dependent

(*Continued on page* 44)

(*Continued from page 43*)

on speaker design parameters such as flux density, type of enclosure and length of conductor in the gap, to cite only a few of the variables. The necessary source impedance is equal to an external series resistance whose value must be varied widely to present various speakers with a critical damping load. In this amplifier, the internal impedance can be varied over a range large enough to match the output circuit to any loudspeaker.

As illustrated in Fig. 4 (p. 39), the damping factor can be varied by changing the proportion of negative current feedback and negative voltage feedback obtained from the output stage. The precise manner of achieving this is shown in the schematic of the complete amplifier in Fig. 5. By combining negative *current* feedback and negative *voltage* feedback with the aid of a ganged potentiometer, the overall feedback characteristic can be adjusted to provide a damping factor either greater or less than unity. Damping factors smaller than unity are obtained by providing varying amounts of negative *current* feedback, and damping factors greater than unity are achieved by providing varying amounts of negative *voltage* feedback from the output to the first stage cathode. Since the total amount of overall negative feedback is maintained at a constant value, the power available from the amplifier is independent of the damping factor and remains constant for all settings of the variable damping factor control.

The circuit described has been found to make it possible to construct an amplifier which is free from switching transients.

The amplifier is not limited in operation by the output transformer, as are conventional push-pull circuits. An excellent output transformer neither inordinate in cost nor complexity may be designed for the new circuit, since the transformer function has been reduced to an impedance matching device between the output tubes and load. No operational limitations are incurred by the introduction of the ancillary output transformer functions as in conventional circuits.

Other methods of obtaining critical damping are possible, but unless the total feedback product remains constant and negative, as in this unity-coupled amplifier, various difficulties may be encountered. If an amplifier's negative internal resistance is generated to damp the speaker, for instance, the amplifier will oscillate violently when the load is disconnected. Methods employing positive feedback should not be used to produce a variable critical damping resistance.

The amplifiers are available in two models. In addition to the 30-watt line amplifier diagrammed in Fig. 5, there is a 20-watt model, a complete unit containing integral preamp controls: Partial schematic of this model appears on the cover and the complete circuit is presented in Fig. 1A; p. 38.

Audio Forum

(*Continued from page 34*)

is then positioned so that the stylus-arm damping block and support lies within the recess between the magnet pole pieces. Assembly is now pressed in firmly, applying pressure only at the stud pin to avoid damaging assembly. The space between the stylus and the two pole pieces should be approximately equal. If it is not, it will be necessary to adjust, by carefully bending the stylus arm laterally at a point as close to the stud pin as possible.

Dual Stylus: To remove the stylus assembly, the selector knob should be

[1]The following color code has been established for quick identification of both size and substance of G.E. styli: 1 mil sapphire—red; 2.5 mil sapphire—white; 3 mil sapphire—natural; 1 mil diamond—black; 2.5 mil diamond—yellow; 3 mil diamond—violet.

pulled off and the mounting screws and cartridge removed from the tone arm. Then one should compress the spring slightly, remove retaining washer, pick off spring and flat washer, and remove stylus assembly from cartridge.

To install, the stylus assembly should be inserted into the cartridge with a rotating motion. The flat washer and then the spring should be placed over the stylus assembly shaft. The spring should be compressed slightly and retaining washer inserted into groove on the shaft to hold the spring. Next, the cartridge should be mounted into the tone arm and the knob installed. It will be noted that the knob key and stylus assembly shaft slot are off-center, so that the knob can only fit on in one position; the knob pointer should face the 1-mil stylus. One should *check key and slot to fit; do not force knob on.* Knob should be pressed firmly on shaft, making certain first that alignment is correct. Pressure should be applied only at exact center of styli to prevent damage to styli parts.

Dual-Single Unit Servicing

To insure optimum performance from the variable reluctance cartridge, its styli, magnetic pole pieces and gaps should be cleaned periodically of foreign particles accumulated from the record surfaces. A soft bristle brush should be used to clean these parts. These parts are more readily accessible for cleaning if the stylus assembly control knob is depressed and rotated to expose the styli, poles, gaps, and the stylus guide and its recess. The gap clearance between the stylus and each of its pole pieces has been adjusted to be not less than .010". To obtain optimum performance from the cartridge, care should be taken not to distort parts of the assembly which would disturb this critical adjustment.

General Considerations

Stylus Selection: Selection of a stylus should be made in accordance with its recommended use and the choice of sapphire or diamond stylus tip. Each stylus assembly is identified by a code color located on the stud pin of the single stylus or on the stylus guide of the dual styli. It is recommended that the 1-mil stylus be used for microgroove recordings, both 33⅓ and 45 rpm; 2.5 mil stylus for NAB transcriptions; and 3 mil stylus for standard 78 rpm recordings.[1]

Amplifier Design: For optimum performance, amplifiers used with *v-r*

(*Continued on page* 48)

by T. L. GILFORD

Extending HF Response of Old Radio-Phonos*

MODIFICATIONS in circuitry to improve treble response have been developed for the Magnavox Windsor Imperial chassis to conform with the improved high-frequency range of modern *hi-fi* phono records.

The *hf* response of these models was limited at the time of its design to approximately 10,000 kc to minimize the high level of distortion occurring above this frequency in phono records made at that time.

Circuit Modifications

To improve the high-frequency response at low volume control settings in Magnavox radio chassis, a 33-mmfd mica capacitor should be connected between the top and arm of the volume control. Also the resistor connected between the arm of the control and chassis should be changed to 470,000 ohms, if it is not already incorporated or is of some other value; Fig. 1.

Each of the radio chassis contains a 10-kc filter which serves to remove the 10-kc beat between adjacent AM stations. In the AM broad-band position of the treble switch this filter is tuned to 10 kc by a mica trimmer. In other positions of the treble switch the filter is tuned by other values of fixed capacitance to provide a high-frequency cutoff. With the filter in the circuit the highest cutoff frequency is in the order of 10-12 kc. Since the new *hi-fi* records extend well beyond this cutoff frequency it becomes necessary to short out the 10-kc filter coil during phono or FM operation without destroying the effect of the filter for AM radio operation. This can be done by the following procedure: in models CR 203 and 207 jumpers should be placed across item 40 (connected to treble switch).

The filter is shorted out by this connection when the treble control is set at the maximum treble position extending the treble response beyond 15 kc.

The 10-kc filter coil on all other chassis (CR 204, CR 211, CR 231) must be shorted by an external switch wired across the filter coil and mounted conveniently at the rear of the cabinet. The switch should be wired as shown in Fig. 2.

The switch, indicated in Fig. 2, should be closed for phono and FM radio operation to extend the treble response beyond 15 kc. It must be in the open position to achieve 10-kc filtering for AM operation. Added capacitance of the shielded wiring to the switch might require slight retuning of the 10-kc trimmer for maximum *beat* rejection during AM operation.

The foregoing changes recommended on all of the Windsor models, have been found generally sufficient for most; however, since hearing efficiency at high frequencies varies between individuals, additional circuit changes for further increasing high-frequency response can be made.

On models CR 203 and 207, item *17* should be changed from .00051 to .022 mfd (grid of second audio), and item *20*, the treble control circuit, must be removed.

On CR 211 and 231, item *45* is removed; this is the plate of the second audio amplifier. In addition, item *36*, a capacitor, is changed from 470 to 220 mmfd. This will be found in the treble-range switch circuit. Also item *39* (in the bass-control circuit) must be altered; and here the 510-mmfd capacitor is changed to a value of .022 mfd.

The foregoing changes apply only when the models include a three-speed changer with a *hi-fi* pickup with either a dual-sapphire or diamond-sapphire styli; if single speed changers are used, they should be replaced with the three-speed unit.

Owners of old type Magnavox sets will probably possess a library of old vintage phono records having considerable distortion and noise. These defects will be further amplified by the foregoing modifications unless the treble control is operated at the minimum treble position. Set owners should be told that *hi-fi* reproduction is possible only from modern records.

Complaints of severe distortion in the high-frequency range of the Windsor radio-phonos have been found to be due to faulty diaphragm and voice coil assemblies in the horn-type tweeter speaker. Diaphragm assemblies should be replaced.

6SN7GT/6SN7GTA Variations‡

A change in the design of the physical structure of the 6SN7GT tube type has resulted in slightly different electrical characteristics necessitating a change in tube type number; 6SN7-GTA. This tube type differs from the 6SN7GT tube type in the interelectrode capacity and plate voltage rat-

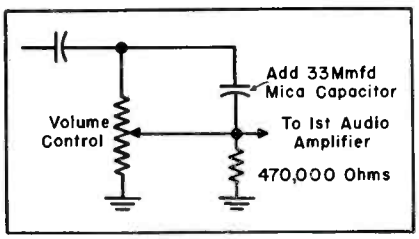
(*Continued on page* 48)

*From Magnavox service department modernization notes.

‡*From RCA service notes.*

(Below)

Fig. 1. Modified treble filter circuit in Magnavox chassis to improve high-frequency response.



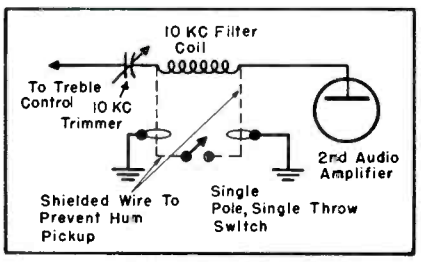


Fig. 2. The 10-kc filter circuit of Magnavox CR 204, 211 and 231 chassis, with a shorting switch that kills filter and extends range to beyond 15 kc, when used for phono.

Servicing Helps

(*Continued from page 47*)

ings. The 6SN7GTA has a higher plate voltage rating and higher plate dissipation than the 6SN7GT. However, the 6SN7GTA may be directly substituted for the 6SN7GT in TV receivers.

