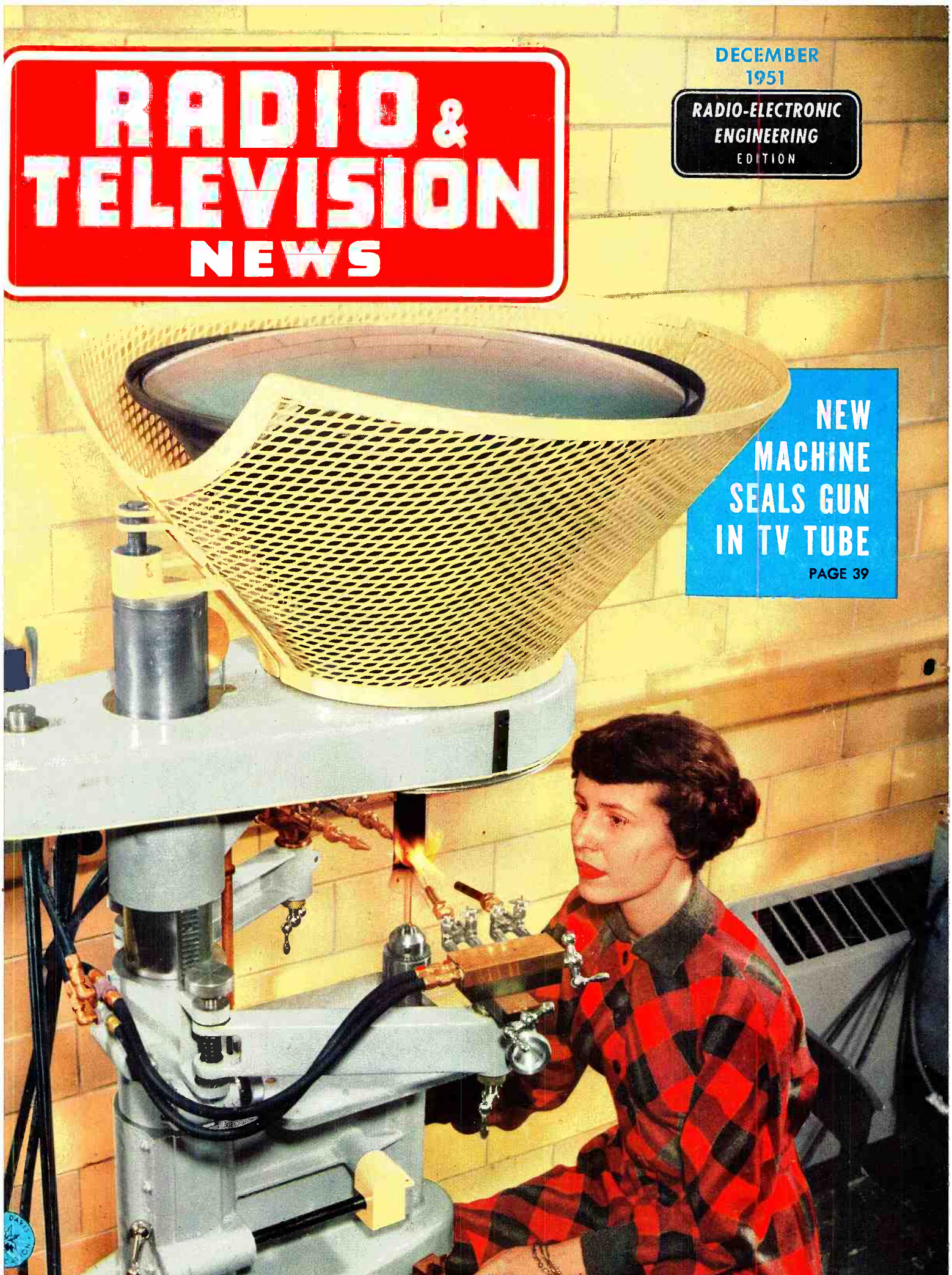
RADIO & TELEVISION NEWS

DECEMBER
1951

RADIO-ELECTRONIC
ENGINEERING
EDITION

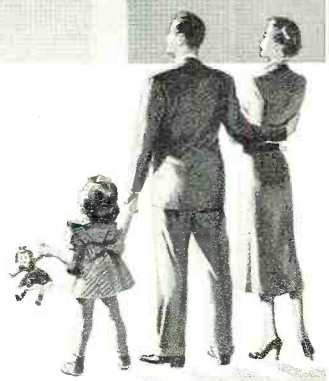


NEW MACHINE SEALS GUN IN TV TUBE

PAGE 39

It's fundamental...

the best established brand name is your biggest stock in trade



Every RCA picture tube you install sells the idea of long-term, high-quality performance . . . and helps develop a permanent customer. Stocking and recommending RCA picture tubes is good business, because no other brand enjoys greater customer confidence . . . and customer confidence is your stock in trade.

Remember—more RCA picture tubes are now in active service than those of any other manufacture . . . *over 5 million since the advent of commercial television,* when RCA pioneered the first large-scale production of picture tubes. Yes, RCA picture tubes of all types have consistently given outstanding performance.

And, today, RCA kinescopes carry a factory warranty that guarantees your customers against any defect *for six months from the date of installation.*

Your local RCA Tube Distributor carries a complete line of RCA kinescopes. Whether you want one or a hundred . . . he's ready to serve you.

Keep informed . . . keep in touch with your RCA Tube Distributor

RCA **RADIO CORPORATION of AMERICA**

ELECTRON TUBES **HARRISON, N. J.**

NEW

I'LL TRAIN YOU FOR YOUR FCC LICENSE

A Federal Communications Commission Commercial Operator's License puts you in line for a good job in Radio or Television Broadcasting, Police, Marine, Aviation, Two-way, Mobile or Micro-wave Relay Radio. Mail coupon below for 64-page book FREE. It will give you complete facts about my NEW Communications course.

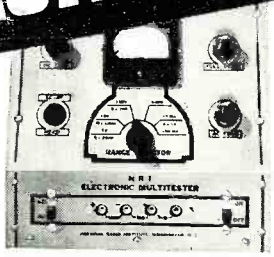
YOU BUILD THIS TRANSMITTER

with parts I send. With this Transmitter you practice how to put a station "on the air." You perform procedures demanded of Broadcast Station Operators, conduct many experiments, make many practical tests.

LEARN COMMUNICATIONS by PRACTICING at Home in Spare Time

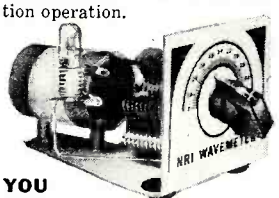
with MANY KITS of RADIO EQUIPMENT I SEND

YOU BUILD this Transmitter Power Supply used in the basic experiments in RF and AF amplifiers, frequency multipliers, buffers, etc.



YOU MEASURE current, voltage (AC, DC and RF), resistance and impedance in circuits with Electronic Multitester you build. Shows how basic transmitter circuits behave; needed to maintain station operation.

YOU PRACTICE setting up code, amplitude and frequency modulation circuits (put voice, music, etc., on "carrier signals" you produce). You learn how to get best performance.

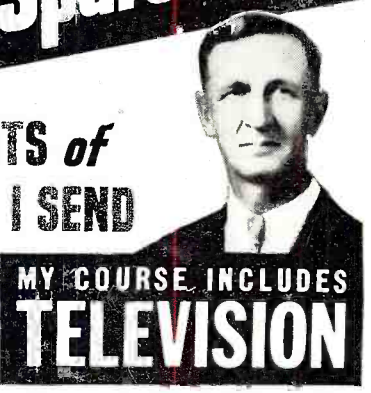


YOU BUILD this Wavemeter and use it to determine frequency of operation, make other tests on transmitter currents.

Ever think HOW FAST Radio-Television Communications is changing, developing, growing? Have you considered what this amazing progress can mean to you?

Look at these facts. In 1946 only 6,000 Television sets were sold. In 1950, over 5,000,000. By 1954, 25,000,000 Television sets will be in use, according to estimates. 100 Television Stations are operating in 35 states. Authorities predict there will be over 1,000 Television Stations. This rapid growth means new jobs, more jobs, good pay for qualified men all over the U. S. and Canada. Then add development of FM, Two-way Radio, Police, Marine, Aviation and Micro-wave Relay Radio! Think what all this means! New jobs, more jobs for beginners! Better jobs, better pay for experienced men!

Are you a beginner who wants steady work in this growing field? My NEW course can help you get an FCC License and prepare for the job you want. Are you a man with some training in Radio or Radar, or a Licensed Operator? My NEW course modernizes, increases the value of your knowledge and experience!



MY COURSE INCLUDES TELEVISION

Course Is New! Different!

Mail coupon now for facts about my NEW, intensely practical course in Radio-Television Communications. Let me send you FREE book. Read outlines of 78 lesson texts written by leaders in Communications and edited for you by my practical staff. See the nine big Kits of Parts I send that "bring to life" theory you learn. Read about the Transmitter you build and operate, about the Electronic Multitester you get. All equipment yours to keep. My NEW course covers Theory thoroughly and you get Practical Experience building units like those shown at the left. It's backed by N. R. I.—the world's oldest and largest home study Radio-Television school.

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If you prefer a good-pay job in Radio-Television Servicing . . . or your own money-making Radio-Television Sales and Service Shop, I'll train you at home. My famous Servicing Course also includes many Kits of Radio Parts. You use them to get PRACTICAL EXPERIENCE with circuits common to Radio and Television. I also show you how to make $5, $10 a week or more EXTRA MONEY fixing neighbors' Radios while training. Full information in my 64-page book. . . . Mail coupon.

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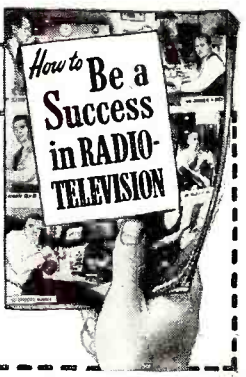

MR. J. E. SMITH, President, Dept. 1NE
National Radio Institute, Washington 9, D. C.

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Name.....Age.....

Address.....

City.....Zone.....State.....

Approved Under G. I. Bill

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"Am Broadcast Engineer at WLPM. Your NEW Communications course shows the kind of equipment we use."—J. BANGLEY, JR., Suffolk, Virginia.

"I am employed by WKBO as transmitter operator. Have more than doubled salary since starting in Radio full time!"—A. HERR, New Cumberland, Penna.

"4 years ago, I was a bookkeeper with hand-to-mouth salary. Am now Radio Engineer with ABC network."—N. H. WARD, Ridgefield Park, N. J.

COVER PHOTO: Positioning the gun within the neck of developmental TV tube is handled at Sylvania by this vertical sealing machine. Both bulb and electron gun rotate together. (Ektachrome by L. F. Ankerson)

First in radio-television-electronics
Average Paid Circulation over 200,000

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DEPARTMENTS

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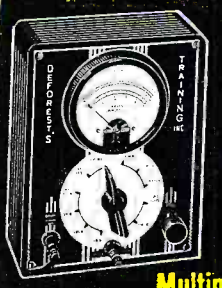
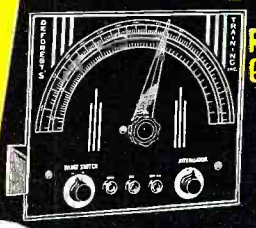
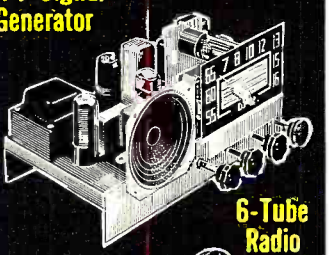


Multimeter

Oscilloscope



R-F Signal Generator



6-Tube Radio

HOME MOVIES

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VERTICAL AUTOMATIC LINEARITY

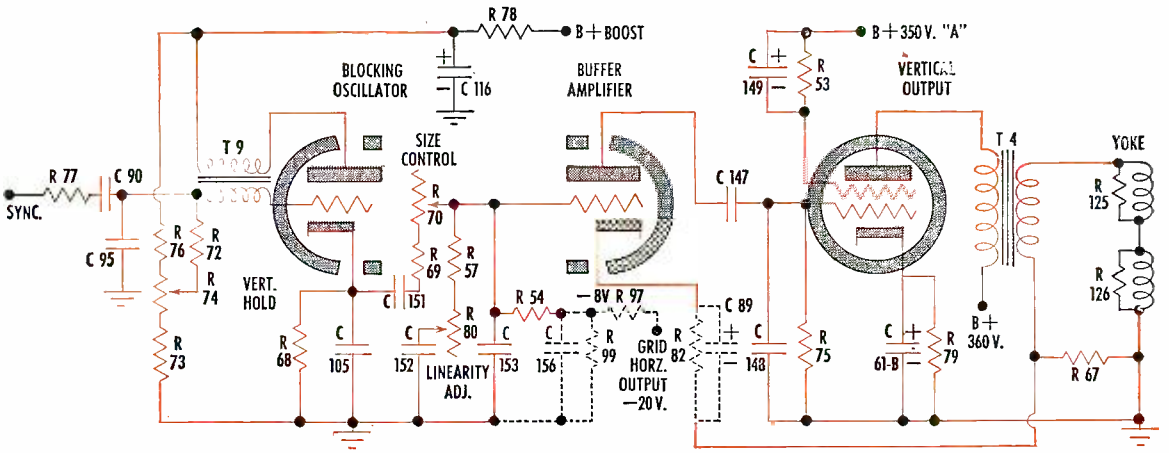
It is desirable to be able to make vertical size adjustments without having to make a compensative vertical linearity adjustment.

Vertical automatic linearity is obtained by properly shaping the sawtooth drive, allowing the vertical output tube (6V6) to operate within its maximum linear input capability as set by the cathode bias, R79 & C61 -B.

The shaping network incorporates an automatically compensating integration (low pass) circuit, whereas the series resistor (R69+R70) is variable to provide a size control of linear vertical scan.

C153 is shunted by a series network of C152 in series with R57 and R80. R80 provides the adjustment to set the linearity characteristic desired. The degenerative feed-back voltage, derived from the yoke current through R67, minimizes linearity distortion in the vertical output stage.

The buffer amplifier (½ 6SN7) gain makes up for the attenuation of the shaping network and provides the proper magnitude of degeneration from a low value at R67 (22 ohms). This amplifier may be biased (—8 volts) by R82 and C89 (R54 grounded) or by a divided and filtered voltage obtained from the —20 volts appearing at the grid of the horz. output tube.



The blocking oscillator (½ 6SN7) operates from a long time-constant boost B+filter (R78 and C116) to prevent vertical bounce due to line voltage fluctuations. The oscillator output across C105 & R68 in the cathode provides a negative going sawtooth. The oscillator frequency is controlled by the vertical hold control (R74) as well as by the values of R76, R73 and the time-constant of R72 and C95+C90.

Improved circuitry such as this is one of many reasons why you can feel free to recommend Raytheon TV to a friend or customer.

For the RECORD

BY THE EDITOR

WHAT THEY WANT

AS WE approach the end of the year it is axiomatic that we review the progress made by our electronic industry. We look back on its success or failure and attempt to analyze its shortcomings. We recall the accumulation of "gripes" sent in by those engaged in the industry, particularly the radio and television service technicians. If each manufacturer of an electronic product would heed the many criticisms directed towards his products, he would soon discover the great opportunity that is his to foster better relations between himself, the technician, and the customer.

Service technicians who have been in the business for many years become valuable analysts of the products that they are required to service. Their findings, therefore, become of prime importance to the aggressive manufacturer. Here's what they want:

1. A coordinated effort on the part of the service dealer, the parts jobber, and the manufacturer to reach a better understanding for the betterment of all! It is felt that the RTMA and its Service Committee will be instrumental in reaching this objective. The RTMA Service Committee is in a position to act as a liaison between the interested groups. Although the RTMA cannot do the job alone, it can examine the many problems confronting the dealers, jobbers, and manufacturers as it relates to the maintenance of television receivers. Its proposals, therefore, will be based on facts learned from all parties and can be presented directly for action to the groups.

2. More intelligent local planning of service groups! The activities of the Joint Electronic Radio Committee on Service of Philadelphia is an example of the type of local organization that can be set up with its own Code of Ethics to set policies within its local area.

3. Consoles and other electronic gear so designed that the removal of the chassis does not become a major operation! Many sets today require the unsoldering of 10 or more wires in order to remove the chassis from its cabinet. The adoption of some standard set of plugs would greatly facilitate the servicing of such sets.

4. Frequent and up-to-date service information direct from the manufacturer to the technician! Although there are two recognized sources for service data, there still remains a lackadaisical attitude on the part of the set manufacturer in supplying the technician with changes and other modifications of a specific model.

5. Common-sense engineering of the auto radio! There is a continual damning of auto radio manufacturers on the design of their products. There is a demand for a foolproof tuning mechanism. Modern auto sets that employ permeability tuners are still subject to inoperation because the assembly isn't dustproofed. Fuses, terminals, and trimmers are still located where it is almost impossible for them to be reached for servicing. Many are literally buried amongst ashtrays and other gimmicks. In some cases tubes are directly exposed beneath the cowl ventilator of the car where rain can soon put the set out of commission.

6. A color television system acceptable to the public! With marked progress made towards a compatible TV system we can be thankful that more time will now pass before color telecasts are resumed. In the meantime each monochrome set sold provides added weight that will have to be lifted when the green light is again given to color telecasts. The public simply is not ready for color. In fact, very few *CBS* color sets were sold to the public.

7. A relaxed material situation to maintain commercial production! Tube manufacturers have now shown that it is possible to produce electrostatic TV picture tubes possessing excellent performance. Speaker manufacturers have found ways and means for cutting back on their cobalt requirements and many other innovations have resulted in satisfactory substitutions for many components. However, essential replacement parts must be available for the maintenance of TV and radio receivers.

8. Commercial phonograph records meeting the standards of the new high fidelity systems! It is amazing but there is a real lack of quality pressings on the market today in spite of the fact that new techniques and standards provide the means for achieving better reproduction.

9. A Code of Ethics for radio and television! The FCC receives many letters from irritated viewers and listeners each week complaining bitterly against horror and crime programs. It is hoped that the drafting of the NARTB code will lead to an improvement in the caliber of television, as well as radio programming. We know of several instances where people have stated that they would not care to own a TV set because of the poor taste displayed on various programs. When this situation is remedied we can look forward to a more healthy market for new television set owners. . . . . O. R.

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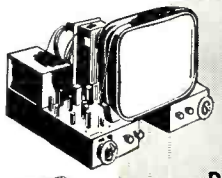

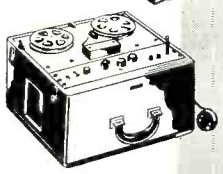

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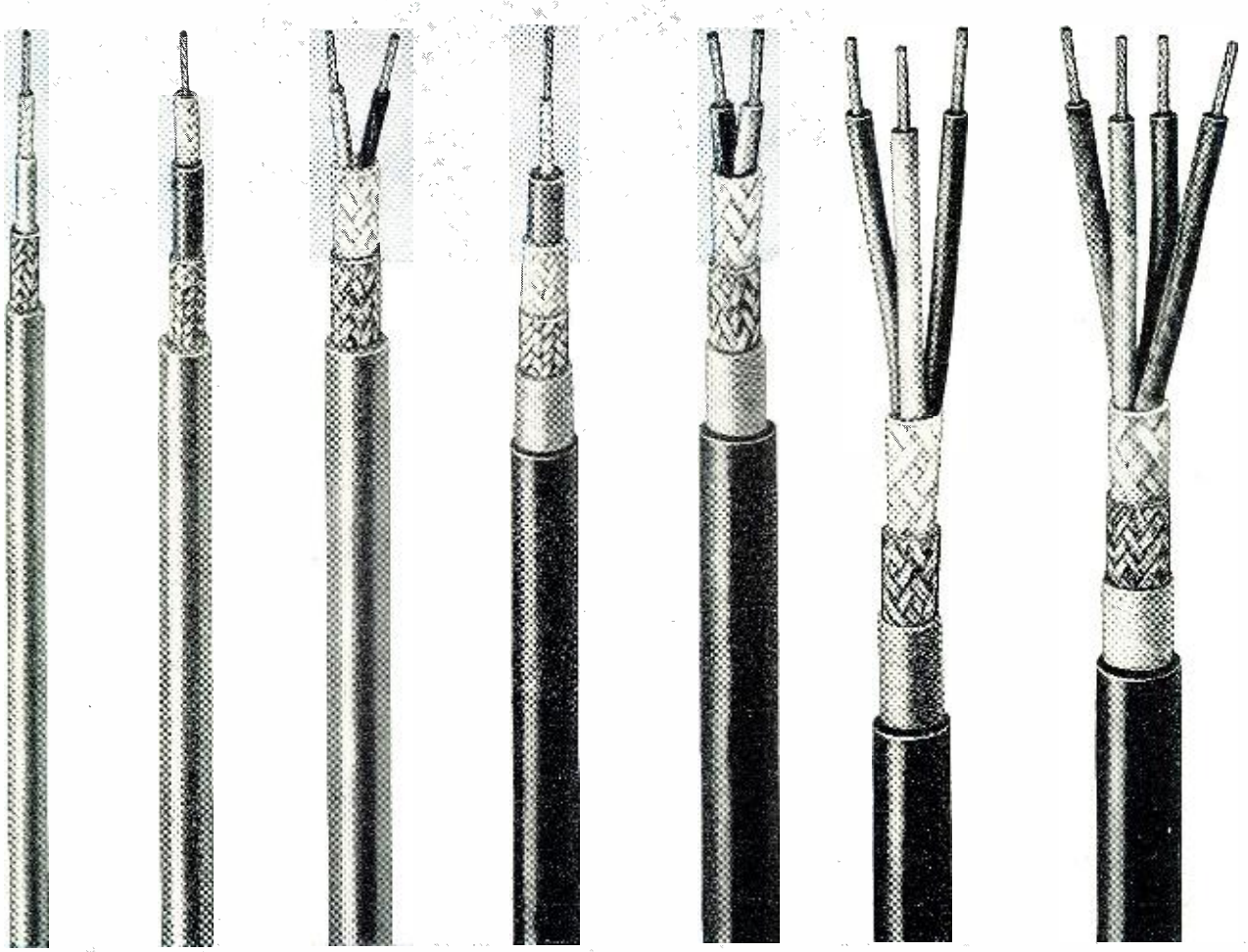

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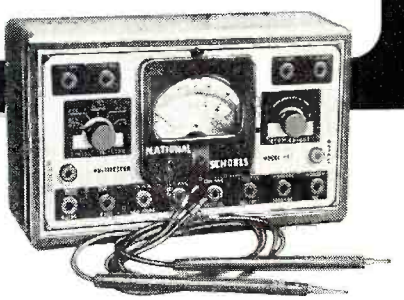

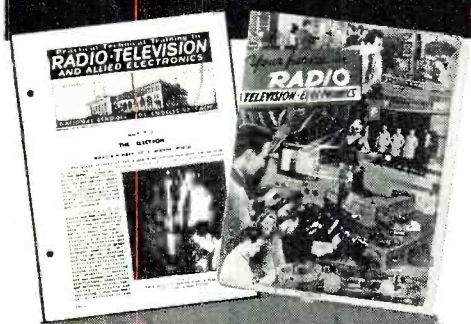

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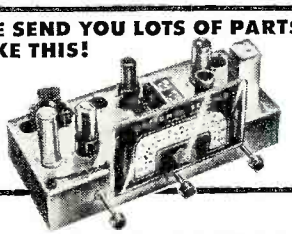

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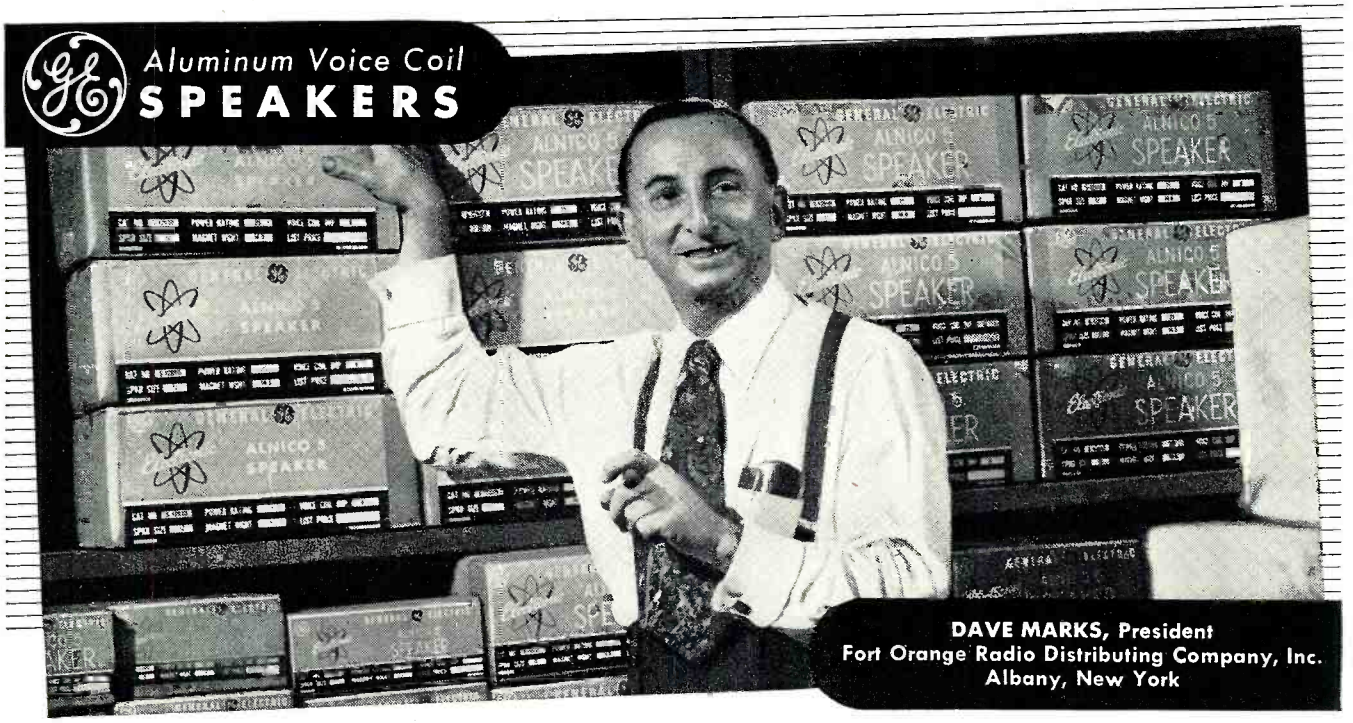

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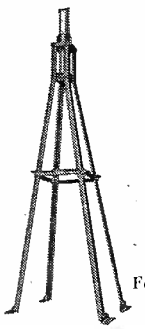

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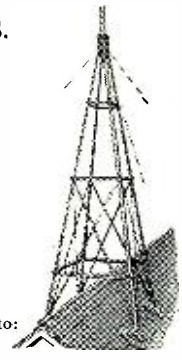

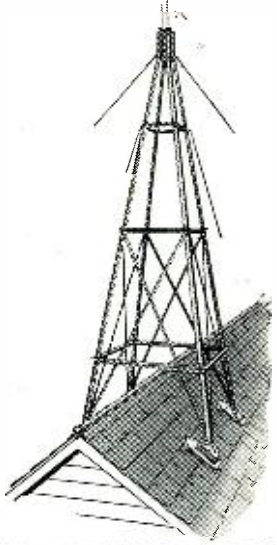

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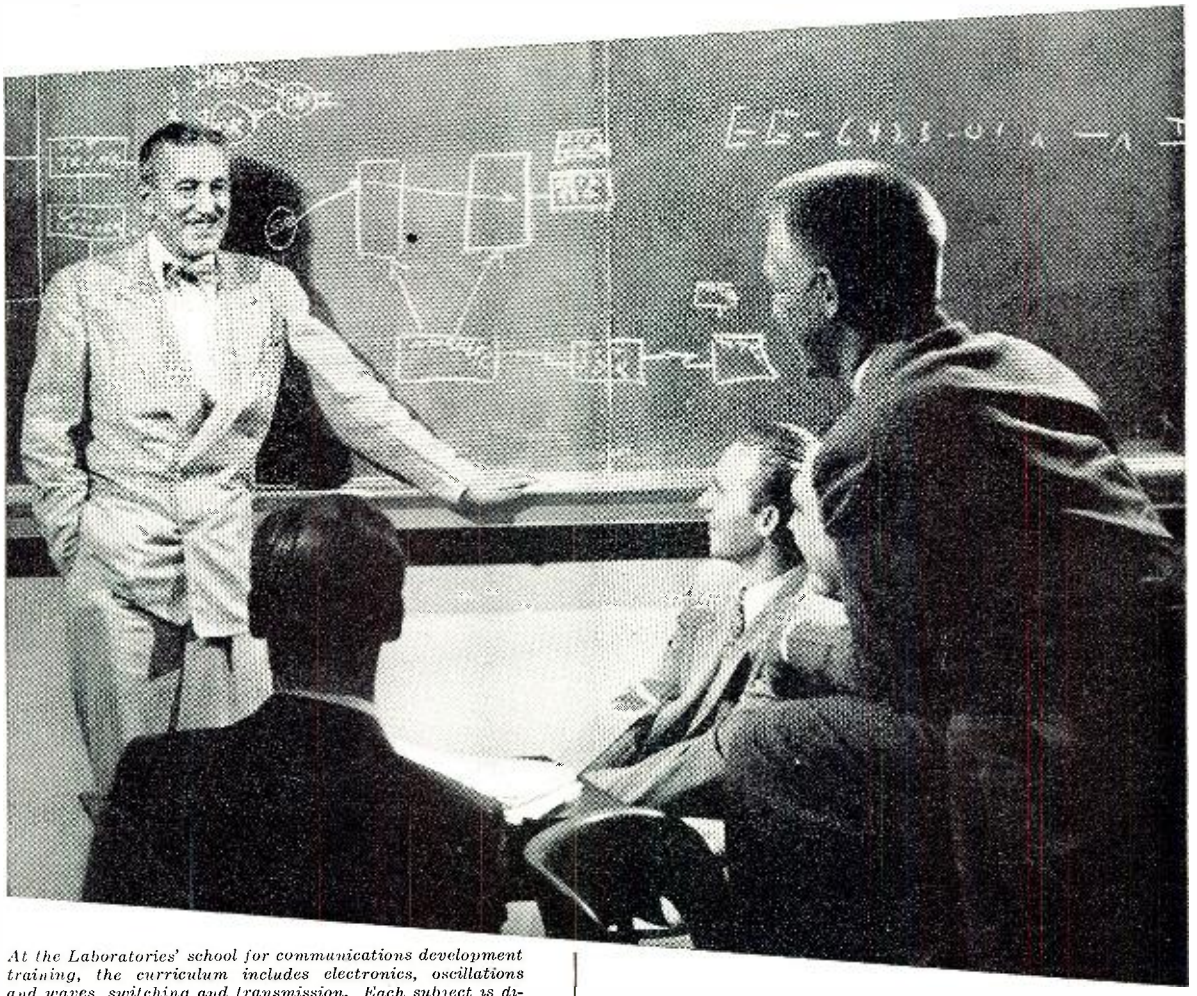

At the Laboratories' school for communications development training, the curriculum includes electronics, oscillations and waves, switching and transmission. Each subject is directly keyed to the latest fields of telephone research.

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Spot Radio News

★ ***Presenting latest information on the Radio Industry.***

By RADIO & TELEVISION NEWS' WASHINGTON EDITOR

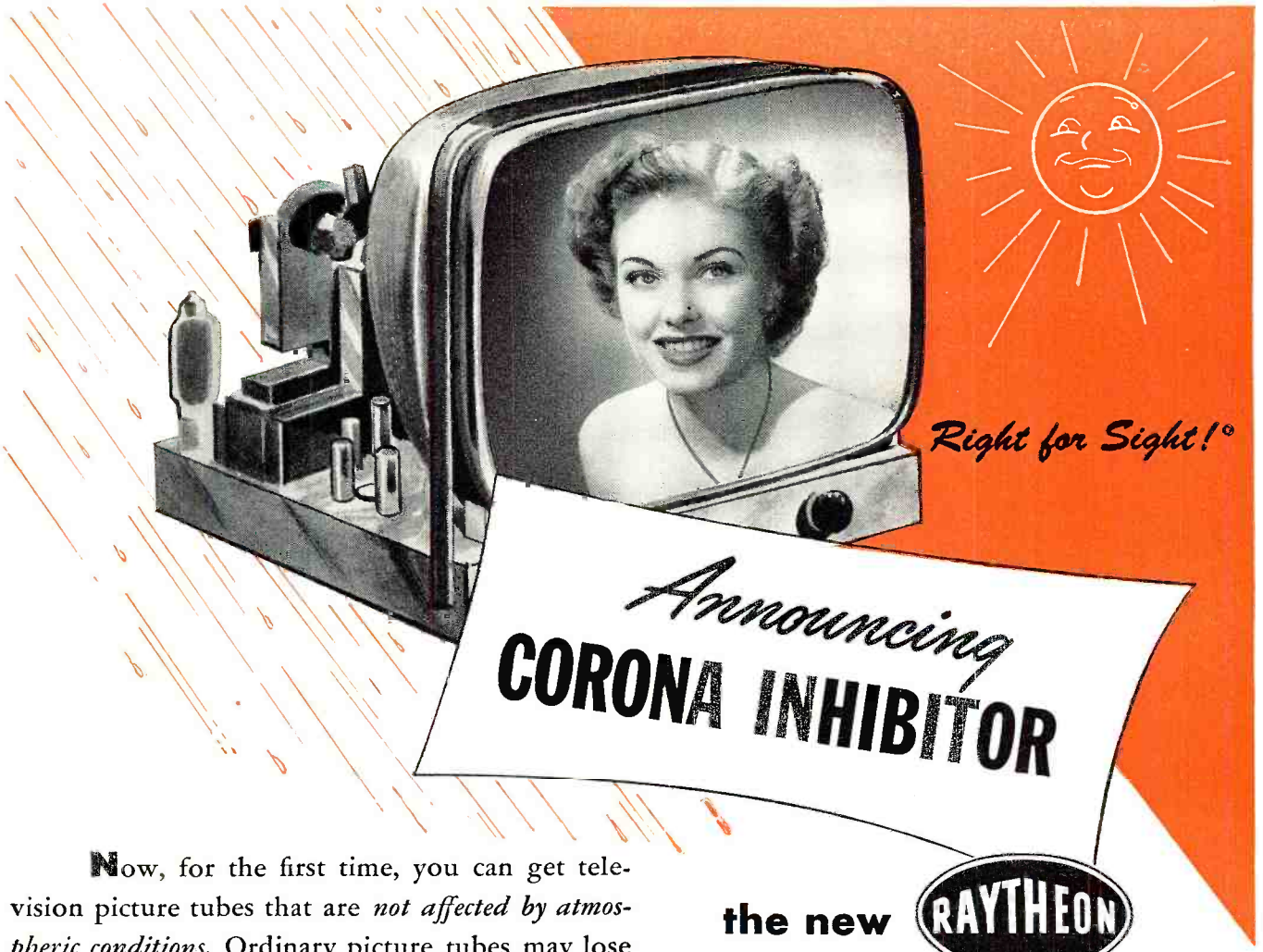
COLOR TELEVISION, which in its mechanically-approved form, had been noted by most of industry as having an immediate future that could only be bleak and questionable, not only because of its involved and incompatible makeup, but because of the sizable quantities of materials it would require, which could be a drain on defense stockpiles, found itself faced with a similar dismal view by those in Washington, and suddenly pitched into a dungeon and doomed for the remainder of the emergency by none other than the director of mobilization, during a hectic weekend in the final weeks of autumn.

Declaring that the defense effort required all of the metals that can be possibly acquired, Washington's chief of defense operations, Charles E. Wilson, noted that industry will be required to suspend plans for the mass output of any new products . . . "which are not absolutely essential and which would require the use of critical materials" . . . a state of affairs which it was felt applied directly to the mass production of color sets. Explaining this situation to *CBS'* Prexy Frank Stanton, Wilson asked that their manufacturing unit suspend all production of color sets, a request that was complied with immediately at the plant, where receivers had just begun to come off the line. Noting that they would have been at present the only suppliers of complete receivers, and that the distribution halt would practically eliminate a viewing audience, *Columbia* also announced cessation of all scheduled color broadcasting. Whether or not experimental telecasts would continue was debatable at this writing, since the defense department had also implied that efforts would be made to suspend all . . . "further developments of color television." The latter move was said to be necessary not only to save key materials but free engineers for use on defense projects. The suspension-of-development statement was bitterly criticized by practically everyone involved in color research, as an unwarranted demand. Blazing rejoinders came from those on the NTSC committees who had been involved in around-the-clock sessions for months probing an industry technique which could eventually be submitted to the Commission. The panel members, stunned by the request, implied that the manpower motive was a weak one, since the color research results were adaptable to defense applications. Some panelmen even suggested that the research shelving might have been part of a plan to eliminate the possibility of future embarrassment to the disc proponents, who might have to combat the effects of highly developed electronic compatible systems as evolved by industry's outstanding specialists.

Scant need for the development curb was voiced by Dr. Allen B. DuMont in a telegram to Wilson, who said that the stop-research proposal was definitely . . . "against national policy and the public interest." In his opinion, it was . . . "inconceivable that any high official of our government would give serious consideration to halting any type of research in the field of electronics or any important defense industry." Supporting the general view that color TV will play an important role in our defense work, he declared that without a doubt it would contribute substantially in our defense preparations for the future. Noting the part that research has played in the past, the TV pioneer said that . . . "America has great industrial and military strength today, because we have had the freedom to explore, experiment, and engage in extensive research. It would be most un-American to place restrictions on any research at this stage for the sake of retaining a competitive position for any company."

Defending the ban, Defense Headman Wilson said that the decision to freeze color had nothing to do with intra-industry disputes or competitive aspects. He noted that we are faced with an emergency which involves scraping the bottom of the barrel for materials and manpower at the technical levels, and that color television was found to be a natural peg for the conservation of both. When questioned as to the problems and difficulties with which many small companies will be faced as a result of the order, Wilson said that he regretted this situation and was sorry that anyone might be hurt, but the interests of the country had to receive prime consideration. Defense comes first, he implied.

A few days prior to the issuance of the color-ice order, both *RCA* and the industry TV committees issued re-



Now, for the first time, you can get television picture tubes that are *not affected by atmospheric conditions.* Ordinary picture tubes may lose as much as one-tenth of their brightness on humid or rainy days, but RAYTHEON made Tubes with CORONA INHIBITOR are 100% efficient *rain* or *shine.*

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RADIO AND TELEVISION RECEIVING TUBES, PICTURE TUBES, SPECIAL PURPOSE TUBES, SUBMINIATURE TUBES, MICROWAVE TUBES

ports that revealed striking progress on the color front, involving theater-size color, new picture tubes, and streamlined receiving and transmitting systems. Supported by an actual demonstration, the large-screen color development revealed that it was now possible to provide high-fidelity reproduction of all colors, in contrast to the uneven and blooming colors that appeared on the screen during the Franklin Institute test four years ago.

The NTSC brief on new color standards reported that the aim, to produce the best color-television service possible within a 6 mc. channel, can be achieved by transmitting two signals, one identical in all essential respects to the monochrome signal, and the other, known as the chromatic signal, carrying two types of color information, which jointly represent the chromatic values of the scene. By use of multiplex techniques these signals can be sent simultaneously over the air. The basis of the color standards were said to lie in the science of color measurement or colorimetry, concerned with three quantities representative of brightness, hue, and saturation. Brightness was noted as being a measure of the lightness or darkness of a color; hue, the specification of whether the color is red or blue or yellow; and saturation, a measure of the mixture of this hue with white light. The hue and saturation values together were said to represent the chromatic values of the color. Color cameras, which are suitable for NTSC standards application, may incorporate three image orthicon camera tubes, each tube being fitted with a color filter or transparent colored glass. Discussing the transmission process, the standards report stated that while it would appear that the transmitter should carry three signals representing the red, green, and blue primary color-values, there were two disadvantages to the method. First, no one of these three signals is ideally suited to the operation of black and white sets, a preferable arrangement involving a brightness signal particularly designed to operate the standard chassis. Second, the transmission of three signals does not make the most efficient use of a TV channel. The characteristics of human vision are such, that to use the channel most efficiently, the three signals should be transmitted in a preferential way, so that one signal (brightness) is accorded the major portion of the width of the channel, while the other signals, which represent chromatic values, are given less channel width.

In the NTSC standards, the chromatic signal modulates a color carrier. The pair of signals representing the chromatic values are applied together to the color carrier to modulate it. Then the two signals are so applied to the color carrier that the carrier is modulated in two ways, in amplitude and in phase. By thus modulating the color carrier in two ways simultaneously, two signals representing the

(*Continued on page* 139)

RADIO ELECTRONIC Engineering SECTION

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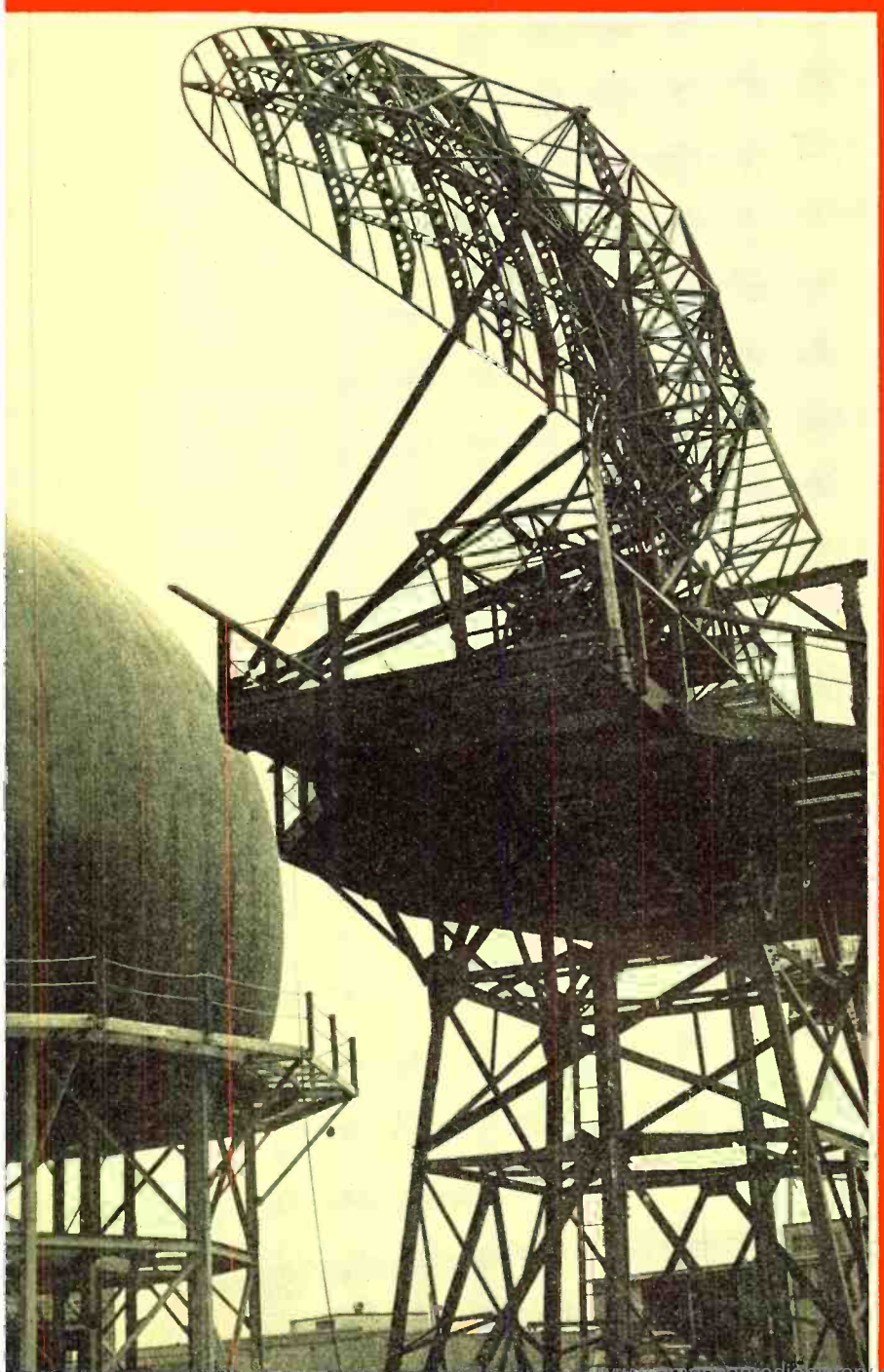

DECEMBER, 1951

DEPARTMENTS

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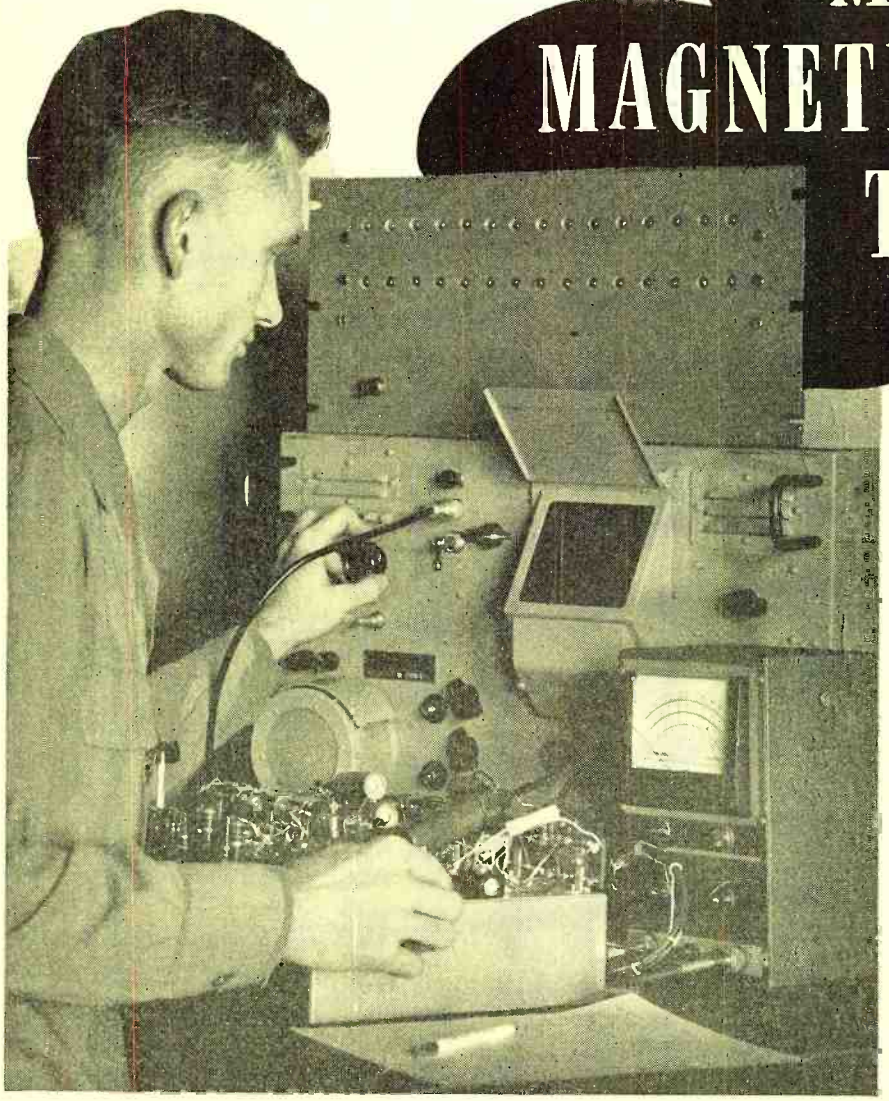
← A scene near the radar test site of Bendix Radio Division of Bendix Aviation Corp., Baltimore, Md. The radome (left) is a plastic bubble transparent to microwaves and supported by internal air-pressure. It protects a radar antenna similar to the one shown at the right.

Bread-board wiring circuits for investigating multi-stable magnetic elements.

Multi-Stable MAGNETIC MEMORY Techniques



By
JOHN D. GOODELL
President

and

TENNY LODE
Chief Engineer
The Minnesota Electronics Corp.

Fast and accurate storage and access times result from the employment of new materials and techniques.

PRIOR TO the advent of large scale computing machinery, desk type calculators were designed almost exclusively for operation in terms of decimal notation; for rotating mechanical structures this was entirely practical. When high speed computers were first developed it became evident that decimal notation was not practical using the storage and computing elements available. Devices capable of operation with two stable states were dependable and simple to design, while structures capable of multiple stable states were possible only with complex linkages between simpler devices. This is one of the reasons that binary arithmetic has been so widely employed in computing machines. The restriction on the use of radices higher than binary is eliminated by the developments described in this article.

There are other reasons and other advantages for specific applications, but it cannot be stated as a generality that binary systems are superior. Obviously, when a machine must communicate with people, it is necessary to provide translation devices so that input decimal information is converted to binary and binary answers converted to decimal, or the machine must operate in decimal, or a re-education program that is not practical must be instituted. It is necessary to educate not only machine operators but also the general public, since many business machines function to print the answers to computing problems in connection with invoices and similar communications. Binary/decimal translation devices usually turn out to require more intricate circuitry than the actual computing elements in business machinery.

There are other reasons for operating with notations other than binary, and for various special applications, a specific radix such as 8, 12, or any other number, may turn out to be desirable. This problem has not yet been completely investigated in its general form and there is considerable controversy regarding the relative merits of various radices. As is true of so many controversies, neither extreme is correct and each system has its place.

Magnetic Storage Elements—Bi-stable

Among the basic structures that have been used for information storage are magnetic materials. These methods are attractive because power is not required to maintain storage, and for other reasons associated with the fact that the elements are passive.

This article is based on a paper presented at the 1951 National Electronics Conference, Edgewater Beach Hotel, Chicago, Ill.

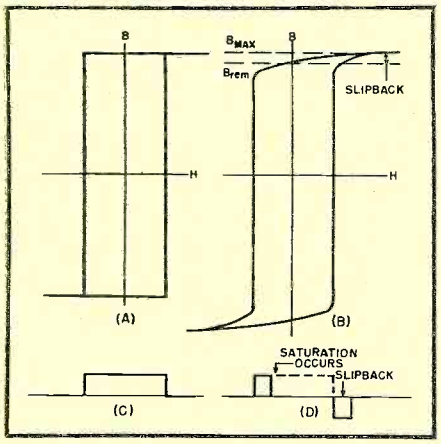


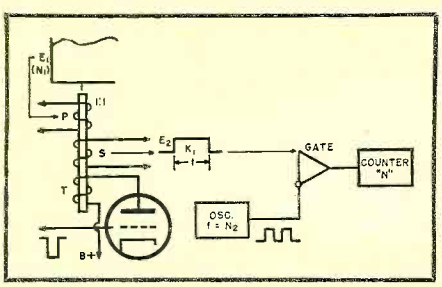
Fig. 1. (A) Idealized rectangular hysteresis loop. (B) Actual rectangular hysteresis loop. (C) Normal pulse. (D) Saturation pulse.

Considerable success has been achieved in work accomplished by others with magnetic materials used as binary elements. For this purpose, an essentially rectangular hysteresis loop is a desirable characteristic. It is also desirable that the coercive force of the materials be low, so that the magnetizing forces required are held to a minimum. These two characteristics are essentially incompatible and the designers of such materials strive to effect a useful compromise.

A rectangular hysteresis loop implies that when a magnetic core is saturated in one sense it will be stable in that state until a magnetizing force is applied in the opposite direction. Using this principle, it is possible to design devices that operate in accordance with binary arithmetic. Information is read into the material by applying a magnetizing force in one direction. Information is read out of the material by applying a magnetizing force in the opposite direction and observing whether a significant flux change is produced. Thus the material may be interrogated to determine whether it is storing one or zero.

Binary magnetic elements have been applied successfully in the design and construction of many computing systems originally developed at the Harvard Computing Laboratory under the direction of Howard Aiken and his associates. At this time, the practical application of magnetic storage elements in binary applications has been limited to moderate pulse repetition rates in an order of thirty to forty kilocycles. It has been indicated that investigators believe this may be increased to very high speeds with the development of new techniques.

Fig. 2. Block diagram of an analogue to digital translation system.



Magnetic Storage Elements—Multi-stable

The steep sides of a rectangular hysteresis loop imply that with the application of a sufficient magnetizing force to overcome the coercive force of the material, the flux will swing all the way to saturation and be passive in that state until a magnetizing force is applied in the opposite direction. This does not mean that the flux is capable of swinging from saturation in one sense to saturation in the opposite sense in zero time.

The rate of flux change in any magnetic material is proportional to the magnitude of the applied voltage across the magnetizing coil. The total flux change is a function of the applied voltage and the time duration of its application. Thus the change in flux is proportional to the volt/second integral of the applied magnetizing force. With materials having a rectangular hysteresis loop, the induced back emf functions to hold the current flow to the minimum required to overcome the coercive force through the entire swing. Thus the most convenient parameters to consider are voltage and time.

Using suitable materials, it is possible to obtain stability not only in the states of saturation but at the intermediate states between these boundaries. This means that by controlling the time duration of applied pulses, it is possible to obtain a multiplicity of stable memory states in a magnetic core. Information is read into the core by saturating the core to a state designated as zero and then applying a series of pulses in the opposite sense. It is necessary to quantize the volt/second integral of such pulses with an accuracy dependent on the maximum number of pulses the system is designed to store in the core. In this way, the flux density is changed in discrete steps and the state of magnetization of the core is directly related to the number of applied pulses.

To read the information out of the core, a train of pulses may be applied to swing the flux back to saturation zero. As the flux swings from the intermediate state representing the stored number, a pulse will appear across a secondary winding for every read-back pulse applied to the primary. When the core reaches saturation zero, there will be no further flux change and the amplitude of any pulses that appear across the secondary will be significantly diminished.

To the extent that rectangularity of the hysteresis loop is not perfect, the performance in accordance with the criteria discussed will be degraded.

A wide variety of techniques is available for reading in and out of multistable magnetic structures of this nature, and the resulting flexibility is useful in many applications. The input information may be applied in the form of discrete quantized pulses, each of which represents a single digit, or it may be applied in the form of a single pulse. In the latter case, the magnitude may be held constant and the time duration made to represent the number to be stored, or the time duration may be held constant and the amplitude varied. The information may be read out in a similar way. Thus information may be dealt with in the system either in digital or analogue form and translated between these forms in accordance with the requirements of the program.

It is also possible to apply an irregular waveform representing information in analogue form, and the storage in the core will be proportional to the volt/second integral. Thus, by reading data out with digitalized pulses, a transformation may be made. For periodic sampling of an analogue quantity, an arrangement such as is shown in Fig. 2 can be useful. The tube conducts current to swing the core to saturation state "q", even with the maximum allowable voltage applied to the primary winding. At selected intervals, a pulse is applied to the grid of this tube so as to cut it off. When the tube is cut off the core is, so to speak, released from "q" and the applied voltage E_1 swings it to saturation in the state "p". The minimum allowable voltage E_1 must be sufficient to overcome the coercive force of the material. If the transfer function is 1:1, the voltage E_2 of the output pulse that appears at the secondary winding will be equal to the voltage applied to the primary. This assumes that the analogue input voltage does not vary appreciably over the time duration involved, and also neglects the resistance of the windings and the constant voltage required to overcome the coercive force. The time duration of the output pulse will be inversely proportional to the instantaneous magnitude of the applied analogue voltage.

The output pulse may then be used to enable a gate to pass a number of pulses from an oscillator of fixed frequency to a suitable counter. The counter may be a magnetic core or some conventional structure. The area K_1 of the output pulse will be a con-

stant determined by the characteristics of the core. If the applied voltage is increased, the time duration of the output pulse will decrease, and vice versa.

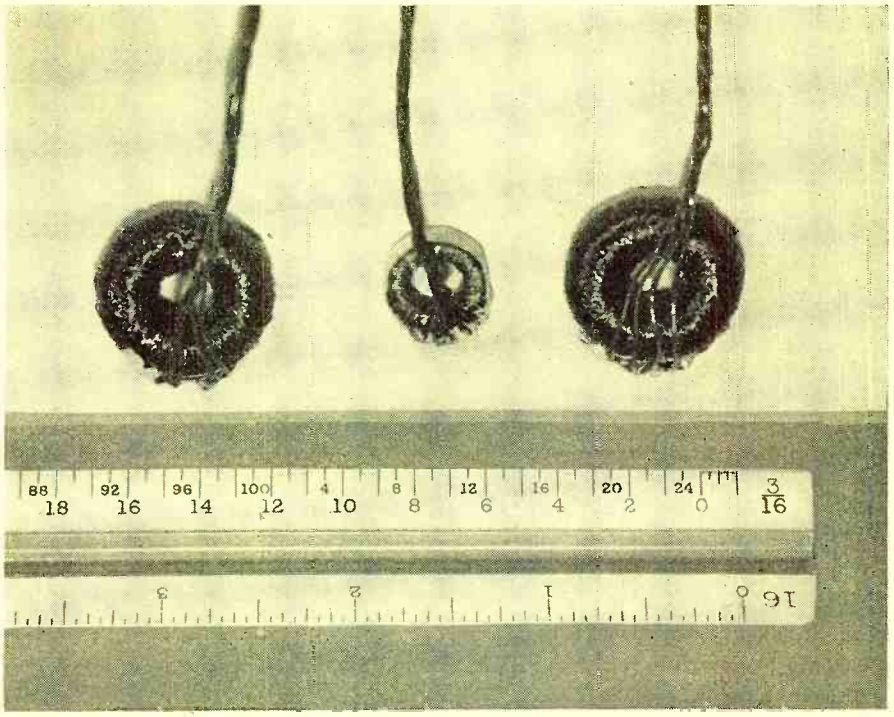
The sampling core in this case is used as a "time" gate and, in one sense, functions as a d.c. transformer. It is of some interest in this arrangement that the number of pulses representing the input voltage is in an exact inverse relationship. Thus, the relative accuracy of the translation increases as the magnitude of the input signal is decreased. This is the opposite of the effect ordinarily obtained in sampling observations of this kind. If the input were, for example, an error signal, such a relationship might be very desirable for it is when the error signal is small that the absolute accuracy is most important. Obviously, the number of counted pulses may be translated into a number directly proportional to the input signal by dividing it into an arbitrary constant.

It is of passing interest that if the magnitude of E_1 is controlled to represent a number N_1, and the frequency of the oscillator is controlled to represent a number N_2, direct division may be accomplished and the output number N appearing in the counter will be equal to N_2 divided by N_1.

There are many methods by which the output transition may be observed. Amplitude discrimination is one of the useful tools, but the negative pulse that results from slip-back to remanence after dynamic saturation is another interesting method. In practical materials, the loop is never precisely rectangular, and consequently when a read-back pulse drives the core material into dynamic saturation it will slip back to B_r from B_{max}. This will produce a negative going pulse at the output that can be observed as an indication that the end of meaningful read-back pulses has been reached.

This same phenomenon is a limiting factor in connection with maximum storage capacity that can be observed with digital accuracy. When the core has been driven into dynamic saturation by a read-back pulse, any additional pulses applied will produce an output pulse of reduced amplitude as well as negative going slip-back indications. The magnitude of the output pulses observed after dynamic saturation of the core will be a result of combined air coupling and the flux change from B_r to B_{max}. Obviously the minimum pulse that is practical for read-out in this manner must be a pulse that differs significantly from the pulses produced by air coupling and slip-back flux changes.

There are various methods of minimizing these effects in order to obtain storage of high numbers. Decimal storage is relatively simple and may be accomplished with a wide variety of pulse volt/second choices, depending on the requirements of the problem. The choice of parameters is limited with respect to short duration pulses by the maximum practical amplitude and, conversely, minimum amplitudes imply longer pulse durations, hence lower repetition rates.



Multi-stable magnetic memory elements for storing large numbers of pulses.

These limitations are not serious in connection with most problems and storage of very large numbers may be accomplished with reasonable pulse parameters. Pulses with a duration corresponding to a fraction of a microsecond may be used without exceeding practical pulse amplitudes. This means that pulse repetition rates corresponding to the limitations of available associated circuitry may be attained.

Multi-stable magnetic techniques may be used for many applications in computing machines. Storage registers may be extremely compact and light in weight with elements that are relatively free from effects of their environment. Magnetic elements with multi-stable characteristics may be used in the arithmetic computing sections of machines and for accumulation of data. Inventory control machines for business and military problems may be constructed with greater memory capacity in a given space than by any other known method. High speed operation with passive elements using almost any convenient radix is made possible and component failure is reduced to a minimum. Access time is very short indeed and associated circuitry is relatively simple.

A considerable amount of experimental work has been carried out in an effort to determine the optimum magnetic structures for these multi-stable applications. In general, ribbon-type toroidal orientations are most desirable, although useful results have been achieved with other types of cores.

The pulses used in this technique must be accurately quantized with respect to their volt/second integral. It is desirable that this be accomplished with passive elements in order to obtain long term stability. Temperature extremes will affect storage capacity to some degree but this does not present a problem of consequence. One of the advantages obtained with magnetic elements is a large degree of freedom from the effects of environmental factors.

Magnetic structures are now being developed for use in so many applications that they make a fair bid toward becoming more important than electron tubes. Magnetic amplifiers, flip-flops, gates, oscillators, counters, accumulators, adders, and almost the complete list of basic circuits appear to be possible of design for an increasingly large number of applications.

Other methods and techniques for applying magnetic principles to the design of computing machinery, control, conversion and sensing structures will be discussed in future articles.

Note: The multi-stable magnetic structures, techniques and systems described in this article are the subject of patent applications assigned to *The Minnesota Electronics Corporation* by the authors.

Multivibrator FREQUENCY DIVIDER

Fig. 1. Front panel view of the M.I.T. multivibrator frequency divider.

By
R. R. RATHBONE and R. L. BEST

Servomechanisms Laboratory
Massachusetts Institute of Technology

This versatile instrument provides a frequency divider, delay circuit and pulse standardizer.

THE multivibrator frequency divider shown in Fig. 1 is a pulse generator with an output range of from 200 kc. to 60 cycles, and which may be synchronized with any frequency equal to or greater than the output frequency. Two free-running multivibrators are used to cover this range, their individual ranges overlapping between 2.5 and 3 kc. Two output pulses are provided: a "standard" pulse and a high-impedance negative pulse used to trigger a synchroscope. The "standard" pulse is 0.1 microsecond on the base line, and is variable up to 25 volts across a 93-ohm load. The high impedance pulse is variable up to 100 volts negative, and has a leading edge of 0.2 microsecond and a slower trailing edge. It will drive an unterminated 93-ohm line of reasonable length, and occurs at the end of a delay interval of from 5 to 100 microseconds. This delay may be continuously variable, or may be varied by the interval between pulses if synchronizing pulses are fed into the "input for lock-in delay." This latter feature gives the most jitter-free operation, especially desirable when a fast sweep is being used or scope photographs are being taken.

The block diagram, Fig. 2, shows the many different ways in which the sections of this unit may be interconnected. The two most important sections are the "High-Frequency Multivibrator" (HFMV) and the "Low-Frequency Multivibrator" (LFMV). These two free-running multivibrators are permanently connected in series, although power may be removed from one or the other by appropriate switching. When both are operating, the LFMV divides the frequency of the HFMV by some integer.

The third important block, designated "Delay Multivibrator" (Delay MV), is a single-shot multivibrator, triggered by either the HFMV or the LFMV. At the end of the selected delay, the Delay MV initiates a negative output pulse which may be used to trigger a synchroscope.

A fourth block, the "Standard Pulse Generator," may be actuated by either the HFMV or the Delay MV and provides 0.1-μsec, half-sine-wave pulses at a 93-ohm impedance level. These pulses are "standard" for all test equipment at the Digital Computer Laboratory, M.I.T.

The switching shown in the block diagram allows for great flexibility in the interconnecting of these blocks. For convenience, let us assume in the following discussion of the circuit details that 1-mc. pulses are being fed to the "input to dividers", and the input selector, S_1, reads "to HFMV." The HFMV divides the pulse repetition frequency to a submultiple, determined by the HFMV coarse frequency setting, and feeds synchronizing pulses to the LFMV. If the standard pulse selector, S_3, reads "from HFMV," then the "standard" (0.1-μsec) pulses will occur at the rate of the HFMV. If the delay selector, S_2, is set to "from LFMV," as shown, the Delay MV will be triggered at the submultiple frequency of the LFMV and, at the end of the delay, will initiate the "output pulse (negative high impedance)."

Editor's Note: The name of Richard L. Best should have appeared as co-author of the third article of this series, Gate and Delay Generator, which was published in the September, 1951 issue.

This is the fifth of a series of articles on test equipment units sponsored by the Office of Naval Research and developed during the past three years by the M.I.T. Servomechanisms Laboratory. These units were designed as building blocks to test pulsed circuits and to simulate the control, arithmetic, and storage functions of an electronic digital computer.

With the above assumptions in mind, let us examine the schematic, Fig. 3, and the waveforms at various important test points. The 1-mc. input pulses are shown in part (a) of Fig. 7, and the output of the input amplifier (V_{1A}) in part (b). Parts (c) and (d) are waveforms of the plate of one section and the grid of the other section of the HFMV (V_3). These may be recognized as typical free-running multivibrator waveforms, with the exception of the synchronizing feature, which operates as follows. The negative pulses shown in part (b) are coupled to each plate of the HFMV through the small (10-$\mu\mu$fd.) capacitors C_4 and C_7, and from there to the opposite grids through the larger cross-over capacitors C_5 and C_6. Whichever triode is conducting amplifies these negative pips, resulting in the positive pulses seen in the lower half of part (c). These positive pulses are also coupled to the opposite grid through one of the cross-over capacitors (C_5 or C_6), synchronizing the triggering action of the circuit. The dual potentiometer (R_{9A}, R_{9B}) controls the free-running frequency of the HFMV, and thus controls the integer by which the input frequency is divided. The right-hand cathode of the HFMV has a peaker circuit, consisting of an inductance to ground shunted by a crystal diode. The diode is connected in such a way that a single positive pulse is generated when this section starts to conduct, and all other ringing is damped out. Part (e) of Fig. 7 shows this cathode waveform. The pips seen after the main pulse are the result of the synchronizing pulses coupled from the opposite plate to the grid of this section while it conducts.

The "Standard Pulse Generator"

(V_{1B}) utilizes a blocking oscillator, peaker, and pulse amplifier; its waveforms are shown in Fig. 6. Part (a) is the cathode output pulse of the HFMV (also shown in part (e) of Fig. 7 but shown here on a faster sweep). With the switches in the positions indicated, this pulse triggers the blocking oscillator (V_{1B}). The resulting pulse of plate current (see waveform (b)) flows through a peaker composed of L_3 and L_4 in parallel, and damped by the diode CR_3. The end of this current pulse causes the peaker to ring positive once before the diode damps it out, generating the waveform of part (c). This signal is then capacitor-coupled to the output pulse amplifier which puts the pulse shown in (d) out onto a 100-ohm line.

Figure 5 shows the waveform of the LFMV (V_4). Synchronization may be accomplished either by connection to the input amplifier or, as is done in Figs. 2 and 3, to the HFMV. The signal from one plate of the HFMV is differentiated and coupled to both plates of the LFMV through the two 2-$\mu\mu$fd. capacitors. Part (a) shows one plate waveform; part (b), the waveform of the opposite grid. The synchronizing action is the same as in the HFMV. The dual potentiometer (R_{16A} and R_{16B}) varies the free-running rate of the LFMV, and determines the submultiple of the HFMV frequency at which the LFMV runs. The right-hand cathode has a peaker (like that of the HFMV) which generates a single positive pulse when V_4 starts to conduct. The cathode waveform may be seen in part (c) of the figure; the pips occuring after the main pulse, while this section is conducting, are a result of the synchronizing signal fed from the HFMV and gave a great deal of trouble in the Delay MV, preventing a smooth continuous delay. Diode CR_5 is biased off by about 8 volts so that these pips are eliminated (see part (d), Fig. 5). The negative pulse that occurs after the main positive one, is fed back from the Delay MV at the end of the delay interval.

Figure 4 gives the waveforms of the single-shot Delay MV (V_5). Part (a) shows the same cleaned-up pulse as does part (d) of Fig. 5, but at a different sweep rate and delay setting. This pulse is capacitor-coupled to a proper d.c. level, and, through diode CR_6 lifts the normally-off grid of the Delay MV into conduction as waveform (b) shows. The plate waveform (c) is coupled through a capacitor to the opposite grid, (d); the d.c. return path for this grid is a bit unusual and merits closer attention. In the quiescent state, the grid is at a voltage determined by the plate drop of the same triode across R_{42} and the divider R_{45}-R_{46}. The highly degenerative circuit maintains the quiescent grid

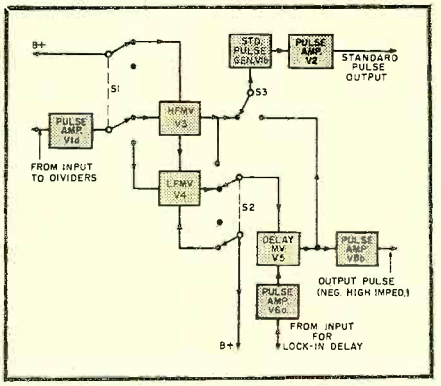


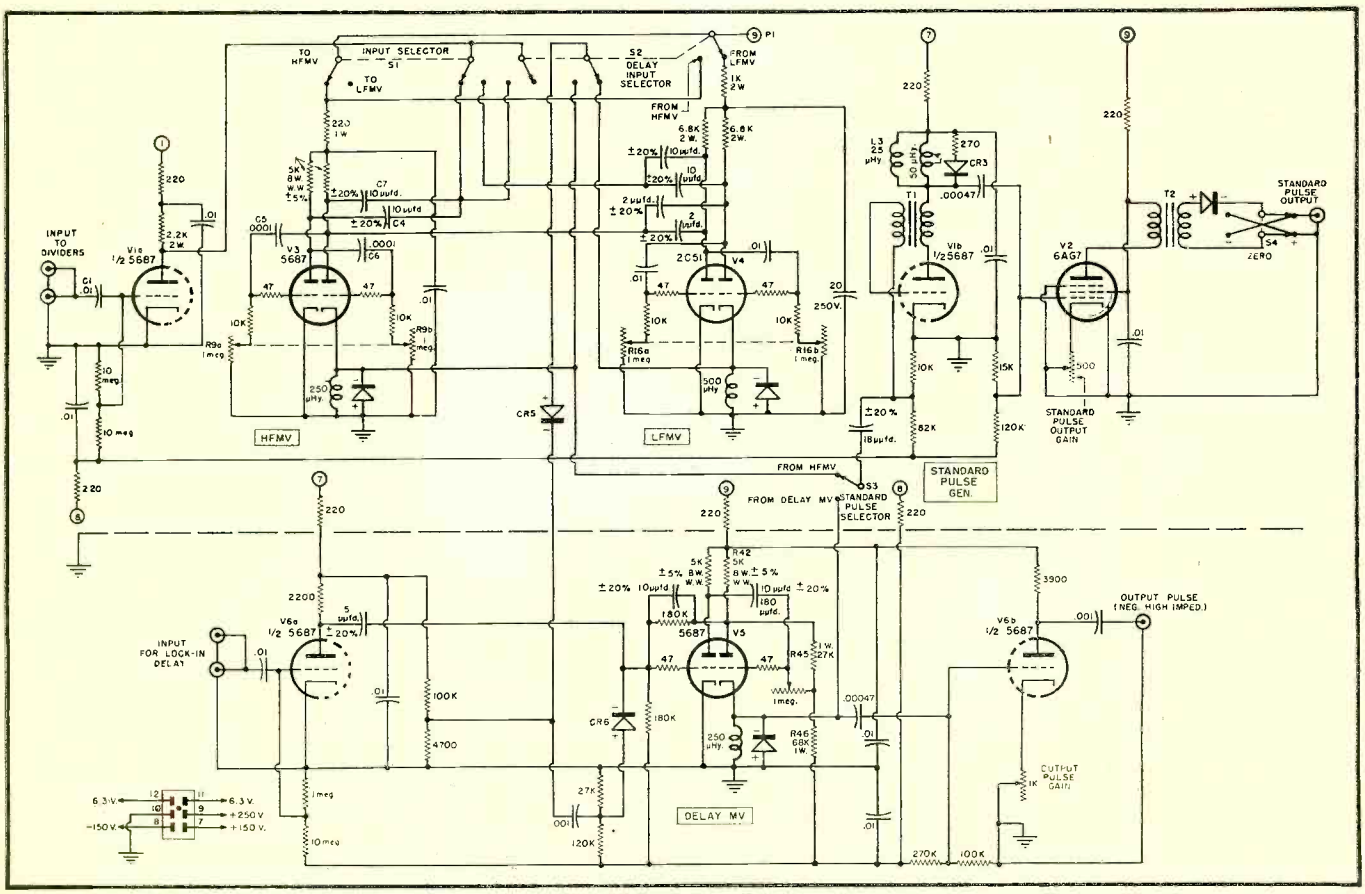
Fig. 2. Block diagram of operation. Numerical notations refer to Fig. 3.

voltage about zero, so that as the Delay MV potentiometer is varied, no great amount of grid current is drawn. During the delay interval, however, the plate of this triode rises as shown in part (e), giving a positive grid return for the now cut-off grid. Thus the benefits of a positive grid return are realized (steep slope of the waveform at the end-of-delay point, and therefore less jitter), with the benefits of zero grid return during standby (prohibitive grid currents are not drawn when adjusted for minimum delay).

Synchronization of this delay could have been accomplished by feeding the

(*Continued on page 29*)

Fig. 3. Circuit schematic and parts values for the multivibrator frequency divider.



AMPLITUDE DISTRIBUTION ANALYZER

By
R. E. NEINBURG and T. F. ROGERS
Mass. Inst. of Technology

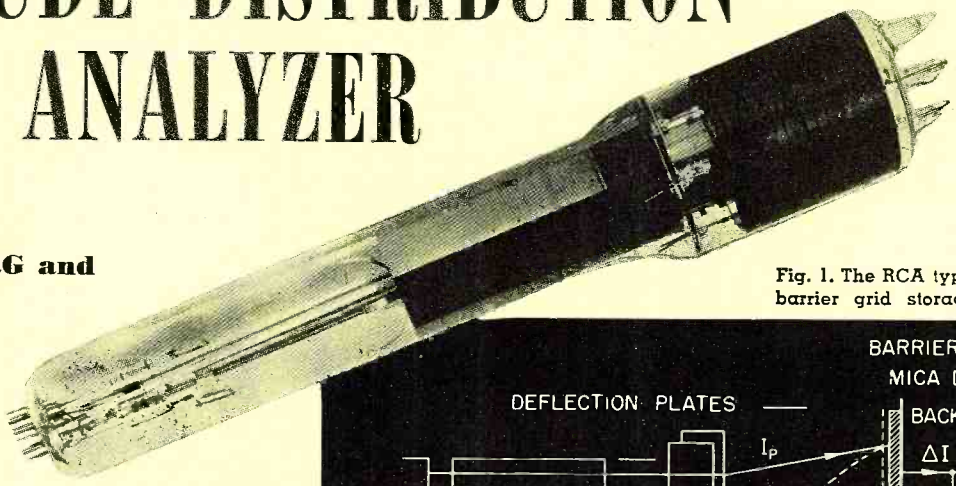


Fig. 1. The RCA type STE-A barrier grid storage tube.

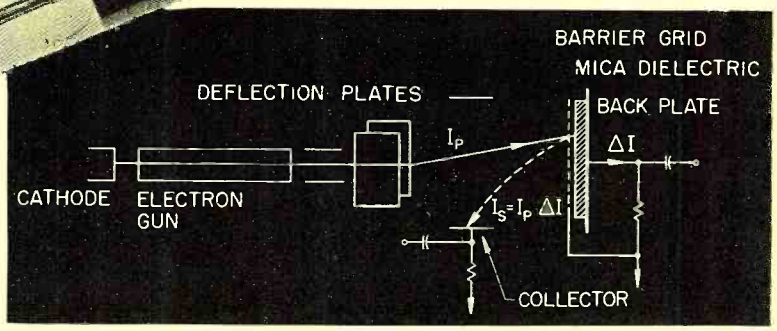


Fig. 2. Simplified drawing of the barrier grid storage tube.

A barrier grid type of storage tube is used in this electronic means for realizing statistical distributions.

THE RELATIVELY recent attention focused upon the statistical means of analyzing various types of signals by the work of Wiener, Shannon, Rice and others has encouraged many investigators to search for an electronic means of realizing statistical distributions. This paper concerns itself with the product of such a search; a device that analyzes signals on the basis of the distribution of amplitude levels which they display. The final results are presented as an oscilloscope trace in the form of the distribution density function, or amplitude distribution, of the signal being analyzed.

At the outset of this study, it was realized that several methods of obtaining amplitude distributions were already available.[1] For example, by the simple process of photographing a signal waveform and determining, by actual count, the number of times the signal enters various incremental amplitude levels, the distribution of amplitude levels can be obtained. However, in this, as in other existing methods, the inherent delay and the expense in man-hours tend to be prohibitive. The object of the investigation then became to design a system that could sample a given signal and present the amplitude distribution of this signal with negligible delay and in a form convenient for dynamic analysis.

The heart of the device is the *RCA* barrier grid type of storage tube, a simplified drawing of which is shown in Fig. 2.[2] This tube is similar to other memory devices of this general type in that the memory is derived from the storage of an electric charge on a dielectric surface, the charge being supplied by a primary electron beam that is formed and focused in an electrostatic deflection system. Enough energy is imparted to the electrons of the primary beam to enable them to dislodge other electrons from the dielectric surface and cause secondary emission. Those secondary electrons emitted with sufficient energy to escape the field at the dielectric surface are focused on a collector ring and thereby escape to the external circuits. The magnitude of the secondary, or collector, current is dependent on the secondary emission ratio of the dielectric surface, which is, in turn, a function of the cathode to dielectric potential. The steady state potential of the dielectric, which results in a value of unity for the secondary emission ratio, may be considered a surface equilibrium potential.

In view of the capacitive coupling that exists between the dielectric and backplate, any positive voltage applied to the backplate will increase the dielectric surface potential by the amount of the applied voltage, and will, therefore, remove the dielectric from equilibrium. As a result, the secondary emission ratio will decrease by an amount proportional to the applied voltage (to a good first approximation for signals $\leqq$ 10 volts) as the surface again seeks the equilibrium potential.[3] Thus, by applying a positive step voltage to the backplate, the dielectric surface is given a positive potential and is, therefore, in a condition to store charge on any area element scanned by the primary beam. The process of storing a charge density distribution in this manner will be referred to as the writing operation.

Interrogating the stored charge (called reading) is accomplished by returning the backplate to the voltage it had prior to the writing period, and scanning the line containing the stored signal by the primary beam. As the variations of dielectric potential caused by the stored charge are encountered during the scan, the secondary emission ratio will vary in such a manner as to produce, across a load resistor in the collector circuit, a voltage waveform that is a replica of the distribution of the dielectric charge density. The read operation, in that it removes

Fig. 3. Charge density distribution for a sine wave.

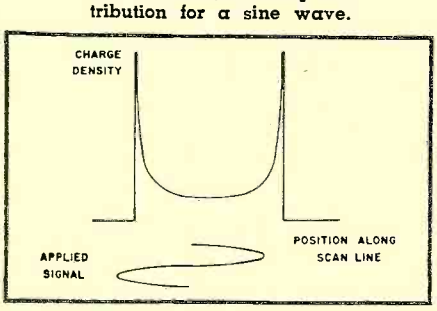
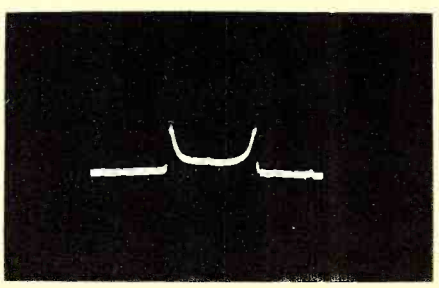


Fig. 4. Amplitude distribution for a sine wave.



the stored charge, is also an erasing operation.

When used as an amplitude distribution analyzer, the storage tube is a summation device, not for amplitude addition as in some applications,[4] but in the following sense. The amplitude distribution of a signal may be determined by dividing the signal into equal amplitude increments and determining, in some manner, the length of time the signal spends within each increment of amplitude. A graph of this time (see Fig. 9) versus the amplitude increments for all amplitudes that the signal displays, is the amplitude distribution of the signal. As the individual increments are chosen so as to approach zero, the distribution approaches the theoretical amplitude distribution. The function of the storage tube in this operation is to determine the relative length of time the amplitude remains within the various incremental levels, with the size of the amplitude increments determined by the diameter of the primary beam.

The summation of time described above is performed by the storage tube in the following manner. A fixed centering voltage is applied to the vertical deflection plates of the storage tube, and the signal to be analyzed is applied to the horizontal deflection plates. Since the position of the primary beam is controlled by the potential developed between opposite plates of the deflection system, it is possible to associate every point along the single horizontal line scanned to a particular amplitude of the signal that is applied to the horizontal deflection plates. The beam will, therefore, scan a horizontal line in a manner determined wholly by the amplitude of the signal.

During the writing period, while the signal is applied to the deflection plates, a positive step voltage is applied to the backplate removing the dielectric from equilibrium and permitting it to store charge. Since, as mentioned previously, the position of the beam at any instant is a linear function of the amplitude of the signal on the horizontal deflection plates, each point along the scan line corresponds to some particular signal level; it follows, therefore, that the charge density on any line segment is proportional to the time the signal spends at the amplitude level corresponding to that segment. Furthermore, since the amplitude distribution is, in effect, a plot of the percentage of time a function remains at each amplitude level versus all amplitude levels, the distribution of the charge density as a function of displacement along the line scanned is the desired amplitude distribution. This, briefly, is the method by which the distribution measurement is made.

To illustrate the basic principles of operation let us assume that a sinusoidal waveform (Fig. 3) is applied to the deflector plates. The velocity of the beam will be maximum at the center of the dielectric (corresponding to the maximum rate of change of the sine wave around the zero level) and, as the peak of the sine wave is approached, the beam velocity will decrease, finally stopping completely and reversing its direction. At the end of one complete sine wave cycle, the beam will have swept to the right a distance dependent on the peak signal amplitude, reversed its direction and traveled to the left extremity, reversed again and returned to the center. If the beam is stopped at this point, the magnitude of charge on any line segment along the scan line will be directly proportional to the time spent by the beam at that segment, or inversely proportional to the velocity of the beam at that segment. It would be expected then, that the magnitude of charge density would be a maximum at the extremities of the dielectric and a minimum at the center, and would closely resemble the calculated amplitude distribution shown above the signal in Fig. 3.

To transform the stored amplitude distribution into a voltage wave, it is merely necessary to read out the stored charge. The backplate writing voltage is returned to the equilibrium value and the signal on the horizontal deflection plates is replaced by a voltage (such as a saw-tooth or triangular waveform) which causes the beam to scan the charged line with a constant velocity.

As discussed previously, in connection with interrogating the distribution of the stored charge, the collector current will vary in accordance with the variations of charge density stored along the scan line. Since the line is scanned with constant velocity during the "read" operation, variations of charge density as a function of distance along the scanned line are transformed into variations of collector current that are a function of time. The variation of collector current will now be proportional to the amplitude distribution of the signal being analyzed. It should be noted that to insure complete erasure, that is, to insure the return of the dielectric surface to the equilibrium potential before the next writing operation, it is necessary to scan the line more than the one time needed to view the distribution.

The basic idea, then, is to allow the beam to travel along the scan line in a manner determined by the amplitude of the signal. Since each segment corresponds to a particular amplitude interval, the charge density at any segment will be proportional to the length of time the signal spends within that interval. The resulting distribution of charge-density is then the desired amplitude distribution, and is read out of storage during the read interval.

The first signals analyzed were those having relatively simple amplitude distributions. In this way, the validity of the early results could more easily be judged.

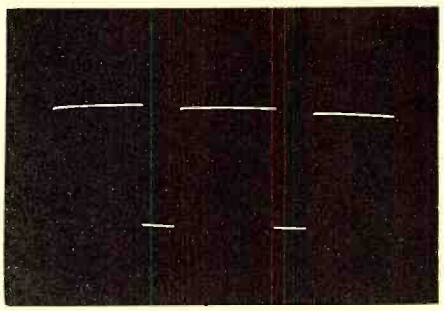


Fig. 5. Rectangular input voltage.

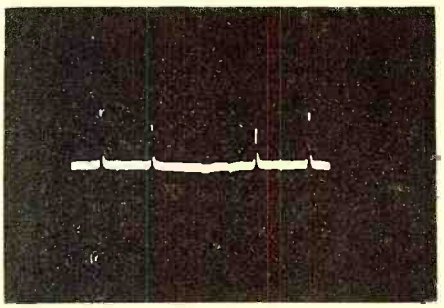


Fig. 6. Amplitude distribution of a rectangular input voltage.

Fig. 7. Output of the second detector of a radar receiver.

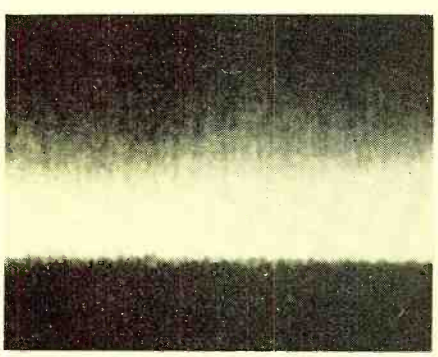
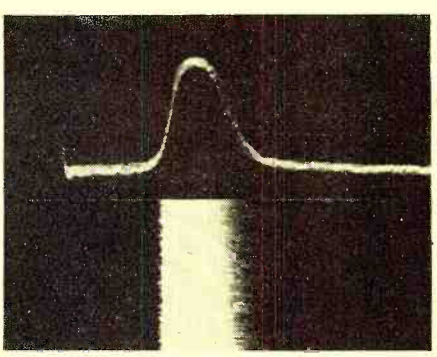


Fig. 8. Experimentally determined amplitude distribution of Fig. 7.



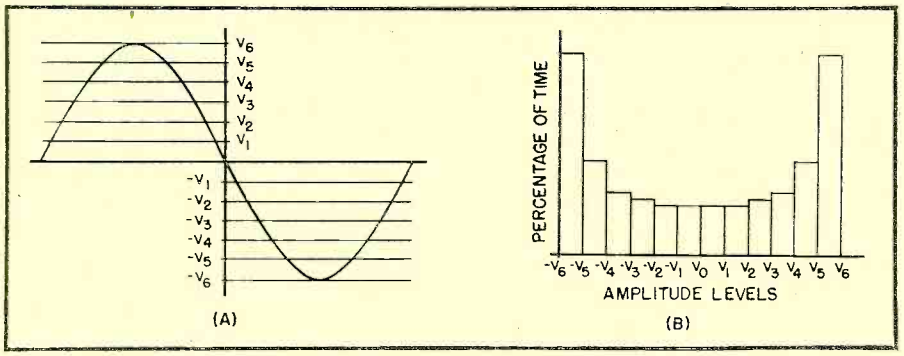


Fig. 9. Diagram of a sine wave and its amplitude distribution.

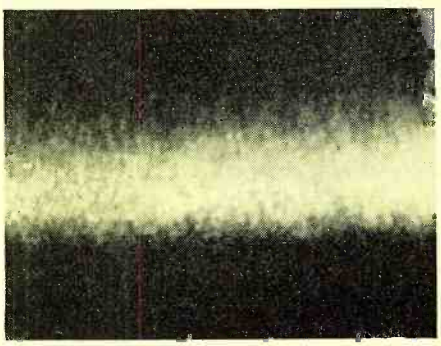


Fig. 10. Signal of Fig. 7 with a carrier introduced.

Fig. 3 shows the calculated amplitude distribution of a sine wave; Fig. 4 shows the experimentally determined amplitude distribution of a sine wave. The two spikes, as before, correspond to the positive and negative sine wave peaks. The fact that the distribution does not go to infinity at the extremities, is due to the quantizing effect of a finite beam current and diameter, and is an indication of measurement limitations. Aside from this obvious discrepancy, the general shape of the experimental and calculated distributions are in close agreement. Although no quantitative comparison was attempted, the results appear to fall within tolerable limits.

Rectangular waves such as those shown in Fig. 5 were also analyzed. The distribution shown in Fig. 6 illustrates the effect of employing a triangular scanning voltage. The image on the left is the result of scanning the charge distribution from left to right. The image on the right, which is the mirror image of the first, is generated as the beam scans from right to left. Many such scans are required to erase the stored pattern. The results realized from the analysis of rectangular waves have special significance in the alignment procedure.

Assuming the rectangular wave to have essentially zero rise time, the primary beam will focus on only two segments of the scan line, one segment corresponding to the raised portion of the pulse, the other to what may be considered the base line. Said another way, we are concerned with a signal displaying only two levels of amplitude, and would, therefore, expect only two areas of high charge density on the scan line. Notice that the ratio of the time spent at one amplitude to the time spent at the other amplitude is approximately 3:1. One would expect, then, that the ratio of the charge density corresponding to each of these amplitudes would also be in the ratio 3:1. In this particular case, the expected results are not verified, the reason being that the primary beam remains focused on one spot of the dielectric for a period sufficient to exceed the linear dynamic range of the storage tube. The charge density stored on that spot is, therefore, not a linear function of time. This phenomenon may be used to good advantage. By applying a rectangular wave of known asymmetry for a given sampling period, the primary beam intensity may be adjusted until the output spikes are in the same ratio as the two amplitude levels of the rectangular wave. The larger of the two spikes is now the largest output possible for the particular intensity setting used, that is, within the limts of tube linearity. Thus a method of system alignment is provided by the use of rectangular waves.

Fig. 11. Amplitude distribution of second detector output noise.

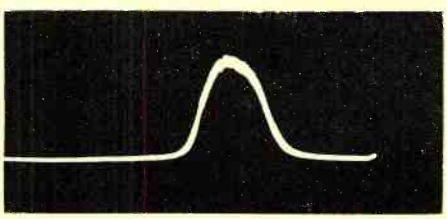
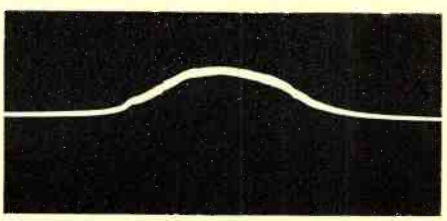


Fig. 12. Amplitude distribution as in Fig. 11 with a carrier present.



As examples of aperiodic signals, two types of noise were analyzed. The first, shown in Fig. 7, is the output of the second detector of a radar receiver, and consists for the most part of positive peaks, resulting in an output that is substantially unidirectional. The experimentally determined amplitude distribution of this signal, shown in Fig. 8, closely approximates the expected Rayleigh curve, being skewed to the right.[5]

The second type of noise analyzed was produced by introducing a carrier into the radar receiver resulting in the disappearance of the unidirectional character as seen in Fig. 10. The distribution of this signal is shown in Fig. 12, with the previous noise amplitude distribution being shown in Fig. 11. Notice how the second distribution has assumed a symmetrical appearance relative to the first, just as the second signal was the more symmetrical of the two. Also, the increased spread of amplitudes is seen to have extended the limits of the distribution and introduced a flattening effect, as would be expected.[6]

The results that were realized by the analyzer in the experiments performed were very encouraging, and serve primarily as an indication of the possibilities of such a device. Further development of the analyzer should greatly facilitate studies of the distributions of signal amplitudes, thereby bringing statistical methods of analysis closer to acceptance as a general communications tool.

The authors would like to acknowledge the guidance and assistance given throughout the course of this research by J. V. Harrington of the Cambridge Research Laboratories.

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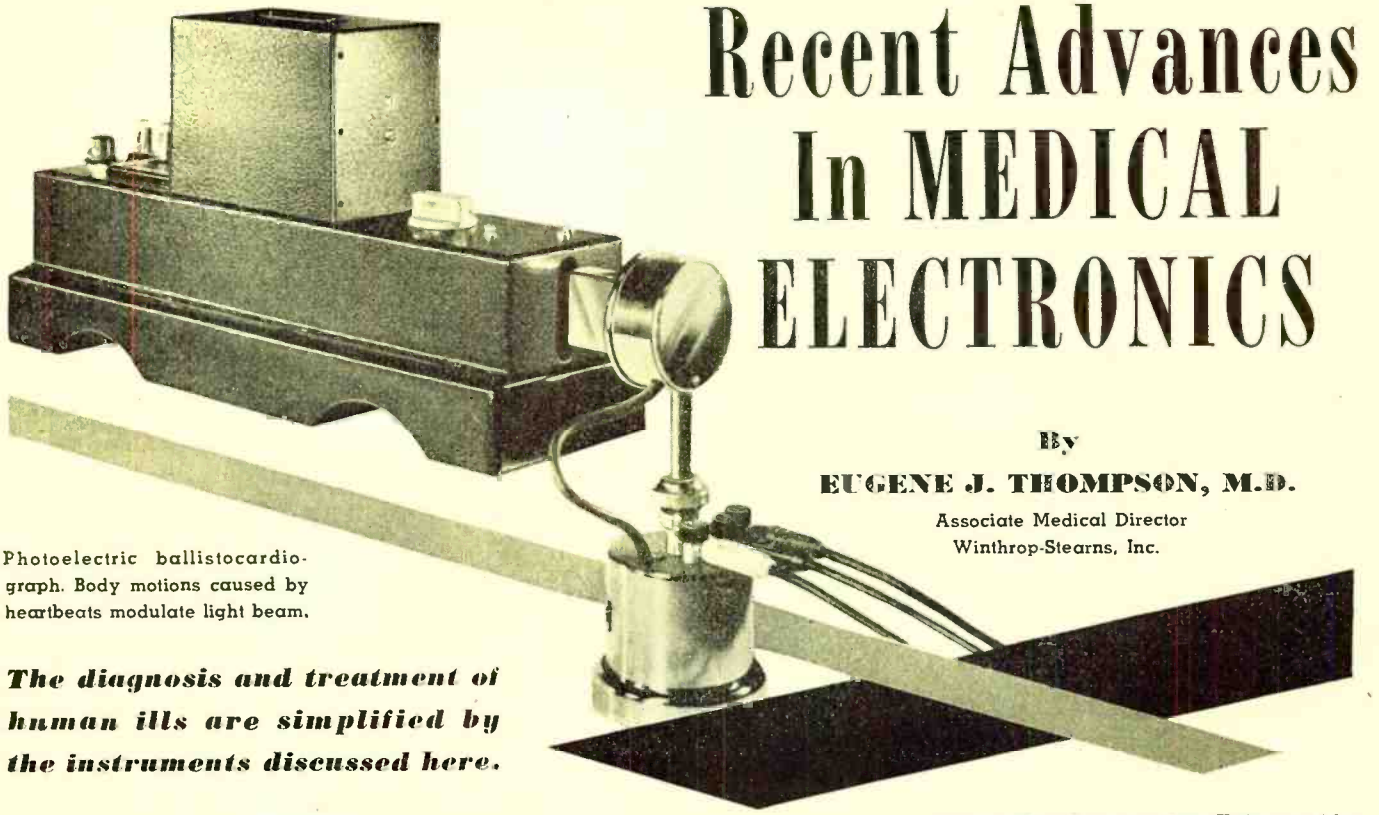
6. *Ibid.*

Recent Advances In MEDICAL ELECTRONICS

By
EUGENE J. THOMPSON, M.D.
Associate Medical Director
Winthrop-Stearns, Inc.



Photoelectric ballistocardiograph. Body motions caused by heartbeats modulate light beam.

The diagnosis and treatment of human ills are simplified by the instruments discussed here.

WERE IT possible to transport the medical investigator of yesteryear to present times, he would almost certainly gaze in awe and amazement at the incredible achievements which the past three decades have witnessed. For this relatively brief span of time has seen the perfection of the electronic cardiograph, the electroencephalograph, and a score of similar devices which the miracle of electronics has fashioned into instruments of such precision and refinement as to have surpassed even his wildest dreams. Yet, to the modern electronic engineer and research scientist, these marvels seem almost prosaic, when matched against the complexities of the instruments which are now taking their place in the great research laboratories.

Many centuries ago Socrates, the great Greek philosopher, said, "I know nothing except the fact of my ignorance." But, ancient as it is, this statement is even more true today. One of the paradoxes of science is that the more we learn, the more we realize what we do not know. For this reason, much more complex multiple channel measurement apparatus is needed for modern medical research.

Two such multiple channel recording instruments are illustrated in this article. These instruments provide the biophysical or other research or investigative laboratory, hospital or teaching group with the widest available range of multi-channel, simultaneous recording of a great variety of biophysical and other phenomena.

The *Sanborn* Poly-Viso, a block wiring diagram of which is shown in Figure 1, through a selection of input circuits, permits separately or simultaneously, any selection of the following, in up to four recording channels:

Any combination of electrocardiograph leads (including four simultaneous "V" chest positions).

Physiologic pressure recording (blood pressure, spinal fluid pressure, gastrointestinal pressure, etc.). This is accomplished with the aid of the electromanometer, to be described later.

Ballistocardiogram, also described later.

Pulse waveforms.

Recordings of respiration.

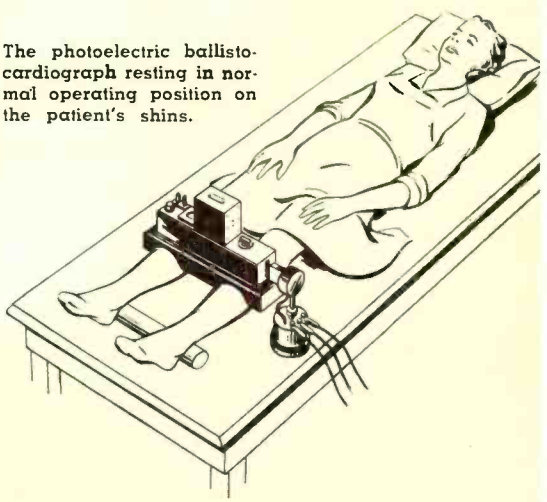
Phonocardiograms, with the aid of a heart sound microphone, to study heart murmurs.

Temperature, volume, and acceleration changes, with the help of a strain gauge amplifier.

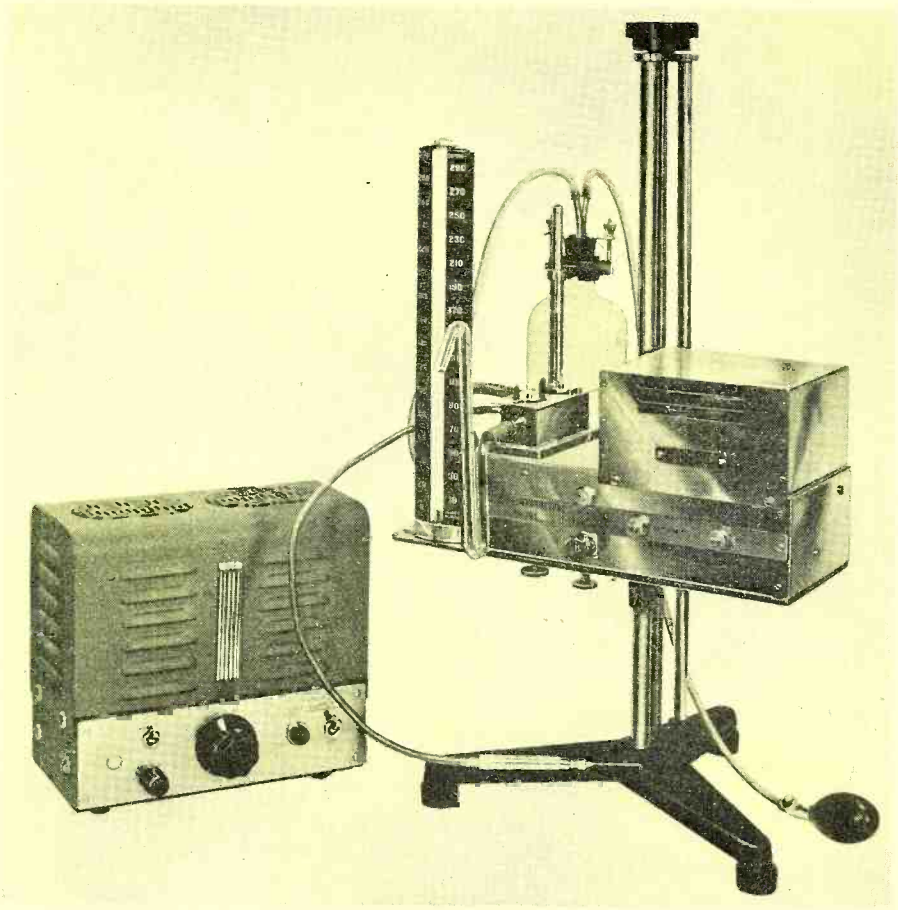
Referring to Fig. 1, it can be seen that the instrument contains four preamplifiers. These are especially designed to amplify with a high degree of accuracy and linearity, any signals of a pulsating nature. Because such signals as the heart's electrical field and other biologic impulses have frequencies extending down to around 1 cycle per-second, amplifiers of this type must have relatively long time constants. This is illustrated by the high value of the coupling capacitors used in the amplifier diagrammed in Fig. 2. Note that the circuit makes use of two stages of high-gain pentode amplification, operated in cascade. This provides a voltage gain in the vicinity of 9000 —an absolute essential when one is dealing with biologic currents with an emf in the fraction of a millivolt range. As a further precaution, the entire amplifier is operated in push-pull which appreciably attenuates extraneous electrical disturbances.

In order to achieve the high degree of constancy in gain which is required for measurement purposes, amplifiers of this type are customarily battery-powered, or equipped with special, high-stability, voltage-regulated power supplies.

Four direct-coupled amplifiers are also included in the instrument. An example of such an amplifier is shown in Fig. 3. This type of circuit serves two important purposes; it provides a



The photoelectric ballistocardiograph resting in normal operating position on the patient's shins.



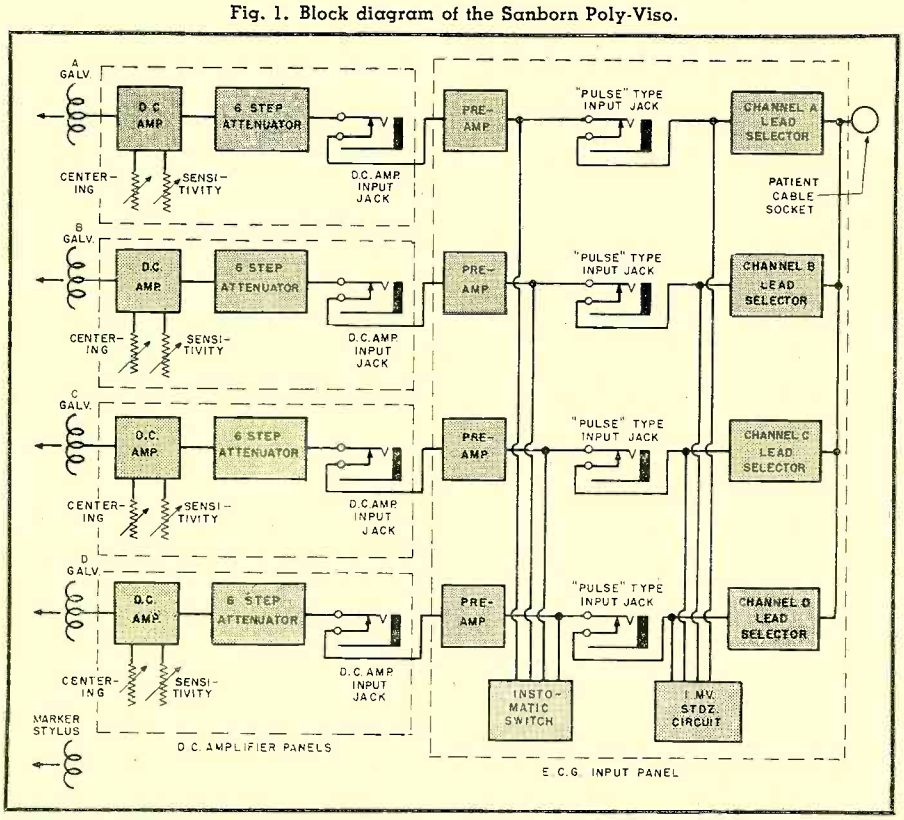
Over-all view of the Sanborn electromanometer.

method for measuring steady-state (d.c.) biologic phenomena, and it also permits quantitative recording of the amplitude of pulsating impulses. It is well-known, of course, that conventional *RC* coupled amplifiers will not amplify direct current.

The important differences between *RC* coupled and direct coupled amplifiers with respect to biologic measurement can best be illustrated by the following example. When one attempts to measure the blood pressure, for example, it is found that it is not constant; instead, the pressure is continually oscillating between about 80 and 120 mm. of mercury, in the normal individual. This difference between the upper and lower extremes of the blood pressure, amounting to 40 mm. of mercury, is referred to as the pulse pressure. If one translates millimeters of pressure into millivolts, by means of a piezoelectric crystal transducer, the emf representing the blood pressure will swing between 80 and 120 millivolts. Under these circumstances, the 40 mm. pulse pressure will be represented by a voltage swing of 40 millivolts. This can be broken down into an a.c. and a d.c. component; the d.c. component will amount to 100 millivolts (the average of 80 and 120), and the a.c. component will be represented by a swing of 20 millivolts above, and 20 millivolts below this d.c. reference level.

If such a signal is fed through an *RC* coupled amplifier, the circuit will not pass the d.c. component. Instead, only the a.c. waveform, representing a periodic change in amplitude of 40 millivolts, will be present at the amplifier output. Unfortunately, this information is of relatively little value, because any range of pressures, separated by 40 mm., will produce the identical waveform, such as 60 and 100 mm., or 160 and 200 mm., etc. There is a world of difference, of course, between the latter abnormal blood pressures, and the normal range of 80 to 120 mm. For this reason, the physician must know the absolute value of the blood pressure. He can obtain this with the aid of a direct-coupled amplifier, because this type of circuit does not discriminate against the d.c. component of blood pressure voltage curve. As a result, the galvanometer or recording arm is deflected to the average voltage level, and remains there instead of decaying as it would with an *RC* coupled circuit. The fluctuations above and below this average are represented by excursions above and below the d.c. setting.

Fig. 1. Block diagram of the Sanborn Poly-Viso.



The 6 step attenuator which is incorporated into the Poly-Viso is similar in principle to the loudness controls used in high-fidelity audio amplifiers. Like the loudness control circuit, it allows variations in amplifier gain without introducing frequency discrimination. It has the additional advantage of providing a selection of gain settings, which are related to each other by an accurately pre-determined ratio (X1, X4, X20, X100, X400, and X1000).

A variety of recording devices is used with multiple channel recorders

of this type. In one of the instruments shown in the photographs, optical galvanometers, which throw a moving beam of light on a roll of moving photo-sensitive paper, are employed. Records of this type must be developed photographically for interpretation.

Another recording method makes use of electromagnetically-driven pens. These produce an inked record on ordinary paper. The most modern recorders, however, and the ones which are used with the most recent, direct-writing electrocardiographic recorders, are the direct-writing galvanometers. These consist of a moderately sensitive galvanometer, of the d'Arsonval type. Attached to the meter suspension is a long, but lightweight, extension arm on which is mounted an electrically heated stylus. The meter movements are etched by the heat of the stylus in the surface of special, plastic-coated paper to produce the finished record. As a rule, provision is made in most modern recorders to plug a cathode-ray oscilloscope into the output circuit of the direct-coupled amplifier.

With the addition of certain accessory equipment, multiple channel recording systems of the type just described become exceedingly versatile research instruments.

Two of the most recent accessory devices which are fulfilling roles of great importance in medical research are the electromanometer and the ballistocardiograph. The electromanometer circuit is shown in block diagram in Fig. 4. It would be difficult to over-emphasize the value of this ingenious instrument as a research tool. In one compact unit, this apparatus represents the culmination of a need, the solution of which has challenged the most brilliant scientific minds of more than two centuries—a method for accurately and continuously measuring the blood pressure. In terms of the countless human lives which will some day be saved as a result of the research into heart disease which this instrument has made possible, its value is immeasurable.

The heart of the instrument is the r.f. oscillator (B) and the condenser microphone-bridge circuit (C). The device operates in the following manner. A needle is introduced into a suitable blood vessel, such as the brachial artery (in the arm). The variations in the blood pressure are physically transmitted through a special salt solution from the needle tip, through a length of lead tubing, to the condenser microphone. When the condenser microphone is stimulated by these pressure changes, the change in capacitance of this element, which constitutes one arm of the bridge circuit, unbalances the bridge. The unbalanced voltage from the r.f.-excited bridge is then amplified and rectified. The rectified voltage which is proportional to the blood pressure is then fed through the power unit and into the multiple-channel recorder.

