RADIO-ELECTRONIC ENGINEERING EDITION

RADIO & TELEVISION NEWS

MAY
1953

IN THIS ISSUE

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COVER PHOTO: Deciding on which audio equipment to buy is a fairly simple matter when a demonstration unit such as Asco's "Audiomat" is available to aid in the selection. (Ektachrome by Irving Greene)

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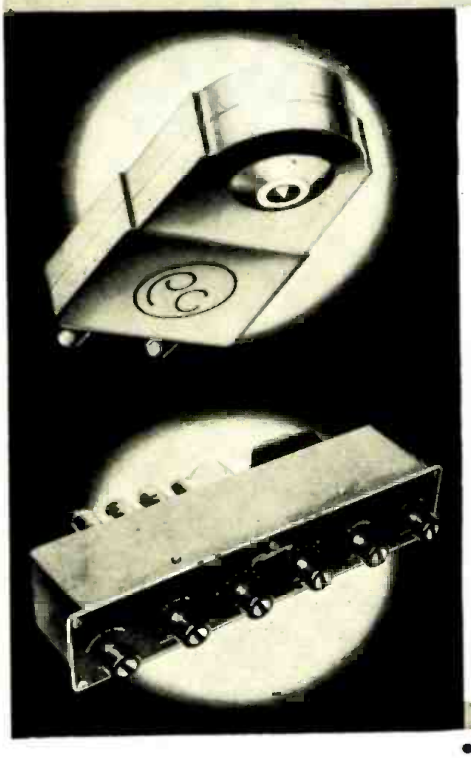

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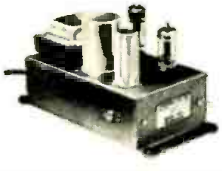

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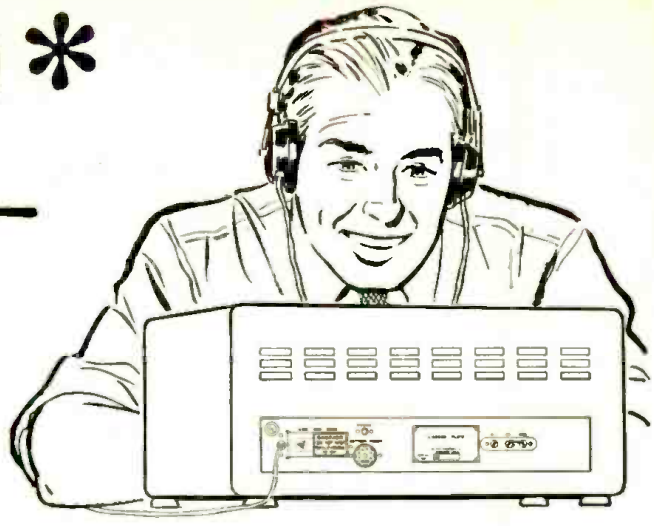

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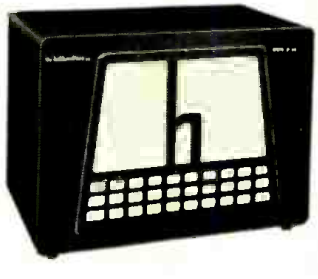

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For the RECORD

BY THE EDITOR

THE QUEST FOR REALISM

MAN strives continuously to give greater realism and depth to sight and sound. The physicist and the engineer continually are seeking better ways and means to give us "third dimensional" aural and visual transmission and reproduction.

The motion picture industry, faced with TV competition, has developed several systems including *Cinerama* and *Cinemascope*. The two are distinguished as three-dimension illusion *(Cinerama)* and wide-screen process *(Cinemascope)*. Both systems provide an "illusion" to both sight and sound and both have contributed a new concept of entertainment via film.

Of equal importance is the latest contribution to the broadcast industry announced recently by Columbia University—the perfection of a system of multiplex radio transmission.

It now appears, more than ever before, that FM will eventually replace AM for broadcast communications. It takes no crystal-gazer to foresee the far-reaching effects on the methods of transmitting intelligence of all kinds over multiplex FM systems.

To Dr. Edwin H. Armstrong (father of FM) and John H. Bose, must be given new recognition for this significant achievement and further development of the FM system. Basically, the new system doubles (perhaps more) the effective function of the FM transmitter. For example, an FM station can transmit a musical program on one channel and, at the same time, transmit another program simultaneously on a second channel.

Of particular interest to the serious listener of "hi-fidelity" is the system's ability to transmit a single program stereophonically on its two channels. This technique has been tested successfully at Dr. Armstrong's Alpine FM station at Alpine, N. J.

The transmission of multiple signals over a common carrier is not new. The Signal Corps has long used this technique. Telephone companies and other communicators are sending many simultaneous signals over single channels.

While multiplex operation of FM in the communications field has been in practical use for many years, its use in broadcasting presented many problems not of importance in the communications field. In pointing to his new development Dr. Armstrong stated, "Because of the extreme high fidelity requirements of the FM system, the problem of cross-modulation between the channels was not simple as the intrusion of one channel into the province of the other has to be kept below one part in a million."

The real significance of the new system, he added, is, "that the most 'Doubting Thomas' will now be obliged to recognize that FM will prevail as the final aural system. It would be completely impossible to multiplex on any AM system, either on the standard band or on a very high frequency band of the same frequency as the FM stations."

The cost of equipping a transmitter for multiplex operation is not high according to the inventor. Transmitters already using Serrasoid modulators which are employed in the new system are most readily susceptible to change, he said.

Receiver prices will doubtless follow the course they have always taken and sets will be produced at prices to fit everyone's purse. The audio enthusiasts, perhaps more than any other group, would provide a ready market for multiplex FM tuners for use with binaural audio systems.

Many of our readers have already heard binaural reproduction demonstrated at various Audio Fairs and shows. The program was transmitted simultaneously over an AM and an FM channel. The result (due to variations in equalization and other factors) left much to be desired for a true binaural facsimile of the program source. Multiplex FM broadcasting is certainly the most promising technique so far developed for providing binaural service to the music lover as well as to provide a stereo effect to mixed sound sources.

Engineers have become increasingly "binaural-conscious" in recent months —in the audio and film industries. The record industry recently became excited over binaural records (two separate sound tracks on one side). A new method will contain binaural sound in one groove on regular LP's. Many methods are being shown to and heard by the public. Some are good—others not so good. Some are complicated to the extreme—others use simpler means to create a stereo and binaural "effect." Dr. Armstrong's latest contribution will serve, when available, to give great impetus to the recording, transmission, and reproduction of wide range sound.

It becomes more and more apparent that the source of sound lies in the realm of physics, while the effect of sound is a physiological consideration. The engineering of sound consists of controlling the cause so as to produce the desired effect. . . . . O. R.

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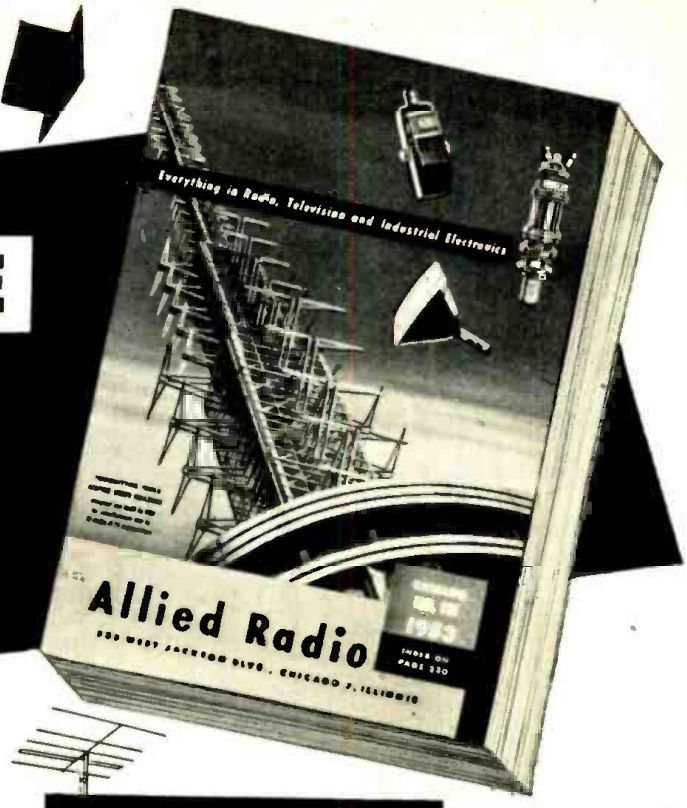

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Spot Radio News

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

By RADIO & TELEVISION NEWS' WASHINGTON EDITOR

THE MULTI-MILLION DOLLAR merger of *ABC*, operating 17 stations (6 AM, 6 FM, and 5 TV outlets) and a national network of nearly 300, with the *Paramount* picture-theater chain, which a number of experts felt certain would be delayed indefinitely after Senator Tobey's blast calling for an investigation in monopoly control, instead found itself officially blessed by the Commission shortly after the fiery Senator's demand.

In defending its action, the communication headmen said that it was no longer possible to delay a decision, and the approval was entirely in order now in the public interest.

The ruling, appearing in a 200-odd page brief, presented one of the most comprehensive reports ever issued on many vital phases of TV broadcasting, including the relationship of the motion-picture industry to TV, theater TV, properties of TV films, and operational costs.

In a discussion of the use of film, talent, and story rights on television, *Paramount* picture executives noted that they have no policy prohibiting the use of its motion picture film by telecasters, and are willing to release film when the TV industry can pay as much as picture theaters. At the present time, it was disclosed, TV can only pay a maximum of from 35- to 55-thousand dollars for the rights to televise films nationally, and national rights for the average film sell for from 10- to 20-thousand dollars. This is hardly enough to support features, it was said, for the average cost of production of about 30 feature films released by *Paramount* in the '51-'52 season was about $1,400,000 each, excluding the cost of distribution and advertising. Films which have been reissued for theater exhibition, it was said, have produced from $125,000 to $750,000 in revenue. When films are seen by the TV audience, without cost, their value to theaters is substantially reduced, the pix moguls added. Therefore, until the monetary return from the licensing of films for TV is comparable to that from theater exhibition, *Paramount* said it cannot afford to release its films for TV. The return will not be comparable, the brief disclosed, until there are more TV stations in operation. When that point has been reached, *Paramount* noted that it intends to make its library and new films, too, available for TV, unless they decide to make special TV pictures.

In addition to the difficulty arising from television's inability to pay as much for feature film as theaters, there are a number of legal and other problems which must be solved prior to releasing films for TV. *Paramount* said that it had many disputes over its rights to telecast its films with various guilds and musician unions, who have demanded additional compensation.

Commenting on theater TV, *Paramount* declared that it intends to apply on a nation-wide scale for authorization to transmit TV programs to theaters.

At the time of the hearing, there were sixty-nine theaters equipped with theater TV gear, of which ten were subsidiaries of the picture-theater chain. These installations were said to represent a total cost of over $200,000. *Paramount* theater execs revealed that the chain had experimented with over 100 theater TV events in its houses, and in each instance suffered a financial loss.

In a review of the financial plight of *ABC* and the need for additional capitalization, the brief disclosed that the network had found it necessary to borrow $2,000,000 during the '51-'52 period. It was also noted that at no time since the chairman of the net, Edward Noble, acquired the *ABC* system in '43, has a dividend been paid or has any salary been drawn, all the earnings having been plowed back into station improvements.

In contrast with other networks, with diversified and in many instances complementary resources, *ABC* said that it was dependent entirely on revenues from its radio and TV network operations, including its owned and operated stations. Because of the necessity for investing its limited funds in physical improvements, the network declared that it was without other funds needed for the development of a program service equal to that of its competitors. A few years ago, *ABC* was unable to hold some of its top entertainment stars on radio in competition with *CBS*, which was able to offer these leading lights capital-gains deals.

Under the merger, *ABC* and *Paramount* theater officers have testified

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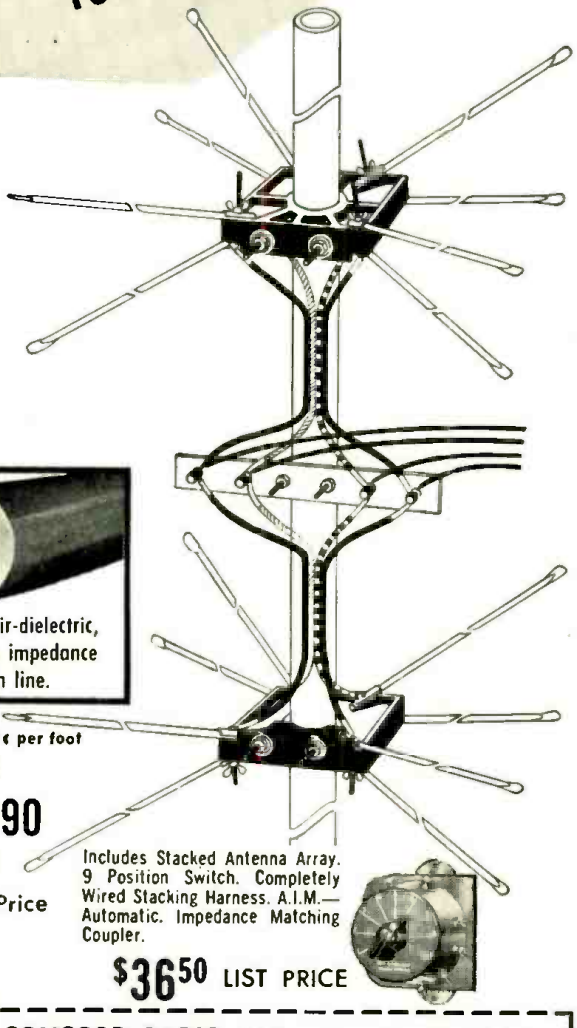

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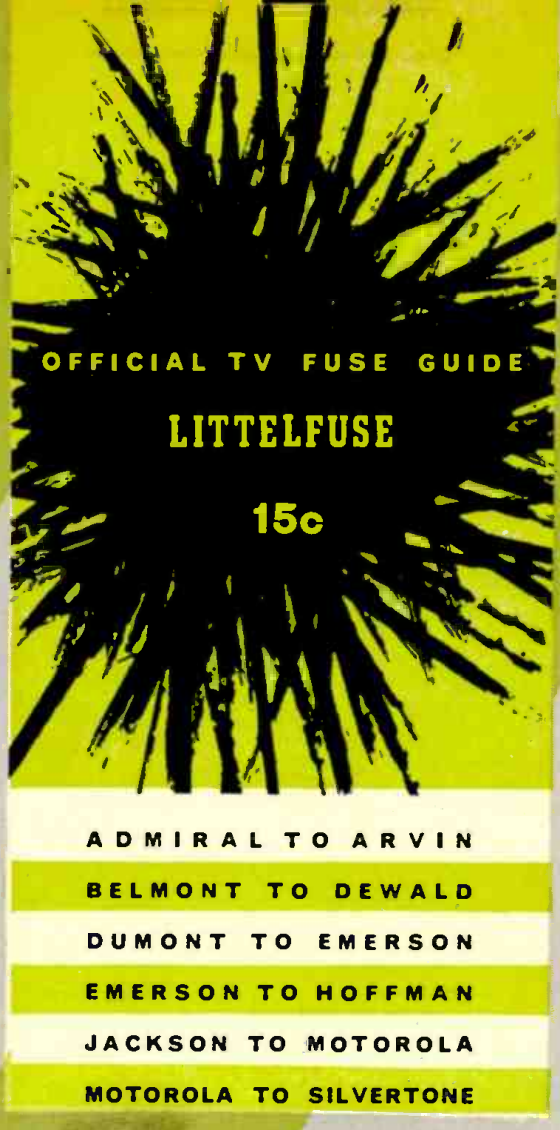
that there will be no joint buying of films for theater and television. While it is contemplated that *ABC* network programming will be 50% film, most of this film will not be motion-picture feature film, but film made especially for TV.

In a revealing analysis of the characteristics of motion picture and TV film, the brief declared that motion picture feature film represents only one type of programming on TV, and its use is subject to certain limitations and disadvantages. In the first place, it was noted, a small screen deprives the audience of background values, and certain lighting effects are unsuited for TV. Then, motion picture films are produced for a disciplined and concentrating audience free from the distractions that occur in many homes. In addition, the length of motion picture films and the unevenness of their lengths create problems, when they are fitted into the TV program structure. Finally, it was pointed out, the length of the feature films provides problems in securing sponsors, and in the case of networks, in securing clearances from stations. Advantages of films specially made for television are many, in contrast, it was brought out. They are not limited by the facilities for production as are live shows in the studio. The films can be used by stations at times when live programs cannot be cleared, and they can be used for rebroadcast or multiple showings. In addition, these films are technically designed for the TV receivers.

The brief noted that there was a view that the Commission's decision on the merger would eventually permit the motion picture industry to take over TV. This argument, it was said, ignores the fact that the operation of television stations is conducted pursuant to a statutory licensing plan. No transfer of a license may be made without Commission consent. And this consent is also required for a renewal of a license. Both require determinations as to the public interest. The fear of domination of television by motion picture interests, therefore, is unwarranted, it was emphasized, in view of the Commission's continuing supervision of the growth of television.

Madam Commissioner Frieda Hennock did not concur with her FCC colleagues and entered a seething dissent, which declared that the merger would not serve in the public interest, and the officers of the theater group were not qualified for the new assignment. According to Miss Hennock, the . . . "Commission has smashed . . . often beyond repair . . . precedents, procedures, and policies which have carefully been built up over the years of its regulatory process. In areas without established precedent, the Commission has taken an undue risk with the future of broadcasting by permitting the introduction therein of a new and potentially deleterious

(*Continued on page* 135)



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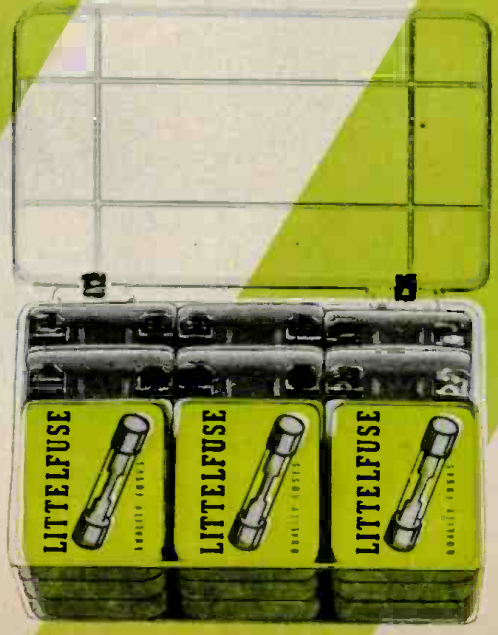

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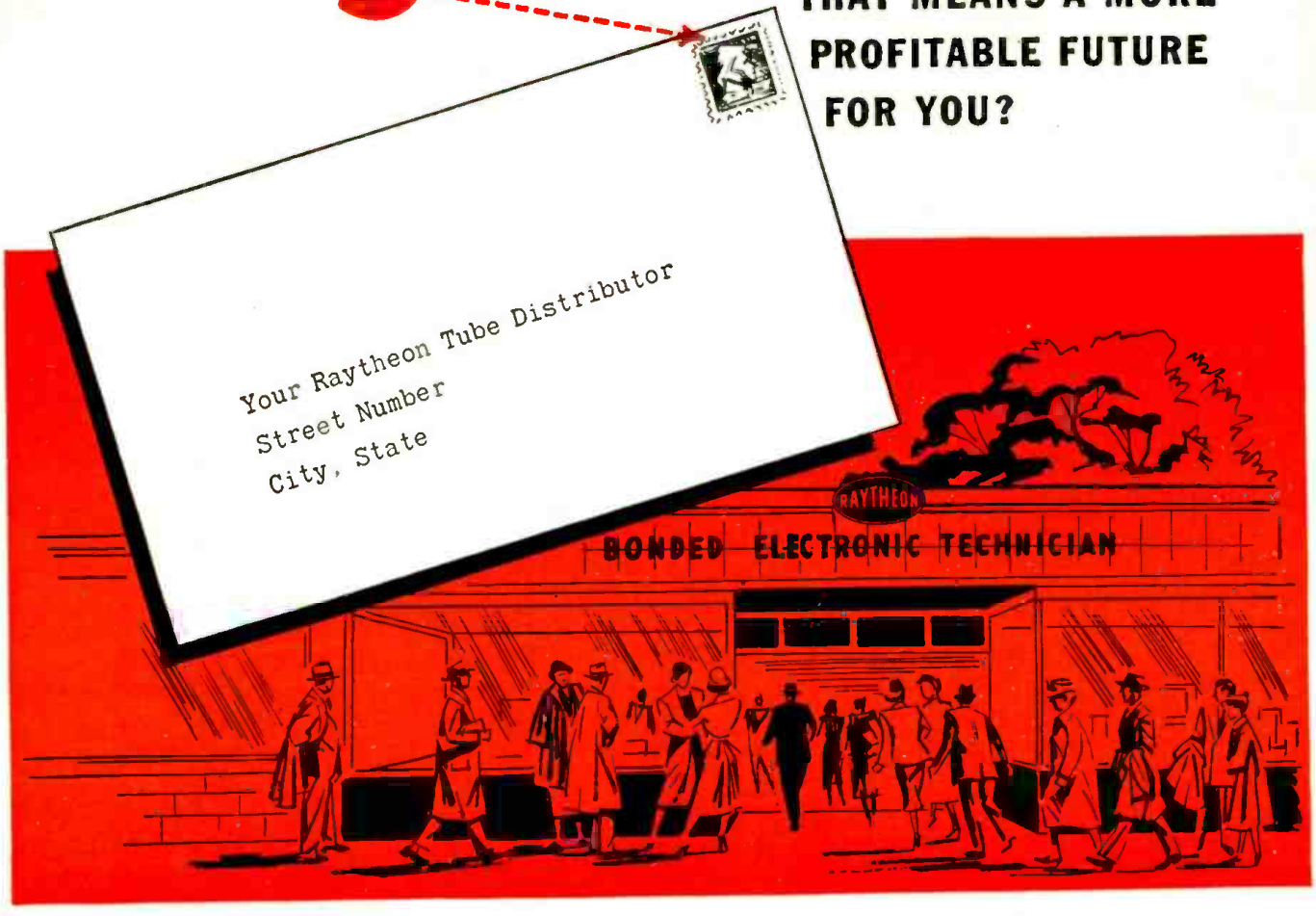

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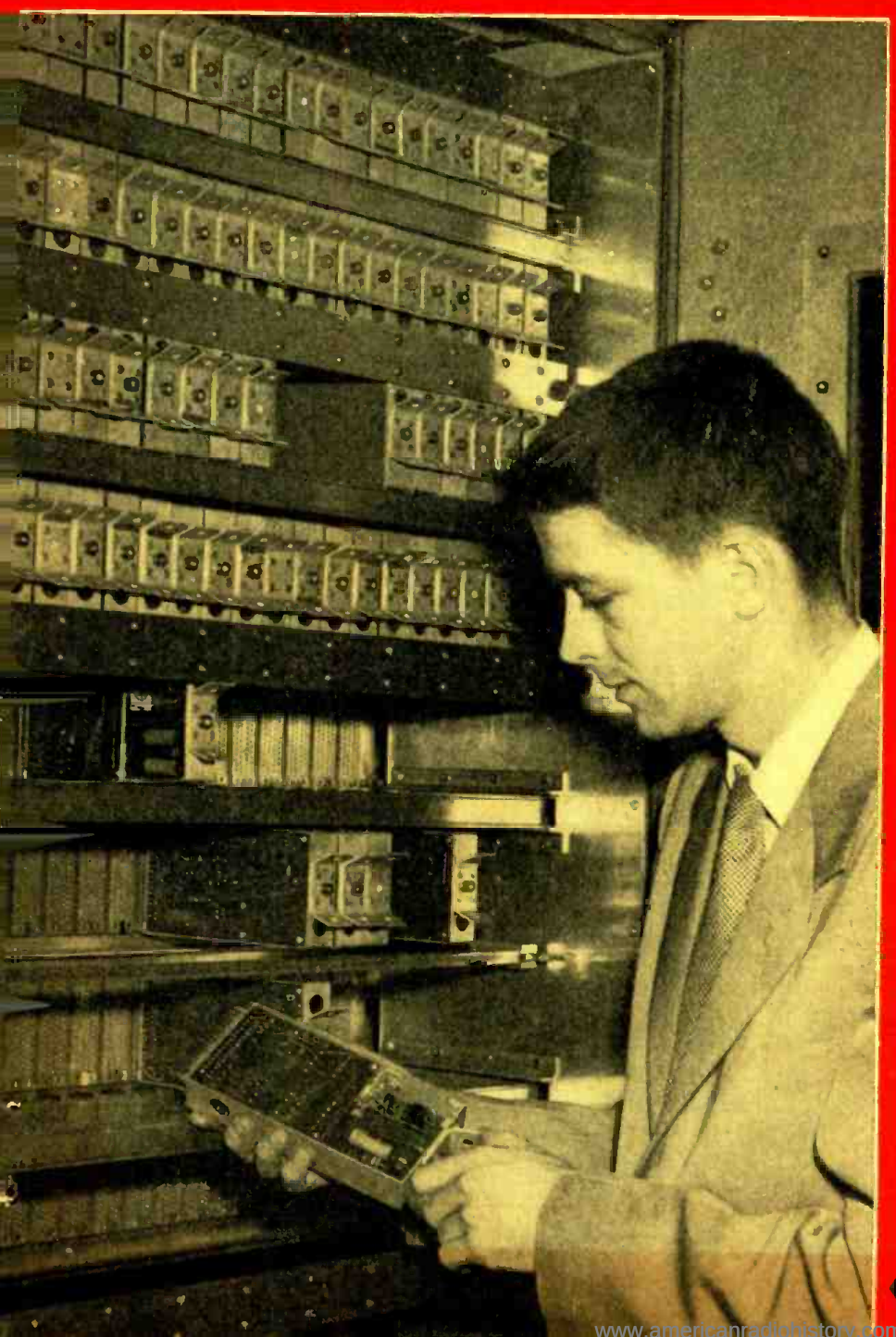

MAY, 1953

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Edited by H. S. RENNE
and the Radio & Television News Staff

Standardized plug-in circuitry packages developed by the National Bureau of Standards for use in computers. A test jack at the top of each package helps locate defective units for speedy replacement.

for MINIATURIZED COMPONENTS

from STOCK

The constant miniaturization of military and portable civilian gear has required audio components of smaller and smaller dimension. This is particularly exaggerated in the case of transformers for use in transistor circuits. The "H" series of miniature and sub-miniature units described below are hermetic military types to cover virtually all audio applications. For even smaller structures our ultra-miniature types are available against quantity orders.

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H-1	Mike, pickup, line to grid	TF1A10YY	50,200 CT, 500 CT*	50,000	0	50-10,000	+ 5	$16.50
H-2	Mike to grid	TF1A11YY	82	135,000	50	250-8,000	+21	16.00
H-3	Single plate to single grid	TF1A15YY	15,000	60,000	0	50-10,000	+ 6	13.50
H-4	Single plate to single grid, DC in Pri.	TF1A15YY	15,000	60,000	4	200-10,000	+14	13.50
H-5	Single plate to P.P. grids	TF1A15YY	15,000	95,000 CT	0	50-10,000	+ 5	15.50
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H-8	Mixing and matching	TF1A16YY	150/600	600 CT	0	50-10,000	+ 8	15.50
H-9	82/41:1 input to grid	TF1A10YY	150/600	1 meg.	0	200-3,000 (4db.)	+10	16.50
H-10	10:1 single plate to single grid	TF1A15YY	10,000	1 meg.	0	200-3,000 (4db.)	+10	15.00
H-11	Reactor	TF1A20YY	300 Henries-0 DC, 50 Henries-3 Ma. DC, 6,000 Ohms.					12.00

RCOF CASE

Length 1 25/64
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Height 1 13/32
Mounting 1 1/8
Screws ..... 4-40 FIL.
Cutout ..... 7/8 Dia.
Unit Weight ..... 1.5 oz.

SUBMINIATURE AUDIO UNITS...SM CASE

SM CASE

Length 11/16
Width 1/2
Height 29/32
Screw ..... 4-40 FIL.
Unit Weight ..... 8 oz.

Type No.	Application	MIL Type	Pri. Imp. Ohms	Sec. Imp. Ohms	DC in Pri., MA	Response ± 2db. (Cyc.)	Max. level dbm	List Price
H-30	Input to grid	TF1A10YY	50**	62,500	0	150-10,000	+13	$13.00
H-31	Single plate to single grid, 3:1	TF1A15YY	10,000	90,000	0	300-10,000	+13	13.00
H-32	Single plate to line	TF1A13YY	10,000***	200	3	300-10,000	+13	13.00
H-33	Single plate to low impedance	TF1A13YY	30,000	50	1	300-10,000	+15	13.00
H-34	Single plate to low impedance	TF1A13YY	100,000	60	.5	300-10,000	+ 6	13.00
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Type M-14879 6 ohms to 10,000 ohms...6 MW...300 to 5,000 cycles.
Type M-14880 30,000 ohms (1 Ma. DC) to 3,000 ohms...6 MW...300 to 5,000 cycles.
Type M-14881 25,000 ohms (.5 Ma. DC) to 1,000 ohms...6 MW...300 to 5,000 cycles.

TYPE UM

* 200 ohm termination can be used for 150 ohms or 250 ohms, 500 ohm termination can be used for 600 ohms.

** can be used with higher source impedances, with corresponding reduction in frequency range. With 200 ohm source, secondary impedance becomes 250,000 ohms . . . loaded response is —4 db. at 300 cycles.

*** can be used for 500 ohm load . . . 25,000 ohm primary impedance . . . 1.5 Ma. DC.

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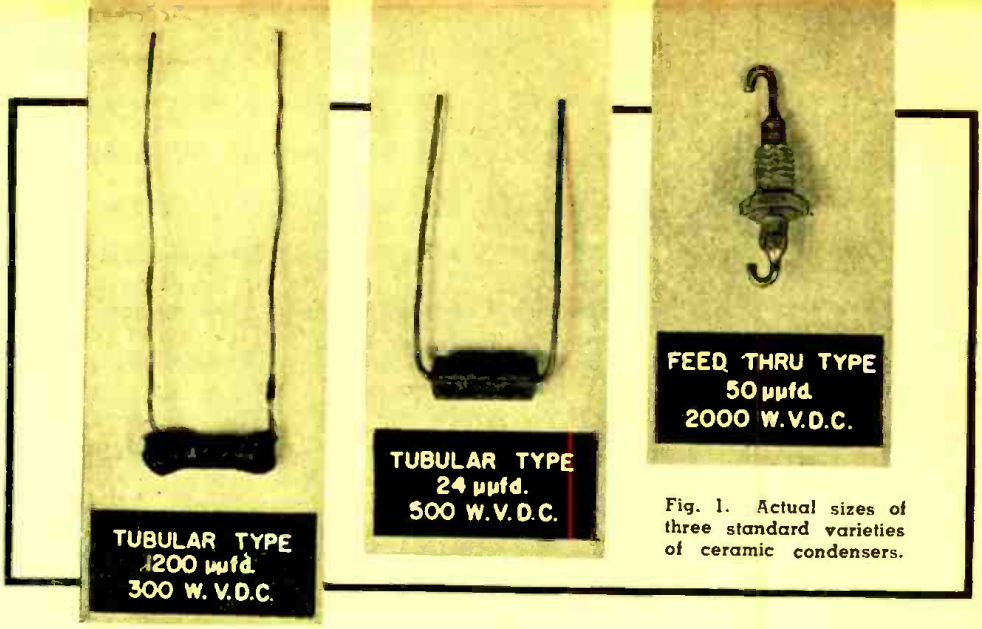


Fig. 1. Actual sizes of three standard varieties of ceramic condensers.

NONLINEAR CONDENSERS

By

LCDR. B. G. LEWIS, USNR

U. S. Naval Air Station

Ceramics with high dielectric constants dependent on temperature and applied voltage have many applications.

THE LARGE amount of interest focused upon the transistor during the past several years has overshadowed the research program which has been carried out very actively in the field of ceramic condensers. To most engineers, the familiar ceramic is obtainable from parts supply houses and is useful in modern circuitry. But the nonlinear ceramic condenser, possessing unusual characteristics and utilized in new and diverse applications—including condenser amplifiers, is largely unknown. This article will attempt to synthesize data on ceramic condensers which have already been made public, discuss some unusual circuit applications, and make suggestions for experiments which can be carried out in the average laboratory.

History of Ceramics

The original research which led to the use of ceramics as dielectrics was undertaken by German scientists soon after the year 1900. For the most part, condensers had been utilizing mica or glass as dielectrics, and Europe had no domestic source of mica. Ceramics were considered as a substitute, but many long years of research were required before a material was evolved, consisting chiefly of titanium in combination with oxygen, that resulted in dielectrics which could be produced stably and in quantities. At first these ceramics were used chiefly in European industries, the United States having little interest in them due to the easily available supplies of mica. However, ceramic dielectrics in certain forms were found to have a very useful property: a linear change in capacitance vs. temperature over a wide temperature range. This, plus other useful characteristics such as high dielectric constants, high breakdown voltage and high current capabilities, accelerated American interest. Domestic supplies of raw materials were found which were not only adequate but in some ways superior to European materials. At first condensers were produced which controlled temperature coefficients, such components seeing great usage during World War II and afterwards. The low-loss factor of these ceramic dielectrics at very high frequencies and the growing shortage of mica increased the need for ceramics until they became a standard item, available in many forms and at low cost.

Present Availability

At present most major condenser manufacturers offer a line of ceramics for many uses. In looking through the catalog of a large radio supply house, a variety of types may be found. These fall into various categories, such as temperature-compensated types, high voltage types, trimmer condensers and miniature styles such as buttons, feedthroughs, discs, standoffs and tubulars. To provide a comparison with the nonlinear condensers, three such standard varieties are shown (actual size) in Fig. 1.

The number of ceramics listed in a radio supply house catalog or in the "Radio Master" catalog is relatively small, scarcely reflecting the thousands of types available to industry and to the armed forces. It is interesting to note that a wide range of temperature coefficients is available. Most coefficients are negative, the total capacitance decreasing as the temperature rises. A common item is the familiar N750 ceramic. Here, the "N" denotes the negative coefficient and the "750" indicates that for a change in temperature of 1°C the capacitance will change by a factor of 750 to 1,000,000. Thus, a 50° change in temperature will result in an approximately 3.7% over-all change in the condenser's capacity. A "P" in front of the numerical designation denotes a positive temperature coefficient, while the familiar "NPO" has a zero coefficient.

Units with temperature coefficients of from P100 to N2500 are commercially available. The temperature coefficient of a ceramic dielectric is varied by blending the basic titanium dioxide (TiO_2) with varying amounts of other metallic oxides. The dielectric constant varies with the blend, increasing with the temperature coefficient of capacitance. For instance, an N2500 ceramic has a K of 300 whereas the N150 condenser has a K of 28. Inasmuch as the K is proportional to the capacitance-per-unit size, the ceramic condenser with the highest temperature coefficient will have the smallest physical dimensions for a given capacity. The range over which these temperature-compensated condensers exhibit a good linear characteristic is generally restricted to temperatures between —60° C and +85° C. At higher temperatures, they exhibit tendencies towards easy voltage breakdown, increased power factor and lower insulation resistance.

Semiconductor Properties

Experiments have established that titanium dioxide becomes an electronic semiconductor at about 600°C. Although this effect takes place under special conditions, it may be of importance. Germanium, another electronic semiconductor which is used in the manufacture of transistors, exhibits its useful properties at room temperature ranges. These properties of germanium were known for many years before sufficient research took place to make them useful. It might follow, therefore, that compounds of TiO_2 will become transistors of the future, constructed to operate at very high temperatures.

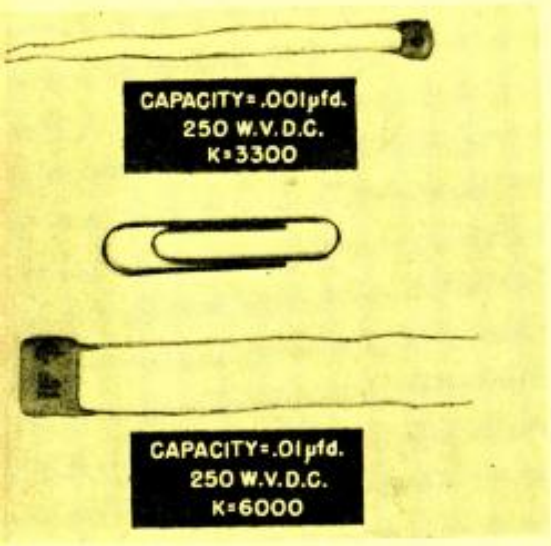
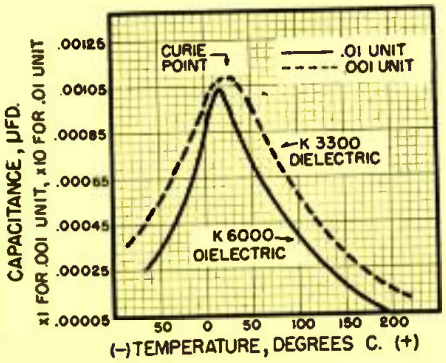


Fig. 2. Two very high K nonlinear condensers are shown in their actual sizes.

A comparison of the K values of the temperature-compensated ceramics with other standard dielectrics is shown in Table 1. Obviously, the use of the N2500 ceramic results in a condenser having very small size-per-unit capacitance. Although 300 is a high value for K by ordinary standards, units have been developed and are in production whose K values extend higher than 6000. Development of the very high K condensers was based upon the discovery, in 1942, that barium and strontium titanates exhibited high K's which fluctuated widely with variations in external parameters. An extensive research program has been carried on throughout the intervening years, both in the United States and abroad, which has borne fruitful results.

In addition to exhibiting extremely high dielectric constants which change with temperature, the K—and consequently, the capacitance—varies with the amount of d.c. potential applied across the condenser plates. A variation of capacity with bias by a factor of about five is possible under certain conditions, the change being linear over a limited voltage range. As will be discussed later, this property enables such condensers to be used as amplifying devices.

Fig. 3. Effect of temperature on capacity at zero d.c. bias for two materials.



Piezoelectric Effects

Another field of application for the barium and strontium titanates was opened up when it was discovered that they exhibit piezoelectric effects, i.e., produce voltages when subjected to pressure or vibration and vibrate mechanically when subjected to electric potential. Although piezoelectric materials such as quartz, tourmaline, ammonium phosphate and Rochelle salts have long been available, the ceramics possess definite advantages which make them valuable in many fields of application. These advantages are as follows:

1. The high K (1200) of the polycrystalline barium titanate causes the slab used as the piezoelectric element to possess a high capacitance, which lowers its internal impedance. Loading the element thus becomes simple, inasmuch as cable and stray capacitance in the circuit have little effect. In other piezoelectric materials, the much lower dielectric constants result in higher input impedances and difficulty is sometimes encountered in coupling, especially where a long cable must be used between the pickup element and the amplifier. (K for quartz is 4.5, K for X-cut Rochelle salts is 200).
2. Effect of temperature and humidity upon the ceramic is negligible, provided that the temperature does not exceed 120° C. Although the Rochelle salts, which are commonly used as piezoelectric elements in microphones and phonograph pickups, possess a higher sensitivity than the ceramic, they melt when raised to 55° C and must be guarded against moisture absorption. Men who work outdoors in the sun with public address equipment use the dynamic rather than the Rochelle salt form of microphone.
3. The ceramic piezoelectric element may be fabricated into whatever shape is desired. In the case of the other materials mentioned, specific cuts along certain crystal axes are required for proper operation.

These advantages have already resulted in the wide usage of piezoelectric ceramics, even though such ceramics were not discovered until 1946. Phonograph pickups using *Electro-Voice* Models 40 and 46-T, *Astatic* Models GC-J and GC-AG-J and *Shure* Models WC31AR, WC24, WC24-T and WC36-B all have cartridges with ceramic elements. *Astatic* Model JT30C crystal microphone has a ceramic element, is unaffected by heat or moisture, and is cheaper than the corresponding JT30 Rochelle salt element microphone. In the field of scientific instrumentation, these elements are found in accelerometers, producing output voltages corresponding to the acceleration to which the elements are subjected. They are adaptable to such diverse operations as guided missile performance tests and vibration studies. The major advantage that the barium titanate element has over other piezoelectric materials in this application lies in the extremely wide range of measurement possible, whereby a range of about 0.02G to 600G (ratio of 30,000 to 1) can be covered with one ceramic element.

Other uses for piezoelectric ceramics are currently under development, some having already reached the production stage. Barium titanate has been found practical for the driver element of a tweeter speaker. Uses in seismographic applications, measurements of ultrasonic vibrations in liquids, ultrasonic thickness gauges, acoustic delay lines and pressure gauges for industrial and medical applications have all been proven feasible.

Ferroelectric Effects

Another unusual effect exhibited by the barium titanates and associated compounds is ferroelectric behavior. Crystals which show piezoelectric effects, such as Rochelle salts, usually exhibit ferroelectric effects which are indicated by spontaneous polarization over various ranges of temperatures not always in the room temperature range. Ferroelectric crystals also show hysteresis losses and will exhibit a hysteresis curve similar to that produced by magnetic material. The ferroelectric effects are limited to certain extremes of temperature, known as the Curie points. Piezoelectric effects are limited to the same extremes of temperature. The polycrystalline barium titanate ceramic has a pronounced Curie point at 120° C, above which temperature both piezoelectric and ferroelectric effects cease; however, it is still a perfectly good dielectric in that region. The Curie point is characterized by a rise of the dielectric constant to a very high value and it is this factor which is utilized to produce the very high K condensers.

Table 1. Values of K for nine materials.

Dielectric	K
Mica	4-10
Isolantite	6
Polystyrene	2-3
Rubber	2-5
Glass	4-9
N2500 Ceramic	300
P100 "	23
N330 "	38
NPO "	17

Figure 2 illustrates the extremely small size of two very high K nonlinear condensers. Note the large relative size of the 1200-$\mu\mu$fd. condenser of Fig. 1 as compared with the tiny 1000-$\mu\mu$fd. unit of Fig. 2. The manufacturer of the very high K units is the *Glenco Corporation*. Data available indicates that the dielectric constant is varied by blending zirconium, calcium, magnesium and strontium into the barium titanate. The curves of capacitance vs. temperature for the two condensers shown are sketched in Fig. 3. Note that in both condensers the capacitance fluctuates widely with temperature, the K=6000 dielectric having the sharper peak. These peaks are at the Curie temperature, which has been shifted downward from the 120° C point possessed by the pure barium titanate crystal. By moving this Curie point downward to the room temperature region, the very high K condensers can normally be operated at the point of highest dielectric constant and will display the large negative temperature coefficient shown; also, they can be operated in the region of no ferroelectric or piezoelectric effect, those effects occurring at temperatures below the room temperature range. Thus, the hysteresis loss factor vanishes, the power factor is lowered, and the possibility of producing an internally generated voltage when subjected to shock or vibration is eliminated.

An outstanding use for the nonlinear condenser is in the field of miniature equipment. Hearing aids are utilizing high K ceramics and it is easy to imagine their wide application in the field of guided missiles, where size and weight constitute factors of great importance. Inasmuch as the capacitance of the K=6000 condenser shown may change by a factor of 2:1 over a range of 40° C, the rated capacitance is usually stated as a guaranteed minimum value (GMV). This is generally measured at 25° C with 5 volts r.m.s. at 1000 cps applied across the condenser. No d.c. bias is used when measuring the GMV because the capacitance changes with the bias. A tolerance of $-0\%, +60\%$ is usually specified for the the K=3300 condenser; $-0\%, +100\%$ for the K=6000 condenser. Caution must be exercised in selecting one of these condensers for an application where a certain minimum value is mandatory. If requirements call for a minimum at all temperatures between two known extremes and a d.c. operating voltage is specified, the GMV value becomes meaningless and curves showing capacitance vs. temperature for the particular dielectric and d.c. bias used must be consulted before the proper condenser can be selected.

These very high K condensers will operate without malfunction to a point beyond 300 mc. At higher frequencies, the value of K drops. At frequencies greater than 750 mc., the power factor increases rapidly and the condenser becomes relatively useless.

Figure 4B qualitatively sketches the shape of the capacitance vs. d.c. voltage applied across the condenser curve as obtained with the K=3300 dielectric, which is used in the .001-μfd. unit shown in Fig. 2. The slope of the curve not only depends upon the d.c. voltage impressed, but also on the amount of a.c. voltage which may be superimposed upon the d.c. The a.c. is generally necessary in order to obtain measurements of the capacitance, and for the particular curve plotted is assumed to be held at some constant value. Temperature is also held constant. Note that a wide range of capacity change is possible with variation in d.c. voltage and that the slope of the curve is negative.

Before discussing the use of these condensers as amplifiers and modulating devices, two other properties might be mentioned. One is the exponential decay of capacitance over a long period of time if the very high K condenser is heated to above 200° C and rapidly cooled to the region of room temperature; the capacitance will rise to a value 15-20% higher than its rating and then take several days to drop back to the original value. The other factor is the time required for one of these condensers to reach its full charge, this being longer than the time required for a conventional capacitor of the same size being charged through the same impedance to reach its full charge. Although the reader may feel that the various odd attributes of these high K dielectrics are troublesome, the fact is that they suggest applications which are new for condensers and which are already proving to be of great value.

Frequency Modulation

One such application. suggested by the variation of capacitance with d.c. bias, is the use of a nonlinear condenser as the modulating device in a frequency-modulated oscillator.

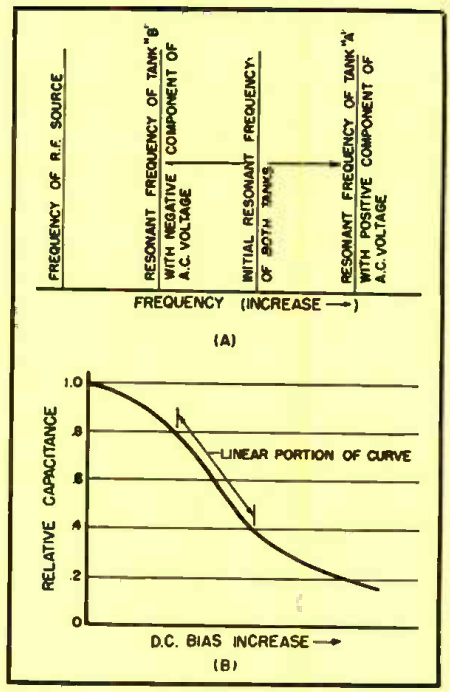


Fig. 4. (A) Tank circuit relationships of Fig. 5B. (B) Capacitance vs. d.c. bias curve for K = 3300 dielectric material.

In Fig. 5A, L_1 and C_1 normally constitute the tank of the oscillator. C_2, the high K ceramic, is inserted in series with C_1. The modulating voltage is impressed in series with C_2 and causes its capacitance to vary in accordance with the intelligence. This changes the effective resonant frequency of the tank and provides frequency modulation. Using the K=3300 dielectric, an over-all variation of about 2.5 mc. from a base frequency of 100 mc. can be obtained when the applied bias is varied by approximately 60 volts. It may be necessary to impress a fixed d.c. bias on the circuit to keep the nonlinear condenser operating on the linear portion of the voltage vs. capacitance curve (see Fig. 4B).

Condenser Amplifiers

Various schemes for the utilization of nonlinear condensers as amplifiers have been proposed and are feasible. As in the case of the modulation device

(*Continued on page* 24)

Fig. 5. (A) Nonlinear condenser as a modulating device. (B) Condenser amplifier.

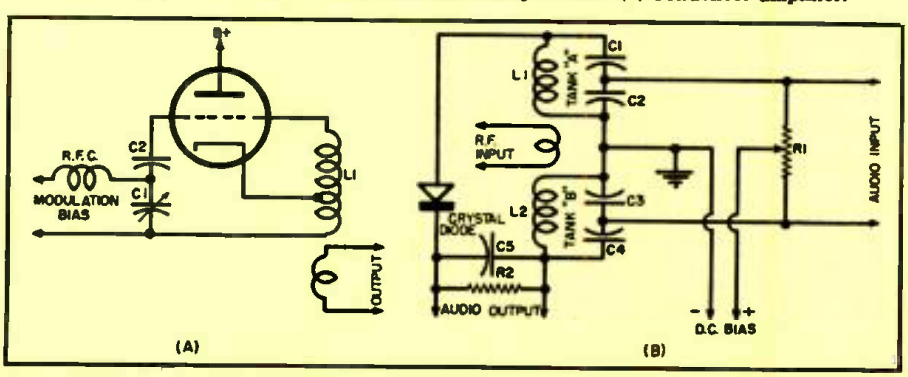


Fig. 1. Making a failure-prediction test on a military radio receiver (left) at NBS.

PREDICTION OF ELECTRONIC FAILURES

Routine checks of such factors as transconductance and leakage can aid in detecting incipient failures.

By

J. H. MUNCY

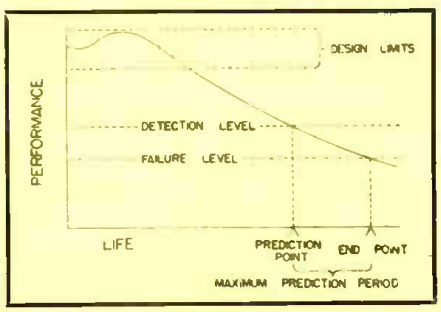
National Bureau of Standards

A RELATIVELY unexplored approach to the problem of insuring higher reliability of electronic equipment is being investigated at the National Bureau of Standards. With promising results, the Bureau is studying the feasibility of detecting incipient failures of equipment long before they affect over-all performance. The ability to make quick and easy failure-prediction checks with unskilled personnel is the goal of the NBS work, conducted under the sponsorship of the Office of Naval Research. A technique has been evolved experimentally in which a maintenance man simply plugs a portable failure-prediction unit into the slightly modified equipment to be checked and turns a multipoint selector switch; a red light flashes on to identify stages or components that have deteriorated below safe levels and have become prospective causes of equipment failure. In accelerated-aging experiments on a military radio receiver, the Bureau has been able to predict most failures many hours before they occur.

As applications of radio and electronic equipment continue to increase in extent and importance, problems of maintenance and reliability become increasingly serious. This is particularly true of military electronic equipment. In addition to its importance for military communications, electronic equipment is relied on more and more by the armed forces for radar detection of aircraft and vessels, for the automatic aiming, firing, and detonating of weapons and missiles, and for numerous instrumentation and control applications. The inevitable complexity of much of this equipment increases the danger that failures of components will cause failures of essential equipment at critical times. Although much progress has been made toward better electronic dependability, particularly through improved-quality components, the dependability of present-day electronic equipment still leaves much to be desired. In some large and highly specialized electronic installations, such as the Whirlwind computer, valuable means for automatically detecting marginal stages have been built into the equipment. Until now, however, very little study seems to have been made of the practical possibility of detecting incipient failures by means of simple routine checks using portable test equipment.

The magnitude of the problem of attaining satisfactory reliability in military electronic equipment is suggested by the fact that some large bombers now use about 2000 vacuum tubes. It has been estimated that the average home television receiver, with about 20 tubes, has an average of one tube failure for every 1200 hours of operation; if a plane with 2000 tubes had the same rate of failure, there would be one failure every 12 hours. Yet failure probabilities are increased in the plane because environmental conditions are much more severe.

Fig. 2. **Curve representative of the change in performance level with service life of an electronic component. A curve of this type is applicable to many types of components—tubes, resistors, capacitors, or complete subassemblies. After some performance fluctuations, either upward or downward, the component gradually deteriorates until it reaches the failure level.**



Failure of electronic equipment to function properly may be caused either by sudden or by gradual failure of a tube or other component. Although improvement of quality seems to be the only way to reduce sudden failures of components, surveys have indicated that at least half of all equipment failures are produced by gradual failures of components. The NBS work has been concerned with practical means of spotting these gradual failures before the equipment becomes inoperative.

In multistage equipment, it is generally impossible to detect such incipient failures by input-output performance measurements. This is because the tolerances of an over-all measurement will usually mask the performance decrease of one stage that may precede failure in that stage. Daily variations in measured gain of a typical piece of equipment are greater than the change caused by the gradual deterioration of one tube in one stage; as the tube continues to deteriorate, the time at which impairment of over-all performance becomes detectable may practically coincide with the time at which over-all failure occurs. Successful failure prediction therefore requires that the con-

dition of each important stage or small group of stages be established individually.

The designer of electronic equipment must allow certain design tolerances for the performance of any type of component, whether tube, resistor, capacitor, or complete subassembly. Component performance may vary both positively and negatively with time, and the designer must allow for these drifts as well as for initial spread. In equipment designed for reasonably long life, a component can gradually deteriorate a great deal before it reaches the level of minimum acceptable performance (the failure level). It is the gradual nature of this deterioration that gives rise to the possibility of predicting failures far in advance.

Tube failures are by far the most common cause of electronic equipment failure, and the experimental NBS failure-prediction system depends primarily on sensing decrease in tube transconductance of critical stages. This is done by operating the tube as a resistance-coupled amplifier, applying a 3000-cycle signal, and sensing whether the voltage gain has fallen below a predetermined limit. This test also detects changes in components other than the tube if the changes are such as to affect the gain of the stage. In addition, provision is made for checking capacitors for leakage, and for voltage and current measurements, although in the equipment studied practically all the failures have been tube failures detectable by the voltage-gain check.

The military receiver selected for experimentation at NBS, an 18-stage guard-channel receiver, required only slight modification to adapt it to the failure-prediction system. Circuits were first examined for sensitivity to weak and gassy tubes. The sensitive stages were those of the r.f. amplifier, first mixer, high i.f. amplifier, second mixer, two stages of low i.f., two crystal oscillators, and two stages of frequency multipliers. Insensitive stages were those of signal and a.v.c. detectors, audio and a.v.c. amplifiers, series and shunt noise limiters, and a.v.c. gate. Wiring was modified sufficiently to permit checks on the ten sensitive stages. Changes consisted chiefly of provision for breaking grid and plate return leads to permit insertion of audio signal and measurement of gain. Necessary connections were made to a multipoint connector into which the plug from the failure-prediction unit could be inserted. Circuit changes entailed the use of only about 7.5 per cent additional components, mostly capacitors and r.f. chokes; wiring and parts were all fitted without difficulty into available space in the receiver.

The experimental NBS prediction test unit includes a 3000-cycle oscillator, voltage-sensing circuits, a leakage detection circuit, and an alarm light. As the main selector switch is rotated to check the gains of the various stages of the receiver, different predetermined levels of audio signal are applied to the grid of each stage. Each input signal is preadjusted so that the voltage-sensing circuits will actuate the alarm light if the gain of the stage has changed by more than a safe amount. After the test unit has been plugged into the receiver, it takes only a few seconds to rotate the selector switch and discover any weak stages. This switching could be speeded up and made automatic by means of stepping-type switches. A separate three-position switch on the test unit permits capacitor-leakage sensing and voltage-and-current sensing, in addition to the gain sensing. For field use, the unit could be made quite compact and portable.

For laboratory evaluation of this failure-prediction system, 1000-hour accelerated-aging tests were run on six of the modified receivers at NBS. To accelerate failures, temperatures of components were cycled between 10°C and 120°C with a 15-minute total period, voltages were maintained at 15 per cent above design values, and switching transients were simulated by raising plate voltages periodically to 150 per cent of normal for one second. Since the emphasis was upon producing gradual failures, vibration and shock were not considered. Prediction checks were made at five-hour intervals.

A total of 79 tube failures occurred in the six 11-tube receivers during the 1000-hour test period. Sixty-five of these failures, or about 80 per cent, were of a gradual and predictable nature—either low transconductance or gassiness—while the other 14 were caused by unpredictable open heaters (seven) and shorts (seven). The fact that other tube-failure analysis studies have shown only about 50 per cent of failures to be gradual is probably attributable largely to the presence of vibration and shock. Six of the 14 opens and shorts at the Bureau occurred during one 60-hour period during which heaters and plates were cycled one-minute-on and one-minute-off; the other eight were spread over 940 hours.

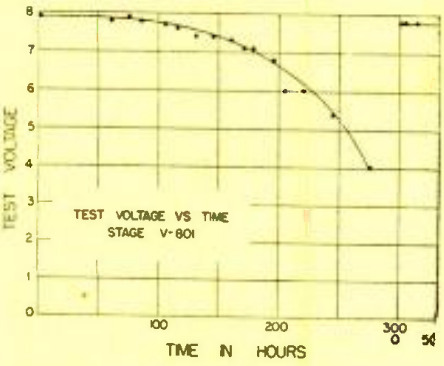


Fig. 3. Actual measurements of gradually decreasing test voltage, corresponding to gradually decreasing gain, for one amplifier stage. Over-all performance was not measurably affected until the test voltage had fallen to little more than half its original value; by then the deteriorating stage was almost ready to cause a complete receiver failure.

Fifty-eight of the 65 predictable tube failures were predicted accurately many hours before the receiver failed. Of the seven predictable failures not successfully predicted, two were in stages not being checked, four were in a single stage where parasitic oscillations interfered with measurement, and one was masked by the change in value of an overloaded resistor. Failures of components other than tubes were negligible and did not warrant any conclusions as to predictability.

The principles of measurement on which the NBS failure-prediction work has been based are not new, and many better failure-prediction systems can undoubtedly be devised; yet until now very little has been done toward developing practical techniques for semi-automatic checks to detect incipient failures. The success of the experimental work at NBS suggests that provision for simple failure-prediction routines for the maintenance of important electronic equipment deserves the serious attention of design engineers.

Fig. 4. Setup for experimentally predicting failures of components in a military receiver. The r.f. oscillator shown at the left is not an integral part of the failure-prediction method.

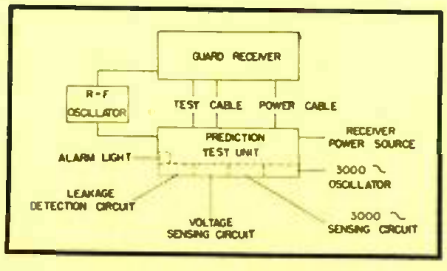
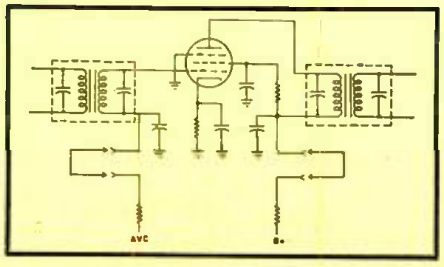


Fig. 5. Block diagram of typical i.f. amplifier stage, showing how grid and plate leads were broken in order to make failure-predicting measurements. Plug-in connections simplify procedure.



CERAMIC VIBRATION PICKUP*

By E. V. CARLSON
Development Engineer, Shure Brothers Inc.

Design of a barium titanate transducer which is superior in many respects to Rochelle salt units.

DEVICES utilizing practically every known method of converting mechanical motion into an electrical duplicate have been constructed and used as a means for studying vibration. The principal methods of conversion which have held a dominant position in recent years employ either magnetic fields or piezoelectric crystals. These means are used to transform a small portion of the mechanical energy of a vibration into electrical energy, which is readily conveyed to a convenient observation station or which can later be made into a permanent record for study. In the observation of geological motions, the magnetic field has been the principal basis for the instrumentation. Here either a magnetic field is caused to move in relation to a coil of wire in which a voltage is induced or an armature is caused to modulate the magnetic field linking a pickup coil. On the other hand, the piezoelectric crystal has found a widespead usage in the industrial field.

Several crystal vibration pickups of a general utility type have been commercially available for many years. They were designed to utilize a Rochelle salt crystal piezoelectric element arranged so as to be sensitive to motion. Throughout most of their operational range, they yield a voltage proportional to the acceleration applied.

The approximate construction of such a transducer is shown in Fig. 4. This device is caused to function when the motion to be examined is coupled to the housing so that the entire unit is vibrated. Inside the housing, mounted on three of its four corners, is a square Rochelle salt crystal element. This sensitive element is formed by bonding together two properly oriented slabs of the active material. When the crystal is forced into motion at its three supported corners, inertia acts over the unsupported portion, tending to distort it into a "saddle" shape. For purposes of approximate analysis, the distorting force can be replaced by a single force F acting at the free corner of the crystal. As the crystal is distorted, it may be seen that in one slab tensions are produced in the direction of one diagonal while compressions are being produced in the other diagonal. A similar but opposite condition occurs in the other slab. The axes of the crystals have been so arranged that one potential is developed on the exterior surfaces and the opposite potential is developed at the interface of the slabs. Electrodes are provided for collecting these potentials which are made available externally by a cable passing out through the housing.

At frequencies reasonably below the resonant frequency of the crystal, the output voltage is directly proportional to the acceleration. At frequencies well above the resonant frequency, the output would be proportional to displacement if the secondary modes of vibration could be sufficiently suppressed. In practice, useful measurements are possible up to about one-half octave below the resonance. To obtain a signal proportional to velocity or to displacement, an electrical integrator (as shown in Fig. 3) is useful.

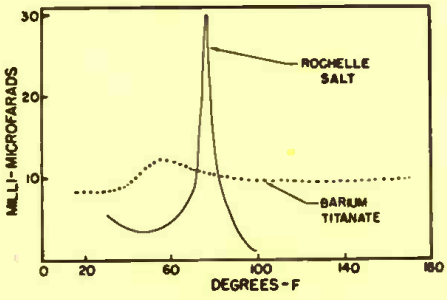
Commercial devices of this type have in general weighed about one-half pound and have had their first resonance in the neighborhood of 1500 cps, with an output impedance equivalent to the impedance of a 10,000-$\mu\mu$fd. condenser, and a sensitivity of about one volt per G of acceleration.

There are some practical limitations inherent in these units:

1. The Rochelle salt crystal is not a rugged chemical combination; it melts at the rather low temperature of 130° F; it is deliquescent in atmospheres of high humidity; and it will lose its water of crystallization in atmospheres of low humidity. Exposure to any one of these three conditions produces a permanent deterioration of the sensitive element.
2. The electrical capacitance is a marked function of temperature. Since the capacity of the crystal and the capacity of the connecting cable form a capacitive voltage divider, the instability of this capacity complicates the application where long cables are necessary and where absolute measurement is desired.
3. Vibration pickups of this construction are also sensitive to one component of rotational acceleration as well as to a component of translation. This can lead to erroneous results if care is not taken in the application.

Use of polarized polycrystalline barium titanate in place of the Rochelle salt as the sensitive element has some favorable and unfavorable aspects:

Fig. 1. Variation of capacitance with temperature for barium titanate and Rochelle salt.



*This article is based on a paper presented at the National Electronics Conference which was held in Chicago, Sept. 29, 30 and Oct. 1, 1952.

1. Barium titanate material can withstand temperatures in the neighborhood of 200° F without losing its piezoelectric properties. It is not permanently damaged by high humidities or even water; however, it may be temporarily affected by surface leakages and some precautions are required. It is unaffected by dry atmospheres.
2. The dielectric constant of barium titanate, and consequently the electrical impedance, is a function of temperature. The variations are minor when compared to those found in Rochelle salt. Figure 1 illustrates this difference.
3. The principal undesirable characteristic of a barium titanate crystal is that it will exhibit a sensitivity nearly 20 db lower than that of Rochelle salt for a similar resonant frequency and output impedance.

A vibration pickup utilizing barium titanite can be similar in construction to one using Rochelle salt. There is a need for one fundamental modification in the construction because of a difference in the piezoelectric behavior of the two materials. Whereas in the Rochelle salt transducer the element was supported on three corners and the acceleration acted upon the fourth, in the barium titanate unit the crystal is mounted at all four corners and the acceleration acts upon the central portion of the element.

The ceramic material is isotropic in the plane of the slabs, which is normal to the direction of polarization. If it were compressed along one diagonal and tensed along the other, as is done in the Rochelle salt element, the effects would tend to cancel and there would be little resultant output voltage. When the four corners are supported, both diagonal directions are treated similarly and there is mostly tension in one slab at the time that there is mostly compression in the other slab. With this more symmetrical treatment, rotations about the center of the element produce forces which tend to cancel in their electrical effects, making the unit insensitive to rotation. As the housing is accelerated, the inertia of the central portion causes the crystal to distort in a "dished" fashion.

Many schemes have been devised to obtain calibration data on vibration pickups. Several have been used at *Shure Brothers Incorporated*; however, for the last ten years measurements of sensitivity have been obtained by attaching the unit to an electrically driven tuning fork equipped with an eyepiece to measure the mechanical displacement. Frequency response data were secured by mounting the unit on a crystal actuator together with a test cell which was resonant well above the range of frequencies to be explored.

The possibility of using the reciprocity technique has for many years seemed like a desirable solution to the calibration problem. The reciprocity method of calibration is a technique by which the sensitivity of a transducer can be determined mainly by electrical measurements. Necessary equipment for such measurements is found in most laboratories, which in itself is a strong recommendation. This method has at its roots the reciprocal requirement that the transfer impedance from the electrical terminals to the mechanical terminal be the same as the transfer impedance from the mechanical terminal to the electrical terminals. If energy is neither lost nor gained as an action passes from the electrical to the mechanical system, or vice versa, the reciprocity method is likely to apply. In the case of these piezoelectric materials, the necessary conditions are sufficiently satisfied. In one form, this type

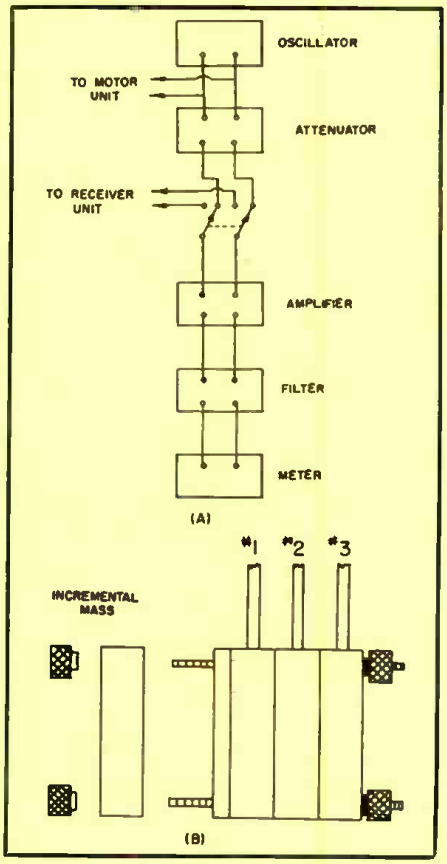


Fig. 2. Calibration of vibration pickups by the reciprocity method.

of calibration involves making three measurements of electrical transfer impedance and knowing the value of the mechanical coupling impedance.

The derivation of the mathematics used in making this type of calibration has been presented amply in the literature. For the present purpose, two equations are sufficient.

$$20\log S_1 = 10\log M - 20\log\omega - 10\log C_1 + \frac{T_{12} + T_{31} - T_{32}}{2} \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (1)$$

(Continued on page 27)

Fig. 3. Schematic diagram of control box and response curves.

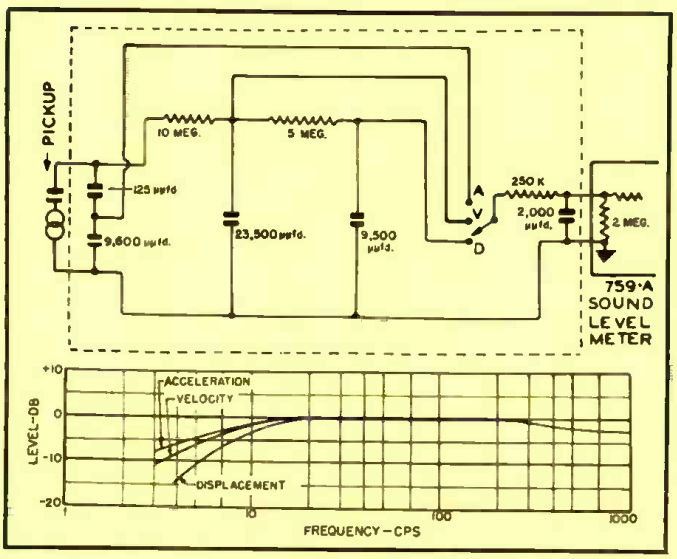
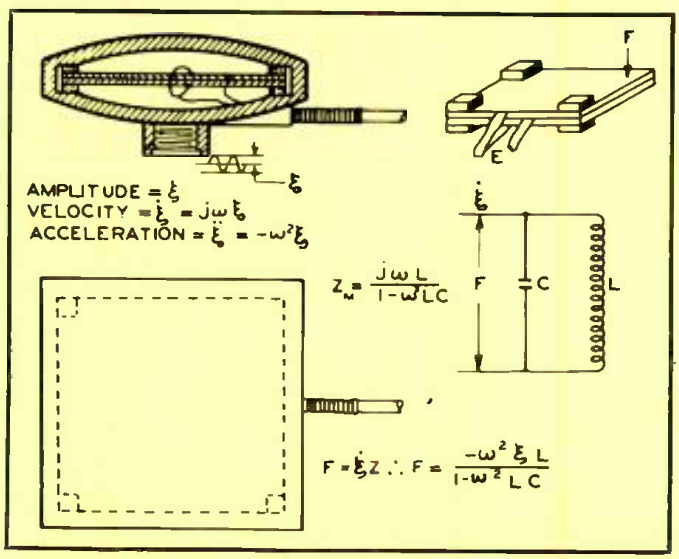


Fig. 4. Inertia-type pickup and approximate equivalent circuit.



DYNAMIC LOUDNESS CONTROL

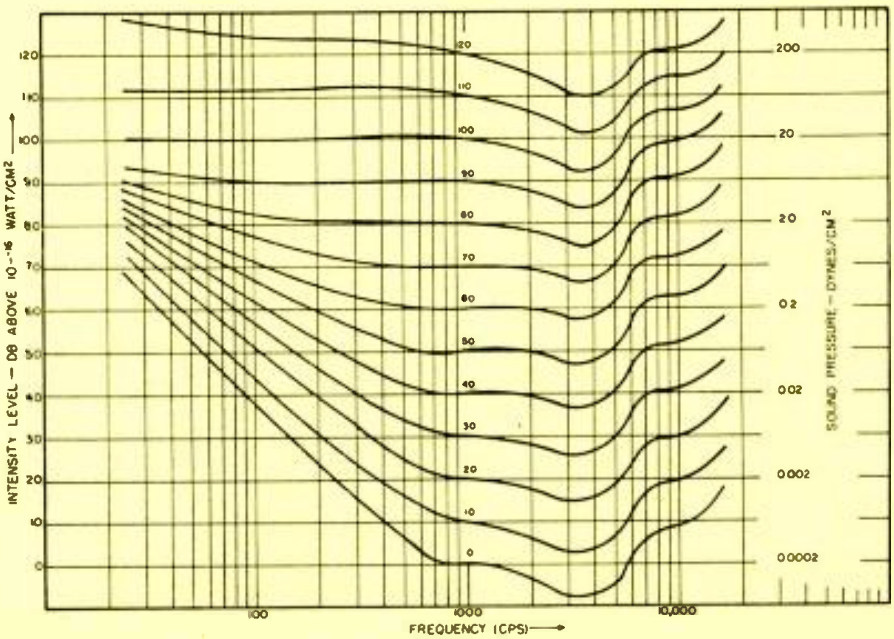
By R. S. JOHN, JR.

This new concept calls for frequency compensation that varies with the instantaneous program level.

JUDGING from the continuing flow of articles on the subject, the design of compensated volume controls is not yet a closed field. Still, only half the story has been told. Although the existing types of controls certainly constitute an advance toward realism in sound reproduction, it will be shown that the basis for the design of all of these controls has been incomplete, so that they fail to compensate correctly — at the higher loudness levels in particular. A number of recent letters to editors have attested to this fact in various ways, although part of the dissatisfaction shown is certainly due to improper manipulation[1]. It has been said that judicious use of the loudness control can greatly increase listening pleasure, but something must be wrong when "judicious use" frequently consists of using the decompensation switch. The points which have been overlooked in present loudness control design (called "static" compensated controls here, for reasons which will be apparent later) may in some cases contribute to making a good system sound like a fair juke box. These points will be discussed, and the correct basis for design will be presented, illustrated with a simple circuit.

It might be well to review briefly the reasons why compensated controls are required in the first place. Referring to the familiar Fletcher-Munson equal loudness level contours in Fig. 1, it may be seen that if the over-all intensity of a reproduced program is reduced with an ordinary volume control by, say, 30 db from the original level, then in order to maintain the same relative loudness distribution between frequency ranges as was present originally, the low frequencies should be reduced in intensity by an amount less than 30 db, or the low frequencies must then be boosted. If the original program level is, say, 80 db on the average, then although the 80-db contour shows a loss of response of the ear at the low and high frequencies, this is entirely natural. Any compensation would be incorrect, either at the original performance (other than changing one's seat), or at the reproduced program played at the same loudness level, since these are assumed to be synonymous in effect. Rather, the *differences* between the reproduced and original loudness levels should be compensated. Use of the Fletcher-Munson contours themselves as design curves, rather than the difference curves, roughly corresponds below 1000 cps to choosing 100 db as the original average loudness level, a value obviously too high in any practical case. The plotted curves in Fig. 2 show these differences, upon which the design of the present type of static controls should be based. It can be seen that no more than about 3 db treble boost is needed for any of the levels shown, contrary to a number of present designs. This boost is already provided by most of the loudspeaker manufacturers in the form of increased speaker efficiency in this general range. The recent tendency to turn up the tone controls to maximum boost, thus producing a saddle-shaped pattern for "showing off the treble," "low level listening," etc., apparently leaves one's ears "saddle-sore" for good reason! These curves cover all the important cases for static controls, since a reduction in level of more than the 40 db shown will place most of any program into the background noise of even a quiet home. The curves presented herein have been constructed from data given in Massa, "Acoustic Design Charts," and checked against other sources.

Fig. 1. Equal loudness contours for normal ears. These curves were first published by Fletcher & Munson in the Journal of the Acoustical Society of America. Oct., 1933.



Although these difference curves are shown compared to 80 db as the basic original loudness level, they will hold within about 2 db (below 1000 cps) for all *lower* levels used as comparison bases. One need consider what the actual original level was only when *using* the control. Toth[2] discusses preferred average original and reproduced loudness levels for music and speech, and finds that manipulation based on an 80-db original average level should generally be most acceptable. This article will be most concerned with the levels above 80 db. These are arbitrarily designated "high level," while the levels below 80 db will be called "low level."

The curves of Fig. 2 do not tell the complete story, however, and the resulting controls may actually destroy natural balance at certain times during the program. Strictly, these curves mean that when the original program level is *instantaneously* 80 db, then the

provision of the bass boosts shown will enable the average person, listening at reduced loudness levels, to perceive the same balance between the various frequencies as was originally apparent. Now, the full symphony orchestra may occasionally achieve a dynamic range of up to 70 db, and while the average may be 80 db, the instantaneous levels may vary from approximately 40 to 50 db up to the threshhold of pain, or for speech from about 40 to 80 db.

Since the instantaneous or short-time-average level varies for each instrument, to produce the shadings and differences in emphasis which constitute so large a part of the appeal of music, it is evident that *a compensated control should provide the amount of boost required at any instantaneous program level*, rather than only at the over-all average level. Suppose it is desirable to reduce the loudness of a reproduced program by 20 db. The compensation indicated in Fig. 2 applies only when the performers play instantaneously at the average level. To continue the process, *all* the curves differing by 20 db at 1000 cps should be subtracted from each other. The curves shown in Fig. 3 include these results, as well as those for 10 and 30 db instantaneous differences. It should be understood that the contours in Fig. 3 show the amount of compensation *actually* required to maintain strict balance between the frequencies at all loudness levels; they include the curves of Fig. 2 as a special case. It may be seen that as the original loudness instantaneously increases above 80 db less bass boost is needed. In fact, when the original level is 120 db (the threshhold of pain), a bass attenuation is needed, as noted in each of the three sets of curves, in order to maintain the correct frequency balance. Fortunately, such a level will probably be attained only at the seats preferred by the veriest audiophiles. The difference curves for original loudness levels less than about 80 db tend to group together closely, on the other hand, so that there is no relative difference between them. Thus, for these low levels, a fixed boost pattern can be provided for a given difference in level from the original level. Such control is obtained with the present types of "static" compensated controls.

One of the common complaints against loudness controls has been that they may tend to make a system sound "boomy," or "muddled," etc. Although part of this has been due to improper manipulation and design of the control, as mentioned above, it is now apparent that one of the main reasons for such effects is undoubtedly contained in the above facts, i.e., that at the higher level passages, when the lower frequencies are louder in any case, the natural balance is completely destroyed by the compensated control supposedly designed to restore the balance! This is true because all such controls introduce a *fixed bass boost pattern*, depending on the setting of the control. When a setting is chosen, this boost *then remains effective for all instantaneous program levels*, both high and low. Such a boost pattern is correct for the low levels, as shown, but when the level is high, the bass — which should be boosted less, if at all — is much louder than would be natural.

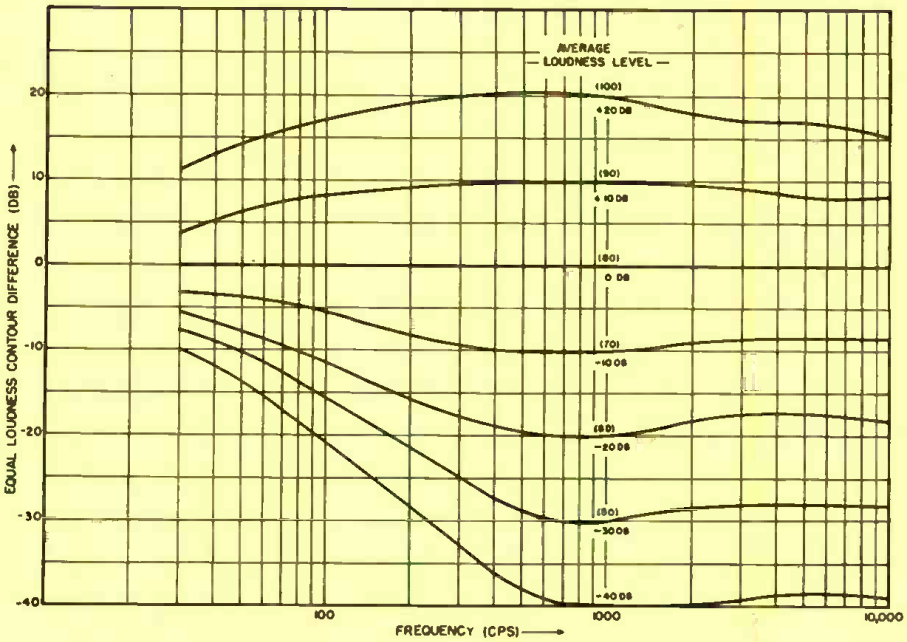
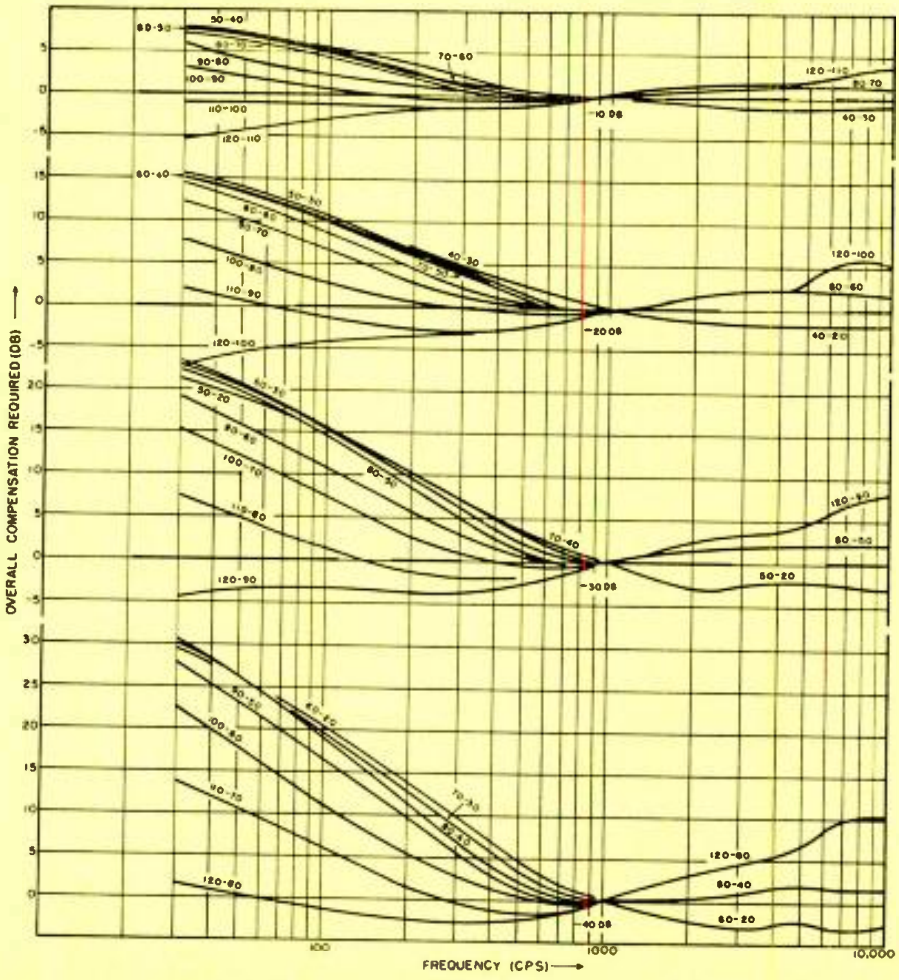


Fig. 2. Difference contours referred to 80 db as a basic level.

Fig. 3. Constant difference contours for four reference levels.



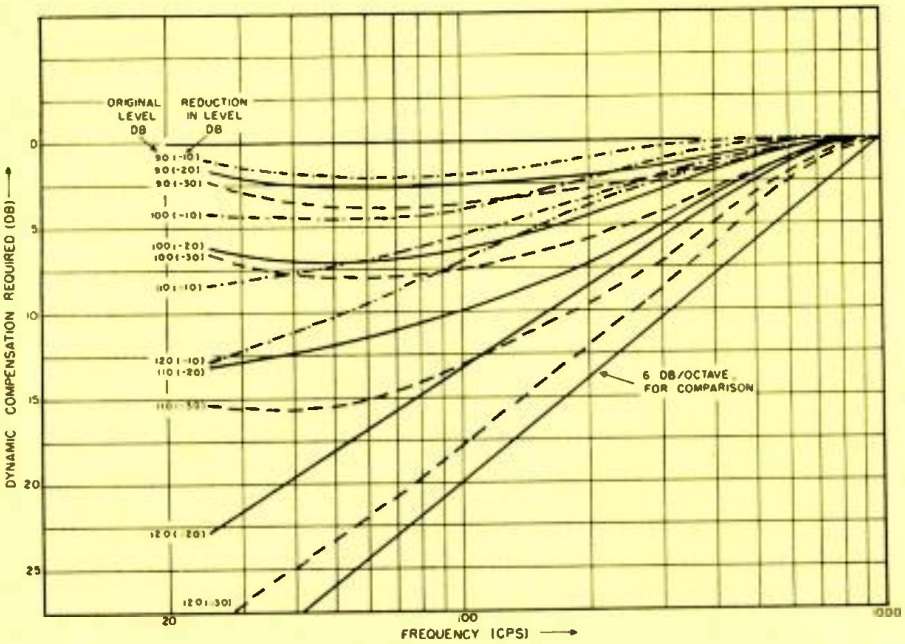


Fig. 4. Dynamic compensation required in addition to that afforded by the so-called static type of loudness control.

Since this is an important point, here is a specific example. Consider only frequencies of 100 cps and 1000 cps as a reference. These are played at various loudnesses, as perceived by a listener at the original performance and at a reproduced program where the level is reduced by 30 db. From Fig. 2, it can be seen that a static control should be designed to provide a 14-db boost at 100 cps under these conditions. Now consider that the instantaneous level at this frequency varies from 30 up to 120 db. From Fig. 3, it is found that when the original level falls between 30 and 80 db, the 14-db boost provided is approximately correct, due to the bunching of the low level difference curves. However, when the original level is instantaneously 90 db, only about 11 db boost is required; at 100 db, only 7 db; at 110 db, only 1 db; and at 120 db, which probably will seldom be attained, an *attenuation* of 3 db is actually required. Thus, at 110 db original level, for example, the present static type controls plainly provide *13 db too much boost*. The bass will sound much too loud at just the time when these frequencies are already most apparent.

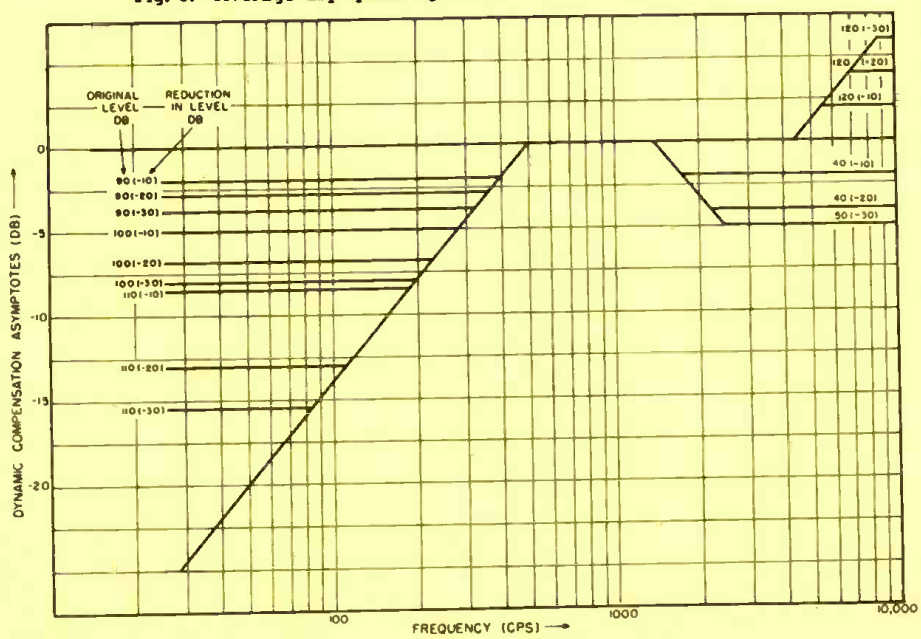
The above discussion has dealt with the effect in the bass frequencies. A similar type of effect exists in the treble as well, but to a much lesser degree. It is interesting to note, however, that this effect is just the reverse of that in the bass, as shown in Fig. 3, i.e., at the higher levels a slight boost is needed, while at the lower levels a slight attenuation is required. It is also interesting to note that the control designs which call for much treble boost as well as bass boost are apt to be balanced only for lower level bass and higher level treble, a situation met only occasionally. For the —30 db difference curves, the maximum boost required in the treble is shown to be about 8 db at 120 db loudness level, the maximum attenuation about 3 db.

It has been shown that while the present control designs are a step in the right direction they may provide undesirable effects at critical times during the program. The next step is to consider whether some form of dynamic control can be designed which will more closely approximate the actual correction curves of Fig. 3. It would hardly be worth while, at present, to attempt to provide the small amount of dynamic control required for the treble frequencies. Consider then the more important section for the bass frequencies. On examining Fig. 3, it may be seen that below about 200 cps the slope of the higher level difference curves is approximately the same as the slope for the lower levels and, therefore, about the same as the slope provided in properly designed static controls. Thus, a simple system, to be used together with a static control, might be one which depresses the lower frequencies at the higher levels by introducing a step of attenuation between variable upper and lower turnover frequencies. The circuit thus should introduce a limited bass rolloff, the amount of rolloff and the turnover being variable with the program level.

Assume that a static compensated control has been designed from the curves of Fig. 2. The additional high level compensation required can be found by subtracting the boost provided by this control (Fig. 2) from the boost required (Fig. 3); the results are shown in Fig. 4. These contours indicate the amount of dynamic compensation required of a dynamic control at the various loudness levels. Shown in Fig. 5 is a set of asymptotic curves derived from Fig. 4 by fitting the actual curves as closely as practical with 6 db/octave asymptotes, which are basically produced by all single-section *RC* or *RL* networks. The actual curves for these will fall within quite reasonable limits of the difference curves of Fig. 4.

Shown in Fig. 6 is a block diagram of the elements which may be included in a dynamic control network designed to be used in conjunction with a static compensated control as suggested above. As shown, the original signal must be fed to a separate amplifier, then recti-

Fig. 5. Average asymptotic dynamic compensation required.



fied and filtered, and applied to a control stage which varies the low frequency transmission characteristics of the main amplifier. It is apparent that this circuit is somewhat similar to an automatic volume compressor, and indeed the concepts of good design for such circuits also apply here although only the lower part of the frequency spectrum is being controlled in this case[3]. The circuit must provide the dynamic bass rolloff described, and some provision must be included for control of the total amount of rolloff, to correspond to the differences between the original and chosen reproduced signal levels.

Fig. 6 suggests that dynamic control may be obtained using selective feedback around an amplifying stage, with the amount of feedback being controlled by the plate resistance of a vacuum tube in the feedback network. In Fig. 7, a circuit is presented which illustrates the type of networks required. The equation for the response of the feedback network of this circuit has been derived, and the values shown were calculated for values of control tube plate resistance, such as is found with a 12AU7 or 6SN7 tube, with a low impedance source driving the entire network. The resulting response curves will be approximately as in Fig. 4 when the proper signal input level is provided for the control grid network.

The "range control" potentiometer shown serves to limit the amount of control action in accordance with the curves of Fig. 4 for various reductions in level from the original level. This control can be ganged with the static control shaft, although its resistance must vary inversely to that of the static control. The total relative attenuation possible with the circuit values shown is about 26 db, which is sufficient for all but the very highest seldom-attained original levels. The pentode plate gain of 33 in the middle frequencies may be higher than can conveniently be incorporated into an existing system, but a voltage divider can easily be provided, as shown, to reduce the effective gain to that required. It is also possible to arrange a feedback circuit for providing the entire range of control required — the primary low level bass boost as well as the high level dynamic attenuation. Such a circuit would be more complicated in that about 35-40 db boost would have to be furnished.