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Audio Forum

(*Continued from page 45*)

pickups should be designed for full output with 10-millivolt input. Circuit equalization must be employed to compensate for recording characteristics of the various record manufacturers, to obtain the desired frequency response. Actual design will vary according to the requirements of the individual installation. For applications involving music amplifiers and radio receivers, a phono preamplifier[2] has been designed to provide the necessary preamplification of the reproducer's low level output and the previously-mentioned circuit equalization. The low frequency crossover of this combination is approximately 700 cycles, and total equalization is 18 db. In any receiver or sound apparatus used with these units, it is necessary *to remove previously employed circuit compensation included for phono cartridge frequency response.*

Tone Arm Requirements: Choice of a tone arm must be carefully considered. The mass of the arm should be low, and the lateral and vertical bearings of the low friction type. If the tone arm has excessive mass, and friction in its bearings, the record groove will be overloaded, causing immediate or early breakdown of the record surface material and consequent destruction of the recording. In general, for the reproduction of narrow-groove records, the requirements are more strict than those required by standard groove recordings. The force

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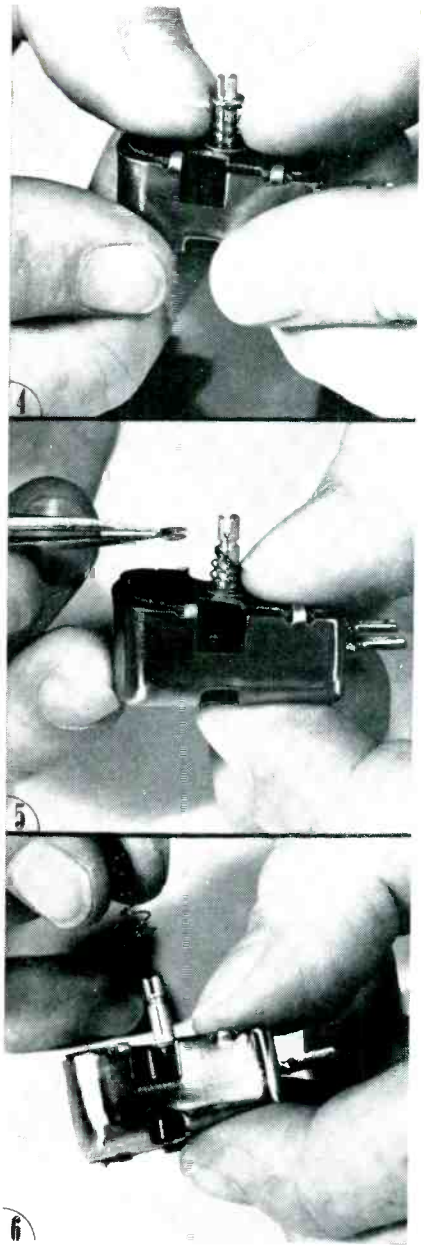
V-R Dual-Stylus Removal



Figs. 4, 5 and 6 (top to bottom): With the V-R cartridge-held stylus side down, tension spring is compressed slightly with thumb nails. Then, holding spring depressed slightly with thumb nail, the C washer is removed with tweezers. Care should be exercised at this point to prevent spring from being lost. After the C washer has been removed, the tension spring can be lifted from shaft.

required to move the pickup and arm in a lateral direction should not exceed 2 grams. The difference in stylus pressure, measured when moving the arm very slowly upward, should not exceed the pressure measured moving the arm downward by more than 2 grams. When making measurements, the stylus must rest on the weight measuring device as the device is moved; first upward approximately ⅛" and then downward approximately ⅛".

Additional Requirements: Additional consideration of equipment de-

[2] G. E. UPX-003A.

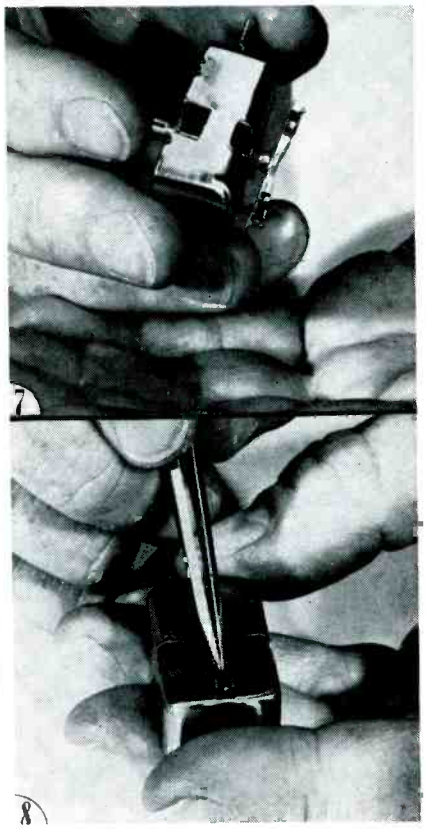
(*Continued on page* 50)

Audio Forum

(*Continued from page* 49)

sign for narrow-groove record reproduction is required in the choice of the phono motor and sound amplifier. Due to the lower output of the pickup cartridge playing narrow-groove recordings (caused by less groove displacement) the hum-to-signal ratio is increased. For minimum hum, the four-pole phono motor has been found preferable to the two-pole type. In addition, adequate filtering of the sound system power supply is necessary to keep the hum-to-signal ratio at a minimum.

V-R Dual Stylus Removal-Assembly



Figs. 7 and 8: Slight pressure applied with finger at end of shaft will drop stylus from cartridge. Avoid damage to styli by dropping assembly into palm of hand. In assembling the new styli in the cartridge the removal steps are reversed. Stylus is inserted with a rotating motion. Flat washer and spring are placed over shaft. Spring is compressed slightly and C washer is inserted in groove to hold the spring. (Note that the knob key and stylus assembly shaft slot are off-center so that knob can only fit on in one position; knob pointer should face one-mil stylus.) After cartridge is mounted in tone arm, a check should be made to be sure that distance between styli and pole pieces is equal. Adjustment can then be made with tweezers as illustrated.

(All v-r photos shown on p. 34, 49 and 50, courtesy G. E.)

Service Engineering

(*Continued from page 26*)

nected directly to the plate of tube *1*. Therefore, when a negative voltage is applied to the grid of tube *1* a more positive voltage will appear at the grid of tube *2*. By tracing this process through the remaining tubes we find that an odd number of tubes will produce a voltage at the output terminals proportional both in direction and amplitude (negative or positive) to the input voltage.

In servicing this form of amplifier the value of the plate, grid, and cathode resistors must be held within close tolerance since the voltages applied to each tube are very critical. Failure of either of the first two tubes in the circuit shown will result in a voltage which will not vary with changes of input voltage. By the addition of a meter at the output terminals of the amplifier, and by the addition of two electrodes at the input terminals, it becomes possible to convert this amplifier into a *ph* meter; Fig. 3. The electrodes are sensitive to the amount of alkali or acid in the solution into which they are immersed. In an alkali solution the sensitive electrode becomes a few hundred millivolts more negative than the reference electrode; Fig. 4. The meter is connected in the circuit so that a decrease in current flow provides a higher numerical reading on the scale. For alkalies the reading will lie somewhere between *7* and 14; for acids the reading will be somewhere between 0 and *7*. If the electrodes were immersed in pure water there would be no voltage difference between the electrodes or *0* voltage input to the amplifier. Pure water has a *ph* of *7*. Therefore when the electrodes are placed in pure water, a zero voltage difference should obtain across the electrodes and the meter should read *7*; this is a useful fact to remember in servicing this type of equipment. To check whether the amplifier is operating properly the input terminals may be shorted, and the meter should produce a *ph* reading of *7*; zero input voltage. When the short is removed the meter reading should change.

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TV Antenna Digest

(*Continued from page 23*)

dicated in the chart on page 23. Or a piece of leadin about 8′ long can be placed across the antenna terminals of set, as shown in Fig. 2 (p. 23). By shorting across the two conductors, the signal will disappear when you reach the ½-wavelength point.

Catalogs and Bulletins

AMERICAN PHENOLIC CORP., 1830 S. 54th Ave., Chicago 50, Ill., has published a 34-page catalog, *W1*, describing coax cables, transmission lines, community TV systems and insulated wire. Features series of selector tables detailing characteristics of coax lines. Also has a selector index for matching cables and connectors.

* * *

EQUIPTO DIVISION, Aurora Equipment Co., Aurora, Ill., has released a booklet, *How To Solve Your Storage Problems*, which explains how to set up storage facilities, make surveys, elevation drawings, and floor plans.

* * *

ARGUS PRODUCTS CO., INC., 4753 N. Broadway, Chicago 40, Ill., has prepared a 4-page folder, describing matching leatherette cabinets for hi-fi equipment. Features a section covering the preservation of cabinets.

* * *

MUELLER ELECTRIC CO., 1583 E. 31st St., Cleveland 14, Ohio, has issued data sheet *168*, detailing the construction and applications of insulated alligator clips.

* * *

TRIAD TRANSFORMER CORP., 4055 Redwood Ave., Venice, Calif., has released 48-page catalog *TV-55*, listing replacement transformers for TV chassis. Includes replacement items for more than 100 TV manufacturers and 5,800 models.

* * *

AMERICAN TELEVISION AND RADIO CO., 300 E. 4th St., St. Paul 1, Minn., has issued an *Inverter-Recorder Selection Chart*, which covers all standard *ac* tape recorder models, listing types of inverters that should be used for use in autos, trains, planes, or *dc* districts.

* * *

RCA, ENGINEERING PRODUCTS DIVISION, Bldg. 15-1, Camden, N. J., has prepared a folder, *For the Best in Multiple TV Distribution, 3R2468*, describing a broadband amplifier (M 5185) for small master-antenna systems providing from 2 to 50 TV receiver outlets.

* * *

MOSLEY ELECTRONICS, INC., 8622 St. Charles Rock Rd., St. Louis 14, Mo., has published a general catalog detailing a line of TV antenna accessories. Included are wall outlets which provide terminal facilities for two antenna leadins, plus rotator control terminals for 4, 5 or 8-wire cable, and a single wall plate which accommodates three separate leadins.

* * *

CBS-HYTRON, Danvers, Mass., has issued the second edition of the *Reference Guide for Crystal Diodes*. Guide lists 185 types of diodes, and provides basic data, including dimensional diagrams.

* * *

B. B. BUTLER MANUFACTURING CO., INC., 3150 Randolph St., Bellwood, Ill., has released a loose-leaf speaker-baffle catalog, describing ceiling, wall and corner baffles for 6", 8" and 12" speakers used in low-level, background music and indoor *pa* systems.

* * *

ASTRON CORP., 255 Grant Ave., East Newark, N. J., has issued a brochure, *How Astron Helps . . . World Technical Cooperation*, highlighting the *Certificate of Cooperation* award recently received from the Foreign Operations Administration of the U.S. Government. Manufacturing facilities of the company are illustrated.

* * *

CARTER PARTS CO., 213 W. Institute Pl., Chicago, Ill., has prepared a catalog sheet, covering miniature phone jacks. Includes mounting dimensions, circuits, and technical specs.