Prior to the development of the electromanometer, the most satisfactory way to measure the blood pressure was

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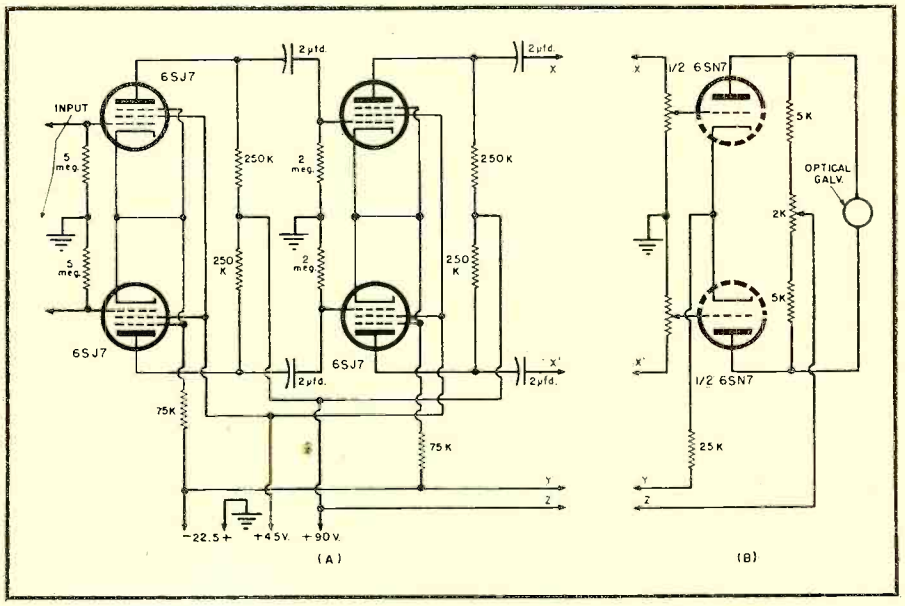
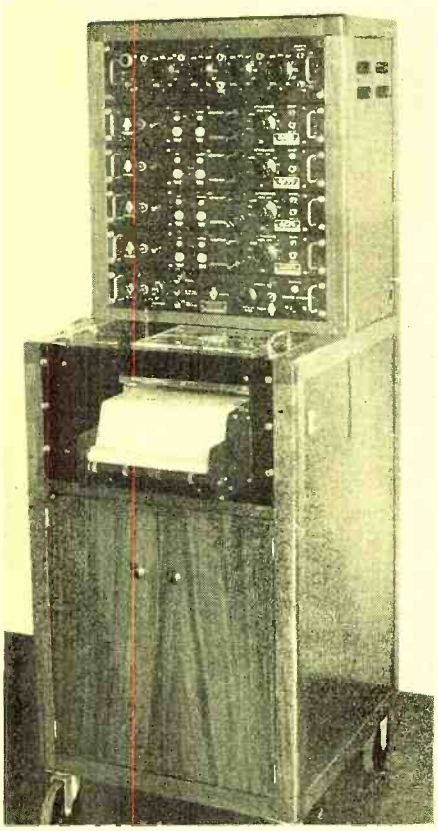
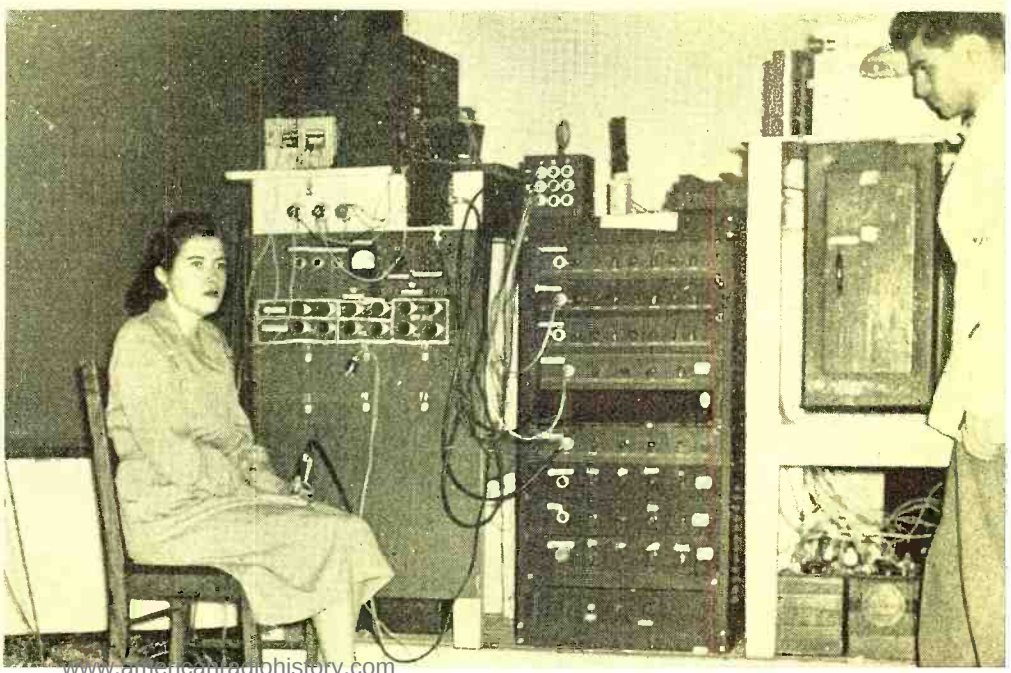


Fig. 2. Circuit of pulse-type, resistance-capacitance coupled amplifier (A), with connections for completely self-contained recorder (B). For a multiple-channel recorder, the terminals X,X' would go to a direct-coupled amplifier.

The Sanborn Poly-Viso recorder.



A ten-channel research recording system in operation.



SQUARE WAVE STIMULATOR for CARDIAC RESEARCH

Details of a dual pulse generator with variable pulse positioning and a repetition rate of 30 to 300 PPM.

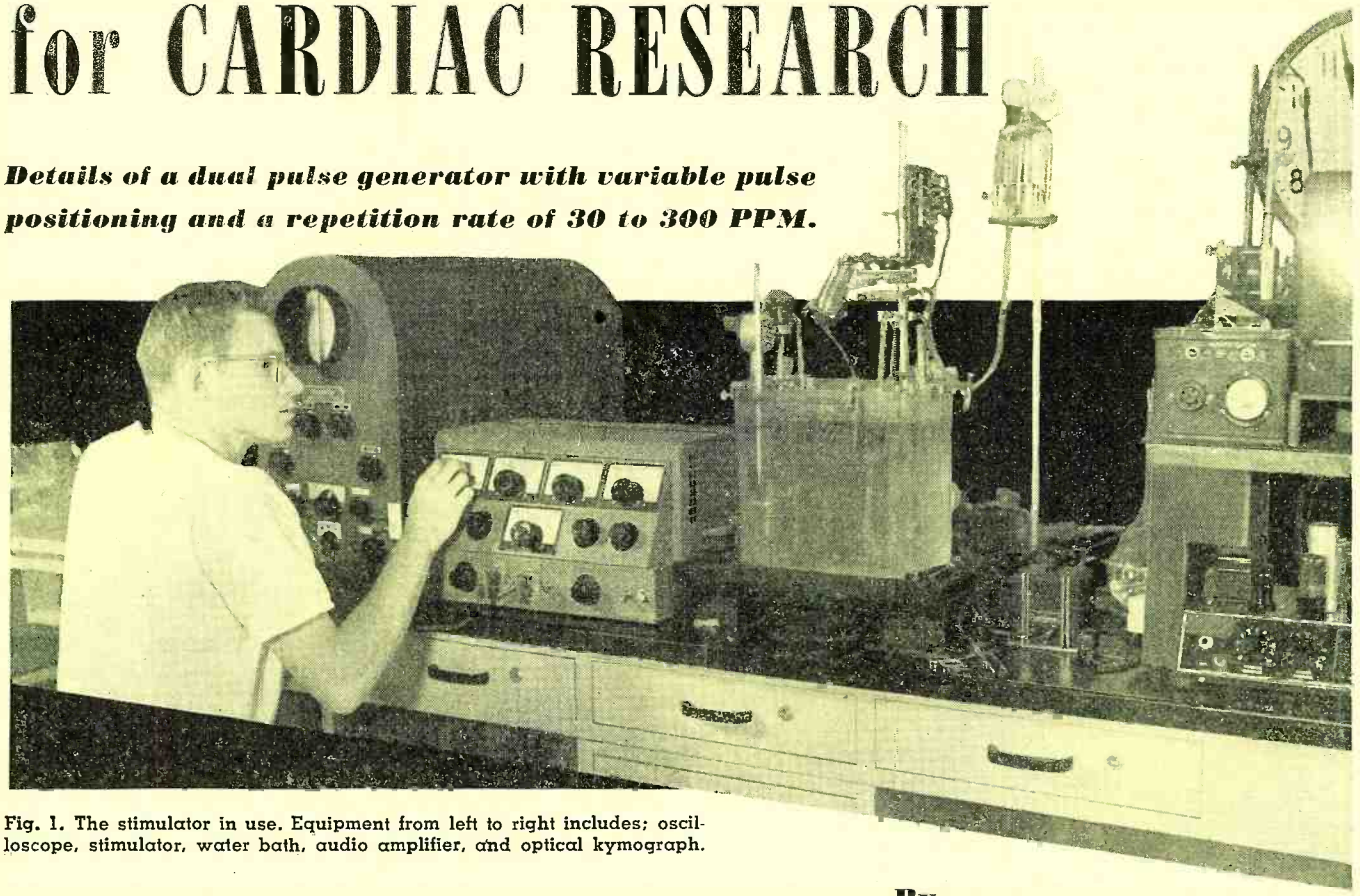


Fig. 1. The stimulator in use. Equipment from left to right includes; oscilloscope, stimulator, water bath, audio amplifier, and optical kymograph.

By

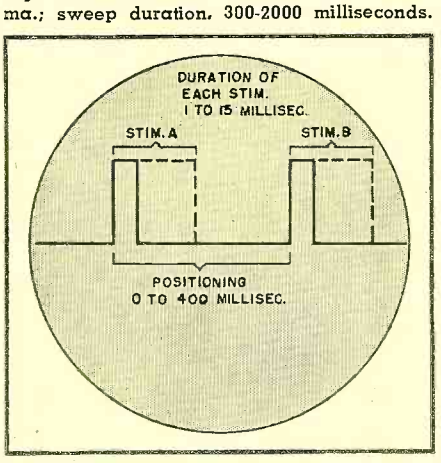
J.R. DiPALMA, M.D.* and E.E. SUCKLING**

DURING THE course of an investigation on the excitability and refractory period of mammalian cardiac tissue, a special stimulator was designed[1]. The requirements were as follows:

1. Rectangular negative pulse in all ranges.
2. Selection at will of a single or a dual stimulus at repetitive rates from 30 to 300 pulses per-minute.
3. Continuously variable dual pulse positioning so that the pulses might be separated from 0 to 400 milliseconds apart.
4. Independent, continuously variable control of the duration of each pulse from 0.1 to 15 milliseconds.
5. Independent output control of each pulse from 0 to 20 milliamperes.
6. Previously calibrated controls so that any of the variables might be quickly selected.
7. Stable operation.

Other investigations on the same problem have, for the most part, used rotary commutators and induction coils[2, 3]. These are difficult to construct mechanically and because of the induction coils and inevitable sparking at the contacts, variations in amplitude and wave shape of the output result. Many types of pulsed electronic stimulators have been designed but none fit the particular requirements set forth above[4, 5]. For this reason, it is felt desirable to present the circuit, certain construction details, and applications of this unit.

Fig. 2. Waveforms obtainable. Amplitude, 0-20 ma.; sweep duration, 300-2000 milliseconds.



V_1 is an ordinary thyratron oscillator (Fig. 4.) The rate of oscillation is set by the potential on its grid. The pulse from V_1 triggers V_2, which in turn empties its plate condenser into the cathode of V_3. The condenser in the cathode V_3, slowly discharges through pentode V_4 in a linear manner. This quick-rise, slow-discharge voltage goes to cathode follower V_6, where it is used to trigger a multivibrator circuit composed of V_7 and V_8. V_5 and the second plate of V_3 limit the charge and discharge of the V_3 cathode condenser. V_6 has a large saw-tooth voltage with a moderately fast rise and a slower discharge each time V_1 fires. V_7 and V_8, the d.c. multivibrator circuit, is triggered off when the grid of V_7 reaches approximately 38 volts. The multivibrator falls back again when the grid of V_7 drops in potential down to 35 volts. The 38 volt charge occurs during the fast rise, and the 35 volt charge during the slow fall. Thus, during the saw-tooth wave, V_7 and V_8 trip and return. The return depends on the setting of the potentiometer in the cathode of V_6, and thus the system gives a delay in relation to the firing of

*Professor of Pharmacology, Hahnemann Medical College.
**Instructor in Physiology, State University of New York.

V_1 of any duration up to 0.4 seconds. When V_7, V_8 return to normal conditions, a negative pulse is passed from the plate of V_7 to the grid of V_9 and is amplified to become a positive pulse which can fire off V_{10}. The pulse from the plate of V_{10} is used to trigger the square wave generator V_{11}, V_{12}. This square wave generator on being triggered off by the unvarying pulse from V_9, produces square waves whose duration can be altered by the combination of condensers and the potentiometer in its plate circuit between the limits of 0.1 to 17 milliseconds. The square wave is taken from the plate of V_{12} for the purpose of amplification and improvement in shape to the grid of V_{13}. From the plate of V_{13} it passes to the grid of V_{14}. This is a power tube whose plate is connected to ground through a 5000-ohm resistance. V_{14} is supplied with negative high voltage to the cathode and is normally cut off. Thus the pulse from V_{13} produces in the plate of V_{14} a step of voltage negative to ground which can be connected without blocking condensers or transformers directly to the biological preparation. The negative current pulse from V_{14} can be adjusted in value to give a stimulus of up to 20 milliamperes. The second channel shown at the bottom of Fig. 4 is exactly the same as tubes V_6 to V_{14}, and has the same characteristics. The attenuator system consisting of T pads allows the outputs of the two channels to be connected in parallel with little interaction between the two output attenuators. In some types of dual stimulation, the T pad attenuator system shown here need not be used but it was found desirable in the experiments which we desired to perform.

The power supply circuits are conventional and are wired in relation to ground so as to supply separate positive and negative voltage. It was found desirable to control the supplies with VR 150 tubes (Fig. 6).

A schematic diagram of the output of the stimulator as it appears on the screen of the cathode-ray oscilloscope is shown in Fig. 2. In this diagram, the two pulses are symmetrical but, as in-

(*Continued on page* 26)

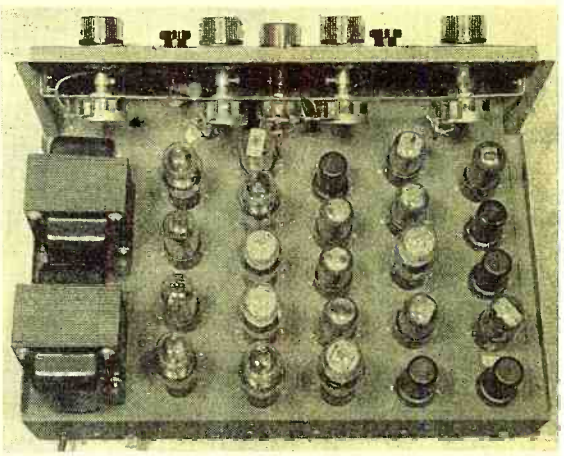
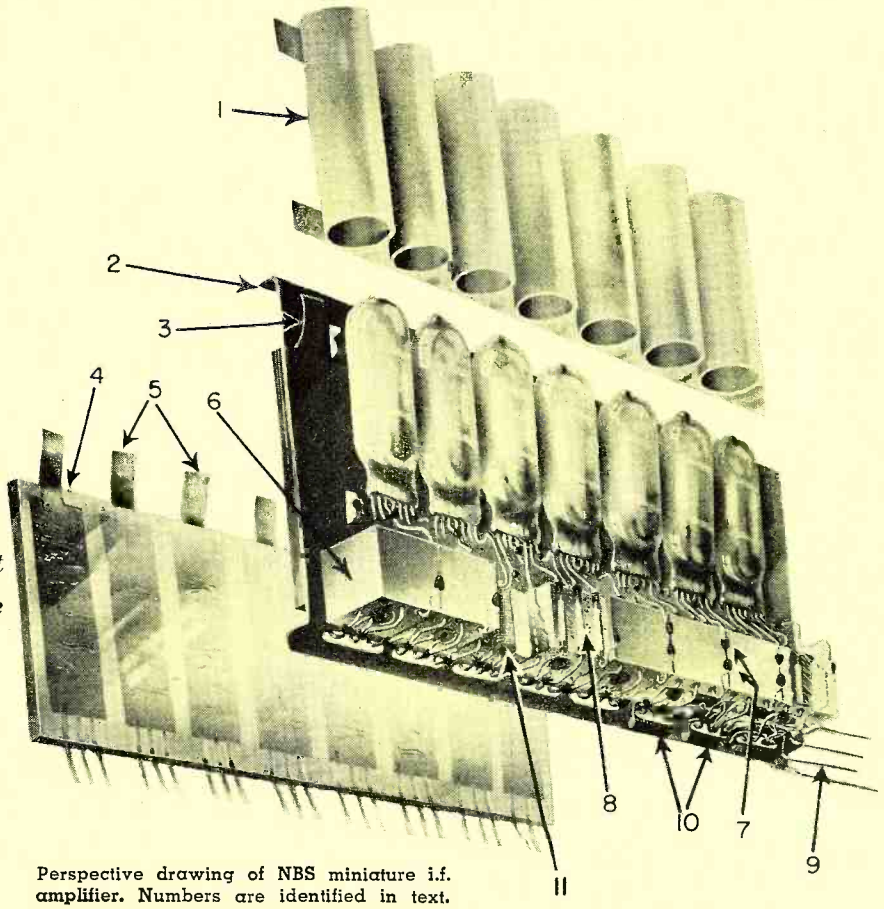


Fig. 3. Top view of the stimulator chassis.

Fig. 4. Complete schematic diagram and parts values for the square wave stimulator.

New MINIATURE I. F. AMPLIFIER

Miniaturization techniques at NBS have resulted in a more compact, lighter-weight unit.



Perspective drawing of NBS miniature i.f. amplifier. Numbers are identified in text.

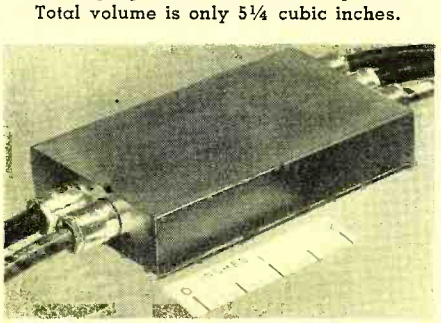
A 7-tube miniature intermediate-frequency amplifier, recently developed at the National Bureau of Standards, embodies several innovations in electronic miniaturization technology. Particular emphasis is placed on the use of preassembled groups of similar circuit elements to simplify production. Developed by Robert K-F Seal and associates of the NBS engineering electronics laboratory, the Model VI i.f. amplifier is a product of a continuing comprehensive program of electronic miniaturization. This program is supported principally by the Navy Bureau of Aeronautics and, for particular equipments, by the Bureau of Ordnance.

Size reduction of electronic equipment is becoming increasingly important for many applications, particularly in military equipment. Electronic miniaturization activities initiated at NBS by the Department of the Navy have already produced a number of advances in printed circuit technology, and techniques for reducing size to what at present seems a practical minimum have been demonstrated. Development of the Model VI amplifier was undertaken, not to effect further substantial size reduction, but rather to work out designs for maximum simplicity, flexibility, and ease of manufacture.

The extent to which the goals of simplicity and ease of fabrication have been attained is indicated by the fact that the Model VI amplifier requires only 40 construction drawings compared to twice that number for its immediate predecessor, the Model V. Attainment of these design goals centered around the use of separate subassemblies, each consisting of a preassembled group of identical or similar circuit elements. Model VI design, suitable for center frequencies ranging from 20 to 100 mc., is flexible also in its adaptability to different types of components; for instance, three resistor types and two capacitor types can be accommodated. Components were not restricted to those hitherto available; when standard components were found wanting, new ones were designed, after consultation with manufacturers to insure that the new units would be adaptable to straightforward fabrication. Designed to be hermetically sealed for protection against contamination and moisture, the new amplifier uses components and materials capable of withstanding the high operating temperatures, up to 200°C, found in compact sealed equipment.

The capacitor, resistor, and tube-shield subassemblies are fastened to the inductor subassembly, which thus serves as the main chassis of the amplifier. The inductor subassembly comprises input and output transformers and six bifilar inductors fitted inside holes in eight ceramic blocks. The outer surfaces of the blocks are metallized by applying silver paint and firing. Besides providing electrical shielding for the inductors, this metallizing permits soldering the eight blocks to the chassis to make up the unitized subassembly.

A non-plug-in case for the i.f. amplifier. Total volume is only 5¼ cubic inches.



The inductors themselves are wound on tubular powdered iron cores having ferrite rods at their centers. Trimming is accomplished by sliding the rods in or out. After the length of insertion has been adjusted, the rod is cemented in place and the protruding end broken off.

The preferred capacitor subassembly is of a new glass dielectric type. Seven groups of three capacitors (heater, plate-supply, and automatic-gain-control bypass) are encased in a single sealed and insulated glass unit. Common ground leads for each group of three are brought out from one edge of the unit, while the other leads extend through the opposite edge. This capacitor subassembly combines compactness with high dielectric strength and ample capacity (about 1500 $\mu\mu$fd. per capacitor). Since the capacity-temperature coefficient and the losses are low, capacitors of this type could be used for tuned circuit as well as bypass applications.[1]

(*Continued on page 27*)

PERFORMANCE

COMES IN...

From the midget champ which spins around a ¼ mile oval in 19 seconds . . . to the Indianapolis winner which clocks 157 m.p.h. on the straightaway . . . performance is the key note in auto racing. In Electronics El-Menco Silvered-Mica Capacitors set the space. From the tiny CM-15 (2-525 mmf. cap.) to the mighty CM-35 (3300-10000 mmf. cap.) . . . unexcelled performance is paramount.

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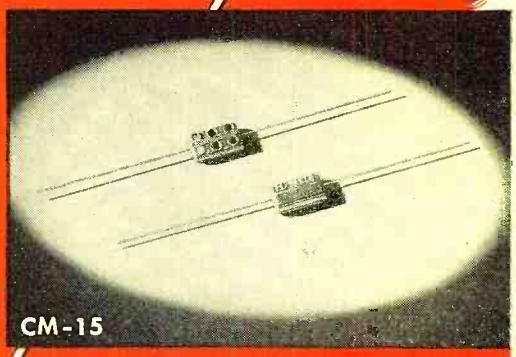
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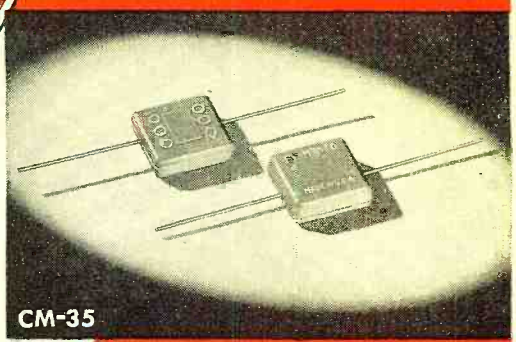
CM-35

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NEWS BRIEFS

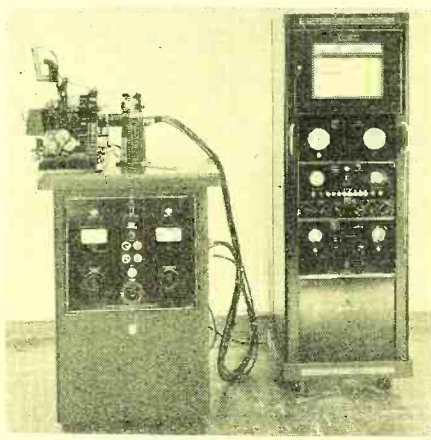
WEST COAST SIDELIGHT

IRE President, Ivan S. Coggeshall, General Traffic Manager, *Western Union International Communications*, at right, discusses manufacturing meth-

ods for powdered-iron torodial inductors used in carrier telegraph equipment, with L. B. Rice, San Francisco Regional Manager of *Western Union*, at left, and Philips B. Patton of *Lenkurt Electric Company*, San Carlos, Calif. Occasion was an inspection tour of the *Lenkurt* plant during the recent Western Convention of IRE and Pacific Electronic Exhibit in San Francisco.

FLUORESCENCE ANALYSIS

Incorporating design improvements to facilitate rapid qualitative and quantitative analysis of constituents in metals, alloys, minerals, ores, chemical mix-



tures and compounds, the *Norelco* Fluoresence Analysis Unit is being produced by the *North American Philips Company, Inc.*, Mount Vernon, N. Y.

This unit employs a wide range vertical goniometer with a sweep radius of 170 mm., and utilizes a horizontal, water-cooled diffraction unit. Operating at potentials up to 50 kv. peak and at current values up to 50 ma., the unit is entirely non-destructive and permits analysis of very small specimens.

HOUSTON IRE

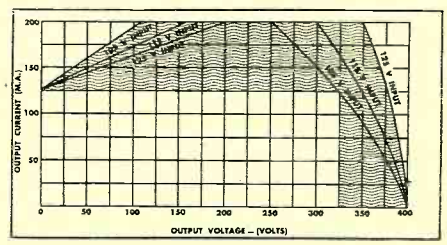
The 4th Southwestern IRE Conference and Radio Engineering Show will be held in Houston, Texas on May 16th and 17th, 1952 at the Rice Hotel.

Comprehensive technical sessions and equipment expositions are being planned for electronic engineers in all fields.

The conference manager is Mr. Gerald L. K. Miller, past chairman of the Houston Section of IRE, 1622 West Alabama, Houston, Texas.

D.C. POWER SUPPLIES

Performance figures on d.c. power supplies, manufactured by *Sorensen &*



Company, Stamford, Conn., indicate minimum current available over the entire specified voltage range, except when voltage approaches zero. The illustration shows the performance of a typical unit, Model 325BB. The unshaded rectangle represents the specified performance, with the rated current output (125 ma.) available at any output voltage above ten volts and with 105 line volts. The shaded area shows the extra current capacity available at any output voltage and at various line voltages.

COMPANY MOVE

The *Technology Instrument Corporation*, formerly of Waltham, has now moved to Acton, Massachusetts, because of the rapidly expanding activities of the company.

All basic manufacturing operations, including winding of potentiometers and transformers, production of basic parts for precision potentiometers such as precision turning, milling, grinding, and boring operations, can be carried on in this new plant. Assembly operations are divided into two sections; one for potentiometers, and the other for precision laboratory instruments. Extensive laboratory facilities for developmental and experimental work are provided for all phases of the company's activities.

WIRING HARNESS

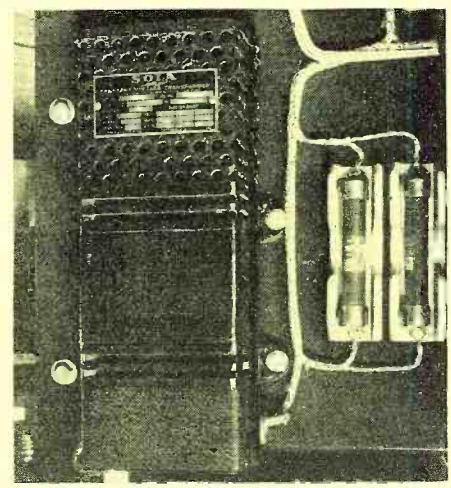
The *Runzel Cord & Wire Co.*, Chicago, Ill., is offering technical advice in

wiring harnessing and is fabricating harnesses completely assembled, finished and terminated, with shielded leads and jacks, terminals and/or plugs properly attached, ready for installation in the various electronic devices and machines.

The illustration shows a typical wire harness in the process of assembly, demonstrating service to manufacturers of electrically operated machinery and devices.

INDUCTION HEATING

Induction heating has proved useful in selective hardening, high temperature brazing, soft soldering, selective annealing, shrink fitting, melting elec-

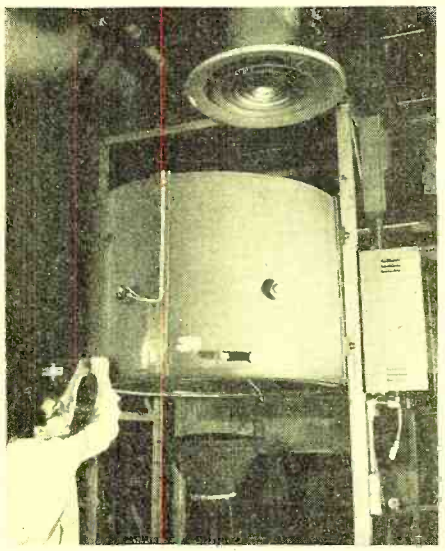


trolytically deposited tin for tin reflow, and melting small amounts of ferrous and non-ferrous metals.

Constant voltage transformers, such as those made by *Sola Electric Company*, Chicago, Ill., protect the filaments of the rectifier and oscillator tubes against voltage fluctuation, thus insuring optimum performance and tube life. The transformer shown in the photograph is one of two such transformers installed in Lindberg Engineering Company's r.f. heating units.

TUBE OVEN

A new baking and annealing oven, used for experimental work for television picture tubes, is utilized by the



General Electric Company, Syracuse, N. Y. Subject to extreme heat, the oven cools slowly, eliminating brittleness in the tube.

PHYSICS DEPARTMENT EXPANSION

Increasing demand for research in fields of physics, electronics and instrumentation, has caused Southwest Research Institute to broaden its Physics Department staff. Recent appointments, as announced by Dr. Paul Erlandson, include the following: James W. Annis, James C. Axtell, Bascom F. Batts, William W. Bradshaw, Graydon E. Buss, William C. Coombs, Dr. Charles A. Culver, Malon H. Dickerson, George A. Furguson, Felix N. Kusenberger, John P. O'Meara, Richard E. Pabst, and M. John Prucha, Jr.

NEW CORPORATION

The formation of a new corporation, *Magnecord International Ltd.*, Chicago, Ill., has been announced by *Magnecord, Inc.*, manufacturers of professional tape recorders.

The international corporation will handle all *Magnecord* business outside of the Western Hemisphere, having as

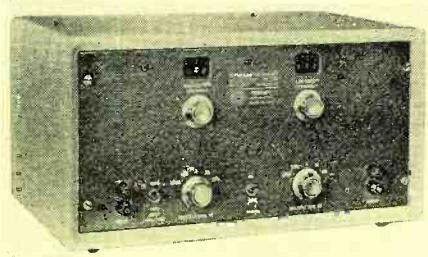
(*Continued on page* 25)

NEW PRODUCTS

REJECTION FILTER

Krohn-Hite Instrument Company, 580 Massachusetts Ave., Cambridge, Mass., announces a new variable ultra-low frequency rejection filter.

Featuring low internally generated



noise, single scale logarithmic dials, electronically regulated supplies, and input and output buffer stages, the Model 350-A is especially useful for vibration studies and electromedical research, for geophysical and seismological instrumentation, and in conjunction with any low frequency phenomenon involving selective amplification.

The high and low cut-off frequencies of the rejection band are adjustable over the frequency range from 0.02 to 2000 cps. A sharp null may be obtained at any frequency between 0.1 and 500 cps, with gain within 3 db of unity at one octave above or below the null frequency.

PULSED CARRIER GENERATOR

A new pulsed carrier generator, designed to give rapid and accurate transient response information, is offered by *Kay Electric Company*, Pine Brook, N. J.

Known as Rada-Pulse, it has the following specifications: Carrier frequen-

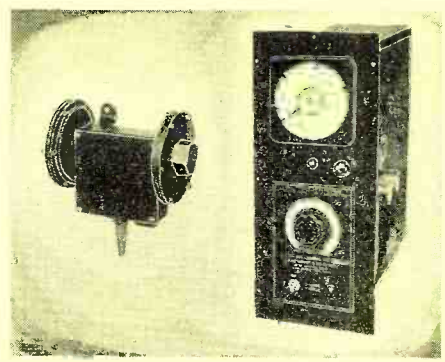
cies: 30 mc and 60 mc. Pulse widths: 0.1 and 0.25 microseconds. Pulse repetition rate: Continuously variable from 500 to 2000 pps. Maximum r.f. output: approx. 1 volt at 70 ohms. Attenuators: 20 db, 20 db, 10 db switched, 10 db continuously variable.

Pulse output is 50 volts at 70 ohms. External modulation: Input terminals provided to permit modulation by other pulse widths from external source. Trigger pulses: Positive and negative furnished ahead of pulsed carrier to trigger oscilloscope sweep circuit. Regulated power supply is built in.

INDICATING CONTROL UNIT

The Cat. 120 Electronic Differential Pressure Indicating Control unit is an electronic control system designed to indicate and control the differential pressure between a volume of corrosive gas and a surrounding gas, manufactured by *The Henry G. Dietz Company*, 12-16 Astoria Boulevard, Long Island City 2, N. Y.

It consists of a sensing element and

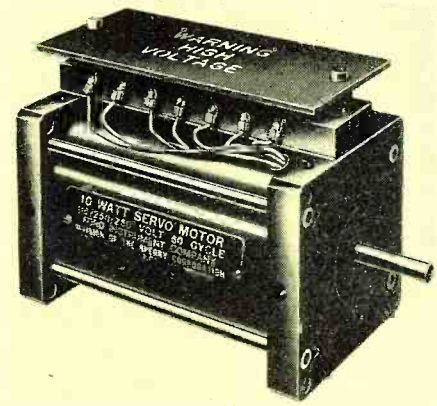


an indicating control unit, the sensing element noting a signal according to the variation in the differential pressure, which will produce a visual indication on the indicating control unit located at a distance of approximately 100 to 250 feet from the sensing element. The indicating control unit, in addition to being a visual indicator, is a two position controller which will close a set of contacts when the differential pressure drops below a predetermined value. A manual control on the indicating control unit is provided so that the pressure differential, necessary to operate the contact points, may be varied. This control system, with modifications of the sensing element, can be adjusted to be used to indicate linear movement and, therefore, may be used to indicate pressures, temperatures, accelerations, and forces, provided the equipment is calibrated in terms of the particular sensing element used.

The sensing element is constructed of special materials, such as teflon and monel, to withstand the action of corrosive gases.

SERVO MOTORS

A complete line of low inertia servo motors with high voltage control windings, which eliminate the need for transformers in servo amplifiers, is now being produced by *Ford Instrument*



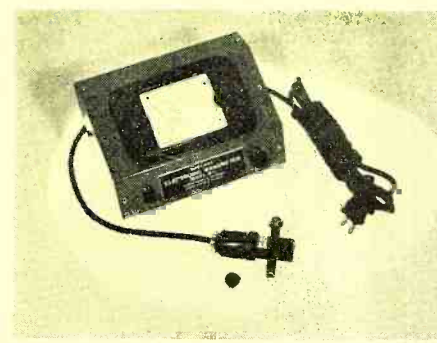
Company, 31-10 Thomson Ave., Long Island City, N. Y.

These motors have close-coupled windings for feedback purposes, and are available in ½, 1-½, 5- and 10-watt sizes. Of particular significance is the space and weight saving resulting from the elimination of the transformer.

ELCTRONIC MANOMETER AND FLOWMETER

An entirely new type, highly sensitive electronic manometer and flowmeter, having no glass or plastic tubes and containing no fluids, is announced by the *Hastings Instrument Company*, Inc., Hampton, Va.

The electronic manometer operates from a noble metal thermopile. The two taps on the gauge tube are connected



to the two points at which the pressure difference is to be measured. To use the instrument as a flowmeter, the tube is directly in the line for low flow rates or connected to pressure taps on two sides

of a calibrated orifice for high flow rates.

The electronic manometer measures extremely low pressure differences, having a dual range of 0.001" to 0.1" and 0.1" to 2" of water. The calibration and accuracy of the instrument are not affected when long extension cables are used from the gauge tube to the meter, and may be used for direct indications or attached to a recorder.

Accessories to the instrument include a 5-position switching attachment, permitting monitoring of gauge tubes in 5 locations with one indicating meter. The instrument operates on 110 v., 60 cycle power, with a constant voltage transformer available to eliminate any effects from variation in the line voltage.

SPRING COMPUTER

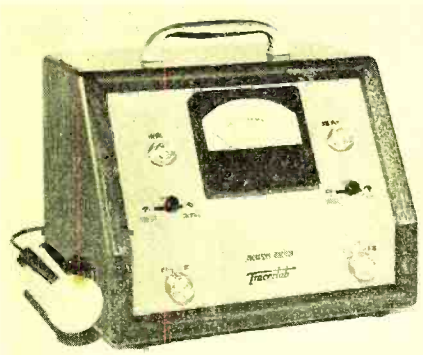
Problems of spring design are solved with the Calculaid Spring Computer, devised by the *American Hydromath Corporation*, 145 W. 57th St., N. Y. 19, N. Y. This computer correlates, in one setting, all the variables in spring design, namely O. D. of spring, wire size in diameter and gauge number, number of active coils, material and its torsional modulus G, maximum sheer stress, load and total deflection.

The computer's stress scale includes the correction for non-linear distribution of torsional stresses in curved wires and is produced from sheets of vinylite plastic, having laminated scale markings.

LABORATORY MONITOR

Featuring greater reliability and a better method of high voltage control, a new laboratory monitor is announced by *Tracerlab, Inc.*, 130 High Street, Boston 10, Mass.

The SU-3B Laboratory Monitor is a.c. operated, and has three full-scale



meter ranges of 200, 2000, and 20,000 counts per minute. It was developed specifically for use as a contamination monitor in radioactivity laboratories. Weighing 17 pounds, it is equipped with a mica end-window Geiger tube, loudspeaker monitor for use as an aural monitor, volume control, and built-in pulse generating circuit synchronized with 60 cycle line frequency, allowing quick calibration check without need of an external pulse generator.

WIDE BAND VIDEO AMPLIFIER

Designed for use as an oscilloscope deflection amplifier for the measure-

ment and viewing of pulses of extremely short duration and rise time, a new improved Wide Band Video Amplifier, Model V-2, has been announced by *Polarad Electronic Corporation*, 100 Metropolitan Ave., Brooklyn 11, N. Y.

The amplifier has a flat amplitude response ± 1.5 db from below 10 cps to 20 mcps. It is a tool for laboratory and industrial use to extend the amplitude range of vacuum tube voltmeters and signal generators. Permitting accurate analysis of television signals by its extended frequencies, sixty cycle square waves are passed with less than 5% tilt.

MINIATURE POWER RESISTORS

The Dalohm resistor, said to pack more resistance per watt per cubic inch than any other resistor on the market today, is now being produced by the *Dale Products, Inc.*, Columbus, Nebraska.

This resistor, made in 2-, 5-, 10-, 25-, and 50-watt sizes, is sealed by a special silicone material, making it completely

impervious to moisture, with completely-welded construction from terminal to

(*Continued on page* 22)

Personals

DR. W. R. G. BAKER was awarded the medal of honor of the Institute of Radio Engineers for his technical contributions to the art of radio transmitting and outstanding service to the Institute. Dr. Baker, Vice President of *General Electric Company*, is also Chairman of the National Television Systems Committee of the Radio-Television Manufacturers Association and is active in many other engineering, management, and civic organizations.

GEORGE R. FAUSTMAN has been named general factory manager of the *Bendix Radio Division of Bendix Aviation Corporation*, according to an announcement by E. W. Foster, Vice President of the corporation. Associated with that company for the past 11 years, Mr. Faustman held successive positions of supervisor of standards, plant superintendent, and chief industrial engineer of the Division, besides being Director of the Society for the Advancement of Management.

JAMES B. FERGUSON has been appointed Chief Engineer of *Link Radio Corporation*, having contributed extensively by designing mobile radio transmitter-receiver units. Among the first 100 men in the country to receive a commercial radio operator's license in 1912, Mr. Ferguson also was a radio engineer in the U.S. NavyDepartment, Vice President of Ship Owners' Radio Service, President of J. B. Ferguson, Inc. and Manager of Press Wireless, Inc.

JAMES E. MYERS has joined the staff of the Research Division of *Burroughs Adding Machine Company*, as Research Engineer. Mr. Myers received the degree of A.B. in Mathematics from the University of Michigan in 1942 and served as an Ensign in the U. S. Navy. From 1946, until joining the *Burroughs* organization, he was a research associate at the Moore School of Electrical Engineering, University of Pennsylvania.

DR. HENRY M. O'BRYAN has been appointed manager of the Physics Laboratories, *Sylvania Electric Products, Inc.* Prior to his work with the Research and Development Board in Washington, he served as Director for the *Baird Associates* of Cambridge, Mass. and was a member of the staff of the Naval Ordnance Laboratory. Dr. O'Bryan received his Ph.D. from Johns Hopkins University in 1930, and was Associate Professor of Physics at Georgetown University.

DR. WENDELL C. PEACOCK has been elected Vice President and technical director of *Tracerlab, Inc.* Responsible for the introduction of many unique pioneer products of that company, his work included synthesized radioactive chemicals and equipment employing radioisotopes. After receiving his doctorate from M.I.T. in 1944, Dr. Peacock participated in advanced procedures for radioisotope standardization at Oak Ridge, Tennessee.

New Products

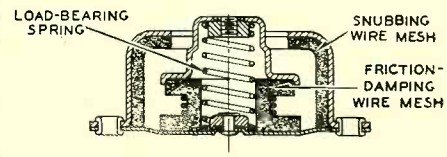
(*Continued from page* 21)

terminal. It has a standard tolerance of one per-cent, with tolerances as high as 0.05 per-cent furnished, plus a resistance shift less than 0.00002 per-cent per degree centigrade. The temperature coefficient of this resistor is substantially flat.

VIBRATION ISOLATORS

New unit vibration isolators, developed and manufactured by *The Barry Corporation*, 870 Pleasant St., Watertown 72, Mass., cover new load ranges of 8 to 16 lbs., 14 to 25 lbs., and 22 to 35 lbs. The new units are available in the 6600 series, the 6645 series, the 6600R series, and 6645R series.

The 6645 and 6645R series units have center studs 5/32" longer than the corresponding units in the 6600 and 6600R

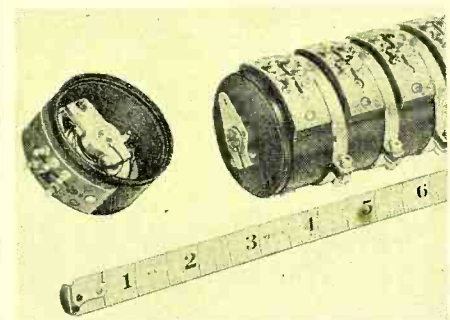


series and may be attached directly to the equipment, instead of requiring dimples at the mounting holes. The 6600R and 6645R units are "Ruggedized" to withstand severe shocks, such as those met in arrested landings in aircraft carrier service and in crash landings. They are tested to meet the shock requirements of Specification AN-E-19 for the equipment sizes listed in JAN-C-172A.

All of these new unit vibration isolators exhibit excellent performance, unaffected by very extreme temperatures.

PHASING POTENTIOMETER

A new C-200 series of potentiometers has been announced by the *DeJur-Amsco Corporation*, 45-01 Northern Boule-



vard, Long Island City, N. Y., with clamping ring method of gauging that permits accurate external phasing of individual units at any angle when circuit elements are changed.

The taps on this potentiometer, Series C-200, can be furnished at any speci-

fied points on the winding within ±½°, and it has a mechanical rotation of 360° continuous, and electrical rotation of 320° ±1°. The resistance range is 10 to 200,000 ohms, up to ±1%, with a linearity accuracy up to ±0.25%. Its operational life is 1,000,000 cycles dependent on rating and has a case of anodized aluminum.

NOISE AND FIELD STRENGTH METER

The incorporation of the "slide-back" technique in the vacuum tube voltmeter circuit of their Model 58 U.H.F. Radio

Noise and Field Strength Meter has been announced by *Measurements Corporation*, Boonton, N. J.

Making possible a greater accuracy of noise measurements of short pulses having a slow repetition rate, or a random variation in magnitude, Model 58's already in use may be modified to include this new facility. Covering the frequency range of 15 to 150 megacycles, Model 58 is used for the measurement of steady carrier voltages or fields; line loss; front-to-back ratios of directional antennas; signal-to-noise ratios of antennas; effectiveness of noise filters and for investigation of ignition and other radio noises.

WIRE HARNESS CLAMP

Built with an interlocking slot and T-shaped tongue, the new Wire Harness Clamp, manufactured by *Tinnerman Products, Inc.*, Cleveland, Ohio, can be opened and closed without the use of tools. The tongue, which slips into a narrow portion of the slot and is held by lateral and outward spring action, may be used singly or in tandem to hold bundles $\frac{1}{16}$" to 1-¼" in diameter. It can be opened without removal from the structure to which it is attached and features pre-assembly to the wire bundle, facilitating installation.

This new type wire harness clamp is also suitable for varying dimensions caused by deviations in wire insulation thickness, and is compatible for mounting to the structure with a screw driver.

TUBING AND SLEEVING SELECTOR

A new and easier way to select the exact size of tubing or sleeving needed to insulate wires is the main feature of a new sample card, the "Dieflex" Selector, distributed by *Insulation Manufacturers' Corporation*, 565 West Washington Blvd., Chicago 6, Illinois.

Leads or wires, slipped into the closest fitting hole on an aluminum gauge, permit determination of the correct size of tubing or sleeving, with seven actual samples of the different types, grades, and colors mounted on rugged pressboard. A description of various tubing or sleeving types is also included on the selector.

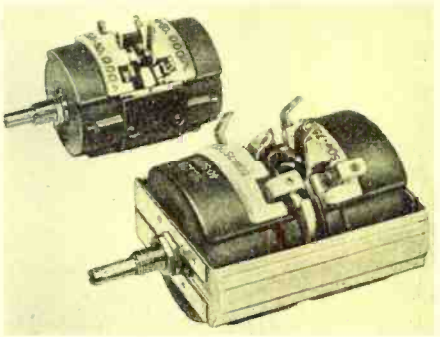
MULTIPLE SPINDLE DRILLING MACHINE

A multiple, 1-½ H.P. axial air gap motor driven Spindle Drilling Machine, ME-25 with three spindles mounted integral to a column, and suited to high volume production, has been introduced by the *Sibley Machine & Foundry Corp.*, South Bend, Indiana.

Featuring a 25" swing, the ME-25 has a wide speed range obtained by a self-locking speed control. A tachometer on the front of the machine provides accurate reading of speeds, with five options of spindle speeds, each with a 4 to 1 ratio, ranging from a low of 206-825 rpm, to a high of 540-2160 rpm, and 3 phase 60 cycle motor. Having a capacity of ¾" in steel and 1" in cast iron, the machine is equipped with a speed chart on the side of the machine showing proper speeds for different drill sizes.

DUAL POWER RHEOSTATS

The DeJur-Amsco Corporation, Long Island City, N. Y., has announced new features to its precision power rheostats. They are available as dual units with single hole mounting of both Models 245 (25-watt each section) and 241 (50-watt each section) for simultaneous



operation of independent circuits by means of one control.

Of all-metal construction, with black anodized aluminum diecast frame, metal winding core, stainless steel insulated shaft, and copper graphite brushes, these rheostats are available in exceptionally high resistance ranges within ±5% up to 50,000 ohms in the 25 watt size, and 75,000 ohms in the 50 watt size. Linear and non-linear windings over this range can be maintained within ±1%.

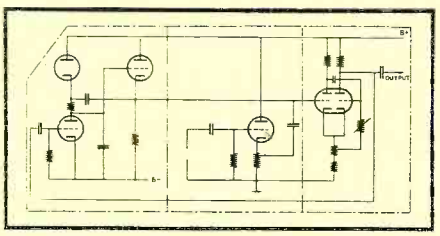
PATENT REVIEW

Printed copies of these or any other patents may be obtained from the U. S. Patent Office for 25c each. Address the Commissioner of Patents, Washington 25, D. C.

FREQUENCY DIVIDER

The object of this invention is to provide a novel, stable frequency divider with a high count-down ratio which depends primarily on the peak-to-peak voltage of an auxiliary wave developed by the circuit.

A linear saw-tooth wave is developed in the left-hand section (see diagram) and fed to a multivibrator or blocking oscillator (right-hand section.) The input pulses developed by the pulse source (center section) are also fed to this right-hand section. Thus, sharp pulses will be superimposed on the saw-tooth wave and, after a certain number of pulses, the voltage at the right-hand section will be sufficient to fire the multi-



vibrator or blocking oscillator. The number of pulses appearing before firing takes place gives the count-down ratio.

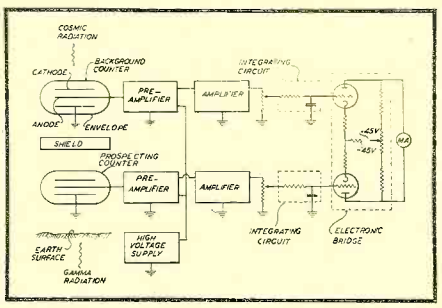
Several variations of this circuit are described, and parts values given for a circuit having a count-down ratio of 14 to 1. Much higher stable count-down ratios are possible with this circuit.

Patent No. 2,562,889 was issued August 7, 1951, in the name of John A. Buckbee.

PROSPECTING

The determination of gamma rays emitted from the earth is a valuable aid in a variety of operations including well logging, geological mapping of contacts, outcrops, etc., and also in locating deeply buried mineral deposits. Because of the weakness of these radiations, they are frequently masked by cosmic rays and the normal background count. This invention presents methods for increasing the accuracy of measuring gamma radiation.

Two detectors are used, both of which have about the same efficiency for the detection of background radiation, such as cosmic rays. One detector is then made more sensitive to gamma rays than the other by any of several methods. The outputs of these two detectors are subtracted electrically and the dif-



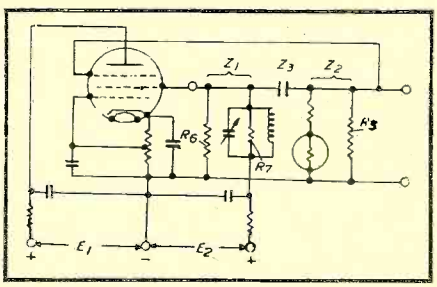
ference is measured. This procedure greatly increases the accuracy of the investigation.

Several variations are described, in addition to the one shown in the diagram.

Patent No. 2,562,968 was issued August 7, 1951, in the name of C. F. Teichmann et al.

STABILIZED ELECTRIC OSCILLATOR

The problem of instability in oscillators, with respect to both frequency and amplitude, has been attacked by engineers from many different angles. This



invention represents one approach to the solution of the problem.

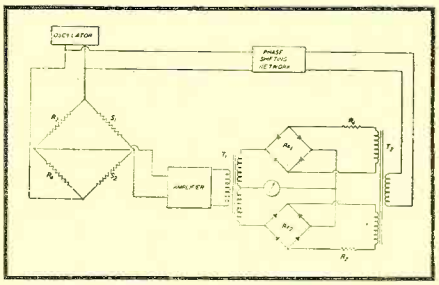
Oscillation circuit arrangements are set up in which the interelectrode impedances of the tube or other device are made to form a part of the oscillation circuit in such a way that variations of their resistive components do not affect the frequency.

The circuit shown incorporates these arrangements, and includes a thermosensitive element (shown circled) which functions in such a manner as to hold the output amplitude constant.

Patent No. 2,562,894 was issued on August 7, 1951 in the name of G. P. De Mengel.

PHASE SENSITIVE DEMODULATOR

In many types of measurements, a carrier wave has superimposed on it a



modulation voltage which varies in direction. In demodulating this carrier, it is many times desirable to distinguish phase or direction as well as amplitude. It is the purpose of this invention to describe such a system.

The circuit, as shown, performs as indicated. A pair of balanced demodulators is connected between two transformers, one fed direct from the bridge output through an amplifier, and the other from the oscillator supply through a phase shifting network. When the circuit is adjusted properly, the indicating meter will denote a 180° phase reversal in the bridge output.

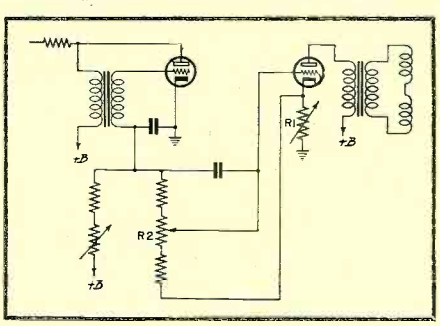
Patent No. 2,562,912 was issued August 7, 1951, in the name of Paul F. Hawley.

BEAM DEFLECTION SYSTEM

This invention presents a system whereby linearity and size of picture in a TV receiver are controlled by a single control, and also includes a novel coupling between a saw-tooth voltage wave source and a power amplifier.

In the circuit shown, picture size and linearity are together controlled by resistor R_1. This resistor provides a size variation and, at the same time, effects a bias change of just the right amount and direction to maintain a constantly linear output once resistor R_2 has been properly set.

The patent includes a set of typical



component values for the proper functioning of this circuit.

Patent No. 2,562,985 was issued August 7, 1951, in the name of Marvin H. Kronenberg.

News Briefs

(*Continued from page* 19)

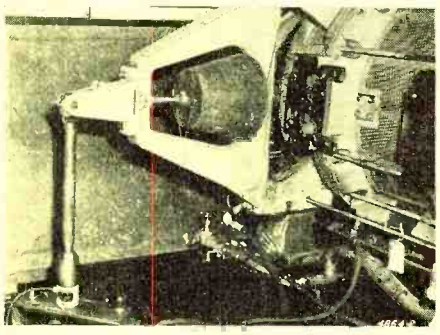
its special aim, the creation of new markets for U. S. goods and the goal of distributing manufacturing "know-how" to the countries unable to manufacture for themselves.

The manager of the new corporation is Mr. Ad. Auriema, who has been widely recognized as one of the leading experts on the export of electronic merchandise.

LOAD CELLS

SR-4 Load Cells, supplied by *Baldwin-Lima-Hamilton Corporation*, Philadelphia, Pa., are being used to weigh dynamometer loads for full scale tests of aircraft reciprocating engines.

Composed of steel columns or rods, the load cells are bonded by SR-4 resistance wire strain gauges. Strains in the column affect the electrical resistance of the strain gauges, with electronic circuits of an indicator changing automatically into units of torque or thrust.



IBM INFORMATION MACHINE

The development of an electronic information searching machine by the *International Business Machines Corporation*, brings to light the use of photoelectric eyes to read scientific information from IBM cards at the rate of 1000 cards a minute.

Coupling electronic principles with a new machine "language" of 792 characters, information contained in a book or article is thus condensed and transferred into IBM cards. When information is desired, the machine matches the question and information cards, selecting those which give the answers. Successfully demonstrated before a group of scientists, the machine has been found to be important in its application to the field of searching for similar chemical compounds.

IRE AWARDS

The Institute of Radio Engineers named 45 leading radio engineers and scientists for its annual Fellow Award, at a meeting held on September 12, 1951 in New York City. Presentation of the awards with citations will be made by the President of the Institute at the Annual Banquet on March 5, 1952 at the Waldorf-Astoria Hotel during the 1952 IRE National Convention.

Among the 45 recipients, was Dr. Newbern Smith, Chief of the Central Radio Propagation Laboratory of the National Bureau of Standards in Washington, D. C., who is well known for his outstanding contributions on the propagation of radio waves. Mr. Smith was also named the recipient of the 1952 Harry Diamond Memorial Award, bestowed annually upon a person in Government service who has made outstanding contributions to the field of radio or electronics.

ELECTRICAL INSULATION

An asbestos-base, silicone-treated Class H high temperature electrical insulation is being offered by *Johns-Manville*, 22 East 40th St., New York 16, N .Y., combining greater safety and opportunity for more compact design.

Identified as "Quinterra Type 3," it is used for both inter-layer and wire wrapping insulation, and is adaptable to a wide range of electrical devices, including air-cooled, inert gas, and silicone-filled transformers.

"Quinterra Type 3" maintains a dielectric strength of at least 350 vpm under continuous exposure to Class H maximum temperature of 180°C, this dielectric strength remaining practically constant even under continuously high humidity. When silicone treated, its uniformity in texture and thickness is aided by the base sheet of purified asbestos, which is completely inorganic and of closed structure with no holes, making winding dimensions easily calculable.

This new electrical insulation is supplied in the form of sheets, rolls and tapes in widths varying from ¼" to 36" with thicknesses from 3 to 9 mils and may be used alone, or combined with other dielectric materials such as mica or glass cloth.

MINIATURIZED COUNTER DECADES

A compact redesign of a four-tube electronic counter decade, approximately one-third smaller than the standard decade, has been announced by the *Potter Instrument Company*, Inc., 115 Cutter Mill Road, Great Neck, N. Y.

Differing only in the maximum counting capabilities, Model 12 is designed for counting at rates up to 130,000 counts per-second, and Model 13, for counting at rates up to 30,000 counts per-second.

Four large quarter-watt neon glow lamps, arranged in a 1-2-4-8 decimal coding, facilitate accuracy of counter

(*Continued on page* 31)

TECHNICAL BOOKS

"ELECTRIC TRANSMISSION LINES" by Hugh H. Skilling. Published by *McGraw-Hill Book Co., Inc.*, 330 W. 42nd St., New York 18, N. Y. 438 pages, $6.50.

The author developed this book during ten years of teaching, which would indicate that the material contained in it has met all tests for accuracy and lucidity. The background necessary for studying the text includes a rather intimate acquaintance with ordinary circuit theory involving lumped constants, and some knowledge of integration and differentiation.

The book is a presentation of the theory of circuits with distributed constants, which is valid at all frequencies, followed by chapters on the application of this theory to radio-frequency lines, power lines, telephone lines, filters, and wave guides. It is written primarily for the more general type of course that treats lines at all frequencies, although specialized material is included on certain applications.

There are numerous problems at the end of each chapter, and numerous footnotes, as well as an appendix, supplement the material found in the main body of the text.

"NOMOGRAPHIC CHARTS" by C. Albert Kulman. Published by *McGraw-Hill Book Co., Inc.*, 330 W. 42nd St., New York 18, N. Y. 224 pages, $6.50.

This book presents a collection of nomographs which have been found to be time-saving devices in engineering and mathematical computations in such fields as hydraulics, mechanics, thermodynamics, and electrical engineering. Each chart occupies a full page, and a brief explanation of its use is included. Accuracy exceeds normal slide rule calculations.

Typical charts in the chapter on Function Scales include 5th, 4th, and 3rd powers and roots; 5/2, 2/5, 1.9, 3/2, 2/3, 1-7/16, 4/3, 3/4, 5/4, 4/5, 1.16, and 1.1 powers; reciprocals; and circle circumference and area. Under General Charts appear charts dealing with compound interest, sinking funds, annuities, and properties of triangles. The group of Hydraulics Charts covers various flow calculations and other hydraulic problems. Groups of charts on mechanics and thermodynamics cover these fields rather thoroughly. The 17 charts under the Electrical group are of value to electronic, as well as electrical, engineers.

A total of 92 nomographs is included in this useful collection.

Square Wave Stimulator

(*Continued from page* 15)

dicated, each might be varied independently to form any rectangular shape with the given limits of duration and amplitude. Also, each pulse can be positioned on the sweep so as to be at any desired distance from the other pulse. Moreover, the pulses can be made to superimpose or even pass each other if desired.

Construction and Calibration

The chassis measures 14 x 17 x 3 inches with a sloping front panel. Positioning of the various components is not critical, and both negative and positive power supplies are built on the same chassis. Five vernier type dials with calibration scales (*National* MCN dial) are mounted on the sloping front. These provide for the selection of the repetitive rate and the duration and positioning of the two stimuli. The duration and output range switches are also on this panel. On the lower chassis panel are the variable output controls, on-off switches and output jacks.

The duration of each pulse was separately determined by synchronization with the sweep of a suitable oscilloscope and timed with a 1000 cycle sine wave. Each duration dial was calibrated in 3 ranges, 0.1 to 3, 1 to 5, and 3 to 15 milliseconds. Each positioning dial was calibrated separately with the dial of the other stimulator set at zero position, *i.e.*, the beginning of the saw-tooth timing pulse in the stimulator. For our purposes it was found satisfactory to use an ordinary ECG string galvanometer recording on the customary optical kymograph to time the distances between the pulses at each setting of the dials. For greater accuracy an oscilloscope with a slow linear sweep synchronized with the beginning of the saw-tooth pulse in the stimulator should be used. The rate dial was most conveniently calibrated with the string galvanometer.

Applications

The stimulator has been found to be most satisfactory for the determination of the refractory period of isolated heart muscle. The variation with temperature, rate, and effect of drugs is easily demonstrable. Strength-duration curves are easily obtained for the determination of excitability. In this instance the amplitude of the stimulator output is measured by utilizing an oscilloscope as a milliammeter. Moreover, the excitability of the heart muscle can be measured during any particular instant of the cardiac cycle by using one of the pulses to drive the muscle and the second pulse to measure the response at any set interval.

Obviously, the stimulator could be used in the intact animal with chest opened and electrodes attached to either auricle or ventricle. Here, as in the isolated preparation, refractory period and excitability may be conveniently studied. Preliminary experiments in our laboratory have shown the stimulator to be entirely satisfactory for this purpose. Other uses might be the study of excitability and refractory period of skeletal muscle and even certain types of nerve and smooth muscle responses.

REFERENCES

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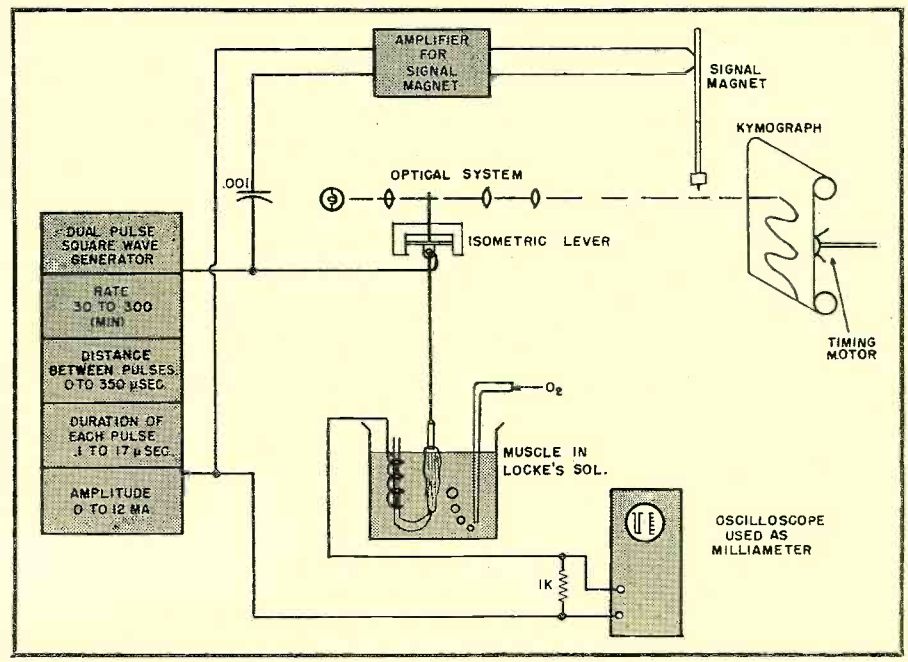
2. *Lewis, T., Drury, A. N. and Bulger, H. A.*

Fig. 5. Block diagram of setup for using the square wave stimulator.



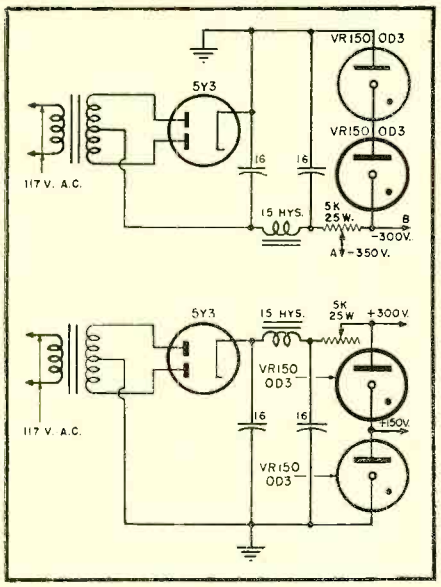


Fig. 6. Circuit diagrams of power supplies for use with stimulator.

Observations on Flutter and Fibrillation. Part IV. The Refractory Period and the Rate of Propagation in the Auricle; Their Relation to Block in the Auricular Walls and to Flutter, etc. Heart, 8, 83. 1921.

3. *Andrus, E. C. and Carter, E. P. Refractory Period of the Normally Beating Dog's Auricle with a Note on the Occurrence of Auricular Fibrillation Following a Single Stimulus. J. Exp. Med.*, 51, 357, 1930.
4. *Woodbury, L. A., Nickerson, M. and Woodbury, J. W. Pulsed Stimulator Aids Medical Research. Electronics*, 22, 84, 1849.
5. *Newman, H. W. A Constant Current Square Wave Stimulator. Proc. Soc. Exp. Biol. and Med.* 63. 201, 1946.

Miniature I.F. Amplifier

(*Continued from page* 16)

Because the multiple glass-dielectric capacitor subassembly was developed specially for Model VI and is not yet in production, an alternative capacitor subassembly was designed. This unit uses capacitors consisting of high-K ceramic tubes of 0.100-inch outer diameter silvered inside and outside. The outside plates are grounded directly by soldering the tubes to the subassembly chassis sheet, while metal inserts soldered inside the tubes provide the inner plate connections.

Three types of resistors may be used with the amplifier. The NBS tape or printed type seems most promising, since all resistors may be applied and fired on a single ceramic subassembly plate. Because all the required tape resistance values are not yet available, however, variations of the Model VI constructed so far have used separate resistors rather than a single subassembly. These have been either conventional ¼-watt carbon composition resistors or the cracked-carbon-on-ceramic type.

The remaining subassembly comprises the tube shields. Thin brass tubes, 1⅜ inches long and 0.400 inch in diameter, are placed side by side and joined in a single soldering operation. Spring fingers on the main chassis hold the resulting shield subassembly in place over the tubes.

Final assembly of the Model VI is a rather simple matter. After the subassemblies have been combined, only the tubes and r.f. chokes remain to be added, and also the resistors if a unitized resistor subassembly has not been used. The seven tubes are of a single type, the 5702,[2] although other types might have been used. The chokes, used in chains in the plate, heater, and agc voltage supply lines, are wound directly on ferrite cores ⅜ inch long and 1/16 inch in diameter. To withstand high temperatures, "Ceroc-200" insulated wire[3] is used for the chokes as well as for the inductors.

Wiring is simple and accessible. Since the layout makes possible extremely short connections, component leads are used exclusively. A high melting point solder of 95 per-cent tin and 5 per-cent silver was used throughout except for the case assembly; for this, a silver solder was used to give greater mechanical strength.

The various subassemblies shown in the perspective drawing (page 16) are identified as follows: (1) tube shield assembly; (2) amplifier chassis; (3) clips for tube shield subassembly; (4) capacitor subassembly; (5) common ground leads for triple capacitor sections; (6) steatite inductor mounts; (7) solder points connecting ground leads to metallized surface of inductor mounts; (8) resistors, cracked carbon on steatite, high temperature miniature type; (9) power, control, and signal leads; (10) chokes; and (11) inductor, bifilar-wound on powdered iron core.

Many types of circuits could of course be adapted to some or all of the design features of the Model VI amplifier, and the circuitry used in the developmental model is not particularly significant. In the developmental model the first two tubes, comprising a low-noise input circuit, were triode connected and were followed by five tuned pentode stages. Over-all bandwidth was about 3.5 mc. with a center frequency of 30 mc., while gain was about 120 db. Input and output of the amplifier were transformer-coupled to coaxial cables.

The NBS Model VI miniature i.f. amplifier thus combines easier producibility, principally through the use of subassemblies, with the great compactness of previous NBS electronic miniaturization developments. The techniques and components embodied in the Model VI amplifier are, of course, adaptable to other electronic equipment.

[1] *These capacitors were developed and manufactured by Corning Glass Works in accordance with specifications submitted by NBS.*

[2] *Product of the Raytheon Manufacturing Company.*

[3] *Product of Sprague Electric Company.*

Medical Electronics

(*Continued from page* 13)

with the combination of a piezoelectric crystal transducer, or some similar device for transforming pressure into an electrical impulse, and a direct-coupled amplifier. Although this method was fairly satisfactory, it suffered from one major deficiency—drift in the direct-coupled amplifier. This created the serious problem of a shifting baseline with its unavoidable error in measurement. That is, if the resting state of the amplifier (representing 0 mm. of pressure) drifts to a new balance point, the recording pen will shift accordingly, and the blood pressure reading will be in error by an equal amount. In experiments in which it is necessary to operate the amplifier over moderately long periods of time (five or six hours), this error can be considerable.

This problem is avoided in the electromanometer by the r.f. bridge circuit which converts the variations in blood pressure to radio frequency instead of direct current. This makes it possible to use the more stable, resistance-capacitance coupled amplifier in which the drift effect is of negligible proportions. By the time the signal reaches the final stage of direct-coupled amplification in the multiple channel recorder, the amplitude of the signals which represent the blood pressure level are amplified to such an extent that the drift effect is almost undetectable.

The diagnosis and evaluation of the severity of heart disease constitutes one of the most difficult problems in medicine. However, with the aid of a new device, the ballistocardiograph, this question is greatly simplified. Ballistocardiography is based on the principle that when an individual lies on a flat solid surface, his body moves back and forth with each respiration and heart beat. Thus, on inspiration the body moves footward, and on expiration the body travels headward; at the time the heart contracts to pump the blood through the body, the body is pushed footward.

It is possible to record these movements of the body in several ways. The changes in pressure of the body against a device for converting pressure changes into electrical impulses, such as a piezoelectric crystal, can be measured. A second method to obtain ballistocardiograms is a magnetic method. This instrument was described by Dr. William Dock of the Department of Medicine, State University of New York, College of Medicine in a recent issue of the Journal of the American Medical Association. The electromagnetic ballistocardiograph, as it is called, is quite simple, consisting of a stationary alnico magnet and a pickup coil mounted on a board which is laid across the patient's shins. As the patient's body moves headward and footward, the pickup coil sweeps across the magnetic field of the alnico magnet. The induced current which flows through the coil as the latter cuts the lines of force from the magnet, is fed into a resistance-capacitance coupled amplifier of the type shown in Fig. 2. The purpose of the 50 μfd. condenser is to filter out the electrical impulses which are produced by the respiratory component of the body's motion.

In the photoelectric ballistocardiograph (illustrated on p. 11) the box-like frame rests on the patient's shins and, as it also rides with each axial ballistic movement of the body, a sharply defined light beam of standard intensity, from a light source within the unit, swings rhythmically across the window of a photoelectric device placed in proper proximity on the testing table. The moving field of light modulates the stationary photoelectric cell proportionately to the ballistic thrusts, and the resulting electrical impulses are amplified and recorded by the same type of amplifier as shown in Fig. 2. The ballistocardiogram is then analyzed to obtain the desired information.

These instruments represent only a few of the refinements which have resulted from the combined efforts of the electronic engineer and the research scientist. Certainly the future will see even greater achievements in the ceaseless war against disease.

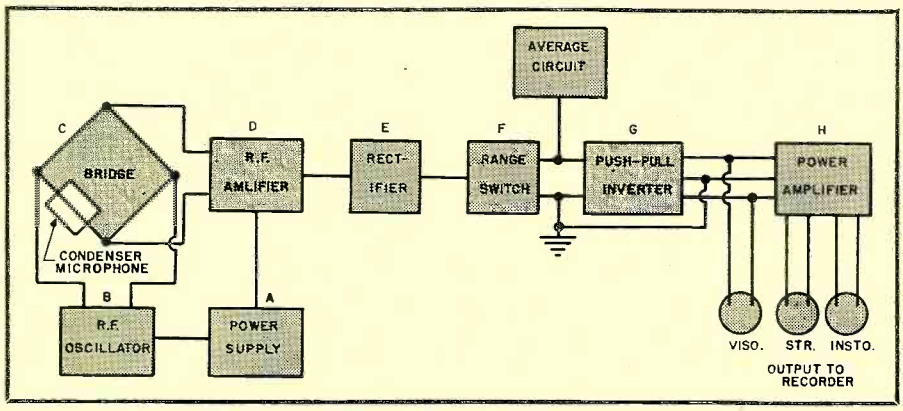
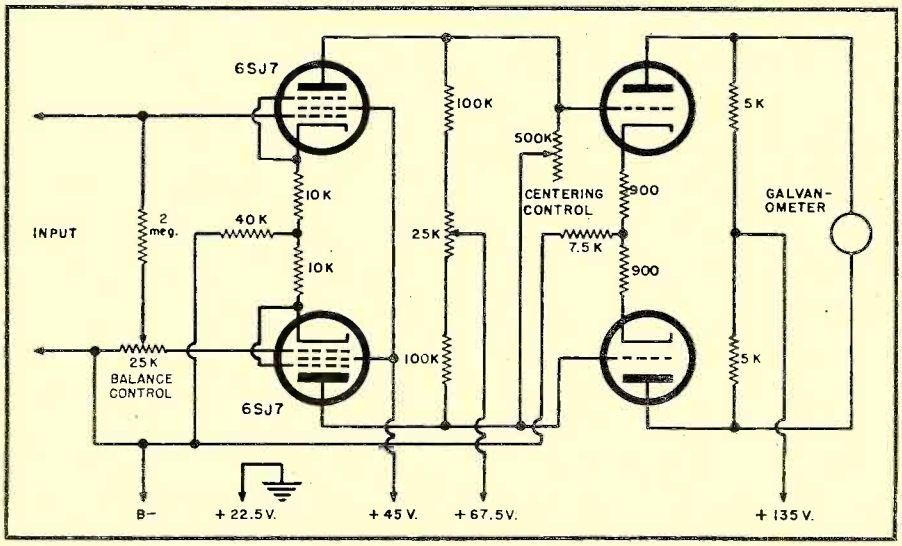


Fig. 3. Block diagram of a typical electromanometer.

Fig. 4. A direct-coupled amplifier for biologic recording.



CALENDAR of Coming Events

NOV. 29-DEC. 1—First JETEC General Conference, Absecon, N.J.

DEC. 6-7—AIEE Conference on Feedback Control Systems, Haddon Hall Hotel, Atlantic City, N.J.

DEC. 10-12—Joint AIEE-IRE Computer Conference, Benjamin Franklin Hotel, Philadelphia, Pa.

JAN. 21-25, 1952—AIEE Winter General Meeting, Hotel Statler, New York.

JAN. 30, 1952—IAS-ION-IRE-RTCA Conference on Air Traffic Control, Astor Hotel, New York.

MAR. 3-6, 1952—IRE National Convention, Waldorf-Astoria Hotel and Grand Central Palace, New York, N.Y.

MAY 16-17, 1952—Fourth Southwestern IRE Conference and Radio Engineering Show, Rice Hotel, Houston, Texas.

Freq. Divider

(*Continued from page 7*)

same 1-mc. input pulses to the "input for lock-in delay." The pulses would then have been inverted by V_{6A}, coupled through a 5-$\mu\mu$fd. capacitor to the normally-off grid of the Delay MV, and would have put positive synchronizing pips on the rising grid waveform, (d) of Figure 4. For taking photographs at fast speeds, this procedure is very useful.

To obtain smooth continuous delay when no synchronizing signals are fed in, it was necessary to place the circuits for the Delay MV in a separate shielded compartment, besides cleaning up the pulses which trigger the circuit, as previously described. As in both the HFMV and the LFMV, a peaker is used in the right-hand cathode of the Delay MV and produces a waveform (f) of Fig. 4. This pulse is capacitor-coupled to a normally-off tube, resulting in the negative pulse (g). This pulse is suitable for triggering a synchroscope and when so used, varying the delay varies the time of the start of the sweep up to 100 μsec. with respect to the synchronizing signals, so that all portions of a waveform may be examined on a fast sweep.

The service records of this model and its predecessor have been exceptionally good. Of the twenty four or so units in use at the Digital Computer Laboratory during the past three years, none have needed major repair work.

Fig. 4. Waveforms of Delay MV. (a) input, (b) normally-off grid, (c) normally-off plate, (d) normally-on grid, (e) normally-on plate, (f) cathode, (g) output pulse. Sweep length, 20 microsec. Fig. 5. Waveforms of LFMV. (a) plate, (b) grid, (c) cathode, (d) after CR5. Sweep of (c) and (d) has been expanded. Fig. 6. Waveforms of Standard Pulse Generator. (a) input, (b) plate, (c) peaker output, (d) standard pulse. Sweep length, 5 microsec. Fig. 7. Waveforms of HFMV. (a) input, (b) output of input amplifier, (c) plate, (d) grid, (e) cathode. Sweep length, 20 microsec.

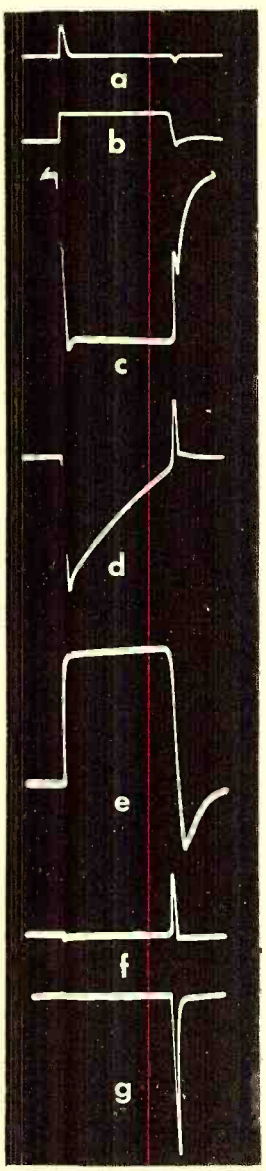


FIG. 4

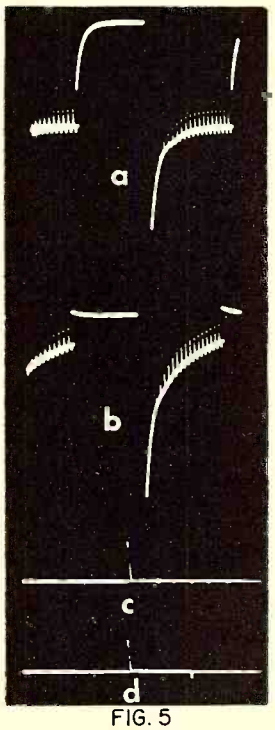


FIG. 5

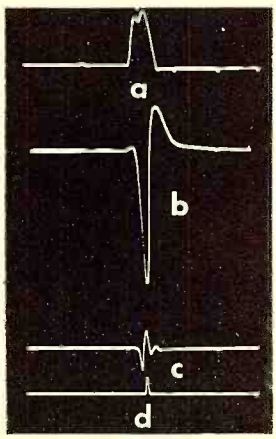


FIG. 6

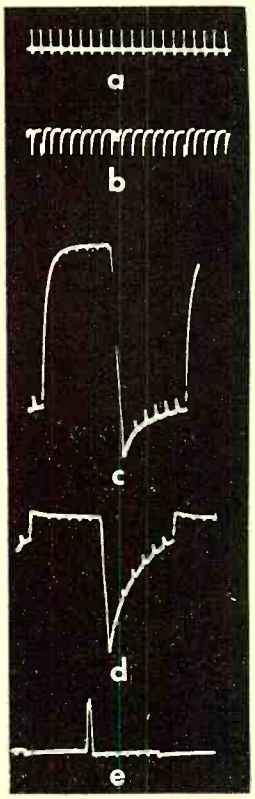


FIG. 7

Radio-Electronic Engineering-1951 Index to Volumes 16 & 17

News Briefs

(*Continued from page* 25)

reading under high ambient light conditions, wide angles, and distance.

Being available with either a remote panel-mouted, four-lamp readout, or with a small plug-in neon cluster on the decade frame for applications, the size of the new unit is 6-⅛" long, 6-½" high, and 1-⅛" wide, including tubes. The decade is equipped with a special silver-plated connector, a binary decimal coding system (1-2-4-8) and is available as a separate component or incorporated in standard and custom-designed counting, timing and computing equipments.

NEW IIT APPOINTMENT

Mr. D. Ward Pease, research engineer for the *A. B. Dick Company* for eighteen years, has been appointed assistant to the chairman of the electrical engineering department at Armour Research Foundation of Illinois Institute of Technology.

Mr. Pease graduated from the University of Illinois in 1920 with a degree in mechanical engineering, and has specialized in the development of technical specialty papers and stencil base tissue.

A native of Chicago, Mr. Pease is the author of a monthly column appearing in POPULAR PHOTOGRAPHY magazine, and is a fellow of the Photographic Society of America.

AMPLIFYING SYSTEM

A design for an amplifying system for use in generating plants was described by S. C. Bartlett, of the *American Gas and Electric Service Corporation*, during a power session of the Fall General Meeting of the AIEE in Cleveland, Ohio.

Explaining the fact that modern plants, with the multiplicity of devices provided to obtain high efficiency, introduce problems of coordination of all personnel, their observations, the readings of instruments and the orders regarding control and adjustment. He further stated that present-day trends in plant design are in the direction of unit construction, in which case a separate P.A. system should be provided for each unit, readily consolidated at one or more points for simultaneous control in the event of any emergency. He concluded with the statement that by adhering to practical considerations, a device may be produced using commercially available components in circuits, obtaining high performance characteristics at low cost.

PHOTO CREDITS

Page	Credit
3, 5	Minnesota Electronics Corp.
6	Massachusetts Institute of Technology
11, 12, 13	Sanborn Co.
16	National Bureau of Standards

NEW LITERATURE

Recording Oscillograph

A highly compact and versatile 5-114 Recording Oscillograph, multi-channeled for the analysis and measurement of strain, vibration, pressure and acceleration, is the subject of a fully illustrated technical bulletin published by *Consolidated Engineering Corporation* of Pasadena, California.

This instrument records photographically up to 18 separate, static or high-frequency phenomena simultaneously at speeds of ½" to 115" per-second, recording timing lines at 1/1000th per-second intervals so that each phenomenon can be interpreted in relation to others, and in relation to time.

Copies of this publication may be obtained by writing for the CEC Bulletin 1500B, *Consolidated Engineering Corporation*, 300 N. Sierra Madre Villa, Pasadena 8, California.

Electrical Insulation

Complete descriptive information and technical data on tubings and sleevings are contained in an 8-page bulletin issued by *Insulation Manufacturers Corporation*, Chicago, Illinois. Their "Dieflex" products are used to insulate leads and wires in all types of electrical equipment, having cotton, rayon, or glass base braids with oleoresinous varnish, vinyl resin, or silicone varnish treatments.

Free copies of this Bulletin, No. 250A, are furnished by Publications Department, *Insulation Manufacturers Corporation*, 565 West Washington Boulevard, Chicago 6, Illinois.

Potentiometer Manufacture

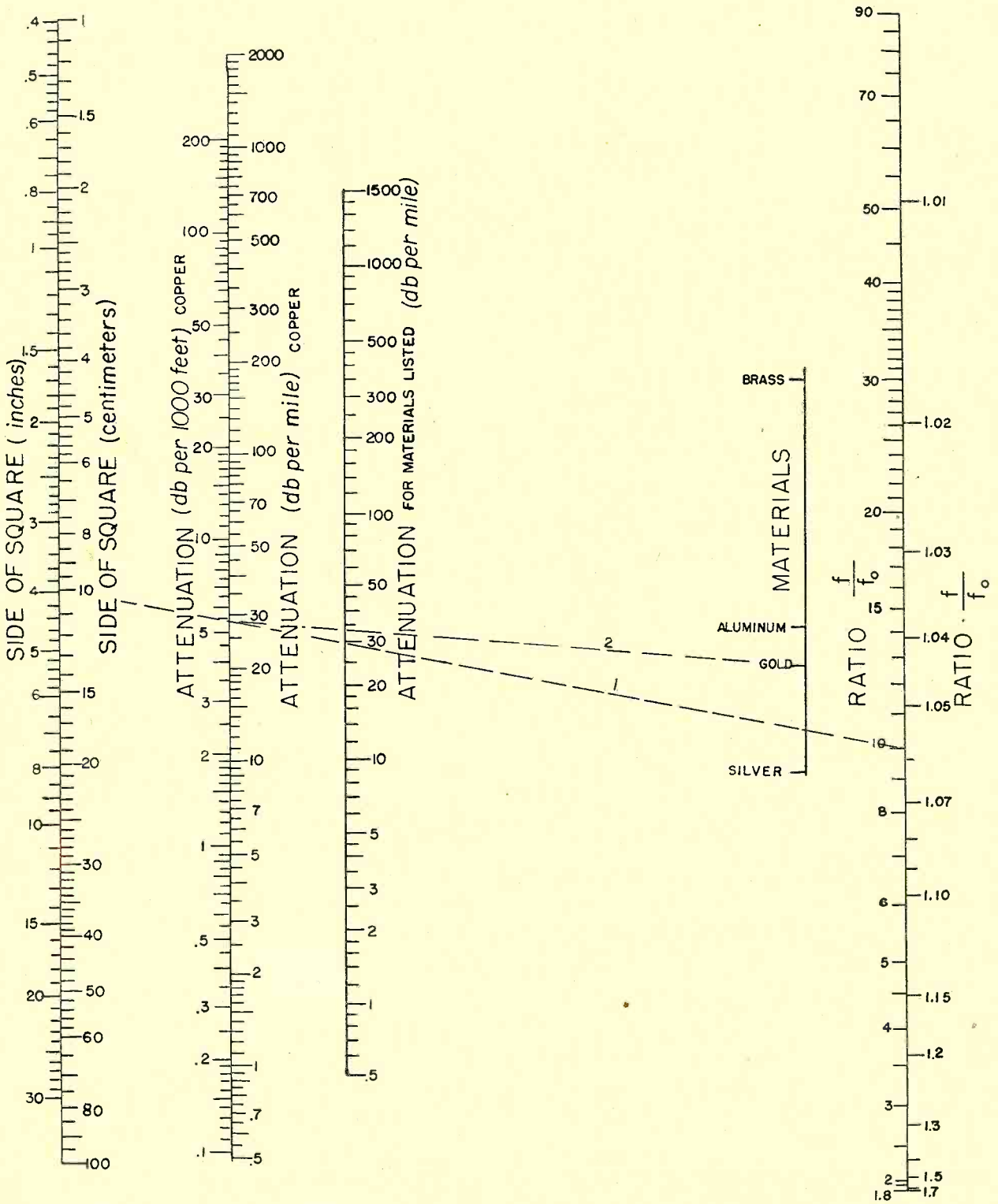
A 38-page, tri-colored catalogue, complete with illustrations, has just been released by the *Helipot Corporation*, South Pasadena, California, containing data tables, comprehensive index, and general specifications on wire-wound potentiometers and associated products.

The catalogue describes standard potentiometers, suggests some of the modifications to accommodate special applications, theoretical and actual characteristics of all types of precision linear wire-wound pots, and the facilities of the *Helipot* factories in their manufacture of these instruments.

This catalogue is obtainable by writing to *Helipot Corporation*, 916 Meridian Avenue, South Pasadena, California.

SQUARE WAVE GUIDE ATTENUATION

A nomograph for determining the attenuation of the $TM_{1,1}$ mode in a square air-dielectric wave guide.



Courtesy of Federal Telephone and Radio Corporation

Introducing...

THE MAGIC OF MODEL M*

"The Magic of Model M" . . . a new trend for TV antennas! And Walsco introduces the *first* antenna with chromate-coated Magnesium cross-arms. Structural strength is almost equal to *steel*, and yet is ⅓ lighter than aluminum. Once you install, *that's all!* No costly call-backs that eliminate your profit. Chromate-coating assures positive corrosion resistance. Elements are made of high-conductivity, super-strength aluminum alloy, reinforced with Swiss "Permalum." Guaranteed sturdier, more dependable under severest weather conditions. Equipped with famous Walsco "signal director" and unbreakable insulator. Same high standards of Walsco *crystal-clear* TV reception.

M

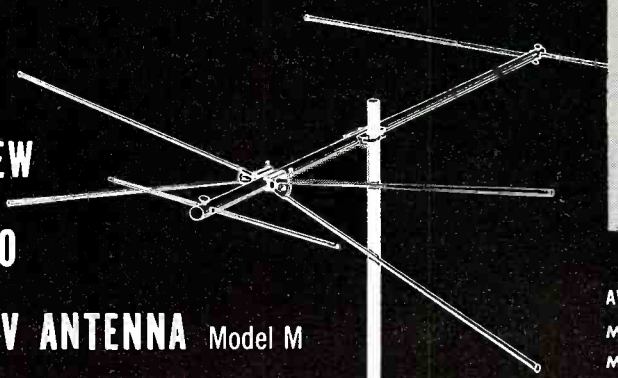
Structural strength almost equal to steel

M

One-third lighter than aluminum

M

Chromate-coating for positive corrosion resistance.



* NEW WALSCO TV ANTENNA Model M

Once you install... thats all!

AVAILABLE AT PARTS JOBBERS EVERYWHERE

Model 4090 M — Single Bay — List $ 9.25
Model 4092 M — Dual Array — List $19.85
Model 4094 M — 4 Bay Stack — List $44.50
All prices without mast.

Walsco quality earned its reputation

WALSCO

WALTER L. SCHOTT CO., 3225 Exposition Place, Los Angeles 18, Calif. Branch: Chicago 6, Ill.

Only G-E Tube Dealers

are backed up by regular full-page tube advertisements in LIFE and the POST!

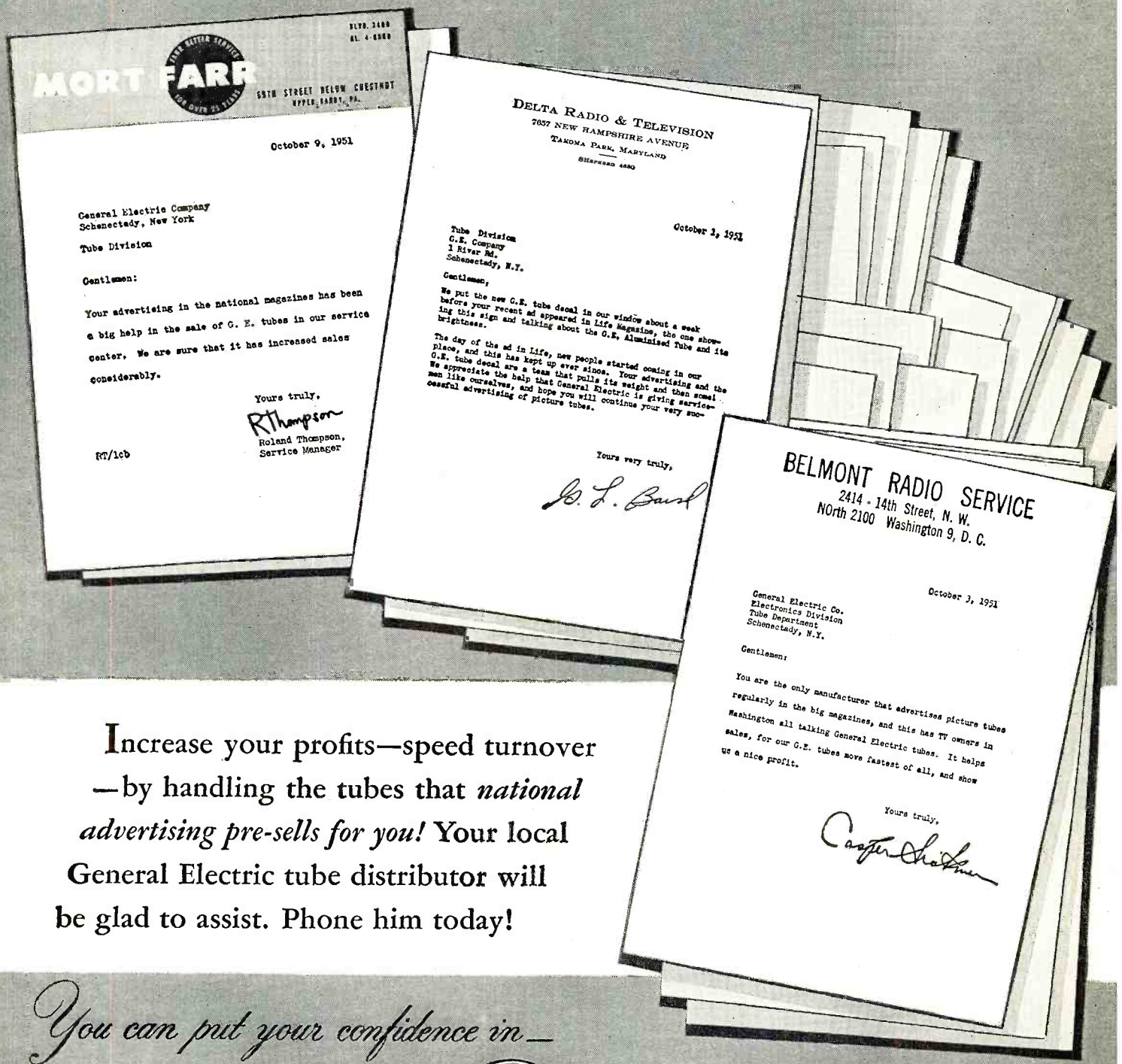
LIFE

THE SATURDAY EVENING POST

READ BY 24,000,000 PEOPLE!

Only G-E Tube Dealers

can write letters like these, proving how powerfully G-E tube advertising helps at point-of-purchase!



MORT FARR
58TH STREET BELOW CHESTNUT
UPPER DARBY, PA.

October 9, 1951

General Electric Company
Schenectady, New York

Tube Division

Gentlemen:

Your advertising in the national magazines has been a big help in the sale of G. E. tubes in our service center. We are sure that it has increased sales considerably.

Yours truly,

RThompson

Roland Thompson,
Service Manager

RT/lcb

DELTA RADIO & TELEVISION
7037 NEW HAMPSHIRE AVENUE
TAKOMA PARK, MARYLAND

October 2, 1951

Tube Division
G.E. Company
1 River Rd.
Schenectady, N.Y.

Gentlemen,

We put the new G.E. tube decal in our window about a week before your recent ad appeared in Life Magazine, the one showing this sign and talking about the G.E. Aluminized Tube and its brightness.

The day of the ad in Life, new people started coming in our place, and this has kept up ever since. Your advertising and the G.E. tube decal are a team that pulls its weight and then some! We appreciate the help that General Electric is giving servicemen like ourselves, and hope you will continue your very successful advertising of picture tubes.

Yours very truly,

G. L. Baird

BELMONT RADIO SERVICE
2414 - 14th Street, N. W.
NOrth 2100 Washington 9, D. C.

October 3, 1951

General Electric Co.
Electronics Division
Tube Department
Schenectady, N.Y.

Gentlemen:

You are the only manufacturer that advertises picture tubes regularly in the big magazines, and this has TV owners in Washington all talking General Electric tubes. It helps sales, for our G.E. tubes move fastest of all, and show us a nice profit.

Yours truly,

Carter Chapman

Increase your profits—speed turnover—by handling the tubes that *national advertising pre-sells for you!* Your local General Electric tube distributor will be glad to assist. Phone him today!

You can put your confidence in—

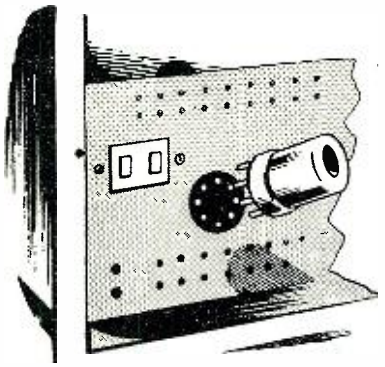
GENERAL ELECTRIC

181-KA10

Precision Pays off in TV!

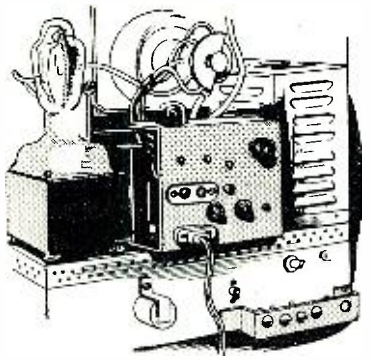
hallicrafters

Ready for Color!....



COLOR

A socket is provided on all Hallicrafters chassis for the connection, at any future time, of an external color attachment using either the mechanical or electronic color system.



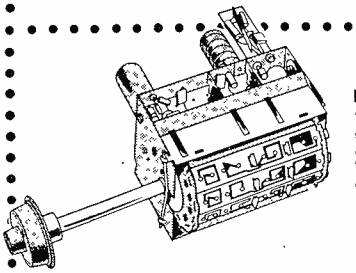
BLACK and WHITE

Provision has also been made for the easy addition, at nominal cost, of an internal "Color Transcender to permit the reception in black and white of color broadcasts not otherwise receivable on present sets.

Ready for UHF!....

READY FOR UHF

If any new UHF (ultra high frequency) TV channels start operating in your area, you can "convert" your Hallicrafters set to receive them merely by the substitution of the proper UHF channel strips for any of the unused VHF channel strips in its rotary tuner.



HALLICRAFTERS DYNAMIC TUNER

Television up to now hasn't approached the amazing perfection that Hallicrafters offers with the new "DYNAMIC TUNER." Photographically reproduced circuits, based on a once TOP SECRET government design, play a vital part in bringing you strong, static-free pictures surpassing any other in television.

Here signals are received first . . . selected, clarified, sharpened . . . all unwanted signals eliminated. Here absolute precision is a necessity for "needle sharp" detail and clearness.

Hallicrafters can definitely promise city-clear and city-sharp reception in areas where never before possible.

The Dynamic Tuner is available on most Hallicrafters 1952 television sets

Tune in Adventure on the WORLD'S MOST AMAZING RADIO

RECEIVES MORE STATIONS, OVER LONGER DISTANCES THAN ORDINARY RADIOS COSTING 3 TIMES AS MUCH

Romantic places clear around the world are brought to your livingroom every night—London, Paris, Moscow, Tokyo, the Vatican—countless fascinating international shortwave broadcasts, as well as police, aircraft, marine, and amateur stations.

It is a radio that is all radio, precision-built by trained craftsmen, long experienced in the high-frequency circuits that have made Hallicrafters famous.

For a generation, Hallicrafters have built more communications receivers than all other U.S. manufacturers combined.

5R10A Only $69.95
U.S.A. Broadcast and Short Wave

hallicrafters
THE SET THE EXPERTS OWN!

WORLD'S LEADING MANUFACTURER OF *PRECISION* RADIO & TELEVISION • CHICAGO 24

(Advertisement)

HOW TO STACK YAGIS WITH 100% EFFICIENCY

New System Eliminates Mismatch; Provides Higher Gain For Yagis

Acting on the complaint of installers of all makes of Yagi antennas that only a small additional gain was achieved in stacking, Channel Master Laboratories engaged in a thorough research project during the past summer. The engineers came up with the new Z-MATCH system, and, like all important discoveries, it is relatively simple.

They noted that although all *single* Yagis claim to match 300 ohm line, they are stacked one-half-wave with ⅜″ connecting rod transformers spaced about 3″ apart, with an impedance of 325 ohms. Each Yagi's impedance, therefore, was stepped up to 350 ohms, with the two in parallel totaling only 175 ohms. This meant a mismatch of almost 2:1 when used with 300 ohm line. (Fig. 1 lower right)

Channel Master engineers reasoned that in stacking, the impedance of each single 300 ohm Yagi must be reduced in order for the total stacked Yagi to match a 300 ohm line, as follows:

1. Let the single Yagi match 300 ohm line perfectly when used alone.
2. Reduce Z (impedance) of each Yagi to 200 ohms for stacking.
3. Use ⅜″ half-wave connecting rod transformers spaced at 3⅛″.
4. These connecting rod transformers have an impedance of 350 ohms.
5. These 350 ohm connecting rods transform each 200 ohm impedance to 600 ohms.
6. The two 600 ohm impedances in parallel equal 300 ohms.
7. **Therefore a perfect match is achieved in both single and stacked antennas!** (Fig. 2)

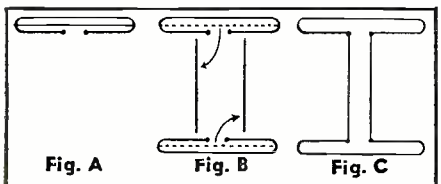


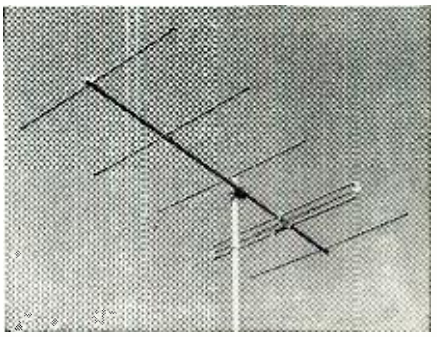
Fig. A Fig. B Fig. C

A) 3 element ½ wave folded dipole of single Yagi showing center bar. B) 2 half-wave folded dipoles with center bars removed. C) Center bars used as stacking rods.

The new Z-MATCH system *automatically* provides for lowering the impedance of each Yagi when preparing it for stacking. A 600 ohm, 3 conductor folded dipole (Fig. A) is used on the single Yagi to provide a perfect 300 ohm impedance. In stacking, the center bar is taken out of the folded dipole which lowers the impedance to 200 ohms and leaves a pair of ⅜″ rods one-half-wave long (Fig. B). These are then used as connecting rods and the result is a stacked Yagi which perfectly matches a 300 ohm line (Fig. C). In order to provide a perfect 300 ohm impedance for the single Yagi, the crossarm had to be lengthened, resulting in *higher gain for the Z-MATCH single Yagi*. The antenna is wider spaced than most other commercial Yagis which use a half-wave crossarm. Furthermore, the cost of extra connecting rods is completely eliminated. Z-Match is an exclusive feature of Channel Master Yagi antennas. Completely pre-assembled,

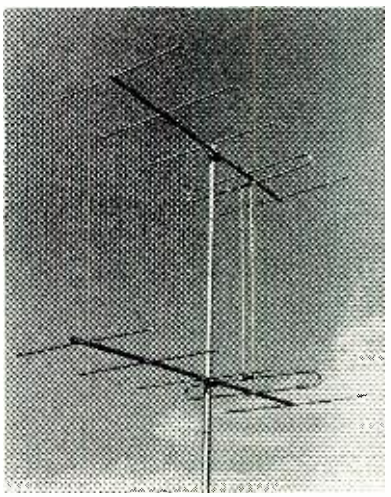
Tests Reveal Serious Mismatch in Stacked Yagis

New Z-Match Yagi Achieves 100% Perfect Match To 300 Ohm Line, Single or Stacked.



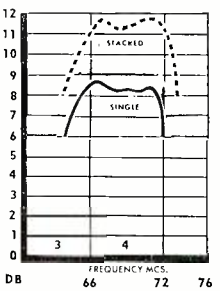
Higher Gain On All Yagi Installations Accomplished By Adjustable Impedance And Wider Spaced Elements.

Now! Stack Yagis without extra stacking bars!

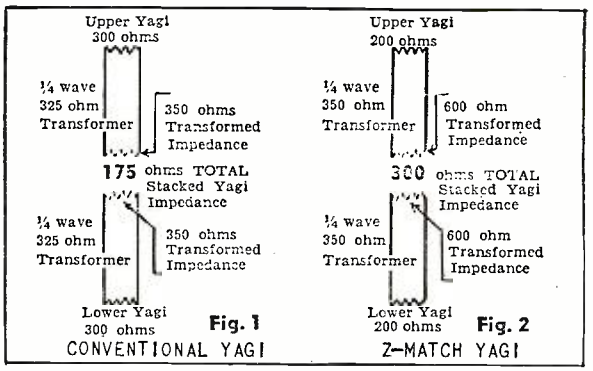


Mismatch eliminated! Now Channel Master proudly introduces the Z-Match Yagi — a new antenna that guarantees 100% perfect match in both single and stacked Yagi installations.

Single bay Yagi perfectly matches 300 ohms because of wider spaced elements. When Yagis are stacked, the center bars of the folded dipoles are removed and used as half-wave connecting rods. This reduces the impedance of each antenna, and automatically creates a perfect 300 ohm match for the complete stacked Yagi array. The Z-Match system, PLUS wide spacing, provide higher gain for Channel Master Yagis, single or stacked. No extra stacking bars result in lower cost.



Gain of Z-Match Yagi on Channel 4



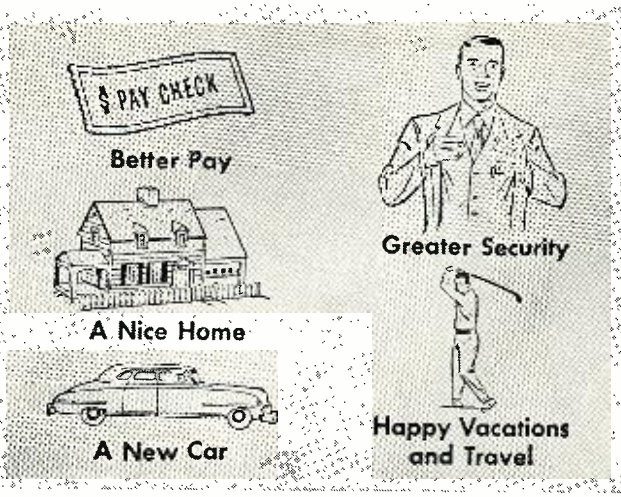
CHANNEL MASTER CORP.

NAPANOCH ROAD, ELLENVILLE, N. Y.

FIRST IN PREASSEMBLED ANTENNAS

Write for complete technical literature.

Which Do You Want?



Get Your FCC Ticket Then Use Our Amazingly Effective Job-Finding Service To Get a Better Job

EDW. H. GUILFORD
Vice President

I can train you to pass your FCC License Exams in a minimum of time if you've had any practical radio experience—amateur, Army, Navy, radio servicing, or other. My time-proven plan can help put you, too, on the road to success.

Just fill out the coupon and mail it. I will send you free of charge, a copy of "How to Pass FCC License Exams," plus a sample FCC-type Exam, and the amazing new booklet, "Money Making FCC License Information."

How to Pass FCC License Exams

Commercial Radio Operator

FREE

Tells where to apply for and take FCC examinations, location of examining offices, scope of knowledge required, approved way to prepare for FCC examinations, positive method of checking your knowledge before taking the examinations.

Get this Amazing Booklet FREE

TELLS HOW— WE GUARANTEE TELLS HOW—

TO TRAIN AND COACH YOU AT HOME IN SPARE TIME UNTIL YOU GET

YOUR FCC LICENSE

TELLS HOW— Employers make

JOB OFFERS Like These to Our Graduates Every Month

Long distance Phone, October 15, 1951, from Chief Engineer, Broadcast Station, Georgia. "Need 1st class licensed man immediately: salary $65 for 40 hour week."

Letter, October 2, 1951, from Chief Engineer, Broadcast Station, Penna., "We are in need of a broadcast engineer with first class license. Experience not necessary and starting pay is $50 per 40 hour week."

These are just a few examples of the job offers that come to our office periodically. Some licensed radioman filled each of these jobs . . . it might have been you!

HERE'S PROOF FCC LICENSES ARE OFTEN SECURED IN A FEW HOURS OF STUDY WITH OUR COACHING AT HOME IN SPARE TIME

Name and Address	License	Lessons
Lee Worthy 2210½ Wilshire St., Bakersfield, Cal.	2nd Phone	16
Clifford E. Vogt Box 1016, Dania, Fla.	1st Phone	20
Francis X. Foerch 38 Beucler Pl., Bergenfield, N. J.	1st Phone	38
S/Sgt. Ben H. Davis 317 North Roosevelt, Lebanon, Ill.	1st Phone	28
Albert Schoell 110 West 11th St., Escondido, Cal.	2nd Phone	23

CLEVELAND INSTITUTE OF RADIO ELECTRONICS
Desk RN-36, 4900 Euclid Bldg., Cleveland 3, Ohio

Our Amazing Effective JOB-FINDING SERVICE Gets Better Jobs for Graduates

Here is just one recent example of Job-Finding Results

OURS IS THE ONLY HOME STUDY COURSE WHICH SUPPLIES FCC TYPE EXAMINATIONS WITH ALL LESSONS AND FINAL TESTS.

GETS FIVE JOB-OFFERS FROM BROADCAST STATIONS
"Your 'Chief Engineer's Bulletin' is a grand way of obtaining employment for your graduates who have obtained their 1st class license. Since my name has been on the list I have received calls or letters from five stations in the southern states, and am now employed as Transmitter Engineer at WMMT."
Elmer Powell, Box 274, Sparta, Tenn.

Your FCC Ticket is always recognized in all radio fields as proof of your technical ability.

Get All 3 FREE

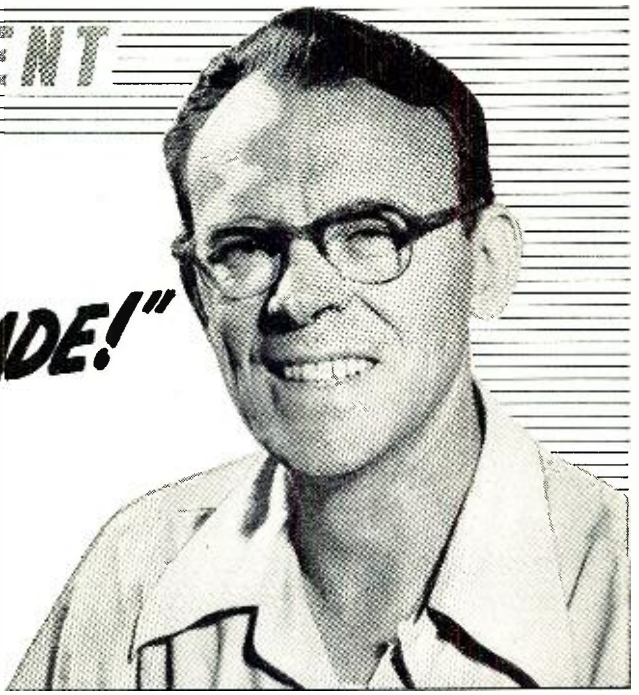
MAIL COUPON NOW

CLEVELAND INSTITUTE OF RADIO ELECTRONICS
Desk RN-36, 4900 Euclid Bldg.
Cleveland 3, Ohio
(Address to Desk No. to avoid delay)

I want to know how I can get my FCC ticket in a minimum of time. Send me your FREE booklet, "How to Pass FCC License Examinations" (does not cover exams for Amateur License), as well as a sample FCC-type exam and the amazing new booklet, "Money-Making FCC License Information."

NAME .....
ADDRESS .....
CITY ..... ZONE ..... STATE .....
Paste on penny post card or send air mail

TEST EQUIPMENT



"BEST LONG-TERM INVESTMENT I EVER MADE!"

"Delivers both VHF and UHF Coverage in One Package . . . Absolutely Tops in Reliability"

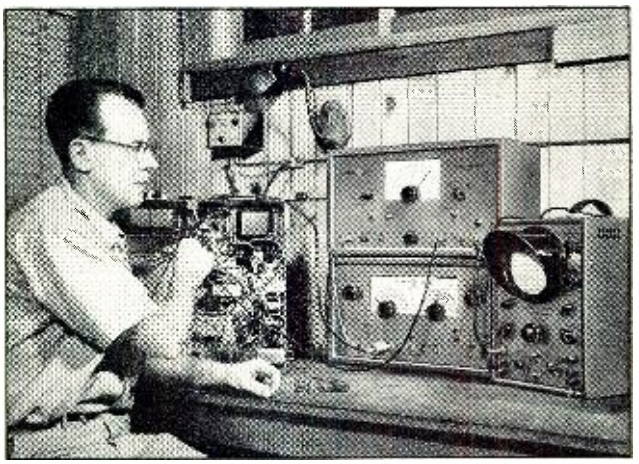
says HAROLD ROBBINS

Paramount Radio and Television Service, Des Moines, Iowa

"ACCURATE work and fewer recalls reflect in the black on my ledger. My 21 years in the electronic service business have taught me that the best equipment pays off in the long run. That's why, after shopping them all, I bought a General Electric Scope, variable permeability Sweep, and crystal controlled Marker Generator. Now I don't have to buy new equipment to test UHF."

Look at it this way. Over 40% of the nation's homes now have television. With new stations coming up, the TV service business is booming faster than ever. Are you keeping pace with this growth?

Best way to get your share of this bonanza is to prepare for it. Equip your shop now with service units that give you fast, accurate results. G-E test equipment will save your time, please your customers, and make it easy for you to train new technicians as your business grows. That's our story in a nutshell.



INDISPENSABLE is the word used by Mr. Robbins to describe his G-E units shown here. So easy to use that other servicemen bring him problems they can't handle on ordinary test gear.

G.E.'s EASY PAYMENT PLAN

Why Tie Up All Your Working Capital? These G-E units can earn their way in your shop—at surprisingly low cost. Your General Electric distributor will show you how.

LET US SEND YOU THESE COLORFUL BULLETINS...

You can put your confidence in—

GENERAL ELECTRIC

General Electric Company, Section 9121
Electronics Park, Syracuse, New York

Yes—send me bulletins with complete information on General Electric TV Test Equipment.

NAME.....

ADDRESS.....