The control grid voltage is obtained from the low frequency portions of the original signal, amplified, then rectified and filtered before being applied to the control grids. The amplifier tube driving the rectifier should be capable of providing high peak currents to charge the filter capacitor rapidly, but the resistance load across this capacitor should be chosen to yield a time constant of at least a second. With such an arrangement, short pulses of sound — such as drum beats — can be controlled before the signal pulse decays. The side amplifier should have sufficient gain to provide about 20 to 25 volts to the control tube grid when the highest level passages occur. Since this highest level signal voltage will vary for different installations, no specifications can be made as to the actual components required for individual cases. However, an electron-ray tube can be used in the adjustment of the amplification if it is set to barely close on the higher peaks.

Although a single-sided circuit would be less complicated, satisfactory operation can probably be obtained only with a push-pull circuit, if vacuum tubes are used as the control elements. This is due to the fact that the control grid voltage variations will cause transients to appear at the control plate; the transients, in turn, will cause thumps if permitted to appear at the output. This effect can be reduced somewhat in a single-sided circuit by driving the feedback network with a cathode follower, and by increasing the "take-effect" time in the rectifier-filter circuit. However, the effect is largely eliminated in a push-pull circuit in which the transients are cancelled in the primary of the transformer. A single-sided circuit might be satisfactory if a different type of control element were used, such as a bead thermistor with a separate heater coil. In this case, the control voltage transients would not appear, since only the resistance of the control element varies. Although thermistors are available with very low thermal lags, thus being able to provide rapid control action, some difficulty might be encountered in maintaining control for a sufficient length of time to avoid distortion of the harmonic structure of the sound as well as flutter due to ripple.

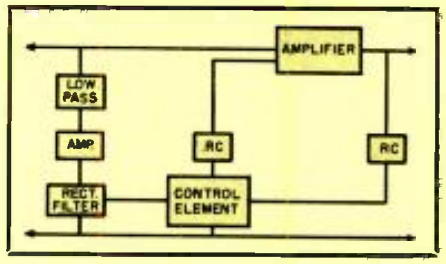
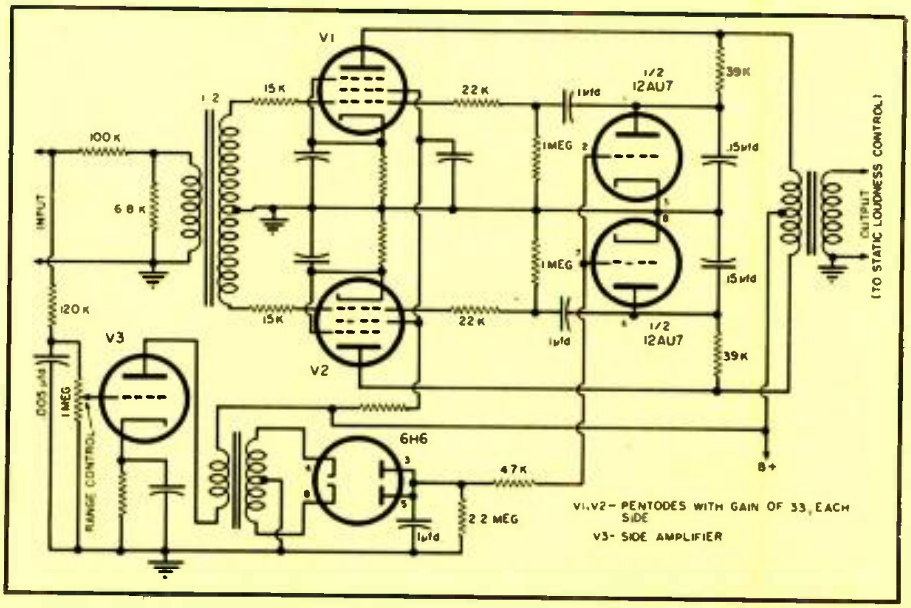


Fig. 6. Block diagram for negative feedback dynamic loudness control.

Since some of the past objections to loudness controls have apparently been caused by improper manipulation, it might be well to examine the procedure involved here. One good arrangement is to gang together the main volume control, the static loudness control, and the dynamic range control onto one shaft. The settings of this control should be marked 0, -10, -20 db, etc. In use, the volume control of the program source should be set by measurement or estimate to provide a program level equivalent to the original program level, whether it be symphony, dance music, or speech; this involves a knowledge of the preferred average original level. When this setting has been achieved, the desired reduction in level can be set with the dynamic loudness control. However, the controls will have to be readjusted for different types of programs, and even for different types of performance within the same program, just as do the present static type controls. This is true since in broadcasting the average level of the entire program is kept at about the same level. Thus, speech and light or heavy music

(*Continued on page* 25)

Fig. 7. Circuit diagram for a suggested dynamic loudness control.



DIFFERENT APPROACH TO ANALOG COMPUTATION*

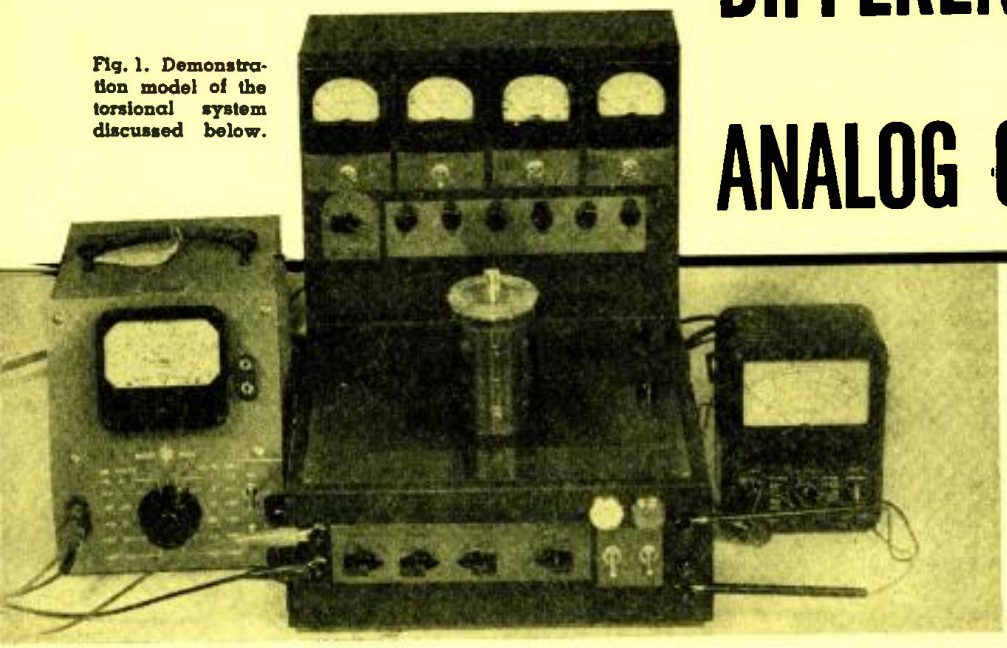


Fig. 1. Demonstration model of the torsional system discussed below.

By

C. R. BONNELL

Research Physicist
Minneapolis-Honeywell Regulator Co.

Electromagnetic torsional integrating analog computers show promise of having a wide range of usefulness.

THE electromagnetic torsional integrating analog system combines much of the speed of electronic systems with the range and accuracy of mechanical systems. Precision construction, jewel bearings, low friction techniques, fluid damping, and refined processes of annealing magnetic metals permit a low threshold, high resolution, and very small errors in the mechanical component. The mechanical component has low inertia, no gear trains, no backlash, and a high frequency response.

General Theory

A shaft with a moment of inertia J, impeded by a damping torque per unit angular velocity F, and having load torques $T_R(L)$, when acted upon by input torques T_i will have the following equation of motion:

$$\Sigma T_i = (JD^2 + FD)\,\theta + \Sigma T_R\,(L) \quad . \quad (1)$$

where $D = d/dt$. Making the load torques $\Sigma T_R(L)$ a function of the angular displacement θ, a more useful form of (1) may be written:

$$\Sigma T_i = (JD^2 + FD)\,\theta + \Sigma T_R(\theta) \quad . \quad (2)$$

In general, the torsional type computers are operated dynamically with no load torques, or they are operated statically through a balance with the load torques. Dynamic operation results in an integration of the input torques.

The particular equation for integration is:

$$\Sigma T_i/D = (JD + F)\,\theta \quad . \quad . \quad . \quad . \quad . \quad (3)$$

and the particular equation for the static condition is:

$$\Sigma T_i = \Sigma T_R(\theta) \quad . \quad . \quad . \quad . \quad . \quad . \quad (4)$$

Basic systems of operation for torsional computers are illustrated in Figs. 3A, 3B and 3C. Figure 3A is a dynamic integrator. Figure 3B is an open-loop static computer wherein the input torques are balanced by an elastic restraint torque generator. Figure 3C is a closed-loop static computer having inherent stability through the feedback rebalance torques.

The existence of precision linear and nonlinear torque generators and signal generators permits a wide range of mathematical operations in a rebalance system.

Current analog inputs converted to linear or nonlinear torque analogs define the left members of (3) and (4). Precision synchros of high resolution together with known data on the load torques on the shaft define the right members of (3) and (4).

Operational Formulae

The torque generators are current devices. They may be operated on either alternating or direct current; but the signal generators are alternating current devices only. Table 1 is a tabulation of some of the torque and

Fig. 2. Schematic diagram of demonstrator shown in Fig. 1.

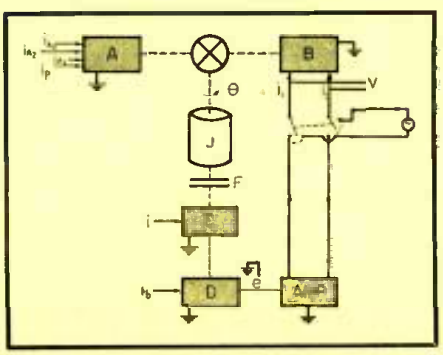
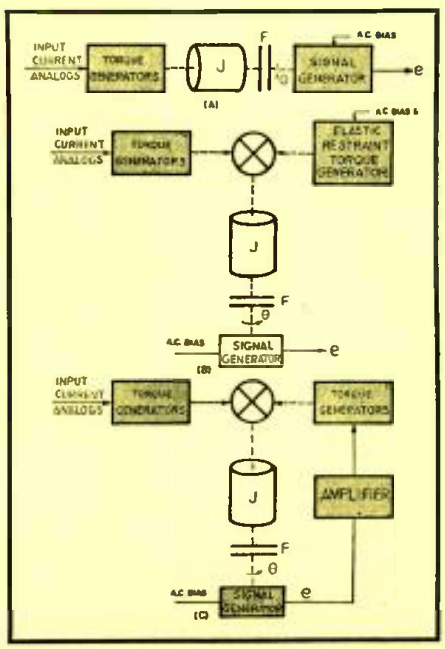


Fig. 3. (A) Dynamic integrator. (B) Open-loop static computer. (C) Closed-loop static computer.



*This article is based on a paper that was presented at the National Electronics Conference held in Chicago, Sept. 29-Oct. 1, 1952.

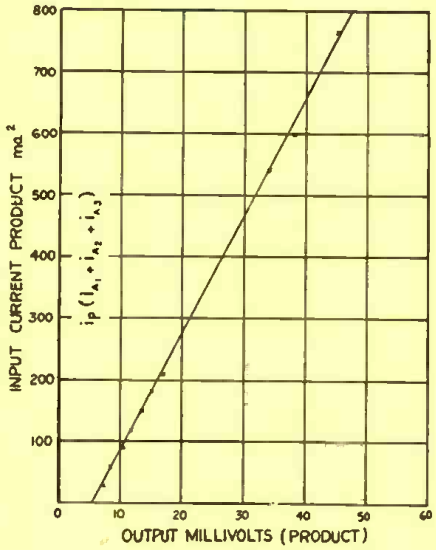


Fig. 4. Open-loop multiplication.

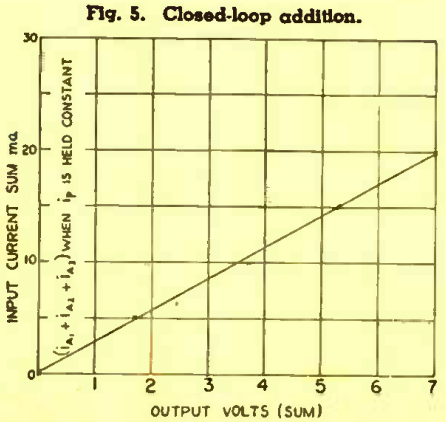
signal generators and their operational formulae. The symbols in Table 1 will be defined as follows: k is a sensitivity factor, i is a current, α is the current phase angle, θ is the angular displacement of the shaft, and f is the alternating frequency of the current involved.

These magnetic devices are composed of a soft iron stator containing coils on four poles and a soft iron rotor. In many instances, a unit consisting of one stator and one rotor can play a dual role of a torque and signal generator simultaneously, thus reducing the size of a computer package. A torque or signal generator has the approximate dimensions of 1.5" in diameter and 0.5" in thickness.

Performance of a Demonstrator

A demonstration model of a torsional system was constructed with limited instrumentation for compactness. This model, which is shown in Fig. 1, contained magnetic components A, B, C and D. The demonstrator can be operated as either an open- or closed-loop computer. Figure 2 is a schematic diagram of the system. The equation of the torques on the shaft in the static condition is by (4) and Table 1.

Fig. 5. Closed-loop addition.



$$k_A i_p (i_{A1} + i_{A2} + i_{A3}) - k_1 i_1^2 + k_2 i_2^2 - k_C i^2 \theta = 0 \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (5)$$

Since the angular displacement θ can be indicated by a voltage e for open-loop conditions, (5) can be written as:

$$k_A i_p (i_{A1} + i_{A2} + i_{A3}) - k_1 i_1^2 + k_2 i_2^2 - k_2 i^2 e / f i_b k_d = 0 \quad . \quad . \quad . \quad . \quad . \quad (6)$$

To multiply in the open-loop system, let $i_1 = i_2 = 0$ and hold i, f, i_b constant.

$$i_p (i_{A1} + i_{A2} + i_{A3}) \propto e \quad . \quad . \quad . \quad . \quad (7)$$

The demonstrator produced a curve for (7) that is slightly translated due to a small zero signal, and the zero signal is an additive constant as shown in Fig. 4.

The double-ended amplifier in the demonstrator's feedback loop can operate to make $(i_1 + i_2)$, normally a function of θ, constant. The torque developed by B then becomes proportional to $(i_1 - i_2)$ when $k_1 = k_2$. A voltmeter placed across both outputs of the amplifier gives a voltage V proportional to $(i_1 - i_2)$. The factor i in equation (5) for closed-loop operation becomes zero, and with the double-ended amplifier in the loop, (5) becomes:

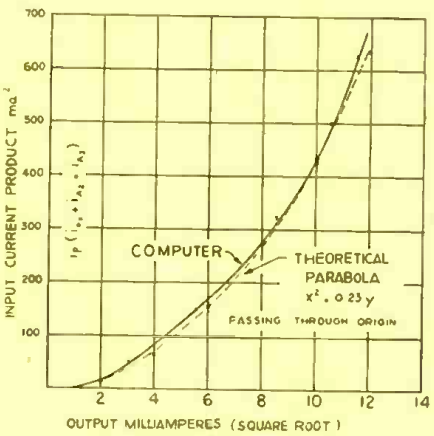


Fig. 6. Square root of a product.

$$k_A i_p (i_{A1} + i_{A2} + i_{A3}) \propto V \propto (i_1 - i_2) \quad (8)$$

Holding i_p constant in (8) makes it a sensitivity factor producing a pure summation. A curve for summing with the demonstrator in shown in Fig. 5.

The method of taking the square root of a product is obvious in (5). Let i and i_2 equal zero in (5); then the relationship has the following form:

$$k_A i_p (i_{A1} + i_{A2} + i_{A3}) \propto i_1^2 \quad . \quad . \quad . \quad (9)$$

By measuring i_1 in (9), the square root of $i_p(i_{A1} + i_{A2} + i_{A3})$ is obtained. A curve for this square root procedure is shown in Fig. 6.

If $k_A i_p (i_{A1} + i_{A2} + i_{A3})$ is held constant and i is set equal to zero, (5) has the form of a hyperbola.

$$C = k_1 i_1^2 - k_2 i_2^2 \quad . \quad . \quad . \quad . \quad . \quad (10)$$

When $k_1 = k_2$ in (10), the equation takes the form of an equilateral hyperbola with asymptotes $i_1 \pm i_2 = 0$. Figure 7 shows an equilateral hyperbola defined by the demonstrator by letting i_1 vary through a shunt impedance. A change in i_1 by the nature of the closed loop forces a change in i_2 so that the torques remain balanced.

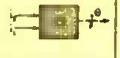
TORQUE GENERATOR	SIGNAL GENERATOR	OPERATIONAL FORMULA
		$T. k_A i_p [i_{A_1} \cos(\alpha_p - \alpha_1) + i_{A_2} \cos(\alpha_p - \alpha_2) + i_{A_3} \cos(\alpha_p - \alpha_3)]$
		$T. k_1 i_1^2 - k_2 i_2^2$
		$T. k_C i^2 \theta$
		$e. k_d f i_b \theta$
		$e. k_e f i_b \sin 2\theta$

Table 1. Operational formulae.

The perpendicular distance from the line $x - y = 0$ to the point (x_1, y_1) is:

$$|(x_1 - y_1)/\sqrt{2}| = |L| \quad . \quad . \quad . \quad (11)$$

It then follows that the perpendicular distance of the point (i_1, i_2) from the asymptote $i_1 - i_2 = 0$ is:

$$|L| \propto |i_1 - i_1| \quad . \quad . \quad . \quad . \quad . \quad (12)$$

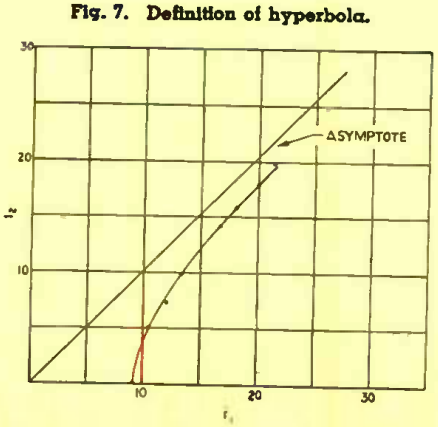
Fignre 8 is a graph comparing actual measured distances from Fig. 7 with computed distances produced by the demonstrator.

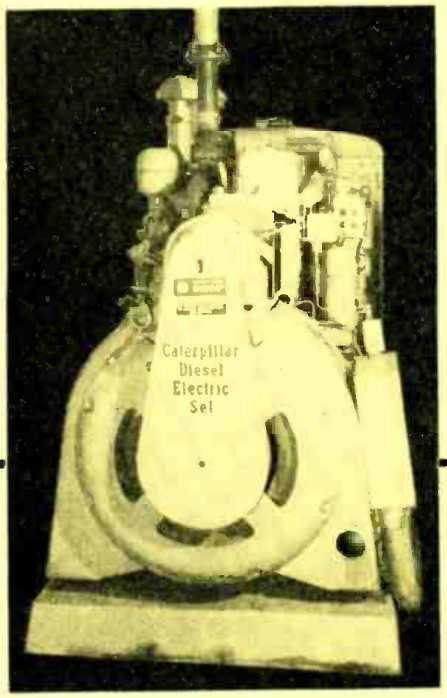
This simple demonstrator will also square, take the square root of the difference of two squares, divide, integrate analytic functions and define some three-dimensional analytic curves. Other operations with this simple demonstrator are still being evaluated.

Figure 9 is a graph of the response of an integrator to a small step input. The integrator is easily balanced for zero output with zero input. It does

(*Continued on page* 31)

Fig. 7. Definition of hyperbola.





One of the Caterpillar diesel electric sets generating power for WOI-TV and FM transmitter at Iowa State College.

POWER FOR TV TRANSMITTERS

By
LOUIE L. LEWIS
Engineer, Station WOI-TV

A solution to problems encountered when utility power sources are not available or are unreliable.

ALTHOUGH television transmission has reached a high level of efficiency, it is still undergoing improvement, often as a result of persistent development work by television engineers.

A frequent problem, and one which will be increasingly considered as new stations go into operation, is that of determining the best source of power. Reliability, of course, is of prime importance, and many station planners expect to purchase their own power plants instead of depending on long transmission lines from frequently overloaded utility power sources. In most cases, they will probably choose diesel-powered generator sets.

Examination of the procedures followed in the installation and operation of WOI-TV, at Iowa State College, will provide some insight into the problems likely to be encountered by engineers employed in planning and operating new TV stations.

WOI-TV was established solely by Iowa State College as an extension service. During the past two years grants have been made by the Ford Foundation for research in the use of television for educational programs. Some of its programs are given wide dissemination on TV stations.

During its early history, the station's facilities were operated entirely from its own diesel electric set which powered all of its facilities independent of utility power sources. Later the studios and camera equipment were moved into Ames, away from the transmitter, where they were powered by a college-owned power plant located on the campus.

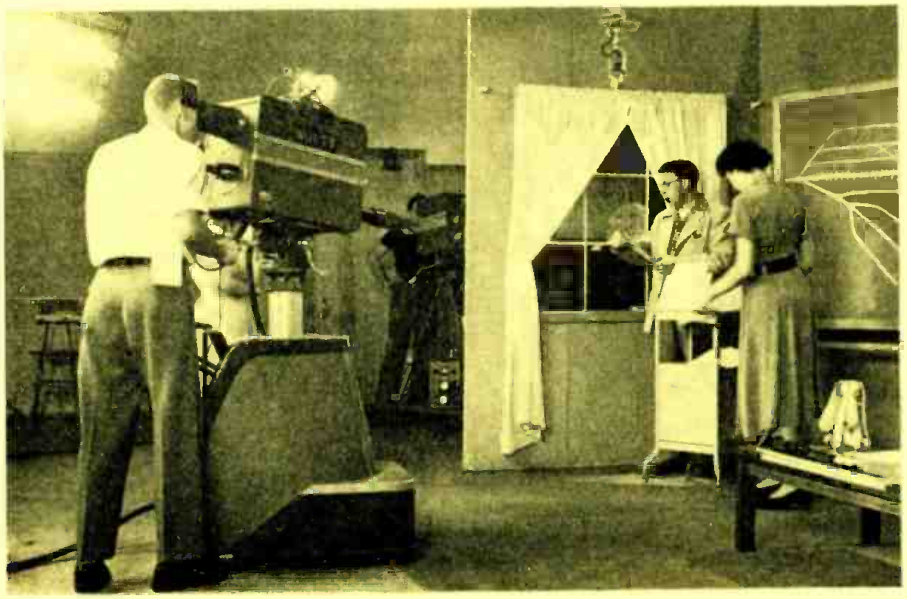
A *Caterpillar* D13000 60-cycle, self-regulated diesel electric set delivering 83 kw. at 900 rpm has been serving the transmitter—located five miles from the campus—effectively and reliably for more than 8000 hours of operation. The electric set was chosen because of the susceptibility of power lines to wind, lightning and ice damage. The entire station installation was housed in a building five miles from Ames. Dependence on power lines would have enabled storm damage anywhere on the five-mile stretch of line to knock the station out.

Some misgivings were felt about frequency control since cameras, studio and transmission all were to be powered from the diesel electric set. Also considered was the necessity for a precise matching of frequencies between network power and station power when network programs were being transmitted. From transmitter specifications, it was determined that frequency regulation had to be 2% or better and that some receivers would show a waver in the picture if the regulation was not within critical limits. Unfortunately, there was no way of determining the exact limits.

After the station was placed in operation, some TV receivers—using the "high inertia scanning system"—indicated frequency variations by distored pictures; the images showed a slight "wiggle." But other type receivers were not visibly affected. Installation of an isochronous governor with a regulation of ½% or better removed the "wiggles." This change in governors had an additional advantage in that the isochronous unit could be operated by remote control. Transmitters were turned on and off at different

(*Continued on page* 30)

Studio view of Station WOI-TV at Iowa State College, Ames, Iowa.

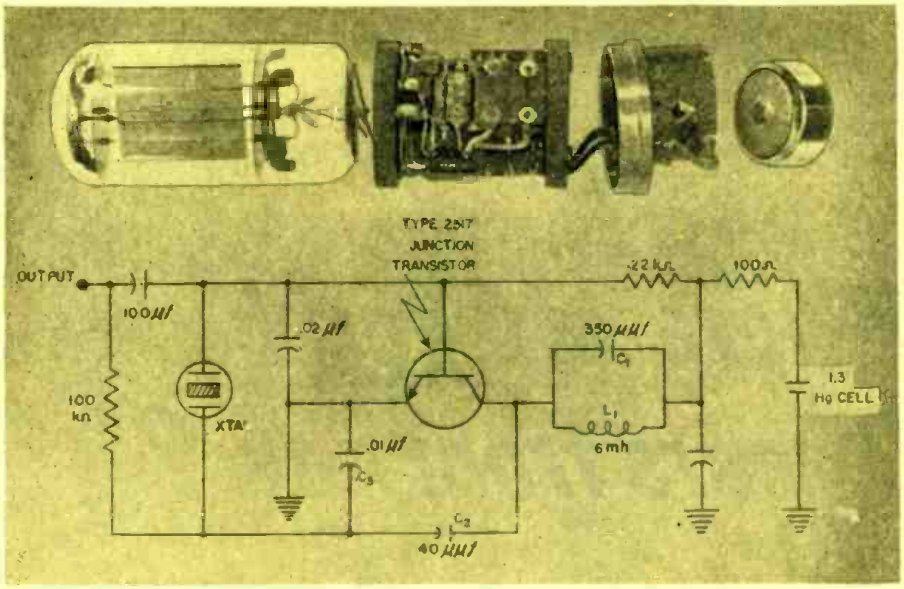


PRECISION TRANSISTOR OSCILLATOR

By

PETER G. SULZER

National Bureau of Standards



Exploded view and circuit diagram of the NBS transistor oscillator.

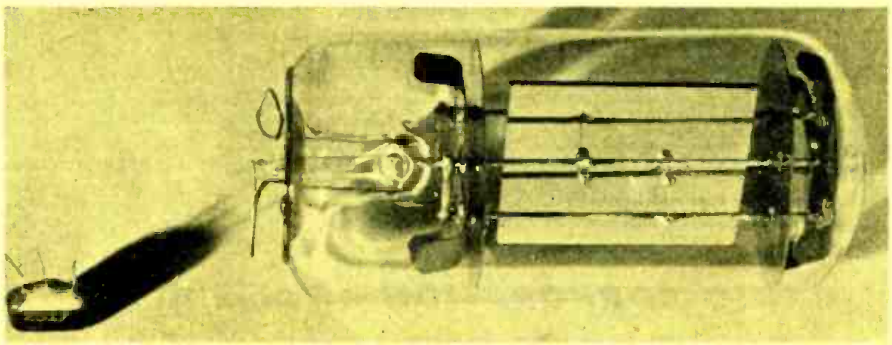
This oscillator has a short-time stability of 3 parts in 10^{10} and a long-time accuracy of 3 parts in 10^9.

AS PART of a program devoted to the improvement of measuring and calibrating standards, the National Bureau of Standards has developed a crystal oscillator that is small, portable, dependable, and accurate over long periods of time. It utilizes a junction transistor as the source of driving power for a high-stability quartz crystal unit. All components of the circuit, including the power supply, fit into a metal tube less than 2" in diameter and about 7" long. At an operating frequency of 100 kc., the long-period drift in the first model was about 3 parts in 10^6 per day.

Basic to most work in research, development, and engineering is an accurate reference or standard to which time intervals and frequencies may be precisely compared. In an attempt to reach a majority of the investigators who need these references, the National Bureau of Standards maintains Radio Stations WWV (Washington, D.C.) and WWVH (Territory of Hawaii), which transmit standard frequencies (2.5, 5, 10, 15, 20 and 25 mc.) and standard time intervals continuously, night and day. The frequencies that are transmitted are accurate to 2 parts in 10^8, and constant to better than 1 part in 10^9 per day.

To obtain the most precise operation of conventional laboratory-type frequency standards, the signals from WWV or WWVH are used in the calibration procedure. The greatest continuous accuracy is achieved by making the calibration at those times when the received standard frequencies are most efficiently propagated by the ionosphere. But laboratory-type standards of the highest stability are expensive to buy and to operate, and their use has been generally limited to the larger laboratories and research centers. In addition, these standards normally involve such auxiliary equipment as lead-acid batteries, voltage regulators, power supplies, a multiplicity of components, and complex temperature controls; they also require large floor space and highly trained operating personnel. The use of transistors in oscillators, counters, amplifiers, etc., shows great promise of making a high-precision frequency standard and crystal clock available when needed. With the development of the transistor oscillator, that part of a compact, high-precision crystal clock is now a reality.

Basic components include transistor (left) and GT-cut quartz crystal unit (right).



The major components of the NBS transistor oscillator are a type 2517 junction transistor, a high-precision 100-kc. GT-cut quartz crystal unit, and a long-life mercury cell. The dry cell supplies power to the whole unit (1.35 volts at 100 microamperes), and has an active life—under these conditions—of five or more years.

Two of the requirements that must be met in developing a high-stability crystal oscillator are constancy of phase shift in the feedback loop associated with the crystal and constancy of the amplitude of oscillation. A constant phase shift is obtained by using large, stable "swamping" capacitors at both crystal connections and by using highly stable components in the remainder of the circuit. Excellent amplitude stability is achieved by operating the transistor in such a manner that collector-voltage limiting is produced.

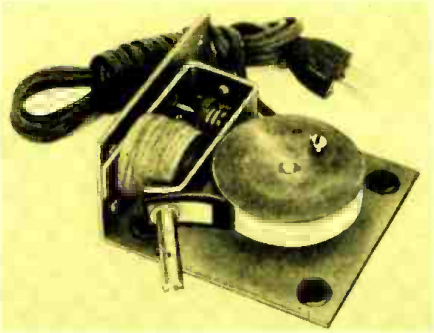
The transistor is used in the NBS oscillator in the grounded-emitter connection. It produces an output of 0.8 volt across a tuned circuit connected to the collector electrode. The tank circuit, composed of a 350-$\mu\mu$fd. capacitor and a 6-mh. coil, is designed to oscillate at 100 kc.; however, the magnitude of the voltage is too high to be applied directly to the crystal unit. Consequently, the voltage is reduced by means of an attenuator, which consists of a 40-$\mu\mu$fd. and a 0.01-μfd. capacitor in series from the collector electrode to ground. The driving current (less than 100 microamperes) for the crystal is taken from

(*Continued on page* 29)

NEW PRODUCTS

ELECTRIC IMPULSE MOTOR

Special features of the "Kasson Vibramotor"—a small electric impulse motor with variable speeds—include low speed without gears and pin-point stoppage the instant current is cut off. Just announced by *General Die and*

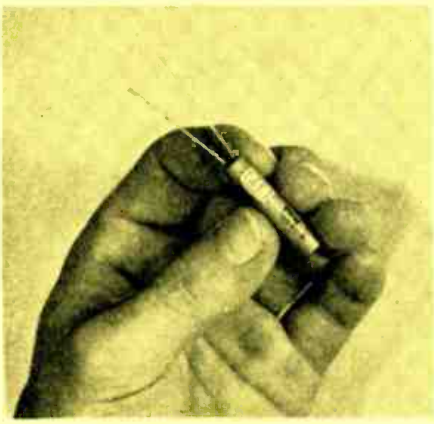


Stamping Company, this unit is constructed entirely of steel with speed controlled by vernier adjustment.

Model AV, with a variable range of 1-250 rpm, has a net weight of only 1½ pounds. The "Vibramotor" is also available geared, reducing speed to a range of ½-80 rpm with greatly increased torque. It is equipped with a 4′ cord and plug, and operates on 110 volts a.c., 60 cycles only. Further details will be furnished on request to the *General Die and Stamping Co.*, 262 Mott Street, New York 12, N. Y.

PULSE FORMING NETWORK

Measuring only 5/16" in diameter and 1-7/16" in length, the miniature PFN 7030B pulse forming network re-



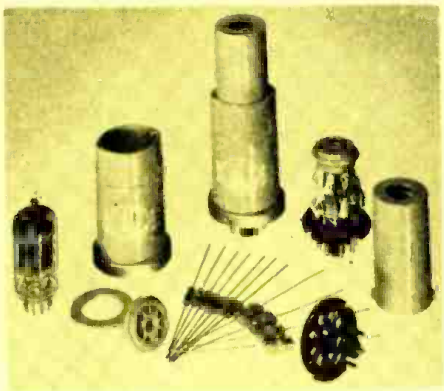
cently developed by *PCA Electronics, Inc.*, has an impedance of 1050 ohms and forms a 0.15-microsecond pulse when used in a suitable circuit.

The small size of this network plus two convenient 1¼" #22 solid copper tinned leads make mounting easy, especially when used in a miniaturized circuit.

For further information on the PFN 7030B pulse forming network, write to *PCA Electronics, Inc.*, 6368 De Longpre Avenue, Hollywood 28, Calif.

PLUG-IN CIRCUITS

Packaged plug-in circuits which offer ease of electronic circuit design, simplified development techniques, and rapid production of highly specialized pulse-type equipment have been announced by



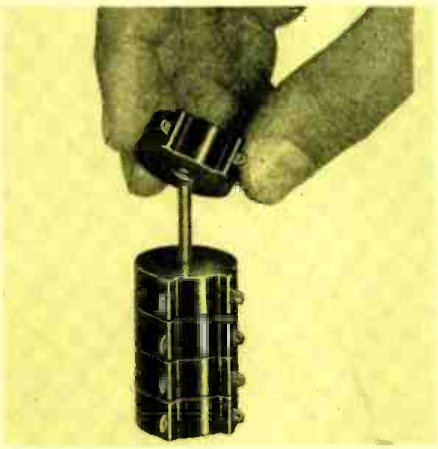
the *Electronic Engineering Company of California*. First developed for use by the armed services, this new series is now being offered to the electronic and allied industries in 26 catalog types and 40 secondary versions.

Standard circuits include amplifiers, flip-flops, multivibrators, squaring circuits, pulse gates, crystal oscillators, "and" circuits, "or" circuits, pulse amplifiers and many others. Circuit descriptions are available in a brochure which may be obtained by writing to Mr. T. E. Coalson, Plug-In Division, *Electronic Engineering Company of California*, 180 South Alvarado Street, Los Angeles 4, Calif.

TOROID COILS

New Type "P" toroid coils, hermetically encapsulated in a special tough plastic compound, have been announced by *Hycor Company, Inc.*, 11423 Vanowen Street, North Hollywood, Calif. These coils will withstand ambient temperatures of −55°C to 130°C, 95% humidity (boiling salt water), and mechanical shock.

The small physical size of the new Type "P" toroid coils makes them ideal

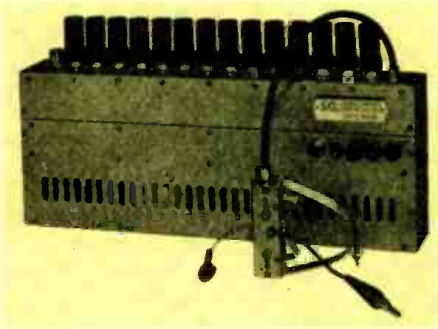


for use in miniature assemblies; they may also be mounted compactly on a single screw. Electrical characteristics are the same as for the older type coils.

CHAIN PULSE AMPLIFIER

Greater bandwidth, fast rise time without overshoot, and high output voltage are among the major features of the *SKL* Model 214B chain pulse amplifier. Fourteen 6AH6 vacuum tubes are used to obtain the maximum output voltage of 125 volts over a bandwidth of 200 cps to 90 mc. This broadband amplifier has a pulse gain of 30 db and a rise time of better than 0.006 microseconds. Frequency response is flat within 1½ db from 500 cps to 80 mc.

The phase response of the Model 214B is substantially linear within the



passband, and the power supply is stabilized to prevent fluctuations of gain due to variations in the signal duty factor. For further information, write to *Spencer-Kennedy Laboratories, Inc.*, Dept. RT, 186 Massachusetts Avenue, Cambridge 39, Mass.

SELECTIVITY CONVERTER

The first and only selectivity converter deliberately designed to provide exact jam-free bandwidths for every c.w. speech receiving condition has been

announced by *J. L. A. McLaughlin*, P. O. Box 529, La Jolla, Calif. It is a continuously variable straight-sided selectivity converter designated as the Type MCL-50 "Signal Splitter."

Type MCL-50 can be used with any standard AM receiver and requires a rack-panel space of only 3½". It has a self-contained power supply and audio amplifier with an output of 18 dbm/600 ohms. Its continuously variable filters provide bandwidths from 0.4 kc. to 6.0 kc. with 60-db cutoffs of from 500 to 600 cps.

"INCREDUCTOR"

Having no moving parts, the Type 65BA1 current-controllable inductor announced by *C. G. S. Laboratories, Inc.*, is suitable for wide-range frequency shift or inductance variation between 1 mc. or lower and about 2.5 mc. or higher, at zero control current. A 7:1 variation of frequency is obtainable with the 65BA1, and the upper

frequency limit with maximum control current is approximately 30 mc.

Trade-marked "Increductor," this unit has a maximum inductance of 30μh at zero control current which can be reduced to at least 1/50th of this value by the application of 40-ma. control current. Its rising *Q* characteristic vs. frequency obtained in tuned circuits tends to reduce bandwidth variations.

For additional information and data sheet, write to Stanley Wolff, Chief Liaison Engineer, *C. G. S. Laboratories, Inc.*, 391 Ludlow St., Stamford, Conn.

DECADE AMPLIFIER

Hermon Hosmer Scott, Inc., has announced a miniaturized laboratory voltage amplifier with 1-mc. frequency response and stabilized voltage gains of 10 and 100. The Type 140-A decade amplifier will extend the sensitivities of oscilloscopes, vacuum tube voltmeters, and other indicating or recording devices.

A low-flux-density transformer permits this unit to be used without affecting nearby equipment operating at low signal levels. Type 140-A is entirely resistance-coupled, and no peaking coils or compensating networks are used which might cause undesirable transient effects.

Frequency response is flat from 2 cps to 1 mc., ± 0.1 db. Equivalent input noise is less than 8 microvolts in the X100 position. A free bulletin giving further details on this decade amplifier may be obtained on request from *Hermon Hosmer Scott, Inc.*, 385 Putnam Avenue, Cambridge 39, Mass.

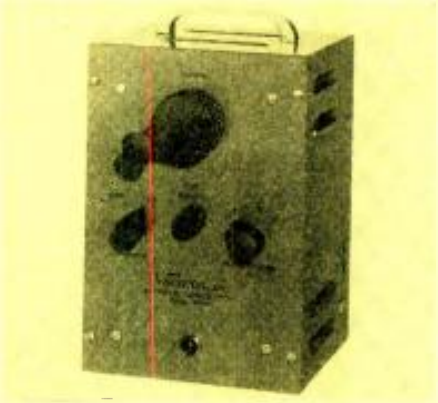
MINIATURE RELAY

The *Phaostron Company* is now manufacturing a miniature, hermetically sealed, double-pole, double-throw relay which weighs only 3½ ounces and is designed to operate through a wide range of environment. This relay will withstand high acceleration, vibration, shock and tumbling; it meets the shock requirements of MIL-E-5400 and will withstand continuous acceleration of 50*G* without malfunctioning.

Certain contact combinations can be furnished with a required coil power as low as 20 mw., and any relay in the PR9100 series can be obtained with a coil resistance as high as 15,000 ohms. Detailed information for specific requirements is available upon request from the *Phaostron Company*, 151 Pasadena Avenue, South Pasadena, Calif.

MARKER GENERATOR

A microwave marker generator is being offered by *Vectron, Inc.*, 406 Main Street, Waltham, Mass., to permit



the addition of 4-, 2- or 0.5-mc. markers to the cathode-ray tube display of any S-band spectrum analyzer. Model MG10S will make possible quick visual interpolation and differential estimates without reference to charts or dials.

Factory-adjusted to an accuracy of ±1% of the marker frequency, this

(*Continued on page* 23)

NEWS BRIEFS

CAR RADIO TESTING

In the photograph below, Mr. R. C. Stinson, head of the radio laboratories of *Chrysler Corporation's* Engineering Division, is pictured running a test on a radio for a Plymouth car. The various tests that are run in this laboratory

check selectivity, sensitivity, tone quality and tuning precision in order to insure the highest standards in radios.

To check the performance of production radio sets for Plymouth, Dodge, DeSoto and Chrysler cars, and to judge the merit of experimental designs, the engineers of the *Chrysler Corporation* use special precision equipment—including a frequency generator which is accurate to two parts in ten million over a 24-hour period, and a device which counts electrical impulses in intervals as small as one ten-millionth of a second.

SEMICONDUCTOR MATERIAL

Brown-Allen Chemicals, Inc., 155 East 44th Street, New York 17, N. Y., has announced the invention of a new type of semiconductor material made from raw materials which are readily available. The new substance, developed by Leonard E. Ravich, vice-president in charge of research of *The Solid State Research Institute, Inc.*, a *Brown-Allen* subsidiary, has been produced in a pilot plant in several different forms. In one form, its principal property is to change light into electric current; in another form, it reveals great storage capacity or "memory" effect.

It is believed that certain developed forms of this new material may solve existing transistor problems of unreliability arising from the use of germanium or silicones, and that other developed forms will lead to improved photocells which will eliminate the use of photomultipliers. Production facilities are now being set up by *Standard Piezo Company*, another subsidiary of *Brown-Allen Chemicals, Inc.*

ANTENNA HOUSING MATERIAL

Polymethylmethacrylate—Plexiglas—is being used to house antennas of radio and television relay stations and radar installations. The photograph shows a television relay station located on the roof of the *Bell Telephone Company* building in Philadelphia where the acrylic glazing was installed to protect personnel and equipment from weather and wind.

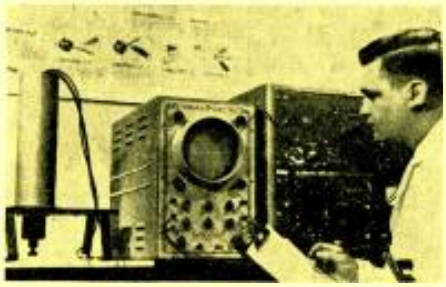
Transparency was required on this rooftop station to permit sighting of the broadcast point and proper directioning of the parabolic reflectors. By the use of V-rib corrugated Plexiglas, both protection and transparency were gained without distortion of the waveforms and with maximum efficiency. Shortly after completion, this installation withstood a 60-mile gale which

ripped a metal door off the relay station.

Further information on Plexiglas may be obtained from *Rohm & Haas Co.*, Washington Square, Philadelphia 5, Pa.

RADIOACTIVITY RESEARCH

Radioactivity methods have greatly accelerated research in semiconductor materials used in transistors, according to Dr. George H. Morrison of the Central Engineering Laboratories staff of *Sylvania Electric Products Inc.*, Bayside, N. Y. In speaking to the American Institute of Electrical Engineers at its Winter General Meeting, he pointed out



that it is possible to measure impurities of one part in 100 million in germanium.

By the use of a method known as activation analysis, the transfer of trace amounts of impurities from the processing container can be evaluated. The graphite container, or boat, is first subjected to nuclear radiation in the Brookhaven (Long Island) reactor of the Atomic Energy Commission, during which certain impurities of the graphite are made radioactive. During processing, a portion of the container impurities are transferred to the semiconductor material. Because they are radioactive, the quantity and identity can be determined by measurement of the intensity and decay rate of the radiation. This determination is being made by a *Sylvania* scientist in the photograph.

ELECTRONICS RESEARCH FIRM

Electro-Sonic Laboratories, Inc., is a new firm of physicists and engineers devoted to research and development in all phases of electronics. Offices and a well-equipped laboratory have been opened at 3215 36th Avenue, Long Island City, N. Y. The chief engineer is John H. McConnell, for many years a member of the technical staff of *Bell Telephone Laboratories, Inc.*

This new organization, an affiliate of the *Insuline Corporation of America*, is ready to undertake technical projects over the whole range from direct current to radar. Its services are available to government and to both large and small industrial firms.

WEATHER-DETECTION RADAR

Development of a new type of airborne weather-detection radar unit is being undertaken by the *RCA Victor Division, Radio Corporation of America*, in cooperation with *United Air Lines, Inc.*, in order to supply commercial air lines with a radar system designed exclusively for weather-mapping use. This radar unit will operate at new frequencies to "map" weather obstacles on

a wide front. It is expected to provide pictures that will give a pilot information on the depth as well as the breadth and height of storm fronts.

RCA expects to deliver experimental equipment early in the summer, so that tests can be conducted during the period of greatest storm activity. The experimental radar system will be installed in a *United Air Lines* "Mainliner."

LABORATORY FACILITY

A 120,000-square-foot engineering laboratory facility will be constructed in Williamsport, Pa., by the Radio Tube Division of *Sylvania Electric Products Inc.* to augment the research and development work now being carried on in its laboratories in Emporium, Pa. The two-story building, in which approximately 400 people will be employed, is expected to be in operation early next year.

The new laboratories will be devoted to development work and pilot plant operation in radio receiving tubes for military use, new product development work, fundamental chemical research, and application engineering—including a rating laboratory in which tubes will be evaluated for performance under abnormal conditions. Other research and developmental activities in various fields of electronics also will be undertaken.

NATIONAL ELECTRONICS CONFERENCE

Dr. J. D. Ryder, head of the electrical engineering department, University of Illinois, has been named president of the 1953 National Electronics Conference, Inc., and Dr. C. E. Barthel, Jr., of the Illinois Institute of Technology, has been named chairman of the board. The ninth annual conference will be held on September 28, 29 and 30 at the Hotel Sherman in Chicago.

At the 1952 conference, the registration totaled 6165. Ninety-seven papers were presented covering a broad field of electronic research, development and practical application; and the technical program was supplemented by 120 booths of exhibits by manufacturers foremost in the electronics field. Copies of the Proceedings of the 1952 conference may be obtained from National Electronics Conference, Inc., 852 E. 83rd Street, Chicago, Ill.

RTMA MEETING

Problems and developments in the electronics industry—both commercial and governmental—were covered in a one-day meeting of the major producers of electronic equipment, parts and components on March 22. This meeting, held at the Roosevelt Hotel in New York City, was the Second General Membership Meeting of the RTMA Technical Products Division.

New Products

(*Continued from page* 21)

compact self-contained unit uses standard receiver-type tubes; and the special harmonic circuit permits continuous coverage of the entire S-band and through the C-band to 6200 mc.

PRECISION SERVO MOTORS

Miniature precision servo motors, approximately 1″ in diameter and slightly over 1″ in length, are being manufactured by *G-M Laboratories Inc.* They are available for frequencies varying from 60 to 400 cycles, and in 2-, 4-, 6- or 8-pole construction.

The extreme precision required in these motors involves tolerances as small as ±0.0001. Type 665-51 can be supplied to meet rigid military specifications with regard to humidity, temperature, vibration and altitude. Further information may be obtained by writing to *G-M Laboratories Inc.*, Dept. O, 4300 North Knox Avenue, Chicago 41, Ill.

MAGNETIC IMPULSE COUNTER

Actuated by electrical impulses, the *Kellogg* magnetic impulse counter is an electromagnetic impulse-counting and storing device which may be described as a specialized single-core, dual-winding, plural-armature relay. It performs the counting and marking function of a chain of 10 to 20 relays or of a 2-magnet, 10-point stepping switch, but at a lower cost and with a considerable saving of space.

Ten individual armatures are provided in the counter, each controlling a make set and a break set of contacts. The armatures are operated sequentially in response to impulses of the digit series being recorded.

For further information and specifications, write to the *Kellogg Switchboard and Supply Co.*, Dept. MIC 7, 79 West Monroe Street, Chicago, Ill.

COLD-CATHODE COUNTER

For the first time, a high speed predetermined electronic counter is available which employs an all cold-cathode tube design—the Model GW has just been announced by the *Haledy Electronics Company*, 57 William Street, New York 5, N. Y. Assuring long life, low power consumption and maintenance-free operation, this counter requires no warm-up time and is simple to operate.

Operating on a control rate of up to 15,000 per minute, the Model GW is able to produce easy-to-read output information on large illuminated numerals for direct panel readouts without any interpolations or additions for any digit.

Personals

ALFRED Y. BENTLEY is the new chief engineer of the Receiver Division of *Allen B. Du Mont Laboratories, Inc.* When he joined *Du Mont* in 1945, Mr. Bentley was made assistant head of the Cathode-Ray Tube Engineering Department; since 1947 he has been chief engineer of the Cathode-Ray Tube Division. Mr. Bentley replaces Robert J. Cavanagh, who will return to his original engineering and research post with *Du Mont's* Research Division.

MALCOLM P. HERRICK has been appointed chief engineer of the *Stromberg-Carlson Company's* Radio-Television Division in Rochester, N. Y. He has been with *Stromberg-Carlson* as a staff engineer engaged in radio and television design and production engineering since his graduation from the University of Maine in 1944. Although his interests are mainly electronic, Mr. Herrick's hobby is experimentation in the field of ballistics.

GEORGE KRYGIER was named administrative engineer of *CBS-Columbia, Inc.*, the set-manufacturing subsidiary of the *Columbia Broadcasting System.* In his new position, Mr. Krygier will handle engineering administrative functions and coordinate the activities of the Engineering Department with other divisions of the company. Prior to joining *CBS-Columbia* in 1950, he was associated with the *Sperry Gyroscope Company* and with *Underwriters' Laboratories.*

WILLIAM P. MAGINNIS, who joined *Federal Telephone and Radio Corporation,* Clifton, N. J.—associate of the *International Telephone and Radio Corporation*—in 1951, has now been elected vice-president and chief engineer; he will direct telephone, radio and vacuum tube engineering. Mr. Maginnis was with *RCA* for 21 years prior to joining *Federal.* He started his career in communications engineering at *Bell Telephone Laboratories, Inc.*

HORACE W. ROYER received the *General Electric Company's* highest honor—the Charles A. Coffin award, given to *General Electric* employees for outstanding achievement. It was presented to Mr. Royer "for his major role in the development of Ultra-Vision which has established a new standard of picture quality in the television industry." Mr. Royer is a product analyst in the *G-E* Receiver Department; he has been with the company for 13 years.

L. W. TEEGARDEN has been elected executive vice-president of the *Radio Corporation of America.* A pioneer merchandiser, Mr. Teegarden has been active in the electrical and electronics industries for many years. With *RCA* since 1930, his most recent position was that of vice-president in charge of technical products for the *RCA Victor Division;* in this position he supervised the activities of both the Engineering Products Department and the Tube Department.

Nonlinear Condensers

(*Continued from page* 5)

described above, these arrangements also depend upon the variation of capacitance with d.c. bias.

In Fig. 5B, C_1 and C_4 are nonlinear condensers and are operated with a d.c. bias applied through resistance R_1. This bias is necessary to operate the condensers on the linear portion of the curve shown in Fig. 4B. Since no d.c. power is drained, the bias may be supplied from a series of low current cells. The two resonant circuits are adjusted to the same frequency, this being slightly different and—for the purpose of this discussion—higher than the frequency of the r.f. source. An a.f. input is supplied as shown. If at any instant the audio input causes an increase in the d.c. bias applied to C_1, its opposite half will cause a decrease in the bias applied to C_4. The capacitance of C_1 will decrease, causing the resonant frequency of the tank (L_1-C_1-C_2) to rise. C_4 will increase and cause the resonant frequency of the other tank (L_2-C_3-C_4) to fall. The resonant frequency of one tank will, therefore, more closely approach the frequency of the r.f. source, while the resonant frequency of the other tank will be pulled farther away from it. Figure 4A sketches these changes. Since the impedance a parallel tank circuit presents to an r.f. source increases as the resonant frequency of the tank comes closer to the source frequency, tank "B" will present a higher impedance to the source than tank "A." Consequently, more r.f. voltage will appear across "B" than across "A." The output of the circuit is the difference of these voltages. Rectification and filtering of the r.f. component by the diode and C_5 will leave, as an output across R_2, an amplified reproduction of the audio input. The power drained by the device consists of the audio lost in R_1 and the r.f. losses in the tanks and through the output circuit. Rough computations show that with tanks having fairly high Q's, one unit change in audio voltage produces sufficient changes in the r.f. resonant frequencies discussed above to produce a difference of about five unit changes in the r.f. voltage output.

The advantages that this type of circuit possesses lie mainly in the fact that such an amplifier lends itself exceedingly well to miniature sealed assemblies, having an indefinite life and being extremely rugged. Like the transistor, no heater power need be supplied. Unlike the transistor amplifier, which has a low input and high output impedance, this circuit has a high input and low output impedance, thus minimizing power drain from the audio source to be amplified. The low output

impedance enables the amplifier to be coupled efficiently to other stages, even through long cables.

Adaptation of nonlinear condensers to all sorts of applications should provide a ripe field for experimenters tired of fabricating arrangements of standard components. Proposals for the use of these condensers in the fields of harmonic generation, frequency conversion and phase shifting have been made the subjects of much research. The Department of Defense has been backing development work on various phases of ceramic condenser development for some time, causing much data to be classified.

The author is intrigued with the possibilities of utilizing nonlinear condensers in temperature control devices, including fire alarm systems. The sharp slope of the temperature vs. capacitance curve, as well as the sharp peak of capacitance at the Curie point, will adapt these condensers for remote control temperature functions. It has already been demonstrated by the manufacturers that the Curie point may be shifted to any desired temperature and that the peak of the curve may be narrowed or broadened. Although thermistors are extensively used in the temperature control field, the nonlinear condenser possesses the advantage of adaptability to the direct control of an oscillator.

Another application is suggested by the exponential decay of capacitance over a long period of time after rapid cooling of the condenser from a high temperature. This factor could be used as a controlling element in an operation where a device is to be turned on for a short time and turned off for a long time. Still another application might be in the field of pulse shaping, where the change of capacitance with d.c. voltage could be used to form special pulse shapes when connected in conjunction with differentiation or integration circuitry.

Undoubtedly the reader will be able to think of uses for these condensers not covered by the author. The very high *K* ceramic condensers are not stocked by the average radio parts house at the present time. Information as to current availability, price and technical data may be obtained by contacting the *Glenco Corp.* of Metuchen, N. J., manufacturer of the line of "GLENNITE" (trade mark) condensers, two of which were discussed in this article.

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Dranetz, Howatt and Crownover, "Barium Titanates as Circuit Elements," Tele-Tech, April-May-June, 1949.

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Loudness Control

(*Continued from page* 13)

will provide about the same signal level to the amplifier, although the desired levels vary with the type of performance. In fact, since the generally preferred levels for speech place the loudness limits at approximately 40 to 80 db, the dynamic action might well be removed completely for speech reproduction, since no dynamic action is required for instantaneous original levels below 80 db. At the same time, the over-all loudness should be reduced from that used for music. Similarly, dance music might require less dynamic control for proper balance than a symphony program. Such specifications can only be very approximate, due to the wide differences between various broadcasting techniques, voices, and musical selections. In any event, with dynamic rather than static control, the higher levels will be boosted less than the lower levels, in the bass, and an incorrect balance will not be as objectionable.

As with any analysis of a single effect such as this, several other factors contributing to the over-all result have not been mentioned, for the sake of simplicity. For example, the compression of broadcast or recorded programs may have peculiar effects on the results obtained. This cannot always be avoided conveniently, since the compression is usually done by hand rather than automatically. However, the amount of compression used in modern recording of LP's and in FM broadcasting is often quite small, and thus will not essentially interfere with the control action. The amount of control required for a particular program may have to be varied slightly, depending on the studio acoustics and microphone placement used, as well as on the type of program. As with other volume expanders and compressors, the type of circuit shown provides for indiscriminate control of the intended level of instruments other than the level providing the highest signal. A softer instrument played at the same time as a louder one would also be attenuated, and in some cases might not be heard at all, quite apart from the masking by the louder instrument. This is just the inverse of the original objection to the static compensated controls; it is much less serious, however, since this situation will not cause as unpleasant an unbalance.

Starting with the simple potentiometer volume control and its faults, the design of static compensated controls has been considered, together with some of the faults of the latter. It has been shown that the *correct* use of the static controls dooms one to listening in the equivalent of a symphony seat in the last row, upper balcony, where the loudness level *peaks* never exceed about 80 db. In an effort to find better equivalent seats, the necessary basis for design has been presented and circuits have been described for providing a dynamic loudness control. It might be concluded that the most fortunate people are still those whose circumstances permit them to reproduce music in their homes at the original program loudness levels, thus returning to the simple volume control, used only to set the level to equal the preferred original level. However, such homes would probably have some of the aspects of castles, or at least civic halls. For those still obliged to live peaceably with neighbors and families, it is felt that the dynamic loudness control, properly designed and manipulated, can provide the desired better equivalent seats at a slightly higher cost for tickets.

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LOOKING at TUBES

By **WILFRID B. WHALLEY**

Adjunct Professor of Electrical Engineering
Brooklyn Polytechnic Institute

Color television use of pickup tubes.

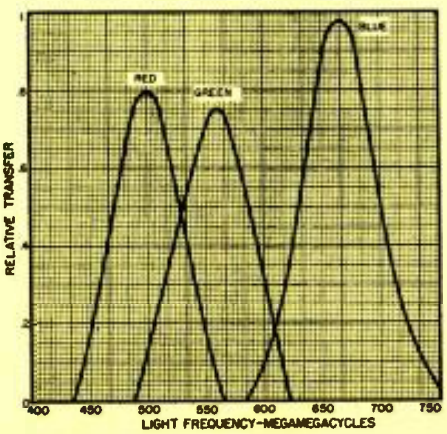
INDUSTRIAL and experimental color television systems at present utilize the same types of pickup tubes as do monochrome systems. Some color television systems require one pickup tube in each camera. Other systems use three tubes, as similar to one another as possible, in a composite unit for each camera. High sensitivity tubes are required for all live color pickup; this is necessary due to light energy loss in color filters or dichroic mirrors. Hence, the *image orthicon* is the most popular type of tube for color television systems, although the *vidicon* may come into use for industrial color television —because of its simplicity, small size and low cost. The method of using the tubes depends upon the type of system.

Classification of Systems

All color television systems, including those under experimental investigation, can be classified into two basic groups. The first group consists of those in which the added color signal is related to the vertical or horizontal synchronizing pulse. They are called field sequential or line sequential systems.

Those in the second group use subcarriers for the color information, and almost invariably require parallel operation of several pickup tubes and associated amplifiers, one for each primary color.

Fig. 1. Relative transfer characteristics of typical red, green and blue filters, such as those used in color television.



Fundamentals

The only basic difference between a color and a monochrome television picture is one added item of information. The detail, variations in brightness, synchronizing and blanking information are already present in the monochrome signals. Therefore, all research in color television is concerned with means of identifying each element satisfactorily with the correct hue.

Visible light covers a frequency range of from 400 to 750 million megacycles, 400 corresponding to deep red, and 750 to the highest visible blue. The eye detects each small change in frequency (an infinite number of them being possible) as a small change in hue.

Consider the means whereby the television camera can recognize the correct hue or light frequency and convert it into a signal which can control the reproducing device in the receiver correctly. It has long been known that the initial velocity of the electrons which leave a photoemissive surface varies with the frequency of the incident visible light;

$$\tfrac{1}{2}v^2\, m = hf - hf_0$$

where v is the electron velocity, f the frequency of the light, and f_0 the minimum frequency required for any electron emission. However, no practical application of this principle to pickup tubes has yet been realized commercially. Instead, the bandpass filter technique used widely in communication circuits has been applied to color recognition.

Color filters with a gelatin base can have restrictive characteristics for light in the red, green or blue regions. By careful choice of dyes, the filters can be made to overlap sufficiently to cover the whole light spectrum. This is the principle of the three primary television colors.

The method of using these filters in the television camera is determined by the type of color system. When a red filter is placed between the pickup tube and the scene, only those portions of the scene which have light energy in the red bands within the response of the color filter will produce signals from the pickup tube. Those areas which extend from green to blue are absent.

Similarly, when a green filter is positioned between the mosaic and the scene, the red and blue regions give no output signals. As can be seen from Fig. 1, light in the upper portion of the red will give an output signal for the red and green filters. This will be a yellow, because the two filter passbands overlap.

Field Sequential Color

In the early 1930's, John L. Baird satisfactorily demonstrated a color television system which associated the color identification with the field synchronizing signal. During one field of the vertical scanning, a red color filter was in position; during the next field a green filter was used; and the third successive field was viewed through a blue filter. Hence, the signals from the pickup tube represented variations in intensity corresponding to the three different areas of the color spectrum.

The filters were mounted in a circular disc assembly, and driven by a synchronous motor locked into the vertical scanning frequency. A similar disc with color filters was positioned in front of the reproducing picture tube, and synchronized so that the viewer saw in succession the same colors that appeared in the original scene. This system, known as the field sequential color system, has been developed and provides excellent color quality with relatively simple apparatus and stable operation.

In present-day industrial equipment, there is an additional control amplifier for each of the three primary colors between the camera and the line video amplifiers to compensate signal output for each primary color correctly, in order to take care of variations in studio lighting and variations in color sensitivity of the pickup tube. It should be noted that no two pickup-tube photosensitive surfaces have the same color response curve. The three amplifier controls are adjusted so that the output signal gives the correct shade of white for a white object in the scene, thus establishing the proper proportion for each color.

This system requires only one pickup tube, with a small rotating color disc. Therefore, each of the color pictures is automatically in registration, the green being in registration with the red and blue as accurately as the synchronization of successive fields of the scanning system.

Ceramic Pickup

(*Continued from page 9*)

$$M = \frac{\Delta M}{\frac{E}{E_{\Delta M}} - 1} \quad . \quad . \quad . \quad . \quad . \quad . \quad (2)$$

Equation (1) expresses the sensitivity (S_1) of the reversible unit in decibels below 1 volt for an acceleration of one meter/second/second. The numbers T_{12}, T_{31}, and T_{32} are ratios of the voltage applied to the motor unit (denoted by the first subscript) to the voltage derived from the receiver unit (denoted by the second subscript) expressed in decibels. C_1 is the electrical capacity of the first or reversible unit in farads, and M is the coupling mass in kilograms. If T_{31} and T_{32} are interchanged, a calibration of unit No. 2 (S_2) is obtained.

Coupling impedance is treated as if it were a simple mass and its value is adjusted as a function of frequency in accordance with Eqt. (2). This method will function satisfactorily if the dissipative portion of the coupling impedance is small compared to the mass reactance of the coupling impedance. The value of M can be determined with sufficient accuracy in some instances by direct weighing of the apparatus; however, a dynamic measurement is desirable as the frequency is increased into the neighborhood of the first resonance. The dynamic measurement of the effective coupling mass is accomplished by adding an incremental mass (ΔM) to the assembly and noting the effect on the transmission.

A convenient arrangement for making this type of calibration is outlined in Fig. 2. Three of the pickups are bolted together, with a provision for adding an incremental mass. One of the units is across the input of an attenuator along with an audio oscillator. The output from one of the other two units is fed to the high impedance input of a preamplifier, which is followed by a bandpass filter and an indicating meter.

The output of the attenuator is substituted for the output of the driven pickup and the attenuator is adjusted to provide the same indication on the meter. Four measurements are made, T_{12}, T_{31}, T_{32} and T_{12} with the incremental mass added. An additional measurement of C_1 at the same temperature and frequency is required, and there is sufficient information to obtain calibrations on units No. 1 and No. 2.

In a group of three units, it is possible to make six measurements of transmission and three measurements of capacity. These data will provide four calculations of sensitivity on each unit, using different combinations of data. Table 1 is a tabulation for four such calculations on a single unit throughout the range from 15° to 170°F.

Frequency response of another unit has been calculated all four ways that the six measurements can be combined. These data appear in Table 2. They are consistent and yield a result approximately 1 db more sensitive than the calibration at 60 cps on the tuning fork calibrator.

When the first attempt to perform this experiment was made back in 1940, using the Rochelle salt pickups, the results were not nearly so encouraging. At that time there were two major pitfalls: the capacity of the motor unit was a function of voltage, and the sensitivity to rotational motion tended to excite rotational motions. Ceramic pickups have practically overcome these difficulties—the electrical capacity is only slightly dependent on the applied voltage, they do not tend to excite rotations, and they are mechanically well adapted to being coupled together in a reliable fashion. It appears that reciprocity calibration using more or less standard laboratory equipment is very practical.

Temperature (°F)	Sensitivity (db re 1v./m/sec²)			
15	-43.8	-43.9	-43.7	-43.9
36	-43.2	-43.3	-43.3	-43.2
55	-43.4	-43.3	-43.3	-43.4
69	-43.5	-43.5	-43.5	-43.6
84	-43.8	-43.8	-43.8	-43.8
89	-43.8	-43.8	-43.8	-43.9
105	-43.9	-43.9	-44.0	-44.0
132	-44.3	-44.4	-44.3	-44.3
152	-44.7	-44.7	-44.6	-44.6
170	-45.0	-45.1	-44.9	-45.0

Table 1. Sensitivity vs. temperature using the four combinations of data.

Table 2. Calculated frequency response using the four combinations of data.

Frequency (cps)	Sensitivity (db re 1v./m/sec²)			
250	-45.4	-45.5	-45.2	-45.1
350	-45.3	-45.3	-45.0	-45.0
500	-45.0	-45.0	-44.6	-44.7
700	-44.7	-44.6	-44.3	-44.3
1000	-43.1	-43.1	-42.7	-42.6
1500	-39.6	-39.6	-39.3	-39.2
1800	-33.9	-33.9	-33.6	-33.5
2000	-27.5	-27.7	-27.4	-27.4
2200	-25.1	-25.6	-25.6	-25.6
2400	-30.8	-30.8	-30.9	-31.2

CALENDAR of Coming Events

APRIL 29-MAY 1—Electronic Components Symposium, sponsored by the AIEE, IRE, RTMA and WCEMA, Shakespeare Club, Pasadena, Calif.

MAY 7-9—Acoustical Society of America, 45th Meeting, featuring Sound Reproduction, Warwick Hotel, Philadelphia, Pa.

MAY 11-13—National Conference on Airborne Electronics, Hotel Biltmore, Dayton, Ohio.

AUGUST 19-21 — Western Electronic Show and Convention, Civic Auditorium, San Francisco, Calif.

TECHNICAL BOOKS

"METADYNE STATICS" by Joseph Maximus Pestarini, Lecturer, MIT and Columbia University. Published jointly by MIT and *John Wiley and Sons, Inc.*, 440 Fourth Avenue, New York 16, N. Y. 415 pages. $9.00.

Some years ago, while studying commutation, Dr. Pestarini recognized and defined a new group of electronic machines to which he gave the name "metadynes." In this book, Dr. Pestarini deals with the theory, design, and application of metadynes, with emphasis on their steady-state characteristics.

Metadyne machines are usually used in systems of machines, rather than individually. These systems of machines can be designed to absorb power under a prescribed relationship between torque and speed as well as response time; they are designed from a synthesis standpoint, with the necessary characteristics built into the component machines.

Dr. Pestarini's approach to the analysis and design problem of these machines is so general, permitting arbitrary distribution of windings and brushes around the machine, that an almost unlimited range of characteristics relating speed, voltages, torque and currents can be achieved.

"THE OXIDE-COATED CATHODE" in two volumes, by Dr. Ing. G. Herrmann and Dr. Phil. S. Wagener. Published by *Chapman & Hall Ltd.*, London. Distributed by *Anglobooks*, 475 Fifth Avenue, New York 17, N. Y. 459 pages. $15.00.

Although oxide-coated cathodes are used in the hundreds of millions of electronic valves that are manufactured every year, this is the first comprehensive treatment of the subject that has been compiled. Originally published in Germany in 1944, the present edition has been translated into English by Dr. Wagener, incorporating the many new achievements in manufacture and the new lines of scientific investigation which have been taken up since then.

The manufacture of the oxide cathode is dealt with in Volume 1. A historical review of the cathode is given, and different types and applications are discussed, followed by a description of the manufacturing processes and of the cathode characteristics. Volume 2 covers the physical phenomena of the cathode, including much fundamental material on thermal emission from metals and semiconductors. Statistical methods have been used in discussing thermal emission.

NEW LITERATURE

LOGARITHMIC CONVERTERS

In a four-page bulletin, *Kalbfell Laboratories, Inc.*, 1090 Morena Blvd., San Diego 10, Calif., discusses the various models of Kay-Lab "Logatens" available together with average d.c. characteristics and accessory equipment. "Logatens" are nonlinear attenuating networks whose output voltage amplitude is a linear function of the logarithm of input voltage amplitude. These logarithmic converters may be used in computing, acoustics, dynamic compression, radar, sonar, and other applications.

VIDICON COMPONENTS

Technical information on deflection-circuit components for the RCA-6198 Vidicon—the new small camera tube for industrial television applications—is available from the *Radio Corporation of America* in the form of a 16-page booklet. Used in the recommended circuits shown in the booklet, these components provide good sweep linearity, high deflection sensitivity, efficient coupling between circuits, proper focusing, and accurate alignment of the electron beam.

These new components permit the design of either a combined camera unit and control unit, or a camera unit separated from its control unit. A copy of "RCA Vidicon Components" (Form No. CTV-1016) may be obtained on request from Commercial Engineering, *RCA Tube Department*, Harrison, N. J.

SHIELDING ROOMS

An eight-page, two-color booklet describing "Multi-Cell" shielding rooms has been published by *Shielding, Inc.*, Riverside Park, N. J. These shielding rooms, available in a variety of sizes and types, can be used for the testing of electrical and electronic equipment for the evaluation of sensitivity, calibration, r.f. interference, susceptibility, spurious radiation, spurious response, quality control, etc. They meet the r.f. suppression requirements of various military specifications.

PHOTOCOMPOSITION

One more example of the myriad uses of electronics throughout all industry is given in "Keeping Up," a current bulletin being distributed by *Television Shares Management Company*, 115 Broadway, New York, N. Y. This bulletin describes the new electronic photocomposition machine produced by *Photon, Inc.*, of Cambridge, Mass.—a machine which delivers film negatives instead of type slugs. The first book printed by this new process was recently presented to the MIT library.

TRANSFORMER BUYER'S GUIDE

The 1953 edition of the *G-E* Instrument Transformer Buyer's Guide is available from the *General Electric Company*, Schenectady 5, N. Y. It contains basic, up-to-date information on the complete *G-E* line.

This fully illustrated, 102-page publication, GEA-4626F, gives ratings, ASA accuracy classifications, and prices of all indoor and outdoor potential and current transformers. Listings of ratio and phase-angle tests, together with tables covering the mechanical and thermal limits of current transformers, are also included.

FIELDISTORS

How to make better crystalline-material (semiconductor) amplifiers to replace vacuum tubes is described in a Government research report now available from the Office of Technical Services of the U. S. Department of Commerce.

Scientists have discovered that some crystalline materials will change conductivity with changes in the strength of the electrical fields around them. Such materials can produce amplifying elements similar to transistors—called fieldistors.

PB 107416, "Research on Point-Contact Field-Controlled Semiconductor Devices," 41 pages, is available from the Library of Congress, Photoduplication Section, Washington 25, D. C. On microfilm, $2.50; in photostat form, $6.25. Send check or money order payable to the Librarian of Congress.

PYROMETER CONTROLLERS

Just published by *The Bristol Company* is a bulletin describing the company's recently announced "Free-Vane" electronic pyrometer controllers. The unit plug-in construction of the new controllers is illustrated, and their use for various types of control is discussed.

Complete specifications and full-size reproductions of actual temperature scales are also included in this bulletin, No. P1248, a copy of which is available on request from *The Bristol Company*, Waterbury 20, Conn.

RAILROAD TELEPHONE NETWORK

Application of a railroad-owned, long-distance telephone network in the administration and operation of the Louisville & Nashville Railroad is presented in a 12-page case history published by the manufacturer of P-A-X business telephone systems. Specific use, advantages and economies provided by this direct telephone communication are discussed in detail.

For a copy of "How L & N Keeps Direct Control Over Operations with P-A-X," write to *Automatic Electric Sales Corp.*, 1033 W. Van Buren Street, Chicago 7, Ill.

ELECTRICAL RELAYS

Catalog No. 53, issued by *Sterling Engineering Company*, subsidiary of *American Machine & Foundry Company*, presents the general line of relays manufactured by this company together with associated electronic components. A 24-page catalog, it contains photographs, line drawings and specifications on many standard models.

Copies of Catalog No. 53 may be had by writing to the Sales Department, *Sterling Engineering Company*, Laconia, N. H.

"ELECTRO-TIN"

Fusion "Electro-Tin TE 400" is a combination of new organic, fast-acting fluxing agents in which finely divided metal tinning agents are dispersed. The combination of the two is said to make soldering possible under the most difficult conditions. Although perfected originally for such operations as dip-tinning of transformer leads and dip-soldering of commutators, this material is finding wide application in all fields of assembly and wiring where soft solders are used.

Readers desiring further information may secure a copy of Bulletin TE-400 describing this material by writing to *Fusion Engineering*, 4504 Superior Avenue, Cleveland 3, Ohio.

PULSE TRANSFORMER

The *Berkshire* "Labtrans" pulse transformer, Type PT-1, is a versatile instrument designed for microsecond and fractional microsecond ranges. It is useful for blocking oscillators, coupling, impedance matching, etc.

For a copy of descriptive sheet T-36, containing specifications and diagrams, write to *Berkshire Laboratories*, 504 Beaver Pond Road, Lincoln, Mass.

360° Phase Shifter

(*Continued from page* 32)

impedance Z_o looking back into the output terminals is:

$$Z_o = \frac{(j)\ (1)}{j+1} \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (7)$$

The output voltage under some complex load, Z_L, is then:

$$e_o' = \frac{Z_L}{Z_L + \dfrac{1}{1+j}}\ (e_o) \quad . \quad . \quad . \quad . \quad (8)$$

where e_o is the open circuit output voltage given by Eqt. (2). Thus, the linearity and constancy of output are not affected by loading.

It has been found experimentally that due to the odd harmonic distortion normally generated by an iron-cored device, such as a resolver, it is desirable to use a filter following the phase-shifter circuit.

This filter may be a simple *RC*-type low pass circuit or a more effective *LC*-type bandpass unit to restore the waveform to its sinusoidal state and achieve maximum phase linearity. Fig. 1D shows the general arrangement of the phase shifter in an actual circuit.

Using optimum components, such as a silver-mica capacitor and a wire-wound resistor carefully matched and heat-cycled to produce maximum stability, it has been found possible to achieve phase-shift linearity of the order of ± 0.1° from 0 to 360°.

Transistor Oscillator

(*Continued from page* 18)

the junction between these capacitors. The crystal voltage is coupled to the output through a 100-$\mu\mu$fd. capacitor.

Over half of the space in the 1¾" by 7" metal tube is consumed by the crystal, which is mounted in an evacuated glass envelope. The transistor, coil, capacitors, and resistors are supported on a Bakelite frame that may be "potted" in casting resin to add to the rigidity of the section. The mercury cell, only about one-half inch deep, is at the base of the assembly and is insulated from the metal "can" by a Bakelite shield.

Determinations of the frequency stability with changes in temperature and supply voltage have indicated that the frequency varies approximately 1 part in 10^8 per °C, and 1 part in 10^8 per 0.10 volt. The transistor oscillator was also compared with the standard oscillators controlling the transmissions of WWV. Short-time variations were about ± 3 parts in 10^{10} and the long interval drift —in days—indicated changes of about 3 parts in 10^9 per 24 hours. These figures are comparable to those obtained from vacuum tube standard oscillators, particularly at the time of their initial installation. Fortunately, frequency drift in the quartz crystal unit of a conventional type of standard oscillator normally decreases with age.

The compactness of the NBS transistor oscillator lends itself to more convenient and portable temperature control measures. Heretofore, standard quartz oscillators or quartz clocks have required relatively complex temperature control apparatus (operating at temperatures up to 60°C) and special high-reliability power sources.

Tests were conducted on the new transistor oscillator with the complete unit operating at 0°C. Reasonable temperature stability was achieved by merely placing the oscillator in a Dewar flask containing crushed clear ice. Among the results was an indication that the reduced temperatures were responsible for reducing drift and increasing the Q of the quartz crystal unit. Thus, it now becomes possible to make available a readily portable, continuously oscillating frequency standard that may be carried to all parts of the world.

A D.C. MILLIVOLTMETER

By PHIL WEISS, T. V. Products Co.

THIS instrument measures d.c. volts from 0.5 millivolts to 10 volts at 10 megohms impedance. It was built as part of an exposure meter for use in making photographs through a microscope. The same instrument could also serve many other purposes. In this case the input is a photoelectric cell, but any other input in the same range could be used.

Since the photocell must frequently be moved from total darkness to full daylight, it is necessary to use an indicating device that is not subject to damage from overload. A twin-electric-eye tube, 6AF6, serves this purpose admirably.

The voltage to be measured is balanced in a calibrated bridge circuit. The bridge output is amplified by a d.c. amplifier which drives the twin-eye tube. When the eye shows that the bridge is balanced, the input voltage is read from the bridge dials.

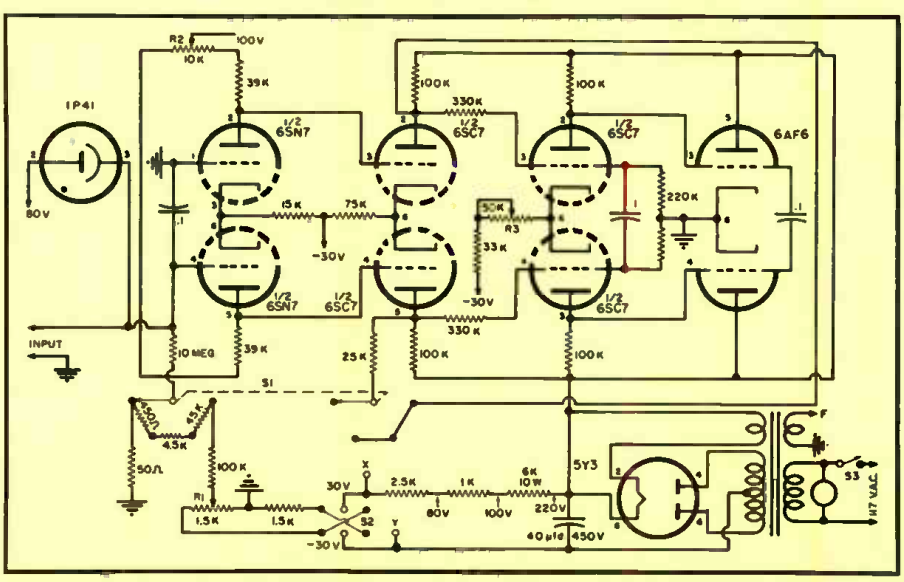
Accuracy of measurement depends entirely on the bridge, and not on the amplifier or the eye, which act only as a null indicator. Neither the amplifier nor the eye is affected by the most severe overloading.

The amplifier consists of three push-pull stages, direct-coupled. Over-all gain is 6000 in the lowest range, and 1000 in the upper ranges. Each stage is designed so that it will not amplify signals of the same polarity applied to its grids, in order to avoid amplifying any changes in operating potential which might be caused by aging tubes or by changing a tube. Each stage is also shunted by a condenser, to avoid amplifying 60-cycle hum or other noises which might cause the eye to flutter.

The circuit diagram is shown in Fig. 1. In addition to the bridge dials S_1 and R_1, there are two controls, R_2 and R_3, for balancing the amplifier at zero input, and a reversing switch, S_2, to accommodate positive or negative inputs. Two pin jacks, X and Y, are provided for monitoring the bridge supply voltage if greater accuracy is desired. All resistors are 2-watt, 10%, except those in the bridge circuit which are 2%. All potentiometers are wire-wound.

In this particular application, a 1P41 photocell is used to measure the light in the microscope. A special holder was made to fit in the upper end of the microscope, with the photocell pointing down the barrel. The eyepiece is removed, of course, during the measurement. The light which illuminates the slide is turned off, and the amplifier is balanced, with the bridge set at zero; this balance includes the dark current of the photocell. The illuminating light is then turned on, and the bridge is balanced again. The setting of the bridge dials indicates the input in millivolts. This information is used to determine the exposure time.

Fig. 1. Circuit diagram and parts values for the millivoltmeter.



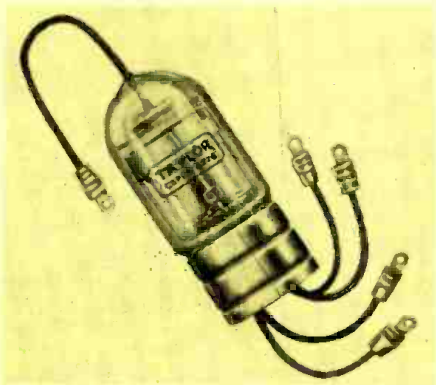
NEW TUBES

THYRATRON RECTIFIERS

Having metallized carbon anodes, the two new *Taylor* "Xenon" thyratron rectifier tubes give more efficient plate dissipation and have the ability to absorb tremendous overloads. Their rugged construction makes them applicable for use in high shock installations up to 200 *G*. They are also adaptable to motor control and inverter circuits and to various tuning and controlling functions.

The C5F14/6278 (shown in photograph) has a flexible anode connection. Average anode current is 5 amp., peak anode current 60 amp., and peak anode voltage 750 volts. Deionization time is less than 200 microseconds.

On the *Taylor* C3R14, the extended anode connection is made through a



medium cap without flexible lead. Average anode current is 3 amp., peak anode current 30 amp., peak anode voltage 1000 volts. Deionization time is under 175 microseconds.

For additional information regarding these new tubes, write to *Taylor Tubes, Inc.*, 2312 W. Wabansia Avenue, Chicago 47, Ill.

POWER PENTODE

The Los Gatos brand Type 4E27A power pentode may be operated as a Class C r.f. power amplifier and oscillator (Class C telegraphy, FM telephony), Class B a.f. power amplifier and modulator, and Class C r.f. plate-modulated amplifier. The 5.0-volt filament is of the thoriated tungsten type and operates at 7.5 amp.

Type 4E27A has a maximum plate current of 200 ma. and a maximum plate voltage of 4000 volts. A technical data sheet is available from *Lewis & Kaufman, Ltd.*, 76 El Rancho Avenue, Los Gatos, Calif., which illustrates the tube and provides dimensions, general electrical characteristics and constant current characteristics under two modes of operation.

RECTANGULAR PICTURE TUBE

Hytron Radio & Electronics Co., a division of *Columbia Broadcasting System, Inc.*, Danvers, Mass., has announced two new 21" rectangular picture tubes—Types 21YP4 and 21ZP4A. These tubes are of all-glass construction and have spherical-shaped face plates.

Features of both types include: single ion-trap gun design, filter-glass face plate, and external conductive coating. In addition, Type 21YP4 features low voltage electrostatic focus, while the 21ZP4A features magnetic focusing.

G-E TUBES

Three *G-E* tubes now being manufactured include: (1) Type 6AH4-GT, a high-perveance triode for vertical output service in television receivers, (2) Type GL-6087, a full-wave high-vacuum rectifier for use in aircraft power supply units of moderate current requirements, and (3) Type 6CL6, a power pentode for use in the video output stage of television receivers.

Type 6AH4-GT, a vertical deflection amplifier, is expected to be particularly useful in receivers with large-deflection-angle picture tubes. It utilizes relatively low plate voltages at high plate currents to deflect wide-angle picture tubes fully, and it is capable of withstanding the high pulse voltages normally encountered in this application.

Type GL-6087, specifically designed for equipment in which extreme electrical and physical dependability is essential, has been added to *G-E's* "Five Star" high-reliability tube line; it can replace the 5Y3-GT. This tube may be used in applications which are subject to altitudes as high as 60,000 feet. It will withstand a peak impact acceleration of 700*G* in any direction.

With Type 6CL6, it is possible to obtain a voltage gain of from 40 to 45 in wide-band video circuits. The 6CL6 features high transconductance, low capacitances and high output current capability. In addition to its use in video output service, this nine-pin miniature may also be used as a wide-band amplifier in industrial equipment.

Further information on any or all of these tubes may be obtained from the *General Electric Company*, Tube Department, 1 River Road, Schenectady 5, N. Y.

Power for Transmitters

(*Continued from page* 16)

times of the day and previously had required the operator to change engine controls in order to maintain normal speed and frequency. For nine months, before the station's cameras were moved to their new studio on the campus at Ames, the isochronous governor guarded against frequency distortion.

Coil slot saturation producing a sawtooth waveform was another problem solved during the early stages of WOI-TV operation. Streak bars appeared across television pictures as a result of the saturation condition sometimes found in larger diesel-powered generators. A filter system eliminated the sawtooth in the waveform of the power supply.

One difficulty, thanks to farsighted engineering, did not materialize. Since the original installation envisioned cameras, studios, transmitters and power supply in one building, it was mandatory that standby and regular power units be installed to achieve the greatest possible sound isolation. Mirrors, tubes and other delicate parts of the station's equipment could easily be damaged or thrown out of adjustment by excessive vibrations. All three power units were mounted on an 8' x 18' rectangular concrete base 4' thick. The base was insulated from the floor by several inches of asphalt treated fiberboard. Rubber shock mounts beneath the engine mountings completed the installation. Neither wall nor floor vibrations could be detected when the *Caterpillar* engine was in operation.

A residential-type exhaust silencer provided adequate noise abatement even though windows were open on the same side of the building as the exhaust outlet. Exhaust gases were piped sufficiently far from the building to prevent their re-entry through open windows, doors or ventilation vents.

During the station's installation and operation, the results of early planning and later experimentation at WOI-TV were carefully documented. It has been concluded that diesel generators are very reliable in providing power for television transmitter equipment. If they are used to power pulse generators, the regulations of frequency must be better than ½%. The equipment must be kept free of hum, as well as the receivers, or hum bars will show in the receiver pictures. Proper sound and vibration isolation must be built into the installation.

Analog Computation

(*Continued from page* 15)

not drift appreciably under severe ambient conditions for long periods of time.

Stability of Closed Loop Systems

Integrators and open-loop static computers are subjected to errors if the frequency or amplitude of the current changes in the signal generators. The signal generators require a regulated supply for the bias i_b. In the closed-loop system, fluctuations in i_b—or in the amplifier—are automatically compensated by a shaft rotation maintaining the balance of input and balance torques. The closed-loop system is inherently stable except for system oscillation which can occur with high gains and low damping. A variable damping coefficient permits the use of high gains and a means of adjusting the time constant.

Application of Torsional Method

The method of cascading various torque and signal generators on a shaft determines in part the number of mathematical operations a system can perform. The way the excitations are applied and the utilization of special amplifiers also broaden the range of operations. Open-loop computers with closed-loop computers and integrators, cascaded to a practical limit, provide an extended horizon of applications. It is necessary to consider the preceding statements to achieve an optimum arrangement for a new application.

In addition to application as computers, these simple systems can be used as modulators, or as demodulators with the added stability of the closed loop, or as servo-shaft positioners for instrumentation with variable gain. It has already been shown that such a system can handle carrier and d.c. signal information simultaneously, and that this method can be used to stabilize the zero drift and gain of a d.c. amplifier.

An example of instrumentation could be a gravimetric flowmeter. Several flowmeters indicate ρv^2 or v, where ρ is the density and v is the velocity of the fluid flowing through the pipe. Assuming that suitable transducers exist, a simple computer could be made to calculate ρv and ρ simultaneously. Figure 10 is a schematic diagram of such a computer. Notice that in Fig. 10 the current analog for the velocity v is the primary of one signal generator, the current through the elastic restraint generator, and an input to a torque generator. Another signal generator on the shaft has an isolated a.c. constant bias. From Table 1, the torque equation has the following form:

$$k_A i_p i_{A1} = k_C i^2 \theta \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (13)$$

Figure 10 shows that i^2 equals v^2 and the product $i_p\ i_{A1}$ is proportional to ρv^2.

$$k_A \rho v^2 = k_C v^2 \theta \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (14)$$

$$\theta = \rho k_A / k_C \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (15)$$

Both of the signal generators have outputs which are functions of θ, but e_1 is also a function of the velocity (f being constant).

$$e_1 = k'_D v \theta \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (16)$$

The other signal generator has a constant bias and its output is a function of the angular rotation only.

$$e_2 = k''_D \theta \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (17)$$

Substituting (16) and (17) into (15):

$$e_1 \propto \rho v \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (18)$$

$$e_2 \propto \rho \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (19)$$

Equations (18) and (19) indicate that this simple computer will produce an analog of the mass-per-unit time-per-unit area flowing through the pipe, and an analog of the density of the fluid. A computer of this sort would permit accurate metering of fluid flow as well as permitting the pipe to carry different fluids and maintain accurate instrumentation.

The open-loop computer just described would have the approximate dimensions of 2″ in diameter and 3″ in height. Construction of this unit would permit the plug-in feature, which is highly desirable in most computer applications.

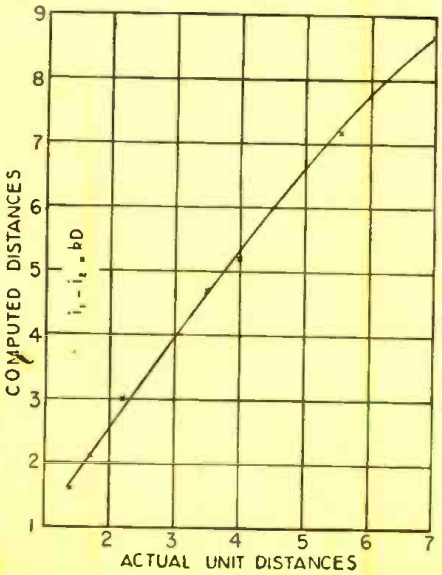


Fig. 8. Actual distances compared with proportional computed distances.

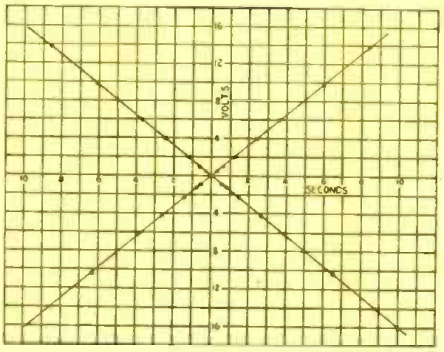


Fig. 9. Graph showing the response of an integrator to a step input.