On Book Row

ADVANCED TELEVISION SERVICING TECHNIQUES (AND LAB WORKBOOK) . . . By RETMA PILOT TRAINING COURSE TEACHING STAFF (PAUL B. ZBAR AND SID SCHILDKRAUT): A practical 2-volume study designed for classroom and field use. Clearly defined are the purpose and contribution of each section of a TV receiver. Symptoms of troubles arising from defects in each portion of the receiver are highlighted, and proper procedures to find these troubles are explained. Includes data on TV test equipment; sweep section; *hv*, sync, video, sound, low-voltage power supply, and front-end servicing; alignment, antennas and transmission lines; TVI; and customer relations. Features an appendix of picture tube patterns illustrating receiver defects as an aid in diagnosing troubles.—*176 pages, 8½" x 11", paper bound, priced at $3.60 (Lab Workbook—48 pages, priced at $.95); John F. Rider Publisher, Inc., 480 Canal St., New York 13, N. Y.*

* * *

FUNDAMENTALS OF COLOR TELEVISION . . . By WILLIAM F. BOYCE: A basic book covering the electronic transmission of color, without pronounced reference to mathematics. Chapters include: What You Need To Know About Color; Color Picture Reproduction; Principles of Operation of the NTSC Color System; Color Receiver Systems and Block Diagrams; Circuit Analysis of Color Receivers; and Service Notes for Color TV Receivers. Book includes typical circuits, waveforms and designs, and compares each detail of color TV with monochrome.—*232 pages, 5½" x 8½", paper bound, priced at $2.00; Howard W. Sams and Co., Inc., 2201 E. 46th St., Indianapolis 5, Ind.*

* * *

MASTER INDEX TO MOST-OFTEN-NEEDED TV AND RADIO SERVICING INFORMATION: A 1955 edition, offering information on diagrams and service data appearing in 14 Most-Often-Needed Radio Diagram manuals, covering radio receivers from '26 to '55, as well as nine TV volumes. Radio manufacturers are listed in alphabetical order, with model or chassis number, and corresponding volume and page where the material for each model is presented.—*40 pages, 8½" x 11", paper bound, priced at $.25; Supreme Publications, 1760 Balsam Rd., Highland Park, Ill.*

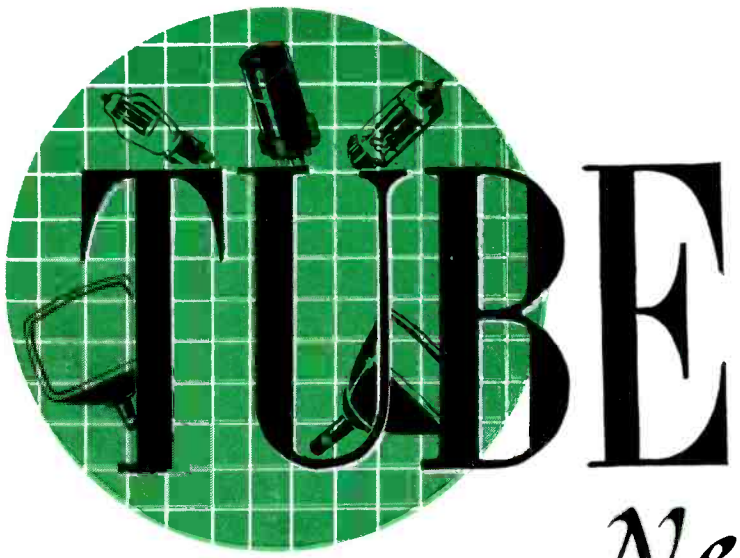
* * *

TRANSISTORS: THEORY AND APPLICATIONS . . . By ABRAHAM COBLENZ AND HARRY L. OWENS: An earthly discussion of the theory, manufacture, and application of transistors. Silicon and germanium transistors are reviewed, including theory of operation and applications, with methods of testing and evaluation. Cascading of transistors, silicon preparation and silicon transistors, the intermetallic compounds and criteria for their selection as transistor materials, power transistors, and *hf* types are detailed.—*Priced at $6.00; McGraw-Hill.*

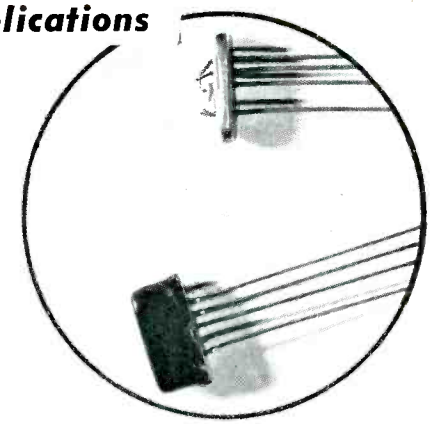
* * *

RADIO-TELEVISION SERVICE PRICING GUIDE . . . By ROBERT T. OELRICH AND HAROLD JUSTICE: A handy field and shop aid with suggested charges for all types of repairs. Prices, represent an average; they are the result of field surveys and conferences with a number of Chicago service companies. Information covers AM-FM radio and TV (alignment), auto radios, record changers, estimates, home service calls, labor charges, pickup and delivery, service warranty, antenna installations, service contracts and TV tuner adjustments. Includes duplicate sets of pages for imprinting own service charges.—*44 pages, plus duplicate sets; Oelrich Publications, 4135 N. Lawler Ave., Chicago 41, Ill.*

Tetrode and Pentode Transistor Applications



News



by W. F. PALMER

Engineer-In-Charge
Applications Section
Electronics Division
Sylvania Electric Products, Inc.

THE INCREASED INTEREST in transistorized equipment has accelerated development of a number of new types of transistors.* Recently it was found possible to produce a point-contact tetrode transistor, type 3N21.

The 3N21, a two-emitter n-type, is similar in construction and electrical characteristics to the 2N32 point-contact triode, with the exception that an extra emitter whisker has been added. Pentode transistors, similar to the 3N321, except that they have three emitters, have also been made.

Fig. 1 illustrates a family of collector characteristics of a typical 2N32 triode or a typical 3N21 tetrode where only one emitter is used; that is, when (say) I_{e_2} is zero. In Fig. 2 we have another family of curves showing how the curves in Fig. 1 are displaced in the direction of higher currents when a *dc* of 1 ma is fed to the second emitter of a tetrode (or pentode). Here we find that the displacement is about 2 ma, indicating that both emitters have approximately the same high current gain, or α; i.e., if the functions of the emitters are transposed, the same characteristics may be used to predict the behavior of the device in a circuit.

Continuing our study of these curves, we now find that the curve for $I_{e_1} = 1$ ma in Fig. 2 is the same as that for $I_e = 2$ ma in Fig. 1. This suggests that the curves of Fig. 1 for tetrodes, pentodes, etc., may be useful in small-signal amplifier design if we use $I_e = I_{e_1} + I_{e_2} + \ldots$, and remember that we can obtain no gain for a signal fed to any emitter if that emitter current becomes less than zero; a situation analogous to grid clipping in tubes having more than one control grid.

Point-contact tetrodes and pentodes also have the same negative input resistance characteristics as the corresponding triodes and are therefore, very useful in switching and computer circuits; usually with some economy of associated components.

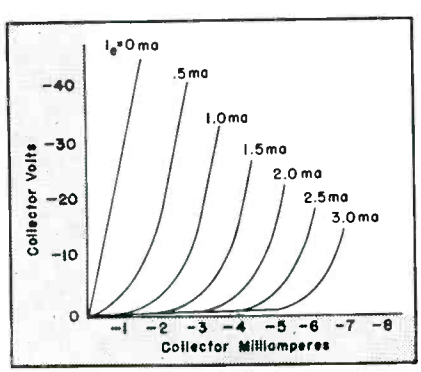
Fig. 3 shows the idealized emitter input negative-resistance characteristic of a 3N21 as a function of current in the other emitter. It will be noted that the uppermost curve is characteristic of the (biased) 2N32 triode, and that increasing the current in a second emitter reduces the extent of the negative resistance region and also depresses it.

Fig. 4 shows a bistable tetrode circuit[1] which can be triggered *on* by a positive pulse applied to either emitter. That is, this circuit has a built-in *or* input; in many computer blocks, this reduces the number of additional components required.

The tetrode may be used in any circuit for which the triode is suitable, but has the added advantage that the

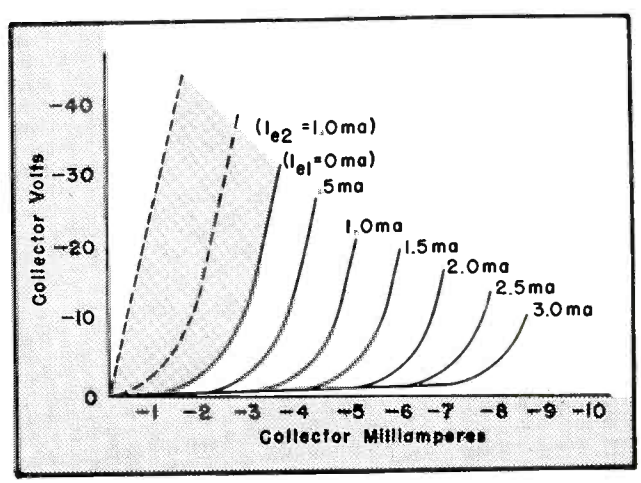
(Below)

Fig. 1. Average collector characteristics of Sylvania 2N32 triode or 3N21 tetrode transistors; each emitter.



(Right)

Fig. 2. Displacement of collector characteristics for one emitter when current is fed to a second emitter of a point-contact tetrode or pentode; e_1 has no control in the shaded region.



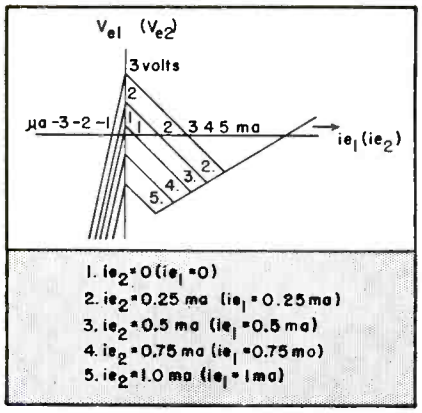


Fig. 3. Emitter negative-resistance characteristics as a function of current of a second emitter.

second emitter can also control the collector current.

An excellent illustration of this action appears in the behavior of the tetrode-mixing circuit shown in Fig. 5. Here, both emitters and the collector are operated class *A* and power gains of 15 to 20 db result for each input. Typical values for components are indicated. Values for C_c and the type of transformer used will depend on the frequency involved.

The tetrode-gating amplifier of Fig. 6 is basically a modulator and may be used as such if suitably biased. As shown, the signal emitter and collector are biased as a class-*A* amplifier. When a positive current pulse of sufficient amplitude is applied to the second emitter the collector is rapidly saturated or *bottomed,* and gain is effectively zero in this condition. An alternative method of gating is possible; the collector may be permanently biased into the saturation region, and shifted into *active* operation by a negative current pulse.

These and other single-tetrode circuits have been combined with other triode and tetrode elements in the construction of ring counters, matrices, modulators and demodulators, and audio and *rf* systems of various types.

*SERVICE, September, 1953, p. 72.

[1]U.S. Patent Pending (#415851), C. Huang, *Transistor Switching Circuit.*

Fig. 4. Tetrode bistable circuit, with or inputs.

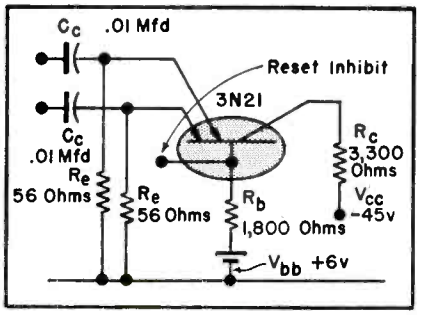


Fig. 5. Two-input mixing circuit.