CITY.....STATE.....

Within the INDUSTRY

A. R. LIEBERMAN, formerly chief engineer and general manager of *Jewel Radio Corp.*, has announced the formation of a new company which will produce radio receivers.

Esquire Radio Corporation has opened a new glass-brick and brick with steel-reinforced concrete plant at 62-01 15th Avenue in Brooklyn. A comprehensive line of related products will soon be released in addition to the clock-controlled radios now in production.

Another principal in the new firm is J. P. Lieberman, a former owner of *Air King Prod. Corp.* Both men have been actively associated in the radio industry for many years.

* * *

PALMER M. CRAIG has been named vice-president (engineering) of the television and radio division of *Philco Corporation.* He joined the company in 1933 as a senior receiver engineer and served as chief engineer in charge of radar and military radio development during World War II. He was named chief engineer of the company's radio division in 1943 . . . *Gem Radio & Television Corporation* has elected **LEO J. GALANEK** president of the firm. He was formerly associated with *Regal Radio Corporation* as chief engineer . . . **TREVOR H. CLARK,** formerly with *Federal Telecommunication Laboratories* of *I.T. & T.,* has been named director of the division of military research and development at Southwest Research Institute in San Antonio . . . The election of **RAYMOND S. PERRY** as a vice-president and director of *Federal Telephone and Radio Corporation* has been announced by the company . . . *Designers for Industry, Inc.* has named **ARTHUR L. BLETCHER** to the post of project designer for the firm. He was formerly a project engineer at *Radiart Corporation* . . . *The Hallicrafters Co.* has made several new appointments of interest to the industry. **MICHAEL D. KELLY** has been named television sales manager; **WILLIAM J. HALLIGAN, JR.** has been appointed radio sales manager; while **WILLIAM S. WRIGHT** is the new operations manager . . . **DALE CROPSEY** has been selected to fill the post of works manager at *Potter & Brumfield.* He was formerly employed in an engineering capacity by *General Motors* and later by *Standard Coil Products Inc.* . . . *Steelman Phonograph and Radio Company, Inc.* has appointed **IGNATIUS VOLPE** chief engineer for the firm. He has been associated with *Air King, Minerva Radio,* and *Jewel* in engineering posts . . . **HENRY F. ARGENTO** has been elected an assistant vice-president of *Raytheon Manufacturing Company* of Waltham, Mass. and named assistant manager of the power tube division. He formerly served as sales manager of the division, a post which he has held since 1941 . . . The new vice-president in charge of sales for *Reeves Soundcraft Corp.* is **FRANK B. ROGERS, JR.** He was formerly vice-president and assistant general sales manager for *Ampro Corporation* of Chicago.

* * *

E. W. MERRIAM, former chairman of the RTMA Service Committee, has been named service manager for the Radio-Television Manufacturers Association.

Mr. Merriam, until recently service manager of the *Allen B. Du Mont Laboratories, Inc.,* has agreed to take the position on a temporary basis in order to implement some of the activities inaugurated by the Service Committee. Upon completion of this preliminary work he plans to return to private industry.

One of his first jobs will be to promote training courses for service technicians in the nation's trade and vocational schools. A recommended agenda for a training course was prepared by a sub-committee of the Service Committee and has been distributed among trade and vocational schools. A complete course is now in preparation.

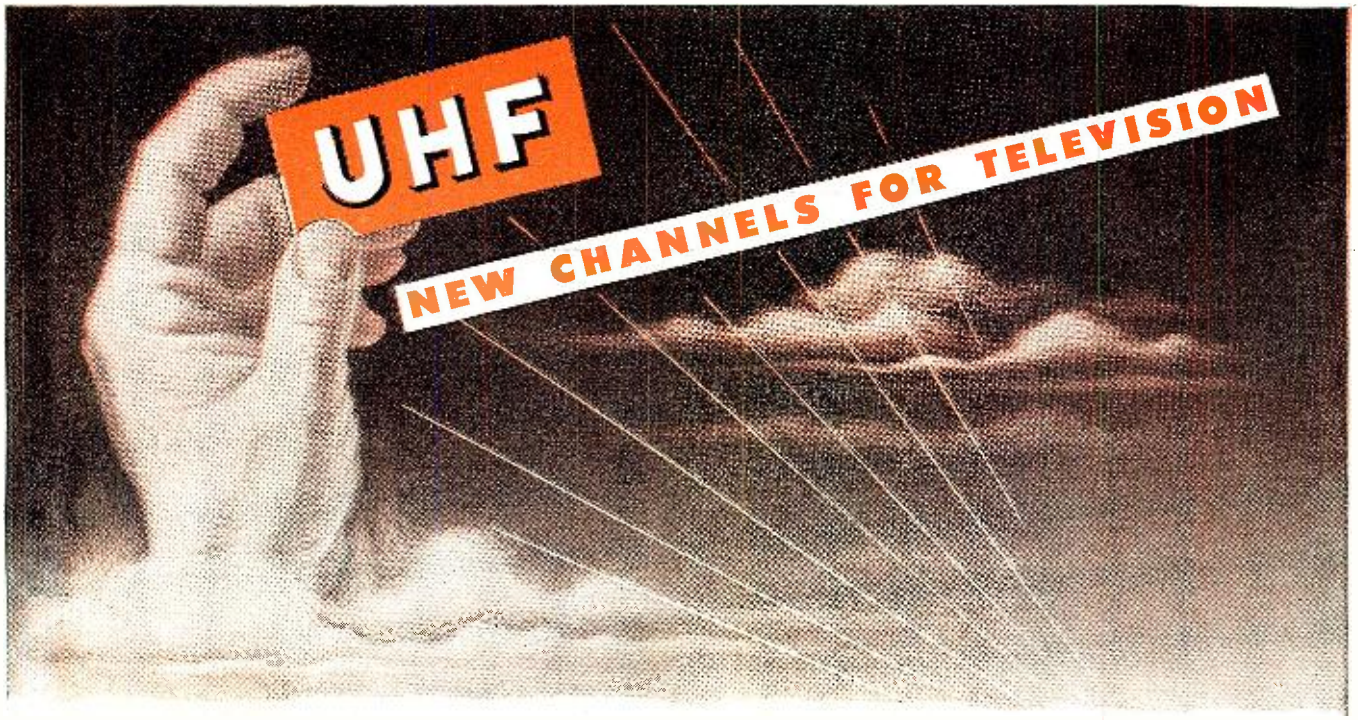
He will also undertake to coordinate various industry activities designed to improve set servicing in the industry and eliminate abuses which have sprung up. He will work with representatives of dealer, distributors, and technicians' organizations in this activity.

* * *

PAUL ESHLEMAN, *Du Mont* production control manager during World War II, has been named to head the company's East Paterson, New Jersey plant.

Formerly the world's largest television receiver manufacturing plant, the facilities in East Paterson are being converted for the production of military equipment.

Since 1942, Mr. Eshleman has been engaged in the production of *Du Mont* receivers and electronic parts. When the company purchased the East Paterson plant from the War Assets Administration in 1948, he personally designed and supervised the conversion of the former *Wright Aeronautical*



A New Market for You . . .
with the Mallory UHF Converter

Here is another first from Mallory—a practical converter to add UHF reception to VHF television sets.

The Mallory UHF converter can be connected to *any* TV receiver by a few external connections—involving only the power line and antenna leads. It permits the tuning of all UHF channels without internal adjustments and without sacrificing reception of VHF channels.

The secret of the Mallory converter is the Inductuner®, pioneered by Mallory years ago. It provides continuously variable tuning, essential to complete coverage of *all* UHF channels.

Here is real sales appeal—a real sales opportunity!

P. R. MALLORY & CO. Inc.
MALLORY CAPACITORS . . . CONTROLS . . . VIBRATORS . . . SWITCHES . . . RESISTORS . . . RECTIFIERS . . . VIBRAPACK* POWER SUPPLIES . . . FILTERS
*Reg. U.S. Pat. Off.
APPROVED PRECISION PRODUCTS
P. R. MALLORY & CO., Inc., INDIANAPOLIS 6, INDIANA

Make Sure!
Make it Mallory!

plant into a television receiver manufacturing operation and redesigned the facility to fit the company's electronic requirements.

* * *

HARRISON JOHNSTON has been named manager of the newly-created product engineering division of *Ampex Electric Corporation.*

An engineering graduate of Princeton University, Mr. Johnston has been associated with *General Electric Company* for the past twelve years. He is a member of the A.I.E.E., the IRE, and the Engineers and Electric Clubs of San Francisco.

He will headquarter at the company's Redwood City, California factory. Among his duties in his new position will be supervising the marketing of the company's audio and data recorders.

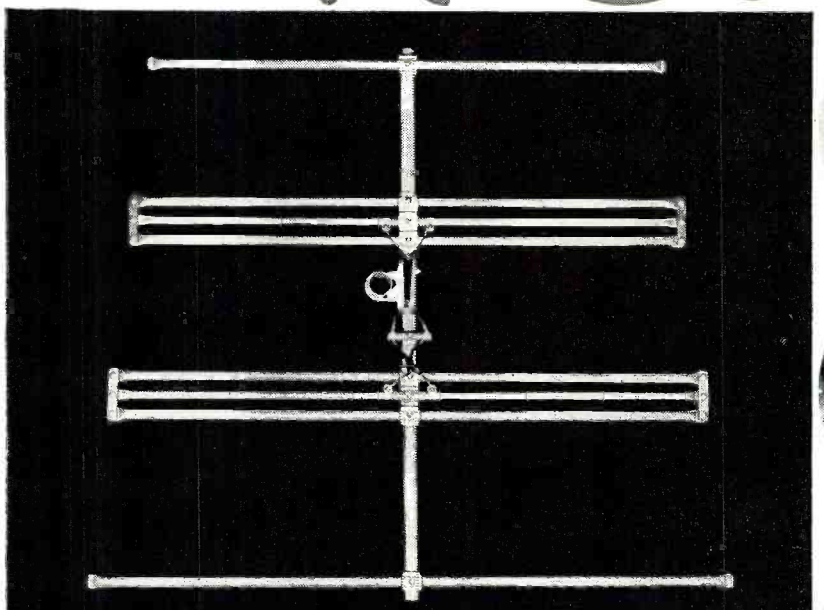
* * *

NEWARK ELECTRIC COMPANY of 323 W. Madison Street, Chicago has taken a lease on a five-story building at 223-225 West Madison Street. The newly-acquired space will allow the company to double its display area, permit warehousing its stocks under a single roof, and increase office space. The company will take possession of the new quarters on January 16th of next year . . . **RADIO RECEPTOR CO., INC.** has increased its plant capacity in Brooklyn to permit the manufacture of germanium diodes . . . A branch plant for the manufacture of components has been opened in Kane, Pa. by the **STACKPOLE CARBON COMPANY** of St. Marys, Pa. The new plant contains approximately 45,000 square feet of floor space . . . **LINDBERG INSTRUMENT COMPANY** of Berkeley, California has recently moved to larger quarters at 1808 Harmon Street in Berkeley.

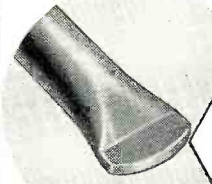
* * *

COPPERWELD STEEL COMPANY of Glassport, Pa. has purchased all of the outstanding stock of **FLEXO WIRE COMPANY, INC.** of Oswego, N. Y. The parent company will operate the New York firm as a wholly-owned subsidiary to manufacture small and fine sizes of wires and cables for the electronics and electrical appliance industries . . . The assets of the **CHICAGO DIE MOLD MANUFACTURING COMPANY** have been acquired by **UNITED STATES RUBBER COMPANY.** The Chicago firm is a custom molder of plastic radio cabinets, dials, and other plastic products. It will be operated as a division of the rubber firm . . . **MAGNECORD, INC.** has announced the formation of a new corporation, **MAGNECORD INTERNATIONAL LTD.** The new company will handle all of the parent company's business outside of the Western Hemisphere. Ad. Auriema has been named manager of the international corporation and will maintain offices in New York. -30-

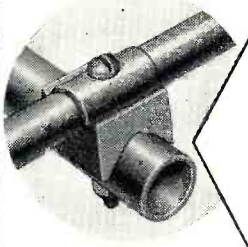
There's No Comparison!



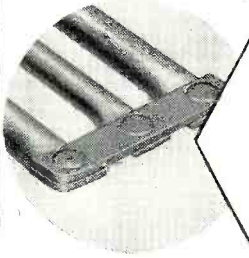
THE TRIO 2 CHANNEL YAGI FULL 10 DB GAIN ON TWO CHANNELS.
MODEL 445 FOR CHANNELS 4 AND 5
MODEL 479 FOR CHANNELS 7 AND 9
Patent pending — no licensing arrangements granted for duplicating principle of this antenna.



Yagi elements of .035" thick seamless aluminum, are full 5/8" in diameter. Ends are crimped for greater strength and to cut down vibration. Prevents entrance of dirt and moisture.



An extra clamping member permits taking up bolts tight without putting undue strain on element. Cast aluminum V block assures perfect right angle alignment. No detail of design or construction has been overlooked to make the TRIO 2-Channel Yagi the finest fringe area TV antenna available anywhere — at any price!



Double-folded dipole sections have heavy gauge aluminum brace bars securely riveted to element ends thus providing positive electrical connection and extreme rigidity. Workmanship throughout is of the highest order.

TRIO — the Original 2-CHANNEL YAGI

TOPS ALL IN DESIGN, CONSTRUCTION, PERFORMANCE

One of the most widely imitated antennas on the market today, the TRIO 2-Channel Yagi still stands alone in efficiency and strength.

TV buyers — and sellers — are discovering that "look alike" is not enough — that imitations are never as good as the original.

There is no secret to TRIO's marked superiority. The simple truth is that TRIO slights no construction detail, overlooks no design feature. This means unparalleled efficiency — rugged dependability for both installer and TV set owner.

Installers! Avoid profit eating call-backs caused by poorly made imitations! Set owners! Enjoy years of dependable, efficient TV reception! Compare the TRIO 2-Channel Yagi with any other TV antenna at any price. Yes, compare — then you, too, will insist on an original TRIO — the 2-Channel Yagi that set the standards.

TRIO the "Trouble-proof" TV Rotator

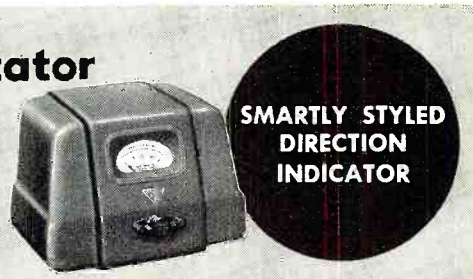
For yeors of dependoble, unfailing service — in good weother and bad — you can't beot the new TRIO TV Rotator and Direction Indicator.

Sturdy and completely weatherproof, the TRIO Rotator will support the heaviest TV orroys — even in 80 MPH winds! Its sound design and construction has been proven by 3 years of extensive field testing under every extreme of weather. The TRIO Rotator will not freeze up!

2 HEAVY DUTY MOTORS

Two separate 24 volt motors are used — one for each direction of rotation. Thus, each motor operates just 50% of the time — cannot burn out. Positive acting electrical stops at both ends of 360° turn eliminates lead damage.

Housing is die-cast aluminum for greater strength, lighter weight and perfect alignment of parts. The TRIO Rotator is precision built throughout.



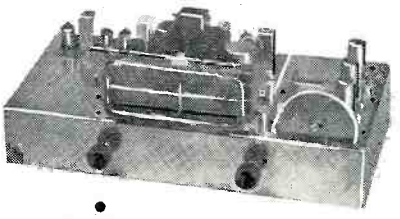
The TRIO Direction Indicator is housed in a sturdy plastic cabinet of graceful lines. It is a beautiful instrument that will blend harmoniously with any furniture style.

Utmost ease in selecting the desired antenna direction is provided by a new "finger-tip" control that operates at a light touch and the easy-to-read dial face that clearly and instantly indicates the exact antenna position.

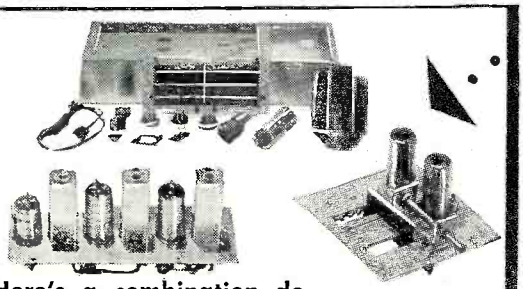
Trio MANUFACTURING COMPANY
GRIGGSVILLE, ILLINOIS

A New Idea in Radio Tuners—
COLLINS "PRE-FABS" SAVES YOU MONEY

Now you can have a high quality Collins FM Tuner at about half the cost. You buy the basic units which have all been prewired, aligned and factory tested. All you do is assemble these into the punched chassis and wire up the power supply. Yes, it's that easy the Pre-Fab way.



The Collins "Pre-Fab" Tuner Assembled.



Here's a combination designed for the pocket as well as the ear... High in quality—low in cost. **$33.75**

There's no finer tuner available than this Collins Deluxe Combination. Engineered for high quality and yet priced right. **$46.50**

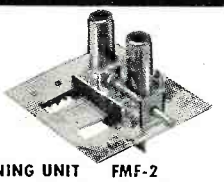
Each Collins "Pre-Fab" combination meets the high standards of the famous Collins FM Tuner—very low distortion and full frequency audio response from 20 cycles to over 20,000 cycles per second. High gain and sensitivity.

All Prices Shown Include Tubes

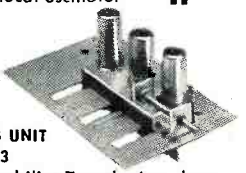
Choose Any Combination

They are priced for your pocketbook from $33.75 to $46.50

ALL YOU BUY IS a tuning unit, an IF Amplifier and the universal chassis kit, which is standard for all combinations. Check the "Pre-Fabs" listed below and make your selection.



TUNING UNIT FMF-2 Permability Tuned . has two tuned stages using a 6AK5 converter and 6C4 local oscillator **$11.50**



TUNING UNIT FMF-3 Permability Tuned...has three tuned stages including a 6J6 RF amplifier, 6AK5 converter, and 6C4 oscillator **$14.50**

IF AMPLIFIER IF-3 Employs three tubes terminating in a new type ratio detector circuit **$8.75**

IF AMPLIFIER IF-4 Also employs a ratio detector ...extra IF stage gives it added gain **$12.25**

IF AMPLIFIER IF-6 Deluxe model . . . has three IF stages, two limiters, and a discriminator type of detector. Superior to any such amplifier on the market in gain and sensitivity. **$18.50**

UNIVERSAL CHASSIS KIT UC-1 Includes a punched chassis, handsome slide rule tuning dial, oversize power transformer, filter condenser, rectifier tube and socket, hardware, volume control and switch, knobs, terminal strips, AC line cord and plug. **$13.50**

Mail—Order Coupon TODAY!

Collins Audio Products Company, Inc.
P. O. Box 368, Westfield, N. J.

Enclosed find ☐ check ☐ money order for_____

Send me the following "Pre-Fab" Units:

- ☐ Tuning Unit FMF-2
- ☐ Tuning Unit FMF-3
- ☐ IF Amplifier IF-3
- ☐ IF Amplifier IF-4
- ☐ IF Amplifier IF-6
- ☐ Universal Chassis Kit UC-1

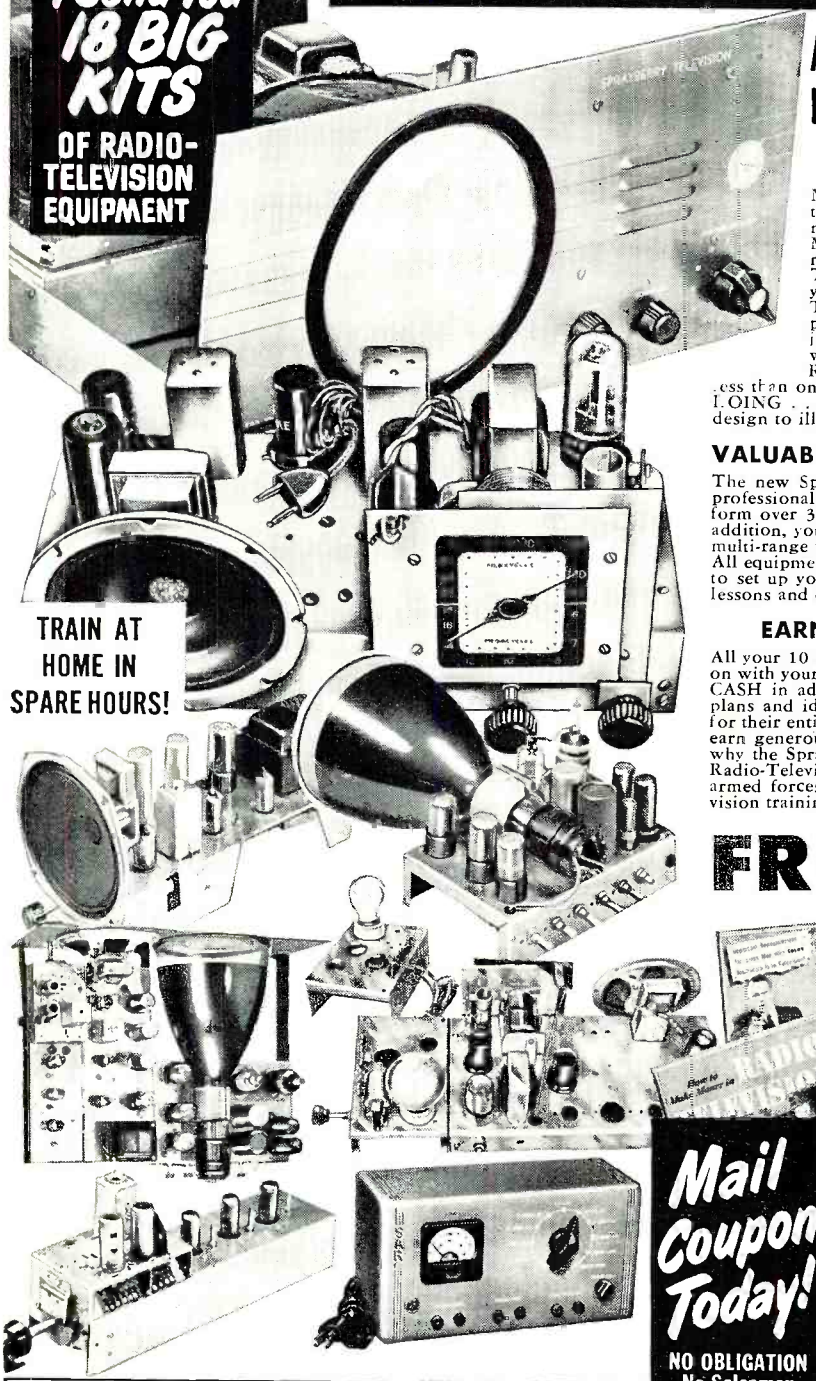
Name_____

Address_____

City & State_____

NOW—Be a Fully Trained, Qualified RADIO TELEVISION TECHNICIAN IN JUST 10 MONTHS OR LESS

I Send You 18 BIG KITS OF RADIO-TELEVISION EQUIPMENT



TRAIN AT HOME IN SPARE HOURS!

New "Package" Unit Training Plan
PAY AS YOU LEARN—YOU SET THE PACE!

No Monthly Payment Contract to Sign!

Now . . . be ready for Radio-Television's big pay opportunities in a few short MONTHS! Frank L. Sprayberry's completely new "Package" training unit plan prepares you in just 10 MONTHS . . . or even less! Equally important, there is NO monthly payment contract to sign . . . thus NO RISK to you! This is America's finest, most complete, practical training—gets you ready to handle any practical job in the booming Radio-Television industry. In just 10 months you may start your own profitable Radio-Television shop . . . or accept a good paying job in this fascinating expanding field at work you've always wanted to do. Mr. Sprayberry has trained hundreds of successful Radio-Television technicians—and stands ready to train you in less than one year, even if you have no previous experience. You learn by DOING . . . actually working with your hands with equipment of special design to illustrate basic theory instead of relying on books alone.

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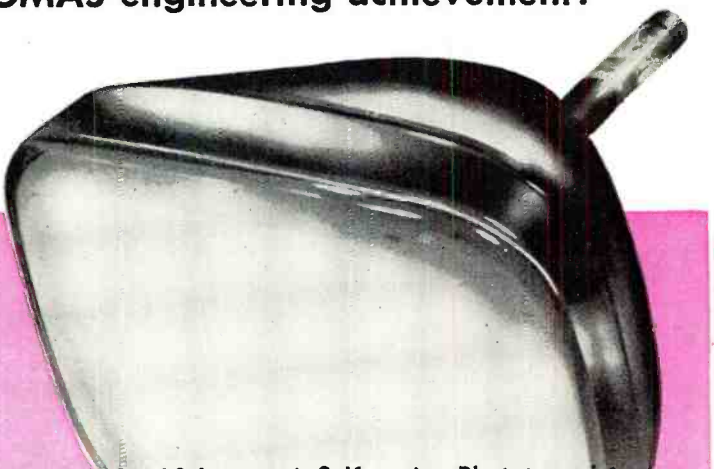

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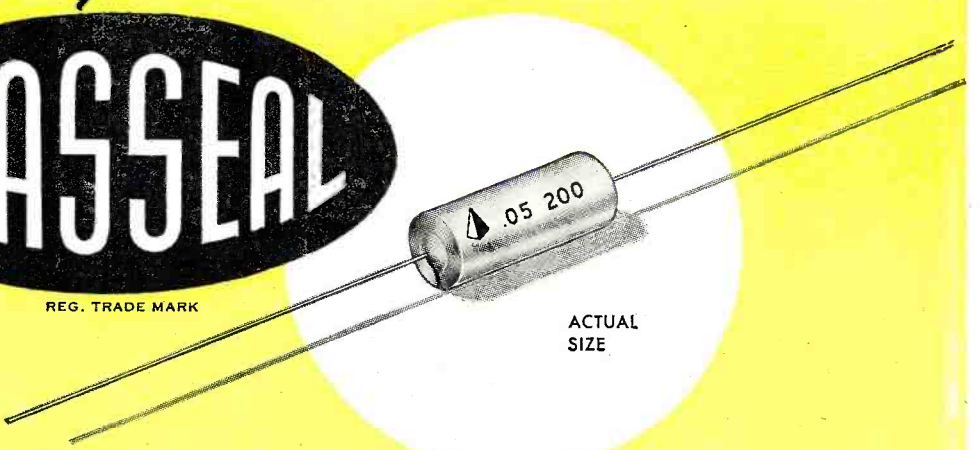

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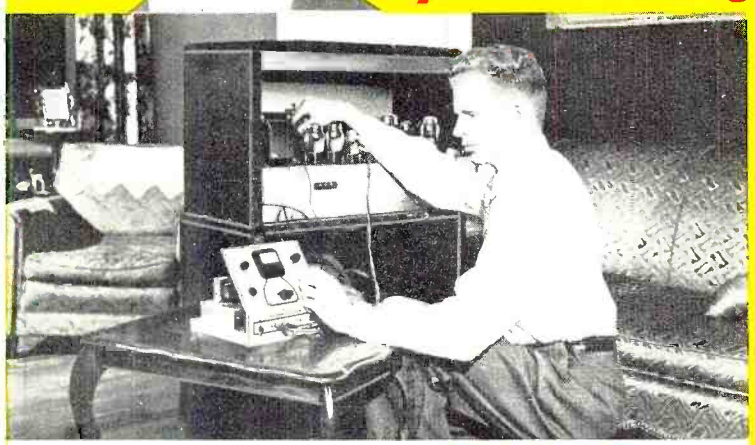

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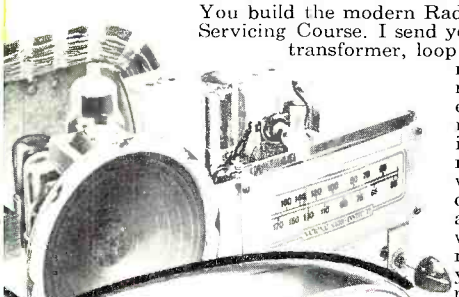

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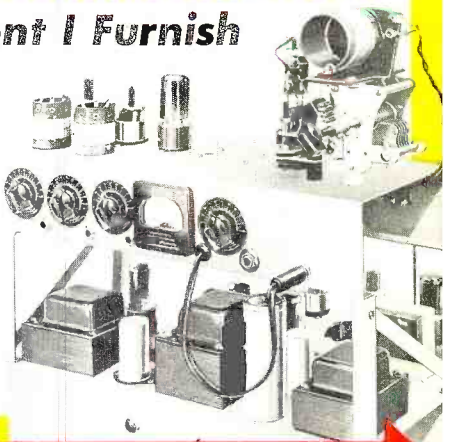

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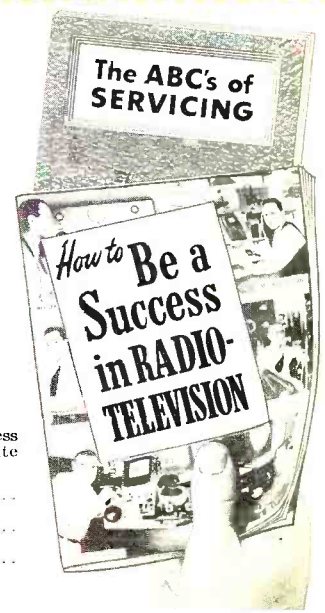

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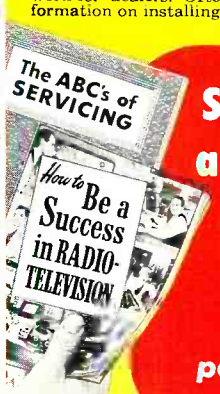

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High Vacuum Triode Ionization Gauges

By
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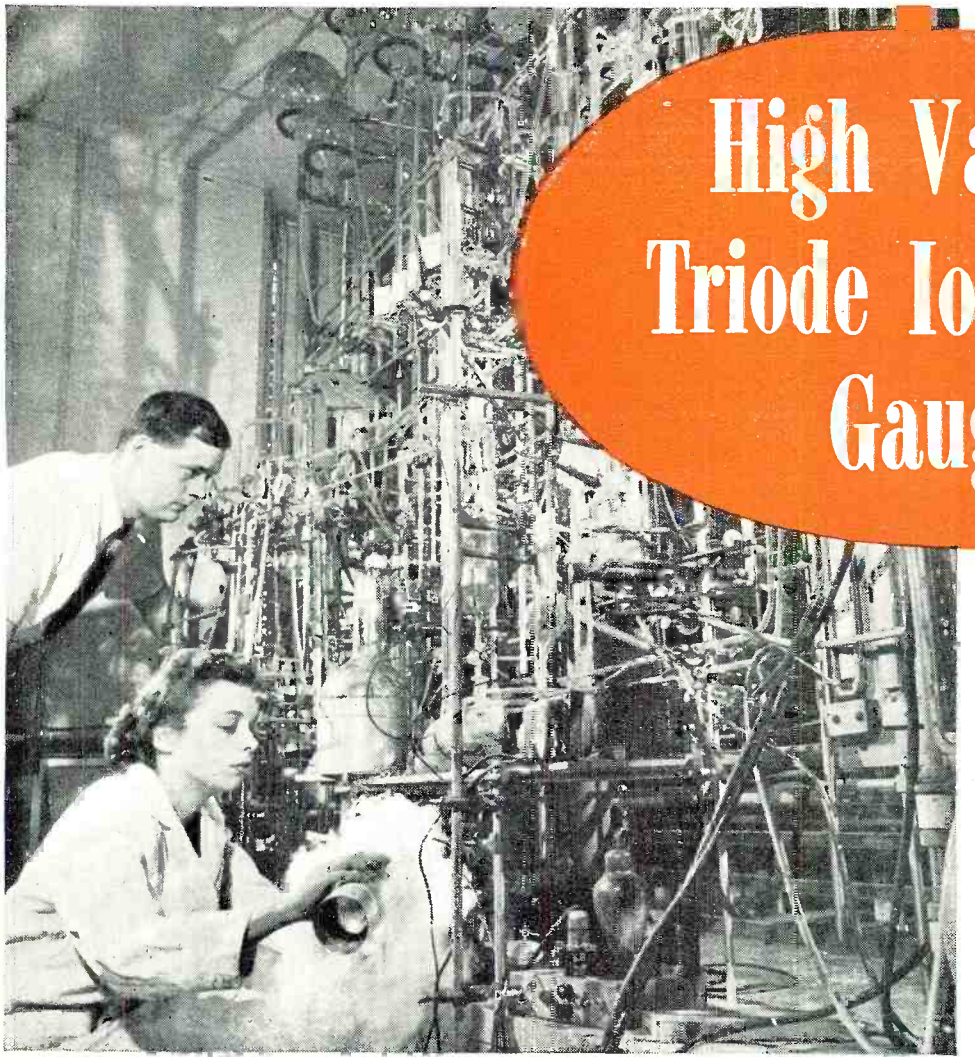


Fig. 1. Vacuum systems and tubulation for converting coal into gasoline.

The familiar radio tube, with modifications, is performing miracles in today's chemical industry.

WHEN a triode vacuum tube is equipped with a glass tube for the introduction and removal of gas, and for the control of the vacuum within a tube, it is differentiated from tubes used for communication purposes by the designation "ionization gauge." This type of operation requires, of course, that the glass envelope and tubulation be connected to a vacuum pump system in order to reduce the internal pressure sufficiently so that the filament will not burn out when energized.

The mere addition of the glass tubulation to conventional or more ideally designed vacuum tubes opens up new horizons in the fields of chemistry and nucleonics. It extends vacuum measurements to regions of much higher vacuum than is feasible by any other method. Despite the simplicity and economy of this method, it makes possible the measurement of pressures that are less than a billionth of an atmosphere!

Fig. 2 shows the physical construction of the Type HK-5989 (VG24G) Gammatron ionization gauge. It is identical in every way to the Type HK24G Gammatron triode widely used in radio communication equipment except for the addition of a glass tube extension on the envelope. The Type HK-5988(VG2) Gammatron ionization gauge is similar to one above with the exception of tubulation brought out of the bottom.

Fig. 4 shows a typical circuit arrangement and potentials employed in the case of these two ionization gauges. A triode ionization gauge has the following electrode conditions:

1. *Filament or Electron Generator* to emit electrons. The filament voltage is varied from zero upward to 5 volts with the typical operating voltage being about 3.5 volts. The filament has minimum time lag or response during changes in filament voltage because it is constructed so as to possess minimum mass.

2. *Grid or Electron Accelerator* to accelerate and capture electrons. The grid is always biased highly positive in a triode ionization gauge. It is designed to function with 300 volts positive bias. The grid current is adjusted by variation of the filament voltage.

3. *Plate or Ion Collector* to capture positive ions. The important consideration in any triode ionization gauge is the capture of positive ions by the negatively biased plate. Instead of high positive bias used with tubes in communication work, the plate of a triode ionization gauge may function at 60 volts negative. A microammeter in series with this negatively biased plate gives a direct measure of the number of ionizing collisions, and/or the pressure of the gas molecules within the tube envelope.

The electron flow from the filament to the highly positive grid or accelerator and beyond in the direction of the negative plate, produce collisions and ionization of the gas molecules in the tube envelope. Such gas molecules are thereby charged and become positive ions which are attracted to the negatively biased plate to provide an indication on the microammeter which is in series with the plate.

A positive ion is an atom which has lost one or more of its normal complement of electrons. This can occur when electrons in the outer orbits of the atom's nucleus are subjected to heat, collision, or impact. While this does not alter the nature of the atom, it definitely alters its electrical property and frequently the chemical property. The atom is then said to be *ionized* and has become an *ion*. It is a positive ion, as required here, when it has lost an electron. Thus the previously neutral atom has become unbalanced by virtue of its having become less negative or more positive in its over-all electrical charges. It would be a negative ion if it had gained an electron. Every atom of every mole-

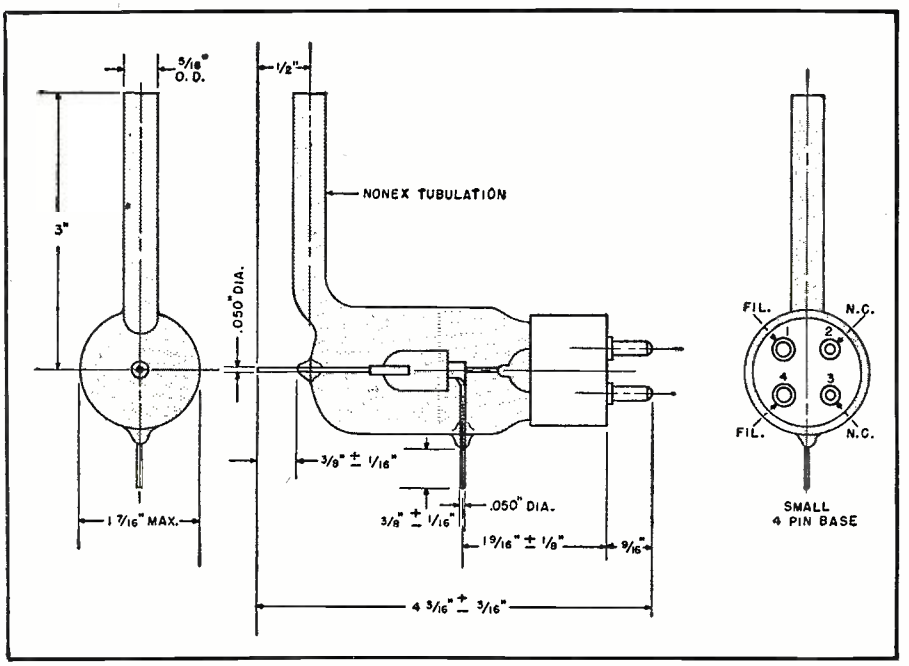


Fig. 2. Typical triode ionization gauge with tubulation from top of glass envelope.

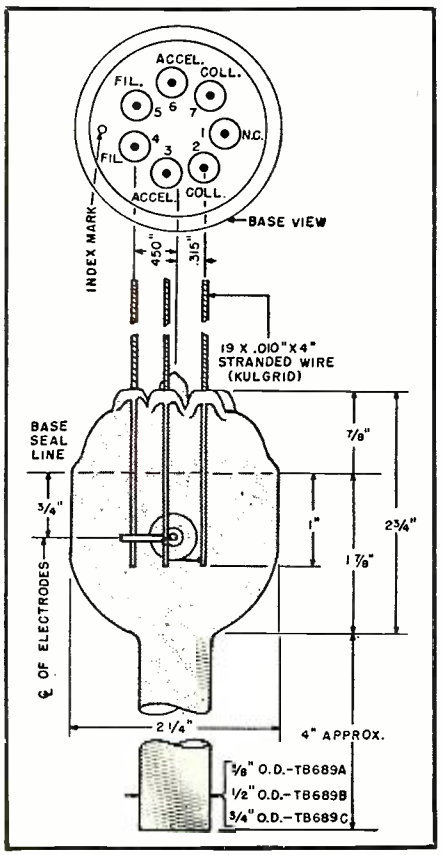
cule is normally balanced with positive, negative, and neutral particles. To become a positive ion which can be attracted to the negative plate or ion collector, it must lose one or more electrons so that the balance is disturbed, creating an excess of positive charges. The mere loss of a single electron is sufficient to make any neutral or balanced atom become a positive ion which can be captured by the negatively biased plate and thus be made to contribute to the microammeter reading.

When ions are created they try to regain their balance and become neutral atoms. The positive ions attract electrons while the negative ions repel electrons. This phenomena of gaining or losing electrons is known as ionization. In the triode ionization gauge, the positive ions are repelled by the positively biased grid and attracted by the negatively biased plate. The grid and plate, by the polarity and magnitude of biasing voltages employed (plus 300 on the grid and minus 60 on the plate), facilitate this action. Different values of electrode voltages can be chosen to modify the sensitivity of response for the measurement of various pressures.

In the initial flight of electrons from the filament, most of them miss the grid. Their momentum carries them towards the negative plate which repels the negative charges and drives them back to the positive grid. Some of these electrons are caught directly while others make several oscillations about the grid before being captured. These various electron paths ionize gas molecules encountered in the course of impact. Such molecules, now converted into positive ions in the grid-plate area, are unwelcome to the positive grid yet are highly attractive to the negative plate.

High sensitivity of the ionization gauge is obtained by the use of sufficiently high positive bias on the grid (up to 300 volts) and a less highly biased plate of reversed polarity (negative 60 volts). The electrons overshooting the grid and repelled by the plate behave in a fashion similar to the Barkhausen Kurz or the reflex klystron techniques known to the microwave art since they may oscillate around the grid several times before being captured by the grid. This increases the electron paths and the likelihood of collision with gas molecules within the tube envelope. The filament of the tube is operated below its normal rating as a communication component in order to permit temperature-limiting of the emission.

Fig. 3. Modern ionization gauge with degassing provisions for evolution of gas after each usage and with cup-shaped electrode support at the extremities for preventing interelectrode leakage paths.



Degree of Vacuum

High vacuum means low pressure. In practice, the pressure within the tube envelope is reduced to less than 10^{-3} millimeters of mercury. Normal atmospheric pressure (14.7 lbs. per square inch) corresponds to 760 millimeters of mercury. The transposition between millimeters of mercury and pounds per square inch can be derived from the following computation for the above numerical values.

$$\frac{760 \text{ mm. of mercury}}{14.7 \text{ lbs./sq. in.}} = \frac{10^{-3} \text{ mm. of mercury}}{X \text{ lbs./sq. in.}}$$

$$X = \frac{14.7 \times 10^{-3}}{7.6 \times 10^{2}}$$

$X = .0000193$ lb./sq. in. atmospheric pressure.

This means, in practice, that the interior of the tube envelope operates at not less than .0000193/14.7 part of atmospheric pressure. The internal pressure is less than a millionth part of the external pressure of a vacuum tube.

The general range used for high vacuum triode ionization gauges extends from about 10^{-3} to 10^{-8} millimeters of mercury. Its lowest limit of vacuum or upper limit of pressure within the tube envelope is the point where a glow will be visible. If permitted to operate at that low order of vacuum, the filament might burn out due to oxidation. Its highest limit of vacuum or lowest limit of pressure within the tube envelope depends only on the smallest positive-ion current which can be measured. This will depend upon the leakage resistance between the electrodes within the triode tube. The vacuum tube serves as an extraordinarily sensitive ionization gauge or device for measuring conditions of vacuum in the order of one million to many billions times greater than existing in air.

Gas Contamination

Proper functioning of the tube requires that the electrodes be free from gas content that could be evolved under operating conditions and thus produce improper readings of the pressure. Except where special provisions have been made, as in the case of the Type HK-5991 (VG100) illustrated in Fig. 3. evolution of gas is greatly minimized by the use of tantalum or nickel. Both of these metals have low internal gas content when properly treated. Table 1 compares the types of ionization gauges now in standard production.

In order to remove gas and surface contaminants from the nickel electrodes, as used in the Type HK-5988 (VG2) ionization gauge, they are heated during the manufacturing process to a high temperature (close to their melting point) in a hydrogen atmosphere. The hydrogen excludes oxygen from the metal and eliminates the possibility of oxidation during the heating process.

In the case of tantalum electrode tubes, such as the Type HK-5989 (VG24G) and the Type HK-5990 (VG54), they are handled in the same manner as their conventional communication counterparts as far as exhaust techniques are concerned. The elements are heated to high temperatures in a vacuum to evolve the gas that is trapped in the metal.

The Type HK-5991(VG100) triode ionization gauge illustrated in Fig. 3 is able to provide a more accurate reading because of the special provisions for insuring that the elements within the glass envelope are free from gas each time it is used. This version of the triode ionization gauge was specifically designed for high vacuum measurements and does not have a communication equivalent. Every element can be outgassed by means of separate connections at opposite ends of each element or electrode. Two available connections to each element make it possible to connect an electrical current in a closed circuit. Thus, each element may be separately heated.

All the electrodes in this ionization gauge are made of helical tungsten which is capable of withstanding much abuse. The simplicity of the degassing process and the use of "hard glass" (*Nonex*) permits the bulb to withstand the "bake out" process for stabilizing its operation.

Outgassing Procedure

To insure proper operation, the tube envelope is heated by an oven or flame at the time of manufacture. This heating is confined to a temperature below the point where the envelope would deform inward by virtue of the vacuum inside. This process is designed to vaporize contamination on the inside wall of the glass. This vaporized material is then pumped out.

Next, the filament is heated to a temperature above normal, such as 2500 degrees Centigrade or within about 300 degrees of the burnout point. This causes sputtering or evaporation of the metal. This sputtering or evaporation causes an undesirable metalized film to form on the inside of the glass envelope and between the electrodes unless special precautions are taken in the design of the tube to prevent it. Without these precautions, leakage paths will exist from the cathode to the plate, between the electrodes, and along the inner surface of the glass envelope. This would result in current path losses that would exceed or mask the ionization current through space in the envelope, particularly at low pressures. This effect also occurs, to a lesser degree, throughout the life of the ionization gauge.

One way of minimizing such losses is to place small discs around the support mounts of the electrodes. These discs serve as metal baffles to cause shadowing around the base of the electrode supports so that there will be no metalized film around the point where the support goes through the glass bulb. In the case of the Type HK-5991 (VG100) shown in Fig. 3, special precautions have been taken in the design so that baffle plates are unnecessary. Cup shaped recesses are provided at the base of the glass envelope for each electrode support connection. In this particular type these electrode support connections also form the heating circuit for degassing the electrodes. The use of the cup shaped recesses eliminates the need of baffle plates, thereby reducing the amount of metal inside the tube. The less metal used, the less possibility of malfunctioning especially when no provision has been made for removing gas trapped in such metal. These recesses, at the points where the electrode supports emerge, are so shaped that the sputtering will land on the sides rather than the trough or base of each cup. Thus the shape of the cup controls the area where the vaporized metal can strike and is so designed that the matter will clear the region where the tungsten electrode supports come through the glass.

Tubulation

The larger the tubing attached to the ionization gauge, the more rapidly will the gauge follow changes in pressure in the vacuum system. Fig. 3 shows the three standard tubulation sizes in which the Type HK-5991 (VG100) is manufactured. This offers the user a selection to fit his existing manifold tubing size. The rate of flow of gas through any orifice is proportional to the cube of the radius of the tubulation.

An ionization gauge is a triode. There is no practical advantage in using more than a triode structure. The optimum arrangement is when the tube is placed closest to the point in the vacuum system where the pressure is to be measured. Larger tubulation minimizes the possibility of pressures varying in a vacuum system of extended length. Some systems where critical measurements are required may employ several ionization gauges around the system to detect variations at different points in the over-all system.

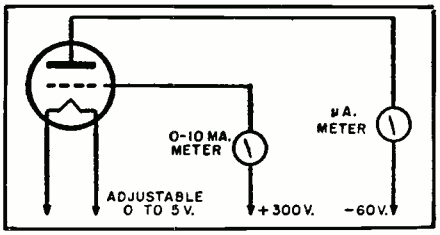


Fig. 4. Typical circuit and potentials for triode ionization gauge.

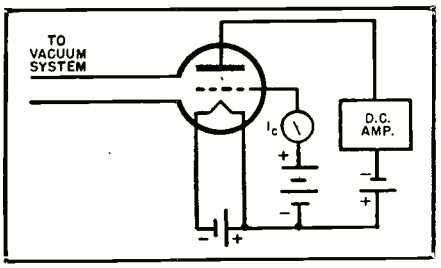


Fig. 5. Triode ionization gauge circuit utilizing a d.c. amplifier for measurement of a trillionth of an atmosphere.

Extending Measurements

When the microammeter used to measure the positive ion current in the plate circuit has to work with extremely small values such as 10^{-4} microampere, a d.c. amplifier must be added. Fig. 5 shows such an arrangement. The amplifier must have a known amplification range. The microammeter in the plate circuit reads the positive ion current which is directly proportional to the pressure in the sys-

Table 1. Comparison of characteristics of the various types of ionization gauges.

	HK-5988 (VG2)	HK-5989 (VG24G)	HK-5990 (VG54)	HK-5991 (VG100)
Comparable communications triode	Similar to HK-24 in appearance but redesigned	HK-24G	HK-54	Special
Plate (Collector)	Cylindrical Nickel	Cylindrical Tantalum	Cylindrical Tantalum	Helical Tungsten
Grid (Accelerator)	Vertical Bar Nickel	Vertical Bar Tantalum	Vertical Bar Tantalum	Helical Tungsten
Filament (Emitter)	Thoriated Tungsten	Thoriated Tungsten	Thoriated Tungsten	Helical Tungsten
Maximum Height	3 7/16" exclusive of tubulation (as required)	4 3/8"	5 5/8"	6 3/4"
Maximum Diameter	1 7/16"	1 7/16"	2 1/8"	2 1/4"
Tube Base	None	Small 4-pin	Medium 4-pin ceramic	None
Filament Rating	6.3 v. @ 3.6 amps.	6.3 v. @ 3 amps.	5 v. @ 5 amps.	.....
Circuit Potentials				
Filament	0-5 v.	0-5 v.	0-5 v.	0-4 v.
Plate	—60 v.	—60 v.	—60 v.	—60 v.
Grid	300 v. plus	300 v. plus	300 v. plus	300 v. plus
Sensitivity in μv./micron	25 for 5 ma. grid current	50 for 10 ma. grid current	200 for 5 ma. grid current	75 for 5 ma. grid current

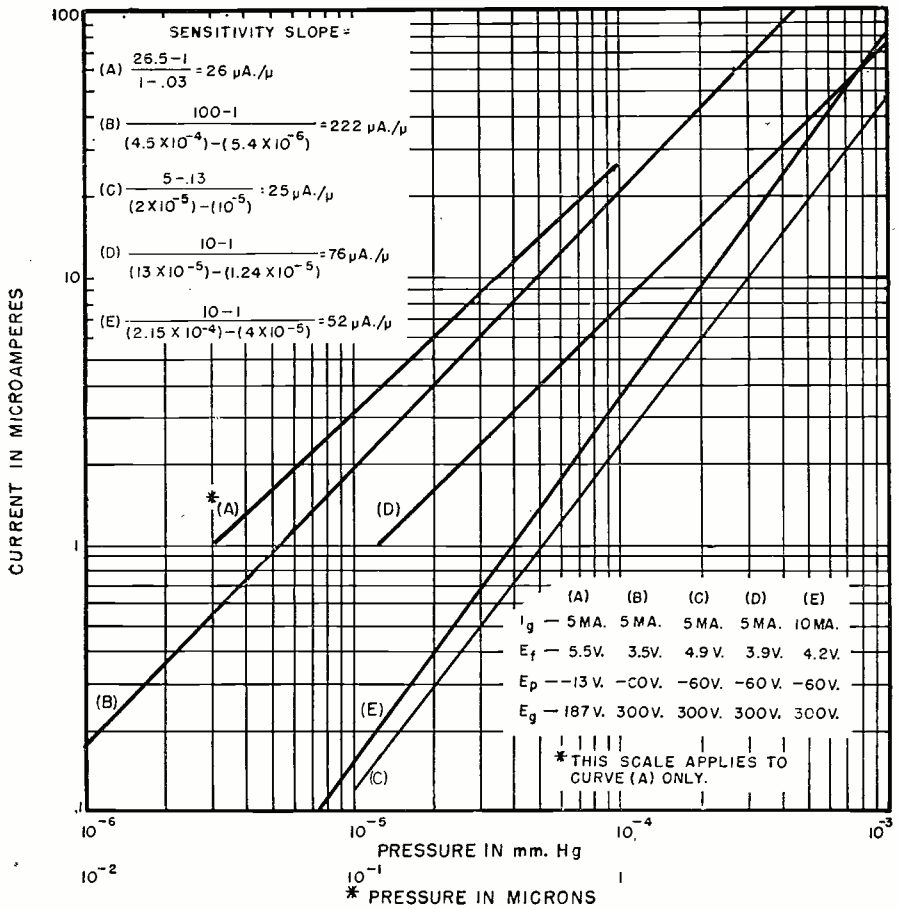


Fig. 6. (A) Plate current vs. pressure for Type HK-5991 (VG100) triode ionization gauge with increased filament voltage and reduced plate and grid voltages. (B) Plate current vs. pressure for the Type HK-5990 (VG54). (C) Plate current vs. pressure for Type HK-5988 (VG2). (D) Plate current vs. pressure for Type HK-5991 (VG100) with decreased filament voltage and increased plate and grid voltages. (E) Plate current vs. pressure for the Type HK-5989 (24G) triode ionization gauge.

tem. The pressure is an indication of the density or quantity per unit volume of the gas within the tube or ionization gauge envelope.

The grid milliammeter is adjusted to a predetermined value by varying the filament voltage. It shows the grid current for the electron flow. The meter scale has a range of 0-10 milliamperes.

The sensitivity of the ionization gauge varies with the voltages used on the elements. It is directly proportional to the negative voltage on the plate, within limits. It is also proportional to the positive voltage on the grid. The latter is not a linear function as in the case of the plate.

An alternative to a d.c. amplifier is the use of a very sensitive galvanometer. This is costly, fragile, and subject to damage because of gas bursts or leaks. Its supersensitivity, leveling, static charges in the meter movement, etc., make it more difficult to operate.

Ionization gauges may be calibrated against the *McLeod* gauge. This is a special mercury manometer which compresses a gas sample of the pressure to be measured at a known volume ratio. The pressure is increased, in inverse ratio, to a point where it is great enough to be measured by direct observation.

Fig. 6A is a graph of plate current *versus* pressure for the Type HK-5991 (VG100) tube for a grid current of 5 milliamperes, a filament voltage of 5.5 volts, a plate voltage of minus 13 volts, and a grid voltage of plus 187 volts. Fig. 6D shows the same graph but with reduced filament voltage and increased plate and grid voltages (filament 3.9 v., grid 300 v. plus, and plate 60 v. minus).

Fig. 6E shows the plate current *versus* pressure for the Type HK-5989 (VG24G) ionization gauge tube operating at 10 milliamperes grid current, 4.2 volts on the filament, 300 volts positive on the grid, and 60 volts negative on the plate.

Fig. 6B shows the plate current *versus* pressure for the Type HK-5990 (VG54) tube operating at 5 milliamperes grid current, 3.5 volts on the filament, plus 300 volts on the grid, and minus 60 volts on the plate.

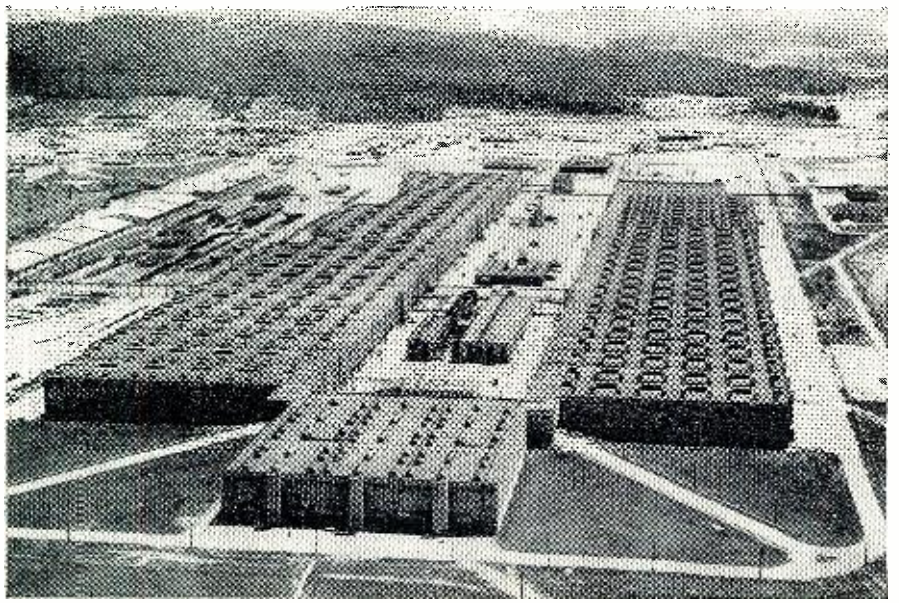
Fig. 6C shows the plate current *versus* pressure for the Type HK-5988 (VG2) ionization gauge tube operating 5 milliamperes on the grid, 4.9 volts on the filament, plus 300 volts on the grid, and minus 60 volts on the plate.

Fig. 1 shows the maze of vacuum systems and tubulation used in a modern petroleum laboratory. Fig. 7 shows the Gaseous Diffusion Plant at the Atomic Energy Project at Oak Ridge where applications of ionization gauges are unlimited. Other important users include the fields of photography, optics, distillation, vacuum tube manufacturing, motion pictures, medicine, fuels, upper atmosphere research, and metallurgy. Its use in gas analysis and as a leak detector for general industrial use has also become important.

Electronic methods for high vacuum measurement are now the preferred technique and the triode vacuum tube with glass tube extension is the best electronic method. These units, used as ionization gauges, cost only slightly more than their communication counterparts.

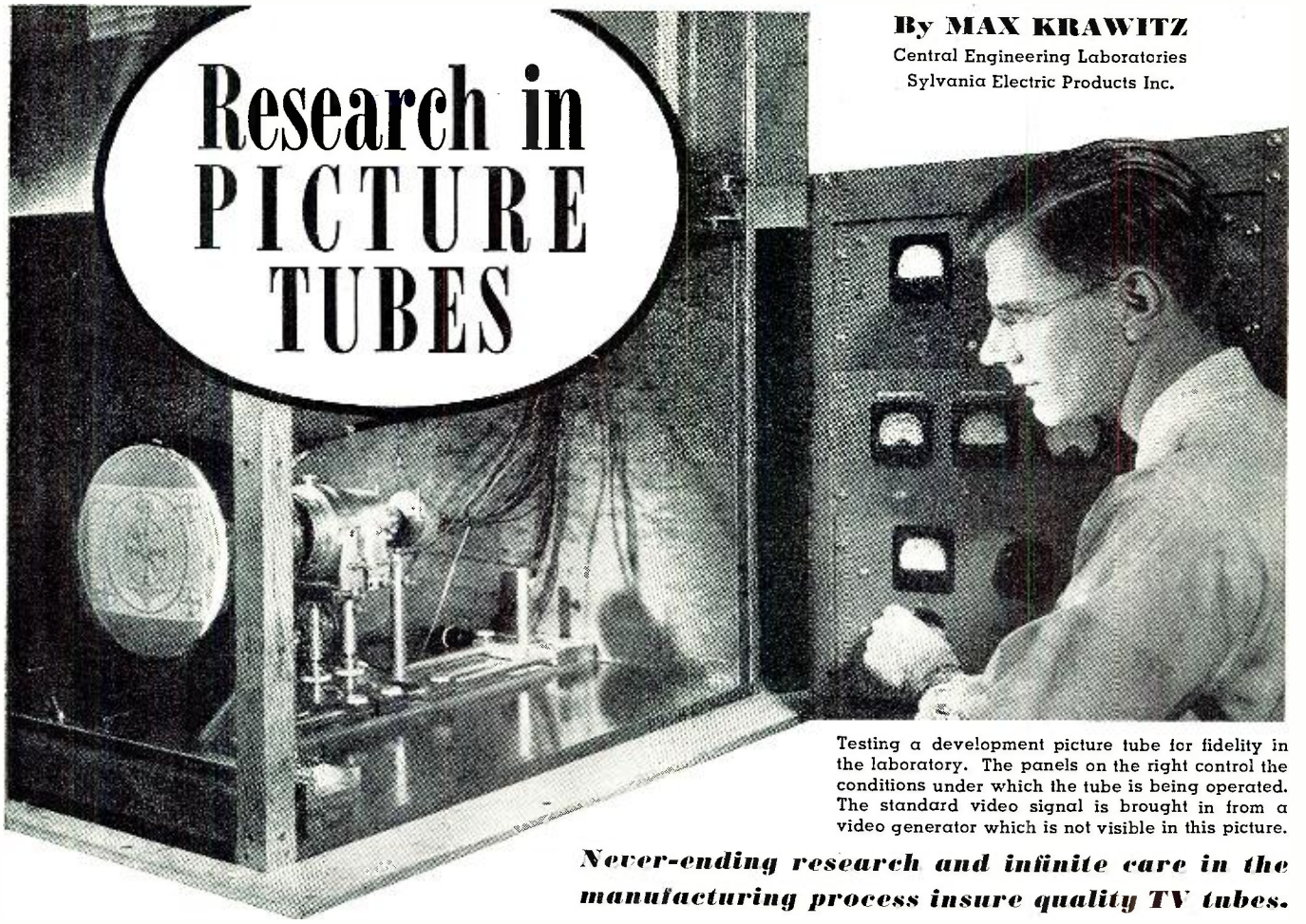
Those interested in a general analysis of ionization gauges are referred to the book "Vacuum Tubes" by Karl R. Spangenberg (*McGraw-Hill Book Co.*). Additional data is also obtainable from the *Heintz & Kaufman Division* of the *Robert Dollar Company,* Redwood City, California. —30—

Fig. 7. Gaseous Diffusion Plant at Oak Ridge where ionization gauges play a major role.



Research in PICTURE TUBES

By MAX KRAWITZ
Central Engineering Laboratories
Sylvania Electric Products Inc.



Testing a development picture tube for fidelity in the laboratory. The panels on the right control the conditions under which the tube is being operated. The standard video signal is brought in from a video generator which is not visible in this picture.

Never-ending research and infinite care in the manufacturing process insure quality TV tubes.

CONTINUAL improvement in television reception and reduced cost are the goals of picture tube research. Research engineers at the *Sylvania Electric Products Inc.*'s Physics Laboratories in Bayside, New York, rely on the contributions of many different fields in the never-ending search for better methods of making picture tubes. Electronics, chemistry, physics, metallurgy, optics, mechanics, and many others contribute fully to the research program.

The construction of picture tubes represents one of the most advanced phases of vacuum tube design and a brief description will give an appreciation of some of the many techniques, processes, and materials involved.

There are three major sections in a picture tube, the electron gun including the focusing and deflection unit (which in some cases may be external to the tube), the fluorescent screen, and the envelope. Each of these sections entails certain specific problems whose solution must be integrated into the over-all design.

The accuracy with which the electron gun is made determines, to a very large extent, the quality of picture produced. Many dimensions and the roundness of the cylinders in the gun must be held within very close tolerances so that the spot size on the screen will be small enough to give the required degree of resolution for satisfactory pictures. In addition to the requirement for closely held dimensions, the parts must not be deformed during processing where temperatures hot enough to soften many metals are encountered.

Another complicating factor is that the path taken by the electrons as they leave the gun is affected to a considerable extent by the magnetic or electric fields present. Thus great care must be exercised to be certain that only the proper fields exist in the vicinity of the electron stream. This also requires that certain dimensions be held very closely and, in addition, necessitates the use of a special non-magnetic stainless steel for the gun elements.

The use of 15,000 volts in many picture tubes imposes severe problems of insulation. Spacings are very small and the several elements must be assembled into a single rigid mechanical structure making insulation a problem of first importance. This has been solved by using ceramic or glass, both of which have high insulating properties, to support and separate the various parts.

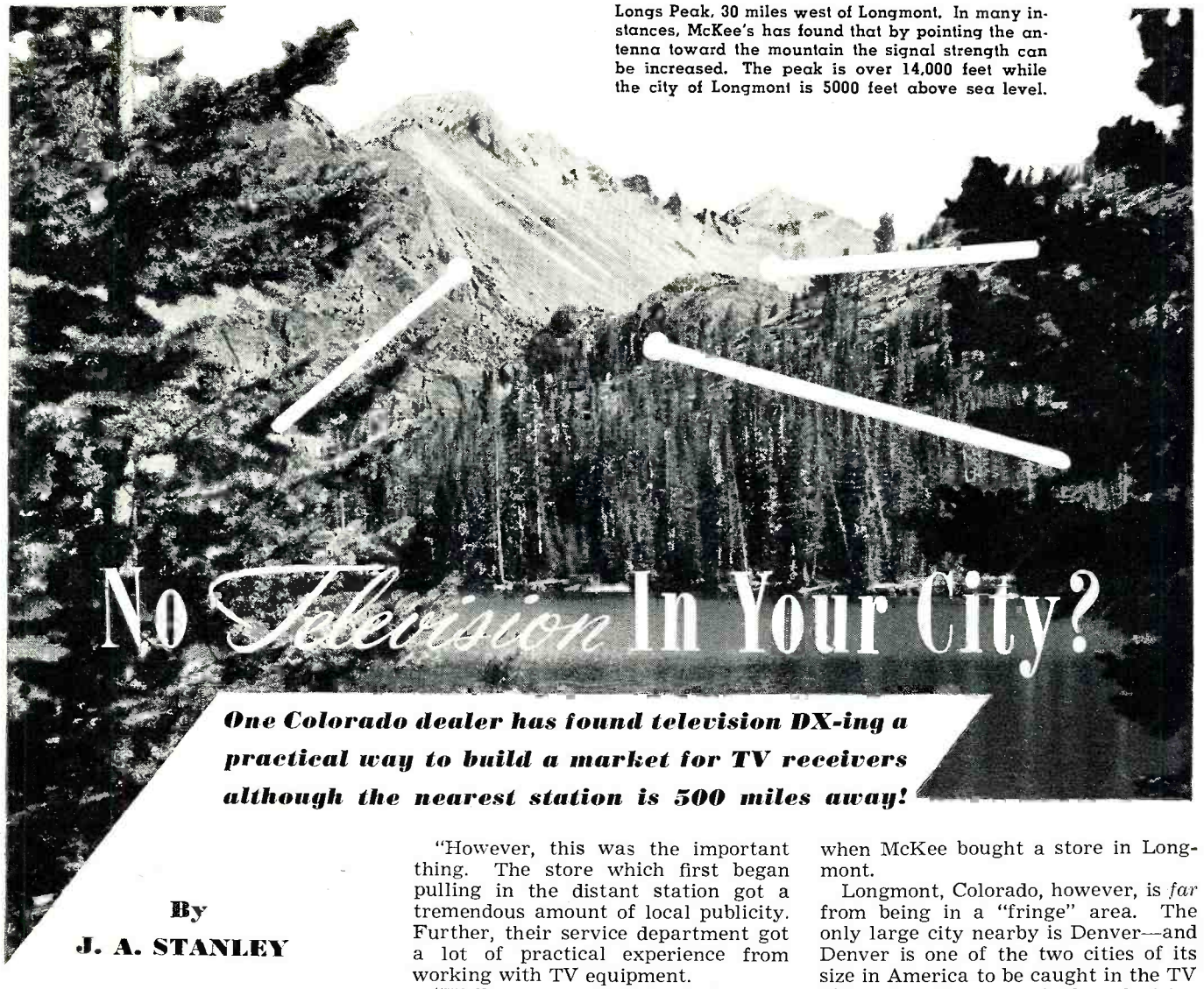
The glass bulb is usually received from the glass company in its finished form. In metal-glass tubes the glass face plate is sealed to the metal cone in the laboratory, or on the production line in the factory. In either case the bulb is very carefully washed and rinsed to remove all traces of foreign matter.

The fluorescent screen phosphor is deposited on the face plate in the following manner. A suspension of triple distilled water and finely divided phosphor powder, together with a bonding agent, usually a silicate which will cause the powder particles to adhere to each other and to the glass face plate, is prepared. After the cleaned bulb has been dried and placed face down on a settling rack, the suspension is poured into the bulb and permitted to settle. After the phosphor powder has settled to the bottom the water is poured very slowly and carefully from the bulb. This is done in a tilt table. Care must be exercised in this operation because the bonding of the powder to the glass has not been firmly established at this point in the production process.

The phosphor, bonding agent, and the water must be of extreme purity since very small traces of foreign matter (often on the order of one part in a million) may cause a variation in the color of the screen or a considerably reduced light output.

In the case of all-glass tubes the conducting coating, a graphite suspension in water, is then applied to the internal walls of the bulb. Care must be taken in order to avoid contamination of the screen. The bulb is then baked at a high enough temperature to drive off the water and to effect adherence of the graphite and screen to the glass.

(*Continued on page* 103)



Longs Peak, 30 miles west of Longmont. In many instances, McKee's has found that by pointing the antenna toward the mountain the signal strength can be increased. The peak is over 14,000 feet while the city of Longmont is 5000 feet above sea level.

No Television In Your City?

One Colorado dealer has found television DX-ing a practical way to build a market for TV receivers although the nearest station is 500 miles away!

By
J. A. STANLEY

LONGMONT, Colorado—a pleasant little city about thirty miles due east of famed Longs Peak—is over 500 miles from the nearest television station. But that hasn't prevented *McKee's Modern Home Center*, an appliance store right on Main Street, from erecting a television antenna, installing a receiver, and actually receiving television signals.

As a matter of fact, Lawrence Pickerell, technician for the store, has logged twenty-four stations, and is adding new ones regularly. Howard McKee, the owner, says that television DX-ing will pay off businesswise—and has had previous experience to prove it.

McKee and Pickerell were associated in another appliance store in Iowa, and that is where the story begins.

"A station with TV came on the air over a hundred miles away," says McKee. "One was due to be built which would be a lot closer. But instead of waiting for it—one store in town went right to work doing everything they could to pick up the 'fringe' station.

"Naturally, reception wasn't good at times. But at other times it was OK.

"However, this was the important thing. The store which first began pulling in the distant station got a tremendous amount of local publicity. Further, their service department got a lot of practical experience from working with TV equipment.

"Well, as was expected, a TV station was finally built close by, and long distance reception was no longer necessary. But when TV sets began to sell in the town, the store which had become known locally as 'the television store' wound up with a lion's share of the TV set business."

Having watched all of this work out in Iowa, McKee and Pickerell decided to follow the same plan in Colorado, when McKee bought a store in Longmont.

Longmont, Colorado, however, is *far* from being in a "fringe" area. The only large city nearby is Denver—and Denver is one of the two cities of its size in America to be caught in the TV "freeze" *without* a single television station.

The nearest TV station is in Omaha, Nebraska—over 500 miles away. It all looked pretty hopeless but "Pick" and McKee decided to give it a whirl anyway.

They decided that despite the distance Omaha was probably the best bet, so they bought a stacked array cut for Channel 6, and fitted it with a rotator. Then they added an *Anchor* booster to their *Sentinel* receiver and they were ready to go.

In the Spring of 1950 they began to receive stations with increasing regularity in the season which Pick says corresponds roughly to the "short skip" season on the 10 meter band. During '50, the best times of day were the noon hour, from 5:00 to 6:00 p.m., and from 8:30 on in the evening. During '51, 8:00 a.m. and early afternoon were the best, with no late evening reception.

Reception during '51 was not as good as in '50, again corresponding to the short skip activity on the 10 meter band.

Approximately 25 per-cent of the stations are received with "program quality." Another 50 per-cent of the stations are of passable quality, good

Table 1. Log of TV stations received in Longmont, Colorado, at McKee's Modern Home Center. TV DX-ing has paid off handsomely.

City	Station	Channel
Birmingham	WBRC	4
Hollywood	KTSL	2
San Francisco	KRON-TV	4
Atlanta	WAGA-TV	5
Chicago	WNBQ	5
Chicago	WBKB	4
Louisville	WAVE-TV	5
Detroit	WJBK-TV	2
Minneapolis	WTCN-TV	4
Kansas City	WDAF-TV	4
Omaha	WOW-TV	6
Albuquerque	KOB-TV	4
Charlotte	WBTV	3
Greensboro	WFMY-TV	2
Cincinnati	WLW-T	4
Columbus	WLW-C	3
Memphis	WMCT	4
Nashville	WSM-TV	4
Dallas	KRLD-TV	4
Houston	KPRC-TV	2
Salt Lake City	KSL-TV	5
Seattle	KING	5
Milwaukee	WTMJ	3
Rock Island	WHBP	4

enough to allow identifying test patterns readily. The remaining 25 percent are pretty rough going, with lots of "snow" and intermittent reception.

"Pick" wondered if nearby Longs Peak, which is over 14,000 feet high and is surrounded by other high mountains, was helping reception along. In 1950 he was about convinced that it was, for in nearly every case reception was better with the antenna pointed *at the mountain*—regardless of the actual direction of the station from Longmont. But this phenomena was not apparent in most of the reception in 1951, so "Pick" hasn't reached any definite conclusions regarding it.

Another interesting phenomenon occurred one day when the antenna was pointed away from the station. A bit of looking out-of-doors revealed a large, black cloud—toward which the antenna was pointed. Turning the antenna away from the cloud made the station fade out completely.

The equipment used for reception is all standard. "Pick" has grounded the a.g.c on the TV receiver to improve contrast, but otherwise the set is an ordinary TV receiver. The location is right in the heart of the business district, on a street which is also a highway, so receiving conditions are far from ideal. "Pick" is working on a neutralized 6J6 booster, which he hopes will improve signal-to-noise ratio.

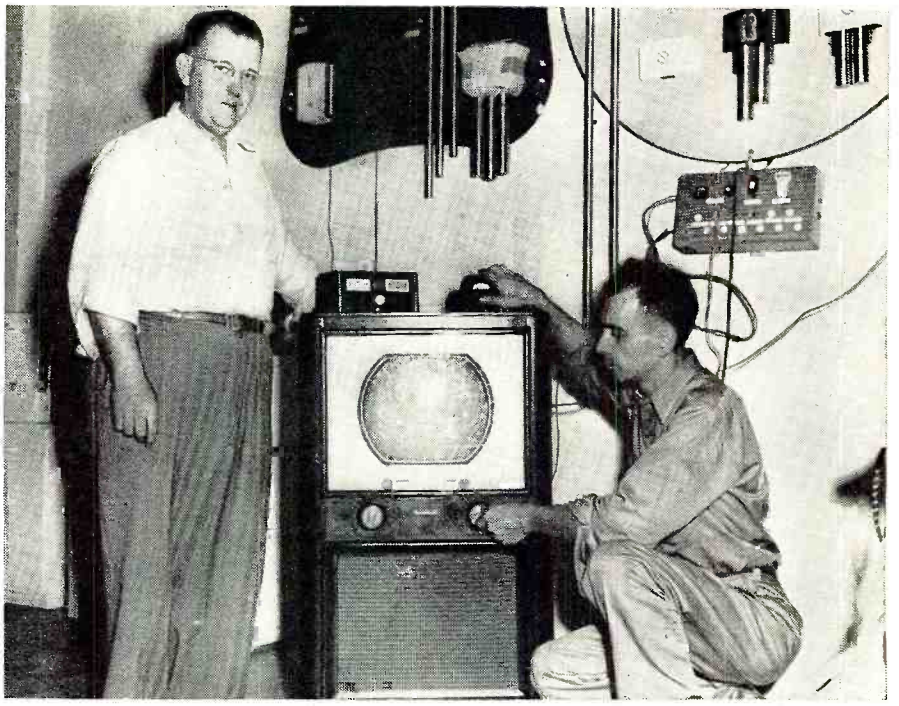
Checking over Pickerell's log (see Table 1) shows that despite the fact that the antenna is cut for Channel 6, most of the reception is on Channels 2, 4, and 5. The most consistent station, and the one with the best signal, is KPRC in Houston, Texas. Pickerell watched the MacArthur broadcast from this city, a broadcast which was "program quality" all of the way.

Will TV DX-ing pay off for the store? It is pretty hard to answer that question now, of course. However, there is no question but that having a TV set to work with—and maintain—is giving McKee's a jump on competitors when it comes to practical experience. Chances are good that the TV DX-ing will do the job of identifying the store with TV.

At any rate, the first place where the writer stopped to track down the rumor that someone in Longmont was receiving TV, a man behind the counter knew all about it.

"Go down to McKee's on Main Street," he told me. "*They're* the television store in Longmont."

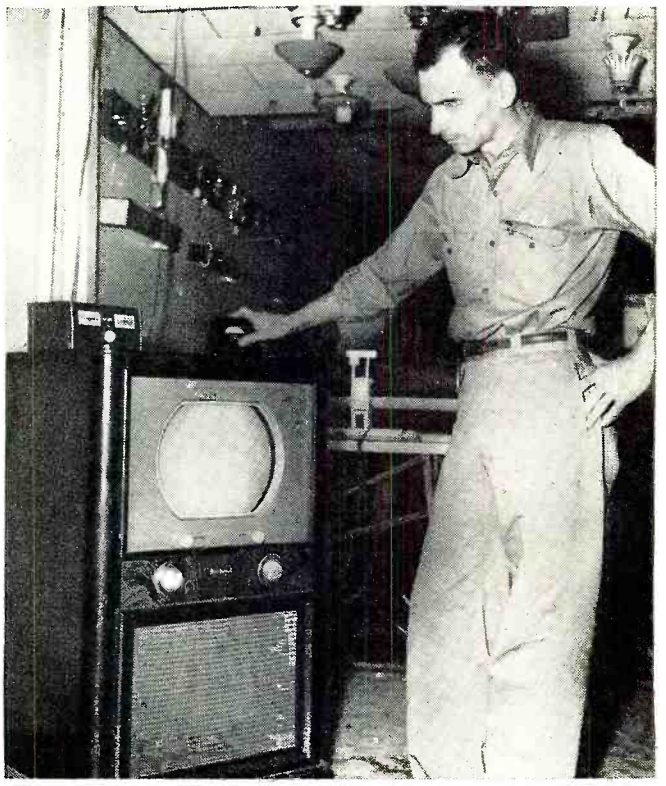
—30—



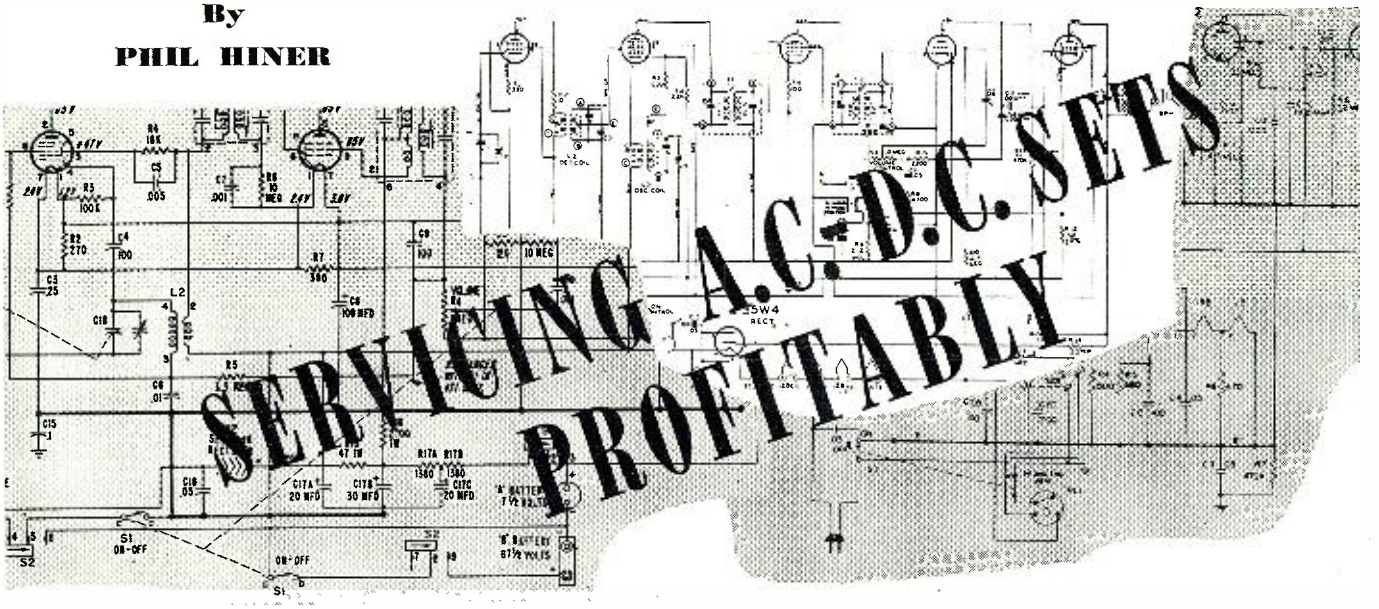
Howard McKee (left) of McKee's Modern Home Center believes that television DX-ing will pay off in future business—and he has had previous experience to prove it.

This stacked television array, mounted on the roof of McKee's Modern Home Center in Longmont, Colorado, has pulled in television stations from as far away as Charlotte, North Carolina.

Using this equipment, Lawrence Pickerell has logged a total of 24 television stations—all from Longmont, Colorado, which is over 500 miles from the nearest television broadcasting outlet.



By
PHIL HINER



Here is one technician who maintains that there is money to be made from well-planned a.c.-d.c. repairs.

WITH the current emphasis on television, the lowly a.c.-d.c. set is overlooked by many technicians as a potential money-maker. The average radio-television shop receives for repair each day nearly twice as many a.c.-d.c. sets as the combined total of large radios, TV, and phono combinations. This ratio is not apt to change appreciably during the next few years.

Time is money in the servicing game. The few dollars you pick up on an a.c.-d.c. repair may look like pocket change compared with a TV overhaul bill but if the time factor is right, your small set hourly-net can actually be greater.

In our shop we have developed over a period of time an assembly-line handling of the a.c.-d.c. set that has made it the most profitable item to come through our doors. The procedure is simple and practical and can be set up in any shop, whether large or small.

As all technicians know, the a.c.-d.c. set follows a pattern of design and construction that varies but slightly, year after year, regardless of tradenames or advertising claims. Its trouble shooting is extremely simple. Nine out of ten small sets that come in for repair need only a tube or a condenser to bring them back to life. However, at least seven out of the ten sets could be vastly improved by the replacement of worn parts, functioning at 50 percent efficiency, other than the one part that brings it back to life. The public seldom takes a radio into a shop with orders to, "Check her over and give her the works," as is common with the automobile, but waits until the set is wheezing like a 1902 gramophone or has actually expired.

In our small set repair line every operation is tailored to eliminate lost motion while doing a thorough job. The test instrument setup is built around an isolation transformer with a switch-controlled, multi-tapped secondary that selects the transformer output voltage within a range of 85 to 150 volts. The set under test is plugged into the isolation transformer and the transformer is plugged into the wattmeter outlet of an *RCA* "Chanalyst." The time-saving features of a variable input voltage in troubleshooting would in themselves furnish material for a complete article. A second very important feature of the setup lies in the fact that with the set under test plugged into an isolation transformer, the a.c.-d.c. "hot" chassis annoyance is avoided.

Without undergoing any preliminary checks, each chassis is removed from its cabinet and energized through the test panel. Response of the "Chanalyst" wattage indicator tells immediately, in one operation, whether or not:

a. The rectifier circuit is functioning.
b. A "B-plus" short exists.
c. The filament circuit is open.
d. The filament circuit is intermittent.

An intermittent filament is often a tricky defect to isolate but with the test described above, shadow flutter of the electron ray wattage indicating tube gives a positive, unmistakable indication of any momentary break in the circuit.

If the filament circuit is OK, a visible increase in wattage after a thirty second warm up indicates that the rectifier is delivering d.c. to the plates of the tubes. An abnormal increase in wattage after a thirty second warm up indicates a "B-plus" short. If the filament circuit is open, immeasurable time is saved each day by locating the bad tube with an ohmmeter filament check rather than by pulling the tubes and going through the time-consuming tube checking procedure. The pros and cons of a 100 per-cent tube check will be discussed later.

The nine sets out of ten that require only the usual uncomplicated repairs, we troubleshoot with the usual methods, using the *RCA* "Chanalyst," a *Du Mont* scope, a *Hickok* signal generator, and a shop-built vacuum-tube voltmeter and signal tracer. That one set in ten that keeps the life of a technician from being all sweetness and light, we do not complete on the repair line but lay aside.

If yours is a one-or two-man establishment, it is still just as important that you tackle the obstinate jobs later, rather than break into the smooth running routine of an assembly line operation. We might mention also, from long experience with technicians, that the frustration that accompanies an unsuccessful effort over too long a period of time may well ruin a man's productivity for an entire day. Lay it aside! The tough ones have to be fixed, of course, but handle them separately as you do the TV and radio-phono combos.

With the set again in working order, the 200 or 400 volt audio coupling condenser is replaced with a 600 volt condenser. Here's why: Defective coupling condensers are one of the most annoying, and often the most illusive, causes of radio complaints. A leaking condenser throws positive voltage on the power tube grid which results in varying degrees of audio distortion and, occasionally, complete blocking of the power tube. This leakage may stubbornly refuse to develop until the set has been running an hour or so. An open coupling, of course, means a dead receiver while a set with an intermittent coupling can drive the whole family crazy with its spasmodic outbursts of volume.

The .01 μfd. low voltage commercial condenser, which is most commonly used as an audio coupling, seems particularly susceptible to intermittence

(*Continued on page* 143)

A Versatile Sweep Frequency GENERATOR

By
ROBERT M. BERLER,
W2EPC

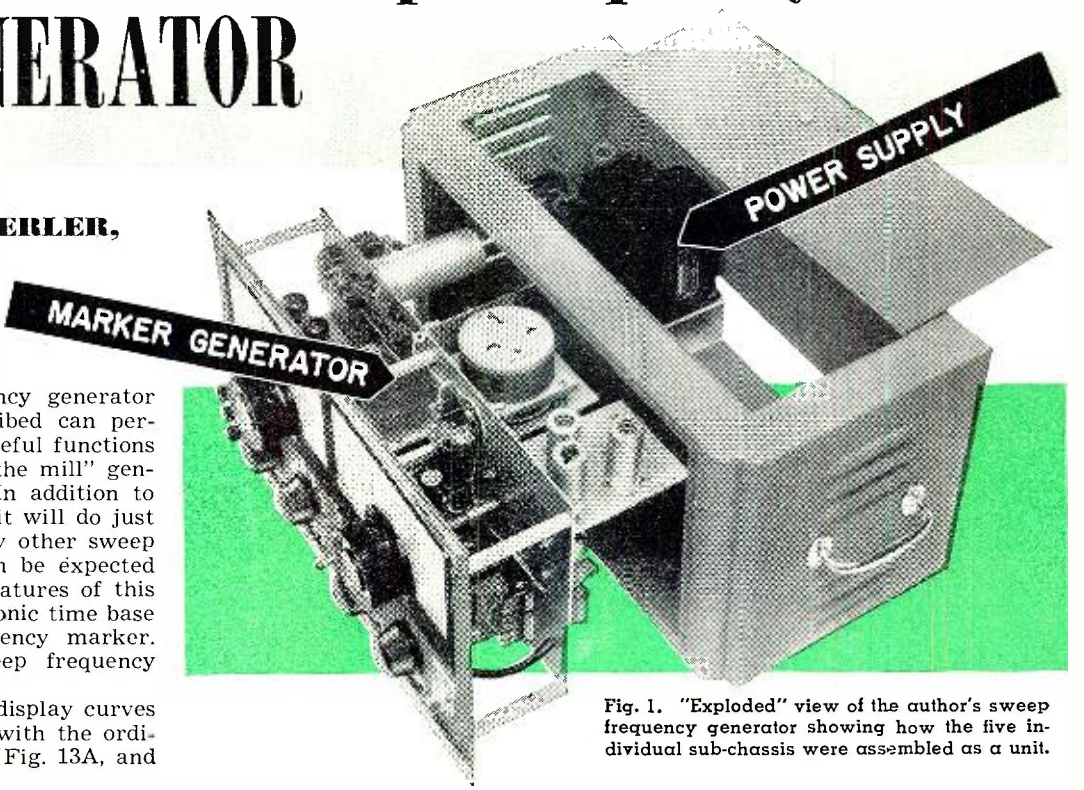


Fig. 1. "Exploded" view of the author's sweep frequency generator showing how the five individual sub-chassis were assembled as a unit.

A laboratory-type instrument which incorporates an intensity frequency marker and electronic time base.

THE sweep frequency generator about to be described can perform some very useful functions that the usual "run of the mill" generator cannot handle. In addition to these special functions, it will do just about anything that any other sweep frequency generator can be expected to do. The two main features of this generator are: an electronic time base and an intensity frequency marker. For example, this sweep frequency generator can:

1—Present the usual display curves seen on an oscilloscope with the ordinary sweep generator. (Fig. 13A, and Fig. 13B)

2—Display a curve on the oscilloscope with its own electronic time base. (Fig. 13C)

3—Present an intensity marker which appears as a small bright spot. This marker will indicate frequency right on the display curve being observed. (Fig. 2A) It will also indicate frequency even though the curve response amplitude is zero. (Fig. 2B)

4—Dispense with phasing (Figs. 13A and 13B) when its electronic time base is used.

5—Indicate bandwidth of response curve at half power points, etc., directly on curve.

6—Be used to calibrate the oscilloscope cross section mask directly in frequency or power points.

Other electrical specifications include power requirements of 115 volts, 60 cycles single phase; a frequency range of from 5 to 110 megacycles with no bandswitching and with the second harmonic output extending the range to 220 mc.; an r.f. output of 100 millivolts or better across a 51 ohm terminating resistor; deviation of 0 to ±6 mc. over the entire frequency range; and a marker frequency of 8 to 56 mc. in six ranges.

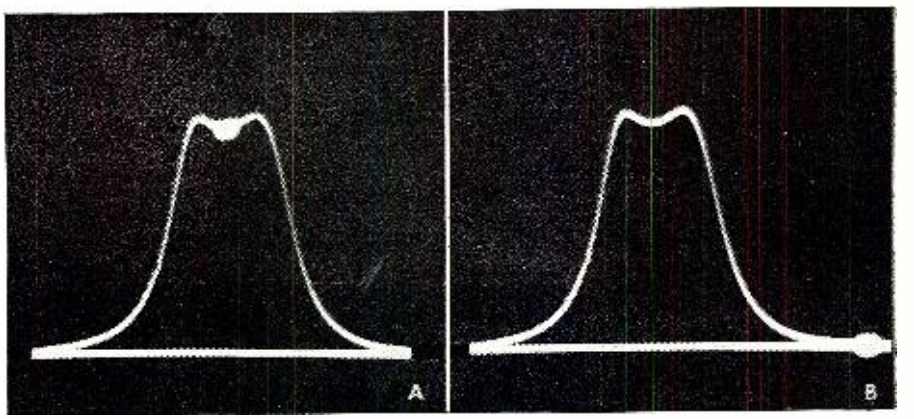
The heart of this signal generator is the electromechanically driven sweep condenser taken from a war surplus APN-1 altimeter (Fig. 17). The APN-1 altimeter is currently being sold by many surplus houses at advertised prices ranging from $4.50 to $7.95. The sweep unit, in appearance, resembles the back of a PM loudspeaker unit. The bottom is completely enclosed by a ceramic disc. On the inside of this ceramic disc, which is concave, are fired, in silver, both stator sections of the condenser. The "rotor" section of the condenser is a thin metal diaphragm which is perforated with small air vent holes. This diaphragm, which is convex in shape to conform to the hollow in the ceramic disc, is silver plated. Behind the diaphragm and connected to it is a voice coil. The field is a strong permanent magnet slug.

When an a.c. current is fed into the voice coil, the diaphragm moves toward or away from the stator sections, causing the capacity to vary. It is this varying capacity that frequency modulates a v.h.f. oscillator.

Theory of Operation

A block diagram of the sweep frequency generator is shown in Fig. 3. The FM oscillator is fixed at its center frequency of 235 mc. (Fig. 7). The APN-1 condenser unit is capable of causing frequency deviations up to ±6 mc. The variable oscillator (band center dial) may be continuously va-

Fig. 2. Oscilloscope patterns of a 10.7 mc. i.f. curve of an FM receiver.



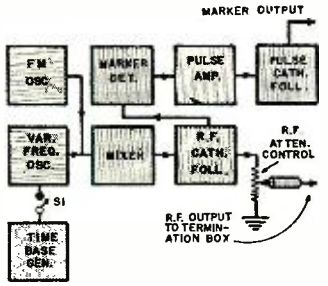


Fig. 3. Block diagram of the sweep frequency generator.

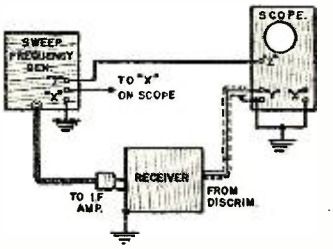


Fig. 4. Block diagram of the equipment setup for alignment.

Fig. 6. Block diagram of set-up for frequency calibration.

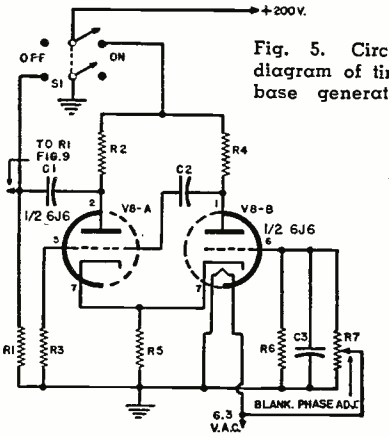


Fig. 5. Circuit diagram of time base generator.

R_1—15,000 ohm, ½ w. res.
R_2—180,000 ohm, ½ w. res.
R_3, R_5—100,000 ohm, ½ w. res.
R_4—470,000 ohm, ½ w. res.
R_6—6800 ohm, ½ w. res.
R_7—200,000 ohm pot.
C_1—.25 μfd., 400 v. cond.
C_2—.02 μfd., 400 v. cond.
C_3—.25 μfd., 200 v. cond.
S_1—D.p.d.t. toggle sw.
V_8—6J6 tube

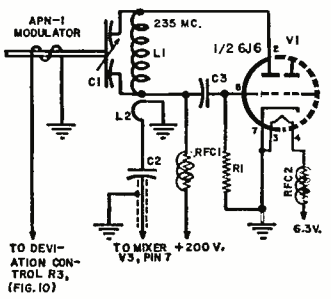


Fig. 7. Wiring diagram of the FM oscillator.

R_1—10,000 ohm, ½ w. res.
C_1—APN-1 capacity modulator
C_2—50 μμfd. ceramic cond.
C_3—10 μμfd. ceramic cond.
RFC_1, RFC_2—#28 en. closewound (winding length ½") on 10,000 ohm, 1 w. res.
L_1—2 t. #12 tinned, wound ¼" dia., spaced to tune with C_1
L_2—1 t. pick-up loop, ¼" dia.

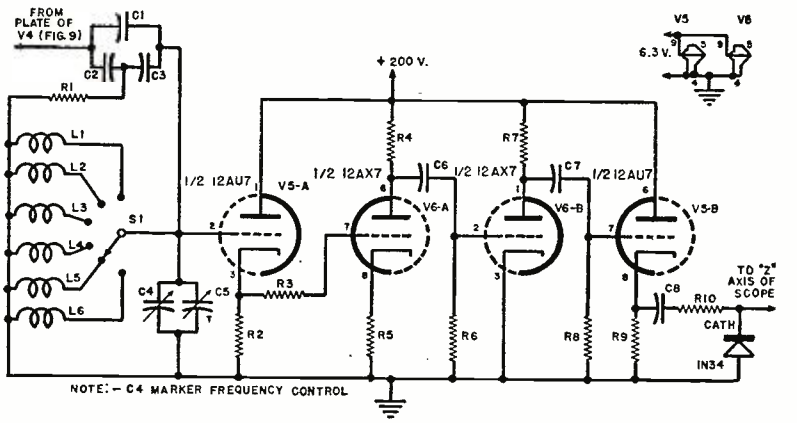


Fig. 8. Schematic diagram of the marker detector.

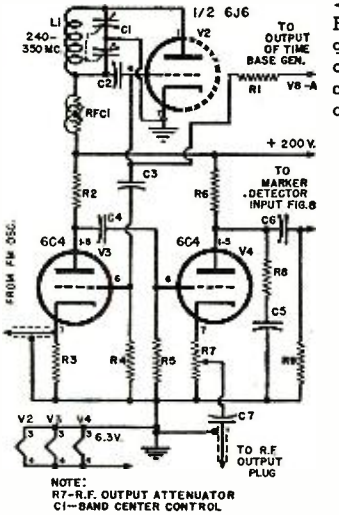


Fig. 9. Wiring diagram of variable oscillator, r.f. cathode follower and the mixer.

R_1, R_2—5600 ohm, ½ w. res.
R_3—1000 ohm, ½ w. res.
R_4—47,000 ohm, ½ w. res.
R_5—12,000 ohm, ½ w. res.
R_6—27,000 ohm, ½ w. res.
R_7—250 ohm, 2 w. pot.
R_8, R_9—220 ohm, ½ w. res.
C_1—35/35 μμfd. split-stator var. cond.
C_2, C_3—10 μμfd. ceramic cond.
C_4—500 μμfd. ceramic cond.
C_5, C_7—1000 μμfd. ceramic cond.
C_6—39 μμfd. ceramic cond.
RFC_1—#28 en. closewound (winding length ½") on 10,000 ohm, 1 w. res.
L_1—1½" #12 wire bent into hairpin turn. Ends to be soldered to stator section of C_1
V_2—½ 6J6 tube
V_3, V_4—6C4 tube

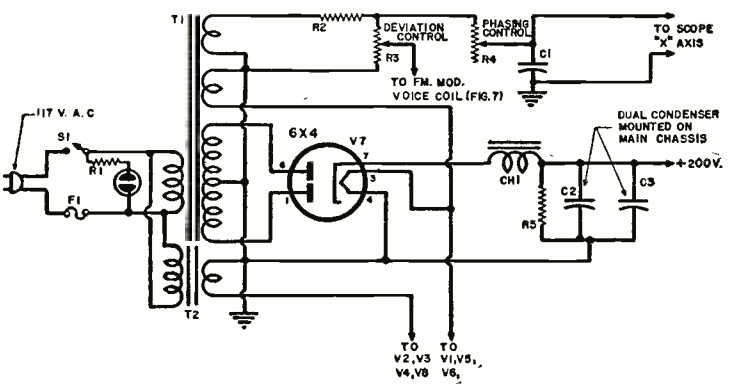


Fig. 10. Complete schematic diagram of power supply.

R_1—200,000 ohm, ½ w. res.
R_2—68 ohm, ½ w. res.
R_3—20 ohm wirewound pot.
R_4—50,000 ohm, ½ w. res.
R_5—82,000 ohm, 1 w. res.
C_1—.05 μfd., 200 v. cond.
C_2, C_3—40 μfd., 350 v. elec. cond.
T_1—Power trans. 250-0-250 v. @ 50 ma. (25 ma. is sufficient if available); 6.3 v. @ 2 amps; 5 v. @ 2 amps
T_2—Filament trans. 6.3 v. @ 2 amps
CH_1—Filter choke 30 hy. @ 25 ma.
S_1—S.p.s.t. toggle sw.
F_1—1 amp line fuse
1—NE-51 neon lamp

ried from 240 mc. to 350 mc. without bandswitching (Fig. 9). When the output of both oscillators is fed into the mixer, an output frequency ranging from 5 mc. to 110 mc. is obtainable. The FM deviation will be constant over the entire band center range for a given setting of the deviation control (Fig. 10). The output of the mixer is fed into an r.f. cathode follower output stage. The cathode follower provides isolation between the r.f. output and the marker generator. It also acts as a low impedance source feeding into a 50 ohm r.f. line. The end of the 50 ohm line (RG58/U) is terminated by a 51 ohm resistor which is located in the output termination box (Fig. 14). A blocking condenser in the termination box is included for the isolation of any d.c. potentials encountered during receiver alignment.

Marker Generator

The plate of the r.f. cathode follower is not perfectly bypassed. This is intentional so that a small amount of r.f. will be available for use in the marker generator. The marker generator consists of a high "*Q*" parallel tuned circuit which is connected to the grid of an infinite impedance detector (Fig. 8). This type of detector offers little loading on the tuned circuit so that a considerable positive voltage is built up on the cathode of the detector at resonance. It is desirable to keep the "*Q*" of the tuned circuit as high as possible because the width of the marker pulse depends upon the sharpness of its resonance curve. A sharp marker means good marking resolution. As the output signal of the generator sweeps past the resonant frequency of the marker detector, a positive pulse is generated in its cathode circuit. This positive pulse is amplified by the pulse amplifier and it is then fed into the pulse cathode follower output stage. A large positive pulse is available at the output which is not too easily loaded down by the grid of the oscilloscope. A d.c. restorer in the output of the pulse cathode follower maintains the base of the pulse at nearly zero d.c. potential. The *RC* network which couples r.f. into the marker parallel tuned circuit is an equalizer. This equalizer supplies the proper amount of r.f. over the wide frequency range of the marker generator. The marker detector coils are bandswitched in six ranges which overlap each other.

Time Base Generator

The blanking generator is a cathode-coupled multivibrator whose function is to remove the return trace that would appear on the oscilloscope (Fig. 5). It switches the v.f.o. on and off at 30 cps and is synced with the oscilloscope sine wave sweep. When the return sweep of the FM generator is removed, the return trace of the oscilloscope plots a straight line, thus generating on every other sweep, a time base. On alternate sweeps, the response curve of the equipment being tested is seen. The over-all result is that the response curve with a time base line is observed. The output of the multivibrator is a large negative pulse. This negative pulse is applied to the grid of the variable frequency oscillator causing it to cut off during the return trace, thus stopping its oscillation. The negative pulse is synced by the 60 cps power supply which also syncs the 60 cps oscilloscope sweep. The duration of the pulse is greater than 180° in order that it will blank out both extreme ends as well as one slope of the sine wave sweep. Thus, the oscillator can only fire on the more linear portion of the remaining slope as shown in Fig. 12.

Built into the time base generator is a phasing control. By means of this control, the firing of the multivibrator can be delayed over a limited range. With this variable delay control, it becomes possible to phase the square wave pulse of the multivibrator output in such a way so as to turn the v.f.o. on and off at the proper portion of the 60 cps sine wave sweep volt-

Fig. 11. Front panel view of the sweep frequency generator. The controls on the front of the panel include the marker frequency dial, band center frequency dial, phasing control, marker bandswitch, power switch, frequency deviation control, and the r.f. output control. The time base generator switch and phasing control are behind panel.

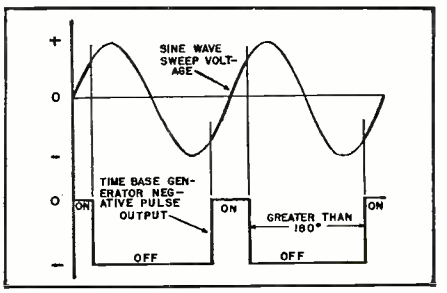
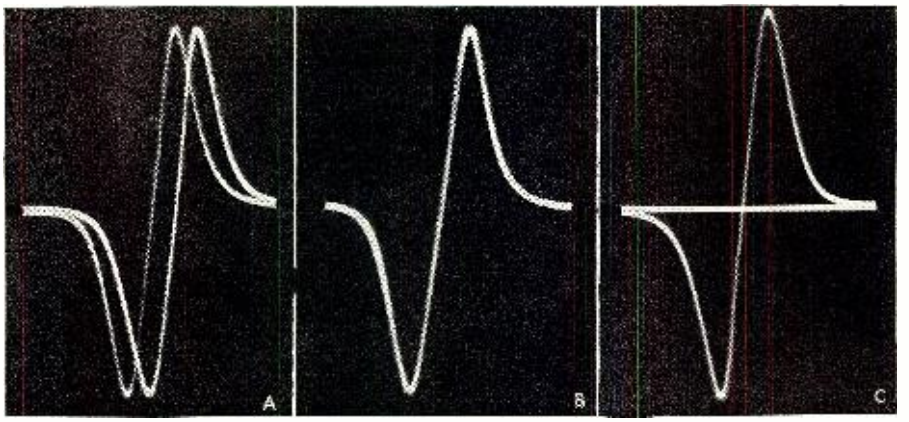


Fig. 12. The duration of the pulse is such that it will blank out both extreme ends as well as one slope of sine wave sweep. The oscillator fires only on the more linear portion of the remaining slope.

Band 1 (L_1)	**8-10.9 mc.**—20 t. #30 en., close-wound on polystyrene rod, ¾" dia.
Band 2 (L_2)	**10.5-14.7 mc.**—12 t. #30 en., close-wound on polystyrene rod, ¾" dia.
Band 3 (L_3)	**14.5-20.6 mc.**—8 t. #30 en., close-wound on polystyrene rod, ¾" dia.
Band 4 (L_4)	**20.4-29.4 mc.**—11 t. #16 en., air-wound with ½" i.d., spaced dia. of wire
Band 5 (L_5)	**29-43 mc.**—6 t. #16 en., airwound with ½" i.d., spaced dia. of wire
Band 6 (L_6)	**40-56 mc.**—3 t. #16 en., airwound with ½" i.d., spaced dia. of wire

Table 1. Complete data for winding coils for marker detector. See diagram, Fig. 8.

Fig. 13. Patterns obtainable with unit. (A) Discriminator curve before phasing. (B) Discriminator curve after phasing. (C) The 10.7 mc. discriminator curve of an FM receiver.



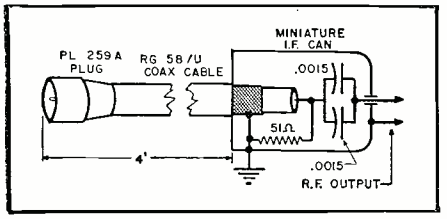


Fig. 14. Details of output termination box.

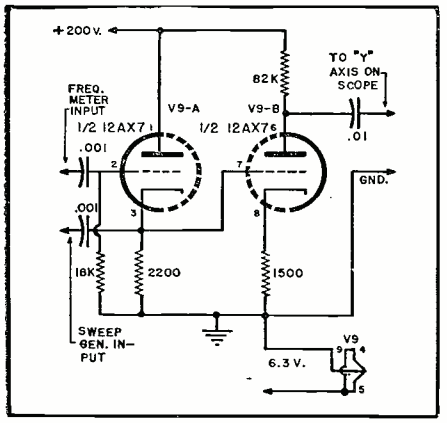


Fig. 15. The marker calibrating detector.

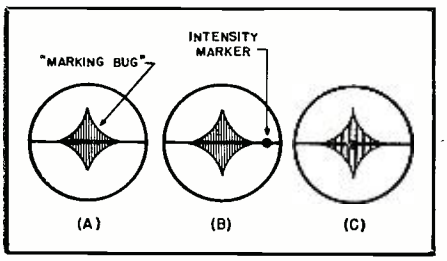


Fig. 16. Oscilloscope presentation of the "marking bug" and the intensity marker.

age. The blanking generator can be used at will merely by throwing a toggle switch.

The author does not believe in laying down rigid and exact methods of construction either in metal work or component layout. Neither does he believe in the use of only certain brands of components. Any manufacturer's part may be used provided that it has both the electrical and physical specifications required for proper operation of the circuits involved. As far as wiring layout is concerned, most people have their individual preferences. The most important fact to bear in mind is that good v.h.f. wiring techniques should be carefully observed. All stray capacities due to wiring should be kept to a minimum. For those interested in the approach used by the author, the entire sweep frequency generator was broken down into individual sub-chassis. Each sub-chassis was then mounted conveniently on a main vertical chassis. The exploded view in Fig. 1 and also Fig. 17 show how these sub-chassis were mounted.

Advantages of using sub-chassis are: 1. Ease of building and wiring small units; 2. Ease of testing each sub-chassis by itself for proper operation; and, 3. Flexibility offered by being able to mount sub-chassis in any manner or position desired on main chassis.

There are five sub-chassis in all. The first sub-chassis contains the v.h.f. beat frequency oscillator, mixer, and r.f. cathode follower (Fig. 9). The second contains the FM oscillator and the APN-1 capacity modulator (Fig. 7). The third sub-chassis contains the marker generator (Fig. 8). The fourth contains the time base generator (Fig. 5). The fifth contains the power supply (Fig. 10).

Each chassis uses *Jones* barrier strips for power supply interconnections. This way, removal of any sub-chassis for servicing is facilitated.

The power supply sub-chassis is located in the left rear position in the cabinet. It is connected to the main chassis by means of a supply cable with a multi-prong *Jones* plug at each end. The power supply chassis contains only the power and filament transformers, filter choke, and rectifier tube (Fig. 10). Electrical failures should be very rare on this sub-chassis outside of tube replacements. The filter condenser for the power supply is located on the main chassis (Fig. 17) where replacement is simple.

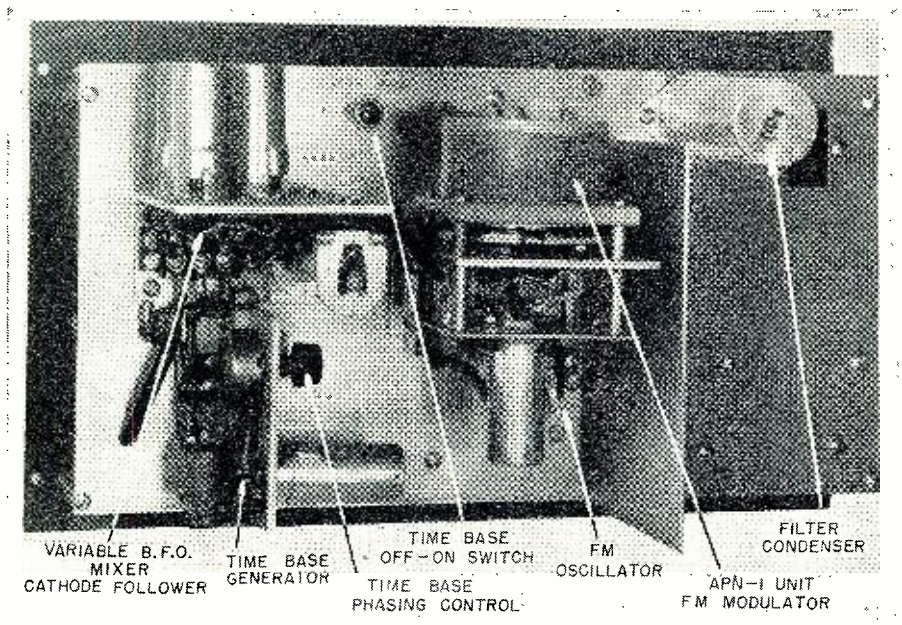
The output termination box is made from the can of a miniature i.f. transformer. The r.f. cable, which is four feet long, is connected at one end to a u.h.f. type PL259A r.f. connector. The other end is connected to the miniature i.f. transformer can as shown in Fig. 14. The bottom of the i.f. transformer can is closed up with an aluminum plate through which the RG58/U cable passes. A 51 ohm, ½ watt resistor terminates the cable in the can. The shield of the RG58/U cable is grounded with short leads to the inside of the can. Two short output leads come out of the can and have small color-coded alligator clips on them. It is advisable to use black for the ground lead and red for the r.f. high side. The two 1500 $\mu\mu$fd. condensers, which are connected in parallel in the can, are of the small ceramic type. All leads in the can should be as short and direct as possible. Two leads coming out of the termination box should be no longer than 2½ inches.