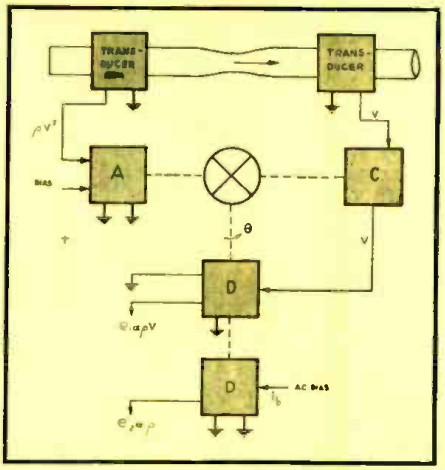


Fig. 10. Gravimetric flow computer.

Possible Memory System

Under the proper conditions, prominent torques can be obtained through the hysteresis effects of the torque generator cores. Residual torques can be obtained by exciting a core with direct current and reducing the excitation to zero, or by maintaining a constant excitation on the torque generator and rotating the shaft. Each method results in a residual flux density. The maximum residual torque that has been obtained for various torque generators is 300 times the threshold of the average torsional computer. This ratio of torque to threshold would provide adequate resolution for a memory system. Since the residual torques can be continuously read out in a torque rebalance system, the stored information in a core would not need to be removed in order to be read. Preliminary investigations have indicated a fair degree of control of the residual torques by the applied excitations, but considerable development still remains to be made in the technique.

PHOTO CREDITS

6, 18.... Nat. Bureau of Standards
14..... Minneapolis-Honeywell Regulator Co.
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A 360 DEGREE PHASE SHIFTER

By **SIDNEY WALD**

A circuit for continuously shifting the phase of a sinusoidal voltage through 360 degrees.

THE NEED for an accurate, reliable means of continuously shifting the phase of a sinusoidal voltage through 360° while maintaining constant amplitude arises more and more frequently in present-day electronic circuitry. Applications for such devices range all the way from grid-controlled thyratrons in industrial machinery, through navigation phase comparison schemes, to radar range measuring circuits.

Various methods for accomplishing continuous phase shift through the positioning of a shaft have been widely employed. The most common method utilizes a resolver whose stator windings are supplied with quadrature currents from a "phase-splitting" circuit. A uniform rotating field is produced.

The voltage induced in the rotor winding of the resolver then has a phase angle corresponding to its physical position in the field. A typical circuit for this type of phase shifter is shown in Fig. 1A.

In order to achieve accurate results with such a circuit, it is necessary that the current flowing in stator 1 lag the input voltage by exactly 45° while the current in stator 2 leads by the same amount. This criterion entails an extremely difficult and critical set of parameters for the various components, since the reactive elements must be low in value and relatively large in size to supply adequately the usual low impedance resolver windings, S_1 and S_2. It is particularly difficult to maintain the linear accuracy of the circuit of Fig. 1A over the wide range of ambient temperatures demanded by military specifications.

This article describes a phase-shifting circuit which has a number of advantages over those previously described. The important differences may be enumerated as follows:

1. The input voltage is applied to the resolver rotor.
2. The resolver functions to supply precise voltage amplitudes only, and there is no rotating magnetic field involved.

The circuit for this phase shifter is shown in Figs. 1B & 1C. R and C may have any convenient values, provided that at the operating frequency the capacitive reactance is exactly equal to the resistance. One other desirable condition is that the resistance R which is chosen be large compared to the resolver stator impedance.

Since R must equal X_c, the analysis of this circuit may be simplified by assuming their common value to be unity. Then the resistance will be 1 and the reactance will be j. The output voltage is then given by:

$$e_0 = \frac{e_1 + e_2}{2} + j\,\frac{e_2 - e_1}{2} \quad . \quad . \quad (1)$$

and the magnitude is:

$$e_0 = \frac{1}{\sqrt{2}}\sqrt{e_1^2 - e_2^2} \quad . \quad . \quad . \quad . \quad (2)$$

Let θ be the angular shaft displacement of the resolver rotor. Then:

$$e_1 = E \sin \theta \quad . \quad . \quad . \quad . \quad . \quad . \quad (3)$$

$$e_2 = E \cos \theta \quad . \quad . \quad . \quad . \quad . \quad . \quad (4)$$

$$e_0 = E/\sqrt{2} \quad . \quad . \quad . \quad . \quad . \quad . \quad (5)$$

This shows that the magnitude of the output voltage is constant.

The phase angle ϕ of the output voltage is given by substituting (3) and (4) in (1) and simplifying:

$$\phi = 45° - \theta \quad . \quad . \quad . \quad . \quad . \quad . \quad (6)$$

This shows that the electrical phase shift is perfectly linear with respect to the mechanical rotation of the resolver rotor and differs from it by a fixed angle of 45°.

So far, the circuit has been analyzed for the ideal condition that the output terminals are not loaded. Does the circuit still function accurately when the output terminals are shunted by a finite impedance? Fortunately it does—the only difference being that the output amplitude and fixed phase shift are other than the values already given.

In order to evaluate the effect of loading on the circuit of Fig. 1B & 1C, Thevenin's theorem can be used. The

(*Continued on page* 29)

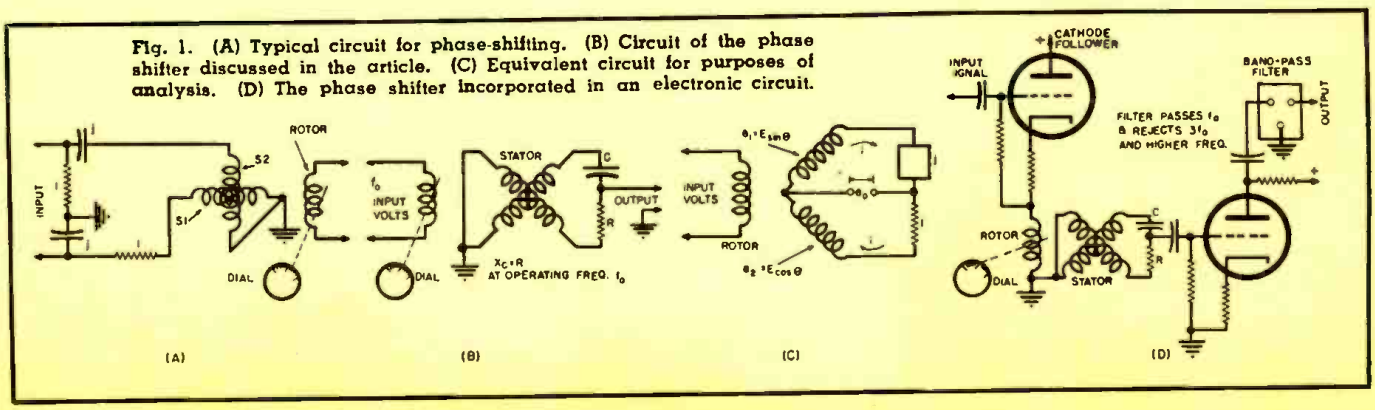

Fig. 1. (A) Typical circuit for phase-shifting. (B) Circuit of the phase shifter discussed in the article. (C) Equivalent circuit for purposes of analysis. (D) The phase shifter incorporated in an electronic circuit.

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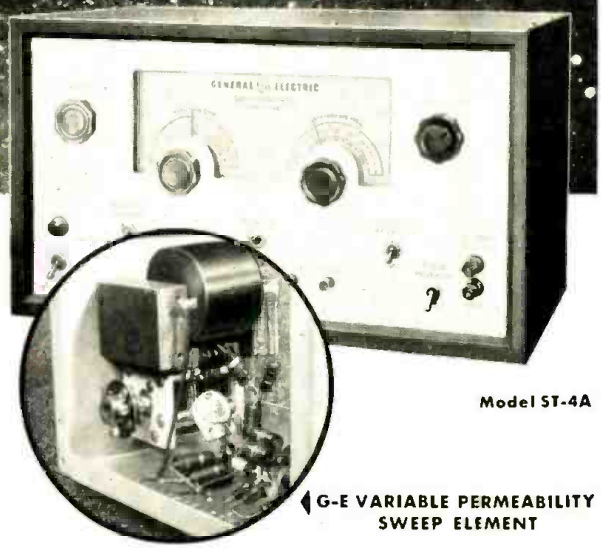

Model ST-4A

G-E VARIABLE PERMEABILITY SWEEP ELEMENT

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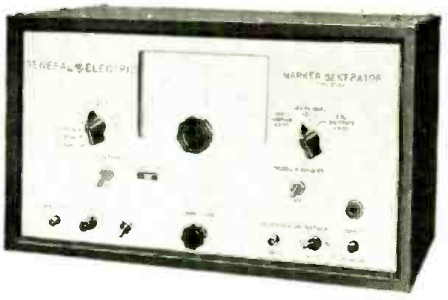

Model ST-5A

Marker Generator ST-5A. Marks all the critical frequencies on a pass band as well as having continuous coverage. Gives fast manipulation with crystal controlled accuracy for outstanding performance. Features separate crystal on each TV channel with simultaneous picture, audio and trap markers on both channel and intermediate frequencies.

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Oscilloscope ST-2A. Reports from thousands indicate this scope does the job they need in TV circuit work. Used in conjunction with the G-E Sweep and Marker you have an unbeatable combination. Special features include wide frequency response plus DC amplifier to adapt the equipment to other applications.

Balanced Output Adaptor ST-8A. Converts single-ended Sweep Generator output to balanced output for 300 ohm television receiver work.

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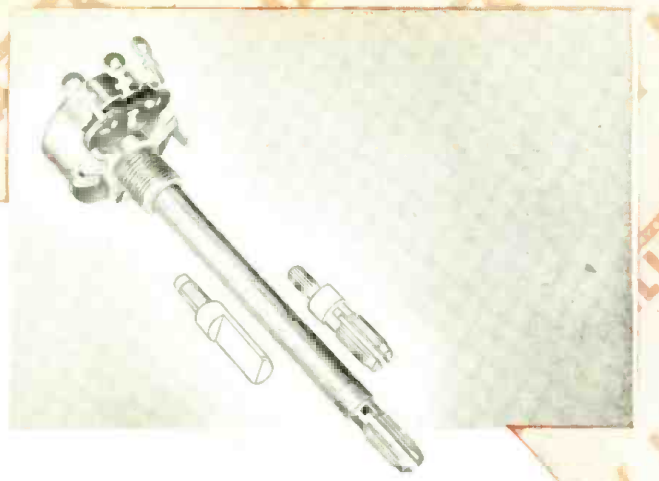

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Midgetrols are engineered to match the electrical characteristics of the original equipment of any TV or radio set. They will give equal, and often better, performance and life than the original control.

For all your service work, use Mallory Midgetrols. They are the answer to fast installation . . . precision quality on every job.

This will save you time, too. Ask your Mallory Distributor for a copy of the Mallory Control Guide. It is a complete cross reference between set manufacturers' part numbers and the equivalent Mallory control.

P. R. MALLORY & CO. Inc.

MALLORY

CAPACITORS • CONTROLS • VIBRATORS • SWITCHES • RESISTORS
RECTIFIERS • POWER SUPPLIES • FILTERS • MERCURY BATTERIES

APPROVED PRECISION PRODUCTS

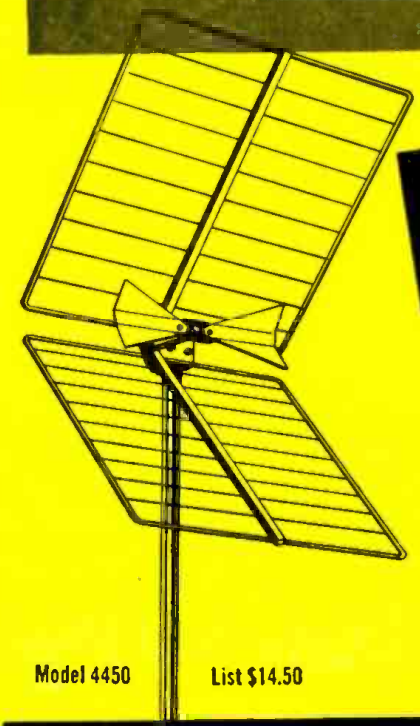
P. R. MALLORY & CO., Inc., INDIANAPOLIS 6, INDIANA

NO OTHER UHF ANTENNA COMBINES ALL 3

1 *Extra high gain*

2 *All channel reception*

3 *Sharp vertical and horizontal directivity*



Model 4450 List $14.50

WALSCO CORNER REFLECTOR

Not 1...Not 2...but all 3 combined for amazing picture clarity

NOTHING . . . *absolutely nothing* compares with Walsco's Corner Reflector. It's the only UHF antenna that offers a 3-way *combination* that produces sharper, clearer TV pictures. Truly a masterpiece in precision electronic engineering.

COMPARISON CHART

	High Gain	All channel Performance	Sharp Directivity
WALSCO CORNER REFLECTOR	YES	YES	YES
ANTENNA B	NO	YES	NO
ANTENNA C	NO	YES	NO
ANTENNA D	YES	NO	YES

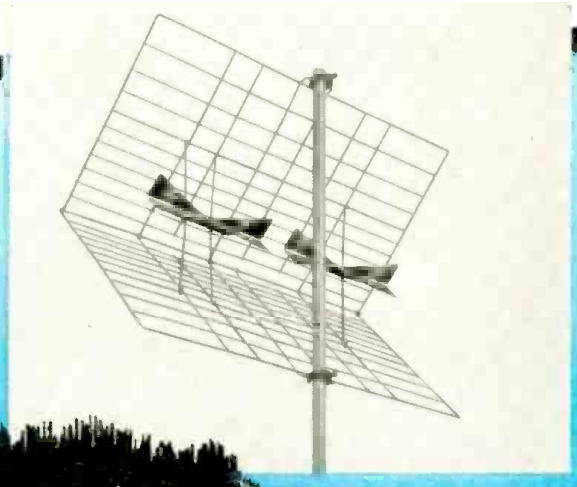
WALSCO *A Model to Fit Every Installation*

Walter L. Schott Co.
3225 Exposition Place
Los Angeles 18, California

Overseas Representative: Ad Auriema, Inc., 89 Broad St., New York 4, New York

New! another Channel Master development!

beats 'em all on UHF!



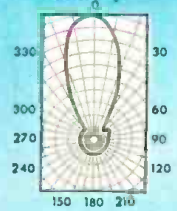
CHANNEL MASTER'S TWIN CORNER REFLECTOR

Model No. 406

Gives the brilliant performance of **2** antennas!

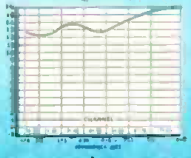
up to **16** db gain

THE MOST SENSITIVE UHF ANTENNA EVER DEVELOPED!



Twice the gain of the BEST standard UHF Corner Reflector.

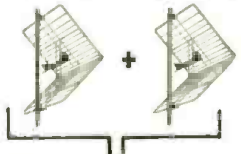
Extremely narrow forward lobe, with no side lobes and negligible rear lobe



Excellent 300 ohm impedance match over the entire UHF range, provided by built-in, pre-cut matching harness

because Channel Master's Twin Corner Reflector really is 2 antennas . . .

stacked side by side into one simple structure



exclusive **DUBL-DIPOLE** design

- 2 antennas, electrically
- 1 antenna, mechanically
- One simple structure . . . one simple installation . . . highest gain, all-channel UHF coverage!

In any area you pick, the Twin Corner Reflector will out-perform any other antenna available today!

Ties together all 3 TV reception bands!

"Free spots" terminals. Impossible for dirt or rainwater to accumulate between the terminals, which can short out the picture. Assures you of brilliant, steady reception in ANY KIND OF WEATHER!

SINGLE LEAD • NO SWITCHING

ELIMINATES INTER-ACTION • NO SIGNAL LOSS ON VHF OR UHF

CHANNEL MASTER'S New!

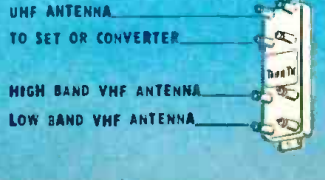
TRIPLE-TIE model no. 9035

electronic inter-action filter

Combines up to 3 antennas with only 1 lead to the set.

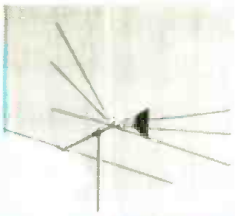
1. Low Band VHF
2. High Band VHF
3. All UHF (Broad Band or Yagi)

Eliminates inter-action between all 3 antennas.

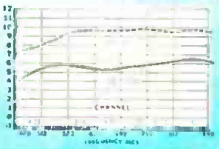


Designed to adapt all HI-LO VHF installations to UHF — quickly and economically

ULTRA FAN series — Complete VHF-UHF coverage



single bay — model no. 413

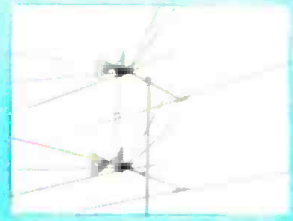


Today's most sensitive All-VU* antennas! The Ultra Fans actually operate on *three* separate electronic principles — automatically:

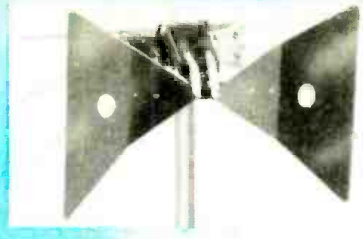
1. Low Band VHF (Channels 2-6) . . . *Conical antenna with parasitic reflector*
2. High Band VHF (Channels 7-13) . . . *Large diameter V antenna*
3. UHF (Channels 14-83) . . . *Triangular dipole with sheet reflector*

One set of All-VU* stacking rods provides highest VHF and UHF gain. Each Ultra Fan has its own 2-stage inter-action filter, so that only one transmission line to the set is required.

*All VHF, all UHF



stacked — model no. 4132



ULTRA DAPTER

model no. 414

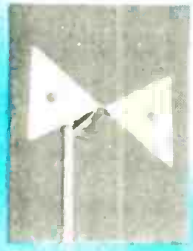
Instantly converts all Channel Master Super Fans into high gain, all-channel, VHF-UHF antennas. *Features a built-in inter-action filter.*

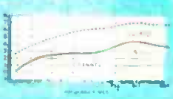
Your best bet for UHF!

CHANNEL MASTER Ultra-Tennas

America's most complete — most effective — UHF antenna line.

Channel Master's advanced engineering pays off again! While rain caused hundreds of UHF antennas to FAIL recently in Portland, *not one Channel Master antenna dimmed or shorted out a picture!* The facts speak for themselves: Rain or shine, Channel Master antennas outperform all others.





ULTRA BOW

model no. 401

The basic UHF antenna for primary signal areas, and the outstanding member of the bow-type antenna family.

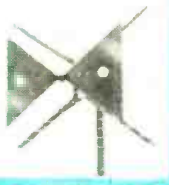
Only Channel Master Antennas are designed to eliminate the "TWIN TERRORS" OF UHF RECEPTION:

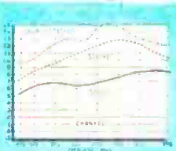
- Vibration, which causes picture flicker.

  Eliminated by Channel Master's Ultra-Rigid construction and advanced mechanical design.

- The accumulation of dirt or moisture around the antenna terminals, which dims and eventually shorts out the TV picture.

  Eliminated by Channel Master's sensational "free-space" terminals which prevent the accumulation of foreign deposits at the feed points.





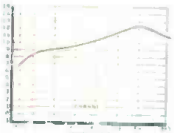
ULTRA BOW

with

SCREEN REFLECTOR

model no. 403

Can be stacked in 1, 2, and 4 bays. High, all-channel UHF gain, excellent front-to-back ratio.



ULTRA VEE

model no. 404

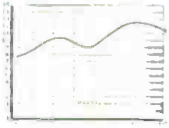
- Good UHF gain
- Low VHF gain
- The most rigid UHF antenna of its type and size.

Gain: 11 DB, single
14 DB, stacked

DELTA WELD

Wide Band 10 Element UHF Yagi

Custom-designed for full coverage of your specific area! Brilliant high gain performance across as many as *23 different channels.*



CORNER REFLECTOR

model no. 405

The outstanding all-channel UHF FRINGE antenna.

MEMBER ANTENNA MANUFACTURERS ASSOCIATION

MEMBER ELECTRONIC INDUSTRIES ASSOCIATION

Sold through the nation's leading distributors

CHANNEL MASTER CORP.

ELLENVILLE, N. Y.

Write for complete technical literature

ULTRA-TIE model no. 9034

Electronic Inter-Action Filter

JOINS separate antennas into a single VHF-UHF antenna system, for use with a single transmission line.

SEPARATES VHF and UHF signals at the set or converter where separate inputs are provided.

The only filter with "free-space" terminals.

Within the INDUSTRY

M. L. MYERS has been named assistant general sales manager of *Sparton Radio-Television* of Jackson, Michigan.

The post is a newly-created one designed to meet the needs of the company's augmented 1953 sales and advertising campaigns.

Mr. Myers, who has been on the company's sales staff for several months, served as division manager for the *Hercules Steel Company* and as sales manager for *Supermix, Inc.* before joining *Sparton*.

* * *

AMERICAN INSTITUTE OF MANAGEMENT has awarded certificates of management excellence to seven manufacturers in the radio and television field. *General Electric Co., Sylvania Electric Products Inc.,* and *Westinghouse Electric Co.* received awards for the third consecutive year. *Motorola Inc., Zenith Radio Corp., Philco Corporation,* and *RCA* were first-time winners.

In order to qualify for an award, the company must receive 7500 out of a possible 10.000 points. These credits are assigned for excellence in ten separate areas of management: economic function, corporate structure, health of earnings growth, fairness to stockholders, research and development, directorate analysis, fiscal policies, production efficiency, sales vigor, and executive evaluation.

* * *

EUGENE C. WHITE has been named to the newly-created post of industrial specialist for the tube department of the *General Electric Company*.

In his new position Mr. White will coordinate *G-E* policies for the sales of industrial tubes to manufacturers of electronic equipment.

For the past year he has been assistant to the sales manager of industrial and transmitting tubes. He is a Carnegie Institute graduate and has been with *G-E* since 1943.

* * *

TRIAD TRANSFORMER MANUFACTURING CO. has taken over the operations of **TETRAD CO., INC.,** manufacturers of miniaturized electronic components. Both firms are located in Venice, California. No change in personnel is contemplated . . . **DIVISION LEAD COMPANY** of Chicago has purchased **EAGLE-PICHER COMPANY'S** Metallic Products Division plant at Argo, Illinois. Equipment and personnel will be retained and absorbed into a combined operation . . . **ALLIED SOUND** of 115 W. 45th St., NYC, has changed its corporate name to **ASCO SOUND CORPORATION.** The management and activities of the firm are unchanged . . . **CLEVITE CORP.** of Cleveland has acquired the majority stock interest in **TRANSISTOR PRODUCTS, INC.** of Boston.

* * *

JOHN J. DOYLE, a 25-year-man with *Westinghouse,* has been named to the new post of manager of renewal sales for the company's tube division.

He was formerly manager of power tube sales and will now be responsible for planning and directing sales of all classes of tubes in the renewal tube market.

The company also announced the appointment of **JAMES L. BROWN,** as manager of equipment tube sales. He formerly headed cathode-ray and receiving tube sales.

These two new posts were created to enable the company to render more specialized service to distributors and service dealers as well as to equipment manufacturers.

* * *

HYTRON RADIO & ELECTRONICS CO. is constructing an ultra-modern television picture tube plant and warehouse in Kalamazoo, Michigan. It will be ready for occupancy during the summer of 1954 . . . **AMERICAN ELECTRONICS CO.** has moved to new and larger quarters at 1203-05 Bryant Ave., New York 59, N. Y. . . . A branch office at 2718 Linwood Blvd. in Kansas City has been opened by **L. F. WAELTERMAN CO.** of St. Louis. The firm acts as manufacturers representatives for a number of electronic firms. A. S. Engelman will be in charge of the new branch . . . **MORT'S RADIO SHACK, INC.** has moved to 1920-22 Milwaukee Ave. in Chicago. The new location offers ample parking facilities, a high-fidelity sound room, and housing for a complete line of radio and television components . . . **UNGAR ELECTRIC TOOLS, INC.** has moved to a new $200.000 plant near Venice, California. The new facilities include a one-story main office and factory building and a rear building to house a woodshop and machine shop . . . **ASTRON CORPORATION** has expanded its plant and manufacturing facilities at 255 Grant Ave. in East Newark, N. J. The additional space will permit the company to double its

productive capacity for condensers . . . **MOULTHROP AND HUNTER,** manufacturers representatives, have moved to 160 Tenth Street in San Francisco . . . **KIMBLE GLASS CO.** is building a modern television bulb manufacturing center at Sayreville, N. J. Equipment to enable an output of approximately 150,000 television bulbs per month is now being installed . . . The offices and showrooms of **DALEO** and **MIDTOWN CABINET SALES INC.** have been moved to 160 E. 56th St. in New York. The company handles television and radio cabinets.

* * *

SYLVAN A. WOLIN, well-known in the electronic parts field for twenty years, has established his own advertising agency at 15 W. Palisade Ave. in Englewood, N. J.

Mr. Wolin recently resigned his position as vice-president in charge of sales of the *Pyramid Electric Company.* Prior to this association, he was with *Solar Manufacturing Corp.*

His firm will specialize in handling electronic accounts.

* * *

ROBERT C. SPRAGUE will return to *Sprague Electric Company* as chairman of the board of directors after an extended vacation. He withdrew his nomination as under-secretary of the Air Force when he decided against selling his stock in the firm he founded. The new officers of the firm, elected recently, will retain their posts . . . **PAUL EVANS** has joined *Heppner Mfg. Co.* as a design engineer. He was formerly a project engineer with *Sylvania* and on the engineering staff of *Westinghouse* . . . *General Instrument Corp.* has named **LEE BALLENGEE** as assistant sales manager and **B. V. K. FRENCH** as manager of the company's Chicago office . . . **DWIGHT W. BLOSER,** formerly chief engineer of the *Transicoil Corp.* of New York has been named vice-president of the firm. He will supervise the design, engineering, and production of the company's products . . . **GEORGE HALSTED** has been appointed to the newly-created position of field training manager for *Motorola Inc.* . . . The promotion of **HUGH F. COLVIN** to the post of vice-president and treasurer has been announced by *Consolidated Engineering Corp.* . . . **HERMAN N. LUBERT** is the new advertising and export manager for *Fada Radio & Electric Co., Inc.* . . . **MYRON T. SMITH** has been promoted to the post of sales manager for *General Radio Company.* **S. W. DeBLOIS** has been appointed export manager for the same firm . . . **JOHN H. CRAFT, JR.** is the new national service manager for the radio and television division of *Stromberg-Carlson Co.* . . . *Stewart-Warner Electric* has appointed **BURTON P. GALE** to the post of advertising manager . . . **NORMAN SKIER** is the new merchandise manager

(*Continued on page* 157)

ONLY THE PHILCO TUBE CHECKER

Tests 'Em All!

Mutual Conductance Dynamic Tube Checker Model 7052

Here's Philco's answer to your tube checking problems . . . a mutual conductance tube checker that tests 'em all from subminiature to acorn low power transmitting tubes . . . featuring the most sensational roll chart yet designed for efficiency and speed of operation. Its compact design, finished in beautiful grey leatherette with blue panel, makes it adaptable for both portable and counter top use. *Size—17" W x 18½" L x 10" D. Weight—21 lbs. (Shipping Wt. 24 lbs.). Operating Voltage—105-130 volts AC.*

- ✓ Most complete, easiest to use roll chart ever designed.
- ✓ Mutual conductance readings given directly in Microhms.
- ✓ Forecasts remaining tube life!
- ✓ Checks shorts and leaks between elements of tubes.
- ✓ Determines noise characteristics and gas content of tubes.

Now Yours on New
SPECIAL PAYMENT PLAN

CATHODE RAY TUBE CHECKER

MODEL 7053. From Philco, the *only* emission CRT checker containing a built-in neon bulb calibrator for individual calibration of bulb sensitivity . . . for pin point accuracy and finest sensitivity each unit is individually calibrated . . . tests all picture tubes.

3-INCH OSCILLOSCOPE

MODEL 7020. The ultimate in portability . . . this Philco scope is 2½ times smaller than other 3" units . . . adaptable for bench use or field servicing . . . now, avoid guesswork with *pre-set* horizontal and vertical sweep rates. Provide measurements accurate to within 5%.

FILL OUT AND MAIL COUPON OR SEE YOUR PHILCO DISTRIBUTOR NOW

PHILCO CORPORATION, Accessory Division
Allegheny & "A" Sts., Philadelphia, Pa.

☐ I am interested in the Philco Test Equipment shown here. Please send me details of your SPECIAL PURCHASE PLAN for obtaining these units.

☐ Please send FREE copy of your new booklet on Philco Test Equipment.

NAME .....

ADDRESS .....

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

PHILCO Test Equipment

SPECIFICALLY DESIGNED FOR THE SERVICEMAN

Sweeping the Country!

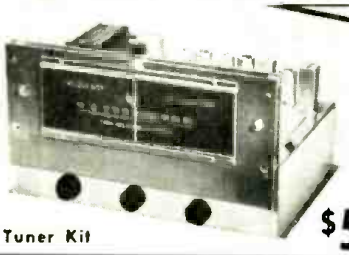
BUY DIRECT AND SAVE

'PRE-FAB' **COLLINS** TUNERS and RECEIVERS

AUDIO PRODUCTS CO.

Collins Audio Products Co. is in no way affiliated with Collins Radio Co.

Two ALL NEW Complete Kits for Every High-Fidelity Need



FM Tuner Kit **$55**

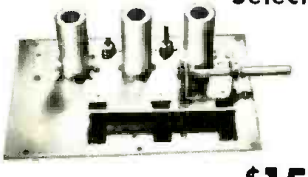
The FM-11 tuner is available in kit form with the IF Amplifier mounted in the chassis, wired and tested by us. You mount the completed RF Tuning Unit and power supply, then after some simple wiring, it's all set to operate. 11 tubes: 6J6 RF amp, 6AG5 converter, 6C4 oscillator, 6BA6 1st IF, (2) 6AU6 2nd and 3rd IF, (2) 6AU6 limiters, 6AL5 discriminator, 6AL7-GT double tuning eye, 5Y3-GT rectifier. Sensitivity 6 to 10 microvolts, less than ½ of 1% distortion, 20 to 20,000 cycle response with 2DB variation. Chassis dimensions: 12½" wide, 8" deep, 7" high. Illustrated monual supplied. Shipping weight 14 lbs.

Each Collins Tuner Kit is complete with punched chassis, tubes, power transformer, power supply components, hardware, dial assembly, tuning eye, knobs, wire, etc., as well as the **completed** sub-assemblies: FM tuning units, AM tuning units, IF amplifiers, etc., where applicable. Since all these sub-assemblies are wired, tested and aligned at the factory, Collins Pre-Fab Kits are easily assembled even without technical knowledge. The end result is a fine, high quality, high fidelity instrument at often less than half the cost — because you helped make it and bought it direct from the factory. Bring your present reproducing system up to date with a new Collins Tuner.

FM/AM Tuner Kit **$77.50**

The original 15 tube deluxe FM/AM pre-fab kit redesigned on a smaller chassis. The tuner now measures 14" wide by 12" deep by 7½" high. This attractive new front and dial assembly opens up new applications where space is at a premium. Kit includes everything necessary to put it into operation—punched chassis, tubes, wired and aligned components, power supply, hardware, etc. Kit comprises FMF-3 tuning unit, IF-6 amplifier, AM-4 AM tuning unit, magic eye assembly and complete instructions. All tubes included. Shipping weight 19 lbs.

Selected Basic Components For Special Applications



FMF-3 Tuning Unit **$15.25**

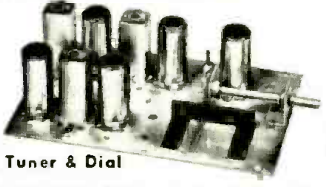
The best for FM. The most sensitive and most selective type of "front end" on the market. 6 to 10 microvolts sensitivity. Image ratio 500 to 1. 6J6 tuned RF stage, 6AG5 converter, 6C4 oscillator. Permeability tuned, stable and drift-free. Chassis plate measures 6½"x4½". In combination with the IF-6 amplifier, the highest order of sensitivity on FM can be obtained. Tubes included as well as schematic and instructions. Draws 30 ma. Shipping weight FMF-3: 2½ lbs. Dial available @ $3.85

IF-6 Amplifier **$19.75**

A remarkable value! 6 tubes are used in the IF amplifier: 6BA6 1st IF, (2) 6AU6 2nd and 3rd IF's, (2) 6AU6 limiters and 6AL5 discriminator. High gain, wide-band response (200 KC) for highest fidelity. 20 to 20,000 cycles. Distortion less than ½ of 1%. Draws 40 ma @ 220 volts. Chassis plate dimensions: 11-5/16"x2½" Shipping weight: 3 lbs.

AM-4 Tuning Unit **$24.50**

Tops in AM superhet performance! A 3-gang tuning condenser gives 3 tuned stages with high sensitivity and selectivity. Assembly is completely wired, tested and aligned ready for immediate use. Frequency coverage 540 KC to 1650 KC at a sensitivity of 5 microvolts. Tubes 6BA6 RF amplifier; 6BE6 converter; 6BA6 IF amplifier and 6AT6 detector. Draws 30 ma @ 220 volts. Mounts on a chassis plate measuring 4"x7⅜". Shipping weight 2½ lbs. Dial available at $3.85.



RD-1C Tuner & Dial **$28.50**

The COLLINS RD-IC FM tuner chassis is unique in the field. A whole, compact FM tuner and dial that fits in the palm of your hand. Convert AM sets to FM/AM receivers for only a few dollars! Unlimited applications where space is at a premium. Use in conjunction with your phonograph amplifier. Full frequency response to 20,000 cycles. Sensitivity 20 microvolts, permeability tuned. Tuning unit and IF amplifier on the same chassis plate. Draws 40 ma @ 100 volts. Tubes: 6AG5 converter, 6C4 oscillator, (2) 6AU6 IF amplifiers, 6AL5 in new ratio detector circuit Shipping weight tuner and dial 5 lbs.

MAIL COUPON TODAY

To: Collins Audio Products Co. Inc.
P.O. Box 368, Westfield, N. J.
Tel. WEstfield 2-4390

☐ FM Tuner Kit ☐ FM/AM Tuner Kit ☐ Slide Rule Dial Assembly
☐ FMF-3 Tuning Unit ☐ IF-6 Amplifier ☐ RD-IC Tuner and Dial
☐ AM-4 Tuning Unit

NAME.....

ADDRESS.....

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

Amount for Kit $..... See weights, add shipping cost $.....

Total amount enclosed $..... Check ☐ Money Order ☐

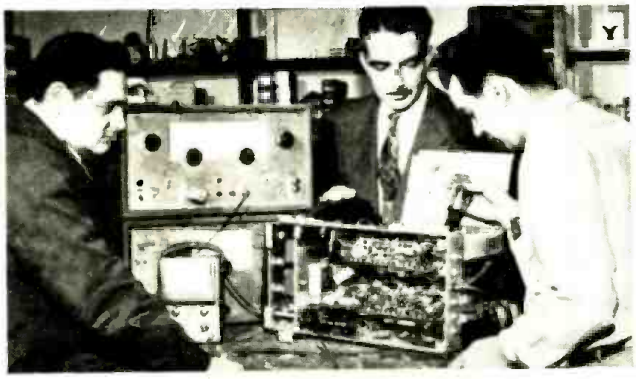
WHEN YOU THINK OF TUNERS, THINK OF COLLINS AUDIO PRODUCTS

G.E. AGAIN TELLS AMERICA THE

● **These ads, and those run in Life and Collier's last fall, are all part of the public relations program General Electric is sponsoring in the interests of the TV Service industry.**

50,000 MEN LIKE "DUSTY" RHODES MAKE TV SERVICE A "PROFESSION"

"DUSTY" RHODES, owner of Rhodes Radio and Television, Paterson, N. J.



HE GIVES PATERSON, N.J., A PROFESSIONAL TEAM OF ACE SERVICE MEN

Across the country, TV service has become accepted as a new "profession." One of the reasons is this new industry's high calibre of men. Take "Dusty" Rhodes of Paterson, N. J. He's on the Chamber of Commerce's Board of Directors. He's president of the Radio and Television Service Men of N. J. He's active on the Community Chest. In other words, he's a credit to his calling and his community.

J. PALMER MURPHY, manager, Greater Paterson Chamber of Commerce, says: "'Dusty' Rhodes is the kind of man any community would be happy to have—a definite asset."

RICHARD E. KINN, salesman, says: "I've sent innumerable people to him—that shows how much I think of his service." Kinn's wife says: "His men are polite and efficient."

MRS. ROSE ZARROW, housewife, says. "Rhodes' service is wonderful. As soon as you call them they're here—no petty excuses—just like the minute-men."

BEN MERKER, Rhodes' service manager, is a graduate of DeForrest Training School and like all Rhodes' service men he regularly attends technical seminars and courses.

One of a series of informative advertisements on TV service. Tube Department, General Electric Company, Schenectady 5, N.Y.

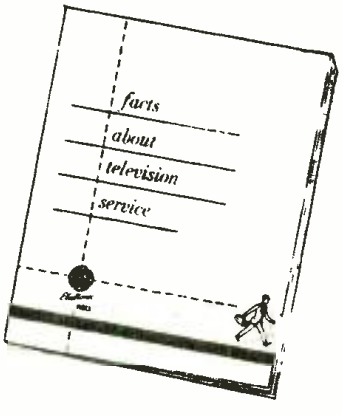
GENERAL ELECTRIC

TRUE STORY OF TV SERVICING

- **Four powerful, informative ads in Look Magazine**
- **Reaching 13,187,140 readers**
- **Reporting the *facts* on typical TV Service Dealers**
- **Convince present and future set owners of the know-how and integrity of TV Service Dealers**

THIS BOOKLET FOR SET OWNERS...

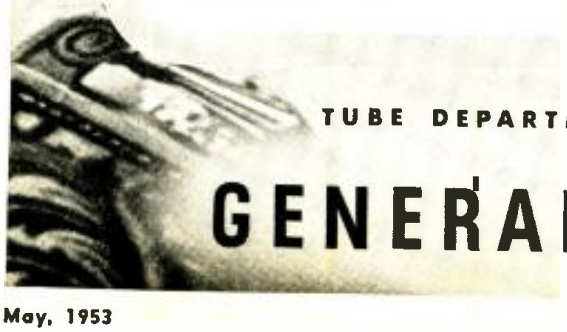
outlining the intricate requirements of TV servicing —was also made available to service dealers. And, through G-E tube distributors and tube dealers, hundreds of thousands of copies are finding their way into the homes of America.



What are you doing to follow through on this effort in your own locality?

HERE'S WHAT YOU CAN DO:

1. You can build customer goodwill through full explanation of service charges.
2. You can endorse sound business practices in your own service associations.
3. You can actively "sell" service, to increase your income and prestige in your community.
4. You can support distributors and programs which advance the interests of the Service Dealer.



TUBE DEPARTMENT, SCHENECTADY, N. Y.

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May 18-21, Conrad Hilton Hotel, Chicago, Illinois

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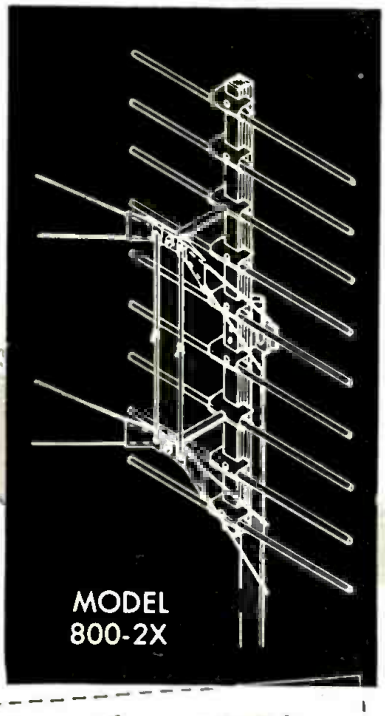
(Continued on page 166)

NOW! ULTRA-HI "CONICAL-V-BEAMS" by telrex ©



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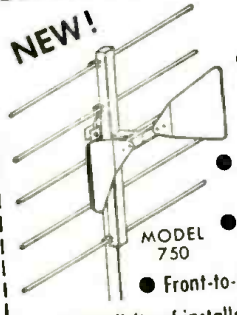

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- Peak efficiency —no "dead" spots
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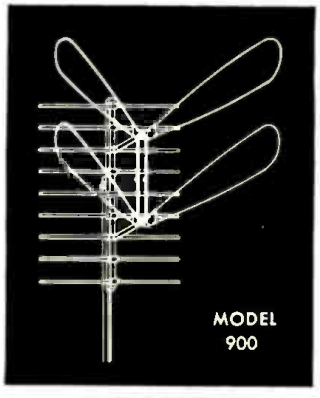

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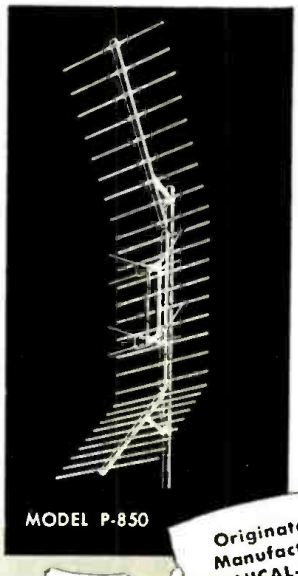

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AMERICA'S OUTSTANDING TELEVISION BEAM

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NEW 7" Push-Pull OSCILLOSCOPE

- Boosted vert. sensitivity: 10 mv rms/in.
- Extended flat freq. response: 10 cps—1 MC (±2 db).
- 3-step freq.-compensated attenuator; cathode follower input.
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- Int. pos. or neg., ext. & line sync.
- On front panel: sawtooth, 60 cps outputs; intensity mod. & ext. sync inputs.
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470K KIT $79.95 WIRED $129.50

New 565K MULTIMETER
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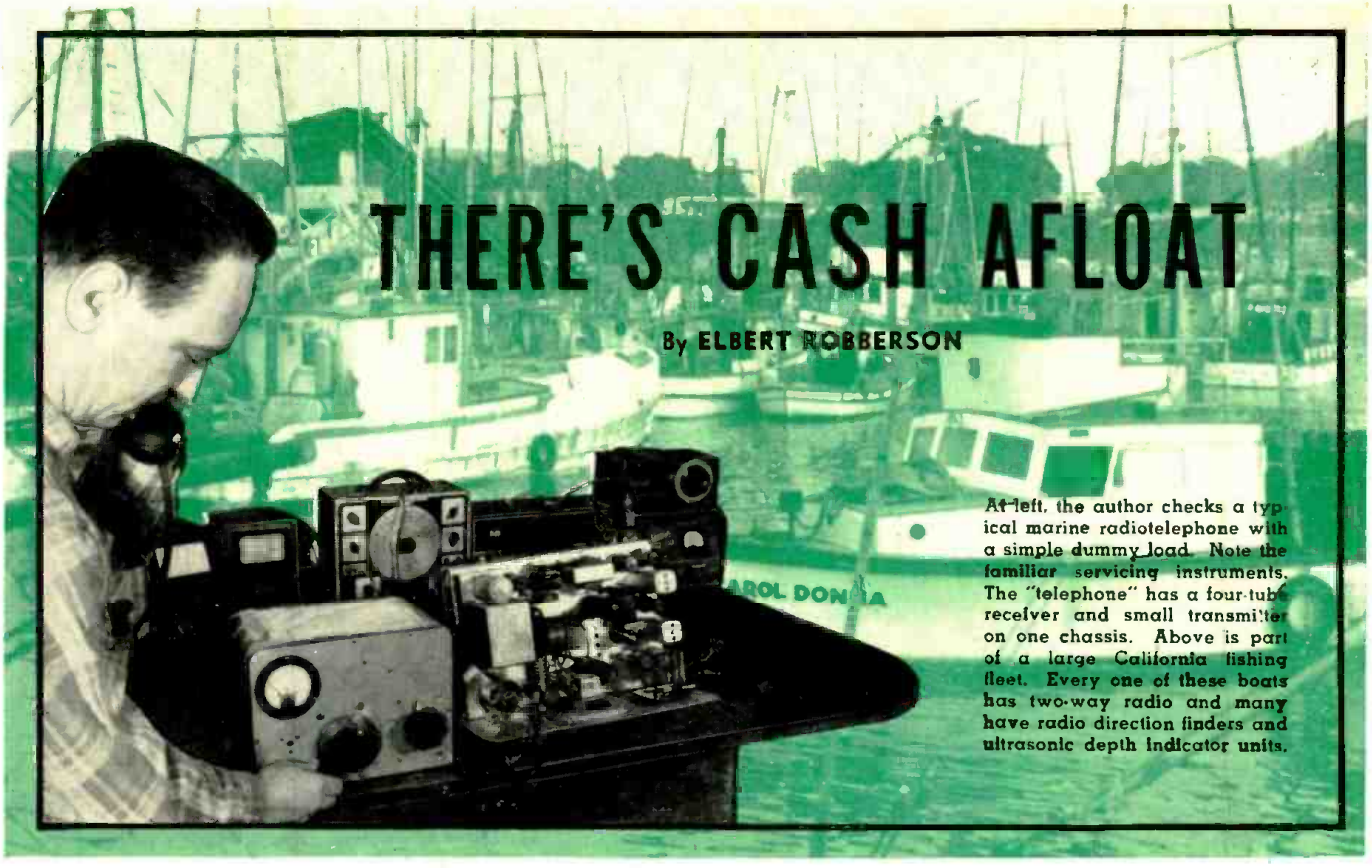
THERE'S CASH AFLOAT

By ELBERT ROBBERSON



At left, the author checks a typical marine radiotelephone with a simple dummy load. Note the familiar servicing instruments. The "telephone" has a four-tube receiver and small transmitter on one chassis. Above is part of a large California fishing fleet. Every one of these boats has two-way radio and many have radio direction finders and ultrasonic depth indicator units.

A big new field of servicing is growing up and has hardly been touched. Marine radio all over the country offers the small service shop or the amateur a bright new opportunity.

I JUST built a two-story concrete building with money earned selling and servicing small boat radio equipment.

"Not for me," you might say—"there's no water for a hundred miles around."

But, just a minute! U. S. Coast Guard registration of motor boats has been showing a rise of about 10,000 craft yearly, with almost a half a million now afloat—and a large percentage of these boats have home ports well inland. For example, boat and engine sales agencies are springing up in states that at one time were the driest in the Union, in the wake of Federal reclamation, power, and conservation projects throughout the mid-continent.

It has gotten to the point that salt water is no longer necessary for marine business; places like Las Vegas and Sioux City are blossoming with marine activity, and wherever a boat sales agency can prosper, so can a marine radio business: from California to Rhode Island, and from Montana to Mexico.

Unlike the television service "boat," which many missed because they waited to see how far it would go before making the jump, and which just kept right on sailing until it was out of sight, this boat is just getting ready to "shove off." The man who equips himself and jumps right now can be in on the maiden voyage. From all signs it appears that this boat is heading into smooth waters for the would-be small businessman who, because of the well-established competition, is having rough going in the older fields.

There are a few personal qualifications to satisfy, and a few other technical ones, but nothing "out of this world" is needed either in the way of qualifications or equipment. Anyone who is capable of making a success in any other branch of the radio business can do it here, and the rewards are gratifying. Not only financially, but in the knowledge that in being expert in this highly important specialty, your radio training is being put to its best possible use: insuring the safety and welfare of a large segment of the public.

First of all, you must have at least a Second Class FCC ticket, phone or telegraph. The next most important requisite is the ability to get along with different kinds of people. You will possibly, as a matter of everyday work, stand face-to-face with every conceivable kind of person from opera stars to men covered with the mud they dredge for a living; and you must be able to show them that you know what you are doing. This is guaranteed to take practice and the exercise of a great deal of practical psychology, but the mental and facial calisthenics will pay well. It is notable that the people who own boats also own a modicum of cash. Serve them well, and you can latch onto a reasonable piece of it yourself.

Many people shy like frightened horses at the mention of getting any kind of FCC license, or taking a government examination. Assuming, however, that the technician who may want to enter this field is a competent one, as he should be, it would cost him little effort to master the material on transmitters required for Second Class licenses and to familiarize himself with the regulations that would apply to him. The Second Class examination material is hardly more difficult than that for the old amateur Advanced Class exam, though there is more of it. An established shop that has an active amateur among its technicians could probably depend on him to sail through the commercial test.

It should not be necessary to state that anyone hopeful of success in this field should be a good workman, as well as a sound theorist. But it is necessary to stress the great difference between the kind of work that can get by in the corner phono-television emporium, and the genuine first class craftsmanship that is absolutely required in the marine field. If the television set you have just worked on quits in the middle of "Uncle Milty," there is no earth-shaking loss. But if the radiotelephone a man needs to call the Coast Guard in an emergency stops putting out, it can cost some-

one's life. Hence a greater-than-normal sense of responsibility is needed.

To be successful within a reasonable period of time, the worker must not only bring some knowledge of his own to the job, but must continue to dig up more along the way. It is not enough to try to get by on just what is learned accidentally—ferreting out information must become second nature. Perhaps in no other field is there more scorn for the inept than in boating. So learn as much about boats as you can. Let no one say: "Oh, that guy. He doesn't know the blunt end from the sharp end." Remember that the blunt end is the stern, and carry the hall from there.

The instruments used in ordinary receiver servicing must be augmented by a few more to enable you to make measurements on transmitters. So, in addition to the sensitive volt-ohmmeter and the signal generator that represent the absolute minimum for any kind of work, at least the following instruments are required:

1. A frequency meter. This can be of the BC-221 family, or any commercial instrument covering the frequency range from 2 to 3 megacycles.
2. A dummy antenna, capable of indicating transmitter power output from 2 watts to 100.
3. A portable field strength meter.
4. An AM modulation meter. (This may be combined with the field strength meter.)

The instruments should be of good quality, remembering that not only do lives possibly depend upon their accuracy but also that your work on transmitters will fall under Federal Communications Commission surveillance—and it is very difficult to cook up satisfactory answers when they ask such rude questions as why a certain transmitter was over-modulating or radiating harmonics, and what, Old Man, do you intend doing about it?

In addition to the instruments, it will be necessary to have in the shop a husky d.c. power supply giving 6 volts up to 50 amperes; 12 volts up to 25 amperes, and 32 volts up to 10 amperes. Occasionally, you will encounter sets operating from 117 volts d.c., but I have found it possible on boats large enough to have 117 volts to service the equipment right on board, without removing it to the shop.

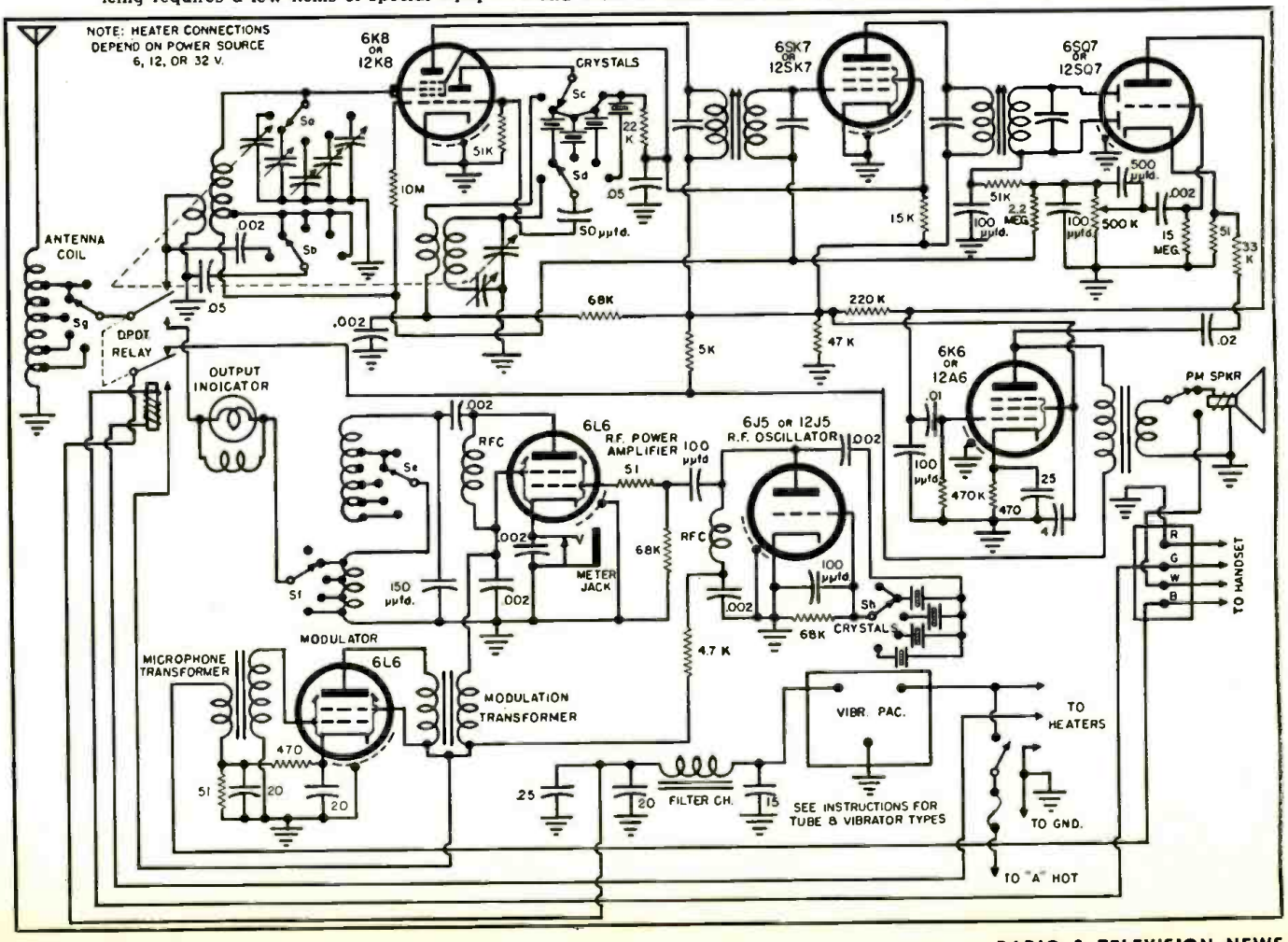
Of course, the cleanest source of all this d.c. power would be a nice heavy transformer and rectifier bank, such as those put out by *Mallory* and others. However, the man starting in business will find it possible to get by very well for a time with five fairly husky automobile batteries hooked in series, with a charger that will put about 6 amperes into them. When charged, or with the charger running, output will be a good 32 volts.

The only batteries that really need to be first class are the ones which you will use for 6 or 12-volt equipment. The ones making up the rest of the 32 volts can be junked batteries, as long as the cells are not absolutely shorted or open. The 32-volt equipment draws very little current, by comparison with the lower voltage gear, so the charger can be used to supply the actual running current for your 32-volt bench work, and the "dead" batteries will suffice very well as a filter to fill in current between peaks of the rectifier output.

These items are enough to start with, and it is better to wait until experience has filled out your list before gathering together a large and expensive layout.

The kind of sets you may expect to sell and service will depend upon your locality. In some places the most important item of service may be radar, loran, or sounding instruments. In others, the loop direction finder may have the greatest play; but almost everywhere will be found a market

Schematic of a typical marine radiotelephone. The receiver is a straightforward four-tube superhet, with nothing unusual except the added fixed-frequency channels. The extremely simple transmitter should hold no terrors for anyone. Servicing requires a few items of special equipment and a d.c. source. This unit is a Hudson American Corp. "Corsair II."



for marine type broadcast receivers and two-way radiotelephones.

Radio receivers for this market stem basically from old-time battery models, such as were used on farms. Nowadays, however, they use a d.c. input vibrator power supply which will operate directly from the boat battery, so they are built for 6, 12, or 32 volts. The main advance in their design over older sets will be slightly more rugged and moisture-proof construction, and the inclusion in the tuning range of the marine radiotelephone frequencies—from 2 to 3 megacycles. An assortment of 6, 12, and 32-volt vibrators, both synchronous and the simple interrupter types, glass fuses, and 0Z4 and 6X5 tubes added to a normal receiver-tube stock will permit service of most marine receivers.

Radiotelephones for marine use have all been designed to fulfill the absolute minimum requirements for communication, to keep size, weight, power drain, and expense all at a reasonable level. For example, none but the largest and most expensive of them have a speech amplifier. Instead, a telephone carbon mike which peaks sharply on voice frequencies feeds through a transformer into the modulator grid. Common practice is to modulate a 6L6 r.f. amplifier with another 6L6; an 807 with another 807, etc.

Transmitter circuits all follow the pattern of a Pierce or other untuned crystal-controlled oscillator, capacity-coupled to a beam-pentode power amplifier. Those installed in coastal waters cover 2 to 3 megacycles; lake and river sets cover from 2 to as high as 9 megacycles. The r.f. output circuits are designed for a Marconi antenna of from 12-foot length on up to one quarter wavelength. Tuning is accomplished in transmitter circuits by placing clips on the tuning coils or by movable slugs. There is one adjustment for each frequency, with all channels pre-tuned by the installer. Once tuned, the transmitter is closed, so the operator (who may be a shrimp fisherman or a used car salesman) will not be able to tamper with the circuits.

"Telephones" of about 10-watts output are powered by a 35-watt vibrator power supply, the output of which is fed either to the receiver plates or the transmitter, as the telephone is "keyed." The receivers are 4-tube jobs, with the antenna coupled directly into the mixer, and input circuits are slug-tuned. The better sets have the receiver oscillators crystal-controlled and all adjustments pre-made, as in the case of the transmitter.

A push-to-talk button on the handset actuates the antenna and power supply changeover relays. The circuit of one of the most popular radiotelephones of the past decade is shown on page 36 as an example of the circuitry to be expected.

Dynamotors power telephones larger than the 10-watters. It is well to locate a source of odd sizes of carbon brushes for servicing these dynamotors. Sometimes it is even necessary to saw and file larger brushes to fit these machines.

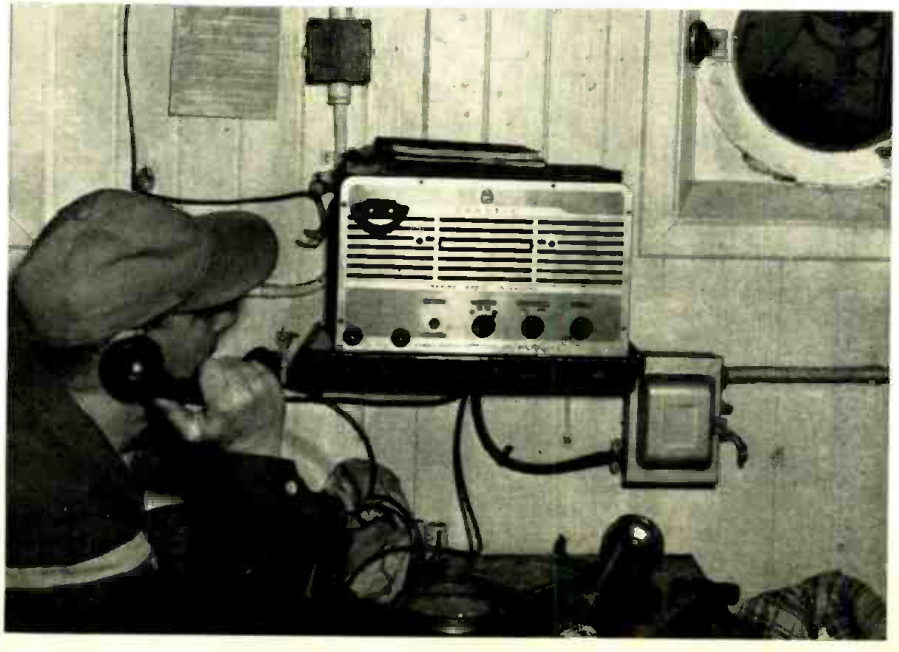
Among the best sales and service prospects are tugs and workboats. Elimination of revenue losses due to wasted time has, in many cases, paid for an installation like this in only one day's operation. Receiver at left monitors the ship-to-ship channel while the radiotelephone at right is busy on the ship-to-shore frequency. Pleasure-craft owners are also increasing use of radio, for safety and convenience.

Direction finders closely resemble the marine receivers in make-up, with the addition of a low frequency band to tune in marine radio beacons from 286 to 314 kilocycles. A shielded loop turned by a handle on top of the receiver cabinet is the means for finding the null-line or bearing of beacons or other stations; and a compass "rose" calibrated in degrees as well as the cardinal and inter-cardinal points is incorporated for transferring bearing lines onto a chart. After installation, direction finders are usually "calibrated" by the installer, which is to say that he determines the amount of radio field distortion around the vessel by comparing radio with visual bearings.

One other marine application of the electronic art the beginner can work with is the depth finder. This is the grand-daddy of radar. A high frequency sound wave is shot out of the bottom of the boat and an electro-mechanical timer measures the interval until its return, with the dial indication in feet or fathoms (6 feet).

(*Continued on page* 161)

Barge crews used to depend on uncertain whistle signals to convey instructions and reports. This radiotelephone, shown in the bunkhouse of an oil barge, makes communication quick, precise, and certain. It can protect lives and property if the engineless barge gets into trouble. This 12-watt unit has a 100-mile range. The typical compact construction makes installation and servicing relatively easy.



A DIMINUTIVE WIRE RECORDER

By
HARVEY SAMPSON
Pres., Harvey Radio Company, Inc.

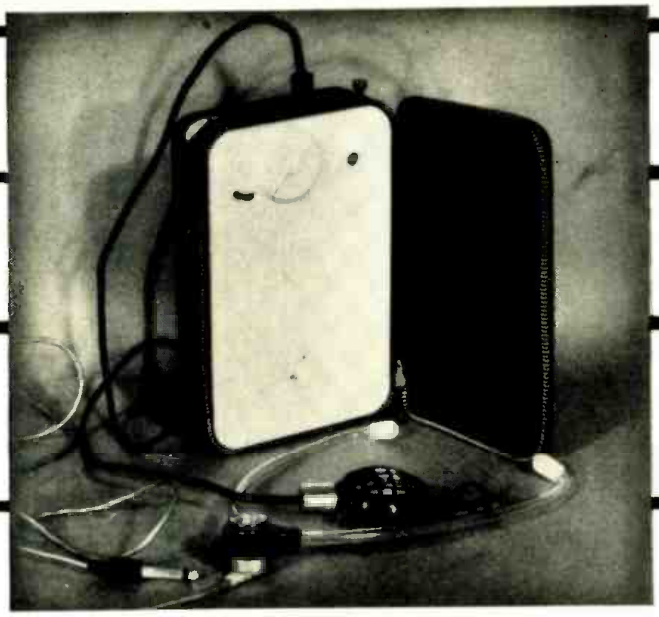


Fig. 1. The "Minifon" measures but 4⅝" x 7" x 2" when contained in its soft leather zipper case. Crystal diaphragm microphone and stethoscope-type earphones come with each recorder.

Technical details on a commercial pocket recorder-reproducer which measures a mere 6⅝ x 4¾ x 1⅜ inches over-all.

EVER since the advent of magnetic recording there has been a steady demand for an ultra-compact device meeting the requirements for a highly portable instrument, entirely self-operated and capable of continuous recording over long periods of time. In the past a few attempts have been made to produce pocket devices but these were not perfected to the point where it was practical to produce them commercially.

The German-made *"Minifon,"* however, does possess almost unlimited possibilities in varied fields of communications, commerce, medicine, and intelligence. Because of its diminutive size, it is ideally suited for street interviews, dictation out in the field, and for gathering realistic sound effects.

The wire used with the *"Minifon"* measures .05 mm or .002" in diameter. The wire speed is approximately 30 cm or 11.8 inches-per-second, which is approximately half the speed employed by the American-made machines. This extremely fine wire is level-wound to slightly more than ¼" on the spool. Up to 2½ hours of material may be recorded on a single *"Minifon"* spool.

The take-up spool is dynamically balanced so that it may also serve as a flywheel in the forward direction. Because the *"Minifon"* may be operated in any position, a locking hub screw is provided on the supply spool, together with a guide pin to prevent slippage.

The "record-playback" head has the same diameter as a fifty-cent piece. Level-wind is provided by a heart-shaped cam located beneath the sub-assembly. A permanent magnet type erase head pivots to come into direct contact with the wire for erasure. The remaining components include the miniature permanent magnet d.c. motor and its helically-wound spring drive belt. Physically, the motor is about the diameter of an average individual's thumb, with an over-all length of less than 2½" including the shaft and governor.

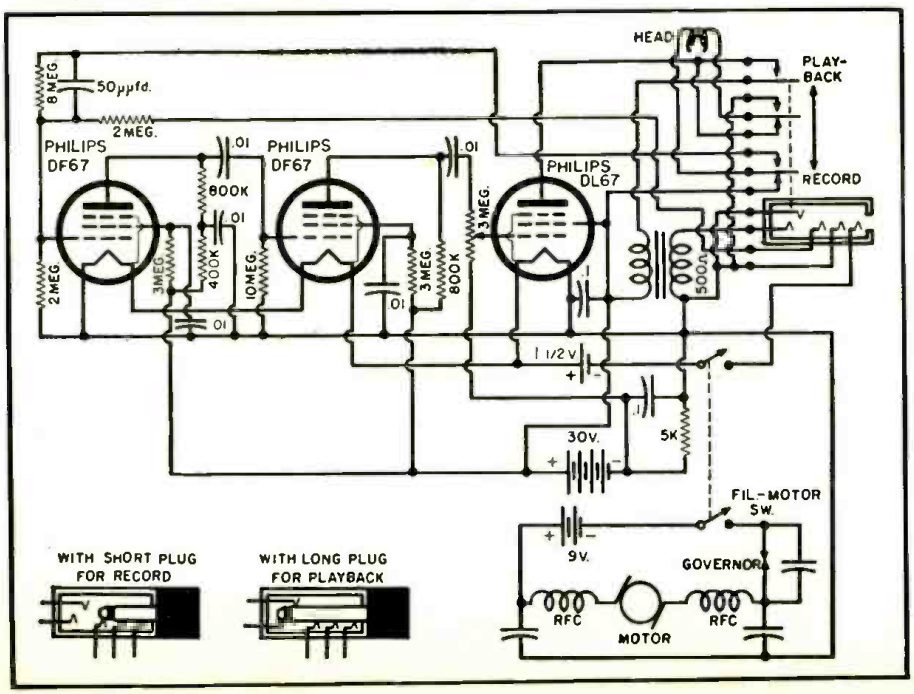
An ingenious jack switch has been devised for the *"Minifon"* which serves to transfer the amplifier circuits from "record" to "playback" when miniature phone plugs of different length are inserted. A tiny gain control, approximately ¾" in diameter, is located next to the output transformer.

The *"Minifon"* amplifier employs two *Philips* Type DF67 high-gain pentodes and a DL67 output pentode in a conventional resistance-coupled amplifier. These tubes are similar to the *Raytheon* CK series. Fixed bias is applied to the output tube grid through the return leg of the volume control to "B—." A 5000 ohm resistor to the negative ground circuit provides the necessary voltage drop. The single 30 volt hearing-aid type B battery and a 1½ volt penlight cell furnish complete power to the amplifier. Contact bias is used on the DF-67's.

As mentioned previously, there is a unique jack system (which could more properly be referred to as a series

(*Continued on page* 158)

Diagram of the German-made "Minifon." Special jacks provide "Rec.-Play" transfer.



AUDIO EQUALIZATION

By LEON A. WORTMAN

Why do identical audio systems sound different in different locations and why do records vary from disc to disc?

The author has been an audio amplifier design engineer and audio facilities engineer for several broadcast stations, chief engineer of KRUX, chief of the technical data division of Fairchild Recording, and director of advertising and sales promotion of Audio & Video Products Corp. and its three subsidiaries. His articles on audio have appeared in most of the technical publications.

PRIOR to the advent of the modern and low output level cartridges such as the *Audax, G-E, Pickering,* and other reluctance and magnetic types, playback preamplifiers were unnecessary in the home entertainment field and were associated almost exclusively with microphones. These new cartridges made the general public acutely aware of the role of the playback preamp as an important link in the chain of a sound reproduction system. For one thing, it became aware of the necessity for *compensation* in the preamplifier to make up for inherent characteristics of the pickups at certain portions of the audio spectrum. As these new pickups became more readily obtainable, the general public availed itself of them and heard recordings in its own home in a way which gave a new aesthetic excitement to the listener. Thus the audio industry found roots in a new activity, the high-fidelity enthusiast.

Then came new awareness, such as an observation of the vast differences in sound quality among the record labels, even among the top five: *Capitol, Columbia, Decca, Mercury,* and *RCA Victor.* This started a new movement—playback equalization for everybody. The now familiar equalizer-preamplifier was evolved, a thought- and discussion-provoking device, if ever there was one!

All of us have been reading numerous articles and expositions about phonograph record playback systems. However, our fears have been growing as we witness the increasing complexity of the preamplifier-equalizer units being suggested. A lot of the pleasure of turning on a record player and settling back to enjoy the "finest in audio" is being sacrificed to the scientific purist's ideas without regard for the human and psychological elements involved. The trend is toward a handsomely styled *mass* of toggles, rotaries, turnovers, boosts, attenuators, and calibrations. We now anticipate the ultimate in developments, a "calendar" switch which would select, from its 21 x 10^5 positions, the year in which each of the five major companies issued the particular recording the listener would like to manipulate into playback position.

We are becoming aware of two additional phases in audio evolution. *One,* we have been impressed with the fact that the five great labels have different sounds, but, now, we realize that records made by the *same* company differ considerably. *Two,* we discover that what sounds grand in my living room and on my equipment may sound better, or maybe not so good, in yours and *vice versa.*

To consider the first of these two "new phases," the differences among the records in the catalogue of one given company, let's relate it to your own experiences. Do you have a favorite concert hall in which you find a symphony orchestra delightful to hear? Probably, like most of us who enjoy sophisticated pleasure, you also have a favorite section or seat in that hall. Why do we have these favorites? Why do we feel that the New York Philharmonic, for example, sounds better in Carnegie Hall than it might in the equally large Ziegfield Theatre? It's the room acoustics, the characteristics of the hall. And, when we say "characteristics of the hall," as we all do say, aren't we perhaps talking about equalization. Therefore, don't we find that the differences in the sound impinging on our ears in one section of the hall as it varies in moving to another section of the same hall much like the adjusting or tuning of a filter or an equalizer? When we have found the seat which enables us to hear the sound which gives us the effect we seek on concert eve, we have actually manipulated a mechanical tone balance control.

This bears on recording and audio equalization in a pure sense, the sense that equalization, because of the characteristics of the chamber in which the original recording occurs, is automatically introduced at the very moment the original recording is being made! Further, the microphone has its inherent characteristics. The usual lengthy connecting cables and their characteristics may also contribute to this *pre-equalization.* Now, let's depart from this for a moment, but, hold the train of thought as we consider the second related "new phase" of our audio evolution—the differences between sounds in your home and mine.

Assume you and I are using the very same equipment setup, from turntable through to the loudspeaker and its enclosure. Yet the two setups sound different, very noticeably different, even when we use the same records for comparison. We try a simple experiment, moving the baffle to various spots in the living room, seeking the best spot for sound. (We did it in the concert hall, trying to find the best seat for hearing. Why not the reverse in positioning the baffle?) Sure enough, we find a spot that seems best. The sound is more pleasing and requires less treble attenuation, less bass boost. Now, we do the same with my baffle and we find an optimum location in the room. We find, strangely, that, although I can almost duplicate your sound, I must use different bass-treble control settings. What has happened then? The living room's inherent characteristics (not necessarily resonance) have contributed equalization between the loudspeaker and the ear. The living rooms are the only different element in our two electrically alike systems. Isn't this all relative to the symphony orchestra performing in different halls, and obtaining very different sounds?

Now, quickly back to the first "new phase" given some paragraphs ago. The engineer is monitoring and mixing the original sounds being picked up by the microphones and is putting them on magnetic tape for later mastering. Of course, he's using a monitor amplifier and loudspeaker. The amplifier is flat, no electrical equalization. The loudspeaker is an excellent one, enclosed according to the manufacturer's recommendations. *Please be fully aware that,* in accordance with what was heard in the monitor speaker, the microphones were moved about and finally placed to the auditory satisfaction of the conductor, the recording director, and the engineer. Also, different conductors and directors have their own ideas of what is tone "balance." Actually, what was done? The best spot in the hall was found for the microphones, to suit the accepted spot in the unidentifiable monitoring-recording room — with its inherent characteristic, or equalization. And, since each record company does its original

(*Continued on page* 120)

U.H.F. TV TEST EQUIPMENT

By
WALTER H. BUCHSBAUM
Television Consultant
RADIO & TELEVISION NEWS

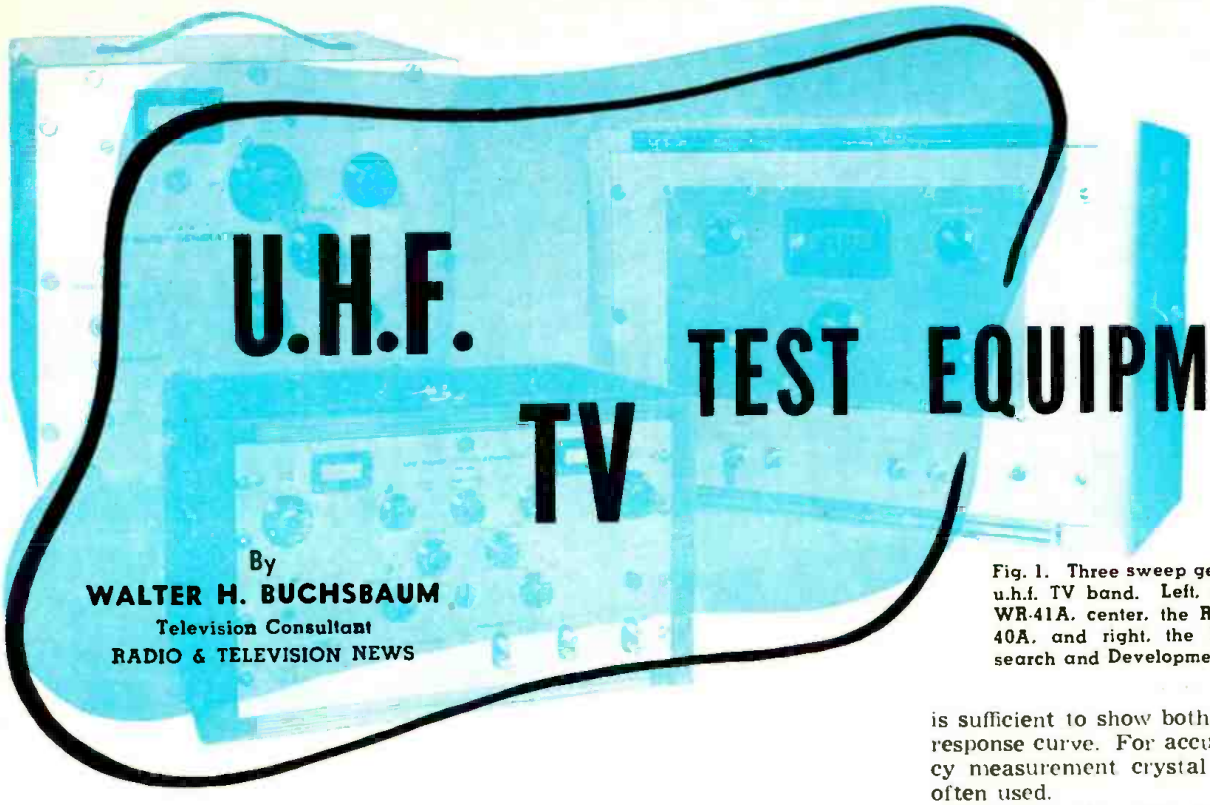


Fig. 1. Three sweep generators for the u.h.f. TV band. Left, the RCA model WR-41A, center, the RCA model WR-40A, and right, the Polytechnic Research and Development Co. type 907.

Survey of available u.h.f. test equipment and timely data on using v.h.f. instruments for servicing u.h.f. tuners.

THE rapid growth of u.h.f. television has removed this topic from the theoretical plane and dropped its problems right into the lap of the service technician. As with v.h.f., correct alignment and troubleshooting without instruments is not feasible and the first step in preparing for u.h.f. is the procurement of suitable test equipment. In some instances service technicians may prefer to send an inoperative u.h.f. tuner back to the manufacturer. However, the long waiting time, shipping charges, and uncertainty of this procedure is a nuisance to the customer as well as the service technician. Eventually, tuners will be out of warranty and require repairs which the technician should be able to do himself. In the long run, u.h.f. test equipment will certainly find its way to every test bench, just as v.h.f. equipment has done.

The purpose of this article is to discuss the types of equipment required, describe currently available items, and those planned for immediate release, and give pointers on utilizing v.h.f. equipment for some u.h.f. chores.

The only portion of the TV receiver where u.h.f. requires new circuits and new equipment is in the tuner. At the present time u.h.f. reception is accomplished either by special u.h.f. strips in the v.h.f. tuner, external u.h.f. converters, or by a combination v.h.f.-u.h.f. tuner. In either system only the u.h.f. portion is different from previous circuits used in v.h.f. sets. The u.h.f. section usually consists of an r.f. network tuned to the u.h.f. channels and a separate oscillator beating with the incoming signal to produce either a v.h.f. signal or else a 40 mc. i.f. signal for the receiver. In some u.h.f. tuners and in all strip-type systems the v.h.f. local oscillator harmonics are used instead of a separate u.h.f. oscillator. The mixer in all instances is a crystal diode, frequently a 1N82 silicon type. From this information we can see that test equipment will be needed to align the u.h.f. r.f.-bandpass networks and to check the u.h.f. oscillator frequency.

EDITOR'S NOTE: Although a method for using v.h.f. test equipment to service u.h.f. circuits is given in this article, rapid and efficient servicing of these circuits will require the use of u.h.f. test equipment. All of the u.h.f. sweep generators available and described herein are laboratory type, and not designed specifically for TV service. However, they may be used for service and in their general circuitry, characteristics, and method of application they are the forerunners of commercial service units.

Types of Equipment

For aligning v.h.f. networks the sweep generator-oscilloscope method, as shown in Fig. 2, has proven most efficient and reliable. It permits visual presentation of the actual frequency response curve of the network under test and the effect of every adjustment is visible at once. Since most r.f. networks in the v.h.f. TV system are designed for about 6 mc. bandwidth, a sweep width of 10 to 15 mc. is sufficient to show both slopes of the response curve. For accurate frequency measurement crystal markers are often used.

Basically, the same type of sweep generator-oscilloscope setup is desirable for u.h.f. alignment. In u.h.f. tuners, however, the r.f. bandwidth is much greater than for v.h.f., ranging from 15 mc. up to 60 mc. for some types of tuners. This means that a suitable sweep generator should have up to 70 mc. sweep width. Another difference from v.h.f. lies in the fact that most present u.h.f. tuners do not use an r.f. amplifier. This means that the output signal of the sweep generator must be sufficiently strong to give a good scope picture even if it is directly connected through a detector. Because standing waves become quite important at u.h.f. it is important that the diode detector be properly loaded which, in turn, means some attenuation and still more loss of signal. These factors all mean that a sensitive scope will be needed as well as a sweep generator with a fairly high signal output. In order to determine actual frequencies a marker signal must be added to the sweep generator. The accuracy of this marker can be less than that required at v.h.f. because the r.f. bandpass is much broader than the 6 mc. required for a single channel and the local u.h.f. oscillator can be tuned accurately on a station signal. The percentage accuracy, however, must still be high because a 1% error, for example, at 500 mc. means a 5 mc. error.

The oscilloscope required may be the same as that used for v.h.f. since the scope, for most adjustments, will be connected to the second detector load resistor as in v.h.f. This will give the bandpass characteristics of the tuner and i.f. circuits for the frequencies in which we are interested. Also, if the signal generator is furnishing the input signal by way of high order

harmonics (as will be explained later) the input signal will probably be very low and amplification will be necessary before a usable signal can be fed to the scope. If it is desired to investigate any of the tuner circuits directly a rectifier probe may be used with the scope, but it should be borne in mind that the input signal must be relatively large to be usable so far forward in the circuit.

So far as other test instruments are concerned, the same v.t.v.m.'s, multimeters, and similar equipment that were found useful on v.h.f. can be used for u.h.f. since after the mixer crystal in the converter the signal is a v.h.f. one and is handled in the regular way as before. Signal generators will be usable if they are capable of generating high enough harmonics of sufficient strength so as to fall into the u.h.f. range for oscillator adjustments, marker signals, etc. The problem of harmonics will be discussed with sweep generators in following paragraphs and is also applicable to signal generators. Most u.h.f. signal generators available are of laboratory or professional type and not specifically designed for service work. Since the sweep generator-oscilloscope method of TV alignment and adjustment has been found to be the most efficient, and since in many instances an r.f. signal output is available from the sweep generator, we will not concern ourselves with signal generators any further in this article.

The problem of u.h.f. test equipment resolves itself, therefore, to the choice of a sweep generator. For u.h.f. alignment the most desirable instrument is undoubtedly a u.h.f. sweep generator, preferably with accurate markers included. At the present time, however, most of the manufacturers of such instruments have not yet brought out such a sweep generator for the service technician. All of them, however, have indicated that they are working on these instruments and hope to produce them sometime in 1953. Until u.h.f. sweep generators, retailing for $200 to $300 become available, the service technician is faced with a difficult choice. There are some good u.h.f. generators on the market, but their prices range from about $600 to $1000 and over. For most average service shops such an investment is hardly warranted, especially if the near future will bring a lower priced instrument on the market. Some service shops, such as those located in active u.h.f. areas, will find the more expensive sweep generator a good investment since it permits them to do better and faster work and it gives them a definite edge over their competition. Before discussing these u.h.f. sweep generators we will present a method of aligning u.h.f. circuits using only v.h.f. equipment.

V.H.F. Gear for U.H.F. Work

The principle which makes it possible to use v.h.f. equipment for u.h.f. networks is a familiar one, namely harmonic generation. The second, third, and fourth harmonics of v.h.f. generators will cover the u.h.f. TV band when used in correct combinations.

The use of a particular v.h.f. sweep generator depends, however, on its upper fundamental frequency limit. This is so because the higher the harmonic used, the smaller will be the signal output available. If your sweep generator has an upper frequency limit of 240 mc. on fundamentals, for example, it will be necessary to use the fourth harmonic to cover Channel 83 (884 to 890 mc.). If your generator, on the other hand, has an upper fundamental frequency limit of about 100 mc. the ninth harmonic will have to be used to sweep Channel 83, with a resultant reduction in the signal available. Exactly how much signal is available depends on the instrument. Of course, the minimum signal that can be used depends on the tuner and receiver sensitivity. Tests with the instrument you now have will quickly tell you whether or not it can be used for u.h.f. alignment and testing.

The method described below applies to any v.h.f. sweep generator with an upper center frequency limit of about 240 mc. Generators which do not go so high may be used for this method utilizing higher harmonics than indicated here.

1. Align the picture and sound i.f. stages and v.h.f. tuner extremely carefully with the v.h.f. sweep generator and marker generator.
2. Connect the vertical scope terminals to the second detector at the video i.f. section.
3. Set the u.h.f. tuner to Channel 14 (470 mc.). If double conversion is used, tune the v.h.f. tuner to the correct channel.
4. Connect the sweep and marker generators to the tuner using maximum sweep output.
5. Tune the generator to 235 mc.

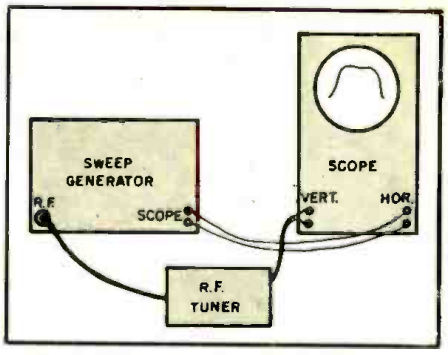


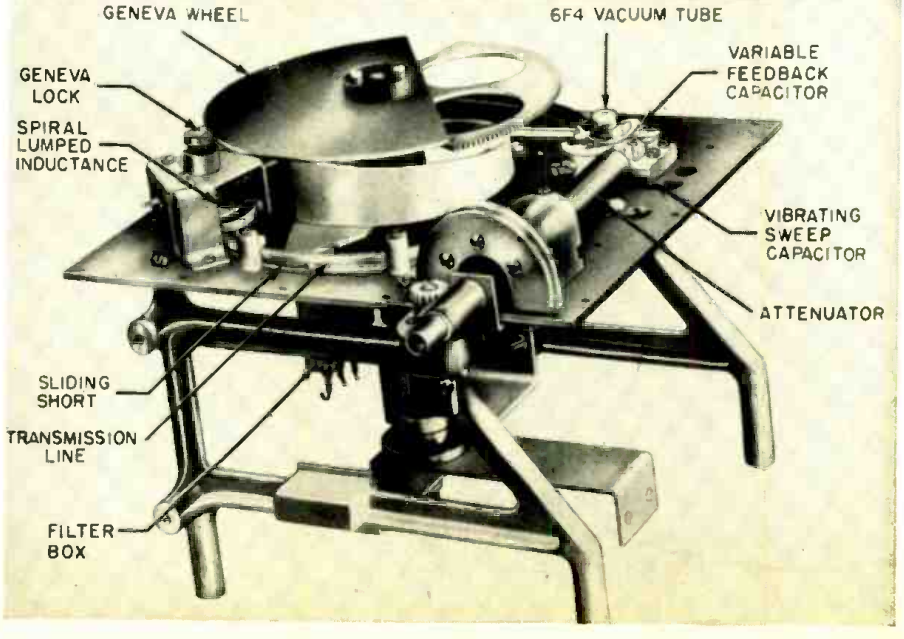
Fig. 2. Test setup for visual alignment.

The second harmonic is now exactly 470 mc. To check actual frequencies, tune the marker generator from 235 to 238 mc. and observe how the marker travels over the entire response curve. The marker signal should appear at the i.f. video carrier point when the second harmonic is 471.25 mc., or the marker dial reads 235.6 mc. Increasing the marker frequency to 237.8 mc. will place the second harmonic marker signal at the u.h.f. sound carrier (475.75 mc.) and on the scope the marker will dip into the sound i.f. carrier spot. If the sweep generator output is reduced and the marker modulated with 400 cps, horizontal bars should appear on the picture tube. Once the frequencies are set, the sweep and marker are adjusted again for a good i.f. response curve on the scope. Then u.h.f. adjustments are made to increase the amplitude of the response curve without affecting its over-all shape.

This process is repeated at each channel in the area. For higher frequency channels third and fourth harmonics must be used. For example, in order to align Channel 23 a signal from 524 to 530 mc. is required. The third harmonic of 174.7 to 176.7 or the fourth harmonic of 131 to 132.5 mc.

(*Continued on page* 138)

Fig. 3. Oscillator assembly of the Polytechnic u.h.f. sweep generator.



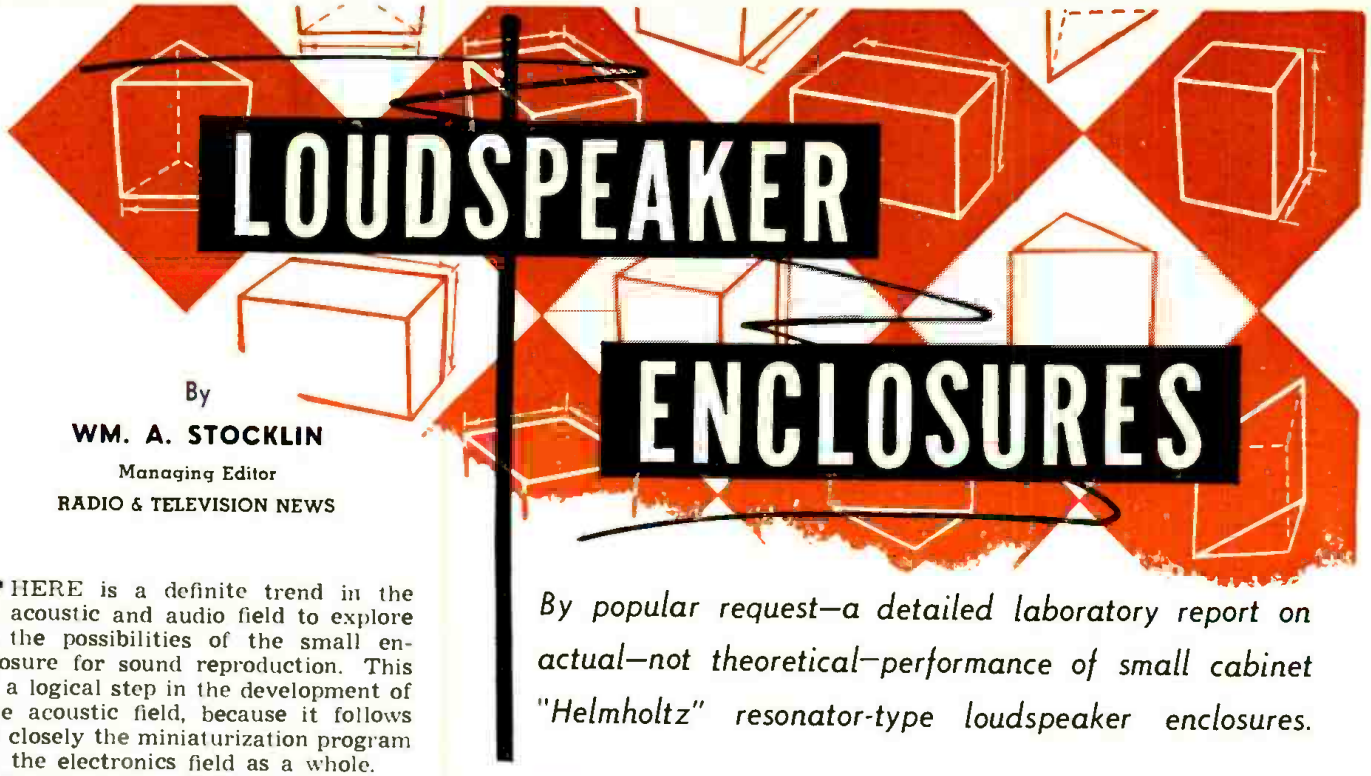
TV PARTS REPLACEMENT GUIDE

Use this guide to order from your parts distributor the correct replacement for a defective TV part. Tables in succeeding issues will cover transformers for other leading TV receiver brands as well as other replacement parts.