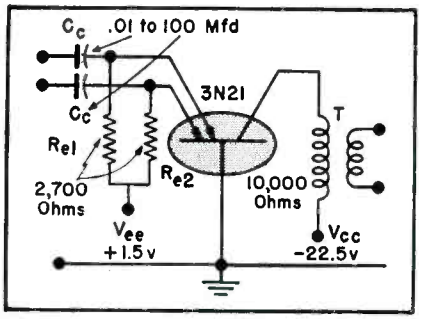
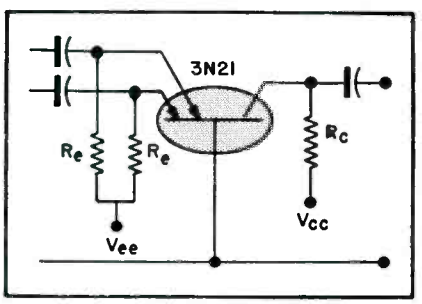


Fig. 6. Tetrode gating amplifier.



Community TV

(*Continued from page* 19)

stage than later, and avoid all possibility of subscriber complaints.

In the viewing tests, one must concentrate on the nearest station; it's unwise to try for those stations that are really beyond reliable range. For instance, when one system was initially installed, an attempt was made to pick up signals from a channel-4 station, that was not only 205 airline miles away, but steeped in mountainous terrain. A large rhombic antenna was erected, and much time spent attempting to obtain a usable signal. While good signals were received *most* of the time, the signal level was just not consistent enough, due to the distance, climatic conditions, and the mountain barriers, for use in a *c-t* system. Instead antennas were set up to receive stations within more reasonable range.‡

When one of the selected stations began operation, with a power of 40 kw *erp*, a very good signal was received in practically all parts of town, on yagi antennas. Some time later, though power was increased, and the antenna pattern was changed to give better coverage. However, this change placed the transmitting-antenna's lobes in a North-South direction, and the town we served, located to the west, found itself out of the pattern; signal levels dropped over 9/10! Fortunately the *c-t* antenna, located in the heart of the signal zone was able to feed an excellent picture to subscribers. But those who had individual installations, with antennas directed to the old lobes, had to reorient their antennas, and in a number of instances increase or decrease the pole heights to accommodate the new patterns.

As to actual field-strength readings necessary, just enough constant signal level must be available to keep the picture on the test receiver at the antenna-site *out of the snow*. In one installation, a minimum reading of 50 microvolts, was found to be satisfactory; a channel-cut ten-element yagi, on a ten-foot mast was used here. The actual reading itself is not too important; a signal of sufficient strength will give an unmistakable indication on any kind of instrument, whether it is a meter or the test receiver. The 7-inch TV receiver mentioned earlier is a must for the final testing, as its use is essential to determine actual picture quality, presence of noise, snow, etc. This monitor may be permanently installed in the *equipment-shack*, along with the bank of line-amplifiers, and used to check the quality of signals being fed into the transmission line to the town below.

The equipment house should be set up, as nearly as possible, in the center of the antenna-field, for convenience in connecting leadin cables to the line amplifiers. This building also provides space for storage of tools, parts and other essential maintenance equipment. Size of the house will be determined by the amount of space needed, type of equipment, power-supply, etc.

The type of antenna finally selected must be determined by experimentation. In our installation, involving reception from three stations on channels *4*, *6* and *7*, a rhombic was selected; it was found to provide superior signal strength readings, and partial immunity to fading. The main disadvantage of this antenna is the large flat area needed for its erection and the high towers required. If the required space is not available for such an antenna, due to sharp peaks on the site or other terrain problems, stacked yagis may be used. According to *c-t* reports, about half of the systems now in operation use yagis and the other

‡In this instance, following stations were selected: KCMC-TV (Texarkana), KARK-TV (Little Rock) and KATV (Pine Bluff), all in Arkansas.

half rhombics. Some are using variations, such as the *horn* model.

Two types of leadin may be used; the standard coax or the heavy *open-wire* line, designed for just such service. The disadvantage of the open-wire line is its higher radiation, which may be disturbing, in some applications.

Matching sections for the rhombics may be easily made up using appropriate lengths of open-wire line, by changing the spacing to match the approximately 700-ohm impedance of the rhombic. This can be *tapered* down to the 450-ohms of the line, and then converted to 72 ohms at the line amplifier, to feed into the transmission line.

Communications BFO

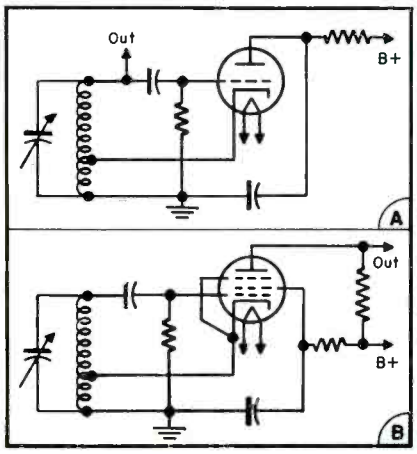
(*Continued from page* 21)

system must be loose; and is usually indirect, through a buffer amplifier, or by use of electron coupling. When the *bfo* is also used for carrier reinsertion, as in several of the newer single-sideband suppressed-carrier systems, the *bfo* must not only be very stable and dependably adjustable, but its amplitude must be controllable†.

Most popular method of reducing *bfo* pulling is by use of an electron-coupled *bfo*, which has most of the advantages of an oscillator-buffer combination, and few of its disadvantages. Although electron coupling has been known and used for more than two decades, there seems to be some confusion regarding exactly what it is, what it does, and in what circuits it is useful. In Fig. 3*a*, a triode tube is shown, connected as a Hartley oscillator. If this triode is replaced by a tetrode or pentode, and the connections, which formerly went to the plate of the triode, are now connected to the screen grid, the output at medium to low power levels will be about the

(*Continued on page* 58)

Fig. 3. Triode Hartley oscillator (a) and electron-coupled Hartley oscillator (b).



Communications BFO

(*Continued from page 57*)

same as with the triode. The screen grid, unlike the plate of the triode, is not a solid sheet of metal, but has many openings in it, so that a portion of the electron stream originating at the cathode, and modulated by the cathode (grid-screen) grid-oscillatory circuit, passes through toward the actual plate of the tube. If this plate circuit is now supplied with voltage, as in Fig. 3*b*, signal in the plate circuit will be at the same frequency as that in the oscillatory circuit, at an amplitude which is, or can be, somewhat greater than that in the oscillator. Additionally, no minor change in the plate load will have much effect on the performance of the oscillator, so that pulling of the *bfo* by the signal in the *if* system is reduced to a negligible, and usually undetectable, amount.

Typical Commercial Circuits

A typical *bfo* circuit used in a communications receiver of recent manufacture is shown in Fig. 4. A tuned grid-tickler *bfo* circuit appears here.** By means of a switch, shorting part of the coil, this oscillator will operate on either approximately 455 kc (switch open) or 10.7 mc (switch closed). This *bfo* works about as well as can be expected of an unbuffered circuit.

Circuit Isolation

In most current *bfo* circuits, and in all *bfo* circuits known to be stable, considerable care has been taken to isolate the *bfo* from other circuits, so that the best frequency is injected into the *if* system only at the desired point, and also so that the signal does not get into the *bfo*. This circuit isolation takes the form of isolating resistors (or chokes) in the plate and screen supplies; and shielding about the inductance. Although this shielding is connected only to ground, it should be considered an integral part of the circuit. Inadequate or omitted shielding will usually permit the beat frequency and some of its harmonics to get into the *if* channel ahead of the desired injection point, producing a peculiar tone, with geometrically interesting, but operationally undesirable, output waveforms.

[*To Be Continued*]

†Arrangements for dual *bfo* levels have been included in the design of the Hammarlund Pro-310 and Hallicrafters SX88 receivers.

**Used in Hallicrafters SX-42; minus pitch control in SX-62.

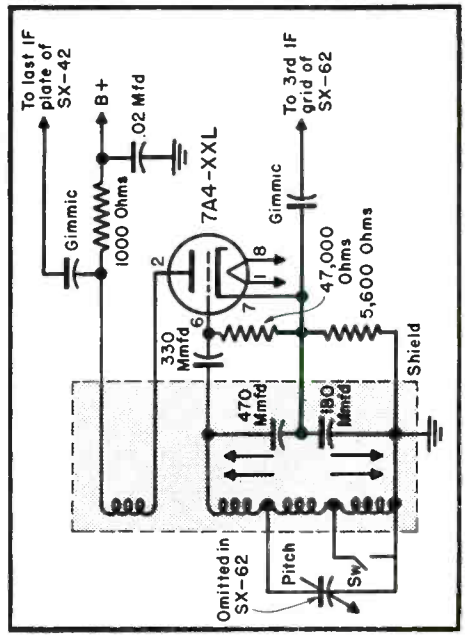


Fig. 4. Tuned grid-tickler bfo circuit used in several Hallicrafters receivers.

Rep Talk

A REALISTIC solution to problems faced by manufacturers' reps has appeared in a report[1] prepared by the RETMA jobber relations committee; correctly designed territorial areas within existing trading areas were proposed to enable a sales rep to spend sufficient time with jobbers. Thirty such areas were suggested, based on a minimum of 35 to 40 parts jobbers; a minimum of 2% of the total sales of replacement parts in the U. S.; mileage from the home office (which should be no greater than the ability of the individual to return to his home base each week after seeing every jobber on his trip); good coverage of the jobber at least once every 30-40 days; and availability of at least 6 lines for the rep. . . . Members of the Wolverine chapter of The Reps, in cooperation with twelve Detroit parts jobbers, sponsored a 2-day TV dealer-Service Men parts show in the Whitehall Exhibit Building recently. . . . *John R. Dailey* has joined the sales engineering staff of the Marshank Sales Co., 672 S. Lafayette Park Pl., Los Angeles, Calif. . . . *Audio Marketing Services*, a rep firm specializing in the sale of *hi-fi* components to southern California, Arizona and Nevada distributors, has been formed by *R. Mark Markman*, at 860 N. Vine St., Los Angeles, Calif. . . . *Robert Cuccaro* has become *New England* rep for Parker Metal Goods Co. . . . *H. George Shefler Co.* (*Herbert Kahn*, partner), Phoenix, Ariz., has been named rep for General Cement Manufacturing Co., in Arizona and New Mexico, plus El Paso county in Texas and Clark county in Nevada. . . . *Edward Hoffman* is now a rep for the Erie Resistor Corp., in Minnesota, North and South Dakota. . . . *John H. Skehan* has been named southwestern rep for Sylvania Electric Products; he will work out of the Dallas, Texas, sales office. . . . *Allen S. Nace*, 7601 Parkview Rd., Brecksville, O., and *Frank A.* and *James B. Daugherty*, 1120 Croyden Rd., Cleveland, O., will cover Ohio, excepting Dayton and Cincinnati, but including Erie, Crawford and Mercer counties of Pennsylvania for Centralab. . . . Two new reps for Sheldon Electric Co. have been appointed: *George J. Rodgers*, 198 Old Farm Rd., Springfield, Mass. (New York), and *John Mustico*, Foster Rd., Philadelphia, Pa. (Pennsylvania, Delaware and southern New Jersey). . . . *Koessler Sales Co.* has moved its San Francisco branch to 2826 Geary Blvd., San Francisco 18, Calif. . . . *Lou Silver* has been named rep for Majestic Radio and Television in metropolitan New York City. Silver is a former vice president of Wilcox-Gay Corp. . . . *Charles A. Hansen* has established his own rep firm in California. Hansen was distributor sales manager of Gramer-Halldorson Transformer Corp. . . . *Adams Engineering, Ltd.*, 1500 Catherine St., W., Montreal, Canada, will represent all product lines of General Instrument Corp., in the territory east of Ontario Highway 41, from Pembroke to Kingston. *H. T. Watt*, vice president of General Instrument-F. W. Sickles of Canada, Ltd., will handle G. I. product lines west of this boundary, with the exception of Watt Electronics solenoids and coils, which will be represented by *F. W. Deacon*, 65 Bloor St. W., Toronto. . . . *William Doyle*, 7002 N. Western Ave., Chicago, Ill., is now rep for Walco in Illinois and Wisconsin. . . . Markel Electric Products, Inc., has named *John H. Vier* as rep in metropolitan New York, northeast Pennsylvania, and northern New Jersey. . . . *LeRoy and McGuire, Inc.*, R. D. 1, Phelps, N. Y., have been appointed reps for United Catalog Publishers, Inc., for New York state, except metropolitan New York City. . . . *Atlas Radio Corp., Ltd.*, 560 King St. W., Toronto, Canada, is now rep for International Rectifier Corp., throughout Canada.