Adjustment and Operation

A grid dip meter will help in setting both oscillators on their proper frequencies. If the grid dip meter is not available, the usual methods will suffice in setting these oscillators to frequency. The FM oscillator is adjusted to 235 mc. The band center v.f.o. is adjusted to 235 mc. with the tuning condenser fully meshed. When the tuning condenser is turned to minimum capacity, the v.f.o. frequency should increase to around 360 mc. The r.f. pick-up loop which couples the FM oscillator to the mixer is a single turn of wire tightly coupled to the oscillator tank coil. This loop is made from one of the wire pigtails of the ceramic coupling condenser and is covered with spaghetti. When the signal generator is completed, it can be given a preliminary test by connecting it to the i.f. amplifier of an FM receiver or television receiver. Clip the leads from the output termination box between grid and ground of an i.f. stage. The "Y" axis of the oscilloscope should be connected across the discriminator load resistance. See Fig. 4. The horizontal sweep voltage output of the sweep frequency generator should be connected to the "X" axis terminals on the oscilloscope. With the deviation control about one-quarter open, vary the band center dial in frequency near the low end of the dial. At a certain setting of the band center dial, a response curve will appear on the screen of the oscilloscope. If the time base generator is in the "off" position, a picture similar to Fig. 13A will appear on the screen. By rotating the phas-

(*Continued on page* 104)

Fig. 17. Rear view of the instrument showing sub-chassis type of construction.



NEW SKIATRON TV PROJECTOR HAS NO C-R TUBE

By
RICHARD H. DORF
Television Consultant

Theater system shows movie-size pictures in either monochrome or color. The definition is high and the voltages are low.

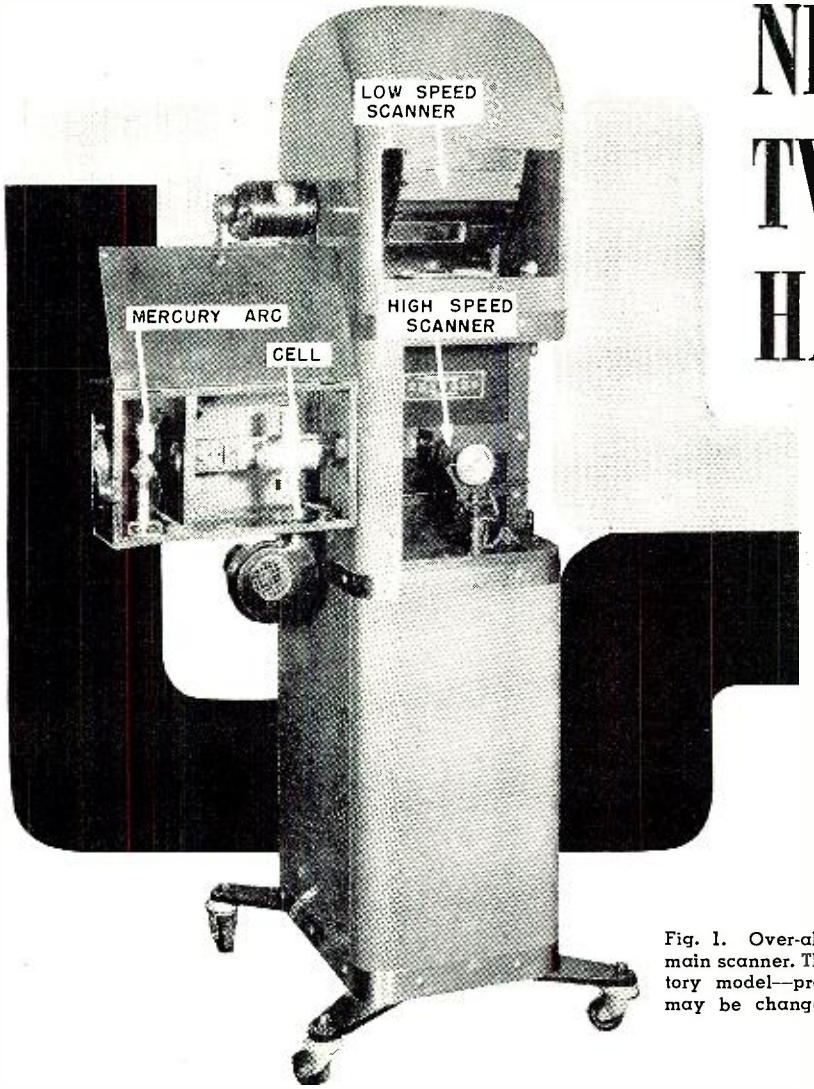


Fig. 1. Over-all view of the main scanner. This is a laboratory model—production units may be changed somewhat.

NEW men who are familiar with television today will deny that the system, at least for direct viewing, is eminently practical. There is no doubt, however, that there are at least two basic changes which, if they were possible, would benefit the art to the extent of giving better pictures. The first would be the transmission of an entire image as a unit, doing away with the element-by-element scanning which is necessary today. The second would be to break away from the restrictions imposed on the amount of light available from the fluorescent phosphor on the face of a cathode-ray tube.

It is not yet possible to transmit unitary images, but a unique and interesting system has just been brought to the point of full development which will do away entirely with the cathode-ray tube. The system, developed by and soon to be marketed under patents of the *Skiatron Electronics & Television Corp.*, is of great value for projection television, for the amount of light it transmits to the screen is not limited by a cathode-ray tube and does not have its high voltage requirements, but is furnished by a separate light source of the same type as used in motion-picture projection. Unlike past non-cathode-ray systems, such as the old Nipkow disc, the image definition is the same as that transmitted, and effective definitions as high as 1000 lines or more are practical when and if TV stations should transmit such pictures. Unlike other non-cathode-ray methods, too, its light output for a given source intensity is not inversely proportional to the number of picture elements, but is much more favorable than that. This is because not one, but hundreds of elements are transmitted to the viewing screen at the same time and the light for each element remains on the screen for the better part of the time required to scan a whole line. As the brightness of a cathode-ray tube screen increases, the traveling spot tends to "bloom" or spread, obscuring detail; there is no such effect in the *Skiatron* system. A full 25-foot theater image retains the same definition as a 10-inch CR tube picture. In addition, the system can be adapted for theater-size field-sequential color reception at less cost than a 7-inch conventional receiver, and without redesign.

The Ultrasonic Cell

The key to the system's operation and its most interesting component is an ultrasonic cell which modulates light. The light-modulating section of the apparatus is shown in simplified form in Fig. 2. The light source may be a standard motion-picture carbon arc, or, for smaller models, a special mercury lamp of great brilliance. Barrier *A*, a front-view detail of which also appears in Fig. 2, is a wall beyond the light source, at the center of which is a rectangular hole with an opaque bar across it. Lenses *A* and *B* are plano-convex and between them is the ultrasonic cell.

The cell is a container with transparent walls on each of two sides and a crystal transducer at the bottom. The cell is filled almost to the top with a nonviscous liquid, such as carbon tetrachloride. Barrier *B* is a second wall which, as the detail shows, has a single slit of approximately the same size as the black bar in Barrier *A*. At right is a white viewing screen, present only for purposes of explanation. Note that the screen is *not* the actual one used for watching the TV picture.

The light source is larger than the apertures in Barrier *A*. The light coming through the barrier, considered as a whole, is a diverging image of a white rectangle with a black bar across its center. Lenses *A* and *B* focus this image on Barrier *B*, so that the image of the black bar falls exactly on the slit in Barrier *B* and no light passes to the screen.

This is the total effect. The liquid in the cell has no effect on the path of the light, for it is the equivalent of a piece of glass with parallel faces; light passes straight through it.

Now let us delve a little more deeply into the paths the light rays take. To

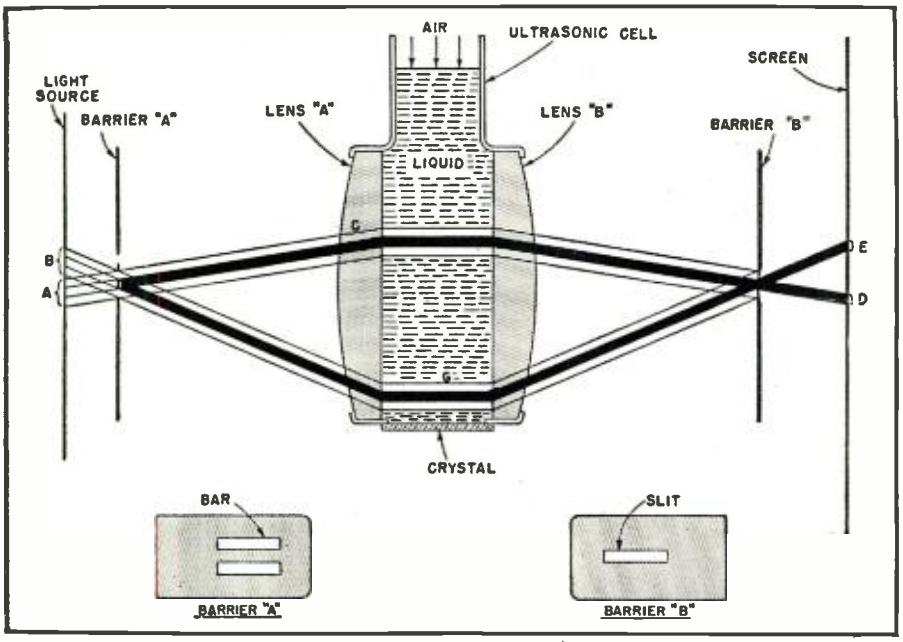


Fig. 2. Light-modulating section of the Skiatron shown in simplified form.

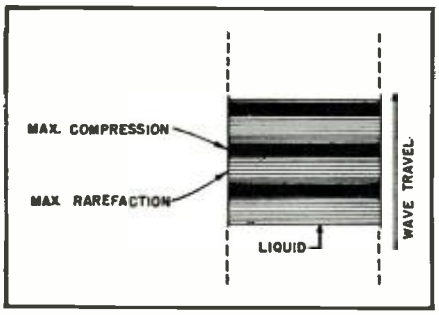


Fig. 3. Liquid compression and rarefaction.

begin with, we all know from using a camera that if we block off a part of the area of a lens by stopping down the aperture, the image is still formed on the film; the only change is that *less total light* passes through. From that we can reason that the image transmission is not dependent on all the light rays but instead on individual rays and groups of rays.

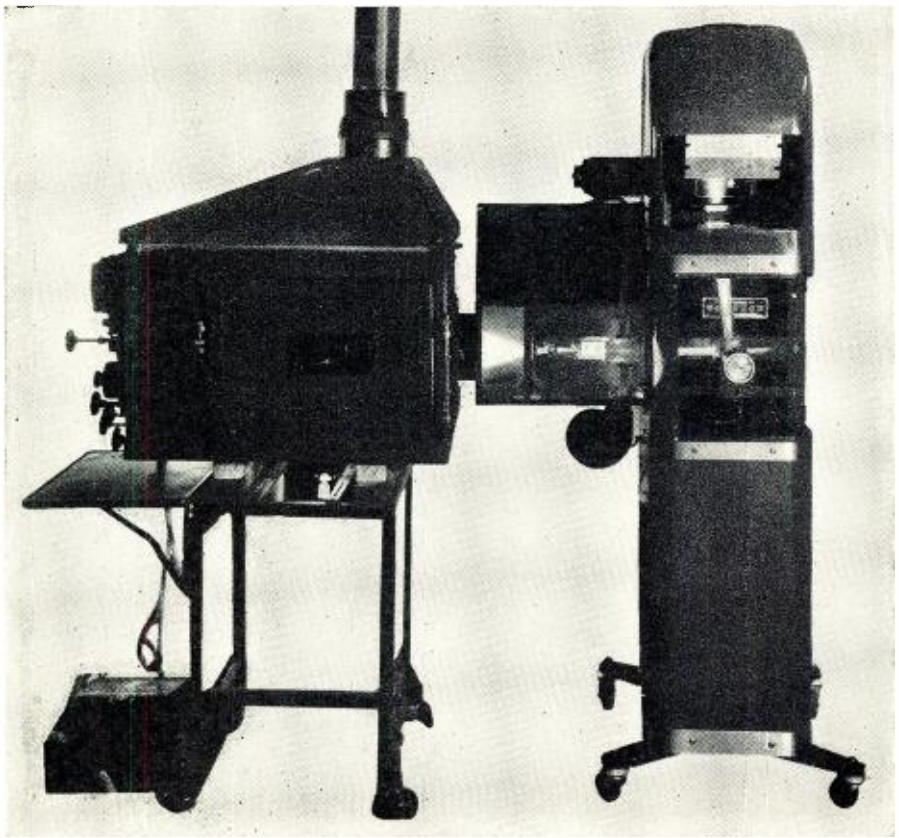
Light is, of course, made up of an infinite number of rays which, from a practical standpoint, we cannot separate. Theoretically, however, we can trace the path of an individual ray or set of rays just as we can explain electron theory by "chasing" a single electron. Let us select for examination the rays emanating from the area marked *A* in the light source and going in such a direction as to meet lens *A* at surface *C*. Some of the rays are interrupted by the black bar in Barrier *A;* in the drawing of Fig. 2 the light, after passing the barrier, is shown to consist of three bands—two outside bands of light and a center dark area.

After the rays from area *A* meet surface *C,* lens *A* bends them so that they enter the cell liquid in a perfectly horizontal direction. Lens *B* bends the rays again and focuses them on the slit in Barrier *B*. Since the light pattern emerging from the lens-cell combination is the same as that entering it, the dark band hits the slit exactly, while the outer light bands strike the opaque walls of the barrier. The result is that a dark spot "passes through" the slit and falls on area *D* of the screen. Of course, in reality this is merely a lack of light; no light passes through the slit from these rays and the screen is not illuminated at area *D*.

Taking next the rays originating in area *B* of the light source, we can trace them to find that they travel a similar path and that they, too, pass only a dark spot to the screen. This second dark spot, however, hits the screen at area *E*.

In fact, all the light rays from the source go through the same action, all producing a dark band at the slit in Barrier *B,* the light bands being stopped by the opaque surrounding wall of Barrier *B*. Each of an infinite number of sets of rays goes through this action to produce an infinite number of dark areas on the screen, with the total result that the screen remains dark. Note carefully, however, that each of an infinite number of light-source areas is illuminating the lens-cell combination separately, and that each infinitesimally small section of the lens-cell combination is doing its own focusing job independent of the other sections. The only reason that all the black slit images are focused on exactly the same place—the slit in Barrier *B*—is that the lenses are spherical *and the liquid in the cell has exactly the same density at all points.* Note, too, that each light-source area and each section of the lens-cell places a black image on a different area of the screen.

Fig. 4. Smoke from cigarette, blown into compartments, shows light paths.



Modulating the Cell

Now let us bring the ultrasonic crystal transducer into action. The output of an ultrasonic oscillator is connected to the crystal so that the crystal vibrates at the oscillator frequency, in this case 18 mc. The vibrating crystal pushes against the bottom surface of the liquid in the cell 18 million times a second, creating a compression wave train traveling from bottom to top of the liquid. If we keep the crystal frequency constant and we damp out the

ripples or waves at the top of the cell so that they do not strike the roof of the container and reflect back, we have continuous compression waves in the liquid. The length of each wave depends on the velocity of propagation through the liquid and the crystal frequency, just as does sound wavelength in air ($\lambda = v/f$).

The waves exist, just as do sound waves, as compressions and rarefactions of the liquid. In Fig. 3 we can see three cycles of compression and rarefaction caused by the sine waveform of the oscillator output and the crystal movement. These compression-rarefaction cycles are created at the bottom of the cell and they travel upward (they are *not* standing waves) just as fast as new ones are made to follow them.

The oscillator which produces the 18 mc. signal drives a power amplifier which excites the crystal and which can be amplitude-modulated by an external modulation source. When the amplitude is maximum, the pressure difference between the parts of the liquid at maximum rarefaction and maximum compression is greatest. When amplitude is lower, compression is not so great, nor is rarefaction. When amplitude is zero, the liquid is not compressed or rarefied at all and it has the same density at all points.

Now suppose that we modulate the 18 mc. power amplifier with a high-amplitude square wave whose duration is about 0.3 microsecond. An 18 mc. wave lasts for about .05 microsecond. Therefore, six of the 18 mc. sine waves will be at maximum amplitude and the rarefactions and compressions will be as great as possible. This group of six waves travels up through the liquid at the same velocity as all waves entering the liquid, a constant determined by the viscosity. Let us consider them for an instant, however, standing still near the bottom of the liquid column, at *G* in Fig. 2, where the light pattern *B* is passing through the cell.

The velocity of light in a liquid depends on the liquid's density. Light rays that fall on the cell at a point of maximum compression take a certain amount of time to pass through the liquid. Those which enter at a slightly higher or lower point and pass through a path of less compression (or rarefaction) take less time to make the trip.

Therefore, while all the rays emanating from area *B* of the light source enter the cell at the same time they do not all emerge at the same time; they are out-of-phase as they emerge from the right wall of the cell. The amount of phase difference depends on the difference between maximum and minimum liquid pressures, which is determined by the percentage modulation of the 18 mc. signal.

The result resembles to some extent what happens when several antennas radiate the same broadcast signal but are fed with r.f. not in phase. Radiation is reinforced in some directions, partially cancelled in other directions.

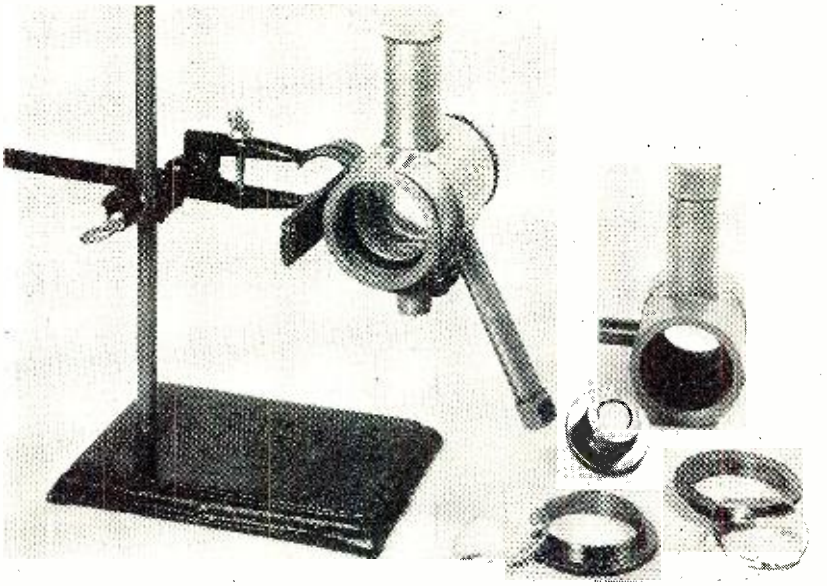


Fig. 5. Two ultrasonic cells. The one at left is complete with lenses and liquid.

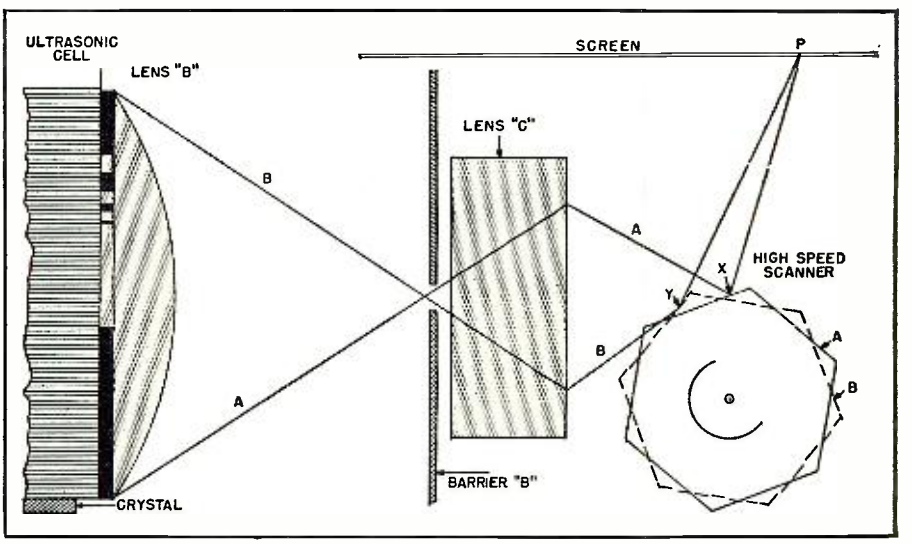
In broadcasting, this type of phased array is used extensively to provide a desired directional propagation pattern with lobes and nulls where desired.

In the optical case of the ultrasonic cell, with the examples we have given, the six compressions and rarefactions equally spaced make this little section of the liquid column into a "phase grating," a specialized form of diffraction grating. As with the phased r.f. signals, the wave properties of light under these conditions produce both destructive and constructive interference. The destructive interference, resulting from the coordinated phase shift at the six elements of the phase grating, causes the light to be weakened over areas that otherwise would be bright. The constructive interference puts light where otherwise there would be darkness. In brief, some of the rays that go into the phase grating are bent up and some are bent down at a certain angle which depends only on the spacing between compressions ---a constant in this case because of the steady 18 mc. oscillator frequency.

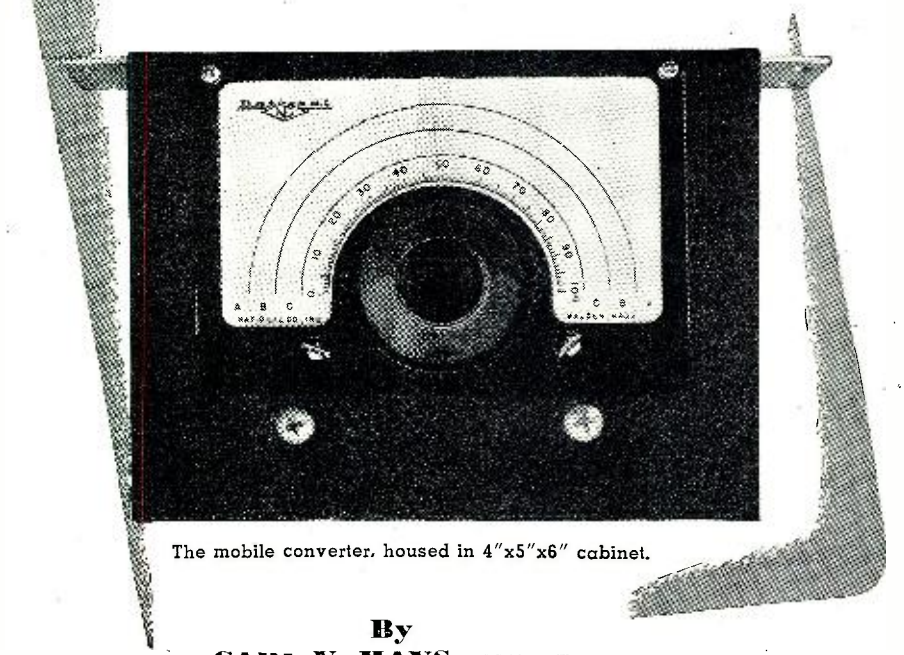
When the liquid is not modulated at 18 mc. there is no phase shift because the liquid has the same pressure at all points. The black-bar image falls exactly on the slit in Barrier *B* and no light passes through. With the maximum useful modulation we have applied during the 0.3 microsecond period, however, the bundle of rays emanating from source *B* is deviated both up and downward during passage through the liquid. Two images of the black bar are formed, one just below the slit in Barrier *B* and one just above it. Fifty per-cent of the light that passed through the upper slit of Barrier *A* now strikes the slit in Barrier *B* and goes through to the screen. The other 50% is wasted because it strikes Barrier *B* just above the displaced black-bar image. In the same way, 50% of the light from the lower slot of Barrier *A* goes through to the screen, with the other 50% striking Barrier *B* below the lower displaced black-bar image. Thus, with maximum useful modulation, 50% of the total light

(*Continued on page* 98)

Fig. 6. How the high speed scanner functions. See text for detailed explanation.



A 10-METER MOBILE CONVERTER



The mobile converter, housed in 4"x5"x6" cabinet.

By
CARL V. HAYS, W6RTP

Construction details on a mobile unit which combines professional appearance with outstanding performance.

WHAT with Civil Defense, TVI, and the sheer enjoyment of it, mobile hamming has boomed to unheard of proportions since the new rules governing such operation were announced. The writer was mildly smitten with the idea, and a run-of-the-mill converter was constructed, and then we began to learn things, the hard way.

Most 10 meter converters seem to tend towards broadbanding the r.f. and detector stages, tuning the oscillator only, in the interests of compactness, "lack of tracking" worries, etc. Slick coupling schemes are touted to the skies, extremely high-gain tubes are used, and the resultant loud hiss that issues from the car BC set when the new converter is fired up convinces us we've really got something; we have, at that, but not what makes for a sensitive, quiet receiver front end!

The converter to be described won't knock the power tube out of your car receiver when you fire it up, but if there's a signal on the band, you'll hear it, weak as it may be, and that's what converters are for, after all. Compactness is highly desirable in such a unit, and this compactness can oh-so-easily let that old devil regeneration rear his ugly (and loud) head, leading to some false ideas about high gain and such. The use of broad-tuned front stages sometimes counteracts this by their very lack of gain, due to the lack of circuit "*Q*," and we have only a mild form of feedback hiss. This isn't a "hot" converter, it's just a poorly designed one.

In addition to the foregoing, the common practice of tuning the oscillator only leads to some highly undesirable effects in the way of antenna pulling, drift, instability, etc. A recent advertisement by one of the major receiver manufacturers points this up for the interested reader, emphasizing as it does the undesirable aspects of such converters at 10 meters and higher.

After learning what didn't work, from the first model constructed at W6RTP, we went about figuring out one that would work. The result is seen in the accompanying photos and the schematic.

A rigid but very light aluminum cabinet and chassis were procured, both standard items, and parts moved here and there, until the layout shown was obtained. It is recommended that the builder adhere closely to this arrangement. The cabinet measures 4"x5"x6", with two sides removable; these removable panels become the bottom and top of the finished unit, allowing troubleshooting and adjustment to be performed very easily, after installation. The dial, chassis, and cabinet can be completely assembled, and all wiring done afterwards, if desired, thanks to the design layout used.

The chassis proper, 3½"x5½"x1", is very easily worked, and simple hand tools will do nicely. The model shown was built on the kitchen table with only the simplest of tools. The only thing out of the ordinary was a ⅝" chassis punch which isn't absolutely necessary.

A glance at the top chassis photo will show three tubes, three coils, a three-gang condenser (of which more will be said later) four feedthroughs, and an output transformer. Where to drill the necessary few holes is clearly shown, and about the only word here is to be sure and make the chassis holes under the condenser section lugs (stators) a full quarter inch in diameter, to allow r.f. wiring to stay clear of the metal. A very important detail not visible in this photo, but shown on the schematic, is the resistor and bypass inside the output transformer can for the detector "B-plus." This construction should be copied as it is, for best results. Just insert the resistor in the "B-plus" lead directly at the plate coil lug, with the .005 μfd. bypass condenser going from the lug to the ground side lug of the coupling coil, and you'll have no trouble here.

The dial mounting method shown, directly to the fixed front panel of the cabinet, gives desired rigidity and eliminates the necessity of "gouging" out the front chassis lip to clear the mechanism of the MCN assembly. Two half-inch spacers, of generous diameter, can be seen holding the chassis front drop to the cabinet, below and to each side of the dial mechanism. These, together with two 6-32 screws (seen on the bottom chassis lips in the under-chassis photo) which protrude through the bottom plate and are secured to it with stop-nuts, gives a very solid chassis-cabinet joining method. It requires only the removal of two nuts and the lid tap-screws to allow easy and complete access to any part of the finished unit.

One other point in the construction should be mentioned, and that is the cutting out of a piece of metal 1"x3½" along the bottom rear edge of the cabinet to clear the connecting r.f. and power receptacles. This can be done quite easily in the soft aluminum material, and won't entail a prodigious wrestling bout with simple tools. The MCN dial mounting is covered very clearly in the template instructions accompanying the unit, and needs no comment.

As to the aforementioned tuning condenser; this *must* be a good, solid, well-designed specimen of three-gang condenser preferably, as shown, of the dial-bearing type. It should turn easily with no shaft wobble nor end-play as trouble inevitably follows the use of any other kind. Ganged singles will do, but space is at a premium, so beg, borrow, or otherwise get something of the type shown, if at all possible, and

make sure it is anchored down firmly, fore and aft.

Inspection of the bottom chassis photo shows the general wiring layout which should be followed as is. The oscillator tube socket may be seen at the extreme top left, with the blocking condenser-grid leak, plate bypass condenser, and trimmer condenser below.

To the right of this section is shown the detector tube socket, bottom center, with its grid-leak/condenser and trimmer condenser in the center of the chassis.

At the rear of the chassis is the r.f. stage and associated parts; tube socket top right (almost covered by the screen bypass condenser), grid blocking condenser and trimmer below, with the r.f. plate bypass condenser and feedthroughs to the r.f. plate coil to the left of the socket proper.

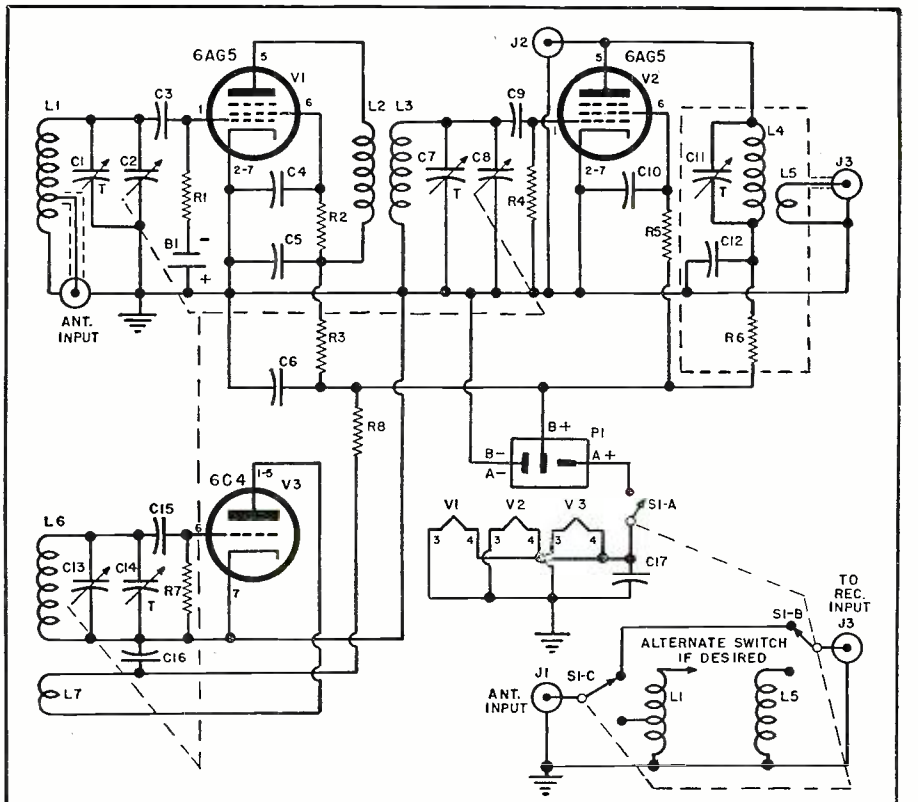
At the extreme right of the chassis are grouped the r.f. input coaxial receptacle (top) with the shield and RG-59/U cable leading to a quarter-inch hole in the chassis, the *Jones* type power receptacle (right) with the two .01 μfd. bypass condensers stacked next the bias battery, and the output coaxial receptacle (bottom). The bias battery for the r.f. grid is grounded by soldering to a lug held under one mounting screw of the power receptacle. A single two-lug tie-point alongside the power receptacle serves to hold isolating resistors and other detector power connections handily.

Any and all nuts must have lock washers and lugs should be bonded firmly to the chassis. Not too clearly shown in the top chassis photo is the r.f. grid coil connection to the inner conductor of the RG-59/U coax, but it is simply soldered directly to the coil, at the tap point indicated in the parts list.

A study of the simple schematic will show grounded cathodes in all stages. Bias for the r.f. stage is from a miniature 1½ volt cell, with a 1 megohm resistor; bias for the detector stage is automatic, remaining optimum for a wide range of oscillator output, since the 5 megohm resistor in its grid gives a voltage directly proportional to signal by the method used; bias for the oscillator is also grid-leak. This system is a sure-cure for ninety per-cent of the instability, drift, and noisy operation.

No oscillator/detector coupling is shown for injection voltage but the stray coupling which is present without any shielding gives very good operation. The grounded cathodes, decoupling resistors/condensers, and careful spacing of the coils allows the unit to be rock-stable, with no sign of instability due to feedback obtainable at any setting of the condensers used for trimming to resonance. This condition is necessary if really high-gain, quiet operation is to be achieved. With no antenna attached, the 6AG5 r.f. stage is completely free from regeneration; with the antenna coupled,

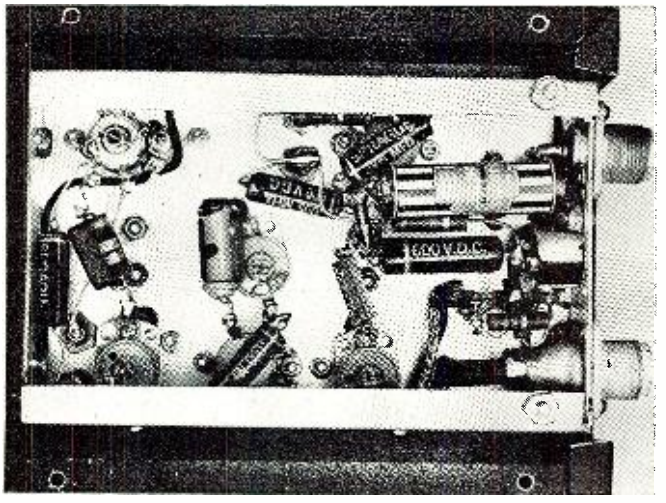
(*Continued on page* 126)



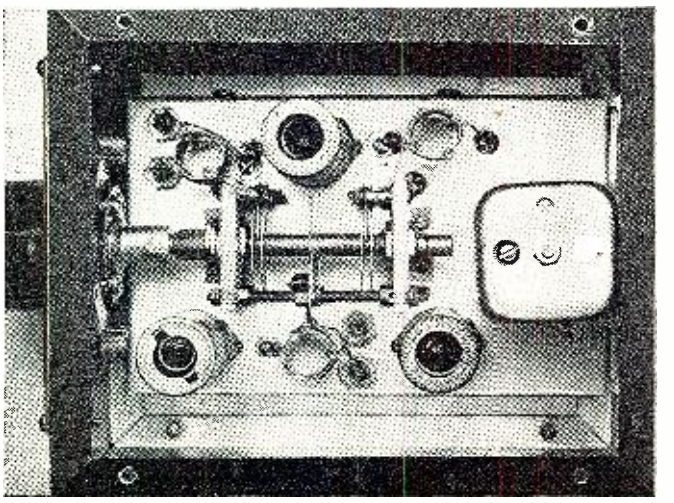
R_1—1 megohm, ¼ w. res.
R_2, R_6—2000 ohm, 1 w. res.
R_3, R_5—1000 ohm, 1 w. res.
R_4—5 megohm, ½ w. res.
R_7—50,000 ohm, 1 w. res.
R_8—10,000 ohm, 1 w. res.
C_1, C_7, C_{14}—7-45 μμfd. silver disc trimmer
C_2, C_8, C_{13}—3-gang tuning cond., 15 μμfd. per sec. (See text)
C_3, C_9, C_{15}—100 μμfd. silver mica cond.
C_4, C_5, C_{10}, C_{12}—.005 μfd., 600 v. cond.
C_6, C_{16}, C_{17}—.01 μfd., 600 v. cond.
C_{11}—Trimmer cond. (Part of L_4, L_5 assembly)
S_1—3-pole, 2-pos. wafer sw. (optional)
L_1—14 t. B & W Miniductor, ½" dia., tapped 4 t. from cold end. (16 t. per in.)
L_2—6 t. #22, d.s.c. interwound with L_3
L_3—8 t. B & W Miniductor, ½" dia. (16 t. per in.)
L_4, L_5—1500 kc. converter output trans. (J. W. Miller Co.)
L_6—6 t. B & W Miniductor, ½" dia. (16 t. per in.)
L_7—2 t. #22 d.s.c., interwound with L_6
B_1—1½ v. mini-cell
V_1, V_2—6AG5 tube *V_3—6C4 tube*

Complete circuit diagram and parts list covering the 10-meter mobile converter.

Under chassis view. Parts layout should be followed exactly.



Top chassis view showing proper location of the components.



LOUDSPEAKER CONSIDERATIONS At Low Frequencies

By
J. CARLISLE HOADLEY

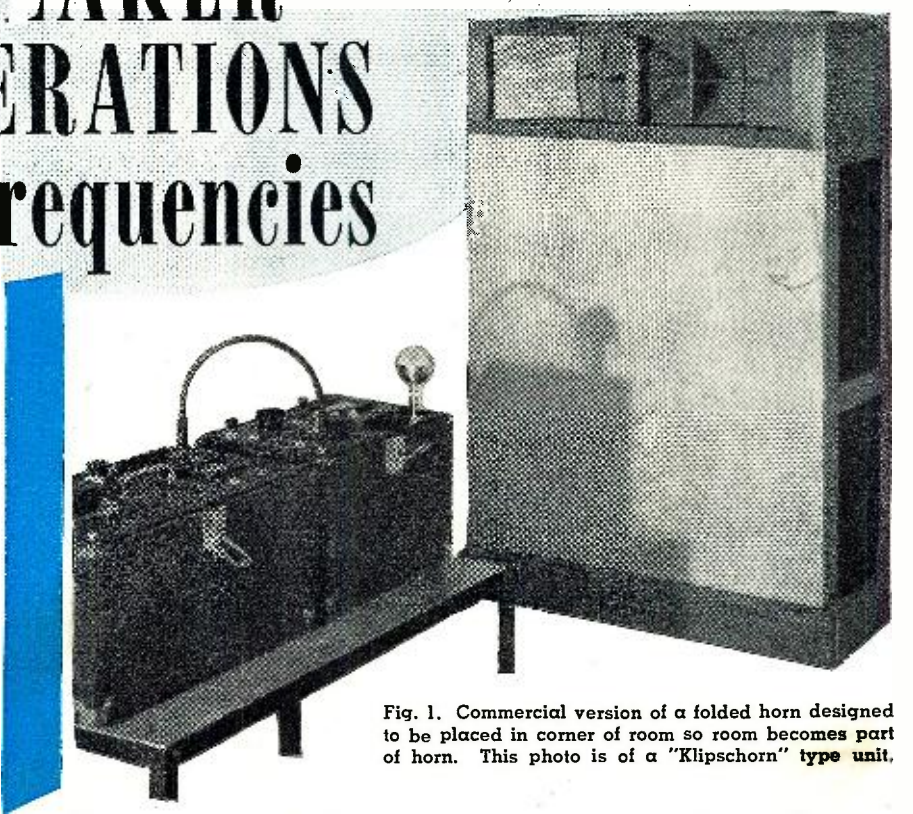


Fig. 1. Commercial version of a folded horn designed to be placed in corner of room so room becomes part of horn. This photo is of a "Klipschorn" type unit.

Certain generalities can be made quickly—other factors are sometimes confusing. There are three interrelated problems which must be considered.

THE choice of a loudspeaker for a high fidelity installation is important and sometimes confusing. Loudspeaker specifications and response curves are often ambiguous and not easily compared by the average user. The economic considerations will usually narrow the field in respect to price, cone size, etc. but from here on in you are on your own.

There are three interrelated problems to consider: First, the choice of the speaker; second, the selection of a baffle; third, the decision as to where the speaker will be located in the room.

Certain generalizations can be made which will tend to clarify the selection of a loudspeaker for a proposed audio system. In general, the cone diameter of the speaker will determine its relative low frequency response. The larger the cone diameter, the lower the frequency that the speaker will be capable of reproducing. The larger the magnet (usually specified by its weight), the greater will be the speaker's sensitivity and the greater its capacity for reproducing low frequencies at high level.

A loudspeaker's sensitivity is dependent on other factors. The type of magnetic material will influence the sensitivity. Most modern speakers use Alnico V which is many times more efficient than older magnetic materials.

The diameter of the voice coil is a major factor in the determination of a speaker's sensitivity. The larger voice coils will spread over a greater area the number of magnetic lines a given magnet will produce. Two speakers with identical magnets and identical gaps but which have different voice coil diameters, will have different sensitivities. The speaker with the smaller voice coil will be more sensitive. The larger voice coil, however. can dissipate more heat and can drive a speaker cone better at low frequencies without cone break-up. Since the larger voice coil has greater mass, its high frequency response may suffer. The size of the magnet will determine the inherent damping of the speaker. Damping is advantageous at low frequencies and, in general, the more damping the better.

Ideally, a moving coil speaker is a constant velocity device. Its distance of cone travel is inversely proportional to frequency, *i.e.,* if the speaker cone excursion is .1 inch at 200 cps with a given voltage applied to its voice coil, the cone will move .2 inch at 100 cps with the same voltage applied.

Naturally, a speaker's cone travel is limited by mechanical factors such as the spider compliance, width of the voice coil, length and uniformity of the magnetic gap, and compliance of the cone rim hinge. For low distortion, the speaker cone should not be allowed to swing beyond the linear region of any of those items.

Since distortion due to large excursions of the cone will show up at low frequencies first, the level at which the speaker is to be used will determine to a large extent the size and quality of the unit chosen. The cone excursions may be reduced by placing the speaker in a suitable baffle. There are, of course, a large number of choices, which range from a flat board to an exponential horn, and include the open back box, bass reflex, and infinite baffle types.

The horn will effect the greatest reduction in speaker cone travel down to its acoustic cut-off frequency which is determined mainly by its flare rate and length. The infinite baffle or closed box rates next, followed by the bass reflex and open box with the flat baffle bringing up the rear.

The horn and bass reflex type baffles increase the loudspeaker's efficiency, thereby producing a given acoustic output with less power input. The infinite baffle does not increase the speaker's sensitivity since the back radiation from the cone is dissipated in absorbent material located inside the closed box. The open box and flat baffles allow the back and front radiation of a loudspeaker to combine at low frequencies in a haphazard way, which produces relatively large peaks and valleys in the response curve and very considerable low frequency distortion.

Nearly any good loudspeaker is capable of good low frequency response below some volume level limit. The maximum level at which the speaker will operate at some low frequency is determined by the distortion which can be tolerated as the cone swing approaches its maximum. This level will be influenced by the choice of baffle and its placement in a room.

The most efficient baffle is, of course, the horn. Roughly speaking, the horn is an acoustic transformer which matches the speaker cone's acoustic impedance to the room impedance. The horn can be considered as a hypothetical speaker whose cone area is the same as the area of the horn's mouth.

The bass reflex or "phase inverter" speaker enclosure is probably the most popular baffle because of its relatively low cost, and because it is easily constructed by the user. This baffle adds the back radiation of the loudspeaker in phase with front radiation at some low frequency, which extends the speaker's low frequency response and increases its sensitivity at that low frequency. The action of this type of enclosure may be varied over wide limits by dimensional changes in cabinet volume, port size, port location, and in the amount, type, and placement of absorbent material located inside the baffle.

Theoretically, the bass reflex baffle volume is chosen to resonate at the same frequency as the speaker with which it is used. The system then comprises an over-coupled acoustic circuit, producing the characteristic double hump response which effectively extends the speaker's response an octave or so lower than it normally would have gone. It provides excellent damping and restricts the cone travel at the speaker's low resonant frequency.

The inverter baffle may also be designed to add the back radiation of the speaker cone to the front radiation below the speaker's resonant point, which will extend the low frequency response of the combination. Fig. 2 shows the measured radiation from the speaker and from the port of a bass reflex baffle.

The amount of absorbent material used in the reflex type baffle will influence the response improvement. The back wave should be absorbed at the higher frequencies in order to prevent addition and cancellation of the front and back waves which will be in- or out-of-phase depending on the frequency. Too much absorbent material will tend to lower the *"Q"* of the reflex baffle and consequently broaden the bass improvement range. As it broadens this range, it will reduce the amplitude of bass improvement, so a compromise must be effected.

The infinite baffle is a closed box of ample cubic content which contains sufficient absorbent material to absorb the back wave of the speaker at all frequencies. This type of baffle adds nothing to the efficiency of the speaker, but provides good damping and yields an acoustic response curve which is smooth.

There is a popular misconception that a speaker rated at 25 watts will deliver 25 watts throughout its rated frequency range. These wattage ratings usually represent the maximum amount of audio frequency power the speaker voice coil and cone structure will stand. Actually, the loudspeaker is capable of radiating much less power at the lower and the higher frequencies, even though it has a flat frequency response curve.

The power rating is sometimes qualified by the statement so many watts of "integrated program material." Since the normal expected power is greatest in the mid-frequency range,

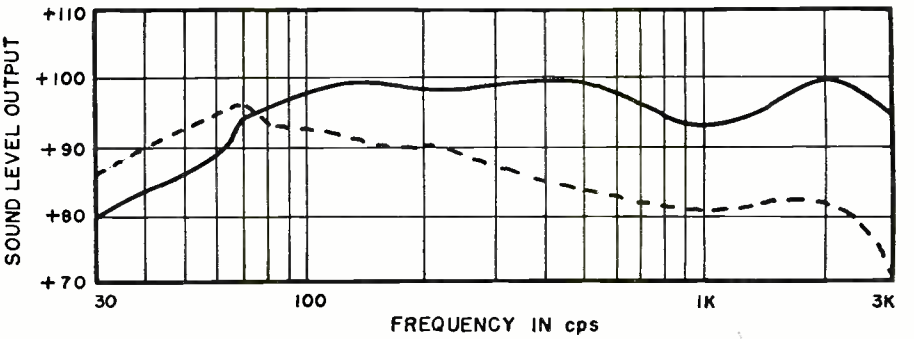


Fig. 2. Comparison of radiation of the cone (solid) and port (dotted) from a 12" speaker in a six cubic foot bass reflex cabinet with sound level meter at 3 inches.

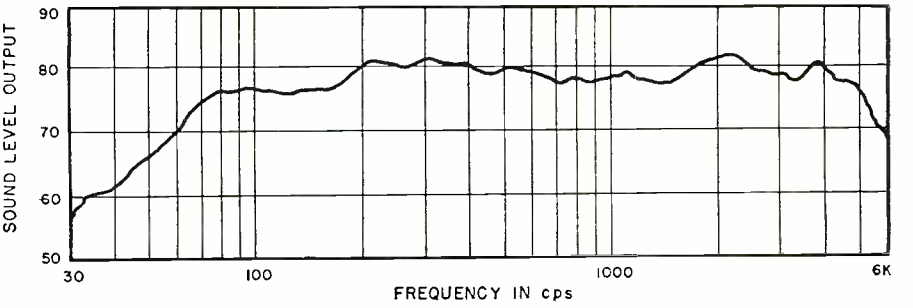


Fig. 3. The free field response of a 12" speaker in a bass reflex cabinet. In this case the sound level meter was located at a point 7 feet on the speaker axis.

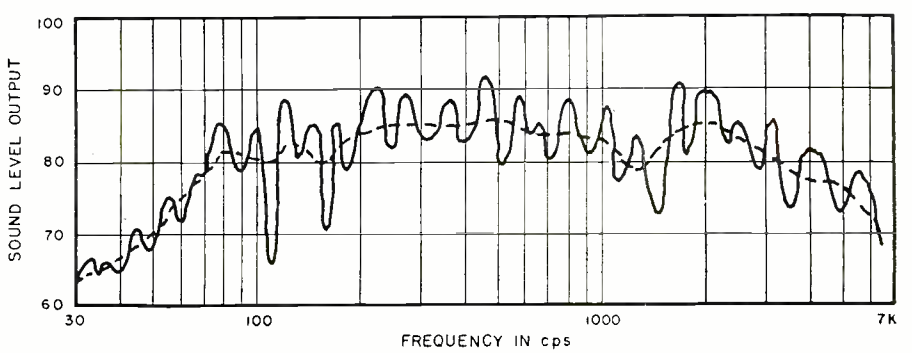
the theory is that the very high and very low frequencies will not overload the speaker. The response curves on even the large 15 inch speakers are run with one electrical watt input or less and usually with one-tenth or one one-hundredth of this value.

Some of the less expensive speakers are rated with no consideration given to distortion. For instance, a typical 12" speaker in the forty dollar net class will radiate a pure 50 cycle sine wave at the 70 db level. When the audio input to the speaker is increased until the sound level meter indicates the acoustic output is 80 db, we find by oscilloscope observation that the output wave is badly distorted. Analysis with a distortion analyzer shows that the 50 cycle fundamental is still at the 70 db level, but that the speaker has generated a 100 cps component in addition to the fundamental. Since the loudspeaker is capable of radiating much greater power at 100 cps, this distorted bass will sound loud. Since, also, the radiated 100 cps is harmonically related to the 50 cps fundamental, it will not sound discordant. Direct comparison with a speaker system which radiates the low frequency fundamentals without harmonic generation will point out the shallow, unnatural sound of the speaker with low frequency harmonic distortion. An overloaded speaker will generate a large number of harmonics in addition to the second.

When reproducing music where a number of low frequency fundamentals are present simultaneously, the possibility of exciting the fundamental resonance of the speaker and baffle is very high. This mechanism accounts for the single note bass heard so often in speaker systems. The only solution to this problem is the selection of a large enough low frequency speaker (or speakers) to handle the power at the listening level you desire, plus a properly designed speaker enclosure, together with a heavy damping factor in the audio amplifier.

The use of bass boosting to attempt correction of a loudspeaker's deficient bass response may severely aggravate harmonic distortion generation. Consider a speaker system which is cap-

Fig. 4. Response when a 12" speaker in a six cubic foot bass reflex cabinet is placed in center of wall facing short room dimension. The room is 12 x 25 x 9 feet. The sound level meter was located 7 feet on axis. A low impedance amplifier was used.



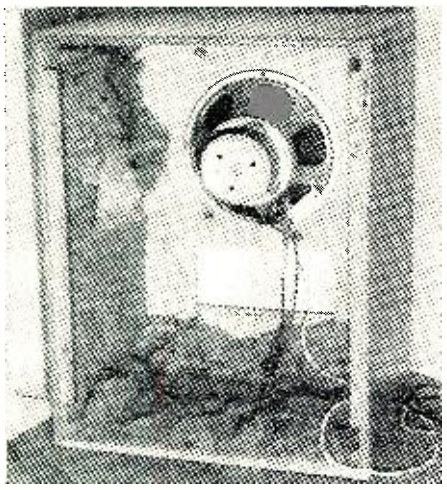


Fig. 5. Six cubic foot phase inverter baffle which housed 12" speaker used in tests covered in article. It measures 24"x 30"x14" and is made of ¾" plywood.

able of handling 5 watts at 30 cps (a relatively large, powerful speaker) connected to an amplifier system which has available a bass boost that can reach 15 db at 30 cps. Suppose that the hypothetical listener wishes his system to be capable of reproducing sound peaks from a symphonic recording at the 90 db level, which is as loud as a sane person would want in a large living room. This level would result seven feet in front of a loudspeaker if the speaker radiated one-tenth of an acoustic watt. Assuming a typical speaker efficiency of 10%, an audio power of one watt would be required. When the user desired to utilize the entire 15 db bass boost, the amplifier would then have to deliver, and the speaker would have to stand, 32 watts at 30 cps (15 db above 1 watt).

With this boost, the speaker would be expected to radiate 3.2 acoustic watts at 30 cps, which would place a 30 cycle sound at the 105 db level. To radiate 3.2 acoustic watts at 30 cps, an 8 inch loudspeaker mounted in an infinite baffle would have a total voice coil excursion of 7¼ inches, a 12" loudspeaker in an infinite baffle would have a total voice coil excursion of 3¼ inches, an 18" speaker a total excursion of 1.2 inches. For a 12" loudspeaker mounted in an exponential horn with a cut-off below 30. cps, the total cone excursion would be .135 inch. The latter is the only value which is within reason, as only the larger, heavier speakers have a linear cone travel at the voice coil of as much as .25 inch.

This example may be a bit extreme but it illustrates the folly of trying to produce high level low frequencies without an adequate loudspeaker system. A typical theater loudspeaker system may use as many as eight heavy duty 15" loudspeakers in its sound system to produce a peak sound level of 100 db at low frequencies.

It is apparent, then, that care should be taken to properly choose and baffle the speaker if distortionless low frequencies are desired.

Remember that the generation of spurious harmonics at low frequencies will increase intermodulation distortion and Doppler modulation distortion in single speaker systems. The amplitude of cone motion must be restricted to its linear region. This can be done in a number of ways.

The most obvious way is to use a baffle which increases the speaker's efficiency at low frequencies. The horn can increase a loudspeaker's efficiency from 10% to 50%, but a horn with a low frequency cut-off of 30 cps will be 16 feet long and have a mouth at least 8 feet square. This is a trifle large for the little woman to tolerate in her 12 x 18 foot living room. The horn may be folded and placed in the corner. This will result in a baffle which is of respectable size and appearance.

There is one example of such a horn which is commercially available. This unit is a folded horn designed to be placed in the corner of the room so that the room itself becomes part of the horn. This unit, called the "Klipschorn," will reproduce frequencies as low as 30 cps at full power and has a measured efficiency of 5%. See Fig. 1. Experience has proven that it is so complicated a structure as to be impractical for home construction. The inventor, Paul W. Klipsch, states that for proper operation, the unit must be air tight enough to hold several pounds of air for six seconds as measured with a water manometer.

There are several other baffles which will improve, to some extent, the loudspeaker's low frequency efficiency. These include the bass reflex, and acoustical labyrinth system which horn loads the back of the speaker diaphragm. Theoretically, these baffling means increase a speaker's low frequency efficiency 3 db (100%). The efficiency at low frequencies may be increased 3 db more by using two speakers in the same enclosure connected in phase. Depending upon the result desired, a speaker's low frequency response may also be varied over quite a range by placing it in different positions in a room.

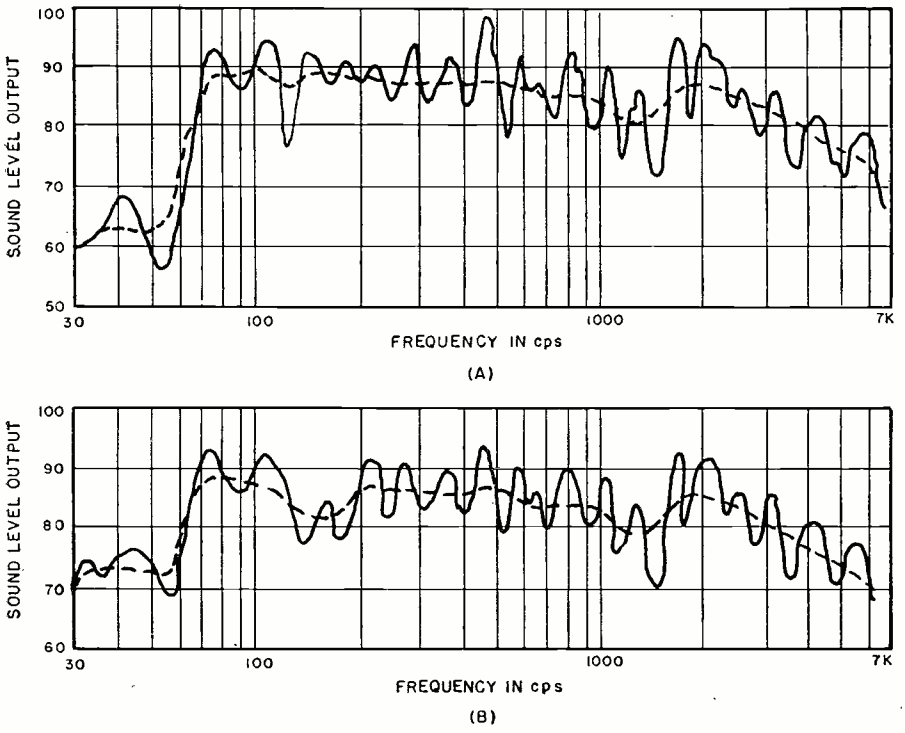
There are several philosophies which may be embraced. One: You may use every means including bankruptcy to obtain high level undistorted low frequency response, or; Two: You may limit the response of the whole system to a value commensurate with your means, or; Three: You may use a combination of both.

To evaluate the results obtained by moving a loudspeaker about in a living room, a typical heavy duty 12" speaker was mounted in a 6 cubic foot phase inverter baffle (for dimensions see Fig. 5). Response curves were taken in three representative positions in a typical living room. The response was measured with a *General Radio* type 75B sound level meter, used in conjunction with a laboratory type 10 watt amplifier, a *Hewlett Packard* Model 200B audio oscillator and a *General Radio* type sound analyzer.

Sound pressure curves on loudspeakers in a living room will include a large number of resonances not present in the free field response of a loudspeaker due to reflections and the room's standing wave structure. A curve, therefore, was made of the test loudspeaker and baffle mounted 20 feet above the ground with the speaker pointed across a 400 foot athletic field. The curve

(*Continued on page* 84)

Fig. 6. (A) Response of 12" speaker in six cubic foot cabinet when speaker is located in center of short wall facing long dimension of room. The sound level meter was 7 feet on the axis. A low impedance amplifier was used in making the test. (B) Same conditions as in (A) but with the amplifier in corner of 12'x25'x9' room.



AUDIO *Simplified*

By
DAVID FIDELMAN

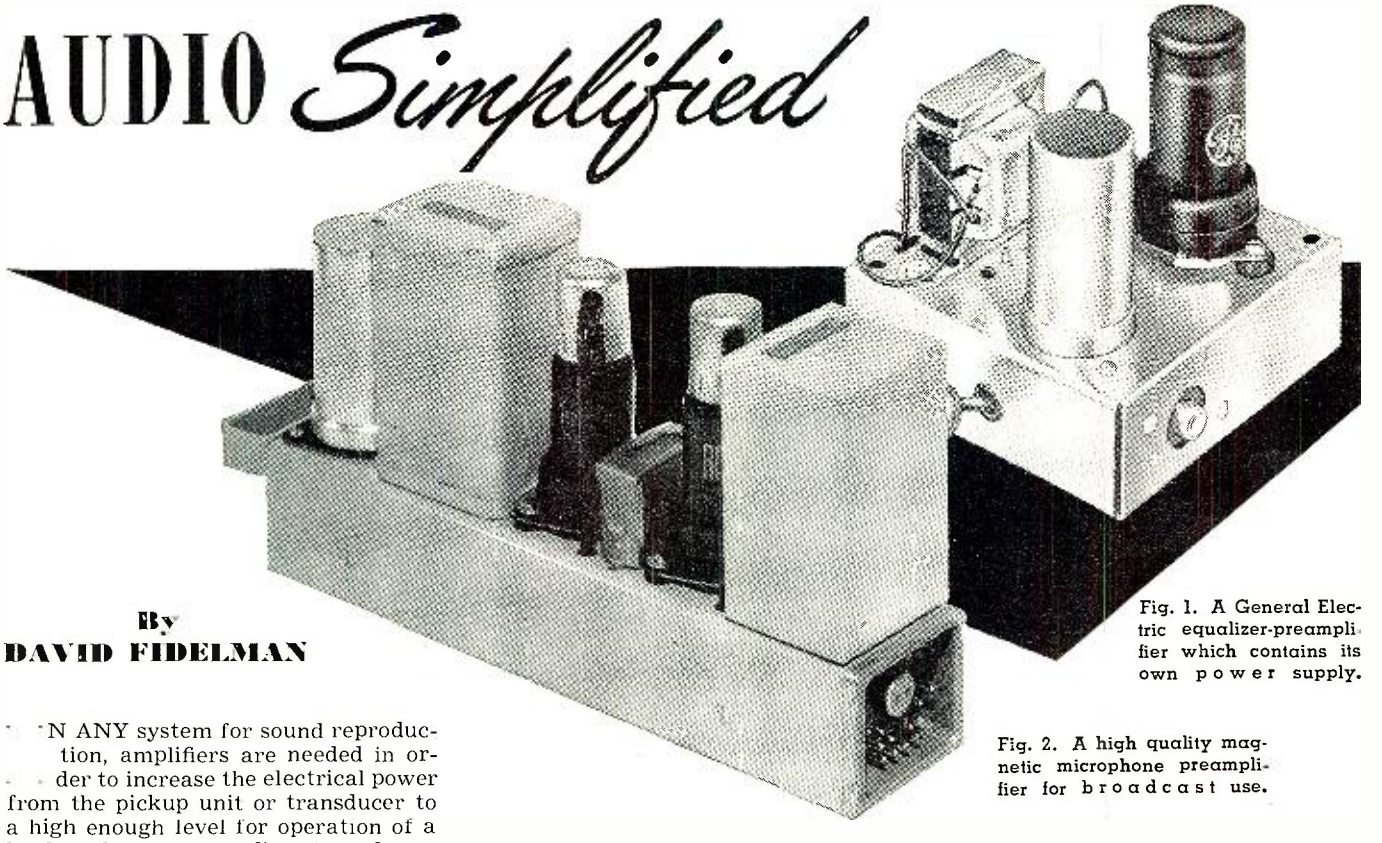


Fig. 1. A General Electric equalizer-preamplifier which contains its own power supply.

Fig. 2. A high quality magnetic microphone preamplifier for broadcast use.

Part 4. Design and construction of preamps for various pickup devices including matching data.

IN ANY system for sound reproduction, amplifiers are needed in order to increase the electrical power from the pickup unit or transducer to a high enough level for operation of a loudspeaker or recording transducer. Microphones and pickups derive their energy from extremely low-power sources—such as the sound pressure vibrations in the air, the modulation of the groove in a record, or the magnetization of an iron wire or an oxide-coated tape. The energy which is available to generate an electrical signal is generally a fraction of a microwatt, therefore the resulting electrical voltage is extremely low. But a considerable amount of audio-frequency power (on the order of 5 to 10 watts or more) is required to generate a sufficient amount of sound energy from the loudspeaker. Therefore the amplifier is required to raise the signal level from the voltage output of the pickup to the voltage required to drive the loudspeaker, both for voltage amplification and to make up the loss in any mixing and frequency-response equalization systems which are used.

The amplifier may be on a single chassis or it may be mounted as several units, but in general it will consist of four different sections:

(*a*) the preamplifier,
(*b*) the voltage amplifier,
(*c*) the driver section,
(*d*) the power amplifier.

These four sections perform different functions in the system, therefore different design and construction techniques must be used for each of them.

(*a*) The most important feature of the preamplifier is that it must amplify extremely low voltages without introducing any noise or other spurious signals into the audio signal which is to be amplified. Its function is to increase the signal power—either by delivering the same signal voltage at a lower impedance, or a higher voltage at the same impedance, or by a combination of both impedance transformation and voltage gain. Since the signal level in the preamplifier is the lowest in the entire system, the greatest care must be taken in the preamplifier to keep the possibilities of extraneous noise pickup to the absolute minimum, and all preamplifier design and construction techniques are set up for this specific purpose.

(*b*) The function of the voltage amplifier section is to give voltage gain. The output signal from a preamplifier, a mixer, or an equalizer network is generally at somewhat higher than microphone level, therefore the introduction of noise into such a signal is not the major factor that it is in the preamplifier. However, this signal is at much too low a level to be used for generating sound or driving a recording transducer directly. It is therefore fed through a voltage amplifier, which raises the voltage to a level at which it can be used for such operations as further mixing, equalization, transmission over telephone lines, etc. The voltage amplifier is designed to have the best possible frequency and phase response characteristics, and since the voltage gain is usually fairly high, care must be taken to avoid oscillations in the amplifier.

(*c*) The output of the voltage amplifier is coupled to the power amplifier by the driver section. The driver must supply sufficient voltage to the grid of the power amplifier to obtain full power output to the load without overloading. When a push-pull power amplifier is used, the driver section usually contains a phase inverter to couple the output of a single-ended voltage amplifier to the push-pull grids of the power amplifier. The most important consideration in the design of the driver section is that it must be able to supply enough power to the grids of the power amplifier to drive it to full output, and it may also contain features to minimize the effects of grid current in the power amplifier grids.

(*d*) The audio-frequency electrical output of the entire system is supplied by the power amplifier. The most important feature of the power amplifier is that it must be able to supply as much power as required by the loudspeaker or the recording transducer to perform its function properly. Generally, the major harmonic distortions in the amplifier system arise in the power amplifier stage, and this must be designed to introduce the minimum amount of distortion into the electrical signal. Since the transducers into which the power amplifier operates are mostly electromechanical in nature, it should also preferably present a low electrical impedance to the load, in order to introduce the proper amount of damping into the mechanical system.

The primary requirement of the amplifier is the amplification of low-level signals, therefore this is the main con-

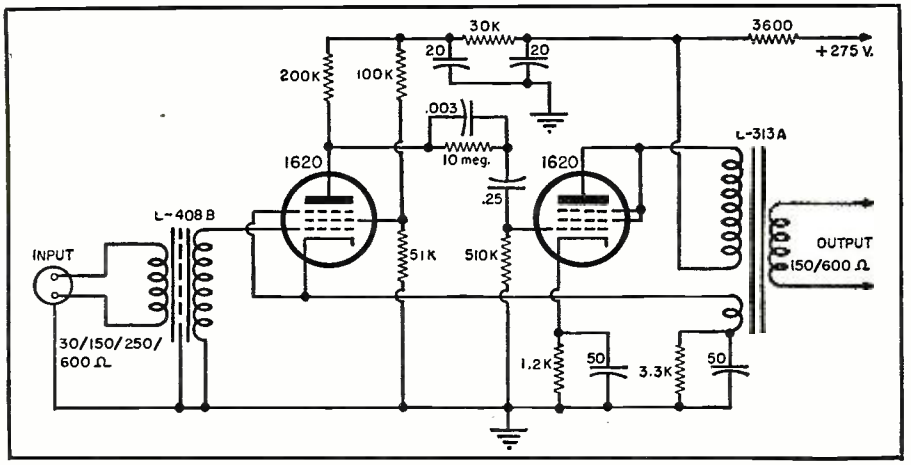


Fig. 3. Simplified schematic diagram of the preamplifier shown in Fig. 2.

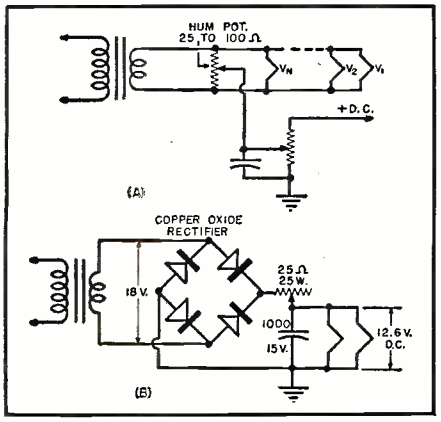
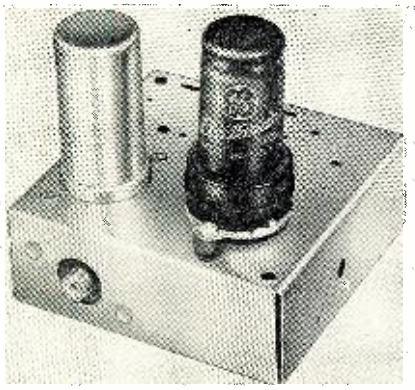


Fig. 4. Methods of reducing hum pickup from heater to cathode in vacuum tubes. (A) Use of a hum potentiometer and positive heater voltage to reduce hum pickup due to heater-cathode leakage. (B) Circuit of a d.c. heater supply for 12.6 volt tubes.

sideration in the design and construction techniques used for preamplifiers. The most important factors are aimed at achieving a unit which introduces the minimum amount of noise and vibration pickup while giving the required voltage gain or impedance transformation.

In general, the most critical applications of preamplifiers are in the amplification of signals originating in microphones, since these are almost always the lowest level signals in any audio system. The electrical power output of most microphones—whether high-impedance or low-impedance—is on the order of 0.01 microwatt, *i.e.*, 10^{-8} watts or less. For example, a microphone with an output impedance of 250 ohms will deliver an electrical output in the neighborhood of 1 millivolt, while a high-impedance crystal microphone will deliver 0.01 to 0.1 volt peak output signal into a 1 megohm load resistance. Low-level signals are also obtained from the various magnetic phonograph pickups which have an output impedance of about 100 ohms and deliver approximately 10 millivolts of electrical signal. When it is considered that a good sound reproducing system should have a signal-to-noise ratio of 50 to 60 db or better, the care that must be taken in the construction of preamplifiers becomes very obvious. Thus the noise pickup should be less than 1 microvolt at the input of a low-impedance microphone preamlifier, and less than 10 microvolts at the input of a preamplifier used for crystal microphones and magnetic phonograph pickups.

Fig. 5. The G-E equalizer-preamplifier for use with the variable-reluctance pickup.



The most serious types of noise problems are:

(*a*) a.c. hum pickup,
(*b*) thermal noise in resistors,
(*c*) vacuum-tube noise.

Although these cannot be completely eliminated, there are a number of design and construction techniques which will reduce these types of extraneous noise to a minimum. A more detailed consideration of the origin and effects of these types of noise will give a better indication of the importance of keeping them to a minimum, and will show what techniques should be used.

Alternating current hum pickup is caused by the presence of any 60 cps or 120 cps electric fields and may be picked up either capacitively, inductively, or by direct conduction. When the input lead from the microphone or phonograph pickup (where the signal level is at its lowest) is at a high impedance to ground, 60 cps voltages may be picked up by this lead because of its electrostatic capacity to some part of the circuit which is at a relatively high a.c. potential. If the input lead is low-impedance, 60 cps voltages can be picked up by electromagnetic induction from any part of the circuit which carries relatively heavy alternating currents. Inductive pickup of this type can occur both in the signal leads and in any input transformer that may be used. If the heaters of the preamplifier tubes are operated from a.c., hum pickup can be caused by direct conduction of electrons from heater to cathode. This will show up as a 120 cps component, since a maximum number of electrons are emitted from the heater at the current peaks which occur twice during each of the 60 cycles per second. It is also possible for 120 cps hum to be introduced into the signal through the power supply if there is any ripple present in the "B+" supplying the tube, but this effect is not a major one, since the remedy is merely to add more filtering to the power supply for the preamplifier.

Capacitive hum pickup in high-impedance input leads can be reduced by covering the signal lead with a grounded shield to decrease its capacity to other parts of the circuit. Either a single-conductor or a double-conductor shielded lead may be used, depending upon whether the signal is balanced or unbalanced with respect to ground. When a shielded lead is used, high-impedance transducers (such as crystal microphones and phonograph pickups) can then be situated at relatively great distances from the preamplifier—the main consideration governing the length of lead being the capacity to ground that can be tolerated by the circuit to maintain good high-frequency response and signal level.

Inductive pickup in low-impedance input leads is kept to a minimum by keeping the signal lead and its return lead as close together as possible (*i.e.*, they should be run alongside one another in the same cable), so that there is very little loop for induction pickup. In addition, the circuit impedance should not be too low, so that the induction currents will tend to be limited by the circuit impedance. Long leads, even at low impedance, should be shielded to minimize the possibility of capacitive hum pickup. When an input transformer is used, it must be one with good magnetic shielding and a hum-bucking type of winding; it should be placed as far away as possible from any other transformer or motor carrying a.c., and oriented in such a direction that its hum pickup is at a very minimum.

Hum pickup from heater to cathode can be kept to a minimum by taking the heater return from the tap of a potentiometer connected across the heater terminals either to ground or to an adjustable positive d.c. voltage, and adjusting the potentiometer and the voltage to give minimum hum pickup. If the hum it not sufficiently reduced, the preamplifier heaters should be operated with d.c.

Thermal noise in resistors is caused by the random motion of free electrons. This electron motion causes small potentials to be developed across the resistor. These are called thermal voltages, and the noise associated with

them increases with temperature, with frequency range, and with the size of the resistance. As an example of the effects of thermal noise, the r.m.s. thermal voltage developed across a 0.5 megohm resistor at room temperature for a frequency band of 5000 cps is 6.4 microvolts, and for a frenquency band of 10,000 cps is 9 microvolts. Ordinary carbon resistors also generate considerably more noise than the normal thermal noise when current is passed through them, due to fluctuations in the contact resistance between adjacent carbon granules. Since resistors of different makes often vary considerably, resistors having the minimum amount of noise should be selected as the plate resistors of low-level stages.

Vacuum-tube noise consists of noise which is generated inside the preamplifier tubes. The generation of hum voltages due to heater alternating currents has already been described, but there are also other types of noise which can originate in the tube. *Microphonics* are caused by variations in the spacings of the different elements inside the tube due to mechanical vibration and shocks. These can be kept to a minimum by using tubes which have been specifically designed to have a minimum of microphonics, and by mounting the first stages on soft rubber mountings which will absorb much of the vibration from the chassis to the tubes. Noise is also generated in the tube due to the fact that the current emitted from the cathode is not a perfectly smooth uniform stream, but is emitted as a large number of discrete electron charges. The variations in current due to this effect will result in fluctuations in the plate current of the tube, and have the same effect as current variations due to noise in the signal circuit. Examples of tubes which have been designed specifically for a low amount of microphonics and noise are the type 1620 and 1603 pentodes, the 5879 miniature pentode, and the 12AY7 miniature dual triode.

Design and Construction

Basically the circuit of the preamplifier has to be one which provides a certain amount of gain or an impedance transformation, and which introduces very little noise into the signal in the process. The specific form which the circuit will take depends primarily upon the impedance of the transducer whose voltage is being amplified, and also upon its output voltage.

The lowest voltages which are encountered in common practice are generally obtained from low-impedance magnetic microphones. A typical preamplifier to be used with this general type of microphone is shown in Fig. 2, and the schematic circuit diagram is shown in Fig. 3. An important feature of this circuit, which should be noted, is that preamplifiers for low impedance microphones invariably make use of an input transformer to match the low impedance of the microphone to the high impedance of the grid circuit and to obtain a voltage step-up in this process. For example, in matching a 50 ohm microphone to a 50,000 ohm grid circuit the impedance ratio is 1000:1, and a voltage step-up of 30:1 is obtained. This increase in the level of the voltage applied to the grid is extremely important, because it results in a considerable improvement in signal-to-noise ratio over what would be obtained without the input transformer. However, the transformer itself must be magnetically shielded and constructed for minimum a.c. hum pickup, if the lowest noise level is to be attained.

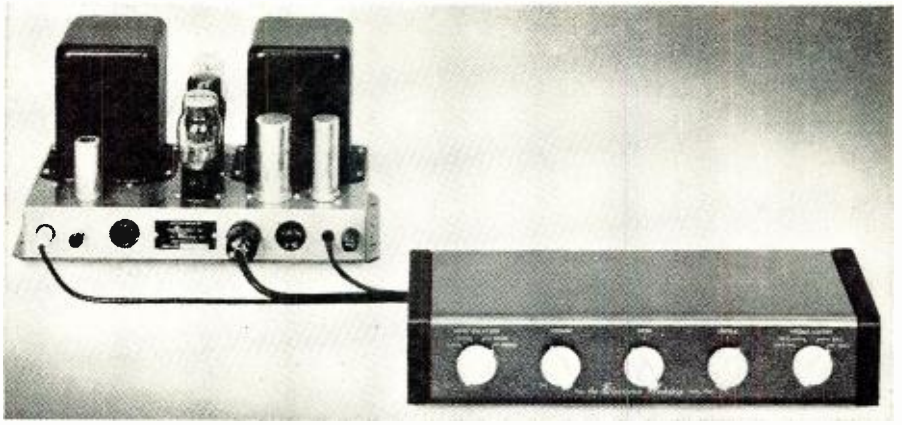


Fig. 6. Commercial amplifier with a remotely located preamp/control panel.

The secondary voltage of the transformer is applied to the grid of the preamplifier tube, either with or without a terminating resistor, according to the specific design of the transformer. The first preamplifier tube is one of the low-level audio amplifier tubes which have been designed and especially selected for a low amount of microphonics and noise. Additional protection against noise due to vibration and shocks is obtained by mounting this tube on rubber which absorbs mechanical vibrations that would otherwise be transmitted to the tube from the chassis.

The required gain and output impedance of a preamplifier are usually determined by the requirements of the complete sound reproducing system with which it is to be used. In broadcast and many other applications it is desirable to have long leads running from the preamplifier to other components of the system, and these leads must, therefore, be run at low impedance—usually anywhere between 150 and 600 ohms. This generally means that a transformer should be used to couple the preamplifier output tube to the line, so that the line may have either one side or center-tap grounded. The output tube is therefore connected as a triode, since the plate impedance of a pentode is too high to permit a transformer to be used as the plate load. This particular unit, shown in the photograph of Fig. 2, is a high-quality preamplifier suitable for broadcast use, with a multiple-impedance input transformer to match various microphone impedances to the first grid, and an output transformer to match a 150 or 600 ohm line. It has an absolute noise level equivalent to a –120 dbm input signal, a gain of 40 db, and a maximum output level of +18 dbm.

Magnetic phonograph pickups have a low output impedance and a higher signal voltage than microphones, therefore they can be used with a preamplifier either with or without an input transformer. A preamplifier with an input transformer is basically the same as used for a magnetic microphone, such as the circuit of Fig. 3. Otherwise the output of the pickup may be applied directly to the grid of the first tube. However, there is one important

(*Continued on page* 112)

Table 1. Performance characteristics of the various types of microphones.

TYPE OF MICROPHONE	DIRECTIONAL CHARACTERISTICS	OUTPUT IMPEDANCE	OUTPUT LEVEL	FREQUENCY RANGE	MAJOR APPLICATIONS
Velocity (ribbon)	Bidirectional	50/250 ohms	—55 dbm	30-15,000 cps	High quality and studio pickup
Dynamic (moving coil)	Nondirectional	50/250 ohms	—55 dbm	40-10,000 cps	Studio pickup, remote and outdoor uses
Cardioid	Unidirectional (usually adjustable to bidirectional and nondirectional)	50/250 ohms	—57 dbm	40-10,000 cps or better	High quality studio pickup
Crystal	Nondirectional	1 megohm (approx.)	—51 dbm	40-10,000 cps at best	Amateur, home and p.a.
Condenser	Nondirectional	About 10 megohms (requires special preamplifier)	Approx. —55 to —50 dbm after preamp	30-15,000 cps or better	High quality studio pickup and as sound measurement standard
Carbon	Nondirectional	100 ohms	Approx. —45 dbm	Voice frequencies	Voice reproduction and talk-back

IMPEDANCE MATCHING for Multiple Speaker Installations

By
ROBERT NEWCOMB
Pres., Newcomb Audio Products Co.

The problem of obtaining correct impedance match and power distribution in a multiple speaker system is not difficult. It can be worked out on paper before actual work is started.

MUCH has been written on the subject of impedance matching but the number of questions received by the author on this subject seems to indicate that much confusion and misunderstanding still exists among sound men. It is believed the following discussion of multiple speaker matching procedures will be found helpful to those who are confronted with the problem.

Paralleling the voice coils of like speakers is perhaps the most common connection for multiple speakers. The matching impedance tap, required at the amplifier output, is then equal to the impedance of the one speaker divided by the number of speakers. For example, when two 16 ohm speakers are connected in parallel, the resulting impedance of the combination is 8 ohms. Thus, the connection to the amplifier is made to the 8 ohm output tap.

What generally happens in installations requiring a large number of speakers, is that the combined impedance becomes so low it is impossible to find a tap of sufficiently low impedance at the amplifier. Even if such low impedance taps were available, the currents in such low impedance lines would probably be so high that excessive line losses would result. Two alternatives are available. The first, but not necessarily the best, is to connect all voice coils in series. The matching impedance would then be the sum of all voice coil impedances. Thus, ten 8 ohm voice coils connected in series would be 80 ohms. The chances are we cannot easily match such a series impedance. Even if we could, the fact that if only one speaker voice coil opened it would stop the entire system, precludes the wide acceptance of this procedure. The second and generally best procedure is to connect to each speaker matching transformers of such primary impedance that the paralleled impedance of all will equal the available output impedance. Thus, the ten 8 ohm speakers could be connected to transformers with 8 ohm secondaries and 5000 ohm primaries. The resulting combined impedance would be 5000/10 or 500 ohms. Another frequent reason for the use of impedance matching transformers is to reduce copper losses in low impedance speaker lines which will occur if these lines are either too long or too small a wire size or both. When deciding to use transformers to reduce line loss, it is important to select transformers whose efficiency is not so low as to dissipate within the transformer a greater amount of power than is being saved by switching to high impedance lines. Losses up to 60% are not uncommon in the small inexpensive impedance matching transformers most frequently sold. Medium sized transformers will generally have losses up to 20 or 25%. High quality matching transformers may have losses as low as 10 or 15%. In only the very largest transformers and heavy duty auto transformers is one likely to find losses less than 10%.

The proper matching of a quantity of speakers having different power requirements becomes fairly involved. It can, however, be simplified by the following formula:

$$Z_t = \frac{W_o \, Z_o}{W_d}$$

Where: Z_t = transformer impedance
W_o = amplifier watts output
Z_o = output impedance tap
W_d = desired power at loudspeaker.

"Transformer Impedance" is the needed primary impedance of the loudspeaker transformer to give the desired power at the speaker. "Amplifier Watts Output" is the actual rated output of the amplifier as per manufacturers' specifications. "Output Impedance Tap" is the amplifier output tap, in ohms, it is desired to use. To achieve correct match, the sum of all powers assigned to each loudspeaker, must equal the "Amplifier Watts Output" used in the formula.

As an example of the practical application of this formula assume two speakers at 5 watts each and two speakers at 20 watts each for a total of 50 watts. We have a 50 watt amplifier. If we decide we want to use the 500 ohm output tap of the amplifier, we proceed as follows: $(50\times500)/5 = 5000$. Thus, each 5 watt speaker would require a 5000 ohm transformer. Then $(50\times500)/20 = 1250$. Thus, each 20 watt speaker would require a 1250 ohm matching transformer. Had we desired to use the 250 ohm output tap in this problem, the result would be speaker transformer matching impedances one half the above.

In many instances, the engineer is primarily concerned with achieving certain differences in output between various speakers. Actual volume per speaker may be of relatively small concern for this can be controlled by the amplifier volume control. As long as the engineer is certain that the amplifier power is sufficient and that the distribution of that power is his only problem, he can simplify his calculations by ignoring the requirement that the "sum of all allotted powers to the speakers must equal the actual amplifier rated power." He may assign any convenient power to one of the speakers and then assign powers to the others in relation to the relative output desired. Add up all the powers thus derived and use this figure in the formula in place of the "Amplifier Watts Output" and an exact impedance match will still result.

For example, suppose in the first example of two 5 watt speakers and two 20 watt speakers, we had arbitrarily started with 6 watts for each of the lesser powered speakers that are to be of equal volume and on the assumption we wanted 6 db more power on the other two, we would assign them a power of 24 watts each. The sum of these speaker powers is then 60 watts. The formula then works as follows: $(60\times500)/6=5000$ ohms (as before), and $(60\times500)/24=$

(*Continued on page* 150)

A SENSITIVE 88-108 MC. R.F. TUNER FOR FM

By
R. G. FINKBEINER

Design details on a well-engineered r.f. tuner. Unit features direct antenna coupling and a.f.c. system.

THE r.f. tuner to be described is intended to be used in conjunction with a 10.7 mc. i.f. strip, audio amplifier, and power supply to make a frequency modulation receiver, or to improve an existing receiver.

This tuner, as originally constructed, was conventional in every respect, but a modification in the antenna coupling system, a change in the 6BE6 grid coil, and the addition of an automatic frequency control system made such an improvement in over-all performance that a description of the final circuit was considered worthwhile.

Direct antenna coupling, an idea used in many TV tuners, made the most noticeable improvement in sensitivity. The coaxial antenna lead-in is terminated in a resistor, R_1, equal to or higher than its characteristic impedance, and connected directly to the grid of the 6BA6 r.f. amplifier. This eliminates the usual tuned circuit and three of its inherent problems; feedback through the common rotor shaft of the tuning condenser, tracking with the mixer and oscillator, and low coil "*Q*". Even when separate, insulated tuning condenser sections were used, the direct coupling still out-performed all tuned antenna coupling methods tried.

Separate excitation of the 6BE6 mixer is used for maximum stability and conversion gain. First examination of the tapped grid coil arrangement would lead one to connect the 6BE6 grid to the top of the coil, L_1, and leave the 6BA6 plate lead tapped down as shown. This gives an apparent step-up ratio, but the increase in circuit "*Q*" with both tapped down permits far better performance.

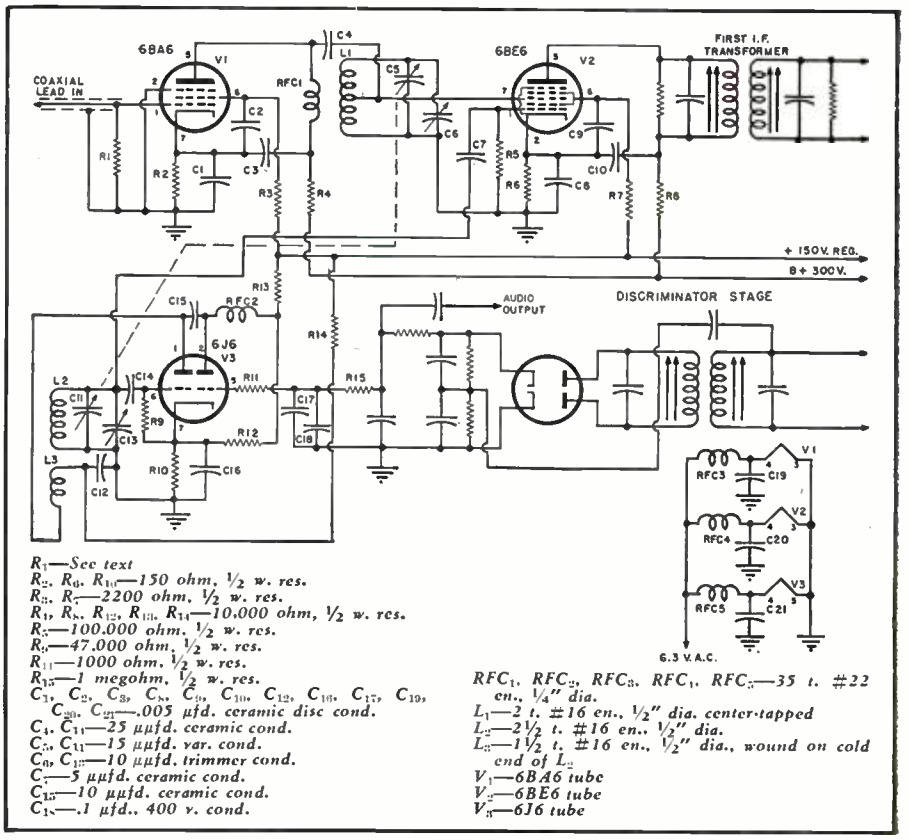
The oscillator is one-half of a 6J6 in a tickler feedback circuit. No temperature compensation is necessary, provided that all high wattage resistors used in the receiver are placed above the chassis and away from the oscillator circuit.

The second half of the 6J6 is a simple automatic frequency control circuit. It is essentially a variable reactance connected across the oscillator tank circuit. The d.c. control voltage taken from the discriminator is negative on one side of resonance, positive on the other side, and zero at resonance. It varies the oscillator frequency to correct for drift and incorrect tuning, within reasonable limits.

If the a.f.c. circuit tends to "pull" the receiver out of tune, it will be necessary to reverse the discriminator transformer secondary leads for proper phasing of the d.c. control voltage.

Alignment consists of squeezing or stretching the oscillator and mixer coils for proper coverage and tracking. It is impossible to specify the exact coil dimensions at this frequency, so a bit of individual pruning will be necessary. The oscillator should operate on the low side of the incoming signal. —30—

Circuit diagram of 88-108 mc. r.f. tuner. It is designed to be used in conjunction with a 10.7 mc. i.f. strip, audio amplifier, and power supply.

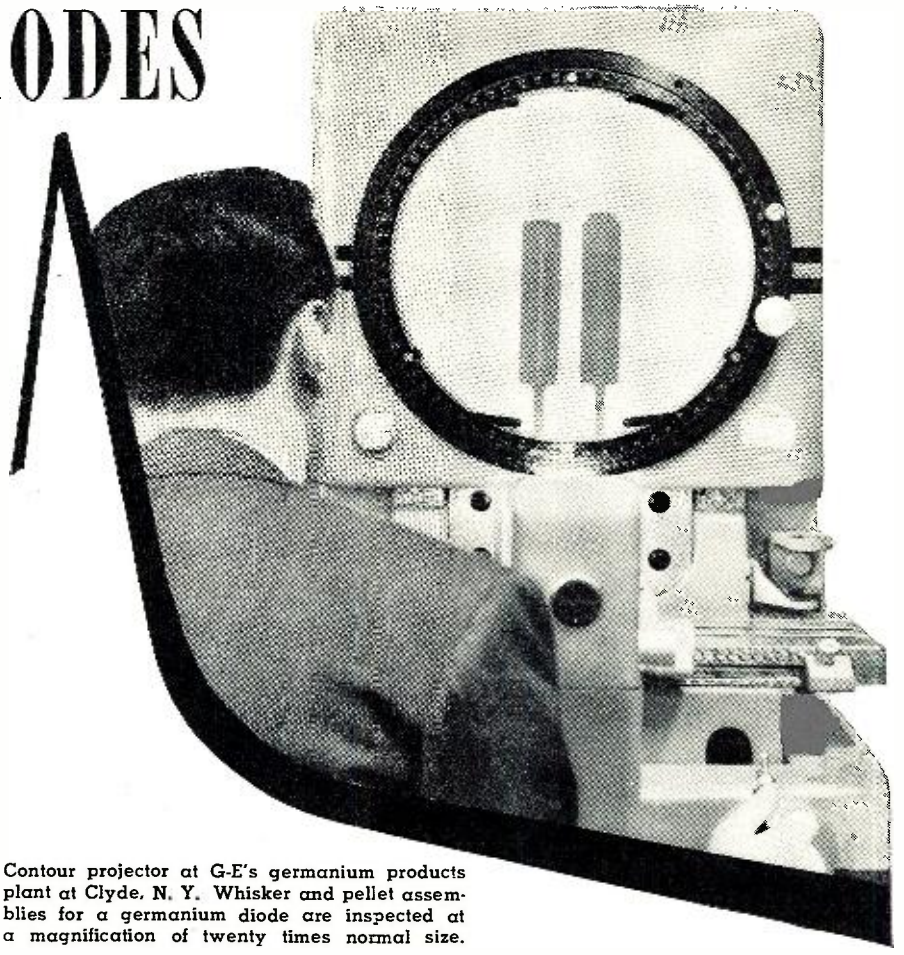


R_1—*See text*
R_2, R_8, R_{10}—*150 ohm, ½ w. res.*
R_3, R_7—*2200 ohm, ½ w. res.*
R_4, R_5, R_{12}, R_{13}, R_{14}—*10,000 ohm, ½ w. res.*
R_6—*100,000 ohm, ½ w. res.*
R_9—*47,000 ohm, ½ w. res.*
R_{11}—*1000 ohm, ½ w. res.*
R_{15}—*1 megohm, ½ w. res.*
C_1, C_2, C_3, C_5, C_9, C_{10}, C_{12}, C_{16}, C_{17}, C_{19}, C_{20}, C_{21}—*.005 µfd. ceramic disc cond.*
C_4, C_{14}—*25 µµfd. ceramic cond.*
C_6, C_{11}—*15 µµfd. var. cond.*
C_8, C_{13}—*10 µµfd. trimmer cond.*
C_7—*5 µµfd. ceramic cond.*
C_{15}—*10 µµfd. ceramic cond.*
C_{18}—*.1 µfd., 400 v. cond.*

RFC_1, RFC_2, RFC_3, RFC_4, RFC_5—*35 t. #22 en., ¼" dia.*
L_1—*2 t. #16 en., ½" dia. center-tapped*
L_2—*2½ t. #16 en., ½" dia.*
L_3—*1½ t. #16 en., ½" dia., wound on cold end of L_2*
V_1—*6BA6 tube*
V_2—*6BE6 tube*
V_3—*6J6 tube*

CRYSTAL DIODES In Modern Electronics

By
DAVID T. ARMSTRONG



Contour projector at G-E's germanium products plant at Clyde, N. Y. Whisker and pellet assemblies for a germanium diode are inspected at a magnification of twenty times normal size.

Part 3. A discussion of the AM applications of germanium crystal diodes in modern receivers.

THE input signal that is fed to the detector stage is an alternating current operating at a frequency represented by the receiver i.f. This signal is modulated by the audio component that was present in the original signal picked up by the antenna. The signal that appears at the output of the detector is the audio component, no more. Thus it is commonly said that the function of the second detector is to demodulate the input signal. The input to the detector is modulated a.c.; the diode by virtue of its rectifying action changes this to pulsating d.c.; and the filter smooths the pulsating d.c. into an audio frequency. In many applications a crystal may perform this rectifying function more satisfactorily than a tube.

Crystal diodes are being used quite effectively in bandpass receivers and may also operate push-pull to give full wave detection, but this is hardly their most common application in AM. With a high fidelity audio amplifier to compensate for the low gain output of a crystal detector, excellent room presence sound is possible by virtue of the linearity characteristic of a crystal detector at low signal voltages.

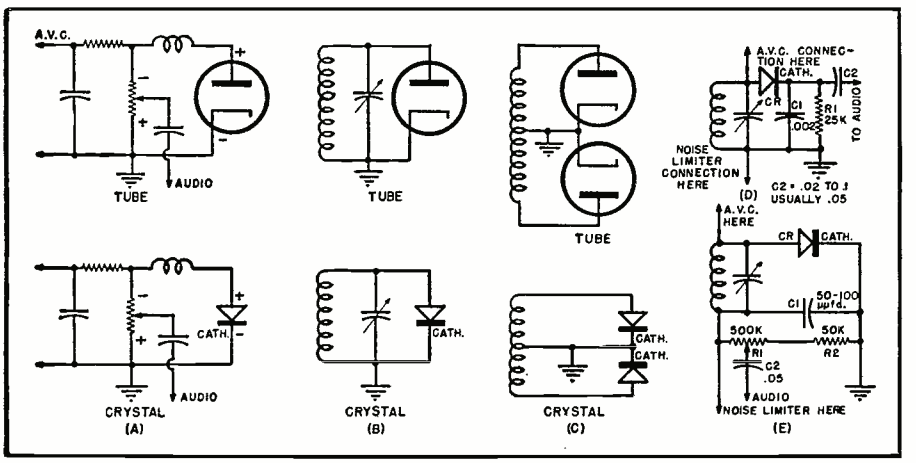
As the demand for good quality audio grows in the AM field, more and more high fidelity receivers are likely to be designed to use crystals. At the present time crystals are not widely used in AM except by amateurs and experimenters. As diode crystals become mass produced manufacturers will seize upon them because they will provide better quality at a lower price on a smaller chassis.

In a diode detector circuit the input r.f. signal is invariably the i.f. of the receiver; this signal is detected by the diode and the modulation component appears in the output as an alternating voltage with a d.c. component. This is the load across the diode load resistor. There is no gain in this type of detector circuit and there is some loading effect on the circuit which feeds it. This type of detection is frequently used in high quality receivers because the demodulated output is relatively distortionless.

One good reason why diodes are popular as second detectors is that they provide a simple method of obtaining a.v.c. But diodes do load a tuned circuit to which they are connected and act to reduce the selectivity somewhat. In high quality receivers special i.f. transformers provide a low impedance input to the diode detector. This is a most desirable situation in which crystals will perform unusually well.

The most common uses of germanium crystals in AM are in connection with the second detector (or demodulator), a.v.c., and noise limiters. Fig. 1 shows series diode second detector circuits in common use for short-wave and all-wave receivers. Space saving and simplicity recommend crystals. These components are so small in size

Fig. 1. Tube and crystal diode versions of (A) basic AM detector, (B) half-wave detector, (C) full-wave detector. (D & E) Two versions of AM second detector. The cheaper 1N51 would give less output, while the costlier 1N52 or 1N65 will give more output.



that they may easily be built into the i.f. can, which is where they should be. At the present time they are not being handled this way because a crystal costs more than a tube. With the tube you also get a first audio stage when you use a 6SQ7 or equivalent type. With mass production this differential is likely to change.

The resistor and condenser values in the associated circuitry are similar to those which would be employed with a vacuum tube detector; in the circuits shown they are for a 455 kc. i.f. Both the 1N34 and the 1N48 are common in this type circuit; the 1N51 may also be used, but it will give less audio output. The 1N52 or 1N65 will give greater output. Therefore, use the best crystal which is the least expensive.

A.V.C. Applications

When an audio signal is across the manually operated volume control the position of the arm determines the strength of the signal fed to the audio amplifier. This audio signal has strong pulsations and is not suitable for use as automatic biasing voltage. Bias voltage should be relatively pure direct current. An additional filter added to the audio circuit smooths the audio pulsations to a relatively pure direct current; the filter condenser in the a.v.c. bus is usually .05 μfd. to make it effective at audio frequencies.

Fig. 3 shows typical a.v.c. circuits which may be used in conjunction with the circuits shown in Fig. 1. Either may be tied to the circuits of Fig. 1 at the points marked "a.v.c. connection here." Both circuits are designed for the popular 455 kc. i.f., but the one shown in Fig. 3A will give better a.v.c. regulation than the circuit shown in Fig. 3B by virtue of superior circuit design.

In a high quality receiver it is good practice to design the circuit so as to have a separate diode for detection and a rectifier circuit for a.v.c. voltage. The reason for using such a circuit is to eliminate shunt loading of the a.v.c. bus in the detector circuit.

One satisfactory arrangement to compensate for a.c. shunt loading effect in the a.v.c. circuit upon the detector load resistance is shown in Fig. 2A. The separate a.v.c. diode takes its r.f. voltage from the plate of the last i.f. amplifier tube; this r.f. supply is rectified by the diode to become the a.v.c. voltage. Note that the audio is connected directly to the grid to achieve diode biasing upon this grid. A more conventional system would be to employ a blocking condenser and a high value of grid resistor (5 to 10 megohms) rather than the direct connection.

Using separate diodes for detector and a.v.c. functions helps to improve audio fidelity; most of the undesirable effects of a.c. shunt loading on a detector diode are thus avoided.

Noise Limiters for AM Sets

The use of noise limiting circuits

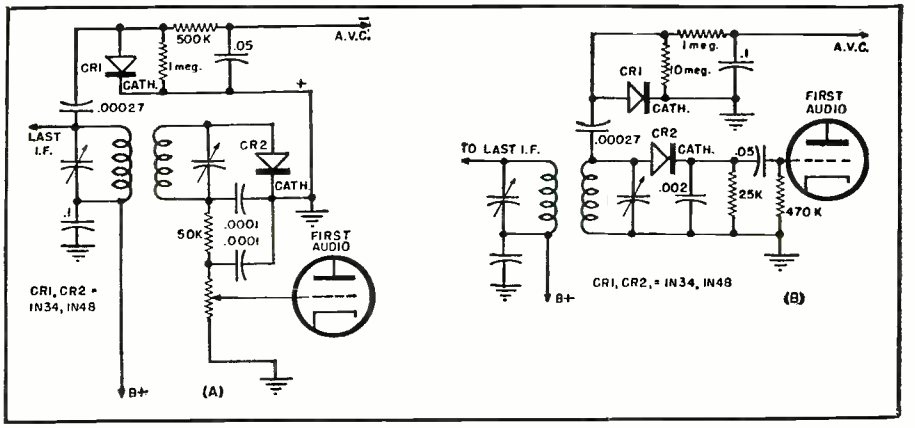


Fig. 2. (A) Minimizing shunt loading with separate a.v.c. and detector diodes. CR_1 and CR_2 may be either a 1N34 or a 1N48. Note the direct coupling from the volume control to the first audio grid. This provides bias for the first audio stage. (B) Separate detector and a.v.c. diodes. Either a 1N34 or 1N48 may be used here.

improves signal-to-noise ratio, particularly for noise attributable to certain types of interference external to the receiver. Germanium diodes may be used in a variety of limiter circuits, each of which has distinct advantages. In mobile installations it is sometimes necessary to obtain reception with normal equipment under severe natural conditions of man-made noise. such as ignition interference. Here a germanium crystal may become a noise reducing device able to render a receiver less susceptible to some of this interference.

Achieving the maximum inherent signal-to-noise ratio within a receiver becomes a problem of obtaining the highest possible effective front end gain with a minimum of internally developed receiver noise due to thermal agitation and tube hiss. Generally the level of external man-made impulse type noise far exceeds the noise contributed by the receiver itself. Most man-made disturbances are of a pulse like nature, and the duration of a single pulse is about one to two microseconds, with perhaps 10 pulses-per-second.

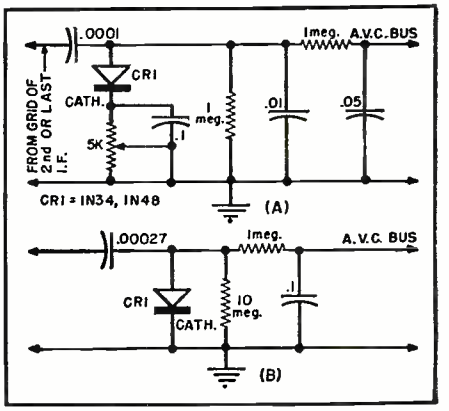
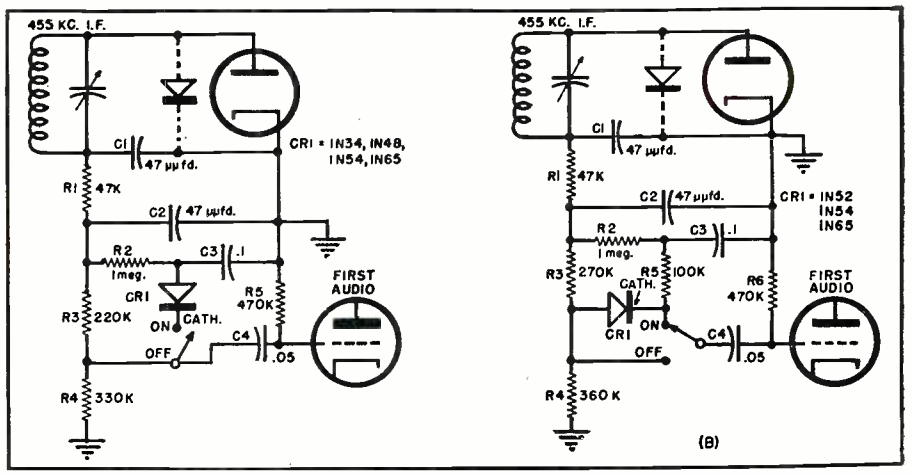


Fig. 3. (A) Delayed and (B) non-delayed a.v.c.

These pulse type noise voltages are of extremely high peak amplitude, but of insufficient time duration to produce any appreciable distortion in audio circuits. They may excite tuned circuits into damped oscillations which can prolong the effect of the pulses; it is usually this which appears as distortion in the audio output.

Several possible methods of reducing noise exist, but the simplest clips

Fig. 4. (A) Circuit diagram of a shunt diode limiter. A 1N34 or 1N48 crystal diode detector, shown dotted, may be used. Components C_1, R_1, and C_2 make up the RC filter. R_2 and C_3 comprise the time constant circuit while R_3 and R_4 combine to form the audio voltage divider. (B) A series diode limiter. The detector, shown dotted, may be a 1N34 or 1N48 crystal type or a vacuum tube. The switch cuts CR_1 and R_5 out of the circuit which is not objectionable since R_5 is an isolating resistor which acts in conjunction with R_4 as part of diode load when diode is conducting.



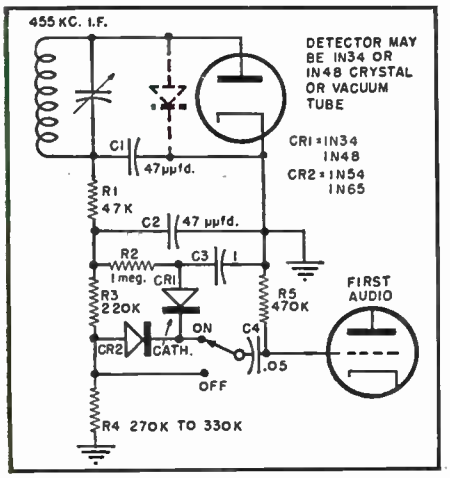


Fig. 5. Compound (shunt-series) limiter. The detector may be either a 1N34 or 1N48 crystal or a vacuum tube. The ratio of R_3 to R_4 should be adjusted for effective limiting with most desirable audio signal. The limiting level decreases as R_3 becomes smaller with respect to the value of R_4.

(or amplitude limits) the pulse at a level slightly below the level of the received signal. Thus any audio distortion introduced is a factor of the modulation percentage. This limiting method is best adapted to become the noise reducing system in any receiver that uses a diode demodulator, because it may be included with a minimum of circuit changes.

The common noise limiting circuits in which diode crystals are used may be any of these three basic types: shunt, series, and compound. The shunt type diode crystal limiter is shown in Fig. 4A. C_1, R_1, and C_2 make up a typical filter for r.f. The values to be selected for this time constant configuration are important because by restricting the energy storage in this filter they reduce the amplitude of any transient that immediately follows the noise pulse.

Experiment has shown that load capacitances as small as 47 $\mu\mu$fd. do not unduly affect demodulation efficiency of the detector at the i.f. normally encountered in broadcast receivers, and that load capacitances of this value do reduce the amplitude of the transient to an insignificant value.

The series combination to ground, made up of R_2 and C_3, must have a time constant sufficiently long to permit the lowest audio frequency to be passed, but the time constant must not be so long that it does not permit the d.c. voltage at the anode of the clipper crystal to follow the normal changes in carrier level.

Resistors R_3 and R_4 perform the function of an audio voltage divider. The ratio of R_3 to R_4 should be such that, under 100% modulation conditions, the d.c. peak audio voltage at the cathode of the clipper crystal approximates the fixed d.c. voltage at the anode. The audio voltage division established by this series combination should be capable of providing a limiting level satisfactory at high modulation percentages.

The adjustment of these resistor values may be made such that satisfactory limiting consistent with minimum audio distortion results. Here it pays to use potentiometers which may be adjusted manually for the most satisfactory signal, at which point the resistance of the pots may be measured and a commercial resistor of appropriate size substituted. The actual values of R_3 and R_4 are not equal, but rather of a ratio about 2 to 3, or 3 to 4.

The limiting action of all clipper circuits shown here occurs in the audio channel and is applied at some point immediately following detection. These circuits are so designed that the clipping level adjusts itself automatically to the level of the received signal, and eliminates the need for any manual adjustments. They are, in effect, automatic limiter controls.

The series diode limiter shown in Fig. 4B is less critical to audio load impedance variations than the shunt type of Fig. 4A; therefore, it is a more flexible limiter. The noise attenuation of the series type is a function of the reverse resistance of the crystal; therefore, use of a high back resistance diode such as the *Sylvania* 1N54, or the GE 1N52 or 1N65 is suggested. Fig. 6 compares the reverse resistance for a 1N52, 1N54, and 1N63. It will be evident from a consideration of the graph that the 1N52, 1N54, and 1N63 are superior crystals for this application.

The compound limiter shown in Fig. 5 combines the advantages of the shunt and series types and provides considerably more noise attenuation. This circuit functions effectively over a relatively wide range of signal and noise amplitudes; and, in the absence of a carrier, an effective audio squelch action is obtained. This compound limiter also provides good limiting action at low signal levels.

Fig. 6. Comparison of back resistances of germanium diodes. The maximum back resistance generally occurs in the vicinity of -10 to -20 volts, although this point will vary between units. The 1N52, 1N54 and particularly the 1N63 are designed for use in high impedance networks. The negative excursion of applied voltage need only be within the peak inverse voltage rating of diode being used. The magnitude of reverse resistance varies depending on the amount of voltage impressed on diode. This resistance increases very rapidly as back voltage is increased from zero to -10 volts.

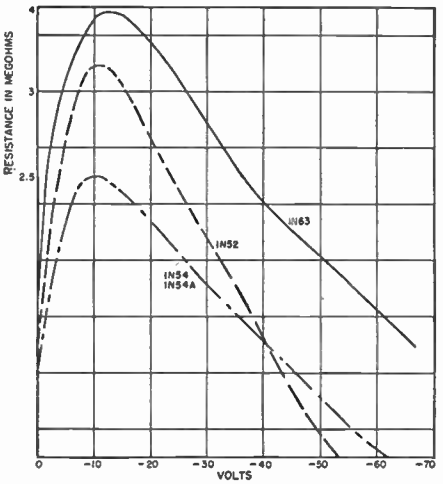


Fig. 7 illustrates a highly effective automatic noise limiter circuit, particularly designed for reduction of impulse interference in amplitude modulation receivers. The circuit is self adjusting to the average level of the input signal and clips noise impulses which exceed a predetermined amplitude relative to the input signal. The 1N54 high reverse resistance crystal is a good series clipper element, and the 1N34 is a good shunt clipper element. All the associated components may be enclosed in the last i.f. shield can and this will provide an unusually high degree of impulse noise suppression. Once this circuit is adjusted it requires no further attention since it is self adjusting to various signal strengths and various noise conditions.

The circuit in Fig. 5 is a difficult one to comprehend because at first glance the diodes seem to buck each other out. In reality they do; they must be back-to-back so that one will open while the other closes. The diode connections are correctly shown due to the way in which they operate in the circuit. In the absence of noise CR_1 does not conduct due to the fact that its anode is held at a negative potential with respect to the cathode by virtue of the charge on C_3. At the same time diode CR_2 is in a state of conduction because its cathode is more negative than its anode due to the negative voltage applied through the 1 megohm resistor and the inverse resistance of CR_1. That condition holds true as long as the sum of the d.c. and back audio voltage at the junction of R_1, R_2 does not exceed the d.c. reference established by the carrier level.

A noise impulse causes the instantaneous potential of the detector load network to become highly negative. Since the anode of CR_2 is connected across a substantial portion of this load network it too becomes instantaneously negative with respect to its cathode and CR_2 ceases to conduct.

However, the attenuation at the grid of the following audio tube is a function of the ratio of the inverse resistance of the diode to the grid leak of that stage. Therefore, limiting would not be complete if the impedance from the grid of the audio stage to ground were to remain equal to the resistance of the grid leak. Since a substantial fraction of the negative voltage appearing at the junction of R_1, R_2 also appears at the input to the audio stage, the cathode of CR_1 is made negative with respect to its anode. CR_1 now conducts, reducing the net input impedance at the grid of the audio stage to a very small value and providing high attenuation of the noise pulse.

For low amplitude pulses CR_2 does all the work. For high amplitude

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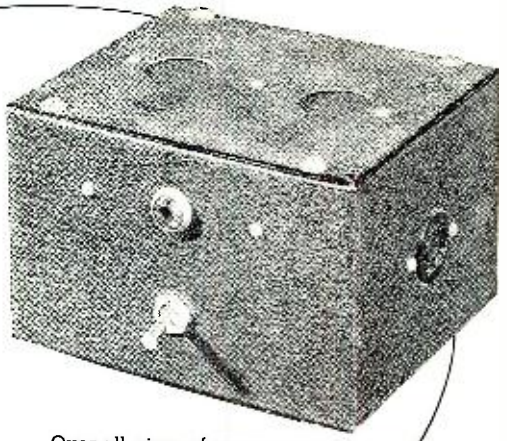
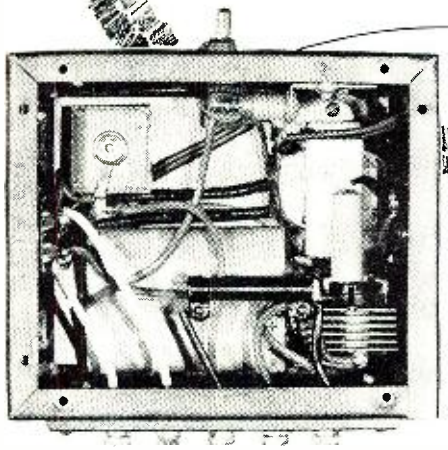
PACKAGED POWER— Economy Size



Over-all view of power supply as built by the author.