TV POWER TRANSFORMERS

RECEIVER MFG. PART NO.	CHICAGO PART NO.	HALLDORSON PART NO.	MERIT PART NO.	STANCOR PART NO.	TRIAD PART NO.	THORDARSON PART NO.
ADMIRAL						
80B1	PH-70	P9205	P-3052	PM8408*	R-8B	
80B7			P-3165	P-8154**	R-33A	T-26R00
80B11	TP-400	P9707	P-3059	P-8154	R-35BC	T-26R00
80B12	TP-210	P9701	P-2952†	P-8155	R-12B	T-26R00
80B13	PV-120†		P-3052†	P-6012	R-12A	
80B15	TP-400	P9707	P-3059	P-8154	R-35BC	T-26R00
80B16	TP-210	P9209	P-2952†	PM8410*	R-12B	T-26R00
80B17	TP-375	P9717	P-3067	P-8160	R-35	T-26R00
80B19	TP-380	P9705	P-3069	P-8171	R-20B†	T-26R23
80B23-1	PH-120	P9207	P-3052	PM8404†	R-12B	
80B24-1		P9735	P-3067*	P-8165	R-35BC	T-26R00
80B32			P-3098		F-25X	
80C26-1	TP-225	P9733	P-3077	P-8164	R-39BC	T-26R00
80C26-2	TP-225	P9733	P-3077	P-8164	R-20B	T-26R00
AIR KING						
M-94157-1, 201T6	TP-365	P9721	P-3061	P-8156†	R-31BC	T-26R00
RC1098		P9725	P-3067	P-8156	R-40BC	T-26R00
A 10109			P-3069	P-8171	R-35BC†	T-26R00
PC 10109				P-8171	R-39BC†	T-26R00
Model A-1016	TP-365	P9721	P-3061	P-8156	R-31BC	
Model 2017R	TP-375	P9717	P-3067*	P-8160	R-35BC	
AIRLINE						
22E27				P-8158		
22E56		P9731	P-3067,3074	P-6165	R-33BC & F52X	T-26R00
52-170	TP-410	P9713	P-3169†	P-8159	R-35A	T-26R00
53X286	PH-120B	P9713	P-2954	P-6014†	R-11B	T-26R04
53X290	PH-70*				R-10B	
53X297	TP-355	P9713	P-3063	P-8159	R-35BC	T-26R00
53X298	TP-355	P9713	P-3078	P-8159	R-38BC	T-26R00
53X302	TP-360	P9713	P-3059		R-37BC	T-26R00
53X308		P9713		P-8159	R-33BC	
53X313	TP-392	P9713	P-3067	P-8159†	R-33BC	T-26R00
53X318	TP-360	P9713	P-3059	P-8169	R-35BC	T-26R00
C12A-18839	TP-360	P9713	P-3059	P-8159	R-35BC	T-26R00
Model 05GCB-3019A, 94GCB-3023		P9731	P-3078	P-8154*†	R-38B	
ANDREA						
ST-3019		P9728	P-3174		R-40A	
ST-3022	PV-200*†	P9318	P-3165*†	PC8413	R-39A	T-26R00
ST-3023	PV-200*†	P9708	P-3169*	PC8413*	R-34A	T-24R94
ST-3033			P-3169†		R-33A	T-26R00
ST-3035			P-3169†		R-50A	
ST-3041	TP-355†	P9711	P-3169	P-8170	R-35A	T-26R00
ARVIN						
Model 4162	TP-356*		P-3078*			
E22571	TP-410	P9713	P-3059	P-8169		
E22807	TP-405	P9711	P-3067‡	P-8156†	R-37BC	T-26R00
E23086						
E23397	TP-225	P9733	P-3077	P-8164	R-39BC	T-26R00
E23837			P-3078		R-39BC†	T-26R00
E23840		F5515			F-18X	
E24654	TP-356*	P9707	P-3078*		R-39BC&F-51X	T-26R00
BENDIX						
TP0Y00			P-3169		R-39BC&F-16X	T-26R00
TP0Y01	TP-392		P-2955,3074		R-33BC	T-26R00
TP0Y02	TP-370†	P9702	P-3070†	P-8160*†	R-42BC	T-26R00
TP0Y03	TP-360	P9303	P-3070		R-35BC	T-26R00
TP0R00	TP-355*†	P9713	P-3070	P-8159	R-42BC	T-26R00
TP0H03	PH-70	P9305	P-2951	PM8407	R-5B	

* ADD SERIES RESISTOR TO REDUCE "B+" VOLTAGE. † DRILL NEW MOUNTING HOLES. ‡ REWIRE FILAMENTS.
** USE UNIVERSAL MOUNTING BRACKETS.



LOUDSPEAKER ENCLOSURES

By

WM. A. STOCKLIN

Managing Editor

RADIO & TELEVISION NEWS

By popular request—a detailed laboratory report on actual—not theoretical—performance of small cabinet "Helmholtz" resonator-type loudspeaker enclosures.

In view of the many requests we have received for performance data on small speaker enclosures, RADIO & TELEVISION NEWS is bringing you an unbiased report on laboratory tests made under our direct supervision. Although only one "Helmholtz" resonator was used in the comparisons, we believe that the results apply equally well to other types. Although the various small speaker enclosures on the market today differ in design, they are, basically, "Helmholtz" resonators.

THERE is a definite trend in the acoustic and audio field to explore the possibilities of the small enclosure for sound reproduction. This is a logical step in the development of the acoustic field, because it follows so closely the miniaturization program of the electronics field as a whole.

It seems to be the trend these days that the electronic field does the pioneer work, and then the audio field jumps on the bandwagon. Perhaps this is a logical sequence of events because, in the last analysis, we cannot have faithful acoustic reproduction unless the electronic signal fed to the loudspeaker is good.

It is not detrimental nor derogatory to the acoustic engineer's point of view to consider miniaturization or even subminiaturization. The fact that in the electronic field we now have amplifiers, transmitters, and receivers small enough to fit into our pockets or even onto our wrists, is really an admirable state of affairs. Great developments are in store for us in miniaturization. However, miniaturization does have its limitations, be it in electronics, or mechanics, or acoustics. Certainly, at the present stage, at least, we cannot expect a pocket-sized transmitter to radiate kilowatts of power. Such a thing today is somewhat unthinkable. Yet, because of this we would hardly say that miniaturization is bad. Nor will we say that miniaturization in the acoustic field is good or bad simply because it is in miniature form.

We have to analyze the situation from the point of view of its application. There are times when miniaturization may be perfectly suitable to an environment, and likewise times when miniaturization is not desirable. What we shall be primarily concerned with in this discussion will be the general form which the miniaturization takes, and then the performance of such miniature systems as compared to what we call the more conventional systems of today. Perhaps at this stage we should stop calling them miniature systems. We termed them such up to now only to highlight certain aspects of development. A box which measures only about from 1 to 1½ cubic feet certainly is small compared to a box which measures 10 or 12 cubic feet and which, up to now, we have been told provided the ultimate in reproduction. So when we hear of an enclosure that is only 1¼ or 1½ cubic feet in volume, it, in a sense, is miniature. We will discuss this problem, not of miniaturization *per se,* but with a view of the *adaptability and the performance* of a small enclosure *versus* a large enclosure.

First, let us say that no matter how good or how bad a system may be, there are always circumstances under which a system may be unusable. Certainly, the dweller in a small apartment which is a combined living room, bedroom, and dining area, all wrapped into one, is limited in the choice of non-essential pieces of equipment he can put into his room.

The word "non-essential" is used in a broad sense, of course. The author knows of a newly-married couple who found that the most necessary piece of furniture for their new 1½ room apartment was a large corner type of enclosure for the gentleman's loudspeaker. Well, it so happens that these people are in the music instruction field and at the same time are audiophiles. They started out married life with a corner cabinet as their first piece of furniture. That is an extreme, for we wouldn't expect to find this in the usual "efficiency" home or to expect it from the usual user of audio equipment. First the consumer must fit his enclosure into his living space or into the area where he intends to use that enclosure. If he has only a couple of cubic feet into which to squeeze an enclosure, then the small enclosure does and will do a good job for him. Parenthetically, we will say at this stage, that this statement does not limit the scope of the small enclosure. We merely take note that in these circumstances the small enclosure does do a good job.

However, there is no question in anyone's mind that if we were to try to fill a reception room 30 x 50 feet in area, that a small enclosure of this sort would not be entirely suitable, and that it might be advantageous to go into large enclosures which could accommodate large speakers or perhaps many speakers of considerable size so that adequate coverage of the area could be obtained with optimum quality. Let us bridge this introduction to the heart of the subject with a simple statement that all enclosures have a usefulness depending upon the circumstances under which they are going to be used.

Baffle Types

It is not commonly realized that no matter what its type, *an enclosure* is a resonant device. Open baffles and horns are anti-resonant devices. To speak of a given type enclosure as a "Helmholtz" resonator does not put it

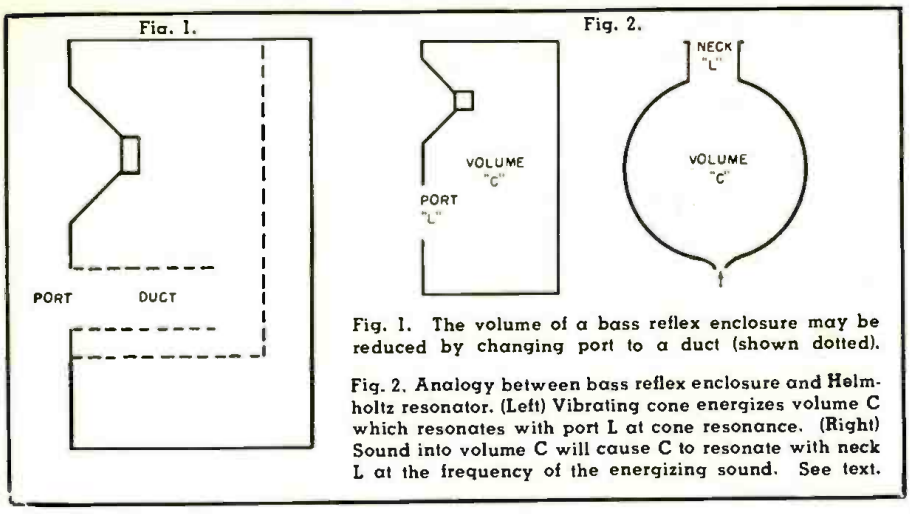


Fig. 1. The volume of a bass reflex enclosure may be reduced by changing port to a duct (shown dotted).

Fig. 2. Analogy between bass reflex enclosure and Helmholtz resonator. (Left) Vibrating cone energizes volume C which resonates with port L at cone resonance. (Right) Sound into volume C will cause C to resonate with neck L at the frequency of the energizing sound. See text.

in a class by itself. The fact is, all reflex baffles are Helmholtz resonators. The formulas for the design calculations of a bass reflex speaker are built around the Helmholtz resonator. Fig. 2 gives a simple analogy of the situation. The back capacitive volume (C) of the cabinet is the capacitive volume (C) in the cavity of the Helmholtz resonator; the inductive area of the vent (L) in the reflex cabinet is equivalent to the inductive area (L) of the neck of a Helmholtz resonator, and the speaker resonance itself energizes the cavity enclosure volume just as the sound directed into the cavity of the Helmholtz resonator energizes the Helmholtz cavity. So we must realize from the start, that to speak of an item as working on the Helmholtz resonator principle does not necessarily remove it from the general class of baffles. If we keep this classification in mind we will have a clearer picture and a better basis of comparison for the type of enclosures to be discussed.

Now, what is the function of an enclosure? Generally, it is to provide loading on the speaker so that its radiation is optimum. We are familiar with speakers mounted in simple flat baffles, open at the back end, a type of baffle from which we have, fortunately, grown away.

The enclosure which quickly followed the use of the flat baffle was the infinite baffle. The infinite baffle is a closed device without any exhaust into the air. This completely isolates the sound field into which the speaker operates from the rear wave of the speaker; and in this manner we obtain a wave front with no cancellation from the rear wave at all. For a while, the infinite baffle was the best type of baffle available for home use. It served as a piece of furniture and, acoustically, it had merit. It did serve to damp out the large self resonance of the speaker considerably. At the same time, however, it had two deleterious effects. The resonance, although somewhat damped out, moved up in frequency and therefore the low frequency response tapered off somewhat, and secondly, the acoustic output of the speaker was considerably reduced because its back wave was completely absorbed within the cabinet.

To make use of this back wave of the speaker, there was developed the reflex type of loudspeaker or, as commonly known by the more technically-minded, the phase inversion type of enclosure.

The phase inverter is simply a box in which the loudspeaker is mounted with the front side of the speaker facing forward and the rear of the speaker facing the inside of the cabinet. In this enclosure the port acts in conjunction with the enclosure volume to take the rear wave from the speaker and to operate on it so that when it comes out of the port of the enclosure it is in-phase with the radiation from the front side of the speaker. This is instantly equivalent to doubling the power output of the speaker at the low frequencies.

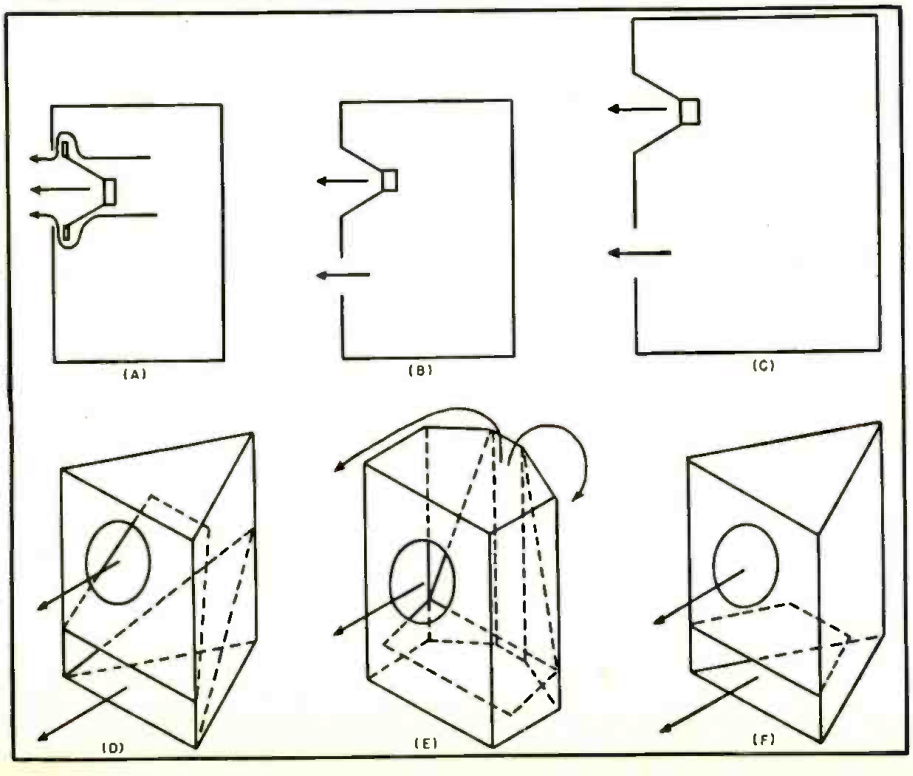
One might say "Well, that's as good as having two loudspeakers," and actually on the low frequencies that is exactly the case. If well utilized, the bass reflex speaker does make use of the rear and front wave of the speaker to give an acoustic output near optimum.

This type of reflex enclosure is the simpler version. A more rigorous type of bass reflex speaker is one where the port is actually the end of a duct, which duct leads into the cavity within the cabinet as shown in Fig. 1. Now the use of such a duct, which for some unaccountable reason, has not been employed extensively, tends to reduce the volume of the enclosure tremendously.

It may be shown that an enclosure which has a volume of 5½ cubic feet may be reduced to 3 cubic feet by the use of a duct coupling the enclosure volume to the port. The bass reflex speaker has suddenly shrunk because of its method of port escapement, but it is still a bass reflex speaker, nonetheless—or more properly—a Helmholtz resonator.

Now we come to the anti-resonant baffles, the horn "enclosures" which have mushroomed so rapidly into prominence. A good horn is characterized by *no* resonances. Its transmission characteristics are such that it gives smooth output from its cut-off frequency at the low frequency end to whatever higher frequency the driving speaker will function. This characteristic of anti-resonance is brought about by the fact that a horn

Fig. 3. Six types of enclosures used in making the tests discussed in article. (A) 1¼ cubic foot Helmholtz resonator. (B) 1¼ cubic foot bass reflex. (C) 3 cubic foot bass reflex. (D) 4½ cubic foot horn enclosure with corner not part of horn. (E) 4½ cubic foot horn enclosure where corner is part of horn. (F) 4½ cubic foot bass reflex partly horn-loaded.



is a pure transmission line terminating at one end in the speaker impedance and at the other end into the characteristic acoustic impedance of open "space." If properly designed, such a transmission line acts as an untuned device, or "anti-resonant." In addition to being anti-resonant in themselves, horns serve to damp out speaker resonances by loading the speaker with an acoustic column of air before its radiation hits free space. An increase in low frequency efficiency is the usual result.

This then, in brief, is a general outline of baffle theory to help us analyze objectively their various properties and peculiarities, be the enclosures small, large, "Helmholtz," "reflex," or "horn."

Measurement Objectives

Now what form shall this objective analysis take? Perhaps the first consideration is the frequency response of the enclosure, especially on the low frequencies. The second consideration would be the cleanliness of the response at these low frequencies.

On this basis, then, it was decided to make just such an objective analysis, employing a single speaker, such as recommended with a given small enclosure of the Helmholtz type and to then compare various other types of enclosures using the same speaker as the driver unit.

It is worthwhile to digress here for a moment to point out that loudspeakers must be matched to the cabinets in which they are to operate. This was stressed in a rather indirect way in the early part of this discussion. It was pointed out that for proper operation of the enclosure, the size of the enclosure and the port vent of the bass reflex had to be properly proportioned to the resonant frequency of the speaker and the diaphragm area of that speaker. We cannot, in general, say that in all instances a speaker or an enclosure will operate better or best in another enclosure, unless we specify the loudspeaker with which that particular enclosure is to work.

There is a wide area of divergence at this point, which we will logically have to avoid on the basis that this is not a discussion of what type of loudspeaker is best suited for a given job, but what type of enclosure is best suited for a specific speaker. On this basis, keep in mind that whatever results are obtained or divulged in this discussion may be radically changed for the better or for the worse if the analysis of one type of enclosure is made with one speaker and the analysis for another type of enclosure is made with a different speaker. On an objective basis, however, merely to classify or categorically compare types of enclosures, it is necessary to stick to one type of loudspeaker. As previously mentioned, the speaker used in this analysis is the one that is recommended for the typical Helmholtz resonator which we are to evaluate against the general field of loudspeaker enclosures comparable in size, and otherwise.

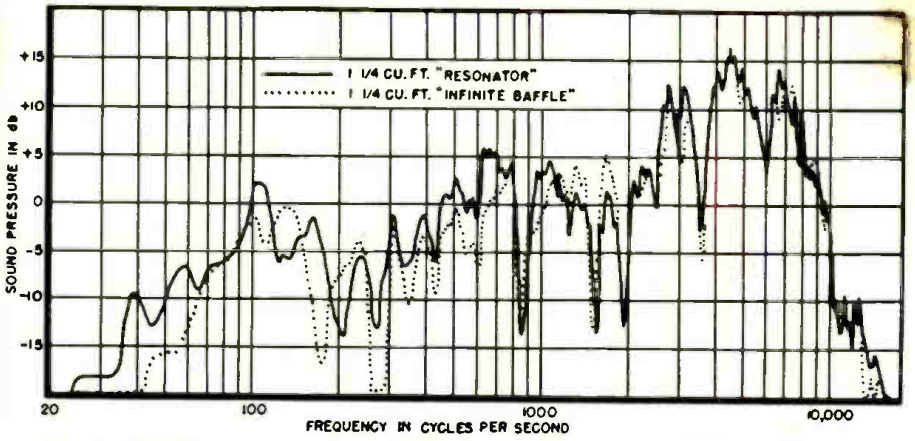


Fig. 4. Relative response of the Helmholtz resonator and an infinite baffle type.

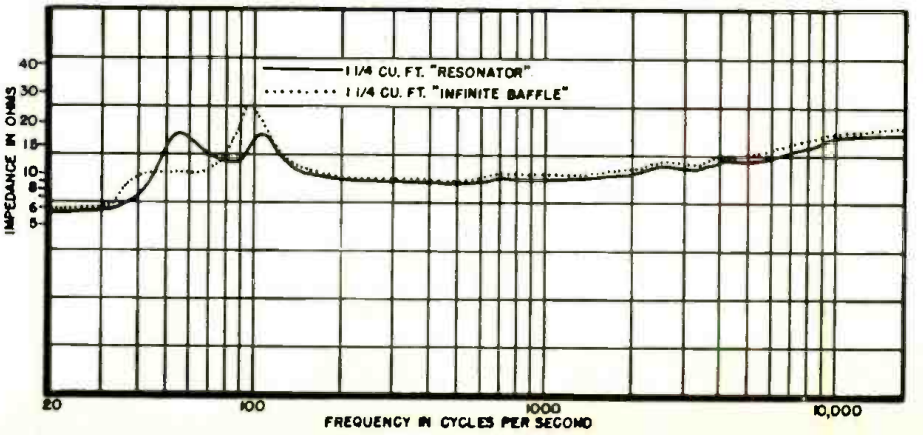
Having thus logically limited ourselves to the one reference speaker, what enclosures are we going to study? Since the reference system consists of a 1¼ cubic foot enclosure of the Helmholtz resonator type, it would be advantageous to make a comparison between this reference enclosure and another enclosure of the same volume, but of the more conventional bass reflex type. This test will thus evaluate the two "basic" types of operation for enclosures of the same size, as shown in Figs. 3A and 3B. We must analyze the effect of increasing the volume of the enclosure by utilizing a bass reflex enclosure of approximately 3 cubic feet (Fig. 3C). Then in the 4½ cubic foot class we shall compare corner type of enclosures, Figs. 3D, 3E, and 3F. Parenthetically, the last three differ in their basic concepts. Fig. 3D represents a horn type of enclosure with front and rear radiation, which utilizes the corner of the room merely to sit in. Fig. 3E represents a horn type enclosure again utilizing front and rear radiation, but where the walls of the room corner form part of the horn system. Finally Fig. 3F represents the more conventional bass reflex enclosure whose port is actually the mouth of a short horn loading the rear cavity.

Now the problem of how to measure the performance of these various enclosures becomes important. If we are going to measure a cabinet such as that shown in Fig. 3E, which requires the corner of a room, are we not penalizing the other cabinets if we do not measure them likewise? The answer is "yes." We would penalize the cabinets if they were not measured in the same corner that the actual corner-employing type of enclosure used. Locating an enclosure in a live acoustical corner of a room tends to reinforce the low frequencies through the reflected mutual impedance of the diaphragm image onto itself from the walls. In any instance, irrespective of the cabinet used, whether it be a corner-employing type or simply a corner-convenience type, we would obtain a different measured effect from a corner of a room than from the midsection of the room. Therefore, in all the measurements to be discussed from here on, we must bear in mind that the speakers were all placed in the same panelled corner. This panelled corner was, in turn, located in an anechoic chamber of considerable size.

Measurement Results

Of immediate interest is the operation of the 1¼ cubic foot Helmholtz resonator type of enclosure as compared with the same volume of enclosure using the same speaker but with no auxiliary acoustic devices built into this alternate enclosure. The alternate enclosure was then simply

Fig. 5. Corresponding impedance curves of systems compared in the graph of Fig. 4.



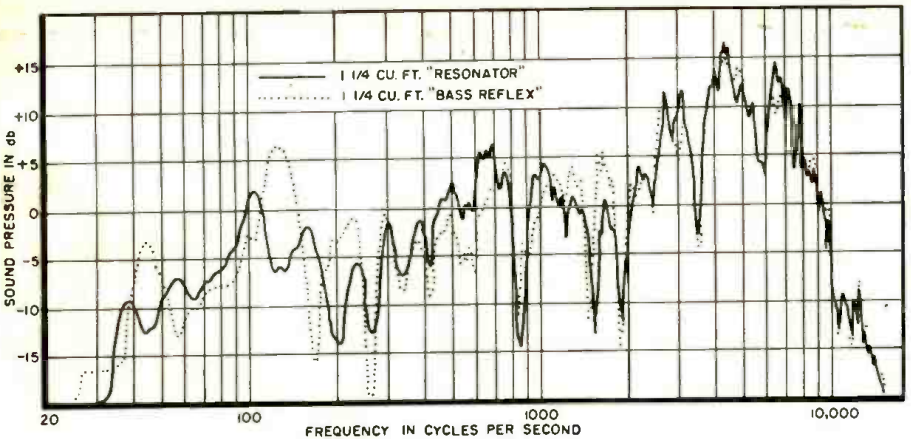


Fig. 6. Relative response of a 1¼ cubic foot resonator and bass reflex of same size.

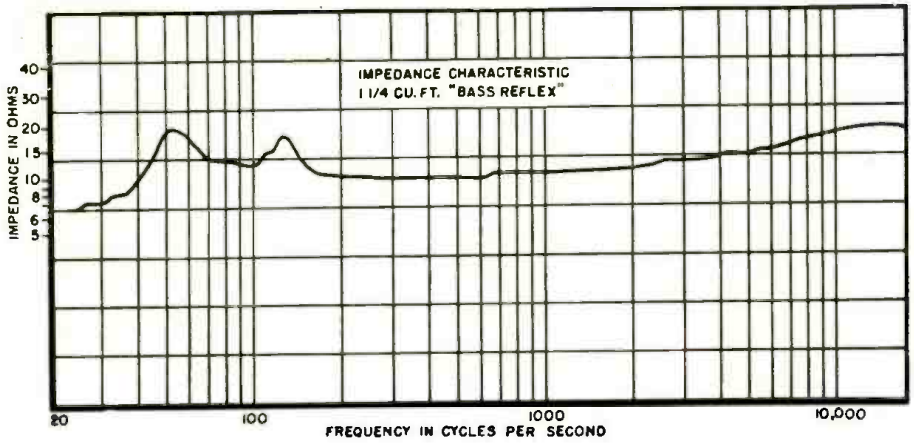


Fig. 7. Impedance characteristic of the 1¼ cubic foot bass reflex type cabinet.

an enclosed box, sealed tight, with the opening for the speaker located in identically the same section of the cabinet as was the case for the Helmholtz resonator. The acoustic performance of these two enclosures is given in Fig. 4, where the full line curve represents the "resonator" and the broken curve represents the alternate similar volume. It will be observed that the "resonator" enclosure has a response which extends into the low frequency by approximately one octave lower than does the uncompensated cabinet of the same size. The corresponding impedance curves of these systems are given in Fig. 5, and it will be noted that where in the Helmholtz resonator type of cabinet there are two equally-spaced impedance peaks, one at 58 cps and the other at 110 cps, that in the uncompensated cabinet there is simply one resonant point at about 100 cycles. This is the evidence we have been looking for concerning cabinet damping. In the Helmholtz resonator there is a nice balance of cabinetry against speaker resonance. Whereas the original free air resonance of the speaker tested was 84 cps, the "resonator" converted the impedance characteristic into two peaks, one at 58 cps and the other at 110 cps. This same speaker when put into the 1¼ cubic foot enclosure without compensation produces a system resonance of 100 cps, which is considerably higher than the free air resonance of the speaker. The general effect of the infinite type of baffle with no acoustic compensation is to tighten up the speaker in a limited frequency range.

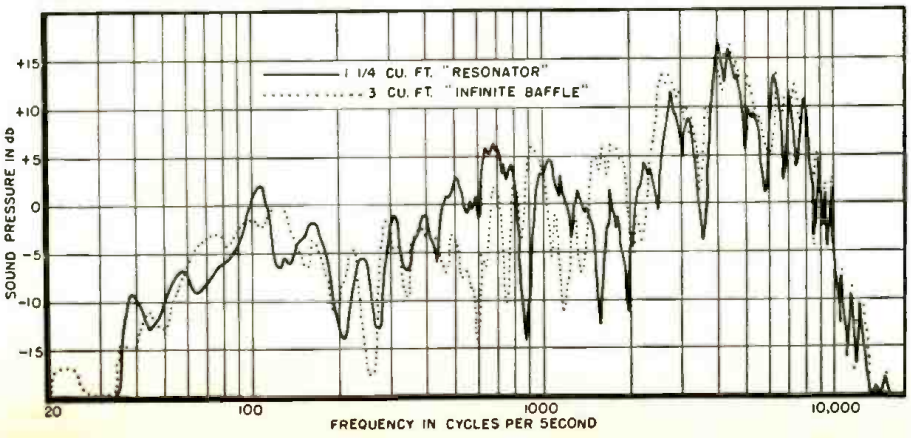
Suppose we now convert this alternate 1¼ cubic foot enclosure into a bass reflex enclosure. Applying the necessary phase inversion formulas for the evaluation of cabinet volume, port area, and speaker resonance, we arrive at a port area of approximately seven square inches. Such a port was cut into the enclosure close to the speaker and a second comparison was made. This comparison is shown in Fig. 6. Suddenly things have happened. By simply adding this seven square inches of port to the infinite baffle we have immediately increased the performance of the system over considerable areas of the low frequency end. This type of enclosure now gives more acoustic output than does the Helmholtz resonator between 40 and 50 cycles, an area where, previously, the infinite baffle was completely deficient. From 50 to 150 cps there is an interplay of energy which balances the two systems very closely.

To those interested in the theory of coupled circuits, as it applies to acoustics, the impedance curve of Fig. 7 should prove of value. It will be observed that whereas we had a single peak at 100 cps for the closed volume, we now find two peaks for this same volume converted into a bass reflex unit; one peak at 51 cps and the other at 120 cps. It is a beautiful illustration of the acoustic compensation possible for any type of enclosure if the compensations are properly made. It is worthy of note that whereas the bass reflex enclosure gives more response in these resonant areas with a consequent dip between these two high output areas, the Helmholtz resonator gives lower output in these resonant areas but relatively higher output between these peaked areas.

This is typical of a situation where there are closely coupled circuits. There are high resonant peaks of output with a large trough between them, or closely spaced resonant peaks with a minimum trough between them. We should point out here that volume for volume the bass reflex enclosure and "Helmholtz" enclosure are pretty well balanced. *The former has higher output, in general, in the low frequency area. The latter has smoother response in the low frequency area.*

Now we come to the problem of "How does an increase in cabinet size affect performance?". For this test a three-cubic-foot cabinet was made up without any acoustic compensation, namely an infinite baffle. The results of this comparison are shown in Fig. 8. It will be noticed that the low frequencies are practically identical with those of the 1¼ cu. ft. Helmholtz resonator, with minor variations in the small ups and downs between the two curves. The 3 cu. ft. cabinet gives a nice smooth response as does

Fig. 8. Relative response of 1¼ cu. ft. resonator and a 3 cu. ft. infinite baffle.



the Helmholtz resonator type of ⅛ its dimensions. We might ask how is it that we get so little output in this three cubic foot baffle? Again this is an infinite type baffle without any port relief or acoustic compensation of any kind and so the prime function of the baffle is simply to subdue the back wave.

If, however, we put a port of 35 square inches in this cabinet, far different results would be obtained, as shown in Fig. 9. It will be seen that the frequency response for the three cubic foot cabinet is now far in excess of what it was without the port. Now there is a world of difference between the original reference enclosure of the Helmholtz resonator type and the three-cubic-foot bass reflex enclosure. It should be reiterated at this point that we are not trying to justify the use of a large cabinet. We are attempting to analyze, study, and digest the characteristics of cabinets. The fact that one shows more output than the other simply means that where there is space available, that space may be used to advantage.

Of final interest from point of view of response is the next set of curves shown in Figs. 10, 11, and 12 in which are compared the Helmholtz resonator and the corner enclosures of 3D, 3E, and 3F respectively. The great improvement in the low frequency response is readily evident. An examination of all these frequency response comparisons, as a function of enclosure volume, leads to the general conclusion that with judicious use of larger volumes, optimum results may be expected from a given speaker. As much as four times the power output is available at the lower frequencies for a given speaker, for a fixed input when checked in an enclosure such as in Fig. 3F, as against the original enclosure with which we started. (The difference of six db on the output curve represents four times in output power.) Now certainly four times the output power is a considerable gain if we can obtain it. Simply because an enclosure is small is no reason for its use when and if a larger enclosure is possible.

Frequency response is not the sole criterion of an acoustic system. The cleanliness of the reproduction is equally important. Now here is a very involved problem. It is not as easy to dispose of this problem as it was of frequency response. How should distortion be measured? There is a school of thought that says we should be interested in the degree of distortion from the systems when these systems are *fed with equal inputs*. Then there is the school of thought that says we are interested in the distortion we get out of the two systems when the systems are *developing equal outputs*. The former method disre-

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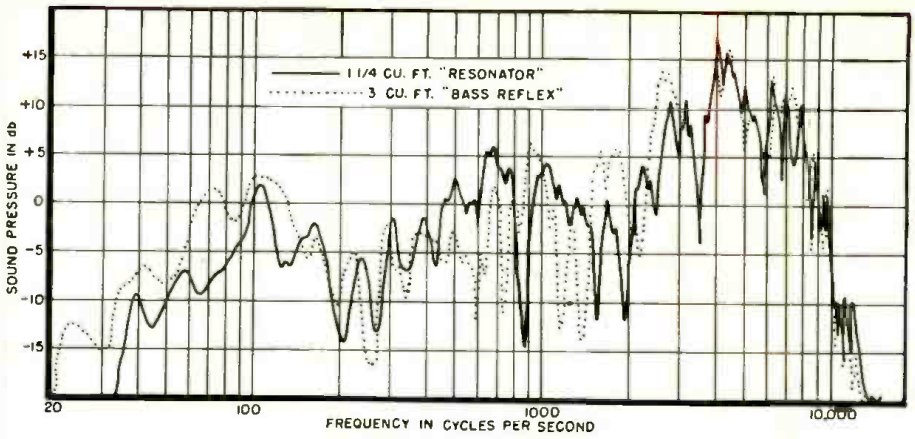


Fig. 9. Relative response of a 1¼ cu. ft. resonator and a 3 cu. ft. bass reflex.

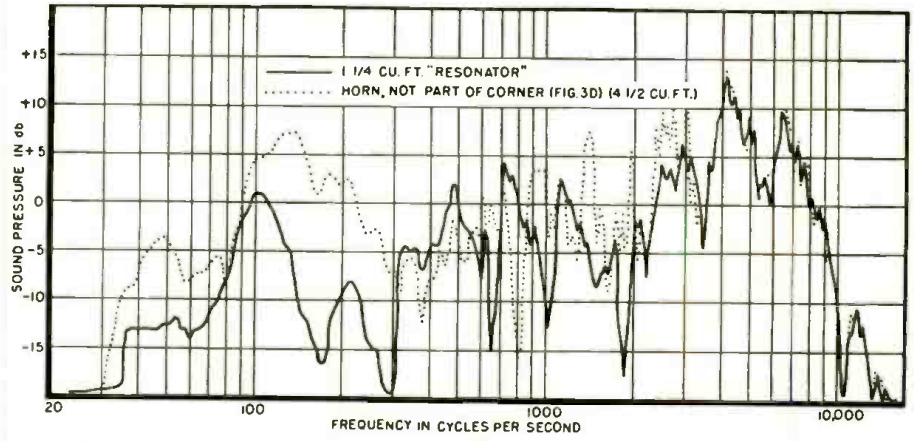


Fig. 10. Relative response of a 1¼ cu. ft. resonator and a 4½ cu. ft. horn which is not part of the corner. See the test set-up shown in (D) of Fig. 3.

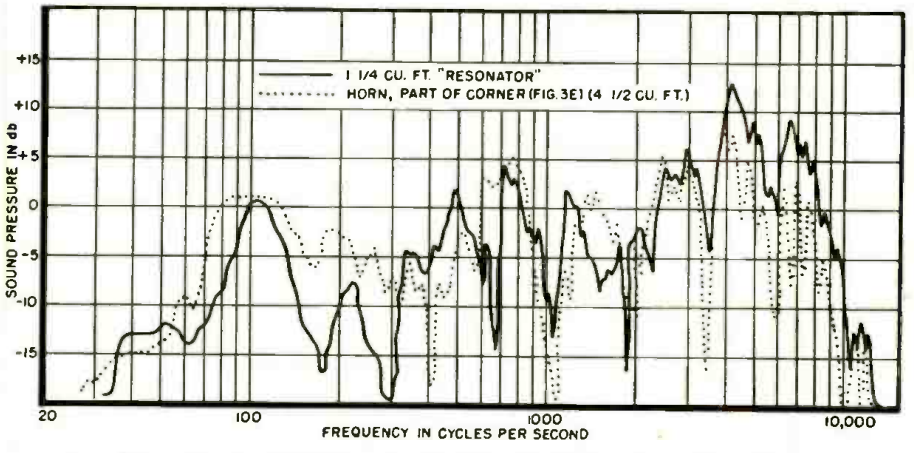


Fig. 11. Relative response of the 1¼ cu. ft. resonator and a 4½ cu. ft. horn which is a part of the corner of the test room. Refer to Fig. 3E for details.

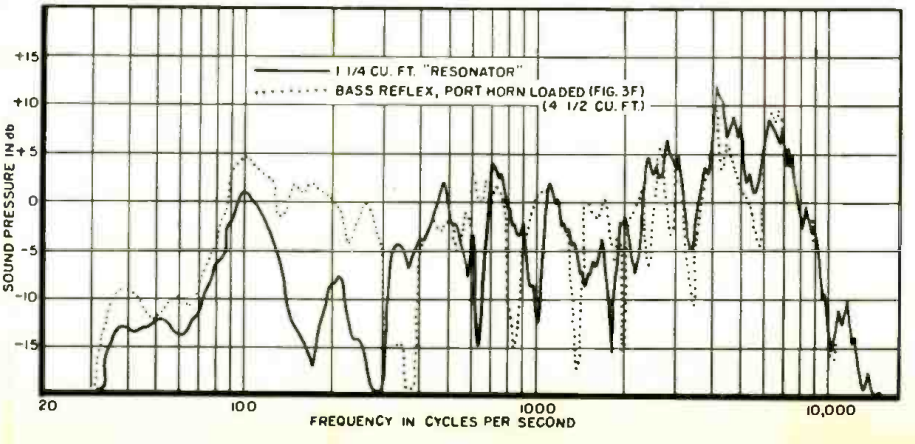


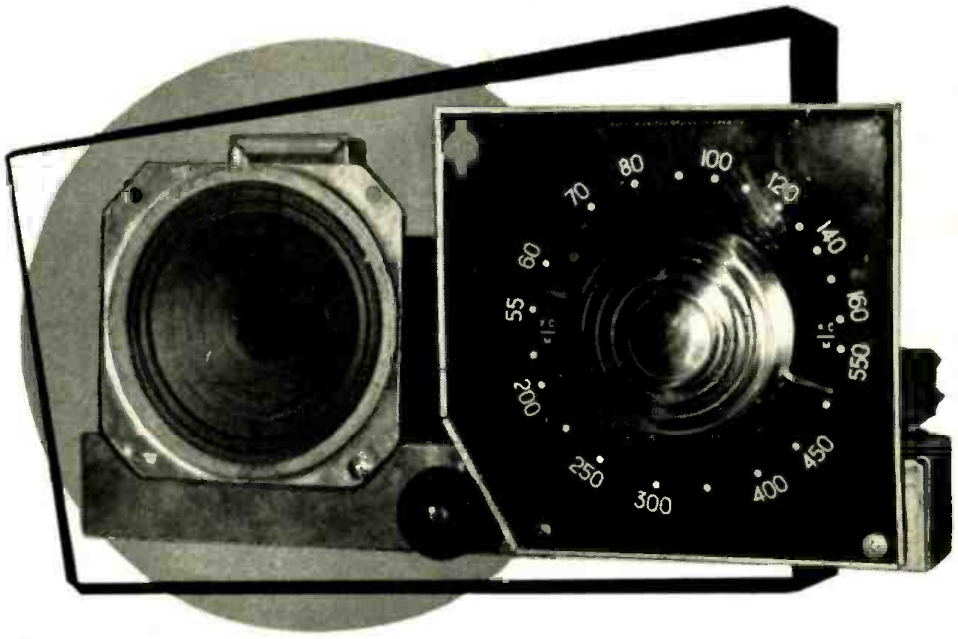
Fig. 12. Relative response of the 1¼ cu. ft. resonator and a 4½ cu. ft. bass reflex with the port horn loaded as illustrated in the diagram of Fig. 3F.

AN ADVANCED REGENERATIVE CIRCUIT

By

IRVING GOTTLIEB, W6HDM

A cathode follower in a novel application overcomes the old defects of a popular circuit.



The advanced regenerative receiver is built on a broadcast receiver type chassis.

MANY an amateur or short-wave enthusiast has cut his eyeteeth on the regenerative receiver, thereafter maturing along a course of technical evolution marked by the construction of more complex superheterodynes.

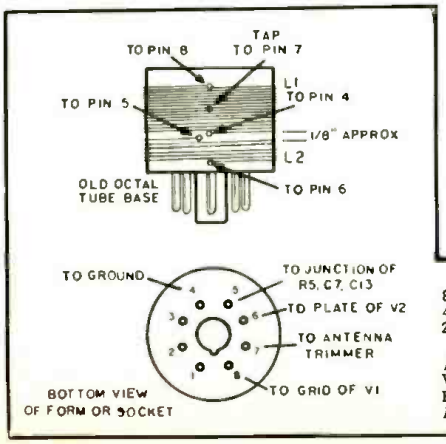
Very little progress has been made since the early days of radio in improving the performance of the regenerative detector. This is surprising considering that the gain afforded by this circuit is sufficient to render audible the thermal noise of the input circuit components. Certainly, any attempt to eliminate the shortcomings which have thus far attended reception with the regenerative detector is a worthwhile effort. It is the intent of this article to describe a modified version of the regenerative receiver which provides a measure of performance not hitherto obtainable with the ordinary regenerative circuit.

One of the drawbacks of the conventional regenerative detector is that much of the inherent sensitivity of this demodulation technique cannot be utilized for phone reception. If the regeneration control is advanced too far, the oscillatory state of the detector will fluctuate with the modulation envelope, thereby destroying the intelligibility of the signal. Closely associated with this defect is the fact that selectivity is poor for phone signals. These, and other undesirable features, such as critical regeneration control and detuning effect of regeneration adjustment can be attributed primarily to one cause. This will be brought out in the ensuing discussion on the operating characteristics of the conventional regenerative detector.

The regenerative detector is, in essence, a reflex circuit, *i.e.*, the tube performs more than one function at a time. Actual demodulation, or "detection," takes place in the grid-cathode circuit. The grid is impressed with both audio and radio frequencies and these are amplified in the plate circuit. The radio frequency component of the signal is fed back to the input of the tube, therein reenforcing the original signal. The audio frequency component is passed on to subsequent audio amplifiers. Now, the demodulation process in the grid circuit involves the flow of current on alternate positive cycles of the radio frequency carrier which exists across the resonant circuit. In other words, the grid-cathode circuit acts as a diode rectifier and constitutes a load to the *LC* tuned circuit. This, of course, degrades the "*Q*" of the tuned circuit and, as a consequence, the amplitude of the signal energy existing across its terminals diminishes. As a corollary to this statement, it is also true that the selectivity of the tuned circuit is decreased by the grid-cathode loading effect. Not only is this effect inherent in such a diode circuit, but the actual amount of resonant-circuit loading will be determined by the strength of the signal.

The strength of a phone signal is continuously varying by virtue of modulation. Therefore, the "*Q*" of the tuned circuit changes at an audio frequency rate. We have now touched upon the basic weakness of the ordinary regenerative detector circuit. The loading of the resonant circuit by a diode detector is bad enough but it is particularly objectionable in the regenerative detector.

Let us examine the reason: the magnitude of the feedback e.m.f. induced in the grid-cathode resonant circuit is, among other things, determined by its "*Q*". However, as we have seen, the "*Q*" of the resonant circuit varies with the amount of loading imposed by the grid. In turn, the grid loading effect increases with the strength of the impressed signal. As a consequence of these relationships, the feedback is not just a constant determined by the setting of the regeneration control. Instead, it varies with the modulation of the signal because modulation constitutes a continuous change in instantaneous signal strength. This causes the detector to become unstable with less regeneration than would be the case if the "*Q*" of the resonant circuit were independent of signal level and grid loading effect. We could, under such circumstances, expect non-critical approach to the threshold of oscil-



Mechanical details and winding data on coils L_1 and L_2 for the regenerator.

	L_1	L_2	Ant. Tap
80 m.	26 t.	7 t.	C.T.
40 m.	14 t.	5 t.	C.T.
20 m.	8 t.	3 t.	3rd t. from gnd. end

All coils closewound on octal base forms. Windings are of 5/40 Litz wire or #26 en. or Formvar. Approx. spacing of L_1 and L_2, 1/8". Adjust for optimum performance.

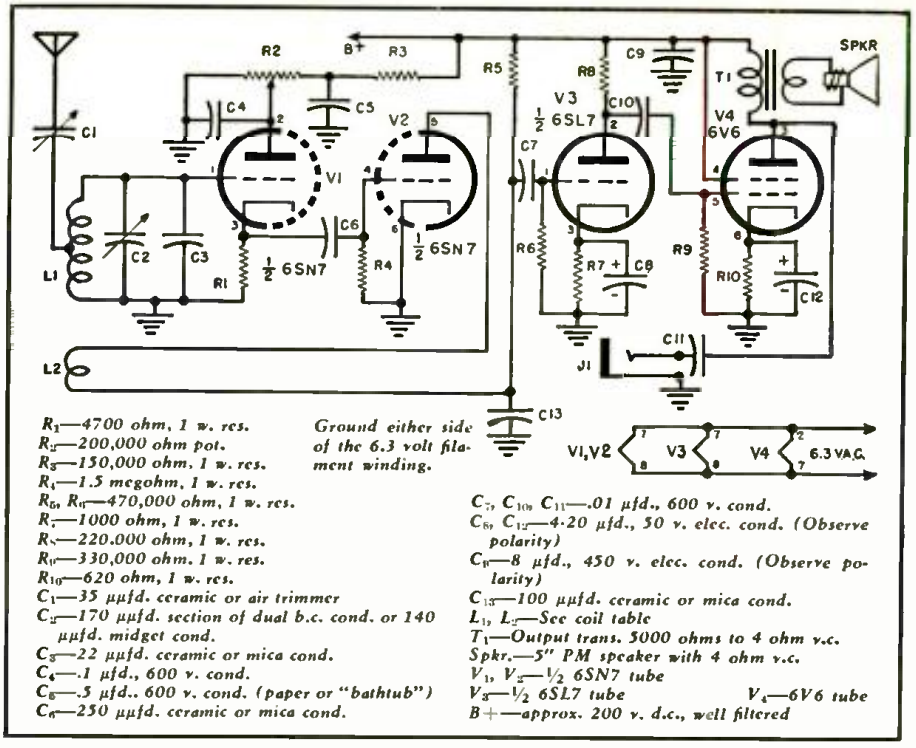
lation by the regeneration control. The receiver would operate with more positive feedback and, paradoxically in terms of the ordinary regenerative detector, with greater stability. Selectivity would also be better, inasmuch as positive feedback supplies the dissipative losses of a resonant circuit, thereby increasing the effective "*Q*".

Another improvement which could be anticipated from the foregoing discussion, if we could successfully isolate the resonant circuit from the grid loading effect, involves the elimination of the detuning influence of the regeneration control. This is so by virtue of the fact that the resonant frequency of an *LC* circuit is affected by resistance as well as inductance and capacitance, although to a lesser degree. Since the loading imposed by the flow of grid current is equivalent to that of a resistance which varies with signal strength, the conventional regenerative detector is bound to suffer in some degree from this undesirable feature.

The Solution

Now that the somewhat obscure and elusive shortcomings of the regenerative detector have been in large measure attributed to tuned circuit loading, the solution to the problem obviously entails the isolation of the resonant circuit from the current demands of the grid. This was accomplished by the author by the insertion of a cathode follower between the resonant circuit and the detector grid-cathode circuit. The feedback coil was then coupled to the input of the cathode follower rather than to the detector itself. The manner in which this is done is depicted in the schematic diagram. Control of regeneration is obtained by varying the plate voltage of the cathode follower. The smoothness of this control would, in itself, justify the circuit.

Since the resonant circuit is not loaded, it is well to wind the coils to display a high "*Q*". This results in the receiver showing good selectivity for strong phone signals when little regeneration is used. Therefore, it is advisable to use Litz wire in the construction of the coils. Any expedient which decreases the losses of the resonant circuit will pay much better dividends in this circuit than in conventional regenerative receivers.



R_1—4700 ohm, 1 w. res.
R_2—200,000 ohm pot.
R_3—150,000 ohm, 1 w. res.
R_4—1.5 megohm, 1 w. res.
R_5, R_6—470,000 ohm, 1 w. res.
R_7—1000 ohm, 1 w. res.
R_8—220,000 ohm, 1 w. res.
R_9—330,000 ohm, 1 w. res.
R_{10}—620 ohm, 1 w. res.
C_1—35 μμfd. ceramic or air trimmer
C_2—170 μμfd. section of dual b.c. cond. or 140 μμfd. midget cond.
C_3—22 μμfd. ceramic or mica cond.
C_4—.1 μfd., 600 v. cond.
C_5—.5 μfd., 600 v. cond. (paper or "bathtub")
C_6—250 μμfd. ceramic or mica cond.

Ground either side of the 6.3 volt filament winding.

C_7, C_{10}, C_{11}—.01 μfd., 600 v. cond.
C_9, C_{12}—4-20 μfd., 50 v. elec. cond. (Observe polarity)
C_8—8 μfd., 450 v. elec. cond. (Observe polarity)
C_{13}—100 μμfd. ceramic or mica cond.
L_1, L_2—See coil table
T_1—Output trans. 5000 ohms to 4 ohm v.c.
Spkr.—5" PM speaker with 4 ohm v.c.
V_1, V_2—½ 6SN7 tube
V_3—½ 6SL7 tube
V_4—6V6 tube
B+—approx. 200 v. d.c., well filtered

Circuit diagram and parts list of the cathode-follower regenerative receiver.

The constructor should experiment with the spacing of the feedback coils in order to achieve optimum results. This adjustment is much easier than in the ordinary regenerative set. Superregeneration and fringe howl can result only from a gross departure from the specified parameters. Tighter antenna coupling and, likewise, closer coupling between the feedback coil and the resonant circuit are permissible in this system. In the conventional regenerative detector circuit, there is coupling from grid to plate as well as in the reverse direction. This only serves to make the threshold adjustment of the regeneration control more critical. In our modified receiver, the cathode follower stage makes the feedback path unidirectional, *i.e.*, energy can be returned from output to input of the detector tube, but not in the reverse direction.

The builder will find that the combination of feedback coil spacing and antenna coupling which allows the threshold of regeneration to occur approximately between the first 20 and 60 degrees of rotation of R_2 will provide good results.

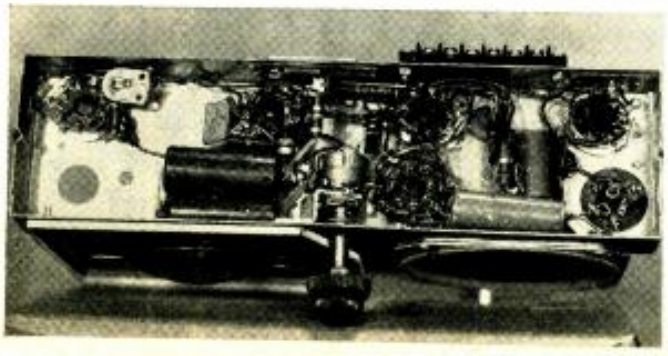
The fixed condenser, C_3, is included in order to make the "*Q*" of the resonant circuit more uniform over the tuning range. This helps to reduce the effect of tuning on the setting of the regeneration control. This effect is negligible over a frequency spectrum as wide as that used by the amateur bands. As a result, once the regeneration control is set, the set has the "feel" of a superhet when it is tuned.

Although many signals will be heard with a short piece of wire strung up around the room, it is highly desirable that a reasonably good outdoor antenna be used. This receiver definitely overcomes several of the shortcomings of the ordinary regenerative set. In common with small receivers however, the antenna system plays a major role in governing the quality of performance.

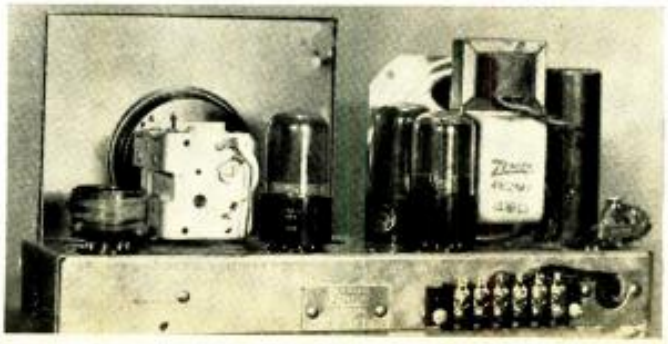
The receiver was constructed around a broadcast radio chassis. The 170 μμfd. section of the original dual variable condenser was used for tun-

(*Continued on page 98*)

Under-chassis view. Good use is made of the sockets and holes of the original broadcast receiver. Wiring is rather simple.



Rear view. The tuning condenser, dial, and speaker are from the old broadcast set, but new parts and chassis may be used.



A TRANSISTOR SINE-WAVE CLIPPER

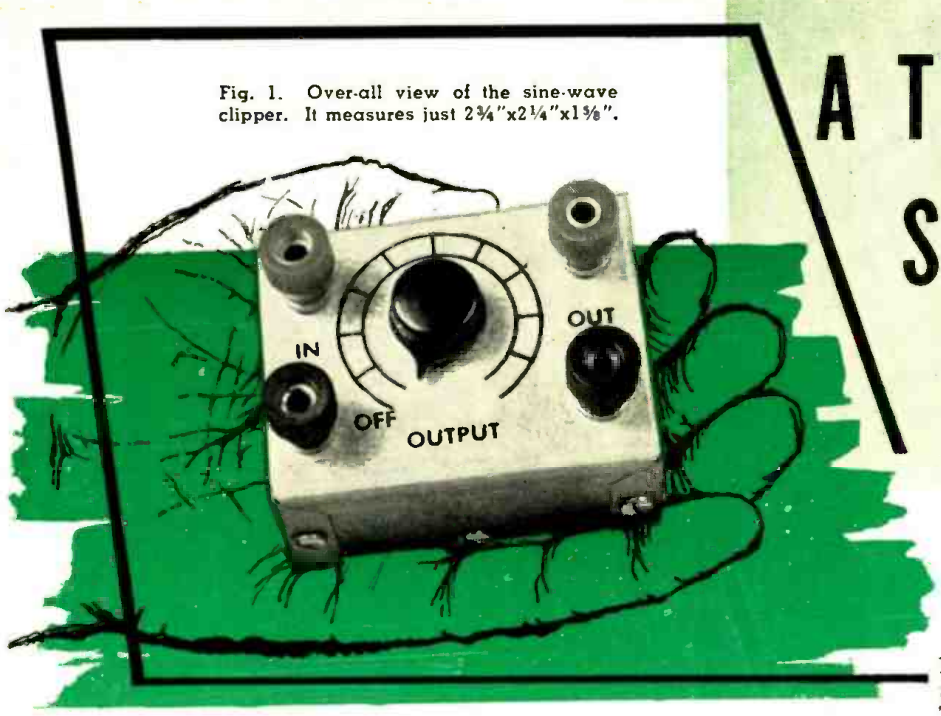


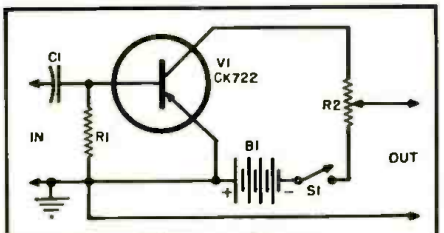
Fig. 1. Over-all view of the sine-wave clipper. It measures just 2¾"x2¼"x1⅝".

By
LOUIS E. GARNER, JR.

This useful test accessory can be used alone or built into an existing audio oscillator. It is compact and reliable.

THE instrument shown in Fig. 1, although small enough to be held comfortably in the palm of the hand, is, nonetheless, capable of producing good quality rectangular waves when driven by a sine-wave signal of moderate amplitude. A further feature of the instrument is that the level of the output signal can be easily controlled, *from zero to an amplitude several times greater than the input signal.* The instrument is completely self-contained! No external power source or batteries are required for its operation.

These features have been made possible in the compact instrument shown by utilizing the new *Raytheon* CK722 junction (*"p-n-p"*) transistor in a clipper circuit requiring a minimum of additional components. This is apparent from the interior view, Fig. 5, and from the schematic diagram, Fig. 2.



R_1—18,000 ohm, ½ w. carbon res.
R_2—10,000 ohm carbon pot, linear taper
C_1—.5 μfd., 200 v. metallized paper cond.
S_1—S.p.s.t. switch (on R_2)
B_1—15 volt hearing-aid battery (Burgess U10)
CK722—Raytheon "p-n-p" junction transistor

Fig. 2. Complete schematic of the sine-wave clipper. CK722 "p-n-p" transistors are used.

Circuit Description

Referring to the schematic diagram of Fig. 2, the CK722 transistor has been connected in a conventional grounded emitter amplifier circuit, *but without "bias" voltage between the base and emitter.* C_1 serves as the input d.c. blocking condenser, R_1 as the input resistor, R_2 as the load resistor, and battery B_1 as the power source.

When a transistor amplifier is operated without "bias," and a sine wave is applied to its input, the output consists of a series of fairly narrow rounded pulses. This effect has been noted previously (see "The Transistor in Simple Circuits" by W. H. Minor. December, 1952. *Radio-Electronic Engineering* Edition of RADIO & TELEVISION NEWS). The appearance of the output signal when a 10 kc. sine-wave signal of low amplitude is applied to the input of the circuit is shown in Fig. 4D.

As the amplitude of the input signal is increased, the top of the pulse is clipped, and a rectangular waveform is obtained, as shown in Figs. 4A, B, and C. The frequency of the sine-wave signals used to obtain these patterns are, respectively, 45 cps, 5 kc., and 25 kc.

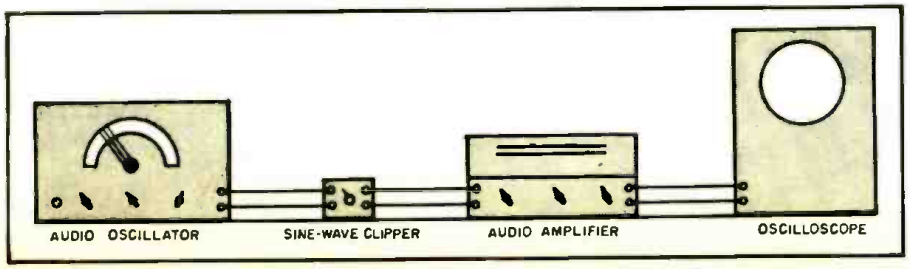
Peak clipping occurs because the peak collector current reaches the maximum possible with the load resistor and voltage source used and, therefore, no further increase in current flow is possible. This was demonstrated in the circuit shown by measuring the peak-to-peak signal across load resistor R_2. The measured value was approximately 15 volts, or equal to the supply voltage.

With the circuit shown, clipping occurs when the input signal is between three and five volts. A good output waveform is obtained over the entire audio range from 30 cps to 30 kc. as long as the input signal level is maintained. In addition, the output waveform remains of constant amplitude regardless of minor variations in input as long as sufficient signal is supplied to maintain the clipping action.

The output waveform is also relatively unaffected by the setting of the output control, R_2, except as far as amplitude is concerned, due to the low value of this potentiometer. An output "blocking condenser" has not been included in the model.

In order to prevent even a minute current flow when the unit is not in use, a switch has been provided in the collector circuit (S_1) and is mounted on control R_2. When in use, the current drain averages only a fraction of a milliampere (the *peak* is about 1.5 ma. drain) and, therefore, the battery life

Fig. 3. Basic instrument set-up for making gain measurements with test unit.



should approach the normal "shelf life."

Construction Hints

The entire circuit is easily assembled in the smallest of the *Bud* "Miniboxes" (CU-3000, 2¾"x2¼"x1⅝") if reasonable care is taken and the components specified in the parts list are used. The use of a *metallized* tubular paper condenser in the input is particularly important as it is virtually impossible to fit a conventional paper condenser of large capacity (.5 μfd.) into a box of this size and still have room for the remaining components.

Leads should be kept reasonably short and direct to avoid stray capacities to ground with resulting deterioration of the output waveform. This should not prove too difficult as short leads are almost naturally used in a circuit wired as compactly as is shown in the photographs (Figs. 1 and 5).

The arrangement of parts used by the author is apparent from the illustrations, but the reader need not follow this layout exactly. As long as excessively long leads are avoided, the layout is non-critical.

For best results, it is essential that a *carbon* potentiometer be used for R_2, although a linear taper is not absolutely necessary. If a wirewound pot is used, however, deterioration of the signal waveform at high frequencies (due to residual inductance) is likely.

In the model shown, connections to the battery have been made by soldering leads directly to the battery terminals and wrapping with *Scotch* electrical tape to prevent accidental shorts. The battery is held in place by a simple bracket found in a commercial "hardware assortment."

The "panel" of the instrument has been labeled by using standard black decals and then spraying with clear plastic to provide additional protection.

The transistor has been wired directly into the circuit by its tinned leads. Although there are special sockets available for the CK722, the author feels that their use would only be justified in equipment designed for continuous 24-hour-per-day operation, due to the inherent long life of transistors.

Circuit Modification

The 15 volt hearing aid battery, B_1, may be replaced by batteries of lower voltage without affecting signal waveform or the action of the circuit—the only difference will be in the amplitude of the output signal. The lower the supply voltage, the lower the maximum output signal. Voltages as low as 3 volts have been tried experimentally without deterioration of output waveform quality.

If a fixed output signal level is preferred to an adjustable output, R_2 may be a fixed carbon resistor, the ½ watt size is satisfactory for use here.

An output d.c. blocking condenser, similar to C_1, but connected between the circuit output and the output terminal or binding post, may be used if desired, and will make it unnecessary to check for a blocking condenser in the circuit to which the clipper is connected for test purposes (or to use an external blocking condenser).

The switch on the output control may be replaced by any suitable s.p.s.t. switch—a toggle, lever, rotary, or slide switch may be used.

If both input and output blocking condensers are used, and a battery of larger size than the one given in the parts list used, it may be necessary to assemble the unit in a larger container. The next largest size *Bud* "Minibox" should be suitable unless regular paper condensers and an extremely large battery are employed.

Where preferred, the circuit may be assembled as part of an existing audio oscillator rather than as a separate accessory. If this alternative is adopted, a switch should be provided so that a choice of either "Sine" or "Rectangular" waves may be made by the operator, or separate output terminals should be provided so that both sine and rectangular waves are available on the front panel simultaneously.

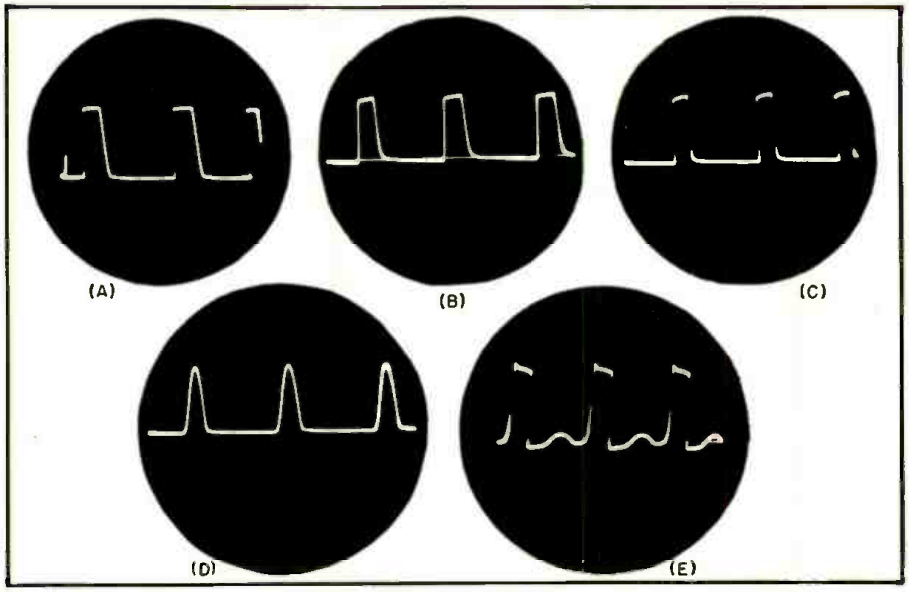


Fig. 4. Waveforms from clipper. (A) 45 cps. (B) 5 kc. (C) 25 kc. (D) Output when 10 kc. sine-wave signal of low amplitude is applied. (E) Overdriven unit.

Fig. 5. Internal view of clipper. All hook-up leads should be kept as short as possible.

Operation: Once the wiring is completed, the builder should become familiar with the basic operation of the clipper before attempting to use it in practical test and experimental work. The best way to do this is to connect the output terminals of the clipper to the "Vertical Input" terminals of an oscilloscope. An audio sine-

(*Continued on page* 163)

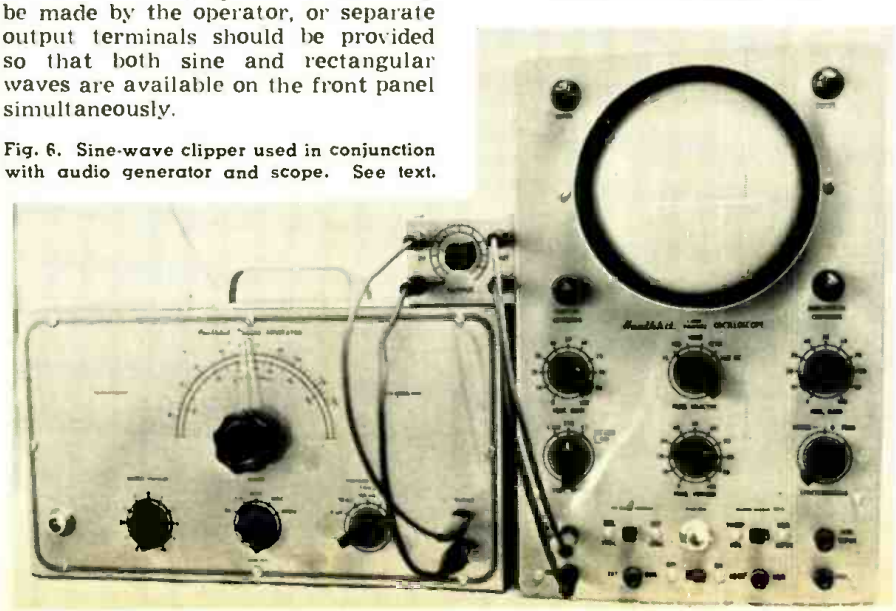
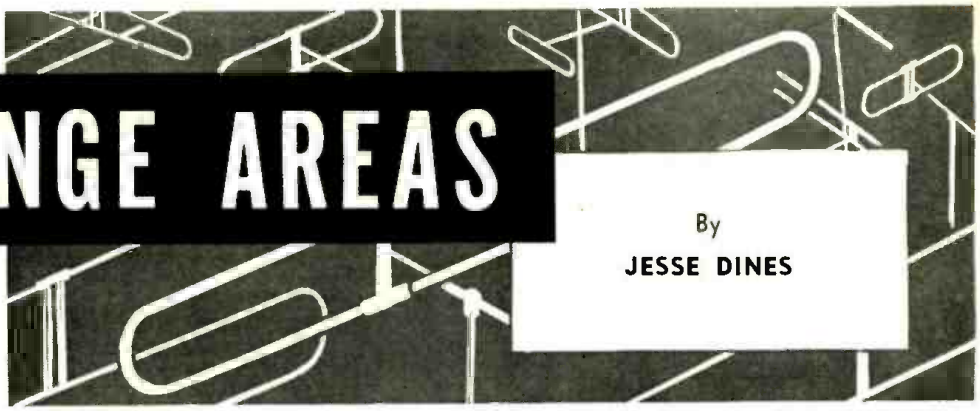


Fig. 6. Sine-wave clipper used in conjunction with audio generator and scope. See text.

FOR FRINGE AREAS



By
JESSE DINES

Special circuits used in a popular fringe area receiver may be duplicated for better picture and sync stability.

THE art of television design has reached the stage where any standard receiver on the market today can be expected to do a creditable job under normal conditions. New competitive designs must make their appeal to the public by offering something extra. With the national growth of television consciousness this medium has ceased to be a strange metropolitan phenomenon. The frontiers are rolling back beyond the fringe. This is the direction in which new design is moving.

Many manufacturers found that the highly regarded *RCA*-designed 630 circuit was an excellent starting point for a super-powered fringe area receiver. To this circuit they have added many improvements based upon the advances in receiver circuitry since the 630 was introduced. To understand what improvements were required, it would be advisable first to consider to what troubles fringe area receivers are subject.

The fringe area generally produces four major receiver complaints:

1. Weak picture, characterized by inability to obtain good contrast and the presence of snow.
2. Weak or garbled sound.
3. Poor sync control resulting in tearing and/or rolling.
4. Excessive susceptibility to interference caused by poor rejection and a relatively low signal-to-noise ratio.

The remainder of this article will discuss some circuits that may be used to reduce these complaints and provide good reception. These circuits have been used successfully by the *Airex Radio Corporation* in their fringe-area TV receiver model 630FA.

Front End: The most important thing to do to improve a fringe area receiver is to increase its signal-to-noise ratio; or, in other words, to provide the receiver with more *usable* gain. In this way, clearer picture and sound, as well as increased sync stability due to the relatively larger sync voltages result. To increase the gain the 630FA and most fringe area receivers use the latest type cascode tuner with a 6BK7 as the r.f. amplifier and a 6J6 as the oscillator-mixer. The 6BK7 is a miniature twin triode with an internal shield giving the high gain of a pentode and the low noise of a triode. There is a marked improvement in signal-to-noise ratio. There is also less local oscillator radiation and, consequently, less interference to other sets.

Sync Amplifiers: As mentioned previously, receiver susceptibility to interference increases in a fringe area. Because of this, spurious signals, such as bursts of noise, tend to upset the sync system by triggering the vertical and horizontal oscillators. The result is picture tearing and/or rolling. To combat this, the 630FA uses a circuit consisting of two 6J5 sync clippers in parallel, as shown in Fig. 1A. The sync take-off point at the plate of the 1st video amplifier simultaneously feeds both clipper grids by means of direct coupling. The high-frequency sync clipper incorporates a cathode network (R_1-C_1) with a relatively short time constant; the low-frequency sync clipper employs a cathode network (R_2-C_2) with a relatively long time constant. The grids are normally from 6 to 8 volts negative with respect to the cathodes. The circuit operates in the following manner:

Suppose high-frequency transients, such as bursts of noise, attempt to enter the sync amplifier circuit. The relatively short time constant of the high-frequency clipper causes them to be grounded through C_1. This effectively puts the cathode at ground potential and degeneration is removed from the high-frequency clipper. This, in turn, causes the stage to amplify to a much greater extent (since the grid is directly coupled its voltage will be highly positive), an increased clipping action results, and the high-frequency transients are prevented from entering the 2nd sync amplifier stage. By the same token, low-frequency transients are prevented from entering the sync system by removing degeneration from the low-frequency clipper.

Vertical Circuit: When the brightness control is advanced in fringe area receivers, or when the picture tube has aged, the blanking effect of the relatively weak sync pulses is overcome, and annoying white streaks appear in the picture. The reason is that most receivers use a simple arrangement to extinguish the electron beam of the picture tube during vertical retrace time; more specifically, the sync pulses, fed to the picture tube along with the rest of the video signal, are used for this purpose. The circuit employed in the 630FA for improved blanking is shown in Fig. 1B. Here the peaked portion of the greatly amplified vertical-output pulse is used as the principal blanking pulse. It goes from the secondary of the vertical output transformer, through R_2 and C_1, to the picture tube cathode. The *RC* combination reshapes the pulse for optimum use. Note the change in waveforms before and after the *RC* network.

Horizontal Sync Circuit: When a set ages, there is an increasing tendency for horizontal jitter or tearing to mar the top of the picture. The usual cause is an increasing susceptibility to change in cathode voltage on the horizontal sync discriminator due to transients. This effect is even more noticeable when the set is in a fringe area. To minimize the effect of a reduction in the 2-volt bias, a 1N34 germanium crystal is used as a negative clamper diode as shown in Fig. 1C. With its associated network, R_1-C_1, it provides excellent regulation of the desired negative voltage by eliminating transients quickly while maintaining a fixed voltage across the discriminator load resistors.

Video I.F. Strip: In fringe areas, it is always necessary to get as much audio and video gain as possible. Four 6CB6's are used for the i.f. amplifiers which give greater amplification. The cumulative effect over the entire strip is a substantial increase in gain. As in the standard 630, the split-sound design is used, but greater audio gain is obtained by advancing the audio i.f. take-off point an extra stage. Instead of coming directly from the tuner, the sound i.f. is taken from a sound trap at the output of the 1st video i.f.

The intermediate-frequency band on which the set operates has also been shifted somewhat from that used in the old 630. The new band of i.f. operation places the sound carrier at 21.9 mc. instead of 21.25 mc. Keeping in mind the susceptibility of fringe-area receivers to interference, this minimizes self-generated interference

on the picture or sound of certain channels. It also lifts the receiver out of danger as far as the new 15-meter amateur band is concerned.

Contrast Control: In many receivers the contrast control is a bias-level adjustment applied to the video i.f. stages. Its manipulation, of course, varies the amplitude of the entire composite video signal, including the sync pulse portion. Since sync circuit take-off is accomplished later on in the video amplifier, sync sensitivity is directly affected by contrast adjustments. Switching from one channel to another or reduction of contrast often tends to unsync the receiver. This becomes increasingly annoying in fringe areas where the sync level is very low. The contrast control in the 630FA appears as a single-stage adjustment in the cathode of the 2nd video amplifier (see Fig. 2). Sync pulse amplitude at the take-off point, the 1st video amplifier, is unaffected.

Width Control: A frequently recurring and constantly irritating servicing problem is that of obtaining adequate control over width. A weak driving signal to the horizontal output stage grid in fringe areas, as well as accumulated differences in the values of components, within tolerance on an individual basis, will often affect circuit operation to a great extent. The width control frequently lacks sufficient range to make up for these differences, even in new sets. The problem becomes particularly painful as sets age. As shown in Fig. 3A, the width coil, normally a winding of relatively high impedance shunted across a portion of the high-voltage transformer secondary, is a low-impedance winding placed directly in series with the horizontal winding of the deflection yoke. In this manner, its ability to affect sweep voltage fed to the yoke is greatly increased. In fact, the variation in width thus obtained is one-third the total horizontal sweep. The 600-ohm resistor shunted across half the width coil serves to damp out any ringing that may develop.

Audio Circuit: Increased audio gain is obtained through the use of a 12AX7 dual triode as the 1st audio amplifier and phase inverter. The push-pull output stage uses a pair of 6AQ5's. Maximum output is thus increased from the usual 3 watts to about 8. Push-pull operation also furnishes reduced distortion.

A.G.C. Circuit: Automatic gain control presents a major problem in fringe areas. Most of the time manufacturers will recommend removing a.g.c. altogether in these areas. This is done to keep the input signal level as high as possible where picture or sound fading is sacrificed for gain.

This receiver uses an a.g.c. circuit which is adaptable for both strong and weak signal areas as shown in Fig. 3B. The circuit features the usual a.g.c. secondary winding on the flyback transformer, which connects the output of the a.g.c. keying tube (6AU6) to the a.g.c. line. As ordinarily driven, this tube tends to develop heater-to-cathode shorting, resulting in loss of picture. This occurs when potentials in excess of 100 volts are applied to the cathode. In the circuit of Fig. 3B a 45-volt drop across R_1 keeps the cathode voltage down to 90 volts, reducing the possibility of failure in this stage.

Also, an externally adjustable threshold control, R_2, is inserted between the a.g.c. line and ground. The proper amount of a.g.c. action may thus be chosen for any particular installation. For fringe-area operation, a.g.c. action may be completely eliminated by rotation to one extreme of the control; at the other extreme, full operation may be obtained to prevent signal overload in strong-signal areas. The advantage for areas where signal strength varies greatly is obvious: the threshold control may be reset from channel to channel.

For prolonged, trouble-free operation, all parts used in the fringe area receiver should be of superior quality, high rating, and close tolerance. Molded plastic condensers, for example, should be used throughout in preference to paper tubulars. They are less subject to breakdown or to change in value with changes in temperature or humidity.

The integrator network used in this chassis is a printed circuit, installed and replaced as a unit. It has proven to be more compact, easier to service, and less subject to breakdown than separate-component circuits.

An interesting feature of the 630FA is the provision for prolonging tube life. A time-delay relay tube is used in series with the output from the low-voltage rectifier. The tube consists of a heater and two heat-sensitive switch contacts. When the tube is cold the contacts are open. As the heater, which is connected in parallel with the other tube heaters of the chassis, warms up the two contacts, they expand and close, completing the low-voltage power supply circuit. By the time this has happened all tube heaters are warm. This results in efficient, long-life operation of the tubes, including the CRT. —30—

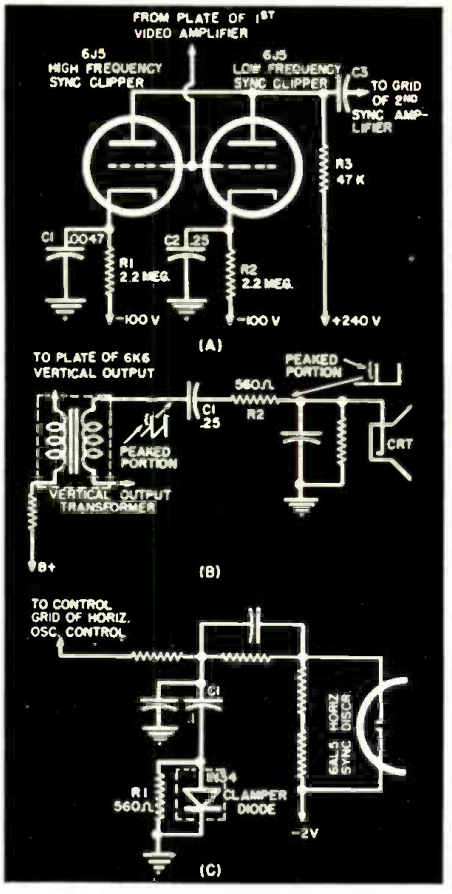


Fig. 1. Circuits used for improving noise immunity, retrace blanking, and automatic frequency control in fringe area receivers.

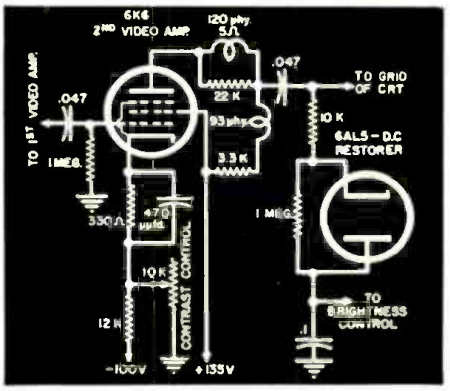
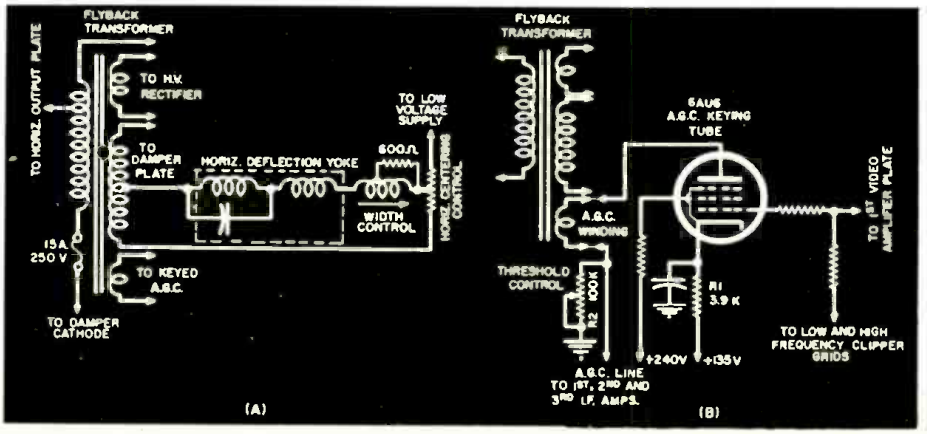


Fig. 2. Contrast control circuit which leaves sync pulse unaffected during adjustment.

Fig. 3. (A) Circuit for increasing the range of the horizontal width control. (B) Keyed a.g.c. circuit with threshold control for weak and strong signals.



NOISE IMMUNITY CIRCUITS

By MILTON S. KIVER
Pres., Television Communications Institute

Part 1. Know your TV receiver noise rejection and sync stability circuits for more efficient, faster servicing.

ONE of the factors which strongly influences the design and servicing of a television receiver is the fact that the eye is a more sensitive organ than the ear. Because of this, a considerable effort is made to protect television receiver circuits from external interference, especially the impulse type of noise. While such pulses may have only a momentary disturbing effect on the picture elements, they can be particularly destructive to the smooth functioning of the receiver's horizontal and vertical sweep systems. A strong pulse can cause the picture to roll (indicating loss of vertical synchronization) or it can break the image up into a series of diagonal slices (indicating loss of horizontal synchronization). Neither effect is desirable and special precautions are taken to avoid them.

One of the simplest circuits used to minimize the effects of noise is shown in Fig. 1. The video signal coming into the first video amplifier (V_{115}) from the preceding video second detector has the sync pulses negative. Any impulse noise voltages that may be present and which could disturb the sweep oscillators would also extend in the same direction. (Noise pulses extending in the opposite direction would not possess the proper polarity to disturb the sweep oscillator.) At the first video amplifier stage, the grid, plate, and screen voltages are so chosen that with a normal signal input level at the grid, the tube is working over most of its operating range. See Fig. 4. Any large noise pulse that may come along would then drive the grid into cut-off, and effectively suppress much of the noise voltage. In effect this serves to improve the signal-to-noise ratio of the receiver.

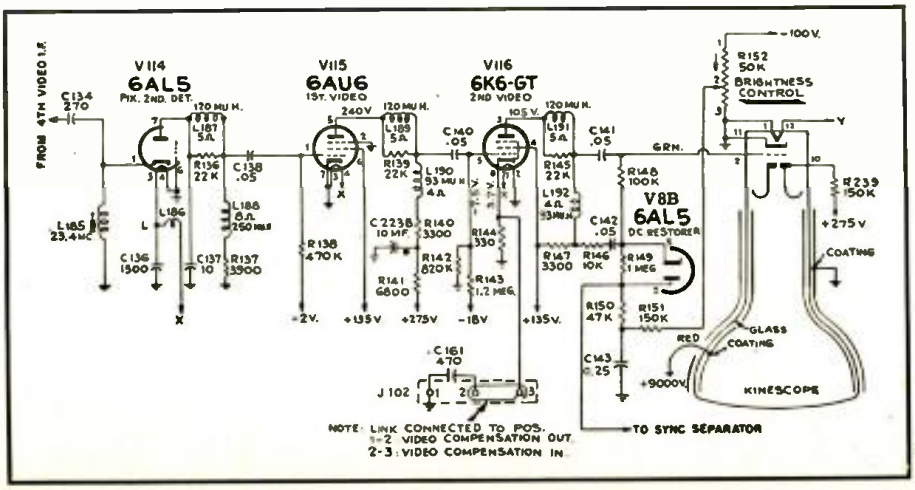
An extension of the foregoing method is employed in the circuit shown in Fig. 2. It was found that the peak-to-peak video signal at the grid of the first video amplifier varied over a 2 to 1 range. This meant that if the sync pulse tips were near tube cut-off on strong signals, they would not be near cut-off on weak signals. Hence, noise pulses received with weak signals would be in a better position to disrupt sweep circuit operation than they would be when strong signals were being received.

To get around this situation, the plate voltage of the first video amplifier is made to vary with signal strength. When a weak signal is received, the plate voltage on this tube drops and hence less voltage is now required to drive the tube into cut-off. On the other hand, when a strong signal is reaching the receiver, the video amplifier plate voltage rises, accommodating the tube to this situation.

The variation in video amplifier plate voltage is accomplished in the following manner (see Fig. 2). The plate leads of the first and third video i.f. amplifiers are returned to "B+" through resistors R_{210} and R_{211}. These same resistors also supply the plate voltage for the first video amplifier. In other words, the plate currents of all three tubes flow through the two resistors. Now, when a weak signal is being received, the a.g.c. bias voltage on the first and third video amplifiers is low, permitting these tubes to draw a larger plate current. This, in turn, means a greater voltage drop across R_{210} and R_{211}. Since the plate of the first video amplifier receives its voltage through these resistors, its voltage will decrease.

By the same line of reasoning, when a strong signal is being received, the a.g.c. bias increases and the video i.f. tubes draw less current. This decreases the voltage drop across R_{210} and R_{211}, enabling the video amplifier to receive more plate voltage. Thus, the plate voltage of the video amplifier is raised and lowered in accordance with variations in signal strength, thereby leading to a better signal-to-noise ratio.

Fig. 1. Simple noise immunity circuit. The first video amplifier (V_{115}) is so biased that noise pulses drive the grid to cut-off minimizing their effect.



6BN6 Noise Immunity Circuit

Noise immunity circuits have been placed in the video amplifier stages (as above) and in the sync separator section. In the latter circuits, one approach has been through the use of special purpose tubes, such as the 6BN6. To fully appreciate the unusualness of this tube, consider its physical structure. This is shown in Fig. 5 and is seen to differ quite markedly from conventional tube design.

Electrons emitted by the cathode are formed into a thin concentrated beam by the action of the focus electrode and the first accelerator slot and projected onto grid #1. Beyond grid #1 a further focusing takes place, this time caused by the curved screen grid and the grounded second accelerator lens slot and aided by the curvature of grid #1. This group of elements projects the refocused beam onto grid #2 and from here is passed on to the plate.

Now, the concentrated beam of electrons approaching grid #1 can be stopped completely if the grid is only slightly negative, possibly no more than −1.5 to −2 volts. When the grid potential rises above the cut-off voltage, current flow starts up and increases rapidly until current saturation takes place at a slightly positive grid voltage. Raising the grid potential above this value does not provide more current. Thus, within the range of a few volts, the tube can be driven from cut-off to saturation.

Grid #2 can also cut-off the beam

current, but only if it is strongly negative. If it is made zero or positive, it will permit electrons to pass without altering their number. In other words it functions as an open gate, while grid #1 determines the extent of the tube current flow.

The structural diagram of the 6BN6 (Fig. 5) is seldom used. Instead, the schematic representation of Fig. 3 is used. Grid #1 of Fig. 5 is shown at pin 2 of Fig. 3. The accelerator is available at pin 5. Grid #2 is shown at pin 6. The plate is pin 7 and the cathode, focus electrode, lens, and shield are all tied together at pin 1. Pins 3 and 4 attach to the heater elements.

One application of the 6BN6 as a sync separator is presented in Fig. 6. The output of a 1N64 video second detector is fed to a 6AB4 amplifier. The sync pulses are negative at the detector output but the 6AB4 amplifies and inverts these before transferring them to the 6BN6 sync separator. The amplification increases the size of the pulses so that they have more than sufficient amplitude to run the 6BN6 from saturation at one end to cut-off on the other.

The signal coming into the 6BN6 from the 6AB4 is coupled to grid #1 of the 6BN6 tube. The grid bias on the tube is initially zero, but when the positive sync pulses arrive, the tube draws a small amount of grid current which, after a number of cycles, charges C_1 to a negative voltage. Between sync pulses, C_1 discharges slightly through R_1, but the positive tip of each arriving pulse produces sufficient grid current flow to recharge C_1 to its previous level. At this positive tip, then, current flows through the 6BN6 and onto the sweep circuits that follow. All other sections of the incoming video signal are more negative than the sync pulses and since only −1.5 volts are required to cut the tube off, it can be seen that the rest of the signal is effectively suppressed. If there are any strong noise pulses present which extend in the same direction as the sync pulses, they are flattened due to tube saturation.

The grid-leak method of biasing the 6BN6 enables it to accommodate itself to weak signals as well as to strong signals. In other words, the sync separator bias is self regulating.

RCA Noise Suicide Circuit

Noise suppression or noise immunity circuits are designed principally to protect the sweep oscillators of the receiver. Of the two, it is the vertical oscillator that requires the greater amount of protection since the horizontal system is, in nearly all instances, protected by an automatic frequency control network. In recognition of this fact, *RCA* employs the following noise inverting (or, as they called it, "noise suicide") circuit. See Fig. 9.

When a strong noise pulse reaches the receiver, it is sufficiently powerful at the grid of the 4th video i.f. amplifier to cause the grid to go positive. The sudden surge of current through the tube causes the screen grid voltage to drop sharply and this decrease, in the form of a negative pulse, is coupled to the grid of the sync separator stage. C_1 and R_1 serve as the coupling circuit between the screen grid of the 4th video i.f. amplifier and the control grids of the sync separators.