[1] *Unit Territory Plan.*

Herbert Kahn

George Shefler

Edward Hoffman

John H. Skehan

Troubleshooting Heater-Filament Lines

by JACK DARR

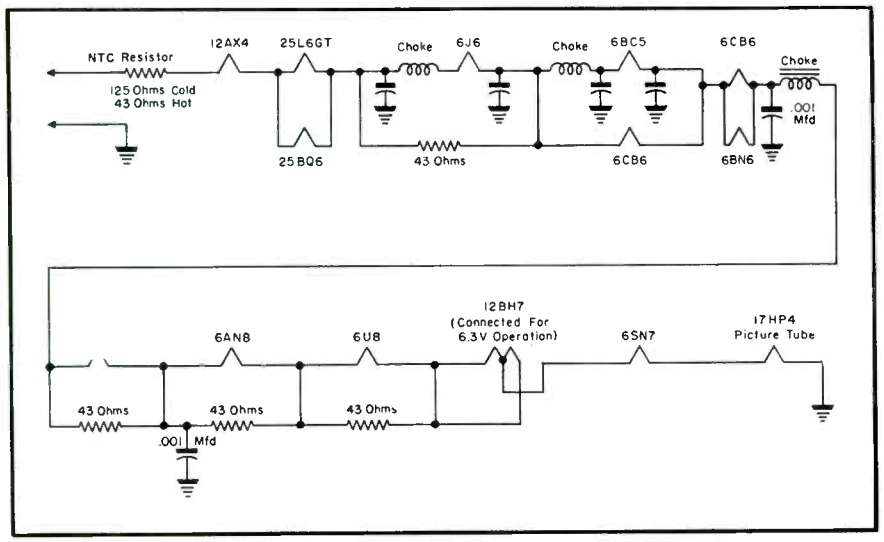
A NUMBER of radio chassis use tube rectifiers (35Z5, 50Y6, 117Z3 or 117Z6) and in many models we find selenium rectifiers. The input voltage to the filter should run well over 125 *v dc*, if the set is to function properly. With 115 *v ac* input to the set, all voltages should be well within the tolerances. If the filter input voltage is down to around 100 *v*, trouble may be expected. A very useful test for these sets is a small auto-transformer, or some means of varying the input line voltage. In this test one tunes in any station, preferably at the high end of the dial, and reduces the line voltage until the oscillator quits. If this occurs at or around 100 *v ac*, the set is satisfactory, but if the oscillator drops out around 110 volts, trouble may be expected. One should check the oscillator tube by replacement, and measure the filter input voltage. The rectifier should be checked, too. Many sets have been built with 75-*ma* selenium rectifiers, which are notorious offenders. The filament string draws 50 *ma* and the tubes take another 10 to 15 *ma;* this leaves a very small safety factor. For better life and more service, 100-*ma* rectifiers should be installed.

Emission in series-string tubes should be up to standard. Low-emission can be the source of many odd problems. In one case, involving a 1N5 in the *if* amplifier stage it was found that the 1N5 read almost 2.5 *v* across its filament, while the oscillator, next in line, had only .8 *v*. Substituting a new 1N5 cleared up the trouble. Apparently the low-emission tube had a high-resistance filament, and was taking more than its share of the filament voltage.

Compensating resistors are also featured in these models; they are shunted across the tube filaments, mainly the power tube. The resistors are used to carry excess current from plate and screen-grid return circuits, shunting the current around the delicate filaments. If the voltages are not right, with good tubes, resistors should be checked for drifting, first removing the tube shunted across it. Most of the resistors are quite small, only 3 or 4 ohms, and consequently critical.

In parallel-filament sets such as straight *ac* and auto-radios, one side of the heater is grounded, usually at each individual tube socket, by a short piece of bus-wire run down to a ground lug on the socket itself. If this wire crystallizes and breaks, or if there is a bad solder joint some very puzzling noise, weakness and intermittents will obtain, especially if it happens to be in an *rf* stage.

Fig. 1. Typical series-parallel circuit encountered in ac/dc TV sets. Note shunt resistors across 300-ma tubes to compensate for extra current; also filament of 12BH7, a 12.6-6.3 combination. This is tied in parallel for operation at 6.3 volts, 600 ma. (Tube following 6CB6 vif and 6BN6 detector-limiter is third vif, a 6CB6)



TV Chassis Filament Strings

While many TV sets use power transformers, with a filament winding, like the familiar *ac* sets, a number have appeared with a series filament string or strings, and selenium rectifier power supplies. Some models have complex filament strings; due to the larger number of tubes in the average TV receiver, the string may have as high as four branches, each adding up to the required 110 volts.

To illustrate, in the filament circuit used in the 14-tube Crosley model 426, the total filament current for the entire string is 600 ma or .6 ampere. (Current requirements for various types differ, with both 350 and 600-ma types being used.) The picture tube, a 17HP4, draws 600 ma, and is placed at the low end of the string.

Beginning at the *hot* end of the string, the current flows first through a 12AX4 damper heater, then through a parallel circuit consisting of a 25L6GT and 25BQ6GT audio power output and horizontal output tubes, respectively. From this point, we enter another parallel circuit; the two tubes in the tuner, 6J6 mixer-oscillator and 6BC5 *rf* amplifier, shunted by a 43-ohm resistor, and the 6CB6 first video *if* amplifier. Thence, into another parallel composed of the second *vif* amp, a 6CB6, shunted by a 6BN6 gated beam detector-limiter. Through a small *rf* choke, the string continues on to another parallel lineup, the third *vif* 6CB6 and a 43-ohm resistor, a 6AN8 video amplifier-sync-clipper, shunted by 43 ohms, and on to a 6U8 sync amplifier also shunted by 43

(*Continued on page* 62)

Superior's new Model 670-A SUPER METER

A COMBINATION VOLT-OHM MILLIAMMETER PLUS CAPACITY REACTANCE INDUCTANCE AND DECIBEL MEASUREMENTS

SPECIFICATIONS:

D.C. Volts: 0 to 7.5/15/75/150/750/1,500/7,500 Volts
A.C. Volts: 0 to 15/30/150/300/1,500/3,000 Volts
Output Volts: 0 to 15/30/150/300/1,500/3,000 Volts
D.C. Current: 0 to 1.5/15/150 Ma. 0 to 1.5/15 Amperes
Resistance: 0 to 1,000/100,000 Ohms 0 to 10 Megohms
Capacity: .001 to 1 Mfd. 1 to 50 Mfd. (Good-Bad scale for checking quality of electrolytic condensers.)
Reactance: 50 to 2,500 Ohms, 2,500 Ohms to 2.5 Megohms
Inductance: .15 to 7 Henries 7 to 7,000 Henries
Decibels: −6 to +18 +14 to +38 +34 to +58

ADDED FEATURE:

Built-in ISOLATION TRANSFORMER reduces possibility of burning out meter through misuse.

The Model 670-A comes housed in a rugged crackle-finished steel cabinet complete with test leads and operating instructions.

$28.40 NET

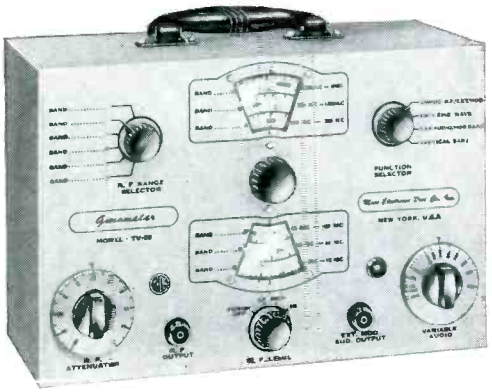
Superior's new Model TV-11 TUBE TESTER

★ Tests all tubes including 4, 5, 6, 7, Octal, Lock-in, Peanut, Bantam, Hearing Aid, Thyratron, Miniatures, Sub-Miniatures, Novals, Sub-minars, Proximity fuse types, etc.
★ Uses the new self-cleaning Lever Action Switches for individual element testing. Because *all elements are numbered according to pin-number in the RMA base numbering system*, the user can instantly identify which element is under test. Tubes having tapped filaments and tubes with filaments terminating in more than one pin are truly tested with the Model TV-11 as any of the pins may be placed in the neutral position when necessary.
★ The Model TV-11 does not use any combination type sockets. Instead individual sockets are used for each type of tube. Thus *it is impossible to damage a tube by inserting it in the wrong socket.*
★ Free-moving built-in roll chart provides complete data for all tubes.
★ Newly designed Line Voltage Control compensates for variation of any Line Voltage between 105 Volts and 130 Volts.
★ NOISE TEST: Phono-jack on front panel for plugging in either phones or external amplifier will detect microphonic tubes or noise due to faulty elements and loose internal connections.

EXTRA SERVICE—The Model TV-11 may be used as an extremely sensitive Condenser Leakage Checker. A relaxation type oscillator incorporated in this model will detect leakages even when the frequency is one per minute.

The Model TV-11 operates on 105-130 Volt 60 Cycles A.C. Comes housed in a beautiful hand-rubbed oak cabinet complete with portable cover.

$47.50 NET



THE NEW MODEL TV-50 GENOMETER

A versatile all-inclusive GENERATOR which provides ALL the outputs for servicing:

A.M. Radio • F.M. Radio • Amplifiers • Black and White TV • Color TV

7 Signal Generators in One!

- R. F. Signal Generator for A.M.
- R. F. Signal Generator for F.M.
- Audio Frequency Generator
- Bar Generator
- Cross Hatch Generator
- Color Dot Pattern Generator
- Marker Generator

R. F. SIGNAL GENERATOR: The Model TV-50 Genometer provides complete coverage for A.M. and F.M. alignment. Generates Radio Frequencies from 100 Kilocycles to 60 Megacycles on fundamentals and from 60 Megacycles to 180 Megacycles on powerful harmonics.