Bottom view of power supply.

Construction details on a compact selenium rectifier voltage doubler which provides 165/330 v. at 150 ma.

By
LLOYD V. BRODERSON
W6CLV

ALTHOUGH commercial interests have long realized the capabilities of the selenium rectifier, only recently has the amateur become aware of its many possibilities.

The unit herein described utilizes this increasingly popular rectifier, resulting in a power supply no larger than one's hand. Lightweight, compact, and inexpensive, it is fully capable of handling a cool forty watt load.

When space and cost must be minimized without sacrificing efficiency, the selenium rectifier should be given serious consideration.

Circuit

The circuit of Fig. 1 is standard in all respects. It is readily recognized as a half-wave doubler employing two 150 ma. selenium rectifiers.

Resistor R_1 protects the rectifiers from peak voltages. Condensers C_1 and C_2 are rated at 40 μfd., 450 volts. Bleeder resistor R_2 places a small drain across the supply and protects condensers C_1 and C_2. Transformer T_1, a midget replacement type, furnishes 6.3 volts a.c. at 1 ampere. The pilot light, PL_1, should be rated as low as possible, inasmuch as current drawn by the pilot reduces the current available at the power socket or terminal strip.

The entire unit is housed in a black, crackle-finish metal utility cabinet measuring 4" high by 5" deep by 6" long.

Both a.c. power and high voltage/heater sockets are centered one at each end of the cabinet. The front panel carries the "On-Off" toggle switch and pilot light jewel. These are centered and placed 1¼" from top and bottom.

The terminal strip is fashioned from a ⅛" thickness of bakelite or other similar insulating material. It measures 1¼" wide by 5" long and is centered 1" down from the top. A cut-out is made to clear the 8-32 machine screws and soldering lugs which make up the terminals.

Ventilating holes in the removable top cover are 1⅛" in diameter, centered and placed 2½" in from each end. A bronze wire mesh screen is used for backing and is held in place at three points by 4-36 machine screws.

Four small rubber feet fastened to the base complete the unit's housing.

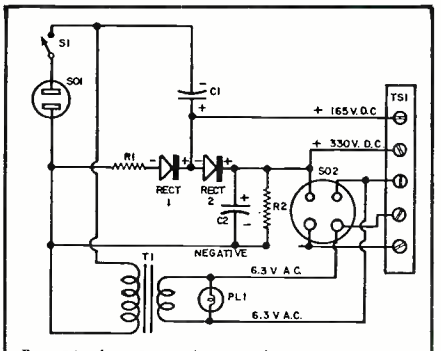
The sub-chassis, fashioned from wood or other suitable material, measures ¾" thick, 4" wide and 5" long. The removable base plate serves to hold the sub-chassis in place by means of four small wood screws.

It will facilitate assembly if all components are wired before the sub-chassis and base plate are bolted to the cabinet. Those components which are mounted on the cabinet proper may be guided into place after assembly.

Only five voltage leads need be soldered to the connection strip after assembly. These are readily accessible and no difficulty should be encountered.

R_1 and R_2 should be so placed that there is adequate circulation around them. Both resistors are self supporting and their respective positions, as shown in the photograph, lend themselves nicely to air cooling.

Fig. 1. Circuit diagram of selenium rectifier voltage doubler. Output is 165/330 v. d.c. at 150 ma. A 6.3 v. @ 1 ampere filament supply is also available at output.



R_1—50 ohm, 5 w. wirewound res.
R_2—50,000 ohm, 5 w. wirewound res.
C_1, C_2—40 μfd., 450 v. elec. cond.
T_1—Fil. trans. 6.3 v. @ 1 amp.
Rect.$_1$, Rect.$_2$—150 ma. selenium rectifier
S_1—S.p.s.t. a.c. toggle sw.
SO_1—A.c. socket
SO_2—4-prong power socket
PL_1—6.3 v. pilot lamp (see text)
TS_1—Terminal strip (see text)

Operation

Assuming 117 volts a.c. as a reference, the total no-load voltage will be 330 volts d.c. The voltage taken off at the first selenium rectifier will be 165 volts d.c. Should condensers C_1 and C_2 be made larger or smaller in capacitance, these voltage values will change accordingly.

A lower d.c. working voltage may be substituted for the first condenser, inasmuch as it is subject to only 1.41 times the r.m.s. value of the line voltage. C_2, however, acting as the "dou-

(*Continued on page* 145)

The Amateur's WIRELESS "TELE-PATCH"

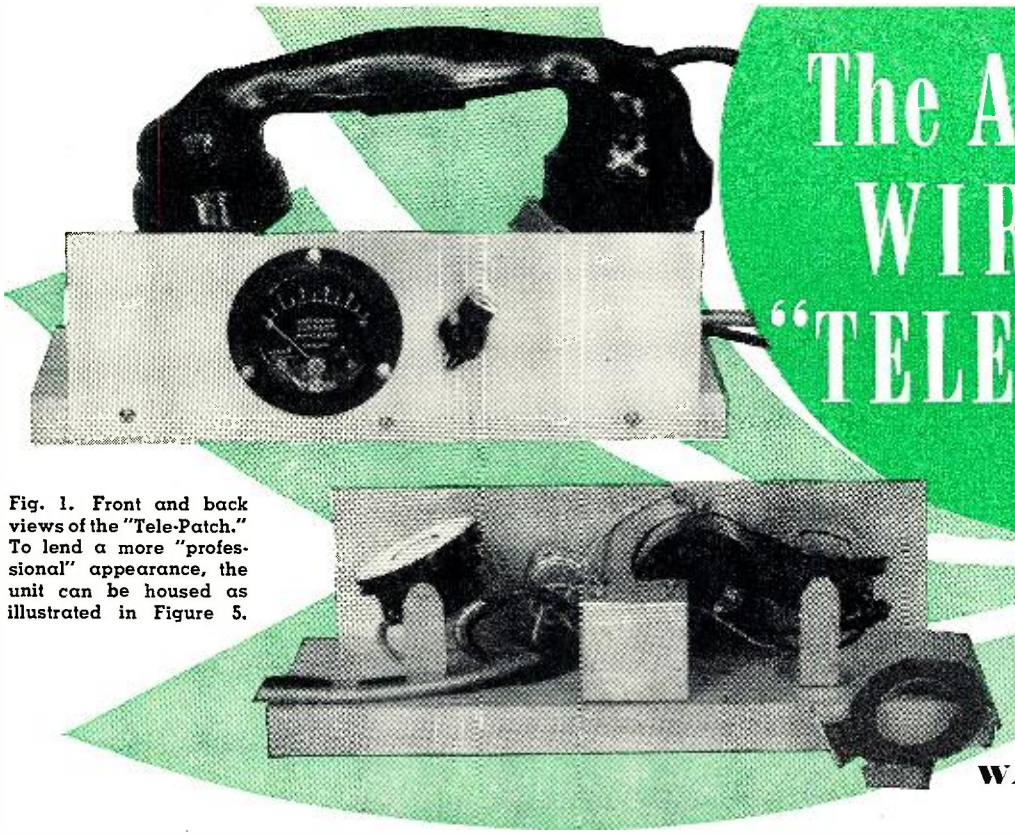


Fig. 1. Front and back views of the "Tele-Patch." To lend a more "professional" appearance, the unit can be housed as illustrated in Figure 5.

By
WALTER S. ROGERS,
W1DFS

Complete construction details on a radio-to-phone system for use in emergency communications work.

THE design of a good amateur radio-to-telephone patching system for emergency communications presents a real challenge to ham ingenuity. To be able to transmit voice signals from the telephone circuit and, in turn, pick up signals from the contact station and send them out over commercial telephone lines is tricky but it can be done.

Most methods of performing this operation require direct metallic connection to the telephone lines or equipment, through isolating transformers or condensers. Telephone companies are quite naturally concerned over the possible impairment of their services when such illegal connections are employed.

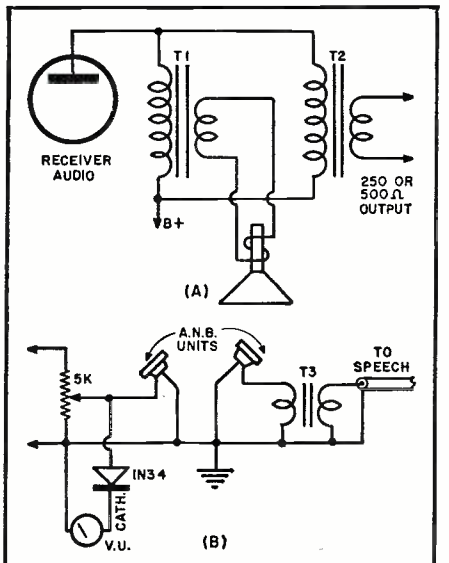
The "Tele-Patch," on the other hand, is a "wireless" acoustical matching device on which the "French" type telephone handset rests. It is so designed that with reasonable care there should be no deterioration of the quality of the telephone service. Thus, while not officially approved by the *Bell System* companies, the "Tele-Patch" appears to conform to the safety and operating requirements for telephone use and civilian defense emergency radio amateur needs.

Third Party Contacts Only

Any ham that fails to observe all of the FCC rules and the telephone company regulations concerning third party contacts is laying himself wide open for plenty of trouble. Remember that stateside W's and K's are approved. Contacts with occupational GI stations that are approved by the local military command are likewise OK. However, all other contacts should be avoided in order to eliminate any chance of running afoul of the law.

For Civil Defense communications such a telephone patch can save time, and improve accuracy, besides providing other branches of the Civil Defense organization with the necessary communications to enable them to evaluate the situation and issue the correcting orders. It is for this particular application that the "Tele-Patch" is recommended.

Fig. 2. The receiver output circuit and complete schematic of the "Tele-Patch" unit.



T_1—*Output trans. (twice plate load of tube used to voice coil)*
T_2—*Output trans. (twice plate load of tube to 250 or 500 ohm line)*
T_3—*Audio trans., 250 ohms to approx. 50,000 ohms*
1—5000 ohm pot
1—1N34 crystal diode
1—0-1 ma. d.c. meter

The Inductive System

Aside from the acoustical "Tele-Patch" system, there is another method of coupling into the telephone circuit—the inductive system. This technique is used in transmitting photographs and is employed by the wire services. Sharply pulsed signals are induced into the telephone box transformer at a high enough level to be received at a distant telephoto receiving point. Attempts to use this same system with voice communications have not, so far, been successful. Telephone transformers are too well shielded and designed to pick up minimum magnetic modulation. Thus, without modification, the inductive method appears to be out of the question.

The "Tele-Patch" System

Several years ago, while pursuing the problem of finding better telephone headsets for radio use, the unusual characteristics of the HS 33 (ANB units) headsets were noted. See Fig. 4. The ANB-H-1 and the ANB-H-1A units are similar. The former is easily obtainable from surplus although not

many of the 1A units have been released to date.

These units make excellent microphones for voice communication. They are unusually rugged—one at W1DFS has been used repeatedly as a tack hammer in order to demonstrate its durability. A crystal unit would have shattered at the first blow. In addition, temperature and humidity have little or no effect on its operation.

The "Tele-Patch" was, therefore, designed around a pair of these ANB units, using the simplest construction possible. In addition to the two ANB units, the "Tele-Patch" consists of a suitable mounting cradle, a volume indictator, a volume control, and the proper matching transformers — all wired as shown in Fig. 2.

Construction

Since most hams have, of necessity, acquired a workable radio building technique it is not necessary to go into elaborate detail regarding the construction of the "Tele-Patch."

It is suggested, however, that all of the material be assembled in one place so that the layout and mounting may be completed with the components on hand since it is possible to substitute parts from the junk box for those listed. After completing a simple version of the unit, a more elaborate instrument can be built up incorporating special features.

To build the unit described you will need: two ANB-H-1 units from the HS-33 headset; an antenna meter, a *Weston* Type 507 (20 millivolt, 3 ohm) meter from the antenna relay unit of the BC442; a relay box from the 374N or ARC5; a *Sylvania* 1N34 rectifier or equivalent; a 5000 ohm wirewound linear taper pot; a mike-to-grid transformer (250 to 250,000 ohms, Type PC77368 surplus or a carbon mike-to-grid transformer may be used); wooden base; aluminum front panel; brass gimbals for holding the ANB-H-1 units; a mike cord, shielded to speech input; a receiver lead consisting of two-wire unshielded phone or "zip" cord (used to connect "Tele-Patch" and receiver); a locating adapter to hold the telephone handset correctly centered (made of sheet aluminum or brass); and finally, an assortment of screws, nuts, and other hardware.

The wood base, measuring 10½"x 3½"x¾", was first cut and finished according to the specifications given in Fig. 3. It is strongly urged that this base be stained, or at least be given a coat of shellac, at this time as it probably will never be given one later. While this is drying, the panel may be finished. The aluminum panel shown in Fig. 1 was finished with steel wool and given a light coat of lacquer to keep it clean. The volume indicating meter dimension is not shown in the diagram as this will vary depending on the meter on hand. A 0-1 ma. millammeter may be used here but the comparative volume of the outgoing ANB unit will have to be determined by the user.

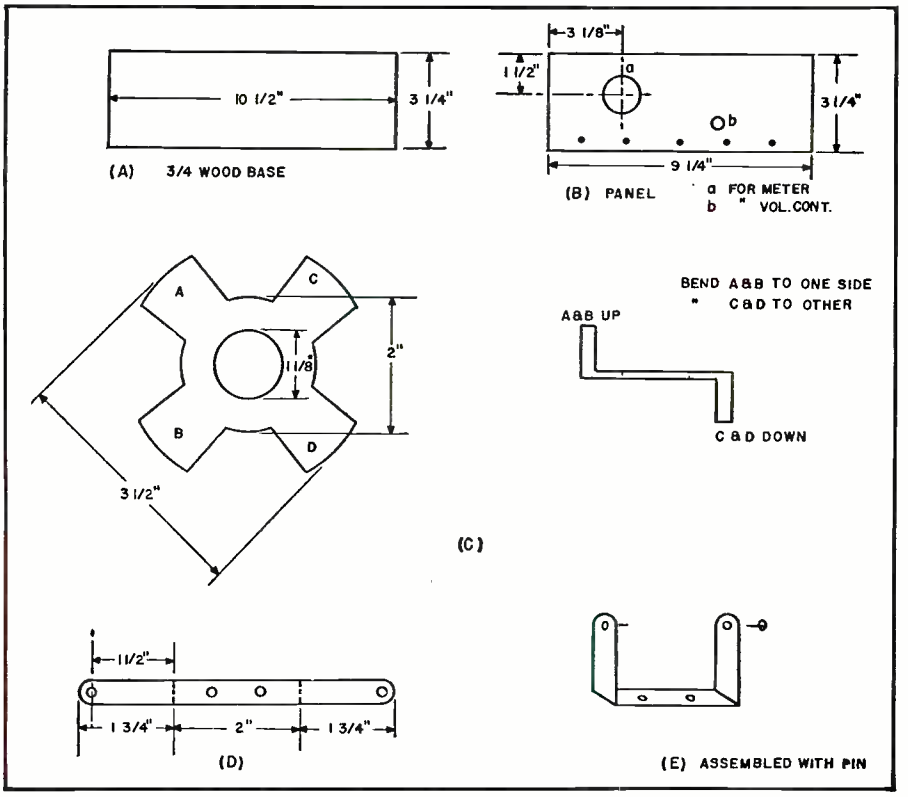


Fig. 3. Details on building the various mechanical parts required in the "Tele-Patch."

A star-shaped handset locating piece (*C* in Fig. 4) is cut with tin snips and finished with a file. It is used to locate the handset directly over the cradled ANB units.

Care is required when using the pin holes in the ANB units as a gimbal mount. See *D* and *E* of Fig. 3. Brass is recommended here in order that the pins may be soldered permanently in place. No. 16 brads, cut to about ¼", were used. These cradles must be mounted so that they fit the telephone headset exactly. There is some variation in the older and newer type handsets, so this will be an individual matter.

The wiring is simple. Wires are laced where possible and clamped in place. Part of the transformer case was drilled and wood screws are used to mount this before the transformer is reassembled. This unit must be firmly secured.

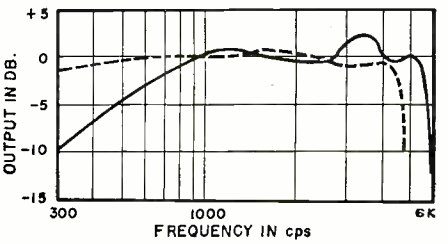
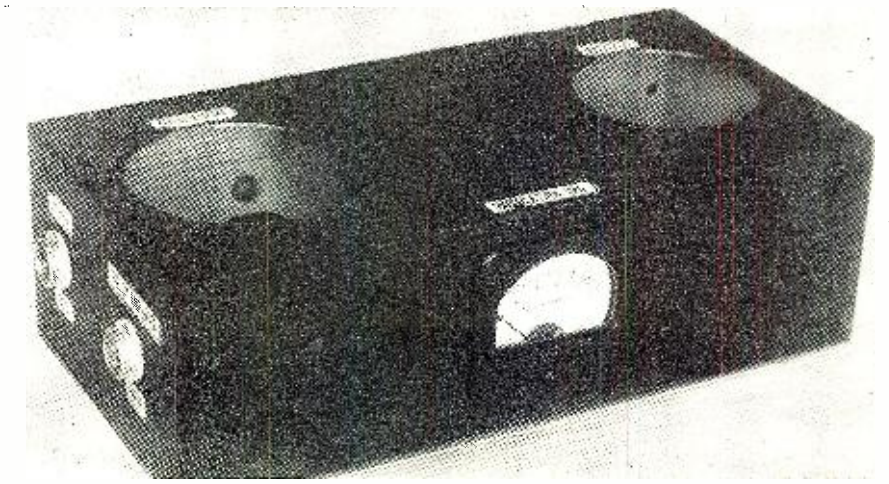


Fig. 4. Typical response curve for the ANB-H-1A. Solid line represents the microphone response while dotted line is for receiver.

Just as a suggestion, W1EAB assembled the unit with input and output plugs and constructed the whole thing on a metal chassis (see Fig. 5) to insure proper shielding and grounding.

(*Continued on page* 110)

Fig. 5. An elaborated version of the "Tele-Patch" housed in a compact metal cabinet.



OSCILLATOR RADIATION INTERFERENCE in TV

By
JOHN B. LEDBETTER
Eng., WKRC, WKRC-TV

A down-to-earth discussion of a growing TV problem. While many technicians have learned to identify this type of interference, few know how these effects can be attenuated satisfactorily.

THE phone rings—another case of TV interference. This time the customer's complaint goes something like "perfect reception on Channel 11 until our neighbor tunes in Channel 7. Then all we can get are black horizontal lines (or bars) which completely ruin the picture."

Sounds familiar, doesn't it? If your TV servicing activities reach to within 150 or 200 miles of Atlanta, Cincinnati, Columbus, Los Angeles, New York City, Omaha, or Philadelphia, this type of interference is probably too familiar for comfort.

Complaints may vary from light, wavy lines to wide, black bars, depending on the strength of the interfering signal. The lines might (1) remain stationary, (2) change to diagonal lines or bars, (3) appear as "zig-zag" vertical lines, or (4) assume a "chicken-wire" pattern. Nor does the interference limit itself to the two channels just mentioned. A combination of Channels 2 and 5, 3 and 6, or 9 and 13 will produce the same effect.

Table 1. Channels affected by local oscillator interference (based on an i.f. frequency of 25.75 megacycles).

CHANNEL NUMBER	VIDEO CARRIER FREQ. (mc.)	LOCAL OSC. FREQ.	BEATS WITH
2	55.25	81.00	Ch. 5
3	61.25	87.00	Ch. 6
4	67.25	93.00	FM Band
5	77.25	103.00	FM Band
6	83.25	109.00	FM Band
7	175.25	201.00	Ch. 11
8	181.25	207.00	Ch. 12
9	187.25	213.00	Ch. 13
10	193.25	219.00	
11	199.25	225.00	
12	205.25	231.00	
13	211.25	237.00	

While this type of interference has often been analyzed as *image* interference, it is *not* caused by image reception; nor is it created by harmonics. It is caused by direct radiation from the local oscillator of a television receiver. When the *fundamental frequency* of the radiating oscillator falls within the limits of a video channel being received on a nearby set, a "beat-frequency" condition is set up and the interfering lines or bars are the result. The number of lines depends on the difference in frequencies and, of course, varies widely. Adjustment of the fine tuning control on either the offending or affected receiver will change the beat frequency, in some cases eliminating or reducing the interference to a tolerable degree.

To understand how this condition can affect more than one frequency or combination of frequencies, consult the figures given in Table 1. (This table, based on an i.f. frequency of 25.75 mc., also holds for receivers in which intermediate frequencies of 23.0 to 26.6 mc. are employed). From the chart, it can be seen that the r.f. and converter stages of a receiver tuned to Channel 2 will fall on 55.25 mc. The oscillator frequency will then be higher by 25.75 mc. (the i.f. frequency) so that its fundamental frequency is 81.0 mc. Since this is well within the band assigned to Channel 5, direct interference or a beat-frequency condition will result when a nearby receiver is tuned to Channel 5 *if* the radiated signal from the first receiver is strong enough. This is not as rare a condition as you might think, since the effective strength of the radiated signal need be only 0.01 or 1 per-cent of the desired signal strength in order to cause serious interference. By this token, local oscillator radiation may be limited to 1.0 microvolt/meter or less and still cause objectionable interference to a 100 microvolt/meter signal. Compare this fact with the relative radiated signal strengths shown in Table 4 and you will better understand the possibilities of oscillator radiation interference in crowded areas.

Referring again to Table 1, note that a receiver tuned to Channel 3 can cause interference to neighboring TV sets tuned to Channel 6. In the same manner, receivers tuned to Channels 7, 8, and 9 can interfere with those adjusted to, respectively, Channels 11, 12, and 13. Note also that the fundamental frequency of the oscillator will fall within the FM band when the receiver is tuned to Channels 4, 5, or 6. This, however, will seldom cause trouble, since the interfering signal must be at least one-half the strength of the desired FM signal in order to be objectionable. (From experience in the field, and of course with tongue in cheek, we could name several receivers which could almost fulfill *that* requirement!).

There are several factors which make oscillator radiation interference especially difficult, and in some cases impossible, to eliminate. First, its very

Table 2. Areas and stations particularly affected by local oscillator radiation.

LOCALITY	STATION, CHANNEL
Atlanta	WCON* 2 WAGA-TV 5
Cincinnati	WCPO-TV 7 WKRC-TV 11
Columbus, Ohio	WLW-C 3 WTVN 6
Los Angeles	KTSL 2 KTLA 5
	KECA-TV 7 KTTV 11
	KFI-TV 9 KLAC-TV 13
New York City	WCBS-TV 2 WABD 5
	WJZ-TV 7 WPIX 11
	WOR-TV 9 WATV** 13
Omaha	KMTV 3 WOW-TV 6
Philadelphia	WPTZ 3 WFIL-TV 6

*Construction permit.
**Transmitter located Newark, N. J.

nature rules out the use of wave traps if the interference is sufficiently strong, since elimination of the interfering frequency will also eliminate or degrade the desired signal. Special antenna installations sometime help but will not be of much assistance if the interfering signal is between the station and affected receiver. Here, an antenna having a high front-to-back ratio would obviously help if installed at the offending receiver.

Modifications or adjustments at the radiating receiver offer the most practical solution but the owner's permission must of course be obtained. This is not always possible, since many set owners quite understandably are reluctant to allow alterations (or even an examination) to be made. In such cases, the affected televiewer must rely on whatever relief can be obtained through the use of wave traps, more directional antenna systems, by antenna orientation, and in some cases by grounding the receiver chassis. These methods will be discussed at greater length in the following paragraphs.

Cincinnati Tests

As you can see from the channel listings in Table 2, Cincinnati is one of those areas particularly affected by oscillator radiation interference involving Channels 7 and 11. As the number of television receivers within this area increased, the interference problem became more noticeable. In some cases interference was negligible and could be eliminated by a slight readjustment of the offending receiver's antenna or by readjusting the fine tuning on the affected set. In other cases, the interference was so strong that it completely obliterated the picture, even though the affected receiver had a good antenna system and the offending set had none at all.

At first, the interference was confined to Channel 11, since the local oscillator in all receivers then in use operated on the high side (video center frequency plus i.f.). In some of the 1950 models, however, this condition is reversed. Several receivers operate the local oscillator on the low side (video center frequency minus i.f.), on the high band only. This created a beat-frequency effect on receivers tuned to Channel 7 when one of the new sets was tuned to Channel 11. Interference in this case usually was much worse than with the original combination, since oscillator efficiency is much greater on the lower channel.

One of *Motorola's* 1950 models, the TS-60, was one of the first to employ the high-channel, low-side oscillator arrangement. This model was quickly modified by local *Motorola* distributors so that the oscillator fundamental would not fall within any of the local video channels. (In the modified circuit, the oscillator is on the high side from Channels 2 through 6, on the low side from Channels 7 through 10, and again on the high side from Channels 11 through 13).

TEST	ANTENNA (Type and Model)	FIELD STRENGTH (μv/m) FRONT	FIELD STRENGTH (μv/m) BACK	FRONT/BACK RATIO	RELATIVE GAIN*, DB.	NOTES
1	Elincor Folded Dipole	27.5	.....	1:1	0	1
2	Channel Master 313	39.0	5.0	8:1	3.0	2
3	Channel Master 308	34.0	31.0	1:1	1.8	.....
4	Yagi Trio 304-11	46.0	12.0	3.9:1	4.4	3
5	Elincor Yagi 5 element	48.0	24.0	2:1	4.8	4
6	Workshop Double-V	41.8	14.0	3:1	3.6	5
7	Workshop Double-V (double-stacked)	48.0	23.5	2:1	4.8	.....
8	Telrex Lazy X (solid elements)	39.5	24.0	1.6:1	3.0	.....
9	Telrex Lazy X (tubular elements)	36.5	23.5	1.5:1	2.4	6
10	Oak Ridge X-66 Di-Fan	37.0	25.5	1.5:1	2.5	7
11	Oak Ridge X-66 Di-Fan	37.5	21.5	1.7:1	2.6	8
12	Oak Ridge X-66 Di-Fan	39.0	18.5	2.1:1	3.0	9
13	Oak Ridge X-66 Di-Fan	40.0	18.0	2.2:1	3.2	10

SET-UP: All antennas mounted successively on 30-foot metal pole and fed with signal from Precision Model E-400 Signal Generator. Antenna for RCA Field Strength Meter (Type WX-1A) 20 feet high and approximately 100 feet from test position.
ENGINEERS: G. Waslo, W. Stoecker, J. Ledbetter.

NOTES:

1. Relative Gain*—Elincor single folded dipole (no reflectors), cut for Channel 11; used as reference or unity in making relative voltage gain measurements.
2. Four minor lobes; 2 on each side of broadside.
3. Yagi cut for Channel 11. Gain dropped to 43 μv/m at 190 mc., 42 μv/m at 200 mc.
4. Yagi cut for Channel 11. Gain dropped to 28.5 μv/m at 190 mc., 29.5 μv/m at 203 mc.
5. Three minor lobes on each side of figure-eight pattern.
6. Null points 15 degrees each side of broadside.
7. Long center stubs on driven elements and reflectors (see Fig. 1A).
8. Short center stubs on driven elements, stubs removed from reflectors (Fig. 1B).
9. Short center stubs on driven elements and reflectors (Fig. 1C).
10. Short center stubs on driven elements, long center stubs on reflectors (Fig. 1D).

Table 3. Relative antenna measurements. All tests were made on Channel 11.

General Electric, starting with the 10-T1 series, has adoped 45.75 mc. as the video i.f. frequency, and it is understood that a number of other manufacturers have followed suit. This eliminates the possibility of radiation within any of the existing TV channels, but of course does not affect the great number of sets already in use which employ such intermediate frequencies as 23.0, 25.75, 26.3, and 26.6 mc. The irony of this situation is that the new 45.75 mc. sets or those especially modified to prevent interference by oscillator radiation, can be interfered with by a receiver employing the above i.f. frequencies in the same degree as any other set.

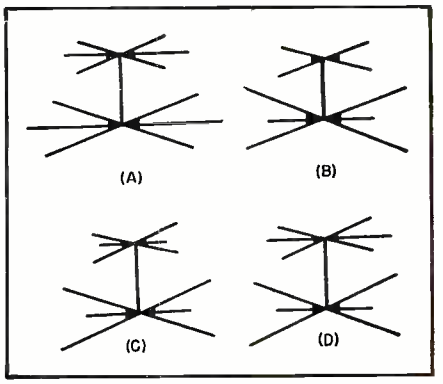


Fig. 1

In an effort to determine just what steps would be most effective in combating local oscillator interference, two general tests were recently made in the Cincinnati area. These tests, carried out by WKRC-WKRC-TV engineers in cooperation with local distributor technicians, were made on a number of television receivers and antennas to determine the relative merits or radiating condition of each.

In the first test, the actual radiated signal from the local oscillators of six different makes of receivers was measured (under identical conditions) and

(*Continued on page* 146)

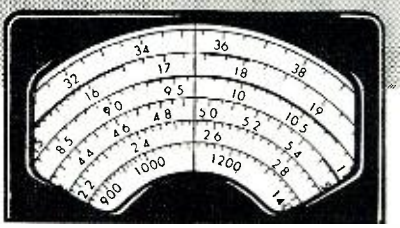
Table 4. Oscillator radiation of several TV sets. Note effect of antenna on radiation.

SET	SET TYPE	I.F. FREQ.	OSC. FREQ.	OSC. RADIATION (μv/m) No. 1	No. 2	No. 3	No. 4	No. 5	No. 6	No. 7
A	Intercarrier	26.3	201.55	37	100	58	58	72	68	
B	Conventional	25.75	201.00	13	30	19	22	23		
C	Conventional	26.6	201.5	12	24.5	10	8.5	7.7		
D	Intercarrier	25.75	201.00	7	49	11	11.5	11		23
E	Conventional	26.3	201.9	7*	12*	5	10	11	7.4	
				7	10.5					
F	Conventional	25.75	201.00	3.3	7.2	3.4	3.8	3.4		

Test 1—Outside two-band folded dipole, with reflectors.
Test 2—Outside Channel Master Di-Fan with reflector.
Test 3—Inside Radion V antenna.
Test 4—No antenna; input terminals open.
Test 5—No antenna; 300-ohm resistive load across antenna terminals.
Test 6—No antenna; 300-ohm resistive load across tuner input.
Test 7—Built-in antenna; set (E) only.

*Lower readings on Tests 1 and 2 (Set E only) made with receiver's 72-ohm input mismatched into 300-ohm transmission line. Top readings made with input matched to transmission line through Miller No. 6162 72/300 ohm transformer.

International SHORT-WAVE



Compiled by **KENNETH R. BOORD**

IT IS a pleasure this month to dedicate the *ISW DEPARTMENT* to the Blue Danube Network, an affiliate of the U.S. Armed Forces Radio Service (AFRS) in Austria. We are indebted to John L. Shaffer, Station Manager, KOFA, for this data:

The Blue Danube Network consists of three stations—KZCA, Salzburg, key station operating on 881 kc., 1 kw.; repeater transmitter at St. Johann, 1367 kc., 350 watts; repeater transmitter at Zell am See, 674 kc., 1 kw.; WOFA, Vienna, 1034 kc., 1 kw.; KOFA, Linz, 890 kc., 1 kw., and the short-wave installation at Salzburg, 9.617, with 350 watts.

"Reception logs will be readily verified by mail," says Mr. Shaffer. In addition to his duties as Station Manager of KOFA, Mr. Shaffer directs all publicity of BDN; any inquiries regarding the Blue Danube Network are most welcome, he says. QRA is APO 714, % Postmaster, New York, New York, USA.

While Mr. Shaffer did not include current schedules with his latest communication, the last schedules from the station listed 9.617 on the air 0100-1900 (Sun. from 0200).

Our best wishes go to the Blue Danube Network!

* * *

Stability of BBC Outlets

Art Russell, California, sends along this interesting data from *"Wireless World,"* British radio publication, about the "guaranteed accuracy of BBC stations":

"The BBC radiates four transmissions that are guaranteed to have a frequency stability of 1 part in 10.

"These standard frequency transmissions are the Light Program transmission from Droitwich on 200 kc., which is broadcast daily from 0300-1800 (*EST*); GRO on 6.180 in the 49 meter band; GSB on 9.510 in the 31 meter band, and GSY on 17.810 in the 16 meter band. . . . The frequencies of the standard transmission on short-wave (GRO, GSB, GSV) are maintained well within 1 part in 10 of their nominal values. In view, however, of the Doppler effect, interference, and the vagaries of the propagation path, it is not expected that these transmissions will be suitable for measurements requiring an accuracy better than 1 part in 10. These transmissions . . . vary seasonally according to the requirements of the Overseas Service. . . ."

* * *

Tests from Geneva

This interesting item comes from *Short Wave News,* London:

It is now possible to give full details of 'Radio Inter Red Cross' at Geneva, 7.210, and for which thanks are due to M. Georges Kuhne, Head of the Broadcasting Service, International Committee of Red Cross. Test transmissions were made on June 7, 9, and 11, and another series will take place during the autumn; following decisions made at the International Telecommunications Conference held in Mexico City, the Swiss Broadcasting Corporation placed a transmitter (probably HEI3) at their disposal, and the tests were very successful. More than 500 reception reports were received, from some 30 countries, mostly in Europe, but also including Tangiers, Saudi-Arabia, and Australia. M. Kuhne goes on to say: 'Radio fans have been most helpful. A good third of the communications received came from them, and their reports were most valuable. This was less often the case of casual listeners, who have not the same technical knowledge and experience. Certain zones seemed completely "dead"—Italy (south of Rome), Sicily, Tunisia, Greece, and the Southern Adriatic region. We may have been heard there, but no reports have been received. It would be helpful if your readers in those areas would undertake to listen to the next tests and we would be very glad if you would kindly make the suggestion to them.' "

* * *

Club Notes

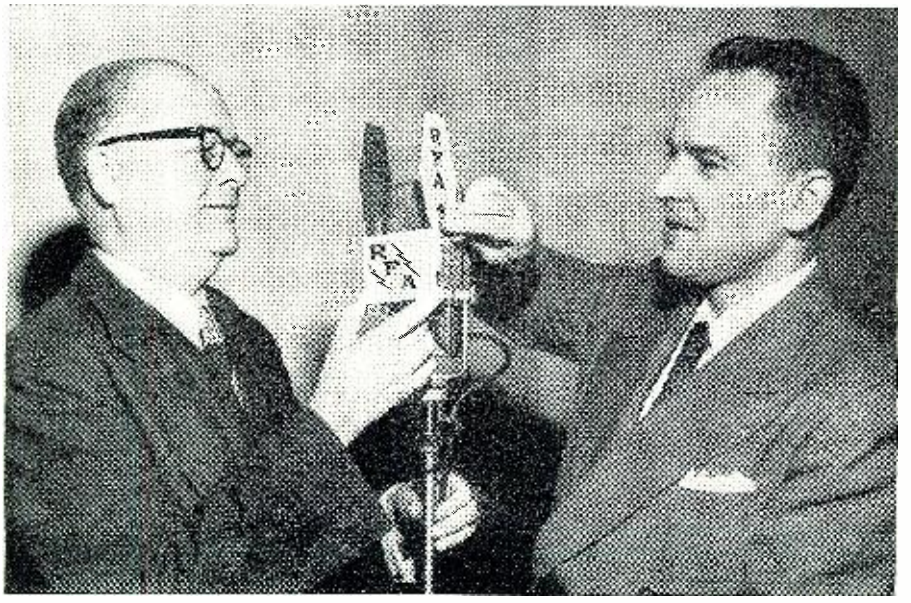
Sweden—Temporarily, the *Scandinavian DX-Club* has had to change the format of its monthly publication from the attractive magazine *Nattugglan* (Night Owl) to a mimeographed bulletin, due to rising costs of publication. However, the club hopes to return to the magazine format early in 1952.

USA—The *United 49'ers Radio Society* has announced that its newly-

(*Continued on page* 118)

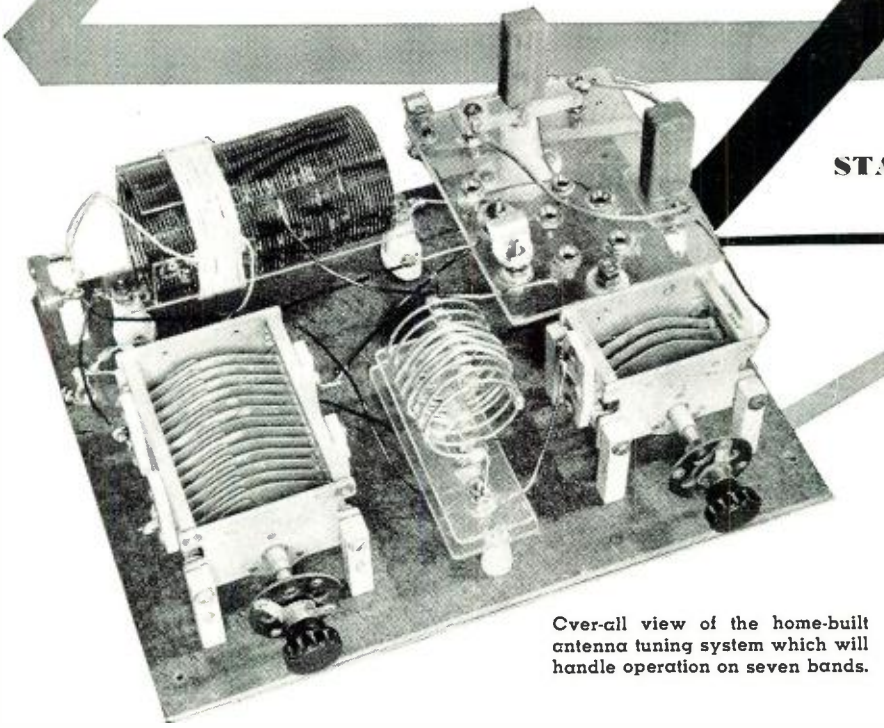
(Note: Unless otherwise indicated, all time is expressed in American EST: add 5 hours for GCT. "News" refers to newscasts in the English language. In order to avoid confusion, the 24 hour clock has been used in designating the times of broadcasts. The hours from midnight until noon are shown as 0000 to 1200 while from 1 p.m. to midnight are shown as 1300 to 2400.) The symbol "V" following a listed frequency indicates "varying." The station may operate either above or below the frequency given. "A" means frequency is approximate.

John W. Elwood, director, Radio Free Asia, and George H. Greene, Jr., president of the Committee for a Free Asia, attach the "RFA" radio microphone shield signifying the start of RFA broadcasts beamed toward those areas of China now behind the Iron Curtain. The first program, news and news commentary, was timed coincident to opening at San Francisco of the Japanese Peace Treaty Conference. Daily programs are short-waved from San Francisco to Manila where they are relayed 0830-0952 to the mainland of China from DZ14, 6.110. English is from 0920 to closedown each day.



WORK 7 BANDS With The "LB-VEE"

By
STAN JOHNSON,
W0LBV



Over-all view of the home-built antenna tuning system which will handle operation on seven bands.

Multi-band antenna system featuring "switchable" directivity and operating from 2 through 160 m.

THIS article is dedicated to that luckless ham who would like to own an "antenna farm"—filled with antennas for every band from 2 meters to 160 meters—but who is stuck with a city lot. The article describes a backyard antenna system which performs on all of the bands mentioned—and does it surprisingly well.

This antenna, which the writer has immodestly dubbed the "LB-Vee", has a lot to recommend it to supplement the single-band beams of the ham fortunate enough to have space for a number of antennas. For the ham who has space for only *one* antenna, it is just about what the doctor ordered. For example:

On 10 meters, the antenna is an honest-to-goodness "Vee" beam, with a gain of 6-8 db in two directions over a fairly wide azimuth in each of the directions. To allow covering just about any additional direction, either leg of the "Vee" can be fed as a long wire, giving a theoretical gain of 2 db—and a practical DX gain of a lot more.

The antenna can be used on 15 meters, with a 5 db plus gain, when and if we ever get the band.

On 20 meters the "Vee" beam hookup gives a 4 db plus gain (because of increased low angle radiation, this is a lot more than equivalent to doubling the power) in the two favored directions. Most of the rest of the compass can be covered by the switching technique employed.

On 40 meters, the antenna will outperform a doublet (at the same height) especially in low-angle DX communication.

On 80 meters, the antenna is at least the equivalent of a good doublet. And on 160 meters, the antenna becomes a *Marconi* or an antenna-counterpoise.

In addition to these bands, the antenna can be used on both 6 meters and 2 meters, with a gain of as much as 10 db from the "Vee" beam.

Among its other advantages, the antenna makes use of a characteristic of all long wires in that it works well at a fairly low height. The writer's antenna is only 25 feet high at the vertex and about 15 feet high at the far ends. Any doublet to be effective for low angle radiation on 10 or 20 meters needs to be a *lot* higher. Further, since the antenna is made entirely of wire, plus a few plastic feeders, it is *much* neater than any ordinary beam made of tubing, an important advantage in many neighborhoods.

The versatility of the antenna is accounted for by two features. First the feeder length, plus the antenna itself, is such that the system is readily resonated with the simplest of antenna tuners. Second, the antenna is fed with a three-wire feeder system, which makes it practical to feed both legs of the antenna, or either leg alone.

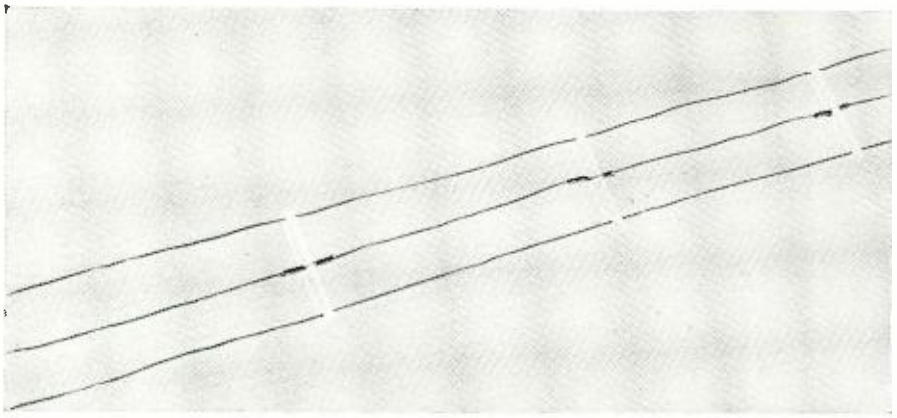
The legs of the antenna are 103 feet long. Ideally, they should be put up in the form of a "Vee", with an angle of 70 degrees. However, the antenna will work, and will show noticeable gain even on 20 meters, with an included angle as small as 45 degrees. Likewise, if most of the operation is going to be on 14 megacycles and lower in frequency, the included angle can be made as great as 100 degrees. An angle of 90 degrees is ideal for 20 meters, if this is the "most used" band.

The direction-shifting "brain" of the antenna is a special, but simple, tuning unit which is coupled through a length of coax to the transmitter. The three-wire feeder connects to this tuner.

The tuner itself consists of two separate tuning circuits. One, built around a 150 $\mu\mu$fd. (approximately) transmitting type tuning condenser, provides a series tuned circuit on 160 meters and a parallel tuned circuit on 80 meters, both using the same coil, which is fixed in the unit. The second tuning circuit (the tuning condenser is approximately 40 $\mu\mu$fd.) uses plug-in coils which allow tuning up for 40, 20, and 10 meters. Two meters and 6 meters are handled differently, as discussed later in the article.

The three-wire feeder goes to three jacks on a polystyrene strip. A pair of flexible leads, fitted with plugs (mounted on a length of polystyrene equipped with a small wooden handle) can be plugged into any two of three jacks, thus providing a simple switching system for feeding both feeders (and thus forming a "Vee" beam) or the "dead" feeder and one of the legs of the "Vee".

The other ends of the pair of flex-



Close-up view of the feedline. Spacers are 6" apart and conductors are spaced 7/8".

ible leads go to another pair of plugs mounted on a polystyrene strip. These plugs go into a pair of jacks arranged along in a row and wired up in such a way that simply selecting the proper pair of jacks automatically insures that the antenna and tuner are properly connected for tune-up on each band. The diagrams show how this is done.

The variable condensers used in the original tuner came from one of the "TU" tuning units of a BC-375, a piece of surplus gear which almost every ham has. If you are an exception, probably one of your ham friends has half a dozen which he bought as irresistible bargains and has never used and from which he can be parted at very reasonable cost, particularly if the XYL has noticed them kicking around the house!

The tuning condensers are mounted on a piece of *Presdwood* for easy construction, although metal can be used instead. The coils for the set are all homemade in order to keep the cost low.

The 160 meter and 80 meter coil (L_3) is self-supporting—being wound of 65 turns of number 18 wire (enameled)—sufficient for powers up to 150 watts or so—which is wound on a 2 inch mailing tube over a couple of layers of wax paper. The turns of wire were separated by "interwinding" with number 20 d.c.c. wire—then the d.c.c. wire was removed, and the coil doped with china cement, applied liberally in strips, and allowed to dry for several days before the second coat was applied. Then, after more drying, the mailing tube was removed by destroying it with a pair of long nose pliers and the coil was ready to mount on the standoff insulators.

Thin polystyrene strips, cemented to the outside of the coil, form a winding surface for the pick-up coil (L_1) which consists of 18 turns of number 20 d.c.c. wire.

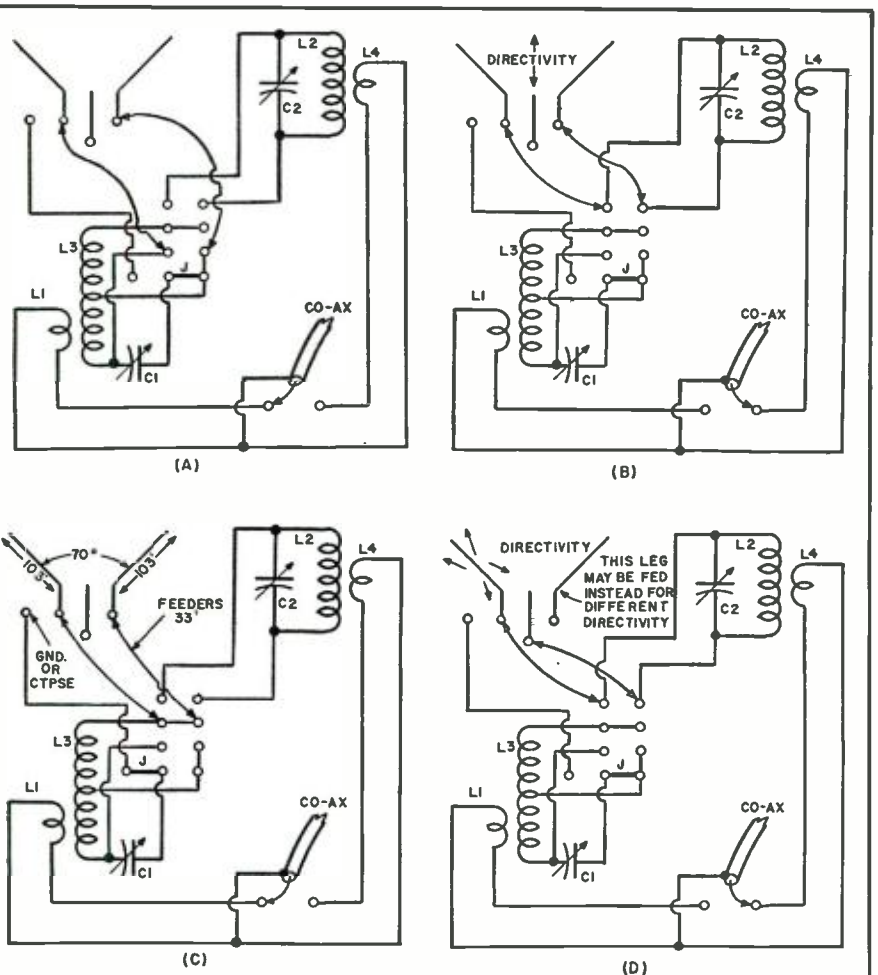
The plug-in coils can be standard transmitting coils with a fixed center link or they can be home-made, as previously described. The 10 meter coil can be spaced out by hand and the 20 meter and 40 meter coils spaced by interwinding wire, as described before. If the coils are homemade, the pick-up coils can be wound directly *over* the coil winding, using a wire with *very good insulation,* such as auto ignition wire.

The coax which connects the tuner to the transmitter feeds to a common connection for the braid. The center conductor of the coax goes to a plug, which is inserted into one or the other of two jacks. One jack is connected to the pick-up coil on the 160-80 meter tuner, the other to the jack feeding the pick-up coil on the plug-in coils.

The 33 foot feeder for the antenna is a bit unusual in that it uses 3 wires, and is *very* closely spaced. Close spacing was adopted so that the antenna can be used on high frequencies without excessive line radiation. It works out very well on low frequencies, of course, but does make feeder construction more difficult in that a lot of spreaders are required. In the original antenna, in which the wires are spaced 7/8" apart, a spreader was used every 6 inches.

Because a lot of spreaders are used, it is important to keep them light in weight. Fairly thin polystyrene (clear plastic) is ideal. The material is easy to work. The feeders for the antenna illustrated were prepared with no other tools than a hack saw, a file, hand drill, and a lot of elbow grease.

Connections for (A) feeding the 80 meter "center fed" antenna; (B) the "Vee" beam for 40, 20, and 10 meters; (C) the 160 meter Marconi or antenna counterpoise; (D) feeding single leg as long wire on 20 and 10 meters. Note that coils L_2 and L_4 are used to cover 40, 20, and 10 meter bands while coils L_1 and L_3 are used to cover 80 and 160 meter bands. Coils L_1 and L_3 are the same irrespective of band covered, however, for 80 meters all of L_3 is used while for 160 meters only half of the coil is connected in circuit. L_2 and L_4 are plug-in units and differ for 40, 20, and 10 meter operation.



C_1—150 μμfd. var. trans.-type cond.
C_2—50 μμfd. var. trans.-type cond.
L_1, L_3—See text.
L_2—Center-link plug-in coil. If handwound: 10 m.-8 t. #14, 1¾" i.d., spaced to 2"; 20 m.-8 t. #14, spaced to 7/8"; 40 m.-16 t. #14, spaced to 1¾". 20 and 40 m. coils 2" i.d.
L_4—10 m.-3 t.; 20 m.-3 t.; 40 m.-4 t. All coils to be of ignition wire wound directly on L_2.

The writer's antenna uses number 18 enameled wire for the feeders, which was deemed more than ample for the 120 watt rig in use. Magnet wire should be used for the feeders (*not* hard drawn wire) and the spreaders can be attached by simply wiring the spreader to the center feeder by means of number 22 enameled wire. The feeder can be further strengthened by daubing the end of the spreader, at the point where the two wires go through, with china cement or coil dope.

Number 18 copperclad steel wire is ideal for the antenna itself, being easy to keep taut and very inconspicuous. However, it snarls easily—so handle it with care or you will have a two-hour job unscrambling the mess. The steel core gives the wire all of the nasty qualities of a steel spring!

Standard antenna insulators can be used, of course, but the writer used short lengths of ½ inch polystyrene rod—again in the interest of being inconspicuous.

The feeders run to a triangular-shaped piece of polystyrene which is attached to the pole at the vertex of the "Vee." This serves as a kind of universal joint which makes stringing the feeders a lot easier.

Finding space for the antenna is something of a trick, particularly in a city in which building sites are small. Of course, if you have a good, big tree in the front yard, and your yard is wide enough in the rear for the antenna, you are "in like Flynn." In most cities with which the writer is familiar there is just about space enough between the house and the far side of the alley for the necessary length—which means that one practical way out is to tie the antenna to power line poles across the alley (perhaps cutting across one corner of the rear of the neighbor's lot)—a technique which can be worked, of course, only if the power company is reasonably broad-minded about such things. The high end of the antenna can be at the house end so that the antenna can be well down the pole below the power lines, and hence safe enough.

If you can't work this out, another practical dodge is to do a selling job on your neighbors across the alley, and tie your "they're practically invisible" wires onto the neighbors' houses. How practical this idea is will depend upon such variables as TVI relations and your selling ability!

Failing in all other efforts, and only then, the antenna legs can be reduced to 67 feet, and used without change in the tuning system on 10 meters and 20 meters. For 40 meters you will have to shift to series tuning and do some experimenting to see whether series or parallel tuning works the best on 80 meters. The 160 meter performance is bound to be poor, although with a loading coil connected in series with the ground lead the antenna can be made to tune up. Gain will suffer seriously on all of the other

(*Continued on page* 148)

Mac's RADIO SERVICE SHOP

By JOHN T. FRYE

BARNEY VS. SELENIUM RECTIFIERS

OUTSIDE the service shop a snowy, blustery, first December storm had all the signs on Main Street swaying and squeaking under its impact. Inside, the mood of Barney, the apprentice technician, matched the foul weather perfectly.

"What you got your face all screwed up about?" Mac, his boss, asked him. "Your nose is out of joint like the president of the WCTU catching a whiff of the town drunkard's breath."

"Aw, it's this stinking selenium rectifier," Barney replied. "I used to think a burned-out power transformer smelled bad, but that's like attar-of-roses compared to the rotten-egg smell of one of these rectifiers that has been too hot. These darned selenium jobs should never have been used in radio and TV sets anyway."

"And why not?" Mac asked with a quick show of interest.

"Because they're simply no good," Barney said with the positive assurance of youth. "They do not last any length of time; they are hard to check and hard to replace; they release heat underneath the chassis where you don't want it; they go to the bad just sitting on the shelf; they—"

"Whoa! Hold up!" Mac interrupted. "Them's mighty sweeping charges you're making, pardner, and you're making them to a man who is just oozing with information on these selenium jobs."

"Since when did you become an authority on selenium rectifiers?" Barney asked suspiciously.

"Since, after noticing a few months ago that we were replacing an increasing number of these units, I sat me down and wrote to several of the companies who make them and asked for information about what could cause these failures. Most of them snapped right back with answers to my questions—and to my charges—for I listed about the same bunch of gripes that you came up with. One of them even called me on the telephone and gave me about a fifteen-minute discourse on the care and feeding of selenium rectifiers. After listening to this and after reading and digesting all of the dope sent me, I have an altogether different slant on these units than I had before."

"Such as—" Barney prompted.

"Well, first let's take up that business about their not lasting very long. These rectifiers were introduced in 1946; and now, five years later, they are just beginning to go bad. Five years is pretty good for a unit that sees the heavy-duty service that a rectifier does. Of course, that still falls short of the put-them-in-and-forget-them and the built-to-last-the-life-of-the-set claims with which some manufacturers launched their own particular brand of rectifiers; and personally, I hold these same manufacturers responsible for much of the dissatisfaction with metallic rectifiers today. Deliberately, or through mistaken enthusiasm coupled with insufficient testing in the laboratory, they gave the impression that selenium rectifiers would last forever. Unfortunately, this just isn't so.

"Possibly the copywriters fell into this error because they knew that metallic rectifiers *can* be built to last an almost indefinite period of time under very adverse conditions if such matters as weight, bulk, and cost can be disregarded. Rectifiers designed for specific applications in industry are often of this nature and are highly regarded for their dependable long life. Those made for radio and television sets, however, must be as light as possible, occupy as little space as possible, and

(*Continued on page* 149)

By
H. M. TREMAINE, D.Sc.
Audio Consultant

Practical SOUND ENGINEERING

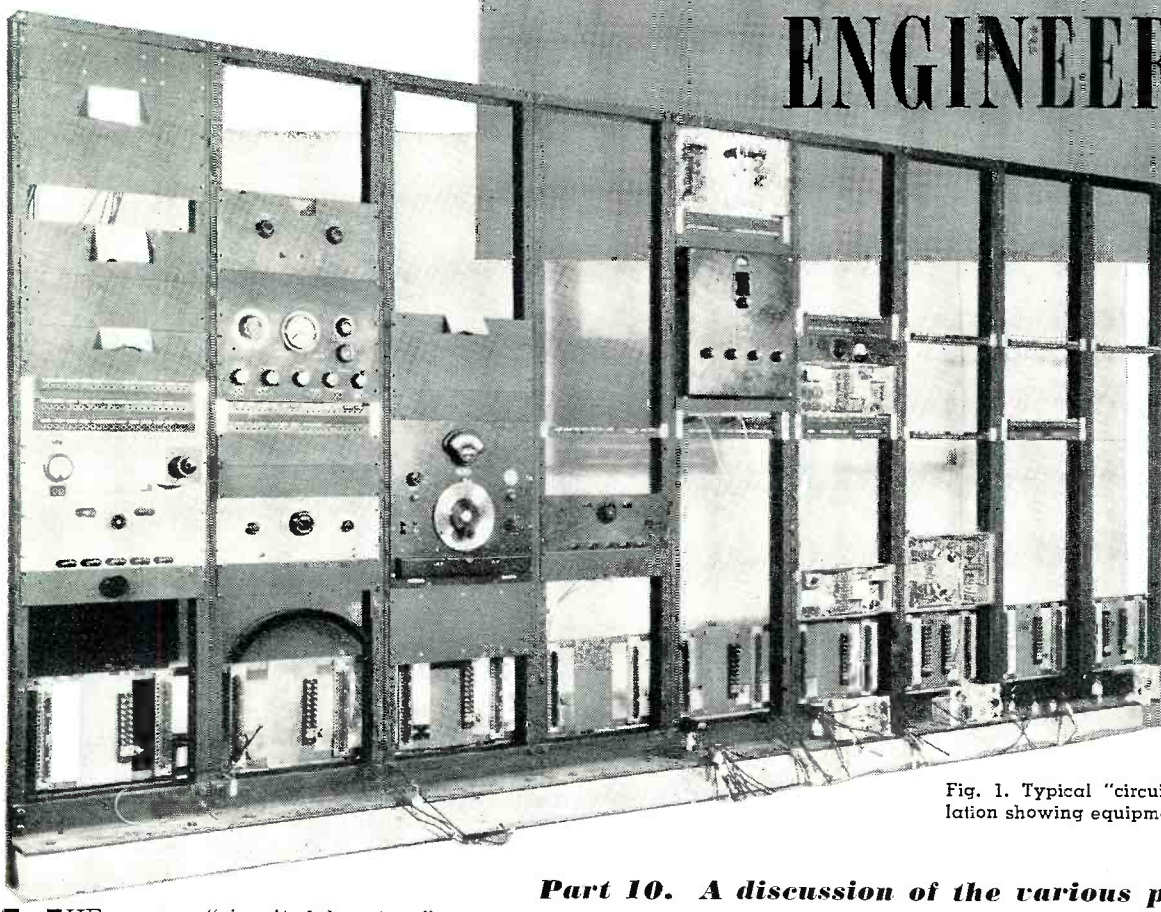


Fig. 1. Typical "circuit laboratory" installation showing equipment mounted in racks.

Part 10. A discussion of the various pieces of equipment used in audio frequency laboratories.

THE name "circuit laboratory" (sometimes called a "transmission laboratory") is the one most commonly applied to the audio-frequency laboratories of motion picture, radio broadcasting, or recording studios where experimental and maintenance work pertaining to audio-frequency equipment and systems is performed.

The laboratory uses many pieces of equipment, including distortion and gain/frequency measuring equipment, amplifiers, oscillators, oscilloscopes, squarewave generators, intermodulation analyzer, repeat coils, pads, and terminations, to name but a few. Most of this equipment is mounted in standard relay racks.

The rack method of mounting electronic equipment originated with the telephone industry, where it is the practice to mount amplifiers, relays, and switching gear in steel racks. This type construction provides ease of operation and accessibility, easy interconnection of units, and facilitates maintenance.

The racks are constructed of two channel-iron side pieces, held together by strap iron at the top, and at the bottom by two pieces of 4 by 6 inch angle iron. Starting at the top of the rack and continuing downward, holes are drilled and tapped in the front surfaces of the rack side pieces in multiples of 1¾ inches for mounting equipment. The height of these racks varies from 4 to 7 feet depending on the type and amount of equipment to be carried. When installed, these racks are set on wooden pieces 4 by 4 inches square, to allow audio lines and power connections to be brought under the racks to terminal blocks at the bottom. Fig. 1 shows a group of racks in the process of installation.

Rack-mounted equipment is generally interconnected by a series of jacks, mounted in "jack strips," Fig. 2, that provide access to the equipment input and output circuits. Connection to the jacks is accomplished by the use of patch cords similar to the one shown in Fig. 3.

The jack strips are mounted at a convenient operating height in the racks, and contain both "normal" and "open circuit" types. Running from these jacks are shielded audio lines to other parts of the laboratory and building. The lines are divided into two classifications, "low" and "high" level. Low-level lines are used for input circuits and high level for output circuits. Lines which are confined to the racks or equipment within the laboratory are often designated "tie lines," while those running out of the laboratory are termed "trunk lines." As a rule, high-level lines carry signal levels above "zero level" and the low-level lines carry those below zero level, zero level being the *reference* level in use for the particular laboratory, which is generally 1 milliwatt. However, some installations still use the 6 milliwatt reference level. This is particularly true of the motion picture industry.

For simplicity of operation, transmission lines are numbered as "LL-1," "LL-2, "HL-10," "HL-20," etc., and are referred to as "originating" and "terminating" at certain points in the plant. When several low- and high-level lines run to a certain section of the building or laboratory, they bear similar numbers. An example would be, "LL-2" and "HL-2." These numbers are never duplicated regardless of location or number of lines required.

Equipment designed for rack mounting is constructed in such a manner that it may be mounted in any position

in the rack, along with jack strips and other equipment, using standard precut panels.

Panels intended for rack mounting are 19 inches in width, the height varying in multiples of 1¾ inches. Panel sizes start at one multiple high (1¾ inches) and continue to 7 multiples which corresponds to 12¼ inches. The material may be either steel or aluminum approximately 3/16 inches in thickness. Each panel is notched at the ends in such a manner that it may be mounted any place in the rack frame. Although the dimension for a three multiple panel is 5¼ inches, actually all panels are cut 1/32 inches under size. This is to allow for variations in the rack mounting holes and the equipment panels to be mounted.

Standard dimensions have also been agreed upon for the mounting of terminal blocks at the bottom of the rack, to allow the connection to internal and external equipment. These terminal blocks may be seen in Fig. 1.

Fig. 4 shows a typical audio frequency development laboratory. In the first rack at the left is mounted an oscilloscope, voltage and power amplifiers. Rack two contains an intermodulation analyzer, while rack three carries a volume indicator, gain set, audio oscillators, and jack strips. In rack four are two special low noise amplifiers and two distortion measuring sets. The balance of the racks contain a high quality radio set, fixed and variable attenuators, patch bay, repeat coils, filters, equalizers, terminations, regulated power supplies, and meters. At the rear of the racks are power supplies for operation of the various devices. This equipment is mounted in standard relay racks, similar to those illustrated in Fig. 1.

Referring again to Fig. 1, it will be noted that external shielded lines have been run to the bottom of the racks and tagged ready for connection to the terminal blocks at the bottom. Cable forms will then be run from these terminal blocks to the various pieces of equipment in the upper portions of the racks.

A frequent practice, particularly in installations where the equipment is mounted in floor racks, is to run 4" by 4" metal "gutter" under the entire length of the racks. This gutter contains a metal separator which divides it into two parts for separating the high- and low-level lines that interconnect the racks or run to other parts of the laboratory. However, if this method of construction is impractical, cable forms may be run along the wall on supporting hooks. In either type of installation, the lines are always run to terminal blocks at the bottom of the racks, then to the equipment above. Separate blocks are provided for a.c. power connections.

Transmission lines generally consist of a pair of #19 "tinned copper, enameled" wires which are cotton covered, twisted, and encased in a "tinned copper" shield. Over this shield is placed a "cloth braid" or "lead sheath." For

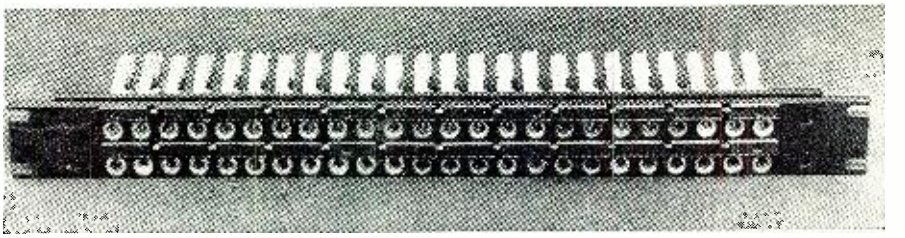


Fig. 2. A "jack strip" of the type used to interconnect rack-mounted equipment.

circuit laboratory work and sound installations, the braided cloth type wire has been found more practical since changes which may be necessary in the cable structure can be made more easily. This particular wire is shown in Fig. 6, Part 8 of this series.

Normally, equipment requiring a.c. power for its operation is placed in a section of the rack or racks where the a.c. fields will not intercouple with other equipment operating at a low level, or would otherwise be affected by the close proximity of an alternating current device.

One of the most important details of any large sound installation is the "grounding system." A *good* ground system contributes tremendously to the *stability* and operation of equipment. This is particularly true where electronic devices are used for the setting of standards, and are required to reproduce precise measurements over a long period of time. Stability, reliability, flexibility, and ease of operation are all dependent upon construction and proper installation of the ground system.

One of two methods of grounding may be employed, the "common ground" or the "transmission" or "system ground." In the common ground method, a single "ground wire" is used to connect the various pieces of equipment to the main ground connection. This is illustrated in Fig. 5.

In this illustration is shown a rack containing four units of which two are "low level" voltage amplifiers, and two are "power amplifiers." Amplifiers designed to operate at low levels, such as microphone or photocell preamplifiers,

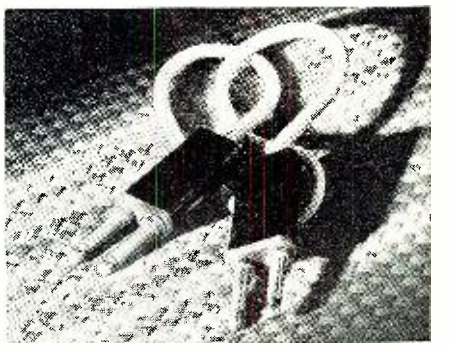


Fig. 3. Typical patch cord which uses a 241A type plug on each end of the cord.

have very low internal noise and require a good ground connection to maintain the low noise level. Power amplifiers as a rule are operated at a fairly high output level and generally have a higher internal noise level, but they also require a good ground connection to reduce noise and hum components to a minimum. If all the units in the system are grounded by a common wire as shown, the noise of units 3 and 4 would be induced in series with the ground return of the voltage amplifiers 1 and 2. Also, it will be noted that any noise in the ground circuit of unit 1 is added to the ground noise of unit 2, and the combined ground noises of units 1 and 2 are added to that of unit 3. Likewise, the upper units add their noise to that of unit 4, therefore the ground bus carries noise currents which are the total of the combined noises generated by the four units.

Although the actual resistance of the ground wire might be only a few hundredths of an ohm, nevertheless, a

Fig. 4. An audio frequency development laboratory showing diversity of equipment.

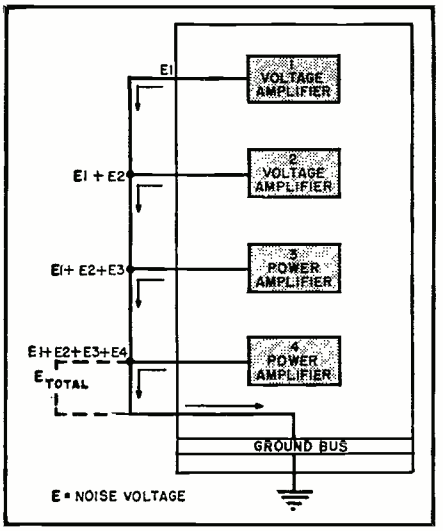


Fig. 5. "Common ground" method of grounding various pieces of the recording equipment.

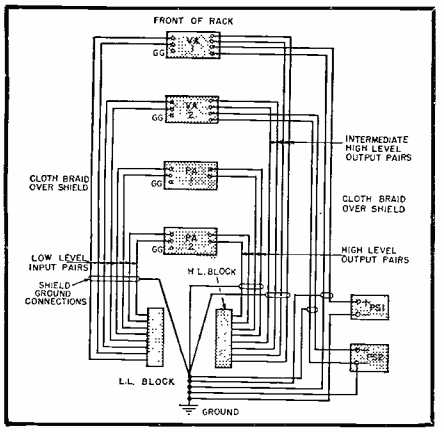


Fig. 6. Alternate grounding method known as the "transmission" or the "system ground."

small "voltage drop" (due to the noise currents) will exist along the ground wire, and high-gain, low-level amplifiers will be affected by the amount of noise currents traveling down the ground wire. Thus, the noise level of all the units would be increased.

The common ground is not recommended for large installations, because of the great amount of flexibility required. Also, the patching of various units creates "ground loops" which cause "crosstalk," noise, or "oscillation" in the system. However, small systems which are fixed in operation may be grounded using the common ground system.

The actual ground connection, in a large installation, is composed of many square feet of copper plate buried in moist ground from which a heavy copper "ground bus" is run to the central part of the installation. If this is not practical, the ground connection may be attached to a water main, but *never* to a gas pipe, as the threaded portions are generally filled with compound to seal the threads which acts as an insulator, resulting in a very high resistance connection to the earth. It is also the practice, in many localities, to use insulated connections between the gas meter and the street gas main to reduce the effect of electrolysis between electrical conduit and the gas pipes.

The whole purpose of a ground is to supply a very low resistance connection to the earth which stabilizes the installation, preventing oscillations and "drains off" extraneous noises that might be induced from power lines and other sources. The ground wire must always be insulated in order to keep it from coming in contact with other grounds and thus defeating its purpose.

The second method of grounding is the "transmission" or "system ground," which is used in large installations to facilitate the location of noise in equipment, to prevent crosstalk between units, and to generally stabilize the system as a whole. This method of grounding is widely used in the audio industry and is to be *preferred* over other methods.

How the "transmission" or "system ground" method functions is shown in Fig. 6. Several pieces of rack-mounted equipment are shown along with the external power supplies. Each piece of equipment has its own input and output pair, and connections to an external power supply, in addition to a terminal marked "CG" or chassis ground. This latter terminal post is tied directly to the metal chassis of each piece of equipment.

In this type of ground system, the *"B minus"* terminal is *not* connected to the chassis, as would be the case where the common ground system is employed, but rather is left "floating." Fig. 7 illustrates how this is accomplished.

This latter diagram shows a two-stage amplifier which is transformer-coupled at both its input and output, as well as interstage. It will be observed that the transformer *cases* are grounded to the chassis, while the transformer *cores* and the envelopes of the tubes are tied to the "B–" terminal. The terminal marked "CG" (chassis ground) connects only to the metal chassis and the shields of any interconnecting wires. This type construction reduces the possibility of inducing ground noises into the tube circuits, transformer cores, and power supply.

Referring again to Fig. 6, it will be noted that each unit in the rack that requires a source of power has separate shielded pairs run between the power supply and the amplifier unit. Also, a separate ground wire is run from the minus terminal of each power supply directly to the ground bus to provide the "B minus" with a ground. The chassis ground wire (CG) may be dispensed with, if a good ground is obtained through the frame of the rack to the chassis. Sometimes this is rather difficult to obtain because of paint and rust on the rack side pieces. The shields for each input and output pair are grounded by running a separate wire for a group or "form" to the main ground bus. Although the lines comprising the input and output cables are shown separately, they are actually laced together into a "bundle" or "form." These wires are shielded pairs with a cloth braid over the outside to prevent the shield of one pair contacting that of another. The shields are then connected together at the lower end of the form and a single ground wire run to the "rack ground."

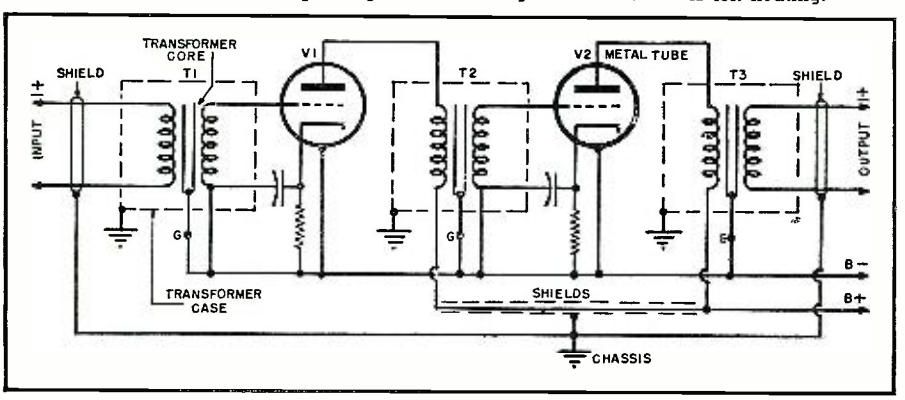
In this system all ground wires must be insulated to keep them from touching any other grounds and causing ground loops between the wiring. Also, under no circumstances should the shields be grounded at more than *one* point, as this, too, would cause a ground loop and might induce noise or hum into the system. Ground wires running from the cable forms are generally #18 stranded wire, while those running from the rack to the main ground are #4 or #6 gauge wire.

At the bottom of each rack is a ground bus of heavy copper about 1¾" by ¼" mounted just above the base of the rack. If several racks are placed alongside each other, the copper bus is continued in one piece across all the racks and the main ground connection brought to its center. On the other hand, should several racks and other pieces of equipment be involved, but separated by several feet, the ground is run to each rack separately.

Fig. 8 shows how ground loops are created. Assume that two pieces of equipment, *A* and *B*, are connected by means of a shielded cable pair and that the shield on this wire is bare and grounded at each end. It is a well-known fact that there are many electrical currents flowing in the ground as a result of the grounding of various pieces of electrical apparatus, such as

(*Continued on page* 127)

Fig. 7. Details of the "system ground" showing how "B minus" is left floating.



German crowd, part of the 1,250,000 from East and West Berlin, sees a typical RCA television program.

"Freedom's window in the Iron Curtain"

You've read the story of last summer's TV demonstrations in Berlin. It attracted a million and a quarter Germans—including thousands who slipped through the Iron Curtain to see Western progress at work.

Behind this is another story: How RCA engineers and technicians broke all records in setting up these Berlin facilities. The project called for a TV station and studio, a lofty batwing antenna, and the installation of 110 television receivers at strategic points. Such a program would normally take several months to complete. It was installed and put to work by RCA in a record-breaking 85 hours!

Programs witnessed by Berliners included live talent shows, sports events, news commentaries, and dramatizations of the Marshall Plan. Observers pronounced reception fully up to American standards—another impressive demonstration of democracy's technical ingenuity and leadership.

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See the latest wonders of radio, television, and electronics at RCA Exhibition Hall, 36 West 49th St., New York. Admission is free. Radio Corporation of America, RCA Building, Radio City, N. Y. 20, N. Y.

Part of the 401 cases of RCA equipment shipped to Berlin for television demonstrations.

RCA **RADIO CORPORATION of AMERICA**
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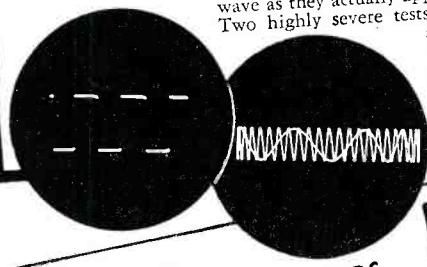
Features OF THE NEW 1952 Heathkits

PROOF OF THE NEW O-7 OSCILLOSCOPE'S OUTSTANDING PERFORMANCE

Below are actual, unretouched photographs showing the outstanding frequency response characteristics of the NEW 1952 HEATHKIT OSCILLOSCOPE MODEL O-7. To the left is a 10 KC square wave — to the right a 4 MC sine wave as they actually appear on the screen. Two highly severe tests to make on any scope (only the best of scopes will show traces like these) — and the O-7 really comes through.

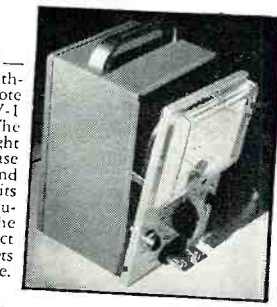


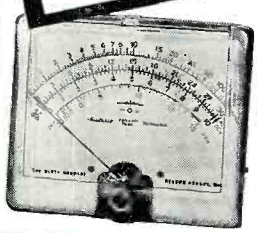
COMPANION VACUUM TUBE VOLTMETERS

Here are the two NEW 1952 VACUUM TUBE VOLTMETER COMPANION PIECES. Matched instruments of new design to open up the whole field of DC, AC, and resistance measurements for you. The new greatly reduced size combines style, beauty, and compactness — The V-5 and AV-1 have the new panel and cabinet construction as shown on the right. A tremendous pair of voltmeters. Small in size but virtual giants in the range of measurements they make.

NEW STYLE AND BEAUTY

Style that's modern, yet functional — that's the trend of today — and Heathkits are right up to the minute. Note the cut showing the new V-5 and AV-1 cabinet and panel construction. The front panel and rear cover slide right over the recessed flange of the case thereby eliminating sharp edges and pointed corners. The voltmeter kits aren't "shelf" or "mounted" instruments — they're moved about on the bench a lot and thus the new compact size and specially designed cabiners — Another 1952 Heathkit feature.





A STATEMENT FROM SIMPSON ELECTRIC CO.

In choosing Simpson Meters for their Heathkit VTVM, the Heath Co. has set a new high standard of kit meter quality. The same high quality of material, workmanship and design that has given Simpson the reputation for building "Instruments That Stay Accurate" is found in the Heathkit Meter Movement.

SIGNED
SIMPSON ELECTRIC CO.

A STATEMENT FROM CHICAGO TRANSFORMER

It is indeed gratifying to note the outstanding sales records you are building with your Heathkits.

This sales success is readily understandable, since we are cognizant of the high quality standards you have established for your component suppliers.

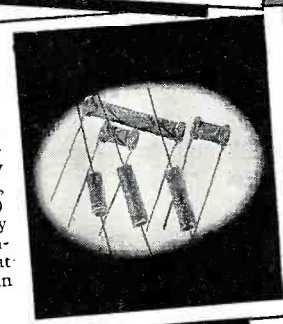
We at Chicago Transformer are proud that our product has contributed to the recognized quality and increasing popularity of Heathkits.

CHICAGO TRANSFORMER DIVISION
Essex Wire Corporation

L. S. RACINE
Vice-President and Sales Manager

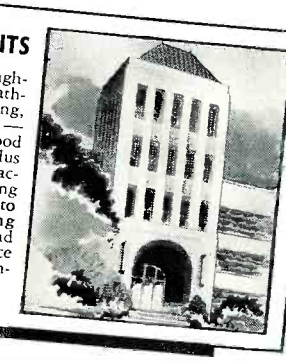
HEATHKIT PRECISION RESISTORS

Where exact resistance values are required for instrument accuracy, the Heath Co. has spared no effort in supplying the finest resistors available. Precision resistors as manufactured by Continental Carbon Inc., and Wilcor Corp., meet the rigorous JAN (Joint Army-Navy) specifications and are small in size, extremely non-inductive, highly stable, have a low temperature coefficient, and can be held to great accuracy. You'll find quality components in Heathkits.



COLLEGES USE HEATHKITS

Colleges and Universities throughout the country are using Heathkits in their electrical engineering, radio, and physics laboratories — Heathkits are the answer to good test equipment at low cost, plus being rugged, dependable, and accurate. Trade schools are having their students build Heathkits to obtain a first hand working knowledge of test equipment and to get the practical experience gained by construction. Heathkits fill school needs.



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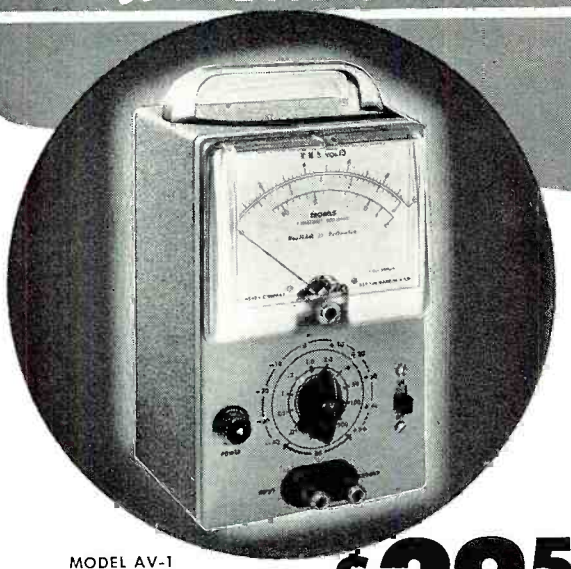
New LABORATORY LINE HEATHKITS



NEW Heathkit A.C. VACUUM TUBE VOLTMETER KIT

Now — as a Heathkit — at a price anyone can afford, an AC VTVM.

A new kit to make possible those sensitive AC measurements required by audio enthusiasts, laboratories, and experimentors. Here is the kit that the audio men have been looking for. Its tremendous range of coverage makes possible measurements of audio amplifier frequency response — gain or loss of audio stages — characteristics of audio filters and attenuators — hum investigation — and literally a multitude of others. Ten ranges consisting of full scale .01, .03, .1, .3, 1, 3, 10, 30, 100, 300 volts RMS assure easy and more accurate readings. Ten ranges on DB provide for measurements from −52 to +52 DB. Frequency response within 1 DB from 20 cycles to 50 KC.

The ingenious circuitry incorporates precision multiplier resistors for accuracy, two amplifier stages using miniature tubes, a unique bridge rectifier meter circuit, quality Simpson meter with 200 microampere movement, and a clean layout of parts for easy wiring. A high degree of inverse feedback provides for stability and linearity.

Simple operation is accomplished by the use of only one control, a range switch which changes the voltage ranges in multiples of 1 and 3, and DB ranges in steps of 10.

The instrument is extremely compact, cabinet size — 4⅛" deep x 4-11/16" wide x 7⅜" high, and the newly designed cabinet makes this the companion piece to the VTVM. For audio work, this kit is a natural.

MODEL AV-1
Shipping weight 5 lbs

$29.50

NEW Heathkit AUDIO FREQUENCY METER KIT

MODEL AF-1
Shipping weight 12 lbs.

$34.50

A NEW Heathkit Audio Frequency Meter — the ideal instrument for determining frequencies from 20 cycles to 100 KC. Set the selector switch to the proper range — feed the signal into the input terminals — and read the frequency from the meter — completely simple to operate, and yet dependable results.

Quality Simpson 200 microampere meter has two plainly marked scales (0-100 0-300. These scales, read in conjunction with the seven position selector switch, give full scale readings of 100, 300, 1000, 3000, 10,000, 30,000, and 100,000 cycles. Convenient ranges for fast and easy readings.

For greatest accuracy, the 1-3-10 ratio of ranges is maintained and each range has individual calibrating control.

Input impedance is high (1 megohm) for negligible circuit loading. A signal voltage anywhere between 2 and 300V can be fed directly into the instrument and a change in signal voltage between these limits will not affect the meter reading. In addition, input wave shape is not critical (the unit will read the frequency of either sine wave or square wave input).

The tube complement consists of a 6SJ7 amplifier and clipper, 6V6 amplifier and clipper, 6H6 meter pulse rectifier, 6X5 power supply rectifier, and OD3/VR150 voltage regulator.

Construction is simple, and quality components are used throughout.

NEW Heathkit INTERMODULATION ANALYZER KIT

Intermodulation testing of audio equipment is rapidly being accepted by more and more engineers and audio experts as the best way to determine the characteristics of audio amplifiers, recording systems, networks, etc. — shows up those undesirable characteristics which contribute to listening fatigue when all other methods fail.

The Heathkit Intermodulation Analyzer supplies a choice of two high frequencies (5000 cycles and a higher frequency) and one low frequency (60 cycles). Both 1:1 or 4:1 ratios of low to high frequencies can be set up for IM testing, and the ratios are easily set by means of a panel control and the instrument's own VTVM. An output level control supplies the mixed signal at the desired level with an output impedance of two thousand ohms. The Analyzer section has input level control and proper filter circuits feeding the instrument's VTVM to read intermodulation directly on full scale ranges of 30%, 10% and 3%. Built-in power supply furnishes all necessary voltages for operating the instrument.

You won't want to be without this new and efficient means of testing

MODEL IM-1
Shipping wt. 18 lbs.

$39.50

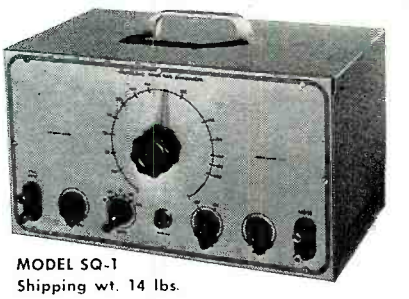
NEW Heathkit SQUARE WAVE GENERATOR KIT

The new Heathkit Square Wave Generator Kit with its 100 KC square wave opens an entirely new field of audio testing. Square wave testing over this wide range will quickly show high and low frequency response characteristics of circuits — permit easy adjustment of high frequency compensating networks used in vidio amplifiers — identify ringing in circuits — demonstrate transformer characteristics, etc.

The circuitry consists of a multivibrator stage, a clipping and squaring stage, and a cathode follower output stage. The power supply is transformer operated and utilizes a full wave rectifier tube with 2 sections of LC filtering.

As a multivibrator cannot be accurately calibrated, a provision is provided to allow the instrument to be accurately synchronized with an accurate external source when extreme accuracy is required.

The low impedance output is continuously variable between 0 and 25 volts and operation is simple. You'll really appreciate the wide range of this instrument, 10 cycles to 100 kilocycles — continuously variable. Kit is complete with all parts and instruction manual, and is easy to build.



MODEL SQ-1
Shipping wt. 14 lbs.

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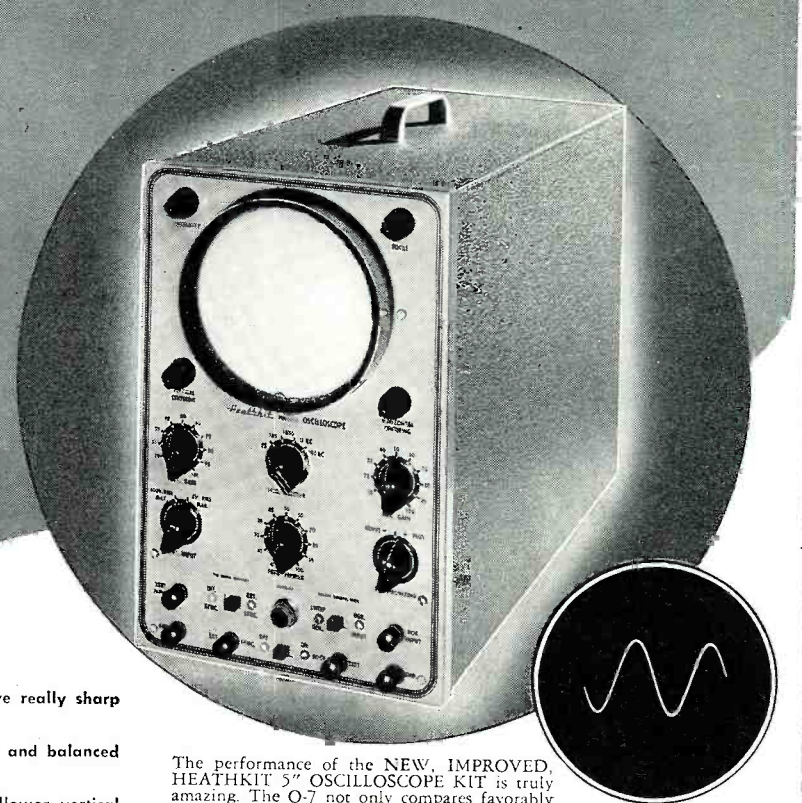
OSCILLOSCOPE KIT

MODEL O-7

SHIPPING WEIGHT 24 LBS.

$43.50



Features

- New "spot shape" control for spot adjustment — to give really sharp focusing.
- A total of ten tubes including CR tube and five miniatures.
- Cascaded vertical amplifiers followed by phase splitter and balanced push-pull deflection amplifiers.
- Greatly reduced retrace time.
- Step attenuated — frequency compensated — cathode follower vertical input.
- Low impedance vertical gain control for minimum distortion.
- New mounting of phase splitter and deflection amplifier tubes near CR tube base.
- Greatly simplified wiring layout.
- Increased frequency response — useful to 5 Mc.
- Tremendous sensitivity .03V RMS per inch Vertical — .6V RMS per inch Horizontal.
- Dual control in vernier sweep frequency circuit — smoother acting.
- Positive or negative peak internal synchronization.

The performance of the NEW, IMPROVED, HEATHKIT 5" OSCILLOSCOPE KIT is truly amazing. The O-7 not only compares favorably with equipment costing 4 and 5 times as much, but in many cases literally surpasses the really expensive equipment. The new, and carefully engineered circuit incorporates the best in electronic design — and a multitude of excellent features all contribute to the outstanding performance of the new scope.

The VERTICAL CHANNEL has a step attenuated, frequency compensated vertical input which feeds a cathode follower stage — this accomplishes improved frequency response, presents a high impedance input, and places the vertical gain control in a low impedance circuit for minimum distortion. Following the cathode follower stage is a twin triode — cascaded amplifiers to contribute to the scope's extremely high sensitivity. Next comes a phase splitter stage which properly drives the push-pull, hi-gain, deflection amplifiers (whose plates are directly coupled to the vertical deflection plates). This fine tube lineup and circuitry give a sensitivity of .03V per inch RMS vertical and useful frequency response to 5 Mc.

The HORIZONTAL CHANNEL consists of a triode phase splitter with a dual potentiometer (horizontal gain control) in its plate and cathode circuits for smooth, proper driving of the push-pull horizontal deflection amplifiers. As in the vertical channel, horizontal deflection amplifier plates are direct coupled to the CR tube horizontal deflection plates (for improved frequency response).

The WIDE-RANGE SWEEP GENERATOR circuit incorporates a twin triode multivibrator stage for producing a good saw-tooth sweep frequency (with faster retrace time). Has both coarse and vernier sweep frequency controls.

And the scope has internal synchronization which operates on either positive or negative peaks of the input signal — both high and low voltage rectifiers — Z axis modulation (intensity modulation) — new spot shape (astigmatism) control for spot adjustment — provisions for external synchronization — vertical centering and horizontal centering controls, wide range focus control — and an intensity control for giving plenty of trace brilliance.

The Model O-7 EVEN HAS GREAT NEW MECHANICAL FEATURES — A special extra-wide CR tube mounting bracket is provided so that the vertical cascade amplifier, vertical phase splitter, vertical deflection amplifier, and horizontal deflection amplifier can mount near the base of the CR tube. This permits close connection between the above stages and to the deflection plates; distributed wiring capacity is greatly reduced, thereby affording increased high frequency response.

The power transformer is specially designed so as to keep its electrostatic and electromagnetic fields to a minimum — also has an internal shield with external ground lead.

You'll like the complete instructions showing all details for easily building the kit — includes pictorials, step-by-step construction procedure, numerous sketches, schematic, circuit description. All necessary components included — transformer, cabinet, all tubes (including CR tube), completely punched and formed chassis—nothing else to buy.

NEW INEXPENSIVE *Heathkit*

ELECTRONIC SWITCH KIT

Model S-2
Shipping Wt. 11 lbs.

Only

$19.50

The companion piece to a scope — Feed two different signals into the switch, connect its output to a scope, and you can observe both signals — each as an individual trace. Gain of each input is easily set (gain A and gain B controls), the switching frequency is simple to adjust (coarse and fine frequency controls) and the traces can be superimposed for comparison or separated for individual study (position control).

Use the switch to see distortion, phase shift, clipping due to improper bias, both the input and output traces of an amplifier — as a square wave generator over limited range.

The kit is complete; all tubes, switches, cabinet, power transformer and all other parts, plus a clear detailed construction manual.

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The HEATH COMPANY

. . . BENTON HARBOR 15, MICHIGAN

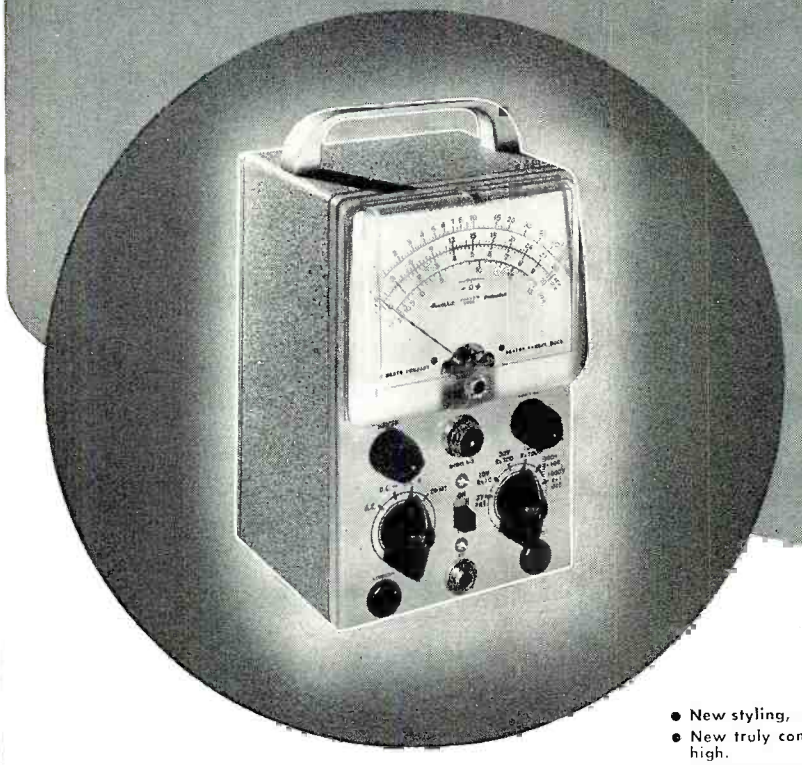
THE *New* 1952

Heathkit

VTVM KIT

MODEL V-5
SHIPPING WT. 5 LBS.

$24.50



Features

- New styling, — formed case for beauty.
- New truly compact size. Cabinet 4⅛" deep by 4-11/16" wide by 7⅜" high.
- Quality 200 microamp meter.
- New ohms battery holding clamp and spring clip — assurance of good electrical contact.
- Highest quality precision resistors in multiplier circuit.
- Calibrates on both AC and DC for maximum accuracy.
- Terrific coverage — reads from ½V to 1000V AC, ½V to 1000V DC, and .1 to over 1 billion ohms resistance.
- Large, clearly marked meter scales indicate ohms, AC Volts, DC Volts, and DB — has zero set mark for FM alignment.
- New styling presents attractive and professional appearance.

A real beauty — you'll have only highest praise for this NEW MODEL VACUUM TUBE VOLTMETER. Truly a beautiful little instrument — and it's more compact than any of our previous models. Note the new rounded edges on the front panel and rear cover. The size is greatly reduced to occupy a minimum of space on your workbench — yet the meter remains the same large size with plainly marked scales.

A set of specially designed control mounting brackets permit calibration to be performed with greatest ease — also makes for ease in wiring. New battery mounting clamp holds ohms battery tightly into place, and base spring clip insures a good connection to the ohms string of resistors.

The circuitry employs two vacuum tubes — A duo diode operating when AC voltage measurements are taken, and a twin triode in the circuit at all times. The cathode balancing circuit of the twin triode assures sensitive measurements, and yet offers complete protection to the meter movement. Makes the meter burn-out proof in a properly constructed instrument.

Quality components are used throughout —1% precision resistors in the multiplier circuit—conservatively rated power transformer— Simpson meter movement — excellent positive detent, smooth acting switches — sturdy cabinet, etc.

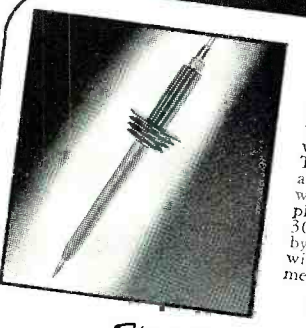
And you can make a tremendous range of measurements — ½V to 1000V AC, ½V to 1000V DC, .1 to over 1 billion ohms, and DB. Has mid-scale zero level marking for quick FM alignment. DB scale in red for easy identification — all other scales a sharp, crisp black for for easy reading.

A four position selector switch allows operator to rapidly set the instrument for type or reading desired—positions include ACV, DC+V, DC—V, and Ohms. DC— position allows negative voltage to be rapidly taken. Zero adjust and ohms adjust controls are conveniently located on front panel.

Enjoy the numerous advantages of using a VTVM. Its high input impedance doesn't "load" circuits under test — therefore, assures more accurate and dependable readings in high impedance circuits such as resistance coupled amplifiers, AVC circuits, etc. Note the 30,000 VDC probe kit and the RF probe kit — available at low extra cost and specially designed for use with this instrument. With these two probes, you can make DC voltage measurements up to 30,000V, or make RF measurements — added usefulness to an already highly useful instrument.

The instruction manual is absolutely complete — contains a host of figures, pictorials, schematic, detailed step-by-step instructions, and circuit description. These clear, detailed instructions make assembly a cinch.

And every part is included — meter, all controls, pilot light, switches, test leads, cabinet, instruction manual, etc.



Heathkit 30,000V DC

PROBE KIT

A new 30,000 V DC Probe Kit to handle high voltages with safety. For TV service work and all other high voltage applications. Sleek looking — Two color molded plastic — Red body and guard — jet black handle. Comes with connector, cable, and PL55 type plug. Plugs into Heathkit VTVM so that 300V scale is conveniently multiplied by 100. Can be used with any standard 11 megohm VTVM.

$5.50

No. 336 High Voltage Probe Kit
Shipping Wt. 2 lbs.

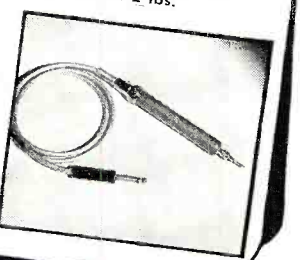
Heathkit

RF PROBE KIT

This RF Probe Kit comes complete with probe housing, crystal diode detector, connector, lead and plug and all other parts plus clear assembly instructions. Extends range of Heathkit VTVM to 250 Mc. ± 10%. Works on any 11 megohm input VTVM. Specify No. 309 RF Probe Kit.

$5.50

Ship. Wt. 1 lb.



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Heathkit SIGNAL GENERATOR KIT

Model SG-6
Shipping Wt. 7 lbs.

$19.50

The new Heathkit Signal Generator Kit has dozens of improvements. Covers the extended range of 160 Kc to 50 megacycles on fundamentals and up to 150 megacycles on useful calibrated harmonics; makes this Heathkit ideal as a marker oscillator for TV. Output level can be conveniently set by means of both step attenuator and continuously variable output controls. Instrument has new miniature HF tubes to easily handle the high frequencies covered.

Uses 6C4 master oscillator and 6C4 sine wave audio oscillator. The kit is transformer operated and a husky selenium rectifier is used in the power supply. All coils are precision wound and checked for calibration making only one adjustment necessary for all bands.

New sine wave audio oscillator provides internal modulation and is also available for external audio testing. Switch provided allows the oscillator to be modulated by an external audio oscillator for fidelity testing of receivers. Comes complete, all tubes, cabinet, test leads, every part. The instruction manual has step-by-step instructions and pictorials. It's easy and fun to build a Heathkit Model SG-6 Signal Generator.

Heathkit CONDENSER CHECKER KIT

Only

$19.50

Model C-2
Shipping Wt. 6 lbs.

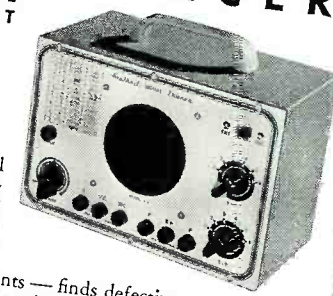
Checks all types of condensers — paper — mica — ceramic — electrolytic. All condenser scales are direct reading and require no charts or multipliers. Covers range of .00001 MFD to 1000 MFD. A Condenser Checker that anyone can read. A leakage test and polarizing voltage for 20 to 500 V provided. Measures power factor of electrolytics between 0% and 50% and reads resistance from 100 ohms to 5 megohms. The magic eye indicator makes testing easy.

The kit is 110V 60 cycle transformer operated and comes complete with rectifier tube, magic eye tube, cabinet, calibrated panel and all other parts. Has clear detailed instructions for assembly and use.

NEW Heathkit SIGNAL TRACER AND UNIVERSAL TEST SPEAKER KIT

$19.50

Model T-2
Shipping Wt. 7 lbs.



The popular Heathkit Signal Tracer has now been combined with a universal test speaker at no increase in price. The same high quality tracer follows signal from antenna to speaker — locates intermittents — finds defective parts quicker — saves valuable service time — gives greater income per service hour. Works equally well on broadcast, FM, or TV receivers. The test speaker has an assortment of switching ranges to match either push-pull or single output impedances. Also tests microphones, pickups and PA systems. Comes complete: cabinet, 110V 60 cycle power transformer, tubes, test probe, all necessary parts, and detailed instructions for assembly and use.

Model TC-1
Shipping Wt. 12 lbs.

$29.50

Heathkit TUBE CHECKER KIT

The Tube Checker is a MUST for radio repair men. Often customers want to SEE tubes checked, and a checker like this builds customer confidence. In your repairing, you will have a multitude of tubes to check — quickly. The Heathkit tube checker will serve all these functions — it's good looking (with a polished birch cabinet and an attractive two color panel) — checks 4, 5, 6, 7 prong Octals, Loctals, 7 prong miniatures. 9 prong miniatures, pilot lights, and the Hytron 5 prong types. AND IT'S FAST TO OPERATE — the gear driven, free-running roll chart lists hundreds of tubes, and the smooth acting, simplified switching arrangement gives really rapid set-ups.

The testing arrangement is designed so that you will be able to test new tubes of the future — without even waiting for factory data — protection against obsolescence.

You can give tubes a thorough testing — checks for opens, shorts, each element individually, emission, and for filament continuity. A large BAD-?-GOOD meter scale is in three colors for easy reading and also has a "line-set" mark.

You'll find this tube checker kit a good investment — and it's only $29.50.

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NEW 1952 *Heathkit*

BATTERY ELIMINATOR KIT

Model BE-3
Shipping Wt. 17 lbs.

- Can be used as battery charger.
- Continuously variable output 0 - 8 Volts — not switch type.
- Heavy duty Mallory 17 disk type magnesium copper sulfide rectifier.
- Automatic overload relay for maximum protection. Self-resetting type.
- Ideal for battery, aircraft and marine radios.
- Dual Volt and Ammeters read both voltage and amperage continually — no switching.

The new Heathkit Model BE-2 incorporates the best. Continuously variable output control is of the variable transformer type with smooth wiper type contacts.

There are no switches or steps and voltage between 0 and 8 Volts is available at 10 Amperes continuous and 15 Amperes intermittent. Maximum safety from overloads and shorts provided by automatic overload relay which resets itself when overload is removed.

The new rectifier is a 17 plate Mallory magnesium copper sulfide type. This is the most rugged type available for long trouble-free use.

Output is continuously metered by both a 0 - 10 Volt Voltmeter and a 0 - 15 Amp Ammeter. Shorted vibrators indicated instantly by ammeter.

Equip now for all types of service — aircraft — marine — auto and battery radios — this inexpensive instrument vastly increases service possibilities — better be ready when the customer walks in.

NEW *Heathkit*

SINE AND SQUARE WAVE AUDIO GENERATOR KIT

Model AG-7
Shipping Wt. 15 lbs.

$34.50

Designed with versatility, usefulness, and dependability in mind, the AG-7 gives you the two most needed wave shapes right at your fingertips — the sine wave and the square wave.

The range switch and plainly calibrated frequency scale give rapid and easy frequency selection, and the output control permits setting the output to any desired level.

A high-low impedance switch sets the instrument for either high or low impedance output —on high to connect a high impedance load, and on low to work into a low impedance transformer with negligible DC resistance.

Coverage is from 20 to 20,000 cycles, and distortion is at a minimum — you can really trust the output wave shape.

Six tubes, quality 4 gang tuning condenser, power transformer, metal cased filter condenser, 1% precision resistors in the frequency determining circuit, and all other parts come with the kit —plus, a complete construction manual — A tremendous kit, and the price is truly low.

THE NEW *Heathkit*

HANDITESTER KIT

A precision portable volt-ohm milliammeter. Uses only high quality parts — All precision 1% resistors, three deck switch for trouble-free mounting of parts, specially designed battery mounting bracket, smooth acting ohm adjust control, beautiful molded bakelite case, 400 micro-amp meter movement, etc.

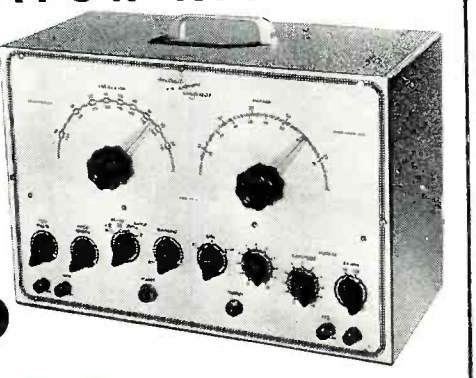
DC and AC voltage ranges 10 - 30 - 300 - 1000 - 5000V. Ohms range 0 - 3000 and 0 - 300,000. Range Milliamperes 0 - 10 Ma, 0 - 100 Ma. Easily assembled from complete instructions and pictorial diagrams.

$13.50

Model M-1
Shipping Wt. 3 lbs.

NEW *Heathkit*

T.V. ALIGNMENT GENERATOR KIT



Here is an excellent TV Alignment Generator designed to do TV service work quickly, easily, and properly. The Model TS-2 when used in conjunction with an oscilloscope provides a means of correctly aligning television receivers.

The instrument provides a frequency modulated signal covering, in two bands, the range of 10 to 90 Mc. and 150 to 230 Mc.— ALL ALLOCATED TV CHANNELS AS WELL AS IF FREQUENCIES ARE COVERED.

An absorption type frequency marker covers from 20 to 75 Mc. in two ranges—therefore, you have a simple, convenient means of frequency checking of IF's, independent of oscillator calibration.

Sweep width is controlled from the front panel and covers a sweep deviation of 0-12 Mc.—all the sweep you could possibly need or want.

And still other excellent features are: Horizontal sweep voltage available at the front panel (and controlled with a phasing control—both step and continuously variable attenuation for setting the output signal to the desired level—a convenient instrument stand-by position—vernier drive of both oscillator and marker tuning condensers—and blanking for establishing a single trace with base reference level. Make your work easier, save time, and repair with confidence—order your Heathkit TV Alignment Generator now!

Model TS-2
Shipping Wt. 20 lbs.

$39.50

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Heathkit IMPEDANCE BRIDGE KIT

Model 1B-1B
Shipping Wt. 15 lbs.

$69.50

This Impedance Bridge Kit is really a favorite with schools, industrial laboratories, and serious experimenters. An invaluable instrument for those doing electrical measurements work. Reads resistance from .01 Ohms to 10 meg., capacitance from .00001 to 100 MFD, inductance from 10 microhenries to 100 henries, dissipation factor from .002 to 1, and storage factor from 1 to 1000. And you don't have to worry about selecting the proper bridge circuit for the various measurements — the instrument automatically makes the correct circuit when you set up for taking the measurement you want. Bridge utilizes Wheatstone, Hay, Maxwell, and capacitance comparison circuits for the wide range and types of measurements possible. And it's self powered — has internal battery and 1000 cycle hummer. No external generator required — has provisions for external generator if measurements at other than 1000 cycles are desired. Kit utilizes only highest quality parts, General Radio main calibrated control. Mallory ceramic switches, excellent 200 microamp zero center galvanometer, laboratory type binding posts with standard ¾ inch centers, 1% precision ceramic-body type multiplier resistors, beautiful birch cabinet and ready calibrated panel. (Headphones not included.)

Take the guesswork out of electrical measurements — order your Heathkit Impedance Bridge kit today — you'll like it.

Heathkit LABORATORY RESISTANCE DECADE KIT

$19.50

Shipping Wt. 4 lbs.

An indispensable piece of laboratory equipment — the Heathkit Resistance Decade Kit gives you resistance settings from 1 to 99,999 ohms IN ONE OHM STEPS. For greatest accuracy, 1% precision ceramic-body type resistors and highest quality ceramic wafer switches are used.

Designed to match the Impedance Bridge above, the Resistance Decade Kit has a beautiful birch cabinet and attractive panel. It's easy to build, and comes complete with all parts and construction manual.

Heathkit LABORATORY POWER SUPPLY KITS

Limits:

No load	Variable	150-400V DC
25 MA	Variable	30-310V DC
50 MA	Variable	25-250V DC

Higher loads: Voltage drops off proportionally

$29.50

Model PS-1.....Ship. Wt. 20 lbs.

Every experimenter needs a good power supply for electronic setups of all kinds. This unit has been expressly designed to act as a HV supply and a 6.3 V filament voltage source. Voltage control allows selection of HV output desired (continuously variable within limits outlined), and a Volts-Ma switch provides choice of output metering. A large plainly marked and direct reading meter scale indicates either DC voltage output in Volts or DC current output in Ma. (Range of meter 0-500V D.C., 0-200 Ma. D.C.). Instrument has convenient stand-by position and pilot light.

Comes with power transformer, filament transformer, meter, 5Y3 rectifier, two 1619 control tubes, completely punched and formed chassis, panel, cabinet, detailed construction manual, and all other parts to make the kit complete.

Heathkit ECONOMY . . . 6 WATT AMPLIFIER KIT

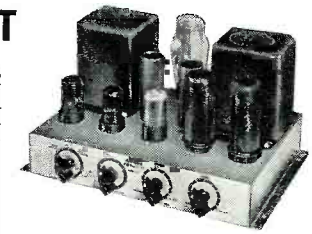
Model A-4
Ship. Wt. 8 lbs.

$12.50

No. 304 12 inch speaker . . . **$6.95**

This fine Heathkit Amplifier was designed to give quality reproduction and yet remain low in price. Has two preamp stages, phase inverter stage, and push-pull beam power output. Comes complete with six tubes, quality output transformer (to 3-4 ohm voice coil), husky cased power transformer and all other parts. Has tone and volume controls. Instruction manual has pictorial for easy assembly. Six watts output with response flat ± 1½ db from 50 to 15,000 cycles. A quality amplifier kit at a low price. Better build one.