The noise pulse is detected along with the normal video signal by the video second detector and then amplified by the video amplifier. The noise pulse now has a positive polarity. It is then applied to the grids of the sync separators, this being the normal path by which sync pulses are transferred into the deflection systems. At the grids of the sync separators, the negative noise pulse obtained from the plate of the 4th video i.f. amplifier and the positive noise pulse (from the video amplifier) cancel each other. As a result, only the normal sync pulses remain to control the sweep oscillators.

It should be noted that normal signals passing through the video i.f. system do not drive the grid of the 4th i.f. amplifier positive and hence do not send any pulses through C_1 and R_1 to the grids of the sync separators. Thus, when the normal sync pulses reach the sync separators, they are not cancelled out.

Minimizing the effect of strong noise impulses is uniquely carried out in the circuit shown in Fig. 7. A triode tube

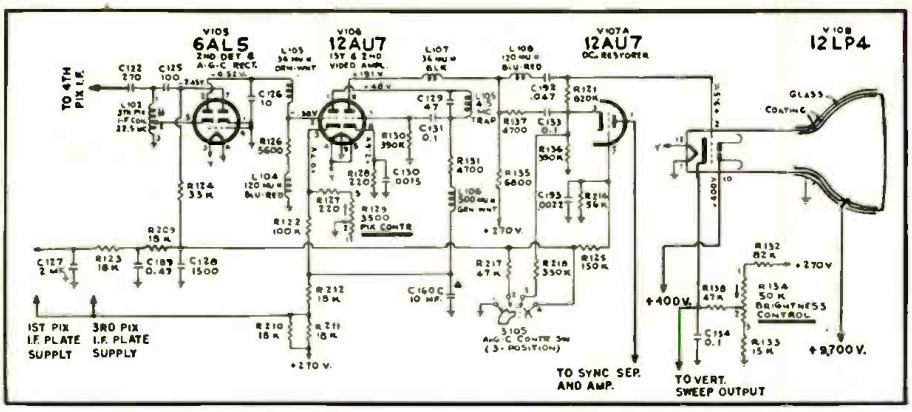


Fig. 2. Improved version of noise suppression circuit shown in Fig. 1.

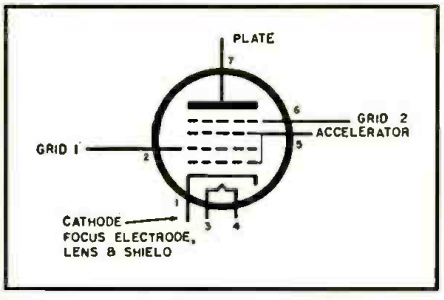


Fig. 3. Schematic symbol of the 6BN6 tube.

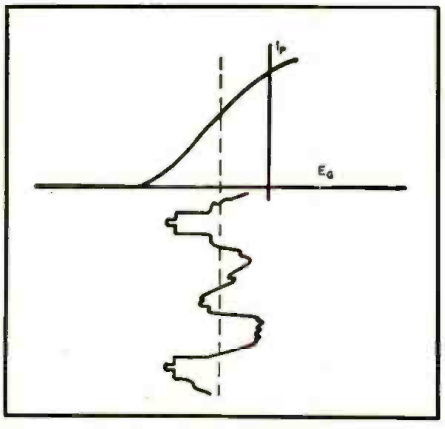


Fig. 4. The first video amplifier of Fig. 1. is operating over most of its range with normal signals; negative noise pulses are cut off.

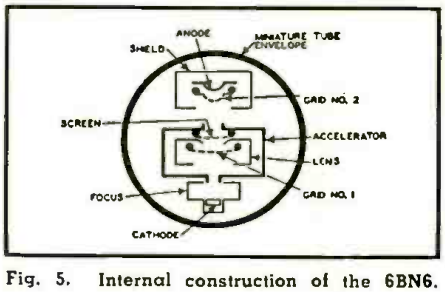
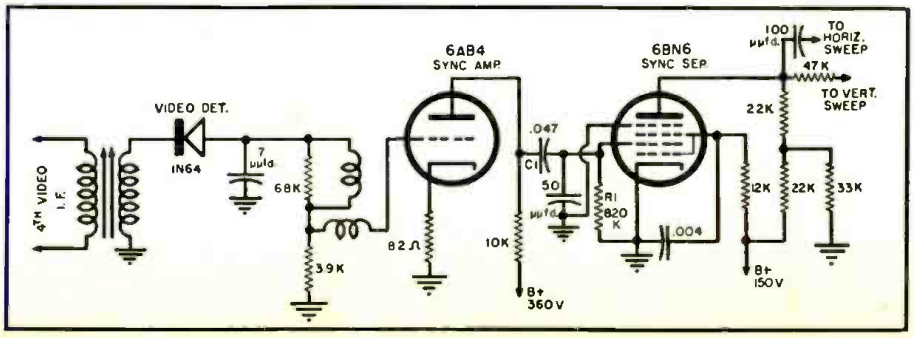


Fig. 5. Internal construction of the 6BN6.

Fig. 6. Application of the beam-gated 6BN6 tube as a sync separator.



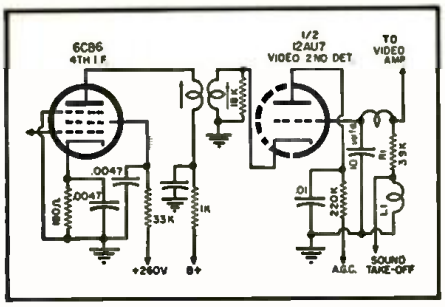


Fig. 7. A noise suppression circuit used by RCA. See text for operational details.

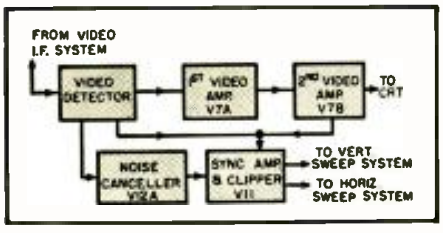


Fig. 8. Block diagram of G-E noise canceller.

is employed in the video second detector stage although, as far as the detection action is concerned, only the cathode and control grid provide the detection. (The control grid serves as a diode plate). Whatever video signal is produced appears across R_1 and L_1 for application to the following video amplifier.

The plate of the triode is tied into the a.g.c. line and is normally negative. Therefore, no current flows through the plate circuit. However, when a strong pulse appears, the cathode is driven more negative than the plate, and current flows rather strongly in the plate circuit. This causes the plate and cathode to appear as a low impedance diode across the output of the final video i.f. amplifier, effectively loading down this circuit and reducing the amplitude of the noise pulse.

Note, then, that the triode functions as essentially two diodes. One diode, formed by the cathode and control grid, is the detector. The other diode, formed by the cathode and plate, is normally nonconductive. However, when a noise pulse causes it to conduct, it acts as a relatively low impedance across the output of the final video i.f. amplifier, loading this circuit down.

G-E Noise Canceller Circuit

A circuit which contains a special noise canceller tube is employed in some *General Electric* television receivers. To better understand the operation of this circuit, it will be best to consider first the block diagram of this set. This is shown in Fig. 8. The box labeled "Noise Canceller" receives its signal from the output of the video second detector. This voltage is amplified, inverted, and then fed to the "Sync Amplifier and Clipper" box. This latter stage also receives a portion of the video signal from the video second detector. (A line is drawn from the final video amplifier to the sync amplifier indicating that some voltage is fed back from this point, too. However, for the purpose of explaining the operation of the noise canceller circuit, this latter feedback may be disregarded.)

A schematic diagram of the noise canceller circuit is shown in Fig. 10A. The grid of the sync amplifier, V_{11A}, is fed the composite signal with the sync pulses pointing in the negative direction. This signal is amplified, inverted, and developed across the plate load resistor, R_{352}. At the same time, the composite video signal is applied to the cathode of the noise canceller tube, V_{12A} through condenser C_{315}. This tube is controlled by two bias controls. An automatic bias is provided by the a.g.c. voltage fed to the grid (not shown in Fig. 10A), and a manual bias is provided by the picture stabilizer potentiometer, R_{311}, connected to the cathode. The noise canceller tube is biased so that it starts to conduct only when noise signals extending above the sync level occur. This tube is shunted across the sync amplifier tube V_{11A} and when it starts to conduct, it virtually short circuits the sync amplifier output, thereby preventing the noise pulse from travelling on to the following clipper tube and the horizontal and vertical sweep systems. If the noise pulse extends over several lines, it may wipe out the associated sync pulses and when the noise pulse itself is removed, there is no sync information left for the sweep system. Generally only a few sync pulses are involved and no loss of synchronization occurs because of the flywheel effect of the sweep oscillators and their tendency to continue operating at the same frequency if left temporarily untriggered.

The a.g.c. voltage does not suffice to bias correctly the noise canceller tube over a wide range of input signals. However, by adding the picture stabilizer potentiometer, bias adjustment over a wide range can be achieved.

Instructions for adjusting this control are as follows:

1. If noise is experienced, turn the control clockwise until the noise disappears. Picture distortion may occur if advanced too far.

2. If two stations of different signal strength are to be received, turn the control until interference is at a minimum when receiving the weak station. Adjust the control to avoid picture distortion on the strong station and minimum interference on the weak station.

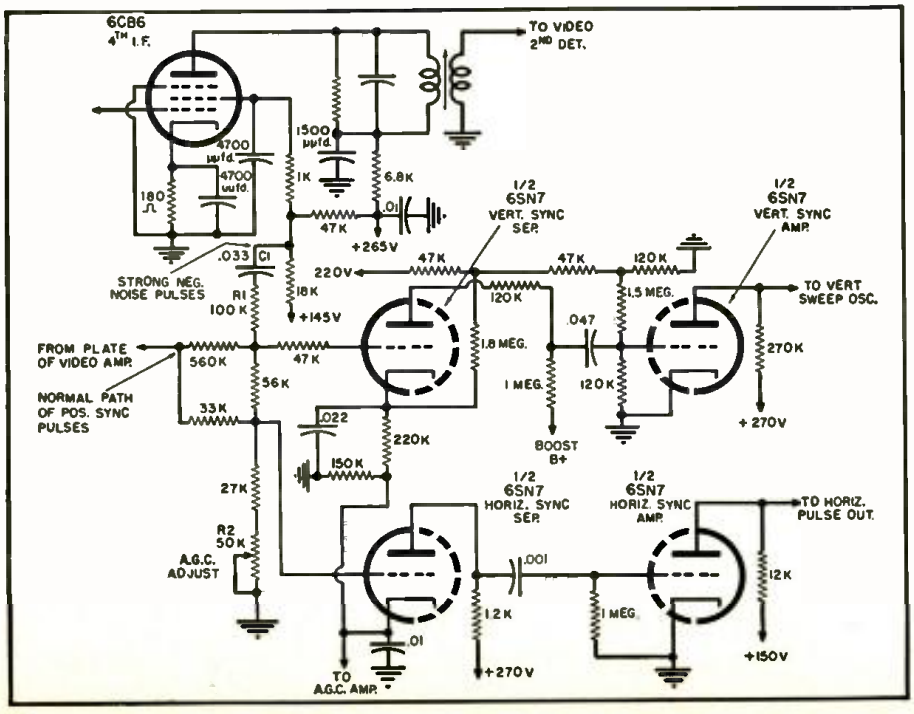
Before we leave this circuit, a word about the two signal paths leading to the sync amplifier, V_{11A}. One path comes from the video detector, the other from the output of the final video amplifier. Considering path 1, from the video detector, we see from Fig. 10B that even the strongest incoming signal will still preserve the sync pulses. Also, on the strongest signal, the noise pulses would be clipped off and for such signals the noise canceller circuit would not be required. The noise pulses of medium and weak signals, however, would get through.

Now let us look at the video signal coming in along path 2. This has been amplified and is so strong that the sync amplifier stage will show a compressed sync pulse on a strong station. See Fig. 10C. Any noise pulses coming in with strong or medium video signals now will be cut off and therefore only a weak station would require the noise canceller circuit.

Thus, if the sync amplifier, V_{11A}, were to receive only the signal from

(*Continued on page* 128)

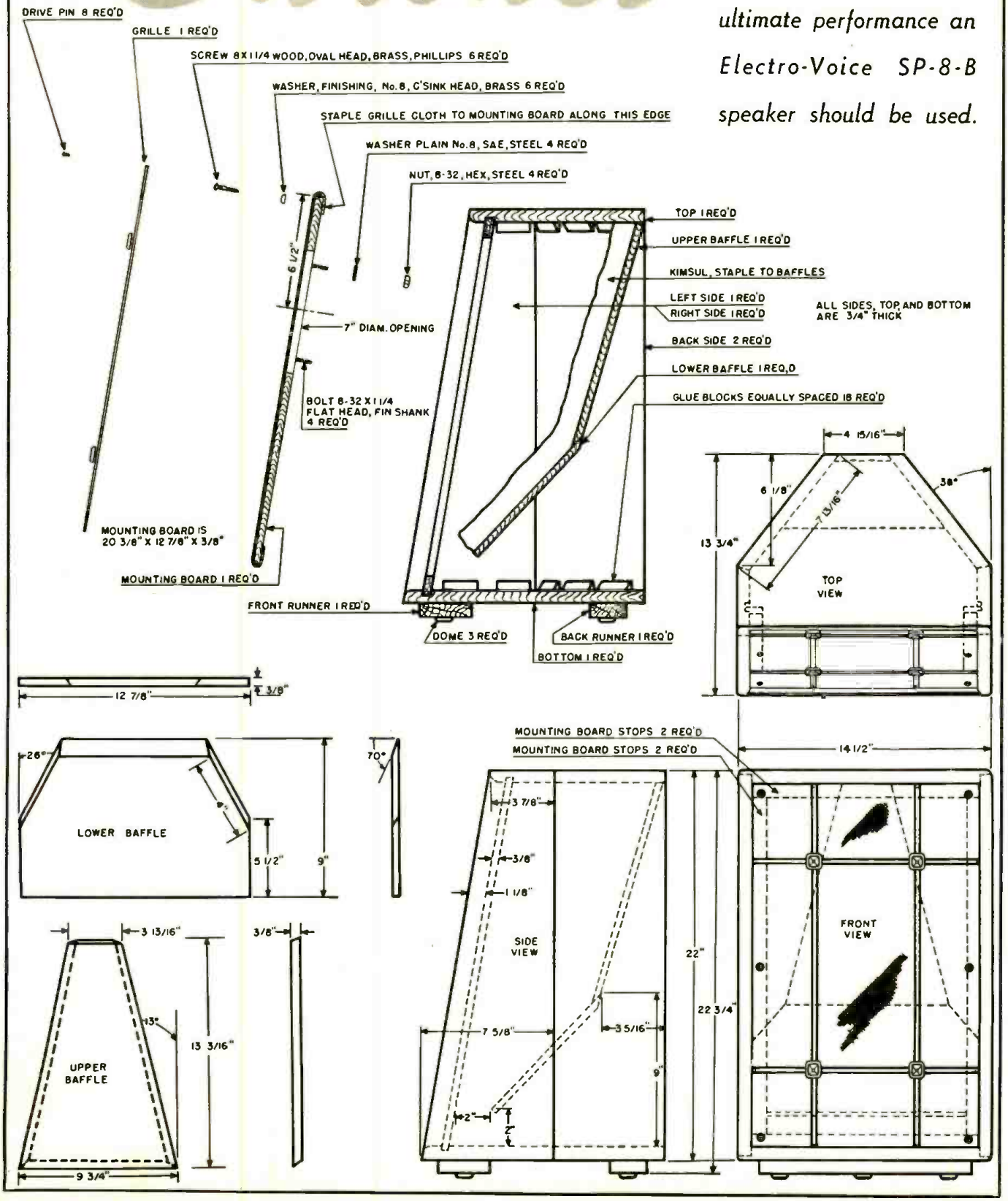
Fig. 9. Simplified diagram of RCA noise suicide circuit used in their KCS66 chassis. The d.c. voltages of the sync separators are controlled by a.g.c. potentiometer R_2.



ELECTRO-VOICE

Baronet

Construction details on a commercially available folded horn cabinet. For ultimate performance an Electro-Voice SP-8-B speaker should be used.



THE ASCO "AUDIOMAT"

By **IRVING GREENE**
Vice-President, Asco Sound Corp.

Music lovers can compare audio equipment under ideal conditions before making their selections.

Test control center for selecting over 9000 combinations of hi-fi audio components.

THE "Audiomat" was designed to provide the maximum flexibility in order to meet the demands of the present as well as future trends in high fidelity equipment. It is capable of providing *split second* switching between any one of ten radio tuners, ten record players, twenty amplifiers, two tape recorders, or twenty speakers. It permits playback of tape from the two recorders through any one of the twenty amplifiers thence through any one of the twenty speakers. Any program from any one of the ten radio tuners or ten record players can be recorded on tape by merely pushing a button. Many steps from the control panel to the equipment racks are saved by the remote control of a.c. power to the equipment. The units are always ready for immediate operation and by the simple flick of a switch any component in the two racks is ready for instant comparison.

The various units of equipment are mounted into specially designed racks which provide two advantages in addition to "listenability." These rack-type cabinets simulate the type of housings in which the equipment will be mounted in the home and give the prospective buyer an idea of the amount of space required for his installation.

A loudspeaker "wall" has been set up to demonstrate speakers in an "A-B test" under ideal conditions. The 14 speakers are mounted in a common "infinite baffle" so that they can be compared on their own merits under identical conditions. This eliminates the problems which arise when one speaker is housed in, say, a *Jensen* bass reflex enclosure and another in an *Aristocrat* folded corner horn for the test and then ultimately installed in an *R-J* enclosure in the customer's home.

The other six speakers used in the demonstration unit are actually two- and three-way systems installed in cabinets or enclosures designed specifically for the speaker system by the manufacturer. In the center of the speaker wall, mounted from the ceiling at an angle, is an indicating panel which contains 20 plastic nameplates that are illuminated when the speaker under test is in the circuit. Thus the listener is always aware of which speaker is under test.

A second demonstration room is very similar to the main salon except that it more nearly duplicates the physical layout of the average home. A miniature "Audiomat" is set up in this "den" to enable customers to select equipment under "home" conditions.

A block diagram of the "Audiomat" demonstration system is shown in Fig. 1. The heart of the entire system is the "Audiomat A-B Test Control Center." Here 67 push-buttons, actuating leaf contacts tipped with silver, control d.c. voltages that energize the coils of more than 80 relays. The relays, designed to switch a unit into the circuit within a fraction of a second, are of the plug-in type (simplifies replacement in the event of a breakdown). The contacts in the relays are gold plated for minimum noise and long life. The relays are hermetically sealed and shielded for minimum hum pickup. As shown in the diagram, only d.c. cables are run from the control panel to each of the two racks. Hence, all of the signal wires are kept to a minimum length thus avoiding diffi-

One of the two equipment racks used in the "Audiomat" demonstration system. Note the pull-out drawers in which the various audio components are compactly mounted.

culties resulting from long leads. The relays plug into specially-wired chassis that are mounted behind the equipment racks. Access to the chassis and relays is easily accomplished through regulation wire panel doors mounted on the wall. The chassis are mounted "rack style" into the openings in the wall behind the back of the equipment rack. All wiring is shielded and all grounds terminate at *one point*, thus eliminating ground loops. The indicating lights for each unit mounted in the rack are energized by the voltage fed across the relay coils. In this manner the relay and the light indicating the unit under test are energized simultaneously at the push of a button. Selection of inputs to any amplifier is automatically accomplished. When a record player is to be switched into the circuit, the listener need only place his record on the turntable, set his player in motion, and switch the selector knob on the amplifier to "phono." Equalization for each of the different type pickups is accomplished by a "correcting resistor" installed across the cartridge terminals to permit the proper "terminating impedance."

Direct current for the relays and indicating lights is supplied by two regulated 6 volt d.c. power supplies. All 6 volt lines are fed to the racks through a special duct installed in the floor. One power supply is for the relays (with the exception of the relays used to select the amplifier inputs) and the indicating lights. The other is used to feed the amplifier input selector relays. These relays are thrown into the circuit with a specially designed master relay.

Another duct installed into the floor carries the 20-speaker transmission lines. Each line is wired with an L pad so that the efficiencies of different speakers can be balanced if the customer wishes to compare them under equal loudness levels. Normally, all pads are out of the circuit and are used only at the request of a listener.

The FM tuners and television units are fed from an antenna line by means of a *Blonder-Tongue* transmission system. A double-array yagi mounted on a 30-foot tower is installed on the roof of a 12-story building. This system feeds an antenna line to 10 radio tuners and 6 television units.

The value of such a demonstration unit becomes clear when one considers the wide range of all types of audio equipment now available.

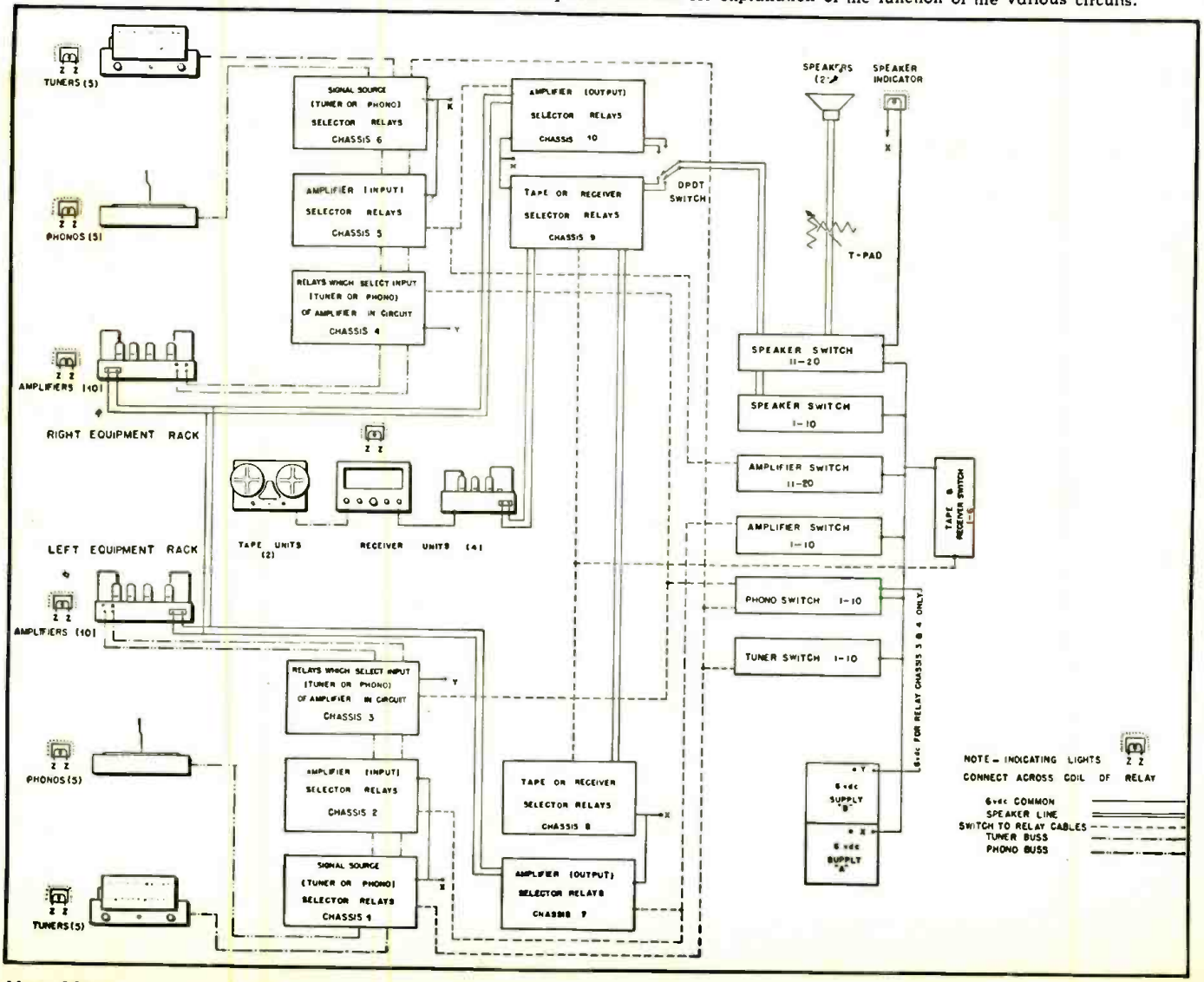
It is only a few years ago that the audio enthusiast could make his selection of equipment unhesitatingly—he could choose the products of Company A or Company B—they being the only manufacturers in the field.

Today literally hundreds of companies are producing quality equipment for the lush new "audio market" and the selection of equipment has become a bewildering procedure. Only by trying out a representative group of amplifiers, speakers, pickups, phono turntables, record changers, etc. can the customer find the equipment which appeals to his ear and his pocketbook.

A unit such as the "Audiomat" enables the customer to make a true comparison under parallel conditions. Customers are secure in the knowledge they have selected their equipment thoroughly and well.

This unique and practical unit has elicited enthusiastic response from the many music lovers who have been able to select their own "custom" equipment from the wide variety of audio components available. —30—

Fig. 1. Block diagram of the "Audiomat" demonstration system. See text for explanation of the function of the various circuits.



QRM-CUTTING SELECTIVITY FOR THE MOBILE RECEIVER

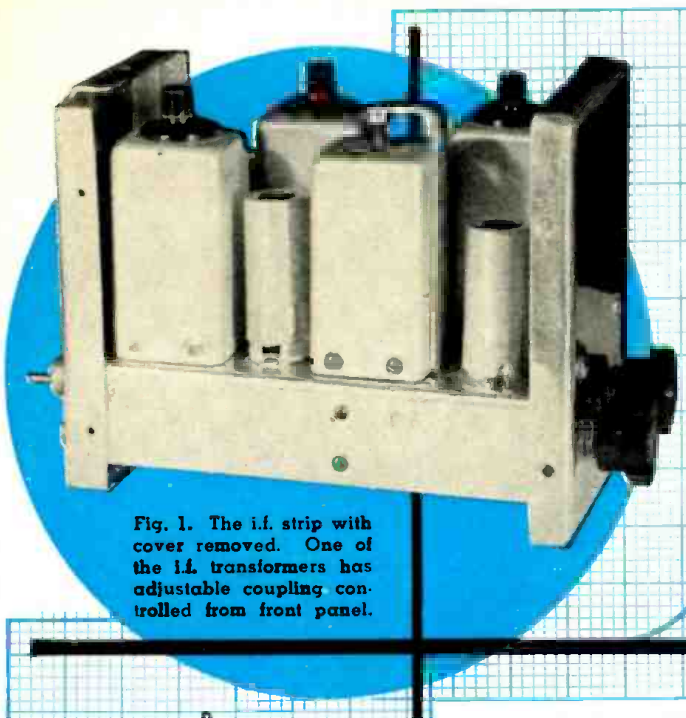


Fig. 1. The i.f. strip with cover removed. One of the i.f. transformers has adjustable coupling controlled from front panel.

By
GEORGE M. BROWN
W2CYY

Fed directly by the amateur-band converter, this i.f. strip provides adjustable selectivity for mobile reception, which is often sorely missed in the average mobile installation.

IT HAS only been in very recent years, and after the ubiquitous BC-453 "Q5-er" showed how much room for selectivity improvement there was even in some of the best and most expensive communications receivers, that manufacturers have been building into them the kind of selectivity required for coping with the QRM in the really crowded amateur phone bands such as 75 and 20. Little has been done, however, to provide similar performance in mobile receivers, where selectivity is often as important as at the home station. The usual practice is to buy or build a converter, and to use the standard automobile broadcast receiver, usually working at 1500 kc., as the remainder of the receiving system. The lack of a noise clipper can be corrected by adding one to the BC receiver. This, however, requires digging into somewhat critical portions of the circuit, and has been known to result in seriously impaired performance on the broadcast band. The consequent strain on family amity is roughly equal to that produced by the first hole drilled in the body of the car for the whip antenna mount. An S-meter circuit too can be provided, by tapping onto the cathode of an r.f. or i.f. stage, but the auxiliary circuitry must be designed for the particular receiver.

The lack of selectivity presents an even tougher problem. After all, we can hardly expect the automobile BC receiver manufacturers to worry much about our plight. Their receivers are built for a different job, and they really don't do so badly. Adding a BC-453 "Q5-er" will work, if the receiver i.f. is in its band, but its size is against it, and a plate power supply must be provided, since it is probably too much additional load for the BC receiver vibrator to handle. In addition, when the time comes to turn the car in on a new one with a different arrangement of tail lights or three propeller spinners instead of an inadequate one or two, the whole process must be repeated. Through some lamentable oversight (I'm sure that must be the reason) last year's radio just won't fit in this year's dash.

After considering these facts of life, and having quite a few 75-meter QSO's broken up when a perfectly readable S-7 or 8 signal was completely blanketed by a stronger one, ten or fifteen kc. off the frequency, it was decided to see if the whole problem couldn't be solved by a single unit. It seemed logical to retain the power supply of the broadcast receiver, and its audio system from gain control to speaker, but to draw the dividing line between the broadcast equipment and the ham equipment at the input to the gain control rather than at the BC antenna input. In addition to permitting whatever selectivity was desired to be built in, this approach permitted designing effective noise-clipping into the demodulator, and also incorporating the necessary circuitry for an S-meter, all in a single small unit.

The "i.f. strip" that resulted turned out to be a straightforward job, with no bad habits and no ticklish tendencies. As shown in the schematic, Fig. 2, it takes the 1500 kc. output of the converter, converts it to 85 kc., and then really goes to work on the selectivity. It includes a built-in peak-clipper, variable selectivity, and a jack for an S-meter—all in a box small enough to strap to the converter, or mount under the dash, and still leave knee room.

Input Circuit

The input transformer, T_1, was made from a 1415 kc. i.f. transformer from a 3 to 6 mc. SCR-274/N receiver. In order to avoid tapping the primary coil, a tapped-condenser type of line-to-grid matching was used, by adding the 2000 $\mu\mu$fd. condenser C_1 in series with the ground side of C_2, the original 180 $\mu\mu$fd. ceramic button. The only other change required was to remove two turns from the primary and three from the secondary, to permit tuning to 1500 instead of 1415 kc. These two tuned circuits, together with the usual single-tuned 1500 kc. output transformer in the converter, provide enough selectivity to attenuate the image of the 85 kc. i.f. by over 60 db, even though it is only 170 kc. away.

There is nothing sacred about the type of input transformer used. If the SCR-274/N type is not available, any permeability-tuned 1500 kc. interstage i.f. transformer such as a *J. W. Miller Co.* 912-W2 would be equally satisfactory, with no modification except to add C_1. C_1 should be made approximately ten times the capacity

of C_2. Also, non-surplus 50-kc. transformers may be used in the i.f. stages, as will be discussed below.

I.F. Amplifier

In order to obtain the high degree of adjacent-channel selectivity that was desired, two stages of i.f., using the three 85 kc. i.f. transformers from a beaten-up BC-453 were used. After removing the little mounting plates that are found on them the transformers were mounted directly to the chassis, using the same four screws each that held them to the plates. There seems to be no particular advantage in retaining the original plug-in mounting, and direct mounting provides a more solid and compact assembly, as well as eliminating the difficulty of trying to salvage the spun-in mounting bases from the original chassis. The external leads were soldered directly into the transformer terminals.

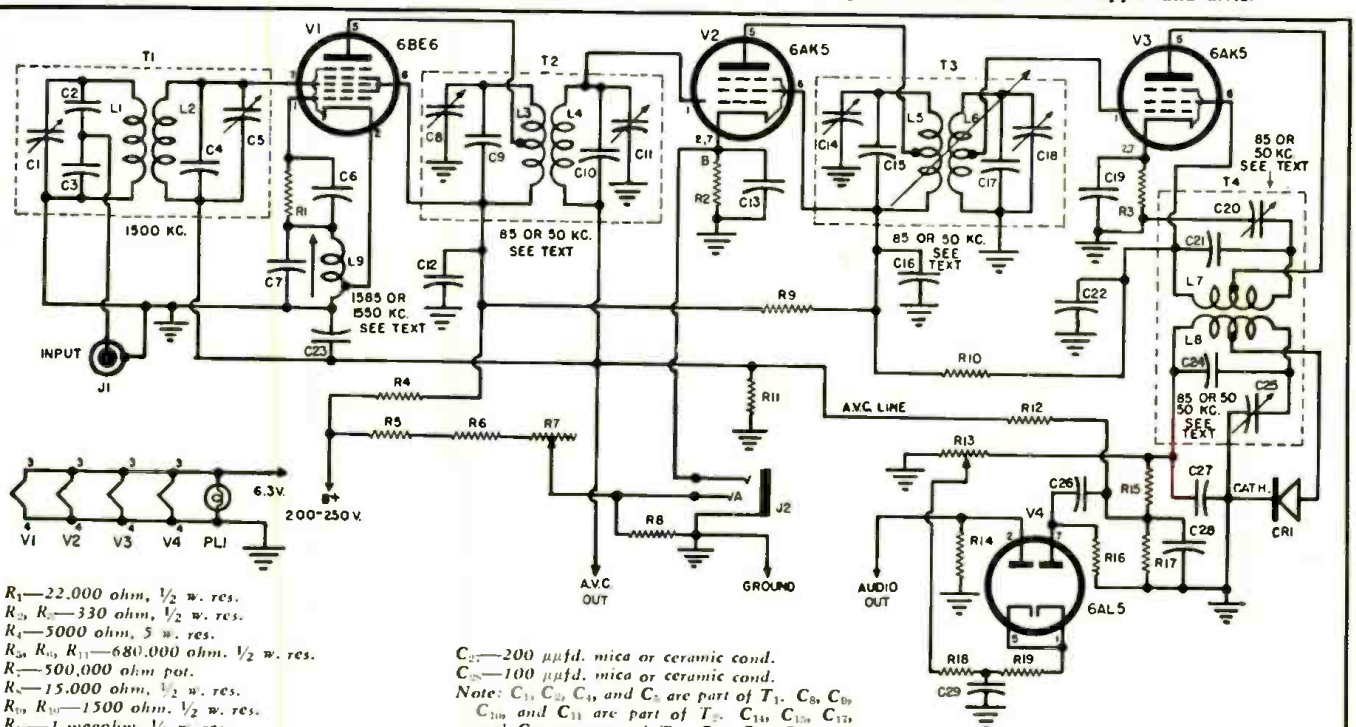
The same method, of course, was used in mounting the 1500 kc. input transformer, since it is identical mechanically to the 85 kc. units.

The plates and screens of all tubes are all fed from the same 100- to 125-volt source, with suitable decoupling circuits. This method of operation permits a single bypass condenser for each tube for both plate and screen, not only saving condensers and screen dropping resistors, but also simplifying wiring. The mutual conductance of the tubes used with plate and screen voltage equal is almost identical to that obtained with higher voltage on the plates, and the power-handling capacity is entirely adequate. Further to save space and for ease of mounting, six of the .05 μfd. bypass condensers were salvaged from the same BC-453 that contributed the i.f. transformers, in the form of two triple units.

Note that all of the i.f. transformers except one have taps on both coils, one for the plate and one for the grid. This feature is intended to increase the "Q" of the circuits, and hence the selectivity, by reducing the grid and plate loading. All originally were so tapped, but it was found desirable to use the full secondary of T_2 in order to obtain a few db more gain that seemed to be needed. The increase in gain was marked, and the decrease in selectivity was negligible.

The BC-453 transformers are built with adjustable coupling, permitting them to be tuned in the uncoupled position and then coupled up to or slightly beyond critical. This feature permits a considerable degree of control over the passband of the amplifier and the temptation to bring one of these controls out to the front panel, for an operating selectivity control, was too great to resist. The Rube Goldberg mechanism shown in the photographs, Figs. 3 and 4, did the job. Note that the selectivity control knob on the panel operates a crank pin, which is coupled by a connecting rod to a bell crank, mounted on the opposite side of the chassis. This bell crank, in turn, operates a push rod, which goes up through the chassis and is secured to the adjusting rod at the top of the transformer by means of a bushing and set screw. It is necessary to remove the threaded bushing at the top of the transformer, normally used to hold the protecting cover, in order to get enough room to make a secure connection to the adjusting rod. In order to prevent vibration from changing the adjustment, and to obtain a snug fit for the shaft that

Fig. 2. Circuit diagram of the selective mobile i.f. system. The input is fed by an amateur-band converter; power and audio are supplied by the car broadcast receiver (connections in Fig. 6). The system has its own noise clipper and a.v.c.



R_1—22,000 ohm, ½ w. res.
R_2, R_5—330 ohm, ½ w. res.
R_4—5000 ohm, 5 w. res.
R_6, R_{11}—680,000 ohm, ½ w. res.
R_7—500,000 ohm pot.
R_8—15,000 ohm, ½ w. res.
R_9, R_{10}—1500 ohm, ½ w. res.
R_{12}—1 megohm, ½ w. res.
R_{13}—100,000 ohm pot.
R_{14}—470,000 ohm, ½ w. res.
R_{15}—100,000 ohm, ½ w. res.
R_{16}, R_{17}, R_{18}, R_{19}—220,000 ohm, ½ w. res.
C_1, C_4, C_8, C_{11}, C_{14}, C_{18}, C_{20}, C_{25}—12 μμfd. trimmer cond.
C_2, C_3, C_9, C_{10}, C_{15}, C_{17}, C_{21}, C_{24}—180 μμfd. ceramic cond.
C_5—2000 μμfd. mica or ceramic cond. added to T_1
C_6—250 μμfd. mica or ceramic cond. (Osc. grid coupling)
C_7—250 μμfd. silver mica or zero-coefficient ceramic cond.
C_{12}, C_{13}, C_{16}, C_{19}, C_{23}, C_{26}—.05 μfd., 600 v. cond.
C_{22}—.05 μfd., 400 v. cond.
C_{27}—.1 μfd., 600 v. cond.
C_{28}—200 μμfd. mica or ceramic cond.
C_{29}—100 μμfd. mica or ceramic cond.
Note: C_1, C_2, C_3, and C_5 are part of T_1. C_8, C_9, C_{10}, and C_{11} are part of T_2. C_{14}, C_{15}, C_{17}, and C_{18} are part of T_3. C_{20}, C_{21}, C_{24}, and C_{25} are part of T_4. C_{12}, C_{19}, C_{23} and C_{13}, C_{16}, C_{26} are two 3-section condensers used in BC-453 and similar receivers.
PL_1—12 volt, 150 ma. pilot light
CR_1—1N34 crystal diode
J_1—Coaxial connector
J_2—Three-circuit jack
L_1—Part of T_1, modified by removing 2 t. (Not necessary with non-surplus part)
L_2—Part of T_1, modified by removing 3 t. (Not necessary with non-surplus part)
L_3—Part of T_2
L_4—Part of T_2 modified by using entire coil for output instead of tap
L_5, L_6—Part of T_3
L_7, L_8—Part of T_4
L_9—Osc. coil. 75 t. #32 en. wound on Millen #69046 form, cathode tap 6 t. from gnd. end
T_1—Input trans. 1500 kc. i.f. trans., (from SCR-274/N 3-6 mc. receiver modified by addition of C_5 and removal of two turns from L_1 and three from L_2 or J. W. Miller Co. #912-W2 unmodified except for addition of C_5)
T_2—85 kc. trans. from BC-453 (modified by using entire secondary for output instead of tapping down. See text. Or Millen #64051)
T_3—85 kc. trans. from BC-453 (modified to permit coupling adjustment from front of panel. See text. Or Millen #64051 unmodified)
T_4—85 kc. trans. from BC-453 or Millen #64051
V_1—6BE6 tube
V_2, V_3—6AK5 tube
V_4—6AL5 tube

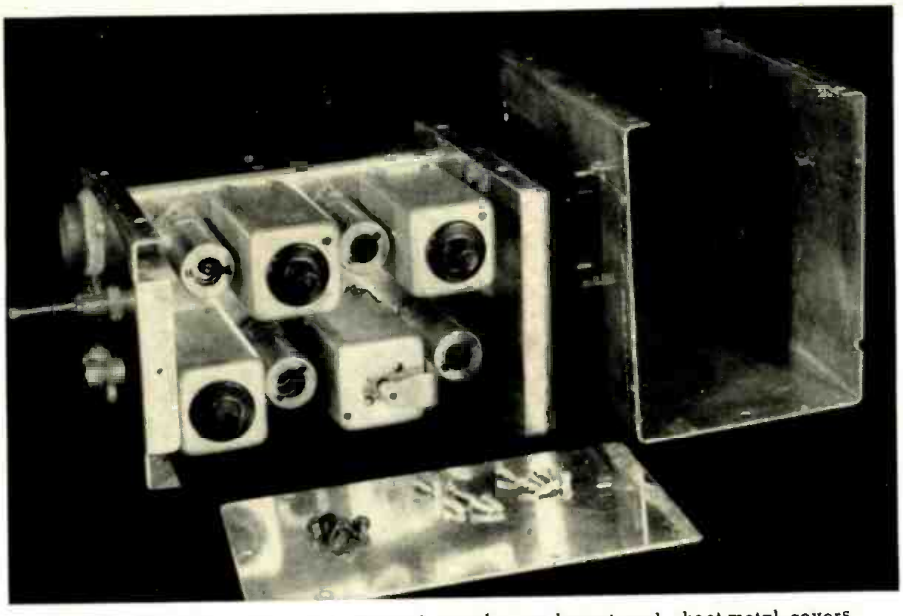


Fig. 3. Top view, showing tube and transformer layout and sheet-metal covers. The method of adjusting the coupling of T_3 (lower right) is explained in the text.

comes through the panel, a *Millen* #10061 dial lock was used as a nut on the inside end of the shaft bushing. Adjustment of the tapered nut of this excellent device permits just the desired frictional drag on the control, and zero slop in the bearing. Its use for this and similar applications is highly recommended.

This may all seem like a lot of trouble to obtain a little front-panel control of selectivity but it has turned out to be well worth the effort expended. With the control set for maximum selectivity, the bandwidth is 3 kc. at 6 db down, and 12 kc. at 60 db down, enough to do a lot of QRM-cutting on a band as crowded as 75, but rather sharp and difficult to tune on 10. At minimum selectivity, it is 7 kc. wide at 6 db down, and about 18 at 60, about right for ten, and also useful on 75 when few stations are on and the added highs provided by the wider passband can be received without QRM. And it is always fun when showing off your mobile rig to be able to amaze the converter-BC receiver addict with the way you can clip sidebands and cut through the QRM just by turning the selectivity knob.

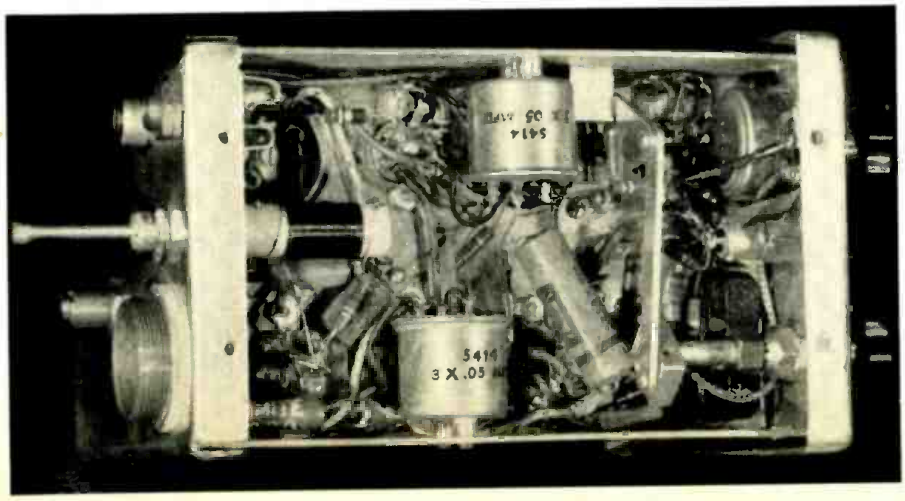
BC-453's, and even their 85 kc. i.f. transformers separately, are still available, but they are beginning to get scarce and more expensive on the surplus market. The best commercial substitute presently available appears to be the *James Millen Co.* #64051. If such a unit is used, it will be necessary to increase the size of the chassis and case slightly to accommodate these transformers, and to eliminate the front-panel selectivity control. The *Millen* transformers are designed for 50 kc., rather than 85 kc. as the ones from the BC-453 are, but all that is necessary to accommodate the different i.f. is to adjust the oscillator frequency to 1450 or 1550 kc., instead of 1415 or 1585. The range of the tuning slug will be found adequate.

Detector-Clipper

A 1N34 crystal is used for the demodulator, working directly into the 6AL5 double series-gated noise clipper. R_{13} was provided as a front-panel adjustment of clipping level, but there is considerable question as to whether or not it is needed. In practice, it was found that the optimum adjustment was for minimum clipping, at which position there was no noticeable distortion from the clipping, and it seemed to do almost as good a job on ignition noise as with heavier clipping and more distortion. It is easy to include, however, and occasionally does some good.

The a.v.c. voltage is obtained from the same germanium diode, and applied to the mixer and first i.f. It is also brought out for use in the converter, where it is most helpful in combating overloading from nearby stations. No a.v.c. is used on the last i.f. stage. This tube has a hard job assigned to it, since it has to supply a considerable amount of power to the diode demodulator and it can't do it properly if it is throttled back by a.v.c. Reduction of the power-handling capabilities of the last i.f. tube by a.v.c. with consequent overloading is the unsuspected cause of much distortion in some receivers. It should seldom be used, and then with great caution.

Fig. 4. Bottom view. Note the crank pin, connecting rod, and bell crank at right for operating the selectivity control push rod, which goes up through the chassis.



S-Meter Circuit

The S-meter circuit shown is designed to produce zero current on the associated meter with zero signal, and increasing current with signal, in contrast to a simple meter in the cathode of a tube controlled by a.v.c. (which reads backward) indicating maximum with no signal and less with increasing signals. This circuit is also not seriously affected by plate voltage changes, particularly in the weak signal and noise level range, where a simple cathode meter may change two or three "S" units depending upon battery condition.

The circuit operates on the bridge principle, with R_7 being adjusted for zero current on the meter with the antenna grounded. Under this condition, a.v.c. voltage is zero, and cathode current of V_2 is maximum, producing a maximum voltage at point "B" (cathode of V_2, Fig. 2). The zero-current adjustment of R_7 produces the same voltage at point "A" (in J_4, Fig. 2). When a signal is received, a.v.c. causes the cathode current of V_2, and hence the voltage at "B" to drop, and current flows from "A" to "B."

The values shown for the resistors are intended for a 150-microampere meter. If a meter of less sensitivity is used, the total resistance of the R_5-R_6-R_7 combination and R_8 will need to be decreased accordingly. A higher sensitivity meter can be used by inserting a resistor in series with it to keep it on scale with the strongest signal. R_5 and R_6 may be replaced by a single resistor of suitable value if desired.

Construction

The entire unit was built on an aluminum chassis 3⅝" by 6⅛" (about 4⅛" by 6⅝" with *Millen* i.f. transformers), bent up from sheet stock.

(*Continued on page* 116)

U.H.F.-V.H.F. ANTENNA COUPLER

By

EDWARD FINKEL and JAMES C. SARAYIOTES
JFD Manufacturing Co., Inc.

Single lead-in from separate v.h.f. and u.h.f. antennas is possible when using a coupler of the type described here.

IN AREAS now receiving u.h.f. service in addition to v.h.f. transmissions, the service technician will often encounter the home owner's reluctance to add yet another antenna to his private skyline and his additional reluctance to invest in a second complete antenna installation to provide u.h.f. signals. Among the new TV products introduced recently is the *JFD* "JeTie," a printed circuit coupling device which combines separate low v.h.f., high v.h.f., and u.h.f. antennas on a single mast with a single downlead. It thus solves the "skyline" problem and minimizes the expense of the u.h.f. antenna installation when added to the existing v.h.f. antenna.

Interestingly enough, the major number of v.h.f. installations, converted to receive u.h.f., require a coupler for quite another reason. TV sets adapted to receive u.h.f. by strip conversion (and most new continuous tuning v.h.f. and u.h.f. sets also) provide only one pair of input terminals. It is not possible to bring separate v.h.f. and u.h.f. downleads to these receivers. A coupling device which will permit the antennas to be terminated in a single downlead is, therefore, a necessity.

For installations using separate u.h.f. translators or converters, providing a pair of terminals for u.h.f. and a separate pair for v.h.f., a coupler at the antennas, a single downlead, and a second coupler at the receiver provide for a completely matched 300-ohm system, a faster, less expensive installation, and a less complicated skyline.

The "JeTie" is a passive broadband network, designed to match the popular 300-ohm balanced input system.

Fig. 2 is a simplified schematic representation of the coupler. The TV downleads are always connected to terminals A and H, and the leads from the u.h.f. antenna (470-890 mc.) are always connected to F and G. When a broadband v.h.f. antenna (54-216 mc.) is used, it is connected across B and E. When separate antennas are used for the high and low v.h.f. bands, the low-band antenna is connected to B and C and the high-band antenna is connected to D and E.

Operation of the *JFD* "JeTie" depends on the properties of the parallel-resonant circuit. Reference to the simplified schematic, Fig. 2, shows that it consists of five parallel-resonant networks. The circuit parameters are such that over the low v.h.f. frequency range, a very high impedance is presented across terminals B, C and a short circuit is presented across terminal pairs D, E and F, G. For the high v.h.f. band, short circuits are presented across terminal pairs B, C and F, G; and a very high impedance is presented across D, E. For signals in the u.h.f. band, shorts are presented across B, C; and D, E and a very high impedance is presented across terminals F, G.

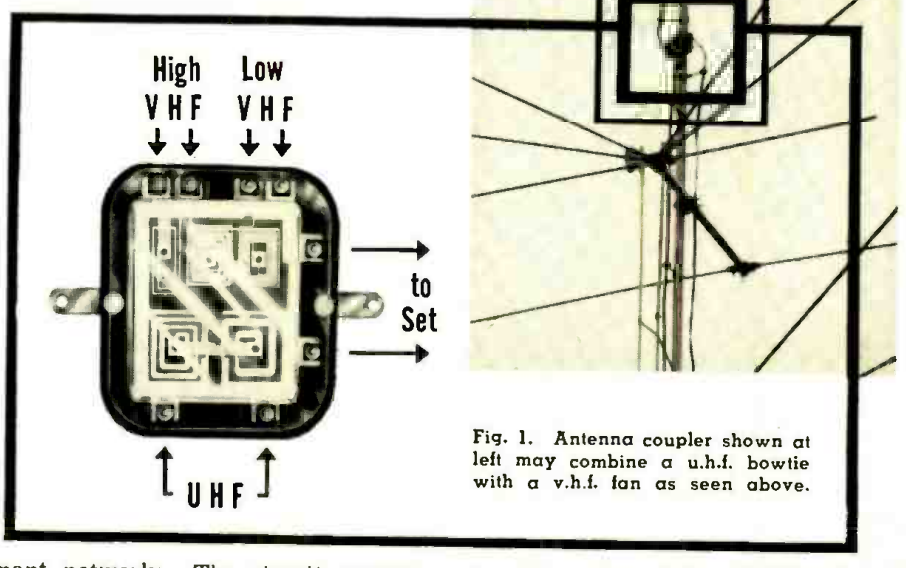
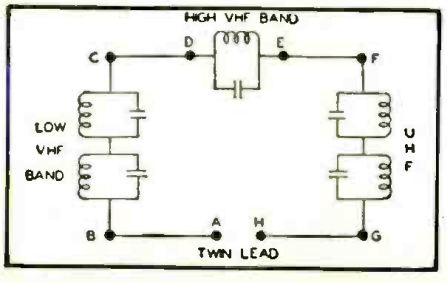


Fig. 1. Antenna coupler shown at left may combine a u.h.f. bowtie with a v.h.f. fan as seen above.

The reason the circuit works in this fashion is that the impedance of a parallel inductance-capacitance network is purely resistive at resonance. Away from the resonant frequency the impedance is inductive or capacitive, depending upon the frequency. The magnitude of the impedance away from resonance depends on the *"Q"* of the circuit; it will be low if the *"Q"* is high and *vice versa*.

It can, therefore, be seen that with the appropriate choice of *"Q"* and *L/C* ratio for each network, it is possible to connect the v.h.f. and u.h.f. antennas simultaneously to a single pair of downleads, and have each properly terminated in the 300-ohm receiver input (over its appropriate frequency range) with a minimum insertion loss and voltage standing wave ratio.

Fig. 2. Equivalent circuit of the coupler showing the antenna connecting points.



The fact that coupling devices of this type are always exposed to rain, heat, cold, snow, and humidity poses very exacting problems, for the accumulation of dirt and rain water threaten to create capacitive effects which can seriously change the electrical characteristics. The "JeTie" is, therefore, hermetically sealed and, as a result, is free from this serious danger.

The housing of the "JeTie" has been deliberately designed to provide maximum separation of the printed circuit from the shell of the enclosure. Five eighths of an inch separates the printed circuit from the shell of the enclosure, thereby minimizing the possibility of developing unwanted capacitive effects between what dirt may accumulate on the shell and the printed circuit itself. In addition, the smooth, convex enclosure surface minimizes the possibility of dirt accumulation. The surface of the coupler, which will face the sun, is clear and silvered, effecting a rejection of heat. The surface which faces away from the sun is black effecting an efficient conduction of heat away from the coupler. -30-

TRANSISTOR-OPERATED PHOTOCELL RELAY

By

LOUIS E. GARNER, JR.

Construction details on a simple unit which has many uses in the home or shop. Power requirements are low and cheap.

Fig. 1. Over-all view of author's unit. A discarded exposure meter cell was used.

WHILE battery-operated, self-contained photocell relays are certainly not new (see "A Photoelectric Headlight Dimmer" by P. J. Vogelgesang, RADIO & TELEVISION NEWS, January, 1953), the unit shown in Fig. 1 does possess several unique features. First, no resistors, coils, transformers, condensers, or vacuum tubes are used in its construction. Secondly, a single inexpensive, comparatively low voltage battery is all that is required for its operation and this is contained within the small housing shown. The battery life is fairly long, due to the low current drain.

All these features are made possible by the use of a self-generating photocell, together with a direct current *transistor* amplifier. Only a few parts are required for the device, as can be seen in the schematic diagram (Fig. 2), and the interior view given, Fig. 6.

Circuit Description

The operation of the circuit may be easily followed by reference to the schematic diagram of Fig. 2. The *Raytheon* CK721 transistor ("*p-n-p*" type) is the "heart" of the device, and is connected as a direct-coupled grounded emitter amplifier. This serves to amplify the weak current obtained from the photocell sufficiently to operate the relay, RL_1.

As long as no light falls on the photocell, the base current of the transistor is essentially zero, and negligible collector current flows through RL_1, which remains open. When light is allowed to fall on the photocell, a small base current starts to flow, permitting a corresponding increase in the flow of collector current through the relay. The collector current is several times greater than the base current, with a current amplification of ten comparatively easy to achieve.

As the light intensity increases, base current and collector current also increase, until the current through the relay is sufficient to close it.

If the light intensity falls off, a corresponding decrease in base and collector current is obtained. However, the relay does not open until the light level drops appreciably, since less current is required to hold the relay closed than is needed to close it. Under normal conditions, the base current does not exceed a few hundred microamperes, while the collector current does not exceed a few milliamperes.

Collector voltage is supplied by battery B_1, with switch S_1 provided to open the collector circuit when operation of the unit is not desired.

Thus, *only five electrical components* are used in the entire device—a photocell, a transistor, a relay, a switch, and a battery.

Construction Hints

With the single exception of the photocell, all the parts used in building the device are easily obtained from radio-electronic wholesale parts distributors. A "self-generating" photocell may or may not be available at a particular distributor, depending on local demand. Although this item is commercially manufactured, not all supply houses have sufficient demand for the item to warrant stocking it.

The photocell used by the author in building the model shown is a selenium cell salvaged from a defective exposure meter of the type used in amateur photographic work. These meters consist of the basic photocell together with a microammeter. Since the meter movement is more susceptible to mechanical damage than is the photocell, it is sometimes possible to pick up a "defective" unit in which only the meter movement is damaged—the photocell is virtually in perfect condition. In most cases, the cost is negligible.

Even where it is necessary to purchase an exposure meter in "operating" condition, the price of a used unit is likely to be quite low. A used but operating unit offers the further advantage of supplying the experimenter with a sensitive microammeter for other work.

A certain amount of ingenuity may have to be exercised by the builder in mounting the photocell, depending upon its actual shape and size—some are round, others square, and still others rectangular. The one used by the author is shown in Fig. 5.

In mounting the photocell proper, it is best not to attempt to solder leads to it. Use spring contacts made from phosphor bronze or similar material. If a commercial unit is used, it will generally have leads or terminals provided.

No special precautions are necessary when assembling and wiring the circuit, and the builder may follow his own inclinations as far as layout is concerned. The unit shown in the photographs was housed in an old shield can, but almost any type of housing may be used—a plastic or wooden box, a small metal utility box, or even a small chassis, with a bottom plate used as a "cover."

A hole must be provided in the housing, of course, to permit light to

strike the photocell. Generally, no lens will be required unless the builder wishes to increase the over-all sensitivity somewhat by concentrating light from a large area on the cell, using a good sized lens.

The effect of light striking the unit from an angle can be reduced either by using a lens ahead of the photocell or by mounting a closed tube in front of the cell, as shown in Fig. 3. The interior of the tube should be finished in dull black to reduce interior reflections. The tube has not been used in the model shown in the photographs.

Parts Substitutions: A toggle, lever, rotary, or almost any type of switch may be used in place of the slide switch employed in the model. A lock switch is particularly good for this application, as it permits only the owner to turn the unit "on" or "off."

Other relays may be used in place of the one specified in the parts list. When choosing a substitute relay, pick one having good sensitivity. The relay should have a reasonably high coil resistance and should close on *less* than 5 ma. However, the so-called "plate" relays are not suitable for use here due to their high coil resistance, requiring much higher supply voltages for proper operation. Best results will be obtained with sensitive relays having a coil resistance of 3000 ohms or less.

In general, the more sensitive the relay, the more sensitive will be the complete device (requiring less light for operation).

If other relays are used, it may be found possible to use a supply voltage of less than 15 volts.

In any case, the choice of a battery should depend on the intended operation of the unit. A hearing aid type battery (*Burgess* U10) was used in the model and is given in the parts list. This particular battery was chosen because of its low cost, ready availability, and reasonable life under the low current drain required by the device.

Where the unit is to be used in an application requiring extreme battery life, a larger battery might well be employed.

Adjustment and Operation

Once the wiring has been completed, a milliammeter should be connected in series with the relay and the unit turned "on." Light should then be permitted to fall on the photocell. A marked increase in collector current flow should occur, as indicated by the milliammeter reading. If this current increase does not occur, reverse the connections to the photocell —base current must have the correct polarity.

Next, the relay's sensitivity must be adjusted so that the relay closes when light is falling on the photocell and opens when the light source is interrupted. Use a focused light source supplying the same amount of light as will later be used in the intended application. The relay's sensitivity can be changed by tightening or weakening the tension on the armature spring and by adjusting the armature's position relative to the core piece.

Be sure sufficient light is employed, the sensitivity of the completed unit may vary considerably, depending on the photocell used, the relay used, the adjustment of the relay, and other factors.

In the model built by the author, the light obtained from a 3-cell flashlight held two to three feet away from the opening in the housing was sufficient to operate the relay. This light fell through a ¾" diameter round hole in the housing to strike the photocell. Because of this, only about half the photocell's area was used. Greater sensitivity could have been obtained by using all of the photocell's active area. The set-up employed in this test is shown in Fig. 4.

Applications

The applications of the photocell relay described in this article parallel the applications of photoelectric relay units in general, although there is somewhat greater versatility because operation is possible anywhere (special power is not required) and because of the small size possible in assembling a complete unit. However, a review of possible applications might be of interest to the reader, and may aid him in selecting or devising special applications of his own.

In considering applications for the photocell relay, the device can be considered as a switch that performs any one of the following functions, depending on how the connections to the relay contacts are made:

1. To open a circuit when light strikes the photocell.
2. To open a circuit when light striking the photocell is interrupted.
3. To close a circuit when light strikes the photocell.
4. To close a circuit when light striking the photocell is interrupted.

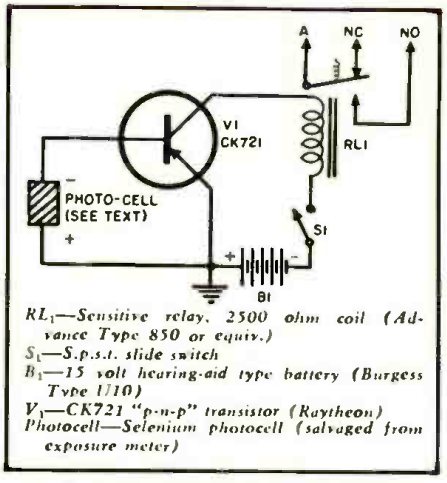
Irrespective of the connections chosen, it is best to supply power to operate the external device from a separate power source, rather than to attempt to use the small battery in the photocell relay circuit proper.

A few possible applications follow, but these should, by no means, be considered a complete list.

Burglar Alarm: The light source and photocell relay may be arranged so that anyone entering a protected area causes an alarm bell to sound.

Doorway Annunciator: A light

(*Continued on page* 165)



RL_1—Sensitive relay, 2500 ohm coil (Advance Type 850 or equiv.)
S_1—S.p.s.t. slide switch
B_1—15 volt hearing-aid type battery (Burgess Type U10)
V_1—CK721 "p-n-p" transistor (Raytheon)
Photocell—Selenium photocell (salvaged from exposure meter)

Fig. 2. Complete circuit diagram of photocell relay. Only five components are used.

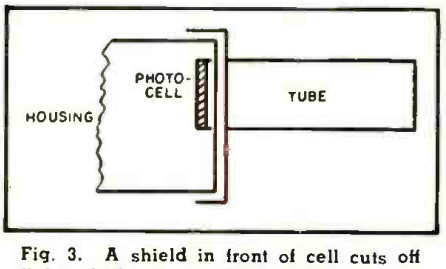


Fig. 3. A shield in front of cell cuts off light which might strike cell from an angle. Suitable for door-opener application.

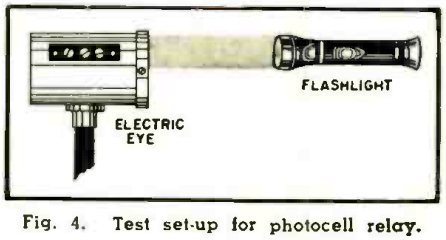


Fig. 4. Test set-up for photocell relay.

Fig. 5. Photocell used by author. Other sizes and shapes may be used. See text.

Fig. 6. Interior view of photocell relay.

MAC'S RADIO SERVICE SHOP

By JOHN T. FRYE

A LITTLE LIGHT ON FM

"MAC," Barney suddenly blurted, "I've got a problem."

"So what. I'm not going to play Dorothy Dix to your Romeo," Mac warned his assistant; "and if you want advice about your love life you can just—"

"I *never* have any trouble with my women," Barney interrupted; "and if I did I'd certainly not ask you for help. Taking such a trouble to an ancient flint-hearted Scotsman would be like asking an Eskimo about cactus. My problem," he concluded witheringly, "has to do with the one subject you know something about: radio."

Mac smothered a grin at this sharp thrust. "It's nice of you to admit I know something about something," he said with suspicious mildness.

"Last night," Barney said, "a friend of mine by the name of Mr. Smith was over at the house, and we got to talking about frequency modulation. He has always been interested in radio and had read a lot about it, but one thing he has never been able to get clear in his mind is how changing the frequency of the carrier can modulate that carrier. He simply cannot see how swinging the carrier farther and farther each side of the center frequency can produce louder and louder tones in the receiver. I tried to explain it to him with no luck at all. To tell you the truth, by the time I finished 'explaining' to him how FM works I was not sure about it myself."

"You should have used an analogy," Mac observed. "The only way you can explain details of an unfamiliar subject to a person is in terms of something that he does understand."

"Okay," Barney challenged, "let's see you dig me up a good analogy I can spring on Mr. Smith tonight."

"Since we are trying to cast some light on the subject of FM and since we are talking now to a very light intellect, suppose we use a light analogy," Mac began. "Assume we have a direct-current lighted neon lamp shining on a photoelectric cell. As we know, the output of the cell depends upon the amount of light falling on its sensitized plate. While steady direct current is lighting our lamp, its light output will be constant and the output of the cell will maintain a fixed value with no variations.

"Next, let us place an alternating current generator in series with the d.c. source lighting our neon lamp. Let's assume the output of the generator is correct to double the brilliance of the lamp when the two voltages aid each other and that the lamp output is reduced to zero when the a.c. voltage and the d.c. voltage oppose one another. Since the neon lamp responds instantly to the voltage across it, its light output will vary smoothly in step with the frequency of our a.c. generator. If that generator puts out 400 cycles-per-second, our light will be going up and down 400 times a second. The photocell responds to the light reaching it, so its output will also be rising and falling 400 times each second.

"The whole system is similar to an amplitude-modulated radio transmitting-receiving system. The lamp is the carrier generator. The a.c. generator is the modulator. The amplitude-modulated light beam is the amplitude-modulated carrier. The cell that faithfully reproduces in its output circuit the variations in the light intensity falling upon it is the AM detector. Note carefully that swinging our d.c. lighted lamp back and forth in a small arc in front of the photocell does not materially change the amount of light falling on that cell and so produces no change in its output."

"I'm with you so far," Barney encouraged.

"Good. Suppose now we replace our single photocell with two carefully matched cells mounted as close together as possible and with their sensitive areas facing the lamp. Furthermore, let us place a mask between the lamp and those cells with a small opening in the mask so proportioned that the light from the lamp just covers the inside half of each cell's sensitive area. The outside halves are in darkness.

"The output of this new light-detector is measured *across* the two photocell outputs; in other words, the only time we will get a reading is when there is a *difference* in the outputs. That means that now if we connect our a.c. generator in series with the d.c. source and make our light brighten and dim as we did before, there will be no equivalent variation in the output of our twin photocell detector. While the output of each cell will be rising and falling in accordance with the variation in light falling on a portion of its sensitized plate, the two outputs will be rising and falling exactly in step with each other; so there will never, at any time, be a difference in voltage measured from one output to the other."

"It's getting a little thicker, but I'm still following—I think," Barney muttered.

"Now let's see what happens when we move our lamp sideways," Mac continued. "As soon as the lamp starts to move, the light shining through the hole in the mask begins to move *off* one of the photocell plates and *on* to the other. The output of the cell whose sensitized area is receiving more light begins to increase; the output of the cell from which the light is leaving begins to decrease. The combination output—measured across these opposite-going individual outputs—begins to rise, and it continues to do so until the lamp has been moved far enough away from its original position so that one of the photocell plates is receiving all the light and the other is in complete darkness. Continuing to move the lamp in the same direction causes the light to move off the plate on which it is shining, and then this cell's output starts to fall toward the zero output of the other cell still in darkness.

"On the other hand if we return the lamp slowly to its original position the voltage difference between the two photocell outputs returns to its original balanced zero condition; but if the lamp is moved on past this point so the cell that formerly lost the light now gains it and the other cell slides into darkness, our combination output again approaches a peak value equal to that attained before, but this time the polarity is reversed.

(*Continued on page* 159)

KNOW YOUR 1953 DU MONT "TELESETS"

By **JOSEPH ROCHE**
Allen B. Du Mont Laboratories, Inc.

Circuit operation and servicing procedures for efficient handling of the new Du Mont RA-166/167, 170/171 chassis.

THE 1953 *Du Mont* "Telesets" have many new features designed to provide optimum response both in primary and fringe signal areas. In order to efficiently service these new chassis, the service technician should understand the operation of the various circuits and, further, should be appraised of the correct procedure for testing and aligning. This article will attempt to convey this information to the reader. Only those circuits which are new or unusual will be explained in detail. The information contained in this article applies to the *Du Mont* RA-166/167 and 170/171 chassis.

All of these chassis are equipped with 13-position turret v.h.f. tuners of similar design. The tuner r.f. amplifier is a 6BK7 in a low-noise cascode circuit. A 6J6 dual triode serves as the oscillator and mixer.

The RA-171 is equipped with separate u.h.f. and v.h.f. tuners. When the v.h.f. tuner turret is placed in the thirteenth position the output of the u.h.f. tuner is connected to the input of the v.h.f. tuner. In addition, the v.h.f. oscillator is disabled and the necessary components in the u.h.f. tuner are switched to permit the v.h.f. tuner to operate as a 41 mc. i.f. amplifier.

The u.h.f. tuner is of the continuous-tuning type. The tuner circuits consist of a double-tuned preselector, a crystal diode mixer and a u.h.f. oscillator, as shown in Fig. 1. Capacitively-tuned shorted coaxial lines are used in the preselector circuits. The coaxial lines are less than a quarter wavelength long and are, therefore, predominately inductive. The lines are tuned to the desired frequency by the addition of capacitance (C_1 and C_2) across their unshorted ends. In this way the tuned lines become parallel resonant circuits. C_1 and C_2 are variable and tune the preselector circuits through the entire u.h.f. band.

The input impedance of the tuner is 300 ohms, balanced to ground. The transmission line is coupled to the first preselector circuit by two half-turn loops located between the inner and outer conductors of the line. Coupling between the first and second preselector circuits is provided by two loops, L_{162} and L_{163}. The loops function in the same manner as conventional link coupling. Two loops are used to provide more uniform coupling over the tuning range. The output of the preselector is applied to a crystal mixer, CR_{102}, by means of a tap on the inner conductor of the second tuned line. The tapped line is analogous to a tapped coil in a lower frequency circuit.

A push-pull, tuned-plate, tuned-grid circuit is used in the u.h.f. oscillator. To permit the use of an existing tube type of known reliability and availability the oscillator is operated at one-half the desired frequency. Operation at a lower frequency also results in improved stability and uniformity in manufacture. The oscillator tube is a 6J6.

The oscillator plate coil is a flat half turn, stamped from heavy sheet metal to provide maximum uniformity and rigidity. The plate circuit is tuned by means of a split stator condenser, C_4. The rotor of C_4 is ganged with the preselector and harmonic selector tuning condensers. L_{153} in the oscillator grid is self resonant at the lower end of the oscillator tuning range. It maintains the oscillator output at the lower frequencies where it would normally fall off.

The oscillator output signal is applied to a crystal harmonic generator, CR_{101}. Coupling between the oscillator and the harmonic generator is provided by coupling loop L_{160}. The harmonic generator distorts the oscillator signal, increasing its harmonic content. The proper oscillator harmonic signal is selected by means of a third tuned coaxial line. By means of a tap on the center conductor of the harmonic-selector coax line, the oscillator 2nd harmonic signal is applied to the mixer, CR_{102}.

The i.f. signal appears across L_{155}. From this point the signal is link coupled (L_{156}) through a 72-ohm coax line to the input of the v.h.f. tuner. The v.h.f. channel selector actuates S_{101}, applying "B+" to the u.h.f. tuner, when it is switched to the thirteenth or u.h.f. position.

The output frequency of the u.h.f. tuner is 41 mc. and the v.h.f. tuner operates as a 41 mc. i.f. amplifier when receiving u.h.f. stations.

I.F. and Detector Circuits

Four 41 mc. stagger-tuned intercarrier i.f. stages, employing 6CB6's, are provided. The grid circuit of the first video i.f. stage is double tuned. All of the other coupling circuits are

Fig. 1. The u.h.f. tuner used in the Du Mont RA-171 chassis. The output of this circuit is a 41 mc. i.f. signal which is fed to the cascode v.h.f. tuner of the set.

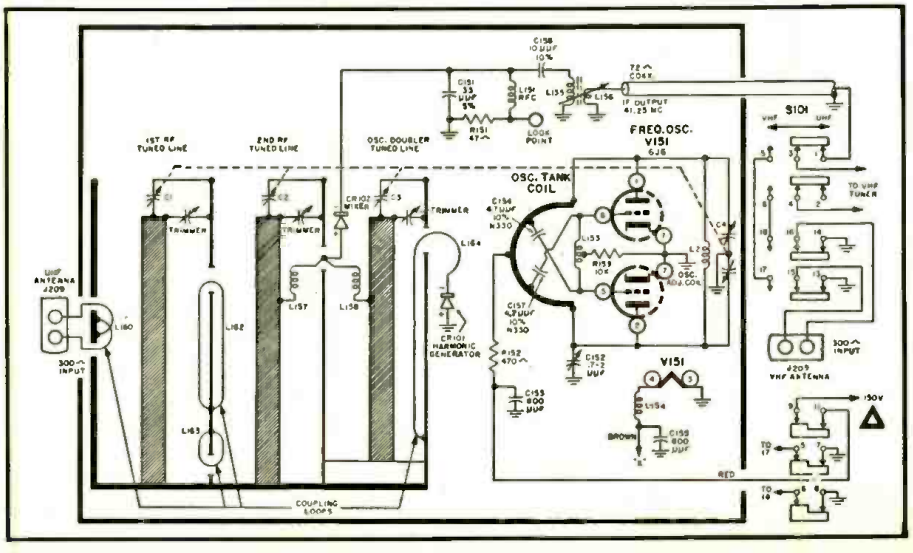
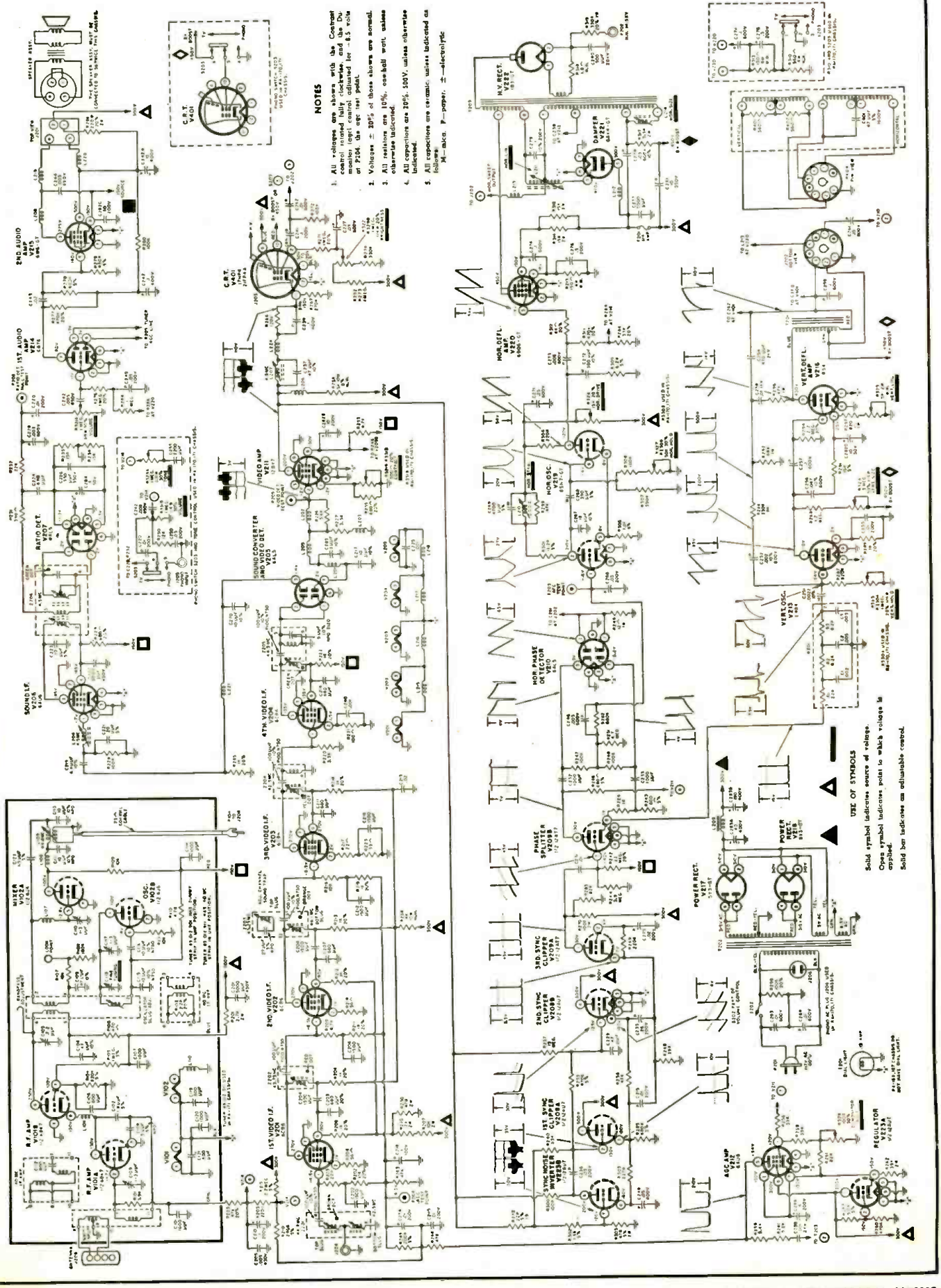


Fig. 2. Complete schematic diagram of the Du Mont RA-166/167, 170/171 chassis.



single tuned. A 47.25 mc. absorption type, adjacent-channel sound trap is provided in the plate circuit of the second i.f. stage.

Separate video detector and sound i.f. converter diodes are provided in place of the usual single diode. The use of separate diodes makes possible an increase in the amplitude of the sound i.f. signal at the output of the sound converter.

Direct coupling is employed between the video detector and the video amplifier as well as between the video amplifier and the CRT. A single high gain 12BY7 video amplifier stage is used. A single 4.5 mc. sound i.f. stage is employed followed by a ratio detector and two audio amplifier stages.

A.G.C. Circuits

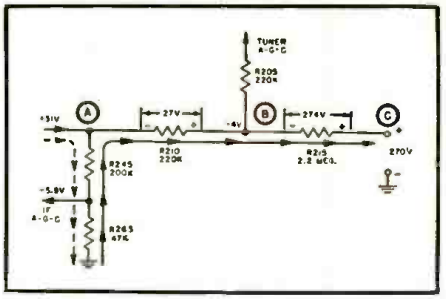
A keyed a.g.c. system with provisions for delaying application of a.g.c. voltage to the v.h.f. tuner is used in these chassis. Delaying the application of a.g.c. voltage to the tuner greatly improves fringe performance by permitting the r.f. amplifier to operate at full gain on weak signals. It also permits the choice of a.g.c. circuit component values which allow the a.g.c. voltage to rise rapidly on strong signals, providing maximum performance over a wider range of input signal levels for a given setting of the a.g.c. control.

The a.g.c. circuit is shown in Fig. 4. The a.g.c. voltage at the plate of the amplifier, V_{212}, is applied to the delay circuit shown within the dotted lines. The delay network is shown in Fig. 3 with the diodes and condensers removed. The negative a.g.c. voltage appears at point A, causing a current to flow through R_{215} and R_{220} in the direction indicated by the dotted arrows. If we assume that this current is 225 microamps, point A will be approximately −55 volts with respect to ground. A bucking voltage of +270 volts is applied to R_{215}, producing a current through the circuit as indicated by the solid arrows. The total resistance of R_{220}, R_{218}, R_{210}, and R_{215} is 2,667,000 ohms, therefore, the current due to the +270 volts is approximately 100 microamps.

Since the direction of the current due to the bucking voltage is opposite that due to V_{212}, the currents subtract and the resultant current through R_{220} and R_{215} is 125 microamps, flowing from point A to ground. As a result, point A becomes approximately 31 volts negative. The a.g.c. voltage for the i.f. stages is taken off at the junction of R_{215} and R_{265}. The voltage at point A divides across these resistors producing a potential of approximately −5.9 volts at the i.f. a.g.c. take-off.

Since point A is 31 volts negative and point C is 270 volts positive, the total drop across R_{210} and R_{215} is 301 volts. This voltage divides across the resistors producing a drop across R_{210} of approximately 27 volts, making point B 27 volts positive with respect to A, or 4 volts negative with respect to ground. The tuner a.g.c. voltage is taken off at point B and applied to the tuner r.f. amplifier through resistor R_{205}.

Fig. 3. Partial schematic of the a.g.c. delay circuit showing the currents produced by the a.g.c. amplifier and the bucking voltage from the power supply.



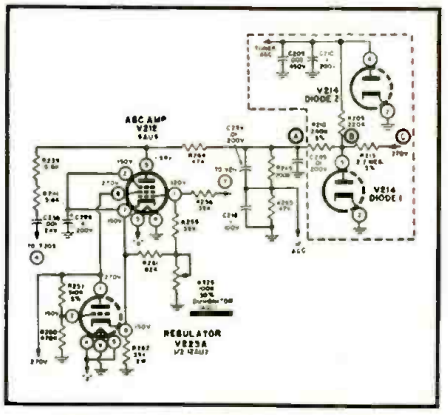


Fig. 4. The delayed a.g.c. circuit.

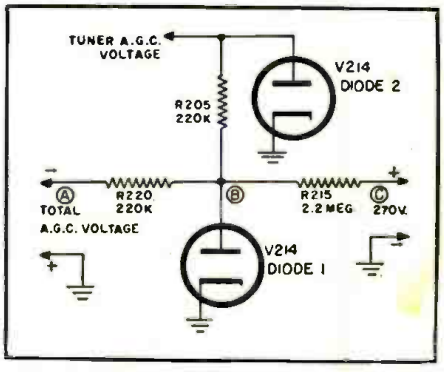


Fig. 5. Diode 1 of V214 produces the delay action of the a.g.c. circuit of Fig. 4.

The delay action of the circuit is described with reference to Fig. 5. Assuming that the same conditions exist as in Fig. 3, point A is −31 volts and point B is −4 volts. Now assume that the voltage at point A is gradually made less negative. This will cause the voltage at point B to gradually become less negative. When the voltage at point A is reduced to approximately −27 volts, the voltage at point B will be zero. A further reduction in the voltage at point A will cause the voltage at point B to become positive. V_{214} keeps this from occurring.

When the voltage at point A is sufficiently negative to produce a negative voltage at point B the plate of the diode is negative and it does not conduct. Therefore, it has no effect on the circuit. When point B tends to become positive, the diode begins to conduct, acting as a very low resistance to ground (practically a short circuit) and maintaining point B at zero potential.

Now let's see what occurs as the signal level at the input of the receiver changes. When the signal is very weak the a.g.c. voltage at point A is not very negative and point B tends to become positive, but the action of the diode keeps it at zero potential. As the signal strength rises, the voltage at point A becomes more negative. However, point B remains at zero until the signal level is great enough to produce approximately −27 volts at point A. The diode now ceases

Table 1. Normal resistance readings to ground at the pins of all tubes in Fig. 2.

		1	2	3	4	5	6	7	8	9
V201	6BC6	80K	56	.1	0	30K	30K	0		
V202	6CB6	50K	56	.1	0	30K	30K	0		
V203	6CB6	50K	61	.1	0	30K	30K	0		
V204	6CB6	.3	100	.1	0	25M	25M	0		
V205	6AL5	.3	.3	.1	0	1K	0	3.3K		
V206	6AU6	100K	0	0	.1	25M	25M	0		
V207	6AL5	INF	INF	.1	0	15K	0	15K		
V208	12AU7	25K	60K	680K	.1	.1	25K	520K	720K	0
V209	12AT7	50K	220K	3.9K	.1	.1	25M	3.9M	1.6K	
V210	6AL5	12	12	.1	0	4.8M	0	4.8M		
V211	12BY7	0-350	3.3K	0	0	0	.1	25K	25M	0
V212	6AU6	30K-40K	27K-30K	.1	0	280K	25K	27K-30K		
V213	6AB4	INF		.1	0		820K-1.8M	1K		
V214	6AT6	2M	0	0	.1	400K	600K	500K		
V215	6W6GT		.1	25K	25K	270K		0	25M	
V216	6S4		820-5.8K		0	.1	2.2M			INF
V217	5Y3GT		25K		18		18		25K	
V218	5Y3GT		25K		18		18		25K	
V219	6SN7GT	5.3M	30K-50K	1.8K	80K-110K	250K-265K	1.8K	0	.1	
V220	6BQ6GT		0	500K	32K	500K		.1	150	Cap INF
V221	6AX4GT			INF		25K		0	.1	
V222	1B3GT		INF		INF		INF	INF		CAP INF
V223	12AU7	25K	300K	30K	.1	.1	150K	30K	1M	0
V401*	CRT	0	1M-1.5M				25K			
			*10		11	12				
			INF		100K	.1				

The above resistance readings were taken with an RCA Model WV97A v.t.v.m. All readings are in ohms, K = 1000, M = million. When the reading is affected by a control two readings are given. These readings indicate the variation produced by the control.

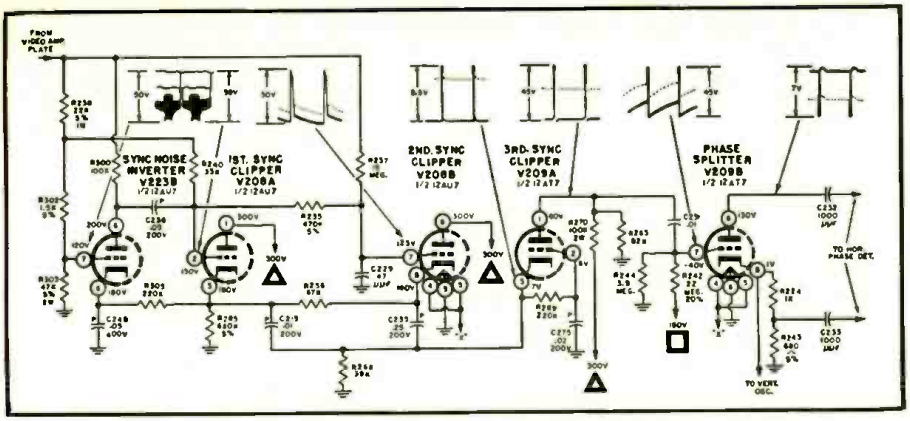


Fig. 6. Schematic diagram of the vertical and horizontal sync circuits.

to conduct and as the input signal level continues to increase, making point A more negative, point B also becomes negative and a.g.c. voltage is applied to the tuner r.f. amplifier.

To keep the plate current of the r.f. amplifier from exceeding the maximum tube ratings, a minimum grid bias of —.5 volt must be maintained on the tube. This bias is obtained from the plate of diode 2 in Fig. 5. When the voltage at point B is zero the plate of diode 2 assumes a potential of —.5 volt, due to contact potential. This contact potential is produced by random electrons which strike the plate of the diode and create current flow in R_{205}.

As shown in Fig. 4, a voltage regulator tube, V_{223A} is provided to stabilize the cathode voltage on the a.g.c. amplifier. This tube prevents line voltage or power supply load fluctuations from affecting the a.g.c. voltage.

Sync Circuits

The sync circuits are shown in Fig. 6. The composite video signal at the plate of the video amplifier is applied to the upper end of R_{238}. That portion of the signal which appears across R_{201} is applied to the grid of the noise inverter, V_{223B}. V_{223B} is biased beyond cut-off and under normal operating conditions there is no signal at the plate of the stage.

When a noise pulse that is greater than the sync pulse comes through, it drives the tube into conduction and a pulse appears in its output. The output of the noise inverter is coupled to the grid of the first sync clipper, V_{208A}. The composite video signal is also applied to the grid of the first sync clipper. The noise cancellation

(*Continued on page* 153)

Table 2. Alignment procedure for the video and sound i.f. circuits of the Du Mont RA-166/167, 170/171 chassis.

STEP	SIGNAL GENERATOR FREQUENCY	SIGNAL GENERATOR CONNECT TO	OUTPUT INDICATOR	CONNECT TO	ADJUST	REMARKS
VIDEO I.F. ALIGNMENT						
1	44.5 mc. no sweep	Pin 5 V101	V.T.V.M.	Pin 2, V211	Z205 for maximum reading	Set signal generator output to maintain reading on lowest range of V.T.V.M.
2	42.5 mc. no sweep	Same	V.T.V.M.	Same	Z204 for maximum reading	Same
3	46.1 mc. no sweep	Same	V.T.V.M.	Same	Z203 (bottom) for maximum reading	Same
4	43.75 mc. no sweep	Same	V.T.V.M.	Same	Z202 for maximum reading	Same
5	47.25 mc.	Same	V.T.V.M.	Same	Z203 (top) for minimum reading	Increase signal generator output to obtain reading on V.T.V.M.
6	43.5 mc. center freq. 10 mc. deviation (min.)	Same	Oscilloscope through crystal probe	Pin 5 V201	Mixer plate coil (L109) and Z201 (top) for 44.8 mc. marker on one peak. Z201 (bottom) for 42.5 mc. marker on other peak	Adjust for waveform below 
7	4.5 mc. 400 cps AM	Pin 2 V211	Oscilloscope through crystal probe	Junction R266, R267, and C239	L207 for minimum reading	
SOUND I.F. ALIGNMENT						
8	4.5 mc. Approx. 1 mc. sweep	Pin 5 V205B	Oscilloscope through crystal probe	Pin 7 V207	L204 and Z206 (bottom)	Adjust for waveform below 
9	As above	As above	Oscilloscope direct	Junction R232, C228	Z206	Adjust for waveform below 

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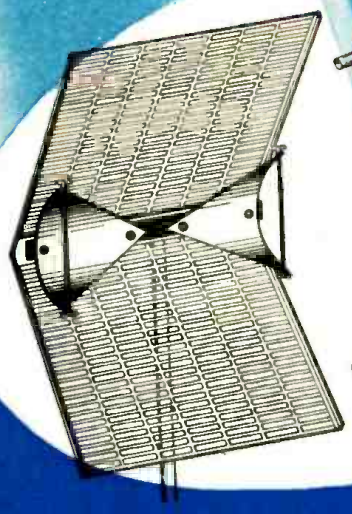
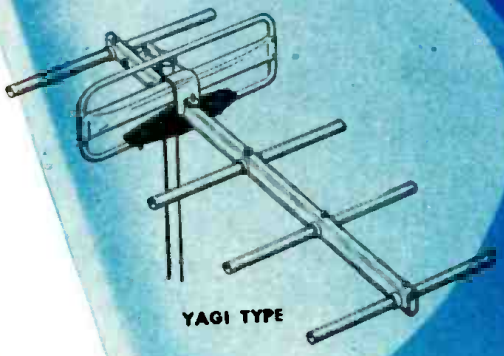


CORNER ARRAY TYPE



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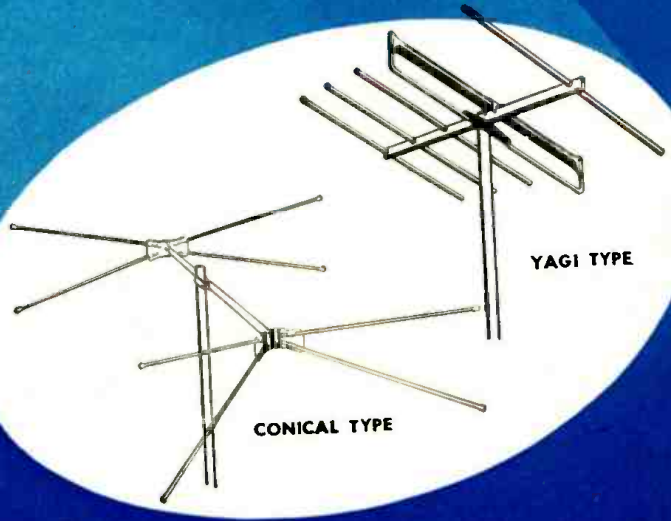

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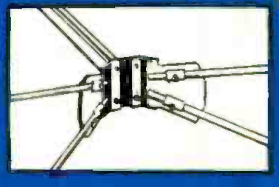

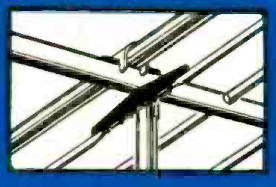

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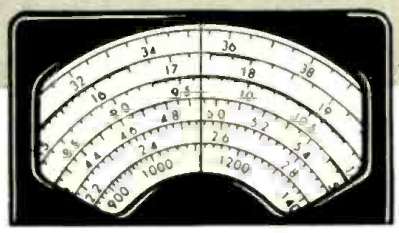

Compiled by KENNETH R. BOORD

BEGINNING with this issue, due to space limitations, the *ISW DEPARTMENT* will, of necessity, be confined largely to items about *new* stations and *changes* in calls, powers, frequencies, and schedules. Please continue to send your *top-flight* DX items to Kenneth R. Boord, 948 Stewartstown Road, Morgantown, West Virginia, USA. Thanks!