VARIABLE AUDIO FREQUENCY GENERATOR: In addition to a fixed 400 cycle sine-wave audio, the Model TV-50 Genometer provides a variable 300 cycle to 20,000 cycle peaked wave audio signal.

BAR GENERATOR: The Model TV-50 projects an actual Bar Pattern on any TV Receiver Screen. Pattern will consist of 4 to 16 horizontal bars or 7 to 20 vertical bars.

CROSS HATCH GENERATOR: The Model TV-50 Genometer will project a cross-hatch pattern on any TV picture tube. The pattern will consist of non-shifting, horizontal and vertical lines interlaced to provide a stable cross-hatch effect.

DOT PATTERN GENERATOR (FOR COLOR TV): Although you will be able to use most of your regular standard equipment for servicing Color TV, the one addition which is a "must" is a Dot Pattern Generator. The Dot Pattern projected on any color TV Receiver tube by the Model TV-50 will enable you to adjust for proper color convergence.

MARKER GENERATOR: The Model TV-50 includes all the most frequently needed marker points. The following markers are provided: 189 Kc., 262.5 Kc., 456 Kc., 600 Kc., 1000 Kc., 1400 Kc., 1600 Kc., 2000 Kc., 2500 Kc., 3579 Kc., 4.5 Mc., 5 Mc., 10.7 Mc., (3579 Kc. is the color burst frequency.)

The Model TV-50 comes absolutely complete with shielded leads and operating instructions.

ONLY $47.50 NET

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NO MONEY WITH ORDER — NO C.O.D.

Try any of the above instruments for 10 days before you buy. If completely satisfied *then* send down payment and pay balance as indicated on coupon. **No Interest or Finance Charges Added!** If not completely satisfied return unit to us, no explanation necessary.

MOSS ELECTRONIC DISTRIBUTING CO., INC.
Dept. D-92, 3849 Tenth Ave., New York 34, N. Y.

Please send me the units checked. I agree to pay down payment within 10 days and to pay the monthly balance as shown. It is understood there will be no finance, interest or any other charges, provided I send my monthly payments when due. It is further understood that should I fail to make payment when due, the full unpaid balance shall become immediately due and payable.

Name .....
Address .....
City ..... *Zone* .... *State* .....

☐ **Model 670-A . . . Total Price $28.40 $7.40 within ten days. Balance $3.50 monthly for 6 months.**

☐ **Model TV-11 . . . Total Price $47.50 $11.50 within ten days. Balance $6.00 monthly for 6 months.**

☐ **Model TV-50 . . . Total Price $47.50 $11.50 within 10 days. Balance $6.00 monthly for 6 months.**

Heater–Filament Lines

(*Continued from page 60*)

ohms; then to a 12BH7 (vertical oscillator and amplifier), with the two halves tied in parallel. Next, the circuit goes on to a 6SN7, the *afc* and horizontal oscillator, and finally to the 17HP4 heater to common. The pix-tube's heater is connected last in the string to reduce the possibility of burnout, should a cathode-heater short occur elsewhere in the string, causing an overload.

In the common-single series circuit used in small radios, removal of one tube or burnout of one heater opens the circuit entirely. In a complicated series-parallel heater circuit, removal of one tube in most places will not open the circuit, but instead place an overload on the heater or resistor in shunt with it. Therefore, when servicing series-filament TV sets, one should never remove tubes unless the set is turned off. This will avoid damage to other tubes or shunt resistors. If it becomes necessary to open some particular circuit for testing or alignment work, one should insert another tube, weak or even shorted in some places, and clip the plate or cathode pins, leaving only the heaters. This need not be the same tube-type, as long as the heaters have the same rating and are connected to the same pins.

In troubleshooting, if one of the tubes in a straight series section of the circuit, such as the 6SN7, is open, the whole string will be found open. If the second *vif* 6CB6 is open, the 6BN6 will glow brightly; obviously overloaded, of course. The set must not be left on too long when making these tests, it would be much safer to check all tubes in a tube-tester. Visual inspection of the shunt resistors will suffice in most cases. However, if the resistors have been subjected to an overload, an ohmmeter check is advisable.

This TV model also utilizes an *ntc* resistor, discussed earlier, but in a different form, to limit the surge current through the heater string. It is a special unit, with a cold resistance of 125 ohms and a hot resistance of 43 ohms. Other special features, not found in radio sets, except FM models, include the use of small *rf* chokes and bypass capacitors in the filament string, between the tuner tubes. These are required to prevent circulation of *rf* currents through the heaters, which could cause regeneration or oscillation. The bypass capacitors are part of the same filter circuit.

In conclusion, the Service Man can locate troubles easily and quickly if he will remember the exact characteristics of the particular circuit involved.

UNITED MOTORS SERVICE FORMS DISTRIBUTORS' COUNCIL

Formation of a *distributors' council*, made up of 15 distributor members, selected not only on a geographic basis, but so that various types and sizes of distributors are represented, has been announced by *W. N. Potter*, general manager of United Motors Service Division of General Motors, Detroit 2, Mich.

It is expected that the council meetings will discuss policies, marketing practices, products, advertising effectiveness and sales organization efficiency. First meeting is scheduled to be held in Detroit sometime during March. Membership on the Council is limited to one-year terms.

UMS distributors who will serve on the '55 council are:

Max Ehrlich, Ehrlich Electrical Service, Inc., Troy, N. Y.; *E. A. Wildermuth*, E. A. Wildermuth, Inc., Brooklyn, N. Y.; *O. H. Hamby*, Southern Bearings and Parts Co., Charlotte, N. C.; *Henry Levene*, United Auto Parts, Inc., Binghamton, N. Y.; *A. C. Volkens*, Sieg Company, Davenport, Iowa; *Kenneth Allen*, Motor Supply Co., Inc., Meridian, Miss.; *John M. Yantis*, Osburn-Crow & Yantis Co., Memphis, Tenn.; *Paul A. Keenan*, Keenan Auto Parts Co., Albany, Ga.; *N. B. Parker*, H. M. Parker & Son, Glendale, Calif.; *W. J. Barron*, Barron Motor Supply, Cedar Rapids, Iowa; *W. D. Crossley*, Hendrie & Bolthoff Co., Denver, Colo.; *A. W. Kleinschmidt, Jr.*, The Automobile Equipment Co., Detroit, Mich.; *E. C. Beard*, Beard & Stone Electric Co., Inc., Dallas, Texas; *J. C. Hamilton, Jr.*, J. C. Hamilton Co., Tulsa, Okla., and *W. B. McCullough*, J. H. McCullough & Sons, Philadelphia, Pa.

NEWS

CBC EXPANDS

Removal to a new plant at 2601 N. Howard St., Philadelphia, Pa., has been announced by CBC Electronics Co., Inc.

New facilities afford approximately six times the area previously occupied.

* * *

MILLER NEEDLE BONUS PLAN

A cash bonus replacement-needle plan has been announced by the M. A. Miller Manufacturing Co., Libertyville, Ill.

Miller replacement needles now carry colored bonus coupons, which can be redeemed for cash; coupons are placed in bonus folder and submitted to jobber or direct to plant.

* * *

WALCO NEEDLE DISPLAY

A Walco needle counter display, measuring 12" x 17", is now available from Electrovox Co., 60 Franklin Street, East Orange, N. J.

Needles, which are precious metal tipped with all-groove points, and fit thumb or set-screw type cartridges, are packaged in gold foil discs imprinted in maroon, black and red; 30 needles are included in display.

* * *

SHURE BROS. TO BUILD NEW PLANT

A building permit to construct an 80,000 square-foot one-story factory and office building at 222 N. Hartrey Ave., Evanston, Ill., has been acquired by Shure Bros., Inc., Chicago, Ill.

Company expects to move into new quarters in April, '56.

* * *

ALBERT BRAND

ALBERT BRAND, secretary-treasurer of Radio Merchandise Sales, Inc., died a few weeks ago.

Brand was co-founder of RMS. In addition to his duties as secretary-treasurer, he was sales manager. He was 46 years old.

* * *

IRC POWER RESISTOR CARDS

Resist-O-Cards introducing IRC's two new 7-watt and 10-watt wirewound power resistors. Each card provides a balanced assortment: Assortment 19 contains 20 selected popular values of type PW7, including frequently requested values of 3300 and 3900 ohms. Assortment 20 contains 20 selected values of type PW10 including the 3300, 3900, and 6000-ohm values. Resistors are rectangular shaped with wirewound elements fully enclosed and sealed in ceramic. Have axial leads.

INDEX

Part II: JANUARY-DECEMBER, 1954‡

COLOR TELEVISION

INSTRUMENTATION

‡Part I appeared in SERVICE, Dec., 1954.

TELEVISION

Instruments

HEATH 'SCOPE

A 5" 'scope model *0-10,* with printed circuit boards, has been announced by the Heath Co., Benton Harbor, Mich.

Unit is claimed to have essentially flat vertical channel response from 5 cps to 5 mc; down 1½ db at 3.58 mc (color TV sync burst frequency). Uses 5UP1 *crt,* and employs new-type sweep generator circuit which is said to produce stable, linear sweeps up to 500,000 cps.

* * *

C-D DECADE RESISTORS

Decade resistor units, featuring pairs of direct reading panel switch scales in series, permitting 110 different resistance values, are now available from Cornell-Dubilier Electric Corp. Units may be used individually or may be connected in series to provide a range of values from one to more than a million ohms, in steps of one ohm.

Three models are available: *RDA* with a resistance range of 1 to 110 ohms in steps of one ohm; *RDB* with a resistance range of 100 to 11,000 ohms in steps of 100 ohms; and *RDC* with a resistance range of 10,000 to 1,010,000 ohms in steps of 10,000 ohms.

* * *

G.E. SERIES-STRING HEATER CHECKER

An instant-action, pocket-size heater checker, for series-string tubes in TV sets, *ac-dc* and portable radios, has been announced by the General Electric tube department, Schenectady, N. Y.

With the heater checker, one inserts tube in one of four sockets available. If the tube heater is satisfactory, a small light-bulb in the checker lights immediately with no warmup time needed. Sockets are provided for eight-pin octal, seven and nine-pin miniature, and picture tubes. Checker with battery weighs under eight ounces, and has a durable plastic case.

* * *

B & K CATHODE REJUVENATOR TESTER

A *cathode rejuvenator tester,* which, it is said, can be used to check and repair weak and inoperative TV picture tubes without removing the tube from the TV set, has been announced by B & K Manufacturing Co., 3731 N. Southport Ave., Chicago 13, Ill.

Unit, it is claimed, tests for emission, interelement shorts, leakage, open circuits, grid cut-off, gas content, and probable useful life; in addition, tester restores emission and brightness, removes shorts, and repairs open circuits. Measures 11" x 7½" x 5".

PYRAMID CAPACITOR-RESISTOR ANALYZER

A capacitor-resistor analyzer, *CRA-1,* designed with a built-in quick-check unit that permits testing of a suspected capacitor, while in the circuit, without disconnecting the capacitor or disturbing circuit in any way, has been developed by the Pyramid Electric Co., 1445 Hudson Blvd., North Bergen, N. J.