Heathkit HIGH FIDELITY . . . 20 WATT AMPLIFIER KIT



$33.50

Shipping Wt. 18 lbs.

Our latest and finest amplifier — the model A-6 (or A-6A) is capable of a full 20 Watts of high fidelity output — good faithful reproduction made possible through careful circuit design and the use of only highest quality components. Frequency response within ± 1 db from 20-20,000 cycles. Distortion at 3 db below maximum power output (at 1000 cycles) is only .8%. The power transformer is rugged and conservatively rated and will deliver full plate and filament supply with ease. The output transformer was selected because of its exceptionally good frequency response and wide range of output impedances (4-8-16-150-600 ohms). Both are Chicago Transformers in drawn steel case for shielding and maximum protection to windings. The unit has dual tone controls to set the output for the tonal quality desired — treble control attentuates up to 15 db at 10,000 cycles — bass control gives bass boost up to 10 db at 50 cycles.

Tube complement consists of 5U4G rectifier, 6SJ7 voltage amplifier, 6SN7 amplifier and phase splitter, and two 6L6's in push-pull output. Comes complete with all parts and detailed construction manual. (Speaker not included.)

MODEL A-6: For tuner and crystal phono inputs. Has two position selector switch for convenient switching to type of input desired.

MODEL A-6A: Features an added 6SJ7 stage (preamplifier) for operating from variable reluctance cartridge phono pickup, mike input, and either tuner or standard crystal phono pickup. A three position selector switch provides flexible switching. Shipping Wt. 18 lbs. **$35.50**

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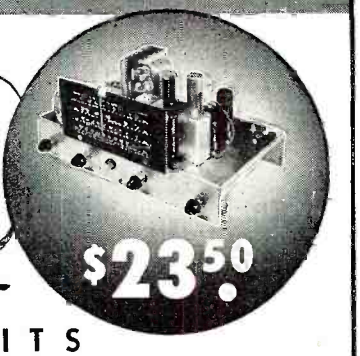
Heathkit RECEIVER & TUNER KITS for AM and FM

Model BR-1 Broadcast Model Kit covers 550 to 1600 Kc. Shipping Wt. 10 lbs.

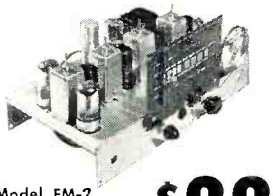
Model AR-1 3 Band Receiver Kit covers 550 Kc. to over 20 Mc. continuous. Extremely high sensitivity. Shipping Wt. 10 lbs.



TWO HIGH QUALITY Heathkit SUPERHETERODYNE RECEIVER KITS

Two excellent Heathkits. Ideal for schools, replacement of worn out receivers, amateur and custom installations.

Both are transformer operated quality units. The best of materials used throughout — six inch calibrated slide rule dial — quality power output transformers — dual iron core shielded. I.F. coils — metal cased filter condenser. The chassis has phono input jacks, 110 Volt output for phono motor and there is a phono-radio switch on panel. A large metal panel simplifying installation in used console cabinets is included. Comes complete with tubes and instruction manual incorporating pictorials and step-by-step instructions (less speaker and cabinet). The three band model has simple coil turret which is assembled separately for ease of construction.



Model FM-2
Ship. Wt. 9 lbs.

$22.50

TRUE FM FROM Heathkit FM TUNER KIT

The Heathkit FM Tuner Model FM-2 was designed for best tonal reproduction. The circuit incorporates the most desirable FM features — true FM.

Utilizes 8 tubes: 7E5 Oscillator, 6SH7 mixer, two 6SH7 IF amplifiers, 6SH7 limiter, two 7C4 diodes as discriminator, and 6X5 rectifier.

The instrument is transformer operated making it safe for connection to any type receiver or amplifier. Has ready wound and adjusted RF coils, and 2 stages of 10.7 Mc IF (including limiter). A calibrated six inch slide rule dial has vernier drive for easy tuning. All parts and complete construction manual furnished.

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	Heathkit VTVM Kit — Model V-5			Heathkit R.F. Signal Gen. Kit — Model SG-6	
	Heathkit FM Tuner Kit — FM-2			Heathkit Condenser Checker Kit — Madel C-2	
	Heathkit Broadcast Receiver Kit — Madel BR-1			Heathkit Handitester Kit — Model M-1	
	Heathkit Three Band Receiver Kit—Madel AR-1			Heathkit Power Supply Kit — Madel PS-1	
	Heathkit Amplifier Kit — Model A-4			Heathkit Resistance Decade Kit — Madel RD-1	
	Heathkit Amplifier Kit — Madel A-6 (or A-6A)			Heathkit Impedance Bridge Kit — Madel IB-1B	
	Heathkit Tube Checker Kit — Madel TC-1			Heathkit A.C. VTVM-KIT — Model AV-1	
	Heathkit Audio Generator Kit — Model AG-7			Heathkit Intermadul. Analyzer Kit—Madel IM-1	
	Heathkit Battery Eliminatar Kit — Madel BE-2			Heathkit Audia Freq. Meter Kit — Madel AF-1	
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Speaker Considerations

(*Continued from page 54*)

thus obtained is shown in Fig. 3. This curve can be compared with the curves taken in different positions inside the house. The curves obtained in a 12' x 25' living room with the speaker facing the short room dimension appear in Fig. 4. The dotted line is the averaged curve while the solid line represents the measured response in the room. The curves of Figs. 6A and 6B illustrate the results with the speaker facing the long room dimension and in a corner facing the room diagonal, respectively.

It will be noticed that as theory predicts, the corner position will increase the low frequency response of the speaker system. It will also be noted that the peaks and valleys are greater. Of particular interest is the curve with the speaker facing the long dimension of the room. This position seemed to form a natural cut-off below 70 cycles per second which in the author's location gave the best sounding reproduction from this particular test speaker. The corner location definitely improved the very low frequency response but seemed to add little to music reproduction except increased turntable rumble, etc. The position with the speaker

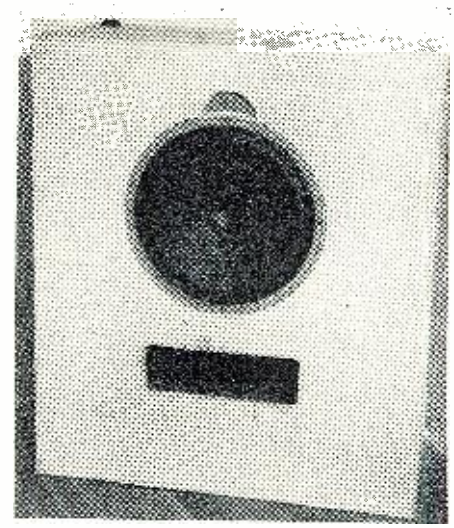
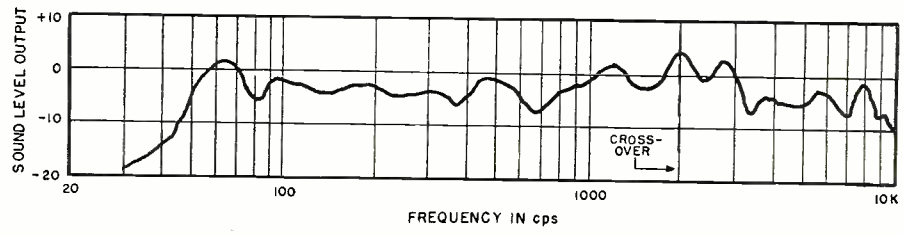


Fig. 7. A duo-cone loudspeaker mounted in an eight cubic foot reflex cabinet.

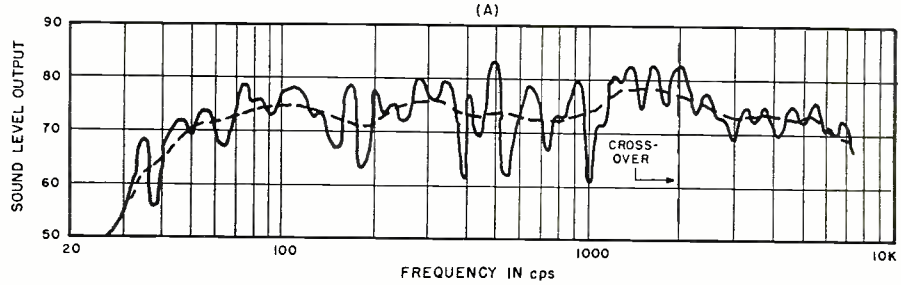
facing the short room dimension gave the smoothest curve most nearly like the free field response of the speaker.

The results obtained in rooms of other sizes and shapes will be similar but not identical. Fig. 8A shows the curve of a 15" duo-cone speaker mounted in an infinite baffle. Fig. 8B is the measured curve obtained when the speaker was placed in the corner of the author's living room measur-

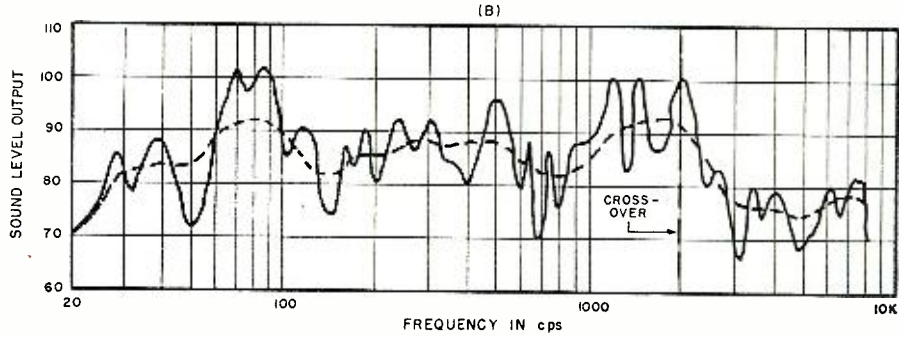
Fig. 8. (A) Response of an infinite baffle in a dead sound room, as measured by RCA. Reference is .1 watt at 400 cps. (B) Response of a 15" speaker mounted in the corner of a 12' x 25' x 9' room. The sound level meter was 7 feet on axis. A low impedance amplifier was used. (C) A 15" speaker mounted in a 36" x 30" x 15" bass reflex cabinet and placed in the corner of a 12' x 18' x 8' room. In this test, windows were closed, sound level meter on 7' axis, and medium impedance amplifier was used.



(A)



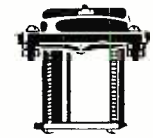
(B)



(C)

RELAYS FOR EVERY PURPOSE






Over a Million in Stock!

Each relay is brand new, standard make, inspected, individually boxed and fully guaranteed.

The following list represents only a portion of our relay stock. Write or wire us for information on types not shown.

STANDARD DC TELEPHONE RELAYS

Stock No.	D.C. Voltage	Ohmage	Contacts	Unit Price
R-806	115*	900	1A	$2.05
R-161	6	10	2B & 1A	1.10
R-518	85/125	6500	1C	3.60
R-633	180/350	10.000	1C & 5 Amps. Oct. Skt.	2.90
R-667	6	.75	1B/10 Amps. 1A/3 Amps.	2.45
R-632	6	12	5A & 1C	1.45
R-154	6/12	200	1A	1.25
R-517	12	250	2A	1.50
R-116	85	3000	1B	1.50
R-631	100/125	3300	2A	3.05
R-545	110/250	7000	1C	1.90
R-124	300	12,000	1A	2.45
R-160	6	12	3C & 3A	1.55
R-155	12	100	4A & 4B	1.30
R-520	200/300	14,000	2C	1.45
R-159	6	50	2A	3.45
R-153	12	200	1C & 1A	1.35

SHORT TELEPHONE RELAYS

R-635	12	100	1C & 1A	$1.35
R-826	12	150	2C, 1B	1.55
R-770	24	150	1A/10 Amps.	1.45
R-771	24	200	1A/10 Amps.	1.45
R-603	18/24	400	2A	1.55
R-575	24	500	2C	2.40
R-764	48	1000	2C & 2A	2.00
R-563	60/120	7500	1A	1.70
R-801	115*	——	None	1.45
R-213	5/8*	——	2A	3.10
R-589	12	125	2A	1.30
R-113	12	150	4A	1.55
R-689	12/24	255	1C	1.55
R-799	24	500	None	1.00
R-115	24	500	1C	1.70
R-110	24/32	3500	1C	1.70
R-121	150	5000	2A & 1C	2.05
R-634	150/250	6000	1A & 1B	2.45
R-800	12	150	2C & 1A	1.55
R-537	12/24	150	2C & 1B	2.00
R-750	24	400	1A	1.60

SPECIAL RELAYS

R-503	12/32	100	3A, 2C	$13.50
R-749	600	——	Max. 28 Amps.	7.45
R-804	550*	——	1B/38 Amps.	4.35
R-579	220*	——	1B	8.70
R-294	27.5	200	1B	5.35
R-686	115*	——	2C	6.10
R-246	115*	——	1B	11.20
R-246A	115*	——	1A	11.20
R-611	24*	——	1A/30 Amps.	5.35
R-283	12	125	1C/10 Amps.	4.35
R-614	18/24	60	1A/15 Amps.	4.35
R-245	12	25	4" Micalex Lever	3.20
R-527	6/12	50/50	In Series	1.20
R-544	12/24	60/60	1C	2.05
R-255	——	——	1A	3.50
R-669	75*	400 Cy.	1B, 1A	1.20
R-660	6	——	⅜" Stroke	1.20
R-651	24	100	Solenoid Valve	3.10
R-295	12	275	Annunciator Drop	2.70
R-230	5/8	2	2A, 1C	2.70
R-813	12	12	Wafer	5.35
R-275	12	750	1A, 1B, 1C	3.45
R-716	24	70	2A/5 Amps.	1.80
R-620	6/12	35	2C, 1A	1.30
R-629	9/14	40	1C/10 Amps.	1.55
R-720	24	50	2C Ceramic	1.70
R-500	12	10/10	2C/6 Amps.	3.55
R-816	12	10/15	2C/6 Amps.	3.55
R-524	24**	——	——	1.20
R-566	115*	Coil Only		1.00
R-710	——	150 Coil Only		.75

*AC. **AC/DC.

CONTACTORS

R-650	24	100	1A/50 Amps.	$3.70
R-312	24	7	1A/200 Amps.	5.50
R-333	98/120	975	4A/Size 2	5.50
R-334	115	1200	3A/Size 2	5.50
R-338	6	7.5	1A/50 Amps.	3.45
R-353	65*	—	2A	3.95
R-358	18/29	200	1A/Dble. Brk.	2.00
R-445	14	12.5	1A/200 Amps.	4.05
R-446	12	18	1A/50 Amps.	3.90
R-447	12	18	1A/50 Amps.	3.90
R-448	24	67	1A/50 Amps.	3.90
R-449	28	150	1A/50 Amps.	3.90
R-450	24	75	1A/50 Amps.	3.90
R-188	24	200	1A/75 Amps.	3.70
R-183	24	60	1A/50 Amps.	3.45
R-187	24	100	1A/50 Amps.	3.70
R-554	24	85	2A/100 Amps.	5.90
R-788	100*	——	3B & 2A	5.45
R-682	115*	35	5A/10 Amps.	6.10
R-767	24*	20	2A/10 Amps.	4.95
R-180	12	25	1A/50 Amps.	4.05
R-265	24	60	1A/100 Amps.	3.45
R-535	24	70	1A/100 Amps.	4.80
R-556	24	70	1A/100 Amps.	4.80
R-557	24	100	1A/50 Amps.	3.85
R-178	24	100	1A/100 Amps.	4.80
R-608	24	125	1A/200 Amps.	2.80
R-184	28	50	1A/100 Amps.	4.90
R-719	24	10	1A/200 Amps.	4.95
R-182	28	80	1A/25 Amps.	2.40
R-244	75*	265	1A/20 Amps.	2.20
R-659	12	7.2	2A/20 Amps.	1.70
R-552	24	70	4A/50 Amps.	5.35
R-185	24	100	1A/50 Amps.	3.45
R-186	24	132	1A/50 Amps.	4.35
R-817	24	150	1A/50 Amps.	3.45
R-534	14	45	1A/30 Amps.	2.05
R-223	28	150	1A/40 Amps./48 VDC.	1.70
R-680	6	3	1A/50 Amps.	3.90
R-677	6	3.5	1A/50 Amps.	3.90
R-532	6	15	1A/50 Amps.	3.90
R-676	12	16	1A/50 Amps. 1AUX/25A	3.90

KEYING RELAYS

R-714	9/14	65	2C/5 Amps.	$1.55
R-850	12	450	1A/1.5 Amps.	1.50
R-721	18/21	290	2C/5 Amps.	1.55
R-694	24	300	1A/5 Amps.	1.50
R-935	28	1000	1C/1.5 Amps	1.65
R-949	2.4*	60 Cy.	1A/5 Amps.	1.95
R-704	2/6	.25	2B/5 Amps.	1.35
R-173	2/6	2	1A	3.00
R-280	6/8	27	1A Dble. Brk.	2.45
R-647	6/12	15	1B/20 Amps.	1.45
R-273	20	160	2A/15A Dble. Brk.	3.55
R-169	24	200	1A	2.45
R-570	24	230	1B Dble. Brk.	2.70
R-960	24	230	3C/15 Amps.	2.95
R-529	24/48	1020	2C	3.10
R-715	24	——	2C Ceramic	3.70
R-584	6	20	1A Dble. Brk.	1.30
R-192	12	44	3C/10 Amps.	1.70
R-204	12	66	2A	1.45
R-224	12	85	1A	1.45
R-221	18/24	5000	1A	2.00
R-205	24	260	2C	1.55
R-891	24	475	1C/5 Amps.	1.45
R-536	27	230	2C	1.55
R-858	27.5	250	1A Dble. Brk.	1.45
R-833	6.5	1300	2C	3.05
R-220	75	5000	1C	1.50
R-828	6/8	42	1A	1.50
R-627	115*	——	1B Dble. Brk.	3.10
R-734	24	150	3C/10 Amps.	1.30
R-598	28	185	2C	1.30
R-622	20/30	200	3A & 2C/10 Amps.	1.45
R-274	24*	——	2A	1.55
R-855	110*	60Cy	160 1A Dble. Brk/15A	3.25
R-277	12	30	2C-D Break Cera	2.20

MIDGET RELAYS

R-572	24	256	1C	$1.25
R-857	24	260	1 Make Before Make	1.75
R-912	4/5	20	3A-1C Ceramic	2.50
R-291	6	5	1A	1.25
R-921	6.7	18	1A Dbl.Brk.@10 Amp.	1.45
R-738	12	60	3A	1.20
R-922	12	75	1A Dbl.Brk.@10 Amp.	1.45
R-144	12	228	1A	1.45
R-145	18/24	250	2A Ceramic	1.45
R-298	21	300	1A	1.25
R-296	21	300	1A	1.25
R-586	21	300	1A & 1C	1.25
R-137	24	300	1C	1.45
R-142	24	400	2C	1.50
R-785	24	200	2C/10 Amps.	2.00
R-607	24*	——	1A	1.20
R-606	24*	——	1A & 1B	1.20
R-605	24*	——	3A	1.20
R-728	6	30	1A	1.25
R-149	6/8	45	1B	1.50
R-732	12	120	1A	1.45
R-281	12	126	2A	1.25
R-818	18/24	300	1B	1.30
R-135	24	250	1B	1.45
R-133	24	300	None	.75
R-138	24	300	4A	1.45
R-132	24	300	2C	1.50
R-731	24	300	2C	1.55
R-292	24	350	1C	1.25
R-626	24	400	1A/5 Amps.	1.55
R-786	60	1300	2C	2.00
R-588	90/125	6500	4C	2.70
R-755	24	300	1A	1.45
R-150	6	30	1A	1.50
R-893	14	150	1A, 1C	2.50
R-895	14	150	2A, 1B, 1C	2.50

ROTARY RELAYS

R-712	24	200	2B	$2.05
R-711	24	200	2C & 1B	2.05
R-573	28	200	1C & 1B	2.05
R-766	24	230	12 Pos. 8 Deck	4.90
R-809	28	7	1B & 12 Pos.W/ 7" Shaft for Wafers.	2.45

DIFFERENTIAL RELAYS

R-208	120	2000	2C/3 Amps.	$2.45
R-209	220/250	8000	1C/3 Amps.	3.10

SEALED RELAYS

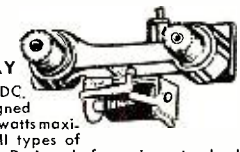
R-261	12/24	1900	1C/5 Pin Plug	$3.75
R-673	48/150	7500	1C/5 Amps.	2.80

VOLTAGE REGULATORS

R-745	6	2	1A/10 Amps.	$1.05
R-780	24	350	1C/6 Amps.	1.05
R-509	6/12	35	1B/2 Amps.	1.05

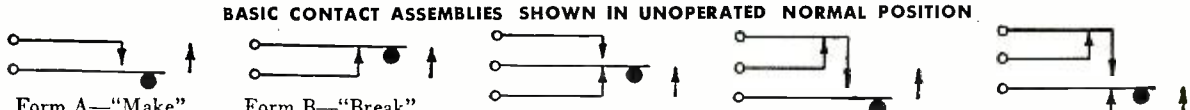
SPECIAL!

CO-AXIAL RELAY



D153766 SPDT, 6 VDC. 19 Ohm coil. Designed to accommodate 75 watts maximum. Perfect for all types of antenna switching. Designed for using standard 83-1SP coaxial fittings. Part of RAX-1 equipment. No. R-846—**$6.95** Ea.

BASIC CONTACT ASSEMBLIES SHOWN IN UNOPERATED NORMAL POSITION



Form A—"Make" (Single Throw, Normally Open)

Form B—"Break" (Single-Throw, Normally Closed)

Form C—"Break-Make" (Double-Throw)

Form D—"Make-Before-Break"

Form E—"Break-Make-Before-Break"

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ing 12′ x 25′ x 9′. The curve in Fig. 8C is the measured results of the same speaker when enclosed in a bass reflex baffle measuring 36″ x 30″ x 15″. This unit was placed in the corner of another room measuring 14′ x 18′ x 8′. Notice that the standing wave structure is very severe in this second room.

Listening tests bore out these measurements. The smoother response at the author's location seemed in part due to the fact that the speaker, when located in the corner, pointed toward the stairway which led to the second floor. Since the sound energy would travel up the stairwell instead of being reflected, fewer standing waves are generated.

In general, then, this discussion may be summed up as follows:

For good low frequency response, procure either a large heavy duty speaker or a number of smaller ones.

Place the speaker or speakers in a baffle which will increase the low frequency sensitivity.

Limit the low frequency response of the system to a value commensurate with the sound level you desire and the abilities of your speaker system.

Place the speaker system in the position in your room which gives the most desirable results. In general, for a wide range system, in the corner, and for a system restricted to a low frequency extreme of 60 cps, facing the long room dimension. In either case, the speaker should face the wall with the highest absorbency.

Attention to the foregoing will reduce, to a large degree, the lack of realism which high fidelity devotees deplore but find difficult to eliminate. —30—

SAVE SERVICE TIME

By H. LEEPER

CERTAIN TV picture tubes are mounted separately from the chassis.

If chassis and tube are removed for testing, time may be saved with electrostatic tubes by having the normal position marked to avoid tilting of the picture upon replacement of the tube.

A little white touch up paint on the supporting bracket and the tube base will do the trick. Paint may later be removed from the tube base if it is near the terminals. —30—

Marking the correct position of CR tube before removing it will save you time.

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money in the bank, job security, and a lifetime career

CHRISTMAS DAY friends and relatives may remember you with handsome gifts of jewelry, men's wear or what not. Some extra-thoughtful person may buy you a special piece of equipment you've wanted.

But nobody, this Christmas or any other day, will give you big paychecks, security, or a real career. These are "gifts" you must acquire yourself. There is no time like this Christmas to make yourself a present of the training you need . . . to get the high pay, the security and the profitable career waiting for you in radio, TV and electronics.

These industries are gobbling up all the qualified manpower America's schools can train. They are calling desperately for more men to man TV stations; to develop, design, test, inspect, manufacture and service the millions of TV sets to come and the 13,000,000 now in use; to service the 100,000,000 radios in current operation; to handle the tremendous defense orders now being placed for electronic equipment and installations.

There are gaping openings. Do you know who will get them? MEN WITH SPECIALIZED TECHNICAL TRAINING! In other words, YOU . . . if you prepare now. To get this training, you must select a school equipped by experience to teach you thoroughly, and that's what you find at CREI, a fully accredited technical Institute which, since 1927, has trained thousands of professionals on a high technical level.

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TREMENDOUS SALE — RECORD PLAYERS — CHANGERS — AMPLIFIERS, ETC.

New Versatile Espey
12-TUBE FM-AM CHASSIS
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★ BUILT IN PRE-AMPLIFIER FOR G.E. VARIABLE RELUCTANCE PICKUP
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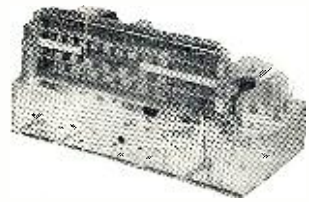
★ MAY BE USED WITH A CRYSTAL MIKE AS A HOME P. A. SYSTEM



McGee's new 1951 model 12 tube FM/AM chassis. Latest design with phono inputs for all types of record players, crystal or G.E. variable reluctance. Receives standard broadcast 550 to 1700 KC and FM 88 to 108 MC. Wide range audio response (push-pull 7C5) and bass boost tone control. Loop antenna for broadcast and 300 ohm line type antenna, may be stapled in cabinet. Attractive lighted slide rule dial. Chassis size, 13½x9" high and 9" deep. Shipping weight 20 lbs. **Stock No. 7-CX.** Made to sell at a much higher price. McGee's sale price is **$64.50**, less speaker (output matches 8 ohms). **7-CX** chassis with our 12" coaxial PM, CU-14X. both **$74.50.**
7-CX chassis with our 12" coaxial PM, CU-14X and latest model 3 speed record changer with crystal cartridge, all for only **$99.45.**
Same combination deal as above except changer has the G.E. variable reluctance turn-a-bout cartridge. All for only **$106.65.**

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8" SPEAKER AND BAFFLE $4.95

Stock No. 818, Tan leatherette covered, plywood slant type wall baffle; plus an 8" Oxford, 2.15 oz. Alnico V magnet PM speaker. A red hot McGee special for only **$4.95** each, or **$4.70** each in lots of 3 or more.

10" SPEAKER AND BAFFLE $6.95

Stock No. CA-12. Tan leatherette covered plywood slant type wall baffle; plus 10" Permaflux, 3.16 oz. Alnico V PM speaker. Only a few hundred to sell at **$6.50** each, or **$6.25** each in lots of 3 or more.

12" SPEAKER AND BAFFLE $6.95

Stock No. CA-12, Tan leatherette covered plywood slant type wall baffle; plus a 12" Quam, 4.64 oz. Alnico V magnet PM speaker. (Popular Adjustacone model). A terrific McGee value for only **$6.95** each, or **$6.60** each in lots of 3 or more.

GENERAL ELECTRIC 2-SPEED CHANGER SCOOP!
WITH VARIABLE RELUCTANCE CARTRIDGES

A terrific McGee scoop!! Look at these brand new 2 speed changers. All have General Electric variable reluctance pickups. (Note: G.E. pickups require a pre-amplifier.) Lowest prices for such high quality merchandise. Limited quantities available. Get your order in now.

P-10 $26.95

P-13 $21.95

Eg-2 $8.95

P-12 $24.95

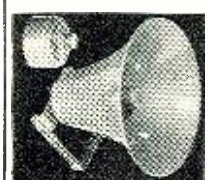
P-10 $26.95 General Electric, 2 speed automatic record changer plays 10" and 12" records, either 78 or 33⅓ rpm. Pickup arm equipped with two separate plug-in heads. RPX-040 with 3 mil sapphire stylus and RPX-041 with 1 mil sapphire stylus. Each of the G.E. variable reluctance cartridges is housed in a plastic head that plugs into arm. Cartridges worth $11.70 alone. Brand new in original cartons. Similar to Webster 70. Base size 14x13¾". Shipping weight 15 lbs. G.E. catalog No. P-10, McGee's scoop price, **$26.95.**

P-13 $21.95 General Electric, 2 speed automatic record changer. Plays 10" and 12" records at either 33⅓ or 78 rpm. Pickup arm equipped with a G.E. RPX-050, turn about variable reluctance cartridge and twin sapphire needle. A simple twist of the knob selects the proper needle. The net cost of the cartridge, if purchased separately is $8.20. This fine changer comes ready equipped with the cartridge. Changer base is 12x12½". General Electric catalog No. P-13 automatic record changer. Manufactured by the VM Corp. Shipping weight 13 lbs. Brand new, factory cartoned. Offered at the low price of **$21.95.** (A self powered pre-amp for use with low gain inputs. Net price **$8.95** extra.)

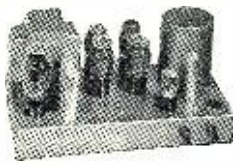
Eg-2 $8.95 AC self-powered preamplifier for General Electric variable reluctance pickup cartridges. This preamp is necessary if you use variable reluctance cartridges with any ordinary radio-phono connection. Some amplifiers are already equipped with the necessary gain for this type of pickup. Simply plug in any of the changers and plug preamp into the radio phono input. Stock No. EG-2 preamp. Net price **$8.95.**

P-12 $24.95 General Electric. 2 speed automatic record changer. Plays 10" and 12" records of either 33⅓ or 78 rpm. Pickup arm equipped with separate plug-in heads. RPX-040 with 3 mil sapphire stylus for 78 rpm records RPX-041 with 1 mil sapphire stylus for 33⅓ rpm records. The two cartridges purchased separately are worth $11.70 alone. However, they are standard equipment with this deluxe changer. Changer base size, 10¾"x12½". Shipping weight 13 lbs. General Electric catalog No. P-12, made by the Milwaukee Changer Co. A $60.00 list changer, on sale at terrific saving at McGee. Scoop price, with both General Electric, plug-in variable reluctance cartridges, for the low price of **$24.95.**

50-WATT BOOSTER AMPLIFIER—$39.95



25-Watt Horn $28.95



50-Watt Booster $39.95

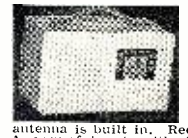
2-Mike Pre-Amp. $10.00 Extra.

50-WATT BOOSTER A sensational value. 50 watt booster amplifier with push-pull parallel 6L6 output tubes. Connect to your present amplifier as a booster or use with the PR-2X Pre-amp to add the use of 2 mikes and one low level input. The booster amplifier has one input jack and with 1 volt input gives 50 watts of audio. Booster has a 6 lb. potted case high fidelity output transformer, matches speaker with 4-8-16 ohm voice coil, also 60 ohm and 250 ohm line. Booster has a 225 mill power supply with 5U4 rectifier. Price includes tubes: 4 6L6, 7N7 and 5U4. The two variable controls are for master volume control and base boost tone control. Size 8 x 6½ x 14½. Stock No. PA-55X. Shipping weight 26 lbs. Sale price **$39.95** ea.

2-MIKE PRE-AMP. Pre-amplifier plugs in directly to the PA-55X Booster amplifier. It enables use of 2, Crystal or Dynamic Mikes plus one low level input. Furnished with 4 foot cables and plugs for remote control of the 55 watt Booster Amplifier. Small chassis size 5 x 3¼ x 4". Stock No. PR-2X, with tubes 7F7 and 7N7. Net price **$10.00** ea.

25-WATT HORN 25-Watt Driver and 3½-foot air column re-entrant Trumpet. The standard type trumpet and driver you see the most. Drivers are 100% weatherproof, horn is spun aluminum, offered to you at a considerable savings. Stock No. MA-33. Shipping weight 20 lbs. Net price **$28.95.**

LOOK AT THESE BARGAINS!



TRAV-LER 3-WAY PORTABLE — $18.95

A lucky purchase makes this value possible. Model 5022 Trav-Ler 3 way portable. Operates on 105 to 125 volts AC or DC, or self-contained batteries. A full 2 gang superhet with Alnico V dynamic speaker. Tube component: 1R5, 1U4, 1U5, 3V4, plus rectifier. Has vernier airplane dial. A smartly styled two-tone portable with ivory plastic front panel and Tan or Red leatherette covered case. Compact size 9 x 5¼ x 5¼". Loop antenna is built in. Receives broadcast 550 to 1600 kc. A powerful set with 6 tube performance. Shipping weight, less batteries, 6 lbs. (7 lbs. with batteries). Trav-Ler Model 5022, portable less batteries **$18.95** ea. Lots of 3 **$18.50** ea. Battery kit for Model 5022 **$1.75** extra. (consists of one 67½ volt 'B' and 2 No. 2 flashlight cells.)

VM 3-SPEED AUTOMATIC—$44.95

Another special purchase offer! VM-975, 3 speed portable automatic record changer. Housed in a deluxe brown leatherette case; 14½ x 17¼ x 8¾" high. Famous VM Tri-O-Matic changer, plays all 3 speed and all 3 sizes automatically. 10" and 12" records of the same speed can be inter-mixed. Flip-over crystal cartridge provides the correct needle size for the record you are playing. Has good quality 3 tube amplifier, a tone and volume control and heavy magnet PM speaker. Regular dealer net is $51.60. Now, a limited number are available at the special sale price of only **$44.95** each. Shipping weight 22 lbs.

3-SPEED PORTABLE—$18.95

Model 7843, deluxe 3 speed electric portable record player. Powerful 3 tube amplifier, (12AT6, 50B5 and 35W4 rectifier). Full size Alnico V magnet dynamic speaker. Plays all records 7", 10" and 12": 33⅓, 45 and 78 rpm. Crystal pickup with all purpose 3 speed needle. Luggage style case, 12½x10½x8¼", expertly covered with tan leatherette. Shipping weight 11½ lbs. Model 7843, deluxe 3 speed portable electric record player. Net price **$18.95** each, lots of 3, **$18.50** each.

3-SPEED CHANGERS ON SALE AT McGEE

WEBSTER CHICAGO 3-SPEED
Regular $47.50 List Only $24.95

Webster Chicago Model 100-16 3 speed automatic record changer with crystal cartridge and all speed Sapphire needle. (1 needle plays all records). Base size 12x12¾". Shipping weight 14 lbs. This offer good only as long as our stock lasts. A special purchase makes this offer possible. Webster Chicago 3 speed changer, Model 100-16, Sale price **$24.95.**

WEBSTER CHICAGO MODEL 100-2 ONLY $26.95

For the first time we offer the world famous Webster-Chicago, model 100-2. Features a newly designed spindle, that drops the records flat: air-cushioned to the turntable. Pickup arm sets down automatically after the last record plays. Plays all records automatically, 33⅓, 78 and 45 rpm. New balanced tone arm with Electro-Voice Tilt-A-Matic cartridge with dual needles. Ordinarily cost over **$37.00.** McGee offers them for only **$26.95** each. Base size 12"x12¾". Shipping weight 14 lbs.

V.M. 3-SPEED MODEL 406 $22.95

VM model 406, deluxe 3 speed automatic record changer. Plays them all. Intermixes records of the same speed. Equipped with a flip over crystal pickup with twin needles. Base size, 12¼x13". Shipping weight 12 lbs. VM-406. Net price **$22.95.**

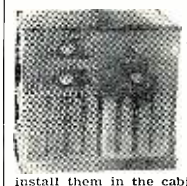
GENERAL INSTRUMENT 3-SPEED $19.95

Another tremendous McGee record changer scoop. Only 500 to sell. General Instrument, 3 speed automatic record changer with standard crystal cartridge and all purpose permanent needle. Brand spanking new. Our first offering of a 3 speed changer at less than $20.00. We purchased a large quantity and pass our saving on to you. Stock No. GI-3384, Sale price **$19.95** each. Price to the small manufacturer in lots of 48 or more, **$19.50** each.

VM-950 3-SPEED CHANGER $29.62

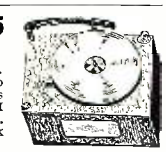
It automatically plays all records, all speeds and all sizes; 12 10", 33⅓ or 78 rpm, 10 12", 33⅓ or 78 rpm and 10" and 12" records of the same speed intermixed. 12 7" 33⅓ or 45 rpm. Automatically shuts off after the last record. Size 13 13/16"x11⅞"x7¼" high.
VM-950, 3 speed changer with standard crystal cartridge and needles 1 and 3 mill for 33⅓, 45 and 78 rpm. Net price **$29.62.**
VM-955, same 3 speed changer as above, except has metal base. Net **$32.01.**
VM-950G.E. 3 speed changer with the new RPX-050 G.E. variable reluctance cartridge, with dual turnabout stylus for 33⅓, 45 and 78 rpm. Net price **$32.80.**
VM-955G.E. Same 3 speed changer as above with RPX-050 V.R. cartridge and metal base. Net price **$35.19.**

20-TUBE AM-FM RADIO PHONO COMBINATION $229.95
ONLY 100 TO SELL



Here is a sensational value. You get an Approved A-710, 12 tube 3 gang condenser, FM-AM tuner, plus a push-pull parallel 6L6 50 watt amplifier, with inputs for microphone and any phono pickup, plus a Webster 70, 2 speed 33⅓ and 78 rpm automatic record changer; with separate plug in General Electric variable reluctance heads with sapphire stylus, plus 2 heavy duty 12" PM speakers, plus this beautiful Capehart cabinet. This beautiful hand rubbed mahogany combination cabinet would cost $150.00 alone. Cabinet is 37" high, 40" wide and 21" deep. Hinged top lifts in two sections covering the radio and changer compartments. The radio and record changer panel are cut to fit the tuner and changer. The chassis, changer and speakers are shipped separately from the cabinet. You install them in the cabinet. No holes to cut, just hook them up. Shipping weight of cabinet alone is 160 lbs. Specify shipment via Express, Truck or Rail Freight. Stock No. MD-PA55710. Special sale price, **$229.95.**

3-Speed—Amplified Record Player Kit $12.95
BUILD IT YOURSELF



Complete kit of parts to build a 3 speed, amplified record player. Kit features a leatherette covered base, 3 speed rim drive phono motor, crystal pickup with an all purpose needle and a kit of parts to build a 2 tube AC-DC amplifier; including an Alnico V PM speaker. Plus, schematic diagram and tubes (70L7 and 12AT6). A complete amplified record player kit. Nothing else to buy. Stock No. RH-35. Shipping weight 10 lbs. Sale price, **$12.95.**

XMAS SPECIAL—3-SPEED PLAYER ATTACHMENT $9.95

An ideal Christmas gift and a full $10.00 worth. Perfect for the home and for the children's play room. Every radio and TV shop should have one for testing purposes. Plugs into your radio, TV phono jack, or any amplifier. Has a standard crystal pickup with an all purpose 3 speed needle. Plays all 3 speeds; 33⅓, 45 and 78 rpm. Operates on 110 volts, 60 cycle AC. Plywood leatherette covered base. Volume control. (No amplifier or speaker furnishcd). Stock AB-3, Net price **$9.95** each.

McGEE RADIO COMPANY

Prices F.O.B. K.C. Send 25% Deposit with Order. Balance Sent C.O.D. With Parcel Post Orders, Include Postage

TELEPHONE VICTOR 9045. WRITE FOR FLYER
1422 GRAND AVE., KANSAS CITY, MISSOURI

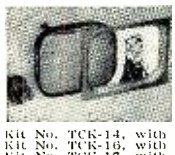
NEW TELEVISION "SLAVE" KIT FOR 16 TO 20 INCH TUBE $39.95

COMPLETE 16 TO 20 INCH TELEVISION "SLAVE" KIT

$39.95 LESS TUBES

Television Slave Kit, Model No. SK-21; for use with 16, 17 or 20 inch rectangular picture tubes, as well as 16 or 19 inch round tubes. It may be connected to your present TV receiver, regardless of screen size, to give you a remote TV slave unit; sometimes referred to as a TV duplicator. You pick up the TV signal at the picture tube grid. The audio is picked up at the high side of the audio gain control. These two connections are all that is necessary on your present set. A two tube cathode follower kit is supplied with the slave kit so that there will be no loading of your present set. The duplicator kit itself is 14¾" wide and 21" long. A ready punched chassis and complete hardware kit is furnished. The circuit is a straight forward AC transformer type. The circuit employs the following tubes: (2) 6SN7, horizontal and vertical oscillators, (2) 6AL5 phase detector and DC restorer, 6K6 vertical output, 5U4 rectifier, 6K6 audio, 6BQ6 horizontal output, 6W4 damper, 1X2 high voltage rectifier, 12AU7 2nd video sync. separator, (2) 6AG5 are used in the cathode follower. (No speaker is furnished). This kit is the same essentially as a full TV kit, except that it has no tuner or video. All resistors, tube sockets, power transformer, etc. are furnished along with a schematic diagram and instructions. WARNING: Only those who understand TV, should buy this kit; as television is very complicated and should not be attempted unless you know what you are doing. TV Duplicator Kit, Model SK-21, complete less all tubes. Net price **$39.95**. Shipping weight 38 lbs. 8" PM speaker, **$2.95** extra. Kit of 12 receiving tubes for SK-21, **$10.00** extra. 17BP4A, 17" blackface picture tube, **$21.95** extra. 20CP4A, 20" blackface picture tube, **$39.95** extra. (Specify when ordering, which picture tube that you intend using.)

CONVERT TO A RECTANGULAR PICTURE



With each conversion kit you get a plastic mask, 70 degree deflection yoke, 90 day guaranteed black face picture tube, plus our new 7731-X 14-000 Volt Universal fly-back and horizontal output transformer that works on any output tube and any single rectifier (1B3 or 1X2). A suggested diagram is furnished for use of the transformer with several different output tubes and rectifiers. We think this is the finest and best priced conversion kit in the country. Shipped Truck or Express, only.

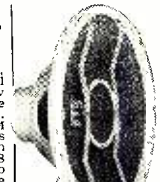
Kit No. TCK-14, with 14BP4A 14" rectangular tube, Net price **$27.95**
Kit No. TCK-16, with 16BP4A 16" rectangular tube, Net price **34.95**
Kit No. TCK-17, with 17BP4A 17" rectangular tube, Net price **29.95**
Kit No. TCK-20, with 20CP4A 20" rectangular tube, Net price **49.95**

BUY YOUR WIDE RANGE COAXIAL SPEAKER AT McGEE

12" COAXIAL PM $12.95

A $32.50 retail value, 20 watt 12" coaxial PM speaker of quality used on radios of the $300 to $500 bracket. Hook up like any PM speaker. High pass filter is built on speaker. Matches 8 ohm output of radio or amplifier. Wide range response, 20 to 17,500 CPS. Model No. CU-14X. Ship. wt. 9 lbs. Special sale price, **$12.95**.

15" COAXIAL PM $19.95



Only $19.95 buys a full 15". 20 watt coaxial PM speaker, with built-in high pass filter. Hook to any 8 ohm output on radio or amplifier. Response below 20 to above 17,500 CPS. Good bass response. A lucky purchase makes this price possible. Full 32 oz magnet in the woofer. 5" tweeter. Model P15-9. Ship. wt. 11 lbs. Sale price, **$19.95**.

QUAM 12" SPEAKERS

3 FOR $15.00

Quam, 12". 4.64 oz. Alnico V magnet PM speakers, with adjustable cones. Only 500 to sell at this terrific saving. $5.49 each, 3 for **$15.00**.

RCA 16GP4 $25.95

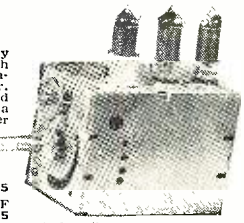
Brand new, in original cartons. Genuine RCA, 16GP4 metal cone picture tubes at a terrific saving to you. Unconditionally guaranteed for 90 days. Sale price, **$25.95** each, two for only **$50.00**.

COMPLETE 17" TO 20" T.V. KIT

★ AC-TRANS-TYPE
★ CONVENTIONAL CIRCUIT
$59.95 LESS TUBES
★ READY WIRED 12 CHANNEL T.V. FRONT END
★ 70° DEFLECTION ★ CERAMIC FLYBACK
★ KIT OF TUBES EXCEPT KINE $16.95 ★ 17BP4A $21.95 EXTRA

A complete kit of parts to build an AC transformer operated television chassis for use with a 16, 17 or 20 inch rectangular picture tube. The 12 channel Sarkes Tarzain tuner is ready wired. The 4 tube video IF strip is also wired. Circuit is of the conventional accepted design, with latest ceramic type flyback high voltage supply. Chassis is ready punched. Warning: Do not buy this kit unless you understand Television and electronics. It is difficult to wire. We furnish schematic and photos. Kit model WH 20 ship weight 40 lbs., less all tubes **$59.95**. Kit of 19 tubes but less picture tube **$16.95** extra. 17 inch 17BP4A **$21.95** extra, 20CP4 inch rect. tube **$39.95** extra.

SARKES TARZIAN 3-TUBE T.V. TUNER $7.95

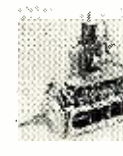


This popular Sarkes-Tarzian television front end is widely used today. The 13 channel rotary switch type with individually tuned coils. Price includes a schematic diagram and 3 tubes, 6C4 osc, 6BH6 RF and 6AG5 mixer. Regular factory cost is twice our price. Each tuner and its own tube sockets are wired, ready to hook up to a video and sound IF strip. May be used with either intercarrier or separate sound IF circuits.
Built-in fine frequency control. Ship. weight 3 lbs. Sarkes-Tarzian Type 2 TV tuner with tubes net..... **$7.95**
Combination deal, Sarkes-Tarzian TV tuner and 205-XX video coil kit, both for **$14.95**
Sarkes-Tarzian Type 3—Same as Type 2 only has input IF coil built-on. Tapped for sound IF channel. Net **$9.95**
Above tuners offered with either 2½ inch or 4⅝ inch shaft length. 3-tube Sarkes-Tarzian tuner with 2⅛" shaft but no fine tuning. With tubes 12AT7 and 26AG5. Stock No. TX-3T **$7.95** with tubes.

RCA T.V. FRONT END $9.95

Terrific buy on this RCA TV tuner. We have a limited quantity of the famous original 201E1, 13 channel completely wired and tested TV front end tuners. Ready to connect to your TV video IF strip. Offered at a sacrifice. Price was originally $44.00, now only **$9.95** each, less tubes. You'll save plenty on this item. 3-6J6 tubes are required. Stock No. RCA-13P TV front end tuner, **$9.95** each, two for **$19.00**. 6J6 tubes 99c each, extra.
New RCA Printed Circuit Tuner complete with 6BC5 and 6J6 Tubes $19.95.

GENERAL INST. T.V. FRONT END Sale Price $7.95

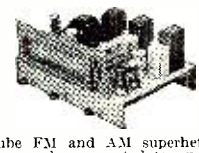


All completely wired, brand new and pre-aligned, 13 channel selector incorporating fixed inductance and variable capacitance. Converter output transformer is attached to be coupled direct to separate sound and video I.F.'s. 6BJ6 tubes are required. Built in fine frequency control. Original factory cost over **$20.00**. Weight 4 lbs. Stock No. GI-13P, less tubes. Net price **$7.95**.
Stock No. GI-13PX Same as above only not in new condition. Have been in sets, but guaranteed a good value—less tubes. G. Inst. Tuner —G1-13PX, net **$2.95**.
Either of the above G.I. tuners are available with either 6¼" or 1½" shafts. Specify which shaft you desire, when ordering. 6J6 tubes **99c** each, extra.

SENSATIONAL NEW 2-BAND RADIO KIT ONLY $14.95

7-TUBE FM-AM TUNER

MODEL RAL-8
★ AC SELF POWERED
$29.95
★ 3 GANG TUNING ★ A COMPLETE KIT



McGee has ready for delivery, this self powered AC, 7 tube FM and AM superhet tuner kit. Build yourself a professional looking tuner that may be connected to any audio amplifier. Receives broadcast 550 to 1650 kc and FM 88 to 108 mc. A 3 gang tuning condenser is used on both FM and AM. This extra stage of TRF makes a smoother working tuner. 2 IF stages on FM and one IF stage on AM (I.F. frequency 456 and 10.7 mc). Lighted slide rule dial with metal escutcheon plate. Our own lab designed and wired an original tuner using these parts. Chassis is ready punched and painted. Everything furnished including 6BA6, FM-AM R.F., 12AT7 mixer, osc., 6BA6 I.F., 6BA6 FM limiter, 6AL5 FM ratio detector, 6AT6 AM detector, 1st audio, plus rectifier and diagrams. Shipping weight 12 lbs. Stock No. RAL-8, net price $29.95.

MODEL ME6-2 $14.95

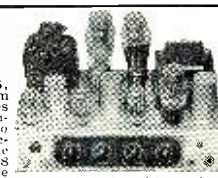
NEW MODEL 6-TUBE, 2-BAND RADIO KIT
A FULL 2-GANG SUPERHET KIT
RECEIVES 550-1600 KC PLUS 6-18 M.C.

McGee's new 1951, 6 tube; AC-DC 2 band radio kit. Receives broadcast, 550 to 1600 kc and short wave, 6 to 18 mc. A straight forward superhet circuit with 2 gang tuning condenser, 456 kc I.F. transformers, etc. 5" speaker illuminated slide rule dial. Everything furnished, including tubes, 12SK7, R.F., 12K8 mixer, 12SK7 I.F., 12SQ7 detector, 1st audio, 35L6 output, 35Z5 rectifier, diagram and a photo showing view of underside of completely wired chassis. The chassis pan and dial parts are factory production. With this kit, you can build a commercial looking and factory quality 2 band radio, housed in a streamlined plastic cabinet. Size: 13 x 6¾ x 6¼". Stock No. ME6-2, shipping weight 10 lbs. Net $14.95.

SELF POWERED AC Broadcast Tuner Kit. 3-Gang Tuning. Complete Kit, $12.95

A self-powered, 3-gang superhet tuner kit with R.F. stage. When wired according to our diagram will make a top quality broadcast tuner (550 to 1650 kc), for use with any amplifier. Don't class this with ordinary tuners; this has its own power transformer. This complete kit is furnished with a diagram, photos and tubes, 6AU6 R.F., 6BE6 oscillator R.F., 6AU6 I.F. detector, 6AL5 diode, AVC, plus rectifier. Connect to any audio amplifier. Ideal for use with our S-2020, TM-16 or 7X5 amplifier kits. Chassis size, 9½x4¾, 4½" high. Shipping weight, 7 lbs. Broadcast tuner kit Model BT-38X. Net price. **$12.95**.

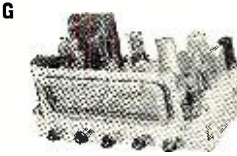
8-TUBE 22 WATT Wide Range Amp. Model 7x5 Kit Only $37.95



A complete kit, including tubes (3-7E5, 2-7F7, 2-6A3, plus rectifier), diagram and photos. All triode circuit makes for minimum harmonic distortion. Inputs for radio tuner any kind of phono pickup (crystal or G.E. variable reluctance) and either crystal or dynamic mike. Output transformer matches 8 ohm voice coil. Twin electronic tone controls, bass and treble with range selector switch for either juke box quality with heavy bass response or brilliant symphonic range. The best quality amplifier kit we know how to make. Has a very wide range output and heavy power transformer. Response 18 to 20,000 CPS. 8 tube all triode amplifier kit, complete with tubes. Weight 25 lbs. Net **$37.95**.

10-TUBE RADIO KIT $29.95

3-GANG TUNING
MIKE INPUT
12 WATT
HI-FI AUDIO
BASS-TREBLE
BOOST



A NEW 1951 ALL-PURPOSE RADIO KIT

10-Tube Broadcast (550 to 1700 kc) Radio Kit for custom builders. Features 3-gang superhet circuit with A.V.C., high gain IF circuit, 8" slide rule dial. Chassis size 12½" long, 10" front to back, 6½" high. Audio inputs for a crystal or dynamic mike, and record changer or player. Tone compensation for standard crystal pick-up or General Electric variable reluctance. Push-pull 6V6 output tubes, shielded high fidelity output transformer matches 8 ohm PM speaker, husky power transformer, 2 tone controls for separate bass and treble boost. A complete kit, including tubes 6SK7 R.F., 6SA7 mixer, 6SK7 I.F., 6H6 detector, AVC, 6SQ7 1st audio, 12AX7 variable reluctance and mike amplifier, 12AX7 phase invertor, 2-6V6 outputs, plus rectifier, diagram and instructions. Shipping weight 18 lbs. Stock No. BK-R10. Net price **$29.95**. 10" PM speaker, **$6.95** extra. Crystal mike and desk stand, **$4.95** extra. 12" coaxial speaker **$12.95** extra.

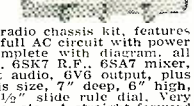
5-Tube Broadcast SUPERHET RADIO KIT $12.95

Model RS-5 tube AC-DC superheterodyne radio kit. Has loop antenna and 2 gang condenser, with lighted slide rule dial and attractive plastic cabinet. Receives broadcast, 550 to 1650 kc. Full size dynamic speaker, matched 456 I.F.'s, automatic volume control. This is a complete radio kit. Everything furnished, including diagram, photos and tubes: 12K8 mixer, 12SK7 I.F., 12SQ7 detector, 1st audio, 50L6 output, 35Z5 rectifier. Shipping weight 7 lbs. Stock No. RS-5. Net price **$12.95**.

Build Your Own Phono-Mike Broadcaster $7.95

Kit Model DE-6R. With this simple kit, you can build a 3-tube phono oscillator that also has a mike input. Will broadcast over any radio, within your home, (about 75 feet) from 1000 to 1500 kc. Inputs for crystal mike or crystal phono pickup. Fader control fades from mike to record. Ideal for a home P.A. system, baby listener and home entertainment. A complete kit of parts including tubes. Kit Model DE-6R. Net price, **$7.95**. DE-6RWT, wired and tested. Net price, **$9.95**. Crystal mike and desk stand, **$4.95** extra. Concealed microphone unit, only 1" in diameter and ¼" thick. Specify hidden mike when ordering. Stock No. T-001. Net **$3.95** extra.

6-TUBE AC-2-BAND KIT $16.95



A New 2-band radio chassis kit, features 3-gang tuning, full AC circuit with power transformer, complete with diagram, all parts and tubes, 6SK7 R.F., 6SA7 mixer, 6SK7 AVC, 1st audio, 6V6 output, plus rectifier. Chassis size, 7" deep, 6" high, 12¼" long, 7½" slide rule dial. Very ideal for schools, etc. A straight forward superhet circuit complete except for speaker and cabinet. Output transformer is part of radio kit. Stock No. AA-61. Shipping weight 9½ lbs. Net price **$16.95**. 6" PM speaker **$2.79** extra, 8" PM **$3.49** extra.

WHAT'S New in Radio

For additional information on any of the items described herein, readers are asked to write direct to the manufacturer. By mentioning RADIO & TELEVISION NEWS, the page, and the issue number, delay will be avoided.

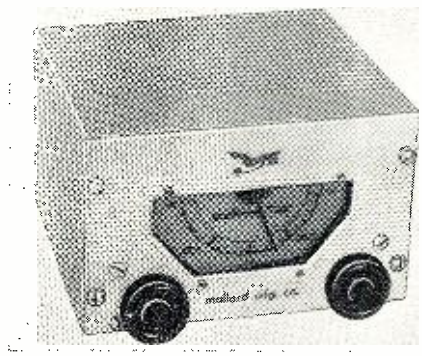
MOBILE CONVERTERS

Mallard Mfg. Company, 6025 North Keystone Avenue, Chicago 30, Illinois has announced the availability of a new series of converters which provide improved mobile reception on the 10, 20, and 75 meter bands.

Featuring nylon gear drive and slug-tuned coils, the new units are said to be exceptionally sensitive and to possess unusual stability under the adverse conditions of mobile operations. Dials are accurately calibrated and ample bandspread makes tuning easy. The nylon gear dial is translucent and illuminated from the rear to eliminate glare for night-time operation.

The "Mallard" 10N, 20N, and 75N converters provide single band reception on the amateur bands indicated by the model numbers. They use 6AB4 oscillators which function efficiently even with low battery voltages common at sub-freezing temperatures.

The 10-20 converter provides reception on both the 10 and 20 meter bands



and is available with or without built-in noise limiter. Bandswitching is accomplished by means of an ingenious two-position sliding switch board that permits short leads, thus assuring high efficiency for two-band operation.

Descriptive literature is available from the company.

VARIABLE RESISTOR

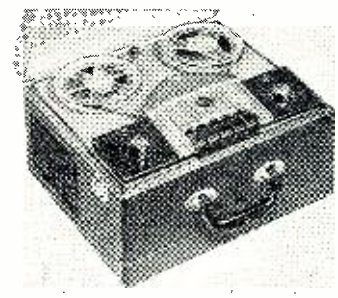
Chicago Telephone Supply Corporation, Elkhart, Indiana is now marketing a new variable resistor which is said to exceed present military specifications for this type of component.

The new Type 90 is manufactured from specially developed materials which will operate over a range of from –55 to + 150 degrees C and from utter dryness to saturation humidity. The unit is available with locking bushing, high torque, and water sealed bearings and mounting. Straight tandem construction is available with panel and rear sections operating separately from concentric shafts, as well as concentric shaft tandem with panel and rear sections operating separately from concentric shafts.

The Type 90 measures 15/16" in diameter and comes in 1 w. ratings (at 70 degrees C) with 500 v. maximum across the end terminals.

NEW TAPE RECORDER

The *Wilcox-Gay Corporation,* Charlotte, Michigan has introduced a com-



pletely new model tape recorder which features several exclusive "firsts" in the industry.

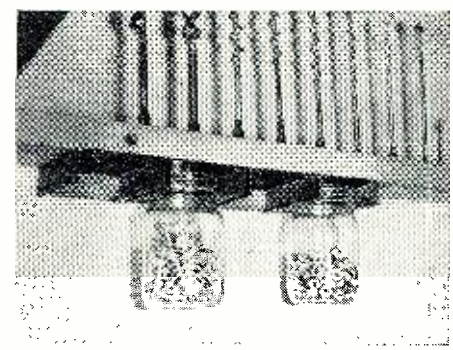
Known as the 2A10, the new unit features fully automatic push-button operation. Five push-buttons control the functions of record, playback, forward and reverse wind, and stop. The instrument handles all necessary adjustments instantly and automatically.

The entire unit weighs less than 20 pounds and measures 12 x 14 x 7 inches. The carrying case is done in two-tone leatherette. The newly-designed control panel carries out the exterior two-tone colors highlighted with a clear plastic grille.

The Model 2A10 provides speeds of 3¾" and 7½". A companion model, the 2A11, offers standard 3¾" and 1⅞" speeds.

SMALL PARTS STORAGE

Triangle Jack Company, Inc., Wichita, Kansas has developed an ingenious de-



vice which should be of interest to service technicians, hams, and hobbyists.

Known as the "Jiffi-Klip," this new shop shelf has special brackets on its under side to accept standard pint

PLATT MUST BE POTTED!

LOOK WHAT HE'S GIVING AWAY FREE TO CELEBRATE HIS ANNIVERSARY!

GRAND FIRST PRIZE!

WIN AN *ALL-EXPENSE PAID* FLORIDA WINTER VACATION

(Includes all travel expenses no matter where you live, hotels, meals, and incidentals.)

5 SECOND PRIZES!

$10 credit on any item in this advertisement.

10 THIRD PRIZES!

$5 credit on any item in this advertisement.

PLUS WHETHER YOU ENTER THIS CONTEST OR NOT..... **5% OFF ANY PRICE IN THIS ADVERTISEMENT FOR EVERYONE!**

ALL YOU MUST DO TO WIN ANY OF THE 16 PRIZES LISTED ABOVE

IS COMPLETE THIS JINGLE →

Platt's prices defy comparo,
Can't be equalled anywhere,
Play it smart and you will see,

(Make your last line rhyme with the 3rd line shown above.)

READ THESE RULES

1. Print or write plainly your "last line" for the jingle on one side of a sheet of paper. Be sure to include your name and address. 2. Mail your entry to Platt Electronics before December 31, 1951. 3. The Platt contest is open to all men and women residents of continental U. S. and Canada except employees of Platt Electronics, their advertising agency, and members of their families. 4. Entries will be judged on the basis of originality and uniqueness. Only one prize awarded to any one individual. No entries will be returned. All entries become the property of Platt Electronics. You accept the terms of this agreement when you enter. 5. All winners will be notified by mail and listed in a future issue of Radio & Television News.

BC-221 Frequency Meter

Real Value! QUANTITY IS LIMITED—so first come, first served. They are just like new, with original calibration charts. Range 125-20,000 KC with crystal check points in all ranges. Complete with crystal and tubes... **$109.50**

Field Telephones

Army surplus, completely reconditioned and electrically tested, using 2 flashlight cells and a pair of interconnecting wires. GUARANTEED—like new. **$18.95**

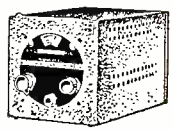
FL-8 RADIO FILTER

Can easily be converted for use with many types of transmitters and receivers.

ONLY $1.29

BEACON RECEIVER BC-1206-C

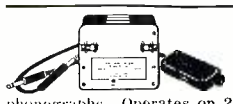
Manufactured by Setchell-Carlson



Frequency Range—195 KC to 420 KC, IF Frequency—135 KC, Receiver Sensitivity—3 Microvolts for 10 Milliwatts output, Output Impedance—300 Ohms and 1000 Ohms to be selected internally, Power Output—230 Milliwatts, Volume Control—RF Gain Control, Power Supply—24-28 Volts Aeroplane Battery, Current—.75 Amperes.

BRAND NEW—ONLY **$10.95**

PRE-AMPLIFIER MODEL K-1



The K-1 is used to amplify output level for microphones and phonographs. Operates on 24-28 VDC. can be converted to 110 AC. Comes complete with PL 55 plug and 2 foot 119-B cord, 2 terminal blocks and instruction book.

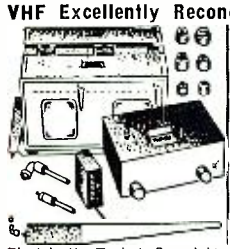
BRAND NEW **$4.95**

Multitester Foundation BIAS METER I-97A

Contains a zero center 3½" round Marion voltmeter calibrated 0-100 volts each side. Movement is one mill each side of center. The unit is mounted in a steel box 7"x5"x4½" and contains 8 contact push button, line cord dual 100 MFD at 200 V DC condenser, a potentiometer 6 1RC 1% wire wound non-inductive resistors: one 400 ohm, two 2500 ohm, one 5000 ohm, one 10,000 ohm, one 15,000 ohm. Excellent for building a zero center multitester with ranges of 1, 10, 100, 1000 volt

COMPLETE BRAND NEW **$7.95**

VHF Excellently Reconditioned Guaranteed SCR-522 AIRBORNE COMMAND EQUIPMENT

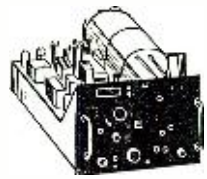


Frequency Range 100 to 156 mcs. in 4 channels receiver and transmitter. Crystal controlled. Complete equipment. Consists of trans/rec, control box BC-602, dynamotor PE-94, AN104A antenna, plugs, etc. Power input with PE-94 is 28 v.

Electrically Tested—Complete as Shown. Only **$99.50**

BRAND NEW—PRICES ON REQUEST

AIRBORNE EQUIPMENT Designed for Aircraft



T-85/APT-5 UHF Transmitter Radar Set AN/APT-5 operates on 80 or 115 volts A.C. at 400 to 2600 cycles requiring 640 volts amperes at 0.90 power factor. Complete with all tubes. Brand new in original packing. **$119.50**

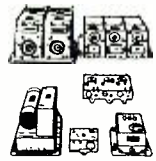
A TERRIFIC BUY AT ONLY

RADIO COMPASS R5/ARN-7

Primarily used for aircraft navigation. Frequency range: 100 KC to 1750 KC in 4 bands. Operates on 115 volts, 400 cycles A.C. Complete installation consists of the following: Radio Compass Receiver R-5/ARN-7, Radio Control Box C1/ARN-7, Loop LP-21, Loop Dehydrator, Indicator I-81-A and I-82-A, Relay BK-22, Coupling MC-203, Cord CD-365, Plugs PL-112, 118, 122. Thoroughly tested and reconditioned by experienced personnel presently engaged in manufacturing for defense.

ONLY **$149.50**

SCR-27N COMMAND and ARC-5 Equipment



RECEIVERS

	USED	NEW
BC-453—190 to 550 KC	$17.95	$37.50
BC-454—3 to 6 MC	11.95	18.95
BC-455—6 to 9 MC	8.95	11.95

TRANSMITTERS

BC-457—4 to 5.3 MC	7.95	12.95
BC-458—5.3 to 7 MC	8.95	13.95
BC-696—3 to 4 MC	16.95	29.95
BC-459—7 to 9.1 MC	16.95	27.50

ADDITIONAL EQUIPMENT

BC-456 Modulator	3.95	6.95
BC-450 Control Box (3 Receiver)	1.49	2.95
BC-451 Control Box (Transmitter)	1.29	2.49
BC-442 Relay Unit (ANT)	2.95	3.95
Plugs: PL-147, 148, 151, 152, 153, 154, 156—EACH	1.25	
Flexible Shafting with gear to fit Receivers		1.69
3 Receiver Rack	2.25	
2 Transmitter Rack	1.69	

HEADSETS

HS-33 low impedance with cord and plug, used, fine condition $1.89
HS-23 high impedance. BRAND NEW with ear pads 4.25
HS-33 low impedance, BRAND NEW with ear pads, cord and PL54 plug. 4.95
HS-30 with ear plugs, low impedance, used, good condition 1.69
CD-307A Cords, 6 ft. NEW ..... .89

T9/APQ-2 RADAR TRANSMITTER

80/115 V 400-260-26 VDC. Designed primarily for aircraft operation.

NEW..... **$42.50**

TRANSMITTER-RECEIVER

Navy Model ABA-1 (CG-43AAG)

Army Model SCR-515A, known as the BC-645

450 MC
15 Tubes

BRAND NEW—ORIGINAL CARTON

Can be easily converted for phone or CW 2-way communication. Covering for the following bands. 420-450 MC ham band, 450-460 MC for fixed or mobile, 460-470 MC for citizens, 470-500 MC television experimental. Size 10½x13½x4¾. Contains 15 tubes: 4—7F7, 4—7H7, 2—7E6, 2—6F6, 2—955, 1—WE-316A door knob. Complete as shown above.

ONLY **$24.95**

SHIP-TO-SHORE BC-223 TRANSMITTER

A 30 watt Transmitter, ideal for ship-to-shore or Ham Rig. Crystal or MO control on four preselected channels. 2000 to 5250 KC. Use of 3 plug-in coils, five tubes: 2—801 and 3—46, and TU 17-18-25 tuning units

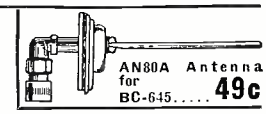
TRANSMITTER ..$39.95
TUBES 5.95
TUNING UNITS ....Each 4.25
PE-125 VIBRATOR POWER SUPPLY FOR BC-223 ..... 18.95

SENSATIONAL SAVING! DYNAMOTOR

For DY-12 Power Supply for ART-13.

NOW ONLY **$15.95** complete

ARMY TEST UNIT 1-236



AN80A Antenna for BC-645..... **49c**

Meter is contained in a metal box 5½" long x 3¾" wide x 3¼" deep. Comes complete with test leads and instruction book. Can be used for testing between AC and DC measuring resistances of circuits, checking fuses and testing capacitors.

ONLY **$5.95**

NOW! Fill Your Battery Only Twice a Year

with Automatic Battery Filler

Made by leading Detroit Auto Mfr. Doubles battery life over ordinary care, prevents battery breakdowns, fits all cars, instantly installed.

ONLY **$1.95** COMPLETE

DUAL PURPOSE EMERGENCY UNIT

- Fire Extinguisher
- Tire Inflator

Made by leading Detroit Auto Mfr. Especially recommended for oil, gas and electrical fires. Guaranteed by mfr. against defects. Order two—one for your home; one for your car in case of flats or fires.

ONLY **$2.29** each

Minimum Order $2.00

Immediate Delivery—Send 25% deposit on C.O.D. orders. All shipments F.O.B., N.Y.C. (N.Y.C. residents add sales tax to your remittance.)

PLATT ELECTRONICS CORP.

DEPT. A, 489 BROOME ST., NEW YORK 13, N. Y.
PHONES: WO 4-0827 and WO 4-0828

salad dressing or Mason jars. The glass jars give visibility and immediate access to the parts needed. The jars snap in and out easily.

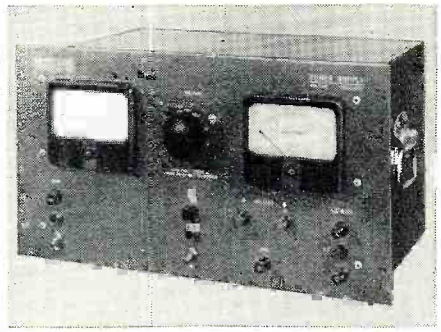
The shelf is designed to mount on a flat wall or to fit between 16" center-to-center exposed studding. It can also be attached to the underside of existing shelves to provide needed bracket facilities. Construction is of heavy gauge metal with crackle finish color coating.

The line will later be expanded to include 8, 4, and 2 oz. jars.

POWER SUPPLY

Kepco Laboratories, Inc., 149-14 41st Avenue, Flushing, New York has just released a new 1000 watt, 50 ma. regulated power supply, the Model 1020.

Characterized by excellent regulation, low ripple content, and low output impedance, the new unit is continuously variable from 0 to 1000 volts and delivers from 0 to 50 ma. In the range 100-1000 volts, the output voltage variation is less than .1 per-cent for both line fluctuations from 105-125 volts and load variation from minimum to maximum current. In the range 30-100 volts, the output voltage variation is less than ½ per-cent for both line fluctuations from 105-125 volts and load variation from minimum to maximum current. Ripple is less than 10 millivolts.

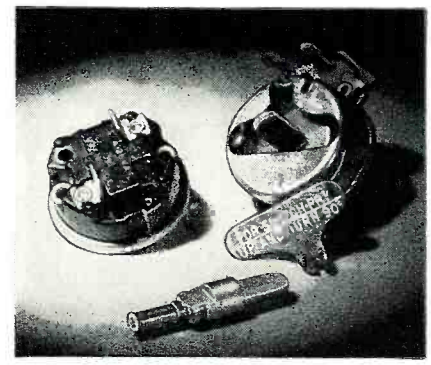


The power supply includes input and output fuses, power "on-off" switch, high voltage "on-off" switch, high voltage control on the front panel. The high voltage d.c. terminals are clearly marked on the front panel. Either positive or negative terminals of the high voltage supply may be grounded.

The unit is designed for relay rack mounting or bench use. It measures 10½" high, 13" deep, 19" wide, and weighs 66 pounds.

SMALL CONTROL

Clarostat Mfg. Co., Inc., Dover, New Hampshire has added a new 15/16"



diameter volume control to its line of replacement units.

For some time past, the Series G (built-in-shaft) and Series AG (attachable "Pick-A-Shaft") controls in the 15/16" diameter size have been available in regular jobber stock. The "Ad-A-Switch" has not been available until now. The company is now supplying its jobbers with this *UL*-Approved attachable switch.

The Series SWB or 15/16" "Ad-A-Switch" is obtainable in s.p.s.t., three-way no "off" position s.p.d.t., and d.p.-s.t. A T-shaped section of the control's dust cap is simply pried up, turned 90 degrees and taken off, exposing the switch-throwing mechanism. The "Ad-A-Switch" readily slips into place.

TWO-WAY RADIO ANTENNAS

Master Mobile Mounts, Inc., P.O. Box 1817, Los Angeles 36, California is currently in production on several new antennas for mobile applications.

The No. 113 is a quarter-wave rooftop design for police, fire, ham, and

(*Continued on page* 134)

TWENTY-EIGHTH BOARD of DIRECTORS R.T.M.A. 1951-52

Sensationally NEW for 1952!

MIDWEST TELEVISION

A Magnificent New Line of Beautiful CONSOLES and Complete CHASSIS featuring the Mammoth 20-Inch RECTANGULAR PICTURE TUBE

FACTORY-TO-YOU

Special Bonus GIFT!

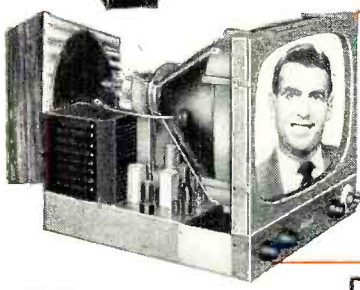
Illuminated TELEVISION CLOCK

Given With Every Purchase of a MIDWEST RADIO or TELEVISION

LIMITED TIME ONLY!

THE New 1952 MIDWEST "VIDEO GRAND"

20-Inch Television-Radio-Phono



MIDWEST 20-Inch TELEVISION CHASSIS and SPEAKER

—for easy installation in your own cabinet.

We Pay Transportation Charges

WRITE or PHONE For This *NEW* 1952 **FREE** MIDWEST TELEVISION RADIO CATALOG

If You Live In One of These Cities Phone and Ask for Your Catalog

NEW YORK MUrray Hill 2-6810
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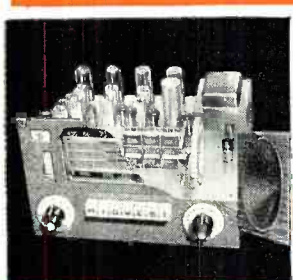
30 DAYS TRIAL

New 1952 MIDWEST "CONSTELLATION" 20-Inch TELEVISION CONSOLE

Also—Powerful New 1952 World-Ranging

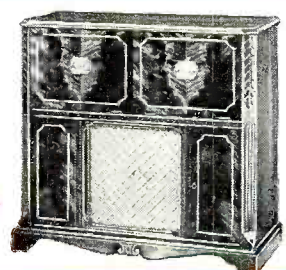
MIDWEST Series of RADIOS

For Beautiful Consoles and Complete Chassis



An entirely new line of radios featuring the powerful Series 16 five wave band AM-FM Radio Chassis and the magnificent Symphony Grand Radio-Phonograph with 3-Speed Automatic Intermix Record Player.

Easy Terms



MIDWEST RADIO & TELEVISION CORP.

DEPT. 375 909 BROADWAY, CINCINNATI 2, OHIO

• WRITE IN NAME AND ADDRESS (PLEASE PRINT) ON COUPON OR 1c POSTCARD •

MIDWEST RADIO & TELEVISION CORP.
Dept. 375, 909 BROADWAY • CINCINNATI 2, OHIO

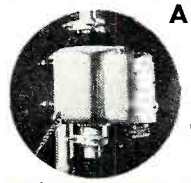
Please send me your new FREE 1952 Catalog.

NAME_____

ADDRESS_____

CITY_____ ZONE____ STATE_____

FOR GOOD TV INSTALLATIONS
ALLIANCE TENNA-ROTORS



The Alliance Tenna-Rotor makes it possible for you to "beam" or turn your antenna in the direction best suited to pick up any TV station within range. When so turned the signal delivered by the antenna to the TV set is increased by giving you a better, clearer picture. The rotator unit is fully enclosed in a moisture-proof housing, factory lubricated for life. Bearings are stainless steel. Works in any weather. Guaranteed for a full year. Approved by Underwriters' Laboratories. Can be used on all masts up to 1⅜" diameter. Takes up to a 20 lb. antenna. For heavier antennas also order the Thrust Bearing Bracket shown below. Operates on 115 V, 60 cy AC 30 watts. Rotates clockwise or counter-clockwise full 360° at 1 RPM. Available in 3 models. Shpg. wt. 15 lbs.

AU-1S. MODEL ATR. Tenna-Rotor with control box which shows end of 360° rotation by means of an indicator lamp on control box. Does not show direction of antenna. Each..... **$20.53**

AU-12. MODEL DIR. Tenna-Rotor with control box which employs an indicator dial showing direction antenna is beamed. Each..... **$26.43**

AU-21. MODEL HIR. Tenna-Rotor with automatic control box. You set the pointer for direction desired and antenna turns to that direction and stops automatically. Each..... **$26.43**

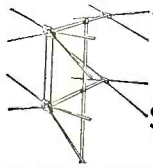
4 Conductor Cable

For use with all Alliance Tenna-Rotors. **W-62,** 100 ft. Coil, ea. **$4.00**

Thrust Bearing Bracket

For use with any above Alliance Tenna-Rotors where extremely heavy antenna is to be used. Supports up to 200 lbs. **AU-13,** each **$2.91**

TV-FM ANTENNAS



AU-61 **$12.99**

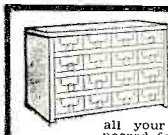
Exceptionally high gain on all channels. Efficient for "fringe" areas. Low standing wave ratio permits use with 72, 150 or 300 ohm lines. Special conical section design minimizes noise, reduces "ghosts"—results in sharp, clear picture. Easily assembled. Double bay with 10 ft. mast. Shpg. wt. 16 lbs.

ALLIANCE TV BOOSTER

STOCK NO. RA-62 **$17.97**

Alliance Booster offers electronic features in design for maximum reception in fringe TV areas. Gives the signal a real boost. One control for all channels. Automatic switch turns Booster on with set. Shpg. wt. 7 lbs. **RA-62**..... **$17.97**

Jiffy Steel Parts Cabinets



The first time Olson offered these handy cabinets they were a sell-out! Just what you need for all your small parts. Engineered for strength. Cabinets are durable steel finished with baked enamel. Drawers are sturdy plastic in a convenient size of 3¾ Deep. 23¼" Wide, 1¼" High, and each is equipped with two removable sliding separators. Drawers have safety catches, will not spill contents if pulled out too far. AVAILABLE IN 6 SIZES.

No.	Description	PRICE
X-231	8 Drawers (24 compartments), 6" deep, 6⅜" wide, 8" high.....	$3.59
X-232	12 Drawers (36 compartments), 6" deep, 9⅜" wide, 8" high....	4.95
X-233	16 Drawers (48 compartments), 6" deep, 12½" wide, 8" high..	6.59
X-252	24 Drawers (72 compartments), 6" deep, 9⅜" wide, 15⅜" high.	8.99
X-234	32 Drawers (96 compartments), 6" deep, 12½" wide, 15⅜" high	10.95
X-235	64 Drawers (192 compartments), 6" deep, 25" wide, 15⅜" high.	20.95

You Can Build This Fine, Precise Vacuum-Tube Voltmeter

Model 909-K Kit Form... **$25.98**

You get more for your money when you assemble your own VTVM. At this sensational price you can't afford to be without this modern piece of test equipment. Easily assembled in one or two evenings. Instruction book is printed in two colors which shows you exactly where to put each wire. Every step is explained. **LOOK AT THESE RANGES—DC: 0-5-25-250-500-1000 volts. AC: 0-5-25-250-500-1000 volts. OHMS: 0-1000-10,-000-1 meg-1000 meg. DB: from –20 to +55DB. VOLTAGE RANGE: Up to 30,000 volts with Precise Model 999 High.** Voltage Probe shown below. This Precise Vacuum-Tube Voltmeter Kit comes to you complete with every single part including the cabinet, 4½ meter, 3 tubes, internal battery, test leads, plugs, and full instructions. Operates on 105-120 volts AC 60 cycles. Case Size 9½"x6"x5".

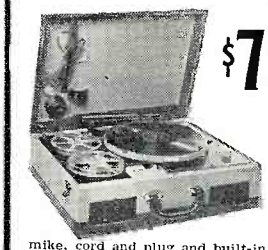
ALSO AVAILABLE COMPLETELY WIRED
Model 909-W.....**$44.98**

PRECISE HIGH VOLTAGE PROBE

Model 999 ea. **$6.98**

To increase voltage range of Precise Vacuum-Tube Voltmeter to 30,000 volts, order one of these probes. Features include: multiple plastic and air insulation, double spring suspension, interchangeable tips and alligator clips. Has three large flash protector guards.

WILCOX-GAY TAPE RECORDER



$79.95 Ea.

PRICE SLASHED—Regular Price $149.95 WHILE THEY LAST
Model 1D10
READ WHAT THIS WILCOX-GAY RECORDER WILL DO!

IT'S A RECORDER . . . a precision tape recorder without equal in the recording field. Makes ½ hour continuous recording on a five-inch reel of tape; 1 hour using both channels. Records at 3¾" per second. The fidelity, clarity and low-noise reproduction of this fine instrument is remarkable. Makes tape recordings from microphone, built in 7S RPM turntable or from any external radio or phonograph. **IT'S A PUBLIC ADDRESS** . . . jack provided for plugging in any PM speaker permitting use as a PA system. **IT'S A PLAYBACK** . . . plays tape back through built-in speaker, and rewinds at high speed. Also will play records if a PM speaker is plugged into external speaker jack. **OTHER FEATURES** . . . two-tone maroon leatherette case, complete with crystal mike, cord and plug and built-in speaker. Neon recording level indicator, tone and volume controls, jack for monitoring. Size 18⅜x13x6". Shpg. wt. 25 lbs. Operates on 105-120 V 60 cy AC.

3 Speed AUTOMATIC CHANGER

Stock No. RA-70
$42.95 WHILE THEY LAST

COMPLETE with VM Model 950 Changer, Amplifier, Speaker and Case. A real Olson value if we ever saw one! Here is the latest VM Model 950 Automatic Changer built into a beautiful carrying case with speaker and fine Amplifier. Plays twelve 7" records (33⅓ or 45 RPM); twelve 10" or ten 12" (33⅓ or 78 RPM); 100% automatic in operation. Nothing more to buy when you order this fine player from OLSON. The cartridge is equipped with a long life needle. Motor shuts off after last record. Equipped with volume control and tone control. Speaker is Alnico V PM. Carrying case is beautifully covered. Size 15" x 17" x 8". For 115 volts 60 cy. AC. Regular list price $77.95.

3-SPEED PHONO-GRAPH Special

$19.97 RA-56

Plays 78-45-33⅓ RPM Discs

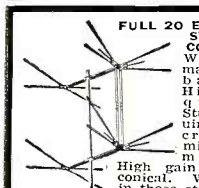
Finest components in the manufacture of these gorgeously designed phonographs. Features include: 3 speed Alliance motor, heavy diecast turntable, 5-volt output tone arm with precision-tip needle, volume control, 2 tube built-in amplifier, Alnico 5 PM speaker, leatherette covered case with rounded corners, convenient carrying handle. Order early and order enough. Every phonograph 100% guaranteed. Original factory-sealed cartons. Operates 115 volts AC. Shpg. wt. 15 lbs.

GENERAL INSTRUMENTS 3-SPEED CHANGER

RA-69, **$19.99** each

A remarkable Olson buy. Actually worth twice our price but we got a bargain and Olson is passing the SAVINGS on to you. Will automatically play 10 records, 7", 10", or 12" size, 33⅓, 45 or 78 RPM. Low pressure cartridge and permanent long life needle. Reject button to reject or skip records. In factory sealed cartons. Size 12" x 12½". Operates on 115 volts AC, 60 Cycles.

FULL 20 ELEMENT STACKED CONICALS



With matching Q bars and High Frequency Stubs Genuine Aircraft Aluminum elements. High gain stacked conical. Will pull in those stations in "Fringe Areas." Works on all channels. Easily assembled.

THIS IS A TERRIFIC VALUE!

Each Antenna consists of two conical bays plus a pair of matching Q bars. Less mast. Packed—3 Antennas to a carton. This gives you six bays and 3 pairs of Q bars.

Sold Only in Boxes of 3 Antennas AU-66.
In lots of 3, each **$8.66**
Carton of 3 ..... **$25.98**
Weight 25 lbs.

OLSON'S SPECIAL — PICTURE TUBES

Dark Face

RCA 16GP4 **$24.95**

Brand new genuine RCA 16GP4 with the new DARK FACE. Fully guaranteed. Buy these tubes from Olson at less than Jobber Cost. 70° defl. 17 11/16" long, neck 6⅞" long, metal envelope.

FP CONDENSER KIT

Assortment of 15 popular FP condensers, double and triple sections. Capacities from 10 mfd to 50 mfd: from 25 to 450 volts. Shpg. wt. 3 lbs. One of Olson's giant Values.

$3.98 each AS-24,

TINY MOUTH AMPLIFIER

★ Small in Size ★ Giant in Action Stock No. RA-66 **$18.95**

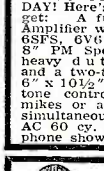
While they last Olson offers these amplifiers which are ideal for window demonstrations, record playing, announcing, etc. Here's what you get: A three-tube amplifier with tubes, 6" PM speaker, and a two-tone leatherette covered case 5½"x8"x 10". Has input for either phonograph or crystal mike. Operates on 115 V, AC, 60 cy. Can be used with microphone shown below.

LOUD MOUTH AMPLIFIER

★ Limited Quantity ★ 8 Watts
Stock No. RA-67.... $24.95

Made by craftsmen and now offered by Olson at a real knock-down price. ORDER THIS OUTFIT TODAY! Here's what you get: A full 8 watt Amplifier with tubes—6SFS, 6V6 and 5Y3, 8" PM Speaker with heavy duty magnet and a two-tone leatherette case—size 6" x 10½" x 13". Has volume and tone control. You can connect 2 mikes or a mike and a phonograph simultaneously. Operates on 115 V AC 60 cy. Can be used with microphone shown below.

MICROPHONE



High output crystal mike for PA systems and recorders. Equipped with handle base and 7' shielded cable. Shpg. wt. 5 lbs.

M-67, each..... **$5.95**

M-66. same but with on-off switch built into handle..... **$6.95**

Stock No. AS-50.... **$5.00**

100 Popular Knobs

★ Olson's Best Buy

You get 100 knobs—with a guarantee that they are worth at least twice what you pay. Included are set-screw and push-on type in Black, Mahogany, Ivory White, as well as fancy colors.

10 WATT RESISTOR KIT

We mean to move 80,000 fine 10 watt wire wound resistors during this sale. REGULAR LIST PRICE OF THIS KIT IS $15.00. Each kit contains 20 popular insulated resistors, with tinned copper leads. Shpg. wt. 2 lbs.
AS-46. Kit of 20..... **$2.49**

VOLUME CONTROL KIT

10 ASSORTED SINGLE AND DUAL CONTROLS

$2.99 AS-44

List value $18.50. Contains 10 popular single and dual controls, with and without switch. All 10 cost you less than the normal price of just two if bought regularly.

AMAZING RECORD PLAYER DEAL

$10 Worth of RCA Discs Included

$19.97 Stock No. RA-60

This is not a kit. The phonograph comes to you completely assembled and factory tested. No troublesome wiring. Just plug in—put on the RCA non-breakable records you get with the outfit and you have dependable entertainment. The amplifier employs 2 tubes, a 50L6 and a 35Z5. Motor is Alliance, the finest. The crystal tone arm is made by Astatic. Sure and Electro-Voice. In addition you get a complete set of RCA Victor non-breakable Children's Records which include such favorites as "Happy the Humbug," "The 500 Hats of Bartholomew Cubbins," "Rapunzel," "Aladdin and His Lamp,' etc. Discs are enclosed in beautifully colored albums giving each story so that the child can follow the recording. Cabinet is decorated with gay circus figures and the volume can be regulated by the full range control. Operates on 115 volts AC. Shpg. wt. 15 lbs. Don't delay, order now. The price is low enough so it pays to order even for the parts contained. Here is a special. You get a nationally famous 78 RPM Record Player and $10.00 worth of genuine RCA Victor non-breakable children's records.

LIMITED QUANTITY. ORDER NOW WHILE THEY LAST.

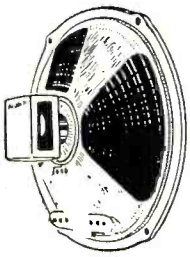
*Look what the parts would cost if bought separately even at our SPECIAL SALE PRICE.

78 RPM Motor.....	$ 3.79
Phono arm and cartridge....	2.99
Amplifier	3.98
Set of tubes for amplifier...	1.89
PM Speaker	1.69
Output Transformer	.69
AC Cord	.29
Decorated Case	4.99
Set of RCA Victor Non-Breakable Records.....	10.00
	$30.31

OLSON RADIO WAREHOUSE • 275 E. Market St., Akron 8, Ohio

MAGNAVOX & RCA SPEAKERS

12" and 8" Sizes



Think of it! Genuine Magnavox and RCA Speakers at a fraction of their real value. Yes—Olson really made a deal—a good deal—and you can cash in. These speakers are brand new, equipped with Alnico 5 magnets and dust-proofed 3.2 ohm voice coils.

STOCK UP NOW—THIS IS REAL VALUE

12" PM Speaker—Individually boxed. Single, ea. $5.95
Stock No. S-140—Lots of 3, ea. **$4.95**

8" PM Speaker
Individually boxed
Stock No. S-123.....EA. **$2.99**

TL-3 FAIRCHILD GRINDER **$9.98**

Every service shop needs one of these handy tools made by Fairchild, famous manufacturer of precision electric grinders. Regular nationally advertised price is $19.75. The set consists of 1—115 volt high speed, air cooled grinder, 6 assorted grinding wheels, 1 circular saw blade, 1 hardened steel reamer, 1 buffing brush, 1 abrasion stone and a natural finish wood case size 10"x5"3" to house the grinder. Shipped in original factory sealed cartons.

GENUINE UNIVERSITY REFLEX SPEAKERS

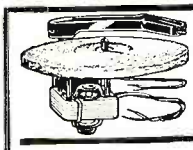
25 WATT DRIVER UNIT No. S-165 **$14.70** each

Unit is breakdown proof, will handle 25 watts continuously and is guaranteed for 1 year. Hermetically sealed, complete protection from outdoor exposure. Has dural 16 ohm voice coil and genuine bakelite diaphragm. Fits trumpet shown below or any other standard trumpet. Brand new factory sealed cartons. Shpg. wt. 6 lbs.

REFLEX TRUMPET No. S-164 **$14.41** each

Trumpet is heavy gauge metal finished with corrosion resistant paint. Equipped with famous adjustable UNIVERSITY "U" BRACKET. Mounts in any position, 16½" diameter. Has heavy rubber rim for improved tone. Brand new factory sealed cartons. Shpg. wt. 15 lbs.

Get both Driver Unit and Reflex Trumpet. Genuine University matched set.... **$29.11**



BIGGEST BARGAIN

Special while they last for the combination **$39.99** RA-91

COMBINATION OFFER—You get an Alliance Rim Drive 78 RPM Phono Motor with turntable PLUS a Pickup Arm with high Output Cartridge.

PHONO AMPLIFIER RA-19. **$39.98** LESS TUBES

A real high efficiency 3-tube amplifier of modern design. Connect to any crystal phono arm and speaker. Has volume and tone controls 7"x 3¼"x2". Shpg. wt. 2 lbs.

SET OF TUBES FOR AMPLIFIER 12SQ7 50L6 35Z5 No. AS-22..... **$2.64**

RIM DRIVE PHONO MOTORS

M-63 **$5.99** 3 SPEED

33⅓ 45 78 RPM

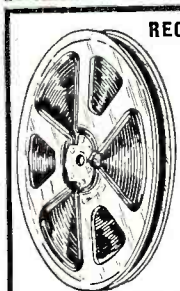
Self starting, complete with turntable. Operates on 115 volt AC 60 cy. Shpg. wt. 5 lbs.

$4.95 M-64

3 SPEED PICK-UP ARM

Cartridge flips by means of a lever. Dual cartridge, one side plays 33⅓ and 45 and other 78 RPM. Double needle.

RECORDING TAPE—Famous Mfr's Close-Out!



Get the buy of your life. Save up to 64% on high quality RECORDING TAPE. A large manufacturer had to sell his inventory and he unloaded the whole deal. Olson now offers you this high grade recording tape at prices which defy competition. Standard ¼" wide, 1200 ft. long. Frequency response 50 to 8,000 cy. Plastic Reel included with each.

PAPER BASE—1200 ft. Stock No. X-248 Single, each $1.69 Lots of 10, each **$1.49**

PLASTIC BASE 1200 ft. Stock No. X-249 Single, each $2.19 Lots of 10, each **$1.99**

PRICES SLASHED ON EMPTY PLASTIC REELS

Finest clear plastic—will not warp.
5" Diameter—600' Size
No. X-250
Single, ea. 39c.
LOTS OF TEN, EA..... **29¢**

7" Diameter—1200' Size
No. X-251
Single, ea. 49c.
LOTS OF TEN, EA..... **39¢**

SEND FOR OLSON'S BRAND NEW BARGAIN CATALOG. GET NATIONALLY FAMOUS RADIO PARTS AND SUPPLIES AT BIG DISCOUNTS

CLEVELAND, OHIO
2020 Euclid Ave.

If you live in or near Cleveland visit our store, get these and many more bargains.

CHICAGO, ILLINOIS
623 W. Randolph Street

If you live in or near Chicago visit our store, get these and many more bargains.

MAIL ORDERS SHOULD BE SENT TO AKRON, OHIO

TUBES UP TO 73% DISCOUNT

Order your tubes from Olson and make more on every sale. Discounts range up to 73% off list on the tubes shown. Every tube is INDIVIDUALLY BOXED and GUARANTEED. Every tube is made by Ken-Rad, Sylvania, Tung-Sol or Raytheon and will be so branded or carry the Olson Akrad Brand or the brand names of set manufacturers like Crosley, Motorola, Jewel, Philco, etc. Here's a deal you need. Almost every set that comes into your service shop needs tubes. Be ready—get your stock from Olson.

5Y3GT, 6J5, 6X4, 6X5GT, 12AT6, 12AV6, 35W4, 35Z5, 80 — **59¢ Ea.**

OZ4, 1H5GT, 5U4, 1S5, 6AR5, 6AV6, 6BE6, 6H6GT, 6SQ7, 6K6GT, 12BA6, 25L6GT, 12BE6 — **69¢ Ea.**

1R5, 1T4, 1U5, 3V4, 6AL5, 6AQ5, 6AU6, 6BA6, 6SA7, 6S4, 6W4GT, 7B6, 12SA7, 12SK7, 12SQ7, 35C5, 50B5, 50C5, 50L6 — **79¢ Ea.**

1LE3, 3Q5, 6CB6, 6V6GT, 6W6GT, 7F7, 7H7, 12A8GT, 12J7GT, 12SN7GT, 25W4GT — **89¢ Ea.**

6SN7, 1X2, 6AG5, 1B3GT, 6K7GT, 6L6G, 6J6, 7N7, 12AT7, 12AU7 — **99¢ Ea.**

6AG7	$1.19 Ea.
6BG6G	1.89
6BQ6GT	1.29
6CD6	1.99
12AV7	1.19

TUBE KITS

Buy in kits and save money. Brand new fresh stock. Made by Nationally Famous manufacturers and packed in handsome shelf cartons. Order some of each.

ALL AMERICAN TUBE KIT

Kit contains one each of the following: 12SA7, 12SK7, 12SQ7, 35Z5, 50L6.
Reg. list price.....$8.50
Kit No. AS-11—Per Kit..... **$3.75**

2 KITS	4 KITS	6 KITS
$7.50	$15.00	$22.25

MINIATURE TUBE KIT

Kit contains one each of the following: 12AT6, 12BA6, 12BE6, 35W4, 50B5.
Kit No. AS-47—Per Kit..... **$3.39**

2 KITS	4 KITS	6 KITS
$6.75	$13.25	$19.50

REMEMBER! Every Tube is guaranteed. Make more money on your service work. ORDER TUBES FROM OLSON'S GIANT WAREHOUSE.

THIS COSTS YOU NOTHING—NOT A RED CENT

Just to get the ball rolling and to get your order to come our way—Olson is going to send you one of his famous TERMINAL STRIP KITS. Contains a total of 36 terminal boards, lug strips, screw terminals, tie points and panel lamp sockets. You get the entire package of 36 popular parts which should be in every service shop. All you need do is to make up an order for $10.00 or more from this ad . . . using this order blank. We will ship your order at once and include the 36 piece kit at no extra charge.

IT'S EASY TO ORDER FROM OLSON'S

How to order: Order directly from this ad. For convenience use this order blank. Fill in columns below with quantity desired, stock number, description and price. You may send remittance with order (include enough for postage or parcel post shipment), or if you prefer SEND NO MONEY, Olson will ship C.O.D. and you may pay mail or expressman for merchandise and postage.

MONEY BACK GUARANTEE: *Everything you order from Olson is guaranteed as advertised. If you are not more than satisfied, you may return merchandise for cash refund.*

Please Minimum Order $3.00

QUANTITY	STOCK NUMBER	DESCRIPTION	PRICE EACH	TOTAL

NAME_____

ADDRESS_____

CITY_____ ZONE___ STATE_____

RN1251

TOTAL	
ADD POSTAGE	
TOTAL AMOUNT	

OLSON AKRAD RADIO WAREHOUSE • 275 E. Market St., Akron 8, Ohio

MARS Station of the Month

NOVICE AND TECHNICIAN CLASSES ELIGIBLE

Authority has now been granted to accept Novice and Technician class radio amateurs for membership in MARS.

According to the terms of the authority any Novice or Technician class radio amateur may apply for MARS membership. He must be a member of one of the Armed Services or the reserves or he must be a civilian who has attained the age of 21 yrs. and who has in his possession at the time of application the necessary equipment to operate on the MARS frequency, 3497.5 kc. The applicant must agree to operate, while on the military frequency, at such times and in such manner as the MARS Command Director may direct.

Full details on this new program are available either from MARS Headquarters (Army), Office of Chief Signal Officer, Washington 25, D. C. or MARS Headquarters (Air Force), Director of Communications, A. F., Washington 25, D. C.

IN RECOGNITION of its active participation in the First Air Force Military Amateur Radio System, radio station AF2RDD/W2RDD has been named MARS Station of the Month by Major Charles C. Mack, Chief of the MARS-Air Force. (Regular readers will perceive that due recognition has also been given the Chief-MARS in the form of a promotion.)

AF2RDD is licensed to Jim Cronn and has been active in the First Air Force MARS program since it first was organized. Jim's application was processed within a week from the time the public announcement made the program known.

Jim joined the amateur ranks in 1946 and still operates the original transmitter, running 125 watts to an 814. In his receiving position he has a BC 779A and he uses a *Meissner* "Signal Shifter" for frequency control. MARS frequencies are crystal controlled.

Cronn's inclination toward amateur radio was apparent for several years before he took out a license. He operated during the 30's as a Short Wave Listener and in 1935 received verifications from 98 foreign countries. His receiver at that time was a three-tube regen using a long wire antenna.

Jim's military history begins with the year 1942 when he became an aviation cadet. He was commissioned a second lieutenant in the Army Air Force in January, 1943, served subsequently as a pilot in the Fifth Air Force in New Guinea, and was discharged in February of 1946.

Junior op, Jim, Jr., shows signs of following in his father's footsteps. Already he manipulates the controls for the OM. Jim, Jr., is four.

—30—

Jim Cronn (AF2RDD/W2RDD) and Jim, Jr. of Hempstead, New York.

21-inch
rectangular tube

24-inch
round tube

BIGGER PICTURE TUBES

of U·S·S Stainless Steel

are television's big news today

30-inch
round tube

Here's a display of big-tube television that any dealer could be proud of. And a big assist in the development of today's large-screen television goes to U·S·S Stainless Steel—U·S·S 17-TV.

The use of U·S·S 17-TV Stainless Steel in picture tube shells cuts tube manufacturing costs. Such metal-glass tubes are also stronger and thus safer, less susceptible to implosion. And this special grade of Stainless Steel makes it possible to keep these giant tubes light and compact. With lighter steel shells, considerable time is saved handling tubes on the production line.

Specifically, these Stainless Steel shells reduce tube weights by one-fourth to one-third—highly important in the 21, 24 and 30-inch picture tube range.

Since the face plate is made separately from the shell in metal-glass TV tubes, it can be made from drawn glass having better optical qualities. The clear, sharp pictures that result are in keeping with their "theater-screen" size.

U·S·S 17-TV Stainless Steel—developed especially for television applications—has proved itself the strongest, lightest and safest material for both rectangular and round tubes. These big, new sets . . . the kind of television your customers want . . . deserve your best sales efforts.

AMERICAN STEEL & WIRE COMPANY, CLEVELAND · COLUMBIA STEEL COMPANY, SAN FRANCISCO
NATIONAL TUBE COMPANY, PITTSBURGH · TENNESSEE COAL, IRON & RAILROAD COMPANY, BIRMINGHAM · UNITED STATES STEEL COMPANY, PITTSBURGH
UNITED STATES STEEL SUPPLY COMPANY, WAREHOUSE DISTRIBUTORS, COAST-TO-COAST · UNITED STATES STEEL EXPORT COMPANY, NEW YORK

USS TRADE MARK

U·S·S STAINLESS STEEL

SHEETS · STRIP · PLATES · BARS · BILLETS · PIPE · TUBES · WIRE · SPECIAL SECTIONS

1-969

UNITED STATES STEEL

Skiatron System

(*Continued from page 49*)

passing through Barrier *A* goes through the slot in Barrier *B* to strike the screen.

Obviously, while we have spoken only of maximum and zero modulation conditions, any value of modulation between those two will cause a proportional amount of light to pass to the screen. We have, therefore, a true light modulator, whose action in producing intensities on the screen between zero and a maximum is controlled linearly by applying modulating voltage to the 18 mc. power amplifier.

Now let us modulate the crystal oscillator with the video output of a TV receiver. At the instant that picture element number 1 comes along, it modulates the oscillator to a percentage determined by its amplitude. At that instant, therefore, there is created at the bottom of the liquid column a few bars of a phase grating whose pressure variations are such as to diffract just enough of the image of the opaque bar to allow the right amount of light for that picture element to pass to the screen. This little group of pressure waves travels up through the liquid column at a constant speed and the resulting spot of light for the picture element consequently travels down the screen at the same speed. Meantime succeeding picture elements are creating their own pressure waves and all of them are traveling in a constant procession up the liquid, producing a continuous column of light spots going down the screen.

The number of picture elements on the screen at one time depends on how many picture elements can exist at one time as pressure groups in the liquid. With about 120,000 total picture elements in every frame, as TV is transmitted today, and 30 frames per second, 3,600,000 elements are transmitted every second. With an oscillator frequency of 18,000,000 cycles per second, there are about 5 oscillations to a picture element. The effective length of the liquid column allows many hundreds of pressure cycles at a time in the liquid and one fifth of this number represents the number of picture elements active at a time. This is quite unlike any other form of TV reproduction (except the intermediate-film projection process), for all other systems employ a single spot of light and only one element is active at a time. The result is a brighter picture because more light is on the screen at a time and less dependence is placed on human persistence of vision.

The Scanning System

Now that we have a continuously moving line of light representing the successive elements of the lines in the TV picture, the next problem is to place them on a viewing screen in such a way that each element remains in one place. We begin by replacing the screen of Fig. 2 with a small wheel of

polished steel whose periphery is cut in the shape of a polygon. This wheel, called the high-speed scanner, is shown in Fig. 6, rotating in a clockwise direction. Its polished edges act as efficient mirrors.

Lines *A* and *B* represent a single picture element at two instants. At time *A* the series of five 18 mc. compression-rarefaction waves has just been created at the bottom of the cell, with an amplitude correct for that picture element. The line represents the travel of the resulting light through the slit to the top of lens *C*. Lens *C* focuses all light coming to it on a spot beyond the wheel, with the result that all the light variations which were formerly on the screen of Fig. 2 in the form of a line of varying light are now reproduced upside down and reduced in size on one of the faces of the polygon. Above the high-speed scanner is (temporarily) a new screen, of which we see an edge in Fig. 6; it is, in other words, facing the edge of the high-speed scanner. The diagram in Fig. 6 is somewhat distorted with shortened distances for compactness.

Lines *A*, representing a picture element just entering the ultrasonic cell, causes the light for that element to be refracted by lens *C* on point *X* of the scanner, which is in the position shown by outline *A*. Since angle of reflection is equal to angle of incidence, the light for that element is reflected to point *P* on the screen.

A few microseconds later the group of liquid waves representing the same element has progressed to the top of the cell. Light through the slit representing the element (line *B*) is now refracted through the bottom of lens *C* to a new point on an edge of the scanner. But the scanner has all this time been rotating clockwise at exactly the right speed so that light spot *B* hits point *Y* with exactly the right incidence angle to cause the reflection to go again to point *P* on the screen. Thus, as the waves for each element travel up through the cell, and light rays travel through them, through the slit, and through lens *C*, the high-speed scanner exactly cancels the movement so that each picture element remains stationary on the screen. Any one face of the scanner accommodates exactly the number of elements which can exist at one time in the liquid; and when one face passes out of use, another one takes over for the next group of elements. The image on the screen of Fig. 6 is exactly similar to what would be seen if a cathode-ray tube receiver were operated correctly in every way except that it had no vertical sweep. There is only one difference—in the *CR* tube there is only a single light spot, while in the *Skiatron* system there is always a line of light.

The only remaining point is to give vertical motion to the line of light so that it will cover the entire viewing screen from top to bottom once per field, or 60 times per second. Fig. 7 shows how this is done.

The screen of Fig. 6 is replaced by a

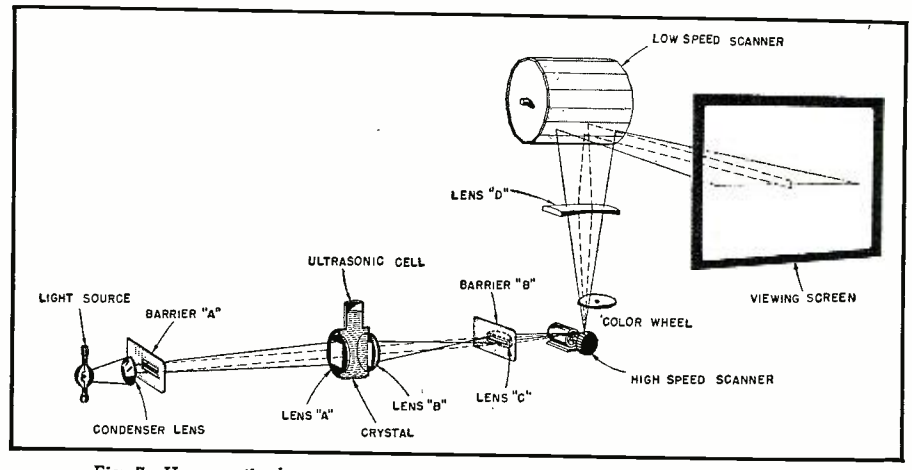


Fig. 7. How vertical motion is imparted to line of light to cover entire screen.

cylinder which rotates on its axis at right angles to the high-speed scanner. This cylinder, an end view or cross-section of which is shown in Fig. 8, is the low-speed vertical scanner, and it has polygon-shaped walls formed of mirrors. The lines of light containing stationary picture elements are reflected onto the low-speed scanner from the edges of the high-speed scanner, the lines traveling outward from the paper as the reader observes Fig. 8. From a face of the low-speed scanner the lines are reflected to the viewing screen.

The low-speed scanner rotates at just the correct speed to sweep the lines of light downward on the screen, so that they reach the bottom at the end of a transmitted field. At that time the next mirror face comes into position and begins its work by reflecting the line to the top of the screen. The screen is translucent, with the viewing audience on the opposite side from the projector.

The entire optical system is diagrammed in Fig. 7.

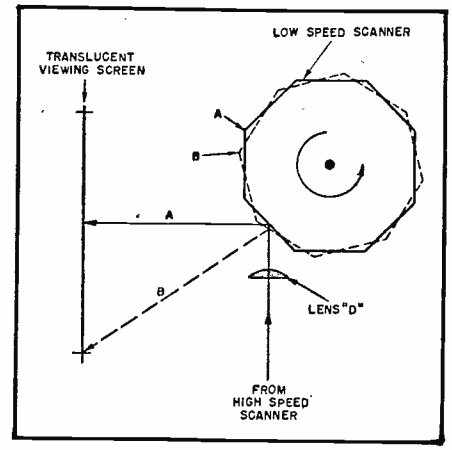


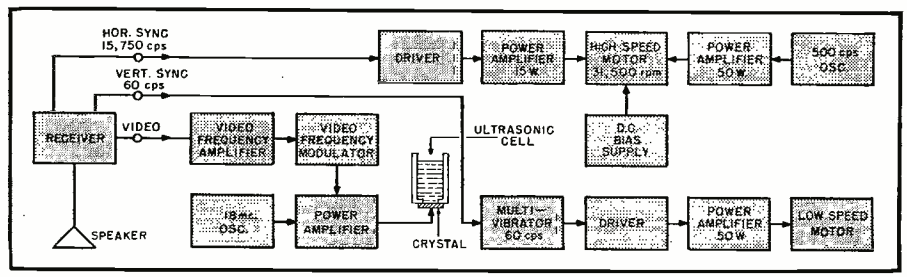
Fig. 8. End view of the slow speed scanner.

Design Details

Two models of the *Skiatron* big-screen projector have been designed. The first to go into production is the smaller one designed to produce a picture 4 feet wide and is intended for clubs, schools, and other semi-public locations. The second, which is scheduled for production late in 1951, is for theaters. It will produce a picture 25 feet wide, which is comparable to the usual 20 to 30 foot motion-picture size. The only differences in the two systems are in the light source and the focusing. The smaller model will employ special mercury lamps made by *Hanovia* for the purpose, and the theater model will use standard carbon arcs. For the theater model, the distance from the low-speed scanner to lens *D*, Fig. 8, is greater, for the somewhat longer throw. Maximum required distance for the projector behind the screen, however, is only about 15 feet, making the unit suitable for any theater which has a stage, even a small one.

The block diagram of Fig. 9 shows the electrical line-up. The receiver and all circuits except those for the motors and the oscillator-modulator are located in the console unit shown in Fig. 10. The motor which operates the high-speed scanner by direct drive has one asynchronous section of the squirrel-cage type driven through a power amplifier from a 500 cycle oscillator. It also has a phonic-wheel synchronous section which is driven by the 15,750 cycle horizontal sync pulses de-

Fig. 9. Block diagram shows the electronic components of the Skiatron system.



WANTED! WANTED!

MILITARY TEST SETS & EQUIPMENT

TS-12, 13, 35, 14, 15, 146, 174, 175, 263, 268, etc. APR, ARC, ART, APS, APA, SCR, BC equipment and parts. Also TUBES, any quantity. WRITE, WIRE OR CALL.

R-H-S
SPECIALS OF THE MONTH

Coaxial Relay K-101 SPDT—24v DC	$ 4.95
Set of 83-1SP Coax-Connectors for Above	1.35
1000 KC Crystal BT cut	3.95
VS-2 Vacuum Switch	6.95
Sigma Plate Relay 5000 ohm SPDT	2.49
RG59/U Coaxial Cable—75 ohm 150' roll.....$11.95. 300' roll	22.50
8" Scope Shield	1.29
2 Speed Dial Drive for ¼" Shaft Ratios 5:1 1 to 1	.39

TUBES!! BRAND NEW! STANDARD BRANDS! NO SECONDS! COMPARE! TUBES!!