* * *

Around the World

(*NOTE:* When this was compiled, some stations had not yet gone on *summer* schedules; hence, in some instances schedules may now be *one hour earlier* than listed herein.—K. R. B.)

Afghanistan—Kabul Radio, 9.975, more recently has been on the air most days 1100-1115A, but some days (such as Sun.) continues with request session to 1135A. (Pearce, England)

Albania—Tirana, 7.850, has *English* now 1600. (Pearce, England) The 6.55A channel carries *separate* program, closes 1605. (Ridgeway, South Africa)

Anglo-Egyptian Sudan—Radio Omdurman has *dropped* its 31-m. outlet, is more recently on 7.664 and 6.438. (Ridgeway, South Africa)

Angola—CR6RO, *Radio Clube de Bie,* Silvo Porta, has *returned* to 7.584 from 7.214; heard 0115-0230, 1200-1545. (Ridgeway, South Africa) CR6RG, *Radio Diamang,* Dundo, 9.340, verified via airmail; listed schedule for all-Portuguese sessions as 1300-1430 and 0600-0730 Sun., holidays. (Hardwick, N. Z.; Kary, Pa.)

Argentina—LRA, 17.72, noted with *English* to North America 1700-1930. (Klein, Va.)

Austria—Radio Wien, Vienna, noted 0915 with recordings parallel on 7.245, 9.664. (Pearce, England)

Azores—By now, Ponta Delgada, 11.090, should be on *summer* schedule 1400-1500. Noted by Saylor, Va., others, 1600-1900 on 4.865.

Balearic Islands—Radio Menorca was spotted recently on 7.410, rather good strength 1400. (Mercier, France)

Bechuanaland—ZNB, 8.233A, Mafeking, relays SABC news 1200, weak, heavy CWQRM. (Hardwick, N. Z.)

Belgian Congo—OTH, 9.210, Leopoldville, relays VOA in Russian 1615-1645, 2215-2245. (Brown, N. Y.) OQ2AB, 11.900, Elizabethville, heard in Sweden 0930-1000 sign-off. (DX-Radio, Sweden)

Belgium—From May 1, *Radio National Belge,* Brussels, will be scheduled 0500-0600, ORU3, 17.860; 0600-0700, ORU3, 17.860, ORU4, 15.335; 0700-0800, ORU3, 17.860, ORU4, 15.335, ORU5, 11.850; 1200-1245, ORU3, 9.745; ORU5, 15.335, ORU5, 11.850; 1245-1300, ORU3, 9.745; 1300-1600, ORU3, 9.745, ORU4, 15.335; 1300-1600, ORU5, 6.000; 1600-1615, ORU3, 9.745; 1615-1800, ORU3, 9.745, ORU4, 11.85; 1815-2200, ORU3, 9.767, ORU4, 9.144, ORU5, 9.705, with relay by OTC, 9.655, Leopoldville, Belgian Congo. (Lindholm, Sweden)

(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.

Radio Tetuan, listed 6.067, broadcasts daily from these attractive studios at 0800-1000, 1400-1800 EST in Spanish and 1000-1200 EST in Arabic. Location is Sp. Morocco.

Bolivia—CP38, 9.496A, La Paz, heard signing on 0557 with "Onward, Christian Soldiers." (Niblack, Ind.)

Brazil—By now, Sao Paulo should have *two new* 50 kw. stations on the air—*Radio Emissora de Piratininga,* 6.025, 9.635, 11.745, and *Radio Exelsior,* 6.125, 9.585, 15.265. (ISWC, London) PRL7, 9.720, Rio de Janeiro, good level around 2000. (Norman, Ga.) Noted closing 2100. (Morrison, R. I.) ZYZ20, 4.905, Rio de Janeiro, heard 2020 with music. (URDXC)

British Guiana—ZFY, *Radio Demerara,* Georgetown, listed schedule on 5.981, 2 kw., as 0515-1145 (from 0545 Sun.), 1445-2045. (Scheiner, N. J.)

British Honduras—Radio Belize, 4.951, is reported with *English* 1315-1400, 2000-2100. (ISWC, London)

British New Guinea—Port Moresby sent this schedule—VLT7, 7.280, 1545-1745, 0315-0745; VLT9, 9.520, 2100-2245, 0100-0300; all-*English* except has native 0130-0300 weekdays. (Scheiner, N. J.)

Bulgaria—Radio Sofia has *English* for Europe 1345-1400, 1600-1630 on 7.671, 6.070; for North America 2000-2030, 2300-2315 on 9.700. (Pearce, England, others)

Canary Islands—EA8AB, Santa Cruz de Tenerife, is now heard near 7.305 to 1800 closedown (1830 Sat.) (Radio Amateur, London)

Cape Verde Islands—CR4AA, 7.130, noted 1600-1700 in Portuguese. (French, Mass.)

Ceylon—Radio Ceylon noted closing on 15.120 at 0230. (Pearce, England) Heard by Cushen, N.Z., on 4.870 lately to 1145 sign-off, excellent strength; noted by Reeder, Pa., on 11.975 at good level 1100 with religious broadcast, and by Washington, N. J., closing 1145 (some days runs later).

Chile—CE1174, 11.740A, Santiago, signs off 2400. (Niblack, Ind.)

China—Radio Peking, 6.100, and other channels, now has POW messages Tue. and Fri. (perhaps other days) in English session 0400. (Gay,

(*Continued on page* 129)

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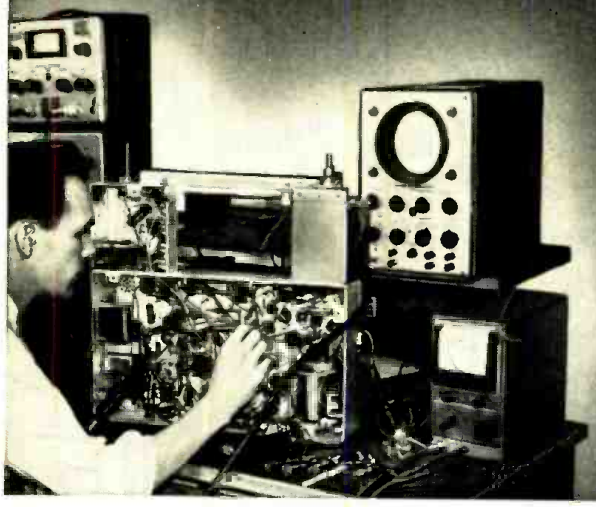

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A NOISE LIMITER DELUXE

By J. J. HOEFER, WØIIJ

A further improvement on recent designs, this compound full-wave noise limiter promises advanced performance.

WITH hundreds of new mobile rigs being installed each year, noise limiting is of increasing importance. One circuit recently described was that of the full-wave limiter circuit [1], which is used in at least one commercial receiver. However, slight changes will improve the limiting action.

The most that can be hoped for in a simple noise limiter is to prevent noise peaks from exceeding audio peaks, regardless of percentage of modulation. More clipping will result in flattening the audio peaks, distorting the sound. Noise silencers may succeed in reducing noise peaks to zero, but only with the addition of amplifiers and complicated circuitry, requiring more current from the overworked battery of a mobile installation.

The full-wave limiter is shown in Fig. 1A. The potentiometer resistance is such that the limiting may be adjusted for modulation percentages of 100 at *B* to 33⅓ at *A*.

In actual practice the potentiometer may be set for as much limiting as needed, fidelity being sacrificed to intelligibility.

Both diodes will be conducting if any negative voltage is developed at *A* by the second detector. Let us assume minus 12 volts d.c. developed at *A* by an unmodulated carrier. The voltages at *C* and *D* will then be minus 8 and minus 4 volts with respect to ground. If the potentiometer is set to *B* and the carrier modulated 100%, an 8-volt peak-to-peak voltage appears at *B*. The voltage at *D* will thus be swinging from 0 to minus 8 volts. Any additional negative swing, such as from a noise pulse, merely causes diode 1 to open and the noise is not passed. Any additional positive swing causes diode 2 to open, with the noise not being passed.

For a lower-percentage modulated signal the potentiometer is set nearer *A*. This increases the amount of audio, and again 8 volts peak-to-peak is applied at *D*. The output signal and noise are both attenuated in the voltage divider composed of diode 1 and the 470,000 ohm resistor between *C* and *D*, section *X*, Fig. 1B. Under signal conditions the diode conducts, and the diode resistance is its forward resistance of approximately 200 ohms. Essentially all of the signal is passed (Section *Y*, Fig. 1B). With strong negative noise pulses present, the diode does not conduct and the diode resistance is its back resistance. This may be on the order of 500 megohms or higher. The noise is very greatly attenuated (Section *Z*, Fig. 1B).

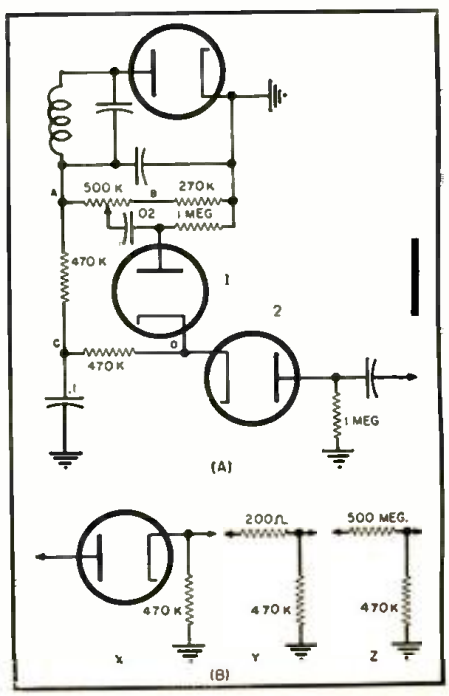
Similar considerations exist for diode 2 and the 1-megohm resistor in the output of the limiter for positive noises pulses.

A vacuum diode is a necessity in this circuit for the above reasons. However, space limitations in existing car receivers may preclude the addition of another tube to the chassis. Additional battery drain is also a factor.

The final circuit, as shown in Fig. 2A, overcomes these difficulties. The only change from Fig. 1 is that two resistors have been replaced by diodes. This circuit is now a full-wave compound limiter. Diode 3 is normally non-conducting and a biasing voltage is applied through its back resistance of 500,000 ohms to the cathodes of diodes 1 and 2.

As in Fig. 1 the output signal and noise are both attenuated in a voltage divider now composed of diodes 1 and 3 (Section *X*, Fig. 2B). Under signal conditions diode 1 conducts and essentially all of the signal is passed

Fig. 1. (A) The full-wave limiter. (B) Attenuation network: basic circuit. X; diode conducting. Y; diode non-conducting. Z.



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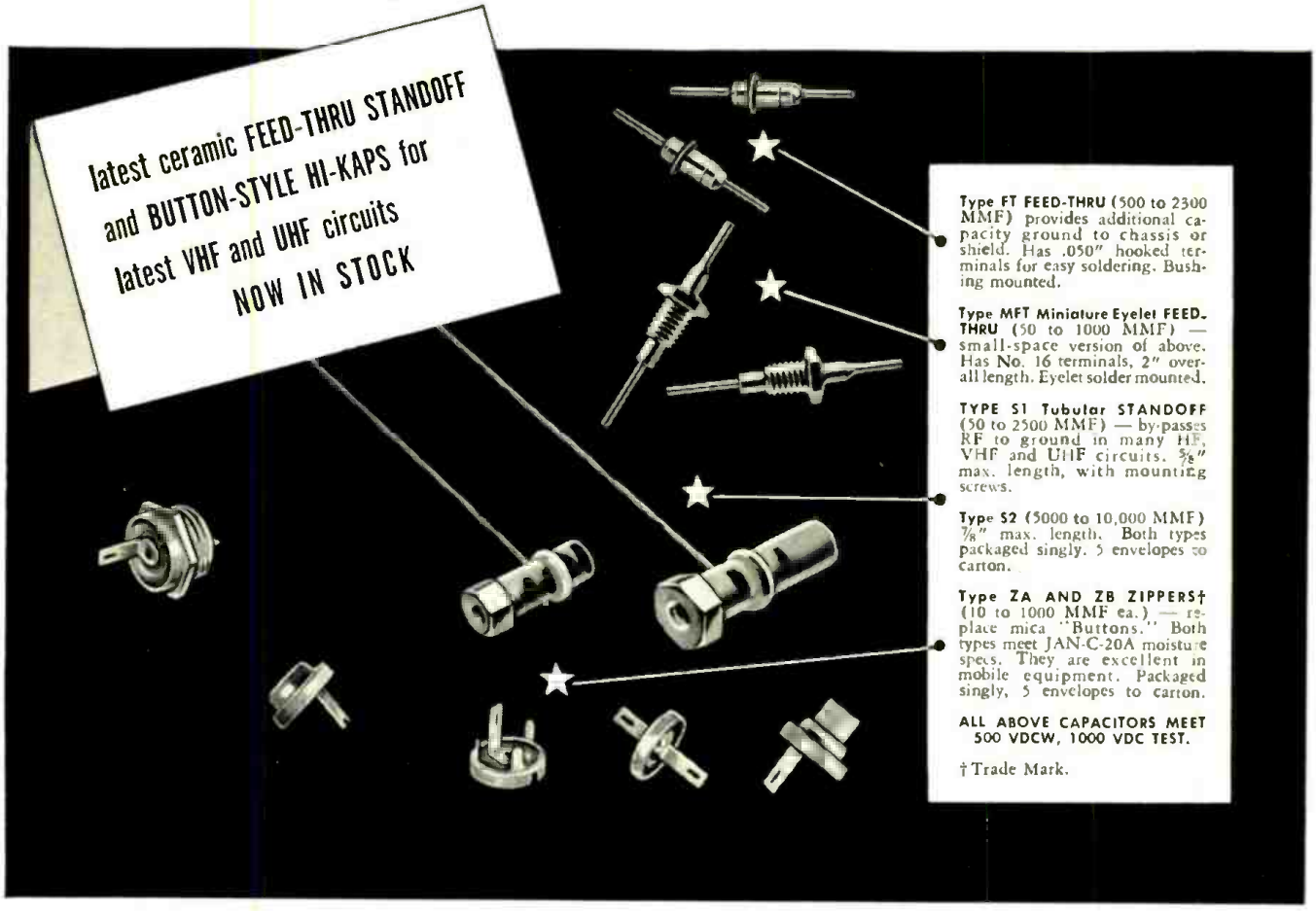

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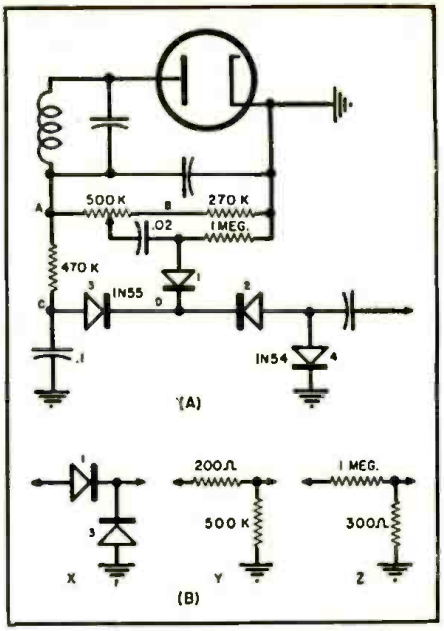

Fig. 2. (A) The full-wave compound limiter. (B) Attenuation network: basic circuit, X: signal conditions, Y: noise conditions, Z.

(Section Y, Fig. 2B). With strong negative noise pulses present, only diode 3 conducts (Section Z, Fig. 2B) and the noise is even more greatly attenuated than in section Z, Fig. 1B.

The action of diodes 2 and 4 is similar for positive noise pulses.

As diodes 3 and 4 have special characteristics only those specified will allow proper operation. Diodes 1 and 2 may be any of a number of different types including 1N54 and 1N55. The 1N54 is preferred as it is a high back resistance type.

It is recommended that the audio detector be replaced by a crystal diode. This eliminates noise leaking around the limiter through interelectrode capacities of the tube. Conventional duo-diode triode tubes simply won't keep the noise where it belongs, and the limiter cannot do its job properly.

The effectiveness of a compound limiter has been demonstrated [2], and it is logical to conclude that the full-wave compound limiter represents the ultimate. All that is needed now is a device to automatically set the potentiometer!

Besides its sheer effectiveness, the full-wave compound limiter offers the advantages of remarkable simplicity and negligible battery drain. Some experimenters may, of course, want to adapt this circuit to the home station receiver, especially in some urban locations where a vast "symphony" of noise, with crescendos and all, seems to be played 'round the clock.

Credit is due WØEDB for the initial design and for timely suggestions during the preparation of this article.

REFERENCES

[1] *Grenfell, W. S.; "A Noise Limiter for Everyone," CQ, August, 1952.*
[2] *Moses, R. C.; "Impulse Noise Limiters," Radio & Television News, REE Edition, June, 1951.*

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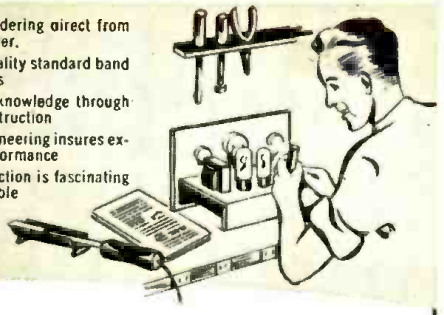

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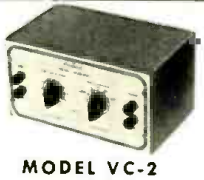

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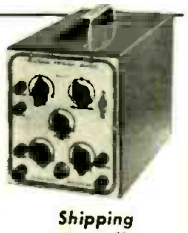

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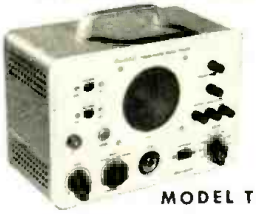

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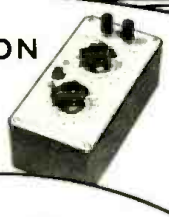

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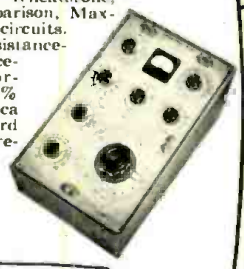

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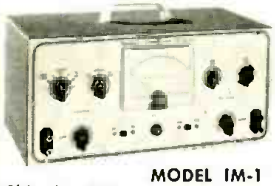

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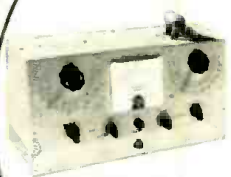

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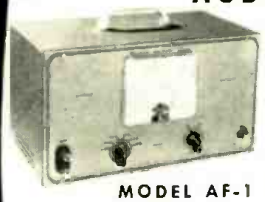

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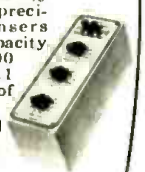

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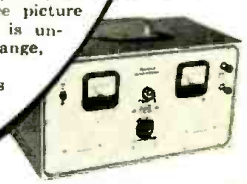

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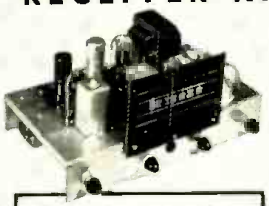

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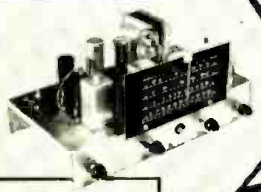

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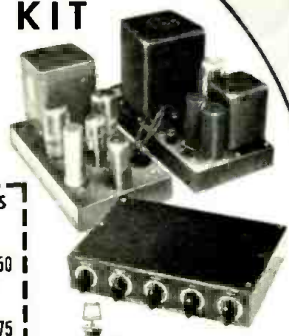

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MODEL A-7
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Shipping Wt. 16 lbs.

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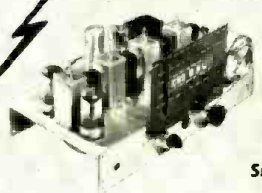

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Sensitive transformer operated 8 tube circuit. Frequency coverage 88–108 mc. Pre-assembled and tuned "front end." Vernier tuning with slide rule type dial.

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MAKE YOUR OWN U.H.F. CHOKES

By **E. J. GAUSS, WØEOS**

An ingenious method for winding self-supporting u.h.f. chokes which are light in weight and have high "Q".

WITH increasing interest in v.h.f. and u.h.f. because of TV and other applications, the experimenter or amateur often finds that he needs small, efficient r.f. chokes. For coils whose inductance is sufficient to make the self-supporting method of winding impractical the conventional way has been to use a resistor for a coil form. A resistor of suitable physical size whose resistance was high enough to be ignored was selected. The inductor was then wound on the resistor. Unfortunately it is often difficult to find a proper resistor. Another objection to this method arose in the design of lightweight model airplane radio control equipment. The weight of the resistor seemed unnecessary.

To meet this problem a simple technique for making "air wound" coils was developed. First a smooth rod whose diameter was slightly smaller than the desired inside diameter of the coil was selected. It is necessary that one end of the rod be free of flanges so that the coil may be slipped off later. A very slight taper in the rod is helpful but is not required. The rod is then wrapped with *Scotch* tape with the sticky side out. (See *X* in Fig. 1A.) Only one layer is necessary and it should be wrapped loosely enough so that the resulting tube will slide freely on the rod. The desired coil is then wound. (See *Y* in Fig. 1A.) The ends of the wire may be secured by a small strip of tape. Spaced winding is easy if two wires are wound together and then one is removed; the wire holds its spacing because of the adhering qualities of the *Scotch* tape. Next the whole coil is covered with a layer of tape. this time sticky side down. (See *Z* in Fig. 1A). The coil is then slid off the end of the rod (Fig. 1B) and the edges are trimmed. If the tape is allowed to extend about ⅛ inch beyond the ends of the wire in the coil the top layer may be stuck to the bottom layer at the ends sealing the coil.

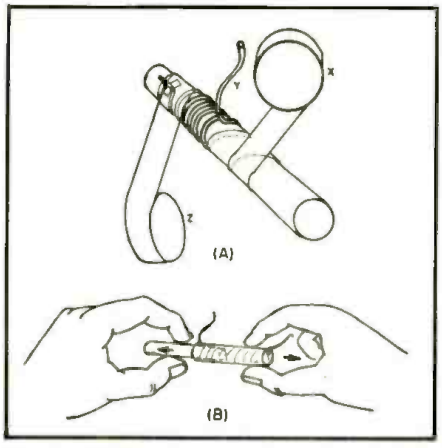
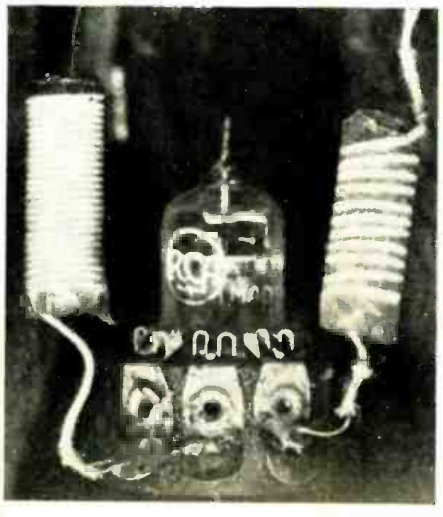


Fig. 1. (A) Steps in preparing rod and winding coil. (B) How coil is removed from rod.

If the coil will not slide off the rod either the wire was wound with too much tension or the first layer of tape was improperly wound. In either case the inductor should be rewound. By using this method anyone should be able to make a good choke in a few minutes with negligible cost for materials.

A one-meter miniature transmitter using isolation chokes of the type described.

A light weight r.f. amplifier which incorporates the self-supporting chokes.



Semi-quantitative tests were run to determine the relative "*Q*" of bare copper coils wound using this method. The comparison was made to self-supporting bare copper wire coils and similar coils wound on resistors. The results showed that the self-supporting coils had the highest "*Q*," closely followed by the cellophane-tape types. Poorest was the resistor - mounted style. —30—

OSCILLATOR BOOSTER FOR BATTERY SUPERHETS

By CHARLES ERWIN COHN

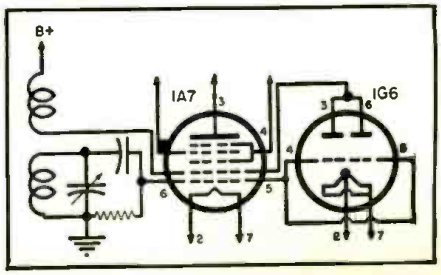
IN most battery superhets the oscillator is the most troublesome circuit, as it is in other sets as well. Many times a weak battery or tube will cause the oscillator to stop functioning, when the rest of the set is still operating normally, and force a premature replacement. This is especially bad if the set has short-wave bands.

This trouble can be overcome in the design of a new set by incorporating an oscillator booster tube, as shown in Fig. 1. The grid and plate of the booster tube (in this case a 1G6) are merely connected to the oscillator grid and anode respectively. Almost any tube is suitable for this purpose. A 1G4 single triode is good, or any r.f. pentode such as the 1N5 connected as a triode. Power output pentodes or beam tubes such as the 1A5 or 1C5 should not be used, as they will draw excessive plate current, being operated with zero bias.

The advantage of this hookup over using the tube as a separate local oscillator and the converter tube as a mere mixer is that the oscillator power obtained is that of the converter and the booster tube combined. For example, on the author's set neither the 1A7 nor the 1G6 alone would oscillate on the low end of the 7 to 15 megacycle band, but with both together in this hookup a strong oscillation was obtained. In sets using the 1R5 converter, the plate of the booster tube should be connected to the screen or wherever the plate winding of the oscillator coil goes. Most battery converter tubes use large grid leaks and instability might be noticed on the high end of a tuning range. In such a case, merely reduce the size of the grid leak until the instability is removed.

The application of this circuit will have two beneficial effects. First, it will provide considerable improvement in the performance of the set in those ranges where oscillation is weak or absent. Second, it will enable the oscillator to operate with lower battery voltages or tube emissions, and thus permit longer tube and battery life. —30—

Fig. 1. Using a 1G6 as an oscillator booster. Many other battery-operated tubes will work in a similar circuit.



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STATE, CITY	STATION	CHANNEL	FREQUENCY RANGE (IN MC.)	VIDEO WAVELENGTH (IN FT.)	VIDEO POWER* (IN KW.)
Alabama					
Mobile	WALA-TV	10	192-198	5.08	316
	WKAB-TV	48	674-680	1.45	270
Montgomery	WCOV-TV	20	506-512	1.94	88
Arizona					
Mesa	KTYL-TV	12	204-210	4.79	26.9
Tucson	KOPO-TV	13	210-216	4.65	316
	KVOA-TV	4	66-72	14.61	11
Arkansas					
Little Rock	KRTV	17	488-494	2.01	2.1
Colorado					
Colorado Springs	KKTV	11	198-204	4.93	250
Denver	KFEL-TV	2	54-60	17.8	56
	KBTV	9	186-192	5.25	240
Pueblo	KDZA-TV	3	60-66	16.06	16.6
Connecticut					
Bridgeport	WICC-TV	43	644-650	1.52	180
New Britain	WKNB-TV	30	566-572	1.73	20
Illinois					
Peoria	WEEK-TV	43	644-650	1.52	170
Rockford	WTVO	39	620-626	1.58	15.5
Indiana					
South Bend	WSBT-TV	34	590-596	1.66	170
Iowa					
Sioux City	KVTV	9	186-192	5.25	29
Louisiana					
Baton Rouge	WAFB-TV	28	554-560	1.77	216
Maine					
Bangor	WABI-TV	5	76-82	12.74	1.9
Massachusetts					
Holyoke	WHYN-TV	55	716-722	1.37	180
Springfield	WWLP	61	752-758	1.31	150
Michigan					
Ann Arbor	WPAG-TV	20	506-512	1.94	22.5
Mississippi					
Jackson	WJTV	25	536-542	1.83	180
Missouri					
Springfield	KTTS-TV	10	192-198	5.08	12.5
Nebraska					
Lincoln	KOLN-TV	12	204-210	4.79	26.9
New Jersey					
Atlantic City	WFPG-TV	46	662-668	1.48	18
North Carolina					
Asheville	WISE-TV	62	758-764	1.29	23
North Dakota					
Minot	KCJB-TV	13	210-216	4.65	29.5
Ohio					
Lima	WLOK-TV	73	824-830	1.19	20
Youngstown	WKBN-TV	27	548-554	1.79	160
	WFMJ-TV	73	824-830	1.19	175
Oklahoma					
Lawton	KSWO-TV	7	174-180	5.61	10
Oregon					
Portland	KPTV	27	548-554	1.79	88
Pennsylvania					
Altoona	WFBG-TV	10	192-198	5.08	316
Bethlehem	WLEV-TV	51	692-698	1.42	2.25
New Castle	WKST-TV	45	656-662	1.50	20.5
Pittsburgh	WKJF-TV	53	704-710	1.40	13.4
Reading	WHUM-TV	61	752-758	1.31	260
	WEEU-TV	33	584-590	1.68	225
Wilkes-Barre	WBRE-TV	28	554-560	1.77	1000
York	WSBA-TV	43	644-650	1.52	170
South Dakota					
Sioux Falls	KELO-TV	11	198-204	4.93	57
Texas					
Amarillo	KFDA-TV	10	192-198	5.08	56
	KGNC-TV	4	66-72	14.61	100
Austin	KTBC-TV	7	174-180	5.61	109.6
El Paso	KROD-TV	4	66-72	14.61	56.3
	KTSM-TV	9	186-192	5.25	64
Galveston	KGUL-TV	11	198-204	4.93	59
Lubbock	KDUB-TV	13	210-216	4.65	31
Wichita Falls	KFDX-TV	3	60-66	16.06	60
	KWFT-TV	6	82-88	11.8	70.9
Virginia					
Lynchburg	WLVA-TV	13	210-216	4.65	28
Roanoke	WROV-TV	27	548-554	1.79	1
	WSLS-TV	10	192-198	5.08	250
Washington					
Spokane	KHQ-TV	6	82-88	11.8	100
	KXLY-TV	4	66-72	14.61	47.9
Tacoma	KTNT-TV	11	198-204	4.93	29.5
Wisconsin					
Green Bay	WBAY-TV	2	54-60	17.8	100
Hawaii					
Honolulu	KGMB-TV	9	186-192	5.25	35
	KONA	11	198-204	4.93	117

*From Station CP application.
The frequency of the video carrier = 1.25 + channel lower freq. limit.
Total number of television stations now on the air: 166 (25 of which are u.h.f.)

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FOR 50 YEARS Wiremaker for Industry

New 300 OHM TRANSMISSION CABLE by BELDEN

To You, Belden's Golden Anniversary Means

—product performance that can come only from a "know-how" that has grown through actual service since the inception of Radio.

—an ability to co-operate in pioneering new wires to meet or anticipate industry's growing needs.

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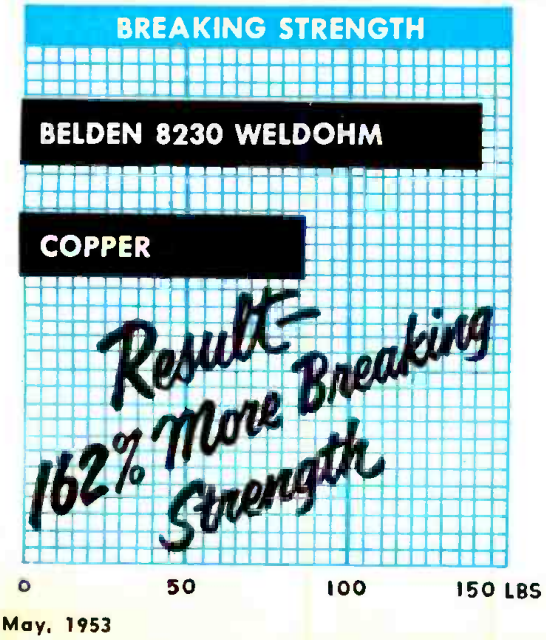

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COPPER-SHEATHED 20-GAUGE STRANDED STEEL WIRE

Brown Polyethylene-Resists Weather and Oxidation

The new Belden Weldohm, 300-ohm Transmission Cable is the greatest advancement in television installation since television began.

Reducing TV lead-in conductor breakage to a minimum is easy. The new Belden Weldohm Cable has overcome the breakage point by 162%, that's 1½ times the strength of pure copper wire.

In actual test, Belden Weldohm Cable will withstand 254% more whipping or severe flexing than the average installation of 300-ohm copper lead-in wire.

There is no difference in the electrical characteristics between an all-copper conductor and the Belden Weldohm copper-coated steel wire. The web is 72 mils of 100% virgin polyethylene.

NEW
FOR U.H.F. INSTALLATION
BELDEN ULTRA-WELDOHM — 8235

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Belden Radio WIRE

AMERICA'S FINEST 28 WATT—50 WATT AND 10 WATT P.A. VALUES

$69.95 BUYS A 28 WATT $150.00 LIST VALUE PORTABLE P.A. SYSTEM

(Illustration B)

3-SPEED PHONO TOP—TWO 12-INCH SPEAKERS 7-TUBES PUSH PULL 6L6'S HEAVY LEATHERETTE COVERED PLYWOOD PORTABLE CASES CRYSTAL MIKE $8.95 EXTRA

STOCK No. AP-28X. Portable 28 watt public address system. You get a 7-Tube heavy duty Push-pull 6L6 amplifier with inputs for 2 mikes either crystal or dynamic with separate mixing volume controls. One phono input. Fully variable tone control high fidelity, wide range frequency response. The heavy duty output transformer has taps for 4, 8, 16, 125, 250 and 500 ohm speaker connections. Two heavy duty 12 inch alnico V P.M. speakers, each with 25 feet of speaker cable. Each speaker is mounted in separate carrying cases. Each case has a snap on back and is large enough to give good speaker baffling. Each case is 21 x 16 x 13 inches. One is used to carry the amplifier. A 3-speed phono motor and pick-up is mounted in the top of the amplifier to play 33⅓, 45 and 78 RPM records.

This portable PA system will put out 20 watts all day long and 28 to 30 watts peak audio. McGee offers you this $150.00 list portable PA system at a terrific saving.

STOCK No. AP-28X complete portable PA system with 3-speed phono and speakers as pictured (less mike) ship. wt. 71 lbs. **$69.95.**

Electro Voice model 910 $28.50 list crystal mike with 20 feet of cable and desk stand **$8.95** extra.

Floor type mike stand instead of desk stand **$4.95** extra.

50-WATT PORTABLE P.A. ON SALE $99.95

3-SPEED PHONO TOP—TWO 12" SPEAKERS

(Illustration A)

10-tube portable 50-watt public address system. 4—6L6G (rush-pull parallel) output tubes. Inputs for 2 microphones, either crystal or dynamic, with separate mixing volume controls. Twin bass and treble tone controls. High fidelity wide range output transformer with taps at 4, 8, 16, 125, 250 and 500 ohms. Complete with 2 super heavy duty 12" PM speakers and 25 ft. cables mounted in separate leatherette-covered carrying cases. 21"x21"x13". The amplifier fits in one of the cases for carrying. This amplifier will put out 40 watts all day long and 50 to 60 watts peak with ease. 3-speed turntable and pickup arm to play all records 33⅓, 45 and 78 RPM is mounted in the top of the amplifier. Stock No. AP-60X. 50 watt portable P.A. system similar to the 28-watt model pictured above, less microphone. Sale price, **$99.95.** Shipping weight, 100 lbs. Shipped via Express or Truck only. Regular $45.00 list Electro-Voice 610 dynamic microphone with 20 ft. cable and desk stand, **$11.95** extra. For floor stand instead of desk stand, add **$4.95.**

10-WATT PORTABLE P.A. ON SALE $42.95

3-SPEED PHONO TOP—10" ALNICO PM SPEAKER

(Illustration C)

5-tube portable 10-watt (14-watt peak) public address system. (Push-pull 7C5) U. L. approved amplifier with wide range response. Inputs for microphone and phono, with separate mixing type volume controls. Tone control. 10" Alnico V PM speaker is housed in a leatherette case 21"x16"x13" which holds the amplifier for carrying. 3-speed turntable and pickup arm to play all records 33⅓, 45 and 78 RPM is mounted in the top of the amplifier. List value, $80.00. Stock No. AP-10X. 10-watt portable P.A. system similar to the 28-watt pictured above, except it has only one case and one 10" speaker, less microphone. Sale price, **$42.95.** Shipping weight, 41 lbs. Shipped via Express or Truck only.

Crystal microphone with non-removable desk stand, **$3.95** extra when ordered with the AP-10X portable P.A. system.

BRUSH CRYSTAL EAR PHONE With Control $5.49

Simply clip on to the speaker voice coil of any radio or TV set or to an audio amplifier. No soldering necessary. Listen in privately to your favorite programs. The tiny Brush crystal ear phone fits your ear just like a regular hearing aid ear piece. A small remote control box enables using 20 ft. from the radio or TV set. Has its own separate volume control and small matching transformer built-in to operate the crystal from any speaker voice coil, ideal for hospitals, homes, hundreds of other uses. 10 times more comfortable to wear than conventional earphones. Stock No. BH-500 includes Brush crystal ear piece, remote control box, 20 ft. of cable and instructions. Sale price, **$5.49** complete. Brush crystal earphone with 30" cord. Stock No. BK-51. **$2.95.** (You connect it like any crystal earphone, diagram furnished.) Accessory kit includes volume control with switch plus coupling capacity and instructions. 99c extra.

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McGee offers you a wide selection of good quality TV and Radio tube types. Individually cartoned. Our private brand. These are not set mfg's. culls, but a carefully inspected private line of tubes with a full 6 months' guarantee. Types listed are in stock to good quantity at this time. Thousands sold. Order 50 tubes and take 10% off the listed prices.

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1A7GT	.59	6AU6	.49	6K7GT	.59	7Y4	.69
1B3GT	.79	6AV6	.49	6L6G	1.09	12AL5	.59
1H5GT	.59	6AX4GT	.69	6S4	.59	12A8GT	.69
1L4	.59	6BA6	.49	6SA7GT	.59	12AT6	.49
1R5	.59	6BA7	.69	6SH7GT	.59	12AT7	.69
1S5	.59	6BC5	.59	6SF5GT	.59	12AU6	.59
1T4	.59	6BD6	.49	6SK7GT	.39	12AU7	.69
1U4	.59	6BF5	.59	6SL7GT	.69	12AV6	.59
1U5	.59	6BF6	.59	6SN7GT	.69	12AV7	.89
3Q4	.59	6BG6G	1.29	6SU7GT	.69	12AX4GT	.59
3Q5GT	.69	6BH6	.59	6T8	.79	12AX7	.69
354	.59	6BJ6	.59	6U8	.79	12BA6	.59
3V4	.59	6BK7	.99	6V6GT	.59	12BE6	.59
5U4G	.49	6BL7GT	.99	6W4GT	.59	12BD6	.59
6AB4	.69	6BQ6GT	.99	6X4	.39	12BF6	.79
6AK5	.89	6C4	.39	6X5GT	.49	12K8GT	.59
6AL5	.49	6CB6	.59	7A7	.69	12Q7GT	.59
6AQ5	.49	6CD6G	1.49	7B6	.69	12SF5GT	.69
						125J7M	.59
						125J7GT	.59
						125N7GT	.69
						125L7GT	.79
						19BG6G	1.79
						25B Q6GT	.99
						25L6GT	.59
						32L7GT	.79
						35Z5	.59
						35C5	.59
						35W4	.39
						35L6GT	.59
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						50L6GT	.59
						70L7GT	.99
						117Z3	.39

UHF TELEVISION CONVERTER $34.95

Sinco UHF television converter with built-in booster. Continuously variable for channels 14 thru 83. Built-in wide band VHF booster for channels 2 thru 13. Self powered for 110 volt, 60 cycle AC operation. Selector switch gives choice of VHF or UHF antenna. VHF antenna may be fed thru the broad band booster or direct to the TV set. Stock No. 21A, shipping weight 7 lbs. Net price **$34.95.**

REGENCY RC-600 $49.95 LIST

Carefully engineered and of highest quality construction. Features extreme stability, air dielectric in the tuning element, image rejection of VHF stations down 50 to 60 db. Converts all sets and is highly recommended for those having split sound and video. Tubes are 6AF4 oscillator, crystal diode mixer, 6BK7 dual triode IF amplifier and selenium rectifier. Front panel change-over switch for UHF or VHF. Input and output impedances 300 ohms. For 110 volt 60 cycle AC operation. Shipping weight 8 lbs. Stock No. RC-600, price **$49.95** each. lots of 3, **$37.46** each.

UHF-VHF ANTENNAS

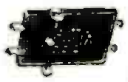
VEE-D-X Ultra Q-TEE. One antenna for all channels 2 thru 83 with a single transmission line (tubular 300 ohm recommended, your cost 4c per ft.) List price $14.25, your cost **$8.38.**

Two stack Ultra Q-TEE antenna for fringe area. List price **$29.55,** your cost **$17.58.**

UHF ADAPTING BRACKET

Permits addition of UHF antenna to existing VHF installation. Mounts three different ways to mast or antenna boom. List $1.50. Your Net Cost..... **88c**

VEE-D-X MIGHTY MATCH



Model MM-30. Provides best method of combining VHF-UHF antenna systems with single transmission line. Automatic action. Printed circuit filters. List $4.00. Your Net Cost..... **$2.35**

CORNER REF. UHF ANT. $8.95

Corner reflector antenna (less mast) for UHF only. As high as 10 db gain on channels 14 thru 83. (Tubular lead recommended, your cost 4c per ft.) With a Mighty Match you can connect this antenna with your present VHF antenna using only one lead to your set.

30 FOOT TELESCOPING MAST $10.95

Famous Trio antenna rotator. Net **$26.43.**

5 wire rotator cable, 3c per foot. Deluxe 30 foot telescoping mast, Stock No. ST-30, $10.95. Complete kit of guy wire, guy rings and base mount for mast, $6.00 extra. Prices do not include Express charges.

50-WATT BOOSTER AMPLIFIER

50-WATT BOOSTER AMP. **$39.95**

2-Mike Pre-Amp $12.95 Extra. Not a Kit, but a Manufactured Amp.

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 bass boost tone control. Size 8 x 6½ x 14½. Stock No. PA-55N. Shipping weight 26 lbs. **Sale price $39.95 ea.**

2-MIKE PRE-AMP. Pre-amplifier plugs in directly to the PA-55N 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 **$12.95 ea.**

McGEE'S $62.50 LIST 15" COAXIAL SPEAKER, $21.95

21 OZ. ALNICO V MAGNET—5" TWEETER

This is the finest 15" coaxial PM speaker value that we have ever offered. New 1952 production, of a famous manufacturer of fine speakers. The 15" speaker has a 21½ oz. Alnico V magnet; equal to 68 oz. of the Alnico 3 type magnet. The cone is free floating, of one piece construction. Will reproduce low frequencies down to 20 cps. The 5" tweeter is coaxially suspended and has a ridged cone to reproduce only the high frequencies. It will respond up to 17,500 cps. The high-pass filter is concealed under the pot cover, leaving only two wires to connect both the tweeter and woofer to any 8 ohm output transformer of a radio, or high fidelity music lover's amplifier. Stock No. P15-CK, shipping weight 13 lbs. Net price **$21.95.**

12" COAXIAL SPEAKER, $12.95

McGee offers the new 1952 model 12" coaxial PM speaker. Quality you would put in your finest sets if you were a manufacturer. 12" woofer has 6.8 oz. Alnico V magnet. Tweeter is coaxially suspended and has a metal diffuser. High pass filter is under the pot cover. Only two wires to connect to your radio or audio amplifier. 8 ohm with 18 watt peak and 10 watt average. Shipping weight 8 lbs. Response from 30 to 17,500 cps. Stock No. CU-14Y. Sale price **$12.95** each: 2 for **$25.00.**

12" JENSEN PM, $15.95

Another McGee Scoop! Jensen Concert 12", 14½ oz. Alnico V magnet PM speaker. 8 ohm voice coil. Will take 25 watt audio. You save dollars on this speaker. Just 100 to sell. Shipping weight 8 lbs. Stock No. P-12P. Sale price **$15.95;** 2 for **$30.00.**

G.I. 3-SPEED CHANGER WITH G.E. $22.95

VARIABLE RELUCTANCE TURN-ABOUT CARTRIDGE

Another tremendous McGee Scoop! Brand new General Instrument 3-speed automatic record changers. Complete with RPX-060 G.E. variable reluctance cartridge with turn-about stylus. Plays all 3 speeds automatically: 7", 10" or 12" records. Has reject button. Repeats last record. Base size, 12"x12⅞". Shipping weight 14 lbs. Stock No. 700-GE. Scoop price. **$22.95.**

GI 3-speed changer same as above, but with Webster flip-over twin needle cartridge. Stock No. GI-700. Sale price. **$21.95** each.

TELEVISION BOOSTERS AND CONVERSION KITS ON SALE AT McGEE

GENUINE STANDARD COIL T.V. BOOSTER $10.95

Not Surplus, But Right From the Factory

Latest Model B-51 Standard Coil Television Booster. McGee makes another lucky purchase and as usual, passes the saving on to you. The famous Model B-51, 12 Channel Standard Coil TV booster, which lists for $35.00, is offered to you for only **$10.95 each Brand new, factory cartoned and fully guaranteed** by McGee. This top quality single stage booster utilizes printed high frequency circuits, for improved performance on all channels. Uses 6AK5 tube. Average gain, 6 to 7 volts on low channels and 5 or 6 on high channels. No distorting of picture or sound. Has extremely low noise factor. Continuous one-knob tuning and channel selector control switch for off-on and by-passing 300 ohm lead-in to set. Modern design, dark brown plastic cabinet, 8"x4¼"x4½". Made for 110 volt, 60 cycle AC operation. Shipping weight 5 lbs. Model B-51, Sale price, **$10.95 each, or buy 2 for only $20.00.**

FRINGE AREA TV RECEPTION IS BETTER WITH OUR McMURDO SILVER TV BOOSTER $10.95—TWO FOR $20.00

Read the article on pages 52 and 53 of the December "Radio & TV News." You will see how a booster like the McMurdo Silver Super Sonic was used for fringe area TV reception. We can't guarantee this unusual reception, but we will guarantee this booster to be a sensational value. Continuously variable inductance type tuner from channel 2 including the FM band through channel 13. Self-powered for 110 volts AC operation. Incorporates a 6J6 tube. Input for 300 ohm TV line and 300 ohm output to TV set. Single knob tuning. Attractive plastic case. McMurdo Silver Super Sonic TV-FM booster. Stock No. GB-6B, shipping weight 5 lbs. Sale price, **$10.95** each or two for **$20.00.**

20 INCH CONVERSION KIT $29.95

YOU GET—

20HP4—20" PICTURE TUBE
20-INCH PLASTIC MASK
14 K.V. FLYBACK AND 70° YOKE

Our 20" conversion kit includes a 6-month guaranteed 20HP4, 20" rectangular blackface picture tube, plus a 14,000 volt G.E. built high voltage flyback transformer, plus a matched 70° cosine yoke, plus a 20" rectangular gold trimmed plexiglas mask and suggested diagram. The picture tube is the latest electro-static focus type that requires no focus coil. Shipped via express or truck only. Shipping weight, 40 lbs. Stock No. 20-TP, net price. **$29.95.** Price with Raytheon or GE 1 year guarantee picture tube, **$10.00** extra.

14-Inch Conversion Kit $25.95

14-inch conversion kit: You get a 14-inch black face, 1 year guarantee G.E. 14CP4 picture tube, a 70° deflection yoke with matching 14,000 volt G.E. flyback and a 14" plexiglas gold trim safety mask, plus conversion instructions. Stock No. 14CC-G. Sale price, **$25.95.**

17-INCH CONVERSION KIT $25.95

You Get—17BP4A 17" Picture Tube
17-Inch Plastic Mask
14 K.V. Flyback and 70° Yoke

17-inch conversion kit with a 17BP4A, 17" rectangular blackface electro-magnetic focus picture tube with 6 months' guarantee, plus a matched 70° cosine yoke, a G.E. built 14,000 volt flyback and a 17" rectangular gold trimmed plexiglas mask and safety shield. Suggested diagram furnished. Shipping weight, 30 lbs. via Express or Truck only. Stock No. 17-14XL. 17" conversion kit. Sale price, **$25.95.** Kit Price with GE or Raytheon 1 year guarantee picture tube, **$5.00** extra.

CAPEHART CABINET, $79.95

BLANK OR CUT TO FIT ESPEY CHASSIS

Buy this cabinet with Espey chassis and the VM changer at the left and have a fine radio-phono combination for less than the value of the cabinet alone. This beautiful cabinet was intended for a Capehart $800.00 combination. It is the finest possible furniture quality cabinet workmanship. 37" high, 40" wide and 21" front to back. Hinged top lifts in two sections. 25½" lid covers the changer compartment and 14½" is the width of the radio compartment. Changer mounting panel is furnished blank. Radio panel is shipped ready cut to fit the 7-C Espey chassis. Baffle is cut to hold 2—12" speakers. Made of top quality walnut veneer, ⅞" material used throughout. Shipped via truck, rail or express only. Shipping wt., 160 lbs. Stock No. C-175, with panel cut to fit Espey 7-C. **$79.95.** Stock No. B-175B, with blank changer and radio panel, **$79.95.** Buy 2—12" 32 oz. Alnico PM speakers for use in this cabinet for only **$15.00** ($7.50 each).

RCA 201E1 T.V. TUNER $7.95

Terrific buy on this RCA 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 I.F. strip. Offered at a sacrifice. Price was $44.00. Now only **$7.95** each, with tubes. Each tuner in good condition but has been repaired. Stock No. RCA-131. TV front end tuner. Convertor coil type for separate sound as used in the famous 630 chassis. Complete with 3—6J6 tubes. **$7.95.** Specify shaft length desired, either 2" or 4".

RCA 201E-1 T.V. TUNER

Same as pictured above only new—with 2⅞" shaft. Stock No. 2Z01. Sale Price, **$11.95.**

3-TUBE SARKES-TARZIAN T.V. TUNER $9.95

This popular Sarkes-Tarzian Type 3 tuner is widely used. 13 channel rotary type switch with individually tuned coils. Price is complete with diagram and three tubes: 6C4 osc., 6BH6 R.F. and 6AG5 mixer. Regular factory cost is twice our price. Each tuner is wired ready to hook up to a video and sound IF strip. May be used with either inter-carrier or separate sound IF circuits. Has built-on convertor coil, built in fine frequency control. Sarkes-Tarzian TV tuner, with 3 tubes. Net price, **$9.95** each. Specify shaft length, either 2⅞" or 4¾".

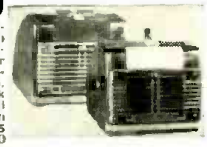
STANDARD COIL SUPER CASCODE TUNER $19.95

UHF STRIPS $9.40 EXTRA

The Cascode Circuit of the Standard Tuner offers a new development of this famous TV front end assembly which affords a 2-to-1 improvement in gain and a 35% to 50% reduction of noise over the pentode tuner. Other advances include: easy conversion to UHF reception by interchange of channel inductors; increased sensitivity for TV sets in fringe areas; elimination of booster use; and a high profit item for the serviceman as a replacement unit sale. Brand new factory TV-2000 TV tuner, compl. with tubes 6BK7 or 6BQ7 and a 6J6. Shaft length 3¼". Scoop UHF (specify channel) strips supplied in pairs for above cascode tuner, **$9.40** per set. UHF strips for other models of the Standard Coil tuners specify channel and series; either F, G, K, Q, R, H or M as printed on the tuner, **$9.40** per set.

3 STATION INTERCOM MASTER $16.95

SUB STATION $3.95



3-station intercom master housed in chrome plated metal cabinet 7½"x6"x5" sloping front. Full 3-tube amplifier for 110 volt AC-DC operation. Press-to-talk switch is on top of the cabinet and volume control with off-on switch and station selector switch are on either side. May be used with from one to 3 substations. (See matching cabinet chrome plated sub-station No. PM-A5). Master is quiet at all times except when press-to-talk switch is pressed at the master or call-back switch is pressed at the sub. Uses 3-wire intercom cable. 3-station intercom master MPM-A3, shipping weight 10 lbs. Sale price, **$16.95** each, sub-stations extra. 3-wire plastic intercom cable, 100 ft for **$1.95**, 500 ft. for **$8.95.**

INTERCOM SUB STATIONS $3.95

Chrome plated, with call back switch for a 3-wire intercom master. Size 7½"x6"x5" sloping front. 5" Alnico V PM spkr. Intercom dealers buy at less than present production costs. Limited quantity. Stock No. PM-A3, ship. weight 8 lbs. Sale price, **$3.95** each or 3 for **$10.00.** Special 3-wire plastic intercom cable, 100 ft. **$1.95**, 500 ft. for **$8.95.**

Brown leatherette covered intercom substation with call back switch for use with 3-wire intercom masters. 5" square and 2½" deep. Has new plastic grill cloth. Alnico V PM speaker. A true McGee value. Stock No. NE-5, ship. weight, 1½ lbs. Sale price **$3.95** each or 3 for **$10.00.** 3-wire plastic intercom cable, 100 ft. for **$1.95**, 500 ft. for **$8.95.**

CAPEHART CABINET FOR 1000 SET—ONLY $99.95

BEAUTIFUL WALNUT

99.95

Beautiful, finest quality walnut combination radio-phono cabinet, 42" high, 42" wide and 22" deep. Made for Capehart's finest combination, selling for $900 and up. Cabinet cost manufacturer over $200.00. Has highly polished matched walnut panels. Made of ¾" material. Top 1¼" solid stock. This cabinet weighs approximately 175 lbs. The changer radio and speaker grill all have hinged doors. Radio compartment on right hand side is 14" high and 14½" wide. Made to mount chassis vertically. Changer compartment is 14" high by 26½" wide. Large enough to hold any record changer or recorder mechanism. Front 10" of top over the changer compartment is hinged to fold back for easy access to the changer. Both radio and changer compartments come with uncut blank panels. Speaker baffle is cut for a 12" speaker and the speaker compartment is completely enclosed. Shipping weight, 275 lbs. Stock No. K-275W Capehart combination cabinet. Net Price, **$99.95.** Walnut.

COMPLETE RADIO, TELEVISION AND AMPLIFIER KITS AT McGEE

3-WAY PORTABLE KIT $15.95

New 1952 Model 3-way personal portable radio kit. Operates on 110 Volts AC-DC or 67½ B plus 1½ volt self-contained batteries. Leatherette covered case size, 5½x5¾x8". Receives broadcast 550 to 1650 KC. A conventional 2-gang superhet circuit with 456 KC iron core IF's. Incorporates the new super gain stick loop antenna. All plated chassis. Lab. approved circuit—matched parts. Price includes all parts, tubes, diagram, Alnico V PM speaker. A factory quality kit. Stock No. PN-4T, shipping weight 7 lbs. The complete kit, less batteries, **$15.95.** 67½V. B, **$1.59;** 1½V. A, 39c extra.

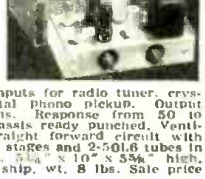
Build Your Own Phono-Mike Broadcaster $7.95

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.

8-Tube Hi-Fi Amplifier Kit $29.95

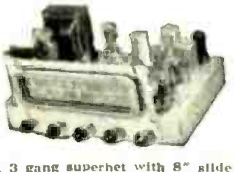
A complete kit, including tubes: 3-7E5, 2-12AX7, 2-triode plus rectifier diagram and photos. Inputs for radio tuner and any kind of phono pickup (crystal or G.E. variable reluctance) and either crystal or dynamic mike. Output matches 8 ohm voice coil. Twin electronic bass and treble tone controls with panic selector switch for either juke box quality with heavy bass response or brilliant symphonic range. Response 18 to 20,000 cps. 8 tube all triode amplifier kit, complete with tubes. Shipping weight 25 lbs. Model 7X5. Net **$29.95.**

10-Watt Hi-Fi Amplifier Kit $14.95



A complete kit of parts including tubes 12AX7, 12AU7, 2-5Q1.6, plus rectifier, diagram and instructions to build a high fidelity twin tone control audio amplifier with bass and treble boost. Inputs for radio tuner, crystal mike and crystal phono pickup. Output matches 8 ohms. Response from 50 to 15,000 cps. Chassis ready punched. Ventilated cover. Straight forward circuit with twin triode gain stages and 2-5Q1.6 tubes in push-pull. Size, 5¼" x 10" x 5¾" high. Model AP-10R, ship. wt. 8 lbs. Sale price **$14.95.**

10-TUBE RADIO KIT $29.95



10 tube broadcast radio chassis kit, complete with tubes: 2-6SK7, 6SA7, 3-6SN7, 1-6S1.7, 2-6V6 plus 5Y3 rectifier, diagram and instructions. 3 gang superhet with 8" slide rule dial. Chassis size, 12½"x10"x6½" high. Features push-pull 6V6 high fidelity audio. Output matches 3 to 8 ohm voice coil speakers. Inputs for G.E. variable reluctance or crystal phono pickup and crystal mike. Heavy duty power transformer. Model BK-10 kit less speaker, shipping weight 18 lbs. Net **$29.95.**

17, 20" T.V. Kit $59.95 Less Tubes

A complete kit of parts to build an AC transformer operated television chassis for use with a 16", 17" or 20" rectangular picture tube. The 12 channel Sarkes-Tarzian tuner is ready wired, as is the 4 tube video IF strip. Circuit is of the conventional design. Do not buy this unless you understand Television. It is difficult to wire. We furnish schematic. Kit model WH-20. Ship. wt. 40 lbs. less all tubes. Net $59.95.

Kit of 22 tubes, less picture tube **$16.95.** 17" 17BP4A, **$19.95.** 20HP4, **$25.00.**

6-TUBE 2-BAND KIT $14.95

Popular with schools and colleges for training. 6 tube AC-DC 2 band radio kit with plastic cabinet. Receives broadcast and 6 to 18 mc shortwave. Full 2 gang superhet with 5" speaker and slide rule dial. A complete kit with tubes: 12SK7, 12K8, 12SK7, 12SQ7, 50L6 and 35Z5, diagram and instructions. Factory quality. Cabinet size 13"x8¾"x8½". Shipping weight 12 lbs. Model ME6-2. Net **$14.95.**

5-TUBE AC-DC KIT $12.95

Model RS-5. A 5 tube AC-DC straight broadcast kit, housed in the same cabinet as ME6-2 above. Complete with tubes. Shipping weight 10 lbs. Net **$12.95.**

AC POWERED BROADCAST TUNER KIT $12.95

A self-powered, 3-gang superhet tuner kit with R.F. stage. This complete kit is furnished with a diagram, photos and tubes. 6BA6 R.F., 6BE6 oscillator R.F., 6BA6 I.F. detector. 6AL5 diode. AVC. Plus rectifier. Connect to any audio amplifier. Ideal for use with our S-2020 or 7x5 amplifier kits. Chassis size, 9½x4x4½" high. Shipping weight, 7 lbs. Broadcast tuner kit Model BT-38X. Net price, **$12.95.**

SPECIALIZE—FOR PROFIT

By YVON O. JOHNSON

Concentrate on servicing a single brand of TV receiver and cut inventory costs and overhead charges in general.

IF YOU have been wondering how to make your small TV service shop stand head and shoulders above the other shops in your locality, consider specializing in the repair of just one brand of receiver.

You should be able to increase your net profit through specialization if it is suited to you and your shop. Specialization can help you with customers, inventory, purchasing, and servicing.

Let's look at the advantages and disadvantages of specialization and then see how you can get started on it. This article applies to small shops doing service work as the main function with sales as a sideline, since the choice of the brand for repair work will determine the brand sold.

The Advantages

Increased customer acceptance. You'll probably agree that the shop which saves the customer money while rendering a quality service will prosper, providing it is operating at a profit.

When you specialize, you will become very familiar with the troubles of one brand. You'll be able to diagnose more sets in the home. You'll be able to repair more of them there because you can have the common replacement parts with you. Carrying parts for one set is fairly easy; for a couple of dozen, very difficult.

Customers will appreciate a shop that knows a brand well enough to service most sets in the home. Customers are reluctant to incur pick-up, shop, and delivery charges.

Of course, there will be many times when the set will still have to go to the shop, but you will have earned a reputation for doing shop work only when it is absolutely necessary.

Customers are impressed by specialization. Generally speaking, wouldn't you rather take your car to an auto repair shop specializing in your make rather than to a shop doing general work?

Better inventory. Your inventory and its turnover are favorably affected by specialization. Many tube types have a very slow turnover, yet it is necessary to stock them against the eventuality that they will be needed urgently at some future time. With one brand of TV, you'll have to stock only the tube types used by that manufacturer. The money that would be tied up in the slow movers can be used to maintain an adequate stock of the types needed.

Take a look around your shop and you'll probably find odds and ends of replacement parts which were ordered and, for various reasons, never used. And isn't each part for a different brand receiver? If you specialize, you'll avoid that problem as the chances are that you'll be able to use that replacement part soon.

You'll be able to maintain an adequate stock for one brand at the same or less expense than for maintaining an adequate stock for several makes.

Decreased purchasing time. The time that you spend in buying can be greatly reduced. You'll have to phone, write, or visit only one set distributor for exact replacement parts. You'll have to become familiar with only one manufacturer's part numbers and ordering procedure.

Parts warranties can be handled economically if you are doing it for one brand. You will not have to run around to several distributors, a tube here and there.

Increased shop efficiency. Unfortunately, all shop time is not productive. You should be able to cut down on diagnostic time when you specialize. You will know what voltages to expect at certain test points. You will know what the waveforms should look like on your oscilloscope. Often, in a repair job, much time is wasted by not knowing whether the voltage or waveform observed is within tolerance or is indicative of trouble.

Not only will you save diagnostic time, but you'll save alignment time. You'll know and remember the exact procedure to be followed. With this skill and speed in alignment, you will undoubtedly find it advisable to give every set that comes into the shop an alignment job. This will be feasible because you will have the necessary plugs, cables, etc., made up for that brand. You won't have to sort through a maze of other cables to find the ones you need.

Likewise, you can have a shop picture tube to avoid pulling the separate picture tubes from cabinets. This is most practical when you know that the shop deflection yoke and focus coil are exact duplicates of those in the home. What's more, they will have the proper plug attached!

You can easily have one or two shop speakers with the right plugs, transformers, and fields used by the one manufacturer in his models. This saves a few valuable minutes on each removal job. Such techniques are

The Picture Tells the Story

TV Antennas exist for one reason — to provide a clear, strong, sharp picture!

TRIO ZIG-ZAG* TV Antennas perform so well in this all important respect that they are America's most wanted.

Yes, a picture — the TV picture — tells the TRIO story more eloquently than anything else! Where all other antenna designs fail, high gain TRIO ZIG-ZAG TV Antennas consistently lock in sharp, clear pictures — from Maine to Texas, in city or country!

TRIO TV antennas look different, work different — provide a magnificent DIFFERENCE in picture quality!

*Patent Pending

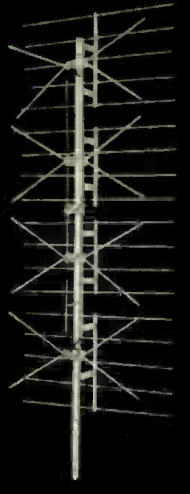
*New insulating sleeve, with longer leakage path and elimination of slit, does away with assembly errors — elements cannot short out. For maximum strength, new steel, electro-plated element clamps have been introduced.

Also in the Picture

The TRIO Rotator and Direction Indicator are the most dependable ever built. Developed after $50,000 research. Fully guaranteed for a FULL two years!

Best Buy in UHF Antennas

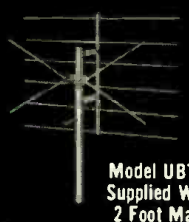
LOW IN COST — HIGH IN PERFORMANCE



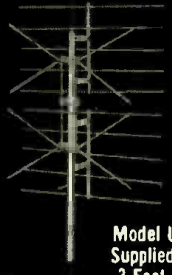
NEW TRIO UHF BOW-TIE with reflector

Sturdy, broadband antennas of uniformly high gain that have been thoroughly field tested. Phasing strips installed, pre-assembled — a jiffy to attach reflector screen. Available in one, two and four bay models. Usual high-quality TRIO construction.

Model UBT-4
Supplied With
4 Foot Mast

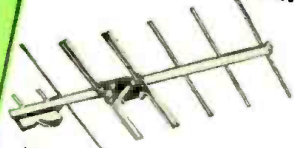


Model UBT-1
Supplied With
2 Foot Mast



Model UBT-2
Supplied With
3 Foot Mast

NEW TRIO UHF MULTI-CHANNEL YAGI ANTENNAS



Broadband yagis developed by TRIO now successfully applied to UHF. Four models cover all UHF channels, rarely more than two needed for any one area.

These high gain six element yagis have sharper directivity, thereby eliminating ghosts. Thoroughly field tested. Entire antenna mounted in front of mast removes metal from field of reflectors or antenna elements. Most clamp supplied. Completely assembled.

Model 6-UBY 14-26
for Channels 14-26
Model 6-UBY 27-42
for Channels 27-42
Model 6-UBY 43-60
for Channels 43-60
Model 6-UBY 61-83
for Channels 61-83

TRIO MANUFACTURING CO.

GRIGGSVILLE, ILLINOIS

shortcuts when you specialize, yet are impractical when you do general service.

The Disadvantages

Surely, the picture cannot be as rosy as it seems. There are definite disadvantages in this method of servicing.

First, there is the possibility that there may not be enough TV sets of any one desired brand in your area to make specialization practical. This, of course, is something that you must find out before you decide to specialize. Should you find there is little chance of keeping busy on one brand in your locality, then, by all means, do not specialize in just one brand. Should you find there is a large enough concentration of that make in your servicing area, then you may decide to go ahead with your plans.

It is improbable that you will be able to capture all the service work for that brand. Other service shops will have some faithful customers who will not think of changing. But it is doubtful that the majority of TV customers have fallen into that pattern. TV is still so new that most people seem to be shopping around for a competent—and inexpensive—service shop.

As a second disadvantage, you might say that specialization is like putting all of your eggs in one basket. Possibly it does not give you a broad enough base during slack seasons.

A partial answer to this is that you can accept any other servicing work that may come your way during the slack season to help compensate for the decreased business.

A third disadvantage is that another shop may decide to specialize in the same brand shortly after you make the same step. This will present a definite problem, but it should not be a hopeless one. If you are building up your customer relations and cutting down on inefficiency more than your competitor is, you should come out on top.

Closely allied to this disadvantage is another: What if the manufacturer or distributor should decide to do home servicing? It might be very difficult for you to compete. However, you might be able to compete successfully on the basis of personalized service.

How to Get Started

Determine the market. Your first job is to determine if the market for your specialized service is large enough to give you sufficient business. Let's say you are thinking of "X" brand TV. Will it be worthwhile?

One rough way to approximate the market is as follows: If the ratio of the number of "X" TV sets in your area to the total number of all TV sets in your area is equal to the ratio of your service jobs to all the service jobs in your area, then you could maintain your present service volume if you were to receive all the repair work on that brand.

This is stated in the form of a proportion:

Pipes that grew without getting bigger

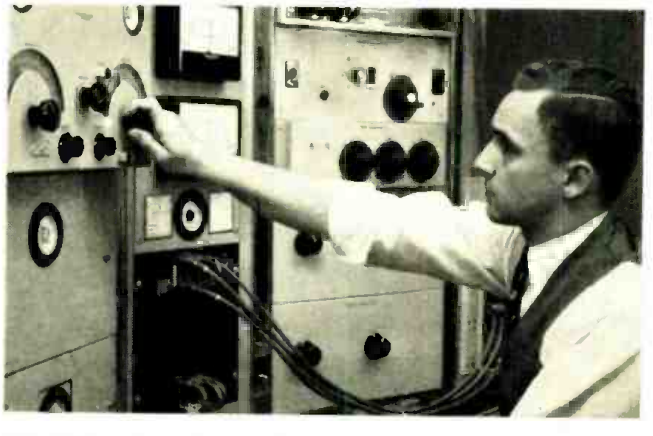
Cross-section of coaxial cable. To triple capacity, Bell Laboratories and Western Electric engineers had to make 1000 amplifiers work perfectly in tandem . . . feed repeater power along the same cable that carries messages . . . put signals on and off the line at numerous cities along the route without distortion.

Pencil-size pipes carry telephone messages and television across country through the Bell System's coaxial cable. Once, each pipe could carry 600 voices, or one television program. Now it can carry 1800 voices, or 600 voices *plus* a broadcast quality television program.

Yet the pipes aren't any larger. They are being made into triple-duty voiceways by new repeaters, new terminal equipment and other transmission advances developed by Bell Laboratories engineers.

The conversion expense is less than the cost of laying extra coaxial cables. But it calls for highly refined manufacturing procedures, made possible only by close co-operation of Bell Laboratories and Western Electric, manufacturing unit of the Bell System.

In improving the coaxial cable system they created more than 20 years ago, engineers at Bell Telephone Laboratories devised a new way to give America still better telephone service, while the cost stays low.



Laboratories engineer tests new triple-duty coaxial system. It marks the first time that telephone conversations and television can travel through the same pipes at the same time. With a wider frequency band being transmitted, big problem was to eliminate interference between the two types of signals.

BELL TELEPHONE LABORATORIES

IMPROVING TELEPHONE SERVICE FOR AMERICA PROVIDES CAREERS FOR CREATIVE MEN IN SCIENTIFIC AND TECHNICAL FIELDS

$$\frac{\text{"X" TV sets}}{\text{all TV sets}} = \frac{\text{your jobs}}{\text{all jobs}}$$

("X" TV sets are included in "all"; your jobs are included in "all jobs." Your jobs and all the jobs are computed for the same period of time.)

Your chances of success are better if the ratio of "X" TV sets to all TV sets is *greater* then the ratio of your jobs to all the jobs. In other words, you won't have to get all the "X" TV business in order to maintain your present volume.

But if the ratio of "X" TV sets to all TV sets is *less* than the ratio of your jobs to all jobs, you had better select another brand for specialization. Perhaps you could specialize on two brands. This would give you benefits over general servicing, yet would not be as advantageous as having only one brand with sufficient volume.

You can see that the smaller the ratio of your jobs to all jobs, the greater the possibility for specialization. Specialization will be worth investigating if you are doing, say, about 10% or less of the servicing business in your area.

Obviously, your investigation will center on trying to determine the four factors in the proportion. You will have to find out how many "X" sets there are in your locality, how many sets of all kinds, how many service jobs you do weekly (or monthly or yearly), and the total of all service jobs for the same period of time in the same area.

The problem of determining the TV ratio can be taken up with sales managers of TV distributors or with a local distributors' association. Get several estimates and then view them in light of your own knowledge. The more accurate the figures, the better informed you will be.

You can compile the number of service jobs you did during a certain period. It may be difficult to get figures on the total number of service jobs performed in your servicing area during the same period. Talking to other shops or your local servicing association, if you have one, will often help. Perhaps it will be necessary to estimate the total number of jobs from the number of technicians that were employed in that area during that period of time.

Evaluate the competition. This is easier than determining the market. Who else is specializing in "X" brand in your area? Is the manufacturer or distributor doing home service work? Is the service work on "X" brand evenly divided among all shops? If it is, or if you have a lead, then you have a fighting chance.

See the distributor. In addition to helping you determine the market, the distributor's personnel can help you with information on the manufacturer's and the distributor's policies, parts ordering, and servicing and alignment techniques.

You may find that the distributor will be glad to hear of a reputable

shop which will specialize in his product. He may refer you to set owners who phone requesting the name of a shop expert on that brand.

Become factory authorized. While talking to the distributor, you can ask him how to become a factory authorized service agency for "X" TV. Being one will increase the punch in your advertising. It will impress customers to have decals and signs in your shop stating you are a factory authorized service agency.

If you have attended the manufacturer's service meetings, be sure to ask for a certificate stating that you have received his "factory training." People outside of the TV servicing business instinctively feel that the certificate represents a great deal of training.

Advertise correctly. If you have a fairly extensive advertising program, you probably will not want to switch overnight to a specialty appeal. It may be best to advertise your specialization in the classified section of the telephone directory first. Be sure to become factory authorized, as pointed out before, so that you won't have any trouble being listed under the manufacturer's name in addition to your own firm name.

Later, other advertising can be switched to this appeal. You might find you can get enough effective advertising from the distributor's and set owners' recommendations.

Use common sense. It is well to wade in gradually. Don't turn down other work until you have all the "X" sets that you can handle. As they increase, you can cut down on the other types. But don't be too slow or some other shop may recognize the potentialities and beat you to it.

To specialize or not to specialize, like many other problems, involves a management decision. The decision should be based on as many relevant facts as you can obtain, viewed in the light of your experience and the experience of other firms in the same business—plus an imagination to see the possibilities in something a little different.

—30—

DX-ING WITH THE ADMIRAL TV MODEL 19B1

By GEORGE R. ANGLADO

TELEVISION DX has become a new and exciting hobby among TV set owners. The months of January, June, July, and December are the best times for trapping the skip signals, however, reports show that signals have been received during the other months too.

Our recently-purchased 1953 Admiral receiver has been doing a good job of bringing in stations within a 300-mile radius, however, after reading reports on 1000 and more mile reception, we figured maybe something could be done to the set to enable it to get into this long-distance reception bracket.

Upon looking over the schematic for this receiver, we saw the possibility of revamping the circuit slightly to provide more gain for the long-distance stations we hoped to log.

These sets are equipped with a "DX Range Finder" control. The positions on the control are marked from 0 to 300, the 300 position being used for DX reception. With this control set in the 300 position, and using a booster with a push-pull 6J6 and rotatable yagi, we were not able to exceed the 300 mile radius.

After examining the schematic we finally pulled the chassis from the cabinet, hooked up the iron, got out a couple of resistors, and went to work. The set really performed. Not only did we hit the 1000 mile bracket—but farther—around 1200 or 1500 miles. The station logged was KRON-TV, Channel 4 in San Francisco—this from Biloxi, Miss. The miracle enabling us to pick up this station was the addition of three resistors!

Sounds too simple to be true? Sure, 1953 sets are a lot better on the whole than the 1952 line. The manufacturers are catering to the fringe area users in their later models but they can still be improved. An experimenter won't let up until it is improved, whether or not it means tearing the chassis apart and rebuilding it or buying two sets and using them both on the same chassis.

Although we didn't tear up the set, here are the simple changes that improved the long-range reception.

First, find test point "T" which is a socket located on the chassis. Using a 100,000 ohm resistor, insert one end in the test point "T" socket hole and ground the other end to the chassis. A good way to keep the resistor lead in the socket hole is to solder it to a banana type plug or to an old tube socket pin. Caution: If you live in a strong signal area, the addition of this resistor will cause the picture to tear. One means of overcoming this is to wire a toggle switch on the back of the set with one lead going to the hare end of the resistor that goes to ground and the other lead of the switch going to ground. In this way the resistor can be cut in or out of the circuit.

The second change involves unsoldering and taking out the two ratio detector resistors whose values are 10,000 ohms and replacing them with two 30,000 ohm resistors. This change improves detector action and gives greater sound output.

Good DX-ing!

—30—

A NEW CBS-HYTRON CTS-RATED* TUBE

*CTS-RATED: Rated for Continuous Television Service. In TV receivers, five tubes work . . . like transmitting tubes . . . *hard!* Account for almost 90% of your replacements. You know them: rectifiers, deflection amplifiers, damper diode. Larger-screen sets aggravate this problem. CBS-Hytron recognizes your need for huskier tubes for these sockets. Brand new designs, not just improved tubes. CTS-Rated 5AW4 . . . another CBS-Hytron first . . . is your answer for the low-voltage rectifier socket. It is CTS-Rated: (1) For heavier average (250 ma. max. d-c) and peak (750 ma. max. d-c) currents, (2) With big safety margins at these currents. You can depend upon the 5AW4 for continuous, trouble-free service. Yes, more CBS-Hytron CTS-Rated tubes are coming. Watch for them.

CBS-HYTRON 5AW4†

NEW HEAVY-DUTY WORK HORSE CUTS 5U4G CALL-BACKS

Worried about slumping TV set performance, because of heavily loaded 5U4G's? Forget it. Use new CBS-Hytron CTS-Rated* 5AW4. A replacement for the 5U4G, the 5AW4 recaptures . . . and keeps . . . that new-set sparkle. Maintains full voltage, despite heavy load. Minimizes burn-outs. Avoids filament shorts while testing chassis on side. Loafs on tough jobs. Gives long, long, trouble-free life. The 5AW4 will cut your call-backs. Boost your profits. See it . . . buy it . . . soon. At your CBS-Hytron jobber's.

†Patent applied for

COMPLETE 5AW4 DATA FREE

See your CBS-Hytron jobber. Or write direct today.

MECHANICAL ADVANTAGES

PLATE — Note formed A-frame construction. Each plate of 5AW4 is formed into two cylinders containing the filament. Uniform filament-to-plate spacing and uniform filament performance avoid hot spots on filament, plate . . . and bulb. Oversize radiating fins and extra large surfaces between formed cylinders dissipate heat faster. Sturdy structure is rigidly supported at eight points.

FILAMENT — Massive, heavy-duty, 20-watt filament offers generous reserve of emission. Cuts burnouts due to ionization attack and back emission. Transmitting-tube-type filament hook and spring suspension prevent sagging — yet reduce stresses on filament. Permits mounting 5AW4 in any position. Useful filament area is contained within formed cylinders of plate . . . to minimize internal voltage drop.

New...Free DECAL

sells for you! *Sells* your magic ability to recapture new-set sparkle. Let this decal pull customers to you. Get it from your CBS-Hytron jobber today.

CBS HYTRON

Manufacturers of Receiving Tubes Since 1921

CBS-HYTRON Main Office: Danvers, Massachusetts

A Division of Columbia Broadcasting System, Inc.

RECEIVING . . . TRANSMITTING . . . SPECIAL-PURPOSE AND TV PICTURE TUBES • GERMANIUM DIODES AND TRANSISTORS

Regenerative Circuit

(*Continued from page 49*)

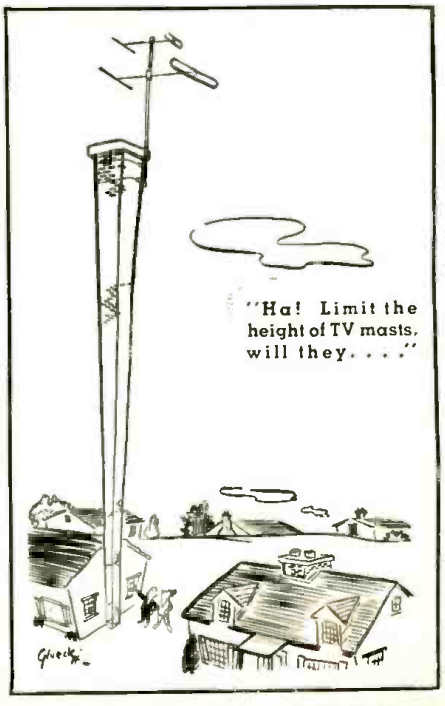
ing L_3. This, in conjunction with the fixed condenser C_3 gives sufficient station separation for satisfactory tuning of the short-wave bands. If more bandspread is desired, this can be achieved by connecting a small variable condenser of about 30 $\mu\mu$fd. in parallel with C_2.

The coils were wound on old octal tube bases. This permitted the least modification of the broadcast receiver chassis used as a base. Of course, the constructor who is starting out with a new, blank chassis and all new parts could substitute a different socket and other coil forms, although the coil data would have to be recalculated for the different form diameter used. The diameter of an octal tube base is slightly over $1\frac{5}{16}$".

All the coils are closewound, and with the specified number of turns, the amateur bands will fall approximately in the middle of the tuning range. L_2 should be wound rather loosely so that its spacing from L_1 can be adjusted for best performance. Once the optimum spacing has been found, the whole coil should be coated with radio cement or coil dope. If 5/40 Litz wire is not readily available for the coils, #26 enameled or *Formvar* wire can be used.

L_1 and L_2 should be wound in the same direction and the relative polarity of the connections should be observed. This is the familiar precaution with regenerative sets, for, as is well known, if the polarity of the connections or induced voltages is wrong, the feedback will be degenerative and the set will not work. While this is an important matter its handling turns out to be very simple.

-30-



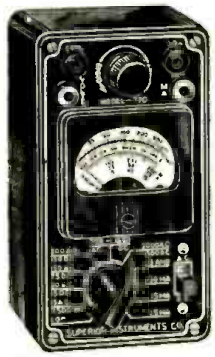
BUY TEST EQUIPMENT
ON THIS RADICALLY NEW
TIME PAYMENT PLAN

NO INTEREST!! - NO CARRYING CHARGES!!

USE CONVENIENT TIME PAYMENT ORDER BLANK BELOW

Superior's New Model 770

VOLT-OHM MILLIAMMETER



Sensitivity—1000 ohms per volt

Uses latest design 2% accurate 1 Mil. D'Arsonval type meter. • Same zero adjustment holds for both resistance ranges. It is not necessary to readjust when switching from one resistance range to another. This is an important time-saving feature never before included in a V.O.M. in this price range. • Housed in round-cornered, molded case. • Beautiful black etched panel. Depressed letters filled with permanent white. Insures long-life even with constant use.

SPECIFICATIONS:

6 A.C. VOLTAGE RANGES: 0-15/30/150/300/1500/3000 Volts.
6 D.C. VOLTAGE RANGES: 0-7.5/15/75/150/750/1500 Volts.
4 D.C. CURRENT RANGES: 0-1.5/15/150 MA. 0-1.5 Amps.
2 RESISTANCE RANGES: 0-500 Ohms. 0-1 Megohm.

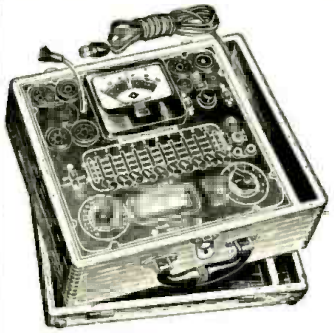
Model 770 is an accurate pocket-size V.O.M. Measures only 3⅜"x 5⅜"x2¼".

$14.90 NET

The Model 770 comes complete with self-contained batteries, test leads and all operating instructions.

Superior's New Model TV-11

TUBE TESTER



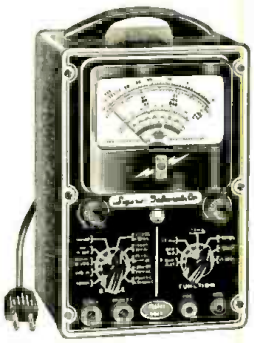
• Uses the new self-cleaning Lever Action Switches for individual element testing. Because all elements are numbered according to pin number in the RMA base numbering system, the user can instantly identify which element is under test. Tubes having tapped filaments and tubes with filaments terminating in more than one pin are truly tested with the Model TV-11 as any of the pins may be placed in the neutral position when necessary. • Uses no combination type sockets. Instead individual sockets are used for each type of tube. Thus it is impossible to damage a tube by inserting it in the wrong socket. • Free-moving built-in roll chart provides complete data for all tubes. • Phono jack on front panel for plugging in either phones or external amplifier detects microphonic tubes or noise due to faulty elements and loose external connections.

Operates on 105-130 Volt 60 Cycles A.C. Hand-rubbed oak cabinet complete with portable cover .....

$47.50 NET

Superior's New Model 670-A

SUPER-METER



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

SPECIFICATIONS:

D.C. VOLTS: 0 to 7.5/15/75/150/750/1,500/7,500 Volts.
A.C. VOLTS: 0 to 15/30/150/300/1,500/3,000 Volts
OUTPUT VOLTS: 0 to 15/30/150/300/1,500/3,000 Volts
D.C. CURRENT: 0 to 1.5/15/150 Ma. 0 to 1.5/15 Amperes
RESISTANCE: 0 to 1,000/100,000 Ohms 0 to 10 Megohms
CAPACITY: .001 to 1 Mfd. 1 to 50 Mfd. (Quality test for electrolytics)
REACTANCE: 50 to 2,500 Ohms. 2,500 Ohms to 2.5 Megohms
INDUCTANCE: .15 to 7 Henries 7 to 7,000 Henries
DECIBELS: —6 to +18 +14 to +38 +34 to +58

Comes housed in rugged, crackle-finished steel cabinet complete with test leads and operating instructions. Size 6¼"x9½" x1½".

$28.40 NET

ADDED FEATURE: The Model 670-A includes a special GOOD-BAD scale for checking the quality of electrolytic condensers at a test potential of 150 Volts.

Superior's New

TV BAR GENERATOR

THROWS AN ACTUAL BAR PATTERN ON ANY TV RECEIVER SCREEN!!

CONNECTS DIRECT TO ANTENNA POST

NO CONNECTION INSIDE RECEIVER

Features.—Can be used when no stations are on the air. • Provides linear patterns to adjust vertical and horizontal linearity • Provides vertical and horizontal sweep signals • Provides signal for testing video amplifiers.

TV Bar Generator comes complete with shielded leads and detailed operating instructions .....Only

$39.95 NET

Superior's Model 660-A—A NEW A.C. OPERATED

SIGNAL GENERATOR

Provides Complete Coverage for A.M.—F.M. and TV Alignment

• Generates Radio Frequencies from 100 Kilocycles to 60 Megacycles on fundamentals and from 60 Megacycles to 220 Megacycles on powerful harmonics. • Accuracy and stability are assured by the use of permeability trimmed Hi-Q coils. • R. F. available separately or modulated by the internal audio oscillator. • Built in 400 cycle sine wave audio oscillator used to modulate the R. F. signal also available separately for audio testing of receivers, amplifiers, hard of hearing aids, etc. • R. F. Oscillator Circuit: A high transconductance heptode is used as an R. F. oscillator, mixer and amplifier. Modulation is effected by electron coupling in the mixer section thus isolating the oscillator from load changes and affording high stability. • A. F. Oscillator Circuit: A high transconductance heptode connected as a high-mu triode is used as an audio oscillator in a high-C Colpitts Circuit. The output (over 1 Volt) is nearly pure sine wave. • Attenuator: A 3 step ladder type of attenuator is used.

• Tubes used: 1—6BE6 as R. F. Oscillator, mixer and amplifier. 1—6BE6 as Audio Oscillator. 1—6H6 as Power Rectifier. The Model 660-A comes complete with coaxial cable test lead and instructions .....NET

$42.95 NET

NEW TIME PAYMENT PLAN
ORDER BLANK

MOSS ELECTRONIC DISTRIBUTING CO., INC.
Dept. B-56, 38 Murray Street, New York 7, N. Y.

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

- ☐ MODEL 770 .....Total Price $14.90
  $2.90 down payment. Balance $2.00 monthly for 6 months.
- ☐ MODEL TV-11 .....Total Price $47.50
  $11.50 down payment. Balance $6.00 monthly for 6 months.
- ☐ MODEL 670-A .....Total Price $28.40
  $7.40 down payment. Balance $3.50 monthly for 6 months.
- ☐ TELEVISION BAR GENERATOR .....Total Price $39.95
  $9.95 down payment. Balance $5.00 monthly for 6 months.
- ☐ MDDEL 660-A .....Total Price $42.95
  $12.95 down payment. Balance $5.00 monthly for 6 months.
- ☐ I enclose $..... as down payment.
- ☐ Ship C.O.D. for the down payment.

Signature.....

Name .....

Address .....

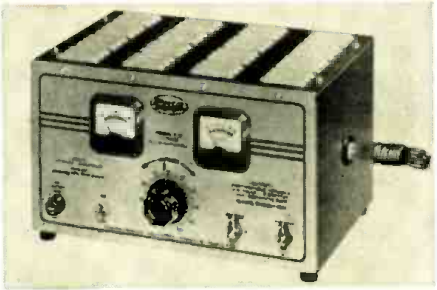
City..... Zone..... State.....

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.

12-VOLT POWER SUPPLY

Electro Products Laboratories, Inc., 4501 N. Ravenswood Ave., Chicago 40, Ill. is offering a filtered d.c. power supply which provides adjustable d.c.



voltage (0-16) from an a.c. source, for all current loads from 1 to 8 amperes continuous output.