Unit, which tests for shorts, opens and intermittents, and also tests for capacitance, resistance, power factor, leakage current and insulation resistance, is equipped with a quick-charge switch to decrease charging time constant when testing high capacity paper capacitors; for safety, discharge feature is provided permitting a capacitor to be discharged before it is removed from test.

* * *

SIMPSON-GREIBACH METER MOVEMENT

A bifilar suspension-type meter movement, *Simpson-Greibach,* has been announced by the Simpson Electric Co., 5200 W. Kinzie St., Chicago 44, Ill.

Armature is held in place by fine bifilar wires kept under tension by disc springs contained in adjustable end pieces of the movement cartridge. Friction inherent in common pivot and jewel construction is said to be eliminated by the bifilar suspension principle. Lab standards constructed by this principle, it is claimed, have been shock tested to 500 *g*'s without appreciable loss of accuracy.

Tools . Parts

RADIO RECEPTOR HIGH-TEMP SELENIUM RECTIFIERS

High-temperature selenium rectifiers, in sizes to 5" x 6", said to operate without derating at 125° *C*, are now available from the Semi-Conductor Division, Radio Receptor Co., 251 W. 19th St., New York 11, N. Y.

Rectifiers can be hermetically sealed without derating; at 125° it is claimed they have a minimum guaranteed life span of 500 hours without derating, and at *normal* temperature will last almost indefinitely. Can also be supplied in cartridge type if desired.

* * *

AEROVOX CERAMIC-CASED PAPER TUBULARS

Ceramic-cased paper tubulars, *P84 CM* or *Duramics*, with increased ratings, have been announced by Aerovox Corp., New Bedford, Mass.

Capacitors feature steatite casing, with specially-developed end-sealing material, and protection against humidity. *Duramics* are for an operating temperature of from —55° to +85° *C*.

Bulletin *NPA-200*, containing detailed information, is available from Aerovox.

* * *

JAMES VIBRATOR RUBBER ASSEMBLY

A sponge rubber assembly for vibrators has been introduced by the James Vibrapower Co., 4036 N. Rockwell St., Chicago 18, Ill.

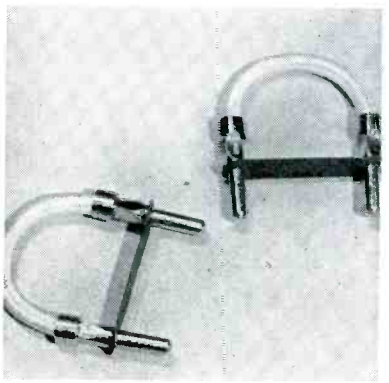
Vibrator is suspended and enclosed in a newly developed sponge material; yet, it is said, unit is held firmly for trouble-free operation.

* * *

CLAROSTAT PLUG-IN FUSE-TYPE RESISTOR

A dual-purpose plug-in fuse-type resistor, *Fuzohm*, designed to withstand high-surge currents without damage, but fuse when surge becomes dangerous to components, has been developed by the Clarostat Manufacturing Co., Inc., Dover, N. H.

An example of this type resistor is series *4FYG-001*, (Part *CM14282*), a 7.5-ohm resistor normally carrying 1 amp and withstanding surge currents of 1.75 *a*. This resistor is designed to fuse at 2.3 *a* in less than 30 seconds.



EVEREADY FLASHLIGHT

A special *Eveready* flashlight, *Heavy-Duty 1251A* (two cell) and *1351A* (three cell), designed for those who want an extra-sturdy light, has been announced by National Carbon Company, 30 E. 42nd St., New York 17, N. Y.

Flashlight features a tube and bottom cap moulded of ethyl cellulose; resistance to high and low temperature extremes and deterioration from the most commonly encountered liquids, greases and solvents; lens-guard made of polyethylene which protects lens and throws a red safety-warning light; and a hand-replaceable, self-lubricating slide switch.

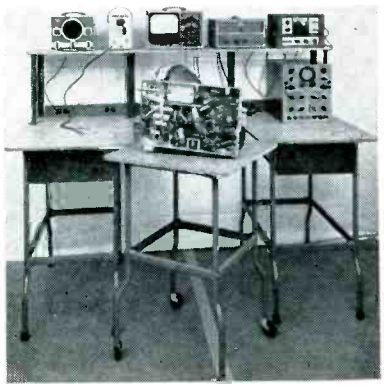
TV Parts... Accessories

BAUMKER TV SERVICE BENCH

A TV service bench, with a movable center table to facilitate chassis handling, has been announced by the Baumker Manufacturing Co., 3870 Summit St., Toledo, Ohio.

Bench, which is constructed of wood and steel, is 72" long by 36" deep and 36" high, and has two drawers for tools. Back panel is equipped with five double outlets, a master switch and a safety indicator light. Adjustable shelf at back provides space for test equipment.

Service table is 24" by 24", of bench height and is mounted on three-inch casters. It fits and locks into cutout center of bench in any of four positions.



CBC VOLTAGE REGULATOR

An automatic voltage regulator, *Regomatic*, designed to operate with TV receivers, has been announced by CBC Electronics Co., Inc., 2601 N. Howard St., Philadelphia 33, Pa.

Available in two models: *200*, a 200-watt unit for small and medium size receivers; *300*, a 300-watt unit accommodating larger sets.

Unit is plugged into wall outlet, and *ac* cord of the TV receiver is plugged into regulator. Fluctuating voltages ranging from 95 to 130 are said to be kept at a constant 115 *v*, ±3%, automatically.

SICKLES TV DEFLECTION SYSTEMS

Two TV receiver deflection systems, (70° and 90°) for large-screen chassis, have been developed by the F. W. Sickles Division, General Instrument Corp., Chicopee, Mass.

Systems include a 90° yoke and flyback transformer for 230 *v* deflection used with shortened 21-inch picture tube and a 70°, 120 *v* setup for compact sets such as the 17-inch portable types, but capable of operating 21-inch picture tubes directly from the line without a transformer.

The 90° system includes a newly-developed yoke, *17189-2*, and flyback transformer, *17252-1*; 70°, 120 *v* system consists of new yokes, *17157-1* (for best pin cushion characteristics) or *17131-1* (for emphasis on best focus), and flyback transformer *17270-1*. Both systems were designed for use in transformerless sets.

Typical circuit diagrams for each of the systems are available on request from sales department.

* * *

RAM-ZENITH FLYBACKS

Two horizontal-output transformers, *X070 and X116*, for replacement in Zenith receivers, have been introduced by Ram Electronics Sales Co., Irvington-on-Hudson, N. Y.

Models have an anti-corona spray feature, special terminal lead distribution and high voltage stand-off construction.

WILLIAM PLATT has been appointed vice president in charge of sales for Winston Electronics, Inc., Philadelphia, Pa.

* * *

LOUIS M. PARK, formerly executive assistant to the vice president-sales of Admiral, has been named coordinator of sales, advertising and management of the TV and radio operations of Raytheon.

PERSONNEL

HERB CORNELIUS is now sales manager of Littelfuse, Inc., Des Plaines, Ill. He is directly responsible for planning and organizing product advertising and promotion.

Herb Cornelius

Robert G. Marchisio

ROBERT G. MARCHISIO has been appointed a vice president of CBS-Hytron, Danvers, Mass. . . . E. GORDON BURLINGHAM has been named sales service manager.

* * *

IRVING G. ROSENBERG, vice president, government and tubes, has been assigned executive responsibility for direction of the communication products division of Allen B. DuMont Labs, Inc., Clifton, N. J. He will continue to manage the *crt* division of DuMont.

* * *

CULLEN MACPHERSON is now assistant manager of the reproducing components division of Electro-Voice, Inc., Buchanan, Mich. . . . GEORGE R. RILEY has become assistant manager of the distributor sales division. . . . EVERETT E. LEEDOM has been named advertising manager. . . . LLOYD W LORING is now sales engineer.

Cullen Macpherson

Everett E. Leedom

JACK WHITESIDE is now general manager of the Simpson Electric Co., Chicago, Ill.

* * *

PAUL L. KUCH is now in charge of advertising and sales promotion of Tobe Deutschmann Corp., Norwood, Mass. Kuch was formerly with Aerovox and C-D.

Associations

ARTSNY

MAX LEIBOWITZ has been elected president of the Associated Radio and Television Servicemen of New York. *Peter La Presti* is now executive secretary, and *George Kimmel*, treasurer. *Phil Goldfarb* has been named chairman of the board of directors.

Business chapter officers and members of the board of directors include: *Jack Ornstein*, chairman; *Jacob Allen*, recording secretary; *Henry Kays*, financial secretary; *Harold Landfield*, corresponding secretary, and *John Wagonny*, sergeant-at-arms. Technical chapter officers and members of the board of directors elected were: *Bob Olsen*, chairman; *Jacob Allen*, recording secretary; *Marty Boxer*, financial and corresponding secretary; and *Lenny Marks*, sergeant-at-arms.

Members of the general board of directors include: *Harold Goodman; Harry Morgan; Jack Selingman; Steven Pokal; Robert Mulwitz* (alternate); *Isidore Forman; O. Capitelli; Eddie Eisen; Harry Temler; Jack Katz; Henry Levine; George Coleman; Joe Willin*, and *Ben Cohen*.

TSE, Kansas City, Mo.

TELEVISION SERVICE ENGINEERS, Inc., of Greater Kansas City, Mo., are planning to ask for legislation to license Service Men throughout the city.

RETA, New Orleans, La.

A NEW DRIVE TO SECURE A STATE license ordinance, prepared by the Radio and Electronic Technicians Association, Inc., New Orleans, La., will be made during future sessions of the Legislature.

Original bill, which passed the Senate and the House committee, was defeated on the floor of the House, because, it appears, small counties did not feel that a statewide measure was necessary.

At recent Detroit two-day parts show, sponsored by jobbers and Wolverine chapter of The Reps: Herb Yassky, sales manager, JFD accessory division, discussing JFD Roto-King rotator with Steve Rizzo, Detroit distributor, and Harry Stewart and Wayne Beitel, Wayne Beitel Co., JFD Michigan rep.

ADVERTISERS IN SERVICE
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Associations

FRSAP, Penn.

BERT BREGENZER (RTSA, Pittsburgh) has been elected chairman of the Federation of Radio Servicemen's Associations, Inc. Others named were: *Charles Knoell,* vice chairman (TSA, Philadelphia); *Leon J. Helk* (corresponding secretary (LRTA, Carbondale); *William Lansberry,* recording secretary (BSCARTSE, Hollidaysburg); *L. B. Smith,* treasurer (Hershey).

The North Lancaster Electronic Technician's Association has become affiliated with FRSAP.

RTG, Long Island, N. Y.

MURRAY BARLOWE is now president of the Radio and Television Guild of Long Island, N. Y.