0A3/VR75	$1.69	3C24	$2.25	227A/5C27	$5.95	812H	$6.90	8014	$29.95	0A2	$1.55
0B3/VR90	1.29	3C31/C1B	3.49	249C	3.95	813	8.95	8020	1.29	0A4G	1.20
0C3/VR105	1.49	3C45	19.95	250R	12.95	814	3.95	8025	5.95	0B2	1.65
0D3/VR150	1.29	3CP1	2.25	250TH	22.50	815	2.95	9001	2.25	0Z4	.75
1B22	3.45	3CP1S1	2.95	250TL	21.50	816	1.30	9002	2.25	01A	.73
1B23	4.95	3DP1	4.95	274A	5.50	827	3.95	9003	2.25	1A3	.73
1B24	19.95	3DP1A	6.95	274B	2.65	828	12.75	9004	.75	1A4P	1.30
1B26	3.95	3DP1-S2A	8.95	276A	9.95	829	12.95	9005	2.95	1A5GT	.78
1B27	24.50	3D21A	1.98	293A	2.98	829B	14.95	9006	.49	1A6	.85
1B29	2.75	3E29	14.95	294A	5.75	830B	3.95	C1JA	9.95	1A7GT	.95
1B32	3.95	3GP1	3.95	300B	1.95	832	9.95	C5B	9.95	1AB5	.80
1B36	24.96	3GP1	4.75	304TH	27.50	832A	12.95	C6A	7.95	1B3/8016	1.25
1B38	32.50	3HP7	3.95	304TL	29.95	833A	41.50	C6J	6.95	1B4	1.15
1N21 Xtal	1.25	4-65A	14.21	305A	34.95	836A	3.95	C100D	1.49	1B5/25S	.95
1N21A "	2.25	4-125A	26.95	307A/RK75	5.95	837	1.69	CK502AX	2.95	1B7GT	1.15
1N21B "	4.25	4-250A	29.95	310A	8.95	838	2.95	CK503AX	2.95	1C5GT	.85
1N22 "	1.35	4AP10	4.95	316A	.65	841	.45	CK505AX	2.25	1C6	.73
1N23 "	2.25	4B22/EL5B	9.95	323A/B	24.50	843	.39	CK506AX	2.25	1C7G	.73
1N23A "	3.25	4B24/EL3C	7.95	327A/5C37	4.95	845	4.95	CK507AX	2.25	1D5GP	.73
1N23B "	5.95	4B25/6CF	8.95	328A	13.95	849	39.50	CK512AX	2.25	1D7G	.73
1N26 "	5.95	4B26/2000	8.95	331A	12.95	851	69.50	CK517AX	8.45	1D8GT	.73
1N27 "	1.69	4B28	4.95	350A	8.95	852	29.95	CK1005	.89	1E5GT	.73
1N34A "	1.40	4B32	9.95	350B	4.95	860	6.95	CK1006	3.25	1E7G	1.19
1P23	3.95	4C27/CV92	9.95	368AS	7.95	861	29.50	E1148	.35	1F4	.73
1P24	34.50	4C35	1.49	371A	1.49	864	.39	EF50	1.49	1F5G	.73
1P36	2.95	4E27/257B	17.95	371B	.98	865	1.45	F123A	8.75	1G4	.73
1S21	6.95	5AP1	3.69	388A	2.75	866A	1.39	F127A	22.50	1G6GT	.73
2AP1	11.95	5AP4	3.69	393A	6.95	866JR	1.29	F128A	89.50	1H4G	.89
2C21/RK33	.69	5BP1	5.95	394A	4.95	869B	49.50	F606	37.60	1H5GT	.73
2C22/7193	.49	5BP4	5.95	417A	12.95	872A	2.95	F660	79.50	1H6GT	1.05
2C26A	.49	5CP1	4.95	434A	4.95	874	1.49	FG17	3.95	1J6	.98
2C34/RK34	.89	5CP7	12.95	446A	4.95	876	.59	FG27A	8.75	1L4	.73
2C39	24.50	5C22	55.00	446B	4.95	878	2.25	FG32	7.95	1LA4	.89
2C40	8.95	5D21	24.50	450TH	47.50	884	1.85	FG57	14.95	1LA6	1.15
2C43	14.95	5FP7	3.25	450TL	47.50	885	1.49	FG81A	3.95	1LB4	1.06
2C44	1.49	5GP1	4.95	527	12.75	902	11.95	FG105	22.95	1LC5	.89
2C46	7.50	5JP1	24.45	559	1.39	905	3.59	FG172	34.50	1LC6	.98
2C51	6.95	5JP2	24.45	562	97.50	908	12.95	FG146	8.95	1LD5	.98
2D21	1.79	5JP4	24.45	575A	13.95	918	5.69	FG434A	4.95	1LE3	.85
2E22	1.95	5J23	12.95	701A	5.95	919	2.79	FG451	.89	1LG5	.85
2E24	4.89	5J29	12.95	702A	3.95	922	.98	FG502A	1.85	1LH4	.89
2E26	3.69	5J30	49.50	703A	7.95	923	1.05	FG562	97.50	1LN5	.89
2E30	2.29	5J32	99.50	704A	1.05	927	1.59	FG592	14.95	1N5GT	.89
2J21A	9.95	5LP1	15.95	705A	2.95	930	1.20	HF125	14.95	1P5GT	.79
2J22	8.45	5NP1	5.95	706BY	39.50	931A	4.95	HF300	19.95	1Q5GT	.73
2J26	29.50	6AS6	3.69	706CY	39.50	954	.39	HY114B	.79	1R4	.73
2J27	29.50	6C21	24.50	706FY	42.50	955	.45	HY115	.79	1R5	.85
2J30	99.50	6F4	5.95	706GY	42.50	956	.45	HY615	.29	1S4	.73
2J31	39.50	6J4	6.95	707B	17.95	957	.45	KG4	37.50	1S5	.85
2J32	39.50	7BP7	8.95	708A	4.95	958	.45	KU610	6.95	1T4	.85
2J33	39.50	7DP4	17.95	709A	3.95	959	.69	ML101	69.50	1T5GT	.73
2J34	39.50	9GP7	14.95	710A/8011	1.75	991/NE16	.39	REL21	3.95	1U4	.89
2J38	97.50	9JP1	14.95	713	5.25	1603	5.25	RK20	9.95	1V	.72
2J37	12.75	9LP1	19.95	714AY	6.95	1613	1.25	RK25	4.49	1X2	1.18
2J38	12.75	9LP7	14.95	715A	7.95	1614	2.25	RK33	.69	2A3	.95
2J39	39.50	10BP4	22.50	715B	9.75	1616	.98	RK34	.89	2A4G	1.25
2J40	39.50	10Y	.49	715C	29.95	1619	.49	RK48A	4.49	2A5	.73
2J46	39.50	12DP7	16.95	717A	1.69	1622	3.25	RK59	1.49	2A6	.73
2J48	29.50	12GP7	16.95	721A	2.59	1624	1.98	RK60/1641	2.25	2A7	.75
2J49	39.50	12HP7	16.95	722A	2.95	1625	.45	RK65	24.50	2B7	.75
2J50	22.50	12LP4	22.50	723A	14.95	1626	.45	RK72	.59	2V3G	.79
2J51B	39.50	12Y	1.19	723A/B	22.50	1629	.45	RK73	.59	2X2	.65
2J55	97.50	15R	.89	724B	3.89	1630	.98	RK74	.59	2X2A	1.60
2J61	49.50	16AP4	42.50	725A	7.95	1631	1.29	RK81A	2.95	3A4	.65
2J62	49.50	16CP4	42.50	726A	6.95	1632	.79	RX120	8.95	3A5	.90
2K25/ 723AB	29.50	19T8	2.90	726B	29.50	1633	.75	V70D	6.95	3B7/1291	.59
2K28	36.25	28D7	1.35	726C	49.50	1634	.75	VR78	.69	3D6/1299	.59
2K29	24.50	30 Special	.59	730A	30.50	1636	3.25	VR91	1.49	3LF4	.95
2K33	310.00	35TG	4.95	750TL	79.50	1638	.65	VR92	.98	3Q4	.79
3AP1	12.95	45 Special	.49	800	1.95	1641	2.25	VT127A	3.95	3Q5GT	.85
3B22/Flip	2.95	43A	5.95	801A	.49	1642	.59	VT158	14.95	3S4	.85
3B23/RK22	4.85	75TL	6.95	802	4.49	1654	2.39	VU29	2.95	3V4	.90
3B24	5.95	100R	.89	803	4.49	1665	1.45	VU111	1.49	5R4GY	3.75
3B24W	7.95	100TH	9.95	804	9.95	1851	1.89	WL168	12.95	5T4	1.95
3B25	4.65	100TL	9.95	805	4.49	1960	.79	WL530	12.75	5U4G	.73
3B26	3.95	203A	8.95	806	29.95	1961	4.95	WL531	12.75	5V4G	1.12
3B27	3.95	204A	69.50	807	1.98	2050	1.90	WL532	2.95	5W4	.81
3B28	8.95	211	.69	808	7.25	2051	1.45	WL578	1.29	5X4G	.89
3BP1	8.95	212E	49.50	809	2.45	8005	5.95	WL616	37.50	5Y3GT	.63
3C22	64.50	215A	.19	810	9.95	8011	1.75	WL619	18.95	5Y4G	.73
3C23	9.95	217C	8.95	811	3.25	8012	3.95	WL677	34.50	5Z3	.89
				812	2.95	8013	2.95	WL681	22.50	5Z4	$0.89
										6A3	1.25
										6A4LA	1.35
										6A6	.92
										6A7	.98
										6A8	1.05
										6AB7	1.05
										6AC5GT	1.20
										6AC7	1.15
										6AD7GT	1.35
										6AE6G	.89
										6AF6G	.95
										6AG5	.89
										6AG7	1.55
										6AH6	1.40
										6AJ5	1.15
										6AK5	1.50
										6AK6	1.10
										6AL5	.82
										6AQ5	.92
										6AQ6	.87
										6AR5	.79
										6AT6	.73
										6AU5	.85
										6AU6	.93
										6AV6	.72
										6B6G	.99
										6B7	.98
										6B8G	.85
										6BA6	.85
										6BC5	.98
										6BE6	.85
										6BF6	.85
										6BG6G	1.18
										6BH6	.97
										6BJ6	.97
										6BQ6	1.15
										6C4	.79
										6C5	.79
										6C6	.79
										6C8G	.98
										6CB6	.98
										6D6	.85
										6D8	.89
										6F5	.79
										6F6	.95
										6F7	.89
										6F8G	.95
										6G6G	1.15
										6H6	.95
										6H6GT	.79
										6J5	.75
										6J5GT	.69
										6J6	1.20
										6J7	.82
										6K5GT	.89
										6K6GT	.79
										6K7	.73
										6K8	.73
										6L5G	.82
										6L6	3.00
										6L6G	1.75
										6L6GA	1.75
										6L7	.98
										6L7G	.95
										6N7	.89
										6Q7	.95
										6R7	.85
										6S7G	.98
										6S8GT	1.05
										6SA7	.85
										6SC7	1.30
										6SD7GT	.98
										6SF5	.89
										6SF5GT	.89
										6SF7	.98
										6SG7	.98
										6SH7	.73
										6SJ7	.89
										6SK7	.89
										6SL7GT	.98
										6SN7GT	$0.98
										6SQ7	.75
										6SR7GT	.85
										6SS7	.95
										6ST7	1.10
										6SU7GTY	2.15
										6SV7	1.25
										6T7G	1.20
										6T8	1.18
										6U5G	.95
										6U6GT	.98
										6U7G	.59
										6V6	1.55
										6V6GT	.89
										6W5	.85
										6W7G	1.05
										6X4	.73
										6X5GT	.75
										6Y6G	.98
										6Y7G	1.25
										6ZY5G	.89
										7A4/XXI	.79
										7A5	.89
										7A6	.85
										7A7	.85
										7A8	.89
										7AG7	1.05
										7B4	.85
										7B5	.85
										7B6	.85
										7B7	.85
										7C4	.79
										7C5	.85
										7C6	.85
										7C7	.85
										7E5	.75
										7E6	.59
										7E7	.89
										7F7	.85
										7H7	.85
										7K7	1.20
										7L7	.98
										7N7	.98
										7Q7	.83
										7R7	.95
										7S7	.98
										7V7	.95
										7W7	1.05
										7X7	1.10
										7Y4	.75
										7Z4	.85
										12A	.65
										12A6	.73
										12A7	1.05
										12A8GT	.79
										12AH7GT	1.27
										12AL5	.93
										12AT6	.73
										12AT7	1.25
										12AU6	.95
										12AU7	1.15
										12AV6	.73
										12BA6	.85
										12BE6	.87
										12C8	.79
										12F5GT	.79
										12H6	.82
										12J5GT	.55
										12J7GT	.82
										12K7GT	.79
										12K8	.89
										12Q7	.89
										12SF5	.89
										12SF5GT	.93
										12SC7	.99
										12SF5	.89
										12SF7	.89
										12SG7	.79
										12SH7	.73
										12SJ7	.79
										12SK7	.98
										12SL7	$1.05
										12SN7	.98
										12SQ7	.85
										12SR7	.85
										12Z3	.85
										14A4	.98
										14A7	.95
										14B6	.95
										14F7	.95
										14F8	.95
										14H7	.95
										14J7	.95
										14N7	.95
										14Q7	.95
										14R7	.95
										19	.69
										21A	.75
										25L6GT	.85
										25Z5	.79
										25Z6GT	1.05
										26	.50
										27	.49
										28D7	1.35
										30	.45
										31	.85
										32	.95
										32L7GT	.89
										33	.93
										34	.89
										35/51	.83
										35A5	.89
										35B5	.89
										35C5	.98
										35L6GT	.85
										35W4	.69
										35Y4	.75
										35Z3	.85
										35Z4	.73
										35Z5	.69
										36	.79
										37	.79
										38	.60
										39/44	.40
										41	.75
										42	.75
										43	.95
										45	.89
										45Z3	.89
										45Z5	.80
										46	.82
										47	.85
										48	.98
										49	.95
										50A5	.95
										50B5	.95
										50C5	.95
										50L6GT	.85
										50Y6	.85
										53	.98
										56	.65
										57	.80
										58	.85
										59	.95
										70L7	.95
										71A	.75
										75	1.25
										77	.55
										78	.60
										80	.79
										82	.73
										83	.89
										83V	1.15
										84/6Z4	1.15
										85	.85
										89Y	.89
										117L7/M7	.45
										117N7	1.35
										117P7	1.35
										117Z3	1.35
										117Z6	.89

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TCS Marine 2 Way Radio
TRC-1 Complete Antenna System.

AN/TPS-1 Search Radar

This is a Pack Portable Ground Search Radar for the detection of aircraft up to 100 miles. Range & Azimuth Data is displayed on a 7" P.P. 1 & a 5" scope. This set was called the G. I's Radar because of its ruggedness, dependability & ease of servicing, complete tech data is as follows: Power Output 150KW. P.R.F. 200 PPS, pulse width 2 microsec, beamwidth 3° horiz. 13° vert, power input 1100w. 115v 400 cyc & 27v DC. weight 1500 lbs. excellent condition.

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1E-19 Test Set for SCR522.
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rived from the receiver's sync separator. About 12 to 15 watts of power are required from the high-frenquency power amplifier and about 30 watts from the 500 cycle source. To insure positive running, a small d.c. bias is placed on the synchronous section to avoid flux reversal which would otherwise be caused by the a.c. excitation.

It was found that the motor operating the slow-speed vertical scanner could be run from the square waveform furnished by a multivibrator or from pulses. The multivibrator is synchronized by 60-cycle vertical pulses from the receiver and its output is stepped up by a 50 watt power amplifier. Required running power is about 30 watts. At the start of the operation cycle the operator may bring both vertical and horizontal scanning in frame by depressing a push-button for each. The button opens the motor circuit and slows the motor down until the picture is correctly framed in each direction. A small cathode-ray monitor tube will be included in the theater unit since all circuits and controls will be within the main housing and the operator will not be able to see the picture from the front of the screen for tuning purposes.

Fig. 11 is a schematic diagram of the oscillator-modulator for the ultrasonic crystal. The 6V6GT at the left is the 18 mc. oscillator and the following 807 is the tuned, class B power amplifier. The amplifier is grid-modulated by the 807 modulator, which is preceded by a 6V6GT amplifier with plate peaking. The diode is a d.c. restorer. The 1000 ohm potentiometer adjusts the video input for 100% modulation. Output of the 18 mc. power amplifier is about 8 watts.

Fig. 1 is a photograph of the main scanner unit. This is a laboratory model on which production will be based, although the appearance may be changed somewhat. In Fig. 4 smoke from a cigarette was blown into the compartments so that the photograph would give good indication of the light paths. The light for this purpose was obtained from an old theater arc-lamp

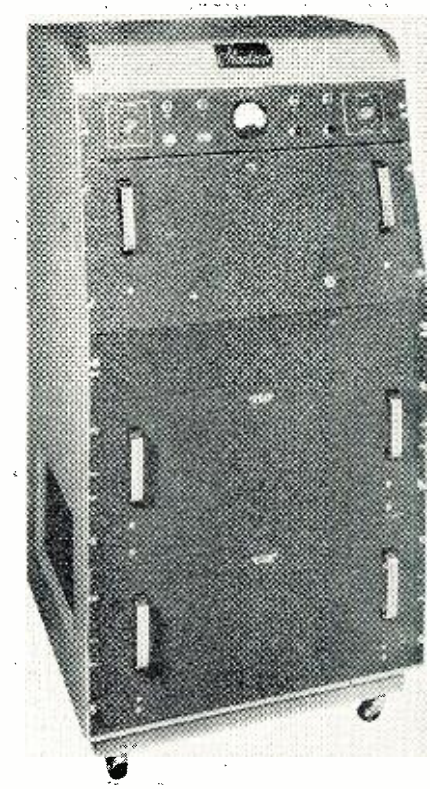


Fig. 10. Console unit used for theater TV.

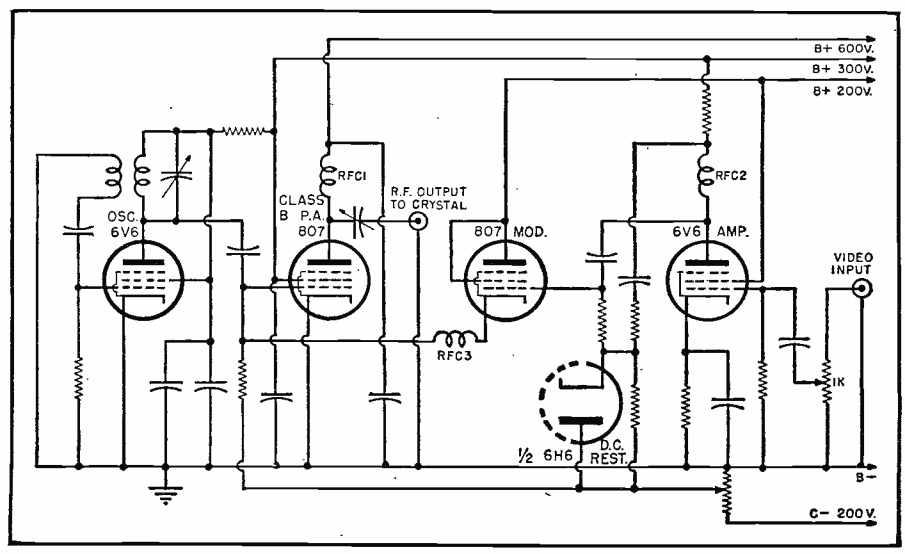
unit used in the past for experimentation.

Fig. 5 is a photo of two of the ultrasonic cells. The one at left is complete with lenses and liquid. The one at right is empty but shows how the lenses are set in place. The crystal is mounted in a hole in the bottom of the cell, with leads emerging from the underside.

Color Adaptation

One of the great advantages of the *Skiatron* projection television system is the fact that it is the only projection system which can be readily and inexpensively adapted for field-sequential color reception. The only changes required are those necessary in the

Fig. 11. Schematic diagram of the oscillator-modulator for the ultrasonic crystal.



cheapest and smallest home receivers —change in scanning frequencies and addition of a synchronized color wheel.

The color wheel is the stumbling block in other methods of color reception. With the cathode-ray projectors using the Schmidt-type optical system the aperture is so large that a color wheel would have to assume unwieldy proportions. With the intermediate-film process the wheel could be made small and placed somewhere in the light path, but there would be no way to synchronize it with the pictures being shown because of the time delay between reception and film showing.

With the *Skiatron* system, a wheel of extremely small dimensions is simply placed at any convenient point in the light path, as indicated in Fig. 7. It is a probability that in future models, there will not even be a need for an additional motor to turn the wheel, since it could be geared to the low-speed scanner motor, the arrangement both synchronizing the color and rotating the wheel. —30—

Picture Tubes

(*Continued from page* 39)

The previously fabricated electron gun is then sealed into the bulb by conventional glass working techniques as shown on this month's cover.

The tube is then sealed to the exhaust system for evacuation during which the air is removed, the cathode activated, and the gun parts outgassed at high temperature. A picture tube in a trolley exhaust machine is shown in the cover photograph. The metal parts are heated by using high frequency heating techniques. When the air pressure has been reduced to a very low value, on the order of one-billionth of atmospheric pressure, the tube is sealed off by heating the glass exhaust tube to the softening temperature so that it closes in as it is separated from the exhaust system. The "getters" are then flashed to reduce still further the pressure within the tube.

The finished tube is based and stabilized by aging it for a considerable time. It is then inspected for any mechanical defects and, if required, the graphited external conductive coating is applied to the conical part of the envelope.

Testing picture tubes, especially developmental models in the laboratory, is an extensive process. Many tests are necessary to determine the characteristics completely. Spot size, emission, gun characteristics, heater current, light output, screen color, and high voltage operation are but a few of the tests required for each tube. An accompanying photograph shows one of the standard methods used to measure the resolution at a number of points.

Refinements are constantly being made in the design of tubes and in the methods of measuring performance. It is only by this constant attention to design details that steady progress can be made in improving television reception in the home. —30—

Versatile Generator
(*Continued from page 46*)

ing control, the curves will be superimposed and the picture will look like Fig. 13B. When the time base generator is turned on, a picture like Fig. 13C will be seen. If the time base line does not run through the entire curve properly, then rotate the time base phasing control (Fig. 5) back and forth until it does. The sweep frequency generator is now operating properly and is ready for calibrating.

In order to calibrate the sweep generator easily and accurately, a calibrating detector is needed. Fig. 15 shows the circuit of a calibrating detector which can be built very simply on a breadboard and then later discarded. A single 12AX7 tube is used as a combination mixer and video amplifier. The high frequency response of the video amplifier is poor. This is desired in order to produce the diamond shaped "marking bug" that will appear on the oscilloscope screen. This "bug" is the beat frequency produced by the frequency meter and the sweep generator. The frequency meter is fed into the mixer grid and the output of the sweep generator is fed into the mixer cathode. Fig. 6 shows how the calibrating detector is connected to the sweep generator and the oscilloscope.

When calibrating, it is advisable to start with the low frequencies and then work up. Set the deviation control about one-half open. Starting with the frequency meter set at 5 mc., vary the band center dial on the sweep generator until a small diamond shaped bug appears on the CRT electronic baseline. (During the calibration procedure, the oscilloscope should have a cross section mask over the CRT.) By tuning the band center dial slowly, bring the diamond shaped marking bug underneath the center cross hairlines of the CRT mask (Fig. 16A). With a pencil, lightly spot the frequency of 5 mc. on the band center dial. Now, leaving everything set, tune the marker frequency dial over its low range (marker bandswitch set on position 1) until the intensity marker appears (Fig. 16B). Tune the marker dial until the marker slides into the center of the marking bug (Fig. 16C). With a pencil, spot the marker dial frequency for 5 mc. Repeat this procedure over the entire range of the sweep generator. Use intervals of .1 mc. on the marker dial up to 20 mc., .2 mc. intervals from 20 mc. to 30 mc.. and .5 mc. intervals from 30 mc. to 56 mc. The band center dial need only be calibrated at 5 mc. intervals over its entire range. Accuracy is not needed on this dial as that is the function of the marker frequency dial. After the band center dial and the marker frequency dial have both been marked off, carefully ink in the frequency calibrations with India ink. The sweep frequency generator is now completed and ready to work.

—30—

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Tube	Frq. Range	Pk. Pwr. Output
2J27	2965-2992 mc.	275 KW
2J31	2820-2860 mc.	285 KW
2J21-A	9345-9405 mc.	50 KW
2J22	3267-3333 mc.	265 KW
2J26	2992-3019 mc.	275 KW
2J32	2780-2820 mc.	285 KW
2J36 Pkg.	3249-3263 mc.	5 KW
2J39 Pkg.	3267-3333 mc.	87 KW
2J49	9000-9160 mc.	58 KW
2J61	3000-3100 mc.	35 KW
2J62	2914-3010 mc.	35 KW
3J31	24,000 mc.	50 KW
5J30		
718DY	2720-2890 mc.	250 KW
720BY	2800 mc.	1000 KW
725-A	9345-9405 mc.	50 KW
730-A	9345-9405 mc.	50 KW

700 A, B, C, D
706 AY, BY, DY, EY, FY, GY

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DM416	14	6.2	330	.170	RU 19
DM33A	28	7	540	.250	BC 456
DM42	14	46	515	.110	SCR 506
			1030	.050	
			2/8		
PE101C	13/26	12.6	400	.135	SCR 515
		6.3	800	.020	
BD AR 93	28	3.25	375	.150	
23356	27	1.75	285	.075	APN-1
35CO458	28	1.2	250	.060	
ZA-085	12/24	4/2	500	.050	
ZA-056	12/24	8/4	12/275	3/110	
B-19 Pack	12	9.4	275	.110	Mark II
			500	.050	
D-104	12		225	.100	
			440	.200	
DA-3A	28	10	300	.060	SCR 522
			150	.010	
			14.5	.5	
5053	28	1.4	250	.060	APN-1
PE73CM	28	19	1000	.350	BC 375
CW21AAX	13	12.6	400	.135	
	26	6.3	800	.020	
		9	1.12		
PE94	28	10	300	.200	SCR
			150	.010	522
			14.5	.5	

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1.5	1000	.85
2	1000	.90
4	1000	1.75
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1	1500	1.30
1.5	1500	1.40
2	1500	1.45
0.15	4000	1.20
2x0.1	4800	1.20
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FT-924	5.25V/21A, 2x7.75V/6.5A	17.95
FT-104	6V, 5A	4.79
FT-824	2x26V/2.5A, 16V/1A, 7.2V/7A, 6.4V/10A, 6.4V/2A	12.95
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STF-682	220	30-25-20V/1 MA	.69
STF-968	230	2.5V/6.5A	1.45
STF-405	230/115	5V 12/9A	2.95
STF-370	220/440	3 x 2.5V/57, 2.5V/15A, 5½ x 5 x 4½	5.25
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STF-631	230	2 x 5V/27A 2 x 5V/9A, 100/4H x 5 x 7 30 lbs.	24.95
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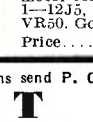

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Tetrad Co., Inc. 4921 Exposition Blvd., Los Angeles 16, California is currently offering copies of its new bulletin covering specialized electronic windings and transformers.

Known as Bulletin 951, the new publication illustrates and describes hermetically sealed miniature transformers, solenoids, radar deflection yokes, radar peaking coils, pulse transformers, universal windings, and television horizontal output transformers, TV focus coils, and radar tuning and peaking coils. Also shown are special coils which are available on a custom basis.

TRIAD BULLETIN

Triad Transformer Manufacturing Co., 2254 Sepulveda Blvd., Los Angeles 64, California has recently issued a new bulletin which highlights the current trend toward miniaturization and the elimination of weight in military equipment.

Bulletin 451 announces the addition of miniature transformers for portable equipment, voice frequency audio components, power transformers (combined plate and filament), filament transformers, and filter reactors.

Use of the 380-1500 cycle line frequencies for power equipment permits notable reduction in the size of transformers and reactors while new developments in core materials and new winding and impregnating techniques permit further reduction in size.

SAFETY RULES

Bud Radio, 2118 East 55th Street, Cleveland 3, Ohio is currently offering a two-color decal which carries the ARRL safety code covering the operation of ham transmitters.

This small decal may be mounted on any clean, flat surface of the rig. It will serve as a constant reminder to use care and common sense when working around the rig.

Copies of this decal may be obtained by sending a stamped, self-addressed envelope to Dept. RN of the company.

PLASTICS STANDARD

The National Electrical Manufacturers Association, 155 E. 44th Street, New York 17, New York has announced the availability of its new standard covering laminated thermosetting products.

Designated Publication No. LP1-1951, the new standard contains infor-

mation on the manufacture, testing, and performance of laminated thermosetting sheets, rods, and tubes. Data is given on paper, fabric, asbestos, glass, and nylon base grades, including three grades of engraving stock.

Specifically, the publication describes the grades and contains standards for form, color, finish, thickness, diameter, length, width, flexural strength, impact and bonding strength, water absorption, dielectric strength, dissipation factor, arc resistance, density, and compressive strength.

In addition, typical values are listed for physical and electrical properties.

Copies of this publication are $1.00 each and may be obtained direct from NEMA.

"FACTS ABOUT PLASTICS"

The Richardson Company, 2764 Lake Street, Melrose Park, Illinois has recently issued a new booklet explaining plastics in clear, non-technical language for the benefit of the layman.

This 24-page book, entitled "Facts About Plastics," is designed to give the layman a basic introduction to the many different plastics now in use, the various ways they are produced, and the uses of plastics in industrial and consumer products. The book is printed in two colors and is illustrated throughout.

Subjects covered include the history of plastics; plastics advantages and limitations; thermosetting and thermoplastic materials; how laminated and molded plastics are made; design suggestions; industrial and consumer applications; comparative properties of different grades; and the products, facilities, and services of the company.

Copies of this publication are available to those making their requests on company letterheads.

NEW G-E PUBLICATIONS

General Electric Company, Schenectady 5, New York has recently issued four new bulletins of interest to the electronics industry.

Bulletin GEC-808 is a two-color brochure on the company's "Tantalytic" condensers. It describes the features of the equipment, its application, and operation. The booklet is illustrated with photographs, line diagrams, and test data graphs. These units are designed for low-voltage, d.c. applications where very small size, light weight, and long operating and shelf life are major considerations.

The second booklet, GEC-809, describes the operation and features of the company's fixed paper dielectric condensers. Line drawings and charts showing the deratings for a.c. and d.c. applications are included in addition to photographs of the units.

GEA-5658 is the designation given to the third publication. This booklet covers metallic rectifier power conversion units and describes the features of the equipment, its application and operation. A specification guide for *G-E* d.c. power supplies and exciters is also included in this publication, as well as

complete rating charts and dimensions.

The fourth publication is entitled "Electronic Components, Equipment, and Allied Products for Communication and Industrial Applications." This 24-page catalogue lists a wide variety of component parts, equipment, and other necessary servicing and maintenance supplies. —30—

Crystal Diodes

(*Continued from page 62*)

pulses where the fraction of the pulse voltage appearing at the grid of the audio tube exceeds the voltage on the anode of CR_1, this crystal conducts and acts as a very low impedance component for the duration of the pulse.

It is, therefore, necessary that the diodes be connected in a bucking position as shown.

One of the virtues of these limiter circuits is that the limiter crystal may be switched in or out of the circuit at will. Where these circuits are used it is recommended that the components be mounted on a suitable strip or enclosed in a shield can to minimize hum pickup to which any limiter circuit is partial under certain conditions. The limiter circuit may be simplified with some loss in limiter action as indicated in the circuit shown in Fig. 8. This is an economical circuit; most of the components may be mounted inside the shield can.

Combination Circuits

It is possible to combine the functions of second detector, a.v.c., and noise limiter in one master circuit, as shown in Fig. 9. The 1N34, or 1N48 does double duty as both second detector and a.v.c., and the 1N54's or 1N65's make effective limiters under conditions that might make satisfactory reception difficult. Fig. 10 is a simplified circuit which does substantially the same job of limiting with but two crystals. The circuit shown in Fig. 7 is probably the most satisfactory circuit for use with crystals since the demodulation, a.v.c., and noise limiter functions are performed separately. This is a fidelity circuit for those who want the best. The compound limiter is capable of achieving as much as 6 db improvement over the shunt or series type limiter; moreover the compound limiter produces materially better limiting action at low signal levels.

(*To be continued*)

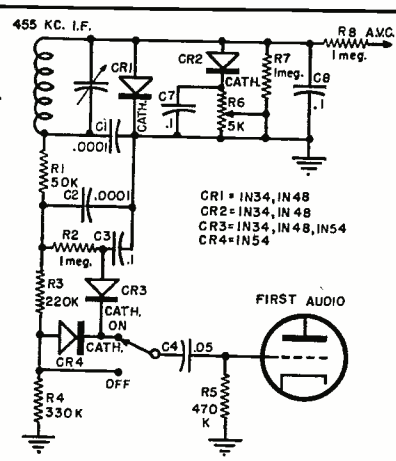

Fig. 7. Schematic of a combination second detector, an a.v.c., and a noise limiter.

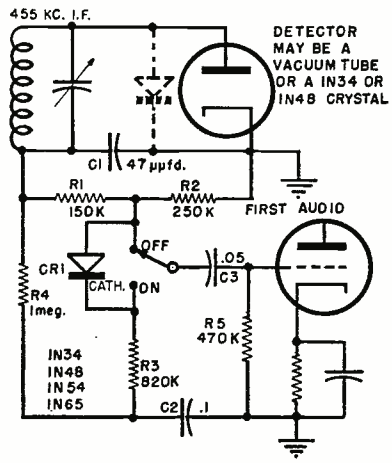

Fig. 8. Simplified series gate noise limiter. Limiting may be improved by varying R_1 downward and R_2 upward. R_1 may be 150,000 ohms to 250,000 ohms while R_2 may be between 250,000 and 470,000 ohms.

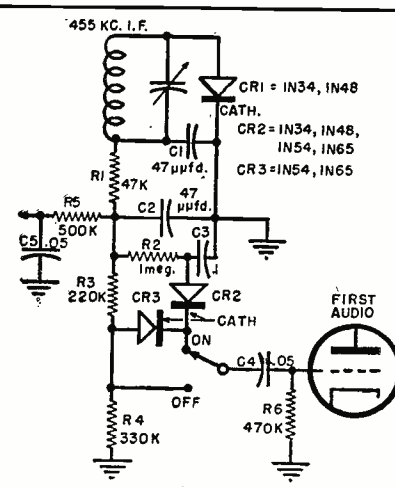

Fig. 9. Combination second detector, a.v.c. and noise limiter. The limiting level decreases as R_3 is made smaller with respect to R_4. The ratio of these resistors should be adjusted for effective limiting with a minimum of audio distortion in circuit.

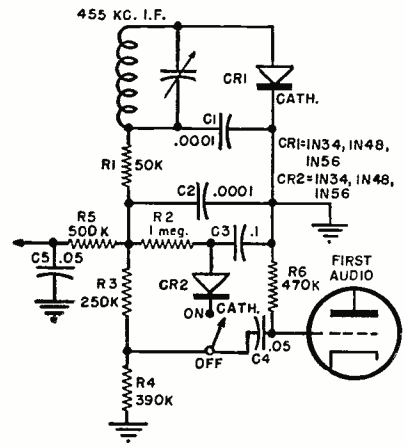

Fig. 10. Simple detector, a.v.c., limiter.

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MN-26C—Remotely controlled commercial type navigation receiver. Freq. range 150 to 1500 KC in three bands. Has twelve 6 volt tubes, 24 V dynamotor and band switch motor, NEW **$39.95**

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Plugs, set of three, New 3.75
Manual, covering complete set, New 1.95

SCR 508 EQUIPMENT

BC 603 Receiver L/dyn	$24.95	Exc. Used
BC 604 Transmitter L/dyn	12.95	Exc. Used
BC 605 Amplifier L/dyn	4.95	New
BC 606 Control Box	.95	Exc. Used
FT 237 Mounting	9.95	Exc. Used
MP 48 Mast Base	2.95	Exc. Used
DM 34, Dynamotor	10.95	Exc. Used
DM 35, Dynamotor	14.95	Exc. Used
DM 36, Dynamotor	10.95	Exc. Used
DM 37, Dynamotor	14.95	Exc. Used
TM 11-600 Tech Manual	1.95	
Crystals, Set of 80	19.95	

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20 pounds assorted radio parts. A real value at... **$1.95**

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CPR-46 ACJ Receiver—509 to 556 mc, new with tubes $29.50
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BC 442 Less Condenser	1.49	1.95
APS 13 UHF Antenna, Pair		.98
I-97 Bias Meter	3.95	4.95
RL 42 Antenna Gearbox Motor and Reel	4.95	7.50
Circuit Breaker 40 Amps		.59
Collins VFO Dial—5 calibrated ham bands from 3.2 Mc to 32 Mc; complete with pointer, gears, logging dial and flywheel. Scale 6" on 8" plate, each		.95
I 82 F Five Inch 360 degree compass indicator and Selsyn receiver		4.95
A-81-2 Transmitters Selsyn for I82 indicator (both I82F & Trans. Selsyn for $7.00)		2.45
PE-101 Dynamotor		2.75
Model 507, Thermal-converter Weston Type D, range .12 amp		.59
BC-1023 Marker Beacon Receiver, complete with tubes, shock mount and instruction manual		9.95
BC-924 27-38 MC. FM Transmitter, complete with tubes	19.95	
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BC-610 10 meter modification kit		3.95
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9 mfd. 90 VAC, 400 CPS, 3 phase Delta GE Pyranol ..... **98c** ea.

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T-21 ARC 5, 5.3-7 mc transmitter	7.95	11.95
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MC-215 Mechanical Drive Shaft, per length		2.45
BC-450 3 Receiver Remote Control		1.95
BC-451 Transmitter Control Box	.69	1.50
BC-442 Antenna Relay, complete		2.95
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1A6	1G1	10Y	49	
1B4P	1G6GT	15R	CRP 72	
1B5/255	1H4G	19	843	
1C6	1H6G	30 spec.	954	

49¢

0Z4A	6J7G	6Z7G	12F5	12J5GT	211
2V3G	6T7G	12A6	12H6	77	957

69¢

CK1005	2X2	6L7G	6ST7	705 A
1A5GT	6J5GT	6R7GT	6W7G	

89¢

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1B32	2A4G	6AL5	6SH7	1613
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Wireless "Tele-Patch"

(*Continued from page 65*)

Before trying to operate this or any other telephone patch, it is necessary to check all receiver and transmitter bonding and grounding. This is something that should have been done when the rig was built—but since it rarely is—now is the time to do it. With a telephone patch this is a "must." As far as possible avoid common grounding leads by observing the principles shown in Fig. 6. The central grounding point, a relative ground as far as r.f. goes, may be at the speech amplifier or at the transmitter rack. A flat copper strip—about 1 inch of #20 gauge—is ideal although one can usually use whatever is at hand. Braid is suitable where there is to be a flexible lead. It is a good idea to use at least No. 12 stranded insulated wire, for convenience. Run all leads as directly as possible, grounding all of the radio equipment concerned.

It is recommended that the dual input preamplifier of the transmitter be built into the speech equipment so that the local or "Tele-Patch" microphone input may be balanced at proper levels and the incoming signal may be turned down quickly if required. One simple method for doing this is shown in Fig. 7. Here either input is adjustable without changing the setting of the other. In the W1DFS speech amplifier, separate tubes are used for each input stage with controls to provide the proper balance between this and the next speech stage, but this isn't necessary.

After completing the required speech amplifier changes and performing the necessary bonding and grounding, it is time to see if the received radio signals can be properly "piped" into the telephone lines. A couple of local hams were called on the landline and briefed as to what had to be done. It was necessary for them to listen on both local and DX signals in order to determine whether or not the quality was good and at the proper volume.

With the 1N34 and the *Weston* 507 used in the author's "Tele-Patch," audio peaks to half scale were good and loud, but not as loud as a strong voice close to the handset mike. Thus, it appeared that at this level there is little chance for crosstalk. In fact the ANB units do not seem to have enough

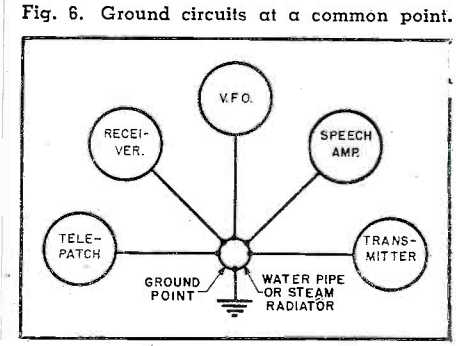


Fig. 6. Ground circuits at a common point.

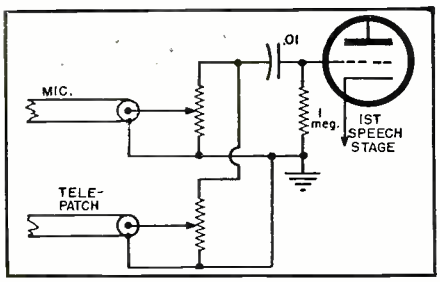


Fig. 7. Schematic diagram of a speech input that will provide proper gain balance.

speaker power to blast the telephone handset mike—but don't take any unnecessary chances.

After the receiver tests the transmitter was shifted to a dummy antenna and then to the live antenna to check for stray r.f. feedback and adequate modulation levels. The input from the ANB unit, used as a microphone, is considerably lower than the "local" microphone as the handset earpiece audio volume is not as strong as the voice. The "local" mike is another ANB unit with a similar transformer, mounted in a convenient case.

As a final check, a reasonably distant "Old Timer" was contacted by radio and "piped" through the "Tele-Patch" to another "Old Timer" on the telephone, both of whom could be relied upon for a candid and critical report. This and several other tests justified the author's belief that the voice quality was clean, clear, and adequate for any telephone patching that might be required.

The transmitter at W1DFS has but one master control switch circuit. This controls a three-pole master relay which shifts the receiver, transmitter, v.f.o., and antenna from "transmit" to "receive" by means of a simple toggle switch. In addition to the operating position at the control desk, a "lazy man's delight" is enjoyed at the couch where there is a second microphone and parallel toggle switch. After tuning the desired signal, it is possible to relax in solid comfort and operate in a "horizontal" position. This is a modern operating luxury. When using the "Tele-Patch," the operator's place is at the control desk so that he may correct the signal levels and stay on top of the controls.

Final Word of Caution

Like any other good thing, there are limits to the use of the "Tele-Patch." If hams abuse telephone patching we may lose the privilege of using it during emergencies.

It appears that these ANB units cannot overdrive the telephone handset but stray r.f. may get into the telephone lines, with or without the patch, or some other unforeseen trouble may arise. Amateur radio enjoys a cordial relationship with telephone companies—so let's keep it that way. Thus, after determining the proper working setting, the "Tele-Patch" should be set aside for emergency use and only brought out for occasional testing.

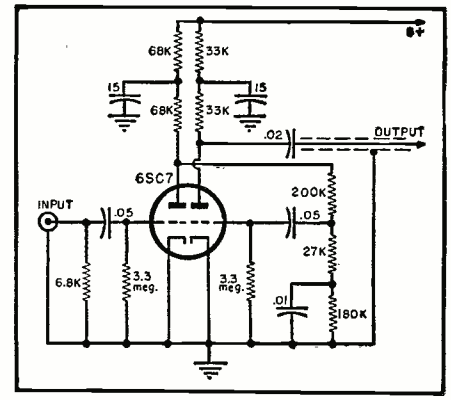
—30—

difference between the preamplifier requirements for magnetic microphones and for magnetic phonograph pickups, because of the frequency-response equalization with which the recording is made. A magnetic pickup has an output voltage proportional to the velocity with which the stylus moves, and since the recording is made with constant amplitude below the 500 cps crossover frequency, the output of a magnetic pickup will be deficient in low frequencies. This deficiency increases gradually from the crossover frequency until it is 15 db at 90 cps, and therefore must be compensated by an equalizer. This equalization is usually incorporated into the preamplifier as a bass-boost section.

Two different preamplifiers which have been designed for use with magnetic phonograph pickups are shown in Figs. 1, 5, 7, and 9. The unit of Figs. 5 and 7 is the original equalizer preamplifier which was designed for use with the *General Electric* variable-reluctance pickup. No input transformer is used in this unit, the pickup being terminated in the 6800 ohm input resistance, and its signal applied directly to the grid of the first tube. This first stage is one-half of a 6SC7 dual triode with a voltage gain of about 26 to 30 db. The three resistors, 200,000, 27,000, and 180,000 ohms, and the 0.01 μfd. condenser form a bass-boost circuit which gives a total boost of approximately 14 db at the low frequencies, with an insertion loss of 19 db. Further amplification is provided by the second triode section of the tube, which also provides a fairly low output impedance so that a shielded lead several feet long may be used for connecting to the main amplifier or to whatever other units follow in the system. This preamplifier has an over-all voltage gain of 35 to 40 db at 1000 cps, an output impedance of approximately 25,000 ohms, and when used with the variable-reluctance pickup will deliver a maximum signal up to 1 volt into a high impedance.

The preamplifier for the magnetic

Fig. 7. Schematic of General Electric's compensated preamplifier (see Fig. 5) used with variable reluctance pickups.



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Exceptional reception and tone. Nowhere else at this price! **$17.59**

Batteries, 1—67½V, 2—1½V flashlite cells. **$1.85**

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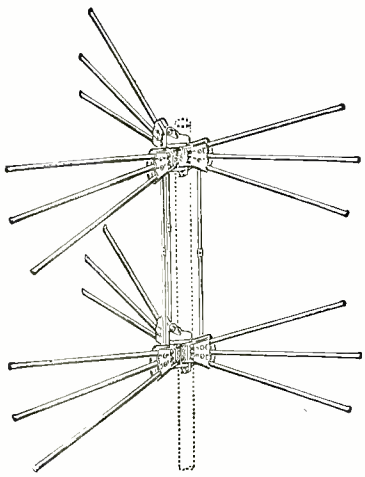

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COMPLETE....**$15.95**

SUPER SALE ITEM
ELECTRIC SOLDERING GUN

Best Made. 250 watt capacity. Heats in less than five seconds. Operates on 60 cy. 120V, AC. Trigger switch. No current or time wasted. **Lightweight.** Gives perfect balance and soldering ease. **Built-in Spotlight.** Compare this gun to any other on the market.

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Complete with nickel and brass tip.
Extra tips..... **15c**

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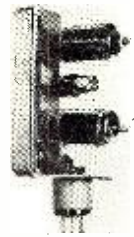

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- Fully concealed within set.
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- No wiring necessary—simple as removing a tube.
- Improves reception—increases video output at least 15%.

Just the thing for fringe area boost or in local areas where antennas are not allowed. PRICE.....**$9.95**

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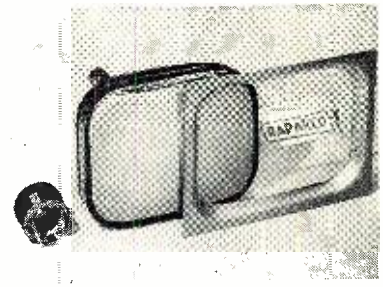

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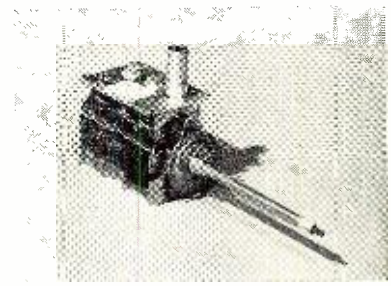

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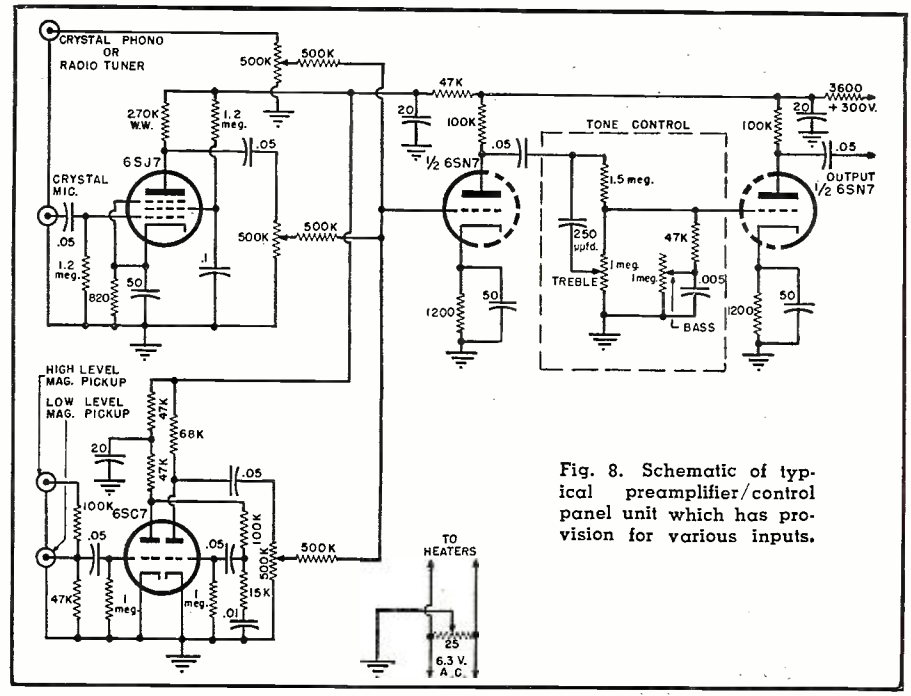


Fig. 8. Schematic of typical preamplifier/control panel unit which has provision for various inputs.

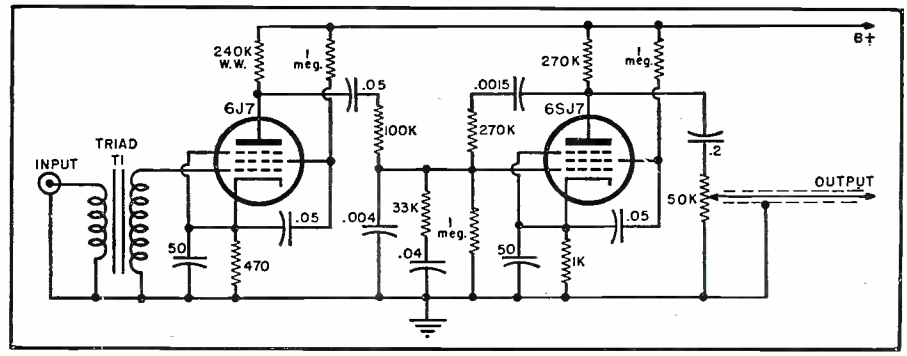
pickup may also be designed for an input transformer, such as the circuit shown in Fig. 9. In this unit the pickup is matched through the input transformer to the grid of the 6J7 preamplifier pentode. Since the voltage delivered by a magnetic pickup is considerably higher than the signal from a microphone, the 6J7 can be used instead of the 1620 tube which is preferred for microphone preamplifiers. At the output of the plate circuit of this amplifier tube, coupling this tube to the second amplifier tube grid is the frequency-response equalizer section which compensates for the recording frequency characteristic. This particular unit is designed to have a high-impedance output, therefore the second tube is also operated as a pentode. The plate circuit of this tube is operated into a 50,000 ohm potentiometer, which acts as the volume control. The output of either of the above preamplifiers can be applied directly to the "Phono" input of the average two-stage audio amplifier (such as the audio section of the average radio receiver).

In many sound reproduction setups it may be desirable to have several low-level input signals which are to be amplified and reproduced. The general setups of such systems already have been discussed in Part 2 (October, 1951). A single-unit control panel for such a system can be built using a multiple preamplifier unit containing the preamplifiers for the various inputs, and also the mixer and the tone control circuits. For example, it may be desired to have provision for inputs from

TYPE OF PICKUP	OUTPUT IMPEDANCE	OUTPUT LEVEL	FREQUENCY RANGE
Crystal	Approx. 1 megohm	Approx. 1 volt	50-8000 cps
Variable Reluctance	Approx. 300 ohms	.011 volt	40-10,000 cps
Pickering	Approx. 100 ohms	.011 volt	40-11,000 cps
Dynamic (moving coil)	50-100 ohms	Approx. .01 volt	30-10,000 cps
Strain gauge	Approx. 100 ohms	Approx. .005 volt	30-10,000 cps
"Radionic" (Zenith Cobra)	Uses special preamp	Approx. 1 volt after preamp	40-9000 cps
Frequency modulation	About 10 megohms, requires special preamp	Approx. 1 volt after preamp	30-12,000 cps

Table 2. Characteristics of various commercial-type phonograph pickup units.

Fig. 9. Preamp for magnetic pickup using input transformer for best signal-to-noise ratio.



microphone, radio tuner, and phonograph pickup. A typical setup of this sort may require, for example, one or more of any of the following:

(*a*) magnetic phonograph input,

(*b*) radio receiver or crystal phonograph pickup input,

(*c*) microphone input (high-impedance or low-impedance).

The schematic diagram of a preamplifier/control-panel unit which has provision for these different inputs is shown in Fig. 8.

This is a typical circuit which is representative of a number of multiple-input tone-control/preamplifier units which are commercially available at the present time. This particular circuit makes provision for simultaneous amplification of any or all of the previously mentioned types of input signals, with the level of each signal being controlled by an individual volume control, and the selection of the particular reproduced signal being made by setting of the volume control. This arrangement permits maximum flexibility in selecting either single or multiple inputs to be reproduced, but an alternative arrangement (when only reproduction of a single input at a time is desired) would be a multiple selector switch for selecting the particular input signal, with a single common volume control.

The input signal from crystal phonograph and from radio tuner or crystal phonograph pickup is applied directly without amplification to a volume control whose output goes into the resistive mixing network, since this signal level is relatively high—in the neighborhood of 1 volt peak. The microphone input channel makes provision for a high-impedance crystal microphone (with output of approximately 0.02 volt peak), since this is a common and inexpensive type of microphone for amateur sound reproduction which gives good results. The preamplifier tube for this high-impedance microphone channel is a 6SJ7 pentode (although a 1620 or 6J7 may be substituted to give a little better signal-to-noise ratio), giving a voltage gain of approximately 40 db to match the signal level in this channel to the level of the crystal phonograph and radio tuner channel. The magnetic phonograph pickup channel includes an equalizer preamplifier section similar to the *G-E* circuit of Fig. 7, which equalizes the bass response of the pickup and gives a voltage gain of 40 db at 1000 cps to match the signal level in this channel to the level in the other channels.

The signals from all the various channels are combined in the resistive mixer network, and the composite signal is amplified by one section of a 6SN7 medium-gain dual-triode tube. In the output circuit of this triode amplifier stage is the tone-control circuit. Any one of several different tone control circuits may be used. These circuits will be discussed in greater detail in a later article. A typical one is shown in this schematic, with an inser-

tion loss of about 20 db at 1000 cps and independently variable treble boost or attenuation, and bass boost up to about 15 db. The loss in this section is made up by the gain of the second triode section of the 6SN7, so that an output signal of about 1 volt peak is supplied to any high-impedance amplifier input. Thus, this preamplifier mixes the various input signals after amplifying the lowest levels to match the higher level inputs, permits variable tone control adjustments, and supplies a medium-level signal at an output impedance on the order of 25,000 to 50,000 ohms.

The hum-reducing and decoupling methods used to reduce hum and motorboating in this preamplifier are shown in the plate supply and heater circuits. Additional filtering is used in the "B+" supply to provide isolation between the various plate circuits, and for additional hum filtering in the power supply. (If a reasonably well-filtered voltage is available, only one section of filtering is necessary, otherwise two may be used.) In this unit, filaments are returned to ground through the variable hum-potentiometer, which is adjusted for minimum hum in the output. A lower hum voltage may be attained by the methods shown in Fig. 4 at the discretion of the individual experimenter.

Certain practices should be followed in the construction of the preamplifier to insure best operation and the least amount of noise and hum pickup. For minimum vibration pickup in the tubes due to shocks and vibration of the chassis, the lowest level tubes should be mounted on rubber so that they do not come into direct contact with the chassis. This may be accomplished by using small rubber shock mounts made for this purpose, or by use of small size soft rubber grommets to isolate the tube socket from both the chassis and the mounting screw. This method of mounting the first tube can be seen in the photographs of Figs. 2 and 5. Methods of minimizing a.c. hum pickup have already been discussed, and these methods should always be observed in construction. Input leads should always be shielded, and all leads carrying 60 cps currents should be kept as well separated as possible from the low-level portions of the circuit. The a.c. heater leads should be twisted to cause the least amount of hum induction into other leads. High-level signal leads should also be kept separated from the low-level sections, since any in-phase coupling between high-level and low-level signals results in positive feedback which produces a tendency toward instability and oscillation. The preamplifier unit as a whole should be removed as far as possible from any power supply or power amplifier sections, and metal shields may be used wherever necessary to reduce electrostatic or magnetic pickup.

The preamplifiers described in this article may be mounted separately from the voltage and power amplifier, or may be incorporated in its construc-

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1A5GT	.65	6AC7		6J7G	.79	7A8		12BH7	.87	35L6GT	.59
1A7	.79	6AG5	.95	6J8G	1.15	7B4		12C8	1.15	35W4	.45
1B3GT	.95	6AG7	1.15	6K5GT	.87	7B5	.65	12F5GT	65c	35Y4	59c
1B5	29c	6AH6	1.40	6K6GT	.59	7B6	.65	12H6		35Z3	
1C7G		6AK5		6K7GT	.79	7B7	.65	12J5GT	.54	35Z4GT	54c
1E7		6AK6	.87	6K8GT	.87	7B8	.65	12K7GT	.79	35Z5GT	
1H6		6AL5	72c	6L5G	.95	7C4	1.15	12Q7GT	.65	35Z6G	.95
1H5GT	.65	6AQ5		6L7	.87	7C5	65c	12S87GT	.95	35/51	.79
1H6G	$1.15	6AQ6	.65	6N6G	1.40	7C6		12SA7GT	.72	41	72c
1J5GT	.95	6AR5	.59	6N7GT	87c	7C7		12SC7	.79	42	
1L4	.29	6AT6	.54	6P5GT		7E6	.79	12SF5GT	72c	43	
1LA4	95c	6AS5	.72	6Q7GT	.65	7E7	.95	12SF7		45	
1LA6		6AU5GT	.95	6R7GT	.95	7F7	.79	12SH7GT	.79	45Z5GT	.59
1LC5		6AU6	59c	6S4	.65	7F8	1.15	12SJ7GT	.65	46	1.04
1LC6		6AV6		6S7GT	1.15	7G7	.95	12SK7GT	.72	47	.79
1LD5	.95	6B4G	1.15	6S8GT	.95	7H7	.72	12SL7GT	.87	50A5	
1LE3	.95	6B5		6SA7GT	72c	7J7		12SN7GT	.79	50B5	72c
1LH4	.95	6B6G	.79	6SC7		7K7	95c	12SQ7	.54	50C5	
1LN5	.95	6B8GT	1.15	6SD7GT	1.04	7L7		12SQ7GT	.59	50C6G	1.04
1N5GT	.72	6BA6	.65	6SF5	.59	7N7	.79	12SR7GT	.79	50L6GT	.59
1P5GT	95c	6BA7	.87	6SF5GT	.65	7Q7	.72	12Z3	.95	70L7GT	1.40
1Q5GT		6BC5	.72	6SF7	.72	7R7	.79	14A7	.79	50X6	.79
1R5	72c	6BC7	.79	6SH7GT	.79	7S7	95c	14AF7	.87	50Y6GT	.59
1S5		6BD5GT	1.15	6SJ7	65c	7V7		14B6	79c	50Y7GT	.72
1T4		6BE6	.65	6SJ7GT		7W7		14B8		71A	.87
1U4		6BF5	.79	6SK7GT	.72	7X6	.79	14C5	.95	75	72c
1U5	.65	6BF6	.59	6SL7GT	.87	7X7	.95	14C7	.87	77	
1X2A	.95	6BG6G	1.29	6SN7GT	.79	7Y4	65c	14F7	.79	78	
2A3	1.15	6BH6	72c	6SQ7	.54	7Z4		14F8	1.15	80	.45
2A5	.79	6BJ6		6SQ7GT	.59	12A7	1.15	19BG6G	2.15	85	.79
3LF4	.95	6BN6	1.15	6SR7GT	.65	12A8GT	.79	19T8	1.04	117L7	1.40
3Q4	.79	6BQ6		6SS7	.72	12AH7GT	.95	20	1.40	117N7GT	
3Q5GT	.87	6BQ7	1.58	6T7G	1.15	12AT6	.54	24A	.79	117P7GT	
3S4	72c	6C4		6T8		12AT7	1.04	25AC5GT	1.04	117Z3	.54
3V4		6C5GT	59c	6U5	.72	12AU6	.72	25BQ6GT	1.15	117Z6GT	.87
5T4	$1.40	6C6	.79	6U6GT	79c	12AU7	.65	25L6GT	.59	807	1.95
5U4G	.59	6C8G	1.15	6U7G		12AV6	.54	25W4GT	.72	813	9.95
5V4G	.87	6CB6	.72	6V6GT	.72	12AV7	1.15	25X5	1.04	1294	29c
5W4	59c	6CD6G	1.69	6W4GT	.65	12AW6	.95	25Z6GT	.79	1299	
5W4GT		6D6	.79	6X4	54c	12AX7	.87	32L7GT	1.15	1619	.45
5X4G	.65	6D8G	1.15	6X5GT		12BA6	.65	35A5	.59	1629	.29
5Y3GT	.45	6E5	.79	6Y6G	.87	12BA7	.87			2050	2.00
5Y4G	.54	6F5GT	59c	7A4	.72					2051	1.15
5X4G	65c	6F6GT		7A5	.79					7193	.87
5Z3		6F8G	1.15							VT51	29c
6A3	$1.15	6G6G	.95							VT52	
6A8GT	.79	6H6	.59								
6AB5/6N5	.95	6H6GT	.65								

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tion on the same chassis. This article has described the details of the design and construction of preamplifiers for the various types of pickup devices, and their matching to the various types of line and amplifier input circuits. The specific circuits which have been described are adequate for use with almost all types of audio reproducing systems. The voltage and power amplifiers with which these preamplifiers can be used will be described in future articles in this series.

(To be continued)

International Short-Wave

(*Continued from page 68*)

elected vice-president, Dan C. Ainsworth, Binghamton, N. Y., has declined to serve due to personal reasons; President Edward Broome has appointed Charles E. McCormick, Jr., to serve as second vice-president, and William McKenna, Big Flats, N. Y., to serve in the chaplain's office. (Boice, Conn.)

* * *

This Month's Schedules

(*NOTE:* At the time this was compiled, some stations were returning to *Winter Time;* in such cases, you may now find some schedules are *one hour later* than listed herein.—KRB)

Afghanistan — Radio Kabul, 9.975, noted 1145 with news; weekdays runs to around 1205 but on Sundays goes as late as 1220A. (Pearce, England)

Albania—Tirana, 7.852, still has news 1515-1630. (Pearce, England) *Radio Shkodra, Scutari,* is now operating on 8.215 at 0000-0100, 0700-0830 (Sun. 0600-0800), 1130-1600. *Radio Korca,* Korce, 7.570, is on the air 0000-0100, 0645-0900, 1145-1600; each has a power of 3 kw. (*Short Wave News,* London)

Andorra—"We have heard for the first time *English* announcements from Radio Andorra, 5.990, when at 1455 they were recently inviting tourists to visit this tiny country." (*Short Wave News,* London)

Anglo-Egyptian Sudan—Radio Omdurman verified and said is using 9.746, 5.975, and 572.5 kc., and added that is now *experimenting* on 17.900. Schedule was given—in Arabic all days of the week 2315-2345; all days *except* Friday 1130-1300; all days 1400-1430; Fridays 1130-1230, 0300-0430, 0900-1000; Sundays 0300-0400; in *English* on Fridays *only* 1230-1300. Station officials explained that during Ramadan, a holy month for the fast, the 2315-2345 transmission was suspended from June 5 to July 4. *Short Wave News,* London, says the 17.900 channel is used for the *English* period on Fridays 1230-1300.

Angola—CR6RN, 7.142, Luanda, Radio Clube de Angola, is heard in Sweden 1330-1445; CR6RJ, 9.7755, Sa da Bandeira, Radio Clube de Huila, is good level from around 1330. (*Nattugglan,* Sweden) Hannaford, South Africa, reports Radio Clube de Angola on 9.636 with musical program 0130, fine level. Ridgeway, South Africa, reports Luanda on 7.158 in parallel with 9.64 early afternoons. Bellington, N. Y., notes Angola on 9.705 to 1530 when closes

with "A Portuguesa." *Short Wave News*, London, lists this one as Radio Clube de Huambo, Nova Lisboa. Ridgeway, South Africa, flashes that Malange, 7.34, is good level 1300, closes 1500 with "A Portuguesa," CWQRM interferes sometimes; says another Angolan, 7.80, believed Luanda, is noted with weak signal from 1300.

Argentina—USA DX-ers report that SIRA at times recently has used the 100 kw. LRA transmitter on various 31-m. frequencies including 9.66 and 9.69. May have been *experimenting.*

Australia—Radio Australia recently effected this "summer" schedule—1950-2145, VLG15, 15.210, to Southeast Asia: 2159-2215, VLG15, 15.210, to New Guinea; 2145-2315 (Fri., Sat. from 2100), VLB21, 21.540, to Japan (on Fri. runs 2100-0230); 2145-2315 (Fri., Sat. 2100-2315), VLA15, 15.200, to Southeast Asia; 2145-0315 (Fri., Sat. 2100-0315), VLC17, 17.840, to South and Southeast Asia; 2330-0045, VLA15, 15.200, to West Coast North America, and VLB21, 21.540, to Africa; 0100-0145, VLA11, 11.760, in French for Europe, VLG15, 15.210, to French Indo-China; 0145-0315, VLB9, 9.580, and VLA11, 11.760, to British Isles and Europe; 0145-0215, VLG15, 15.210, to Southeast Asia; 0230-0330, VLG11, 11.810, to New Caledonia in French; 0328-0450, VLA11, 11.850, to Japan and Korea; 0328-0855, VLB9, 9.580, to Japan and Korea; 0328-0900, VLC15, 15.320, to South and Southeast Asia; 0345-0700, VLG11, 11.880, to China; 0500-0645, VLA11, 11.850, to Southeast Asia; 0700-0900, VLA11, 11.810, to Eastern North America; 0715-0830 (Sat. to 0900), VLG9, 9.540, to Southeast Asia; 0900-1000, VLC15, 15.320, to South and Southeast Asia and British Isles; 0900-1115, VLB9, 9.580, to South and Southeast Asia; 0900-1000, VLA11, 11.810, to Central and Mountain Zones of North America; 1000-1115, VLA11, 11.810, to West Coast North America; 1015-1115, VLC15, 15.200, to Africa; 1500-1655, VLC15, 15.200, to New Zealand; 1500-1800 (Sun. to 1815), VLA11, 11.710, to British Isles and Europe; 1530-1800 (Sun. to 1815), VLB15, 15.160, to Forces in Japan; 1715-1950 (Sat., Sun. to 2100), VLC17, 17.840, to South and Southeast Asia; 1815-1950 (Sat., Sun. to 2100), VLA15, 15.200, to Southeast Asia.

Austria—Innsbruck, 6.000, has been noted in Britain recently with good signals late mornings (*EST*). (*Short Wave News*, London)

Bechuanaland—Nattugglan, Sweden, reports Mafeking heard on 8.230 with good level in Sweden 1200-1430, best around 1300. Ridgeway, South Africa, lists frequency of ZNB as 8.245, heard from 1200; says signal deteriorates by 1300.

Belgian Congo—Ridgeway, South Africa, reports Leopoldville on 6.30 at 1330 in French; bad CWQRM.

Radio Congo Belge, Leopoldville, was noted recently down to approximately 9.390; had been on 9.400; opens 0000. (Stark, Texas)

Bolivia—La Paz, 9.497, noted eve-

nings to around 2115 sign-off. (Stark, Texas)

Brazil—Radio Borborema, Campina Grande, State of Paraiba, some 200 km. northwest of Recife, is a *new* station, noted *testing* on 3.325 at 1900-2100, sometimes 2200-2400; QRA is Radio Borborema, Rua Cardoso Vieira 36, Campina Grande, Paraiba, Brazil; power is 1 kw.; shortly will issue a QSL card. Other stations that will soon have QSL cards include ZYK-21, 3.265, *Radio Tamandare,* Recife, Pernambuco; ZYN6 and ZYN7, Ceara Radio Clube, Fortaleza, Ceara. PRF6, *Radio Bare,* Manaus, Amazonas, on 4.895, is heard after 2200 *testing* its new *Philips* 5 kw. transmitter. (Serrano, Brazil) The latter outlet also has been heard in California from around 2335 to as late as 0100. (Gay)

Radio Nacional, Rio de Janeiro, is now broadcasting over PRL7, 9.72, daily 0400-2310. PSL, 7.935, PSH, 10.220, and PSF, 14.690, can be heard weekdays 0700-0800, 1300-1400, 1600-1700 with news bulletins in Portuguese; 1715-1730 with music, and 1730-1800 with "A Voz do Brasil" program (relayed by all m.w. and s.w. stations); this program is produced by "Agencia Nacional," which is government-owned and operated. Reports may be written in any language. PSL, PSH, PSF are not owned by "Agencia Nacional" but by "Radio Internacional do Brasil," which maintains telephone and telegraph service on these channels and relays the "Agencia Nacional" program on the above schedules; it is only at those times that they serve as "broadcasting" stations. (Serrano, Brazil)

British Guiana—ZFY, 5.980, Georgetown, noted in New Zealand *testing* 0450 and signing on 0500. (Cushen)

British Somaliland—Dilg, Calif., says *Radio Somali,* 7.125, is again audible; fair level signing off 0930.

Bulgaria—Radio Sofia, 6.070, still has news 1500 and 1600. (Pearce, England)

Burma—When this was compiled, Dilg, Calif., was hearing Burma on a *new* channel of approximately 4.775 in *English* around 0915. Hannaford. South Africa, flashed that he had heard (on the 9.543 outlet) an announcement that Rangoon would be using 4.775 in parallel with 9.543. News is 1000, followed by program preview and closedown at 1015A.

Canada—VED, Edmonton, Alberta, appears to have moved from 8.265 to approximately 7.315; noted to 0205 sign-off. (Russell, Rosenauer, Calif.; Bellington, N. Y., others)

CFRX, 6.070, Toronto, Ontario, is on the air Sundays 0715-0000; weekdays 0500-0005; sent nice QSL from *Rogers Broadcasting Co., Ltd.,* 37 West Bloor St., Toronto, Ontario, Canada. (Bruner, Ohio)

CBNX, 5.975, St. John's Newfoundland, is seldom heard in New Zealand, but was noted recently signing on 0500 with anthem and morning music. (Cushen)

Ceylon—According to the *N.Z. DX Times,* Radio Ceylon's Commercial Service is now heard on 3.400 to 1145 sign-off. Ridgeway, South Africa, reports Radio Ceylon, 7.190, in parallel with 9.51 and 11.975 at 1000 and to 1145 closedown; the 17.830 outlet noted 0445. Stein, Calif., says the 11.975 outlet is good to 1145 closedown.

Chile—Serrano, Brazil, reports an unidentified Chilean station closing down 2200 on 6.045, with strong QRM from WABC on 6.04; has news in Spanish 2130.

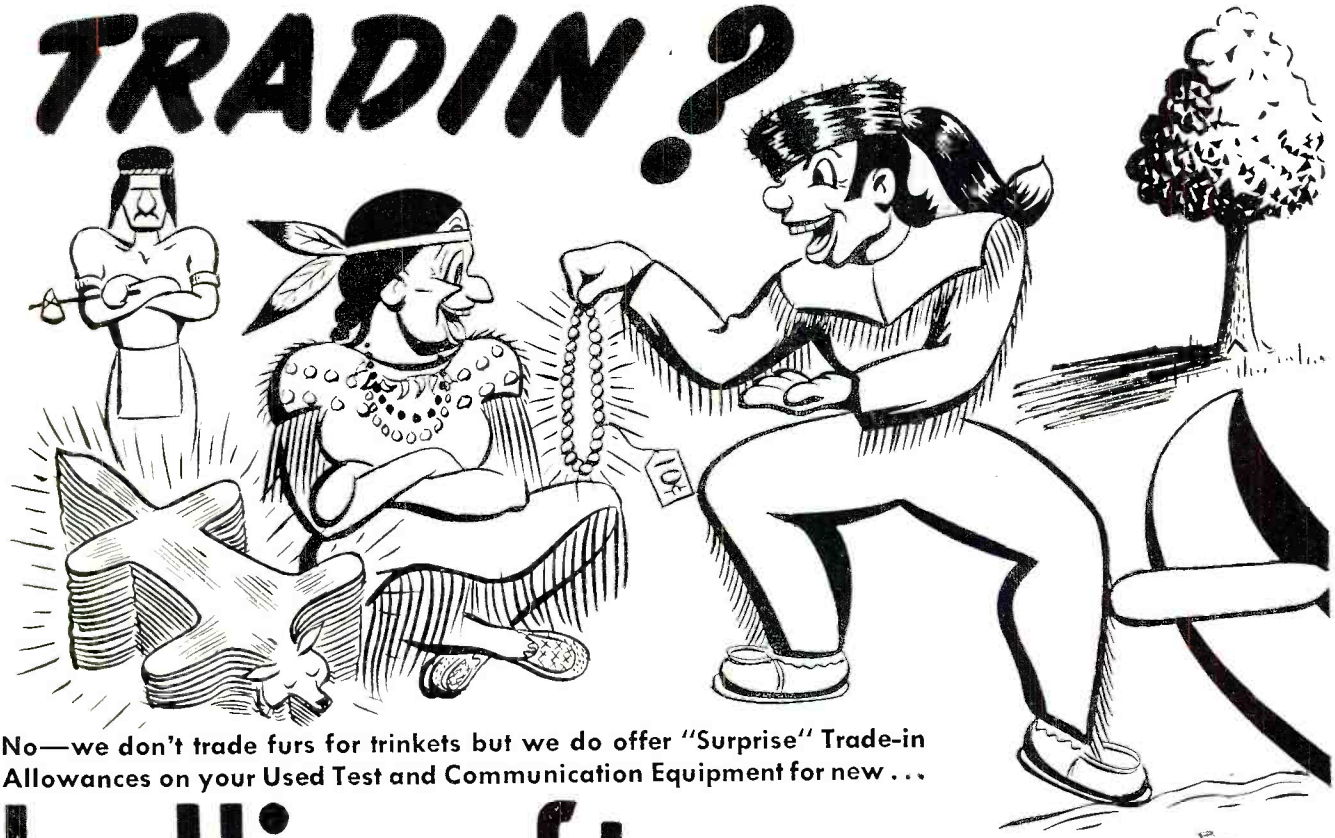
China—Radio Hsin-Hua, 7.100, Harbin, Manchuria, is heard in Sweden 0925 through CWQRM and with QSB. (*Nattugglan,* Sweden)

Dilg, Calif., says the Chinese newscast from *Radio Peking,* relayed by many Chinese Communist outlets, now appears to be at 0700 instead of (former) 0800.

Colombia—HJDE, 6.145, Medellin, "La Voz de Antioquia," noted 2330-0000 sign-off; all Latin-American music with announcements in Spanish; excellent signal. HJFB, 6.225, Manizales, noted 2246-2300 when closed with Co-

Representatives of the various member-chapters of the Federation of the Radio Servicemen's Association of Pa. who attended the annual Clam Bake held by the Radio Servicemen's Association of Luzerne County (Wilkes Barre) at Lily Lake. The group spent a large part of the day discussing Federation business and policies.

TRADIN'?



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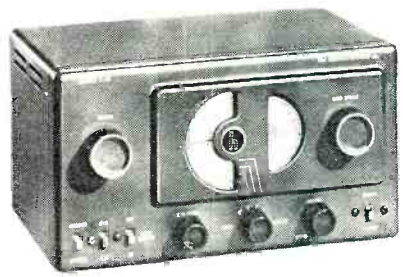

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lombian National Anthem. (Patterson, Ga.)

Costa Rica—TIHH, 11.972, San Jose, noted 2230-2243; all-Spanish. (Patterson, Ga.) A station on 6.152 was heard recently identifying 2035 as TIRH, Radio El Mundo, San Jose; usually signs off 2300. (Stark, Texas)

Cuba—Hoogerheide, Wis., reports *Radio Suaritas,* Havana, spotted on approximately 9.900 around 2200.

Czechoslovakia—Prague noted recently ending *English* period 2000 on its 9.55 outlet; measured 9.54943. (Russell, Calif.) Heard with *English* 1430 and 1600 on 9.55 and 11.875. (Ridgeway, South Africa) Noted more recently with *English* 1400-1430 and 1600 on 6.135; and with *English* 0715 on 11.840 in parallel with 15.320. (Pearce, England)

Denmark—WRH Bulletin says the *new* broadcast from Copenhagen beamed to India-Malaya on Tue., Sat. is now over 15.320 at 0800-0900.

Dominican Republic—HI1Z, 6.112, Cuidad Trujillo, noted 2000-2130. (Hoogerheide, Wis.)

Dutch New Guinea—Hollandia radio officials inform Rosenauer, Calif., that the station is operating currently on 7.1266 at 0415-0630 daily and with an additional period on Sundays 0200-0400; signs on daily with "Washington Post March," off with Dutch National Anthem; news in Dutch daily 0615. Said, "reports from foreign listeners are highly appreciated and are answered by personal letter. Return postage is welcome but not required. Our new installations are still under construction. In the near future, extension of power and broadcasting hours is to be expected." Power output at present is 500 watts. Particularly requested reports on the Sunday 0200-0400 transmission; if possible, wants comparison with regular daily transmission 0415-0630; said no foreign listener had yet reported this transmission and that the first one to do so will receive a "special" verification letter.

Ecuador—According to a *WRH Bulletin,* HC6GY, *Radio Luz,* Ambato, operates on 5.990 daily at 1000-1300, 1400-1700; announcements are in Spanish and *English.*

HC4CF, 4.930, Casilla 67, Quito, verified by airmail; uses 1 kw.; operates 0630-0800, 1300-1500, 1800-2215. *(N.Z. DX Times)* Is often buried by HJAP, Cartegena, Colombia, which often runs to 2250 sign-off. (Stark, Texas) HC1FM, 6.185, Ibarra, *Radio Equinocial,* recently noted signing off 2130; at times has been heard as late as 2300. (Stark, Texas)

Egypt—Ridgeway, South Africa, flashes that SUV, 9.985V, Cairo, has news, commentaries, and occasional request recordings in a daily *English* session which opens 1145 and ends 1200A; opens with "Toreador Song" from Carmen; re-opens around 1230 in French, and leaves the air 1500A.

Ethiopia—Radio Addis Ababa, ETA, 9.624, has good signal in South Africa around 1045; on Mon., Wed., Thur., Sun. has "Voice of the Evangelical,"

religious program in *English* 1100-1130, sponsored by the Sudan Interior Mission; on Wed. has *English* commentaries 1045-1100; jamming usually starts 1130 and is not heard well onwards. (Ridgeway)

France—Paris, 15.24, noted around 1600 with music; commentary in French 1615. (Russell, Calif.)

French Equatorial Africa—Radio Chad, 15.596A, noted afternoons in South Africa; announces "Houna Radio Chad." (Hannaford) Ridgeway, South Africa, says *Radio Chad* now opens 0030 on Brazzaville's frenquency of 15.596, and that the channel is used by Brazzaville for its mid-day (local time) session; *Radio Chad* closes first session 0130 but interval signal (reed instrument) continues to 0145 when further session (may be different dialect) comes on the air; signal fades after 0200; strong 0100.

French West Africa—Radio Dakar noted on 11.896 at 1400 with *English* news; strong signal, in clear. (Hannaford, South Africa) Heard with interval on 15.346 at 1405 and signing on 1410; headline news in French 1425. QSL card lists scheduled on 15.346 as 1410-1600; 11.896 at 0200-0320, 0700-0830, 1245-1800. (Pearce, England)

Germany—RIAS, 6.002, Berlin, noted from 2200 sign-on to as late as 0400; carries all-German programs. (Saylor, Va.) Osterloog (Hamburg) noted fair level 0000 but with sideband interference from London; is buried by "Voice of America" at 0100. (Cushen, N. Z.)

Pearce, England, has received word from officials of *Radio Free Europe* that the 11.735 channel he heard is *used only point-to-point* for relays between various *RFE* stations in Europe. A letter to Pearce from H.Q. American Forces Network, APO 757, % Postmaster, New York, New York, says 5.470 is used for relaying AFN programs to various AFN transmitters "within" Germany; no schedules were given.

Gold Coast—ZOY, 4.915, Accra, is heard best around 1215-1300. (*Short Wave News*, London) Best months to try for this one are November through February.

Greece—Athens seems to have moved from 11.718 to 9.607 where opens 2000 to North America. (Bellington, N. Y.) And now uses 9.607 for *English* at 1430. Although some time ago, Greek Armed Forces Station, 6.330, Athens, announced *English* for Mondays 1630-1700, *English* has not been heard lately at that time. (Pearce, England)

Greenland—Godthaab, 7.552, noted 1700-1745, mostly with music. (*Nattugglan*, Sweden)

Guatemala—TG2, 6.620, Guatemala City, noted at fair level with Spanish news 2000-2030, then classical music. (Hoogerheide, Wis.) TGNA's *new* 11.85 outlet, used parallel 9.668 around 2200-2230 for *English* broadcasts, is reported at fine level in most parts of the USA.

TGWA, 9.758, sometimes has *English* around 2015-2030. (Bellington, N. Y.)

Haiti—4VN, 6.013, comes in fine from

around 2015-2135 sign-off; all-French; many commercials; uses American records a great deal; announces "Radio Haiti." (Saylor, Va.) 4VEH, Cap-Haitien, 9.710, noted signing off 2100. (Nichols, W. Va.) Has strong signal mornings, usually with *English* programs from 0600 or 0700.

Holland—Current schedules for *English* transmissions from *Radio Nederlands* are *weekdays only* 0530-0610 to Australia, New Zealand, and Pacific Area, 21.480, 17.775, 15.22, 6.025; 1100-1140 to South Asia, 11.73, 9.59, 6.025; 1500-1540 to Africa, Great Britain, Ireland, and Continental Europe, 11.73, 9.59, 6.025; and 2130-2310 to the USA-Canada, 9.59, 6.025. "Happy Station Programs" are listed for Sundays *only* 0530-0700, 21.48, 17.775, 15.22, 6.025, to the Far East, the Pacific Area, and Europe; 1100-1230, 11.73, 9.59, 6.025, to the Near and Middle East and Europe; 1630-1800, 11.73, 9.59, 6.025, to South and Central America, and 2130-2300, 9.59, 6.025, to North America.

Honduras—HROW, 6.675, Tegucigalpa, logged 2223-2237 with all-Spanish program. (Patterson, Ga.) Tegucigalpa, 6.410, no longer gives call letters but announces as "Radio America"; noted evenings. (Stark, Texas)

Hong Kong—ZBW3, 9.525, noted with BBC news relay 0600, fair signal; Chinese program follows. (Dary, Kans.)

India—AIR, 9.757, signs off 1930. (Bellington, N. Y.) Pearce, England, reports AIR around 5.990 from around 1200; says when Andorra signs on 1300, AIR still can be heard in background. Rosenauer, Calif., lists AIR on 5.970 from 0815 tune-in to 0915 sign-off; all-native; after short pause has tuning signal to 0930 when re-opens with program in native language; still on 0945 tune-out; best 0815-0915.

Calcutta, 4.880, opens 0815, fairly good signal in Calif. (Dilg) VUB2, 4.840, Bombay, noted in native signing off 1230. (Pearce, England)

Indo-China (Vietnam)—Dary, Kans., reports "Voice of Vietnam" on 7.090A around 0730-0900 sign-off; has *English* 0800-0830 and may continue with *English* to 0900, not certain.

The Indo-China station on 7.227 still closes around 0945. (Stark, Texas)

Radio France-Asie, Saigon, lists *English* transmissions as French by Radio, 0515, on 11.830, and 0800 on 11.830; general news in *English* 1730-1745 on 9.524; 1900-1915 on 9.754; 2030-2045 on 9.754 and *testing* on 11.830; 0900-0915 on 11.830. *(United 49'ers)* Should have *English* news also 0500.—KRB.

Iraq—Baghdad, 11.724, has Arabic chanting from around 2302-2330, then news in Arabic; 2345-0010 Western music, followed by Arabic music. (Bellington, N. Y.) Signs on 2300 and is best Sat., Sun., when Canada is not using 11.72 at 2300. Pearce, England, says usually has *English* news 1415 and closes around 1500.

Israel—"Yalei-Zahal," 4X43A, 6.725, Tel-Aviv, is heard 1330-1400 with recordings. (*Nattugglan,* Sweden) Although "Kol-Yisrael, 9.010A, Tel-Aviv, is scheduled to sign-off 1700 at end of *English* session, lately has been noted as late as 1825 with religious (native) broadcast. (Bellington, N. Y.) When this was compiled, the 6.83 and 9.010A outlets still had news 1415, but by now may be on winter schedule of 1515.

Italy—Rome has *English* now 1350 on 6.010, 11.810. (Radio Sweden) Is also noted then on 9.575. (Pearce, England) Heard with news 1900-1915 on 9.575. (Dary, Kans.)

Japan—Tokyo on 6.015 does not give location when announcing in *English* 0800; announces "This is the Voice of the United Nations Command Calling the Peoples of Korea" (sometimes "calling the Forces of Korea.") (Rosenauer, Calif.) Cushen, N. Z. says the "United Nations Command" broadcast is now heard daily 0600-0900, using transmitters of the Broadcasting Corporation of Japan, with programs in Korean and Chinese for the North Korean (Communist) Forces; the UN Command Radio also has programs relayed by the Korean Broadcasting System, Seoul; transmitters in Japan are JKK, 6.015; JBD, 9.505; JBD2, 9.560; JKH, 7.257, as well as 14 m.w. outlets. Time may now be 0700-1000 since Japan is now back on winter time.—KRB.

The Far East Network (AFRS), Tokyo, is now operating with *all-English* programs 1600-0300 on 9.605 and 11.825; 0345-1000 on 4.860, 6.175; news 1630, 1700, 1755, 2000, 2230, 0100, 0400, 0555, 0700, 0800, 0900, 0955. *(WRH Bulletin)*

Gay, Calif., notes a Japanese outlet on approximately 6.000 in parallel with 4.95A carrying *English* language lesson daily 0400-0415; poor signal on both channels.

Kashmir—Nattugglan, Sweden, reports Srinagar on 4.860 to 1200 sign-off. The *Indian Listener,* New Delhi, lists *Radio Kashmir* at 2130-2330 on 4.860; 0100-0230, 7.270; 0700-1200, 4.860; news 2130 and 1030.

Lebanon — Beirut, 8.036A, noted opening 2330 with march. (Bellington, N. Y.)

Liberia—ELBC, 6.025, Monrovia, continues to be heard in Eastern USA with fair to good signal from as early as 1700 to 1845A closedown; uses *English* and plays many American recordings.

Madagascar—Radio Tananarive is good level in South Africa 1210 on 3.240; slight CWQRM. (Hannaford) Ridgeway, South Africa, says Tanana-

(*Continued on page* 136)

Merry Christmas

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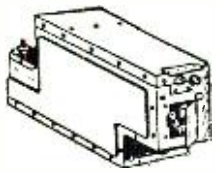

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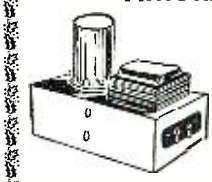

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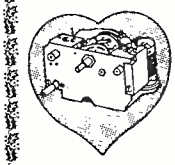

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Mobile Converter

(*Continued from page 51*)

gain is such that a wire scraped with a screwdriver, a few feet from the antenna, produces noise in the receiver at any dial setting, which we figured was about good enough.

The very low value of resistors shown in the screens and plates may lead to some question, but their values are sufficient, since only eighty volts are used (from the BC set) as "B-plus." This voltage is dropped to about fifty volts for the 6C4 oscillator, which results in almost complete freedom from warm-up drift. At no time in a month's operation has it been necessary to retune after a transmission to insure hearing the comeback in a QSO, irrespective of battery condition. The low oscillator voltage and lack of varying filament/cathode capacity due to the grounded cathodes, really is worthwhile.

As used, no switching is necessary, but a circuit is shown for those desiring such switching to a BC set. Primarily designed for mobile use, the little job is really hot ahead of a communications receiver, for fixed station use. It is particularly useful with surplus receivers, for extending coverage, or for some of the simpler receivers which do not employ a tuned r.f. stage. Its use with this last type, for ten meter reception, will be highly satisfactory. Filament and "B-plus" drain are very reasonable; "robbing" from any receiver is eminently practicable without overload.

Since so few parts are used, the condenser types specified are urged strongly. The cost is negligible and good performance is assured through their use as bypasses and blocking condensers. Cheaper types will save only pennies. As always, quality components pay off. Don't revise the circuit, and don't use inferior parts, and you'll have a converter that can't be touched by some costing triple the outlay entailed. Hope you enjoy building it as much as we did, and we're sure you'll enjoy operating it.

—30—

"A $500 dual speaker, a Williamson amplifier, a transcription turntable — and I hafta hear Beethoven through a tin horn!"

the ground return system used by street cars, power houses, pole transformers, etc. Consequently, if both ends of the shield are connected to ground at points *"x"* and *"y,"* any electrical currents which might be flowing through the ground at that point will have a path of very low resistance via the shield to the other end, then down the ground wire, and back to the starting point through the earth.

When an electric current flows through a conductor, magnetic lines of force are created which expand and contract about the conductor, if the current is an alternating one. If there is another conductor within the lines of force, they cut the second conductor and induce a current. This current will have a characteristic similar to the one inducing it.

This is precisely what happens when ground currents flow through a shield which is attached to the ground at more than one point. The result is that the audio current-carrying conductors within the shield have an additional voltage induced in them in the form of noise caused by oscillating ground currents flowing over the shield. These ground currents which are induced in the shield as a result of several grounds are known as "ground loops." The dotted lines indicate how these loops may develop.

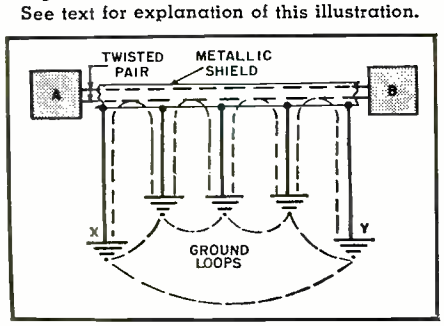
If the practice which is general throughout the radio industry is followed; namely, grounding at several points, it may readily be seen that each additional ground provides another path for the ground currents. The net result is that instead of helping the situation it is actually made worse. Therefore, the shield must be grounded only at one end and covered on the outside with an insulated covering to prevent ground loops.

If the transmission ground system is carefully adhered to, noise and hum pickup will be reduced to a minimum. This system also allows the ground to be "lifted" at a particular piece of equipment for testing.

The material contained in this article was supplied by and through the courtesy of Hollywood Technical Institute, 3359 Cahuenga Blvd., Hollywood, California.

(*To be continued*)

Fig. 8. How ground loops are created. See text for explanation of this illustration.



RADIO-TV Service Industry News

AS REPORTED BY THE TELEVISION TECHNICIANS LECTURE BUREAU

THE creation recently of the post of Service Manager by the Radio-Television Manufacturers Association and the appointment of E. W. Merriam, former chairman of the RTMA Service Committee, to fill it is a good development. It is concrete evidence of the industry's awakened consciousness of the needs of the independent service forces and a tangible step in helping to solve the problems that have bedeviled the independent service business men.

In a recent speech Glen McDaniel, president of RTMA, pointed out the reasons for the Association's move in creating this new department. Speaking of the flood of criticism that had been leveled at independent television servicing, he said, "there always have been some difficulties in the field, and all of you will recall the prewar crusades of newspapers and other publications—all media rivals, by the way—over incompetent and dishonest practices of a small minority of unscrupulous servicemen or dealers. So the outcry is not new; it's just louder. There are two reasons for this: (1) radio repairs seldom are as expensive as those on a TV receiver and (2) many persons are unable to detect faulty sound reproduction in a radio, whereas even a child can note distortions or other obvious faults in TV picture reception.

"While there are unquestionably some grounds for complaint on the part of the public, much of the criticism that has been directed against the servicing segment of our industry is unfair in that the entire industry is damned for the offenses of a very few. Moreover, many consumer complaints, when investigated, turn out to be unfounded and result chiefly from the complete technical mystery that a television receiver presents to the average owner.

"I believe the vast majority of TV service technicians are honest and that there are no more unscrupulous or dishonest operators in the TV servicing field than in any other similar occupation. And I also believe that the only way to control larceny in any form is to enforce existing laws which prohibit it. You do not make a thief honest merely by passing a new law compelling him to take out a license.

"TV set servicing has been handicapped from the beginning by a shortage of trained service technicians due to the newness of the art and its technical complexities. Yet the American public has taken this remarkable device into the home as casually as any of the relatively simple gadgets which make life more pleasant.

"The rapidity with which television has grown since World War II—despite a three-year-old 'freeze' on TV station construction—has made it difficult, if not impossible, for the industry to train servicemen as fast as set ownership has grown."

RTMA's Plans

One of Mr. Merriam's first jobs is to promote training courses for service technicians in the nation's trade and vocational schools. A recommended agenda for a training course was prepared by a sub-committee of the Service Committee and has been distributed among trade and vocational schools. A complete course is now in preparation.

It has been obvious for a long time that aggressive action was necessary to interest more and more people in television installation and service as a vocation if the industry is to capitalize on the growth that is being made possible through the rapidly expanding developments. The unavailability of trained or even semi-trained men has been a serious handicap to independent service operators everywhere.

The defense program has had a dual effect on the independent servicing forces. The draft is taking thousands of men who normally would be available for training and employment in installation and field service work. This has served to cut down the supply of men available for training and employment.

On the other hand, many of the best skilled technicians left the service field to take jobs in manufacturing plants to work on electronics equipment production or some other phases of the defense program. This "squeeze" has thrown the responsibility and especially in television installation and service, on the shoulders of a decreasing service force.

The action of RTMA in developing a program to encourage definitive

training in television installation and maintenance work in the trade and vocational schools is a move that should be supported whole-heartedly by every independent service operator in his local community. A vastly expanded pool of trainee technicians will be a "must" after the station construction freeze is lifted and u.h.f telecasts become available.

A Service Responsibility

When a manufacturer runs into a problem of shortages in skilled labor to handle his production requirements he sets to work to find out how they can handle the required production with the skilled men available. Time studies will sometimes disclose how man-hour production can be increased by changes in the production procedures. Or new tools may be developed that will increase the man-hour production.

This is the problem that faces the independent servicing industry—how to handle more installation and maintenance work with the skilled personnel available. Again, this will be especially true when the shackles of the "freeze" have been broken. It is entirely possible that out of necessity a highly efficient type of independent service business will come into being which will be capable of handling the expanding requirements of television installation, maintenance, and service satisfactorily with the trained personnel available.

Service as a Business

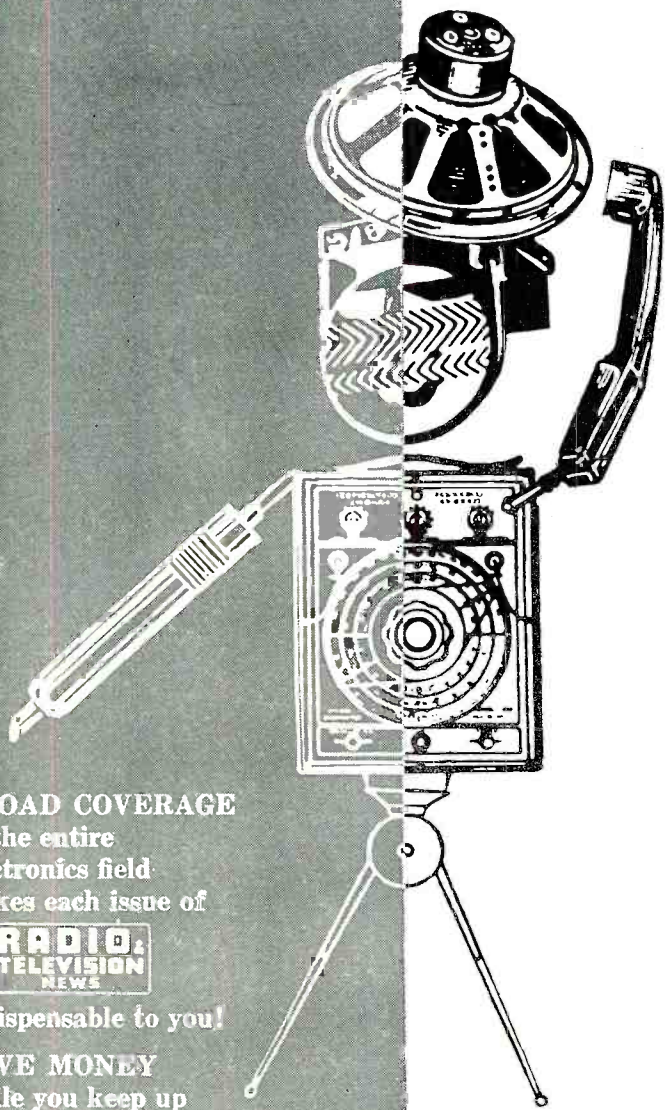
Many of the hundreds of readers who have written for a copy of the bulletin *"TV Service Business Management"* have asked what steps they should take to entrench themselves against the future competition of such organizations as *Western Union Services, Inc.*, or any other independent national servicing organization that may be started.

It has been pointed out on numerous occasions in this department that the two factors in which big business may be superior to small independent service operators will be in their *service selling* campaigns and in the maintenance of good customer relations.

Properly conducted service selling programs will provide a comparatively consistent volume of business. The basic weakness of independent service business has been in its drifting along with the industry's sales cycles without trying to find some way to cushion the regular periods of business slumps. Since the income of a service business is largely from the sale of labor or "time" these slumps force a drastic curtailment of trained service personnel. Then when service business climbs sharply and rapidly—as it always does after a bad slump—the shop is swamped and work lags far behind. This does not tend to create contented customers.

There is some parallel in the history of the automobile maintenance business. During the first twenty-five years

IN THE GREAT JANUARY ISSUE!



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of its existence the automobile industry worked on the theory that a service department should be operated on a "break-even" basis. Actually this meant that the departments were operated at a loss since any business that doesn't strive hard to make a profit from its services will most assuredly end up with a loss. Often times a business is lucky to break even when its management is using every possible means to make a profit.

The automobile industry was forced to do something about losses on service when the profits from car sales failed to support the sales establishments that had been created. Various types of maintenance campaigns were used, particularly to create business during the winter months which was the normal annual "slump" period in automobile maintenance and repair.

Someday we may create an effective summertime maintenance plan for radios, television, and other home electronics devices that will level out the slack period that each year leaves a large number of service businesses hanging precariously on the financial ropes.

Customer Relations

In order to get along well with your customers you have to be interested in them. Your customer is your employer —your boss—and when he spends money for maintenance or repair work on a radio or a television receiver he is probably using money that he would prefer to spend on something else. Consequently he isn't too happy about having to part with some of his earnings for the repair of something he owns.

The independent servicing industry is comprised almost entirely of men skilled in working with highly technical material and who are inclined to keep their minds focused on the technical aspects of their work. So when we are called to service a set we are inclined to completely overlook the customer who is our boss and concentrate our entire attention on the receiver to be fixed. In other words, we are prone to give the customer a "brush-off" when he asks questions. The results have been that independent servicers and the set users haven't gotten along too well.

Every technician in our industry would do well to read some of the excellent books available on the simple fundamentals of salesmanship. It is what we need most in the independent servicing industry—a better understanding of our customers and how to get along with them.

Efficient Business Operation

Since there is no indication that the technically-trained manpower shortages will be eased for a long time to come while the industry will probably continue to expand because the defense effort is expected to use a maximum of only 20% of the industry's productive capacity, there will be a strong trend toward the development of more efficient service businesses in order to

make the best use of the skilled technicians available.

We have been asked by many service shop operators about what steps they should take to put their own businesses on a more efficient operating basis. Since most service businesses are geared to the peculiar needs of the area where they are located and the type of service business they are handling it is impossible to offer anything other than general suggestions.

Service operators will do well to carefully appraise their present businesses with respect to:

(1) Study the layout of your shop and the way you are handling "in shop" service and bench work for more efficient and time-saving ways of doing the work. Test equipment should be readily accessible to every bench position. Means for checking test instruments for accuracy each morning should be available for quick use. This will take the guesswork out of test instrument accuracy.

Parts and supplies should be racked and plainly marked to eliminate time wasted looking for correct value components.

(2) Make a careful appraisal of your customer relations in both face-to-face and telephone contacts.

(3) Talk to your parts distributor about a "sales promotion" system that will fit your budget but which will be carried out with clock-like regularity.

(4) Are you making home service calls on a "hit-or-miss" basis or do you have a system that provides for minimum transit time between calls?

(5) Does your accounting system provide you with an accurate picture of your business at all times?

Failure to properly *manage* their shops has cost independent service operators more money than any other single loss factor in the business. The old radio cabinets, chassis, and other junk that accumulate in the average shop are not only an eyesore but also a serious handicap to the orderly handling of service jobs in the shop. It is almost a universal failing of the independent service industry to hang onto discarded cabinets and chassis, probably with the hope of finding time to fix them up some day and get a few dollars out of them. The wisest course is to dispose of them as fast as they come in and keep the shop clear for current service work.

Improperly planned bench work, too, costs the service industry lots of money in lost time. Test procedures are still conducted on a hit-or-miss basis in most shops and test instruments are used only as a last resort. Where test equipment is used on a "last resort" basis it usually means that at least an hour was lost in probing around trying to locate the source of the trouble. Then since the test equipment is not used regularly, still more time is lost setting up the instruments, checking them and in determining the circuits to be checked.

In those shops that have incorporated the use of test instruments as

part of the normal servicing procedure the man-hour production will run almost twice that of the less efficient shops.

Service selling programs are not hard to maintain after a program has been determined and the material selected or developed. The important point about any sales plan is that it should be carried out regularly and consistently. If you use a direct mail postcard campaign, your name will become imprinted on the minds of the people who receive your cards if they are sent out with clock-like regularity. That is the secret of it. To make your name and the services you have to sell known to the people you want to have as customers you must make a call by mail at regular intervals. —30—

What's New in Radio

(*Continued from page* 92)

other services operating in the range from 140 to 165 mc. This model requires a single 7/16" hole cut in the car roof for mounting. The coaxial cable is fed through, and the antenna can be screwed firmly in place. The antenna is of stainless steel wire. It comes with a 10 foot length of coaxial cable.

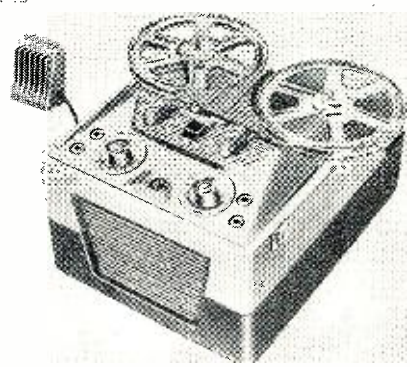
The No. 114 is a v.h.f. antenna of the sleeve type and is designed for open vehicles such as convertibles, station wagons, fire trucks, taxis, emergency trucks, and for amateur use. It operates in the same band. The design permits mounting on any convenient place by means of the company's standard mountings. It is supplied with an 18" adjustable section. A 10 foot length of coaxial cable comes with the unit.

Complete information and descriptive literature are available on request.

PORTABLE TAPE RECORDER

A new dual-speed portable tape recorder is the latest addition to the *Pentron Corporation* line of audio equipment.

This new portable unit weighs 27 pounds with all accessories. The recorder offers push-button speed change for either 3¾" or 7½", plus superspeed rewind and forward speeds, au-



tomatic amplifier equalization at either speed, two hours' continuous performance on 7" reel at 3¾" per second, a push-button editing key which permits correction of recordings on any section of the tape while playing, magic eye recording indicator, an interlock switch which prevents accidental erasure and tape spillage, and the company's exclusive record and erase heads which prevent tone distortion. The unit employs the company's crystal microphone, jacks for microphone, radio, or TV, and an auxiliary speaker and amplifier. It is available with dual track or single track heads for broadcast use.

For new literature and detailed specifications write the company at 221 East Cullerton Street, Chicago 16, Ill.

D.C. RECORD CHANGER

A new three-speed record changer which operates on d.c. has been announced by *Garrard Sales Corporation,* 164 Duane Street, New York 11, New York.

The RC80 "Triumph" is identical to the company's original changer. Two interchangeable spindles easily adjust to accommodate 33⅓, 45, and 78 rpm. The changer also incorporates a muting switch which eliminates all noise

between records and an automatic stop which operates at the end of any type record.

Original music quality of the records is insured through the jewel-mounted tone arm and the resultant true-tangent tracking. The company's pusher-type platform is another feature of this unit.

This particular unit is intended for the many d.c. areas throughout the country.

TRANSFORMER WINDER

Geo. Stevens Manufacturing Co., Inc., Pulaski Road at Peterson, Chicago 30, Illinois has developed a new machine which will automatically wind heavy wire bobbin and transformer coils for production, laboratory, or experimental use in military and other types of equipment where space is critical.

Wire sizes as large as 14 gauge are wound in tight, perfectly uniform layers, without tangling or miswinding at the ends of layers during reversing. High tension is applied through exceptionally high winding power and a heavy winding head to put wire exactly where desired. No loss of turns and accurate margins are assured by a screw feed and an electrically controlled clutch.

For complete details on this and other models in the company's line, write direct to the firm at its Chicago address.

—30—

International Short-Wave

(*Continued from page* 124)

rive, 7.38, is in parallel with both 3.240 and 6.170; opens around 1200 and closes 1430; fair level.

Malaya—Radio Malaya, 6.025, Kuala Lumpur, has fine level in South Africa 1000 with *English* program; closes 1030 with clock chiming 11 p.m. local time, followed by "God Save the King." (Ridgeway) Noted with improved signal in West Virginia 0630 with news.

Monaco—Radio Monte Carlo, 6.035, has been good level lately after 0130 with all-French program. (Saylor, Va.) Is parallel on 9.785.

Mozambique—Lourenco Marques still noted on 11.762 in *English* from 2300; commercials and frequent time checks. The Portuguese program is still heard on 9.840A from 0000 (Sun. from 0100); usually has interval signal from ten minutes before the broadcast begins. (Dary, Kans.) Noted on 4.925 from 2300. (Stark, Texas)

The 9.840A channel is noted in Britain to closedown 1500; heard as early as 1145 tune-in. CR7BV, 4.82, noted 1445 with light music in parallel with 9.840; signs off 1500. (Pearce)

Nicaragua—YNZZ, 6.450, Managua, noted 2130 with popular music to after 2215; good level in Wisc. (Hoogerheide)

Northern Rhodesia—Lusaka, 3.75, is in parallel with 7.22 at 1100 when relays BBC news; closes 1230; high level in South Africa. (Ridgeway)

Panama—HP5B, 6.030, Panama City, *Radio Miramar,* logged 2220-2240; all-Spanish; many commercials. (Patterson, Ga.) Cushen, N. Z., reports HO50 now heard on 5.995 at 0600-0000; a later report from Bellington, N. Y., says noted back on 6.045 to 2359.

Paraguay—ZPA3, measured 11.8516, Asuncion, noted 1815 in Spanish; improves by 1930; slogan is "Radio Teleco"; call given frequently. (Russell, Calif.)

Peru—At the time this was compiled, *"Radio Nacional,"* Lima, was noted *testing* in the (announced) 19-, 31-, and 49 m. bands. Asked for reports to Box 1841, Lima, Peru. Tests were around 1845-2200 and while frequencies were not given, *ISW DEPARTMENT* monitors reports the signals on OAX4R (measured), 15.14638; 9.56057 (measured), and 6.080A. (Russell, Calif.; Lane, Wyoming, others)

Cushen, N. Z., says the *new* Peruvian on 6.155 is *Radio Central;* relays OAX4E, medium-wave, Lima; sign-off is 0200; OAX4V, Lima, *Radio America,* is now heard on 5.990 to 0200 sign-off (at least on Sundays), says Cushen.

Philippines—When this was compiled, DZI4 (formerly DZI3), 6.110, Manila, was relaying *Radio Free Asia* programs (from San Francisco) to the mainland of China at 0830-0952A; *English* from 0920A to closedown (which varies). Some days was having difficulty in making the relay. (Dilg, Rosenauer, Russell, Calif., others)

"Voice of Cebu," 6.14, Cebu City, noted 0900-1000 sign-off; scheduled 1600-1000, but is unreadable to around 0800; *English* news 0900-0915; at 1000 announces as Cebu Broadcasting Co., affiliated with *NBC* of USA, and as on 6.14. (Gay, Calif.)

DZH2, 9.64, Manila, noted 0900-0915 with news; 0930-1030 with music, *English* announcements; announces "This is MBC, the Manila Broadcasting Company"; good level in Kansas. (Dary)

The Far East Broadcasting Co., Manila, has *English* weekdays 1830-2030, 0000-0100, 0300-0515, 0700-0900 on 3.325, 6.030, 9.730, 15.300; 1000-1030 except on 3.320; Saturdays at 1800-0000, 0030-0530, 0630-1100 on all channels; news at 1830, 2000, 0000, 0500, 0830. *(WRH Bulletin)*

Poland—Radio Warsaw, 7.205, announces *English* schedule for North America as 1700-1730, 1730-1800, 2315-2345, 0030-0100 all on this channel. (Dary, Kans.) Warsaw broadcasts on 6.115, 6.220, 7.205, 9.525, 9.570, 11.740, 11.815. (Radio Sweden)

Portugal—Lisbon now uses 11.995 for both the 1230-1530 and 1600-1800 periods, parallel with 9.745. (Pearce, England)

Portuguese India—Ridgeway, South Africa, says *Radio Goa* is still heard on 9.610 at good level from 0830; on Fridays has request program in *English* 0830-0930; has Portuguese after 0930. A letter from the station told Ridgeway there is a 49-m. outlet but frequency was not stated.

The "Lutheran Hour News" says that *Radio Goa*—which at times broadcasts "Bringing Christ to the Nations"—operates simultaneously on 6.023, 9.610, 17.795, 21.685. (*Short Wave News,* London) *Not confirmed.*

Saudi-Arabia—Djeddah noted opening 2300 in Arabic on 11.85, fair level in Indiana. (Niblack) Bluman, Israel, says Djeddah is using 3.950, 5.975, 9.650, 11.850, and 11.950 (11.750 has been dropped) daily 2300-2345, 1200-1315. (*WRH Bulletin*)

South Africa—"Springbok Radio," Johannesburg, Commercial Service of the SABC, logged 1245-1315 on measured 4.94575; fair level but considerable QRN and CWQRM; announcements in *English.* (Catch, England) Frequencies used by Johannesburg for its *experimental* transmissions are 15.230 during local daylight and 9.80 at night. (ISWC, London) Cape Town noted on measured 5.892762 recently 2356 with setting-up exercises in Afrikaans; fair level in spite of heavy CWQRM. (Rastorfer, N. Y.)

Spanish Morocco — Radio Tetuan verified by letter, gave schedule of 0800-1000, 1500-1900 in Spanish and 1000-1200 in Arabic on 6.067. *(N.Z. DX Times)* Noted signing off 1800. (Bellington, N. Y.)