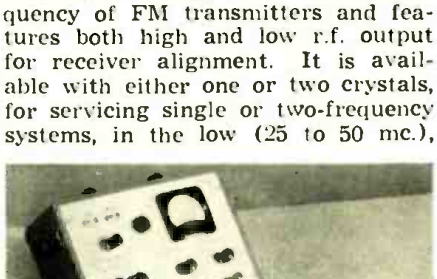
The C-12 incorporates a special filter circuit which reduces a.c. hum or ripple to less than 3% at 8 amperes.

Full performance data and information on your nearest distributor is available from the company on request.

TEST GEAR

A new frequency and modulation meter for use in the maintenance of two-way radio systems has been announced by the Electronics Division of *General Electric Company*, Syracuse, N.Y.

The meter, type ST-13-A, measures modulation swing and carrier frequency of FM transmitters and features both high and low r.f. output for receiver alignment. It is available with either one or two crystals, for servicing single or two-frequency systems, in the low (25 to 50 mc.),



medium (72 to 76 mc.), and high (152-174 mc.) bands.

For complete data write Dept. N-14 of the Inquiry Section of the company.

STORAGE BINS

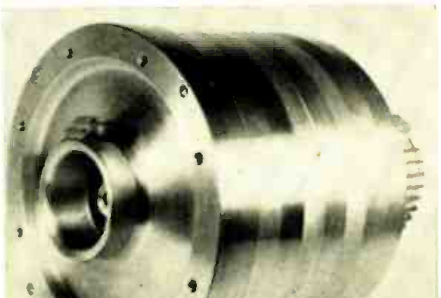
Akro-Mils, Inc., P.O. Box 989, Akron 9, O. has added a new 128-drawer model to its line of "Haz-Bin, Jr." storage units. The new cabinet has been designed to hold the hundreds of different small parts used in service shops and dealer outlets.

The cabinet provides maximum visibility and space economy. Clear plastic drawers make visual selection possible. The line is now available in nine models with 8, 12, 16, 24, 32, 48, 64, 96, and 128 drawers. Drawer size is the same in all models. The individual drawers can be subdivided into 2 or 3 separate compartments—lengthwise or crosswise. A built-in safety catch prevents accidental spilling of contents should drawer be pulled out too far.

ROTRON BLOWER

Rotron Mfg. Co., Schoonmaker Lane, Woodstock, N. Y. is in production on a new blower which is small, light-weight, direct-driven, brushless, and with axial flow.

Designed to be built into electronic and instrument cabinets whenever



high air pressures are required in combination with relatively low volumes, these new units are powered by totally enclosed induction motors built on a single shaft with the blower.

Over-all diameter is 7¼" and length varies with number of stages and type of power supply. Pressures range from 5" to 28" of water.

RADIO PACKSET

Industrial Radio Corp., 428 N. Parkside Ave., Chicago 44, Ill. is in production on a portable, two-way radio packset for industrial, police, fire, utility, and conservation department applications.

The "Pak-Fone" consists of an 8-tube transmitter and 15-tube receiver and is completely self-powered. It conforms to FCC licensing regulations and is designed to provide two-way radiotelephone communication between other portable stations, mobile, or fixed stations.

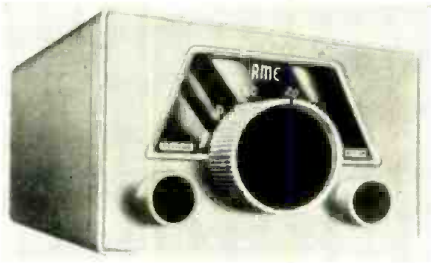
The units are designed to operate in either the 25 to 50 mc. or the 152-174 mc. bands. A complete descrip-

tion and technical specifications are available from the company.

PRESELECTOR

Radio Mfg. Engineers of Peoria, Ill., is currently offering a new preselector for coverage of all amateur bands from 3.5 to 30 mc.

The DB23 has three neutralized push-pull stages employing 6J6 dual-



triodes in a novel combination of selected and wideband r.f. amplifiers. The manufacturer claims a constant gain of 25 db or more throughout all amateur bands (from 3.5 to 30 mc.) with an average image ratio improvement of approximately 12 db on 21 mc. and 25 db on all lower frequencies. Signal-to-noise ratio is said to be better than 7.5 db over that of the receiver itself.

The unit is completely self-contained and is housed in a streamlined cabinet measuring 5" x 7⅝" x 6⅛". Three easy-to-use controls for "On-Off," "Band Selector" and "Ant. Peaking" simplify operation.

MINIATURIZED CIRCUITS

Vacumet Inc., 1267 N. Clybourn Ave., Chicago 10, Ill., has developed a line of "in-bedded" circuits which offers new opportunities for miniaturization of circuits and components.

The "in-bedded" process consists of embedding solid metal conductors which are formed into any desired circuit pattern, into the face of a suitable insulating base. The base material can be plastic, glass, or ceramic and a special molding process makes the metal conductors and base an integral unit.

Conductor line widths as narrow as .001" can be produced and intricate designs are readily reproduced. "In-bedded" wiring .005" wide can handle a continuous current load of 250 ma. and the line width can be held to within ±.0002".

Circuit wiring, commutators, switches, inductors, and other components can be made by this process.

7" SCOPE KIT

Electronic Instrument Co., Inc., 84 Withers St., Brooklyn 11, N. Y., is in production on the Model 470, a 7" oscilloscope which is available in both kit and wired form.

Features of this new scope include boosted vertical sensitivity of 10 mv. r.m.s./in.; extended flat frequency response from 10 cps to 1 mc., ±2 db; three-step frequency-compensated attenuator input to vertical channel; push-pull outputs for both vertical

and horizontal amplifiers; wide range gain and sweep control; internal voltage calibrator for peak-to-peak voltage measurement; internal retrace blanking; and provision for direct connection to CRT plates.

In kit form the new scope is designated as the Model 470-K. Further information is available from the company on request.

NEW V.T.V.M.

Elliott Laboratories, 50-34 201st St., Bayside, N. Y., has released its Model 940 v.t.v.m. to the trade.

Peak-to-peak or rms voltages with a frequency response of 25 to 10,000 cycles are obtainable. The input resistance of 16.5 megohms will not cause the circuit under test to be overloaded.

The unit uses a dual-triode balanced bridge circuit. Six a.c. ranges (3, 15, 30, 150, 300, and 1500 volts) and six d.c. ranges (same voltages) are included. Resistance is measured in five ranges from 0-1000, 10,000, 1 megohm, 10 megohms, and 1000 megohms while decibels may be read on five ranges.

The meter is housed in a bakelite case measuring 5¼" x 6⅞" x 2¼".

AMPLIFIER KIT

Philmore Mfg. Co., Inc., 113 University Place, New York, N. Y., has introduced a 20-watt high-fidelity amplifier in kit form.

The preamplifier and amplifier are built onto the same chassis. Four

separate jacks are provided for magnetic pickup, microphone, crystal pickup, and radio or TV. Volume, bass, and treble control switches are on the front panel. The rear panel carries

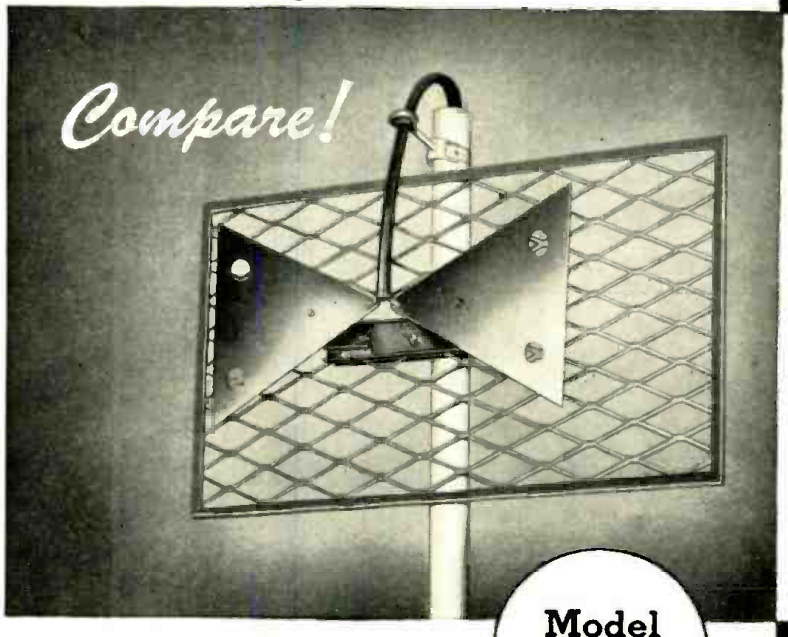
while others plunged
WE WAITED

while others promoted
WE TESTED

while others gambled
WE ENGINEERED

NOW VEE-D-X

GUARANTEES YOU
THE *finest*
BOW TIE
OF THEM ALL



Model BT-U

- Precision-built
- Easiest to install
- Brilliant performer
- 8 db gain across the entire UHF band
- 50% additional gain on stacked arrays
- Engineered for super sharp picture reception from 470 to 890 mcs.
- Assembled in less than a minute
- Weather-resistant finish
- Compact packaging — only 12" by 20" by 1½" deep
- No insulators required

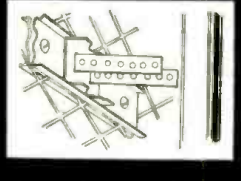
The Aristocrat of Bow Ties

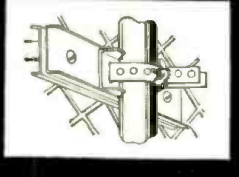
BASED ON A COMPLETELY *New Antenna Formula*

- Eliminates insulators
- Permits all-metal construction
- Higher gain
- Flatter response over the

ENTIRE **UHF** BAND

EXCLUSIVE VEE-D-X FLEX-CLAMP

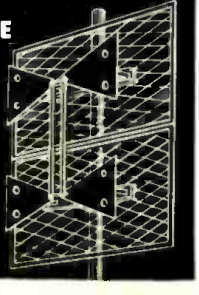




This exclusive VEE-D-X feature makes mounting of the BT-U amazingly fast and easy; especially when adding to existing installations at rooftop. No more fussing or fumbling with U-Bolts — just one screw to tighten and FLEX-CLAMP holds the antenna with a vise-like grip. FLEX-CLAMP completely facilitates probing — just loosen the screw and the antenna can be moved up or down the mast with ease. Will accommodate up to 1½" mast.

VEE-D-X STACKED BOW TIE
For fringe area reception

This stacked array provides 50% additional gain on all UHF channels. A special phasing harness, VEE-D-X screen clips, plus exclusive FLEX-CLAMP, permit fast, easy installation of this unit. Order stacking harness Model BTH-U.



La Pointe ELECTRONICS INC.
ROCKVILLE, CONNECTICUT

May, 1953

a switch with three preamplifier inputs.

This kit is illustrated and described in the company's 16-page 1953 catalogue which is available on request.

NOISE SUPPRESSOR

A new model "dynaural" noise suppressor, the Type 111-B, has been added to the line of audio equipment made by *Hermon Hosmer Scott, Inc.* of 385 Putnam Ave., Cambridge 39, Mass.

The new unit features redesigned dynamic noise suppression circuits, providing improved operation with LP records and extended bass-response loudspeaker systems. In addition, the effectiveness of low-frequency rumble suppression has been increased substantially.

The Type 111-B is designed to be used with the company's Type 214-A remote control amplifier but may also

be used with amplifiers of other manufacturers. A free bulletin will be sent on request.

WIDE-ANGLE TRUMPET

University Loudspeakers, Inc., 80 S. Kensico Ave., White Plains, N. Y., has developed a wide-angle trumpet which features a pair of exponential horns having twin air columns in a single assembly.

The "Cobreflex-2" is designed so that the wave fronts from each mouth form a single, uniform arc which results in a smooth radiation pattern free from the usual cancellations. Sound dispersion is 120 degrees horizontally and 60 degrees vertically. Low frequency cut-off is 250 cycles for maximum penetration of high noise levels without low-frequency masking effects.

WELDING UNIT

Precision components for transistors may be produced in quantity with variations of a new machine developed by *Kahle Engineering Co.,* 312 Seventh St., North Bergen, N. J.

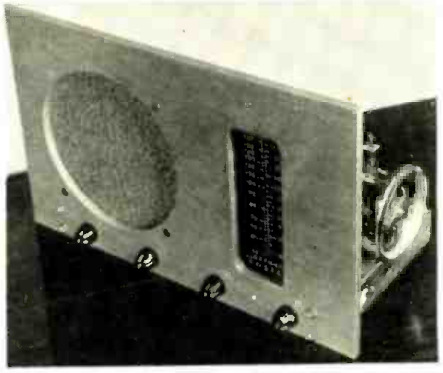
The automatic lead wire welding machine (Model 2148) was designed and built to make 12,000 three-piece leads per hour for miniature receiving tubes. This machine is the basis of another version which is capable of turning out leads for transistors.

The company will supply complete details on the Model 2148 and other machines in its line which are adaptable to transistor production.

FM-AM TUNER

A new FM-AM radio chassis for built-in installations has been introduced by *Arthur Ansley Mfg. Co.* of Doylestown, Pa.

Using 10 tubes, including rectifier, and a straight a.c. circuit with power



transformer, the set, known as the Model R-1 chassis, gives 5 watts' output. It is equipped with a phono jack and a phono position on the bandswitch for use with a record changer or player.

The complete set, with 8" speaker, is mounted on a natural-finish birch panel which measures 10" x 16". Behind-the-panel depth is 8".

MIDGET TAPE RECORDER

Mohawk Business Machines Corp., 47 West Street, New York, N. Y., has introduced a complete recording-playback system which weighs less than 6 pounds and is only 6 inches in length over-all.

The "Message-Repeater" uses an endless plastic tape enclosed in a cartridge the size of a pack of cigarettes. The unit contains a microphone and *Alnico* V speaker and through use of an amplifier booster and external speaker can be used as a public address system.

Messages up to two minutes in length can be recorded or the two-minute interval can be broken down into shorter messages. Previous recordings are automatically erased when a new message is spoken into the microphone.

NEW CARBON INK

Electrochemical Laboratories, 1430 Terrace Drive, Tulsa, Oklahoma has introduced a new carbon ink which, it is claimed, has very unusual qualities.

The carbon suspension has the covering power of India drawing ink, but is so stable that it can be used in some fountain pens and withstands freezing and thawing without harm.

Good adhesion on glass, smooth cellulose acetate, cellulose nitrate, etc. is claimed. It is a two-minute drying ink. Work done with this ink can be rendered water resistant by a brief heat cure at 180 degrees F.

It can be used for marking recording tapes, etc. Full details on this new product are available from the company on request.

CBS-HYTRON TRANSISTORS

CBS-Hytron, Danvers, Massachusetts is now in mass production on two point-contact type transistors—the PT-2A for amplifying and the PT-2S for switching.

Both units are moisture resistant, are available as plug-in or solder-in styles, have sturdy triangular basing, polarized base connections, are auto-electrically formed, are thoroughly stabilized, and operate at temperatures up to 55 degrees C.

Data on the PT-2A, the PT-2S, and the associated T-2 socket is available from the company on request.

AUTO VIBRATOR

P. R. Mallory & Co., Inc., 3029 E. Washington St., Indianapolis 6, Ind., has introduced a new vibrator which is designed to meet the special requirements of automobile radio sets which operate on 12 volt systems.

The new vibrator is the G874, produced as a replacement for original equipment vibrators in audio radio sets used in 1953 *Cadillacs*, *Buicks*, *Oldsmobiles*, and *GMC* trucks.

The G874 measures 1½" x 3¼" and has a unique pin arrangement which serves as a guide for quick insertion of the vibrator into the set. It also prevents it from being plugged into a 6 volt set by mistake. The pins are arranged in triangle formation with the longer pin connected to the reed.

"LOK-BLOK" SCREWDRIVER

Upson Bros., Inc., of Rochester 14, N. Y., is offering a new type of screwdriver whose resistance to torque and penetrating force has been increased beyond normal requirements for such units.

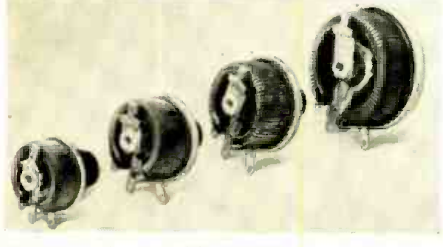
This increase in resistance to two of the most important factors contributing to screwdriver failure has been made possible by a new blade locking method.

The new "Hold-E-Zee" line features a precision-molded hexagonal block of extra hard plastic which drive-fits with extremely close tolerance into a hex cavity in the insulating handle. This permits the blade and block to freeze for utmost sturdiness.

POWER RHEOSTATS

Tru-Ohm Products, 2800 Milwaukee Ave., Chicago 18, Ill., has added three new power rheostats to its line. Available sizes now include 50, 75, 100, and 150 watt units.

Each of the models incorporates an extra deep ceramic core on which the resistance wire is toroidally wound and bonded in place with vitreous enamel. Positive and constant brush



pressure is provided with an exclusive torsion spring assembly.

Standard and special versions of these power rheostats are available. For complete information write the company direct. —30—

SERVICE HINTS ON DU MONT TV SETS

RA-103D, 104A, 106A, 108A, & 110A

Low or no high voltage.

Sometimes the corona shield stand-off insulator in these sets cracks when the screw holding it to the shield is drawn too tight. Moisture entering the crack produces high-voltage leakage which eventually carbonizes the insulator.

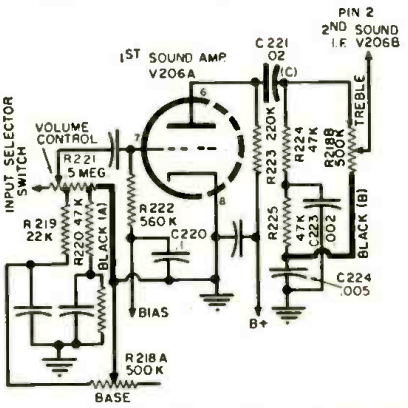
Check this insulator and replace it if defective.

RA-109A

Audio hum.

This may be caused by faulty lead dress.

Shorten black lead (A) connected



to ground side of the volume control by about 2¼ inches.

Shorten black lead (B) connecting tone control to C224 by 1 inch.

Dress C221 (C) located near tone control so that flat side is not facing chassis.

RA-109A, 112A, 113, 116A, & 117A

Repeated blowout of high-voltage fuse.

An intermittent short in the 5U4G low-voltage rectifier may be the cause, especially if a check of the high-voltage circuits indicates normal operation.

Strike the 5U4G; if it is intermittent it will usually produce a bright flash.

Replace the tube if it is defective.

RA-109, 116, 119, 130, & 133

Erratic a.g.c. action.

This may be due to intermittent opening of L216 (video peaking coil) at the grid of V216 sync amplifier.

Check the signal at the grid of V216 with an oscilloscope; if L216 is open the signal on the scope screen will reverse phase about 15 seconds after the probe is connected to the circuit. If the condition is intermittent, leave the scope in the circuit until it recurs.

If L216 is at fault, replace it with *Du Mont* part No. 21006621.

RA-109A, 116A, & 119A

Vertical shrinkage intermittently.

This may be due to intermittent open of the decoupling condensers in the plate circuit of the vertical saw-tooth generator.

Check condenser C294 and replace it with a 40 μfd., 350 v. electrolytic if it is faulty.

RA-109A, 116A, & 119A

Intermittent loss or complete loss of sync.

This may be due to an increase in the value or an open in bleeder resistor R283C. Replace this resistor with a new 1975-ohm unit if it is faulty.

RA-109A & 130A

Unstable horizontal sync.

When this condition is accompanied by a disappearance of the bias voltage at the grid of the reactance tube (V225) with the antenna disconnected, the probable fault is a shorted C265, negative voltage filter condenser.

Replace this condenser, if faulty, with a 10 μfd., 25 v. electrolytic.

RA-112A & 113

High frequency whistle.

This may be caused by loose terminal board on the flyback transformer.

Tighten the screw which mounts the flyback terminal board onto the transformer.

RA-112A, 113, 117A, & 147A

No vertical or horizontal hold.

When this condition is accompanied by an overloaded picture the fault is probably an open in L214, video peaking coil at the grid of the narrow band sync amplifier V212 (6BA6).

Replace this with new part (*Du Mont* part No. 21006621).

RA-112A, 113, 117A, & 147A

Pull at top of picture.

This may be due to a faulty coupling condenser between the second sync clipper (V220A) and the horizontal a.f.c. tube (V214).

Check condenser C264 and replace it with a 180 μμfd., 500 v., 5% mica if it is faulty.

RA-119A

White and dark horizontal bars.

Alternate white and dark horizontal bars about ¼" wide may be caused by microphonic vertical deflection amplifier tube. This effect is similar to that caused by a low frequency interfering signal

MAIL YOUR ORDER TODAY—OLSON WILL RUSH IT RIGHT AWAY!

GIANT AKRAD "LOADMASTER" CONDENSER KIT

STOCK NO. AS-20

$16.95 4-DRAWER STEEL CABINET **FREE!**

69 PIECES List $52.00

Here's your chance to get 69 By-Pass and Electrolytic Olson Akrad "LOADMASTER" Condensers all packed in a Big 4-Drawer Chest (10" x 11½" x 10") which we give you absolutely FREE. Treat yourself to a supply of these high-quality Condensers and see for yourself why 150,000 Radio Repairmen insist upon Akrad.

42 "LOADMASTER" By-Pass Condensers

Qty.	Cap.	Volts	List. ea.	Total
2	.001	600	$ .25	$ .50
2	.002	600	.25	.50
2	.005	600	.25	.50
5	.01	600	.30	1.50
5	.02	600	.30	1.50
10	.05	600	.40	4.00
10	.1	600	.45	4.50
2	.005	1600	.60	1.20
2	.008	1600	.65	1.30
2	.01	1600	.65	1.30

27 Akrad "LOADMASTER" Electrolytic Condensers

Qty.	Cap.	Volts	List. ea.	Total
2	10	25	$1.00	$2.00
2	25	25	1.00	2.00
3	20	150	1.20	6.00
5	40	150	1.35	6.75
4	20-20	150	1.65	6.60
5	8	450	1.25	6 25
4	16	450	1.40	5 60

69 Condensers List Value $52.00

SETS A RECORD—BUT GENTLY

BRAND NEW 3-SPEED GENERAL INSTRUMENT AUTOMATIC RECORD CHANGER

Changes All Sizes—7", 10" and 12"

All Speeds—33⅓, 45 and 78 RPM

Imperial Deluxe Model

STOCK NO. RA-69

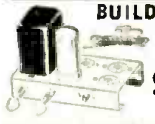
Equipped with single needle, with precious metal long-lasting tip. Plays all speed records, 33⅓, 45 and 78 RPM. Regular retail price $47.50. Shpg. wt. 15 lbs.

Single, each $19.99. In lots of 3, each, only.. **$18.99**

This famous model is Olson's All-Time Best Seller in Record Changers. For good reasons, too. Records slide gently down the center spindle—no chance of damaging your valuable records. Simple to operate and factory adjusted to insure years of trouble-free service. Connects to any radio amplifier or TV. Clever "Touch-Plate" allows you to reject or skip a disc if desired.

Precision-engineered by craftsmen with years of experience, these General Instrument Changers are Brand New, in Original Factory-sealed Cartons and 100% Guaranteed by the Manufacturer and Olson. Operates on 115 V. AC, 60 cycle. Base size 12" x 12½" x 5⅛" above plate and 3½" below.

BUILD YOUR OWN 3-TUBE POWER AMPLIFIER



STOCK NO. AMP-11

$7.95 LESS TUBES

Olson Super Bargain. Kit includes punched chassis, sockets, condensers, power transformer, choke, 2 controls, connectors, all hardware and complete wiring diagram. 115V AC input for any crystal, dynamic or ribbon mike and separate input for phono. Shpg. wt. 10 lbs.

KIT OF TUBES FOR AMP-11: 6X5, 6SL7 and 6V6GT. STOCK NO. AS-69—$2.59.

OUTPUT TRANSFORMER FOR AMP-11: Matches 6V6 to any 3.2 ohm voice coil. STOCK NO. T-57—69c.

12" Magnavox Speaker and Baffle Close-Out

Stock No. AS-66

Get both for only... **$7.95**

In lots of 4 sets. One set for $8.95.

You get Magnavox's fine 12" PM speaker with Alnico 5 magnet. (Same as you'll find in those expensive Magnavox Super-Radio-Phono Combinations.) Power output 8 watts. Voice coil fully dustproofed. Impedance 6-8 ohms. In addition you get a walnut Speaker Baffle to bring out the full rich, rounded tones of the Magnavox Speaker. Baffle may be mounted on a wall or it will stand on a table. Here's the ideal combination for extension speakers for porches or other rooms. Can be connected to any radio or amplifier. Order 4 or more sets and install them in restaurants, auditoriums, halls. Shpg. wt. 12 lbs.

CRYSTAL MIKES

Astatic high output crystal mike for PA systems and recorders. Equipped with handle base and 7' shielded cable. Shpg. wt. 5 lbs.

STOCK NO. M-67, each..... **$5.95**

STOCK NO. M-66, same but with on-off switch built into handle..... **$6.95**

BIG INSULATED RESISTOR KIT

OLSON SPECIAL PRICE

Contains a carefully selected assortment of 140 insulated resistors. Standard EIA color code. Included are 70—½ watt, 20—1 watt and 10—2 watt resistors. Handsomely packed in a durable plastic box. Regular List Price $15.80. Shpg. wt. 2 lbs.

$2.99 Stock No. AS-32

COMPLETE TV ANTENNA

A complete stacked array. Made by a famous manufacturer whose name and brand is on every factory sealed carton. Look what you get: 2 Six-element conical bays, 1 pair "V" bars, 2 Five-foot mast sections, 60 ft. 300 ohm twin line, 5 Standoff insulators, 1 mounting base, 1 guy ring, 1 clamp, hardware. Elements are highest quality aluminum. Reg. list price is $31.95. Shpg. wt. 15 lbs. Express only.

Stock No. AU-24

$11.99 Complete Set

FREE! OLSON'S BIG NEW BARGAIN CATALOG

Get Olson's LOWER-than-wholesale prices from this famous book. STANDARD BRANDS—FRESH STOCK. IMMEDIATE DELIVERY. Catalog is two colors—40 full pages of unbelievable bargains. A new catalog mailed Bi-Monthly—with new low bargains each mailing. Simply note on your order or write today for your free copy from: OLSON RADIO WAREHOUSE, 275 E. MARKET ST., AKRON 8, OHIO.

OLSON STORES TO SERVE YOU IN:

CLEVELAND, OHIO
2020 Euclid Avenue

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CHICAGO, ILLINOIS
623 W. Rondolph Street

If you live in or near either of these cities visit our Bargain Stores where you'll find these and hundreds of other Olson Buys.

OLSON HAS OVER 150,000 SATISFIED CUSTOMERS

REG. LIST $95.00

NEW MASCO WIRELESSFONE 2-STATION WIRELESS INTERCOM

COMPACT • PORTABLE • VERSATILE

Stock No. AMP-14

FOR ONLY... **57.00 PR.**

Extra Stations Order AMP-15 $28.50 each

No Wires or Interconnecting Cables Required. Just plug line cord into socket and Wirelessfone is ready to operate. Noise-Silencing Control, pre-set at factory, keeps system quiet until in actual use. Additional Stations may be added. Pilot Light On-Off Indicator. Ideal for Home, Farm, Commercial, Professional and Institutional Users. No interference with radio sets. May be used on AC or DC current. FEATURES: A Complete System Ready to Operate. No Installation Cost. Unbreakable Cast Aluminum Housing. Powerful sound amplification of 2½ watts. Talk-Listen-Dictate Switch, a 3-position switch. "Dictate" position enables a secretary to take notes of a conference without actually being present and is ideal for baby-sitting. Shpg. wt. 11½ lbs.

CONVERT 6V DC to 110V AC

Now you can have all the advantages of a 110v AC power supply IN YOUR OWN CAR! Converts 6v DC to 110v AC 60 cycle with capacity to 45-50 watts. Fully filtered. Just plug in cigar lighter and operate portable phonos, radios, dictating machines, lights, electric shavers, etc. Only slightly larger than cigarette pack! Ideal for picnics, camping, summer traveling pleasure. Shpg. wt. 5 lbs.

Stock No. RA-104

$10.63

TELEPHONE PICKUP

Stock No. M-80

$4.50 Record or amplify both sides of a telephone conversation. No connection to telephone necessary. Just lay pick-up under any cradle type phone and connect lead to hi-impedance input of any disc, wire or tape recorder or any amplifier. Operates by induction. Shpg. wt. 1 lb.

CONDENSER KIT

$1.99 YOUR COST ONLY

Stock No. AS-83

50 POPULAR BY-PASS CONDENSERS

Contains values from .001 Mfd. to .05 Mfd. All brand new. Famous manufacturers' overstocks. List price $9.85. Shpg. wt. 2 lbs.

WEN Soldering Gun STOPS SOLDER-JOB HOLDUPS

Stock No. TL-22

$9.71 EACH

Pkg of 6 tips for gun. STOCK NO. TL-23 **89c**

Fastest, most convenient way to solder. Heats almost instantly; economical trigger control saves on electric bills; built-in spot-light and "long reach" replaceable tip combine to make the tightest corner solder job easy. Sturdily constructed—heat and shock resistant, fully guaranteed. 250 Watts 120 V—AC. Shpg. wt. 6 lbs.

RELAYS

Small fast acting relays for dependable operation. Pure Silver Contacts. Choice of 2 models. About 1½" square.

STOCK NO. SW-29

6000 Ohm Coil

Operates in Plate series circuits. Pulls in as current is drawn. Double Pole—Double Throw.

CHOICE **$1.99** EACH

30 Ohm Coil

Operates on 6 Volts or less. Single Pole—Double Throw. Shpg. wts. each 4 oz.

STOCK NO. SW-30

WILCOX-GAY RECORDIO TAPE RECORDER

2 Full Hours of Recording or Play-back • Automatic-Foolproof Push-Button Controls • 2-Speeds • Records • Plays Back • Erases • Portable

BRAND NEW REG. $149.50 NOW ONLY.. **$99.50**

Stock No. AMP-10

Order your Wilcox-Gay Tape Recorder for less than Dealer's Cost! This is the finest Recorder Olson has ever offered—at a price that is really give-away. We made a real deal and you get the benefit.

Five "Prest-o-matic" Push-button Controls allow instant choice of all operating functions—fast forward and reverse, record, stop, and playback. The easiest of all recorders to operate. Handles up to 7" reels. Full range of recording times—7" reel records for a full hour at 3.75" per second, plus another hour on other half tape; and at 7.5" per second you get a full recording hour on both halves of tape. Rewinds in less than 3 minutes.

Automatically records from FM or AM radio, phonograph, TV or mike. Plays back through powerful built-in amplifier and 5" x 7" elliptical speaker. Frequency response—70-8500 cps at 7.5" per second, and 90-6000 cps at 3.75" per second. Output—2 Watts. Maximum Fidelity gained by Automatic Speed Selector.

Complete with Controlled Reluctance Mike, Record Lock Button, External Speaker Jack, Full Range Variable Tone and Volume Controls. 4 Tubes—6SJ7, 6AQ5, 12AX7, 6X4 Rectifier. 7 ft. Cord. Neon Recording Indicator. Handsome Removable Cover.

Ideal for Office, School, Church, Club, Home, etc. Lightweight, only 23 lbs. complete. Portable size 12" x 14" x 9". 110-120 Volt 60 cycle AC. U.L. Approved.

PLASTIC BASE 600 FT. REEL

STOCK NO. X-275

Single, ea. $1.49 Lots of 10 **$1.29** each

1200 FT. REEL

STOCK NO. X-249

Single, ea. $2.19 Lots of 10 **$1.99** each

FULLY GUARANTEED BRAND NEW FIRST CLASS RECORDING TAPE NATIONALLY KNOWN NAME BRAND

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, 600 and 1200 ft. lengths. Frequency response 50 to 8,000 cy. Plastic Reel included with each. Shpg. wt. ea. 1 lb.

6J6

Reg. List $2.50

Single, ea., 99c Lots of 10, **69c** ea.

MOST POPULAR TV TUBES—Discount Over 72%

INDIVIDUALLY BOXED • BRAND NEW

MADE BY LARGEST MFR. • 100% GUARANTEED

Here's the inside story on how Olson bought these fine brand-new tubes. America's largest tube manufacturer made them and was ready to ship to a big company when they suddenly got a cancellation. Olson stepped in and made a deal and bought a terrific quantity. Then we had our "Akrad" brand put on every tube. They're individually boxed and carry the usual 100% Olson Money-Back Guarantee. Order Plenty at This Price.

REAR DECK AUTO SPEAKER KIT FOR ALL CARS

$2.95 EACH

STOCK NO. AS-81

Install a rear seat speaker in any car, any radio. Complete Kit of parts furnished with easy instructions. Includes beautiful grille and 3-way dashboard switch for operation of front and rear speakers separately or together. Supplied less speaker. Requires popular 6" x 9" size speaker. Shpg. wt. 3 lbs.

SPEAKER FOR AS-81 KIT

Heavy duty—high volume PM 6"x9" speaker with 3.2 ohm voice coil for AS-81 installation. Shpg. wt. 6 lbs.

STOCK NO. S-114 **$3.39** EACH

DON'T THROW AWAY OLD PICTURE TUBES

BOOST BRILLIANCE WITH THIS TV TUBE BOOSTER

$2.95

Stock No. T-100

Completely automatic. Easy to install—no tools needed. Just plug into old picture tube that is starting to dim and watch the big change. Works on any Tube—10" to 30" in all AC parallel circuits. Adds months and months of service to those old tubes. Reg. $5.95. Shpg. wt. 1 lb.

OLSON RADIO WAREHOUSE 275-A EAST MARKET ST., AKRON 8, OHIO

at the grid of the video amplifier. Check by replacing the 6AU5.

RA-160 & 162

Horizontal jitter at top of picture, white streaks.

This condition is especially noticeable when receiving weak signals. and is due to internal corona in C501, the anti-ringing condenser connected across part of the horizontal deflection yoke.

Replace this condenser with a 68 μμfd., 2 kv. unit.

RA-160 & 162

No high voltage, buzz in sound, no a.g.c.

This is probably due to shorted condenser C231 in the cathode circuit of the a.g.c. gate (V209B). This will cause R264 and R239 to burn out.

Replace C231 with a 120 μμfd. condenser.

RA-160 & 162

To improve horizontal sync and increase brightness.

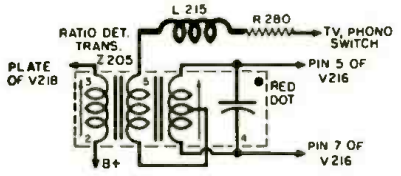
Check R348B, the power supply voltage divider, for open or intermittent.

Replace it with a wire-wound, 2900 ohm, 10 w. unit.

RA-160 & 162

Sync buzz.

Probably due to improperly adjusted oscillator slug. If buzz persists after slug adjustment, check



for the presence of L215, fixed inductor, connected between pin 5 of the ratio detector transformer, Z205, and one end of resistor R280 (270 ohm, ½ w. carbon). If L215 is present, remove it and connect R280 directly to pin 5 of Z205.

RA-164 & 165

To eliminate horizontal line displacement with noise.

Do the following to increase the immunity of the a.f.c. circuit to short duration noise pulses, especially when receiving weak signals:

Replace C228 with a .01 μfd., 20%, 200 v. condenser.

Replace C268 with a .05 μfd., 20%, 200 v. condenser.

Replace R241 with a 220 k, 10%, ½ w. resistor.

RA-164 & 165

To reduce picture noise and increase sync stability.

Reducing the source a.g.c. voltage, especially the a.g.c. voltage fed to the tuner, improves picture quality in weak signal areas. To effect this improvement do the following:

a. Remove the blue lead from the

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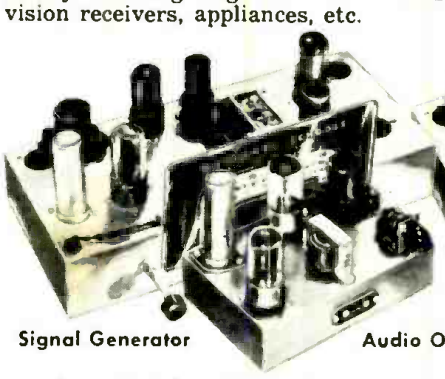

Signal Generator

T.R.F. Receiver

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Business of Your Own • Broadcasting
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Garages: Auto Radio Sales, Service
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Theatre Sound Systems, Police Radio
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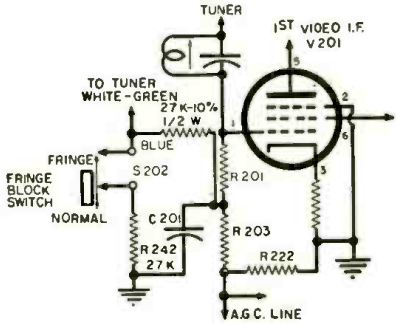
junction of R203 (330 ohm) and R222 (82k) and connect it to the white-green lead from the tuner. Disconnect this latter lead from C201 (5000 μμfd.).

b. Connect a 27k, 10%, ½ w. resistor between the junction of R201-R203 and the junction of the blue and white-green leads.



c. Replace C218 (.01 μfd.) with a .02 μfd., 20%, 600 v. condenser and C221 (.01 μfd.) with a .02 μfd., 20%, 400 v. condenser.

d. Replace R230 (1.8 meg.) with a 3.9 meg., 10%, ½ w. resistor, R226 (27k) with a 22k, 10%, ½ w. resistor, R227 (27k) with an 18k, 10%, 1 w. resistor, and R242 (39k) with a 27k, 10%, ½ w. resistor.

RA-164 & 165

Hook in picture.

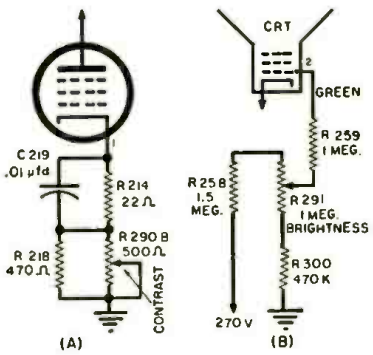
This can be caused by leaky C225, coupling condenser between the 2nd sync clipper (V206A) and the horizontal phase detector (V207). Replace C225 with a new 1000 μμfd., 450 v. ceramic condenser.

RA-164 & 165

To increase picture drive and contrast range.

Remove C219 (.01 μfd.) and R214 (22 ohm) at cathode of V204 (12BY7 video amplifier).

Connect pin 1 of V204 to the junction of R218 (470 ohm) and R290B (contrast control). See (A).



Remove R258 (1.5 meg.) and replace it with a 1.2 meg., 10%, ½ w. unit. See (B).

Remove R300 (470k) and replace it with a 390k, 10%, ½ w. resistor.

ALL SETS

Snow in picture.

Snow appears after set is in operation for some time. Grid-to-cathode leakage in one of the a.g.c. controlled video i.f. stages will

cause the i.f. a.g.c. voltage to drop and the r.f. a.g.c. voltage to increase.

Locate the defective tube by substituting good ones for those in the i.f. stages.

ALL SETS

Microphonic sound, tubes O.K.

This may be due to loose clip on top of adjusting screw of the sound discriminator transformer. Solder clip to top of transformer can. —30—

CURING "BRAKING" IN ROTARY BEAM MOTORS

By JACK WATT, W8HYQ

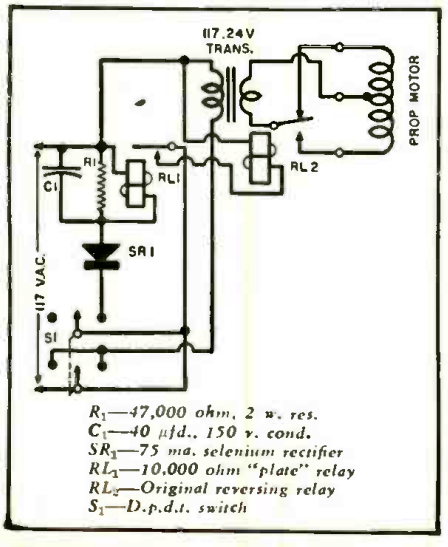
THE propeller-pitch motors widely used as rotators for amateur rotary beam antenna systems are often subject to a violent "braking" action when the control switch is thrown "off" after being in the "reverse" position. The braking is very severe on the smaller-sized motors, and when they are used with anything as large as a 20-meter array, the action could eventually wreck the most ruggedly-built beam.

When the control switch is opened and the power is removed from the system, two things happen: the reversing relay returns to its "normal" position, and the field of the stepdown transformer collapses. The motor inertia tends to keep it turning in its original ("reverse") direction. Since the reversing relay has returned to the "forward" position, the collapsing field sends a surge through the motor which has a tendency to turn it in the opposite direction. The result is a terrific jerk to the beam structure.

By inserting a time-delay circuit (see diagram) the reversing relay is energized for about five seconds after the power is cut off, allowing the motor to come to a complete stop before the relay returns to its normal position. The time delay can be varied by substituting different sizes of resistors and condensers for the ones shown.

The time-delay circuit is installed at the operating position, so it is still possible to have complete reversing control with only three wires. The stepdown transformer remains right at the motor and the control wires are still fairly light, a necessity if the beam is a long way from the operating position. —30—

Wiring diagram of the time-delay circuit.



R_1—47,000 ohm, 2 w. res.
C_1—40 μfd., 150 v. cond.
SR_1—75 ma. selenium rectifier
RL_1—10,000 ohm "plate" relay
RL_2—Original reversing relay
S_1—D.p.d.t. switch

MANUFACTURERS' LITERATURE

Readers are asked to write directly to the manufacturer for the literature. By mentioning RADIO & TELEVISION NEWS, the issue and page, and enclosing the proper amount, when indicated, delay will be prevented.

MINIATURE TUBE GUIDE

Hytron Radio and Electronics Co., Danvers, Massachusetts now has available copies of the Sixth Edition of its "*CBS-Hytron* Reference Guide" covering miniature tubes.

Pertinent characteristics data is given for 250 miniatures, 87 of them new since the Fifth Edition was published. The Guide also includes 111 basing diagrams and indicates similar larger prototypes.

Data is as complete as possible and includes operating conditions for individual tube types.

The material is presented in tabular form in order to provide the maximum information for the service or electronic technician in the most usable style. Copies of the Guide are available on request.

CONCORD CATALOGUE

Concord Radio, 55 Vesey Street, New York 7. New York, has recently issued a 36-page catalogue covering various types of electronic equipment.

Catalogue 153 lists tubes, audio equipment, test equipment, kits, antennas, converters, TV accessories, tools, parts, ham gear, etc. Copies are available upon request to the company direct.

SPEAKER ENCLOSURES

Bud Radio, Inc., 2118 E. 55th St., Cleveland 3, Ohio, now has available a four-page pamphlet describing a complete line of metal speaker enclosures for hospitals, auditoriums, stadiums, school rooms, restaurants, airports and railroad stations, department stores, industrial, and commercial applications.

Complete information is given on each model including mechanical specifications, finishes, and prices.

MAIL ORDER CATALOGUE

Radio Shack Corporation of 167 Washington St., Boston 8, Mass., has published an 8-page sale bulletin which lists junction-type transistors, u.h.f. television antennas and converters, a TV-FM booster, wire, tubes, blowers, transformers, condensers, resistors, and sale-priced high-fidelity tuners and amplifiers.

Copies of this bulletin are available on request.

BOGEN EQUIPMENT

David Bogen Company, 29 Ninth Ave., New York 14, N. Y., has issued a 24-page booklet covering its line of amplifiers, p.a. systems, television boosters, and allied equipment.

Entitled "Electronics for Audio-Radio-Television," the new publication gives design features, specifications, and prices on the equipment. The amplifier section includes p.a. units ranging in output from 10 to 70 watts. Three mobile amplifiers are also listed for 6 volt d.c. or 117 volt a.c. input; two broadcast quality preamps, one designed for mixing and fading up to five inputs; and 125 watt and 50 watt booster amplifiers are also covered.

Copies of this booklet are available without charge from the company.

STEEL SHELVING

Precision Equipment Co., 3712 N. Milwaukee, Chicago 41, Ill., is offering a copy of its new catalogue covering steel shelving, lockers, etc., as well as other storage and maintenance equipment for industrial use.

Various items of interest to the radio and television service shop owner are illustrated and described. A copy of this 32-page booklet is available on request.

JENSEN PUBLICATION

Jensen Manufacturing Co., 6601 Laramie, Chicago, Ill., has issued its "Technical Bulletin No. 4" which describes the company's four-channel, ultra-fidelity system as demonstrated at the two 1952 Audio Fairs and at the February 1953 Audio Fair in Los Angeles.

Included is construction information on the "Transflex" bass reflex transmission line unit and associated 45-cycle crossover network for the frequency range adjacent to the lower limits of audibility.

RECORDING EQUIPMENT

Audio & Video Products Corp., 730 Fifth Ave., New York 19, N. Y., is offering a 4-page illustrated catalogue with detailed specifications and prices on the complete line of *Ampex* recording equipment and audio accessories handled by the firm.

The publication includes details on the new *Ampex* playback which allows up to 8 hours of continuous play with automatic reversal and on pre-recorded music-on-tape for use with these machines.

CLAROSTAT MANUAL

Clarostat Mfg. Co., Inc., Dover, N. H., has announced the availability of the Second Edition of its "TV Control Replacement Manual."

This publication carries over 262 pages of factual control replacement information by set model and chassis

RADIO—TV—ELECTRONICS

will these fast-growing industries

leave you behind . . .

or skyrocket you up with them?

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When you find success in your chosen field, you may look back on one small incident that changed the course of your career. It may be a conversation you had. It may be the day your father bought you a radio kit, or the day you applied for a job just when somebody was needed. It may well be (as it has for thousands) the day you took two minutes to request the free CREI booklet called "Your Future in the New World of Electronics."

When you read this fact-packed booklet, you will get a complete picture of the electronics industry: where it is going, and what you can do to rise with it. For here is a field expanding so rapidly that the most optimistic experts fall short in their predictions.

Consider the 109 TV stations now operating, and the 2,000 more made possible by the recent FCC "unfreeze." Consider the 20,000,000 TV sets and more than 100,000,000 radios now in operation. Consider the gigantic defense orders for electronic equipment and installations.

Consider the thousands of radio-equipped fire and police departments; the radio-equipped railroads; the hundreds of cities with 2-way radio service for cars and cabs; the wide-ranging field of aviation communications—radio-controlled aircraft, navigation-and-traffic control, airport stations.

Consider the maritime world with its radar and navigation aids, fathometers, ship-to-shore and ship-to-ship communications. Think of electronic heating, Fax and ultra-Fax, electronic medicine, electric computers, and all the industrial applications of electronic know-how.

Then think of the unlimited number of positions to be filled—in development, research design, production, testing and inspection, manufacture, broadcasting, telecasting, and servicing. Luck won't get you a job. Contracts won't. Knowledge *will*. You will have knowledge if you prepare now—if you are alert enough and ambitious enough to obtain that knowledge—if you take two minutes to send for "Your Future in the New World of Electronics" and then follow the plan it describes.

This helpful book shows you how CREI Home Study leads the way to greater earnings through the inviting opportunities described above. However, being an accredited technical school, CREI does not promise you a "short-cut." You must translate your willingness to learn into salable technical knowledge—via *study*. CREI knows what it means to grow along with a booming industry. This year CREI is celebrating its 25th Anniversary, having started in 1927 in the early days of radio-electronics. Since then CREI has provided thousands of professional radiomen with technical educations. During World War II, CREI trained thousands for the Armed Services. Leading firms use CREI courses for group training in electronics at company expense; among them are United Air Lines, Canadian Broadcasting Corporation, Trans-Canada Airlines, Sears Roebuck & Co., Bendix Products Division All-American Cables and Radio, Inc., and RCA-Victor Division and Macklett Laboratories. CREI courses are prepared by recognized experts, in a practical, easily-understood manner. You get up-to-date study materials; your work is under the personal supervision of a CREI Staff Instructor who *knows* and *teaches you* what industry needs. You choose your own hours of study *at home*. Upon completion you join the many CREI graduates who have found their diplomas keys-to-success in Radio, TV and Electronics. CREI alumni hold many top positions in America's leading firms.

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designation, the set manufacturer's part number, the *Clarostat* catalogue number, and the function of the control. Several cross indexes serve as additional checks in determining the right replacement.

The manuals are available at $1.00 each from distributors or the company direct.

FREE PUBLICATION

Allied Radio Corporation, 833 W. Jackson Boulevard, Chicago 7, Ill., has released the first issue of the *"Allied* High-Fidelity Auditioner," a four-page quarterly publication containing information about new products and developments, especially in the field of high fidelity.

An interesting feature is a column called "Hi-Fi Clinic," with questions and answers about typical problems encountered with hi-fi equipment.

This new publication will be sent without charge to audio technicians, hi-fi installers, experimenters, and hobbyists. To be placed on the mailing list send your request to "High-Fidelity Auditioner" at the company address.

"SCOTCH" TAPES

Minnesota Mining and Mfg. Co., 900 Fauquier St., St. Paul 6, Minn., has announced an 8-page booklet describing applications of seven *"Scotch"* brand paper-backed electrical tapes in electric motor, coil, and transformer construction.

The physical and electrical properties of all applicable tapes, together with the electrolytic corrosion factors of each are listed in the book, copies of which are available from the manufacturer.

CONSUMER BOOKLET

The receiver division of *Allen B. Du Mont Laboratories, Inc.*, has issued a comprehensive consumer booklet on cabinet design, construction, and styling.

This purse-sized booklet breaks TV cabinet styles into four distinct categories; traditional, contemporary, modern, and mixed and contains an exhaustive description of each of the styles.

The booklet will be distributed to consumers through the company's authorized "Teleset" dealers.

TUBING COMPONENTS

Uniform Tubes, Inc., 1220 Level Rd., Collegeville 2, Pa., is currently offering copies of a four-page booklet describing a wide variety of miniature and subminiature metal tubing for use as component parts of transistors and other advanced electronic equipment.

Manufacturers' inquiries are invited by the company.

THERMAL RELAYS

A copy of *G-V Controls Inc.'s* new catalogue covering its miniature and octal size thermal time delay relays is now available from the company at 28 Hollywood Plaza, East Orange, N. J.

Publication #30, a 4-page, 2-color

brochure includes cutaway views of the stainless steel mechanism and metal shell, a complete set of curves of operating characteristics, and detailed specifications on the six time ranges now in production. Delay intervals range from 3 seconds to 5 minutes.

SERVICE MANUAL

Sylvania Electric Products Inc. has announced the publication of a new service manual, covering all of the company's TV models from 1950 to 1953.

Superseding the three former volumes issued since 1949, the new manual omits all duplicate information on each chasis as it was built. Condensed and revised schematics, waveforms, alignment procedures, and replacement parts lists for all models through the 508-510 chassis, in addition to code changes in the bridge, chassis, and model numbers, are featured.

In addition to the manual, the company is offering a one-year subscription to all of its TV technical information. The manual and subscription will sell for $2.00 each. Contact your *Sylvania* distributor for further information.

RAILROAD RADIO DATA

New heavy-duty railroad radio equipment is described in an 8-page booklet currently available from *Westinghouse Electric Corporation,* Box 2099, Pittsburgh 30, Pa.

The booklet, B-5787-A, describes features of the equipment that enable it to readily fulfill the five basic needs of railroad radio communication: end-to-end; train-to-train; wayside-to-train; dispatcher-to-any-wayside or train; and bridging wire-line breaks in an emergency.

The electrical and mechanical description of the equipment includes ratings, dimensions and weights, and power requirements.

The equipment covered is the company's Type FE. —30—

CAPSULE RADIO CONTROL

THE first master test unit of a revolutionary capsule radio control for municipal street lighting systems, invented by Broadway Maintenance Corp., has been installed in New York. The inexpensive new control is expected to save American cities millions of dollars annually in lighting and maintenance costs.

It also provides the city with instantaneous emergency control of its street lights without additional equipment of any kind, should such control become necessary.

The capsule control, approximately the size of an electric bulb, is so inexpensive that it can be replaced rather than repaired. It is a monitor-type receiver which monitors a steady radio signal and switching assembly. It can be controlled from any standard commercial radio transmitter. In this way all street lights can be operated simultaneously without the malfunctioning now encountered with the astronomical time clock or photoelectric cells currently in use. —30—

QRM-Cutting Selectivity

(Continued from page 62)

The front and rear panels were similarly formed from sheet aluminum, as was the wrap-around case and cover. Note that the front panel is slightly larger than the rear one, to permit the wrap-around and cover to go inside the lip of the front and outside the rear. It can thus be slid off over the rear cover by removing the sheet-metal screws holding it in place. The parts of the disassembled case are shown in the photograph Fig. 3. To save space, no socket is used for the pilot light. Its only function is to indicate whether or not heater power is on the unit, and a 12-volt bulb, operating on 6 volts and soldered in place by its base behind a small hole in the panel was found to do the job admirably, and without glare. The hole may be seen between the knobs in the photograph, Fig. 5.

External Connections

Fig. 6 shows the connections that need to be made between the converter, the i.f. strip, and the broadcast receiver. Note that a d.p.d.t. switch is installed in the receiver and is used to switch both the audio input to the receiver gain control and the heater power. In one position, all BC receiver heaters are on, the converter and i.f. heaters are off and the gain control is connected to its original BC circuit. In the other, the BC receiver r.f. and i.f. tube heaters are off, power instead being supplied to the converter and i.f. strip heaters, and the input to the gain control is switched to the i.f. strip output. By thus switching heaters, it is possible to leave plate voltage on both the i.f. strip and the entire BC receiver at all times, since turning off the BC r.f. and i.f. tubes stops them from drawing plate current, and makes it available for the i.f. strip which requires approximately 30 milliamperes. Be sure to trace out the receiver 6-volt circuits, however, so that the audio and rectifier tubes (if any), the vibrator, and the speaker field, if operated at 6 volts, run all the time.

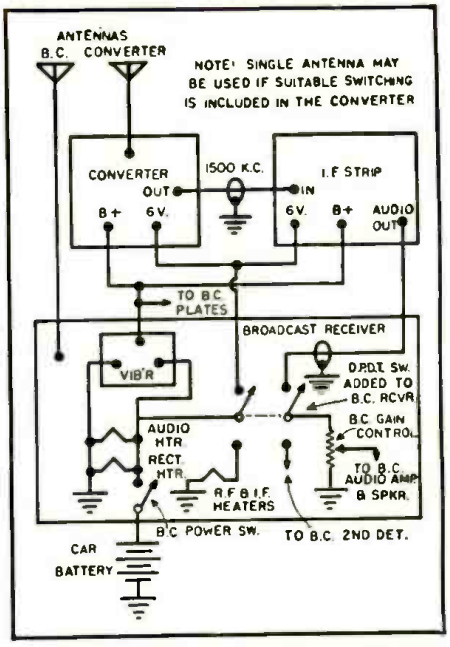
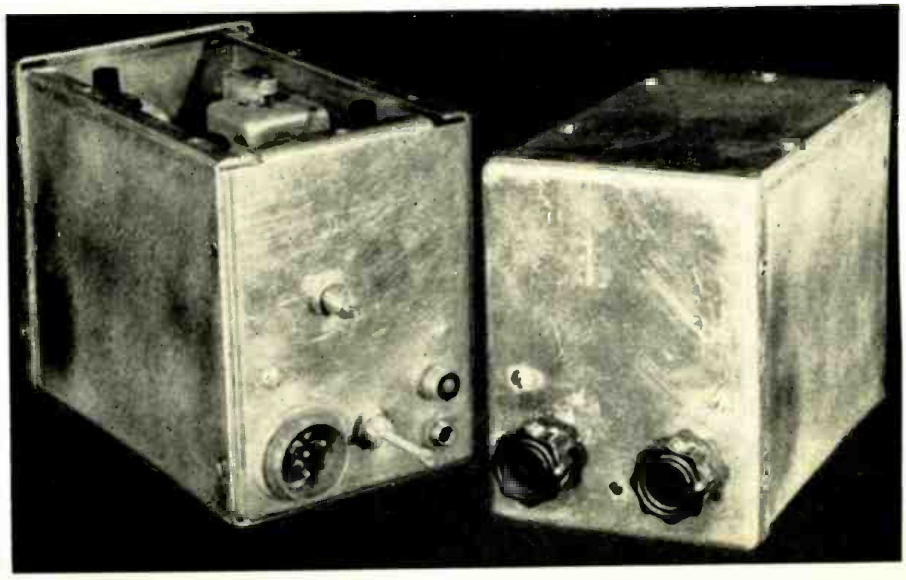


Fig. 6. External connection diagram. Most of the car receiver is disabled to save power when the attached equipment is used.

It is important to shield the audio output lead from the i.f. strip to the BC receiver, since otherwise it will be likely to pick up vibrator hash and feed it into the audio system. Other cables can also be shielded in the interest of minimizing ignition noise, although that has not always been found necessary.

No other changes need to be made in the BC receiver, and it can still be operated normally without any of the ham gear connected. This is a decided

Fig. 5. Front and rear views of i.f. strip. In the front view: clipping level adjustment knob (left) and selectivity control (right). Rear view at left: power and audio connector (bottom left), oscillator tuning slug (bottom center), S-meter jack J_2 (bottom right), input jack J_1 (above J_2), S-meter adjustment pot (center of panel).



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New 1953 630 FA-2*

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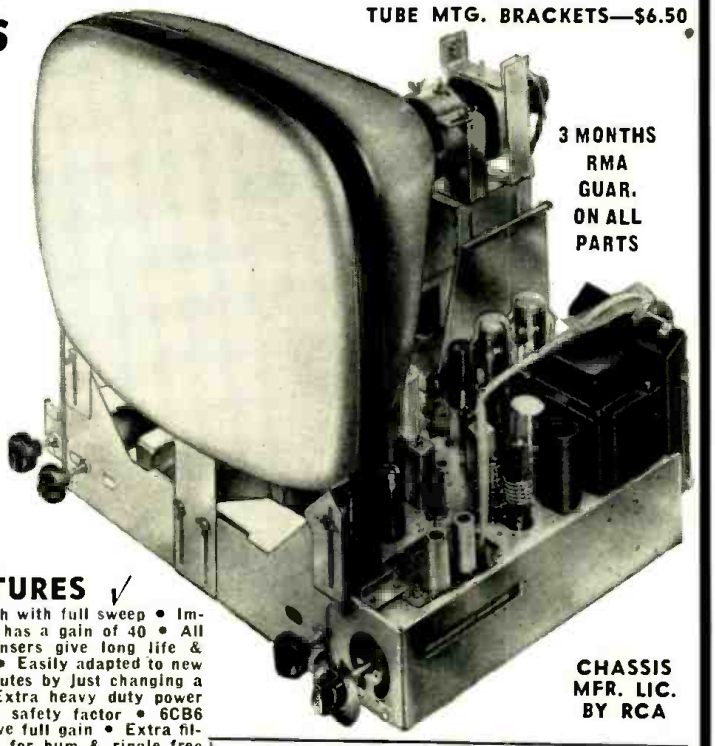

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• 10 WATT push-pull audio output. Frequency range from 40 to 12,000 cycles • Standard Coil Cascode Tuner prevents radiation • Retrace Blanking Circuit allows you to raise the brightness without the annoying vertical retrace lines • Heavy duty front focus control • Automatic gain control potentiometer allows you to adjust the threshold sensitivity as low as 4 microvolts & still keep the full 4MC band width • Improved sync amplifier • Improved automatic brightness control • Set aligned for 21.9 MC. New Ham band will not interfere • Improved fused high voltage power supply gives full 14.5 KV under load • Will handle all picture tubes up to 24 inch with full sweep • Improved video amplifier has a gain of 40 • All moulded plastic condensers give long life & trouble-free operation • Easily adapted to new UHF stations in 2 minutes by just changing a strip in the tuner • Extra heavy duty power transformer with large safety factor • 6CB6 tubes in Video IF to give full gain • Extra filtering in power supply for hum & ripple free operation • Phono Connection & switch on chassis allows you to play your phonograph or tuner through the built-in 10 watt hi-fidelity amplifier • Extra heavy duty focus coil, which runs cool • Full focus cosine yoke.

TV PICTURE TUBE SALE

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- 16" Tube—$25.94
- 17" Tube—$27.95
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- 20" Tube—$34.95
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Send for free folder and price list. Full line table models, consoles, consolettes and TV-Radio-Phono combinations. Many styles, mahogany, blonde, etc.

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Webster 3 speed 1953 Model Automatic Stop $33.95

GI 3 Speed....$17.95

Garrard RC 80..$41.30

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- **ESPEY MDL 7C 12 TUBE FM-AM** with 12" Hi-Fi speaker.....$64.95
- **PILOTONE'S NEWEST HI-FI MODELS**
  Pilotone FM-AM Tuner Mdl AF821A with built-in preamplifier.....$99.95
  Pilotone FM-AM Tuner Mdl AF-723...$79.95
  Pilotone Amplifier Mdl AA901 with Wiliamson circuit $99.95
  Pilotone Amplifier, Mdl AA902.....$44.95
  Pilotone Pre-Amplifier, Mdl PA911...$29.95
- **RADIO-VISION FM TUNER** with power supply.....$24.95
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Standard Coil Cascode Tuner. 12" RCA Hi-Fi Speaker. Fed. Tax Incl.....**$154.95**

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MAIL ORDER DEPT.: 400 Lafayette St., N.Y.3

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advantage when the car is to be turned in, since it is bad enough to have to convert the BC receiver when the car is new, and worse to have to reconvert it when it's old and you'd much rather be cutting holes in the fenders of the new one with the three propeller spinners.

Alignment

The first step in putting the i.f. strip into operation is to set the oscillator on the correct frequency. It may be operated on either 1415 kc. or 1585, for 1500 kc. input, and either is satisfactory. If the *Millen* units are used, tune the oscillator to 1450 or 1550 kc. Its frequency can be checked quite closely by listening to it in a broadcast or communications receiver, and adjusting the slug as required. A 1500-kc. signal should now be fed to the input receptacle, either from a signal generator or, if not available, from a converter, and the i.f. transformers tuned. They should be tuned for maximum with their coupling adjustment rods pulled out as far as they will go, and the selectivity control in maximum selectivity position. The selectivity thus obtained is usually too sharp for phone work, however, and it can be broadened by increasing the coupling of T_2, T_3 or both. The control on T_3 will then provide additional control from the front of the panel. It has generally been found that the best results are obtained by coupling T_3 all, or almost all, the way in, and leaving T_2 all the way out.

If the 50-kc. *Millen* transformers are used, most of these considerations will not apply, of course. The builder may in that case decide to align the i.f. strip by the conventional method of working from the demodulator back to the mixer-oscillator stage.

The 50-kc. units are inherently sharper than the others, and since they do not have adjustable coupling, the builder may find that experiments with resistive loading and stagger tuning may be in order.

If means are available for checking the selectivity curve, either visually or point-by-point, some slight improvement in symmetry may sometimes be obtained by slight readjustments of the trimmer condensers after the coupling is adjusted, but this step is not necessary and may be omitted unless convenient, since the improvement is hardly noticeable to the ear.

The input transformer should, of course, be adjusted to 1500 kc., preferably with the converter with which the strip is to be used connected and a signal on appropriate frequency fed through it.

This unit has proved itself to be an outstanding improvement in the mobile station. It provides just about all the selectivity that can be used for phone operation, and actually outperforms a very high percentage of home station receivers. Similar units built by W2DZV, W2AIH, and others have been equally successful.

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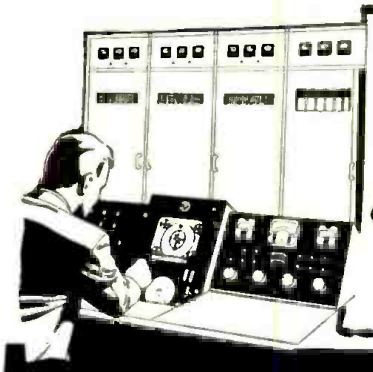

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Letter from nationally-known Airlines, "We would also appreciate if you would place the following additional advertisement in your bulletin—Wanted—Superintendent of Communications . . . Salary $666.66 per month."

Letter from nationally known manufacturer of high quality AM and FM transmitters, "We are very much in need at the present time of radio-electronics technicians and would appreciate any helpful suggestions that you may be able to offer. Salary up to $412 per month to start."

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
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Clifford E. Voot. 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, Calif.	2nd Phone	23

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"I have obtained my 1st class ticket (thanks to your school) and since receiving same I have held good jobs at all times. I am now Chief Radio Operator with the Kentucky State Police."

Edwin P. Healy, 264 E. 3rd St., London, Ky.

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.

GETS CIVIL SERVICE JOB

"I have obtained a position at Wright-Patterson Air Force Base, Dayton, Ohio, as Junior Electronic Equipment Repairman. The Employment Application you prepared for me had a lot to do with me landing this desirable position."

Charles E. Loomis, 4516 Genesee Ave., Dayton, Ohio.

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Name.....

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Paste on 2-cent postcard or send air mail.

Audio Equalization

(*Continued from page* 39)

recording work in a large variety of halls and rooms, each with its own set of audio characteristics, and since the monitor room at each of those recording sessions is likewise dissimilar, it is obvious that different sounding recordings will be issued by the same company!

Then what about the mastering? Isn't that where the recording equalization is inserted? Yes, that's correct. But what exactly happens? What is the procedure in the master-room where the final lacquer disc is cut for processing and pressing? Here are some of the simple facts: the master recording engineer plays the original tape *into his monitor speaker* and, using one of the various professional "program" type line equalizers, he accents or diminishes the bass and treble spectra. He equalizes for sound and, also important, for proper bass content, commensurate with the playing time of his particular selection, which determines the cutting pitch and, to an extent, the allowable cutting stylus' lateral excursions on the passages heavy with bass. Go back a few paragraphs, if you will, to our discussion of the difference in sounds in "your home and mine" and we wonder what would have been the equalization introduced, if the master recordist's monitor speaker had been located in my home, or in yours.

How, then, does the sincere recording company decide what to do for master equalization? It combines the several factors of its own discretion in hearing, conclusions as to what is good sound, experiences which have taught what its experts consider to be the "average sound," and an honest desire to manufacture a reputable product which pleases more than it displeases.

What does this leave the sincere high fidelity enthusiast? When and how does he arrive at proper playback equalization? We believe quite sincerely that he arrives at proper playback equalization when the sounds from his pickup, amplifier, and loudspeaker, combined with the audio characteristics of his home and the surrounding noise levels, give him the *maximum satisfaction*. Above all, when it pleases his own ears—*that's* when he has equalized the recording characteristic, which was never adjusted to please the "square" screen of an oscilloscope or the cold mind of a vacuum tube voltmeter, but was adjusted to meet certain physical and uncertain psychological conditions.

How does he achieve it? By availing himself of a playback equalizer with maximum flexibility in adjusting "tone balance"—the same effectual adjustments which the room, the conductor, the recording and re-recording engineers make. By using a preamplifier-equalizer with separate bass and

treble spectra controls and a few selectable turnover frequencies. For maximum flexibility, the bass and treble controls should have an electrically infinite number of steps of spectra control over their usable ranges. A continuously variable control, such as the variation provided by a potentiometer, one for bass and another for treble, affords the infinite degree of desirable spectra control with the very minimum of circuitry that a switch selector cannot possibly provide. As for the turnover points, there is too little difference between a 250 and a 300 cycle, or a 400 and a 500 cycle, or a 800 and a 1000 cycle turnover, for example, to warrant the inclusion of all the 8 or 9 turnover points required to meet the needs of commercial records being manufactured today, here and abroad.

In conclusion, I would like to state that I do not believe that there is no exact science to the art of recording and equalization, nor do I infer that the same science could not be applied to the playback system. I am endeavouring to point out some of the human and physical elements which enter into the "art and science," and the human and physical elements which are the listener's lot to cope with. The ear and the mind and the aesthetic criteria of the human being are not as consistent as oscilloscopes or other measuring devices of the laboratory. Humans are measured by so called "averages." Laboratory instruments are measured according to "tolerances" and they, in turn, measure only electrical tolerances. Recordings are not made to be played for the pleasure of a laboratory's measuring devices.

-30-

WAGE-HOUR REPORT

VIOLATIONS of the overtime pay provisions of the Fair Labor Standards Act were the chief cause last year of back wage liabilities for firms in the communications industry, according to the recently-released annual report of the U. S. Labor Department.

Employers in the industry paid $149,935 in back wages to 1170 employees as a result of the division's activities.

Of the 486 establishments investigated by the division during the year 1952, 63 per-cent were found in violation of the overtime pay requirements. Twenty-nine per-cent had failed to comply with the statutory minimum wage. Violations of the Act's child-labor provisions were found in 3 per-cent of the investigated establishments.

The report emphasizes that the fact that 71 per-cent of the investigated establishments had violated one or more of these basic provisions of the Federal Wage and Hour Law should not be considered representative of compliance by the communications industry as a whole. Investigations are made on a selective basis with concentration on plants where complaints have been made.

The Act covers only those employees engaged in interstate commerce or in the production of goods for interstate commerce.

-30-

NEW TV PRODUCTS on the Market

BUILT-IN ANTENNA

Arvin Industries of Columbus, Ind. has announced that all of the company's u.h.f.-equipped television sets now incorporate a built-in, all-channel antenna which accommodates both u.h.f. and v.h.f. reception.

Since approximately 80 per-cent of all of the company's TV production is now concentrated in sets equipped with the all-channel built-in tuner which was first introduced last Spring, the same percentage of *Arvin* sets is now all-channel antenna-equipped.

ALL-CHANNEL SET

Raytheon Television and Radio Corp. of Chicago is featuring one-knob, all-channel tuning in its 1953 line.

The single-knob tuning feature applies to both v.h.f. and u.h.f. bands. A single knob tunes all 70 u.h.f. channels. One of the models recently shown in the 1953 line was the Model C-2115, "Stockholm," which features

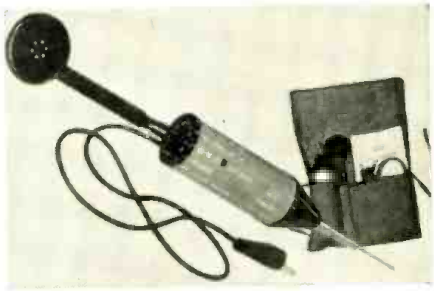
a 21-inch picture tube and is equipped with a pull-out drawer for optional phonograph equipment.

"T-V SERVISET"

Lee Electronic Labs. Inc. of Boston 19, Massachusetts has developed a compact circuit analyzer for the field or bench servicing of radio, television, radar, communication, and allied equipment.

The Model EC is completely self-contained, is simple to operate, will not load or detune the circuit under test, and does not employ tuning controls.

It may be used as an r.f. and a.f. signal tracer; r.f. and a.f. signal injector; an a.c. voltage indicator (0-60-550-20,000 volts); d.c. voltage indicator (same ranges); d.c. polarity indicator; low ohms continuity and short indicator; high ohms continuity and leakage checker; substitute and test for high capacity electrolytics and bypass condensers; a substitution and test for high value grid, plate load,



a.g.c., and a.v.c. resistors; substitution and test for medium value dropping, plate load resistors, etc.; substitution and test for low value cathode bias, current limiting resistors, filter chokes, etc.; and a dynamic checker for speakers, phones, etc.

The "T-V Serviset" comes complete with instruction manual, high-impedance, high-sensitivity *Alnico* phone, a special phone extension cord, a *"Klip-zon"* type extension tip, a special high voltage adapter, kinkless test lead with built-in lamp remover, and fabric pouch which houses all accessories and the manual.

TV SERVICE SYSTEMS

Markem Service Systems, 145 Hudson St., New York, N. Y. has developed a special service systems package for television organizations.

Simple in operation and sufficiently flexible to apply to any type of service being rendered, the TV operator is afforded continuity and control in handling the service operation from the initial call to the point where the repair job has been completed and the technician returns.

The package consists of proportionate quantities of all the forms comprising the system, housed in a specially-designed desk tray. The company will provide complete details on request.

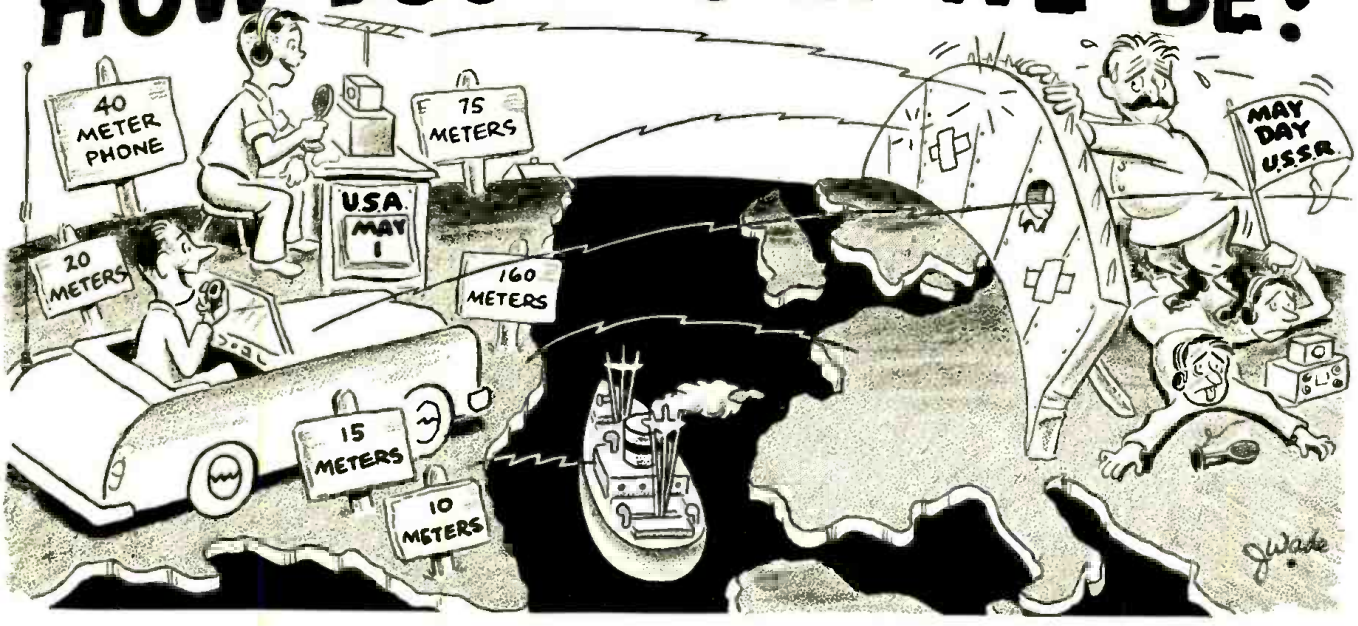
TV CONTROLS

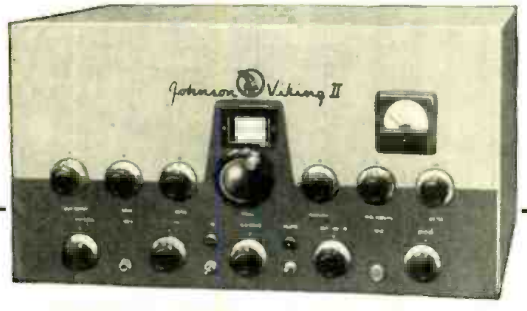
International Resistance Co., 401 N. Broad St., Philadelphia 8, Pa., has added three new TV controls to its replacement line.

The Type 4WK is a universal 4-watt wirewound control which comes equipped with the company's "Knob Master" shaft, knurled, flattened, and grooved to fit most knob requirements without modification except for cutting to required length. Diameter is 1¾" with 11/16" depth behind the panel.

The Type 4WS is identical except for the shaft dimensions. The third

HOW LUCKY CAN WE BE?





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All-Wave Portable.
Less battery pack.
Only $109.95
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Only $4.17

NATIONAL NC-125
with built-in Select-O-Ject. Less spkr. Shpg. wt. 36 lbs.
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unit is the Type VB, a two-watt carbon element high voltage control for use in television receivers employing electrostatic picture tubes.

Form S-081, available from the company, provides complete details.

CROSSOVER NETWORK

A new crossover network which combines u.h.f. and v.h.f. into a single antenna system is now available from *Eby Sales Co.*, Dept. K. 130 Lafayette St., New York 13, N. Y.

The network is an electronic filter which employs a high and low pass resonant circuit, designed to isolate the v.h.f. antenna from the u.h.f. antenna and to eliminate interference.

Housed in a weather-resisting plastic case, the crossover network can be installed on the mast or crossarm of the antenna by means of a clamp which is supplied. All elements and metal parts are of corrosion-resisting materials.

NEW U.H.F. ANTENNA

Radiart Corporation of Cleveland, Ohio, is offering a new and sturdy antenna for u.h.f. television reception.

The "U-4" is a broadband antenna of uniform gain covering the entire u.h.f. spectrum. It is completely factory pre-assembled for speedy installation and may be stacked, measuring 12" x 12" x 5".

Further information on the "U-4" is available on request.

PORTABLE VOLTMETER

A new, low cost, high voltage measuring device designed for busy TV service technicians has been announced by *American Research Corp.*

The "TV Voltprobe" enables the technician to measure the accelerating d.c. voltages on a TV tube from 4000 to 25,000 volts quickly, easily, and accurately.

The unit is 10" long, lightweight, and completely self-contained. In operation an alligator clip is connected to the chassis of the set. The probe end of the instrument is connected to the second anode by piercing the rubber protective cap.

The "TV Voltprobe" is being distributed nationally by *Clover House*

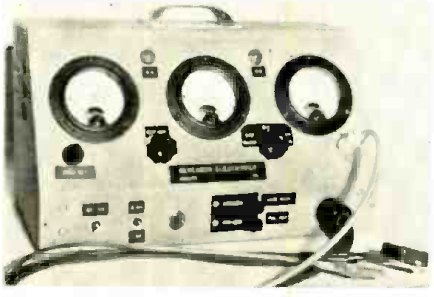
Products, Dept. 61, Box 1107, Santa Monica, Cal. Write to the distributor for full details or information on dealer and distributor opportunities.

CR TUBE TESTER

Research Electronics of Roslyn, Pa., has developed a cathode-ray tube test set which will handle all television

picture tubes and magnetically deflected radar types.

This portable test instrument will measure all characteristics including emission, cut-off, gas ratio, heater-cathode leakage (positive and negative), grid-cathode leakage, A2 leakage, and G2 leakage. It features electronically-controlled and regulated circuits. The unit operates from 117 volt, 60 cycle a.c. lines.



OPEN LEAD-IN

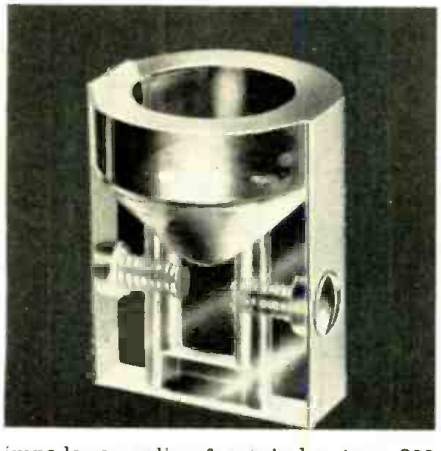
Imperial Radar and Wire Corp., New York 66, N. Y., has developed a new open lead which is said to insure lower signal loss in u.h.f. and v.h.f. installations.

The new line has a nominal impedance of 250-275 ohms and can be used with 300 ohm equipment without mismatch. The narrower spacing for 250-275 ohms is said to be more desirable at u.h.f. Losses are .35 db per 100 feet dry at 500 mc.

Distributors are handling this line in spools carrying 100, 250, and 500 foot lengths.

LINE SPLICER

A new, solderless transmission line splicer designed to provide a constant impedance splice for tubular type 300 ohm lines to flat types has been announced by *Mosley Electronics, Inc.*, 2125 Lackland Road, Overland 14, Mo.



The splicer, Catalogue No. 29-S, is intended for use with any of the currently-available tubular or oval types of line in use for u.h.f. installations.

TELESCOPING MAST

Alprodco, Inc. of Mineral Wells, Texas is offering a telescoping slip-up television mast to the trade.

Made of hot-dip galvanized heavy gauge tempered steel tubing, thumb bolts engage curved tube nuts for

easy finger-tip locking of joints. Notched bottom ends assure positive orientation, automatic joint locking clips, and erection safety. The unit features automatically- aligning mast sections with rotating guy rings and optional bases.

The "Custom-built" mast can be installed by one man.

AUTOMATIC IMPEDANCE MATCH

Rytel Electronics Mfg. Co., 9820 Irwin Ave., Inglewood, Calif., is marketing a new patented device which matches impedance automatically and exactly between antenna, lead-in, and receiver.

The "AIM" unit corrects impedance mismatch of greater than 10 to 1 ohmic ratios by means of a relatively simple-appearing, conductance-inductance coupling circuit. Use of special lead-ins to avoid mismatch is, therefore, eliminated.

The unit is attached to the receiver with which it is to be used thus making installation simple and easy.

TUBE CADDY FOR TV

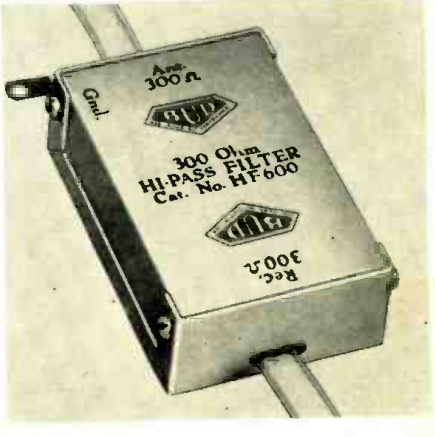
Argos Products Co., 4753 N. Broadway, Chicago, 40. Ill., is on the market with a deluxe tube caddy which incorporates a convenient tool tray for television technicians.

Other features of the new model include heavier draw type clasps, a standup support for the cover, and black-and-white pebble-grain leatheroid covering. The deluxe model measures 18" x 14½" x 9¼". The company's regular and junior models are also available.

Price information and complete specifications on any or all of the units are available from the company.

HIGH-PASS FILTER

Bud Radio, Inc., 2118 E. 55th St., Cleveland 3, Ohio, is marketing a filter unit that will eliminate or greatly reduce television interference from broadcast stations, ham transmitters,



diathermy and ex-ray equipment, auto ignition systems, and many other interference-producing sources.

The high-pass filter is designed to have a cut-off frequency at 42 mc., thus rejecting signals from 0 to 42 mc. Since there is no attenuation above 42 mc. picture strength is not affected.

We have complete lines of AEROVOX capacitors, ATLAS Sound Systems, BOGEN Amplifiers, BUD Variable Capacitors, CLAROSTAT Controls, GARRARD Changers, MERIT Transformers, QUAM Speakers, RIDERS Publications, SAMS Photofacts and SIMPSON Meters which are exact replacement parts. Send us complete lines of AEROVOX capacitors, ATLAS Sound Systems, BOGEN Amplifiers, BUD Variable Capacitors, CLAROSTAT Controls, GARRARD Changers, MERIT Transformers.

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0Z4G		3V4	.95	6AX6	.69	6H6GT	.89	6SQ7	59c	7F8	1.47	12BZ7	1.19
1A5GT	.79	5T4	1.40	6AY5GT	.89	6J5GT	.59	6SQ7GT		7G7	1.19	12F5GT	.65
1A7	.69	5U4G	.59	6B4G	1.44	6J6	.79	6SR7GT	.59	7H7	1.05	12H6	.89
1A7GT	.79	5V4G	.87	6B8GT	1.15	6J7G	.69	6SS7	.99	7J7	1.19	12J5GT	.75
1B3GT	.95	5W4	59c	6BA6	.59	6J8G	1.15	6T8	.89	7K7		12K7GT	.69
1B5	.29	5W4GT		6BA7	69c	6K5GT	.69	6U5		7L7	.79	12Q7GT	.89
1H5GT	.59	5Y3GT	.45	6BC5		6K6GT	.59	6U6GT	69c	7N7	.69	12SA7GT	.69
1J6GT		5Y4G	.54	6BC7	1.05	6K7GT	.69	6U7G		7Q7	.79	12SC7	1.05
1L4	69c	5X4G	81c	6BD5GT	.89	6K8GT	1.19	6U8	.89	7R7	1.19	12SF5GT	.69
1L6		5Z3	1.68	6BE6	.59	6L5G	.95	6V3	1.29	7S7	1.19	12SF7	.99
1LA4	1.19	6A3	1.21	6BF5	69c	6L6G	95c	6V6GT	.69	7V7	.79	12SG7	.89
1LA6	1.19	6A7	69c	6BF6		6L6GA		6W4GT	.59	7W7	1.19	12SH7GT	
1LC5	.69	6A8GT		6BG6G	1.69	6L7	1.19	6W6	.69	7X6	1.05	12SJ7GT	69c
1LC6	1.19	6AB4	69c	6BH6	69c	6N6G	1.40	6X4	59c	7X7	79c	12SK7GT	
1LD5		6AB7	1.15	6BJ6		6N7GT	1.19	6X5GT		7Y4	.89	12SL7GT	
1LE3	1.19	6AC5GT	.89	6BK7	1.19	6P5GT	.69	6Y6G	.69	7Z4	1.59	12SN7GT	.99
1LH4	1.19	6AC7	1.45	6BL7	.79	6Q7GT	.59	6Z4/84	.72	12A7	.69	12SQ7	69c
1LN5	1.19	6AG5	1.05	6BN6	1.19	6R7GT	.69	7A4	.95	12A8	1.38	12SQ7GT	
1N5GT		6AG7	1.49	6BQ6GT	.85	6S4	.59	7A5	1.19	12AH7	.54	12SR7GT	
1P5GT	79c	6AH6	1.89	6BQ7	1.29	6S7GT	1.15	7A6	.89	12AL5	.59	12Z3	.95
1Q5GT		6AK5	.89	6BZ7		6S8GT	1.25	7A7	79c	12AT6	.89	14A7	1.05
1R5		6AK6	1.08	6C4	.59	6SA7GT	69c	7A8		12AT7	.69	14AF7	.93
1S4	.99	6AL5	.89	6C5GT		6SC7		7B4	.89	12AU6	.79	14B6	89c
1S5		6AQ5	69c	6C6	69c	6SD7GT	.99	7B5	.89	12AU7	.59	14B8	
1T4	69c	6AQ6	.81	6CB6		6SF5	.59	7B6	.89	12AV6	.89	14C5	1.25
1U4		6AR5	.79	6CD6G	1.69	6SF5GT	.59	7B7	89c	12AV7	.89	14C7	1.12
1U5	.59	6AT6	.59	6D6/78	1.10	6SG7	69c	7B8		12AW6	1.19	14F7	1.05
1V	.88	6AS5	.90	6D8G	1.15	6SH7		7C5	.89	12AX4	.69	14F8	1.45
1X2A	.89	6AU5GT	1.29	6E5	.69	6SH7GT	.69	7C6		12AX7	.69	14H7	1.12
2A6	89c	6AU6	.59	6F5GT	59c	6SJ7	.79	7C7	79	12BA6	.59	14Q7	1.05
2A7		6AV5GT	.89	6F6GT		6SJ7GT	59c	7E5		12BA7	1.19	14W7	1.19
2X2/879	.74	6AV6	.59	6F7	1.59	6SK7GT		7E6		12BE6	59c	14X7	1.19
3Q4	.69	6AX4	.69	6F8G	1.59	6SL7GT	.69	7E7		12BF6		19BG6G	1.49
3Q5GT	.89												

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19T8	.89	25AC5GT	1.04	25BQ6GT	1.15	25L6GT	.59
25W4GT	.69	25Z5	.69	25Z6GT	.69	32L7GT	1.15
35A5	.99	35B5	69c	35C5		35L6	.59
35W4	.59	35Y4	99c	35Z3		35Z4	.75
35Z5	.55	38	88c	39/44	.72	41	.69
42	.69	43	72c	45	.69	45Z5	.69
46	89c	47	.69	50A5	1.05	50B5	69c
50C5		50C6G	1.39	50L6	.69	50X6	.69
50Y6	.99	70L7	89c	70L7GT	.89	71A	.87
75	.79	77	.69	78/6D6	1.10	80	.69
83	1.45	84/6Z4	.72	VR90	$1.19	VR105	
VR150		117L7	1.40	117N7	1.95	117P7	1.95
117Z3	.59	117Z6	1.19	807	1.55	813	10.95
866A	1.49	2050	2.00	2051	1.15		

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SEND US YOUR ORDER AND WE WILL SHIP FROM STOCK IMMEDIATELY

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7 inch	$17.95	16 inch	$19.95
8 inch	31.50	17 inch	20.95
10 inch	12.95	19 inch	23.95
12 inch	16.95	20 inch	24.95
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ONE FULL YEAR WARRANTY ON ALL TYPES

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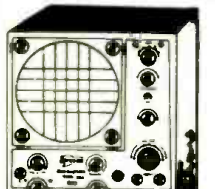
HERE IS THE BUY



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Unbeatable for fringe area and DX—The only television antenna with a money-back guarantee. With the new Electronic Dipole Separators, less mast $20.55

5' aluminum mast heavy gauge 1¼" diam. with interlocking end. Slip two sections together for a ten footer ..... each $1.00

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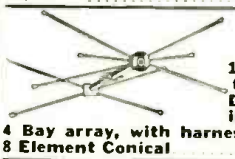

10 Element conical . . . rugged throughout ..... only $3.95
Double bay array, with stacking bars $7.75
4 Bay array, with harness and stacking bars $14.95
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Vacuum Tube Volt-Meter. 1% accuracy ceramic precision resistors; Coax DC connector; FM zero alignment scale; burn-out proof circuit. Rugged oversize 4½" meter.