Jim Lyons has been elected vice president; *Chris Stratigos,* corresponding secretary; *Bob Henderson,* recording secretary; *Jim Thornton,* treasurer; *George Volkens,* sergeant-at-arms. A number of trustees were also elected for the various counties. For Nassau: *Art Cyr, Jack Wheaton* and *Ralph Raynor.* For Queens: *Chet Amble, Jim Clifford, Henry Rogers* and *Len Silverman.* And for Suffolk: *George Knoldl, Sam Margolis, H. McDonald, Gerry Rawlins* and *Fred Strickland.*

TEN YEARS AGO

IN A PROFOUND introspection of postwar era requirements of Service Men *L. A. Goodwin, Jr.,* manager of the test-measuring equipment section, RCA, declared that both in the field and on the bench quality test-equipment would be basic. There'll be, he added, a continued use and application for general-purpose type equipment, such as 'scopes, signal tracers, tube testers, voltage and resistance measuring instruments, plus a number of special instruments to meet the particular needs of the new electronic fields. Goodwin felt that an increased knowledge of the techniques involved in the new fields would be essential to permit the proper use of this gear; the finest equipment, he emphasized, was of little value unless the know-how was there to put it to work efficiently.... *Roger M. Wise* became vice president in charge of engineering of Sylvania.... *K. C. Burcaw* was named sales manager of the jobber division of Cornell-Dubilier. . . . *Louis Calamaras* was elected executive secretary of NEDA. . . . *Neal Bear* was named distributor sales manager of The Radiart Corp. . . . *Russ Diethert* was elected president of the Chicagoland chapter of The Reps. . . . *Thomas A. White* was elected president and general manager of Jensen Radio Manufacturing Co. . . . *Otto Pashkes,* president of Solar Manufacturing Corp., celebrated his 25th anniversary in the radio business. . . . *Terry Cunningham* became manager of the commercial department of Colonial Radio Corp. . . .

JOTS AND FLASHES

SUBMINIATURIZATION, featured in many items developed for the government and communications industry, has now become a factor in electronic consumer products, thanks to the transistor. A number of receivers, now in production and scheduled to be announced soon, include such tiny components as ½" x ½" x ½" *if* transformers and oscillator coils. The *ifs*, designed by Vokar for one set, are permeability tuned to 262 kc, include a 200-mmfd capacitor, and are enclosed in a shielded assembly; their unloaded *Q* is 80. Speaker, developed by Jensen, for pocket-model radio, is 2¾" in diameter and 1 3/32" in depth. . . . Vertical printed-circuit chassis will now be found in G.E. table model sets. In one receiver, wiring is plated on both sides of the board and through the terminal holes in such a manner as to establish a connection between two sides without the use of eyelets or terminal pins. . . . *Edward Bluestone* has been appointed chief engineer for Instruments For Service, Inc., 96 S. Grand Ave., Baldwin, L. I. . . . *Ralph L. Power, Advertising*, has moved to 11-300 E. Mesa Rd., Littlerock, Calif., with mailing address at Star Route 1, Box 34. Los Angeles office will continue to next July as a branch. . . . Production of the millionth picture tube, an aluminized 21" model, by Westinghouse, was recently announced by *R. T. Orth*, tube division vice prexy. . . . *John P. Brocki* has been named assistant service manager and *A. C. Boss*, chief field engineer, of the television and broadcast receiver division of Bendix Aviation Corp. . . . The Audio Fair-Los Angeles, slated for February 11-12-13 in the Alexandria Hotel, will offer five floors of audio component exhibits. . . . The Southern California Council of the West Coast Electronic Manufacturers Association recently elected *Gramer Yarbrough*, assistant manager of American Microphone Co., as chairman for '55. . . . *Lynn C. Wimmer* is now vice president of Burton Browne Advertising, Chicago and New York. . . . *Allied Radio* is now sponsoring a series of 13 chamber music concerts on WFMT (98.7 mc), Chicago. . . . *Rohn Manufacturing Co.*, Peoria, Ill., has acquired a third plant with an additional 20,000 square feet of factory and office space. . . . The *Sprague Electric Co.* has started construction of a 13,000-square foot, one-story building in the Venice section of Los Angeles, to house its southern California operations. . . . *Dr. Donald B. Sinclair* has been appointed vice president for engineering of General Radio.

P. R. MALLORY & CO. Inc. MALLORY APPROVED PRECISION PRODUCTS

You've made them the leader FOR 25 YEARS

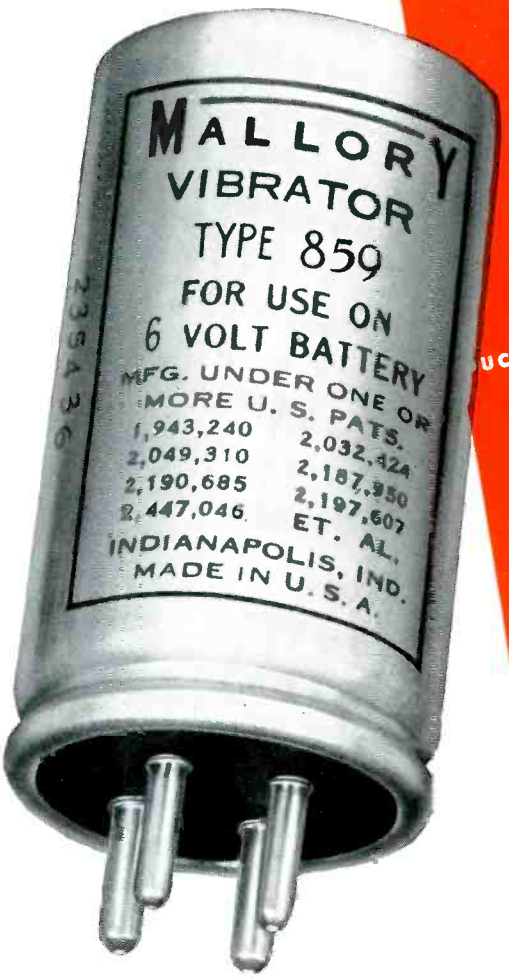
Ever since Mallory introduced the first commercial vibrators 25 years ago, they have consistently led the field. They have led . . . and are still leading . . . not only in quality but also in acceptance by service men and manufacturers alike.

Service men prefer them. Surveys show that 5 out of 6 service men use Mallory vibrators for replacement work.

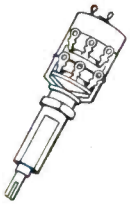
Set manufacturers prefer them. More Mallory vibrators are used as original equipment than all other makes combined.

Now better than ever. New standards of quiet operation are set by the latest Mallory vibrator. A floating mounting for the internal mechanism cushions out hum . . . makes these the quietest vibrators ever.

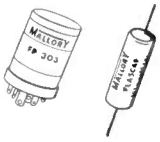
See your distributor today. Ask him about the special Mallory Vibrator Deal—6 vibrators that cover 75% of your replacement jobs. And get a copy of the latest Mallory Vibrator Guide.



ON AUTO RADIO JOBS BE SURE TO USE . . .



MALLORY MIDGETROLS®—Simplified design cuts replacement time to minutes. Accurate tapers, noise-free operation, and excellent stability. Versatile line of single and dual types.



MALLORY CAPACITORS — FP electrolytics . . . the only fabricated plate capacitors for replacement work . . . have long life even at 85° C. Plascaps®, tubular plastic type, have permanent, moisture-proof terminal seals.

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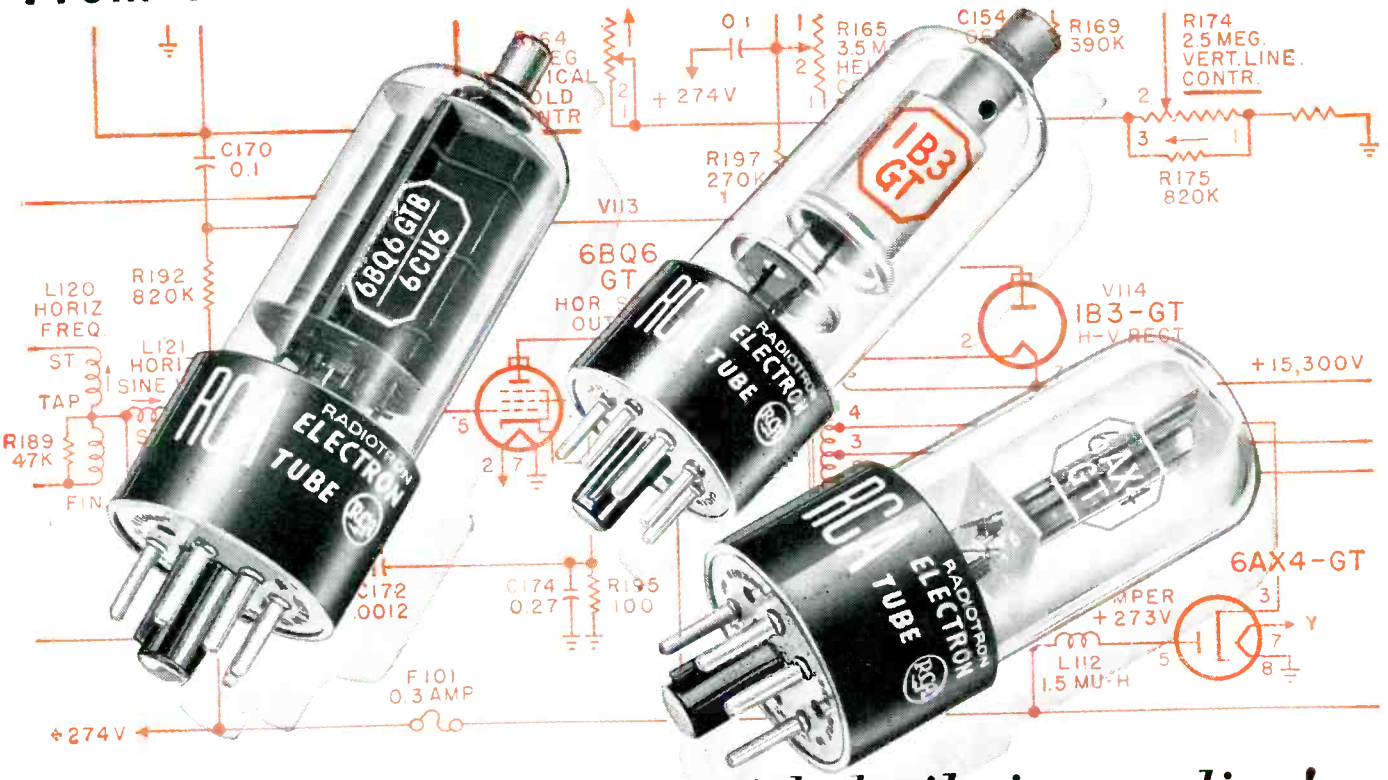
From TV-Deflection and High-Voltage Circuits . . .



Use RCA TUBES . . . with built-in quality!

Better performance and longer life are *built into* each RCA Tube. In TV Deflection and High-Voltage Circuits, RCA Tubes operate with high efficiency. That's because rigid structural specifications help them to deliver the required currents or to withstand the high voltages. For instance, on the new RCA 6BQ6GTB/6CU6 striking structural changes have produced a decidedly uniform temperature radiation and new cathode material assures greater reliability. You get greater deflection and higher efficiency. RCA's severe dynamic life tests simulate actual operating conditions and help assure you better-performing, long-life tubes.

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