Surinam — PZC, measured 15.4084, Paramaribo, noted 1745 with music. (Russell, Calif.) Widely reported with good level.

Sweden — It is hoped that *Radio Sweden's* new high-powered transmitters will be ready to go into regular

operation early in 1952. (Skoog, Sweden) "Sweden Today" *(English)* is now noted 0815-0830 over 15.155, 11.705; *English* for North America opens 1900 on 15.155, 10.780.

Switzerland — Berne has replaced 11.715 with 9.665 for the Home Service relay for Europe 0115-0240, 0500-0830, 1030-1730. (ISWC, London) Lately has been using 7.210, 9.535, to the United Kingdom and Ireland 1345-1430. (Pearce, England)

Syria—Damascus, 11.914, noted in Indiana at 1650 in *English,* fair level. (Niblack) Still closes down at 1730.

Tahiti—When this was written, *Radio Tahiti* was still noted on 6.135 to 0130. Uses *English* irregularly, usually Sundays around 0000-0015. May test soon on 9.053?

* * *

Press Time Flashes

The Central Radio Propagations Laboratory, Washington, D.C., predicts sunspot No. 53 for December (up one number from November prediction). (Stark, Texas)

ISWL, London, reports that a USSR Underground Station operates intermittently at irregular intervals on one of these channels—7.550, 7.700, 7.730.

Dilg, Calif., sends along this interesting data on Asiatics—Chungking, 6.155A, signs off 1000, fair level; Hankow, 6.500A, signs off 1000, fair signal, in dual with 10.420V; Hankow, 10.800V, signs off 1000, fair, parallel with 10.420V and 6.500A; Kunming, 7.140A, signs off after 1000, weak and erratic; Mukden, 7.670A, signs off 1000, fair; a station on 5.510A, believed Mukden, heard 0800, fair, not in dual with 7.670A; Shanghai, 5.985, signs off after 0900, good level; Shanghai, 6.320V, signs after 0900, fair, dual with 5.985; Shanghai, 9.325A, signs off 0830, fair; Sian, 6.395A, signs around 0900, fair; Peking, 6.100-6.130, signs off after 1100, fair; Peking, 10.260V, signs off after 1100, fairly good, but has been noted as high as 10.420 at times; 15.170, Peking, seldom heard now; Harbin, 7.100, is erratic, weak signal at best; North Shensi, 7.500V, fades out after 0930, same for North Shensi on 9.040A; unidentified, 9.420A, carries Peking news in Chinese 0700, fair level. Dilg has noted that the Nationalist Chinese (Taiwan) generally use BED calls for Home Service while those directed to the mainland of China normally have a BEC call, says Taipeh, BED24, 6.095, fades out by 1100, fairly good; BED7, 7.133A, fades out by 1130, good; BED6, 11.735, fades out by 1130, good; BEC22, 7.010, signs off around 1030, fairly good, is Armed Forces Station; BEC32, 9.775, signs off around 0930, poor, is Air Force Station; BEC36, 7.335A, signs off after 1100, fairly good; Chiayi (?), BED26, 10.420A, heard around 0900, fair. Reports Jogjakarta, YDJ2, 7.098A, signs off after 1000, fair; Jogjakarta, YDJ, 5.060A, 4.840, heard around 0800, weak; unidentified Indonesian, 4.855A, heard around 0800, weak; 11.080A signs off 0930, weak (Makassar formerly used this channel); Djakarta, YDB3, 7.270A, signs off 1130, fairly good; Dja-

karta, 11.770, is heard around 0930, very good.

Nepal Radio, 7.100A, is being heard by Dilg, Calif., around 0915.

"La Voz de Fundacion," Dominican Republic, is on 6.152 to 1905V sign-off; is listed HI1R, San Cristobal; has QRM, probably from TIRH, Costa Rica. (Stark, Texas)

Radio Jamaica, 3.360, Kingston, noted 2115-2130 with news, 2135-2200 with music. (Crandall, N. Y.) Concludes BBC relay 2300 and continues for five minutes with religious program, then signs around 2307 after "God Save the King." (Russell, Calif.)

4VRW, 9.838, Haiti, noted to 2140 sign-off; has *English* 2130 on Mon. and Fri. (Leary, Ind., Shanahan, Wisc.)

Brazzaville's 9.440 channel was recently measured by Oskay, N. J., as 9.4395, which is 5 kc., *higher* than on previous check.

Radio Salas, 9.026, Havana, has "English by Radio" of the BBC, London, at 0800-0810 at least on Mon., Tue., Wed. (Gaynor, Calif.)

* * *

Acknowledgement

Many thanks, fellows, for the FB cooperation during 1951! Best of holiday wishes—and keep the reports coming in during 1952 to Kenneth R. Boord, 948 Stewartstown Road, Morgantown, West Virginia, USA. KRB.

Spot Radio News
(*Continued from page* 18)

chromatic values can be carried without loss of identity, provided that proper timing is maintained between the modulation process at the transmitter and the inverse demodulation process at the receiver. This latter requirement was noted as being met by sending to the receiver, along with the television sync pulses, a timing signal known as the color-phase signal. It is this signal which causes the receiver chromatic signal circuits to operate in synchronism with those at the transmitter.

The problem of arranging the chromatic and the brightness signals so that they will utilize the channel assigned to the transmitter without undue interference, has been simplified in the NTSC approach by the scanning process used in dissecting and reassembling the image, the brightness signal components being concentrated in uniformly spaced intervals across the channel. The chromatic signal was noted as being concentrated in a similar fashion, since it arises from the same scanning process. It is feasible to shift the concentrations in the spectrum of the chromatic signal so that they fall between those of the brightness signal spectrum. This can be accomplished by choosing the frequency of the color carrier as an odd multiple of one half of the line frequency. In this manner, the whole of the spectrum assigned to the picture transmission is more completely occupied, and the two

sets of signals are transmitted simultaneously without one interfering with the other. This effect can be achieved, because with the particular choice of carrier frequency, the unwanted signal received with a certain phase in one field will be received with the opposite phase in a succeeding field, one-thirtieth of a second later.

The issuance of the standards by NTSC was described as being particularly significant at this moment, in view of the cease-color edict, since it discloses the substantial progress achieved and the possibilities of a system which does not require wheels, rods, motors, saturation reactors, plus magnifiers.

GOVERNMENT CENSORSHIP, as intimated in the controversial bill of Senator William Benton, has been bluntly attacked as an . . . "undesirable" and a . . . "dangerous" . . . move not only by members of the FCC, but those on the program standards committee of the National Association of Radio and Television Broadcasters, who countered with a code of ethics, covering, in particular, TV.

According to a majority report issued by the Commission, the suggested national citizens' advisory board for radio and television would conflict with the functions of the present body. "The Commission, unlike the proposed board," they said, "is expressly confined to the review of program operations of broadcast licensees and to recognize factors within the standard of 'public interest, convenience and necessity,' and is expressly precluded from exercising any powers of censorship."

FCC Headman Coy and Commissioner Walker, in separate opinions, noted that worthwhile results may flow from the type of study proposed in the bill, if the board had no compulsory power over licensees and simply served as a truly advisory body to Congress.

Opinions offered by NARTB hammered away at the free rights of broadcasters, which the bill would remove. In an address at Salt Lake City, the association's prexy, Harold E. Fellows, declared that . . . "We are fighting this dangerous legislation and shall continue to resist this and all other efforts to gnaw away at the foundations of this basic bulwark of our American heritage." Noting that there is but one issue at stake, Fellows said: "We are not left to our imaginations in this vivid day and age as to what the consequences of opening the doors of government regulation of the press, radio, and television to those who, for what they choose to call the 'public good,' want to establish boards of governmental experts to determine what the citizens shall read, see, and hear. History has amply demonstrated that there is no such thing as partial censorship, or slight regulation." He felt that . . . "once the power of the state to deal administratively with information content is established in any de-

gree, the urge to extend . . . that power and exert control is irresistible." Referring to the tyrannical censorship existing in too many countries throughout the world, the broadcasters' chieftain said . . . "With such a shocking and brazen picture before us, the choice between our American system of broad freedoms for the broadcasting and press media, and the course of the police state with its mockery of truth and its garish distortions of fact, should be, for each one of us, a firm, voluntary, and knowing choice in favor of freedom."

Earlier the association had sent a petition to Senators Ernest McFarland and Edwin C. Johnson, both of whom were concerned with the legislation, which declared in part that the proposals were . . . "potentially more dangerous to free expressions than any legislation that has been before the Congress in the 30-year history of American broadcasting. . . ." The statement also noted that the . . . "indictment of American broadcasting evident in the testimony of proponent witnesses . . . is absolutely counter to the fine record of this great industry, which has grown in the American tradition to such stature that no other broadcasting system of any nation in the world surpasses its performance, and none matches the esteem in which it is held by the people it serves." Stating that the Benton plan would set up an eleven-man commission that would report to Congress on the program performance of broadcasting, the petition asked the Senators if . . . "eleven persons can determine the tastes of 120,000,000 . . . And if they should, through whatever means, force the deletion of a single broadcast program, is this not censorship?"

According to the code submitted to TVcasters, in rebuttal to the Benton plan, management would self-police the scripts and productions, and eliminate any obscenities in copy, staging, dress, lyrics, etc. It would be up to the station's directors to see to it that extreme discretion is exercised in planning programs that would be viewed by juvenile audiences during the day and early evening.

Present plans call for the adoption of the code by all stations before the holiday season is with us.

STEREOPHONIC BROADCASTING. demonstrated on several occasions in this country, received recently, during the CCIR conference in Geneva, an extremely dramatic test which it was said disclosed new practical possibilities for the technique.

The system featured the use of a single carrier wave for separate channels coming from two microphones, one of the channels modulating positive-going halfwaves of the carrier and the other channel modulating negative-going halfwaves. Using two detectors, the channels can be separated, with one being fed after reversal of the polarity of the double modulated wave. In a description of the use of the ap-

proach in a studio, in the journal of the *European Broadcasting Union*, it was noted that each channel modulates a separate train of half-sinusoids or pulses coming from the same generator, the second train being displaced one-half period relative to the first. After modulation, it was said, the polarity of the second train is reversed and the two trains are then superposed. By passing the result through a selective circuit to eliminate the harmonics of the pulse-recurrence frequency, one train will contain a single carrier wave bearing the two modulations. Noting that such a carrier wave will occupy rather a wide band if the two modulations are not identical, the report pointed out that experience has shown that the stereophonic effect remains adequately clear when the spectrum is cut off beyond the third harmonic of the audio frequency (on both sides of the carrier, making the total bandwidth six times the audio frequency), or at any rate beyond the third harmonic of the highest acoustic frequency, permitting the transmission of higher order harmonics for the mid-frequencies.

A closed circuit was employed during the tests, with two speakers set up on opposite sides of a medium sized auditorium. The stereophonic was noted as being striking, particularly when those in the studio favored the microphones involved in the test.

TEACHING BY TELEVISION, described as an excellent possibility, which merits sturdier support, particularly by those in commercial broadcasting, has found enthusiastic friends in the military departments in Washington, as the result of a series of tests conducted by the Air Reserve Training Section of the Aviation Training Branch, Office of the Chief of Naval Operations. In an effort to determine if television can be used effectively to teach Naval air reservists, an experiment was evolved by the Special Devices Center of the Navy and Fordham University, during which some groups would be taught by television, TV recordings and others in the conventional manner. At Willow Grove, Floyd Bennett and Anacostia stations, live TV programs were used. Groups of trainees at Dallas, Olathe, and Glenview saw recordings of the same TV programs presented as sound motion pictures, while conventional classroom instruction based on the same lesson plans as the television programs was given by local instructors at Akron, Minneapolis, and Grosse Ile. Subjects covered aerology, navigation, engineering, high-altitude flying, cross-country flight, ordnance and gunnery, survival and safety, jet engines, and nuclear physics.

The live programs were viewed on 16-inch sets, and students were able to question the TV instructor through a talk-back microphone. The TV movie test involved the use of a 16-mm projector.

The results certainly were impressive for TV, for television instruction was found to be better than teaching by local instructors in half of the comparisons made. Specifically 80 per-cent of the comparisons showed that TV was as good or better than the local instructors. The recordings were found to be more effective than personal instruction in more than 40 per-cent of the comparisons made, whereas in comparison with live TV, they were found to be just as effective.

In summarizing the results, the Naval authorities declared that TV can be a key aid to education, but it will be necessary to use the services of those who specialize in writing and directing educational TV programs exclusively. . . . . L.W.

The Army's Signal School at Fort Monmouth, New Jersey, is now piping TV lessons into its classrooms, using this medium as a training aid in teaching students complex communications equipment and systems. Filming the lesson on the cathode-ray tubes are cameramen (left to right) Sgt. Joe Thompson of Marlow, Okla.; Pvt. Rodney Tillotson of Salisbury, Mo.; and Pvt. James A. Mann of Montgomery, Ala. The instructor is Cpl. Barkey Balikian of Beirut, Lebanon.

A.C.-D.C. Servicing

(*Continued from page 42*)

and this condition may manifest itself only once or twice within a twenty-four hour period. As a preventative measure, then, we change the condenser between the power amplifier grid and the preceding stage. If the set is old it is advisable to also change the coupling condenser at the volume control. As a result of this and other preventative measures, our "kickback" percentage is lower for the a.c.-d.c. set than for any other type of repair.

The filtering block is checked simply by shunting additional capacity across the circuit and at the same time measuring the "B-plus" voltage. If the additional filtering causes the voltage to increase by more than two or three volts or causes a marked lessening of a.c. hum, the filtering block is replaced. This is particularly essential in battery-electric sets where a small decrease in "B-plus" voltage results in fade-out of the local set oscillator. If in doubt, decrease the isolation transformer secondary voltage slowly and observe the meter reading at which the set oscillator fades. The oscillator should hold for values ten or fifteen volts below normal line voltage.

The over-all gain of the set is checked quickly and with sufficient accuracy for practical servicing by tuning in on a weak station at each end of the dial and comparing results with normal performance. The gain test is substituted for a complete tube tester check of tubes. This may seem unorthodox to some of you but unless you are merely after tube sales, it is just as satisfactory and a vast saving in time. This tedious tube checking business alone costs most shops hundreds of dollars a year in needlessly wasted hours. As any technician knows, the conventional tube checker test is, at best, little more than an indication of emission and will not catch many of the more subtle defects. If the set gain is satisfactory, why check emission? However, the tube checker should be used when there is some indication of trouble such as a 60-cycle distortion which may indicate a cathode-to-filament short in the power tube.

As a check for a tired, punchy rectifier, the "B-plus" voltage is measured when the set is first energized and again after fifteen minutes of operation. A ten per-cent drop in voltage is cause for suspicion.

A substitution tester is a big time saver in tracking down oscillations, and in looking for open condensers and open resistors. The shop-built substitution tester in our test panel will throw any of the common values of condensers and resistors across the test probes with the flick of a multiple-contact, rotary switch.

Careful alignment is good business. Factory alignment often isn't too good and the resonant frequency of cheap components shifts rapidly. The i.f. trimmers are carefully balanced with

a scope pattern while the r.f. and oscillator trimmers are adjusted for maximum at the proper dial settings. With the equipment already set up and operating, it takes only a couple of minutes.

Following is itemized the complete treatment given each set:

1. Return the set to playing condition.
2. Replace the audio coupling condenser.
3. Check the filters and bypass condensers, replacing them if necessary.
4. Check the over-all gain.
5. Align the set.
6. Clean and polish the cabinet and dial.
7. Replace the pilot bulbs.
8. Tighten the dial cord.
9. Re-glue the speaker cone when necessary.
10. Give the customer an itemized bill, showing the above. (Let him know he's getting his money's worth.)

Sounds like a lot for a little, doesn't it? Actually it is. But it doesn't take long, providing the test setup is right and the routine is organized. Additional time is saved by having an apprentice remove and replace the chassis in its cabinet, clean and polish the set, and draw up the customer's bill. We once experimented with the idea of letting the technician do only the diagnosing while the apprentice made all the repairs but this plan did not work out chiefly because of the number of sets with multiple defects wherein the diagnosis of one defect is not practical until another defect has been repaired.

Ease of troubleshooting isn't the only advantage in servicing of the small set. Practically all small sets are delivered to your bench while TV and large radios must be picked up, repaired, and then delivered. The saving in man-hours and truck expense is quite an item, not to mention the occasional deadbeat who lets you re-install his repaired TV, and then blandly informs you that he is fresh out of cash and would you wait until the Monday after this coming Saturday, which is payday. This can't happen in your shop, where the green stuff passes over the counter before the repaired set budges from the shelf.

To make money with the a.c.-d.c. set, the first consideration is speed in servicing. Running an important second, is adequate compensation for each job. Most technicians seem reluctant to ask their customers for the few dollars they have earned on the small set while, oddly enough, they think nothing of writing up a $35 ticket on a TV repair. With shop overhead skyrocketing, no set should pass over the counter for less than $4.50, regardless of its original cost or condition. If given the full treatment described in this article, it is worth every penny of that charge to the set owner. The average charge for the small set should be in the $5.85 price range. A few small sets will require greater outlay in time and material and must bring 6 to 10 dollars.

By use of the assembly line, time-saving techniques, we find that a technician can go through 15 to 20 small sets a day. With an average charge of $5.85, this production permits a gross take of between $87.75 and $117. Not bad, considering it is all inside work and without either truck expense or the possibility of profit-killing call-backs. Looking at servicing strictly from a remunerative viewpoint, if I had to choose between a daily diet of TV repairs or a.c.-d.c. repairs, my competitors could have the Milton Berle addicts. —30—

Packaged Power

(*Continued from page 63*)

bler" capacitance is subject to twice this value and therefore must carry a 450 volt d.c. rating.

A separate filter section was found unnecessary as the a.c. component present in the output is negligible.

It is well to remember that one side of an a.c. line is already at ground potential. If an additional ground is desired, one should first ascertain which side of the a.c. line is grounded. This is easily determined by connecting a 120 v. lamp in series with the unit's negative lead and one side of the a.c. mains.

If the lamp does *not* light, a direct ground connection may be made. If the lamp does light, the a.c. cord plug must first be reversed before grounding the unit. Thereafter note in which position the plug should always be inserted.

Conclusion

A versatile power supply is a distinct adjunct to any amateur station. Numerous applications will suggest themselves to the user.

Voltages available at the four prong socket are ideally suited for powering a 40 watt transmitter. Terminal strip connections may be used for test purposes or supplying screen, plate, and heater requirements of receivers and other associated equipment.

The unit described may be duplicated with a minimum of time, tools, and expense. For those seeking packaged power without recourse to machine shop or laboratory, the economy size selenium power supply is well worth the effort. —30—

NOVICE CONTEST

THE Hallicrafters Co. has announced the establishment of a Merit Award for outstanding achievement by new novice-class radio amateurs.

The award will be given to all novices who between 12:01 a.m., September 8, 1951 and 12:00 p.m., September 7, 1952 work all states and have obtained their regular ham tickets. The first ten novices to qualify will receive a Hallicrafters S-76 receiver while all others who qualify will receive $25.00 in cash. The company's October ads carry complete details. —30—

Oscillator Radiation

(*Continued from page 67*)

the results tabulated in Table 4. Although this particular test was conducted solely for the sake of obtaining relative information as to radiation capabilities and hence should throw no reflections on the manufacturer of any one set, the names were omitted to prevent possible misinterpretation.

The set-up for making the measurements was simple. All tests were made with receivers indoors (due to inclement weather), with each set placed on the same bench, facing the same direction, and connected successively to the same antenna leads. Radiation measurements were made from outside with an *RCA* Type WX-1A Field Strength Meter at a distance of approximately 70 feet. The field strength meter antenna was mounted on a tripod and elevated 10 feet above ground. Each receiver was adjusted to Channel 7 and the fine tuning control (if used) adjusted to its normal setting. The oscillator output on Channel 11 was then measured directly in microvolts-per-meter (μv/m) on the field strength meter.

Tabulation of the receiver measurements brought out two important facts. First, and possibly the most important from a practical standpoint, is the fact that all the radiated signal strength in the tests was picked up directly (by air). Use of the battery-powered field strength meter automatically ruled out the possibility of pickup through power lines. (In actual practice, a certain amount may be transmitted in this manner, but usually not to such an extent as noted in the Table 4 tests.

The second fact is the importance of shielding in reducing oscillator radiation. Set (A) had no shielding between tuner sections, while set (E) had a well-shielded inductance-type tuner in which individual gang sections were isolated rather effectively. Set (F) employed a new-type tuner in which the gang sections of the selector switch were individually shielded and the oscillator section effectively double-shielded. Note the results in the radiation figures.

Note also the effect of the antenna system in increasing or decreasing interference, particularly in tests 1 and 2. The gain of the *Channel Master* "Di-Fan" was higher than that of the folded dipole, hence increased the amount of direct-line interference. This bears out the previous statement that the greater portion of the radiated signal normally is received through the antenna system. This statement seems to be contradicted in tests 4, 5, and 6, where radiation with no antenna connected is approximately the same as with the inside antenna (test 3) attached. In these cases, however, the oscillator coupling and short ribbon section from the tuner to antenna terminals are acting as an antenna or signal dispersing element. Efficient shielding and isolation of the oscillator section from the antenna circuit would result in a tremendous reduction of the radiated signal. This was borne out by the test involving receiver (F).

Since the first test proved the importance of a good antenna system, a succeeding test of several popular types was made. The results appear in Table 3. Again, note that the gains are relative and do not necessarily represent the actual gain of the individual antennas. The front-to-back ratios of three similar "Di-Fan" antennas, for example, varied widely. While this *may* be correct, it was felt that varying conditions in the field would cause a tremendous change in characteristics and therefore should not be taken as the official or representative figures. The point to be made, however, is that under the same conditions for each antenna, the characteristics obtained were those shown in Table 3. (These comparative readings were taken only at 195 mc.).

After studying the front-to-back ratios, gain, etc. of the various antennas, it will be apparent that no single type can be chosen as *the* antenna. Note, for instance, that the double-V, double-stacked antenna (test 7) has the highest gain of the group (4.8 db) except the 5-element yagi (test 5) but has a front-to-back ratio of only 2:1. The Di-Fan" (test 2) has a gain of 3.0 db and a front-to-back ratio of 8:1. This feature is desirable if the interfering signal is coming from a point behind the receiving antenna.

The effect of center stubs in a "Di-Fan" arrangement is shown in tests 10 through 13 (Table 3) (see also Fig. 1 and notes 7, 8, 9 and 10 in Table 3). For Channel 11, the gain, as well as the front-to-back ratio, is improved by using *short* center stubs on the driven elements and *long* center stubs on the reflectors. The long reflector stubs seem to provide slightly better rejection to undesired signals from behind, particularly at 195 mc. (Another point of possible interest—as the gain of a particular antenna is increased, *i.e.,* if stacks, directors, or reflectors are added, the front-to-back ratio may be decreased. This fact may be helpful in selecting the proper array or in making alterations for a particular installation).

Interference Remedies

Here are a few corrective measures which have been tried locally. In some cases results have been satisfactory; in others, the same measures have been totally ineffective or only partially successful.

1. *Wave Traps.* Either the high-"*Q*" tunable type or the 300-ohm twin-lead stub are successful in some cases, absolute failures in others. Usually not very effective if interference is very strong, since trapping out the undesirable signal also takes out most or all of the desired signal.

2. *Antenna Installation.* Many cases of interference were cured by installing a good antenna system and orienting

it for best compromise between best picture and lowest interfering signal. Shielding the lead-in and grounding the shield near the set often helped.

3. *Orientation of Offending Antenna.* This is one of the most effective means of eliminating interference in cases where the radiated signal is being emitted through the antenna system. If tests can be made with the owner of the offending set, it will often be found that turning *his* antenna very slightly will clear up the interference. Along these lines, the affected set's antenna may sometimes be relocated several fect to one side of its original position with the same results.

4. *Grounding at the Affected Receiver.* Interference in some cases has been eliminated by grounding the chassis of the affected set with #8 aluminum wire, using as short a lead as possible. In one particular case, interference on an *Admiral* was eliminated by this method when wave traps were not successful at all. *NOTE:* Make sure the chassis is not "hot" before attempting grounding. If not certain, consult the circuit diagram or contact the local set distributor.

5. *Shifting the Intermediate Frequency.* This has been effective in some cases locally, not so in others. In particular receivers, a shift of 1.0 mc. was sufficient to move the beat-frequency out of the video channel; in others, shifting the i.f. was out of the question, since tests had indicated a shift of 3.0 mc. or more would be required. In the latter case, it was necessary to resort to one or more of the above methods in order to effect a remedy.

It would be interesting to hear from technicians in other localities as to the methods they have most successfully employed. Possibly a mutual exchange of ideas through this magazine or in subsequent articles would help to curb a type of interference which is likely to grow progressively worse.

-30-

ADJUSTING HV TRIMMER

By M. KALASHIAN, W1NXT

THE point of maximum d.c. output voltage is not always the optimum setting of the trimmer condenser on the r.f. power supplies so often found in the 7-inch and some of the larger, inexpensive television receivers.

This setting of the condenser will usually result in intermittent operation in that the circuit often refuses to oscillate immediately when the set is first turned on.

The best way to set this adjustment is for maximum d.c. output voltage consistent with continuous circuit operation when the cap of the 1B3 high voltage rectifier is touched with a screwdriver to draw an arc. To simplify this statement: A point of maximum d.c. output voltage will be reached by adjustment of the trimmer, but by touching the cap of the 1B3, the circuit will stop oscillating. Then back off on the trimmer until touching the 1B3 cap will not stop the oscillation.

-30-

Work Seven Bands

(*Continued from page 71*)

bands as well, so if there is any way to do it, by all means put up the full 103 foot legs.

For 2 meters and 6 meters the antenna is so long that it is bound to be fairly broad tuning—so you can feed it by plugging a short additional length of feeder into the proper jacks—and then cutting this additional feeder to a length which gives satisfactory loading on the frequency used. Of course, if you plan to do a lot of moving around in frequency, an additional tuning unit would be advisable. It can duplicate the plug-in coil portion with a smaller variable condenser and coil.

Results

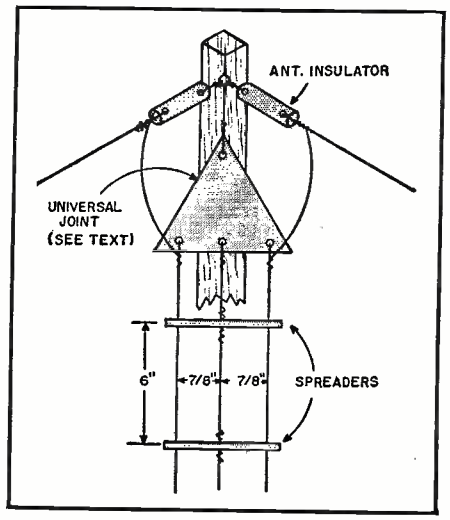
On the bands on which the antenna has been tested to date its practical performance in every case has exceeded the theoretical performance. On 10 meters, for example, distant stations report a gain of from 8-10 db on the "Vee" over either single leg. The single long wires will whip a doublet at the same height to death.

The directivity is very pronounced and checks out with the theoretical directivity in switching from one leg, to the "Vee" beam, to the other leg.

How does the antenna compare with standard parasitic arrays? There are too many variables to give an answer to that one. But it is the writer's observation and opinion that the "Vee" beam with the 103 foot legs will perform alongside a *good* 3-element beam at modest height and will frequently edge it out on reception. The only theoretical justification for this lies in the greater "antenna efficiency" which is gained from a long wire antenna with its much larger surface exposed to the incoming waves.

On 20 meters, the gain is less, of course. But the "LB-Vee" is still just about as good as a two element beam. It is bound to be more popular with the neighbors! —30—

Construction details on antenna feeder.



Mac's Service Shop

(*Continued from page 71*)

sell for a price that will allow them to compete with the vacuum tubes they replace. In order to secure these important advantages, some degree of longevity must be sacrificed. But look at this graph of the voltage output of a typical selenium rectifier running at full rated current and voltage at an ambient temperature of 45° C.," he said as he tossed a sheet across to Barney. "Notice that at the end of 8000 hours of continuous operation the voltage output is down only about 3%. Those 8000 hours would represent about six or seven years of operation in an average TV set."

"What makes a selenium rectifier go bad?" Barney asked.

"Well, all selenium rectifiers undergo some 'aging,' which shows up as a gradual increase in the forward (conducting) and the reverse (blocking) resistances. The end effect of this aging, which may continue for as long as a year before it stops, is a gradual slight decrease in voltage output. With a resistive-inductive load, this decrease in voltage will have a normal value of around 5%. With the more commonly-used capacitive loads, the drop is less. However, if the current rating of the unit is exceeded for a considerable length of time, or if the temperature is allowed to go too high—say above 85° C.—this aging process is greatly accelerated and aggravated."

"Then a partially-shorted input filter condenser could damage a rectifier pretty quickly, couldn't it?" Barney offered. "It would probably be just good insurance to renew the filter condensers when replacing a selenium rectifier. I can see that another way to shorten the life of a rectifier would be to crowd it back into a corner of the chassis where it would not have sufficient ventilation to carry off its own heat. I have seen many of them mounted in just such spots. But tell me: does a rectifier lose some of its sock just sitting on the shelf?"

"They do age to some extent under shelf-storage conditions," Mac admitted; "but unless the storage period becomes excessively long, say a year or longer, there should be no permanently harmful effects. They should be stored in a reasonably cool place that is not too humid, but no other special precautions need be taken with one single important exception: selenium rectifiers should *never* be used or stored where mercury vapors are present. Mercury is pure poison to these units. Even a broken thermometer contains enough mercury to be a hazard."

"I never can figure why they get as hot as they do," Barney mused. "Most of them only have a five volt drop across them even with a 100 ma. load. When you use this information to figure out the I^2R losses, you come up with about half a watt, but I know there is more heat than that thrown off."

"What you are overlooking," Mac explained, "is that a metallic rectifier, unlike a vacuum tube job, has a very definite and substantial amount of reverse current flowing; and this reverse current makes a large contribution to the heat losses of the unit. In fact, it has been calculated that in a half-wave circuit with capacitive input there is a 64% loss in the reverse direction and only a 36% loss in the forward, or conducting direction. In full-wave circuits the losses are evenly divided with 50% being due to the forward current and 50% being charged to the reverse current.

"You can see that this reverse current is just so much wasted energy, and it must be held to a reasonably low value if the rectifier is not to overheat. In fact, its voltage rating is really determined by the amount of voltage that can be safely applied to it without producing an excessive amount of reverse current. This rating, of course, includes a safety factor so that a selenium rectifier can be safely subjected to voltage surges of short duration."

"You've got me convinced that heat is not so good for a selenium rectifier, but how does cold affect it?"

"Extreme cold greatly increases the resistance and so reduces the current flow; however this is not of much consequence at any temperatures ordinarily encountered because as soon as current starts through the rectifier the temperature starts to rise, and as the temperature goes up the resistance goes down and the current increases until a state of equilibrium is reached. In testing a rectifier it is usually a good idea to apply the voltage for about five minutes so that it can come up to operating temperature before making a test of the output voltage."

"How do you test them, anyway?"

"Various publications have carried diagrams of selenium rectifier tester circuits, some of them pretty elaborate; but the one that appeals to me is given in the 'Selenium Rectifier Handbook' put out by *Sarkes Tarzian* of Bloomington, Indiana. It consists of three electrolytic condensers, three wirewound resistors with sliding taps, a voltmeter, and a couple of switches. When this tester is used on a rectifier, the proper voltage is applied to the unit, the correct filter condenser is switched across its output, the full rated current is made to flow through the rectifier, and then the output voltage is measured. If this voltage is below what it should be, the rectifier is rejected. It would be hard to dream up a more simple tester; yet it yields the voltage-output-under-load information that you really want."

"Well," Barney admitted, "you've convinced me that selenium rectifiers are more sinned against than sinning. Apparently if they are installed with some consideration for their peculiarities and are employed in a well-designed circuit, they are a pretty sturdy piece of equipment."

"That's right," Mac said; "but you made a couple of good points yourself. There's no denying that changing selenium rectifiers, especially when they are used in a bridge circuit, takes a lot more time than simply replacing a tube. It is also true that most of them are mounted below the chassis where their heat does no appreciable amount of good to the condensers, coils, and other parts mounted near them. I can see no good reason why these rectifiers—even in bridge combinations—could not be mounted on plug-in bases and set on top of the chassis. Of course some sort of perforated cage would have to be put around them to avoid any shock hazard, but that should not take too much doing. Mounting them in this fashion would remove the two strongest objections to their use."

"Could I make just one more suggestion, Boss?" Barney asked meekly.

"Shoot."

"Couldn't the rectifiers be painted with some sort of solidified *Chanel* 'Number 5' so that when they burned up they would stink real nice?" Barney asked plaintively as he sniffed at the odor still clinging to his fingers from handling the scorched rectifier.

—30—

Impedance Matching

(*Continued from page* 58)

1250 ohms (as before). Thus, when the powers assigned to each speaker are purely relative and need not result in the exact values assigned, one needs only be sure that the "Amplifier Watts Output" used in the formula is equal to the sum of all assigned speaker powers in the system. A perfect match will then result.

To achieve this simplicity by using the 70 volt tap available on some amplifiers would require that the actual impedance of the 70 volt tap be known and then proceed as above rather than using the arbitrary 5000 figure indicated in the following formula. As the 70 volt formula stands, the sum of all speaker powers *must* equal the amplifier *rated* power output to achieve proper match.

Some amplifiers have a 70 volt tap. For those who desire to use this tap, the formula is exactly the same as first, but the figure 5000 is substituted for the product of the "Amplifier Watts Output" and "Output Impedance Tap." Thus, the formula would be:

$$Z_t = \frac{5000}{W_a}$$

A practical procedure to follow in establishing power requirements for individual loudspeakers in a multiple speaker system is to group the speakers into like groups. For example, in a twenty speaker system, there may be fifteen that will need to be almost exactly the same power. Irrespective of how much power is actually needed, we may group those fifteen speakers into the main group, then determine, by whatever means are available, the

amount in db by which each additional speaker must differ from the majority. In general, it will not be necessary to work with differences of less than 3 db steps. Every time you increase the sound output by 3 db, you require twice the power input to the speaker. Likewise, each time you reduce the sound output needed from a loudspeaker by 3 db, you cut the necessary input power in half. By starting from fairly well known points, one can generally arrive at rather accurate relative power requirements for each speaker in a short time. The value of this system is that one who does not have a sound meter to measure actual sound levels usually finds it easier to determine probable *differences* in sound level than to determine actual sound levels. Having established suitable differences, the actual level can be varied by using more, or less, amplifier power. If ample audio power is installed in the first place, a mere adjustment of the volume control will establish correct levels. In order to allow for minor adjustments between speakers, in the final system, it is well to use adjustable matching transformers.

Another wise precaution is to include a dummy speaker load in the system, being sure to include it in your computations and when adding speaker powers. Let the dummy load absorb sufficient power for future expansion or to allow for added power to certain speakers that may later need it. By doing this, it will not be necessary to re-adjust all other speaker impedances to obtain correct impedance match. If one speaker is re-adjusted, all that is necessary is to add or subtract from the dummy load resistor the power to be removed or added to the loudspeaker needing adjusting. Volume controls on speakers should be avoided wherever possible as they consume power. They also cause frequent complaints in that they allow anyone to re-adjust volumes to his personal tastes, thus undoing hours of the sound engineer's work in establishing levels proper for the majority needs.

—30—

HAM PRIORITIES

THE National Production Authority has issued a new order which is designed to keep America's ham radio operators on the air and to encourage an expansion in the number of ham stations participating in defense and security activities.

Under the new order, a licensed ham who needs hard-to-get parts may place a delivery order with his supplier, using the allotment symbol MRO to obtain controlled materials (steel, copper, and aluminum), and the rating DO-MRO for components and end equipment. His delivery order must be certified over his signature and show the station call letters.

Members of nine major military and emergency nets will have an annual quota of $200 in rated orders. Other hams will be limited to $100 of self-rated orders.

—30—

Technical BOOKS

"THE COLOR TELEVISION NOTEBOOK" by W. B. Whalley, et al. Published by *Paul H. Wendel Publishing Company, Inc.,* Indianapolis. 39 pages. Price $1.00. Volume Two. Paper bound.

This is the second volume of "The Color Television Notebook" and covers the fundamentals of color television systems, receiver circuitry for the *CBS* color television system, details on the *CBS-Columbia* receiver and the *Tele-Tone* color receiver.

The text material, prepared by five specialists, includes an introductory section covering the fundamentals of color television systems; explanatory material and schematic diagrams of the *CBS* color system including data on standards, signal considerations, horizontal scanning, vertical scanning, hum, possible picture defects and their causes, horizontal jitter, vertical jitter and interlace, flicker and flutter, misregistration, and color fringing and color shading.

The *CBS-Columbia* color receiver is described in some detail as is the *Tele-Tone* receiver designed for reception of *CBS* color signals.

Like Volume 1, the text is clearly and concisely written with sufficient schematic diagrams, block diagrams, and photographs to make the subject matter easy-to-understand.

* * *

"ELECTRONICS" by Jacob Millman & Samuel Seely. Published by *McGraw-Hill Book Company, Inc.,* New York. 582 pages. Price $7.25. Second Edition.

This second edition of a text which originally appeared ten years ago contains much new and revised material in the field of electronics.

In addition to providing new illustrative material and revised diagrams, the authors have rewritten large portions of the text to conform with present-day notations and terminology. While some portions of the book have merely been brought up-to-date, other chapters have been completely reworked to enhance the book's value as a teaching tool.

The book is divided into 18 chapters and 9 appendices and covers such subjects as the motion of charged particles in electric and magnetic fields, the applications of the motions of particles in applied fields, electronic phenomena in metals, statistical electron theory of metals, characteristics of thermionic cathodes, diode characteristics, the kinetic theory of gases, fundamental processes in gases, electrical discharges in gases, commercial gas tubes, rectifiers, filters for rectifiers, polyphase rectifiers, etc.

The appendices carry data on the probable values of general physical constants, conversion factors, periodic table of the elements, the MKS system, definite integrals, Poisson's equation, graphical symbols for tube elements,

circuit notation conventions, and plate characteristics of receiving type tubes.

The authors have assumed that users of this text will be familiar with calculus and elementary differential equations. A working knowledge of the basic principles of a.c. theory, including elementary Fourier analysis is essential.

* * *

"PRINCIPLES OF ELECTRICAL ENGINEERING" by W. H. Timbie & Vannevar Bush. Published by *John Wiley & Sons, Inc.,* New York. 618 pages. Price $6.50. Fourth Edition.

The latest edition of this well-known source book in the electrical engineering field has been almost completely rewritten to bring the text material up-to-date and in order to include new circuits and techniques.

Designed as a text book at the college level, the authors have assumed that the student has a working knowledge of calculus and physics. The text material is divided into fifteen chapters and an appendix. The chapters cover such subjects as fundamental considerations, Kirchhoff's Laws, electrical power and energy, simplification of electric networks, conductors and resistors, conduction in solids and liquids, transients in electric circuits, a.c. circuits, the magnetic circuit, interaction between electric circuits and magnetic fields, magnetic properties of iron and steel, steady magnetic fields, steady electric fields, electronics, and electromagnetic waves. The eight tables included in the index provide data on resistivity, temperature coefficient and intercept of t-axis; resistance of international standard annealed copper wire; allowable current-carrying capacities of conductors; resistance of international standard annealed copper cables (stranded); dielectric strengths (average values); specific dielectric constants (average values); miscellaneous constants; and conversion factors.

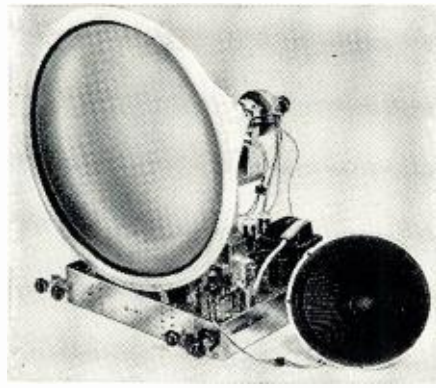
Since most of our readers are familiar with the earlier editions, suffice it to say that this latest edition tops them all. —30—

". . . Of course, I'm a service man. Now, will you please give me One Five . . . Zero . . . L . . . Six!"

NEW TV PRODUCTS on the Market

CHASSIS FOR 24" TUBES

Tech-Master Products Co., 443-445 Broadway, New York has added three new custom-built models for 24" pic-



ture tubes to its line of TV chassis. The model numbers are 2430, 2431P, and 2431C.

The Model 2430 has been designed specifically for all picture tubes requiring from 65 to 70 horizontal degrees deflection and is supplied with a 5" x 7" PM speaker and universal picture tube mounting brackets. The Model 2431P is similar to the first model but contains, in addition, push-pull audio and a phono input jack. This model is equipped with a 12" PM speaker and universal picture tube mounting brackets.

The Model 2431C is basically the same as the 2430 but has a continuous tuner, push-pull audio, and a phono input jack, allowing for complete coverage of both TV and FM bands. This model is supplied with a 12" PM speaker and universal picture tube mounting brackets.

Complete details on any or all of these models are available from the company.

"TELE-PLEX" COUPLERS

JFD Manufacturing Co., Inc., of 6101 Sixteenth Avenue, Brooklyn 4, New York has recently introduced a new

item to its line, the "Tele-Plex" TV coupler.

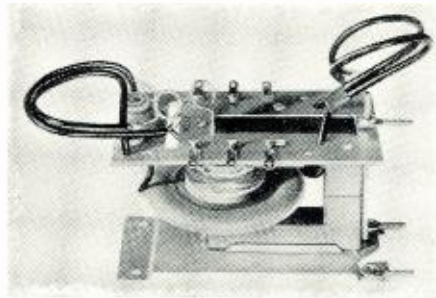
This new unit delivers full signal strength to two, three, or four sets using the same antenna. Each unit has built into it the company's "Little Giant" lightning arrester to protect the home and set against lightning damage.

The company suggests the use of these couplers to solve the trade-in problem on old TV sets by encouraging the customer to keep both sets in the home at minimum cost. Making use of the existing antenna installation, the couplers can be installed in minutes and do not require any booster, electric current, or maintenance.

Housed in compact, lightweight instrument cases, the couplers can be attached out of sight on back or inside of the TV cabinet or on the wall or baseboard. Three models are available: Model TC2L-300 couples two 300 ohm sets to a 300 ohm antenna, the Model TC4L-300 handles four sets, while the Model TC4L-72 couples four 72 ohm sets to a 300 ohm antenna.

FLYBACK TRANSFORMER

Merit Coil and Transformer Corporation, 4427 North Clark Street, Chicago, Illinois has recently introduced a new flyback transformer which can be mounted above and below the chassis,



horizontally or vertically or on the side wall of the high voltage cage within the TV set itself.

The new unit is a 77J-1 type and is in all other respects electrically identical to the company's HVO-6. The additional advantages of the universal mountings with this new HVO-7 offer the technician greater flexibility in installation.

"ROOF-THRU"

Mosley Electronics, Overland, Missouri, has developed a new weatherproof feedthrough bushing designed to permit direct entrance of TV transmission line through the roof without allowing moisture to enter.

Tradenamed the "Roof-Thru," the new device consists of an acrylic plastic bushing combined with a copper flashing plate. It is readily installed in buildings under construction or may be easily installed in existing structures by lifting a few shingles, drilling

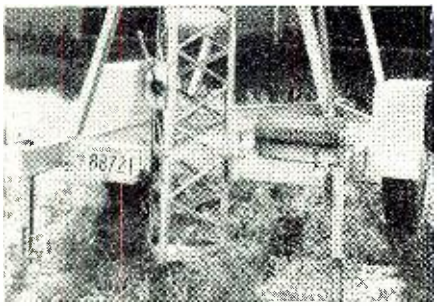
a hole 1" in diameter through the roof sheathing, inserting the unit, and then replacing the shingles over the copper flashing.

Further information may be obtained from the company at 2125 Lackland Road in Overland.

TV TOWER RIG

A telescoping aluminum TV tower which is mounted on a two-wheel trailer has been introduced by *Alprodco, Inc.* of Kempton, Indiana and Mineral Wells, Texas.

Capable of being raised to 72 feet in 15 seconds, this new unit consists



of three 24 foot lengths of aluminum towers that telescope together, all mounted on a framework that is fastened to a two-wheel trailer. The trailer is equipped with jacks which are used to level and steady it while it is being used.

The unit has been designed to meet several requirements, *i.e.,* demonstrating television receivers in the prospect's home; equipped with a 12 foot mast it can be used for testing signal strength up to 78 feet, or it can be erected as a permanent tower.

The tower can be erected by two men in a short time and is easily handled throughout installation.

TV ANTENNA KITS

Ward Products Corporation, 1523 East 45th Street, Cleveland, Ohio has announced two new television antenna kits which make available in a single package all of the components required for a television antenna installation.

For local installations there is a single-stack package, Model TV-105, while for fringe areas the double-stack Model TVS-103 is recommended. Each package includes a conical antenna, mast, lead-in, standoffs, pipe strap, base and other installation material. The double-stack package has an additional antenna bay and mast.

Free literature on these new kits is available from the company.

5-ELEMENT YAGI

Telrex, Inc., Asbury Park, New Jersey is currently marketing a new series of 5-element yagi arrays for use in areas where high back signal rejection plus high sensitivity is required.

These antennas are individually cut for Channels 2 through 13 with all elements operative and contributing to gain and back rejection. The high frequency yagis are pre-assembled, ready for immediate installation. The low channel models are completely col-

lapsible, incorporating an exclusive hinging and clamping assembly for swift, easy assembly combined with high mechanical strength.

Because of the high impedance reduction caused by the coupling of parasitics in a 5-element array, these yagis are designed around a folded dipole to achieve an impedance step-up ratio of 20 to 1 which provides a terminal impedance offering an excellent match to standard 300 ohm line.

DISTRIBUTION UNIT

Blonder-Tongue Laboratories, 38 North 2nd Avenue, Mount Vernon, New York has developed a new 8-outlet distribution system which will enable any television technician to hook up an all-channel, no-loss master antenna system in a matter of minutes.

This 8-outlet unit is an all-channel distribution amplifier which has been

designated the DA8-1-M. It has four television set outlets on the front and four on the rear of the unit. The simple screw-type terminals will handle both 75 and 300 ohm line. Matching transformers are built-in. The need for special connectors, individual channel equipment, and engineering services has been eliminated, according to the company. The only requirements for a master antenna system of any size are the proper number of DA8-1-M units, a good antenna, a screwdriver, and pliers.

The company will supply full details on request.

NEW ANTENNA LINE

Louis Bros., 3543 16th Street, Los Angeles 23, California has developed a new line of antennas which requires no screws, wing nuts, or tools to assemble.

The 400 series models, six different types in all, are completely pre-assembled at the factory and feature the company's exclusive "Self-Lock" design. All elements swing out at a touch, then by powerful spring action automatically lock securely and permanently into place, giving positive electrical contact.

NEW COLOR TUBE

Of interest to the industry is the announcement made recently by *Chromatic Television Laboratories, Inc.,* of the development of a new tricolor, direct view color television tube.

Known as the "Lawrence-Para-

mount" tube, the new component will receive color transmission either under existing commercial standards or any of the other presently-proposed systems for color television transmission, in addition to receiving black and white.

According to an announcement made by the company, the new tube can be used in any good quality black and white receiving set and, with the addition of an adapter plus minor circuit adjustments, will receive both black and white and color transmissions under present commercial color standards.

One of the outstanding features of this new tube is the fact that it can be produced relatively inexpensively. In addition, there is no major problem of mechanical registration of the colors within the tube. The manufacturing tolerance of 10 to 1, unique with this tube, permits simplicity of manufacture and the use of conventional production tooling techniques. The company's plant is in Stamford, Conn.

RCA 17" KINESCOPE

The Tube Department of *Radio Corporation of America,* Harrison, New Jersey has announced the availability of a new 17" kinescope utilizing low voltage, electrostatic focus.

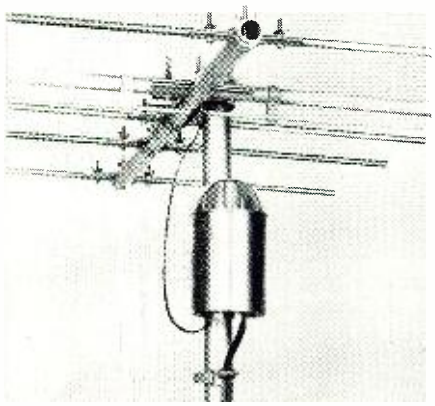
The new design eliminates the need for a focusing coil or magnet and makes it possible to obtain the voltage for the focusing electrode from the low voltage d.c. supply of the receiver.

Designated as the *RCA*-17TP4, the new tube requires very low current and the focusing voltage can be obtained from a fixed or adjustable tap on the receiver's low voltage d.c. supply. With either arrangement, focus is automatically maintained, despite variation in line voltage and adjustment of picture brightness.

TV BOOSTER

The LaPointe-Plascomold Corporation, Windsor Locks, Conn. has developed a new mast-mounted, single-channel booster which incorporates several new features.

This new "Vee-D-X" unit provides for scientific heat dissipation, compen-



sating adjustments for voltage loss in transmission line regardless of line length, and amplification of the signal before line noise pickup.

Housed in a streamlined aluminum case, the new "Rocket" booster is simple to install and easy to service. Power is supplied from a separate power pack on the back of the set which is automatically turned on and off by the television receiver.

The new Model OS incorporates all of the advantages of the company's Model OB, including a unique r.f. assembly using a 6J6 push-pull cross neutralized amplifier and an 18 db gain with full 5 mc. bandwidth.

"Z-MATCH" YAGI

A new type yagi antenna that achieves 100 per-cent perfect match to 300 ohm line for both single and stacked arrays has just been introduced by *Channel Master Corporation* of Ellenville, New York.

The "Z-Match" yagi features adjustable impedance and automatically provides a perfect match in addition to having wider spaced elements which result in higher gain, narrower lobe, and better rear rejection on all installations.

No extra connecting rods are needed with this antenna. When antennas are stacked, the center bars of the folded dipoles are removed. This reduces the impedance of each antenna and automatically creates a perfect 300 ohm match for the complete stacked yagi array. The removed center bars are then used as perfect half-wave connecting rods.

NEW TV ANTENNA

Walter L. Schott Co., 3225 Exposition Place, Los Angeles 18, California is currently introducing its "Model M" antenna to a national market.

The use of chromate-coated magnesium is said to provide a sturdier and longer lasting unit. The company claims that the "Model M" is the first TV antenna to use a magnesium alloy which provides greater ruggedness to the cross arms.

The elements of this new unit are made of high conductivity aluminum alloy, reinforced with Swiss "permalum."

The antenna has the "Walsco" signal director which improves the gain on high band channels and eliminates ghosts. It also includes the company's patented insulator, which is guaranteed unbreakable under all conditions.

FRINGE AREA ANTENNA

Radio Merchandise Sales, Inc., 1165 Southern Blvd., New York 59, New York has introduced a new antenna which is designed specifically for fringe and extreme fringe areas.

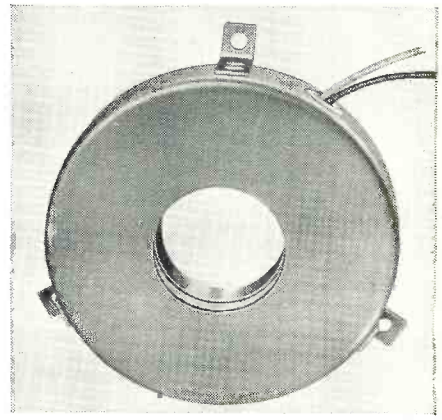
The antenna, a corner array unit, is presently being made for the high frequency channels, cut to full-wave, but units for Channels 6 down to 2 can be supplied cut to half-wave.

Complete rigging of the antenna can be accomplished quickly. Reflectors are ⅜" butt seam aluminum tubing and receiving elements are of ½" butt seam tubing. The design is parabolic to provide the high gain necessary in such outlying areas.

FOCUS COIL REPLACEMENT

Standard Transformer Corporation of 3584 Elston Avenue, Chicago 18, Ill. has added a new product to its TV replacement line, the FC-11 focus coil.

Designed to be used with direct view kinescopes requiring external magnetic



focusing, the new coil is equivalent to the *RCA* 202D2. The FC-11 has a d.c. resistance of 470 ohms, maximum ma. of 140. The unit has a diameter of 4¾" with mounting centers 2 11/16" radius, 120 degrees apart.

For information on this and other components in the company's replacement line, ask for a copy of the *Stancor* "Transformer Catalogue and Replacement Guide #338." —30—

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As a service to our readers we are again presenting a complete listing of all feature articles which appeared in RADIO & TELEVISION NEWS during 1951. We suggest you keep this for reference.

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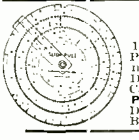

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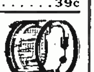

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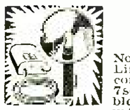

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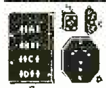
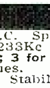


A. 4-crystal holder ⅛" pins, ¾ & ½" spacing **10c; 12/$1**
B. HiFreq Dual Xtal holder **10c; 12/$1**
C. HF Xtal Holders ½" spacing ⅛" pins ....**10c; 12/$1**
D. Johnson Mycalex 3 pin BENDIX..**35c**

CRYSTALS



Mtd FT243 exacting S.C. Specs 3525Kc 4190Kc 5233Kc 3980Kc 5030Kc **ea. 98c; 3 for $2** Write for other Frequencies.
Htr Oven Xtals—HiAccy Stability 5010, 5025, 5055Kc, ea. **$14.98**
Rochelle Salt Xtals, 69c; 10 for $5.00

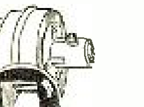
35mm and 16mm FILM Guaranteed Govt. Surplus

35mm Microfilm 20 Exp cart.**5 for $1.00**
16mm PAN film GSAP camera. Perfect 54 rolls (1320 ft.) **$5.98**
Fresh 35mm Fine Grain PAN film. Original Factory Pkg. in 20 exp Cart & Safety Can, Day 50, Tung 32, 49 Date Special 5 Cartridges for **$1.00**

ALIGNMENT TOOLS

Ideal NO-LOSS Alignment Screwdriver TL150, long Insulated Shaft. Sure-Grip Knurled Knob. Only...............**49c**
RELAY Spring Adjuster & Switch-Bd Tool Slot takes up to .022". WEC No. 293.**98c**
Feeler Gauge for Relay, Telephone & Teletype contact, 8 Detachable sizes......**98c**

BLOWERS



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40 CFM 28vacdc...**$5.98**
70 CFM 115v/400cy **4.49**
250 CFM 28vacdc.. **9.95**
250 CFM & 28 to 115 vac Transformer..**11.95**
40 CFM 24vdc BL1000 .... **6.98**
175 CFM 220vac...**11.98**

"WILLIAMSON" 10W HI-FI KIT

10 to 20000cycles with Ease! Internationally Famous; For HiFi enthusiasts. Incl Pwr supply, selected parts; Balanced resists.....**$29.95**
W'mson PreAmp Kit & Tone boost Amplifier, chassis, parts, pwr supply....**$34.95**
SUPER-Wide-Range HiFi TRIODE LOW KIT. 10to20000 cycles, 6B4G's, Max Harmonic Distortion 1¾% at full outpt & only ½% at 5W outpt. Includes Bass & Treble tube boost & Tone ckts 4PreAmp G.E. pickup 5dual & 2outpt (7) tubes, Parts, RCA chassis & info., less outpt xformer....**$29.95**
UTC Hi-Fi Outpt Xfrm for P.P. 2A3, 6B4, 6A5 & 6L6. Csd cap 30W; Sec 5 taps 2½ to 250 ohms **$6.98**
GE Reluc Cartridge perm needle...$1.98
GE Dual Reluc Cartridge RPX 050..$7.29
GE Reluc Cartridge RPX040 or 041.$7.29
GE S1201D Hi-Fi Hvy dty 12" PM Spkr **$18.98**
Sensational 10" HiFiSpkr Ideal 10 Watt Home Size, Concentric, Separate Driver Woofer & Horn **Driver Tweeter—30 to 16000 cps Range**..................**$18.98**
Electro Voice EV16H dual twilt Cart.$3.98
"LP" Anti-Static fluid GUD 1000 plays.69c
Extra dual needle for Twilt Cart....$1.20

Hi Gain Dynamic Mike & Xfrm. Buy Comb. Spcl. Dyn Mike & Xfmr. **$1.98**
XFMR Hmt-sld UTC/SuperElect 3 wdg. 600∼ct & 400tapped 250 & 150∼can be used Mike to Grid, Line to Grid & Line to Line. Csd & Hmt Sld **SPECIAL 49c; Ten for** **$4.49**

TUBES

"TAB" TESTED & GUARANTEED

PRICES SUBJECT TO CHANGE

OA2	$1.58
OA3/VR75	1.47
OA4G	1.45
OB2	1.58
OB3/VR90	1.23
OC3/VR105	1.43
OD3/VR150	.98
OY4	2.53
OZ4	.79
VS-1	12.49
C1A	9.75
01A	.69
1A3	1.10
1A4P	.79
1A5GT	.79
1A6	1.49
1A7GT	.98
1AE4	1.80
1B3/8016	.89
1B4P	.89
1B5/25S	.99
1B7GT	.99
1B21/471A	2.85
1B22	3.23
1B23	9.90
1B24 Wstnghs	8.75
1B24 Sylv	17.49
1B26	2.65
1B27	24.00
1B32/532A	3.98
1B35	11.98
1B37	18.00
1B38	29.95
1B40	4.95
1B41	49.95
1B42	18.00
1B46	1.98
1B53	49.95
1B56	38.50
1B58	350.00
1B60	69.75
EL1C	2.70
1C5GT	.89
1C6	.79
1C7G	.89
1D5GP	.99
1D7G	.89
1D8GT	.89
1E5	.99
1E7G	.99
1F4	.69
1F5G	.79
1F6	.89
1F7G	.89
1G4GT	.89
1G5G	.89
1G6GT	.79
1H4G	.89
1H5GT	.89
1H6GT	.79
1J5G	1.20
1J6GT	.79
1L4	.69
1L6	.98
1LA4	1.19
1LA6	.99
1LB4	1.29
1LC5	.79
1LC6	.89
1LD5	.99
1LE3	.99
1LH4	.89
1LN5	.79
1N5GT	.99
1P5GT	.79
1P42	4.32
1Q5GT	.89
1Q26	69.00
1R4/1294	1.29
1R5	.79
1S4	1.19
1S5	.79
1S21	6.90
1T4	.79
1T5GT	.99
1U4/5910	.69
1U5	.79
1V	.79
1V2	.70
1X2	.99
1Y2	6.98
1Z2	3.98
2A3	1.19
2A4G	1.19
2A5	.69
2A6	.69
2A7	.69
2AC15	4.98
2AS15	4.98
2B7	.89
2B22	3.90
2C21/1642	.67
2C22/7193	.33
2C26	.19
2C26A	.47
2C33/RX233H	2.98
2C34/RK34	.69
2C39	33.98
2C40	9.98
2C40 JAN	19.90
2C43	26.75
2C43/464A	9.49
2C44	1.20
2C51	6.95
2C52	5.98
2D21	1.49
2E5	1.19
2E22	1.25
2E24	4.85
2E25/HY65	5.15
2E30	2.19
2J21	10.69
2J21A	9.25

2J22	7.90
2J31	29.75
2J31A	79.95
2J32	59.95
2J33	39.39
2J34	38.50
2J36	120.00
2J37	12.70
2J38	17.75
2J39	49.50
2J42	250.00
2J48	28.50
2J49	39.45
2J50	27.50
2J52	249.50
2J56	199.50
2J62	49.45
2K25	31.95
2K25/723AB	29.45
2K29	23.95
2V3G	1.29
2W3GT	.98
2X2	.69
2X2A	1.89
3A4	.99
3A5	1.69
3A8GT	1.59
3B4	2.69
3B5	.98
3B7/1291	.69
3B23/RK22	4.95
3B24	5.40
3B25	4.50
3B26	3.70
3B28	8.80
3C6/XXB	1.49
3C22	64.25
3C23	10.98
3C34/HK24	5.49
3C31/C1B	3.45
3C45	19.90
3D6/1299	.69
3D21A	1.95
3D23	4.90
3E29	14.95
3LF4	1.29
3Q4	.79
3Q5GT	1.29
3S4	.79
3V4	.79
4-125A	29.95
4-250A	40.95
4-1000A	108.50
4B27	4.98
4C25/HK54	5.98
4C33	59.00
4C36	15.98
4E27/257	14.98
4J22	148.50
4J31	95.00
4J34	194.00
4J42/700	27.00
4J47	260.00
4J47CY	198.00
4J52	350.00
4T4/2	5.95
4X150A	45.00
4X-500F	85.00
5AX4GT	.54
5AZ4	1.35
5C30/C5B	3.95
5D21	24.30
5D23/RK65	24.95
5J29	12.40
5R4G Spec.	1.49
5R4WGY	2.98
5T4	2.49
5U4G	.59
5V4G	1.39
5W4	.89
5X4G	.79
5Y3GT	.49
5Y4G	.79
5Z3	.99
5Z4	1.29
C6A	6.75
6A3	1.59
6A4	1.89
6A5G	2.39
6A6	.89
6A7	1.39
6A8GT	1.09
6AB4	.79
6AB5/6N5	1.33
6AB7/1853	1.39
6AC5GT	1.09
6AC6G	1.49
6AC7	.99
6AD69	.98
6AD7G	1.49
6AE5	.89
6AF6G	1.33
6AG5	.89
6AG7	1.99
6AH5G	1.49
6AH6	1.99
6AJ5	2.16
6AK5	1.39
6AK5W	2.98
6AK6	1.49
6AL5	.69
6AL7GT	1.29
6AN5	5.95
6AQ5	.69
6AQ5W	5.98
6AQ6	1.25
6AQ7GT	1.19
6AR5	.79
6AR6	2.98
6AS5	.79
6AS6	2.79
6AS7G	4.98
6AT6	.59

6AU5GT	1.49
6AU6	.69
6AV5GT	1.29
6AV6	.59
6AW6	1.89
6AX5GT	.79
6B4G	1.39
6B5	1.19
6B6G	.89
6BF5	1.09
6B8G	1.09
6BA6	.79
6BA7	1.19
6BC5	.69
6BC7	1.23
6BD5GT	1.65
6BD6	.89
6BE6	.79
6BF6	1.49
6BD6G	1.65
6BH6	.89
6BJ6	.99
6BL7GT	2.75
6BN6	1.49
6BN7	1.69
6BQ6GT	1.29
6BQ7	2.45
6C5GT	.79
6C6	.79
6C7	1.26
6C8G	.89
6C21	29.45
6CB6	.89
6CD6G	2.49
6D4	2.85
6D6	.89
6D7G	.89
6D8G	.89
6E5	.89
6E6	1.39
6E7	1.39
6F4	6.35
6F5	.79
6F6	.99
6F6GT	.79
6F7	1.39
6F8G	1.29
6G6G	1.39
6H4GT	.98
6H6	.89
C6J	6.95
6J4	7.65
6J5GT	.59
6J6	1.29
6J7	1.09
6J8G	1.19
6K4	3.39
6K5GT	1.09
6K6GT	.79
6K7	.85
6K8	.99
6L5G	.79
6L6	2.43
6L6G	1.69
6L6GA	1.69
6L6GAY	2.29
6L7	1.19
6N4	2.39
6N6G	1.69
6N7GT	1.29
6P5GT	.89
6Q7	.89
6R7	.99
6R8	1.39
6S4	.98
6S7G	.89
6S8GT	.99
6SA7GT	.89
6SA7GTY	3.37
6SB7Y	1.19
6SC7	1.39
6SD7GT	.99
6SF5	.89
6SF7	.89
6SG7	1.39
6SH7	.99
6SJ7	.89
6SK7GT	.89
6SL7GT	.89
6SN7GT	.79
6SN7WGT	2.25
6SQ7GT	.79
6SR7	.69
6SS7	1.09
6ST7	1.33
6SU7GTY	3.37
6SZ7	1.05
6T7G	.89
6T8	1.09
6U4GT	.89
6U5/6G5	.99
6U6GT	1.09
6U7G	.69
6V6	2.25
6V6GT	.69
6V8	1.99
6W4GT	.69
6W6GT	.89
6W7G	1.33
6X4	.49
6X5GT	.49
6Y6G	1.27
6Y7G	.89
6Z7G	.89
6ZV5G	.89
7A4/XXL	.89
7A5	.99
7A6	.79
7A7	.99
7A8	.89
7AD7	1.49
7AF7	.89
7AG7	1.99
7AH7	1.19

7B4	.79	14W7	1.09	58	.79	355A	14.15	866A	1.35
7B5	.79	14X7	1.23	RK59	1.45	368AS	7.75	868/CEIC	3.49
7B6	.79	15E	1.47	59	1.78	371B	.90	869	36.95
7B7	.89	15R	.89	T60	10.49	380A	.79	872A	2.35
7B8	.89	FG17/5557	4.95	HY69	4.98	388A	1.49	GE872A	4.98
7C4/1203A	.79	18	.98	70A7	1.59	393A	8.90	874	1.39
7C5	.79	19	.69	70L7GT	1.59	394A	4.90	878	1.95
7C6	.99	19BG6G	1.79	71A	.79	FP400	15.98	884/6Q5G	1.80
7C7	1.49	19T8	1.09	72	.95	X400	14.98	885	1.45
7C23	72.00	19V8	1.62	CRP72	1.37	417A	8.95	893A	250.00
7C29	69.95	T20/1623	3.79	CRP73	1.49	GL434	14.98	922	.95
7E5/1201	1.29	TUF20	5.19	73	1.67	446/2C40	1.19	923	1.00
7E6	.89	TZ20	3.79	NR74	.29	446B	3.89	927/CE25	1.49
7E7	.89	20	1.17	HY75	4.59	450TH	39.00	929	1.33
7F7	1.09	RK20A	8.95	75	.79	450TL	44.00	930	.98
7F8	2.19	RX21	3.75	75TL	6.89	460/HE200	15.95	931A	6.90
7G7/1232	1.29	22	.99	76	.79			954	.29
7H7	.89	24	.85	77	.69	WL468	13.95	955	.40
7J7	1.09	24A	1.10	78	1.05	GL471A	2.69	956	.39
7K7	1.29	24G/3C24	1.90	79	.89	GL502A	1.79	957	.45
7L7	1.19	25A6	1.09	80	.69	RH507	9.98	958A	.67
7N7	1.19	25A7	3.17	81	1.69	GL530	22.00	991	.39

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7Q7	.79	25AC5GT	1.59	FG81A	3.90	531	6.98	FM1000	1.50
7R7	.99	25AV5GT	1.29	82	1.19	WL532	3.89	CK1005	.85
7S7	1.09	25BQ6GT	1.19	82V	1.39	550P1	19.95	CK1006	3.49
7T7	1.03	25C6	1.18	83	1.89	575A/975	13.75	CK1007	.89
7V7	1.39	25L6GT	.69	83V	1.89	WL579	10.49	CK1090	2.69
7W7	1.19	25W4GT	.89	84/6Z4	.99	WL579B	12.98	R1100	5.00
7X7 XXFM	1.19	25Y5	.79	85	.79	601B	.19	R1130	12.00
7Y4	.69	25Z5	.79	89	.75	HY615	.25	E1148	1.35
7Z4	.69	25Z6GT	.99	VR92	.25	616	37.00	HY1231Z	5.39
8DC-15	4.98	26	.79	FG95/5560	24.85	KU627	18.00	1612	1.98
10Y	.49	27	.69			WL670A	11.98	1613/6F6X	.98
12A	.89	FG27A	8.70	FG98	19.95	701A	5.89	1616	.90
12A5	1.39	RK28A	4.89	100TH	8.89	702A	3.29	1619	.29
12A6	.89	28D7	1.39	102D	2.98	702B	5.98	1620	5.75
12A7	1.29	30	.79	102G	2.98	703A	5.98	1622	2.69
12A8GT	.79	31	.59	FG104	37.98	704A	.98	1624	1.90
12AC7	1.45	HY31Z	2.75	FG105	18.98	705A/8021	2.79	1625	.42
12AH7GT	1.99	32	.49	VU111	1.45	707A	10.49	1626	.42
12AK5	1.98	FG32/5558	13.85	HY114B	.75	707B	17.49	1629	.35
12AK5W	2.98			HY115/145	.79	710A/8011	.95	1630	.97
12AL5	1.11	32L7GT	1.49	117L/M7GT	1.59	713A	1.00	1631	1.25
12AT6	.59	33	.59	117N7GT	1.79	NL714	5.95	1632	.77
12AT7	1.39	34	.69	117P7GT	1.39	714AY	5.90	1633	.73
12AU6	.89	35/51	.89	117Z3	.59	715A	6.45	1634	.73
12AU7	.95	35A5	.79	117Z4GT	1.39	715B	9.65	1635	1.49
12AV6	.69	35B5	.79	117Z6GT	1.19	715C	24.25	1636	3.19
12AW6	1.79	35C5	.69	117Z7GT	1.49	717A	1.49	1644	.95
12AX7	.99	35L6GT	.79	CK118		718BY	48.45	2000T	149.50
12AY7	2.95	35T	4.89	F123A	8.49	718CY	48.45	2050	1.79
12BA6	.79	35TG	3.45	T125	12.49	719A	49.95	2051	1.19
12BA7	.79	35W4	.49	F127A	19.98	721A	2.49	R4340	36.00
12BD6	1.75	35Y4	.69	VT127A	3.90	722A/287	2.45	5516	7.75
12BE6	.89	35Z3	.79	CV148	4.98	723A	9.75	5517	3.39

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12BF6	.85	35Z4GT	.69	150T	14.50	723A/B	14.49	5594	6.65
12BH7	1.29	35Z5GT	.59	VT158	14.49	724A	3.95	5608A	5.95
12C8	1.39	REL36/6J4	.49	FG166	49.00	724B	3.45	5651	3.30
12F5GT	.79	36	.65	FG172	42.50	725A	6.49	5653	....
12H6	.89	37	.69	182B	1.20	726A	6.90	5654	4.79
12J5GT	.69	38	.59	FG190	12.80	726B	59.95	5656	9.98
12J7GT	.99	RK39	2.89	T200	22.98	726C	69.95	5658	....
12K7GT	.89	39/44	.59	201A/CX301A	.98	801A	.45	5663	1.85
12K8	.99	CRC40	.59			802	3.98	5670	5.98
12Q7GT	.79	T40	4.29	203A	5.98	803	3.89	5684	14.98
12S8GT	.98	TZ40	3.98	205B/VT2	1.69	804	8.95	5686	4.23
12SA7GT	.89	40	1.09	CE206	3.15	805	3.90	5687	5.75
12SC7	1.39	HY40Z	3.75	211/VT4C	1.89	807	1.67	5692	7.69
12SF5GT	.79	41	.79	CE215	8.98	808	2.98	5693	7.69
12SF7GT	.59	42	.69	RX125	9.95	809	2.43	5694	3.65
12SG7	.89	43	.85	WE215A	.18	810	10.98	5726	4.39
12SH7	1.10	45	.69	217C	8.75	811	2.90	5749	4.39
12SJ7GT	.79	45S/VT52	.34	227A	4.98	812	2.90	5751	5.98
12SK7	.89	45Z3	.69	231	1.20	813	8.65	5763	1.70
12SL7GT	.79	45Z5GT	.89	242C	8.49	814	3.85	5812	2.99
12SN7GT	.89	46	.89	244A	4.15	815	2.90	5814	5.49
12SQ7GT	.79	47	.99	247A	9.95	816/866Jr.	1.09	5881	3.39
12SR7	.98	48	1.99	250R	9.90	826	.95	X6030	4.49
12X3	.90	RK48A	14.85	250TH	22.25	828	11.29	UX6653	.69
12Z3	.89	RK49	7.50	250TL	19.40	829	11.49	8002R	99.50
14A4	1.09	49	.83	HK254	14.49	829B	13.45	8005	5.85
14A7/1287	.99	50	1.19	262B	3.98	830B	3.49	8008	6.49
14AF7/XXD	1.19	EF50	.98	274B/5R4	1.90	832	5.65	8012	2.89
14B6	.99	50A5	1.19	276A	9.89	832A	9.75	8013	2.75
14B8	.89	50B5	.79	T300	26.98	833A	48.90	8013A	4.79
14C5	1.09	50C5	.69	304TH	11.25	834	5.95	8014A	28.95
14C7	1.09	50C6	1.49	304TL	11.25	836	4.75	8020	1.25
14E6	.99	50L6GT	.69	307A/RK75	4.85	837	1.55	8025	5.79
14E7	1.09	50X6	.89	310A	6.75	838	3.98	9001	1.65
14F7	1.09	50Y6GT	.79	311A	7.90	843	.39	9002	1.29
14F8	1.29	50Z7G	.98	313C	2.98	845	4.90	9003	1.19
14H7	.99	52	.99	316A	1.49	849	29.45	9004	.59
14J7	1.19	53	.69	323A	24.25	852	19.98	9006	.29
14N7	1.49	TS5	8.79	327A	4.95	860	4.90	Sub-Miniatures	
14Q7	1.09	55	1.06	350B	5.90	861	23.95	1AD4	2.95
14R7	1.19	56	.85	353A	4.75	864	.39	2E31	1.49
14S7	1.09	57	.79	HK354	24.98	865	1.29	2E36	1.49

2E43	1.39
CX501X	1.26
CK501AX	1.26
CK502AX	1.79
CK503AX	1.79
CK505AX	1.79
CK506AX	1.79
CK509AX	1.26
CK512AX	1.79
CK522AX	1.79
CK525AX	1.79
CK526AX	1.98
CK528AX	1.79
CK529AX	1.98
CK531DX	.98
CK532DX	.98
CK533AX	1.39
CK534AX	.89
CK536AX	.89
CK537AX	4.98
CK538DX	.89
CK539DX	.98
CK541DK	1.98
CK542DX	.98
CK543DX	.98
CK544DX	.98
CK546DX	1.98
CK547DX	1.98
CK571AX/5886	6.98
SD828	.98
SD969	.98
CK1028	9.98
CK1089	4.69
CK1090	4.69
5638	4.79
CK5672	3.15
CK5676	2.98
CK5678	2.45
CK5697	5.98
CK5702	5.98
CK5704	5.79
CK5783	6.69
CK5784	4.49
5829	5.98
CK5875	1.98

C'Ray Tubes

2AP1	11.90
3AB1	12.95
3AP1	14.25
3BP1	7.95
3BP1A	14.98
3CP1	2.20
3DP1	4.85
3EP1	5.85
3FP7	1.89
3FP7A	14.98
3GP1	4.70
3HP7	3.85
3HP14	14.98
3JP7	12.50
3JP12	19.95
3JP14	16.95
4AP10	4.69
5AP1	3.65
5BP1	4.89
5BP1A	14.98
5BP4	4.75
5CP1	4.89
5CP7	4.95
5FP7	2.95
5FP14	18.98
5HP1	9.75
5HP4	9.75
5JP2	24.40
5LP1	29.95
5MP1	9.75
5NP1	5.85
7BP1	4.95
7BP7	6.75
7JP4	18.39
9GP7	14.89
9LP7	10.95
10BP4	18.29
10FP4	24.50
12DP7	16.89
12DP7A	49.50
12GP1	49.98
12GP7	16.89
12HP7	16.89
12JP4	27.00
12KP4	47.00
12LP4	21.25
16KP4	47.29
16LP4A	36.98
16MP4A	43.98
16RP4	36.49
16TP4	39.98
16YP4	43.98
17BP4	43.45
17BP4A	36.49
19DP4A	67.65
20CP4	68.25
902	10.65
905	3.49
912	89.98
913	11.98
914A	45.00

Vacuum Capacitors

MMF	5KV	Each
25	5	3.49

100	7.5	6.95
50	15	7.98
12	20	9.98
50	20	9.98
55	20	9.98
100	20	12.98
150	20	14.98
12	32	12.98
25	32	14.98

Tungar Bulbs

16x897	3.49
20x672	2.95
195528	2.49
217283	6.75
289881	2.50
859483	2.95

Mazda Pilots

49, box 10	.60
51, box 10	.55
55, box 10	.50
64, each	.07
S6/T4/3W	.18
100W/20V	.25
291, box 10	.36
311/28V	.15
313/28V	.15
323/3V	.25

Sylvania

S6/6W120V	.15
WStghs C7/7W/120V	.15

MedScrewBase

15W/125V	.08
25W/125V	.08

Neon Bulbs

NE16/991	.40
NE20	.10
NE21	.45
NE32	.35
NE45/2W	.27
NE51/NE20	.10

Xtal Diodes

Many Late Dates Latest JAN Specs

1N21	.89
1N21A	1.65
1N21B	3.98
1N21C	26.70
1N22	1.25
1N23	1.49
1N23A	2.98
1N23B	4.98
1N25	7.45
1N26	6.45
1N27	1.65
1N29	3.50
1N32	18.00
1N34	.69
1N34A	.89
1N35	1.95
1N38	1.62
1N39	5.65
1N40	9.98
1N45	1.39
1N46	.89
1N48	.70
1N51	.52
1N52	.95
1N54	.89
1N55	2.99
1N56	.89
1N57	.89
1N58	1.19
1N60	.60
1N61	1.98
1N62	Write
1N63	3.89
1N64	.75
1N67	1.95
1N69	1.98
K34	1.39
CK705	.77
CK706	.54
CK707	1.80

Thermistors

WEco 10A	.90
WEco 12A	1.10
D167019 Vol Limiter	2.95
D168391 Thermal Comp	2.95
D170396 HF Pwr. Meas.	.90
1C Bulb Time Delay	.90

Varistors

CW20259/USN38C	2.95
WEco 40A	1.50
WEco 41A	1.50

Xtal Freq Stds

200Kc	4.50
1000Kc	3.49
4700Kc	.98
5000Kc	3.98

HtrOvenXtals

5010/5025/5055 Kc. ea. 14.98

THAT'S A BUY **"TAB"** THAT'S A BUY

DEPT. 12RN, **SIX CHURCH ST. NEW YORK 6, N.Y., U.S.A.** - CORNER CHURCH & LIBERTY STS. ROOM 200

Money Back Guarantee (Cost of Mdse Only) $5 Min. Order FOB NYC. Add Shpg. Charges & 25% Dep. Tubes Gtd. via R-Exp. only. Prices Subject to Change Without Notice. Phone: WOrth 2-7230.

TRANSFORMERS

115 V 60 Cyc Input TV & CR Pwr Xfmr for 7" to 20" Tubes. Hi VOLTS to 20KV (w/quadrupler ckt). ALL Tubes, PL & FIL wndgs dlvrng: 300 VDC/275Ma Full-Wave. 6.4V/10.3A. 5.4/8A, 2.5V/3A Hypersil Core. Oil impreg..........$7.98
2500V for CRT. 6.3V/.6A. 2.5V/1.75A CSD Kenyon Hvins. 4/BC412 Replmnt.....$7.98
1400VCT/90MA. 6.3V/3A. 5V/3A Hsld.$5.98
1320V & 375VCT/110MA, 5V/3A. 2.5V/3.25A; 6.3V/2.75A HSLD HVINS...$9.98
1100VCT/200MA, 6.3VCT/4A, 5V/3A.$5.98
1030VCT/300MA, 5V/3A, 2.5VCT/5Ahmsld $9.98
1000VCT/200MA, 18V/.55A. 6.3V/5A, 5V/6A $6.98
1000VCT/150MA, 300V BIAS. 6.3V/5A. 5V/3A 2X6.3V/.65A, 6.3V/1.25A...$4.98
1000VCT/125MA, 500VCT/100MA, 2X5V/3A, 18V/1A. 6.3V/8A U.T.C.......$5.98
1000VCT/45MA, 795VCT/80MA. 360VCT/55MA, 3X5V/3A. 6.3VCT/1A, 6.3VCT/.3A CSD HVINS CAN BE USED 2X RATING RAYTHEON HIPERSIL CORE.......$4.98
900V/35MA, 2X2.5/2A. XCLENT 1800V DBLR TWO 2X2 FIL. WNDGS HSLD HVINS $2.98
900V/3MA, 6.3V/2A. 2.5V/3A.....$2.98
840VCT/110MA, & 530VCT/21MA, 2.5V/3A 6.3V/1A. 6.3V/.3A CSD HVINS..$4.98
770VCT/85MA, 5V/2A, 6.3V/3.5A $3.98
770V/2.5MA, 2.5V/3A HVINS HMSLD includes FILTER PARTS...........$3.69
760VCT/120MA, 2.5VCT/10A. 6.3VCT/2A, 5V/3A. 10V/3.25A $6.98
720V/85MA, 5V/3.5A. 6.3V/3.5A...$2.98
700VCT/125MA, 6.3VCT/4A. 5V/3A.$3.98
700VCT/85MA, 6.3V/.3A, 6.3V/7.5A, 5V/2A $3.25
650VCT/150MA, 5V/3A. 6.3V/2.1A.$2.98
600VCT 150MA, 6.3V/4A, 5V/3A ..$3.98
570V/150MA, 5V/3A 12V/4A HSLD.$4.49
550VCT/275MA, 5V/4A. 6.3V/6A...$4.49
500VCT/60MA, 6.3V/4A HSLD....$2.98
480VCT/80MA, 6.3VCT/4A. 5V/3A..$2.69
420VCT/90MA, 6.3V/1.9A W/INPUTS 6, 12, 24. 115VDC & 115 230VAC @ $1.98
420V/30MA, 6.3V/30MA. 6.3V/.6A, 6.3V/1.1A $2.39
550VCT/150MA, 5V/3A, 6.3V3A....$3.49
220V/50MA. 6.3V/2A. 6.3V/1A, 5V/6.5A **JEFFERSON H'SLD** $1.89

FILAMENT TRANS

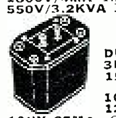
2.5V/2A @ 79c,..........2 for $1.49
2.5VCT/10A 10KVINS 4.98
2.5VCT/20A/12KV INSUL CSD **HSLD** 7.98
2.5V/40A/20KV INS 12.98
5VCT/10A4KV INSUL CSD HSLD.. 5.95
5VCT/10A/12KV INSUL G.E...... 6.98
5V/60A CSD KENYON HVINS..... 12.95
5V/115A CSD KENYON HVINS..... 16.95
6.3VCT/.6A 1KV INS CSD HVINS..1.98
6.3VCT/.7A NAVY HSLD HVINS... 1.98
6.3VCT/1A THORDASON HVINS CSD 1.98
6.3V/2A @ $1.39. 2 FOR....... 2.69
6.3VCT/4A USN USABLE 6.5A CSD 2.69
7.5VCT/12A HVINS CSD KENYON. 4.98
12.6VCT/1.25A CSD HMSLD..... 1.98
24V/2A CSD @ $1.98, 2 FOR.... 3.49
24V 6A CSD @ $4.98, 2 FOR.... 5.49
42.5V/2A SEL RECT TRANS...... 4.85
2X5V/10A. GE 12.5VINSL....... 10.98
6.3V/.6A, 2X2.5V/1.75A HSLD... 3.49
2X2.5VCT/6A, 2.5VCT/12A/12KVINS BRDG. RECT 8.49
6.4V/12A, 6.4V/10.6A. 3X5V/3A, 2.5V/1.75A. 2X6.3V/.3A. 2X5V/3A.6A, 7V/14A .147KVA GE.... 4.98

STEP UP OR STEP DOWN

220V to 110V/100W Ametran.....$ 3.98
440V to 220V/200W @ $4.98, 220/110V/200W 4.98
Isolation 115to115V/185Watts ... 3.98
90, 95, 100, 105, 110, 115, 120, 220V 2KW 19.95
220-110V/250W G.E. 5.98

PLATE TRANS

2X330VCT/25MA or 660VCT CSD..$ 1.29
355VCT/325MA 490V TAP HVINS. 4.98
1100VCT/212MA; PRI 115 or 230V 6.50
3000V/10MA CSD WE D161913... 8.95
5500/650MA USN WSTGHS CSD... 69.95
15000V AS V'DBLR WE. SIG 3H5629/7500V/35MA 19.95
1800V/4MA NAVY HSLD HVINS.. 4.49
550V/3.2KVA HVINS 12.98



CHOKES

DUAL 30HY/60MA CSD.$0.98
3HY/40MA HI Q CSD **2 For** .98
15HY/40MA AC/DC SETS **3 FOR** .98
10HY/60MA/UTC **2 FOR** 1.25
12HY/80MA CSD 2.25
10HY 85MA @ 98c........**2 FOR** 1.79
5HY/100MA HMSLD G.E.......... 1.39
8HY/100MA/60MA/CSD/H'SLD/2KVINS/USN 1.49
10HY/100MA/80~UTC HSLD 1.89
59HY/100MA/CSD 3KVINS/ HSLD.. 1.98
DUAL 5HY/120MA/2000VTEST 2.89
50HY/125MA/CSD/HSLD 2.25
DUAL 12HY/150MA/CSD/2KVINS... 2.98
8HY/200MA UTC 2.25
12HY/300MA/CSD/3KVINS/HSLD.... 3.95
12HY/200MA UTC TAPPED........ 3.65
8HY/225MA THORDASON 3.65
DUAL 2HY/300MA HMSLD USN @ **$1.25** ....**2 FOR** 1.98
20HY/300MA, or 15HY/400MA/12KVINS 8.95
3HY 400MA, 15KVINS HMSLD..... 3.49
.35HY/2.5A/GE/1.8KVINS 3.98
10HY 135MA 1.35

MODULATION and AUDIO XFMRS

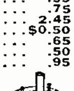
MODUL/240 Watts Peak PP Par 807's to PP807's RF/2000 ohm Load STANCOR/USN H'Sld $6.95
UNIV OUTPUT/12 Watts Any Tube Any Voice Coil UTAH 5999.**$1.29; 2 for $1.98**
Line Auto Former/30W UTC LVM-11.$3.49
Mike or Line to Grid "ouncer" UTC 0-14 50:1/200 ohms to ½ meg **$13** List.$2.98
OUTPUT/300 Watts Hi-Fi PP805 to 9 ohm VC, Weco H'Sld HiVins..........$12.98

CONNECTORS

UG9/U	$1.90	UG58/U	$0.75
UG19/U	2.20	UG106/U	.10
UG21/U	1.30	UG254/AU	3.40
UG22/U	1.60	CW123U	.55
UG24/U	1.50	M359A	.75
UG27/U	.70	UG30/U	2.45

831R/SO239 Receptacle $0.50
831SPN/PL259A Plug .... .65
831SP/PL259 Plug .... .50
83-1J/PL258 Junction .... .95

VARIABLE CONDENSERS



A. 150mmf/300VGap HF .$1.39
B. BUD Dual 75mf ea. Sect 1000V Gap. HF....$1.29
C. JOHNSON 70H30 70 mmf/3000V Gap $1.29
D. Cardwell Neut ZT/12 mmf 500 Volt Gap 98c
E. CARDWELL TK-300-US 53 to 312 mmf. Can be made Split Stator. BRAND NEW $10.95
Vernier Drive 10 to 369mmf, each....69c
Midget 3 to 15 mmf, Midline, each...39c
Phasing Condenser 90 Degree Quadrants, 4 Taps, 360deg Sinewave Gen......$4.98
2½ Meter Butterfly Cndsr 30mmf w/RF Tank & Choke........59c; 2 for 98c

"TAB"
THAT'S A BUY

OIL CAPACITORS

Mfd	Each
25wvdc	
50	$6.98
50wvdc	
4	.49
150wvdc	
1-1-3-5	.69
250wvdc	
1	.39
2x.25	.35
300wvdc	
1.2	.39
400wvdc	
.1	.49
.25	.55
.5	.59
1	.69
4	1.69
6	2.29
8	2.49
10	2.89
2x.1	.75
2x.5	.94
3x.1	.91
3x.25	.99
600wvdc	
.034	.49
.1	.64
.2	.69
.25	.71
.5	.75
1	.85
2	.99
3	1.08
4	1.89
5	2.29
6	2.69
7	2.89
10	3.29
2x.1	.79
2x.25	.85
2x.5	.98
2x1	1.19
2x2	1.39
2x8	3.49
3x.05	.89
3x.22	.98
3x.25	1.09
700wvdc	
4	1.98
800wvdc	
.1	.69
1000wvdc	
.1	.73
.45	.79
1	.99

Mfd	Each
2	1.69
4	2.29
5	2.98
10	3.98
15	4.98
1400wvdc	
.25	1.29
.5	1.39
1500wvdc	
.5	1.59
.75	1.69
1	1.79
2	2.29
4	2.98
5	3.49
6	3.98
.05	.79
2000wvdc	
.1	1.49
2x.1	1.75
1	1.98
2	2.49
3	3.98
4	4.49
5	5.39
8	9.49
2500wvdc	
.25	2.29
3000wvdc	
.1	2.49
.5	2.98
2	4.49
3	5.39
4	6.49
4000wvdc	
2	8.98
5000wvdc	
.2	4.49
2	10.98
4	19.98
5500wvdc	
2	12.98
7000wvdc	
.002	1.69
.0075	1.98
.1	4.98
7500wvdc	
.03	2.98
.05	3.49
10000 wvdc	
.03	3.49
12000 wvdc	
.02	4.98

Mfd	Each
12500 wvdc	
.65	16.98
2	95.00
15000 wvdc	
.0016	9.98
25000 wvdc	
.00025	7.49
1	95.00
AC RATED	
220vac/600dc	
2	.69
4	.89
5	1.29
225vac/630dc	
3.3	.79
230vac/630dc	
5	1.29
330vac/1000dc	
1.25	.79
1.5	.89
1.75	.98
2	1.03
2.5	1.09
2.8	1.15
3	1.19
4	1.29
5	1.49
12	3.49
15	3.98
25	6.49
40	9.98
405vac/1200dc	
.15	1.29
600vac/1800dc	
16	6.98
660vac/2000dc	
5	4.49
6	4.98
10	6.98
16	7.98

Brand NEW Made to Rigid Gov't Specs.

MICA CAPACITORS

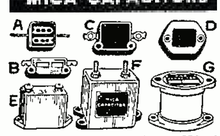


Fig. A. Postage & ½ Postage (*Silver Mica)

Mfd.	Each	Mfd.	Each
.00002	$0.09	.0011*	$0.17
.000022	.09	.0012*	.23
.000024*	.17	.002	.15
.000025*	.17	.00224*	.27
.00004	.09	.0025	.15
.00005*	.17	.003/1KV	.29
.000082	.09	.0033*	.35
.0001	.09	.004	.22
.0001*	.17	.004*	.43
.0003	.09	.005	.22
.001*	.17	.006	.23
.0011	.09	.01	.29
.0002	.08	.00015	.09

Fig. B. .001 mf, **10c;** .006 mf, **23c;** .01 mfd, **35c.**

Fig. C. Solder Lug Terminals & Mtg Holes

Mfd.	Each	Mfd.	Each
600 WV		**600 WV**	
.0001	$0.29	.02	$0.76
.001	.42	.03	1.19
.002	.45	**1200 WV**	
.004	.53	.002	.66
.005	.55	.004	.68
.006	.59	.005	.71
.008	.63	.01	.78
.01	.66	**2500 WV**	
		.00047	.59

Fig. D. Screw Term & Mtg

Mfd.	Each	Mfd.	Each
600 WV		**1200 WV**	
.0001	$0.29	.01	$0.78
.00055	.37	.013	.89
.00085	.42	.03	1.89
.0012	.44	.033	2.39
.003	.49	**2500 WV**	
.005	.54	.0004	.59
.015	.71	.002	1.09
.02	.78	.0022	1.09
.03	1.19	.0024	1.13
.033	1.29	.0035	1.19
.039	1.98	.0036	1.19
.04	2.09	.0043	1.29
.05	2.39	.005	1.45
1200 WV		.006	1.55
.001	.61	.01	1.89
.002	.66	.015	2.19
.0051	.71	**3000 WV**	
.0068	.75	.0055	1.35

Fig. E. Upright Xmtg Micas

Mfd.	Each	Mfd.	Each
250 VDC		**3000 VDC**	
.05	$0.47	.005	$1.65
.2	2.59	.008	1.79
1500 VDC		**3500 VDC**	
.04	.89	.000033	.78
.05	1.08	**5000 VDC**	
2000 VDC		.000082	1.65
.003	1.08	.0001	1.79
.005	1.19	.00015	2.29
.006	1.25	.00018	2.39
.01	1.39	.0002	2.49
.015	1.68	.0003	2.75
.02	1.98	.00043	2.85
.03	2.35	.0006	3.59
2500 VDC		.001	3.89
.0025	1.08	.005	4.29
.006	1.65	.01	4.79
3000 VDC		**6000 VDC**	
.00005	.78	.001	4.29
.0001	1.08	.002	4.79
.0003	1.15		
.0007	1.19		
.0055	1.39		

Fig. F. Heavy Duty, Upright, Bklte Csd

Mfd.	Kv.	Each	Mfd.	Kv.	Each
.004	6	$5.59	.01	8	$10.95
.0003	8	3.98	.0025	8	5.59

METER SPECIALS

Best Buy—5 Ma DC Tuning Meter. G-E. 2½" dia. $1.29
SPECIAL—0-15 VAC. 2 1/16" Rd., GE. 800 cyc. USN. .$1.69

DC MICROAMMETERS

0-50 ua Weston 3" sq. 16.98
0-150 ua. 2" McClintock.......... 8.49
0-500 ua, 2½" DeJur.......... 6.98

DC MILLIAMETERS

0-1 Ma (Reads 5KV. Less Mult) 3" sq. Weston 7.50
0-10 Ma & 0-5KV (Basic 1 Ma). 3½" 4.98
0-10 Ma & 0-1KW (Basic 1 Ma), 3½" 4.98
0-25 Ma, Weston 3" sq.......... 6.98
0-30 Ma, Weston 3" sq.......... 6.98
0-200 Ma, 2½" GE.......... 5.98
0-300 Ma, Weston 3" sq.......... 5.98

DC AMMETERS

0-1A, 3½ Wstghs 4.98
0-5A, 2½" Triplett.......... 3.49
0-10A, 3½" sq. Triplett.......... 3.98
0-15A, 2½" Triplett.......... 3.49
0-30A, 2½" Shunt WECo, Wstghs.. 2.98
0-35A, 2½" Gen. Elec.......... 3.49
0-60A, 2½" Int. Shunt. WECo..... 3.49
0-120A, 2½" Ext Shunt WE/Wstg.. 3.98
0-240A, 2½". Less Shunt........ 3.98
0-300A, 3", Less Shunt, WECo..... 4.49
30-0-30A, 2⅜", Weston 203P&Wstg 4.98
60-0-60A, 2½". W/Shunt, WE/Wstg 4.98
620-0-120A, 2½" Shunt. WE/Wstg. 3.98
240-0-240A, 2½" Less Shunt, GE.. 3.69
480-0-480A, 2½" Less Shunt. Wstg. 3.69

DC VOLTMETERS

0-5 Volts, 2" sq. Wstghs......... 2.98
0-800 Volts, Weston 3" sq. Bilt-in Mult. 12.98

RF METERS

0-1A, 2½" G-E. USN—B'Csd....... 3.95
0-8A, 3" Triplett Hi-Freq.: Int.C ouple 4.98
0-9A, 2½" Wstghs USN.......... 2.49
0-5A, 2½" Rnd Wstghs 3.79

AC VOLTMETERS

0-7.5V, 3½" Wstghs 2.49
0-8V, 3¼". Weston 3.49
0-130V, Weston 476. 3½" Rd..... 7.49
0-150V, Weston. 3" sq., Rect. Type.. 8.98

VOLUME LEVEL INDICATOR

−20 + 3VU, Weston, 3 sq..........16.98

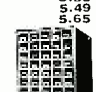
LINE FILTERS

10Amp/130vacdc Csd USN 0.1 to 1000 Mc's....**$1.29**
30Amp/250vacdc Csd USN 0.1 to 1000 Mc's..........**$3.98; 2 for $6.00**
50Amp/600vdc/250vac. Fltrs both sides of line. SOLAR "Elim-O-Stat". New **$9.98;**
100Amp/usable 110 vacdc GE **2 for $1.98**

SELENIUM RECTIFIERS

Volts In	Volts Out	Amps	Each
HALF WAVE			
18	12	.15	$0.69
130	120	.075	.59
130	120	.065	.55
130	120	.09	.69
130	120	.2	.98
FULL WAVE BRIDGE			
18	14	2	$2.40
18	14	4	3.85
18	14	6	5.49
18	14	8	5.65

PARTS CABINETS



50 Draw Hvy Steel 34½"H/18"W/9"L/65Lbs. draws3"W/2½"H/8"L ......@ **$38.00**
100Draw as above @ **$63.00**
27Draw Hvy Steel 37"H/30¾" W/14¼" L/120 Lbs Draws 3"H/9"W/12"L ....@ **$39.95**
Write for Quantity Price "Extend Do"

END EQUIPMENT BUYS!

US Navy Version BC645 Ideal Citizens Band Conversion, NEW, less tubes, connector & Dyn. $12.95
RADIO COMP RCVR Less Tubes,AsIs 5.98
TG5 Keyer, As Is.......... 5.98
EE8 RingingGenAssy, Like New, Less Handset(TS-9) 7.98
RM-53 TEL CONTROL 4 Xmitter.... 5.49
R9/APN4 Receiver, Less Tubes. As Is 14.98
TG10 Code Unit, Less Tubes & Cabinet, as is 19.95
RM29 Control Unit. BRAND NEW.. 11.98
RT34/AP513 30 Mc IF Less Tubes, As Is. Good Condition.......... 7.98
R59/TPS3 Good. As Is, Less Tubes. 29.98
EE65 Telephone Test Set, Fine Cond. 24.98
BE65 Time Interval Signal, Used... 3.98
R74/CRW Rcvr, Less Tubes, As Is.. 2.49
I-81 Compass Indicator. Like New.. 7.95
I-82 Compass Indicator. Like New.. 4.95
PE97 Plate Supply Unit, Less Tubes 9.98
I-108 Range Calibrator, Metal Case. 29.98
PE120 Pwr Supply, Less Tubes. Used 9.98
Mackay 168BRadioXmitter, w/Metal Case, Less Vibrapack & Tubes. As Is 2.98
I-198 Sig. Gen,Good Cond.LessTubes 14.95
ART SPCH AMP, New Less Tubes.... 6.98
BC456 Mod. Less Tubes, Dyn. As Is 1.98
BC457 Xmtr (4-5.3Mc), LT*, As Is.. 3.49
BC458 Xmtr (5.3-7Mc), LT*, As Is. 3.98
SCRIFF Unit, Less Tubes, As Is.... 3.98
BC602 Cont Box for 522, As Is.... 1.29
BC605 Amp, Less Tubes, As Is.... 3.98
BC733 Rcvr, CAA appvd, LT*. As Is 19.98
BC906 Freq.Mtr.ExcCond.LessTubes 29.95
FOXBORO GRAPHIC RECORDER.....39.50
BC 322, WALKIE TALKIE w/Bag, Tubes Crystal. A pair.......... 98.00
DYNAMOTORS in stock—What are your requirements?

TUBE SOCKETS, ALL TYPES

A. RCA 5-pin GIANT. 803. etc.....$1.49
B. Johnson 4-pin Bayon, 866. etc.. .85
C. 304TL Socket 1.15
D. Johnson 7-pin Steatite, 829B; **69c; 10 for** 5.00
D. Johnson 122-237, HK257, 813 .63
E. Small Shell DUODECAL, 2BP1... .75
F. Med Shell DIHEPTAL Cinch MICA .89
G. 5-pin ACORN 1-9/16" dia.... .39
H. Johnson 122-234, w/tube Lock, 5D21 .... .98
I. 4-prong STEATITE Johnson, 866 .30
J. 5-prong STEATITE Johnson, 807 .30
K. 7-pr. STEAT Johnson, 1625..... .36
L. 7-pin NATIONAL CIR7L Steatite .30
M. MINI 7-pin Mica 'B-HF & Shield .30
M. MINI 7-pin Mica 'B Top Mtg&½ Shld B .... .23
M. MINI 7-pin Bot Mtg Bklt Sim Amph 147-500 .... .13
M. NOVAL 9-pin Mini. ½ Shld Base, Top Mtg. .... .45
M. NOVAL 9-pin Min. ½ Shld. Top .45
M. NOVAL Shld. 1½", **12c;** 1-15/16" .14
N. AMPH fem 78F Pin 4,5.6.8...... .17
O. 4-pin AMPH49RSS4&mtg Ceramic .27
P. OCTAL 8-pin & plate Bklte..... .10
Q. OCTAL 8-pin & plate Steatite... .25
Q. OCTAL 8-pin & plate Mica 'B.... .11
R. LOKTAL 8-pin & lock Mica 'B HF .10

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No Mfrs Choice—We Ship Types in Stock

0.116	271	1200	3100	14550	90000
0.42	275	1223	3163	14600	91000
0.425	280	1250	3259	15000	93300
0.607	286	1260	3290	16000	95000
0.7	289	1300	3333	16500	100000
1.03	299	1350	3384	16800	110000
1.3	300	1355	3500	17000	115000
1.75	310	1400	3509	17500	116667
2.5	311.5	1488	3700	17977	120000
3	320	1495	3730	18000	130000
3.83	325	1500	3760	18300	135000
4	330	1510	4000	18380	140000
4.35	340	1518	4030	18500	141000
5	350	1600	4200	18800	145000
5.025	360	1640	4220	19000	147000
6.25	366.6	1646	4280	19500	150000
6.5	370	1650	4300	20000	155000
7	375	1670	4314	20441	160000
7.8	380	1680	4440	20500	165000
7.9	389	1710	4444	21000	166750
8	390	1712	4500	21500	167000
10.38	400	1740	4720	22000	169200
11.25	410	1770	4750	22500	175000
12	414.3	1800	4850	22990	180000
13.52	418.8	1818	4885	23000	180600
14.2	425	1830	4900	23150	185000
14.25	426.9	1865	5000	23325	186600
14.5	427	1892	5100	23400	190000
15	440	1894	5210	23500	198000
16	450	1895	5235	24000	200000
17	452	1896	5270	24600	201000
19	460	1897	5300	25000	205000
19.2	470	1898	5500	25200	210000
20	475	1899	5600	25400	215000
22	478	1900	5730	25833	220000
23	480	1901	5770	26000	225000
24	487	1902	5910	26500	229000
25	500	1903	6000	26600	230000
26	520	1904	6100	27000	235500
28	525	1905	6125	27500	238000
30	540	1906	6140	28000	240000
31.5	550	1907	6200	28430	245000
37	575	1908	6300	28500	250000
48	580	1909	6495	29000	265000
49	588	1910	6500	29500	268000
50	600	1911	6840	29990	270000
51.78	612	1912	6990	30000	275000
55	625	1913	7000	31000	294000
56.7	633	1914	7320	31500	300000
60	640	1915	7500	32000	307500
63	641	1916	7700	33000	311000
68	645	1917	7717	35000	314000
74	649	1918	7900	37000	316000
75	650	1919	7930	38140	325000
80	657	1922	7950	38500	330000
81.4	665	1924	8000	39000	333500
88	668	1926	8094	39500	350000
89.8	670	1960	8250	40000	353500
95	673	1980	8500	42000	375000
100	675	2000	8700	43000	380000
101	680	2045	8770	45000	400000
105	681	2080	9000	.....	402000
105.7	684	2095	9100	47500	420000
107	689	2141	9445	48000	422000
120	697	2142	9500	48660	425000
121.2	699	2145	9710	49000	450000
125	700	2150	9800	50000	458000
130	711	2160	9900	52000	478000
135	733	2180	9902	55000	500000
147.5	740	2187	10000	56000	520000
150	750	2195	10430	57065	521000
160	800	2200	10500	58333	525000
165	806	2250	10600	60000	543000
170	850	2300	10900	61430	550000
175	854	2400	10936	62000	570000
179	899	2450	11000	64000	575000
182	900	2463	11400	65000	600000
182.4	910	2485	11500	66600	620000
200	917	2490	11690	66650	650000
209.4	946	2500	12000	67500	654000
216	978	2525	12500	68000	660000
220	1000	2600	12800	70000	690000
220.4	1030	2625	13000	72000	700000
225	1056	2635	13100	73500	750000
230	1059	2700	13500	75000	761300
235	1067	2750	13550	80000	800000
240	1100	2850	13600	82000	813000
245	1110	2860	14000	84000	850000
245.4	1150	2870	14250	85000	900000
250	1155	2900	14400	85750	930000
260	1162	3000	14500	88000	950000

Any Size Above, Each 35c; Ten for $3.29

MEGOHMS

1.	1.57	2.25	3.673	6.	8.02
1.1	1.579	2.5	3.75	6.5	8.5
1.2	1.65	2.7	3.9	6.6	9.05
1.25	1.75	2.75	4	6.7	9.5
1.3	1.8	2.8	4.23	7	10
1.35	1.9	2.855	4.25	7.5	11.55
1.39	2	3	4.5	7.62	12
1.4	2.11	3.3	5	7.74	12.83
1.5	2.2	3.5	5.5	8	13
					13.85

Any Size Above, Each 70c; Ten for $6.49

Vacuum Precision HiVolt Resistors

Megohms—.12/.25/.6/.75/.83/.99/1/1.5/2/3/3.75 ½% Accy...Ea. **$1;** 10/**$7.50**

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SPNC/10A/WZ-RQ11/Plunger $0.69
SPNO/10A/YZ-7RTC/Pin Plunger... .54
SPNO/10A/G-7RS1/Plunger ...... .59
SPNC/30A/B-1/HI-ALT/Cased 1.25
6 AMP/125V Removed from Equip. Bklt. CSD **CLEAN** SPST..**4/$1;** DPST..**3/$1**

6-VOLT CARTER GENEMOTORS

Brand New! Way Below List Price

Inpt.	Outpt.	Model	Each
6V/29A	400V/375maint	4037AS	$29.95
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All Carter Genemotors Supplied with General Electric Input Filter Free

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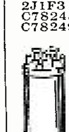
2J1G1 GE As Is No Returns...2 for .49c
2J1H1 GE Selsyns ....2 for $6.98
2J1F3 GE Brand New115V/400cy.ea.$9.75
C78248 Sync.Trans115V/60cy.2for $18.00
C78249 Sync.Diff. 115V/60cy. @ $9.95; 2 for $18.00



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50 mf/350vdc FP........**3 for 98c**
30-15-10mf/250vdc .....**3 for 98c**
40-20mf/250-25vdc .....**4 for 98c**
30-2x20mf/450-25vdc FP..**2 for 98c**
10-2X 20mf/450-25vdc FP **3 for 98c**
4mf/450vac "Tynee-Dry"..**2 for 98c**
6000mf/15vac. SPECIAL.....**$3.29**

HIGH CURRENT MICA CNDSRS.

CYLINDRICAL SIMILAR TYPE "G"

Mfd	Kv	Amps	Mc	Each
.09	1.5	35	1	$12.49
2X.003	1.5	7	1	2.98
0002	6	5	3	5.98
01	10	37	1	35.00
00005	20	4.5	3	6.98
0005	35	13	3	37.50

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COLOR TELEVISION PRODUCTION QUALITY

In the CBS-Columbia design laboratories, Al Goldberg takes some important readings with the EICO Model 221 Vacuum Tube Voltmeter and Model 555 Multimeter, as Harry R. Ashley looks on.

Mr. Al Goldberg, Assistant Chief Engineer of CBS-Columbia, and Harry R. Ashley, President of EICO, inspecting the use of the EICO Model 221 Vacuum Tube Voltmeter and Model HVP-1 High Voltage Probe at the Sweep Frequency Troubleshooting Position on the CBS-Columbia Color Television production lines.

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NEW 555K MULTIMETER
KIT $29.95. WIRED $34.95
20,000 ohms/volt

320K SIG. GEN. KIT $19.95. WIRED $29.95

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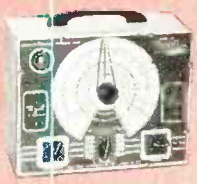

NEW 950K R-C BRIDGE & R-C-L COMP. KIT $19.95
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NEW 1040K BATTERY ELIM.
KIT $25.95. WIRED $34.95

For Laboratory Precision at Lowest Cost— the Leaders Look to EICO!

WHY does CBS-Columbia, Inc., today's headline-maker in Color Television set production, use EICO Test Instruments on its new Color Television production lines and in its design laboratories?

BECAUSE — like Emerson, Tele-King, Teletone, and many another famous TV manufacturer coast to coast, CBS-Columbia knows that . . .

Only EICO Test Equipment delivers All 10 EICO nomical Features!

1. Laboratory Precision
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3. Lifetime Dependability
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5. Rugged Construction
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WIRED $49.95

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1000 ohms/volt

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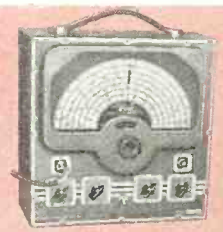

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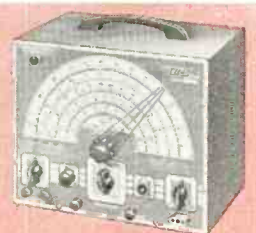

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276 NEWPORT STREET, BROOKLYN 12, NEW YORK

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In a survey of hundreds of servicemen, the importance of fast, sure installation was emphasized time after time in connection with volume controls. If you want a control that lets you do the job fast . . . and do it right . . .

Make Sure! Make it Mallory!

When you use the Mallory Midgetrol*, you get a combination of features that can't be matched.

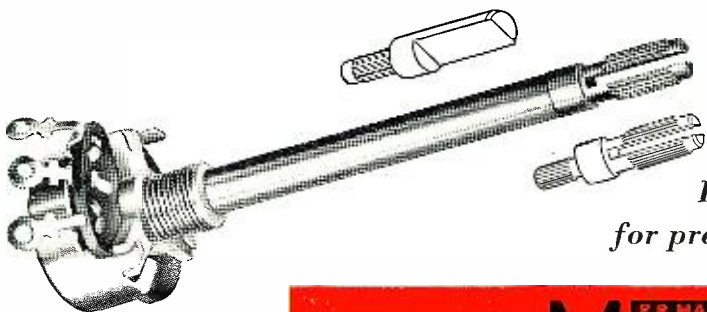
First, you get a *permanently fixed, tubular brass shaft* that can be adapted for split-knurl or flatted type knobs in a few seconds by inserting one of the steel shaft ends supplied in every package. This means utmost convenience without sacrificing the stability of permanent, two-point shaft suspension.

Second, you get the convenience of AC switch design that permits secure attachment, *without removing the control housing*. Positive indexing assures proper position.

Third, you get exceptionally accurate resistance values and taper curves.

Fourth, you can be sure of years of quiet, satisfactory service life through extremes of humidity and temperature.

Make it Mallory and make sure! Ask your distributor to show you the time-proved Mallory Midgetrol with the new features that make installation faster and simpler than ever.



Single Section Control Illustrated

Dual concentric Mallory Midgetrols can be made up easily by combining factory-assembled front and rear sections of desired resistance values. Ask your Mallory Distributor for details!

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