Model 909, factory wired $44.98. 909K-Kit ..only $25.98

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I. F. TRANSFORMER—456 Kc 19c
PILOT LIGHTS, Type No. 47
10 for 39c ..... 100 for $2.95
VOLUME CONTROLS with SWITCH, 2" shaft 1 meg. ½ meg. ¼ meg 34c
SINGLE ION TRAPS ..... ea. 15c
OUTPUT TRANSFORMER—for 50L6 29c ..... for 6V6 39c
UNIVERSAL OUTPUT TRANSFORMER, 12 watt 99c
CHIMNEY MOUNT for TV ant. 98c
6 foot LINE CORD UL ..... 10 for $1.95
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12" COAXIAL PM SPEAKERS $12.95 ea.
High Fidelity with high pass filter attached. 20 watt; 40-17500 cps. response; 8 ohm Voice-Coil.

8" COAXIAL PM SPEAKERS ..... ea. $9.95
Very best quality—NATIONAL BRANDS. Individually Packed.

3"	ea. $1.39	8"	ea. $3.23
4"	ea. 1.59	10"	ea. 5.10
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6" SPECIAL PRICE	ea. $1.79		

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Insulated ½, 1 and 2 watt assortment of most used values, I.R.C. Ohmite, Stackpole, Speer, etc., 100 for $2.95

300 OHM TWIN LEAD

55 Mil. 100 ft. ..... $1.49 1,000 ft. $10.95
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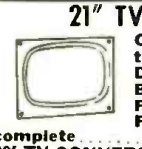

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complete	$31.95
20" TV CONVERSION KIT, as above, complete	$28.95
17" TV Conversion Kit, as above, complete	$23.95
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TERMS 20% DEPOSIT with order, balance C.O.D. All shipments F.O.B. Chicago. ORDERS LESS THAN $5.00—$1.00 SERVICE CHARGE. CABLE ADDRESS: CONTULAB.

These prices supersede all Previous advertised prices, subject to change without notice.

Please include the name of set and model number and/or part number which you need. WRITE for completely illustrated CATALOG. We have

The unit measures 3¼" x 2⅛" x 1⅛" and is housed in an aluminum case which may be mounted at the rear of the TV cabinet.

U.H.F. CONVERTER

Granco Products, Inc., 36-17 20th Ave., Long Island City, N.Y., has developed a u.h.f. converter which features coaxial cavity tuning.

The Model CTU incorporates three coaxial cavities, two functioning as a bandpass preselector with the third controlling the local oscillator frequency. A cascode amplifier and a power supply complete the unit. The preselector is essentially an overcoupled, double-tuned transformer with a balanced 300 ohm antenna input and unbalanced output to the mixer. The local oscillator tunes below the signal frequency for double superheterodyne or converter applications.

The unit is controlled by a single knob with the complete u.h.f. television band being covered by five turns of the tuning knob. The circular dial is calibrated directly in channel numbers. —30—

Noise Immunity Circuits

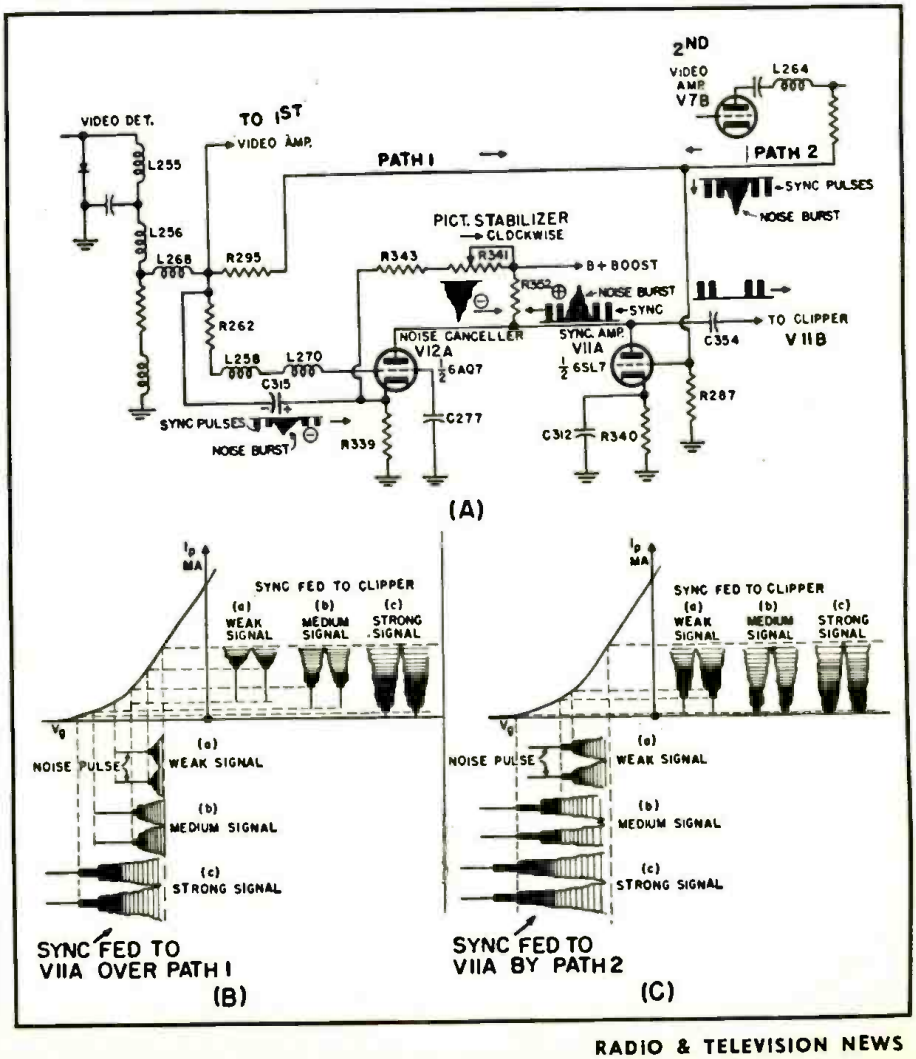
(*Continued from page 56*)

the video detector it would be susceptible to noise interference. On the other hand, if it were to receive the signal only from the output of the final video amplifier, synchronization would be hard to maintain on strong signals due to sync compression. By combining the signals from both points, good synchronization can be maintained over a wide range of input signals.

Next month's (concluding) article will describe the operation of several other noise immunity circuits.

(*To be continued*)

Fig. 10. (A) Schematic diagram of the G-E noise canceller circuit. (B) and (C) show the strength of the signals reaching V_{11A} over paths 1 and 2. See text for details.



International Short-Wave

(*Continued from page 74*)

Calif.) Noted with *English* 1730-1800 on 7.500, 9.040 (best), 11.690A. (Sutton, Ohio)

Costa Rica—A *new* San Jose station is noted on 6.502A from around 2000 to as late as 2330; seems to announce "Radio Excelsior." (Robbins, Ind., URDXC)

Cuba—Some weeks ago, COBZ, *Radio Salas*, conducted *tests* in *English*-Spanish around 2300-2400 or later; asked for reports to Box 866, Havana, Cuba. (Riggs, Calif., others)

Cyprus—Sharq-al-Adna, Limassol, noted on 6.135, 6.170 around 0005-0015. (Niblack, Ind.) The 6.790 channel relays VOA in Greek 1530-1545. (WRH)

Czechoslovakia—Prague, 9.55, noted in *English* 1930-2000 for North America. (Beach, Mass.; De Hond, N. Y.)

Denmark—OZF, 9.52, noted at good level 2200-2300 to North America. (Littlefield, Mass.)

Dominican Republic—HI1G, 6.130, Ciudad Trujillo, noted 2255 at excellent level; off 2300. (Niblack, Ind.)

Egypt—Cairo, 11.815, noted with news 1330. (Niblack, Ind.) With recordings 1445-1515. (Harris, Mass.) The Home Service lately has been carried on a *new* channel of 9.750A from around 1030-1430A closedown; all-Arabic, announces "Huna Kahera." (Pearce, England, Bellington, N. Y., others)

Ethiopia—ETAA, 15.047AV, now has *English* 1330-1430 sign-off. (Saylor, Va., others)

Finland—Helsinki has *English* 0700, 1430, 2200 over 9.55, 15.19, 17.80. (Lindholm, Sweden)

France—Paris, 17.850, noted at fair level 1045 in French.

French Morocco—*Radio Rabat*, normally closes 1800, but has been noted to 1830 Sat. (Pearce, England)

Germany—AFN, 5.470, Bayreuth, is scheduled 0000-1900. (ISWC, London)

(*Continued on page 130*)

Greenland — Radio Angmagssalik, 7.570A, noted 0913-0951 closedown. (Pearce, England) Godthaab's OXI, 9.300A, noted from 1740, fair level in Ontario. (Bromley)

Greece—Radio Jannina, now near 7.090, noted closing 0200 (some days 0230); heard from opening 1500 to closedown 1700—with chorus. Athens, 7.300, has news 1430. Greek Forces Station, 7.050A, Athens, noted closing 1630. (Pearce, England) The VOA session in Greek 1530-1545 is now relayed over *all* Greek short-wave outlets. (WRH)

Haiti—4VEH noted Sun. on 9.710A at 1630-2130 sign-off. (Pfisterer, Pa.) By now should be using 9.667A daily 0630-0900 (or 0930).

4VCP, 6.385A, some days is strong around 2130, off 2154 with anthem; is "La Voix du Nord." (Bellington, N. Y.)

Honduras—HRP1, 6.351, San Pedro Sula, noted 2036-2101; HRQ, 6.125, San Pedro Sula, heard 2035-2054. (Patterson, Ga.)

Hungary—Budapest lists 6.248, 9.833, 7.220 for *English* 1700-1730, 1930 and 2300. (Lindholm) By now, however, may be using 11.910A instead of 6.248.

Iceland—Heard on 12.175 on Sun. *only* 1115-1130. (Bellington, N. Y.; Loven, Sweden)

India—VUB2, 4.840 and 7.240, Bombay, and VUC2, 4.880, Calcutta, noted closing 1230. (Hardwick, N. Z.) Delhi, 11.85, heard with news 0835. (Glick, Ind.)

Indo-China (Vietnam) — "Voice of Vietnam," 7.285A, excellent some days with news 0930. (Riggs, Calif.) *Radio France-Asie,* 11.925, Saigon, noted with news 0900, then with bilingual programs; heard on 9.754A from around 1035 with *English* 1100-1130 closedown (for Europe). (Pearce, England; Olsson, Sweden) Heard on 15.430 with news 0500. (Svensson, Sweden)

Iraq—Radio Baghdad, 6.135, noted with *English* 1415-1500 closedown. (Hardwick, N. Z.)

Israel—"Voice of Zion," 9.010A, has news 1515 (in *summer* may be 1415); announces news for 0645 over 9.010A, 6.830. (Pearce, England)

Italy—Rome noted daily in Italian 1100-1225 on 9.78, 11.81. (Gal, Calif.) With *English* for North America 1930-2000 on 9.575. (De Hond, N. Y.)

Japan — AFRS, Tokyo, announces schedule of 1600-0330, JKI, 11.825, JKL, 9.605; 0345-1000, JKI, 6.080, JKL, 4.860. (Riggs, Calif.) Kawachi, 4.940, noted 0410, good level; Nazaki, 4.910, heard 0415, excellent signal; Kawachi, 11.800, heard 1830, good level, moderate fading. (Ballou, Calif.)

Kashmir — Murree operates under the Kashmir Govt., scheduled 2130-2300 on 3.440; 0230-0400 on 6.250, 0630-1230 on 3.440. *Radio Kashmir,* Srinigar, operated by the Indian Govt., runs 2130-2330 on 3.277; 0200-0330 on 6.110, 0630-1200 on 3.277; relays news from AIR, Delhi, 2130-1030. (Radio Australia)

Kenya Colony—Nairobi, 4.855, noted closing 1500 with "God Save the

Queen," after time pips. (Pearce, England) Forces Broadcasting Service, East Africa Command, 7.265, Nairobi, noted 2300 with relay of BBC news. (Ferguson, N. C.)

Kuwait—Radio Kuwait, 5.000, noted around 1300-1401 closedown; all-Arabic. (Pearce, England) Uses 1 kw. and transmits 1130-1400 (*winter*) and 1230-1500 (*summer*) with additional period Fri. 0000-0200; programs are Arabic music, topical features (all-Arabic); Chief Broadcasting Officer and announcer is H. E. Shaikh Abdulla Mobarak; QRA for reports is The Broadcasting Officer, Radio Station, Security Department, Kuwait, Arabia. (Radio Amateur, London)

Madagascar—FIQA, 9.515, Tananarive, noted from 1130 in French. (Pearce, England) Heard opening on this channel 2230 in French. (Riggle, Ohio)

Mozambique — CR7BU, 4.918AV, noted signing on 2300 with *English* session. (Niblack, Ind.) Noted in Portuguese on 4.870A closing 1514 with "A Portuguesa." (Pearce, England)

New Zealand — Wellington, 9.54, noted 0225-0305. (Hyson, Md.)

Nigeria—Radio Nigeria, 4.800, Lagos, heard in Britain around 1300-1500 or later. Relays BBC news 1300, 1500. (Pearce, Catch)

Northern Rhodesia—ZQP, 7.200, Lusaka, is heard in Sweden around 1130. (GDX-aren, Sweden)

Outer Mongolia—Ulan-Bator can be heard on 6.325 from about 0400 to 1000 closedown. (WRH)

Pakistan — Radio Pakistan, 17.710, has news 0330, closes 0430; heard signing on 0630 on 15.270 to Indonesia (parallel 11.674); closes 0715. (Pearce, England) Noted on 3.320 with news 1015-1030, fair. (Hardwick, N. Z.) In parallel on 5.990A. (O'Sullivan, England) Noted closing 1600 on 7.010. (Sutton, Ohio)

Peru—OAX4Z, 6.082, Lima, is reported widely closing 2400 with announcements in Spanish, *English,* French. Robbins, Ind., notes OZX4B, *Radio Azul,* Cerro de Pasco, *moved* from 6.526 to 6.560, best *after* 2300.

Philippines — DZH3, 9.500, "Radio Philippines," Manila, lists schedule of 1600-1000; power has been raised from 250 watts to 1 kw. (Hardwick, N. Z.) DZH6, 6.030, Manila, fair to good around 0400. (Saylor, Va.) DZH8, 15.300, noted weekdays 0730-0800 with "Sacred Song Request" session. (Svensson, Sweden) DZH9, 11.855, noted 1845 weak level. (Bromley, Ontario) DZH5, 9.690, 250 watts, Manila, is scheduled 1700-2030 *only.* (Navarro, Philippines)

Poland — Warsaw has *English* for North America from 0600 on 9.55, 9.57. (Pearce, England) And from 0715 on 9.555, 11.740. (Saylor, Va.)

Portugal—CSB51, 12.875, heard well 1600. (Nilsson, Sweden) Lisbon, 15.125, noted signing off 1200. (Bishop, Ohio)

Portuguese Guinea — CQM4, 5.838, noted 1700-1800 closedown. (Osterblad, Finland)

Portuguese India—Radio Goa, 9.610, scheduled 2100-1230, heard in Germany

around 1000. (ISWC, London) Has religious broadcasts in *English* some days 1030. (Pearce, England)

Roumania — Bucharest noted with *English* 1500-1545 on 9.252, 6.210 (no longer says "Radio Romana Libera" for this channel). (Pearce, England) Noted closing 1630 on 9.252. (Chatfield, N. Y.)

Sao Tome—Noted on 17.677A with good level Sun., Thur. 0700-0800 in Portuguese. (Svensson, Sweden)

Saudi-Arabia — Djeddah (with programs from Mecca) uses 752 kc. and 3.970 for Ryadi (Central Arabia) and the Persian Gulf; 7.245A for Egypt; 6.100 for Syria and Lebanon; 11.850 or 11.950 for Indonesia. (Radio Amateur, London)

South Africa—*Springbok Radio*, Johannesburg, is being heard at weak level most days on 4.945, with *English* around 2320-2345 fade-out. (United 49'ers) Johannesburg, 4.895, heard opening 2345 in Afrikaans with trumpet fanfare, then setting-up exercises to piano accompaniment. (Niblack, Ind.) Heard closing 1130 on 11.937, at 1200 with SABC news on *new* channel of 9.595A. (Pearce, England)

South Korea—HLKA, Seoul, is reported on 9.555 parallel Pusan, 7.935A. Not reported to *ISW DEPARTMENT* yet as heard in USA.

Southern Rhodesia—Salisburg, 3.320, noted 1300 with BBC news relay. (Pearce, England)

Spain—*Radio Falange de Valladolid*, 7.006A, noted with music 1400-1800. (Nilsson, Sweden) *Radio S.E.U.*, 7.093V, Madrid, noted 1435 with music. *La Voz de Falange*, 7.380A, Madrid, heard 1445 with music. (Pearce, England) *Radio Nacional de Espana en Malaga* has *moved* to 6.980 from 6.950A; closes daily 1830A. (Kary, Pa.) Madrid, 9.363, good 1800 and 2215 in *English* for North America. (Annala, Ore.)

Spanish Morocco — *Radio Tetuan*, listed 6.067, sent daily schedule of 0800-1000, 1400-1800 Spanish, 1000-1200 Arabic. (Kary, Pa.)

Sweden—*Radio Sweden*, 9.535, noted with *English* 2300-2330. (Osburn, Calif.)

Switzerland—*United Nations Radio*, 6.675, Geneva, carries "U. N. Album" Mon., Wed., Fri. in *English* and Tue., Thur. in French 1315-1330; *except* Sat., Sun. has news 1330-1345, and news in French 1345-1400. (ISWC, London) Berne, 6.165, good 2030-2100. (Barras, La.) Noted on 15.305 at 0828 in *English*, strong. (Machajewski, N. Y.)

Syria—Damascus, 7.145, noted 1515 with Arabic session. (Pearce, England) Still has news 1715, closes 1730 on 11.915A. (Sutton, Ohio)

Tahiti—*Radio Tahiti*, 6.135, Papeete, is coming through with weak level around 0000-0130 closedown. (McPhadden, Calif.)

Taiwan—"The Voice of Righteousness," BEV34, operates on 7.400 at 0200-0300 in Chinese, 0300-0400 in *English;* "The Voice of Salvation," BEC26, uses 7.400 at 0630-1030. (Radio Australia) "The Voice of Free China," Taipeh, operates to Europe and Middle East over BED4, 11.800, at 1400-1600 (*English* 1420); in *English* for USA over 15.235, 11.735 at 2300-2400; relays VOA to China 1700-1730 daily over 11.920. (ISWC, London, and others)

Tanganyika — Dar-es-Salaam hopes to have a 20 kw. transmitter in service by mid-1954. (Ridgeway, South Africa)

Tangier — *Pan-American Radio*, 7.300, noted 1400-1500. (French, Mass.) Signing off 1900 in Spanish, French, *English*. (Niblack, Ind.) *Radio International*, 6.110, noted from 1530. (Ballington, N. Y.) *Radio Africa*, 7.126, noted 1000 with popular songs in French, Spanish. (Pearce, England, and others)

Thailand — Bangkok, 6.240, noted 0553, good level; started fading 0645.

(Riggle, Ohio) Noted on 6.240 at 1845 with American recordings, identified 1900 in Thai, *English*, then continued in Thai. (Mercier, France)

Trinidad—VP4RD, 9.625, noted 0650 at fair level. (Harold, Wisc.)

Turkey—TAT, 9.515, good level 1815-1900 with *English* to North America. (Dadson, Mich.)

USI—"Voice of Indonesia," 9.710 (*new* 50 kw. transmitter). Djakarta, now has *English* 0600-0700, 0930-1030 (news 0945); also used for Europe, New Zealand from 1200A. (Radio Australia) In the 0930-1030 period is parallel with 4.910. (Pearce, England, others) YDF7, 11.770, noted with *English* 1400-1500. (Hardwick, N. Z.)

Vatican—Currently, HVJ has *English* 1000 over 9.646, 11.740, 15.120; 1315-1345 over 9.646, 7.280, 5.968. (ISWC, London)

Venezuela — Radio Rumbos, YVLK, 4.970, Caracas, noted signing off 2400. (McPhadden, Calif.) Has *English* daily 1800-1900.

Yugoslavia — Belgrade announces *English* for 0130 on 6.100, 9.505; 1200 on 6.100; 1315, 1645 on 6.100, 6.150. (Pearce, England, others)

Press Time Flashes

The Fiji Islands' short-wave station is now on the air from Suva with 500 watts, to serve those portions of the Fiji group which are not adequately covered by the 2 kw. medium-wave outlet, ZJV. Has been *testing* on frequencies in the vicinity of 6.000 (6.005, 5.995, 6.130), and more recently on 7.195; in verifying for Rosenauer, Calif, said times of *test* transmissions are 1900-2100, 0030-0500 daily which are the hours of the medium-wave transmitter; when the final frequency has been established, an additional transmission will be 1400-1600. *Wants reports* to Fiji Broadcasting Company Limited, Victoria Parade, Suva, Fiji. On tests, Rosenauer found the 7.195 channel *best* (heard from 0300 fade-in to 0500 sign-off), despite slight ham QRM.

The Milwaukee Radio Amateurs' Club, Inc., recently celebrated its traditional "Old Timers Night" and its 35th year of existence; claims to be the oldest continuously active radio club in the world.

The annual outing of the United 49'ers Radio Society will be held July 19 at the home of James Pickering, Hightstown, N. J.; Pickering is treasurer of the club. (Boice, Conn.) The World Friendship Society of Radio Amateurs, England, is conducting a membership drive, particularly to enroll members in USA; details can be had from representative Gary Ripton, 47 Lake St., Le Roy, N. Y.

Tests are scheduled to begin shortly from Apia, Western Samoa, 6.040, relaying medium-wave ZM2AP, 1420 kc.; the last series of tests planned a year or so ago was cancelled.

Radio Free Asia is now relayed daily *except* Mon. 0645-1015 over DZI4, 6.110, DZI5, 11.940, Manila, and by Guam, 9.490; heard best in Britain on

11.940. (Pearce) Noted on 6.110 with news 0945. (Balbi, Calif.)

A *new* Broadcasting Center of *four* short-wave transmitters of 100 kw. each is now under construction at Cairo, Egypt; when put into service, will beam programs to Asia, America, Europe. (WRH)

The *new* station *Radio Emisorra de Piratininga*, 6.025, Sao Paulo, Brazil, has been logged by Niblack, Ind., with good signal as early as 1800; call seems ZYR63.

According to Wadia, Japan, *Radio Japan* will shortly begin a transmission for South America.

A *new* transmission for South West Africa (not to be confused with the African Service) is aired by SABC, Johannesburg, over 9.680 Sun.-Thur. 2345-0130, 0315-0715, 0900-1605; Fri. 2345-0130, 0315-1650; Sun. 0055-0130, 0315-1605. (WRH)

When this was compiled, press dispatches from Germany indicated that a *new* short-wave station, "Radio Liberation," had just taken to the air from Munich to broadcast to Iron Curtain countries.

After quite an absence, TGWA, Guatemala City, has returned to the air; schedule is believed 0730-1900 on 15.170 and 1900-2400 on 9.760; has "Belize Program" (*English*) 1900 in parallel over TGWB, 6.180A.

On Mon. *only*, YVKO, 6.17, Caracas, Venezuela, has *English* session 1815. (Chatfield, N. Y.)

Radio Jamaica lately has been using 3.305A (replacing 3.360) at 0600-0700, then 4.950 to around 1600, when again uses 3.305A to 2300A sign-off. (West, Va., Bellington, N. Y., others)

Radio Clube de Angola, Luanda, Angola, has returned to 9.470 after using 9.092A for a few days. (Bellington, N. Y.)

Radio Belize, British Honduras, has been noted on its *new* 6.100 channel parallel with 4.951 at weak level around 1830-2100 sign-off with "God Save the Queen"; best around 1900. (Stark, Texas)

ZNB, Mafeking, Bechuanaland, is using both 8.232 and its "old" channel of 5.900 (which had been inactive) in parallel 0600-0700, 1200-1430; relays SABC news 0615, 1200. (Ridgeway, South Africa)

A *new* Spanish station is *Radio Juventud de la Coruna*, heard Sun. 1205 on 7.035. (Mercier, France)

The East Coast North America "morning" beam from *Radio Australia*, VLA11, 11.84, is now at 0700-0855; DX session Sundays is now 0840.

According to announcement, TGNA, 9.668, 11.850, should have changed schedule for *English* to 2200-2300 daily. (Bellington, N. Y.)

Radio Nederland, Hilversum, Holland, now has *English* 0445-0525, 21.48, 17.775, 15.22, 6.025; 1100-1140, 11.73, 9.59, 6.025; 1630-1710, 9.59, 6.025; 2130-2210, 9.59, 6.025.

Revised schedule from *Radio Japan* is 0000-0100 to North America, JOA6, 15.135, JOB4, 11.705; 0600-0700 to North China, JOA3, 9.675, JOB2, 7.180;

0700-0800 to Central China, JOA3, 9.675. JOB2, 7.180; 0900-1000 to Philippines-Indonesia, 1030-1130 to India-Pakistan, JOA3, 9.675, JOB4, 11.705. (Scheiner, N. J.)

All broadcasts from Lusaka, Northern Rhodesia, are directed to the African population of the three Central African territories of Northern and Southern Rhodesia and Nyasaland, while programs for European listeners are transmitted from Salisbury, Southern Rhodesia. The Lusaka station has plans for extending its operations considerably in 1953 when a *new* station is to be erected; the ultimate aim is to have two simultaneous transmissions in African vernaculars and simple *English;* the hours will be further extended also. (Radio Amateur, London)

* * *

Acknowledgment

Thanks for the fine reports! Keep them coming to 948 Stewartstown Road, Morgantown, West Virginia, USA. . . . . K.R.B.

Spot Radio News

(*Continued from page* 16)

force and by setting in motion a series of events that must be productive of harmful future consequences upon our radio and television services. There is no disguising the fact that such consequences will hamper and stunt the growth of that most vigorous and flourishing competitive broadcast system which the American people need and deserve. . . ." Continuing her angry rebuttal, Madam Commissioner said that she failed to . . . "see any real need or substantial justification for the Commission's approval of the merger."

THE POSSIBILITY that very low-priced (640 and 1240-kc.) portables may be made for Conelrad emergency use for family protection during air raids was reviewed recently during a special conference of set makers and officials of the Federal Civil Defense Administration in Washington. Under the Conelrad plan, to be placed in operation when there is danger of an enemy air attack, AM stations would transmit, under limited power on the 640 and 1240 kc. bands, raid information.

FCDA and the Bureau of Standards are preparing specs for a basic small dual-frequency receiver which would become available to everyone in industry.

Among those at the meeting were Lewis Clement, *Crosley;* Dorman Israel, *Emerson Radio;* Don Gaertner, *Admiral;* Leonard Sutton, *National Alert Co.;* W. A. Moore, *Packard-Bell;* K. B. Anderson, *General Electric;* W. F. Chaffee, *Philco;* James D. Secrest, RTMA, and members of FCDA, NPA, and the Commission.

RECOGNIZING THAT THE COMMISSION is not too keen about granting an exclusive allocation of 360 mc.

in the 5925-6875 mc. band for theater TV, exhibitors and motion picture interests have entered a compromise proposal asking for the use of common carrier frequencies by a limited common carrier. The plan also suggested that existing common carriers cooperate with the theater TV carrier, presently, because of a lack of national-networking facilities.

No specific company was named to serve as a theater TV carrier, although it appeared as if a cooperative company would be set up, similar to Aeronautical Radio, for the purpose.

FCC'S timetable calling for over 40 grants a month was once again on schedule during the second month of the new year, bringing the total of post-thaw approvals to 274; 87 for very-high and 187 for ultra-high stations.

Grants are well scattered now, as the table on page 148 illustrates, with even northern New England areas receiving a share of the new u.h.f. approvals. North Adams, for instance, in Massachusetts, will eventually have a Channel 74 outlet, which may serve Pittsfield, too, if permission is granted to place an antenna atop Mount Greylock, a peak mountain point in the state. And Portland, Maine, was awarded Channel 53, whose operators have indicated that they might be able to begin telecasting in the early fall of the year. Texas continued to receive the lion's share of grants, with five being awarded to Dallas, Longview, McAllen, Midland, and Texarkana. Missouri also appeared as a winner of a number of authorizations, four going to Hannibal, St. Louis, Clayton (area of St. Louis), and Sedalia. Most of the approvals for the month were for ultra-high stations.

EDUCATIONAL TV received quite a jolt in New York recently when the temporary State Commission on the Use of Television for Educational Purposes, rejected a 10-station statewide network plan, noting that such a program was neither necessary nor desirable at this time.

The state commission declared that the cost of constructing and operating such a system would be staggering. They estimated that the construction cost for ten stations would be at least $6,000,000, the operating costs a minimum of around $8,000,000, and an additional $10,000,000 outlay would be necessary if half of the classrooms in the state were equipped with TV receivers costing about $250 each. Another $4,000,000 would also be necessary for special films which might be produced at the rate of five per week for 40 weeks, with each film costing about $20,000.

The report of the state commission added that if the . . . "major use of educational television is to be the showing of educational film . . . there was no reason why this could not be accomplished through the simple use of motion picture projectors and

screens now available in most schools."

The FCC was asked to continue for . . . "at least five to ten years, the allocation of the channels . . . for educational purposes . . ." since more time was necessary to study the possibilities of the service. Development of television for educational TV was favored, but private funds available through non-profit organizations, can be more effectively used at present, it was said, particularly for pilot stations, following the pattern adopted in Los Angeles, San Francisco, Houston, and Dade County, Florida.

In Chicago, a fund of at least $500,000 was being sought for an educational Channel 11 TV outlet. According to Edward L. Ryerson, chairman of the committee seeking funds, it . . . "would be a disgraceful episode in the history of Chicago, if . . . we failed to make use of the channel."

THE 90TH BIRTHDAY of the Signal Corps celebrated at Fort Monmouth, a few weeks ago, was a festive event with Major Gen. George I. Back, chief signal officer opening the birthday program with an address to 900 Signal Corps officers stationed at the post, now under the command of Major Gen. Kirke B. Lawton. At a reception-dinner, guests included former chief signal officers Major Gen. Joseph O. Mauborgne and Major Gen. George Van Duesen.

Congratulations poured in to the Fort, and tribute was paid to Major Gen. Albert J. Meyer, under whose command the Signal Corps was established on March 3, 1863. The general, a physician, invented the famous flag wigwag system as a means of communication for the deafened, which became a standard means of communication. The nation is indeed grateful to Gen. Meyer and his brilliant successors for their continued contributions to the art . . . . . L. W.

CR TUBE SHORTS

By WILBUR J. HANTZ

CATHODE-TO-HEATER shorts in picture tubes are constant headaches to the service profession. In many cases the manufacturer refuses to replace these tubes during the set warranty period.

It is entirely possible to use the a.g.c. keyer tube filament winding to supply the picture tube heater if it can stand the extra current drain. In receivers of the transformerless type, something else must be done.

Some technicians apply high voltage between the kinescope cathode and filament which in some cases does clear up the short. A more positive method is to apply a source of low voltage, high current. Practically all service shops have a 6-volt A-battery eliminator which they use for servicing car radios and this is a good source of low voltage and high current. Connect a 500 μfd. electrolytic condenser across the A eliminator output and intermittently flash the picture tube with this unit. You will find that cathode-to-heater shorts clear up faster and stay clear longer with this technique.

—30—

U.H.F. Test Equipment

(Continued from page 41)

could be used. Similarly, for Channel 83 (884 to 890 mc.) the fundamental will be 221 to 222.5 mc. and the fourth harmonic will be used. One important thing to consider in the use of harmonics is the increased sweep width due to the tripling or quadrupling. This requires adjustment of the sweep width and horizontal scope controls. If the fundamental sweep width is 10 mc., then at the third harmonic the width will be 30 mc. Since the i.f. bandpass of 3 mc. or so is the one actually observed on the scope, this will appear very narrow unless the sweep width is reduced accordingly.

From the above procedure it becomes apparent that the use of v.h.f. equipment for u.h.f. alignment is neither simple nor efficient. If only one or two u.h.f. channels are received optimizing the u.h.f. tuner for these channels with v.h.f. generators is quite feasible, but if more stations are received, u.h.f. equipment is required.

U.H.F. Sweep Generators

Although a number of test equipment manufacturers are now designing u.h.f. sweep generators, only four are currently selling these units. These are: *Tel-Instrument Co., Kay Electric Co., Polytechnic Research and Development Co.,* and *RCA,* the last offering two models. All of these generators cover at least from 470 to 890 mc. through continuously tuned networks. All of them have adjustable sweep width, internal blanking, and a sine wave voltage for horizontal scope deflection. Their prices range from $575 for the *Kay Electric* "Mega-Sweep" 111A to about $1500 for some of the other models.

Kay Electric Model 111A: This unit is basically the same as the standard "Mega-Sweep" made by this manufacturer. Two klystron oscillators are used, one is frequency modulated, the other is tuned over the range and the beat resulting from the two is fed out as the r.f. sweep signal. The new model 111A features 300-ohm output over the u.h.f. TV band with maximum available sweep width of 60 mc. Output voltage is stated as 0.3 volt across 300 ohms. The main drawback of this unit is the fairly complex tuning, tracking, and frequency determination inherent in klystron operation. A great deal has been written about the original "Mega-Sweep" and most of it applies equally well to this later model. One distinctive feature of this unit is that it can be used for v.h.f. and i.f. alignment as well. Its list price is $575.

Polytechnic Type 907: The outward appearance of this sweep generator is shown in Fig. 1. Its controls are fairly simple and feature a well calibrated, vernier-type dial covering from 35 to 900 mc. While this unit has no internal marker, provisions are made for

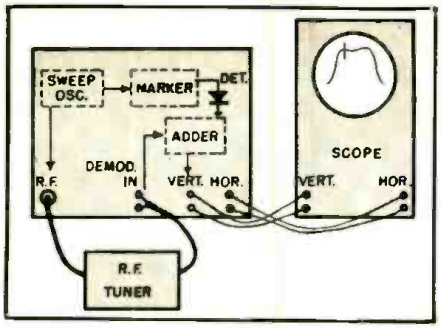


Fig. 4. Visual alignment setup using u.h.f. sweep generator which adds marker to detected sweep signal after it comes from tuner.

adding external markers through circuitry in the unit itself. This network is explained in detail in connection with the *RCA* WR-40A. The output impedance of the Type 907 is 75 ohms and the r.f. output can be varied from 10 microvolts to 1 volt. The internal construction of the generator using a 6F4 u.h.f. triode oscillator is shown in Fig. 3. The complex mechanical structure is required to assure good stability and accuracy over this wide frequency range. List price of this unit is $625.

Tel-Instrument u.h.f. sweep generator: Primarily designed for TV manufacturers, this sweep generator features crystal-controlled internal markers of adjustable amplitude. These crystal markers are located at every 36 mc. to permit simple identification of the particular section of the u.h.f. band. The sweep width is said to be adjustable up to 50 mc. The sweep frequency dial is calibrated in 36 mc. steps and a maximum output of 1 volt across 75 ohms is available. This unit is priced at $950 f.o.b. plant.

RCA: The *RCA* Model WR-40A u.h.f. sweep generator is probably the most complete u.h.f. instrument available. In addition to a continuously tuned sweep output from 470 to 890 mc., it also provides an accurate, tunable marker and a set of crystal controlled markers at 1 mc. and 10 mc. intervals. The amplitude of each of these three sets of markers is variable. Fig. 1 shows the complete unit. A very ingenious and slightly complex system is used to combine the sweep output with the markers. This is accomplished inside the generator, but after the sweep r.f. has passed through the unit under alignment. A block diagram of this scheme is shown in Fig. 4. The sweep output goes through the r.f. tuner and is then detected as in most visual alignment systems but, instead of going directly to the scope, it goes to the "adder" section of the generator. At the same time, a portion of the sweep signal is fed to the marker oscillator, the combination is detected and also fed to the "adder" section. In the "adder" circuit the two detected signals, essentially now 60 cps, are combined and connected to the vertical scope terminals. The advantage of this system is that it makes the sweep and marker amplitudes independent of each other. The same principle of

combining the detected signals is employed in the *Tel-Instrument* and *Polytechnic* sweep generators, although the latter does not have a built-in marker. The *RCA* model WR-40A retails for $1450, a price in accordance with the special features of two sets of crystal-controlled markers and an accurate variable marker.

To reach a wider market and supply a simpler instrument *RCA* also produces the model WR-41A u.h.f. sweep generator. This unit is shown in Fig. 1. It does not contain the crystal-controlled or the variable marker portions, but otherwise performs the same as the more expensive edition. Both sweep generators contain a built-in detector which permits monitoring the r.f. output. To use this feature a short coaxial cable is connected between the r.f. output and the demodulator input terminal. The demodulator output can then be connected to the vertical scope terminals for presentation. The model WR-41A sells for $595 and adjustable marker units are sold as accessories with it. It is possible to use a maximum of four of these absorption type, presettable units. They are inserted into the sweep oscillator box and cause dips in the response curve at the desired frequencies.

Use of U.H.F. Sweep Generators

The basic connections for using the u.h.f. sweep generator are the same as for v.h.f., except where marker addition requires some changes. In aligning u.h.f. networks the same principles apply as in v.h.f., but some of the effects hardly noticed in v.h.f. assume major importance when dealing with u.h.f. With the exception of the *Kay Electric* "Mega-Sweep" model 111A, all other units have an output impedance of 75 ohms. This means that if a u.h.f. tuner is aligned which has the same impedance as the v.h.f. section, *i.e.*, 300 ohms balanced, the 75 ohm unbalanced output from the sweep generator will have to be matched to the tuner. Several types of matching devices are available for u.h.f. and their performance will greatly influence the alignment and the appearance of the response curve. If the impedances are not matched closely, standing waves will result which can materially distort the response curve pattern. In trying to align the r.f. tuner then, it is actually possible to ruin the tuner response curve, while a good curve appears on the scope. For this reason it is essential that there be a proper impedance match between sweep generator and tuner. Some u.h.f. tuners use 50-ohm or 75-ohm coaxial input networks so that the problem of matching is much simpler. In any event, before aligning a tuner its input impedance and whether it is balanced or not should be ascertained.

Impedance matching devices which transfer from a balanced to unbalanced system are often called "baluns." There are several types on the market and some are available with the sweep

generator. *Polytechnic Research* manufactures a very good 50 to 300 ohm "balun" which sells for approximately $30. *RCA* supplies a matching pad which matches their 75-ohm generator to a 300-ohm system by means of a resistor network.

Many service technicians will remember the early days of television when alignment of the r.f. tuner was a major operation and required all sorts of tricks and precautions. We are now in the same stage as regards u.h.f. Aligning a u.h.f. tuner requires an accurate knowledge of the characteristics of the particular tuner as to bandwidth, input impedance, tracking, and peaking adjustments as well as familiarity with u.h.f. test equipment. With time, however, the familiarity and experience will come and as tuners and test equipment become more standardized, u.h.f. alignment will become just as routine a service job as present v.h.f. work. —30—

GDO TIP

By LEON CARTER

THE low-cost surplus "S" meters now on the market can be used to advantage in grid dip oscillators despite their relatively low sensitivity (3 to 5 ma.), by connecting them in a simple v.t.v.m. circuit as shown.

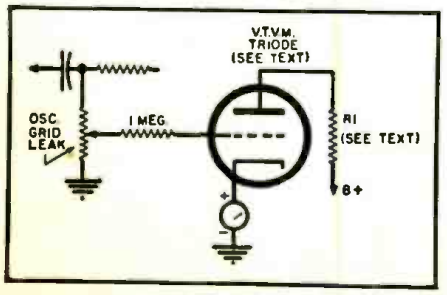
The oscillator grid leak is a carbon pot and the slider is connected to the triode grid through a 1 megohm isolating resistor. The tube can be a general-purpose triode capable of handling the full-scale meter current. R_1 should be the correct value for providing full-scale current through the meter with zero volts on the grid of the tube. 50,000 ohms is a good value as a starter.

Set the pot slider at the grounded end for this adjustment. Full scale is to the left of the scale with "S" meters, to the right with other types of meters. When the GDO is operating, increasing the pot setting will place a negative voltage on the triode grid, from the oscillator grid leak, and reduce the meter current. This adjustment gives a good reading on the meter as the oscillator amplitude falls off normally on the higher ranges and the dip is more easily seen.

When the instrument is used as an absorption wavemeter, the pot slider is set up toward the grid end to take advantage of the full voltage across the grid leak. Adjustment of the pot has a slight effect on the oscillator frequency up to 40 mc. but this is negligible. At v.h.f. it may become objectionable.

The v.t.v.m. tube may be half a twin triode with the other half serving as the oscillator, if desired. The GDO should be calibrated with the pot set to give a normal scale meter reading on each frequency range. —30—

Increasing "S" meter sensitivity.



RADIO-TV Service Industry News

AS REPORTED BY THE TELEVISION TECHNICIANS LECTURE BUREAU

IF YOU operate a service business, whether it is radio, television, audio, or mobile equipment, have you ever given any serious thought as to *why* set owners should select *you* to handle their service? What facilities or special abilities do you have that will permit you to give better or more satisfactory service than, for example, the dealer who originally sold the equipment? Is there some good, solid reason why service customers should patronize you in preference to your competitors?

Or do you feel that since you are *in* the service business customers should turn to you for service for no special reason except that you are in the business? Do you feel that somehow or other service customers in your area have some sort of an obligation to have you do their electronic service work? Or do you harbor the thought that the industry generally has a responsibility to help you *individually* make a success out of your service business?

These are soul-searching questions but they pose the fundamentals that must underlie sales planning in any business that hopes for long range success in the sale of service. When you set up any business to serve the public your major problem is effective sales promotion carried out at a cost that your volume of business will support. Without such a program carefully planned and consistently carried out, your business venture will flounder during seasonal lulls. If you do not have a planned service sales program geared to the needs of your specific locality or area you are not guiding your business through management; you are merely drifting along with the economic tide which will eventually land you on the rocks of failure.

Service Customers and You

In its tours about the country the TTLB staff comes in personal contact with many set owners and especially owners of television receivers. The essence of the information gleaned from these contacts is that set owners are more confused than dissatisfied with TV service. They have little idea about the complexities of TV circuitry and probably less about what good service should cost. Another problem that confuses them is, "How do you pick out a good, reliable service company from all the listings in the telephone directory?"

In order to gather factual information on the dormant market for electronic service and set owner attitudes toward independent service operators, the Bureau arranged to conduct a series of consumer surveys in various parts of the country. The first of these surveys has just been completed. It reveals some very interesting information.

To get a true cross-section of opinion in a selected area the surveys were set up to blanket the chosen section. Interviewers contacted set owners in a house-to-house program and gathered information on all electronic home instruments including television, radios (broken down into consoles, table models, battery portables, and auto), and record players. One hundred homes were covered in the first survey.

The cardinal point crystalized in this study merely emphasizes with facts a sad failing of independent service operators that has been pointed out many times in this department: Independent service operators are failing to sell themselves and their know-how and service facilities to the set owning public.

Despite the fact that manufacturers have made exceptionally good service selling promotional material available to service operators, so little of this is being used that it hasn't made even a dent in public opinion. All too often service people read a new public relations booklet on service made available to them by some manufacturer and say, "Gee, this is swell." Then what happens? Nothing. The only way these fine promotional pieces will ever be read by set owners in your area will be for *you* to order them and either mail or distribute them house-to-house.

Take the RTMA—BBB consumer booklet on television and service as an example. Probably a quarter of a million of these booklets have been

ordered and distributed. There are twenty million TV set owners. Just think of it—only one booklet has been distributed for every 80 set owners!

A Few Set Owner Facts

Of the first 100 homes covered in the TTLB set owner survey, 84 have television receivers. Twelve of these have required no service to date, 8 have had one service call under warranty, and 4 are serviced by the owners themselves.

The average "in service" life of the 60 receivers on which service costs were obtained is 20.1 months per set. These sets have required a total of 176 service calls for which the owners paid $959.25. This averages 2.9 calls per set at $5.45 per call.

Forty-five of these set owners said they preferred to call the dealer from whom they bought the set when it needs service. Four sets are serviced by part-time TV service technicians and only eleven are handled by independent TV service companies! TV service operators who have been afraid that radio and appliance dealers will get into the service field more aggressively should study this next fact.

Eight of the dealers who handled most of the sales involved in this survey maintain service departments. However, all of these dealers are interested in service only to the extent of maintaining customer good-will. They would prefer that independent service operators take over the servicing after the sets are out of warranty. But they will not assume the responsibility of recommending an individual service company to their customers. They feel that is a selling obligation of the service company who wants the service business.

Yet no independent TV service company has been able to capture the interest of an appreciable percentage of these people so they will call him for service.

Price Advertising?

A weekly community newspaper is distributed to every home in this area. Each week there are four or five ads in it offering TV home service at prices ranging from $2.50 to $4.00. Evidently none of this advertising is effective for not one of these advertisers was mentioned by set owners as their source of TV service.

When set owners are properly sold on what good service can accomplish in maintaining top picture quality the cost of service becomes secondary to the caliber of service rendered. The sales promotion necessary to sell the facilities, qualifications, and know-how of independent service companies is a responsibility of the service company itself—no one else can or will do that job for him.

After-Market Sales

The city in which this TTLB survey was made is a primary signal area on Channel 6 and a fringe area for a Channel 10 station. A good signal can

be picked up from the latter station from a properly selected and installed antenna system. Almost all set owners in a single station area tire of the programs available from the one station after a few months of set ownership and are good prospects for the necessary equipment that will permit them to receive a second station.

But only 11 sets out of the 84 covered in this study have outdoor antennas that permit them to get Channel 10!

Just consider the dollar volume of business that is waiting in this area for the sales promotional activity that will crystalize it into sales on antenna systems. Good sales promotion and follow-up salesmanship would interest a large part of these set owners in a deluxe antenna installation which would include a booster and a rotator in addition to a deluxe type fringe area antenna. This type of installation would give the TV service company a gross return of $150.00 per set. In the handful of homes covered in this survey there is a potential of more than $10,000 worth of antenna equipment and installation income.

Sales Promotion Service

At the present time, TV set dealers are not interested in the after-market sale of accessory equipment that requires installation. Dealers' sales programs are usually geared to the sale of new units and once a sale is completed and the set installed to the customer's satisfaction the average dealer is content to wash his hands of the account until it becomes a prospect for other new units that he handles.

As u.h.f. telecasting expands its coverage and present v.h.f. stations increase their power, many original primary signal areas will become fringe areas for new stations or for present v.h.f. stations with increased power. Thousands of set owners who bought sets for single or dual station reception with indoor antennas will become prospects for substantial antenna systems to add to the stations available to them.

But the majority of these people will remain *prospects* until some one *sells* them on the increased pleasure available to them from the stations they could get with properly selected and installed antenna systems.

Who is going to do this selling?

The set manufacturer has nothing to gain income- or profit-wise by promoting the sale of supplementary antenna systems and accessories to customers who already own his receivers. Neither has the set dealer who does not maintain a service department as a profit-producing function of his business have anything to gain by after-market sales of equipment that requires specialized installation.

The two industry elements which stand to gain everything in the sale of after-market equipment are the parts distributors and the independent TV service companies. So if these new

markets for antenna systems and associated accessories are to be properly exploited they will have to do it.

Sales Responsibility

The fundamental difference between a "jobber" and a "distributor" is that the jobber performs only a warehousing function through financing substantial quantities of the products he handles and jobs them in smaller quantities to the dealers or service companies that use them. A distributor not only handles this warehousing function but he also assumes some of the merchandising responsibility for getting his suppliers' products into the hands of its ultimate end market.

The tremendous expansion of the TV equipment after-market which will follow in the wake of u.h.f. expansion will throw local promotional responsibility squarely in the laps of parts distributors and their major service accounts. While some antenna manufacturers will expand the consumer advertising campaigns that have been tried in a few metropolitan areas it is highly questionable whether they will extend them into other than densely populated areas.

Merchandising-minded parts distributors will not wait for manufacturers to take the lead in exploiting the TV set after-market equipment sales. They will develop cooperative promotional sales programs with their major TV service accounts which will keep market control in their own hands.

The immediate need for such programs will probably become apparent to many distributors before the coming summer arrives. The TV-viewing boom that started with the political conventions last year and continued through the campaigns and the inauguration last January apparently has been gradually subsiding as indicated by reports from many of the older TV areas.

What About Radio Service

It has been apparent for a long time that service companies in TV areas have focused their promotional efforts entirely on television and have neglected radio service completely. At TTLB business meetings during the past few months many TV service operators have reported a growing number of set owners who have asked their technicians to take radio sets back to the shop with them for repairs.

The set owner survey provides factual proof of the vast field of radio service that has been neglected. Twenty of the set owners interviewed said they had radio sets that need repairs and they did not know who to call for service.

The one hundred householders reported ownership of 218 radio sets. This included 48 consoles, 147 table models, and 23 battery portables. Four users said their battery portables needed complete sets of batteries.

These facts revert again to the original premise that if service operators

want this business they as individual businessmen must carry out sales promotion programs to get it. Irrespective of how many excellent manufacturer and industry public relations programs are developed, they will lose their effectiveness if individual service businesses do not tie in with sales promotional campaigns of their own. It is the only way an individual shop can capture set owner interest and gain personal identification of its facilities and reliability as a source for electronics home instrument servicing.

New Booklets Available

Two new booklets recently announced provide TV service operators with more excellent public relations "ammunition" to build good-will for their activities and to identify themselves as sources of competent dependable service.

Tung-Sol Electric recently released an unusual 16-page booklet titled "Your Eyes and Television." Completely illustrated with the interest-impelling caricatures that add a special touch to *Tung-Sol's* sales promotional material, the book will be read with deep interest by every set owner who gets a copy.

Promotion-wise service operators will recognize the interest that eye specialists and optometrists will have in this booklet. A service operator who has a supply of these booklets imprinted with his own ad will find eye specialists happy to distribute them to patients which will make his service business known to many new, prospective service customers.

General Electric recently announced a pocket-sized eight-page booklet titled "Facts About Television Service" for service distribution to TV set owners. The text covers in simple, non-technical language the complexity of a television receiver, the implosion and high-voltage dangers involved when unskilled persons tamper with a set, and reasons for calling a skilled technician when repairs are necessary. One page is devoted to hints to the set owner on the care of his set.

The *G-E* booklets are suitable for distribution by service operators to set owners at the shop or on home service calls and they may also be used as direct mail pieces.

The *Tung-Sol* booklets are available from the company's tube distributors and the *General Electric* booklet (ETR-641) can be obtained from that firm's tube distributors.

Rebuilt Picture Tubes

RTMA recently obtained the views of the Bureau of Internal Revenue with respect to the application of radio-TV manufacturer's excise tax on the rebuilding of TV picture tubes. They reported it as follows:

1. *Q.* Under what circumstances is a rebuilt television picture tube "manufactured or produced?"

A. If a used tube is not opened or disassembled but is merely subjected to a reconditioning electrical treat-

ment, there is no manufacturing process and no tax applies to the reconditioning. If used tube is opened, new or reconditioned parts installed in the used or reconditioned shell, and the tube re-exhausted and resealed, the process is a manufacturing operation and the rebuilt tube so produced is a taxable article under Section 3404 (b) of the Code.

2. *Q.* Who is the manufacturer or producer for excise tax purposes?

A. Where the tube remains identified as the property of the rebuilder's customer throughout the operation and the identical tube is returned to the customer after the replacement of defective parts, the rebuilder is only acting on behalf of the owner and and is not the manufacturer for excise tax purposes. In such a case the customer who has the tube rebuilt on his behalf is the producer of the rebuilt tube and liable for tax on his sale or use. An individual owner of a television set who had his kinescope rebuilt for his own use would not be liable for tax in accordance with Reg. 46, Sec. 316.7 which provides:

"However, the tax on the use of such taxable articles will not attach in cases where an individual incidentally manufactures, produces, or imports for his personal use, or causes to be manufactured, produced or imported for his personal use any taxable article."

A dealer who has tubes rebuilt for sale by him will be liable for tax on such sale.

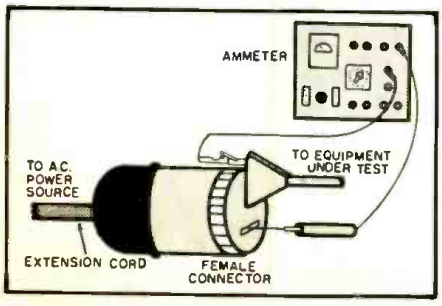
It will be presumed that the rebuilder of the tube is the "manufacturer" unless the rebuilder establishes that by agreement with the customer, ownership remained in the customer and the customer understood that he, not the rebuilder, is the manufacturer of the rebuilt tube and therefore liable for the tax applicable to the sale or use by manufacturers of tubes. —30—

MEASURING CURRENT

By MONROE CORN

SOMETIMES it is necessary to measure the current drawn by an electrical appliance. Usually this involves "cutting in" on the line so that an ammeter may be connected. A simple method which avoids any "cutting in" is shown in the diagram. By using an ordinary a.c. extension line cord and making connection so that the plug is offset, the ammeter can readily be connected to complete the circuit. —30—

How to make current measurements on electrical appliances without cutting line.



NEW TV GRANTS SINCE FREEZE LIFT

Continuing the listing of construction permits granted by FCC since lifting of freeze. Additional stations will be carried next month.

STATE	CITY	CALL**	CHANNEL	FREQUENCY (mc.)	POWER (Video)*
Alabama	Decatur	WMSL-TV	23	524-530	21.5
Arizona	Mesa	KTYL-TV	12	204-210	13.5
California	Eureka	KIEM-TV	3	60-66	17.5
"	Monterey	.....	8	180-186	10
"	Salinas	.....	8	180-186	10
Georgia	Macon	WTWV	47	668-674	100
"	Rome	WROM-TV	9	186-192	2.9
"	Valdosta	WGOV-TV	37	608-614	98
Idaho	Pocatello	KWIK-TV	10	192-198	3.2
"	Pocatello	KJRL-TV	6	82-88	7.2
Illinois	Champaign	.....	3	60-66	100
"	Springfield	.....	20	506-512	18.2
Kansas	Pittsburg	KOAM-TV	7	174-180	105
"	Wichita	.....	16	482-488	200
Louisiana	New Orleans	WJMR-TV	61	752-758	200
Maine	Portland	WPMT	53	704-710	22.5
Massachusetts	North Adams	.....	74	830-836	1
Michigan	Lansing	WILS-TV	54	710-716	25.5
Mississippi	Gulfport	WGCM-TV	56	722-728	21.5
Missouri	Clayton (area of St. Louis)	KFUO-TV	30	566-572	175
"	Hannibal	KHMO-TV	7	174-180	10.5
"	St. Louis	WIL-TV	42	638-644	46
"	Sedalia	KDRO-TV	6	82-88	6.3
Montana	Billings	KOOK-TV	2	54-60	17.5
"	Butte	.....	6	82-88	2
New York	Elmira	.....	18	494-500	58.3
North Carolina	Winston-Salem	WTOB-TV	26	542-548	200
North Dakota	Minot	KCJB-TV	13	210-216	29.5
"	Minot	.....	10	192-198	58
Ohio	Ashtabula	WICA-TV	15	476-482	19
Oklahoma	Oklahoma City	.....	25	536-542	17.5
"	Oklahoma City	KLPR-TV	19	500-506	91
Oregon	Eugene	KSPF-TV	20	506-512	19.5
Pennsylvania	Scranton	WARM-TV	16	482-488	245
South Carolina	Columbia	WIS-TV	10	192-198	265
Texas	Dallas	KLIF-TV	29	560-566	50
"	Longview	KTVE	32	578-584	20
"	McAllen	KRIO-TV	20	506-512	86
"	Midland	KMID-TV	2	54-60	50
"	Texarkana	KCMC-TV	6	82-88	18.5
Virginia	Hampton (area Norfolk)	WVEC-TV	15	476-482	220
"	Newport News	WACH	33	584-590	20.5
West Virginia	Parkersburg	.....	15	476-482	19
"	Wheeling	.....	51	692-698	24
Wisconsin	Beloit	WGEZ-TV	57	728-734	21
"	Eau Claire	WEAU-TV	13	210-216	52.2
"	Milwaukee	WCAN-TV	25	536-542	105

*ERP = (effective radiated power). **Call letters without TV suffix from application files and subject to change; except where included in calls such as KKTV or WTVT. .. = Call letters to be announced

Loudspeaker Enclosures

(*Continued from page 47*)

gards the efficiency of the system, whereas the latter system takes into account the relative efficiencies of the two systems. The two schools of thought are not compatible.

In listening to a pair of loudspeaker enclosures, we cannot compare the two systems if one of these systems is working at a much higher level than the other. Ear sensitivity is not linear with loudness. If we were to listen to a speaker system which was running at a considerably higher output level than the other, our hearing characteristic, which follows the familiar Fletcher-Munson curves, would paint a different acoustic picture for this higher level system than for the one operating at a lower output level. We would experience a different balance of frequencies, audibly, from one system to the other. So it is perhaps necessary to consider the performance of the two systems when operating at the same *output* level rather than at the same input power.

In an effort to make this test as objective as possible, it was decided that the proper basis upon which to make this equal output comparison would be at a listening level one would expect to prevail in a normal living room. We wouldn't care to make this test at a level so high nor so low that it would in no way represent the normal listening level. With both systems operating at this equal output power of comfortable level, however, we could then compare the distortion products involved.

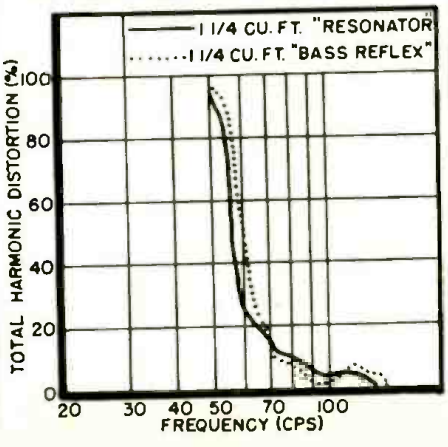
In addition to this requirement, for purposes of objective measurements, data should be taken on *one system at a time,* then that system should be removed, and the alternate system reintroduced into the same identical spot. Not only would this procedure give each system the same qualitative room conditions, but it would at the same time remove from the vicinity of the system under test, the mutual acoustic coupling of one system upon the other, especially when placed close to one another. Still again, the *same speaker should be used in both enclosures,* if it is enclosures that we are testing. Manufacturers of loudspeakers do their best to maintain standards of quality, however, commercial tolerances are a necessary prerequisite to successful commercial endeavor, and no matter how close those tolerances may be, there will be slight differences in two finished products albeit they bear the identical model number, and successive serial numbers. Especially must we be careful when measuring systems around resonances. Even though a shipping container may, in bold print, proclaim that the speaker has a resonance of 68 cps, there is the possibility of its resonance turning out to be five or ten cycles higher or lower. This variation may then throw

out of the window "A-B" comparison tests made around resonance systems *assumed* to be the same. Therefore it is essential that the same speaker be used in the various enclosure systems for the results to be truly useful.

Although it is our considered opinion that these measurements should be made on a basis of equal sound power output from the systems, in all fairness to the alternate method of measuring distortion (equal input method) a comparison was made, on this latter basis, of the Helmholtz resonator and the bass reflex enclosure of equivalent size. This comparison is given in Fig. 13. and was made on the basis of one-half watt input to the two systems. It will be observed that measurements below 50 cps were not made. This was not a premeditated condition, but one which befell the tests simply because distortion meters will not operate on incoming signals that have over one hundred per-cent distortion. Such instruments work on the principle of eliminating the fundamental from the input signal and making measurements of all the combined resulting harmonics. Where the harmonics are two to three times the amplitude of the fundamental, this fundamental cannot be tuned out by the meter. Consequently, distortions in the hundreds of per-cents may not be read by the distortion meter and we are limited to an analysis of the distortion products over an area where the measurement falls below one hundred per-cent. The interesting thing to note is that at the frequencies of 40 to 50 cycles which fall in the region of the lower resonant peak, the distortions for both systems was astronomically high, and not measurable by means of the distortion meter. As we go into the 50 cps region and higher, the distortion products fall below the 100% mark and become measurable.

It is worthy of note that there is very little to choose from as far as these figures are concerned. The "Helmholtz" resonator has a slight edge over the bass reflex system up to 70 cps, and then a reversal takes place, although the difference is quite slight.

Fig. 13. Total harmonic distortion for ½ watt input for 1¼ cu. ft. resonator and 1¼ cu. ft. bass reflex cabinet systems.



ENCLOSURE	DISTORTION
Horn (Fig. 3D)	76%
Resonator	32%
Horn (Fig. 3E)	31%
Resonator	32%
Bass Reflex (Fig. 3F)	27%
Resonator	31%

Table 1. Relative total harmonic distortion taken at 70 cps. Output of resonator is made equal to output of individual enclosure with which it was compared.

To return to our preferred method of making distortion measurements, namely, at equal output power, we must refer back to Figs. 10, 11, and 12, which compare the output of the "resonator" with the series of larger cabinets. It will be recalled that these larger enclosures produced considerably more output in the low frequency region than did the "resonator." Accordingly, to make the necessary measurements on an equal output basis, the input to the "resonator" had to be adjusted upwards to the point where its acoustic output was equal to that of the larger enclosure with which it was being compared. To make this adjustment point-by-point with frequency would not be entirely fair to the smaller system, inasmuch as there may be single areas of very high response on the part of the larger system which would be unattainable by the smaller system unless driven into regions of diaphragm excursion nonlinearities. Accordingly, merely to point out the trend, one frequency in the low frequency end was chosen as being close to the midpoint between the two resonant points of the system, specifically 70 cps. This would be the trough area between the two resonant peaks and would represent a point where the diaphragm excursion would be rather limited. The results of this last set of measurements are given in Table 1. From this table it will be noted that in two cases the "resonator" produced more distortion products, and in one case, less.

Distortion will generally increase when a system is driven harder. Several factors contribute to this increase. The diaphragm itself may be driven beyond its limits of linear excursion, the voice coil may travel out of regions of flux linearity, the diaphragm may "break up" acoustically, heating of the voice coil may cause poor load regulation, and the acoustic damping may not be sufficiently great to adequately control the diaphragm velocities. Therefore, it is necessary to conclude in this final analysis that the greater distortion of the "resonator" as compared to the larger enclosures, simply stems from the fact that the speaker has to be pushed harder to give the same output as the larger system. This would be the case for any frequency that might be chosen in this area. Even though a large number of points were chosen, who is to say that more distortion can be tolerated at 60 cps for one system than

at 50 cps for another system, or at 80 cps for still another system as against 65 cps for still a fourth system. One might bounce these distortion figures around without any logical answer other than to say that at one particular frequency, system A distorts more than system B, and *vice versa* for another frequency.

Now what general conclusion may we derive from this total analysis? It is obvious that the small enclosure may be designed in various ways. It may be of the type that utilizes a simple aperture, or a duct. But volume for volume, the speaker will give the same general response whether it be of the Helmholtz resonator type, as popularly known, or the bass reflex type. Next we must recognize that as the speaker enclosure size gets larger, more acoustic output may be expected in the low frequency area, for a given input. Also, in general, volume for volume there is a balance of distortion products between the two systems, but that as the volume increases, proportionately less distortion ensues for a given output. Finally, we may say that for optimum acoustic reproduction it is desirable to utilize as much space as possible, and that it must be utilized judiciously in an acoustically economical fashion. But we must also realize that under certain circumstances where space is not available, and where limitations in acoustic volume must be maintained, that very acceptable results can be obtained from the small enclosures.

—30—

FM IMPROVEMENT

By GEORGE R. ANGLADO

HERE is one way I have found for jacking up the gain of an FM set that has the lead-in coupled to the antenna coil through a condenser. The value of this condenser will range anywhere from 100 $\mu\mu$fd. to 250 $\mu\mu$fd.

Our set is a Western Auto Model D-2929 and upon inspecting this condenser it was found to have a value of 250 $\mu\mu$fd. We got to thinking about the losses developed in condensers in different parts of the circuit and decided to experiment with lower values.

We took out the 250 $\mu\mu$fd. unit and substituted a 100 $\mu\mu$fd. unit in its place, with the dial set on a weak station. This condenser value improved reception considerably and we wondered if lowering this value still further would provide additional improvement. The next step was to substitute a 50 $\mu\mu$fd. unit. The results were astonishing. The signal more than doubled its input. After this we figured that the next step was to hook the lead-in directly to the coil. The results were disappointing. The signal was OK but the noise was up.

A still lower value condenser did the job. The signal improved approximately five times. Noise dropped to a minimum and stability was improved. Although the coil was mounted in a can on top of the chassis, reception could have been further improved if the can was removed and about 5 or 6 turns of #18 or #20 wire wound over the coil. Readers can try this scheme on any FM set that has an antenna coupling condenser of more than 10 μfd.

—30—

1953 Du Mont "Telesets"

(*Continued from page 70*)

action shown in Fig. 7 takes place at this grid. Note that the polarity of the noise pulses from the plate of V_{220B} is opposite to the polarity of the noise in the composite video signal. Because of this the noise pulses cancel and the resultant signal appears as shown at C in Fig. 7. In this way a large portion of the noise in the composite video signal is eliminated before application to the sync clipper.

Tube V_{208A} is biased well beyond cut-off, so that it conducts only on the horizontal sync pulse, and the video and blanking information does not appear in its output. In addition to eliminating the video and blanking information, V_{208A} removes most of the vertical sync signal.

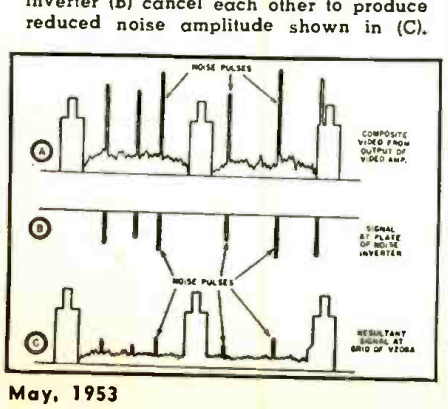
The component values used in the cathode-bias network of V_{208A} are chosen so that the comparatively long duration, vertical sync pulses (27 microseconds) build up a charge across the cathode bypass condenser, C_{216}. This charge increases the bias on V_{208A} during the vertical sync interval and the vertical sync does not appear in the output of V_{208A}.

The comparatively short horizontal sync pulses (5 microseconds) do not increase the bias on the tube and thus appear in the output of the stage. V_{208A} operates as a cathode follower with output taken off across R_{205}.

The advantage of this type of sync clipper lies in the fact that short duration pulses do not increase the bias on the tube. In the usual grid-leak-biased clipper circuit the grid bias is determined by the peak amplitude of the input signal. As a result, high amplitude noise pulses increase the grid bias and compress or completely eliminate the sync signal.

The price paid for this advantage is the elimination of the vertical sync, therefore, a second sync clipper must be used to separate the vertical sync signal. This function is performed by V_{208B}. The composite signal at the grid of V_{208A} is applied to the grid of V_{208B} through R_{205}. V_{208B} is negatively biased beyond cut-off so that it does not pass the video signal. The grid circuit time constant (R_{235} and C_{229}) is

Fig. 7. Noise pulses from the video amplifier (A) and inverted noise pulses from the inverter (B) cancel each other to produce reduced noise amplitude shown in (C).



27 microseconds. As a result, the short duration horizontal sync pulses (5 microseconds) and equalizing pulses (2.5 microseconds) do not produce sufficient amplitude at the grid to drive the tube out of cut-off. Thus only vertical sync information appears across cathode resistor, R_{208}.

Since R_{208} is common to V_{208A} and V_{208B}, both the vertical and horizontal sync signals appear across it.

The composite sync signal appearing across R_{208} is applied to the cathode of the third sync clipper, V_{209A}. The signal at this point is positive and, since it is applied to the cathode of the stage, it drives the tube into cut-off, clipping the upper portion of the sync pulses. This clipping removes all noise superimposed on the sync signals.

The output of V_{209A} is applied to the grid of a phase splitter circuit, V_{209B}. V_{209B} provides the out-of-phase horizontal sync signals required for operation of the horizontal phase detector, V_{210} (Fig. 2). The phase detector produces a correction voltage when the horizontal oscillator frequency does not correspond to the incoming horizontal sync signal.

The horizontal oscillator, V_{210}, is a conventional cathode-coupled multivibrator. The vertical sweep signal is also generated by a multivibrator circuit. This circuit performs the combined functions of vertical oscillator and vertical deflection amplifier.

Servicing Hints

Oscillator Tube Replacement: Due to normal variations in interelectrode capacitances among tubes of the same type, replacement of an oscillator tube may result in excessive frequency shift. Readjustment of the oscillator frequency can usually be avoided by trying several tubes and selecting the one which causes the least frequency shift.

Horizontal Pull: When servicing the chassis on the bench keep the CRT leads well clear of the high-voltage compartment. If the leads are run close to the compartment the video signal may enter the horizontal sweep circuits causing a misleading horizontal pull in the picture.

Loss of Picture and Sound: The "B+" voltage for several of the circuits in this receiver is obtained from the cathode of the audio output tube, V_{215}. As a result, failure of the output tube, or the audio-transformer primary, will cause loss of the picture as well as the sound. The same symptoms will result if the speaker plug is disconnected. When these symptoms occur check these components and when servicing the set be sure to connect the loudspeaker.

I.F. Alignment

The i.f. stages of a TV receiver rarely drift out of alignment. Consequently, realignment should not be attempted until all other possibilities have been checked. The following are a few points which are helpful in de-

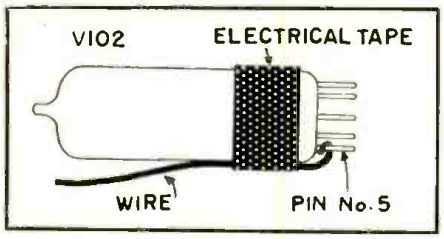


Fig. 8. A convenient method for applying alignment signal to mixer-oscillator.

termining whether or not a receiver requires realignment:

1. If the picture is weak (with or without snow), but the picture quality is satisfactory (good resolution, little smear, etc.), realignment is probably not required.

2. If the picture quality is unsatisfactory, and adjustment of the fine tuning has little effect, check the video amplifier stage before realigning.

3. If the picture quality is unsatisfactory, and adjustment of the fine tuning control has a marked effect on the picture quality, realignment is probably required.

Test Equipment Required: The following test equipment is required to align the i.f. stages of RA-166/167 and 170/171 chassis:

Sweep Generator: Frequency range—4 to 50 mc.
Deviation—10 mc. minimum.

Marker Generator: Frequency range—4 to 50 mc., with provisions for amplitude modulation of the signal, and crystal calibration.

Vacuum Tube Voltmeter

Crystal Detector Probe

Cathode-Ray Oscilloscope: The oscilloscope used should have good low-frequency response and a vertical deflection sensitivity of at least 0.1 r.m.s. volt-per-inch.

Procedure: The i.f. alignment procedure is shown in Table 2. Before beginning alignment place the station selector between channels to disable the oscillator, and remove fuse F_{201}, to disable the sweep circuits. A convenient method of connecting the signal generator to the mixer-oscillator tube, V_{102}, is shown in Fig. 8. Twist one end of a short length of wire around pin 5 of the tube and attach the wire to the tube envelope with electrical tape.

After completing the alignment procedure tune the receiver to the best signal available and examine the picture for traces of smear or trailing whites. If either condition is present adjust the top slug of Z_{201} to eliminate it. Do not adjust the slug more than one-half turn. —30—

RTG ELECTION

THE Radio Technicians Guild of Rochester, New York, has re-elected Harold Eskin to the presidency for a third term.

Serving with Mr. Eskin will be Don Lisow, vice-president; Francis Stoffel, secretary; and Alfred Best, treasurer.

The group has headquarters at 703 Temple Bldg. in Rochester.

—30—

Technical BOOKS

"THE RADIO AMATEUR'S HANDBOOK" by the Headquarters Staff of ARRL. Published by *American Radio Relay League,* West Hartford, Conn. 900 pages including catalogue section and index. Price $3.00 in U.S. Thirtieth Edition (1953).

This latest edition of the "Handbook" has been revised to meet today's demand for an authoritative and up-to-date text.

The book is divided into 27 chapters, the first four of which comprise a background or introduction to the more technical chapters to follow. They include a history of amateur radio, electrical laws and circuits, vacuum tube principles, and data on high frequency communication.

The balance of the handbook deals with high frequency receivers and transmitters, power supplies, v.h.f. and u.h.f. apparatus and communications techniques, measurements, vacuum tube data, amateur station construction, etc.

The catalogue section includes the products of 89 companies and comprises 180 pages of data on commercial products. The book, as is customary, is lavishly illustrated and the text material is supplemented by some 95 charts and tables, 466 tube base diagrams, and 85 basic formulas.

It is scarcely necessary for a reviewer to evaluate this book since it is so widely known not only among the ham fraternity but others in the electronic field that to say that there is a new "Handbook" out is sufficient to send its "fans" storewards.

* * *

"VACUUM TUBE OSCILLATORS" by William A. Edson. Published by *John Wiley & Sons, Inc.,* New York. 464 pages. Price $7.50.

Since vacuum tube oscillators are to be encountered in practically every radio, television, or radar transmitter an understanding of their functions is of vital importance to the engineer.

It is this reviewer's belief that this is the first book dealing exclusively with this subject and as such merits the attention of the engineering profession.

The author has divided his subject matter into 18 chapters covering transient behaviour of linear systems, negative resistance oscillators, nonlinear oscillations, feedback systems and stability criteria, resonators, linear oscillators, conventional harmonic oscillators, crystal-controlled oscillators, intermittent behaviour, operation at high power levels, practical relaxation oscillators, locking and synchronization, frequency multiplication and division, tube and thermal noise, modulation of oscillators, a.f.c., and long-line and multiple resonance effects.

The subject matter is presented at an engineering level and mathematical analyses are freely used. Prerequisite to an understanding of this work would be an engineering degree or work at a senior level in an engineering school. A fairly comprehensive bibliography has been appended for the benefit of those who wish to make further investigations on the subject.

* * *

"LINEAR SCALE NON-LOGARITHMIC SLIDE RULES" by Morris L. Groder. Published by *G & G Corporation,* 2003 E. 12th St., Brooklyn 29, N. Y. 64 pages. Price $2.98. Paper bound.

This little, pocket-size book tells how to construct a linear slide rule by using a straightedge, a pencil, a sheet of cross-section paper, and a compass.

According to the author, those who follow the instructions will be able to add, subtract, multiply, and divide on the same scales. Reciprocals, folded scales, and logarithms can be obtained by this technique too.

Complete instructions are included in the book and the author's easy-to-follow step-by-step instructions should cause no difficulty.

* * *

"MOST-OFTEN-NEEDED 1953 TELEVISION SERVICING INFORMATION" compiled by M. N. Beitman. Published by *Supreme Publications,* Chicago. 192 pages. Price $3.00. Paper bound.

This seventh volume in the *Supreme* TV series covers data on 1953 television models from 29 different manufacturers.

As with previous volumes, information on each receiver includes a circuit diagram, aligning data, response curves, special hints for adjusting various sections of the set, and other pertinent material for the rapid and accurate servicing of television receivers. —30—

SERVICING CRT's

By RICHARD BLITZER
Tele-Video Associates

WHEN the raster is gone or goes out intermittently, a common trouble is an open CRT heater. Very often we've found that the break apparently was in the soldered connections inside the pins. When your ohmmeter, or a lack of heater light, indicates an open heater, "sweat" the heater pins No. 1 and No. 12 with your iron, and apply additional solder. Try to get the solder to flow into the hollow pins. We have "saved" many a picture tube in this simple manner, and have had the customer swear by us instead of at us.

Another symptom of a bad CRT is the picture turning silvery when the brightness or contrast controls are turned up. This is usually necessary because the picture seems weak. We've tried the following trick with excellent results: Disconnect the CRT socket from the tube. Connect a wire from the cathode, pin No. 11, to the chassis. *Momentarily* touch a well insulated wire from the high voltage to the CRT grid, pin No. 2. A bright flash will be observed inside the neck of the tube. Shut off the power and reconnect the CRT as usual. You and the set owner will be pleasantly surprised to see the picture restored to its normal appearance. A momentary flash or two will not harm the CRT. —30—

Please Allow at Least 60 Days for Change of Address.

Within the Industry
(*Continued from page 26*)

of the receiver sales division of *Allen B. Du Mont Laboratories, Inc.* . . . The appointment of **DONALD W. TAIT** as manager of sales promotion has been announced by the equipment sales division of *Raytheon Mfg. Co.* . . . **JOSEPH SCHLIG,** former manager of advertising and sales promotion for the *Westinghouse* electronic tube division, has been appointed assistant to the division's sales manager. . . . **J. H. (ROBBY) ROBINSON** has been named sales manager of *Aerolite Electronics Corp.* . . . **C. J. MOLTHOP** has been named to the newly-created post of manager of the new market development of the receiver division of *Allen B. Du Mont Laboratories, Inc.* . . . **MARION E. BOND,** chief engineer of the communications and electronics division of *Motorola Inc.,* died recently. He was known for his pioneering work in the mobile radio communications field . . . **C. CLINTON HONEYWELL** has been named chief engineer of *Servo-Tek Products Co.* of Hawthorne, N. J.

* * *

ROBERT T. CAVANAGH has been appointed assistant director of research of the *Du Mont* Research laboratories.

The promotion follows a leave of absence of 18 months from the division during which time Mr. Cavanagh served as chief engineer of the company's receiver division.

He joined the company as a research engineer in 1947. He holds an E.E. degree from the University of Toronto and is a registered engineer in the Association of Professional Engineers of the Province of Ontario.

Read RADIO & TELEVISION NEWS Every Month

Wire Recorder

(*Continued from page 38*)

contactor) which is used to transfer the circuits from "record" to "playback." The jack assembly consists of a molded receptacle in which five spring contacts are secured. The crystal diaphragm-type microphone (which is standard equipment for the "*Minifon*") employs a conventional phone plug of miniature dimensions. The length of the contact area of the sleeve plus the tip contact is such that when inserted into the special jack it will complete the circuit from the filament supply to negative ground. This insures that the filaments will be off when either microphone or headphone plugs are removed for erasing but will still permit operation of the drive motor. The tip of the microphone plug engages the third contact which feeds the output voltage from the microphone through a pre-equalizer resistance network to the grid of the input tube.

The "record-reproduce" head receives its signal voltage from the plate of the output tube with one side connected directly to the screen. The resulting plate current passing through the head provides the necessary d.c. bias component for recording.

A similar plug is provided for the stethoscope-type earphones with the exception that the sleeve length of this plug has been extended and, when inserted, picks up additional spring contacts. Two *Bakelite* rods are actuated when the long plug is inserted into the jack. These rods connect to the two changeover switches for playback.

The head, in the playback position, feeds its signal through a post-equalizer consisting of an 8 megohm resistor shunted by a 50 μμfd. condenser. The input grid is loaded with a 2 megohm resistor. The switching mechanism also transfers the plate of the output tube to the primary of the transformer, the secondary of which feeds the low impedance headset or an external amplifier. Care has been exercised in the design of the plate circuits because of the high gain afforded by the use of the three pentodes. Suitable decoupling networks provide the necessary isolation.

The "on-off" switch controls both the filaments to the amplifier tubes and the 9 volt d.c. motor. Motor hash and brush noise are effectively suppressed by two miniature r.f. chokes and suitable bypassing. A governor, in series with the battery supply, limits the motor speed to that required for proper operation.

EDITOR'S NOTE: The "Minifon" is distributed in the USA by Harvey Radio Co., New York City. The above discussion is from the paper, "A New Pocket Wire Recorder," by Oliver Read, presented at the Audio Engineering Society, October 29, 1952.

—30—

Mac's Service Shop

(*Continued from page 66*)

"It should not now be too hard to picture what will happen when our lamp is swung rapidly back and forth in a small arc whose center is the original fixed position. This lateral movement of the light source produces an alternating voltage across the output of our combination photocell detector. The frequency of the alternating voltage will be exactly the same as the number of mechanical oscillations of our light source. If we could swing the lamp back and forth 400 complete oscillations per second, we could produce a 400 cycle audio voltage across our light-detector output.

"Furthermore, the amplitude of this audio voltage will depend, within limits, upon the length of the arc through which our lamp moves: if it is swung back and forth just a short distance either side of the normal position, the audio voltage will be small; but if the excursions of the lamp are made greater, the amplitude of the voltage across the photocell output will be increased.

"There is a very close analogy between this light-beam system and the FM transmitting-receiving system. The lamp is again the transmitter. Its *position* is similar to the *frequency* of the transmitter. Swinging the lamp back and forth is the same as moving the frequency of the transmitter back and forth across a center frequency. The shifting-position beam of light corresponds to the frequency-modulated carrier. The twin photocell arrangement that produces an audio voltage when actuated by the shifting beam of light is like an FM detector.

"As can be seen from this analogy, the big receiver difference between the AM system and the FM system is in the kind of detector used. We have to have a detector that will respond to frequency changes the way our twin photocells respond to position changes of the light source. This is not hard to accomplish—especially after Mr. Armstrong showed us how! For example, suppose we have two AM detectors tuned respectively to 455 and 445 kc. Suppose, too, that the response of each gradually falls to zero at precisely 10 kc. either side of the frequency to which it is tuned. Let us now present a 450 kc. carrier simultaneously to both detectors. They will respond with equal outputs since the carrier is exactly 5 kc. from the maximum response frequency of either, but since the outputs *are* equal, no voltage can be measured across the output circuits, just as was the case with our twin photocells.

"In the same way variations in amplitude of the 450 kc. carrier will not produce any voltage variations between the two outputs. But if we shift the frequency of the carrier one way or the other, immediately the output

of the detector toward whose frequency the carrier is moving begins to increase and the output of the other begins to decrease, just as happened with our photocells.

"I think you can take it from there," Mac broke off. "This detector responds to frequency change exactly the way our twin photocells responded to light change. The output of the double-barrelled detector produces an alternating voltage whose frequency is equal to the frequency with which the carrier moves back and forth across the center frequency. The amplitude of the audio voltage is directly proportional to how far the carrier frequency is shifted back and forth."

"Is that really the way an FM detector works?"

"It is how it works, but the actual methods used are different. There are several different types of FM detectors, but they all produce zero voltage when the carrier is at the center of the FM channel and increasing voltages of opposite polarity as it moves away from this center frequency in one direction or the other. The actual methods used to accomplish this end are not easy to explain without going into phase, vectors, etc.; but I doubt if your Mr. Smith is interested in these technical details. He doubtless will be satisfied if you can show him how a frequency modulation system *can* work."

"Lots of FM detectors have limiters ahead of them. How come?"

"It's pretty hard to design an FM detector—or anything else—that works perfectly," Mac explained. "Most of them tend to have *some* response to wide changes in amplitude, such as are produced by noise pulses. The best way to keep these amplitude surges from appearing in the detector output is to keep them from reaching its input. Limiter stages do just that. They are designed to pass only a certain amplitude of signal, no matter how large a signal is presented to them. As a result, the signal they deliver is uniform in amplitude, with all the surges pruned off. The important frequency deviation, of course, is unchanged; so our FM detector can do a good job of translating these frequency changes into audio voltages without having to contend with disturbing changes in amplitude, too."

Barney snapped shut the notebook in which he had been scribbling while Mac talked, and a gleeful grin spread across his freckled face. "Boy, am I going to give Mr. Smith the works tonight!" he exclaimed in happy anticipation. —30—

GERMAN EXHIBIT

THE postponed German Radio and Television Exhibition has now been rescheduled for August 29th through September 6th at the Dusseldorf Exhibition grounds.

The Exhibit was postponed last year when the industry was unable to complete the requisite television circuits to enable programming for demonstrating the TV receivers. —30—

There's Cash Afloat

(*Continued from page 37*)

Gas tubes and audio type amplifiers are involved here, as well as Rochelle salts and magnetostrictive transducers. However, receiving type tubes, and spare vibrators and fuses are the most frequently required service items.

The depth finder is an example of the breathtaking growth of small-boat marine electronics. A surprising number of private pleasure craft are installing them, but one of their most outstanding applications is with fishing fleets. Schools of fish show up on a depth indicator, and there is no need to dwell on what this means to a commercial fisherman. The fishermen also find fog a condition of their work a large part of the time and their electronic instruments are worth their weight in gold if they get the catch to market promptly.

There is nothing to the installation or maintenance of the above that the able-bodied and conscientious worker cannot creditably handle. Instruction books furnished with all new equipment specify in sufficient detail any special requirements of that equipment. Perhaps the most important single requirement is that power feed wiring be heavy enough so the voltage drop in the line never goes above a few per-cent. This information is usually given tabularly in instruction books for different distances to the vessel's batteries. The heavy wire required (No. 6 and larger) can be obtained from auto supply houses.

Next to warrant careful treatment is the telephone antenna and ground system. Insulation must be very good, impervious to water and dirt, and the mechanical structure must be corrosion-proof and capable of riding out any weather the boat will float in. Most radiotelephone manufacturers also supply antennas designed for their gear. Lead-ins must get out in the open, fast; and not meander through the boat. Ground connections must be heavy and direct.

Engines will require standard treatment for radio noise suppression if reception is expected with the boat underway.

Then, the worker must cultivate neatness in routing wires, drilling holes, and making connections. The man who has just shelled out $49,000 for some gleaming ark will be very glum with anyone who chops up or scratches his treasure. Study the construction of every type of boat that comes along, so the most favorable placement of equipment and its wiring will come almost instinctively. And wear rubber soled shoes on varnished decks. The owner may feel more concern over that varnish than over his wife!

What is in it. for all of this effort? Expect a markup of from 25% to 35% on new equipment. This may not sound like much, but the price of just

a 10-watt radiotelephone and antenna will come to around $475 to which the installation fee (usually $50 or more) is added. Sales like these are worth spending a few days on! Service charges in general should run around $5 per hour, depending on locality; or about one dollar more than TV service since a higher degree of responsibility and government licensing are required.

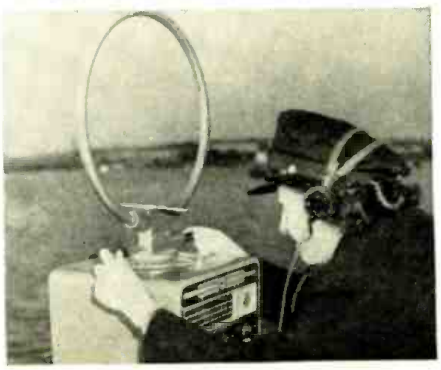
The names of the more prominent marine radio manufacturers can be found in such periodicals as *"Yachting"* and *"Motorboating,"* and cooperation can be expected from the manufacturers in setting up any venture that holds promise of expanding their market. Some of them have even made a practice of shipping equipment on consignment.

The impetus given electronics by television and government needs has sent developments ahead at rocket speed. To keep up with most applications of the art, complex facilities and extremely specialized training are absolutely necessary. The amateur who would like to turn professional, or the small operator looking for a business opportunity is therefore often reluctant (and in some cases unable) to plunge into the maelstrom of general radio and TV servicing. But here is one field in radio, *and it may be the last,* where a profitable career can still be built without the backing of Fort Knox.

If the idea of attempting to start "cold" in the field is not too appealing, opportunity exists in several maritime centers—such as northern seacoast cities in the summer, and Florida and Gulf of Mexico ports in the winter—for you to break in on the job, working for somebody already established. The most popular man on many waterfronts is the radiotelephone specialist, and the clamor for him is such that it is not at all uncommon, when you step foot on the dock, to hear the call echoing through the fleet moored alongside: "Here comes the radioman!"

There's loot in those boats—and these days it doesn't take a Blackbeard to get it! —30—

This yachtswoman is familiarizing herself with a new direction finder by comparing the null line of radio bearings with the line of sight. Servicing such equipment involves no unique techniques. This unit covers the broadcast and short-wave bands as well as the radio beacon band.



Sine-Wave Clipper

(*Continued from page* 51)

wave generator is connected to the input terminals of the instrument. The set-up used is shown in Fig. 6.

Turn on all the equipment, allow sufficient time for "warm-up" of the scope and generator, then adjust the scope controls until three or four cycles of the signal can be easily observed. The frequency is not too important, and the generator may be set to deliver a sine wave from 30 to 30,000 cps.

Gradually turn "up" the amplitude or output control of the sine-wave generator. The output signal should first appear as shown in Fig. 4D, then the pulse peak should flatten, as the signal level is increased, until a pattern similar to those shown in Figs. 4A, B, and C is obtained. The output of the sine-wave generator should be between 3 and 5 volts when the proper pattern is obtained.

If too much signal is applied, a pattern similar to the one shown in Fig. 4E will be obtained. Under these conditions there is some danger of damaging the transistor.

After the output signal level of the sine-wave generator has been set, the frequency of the generator should be varied and "spot checks" made at different frequencies over the audio range. The scope should be readjusted at each point as may be necessary to obtain a complete and steady pattern of two or three cycles.

In a few instances, it may be found that the output of the sine-wave generator varies sufficiently to require readjustment of its amplitude control to insure complete "clipping" at some frequencies. In such a case, an effort should be made to select a signal level that will insure a good rectangular output signal from the clipper at any frequency, but without distortion at any point (as shown in Fig. 4E). If such a setting of the amplitude control can be found, it will save considerable time when a series of tests is to be made at different frequencies.

Applications: There are three major applications of the output signal obtained from the sine-wave clipper. It may be used for gain measurements, for rapidly checking frequency and transient response characteristics of an amplifier, or as a source of pulse signals. Let us discuss each application separately.

Gain measurements: When proper clipping occurs, the output signal level of the sine-wave clipper remains constant, *irrespective of minor variations* in the input signal level. Because of this, the output signal is ideally suited for gain measurements at different frequencies.

The basic instrument set-up illustrated in Fig. 3 may be employed. The scope is first used to check the output from the sine-wave clipper so that the sine-wave generator can be ad-

justed to supply sufficient signal for proper clipping. Once this is done, the *output control of the sine-wave clipper* (R_2, Fig. 2) is adjusted to deliver the desired input signal to the amplifier.

The input signal amplitude to the amplifier will now remain constant at the predetermined level, even if the frequency of the sine-wave generator is changed (provided, of course, that the signal supplied to the sine-wave clipper by the generator does not drop so low as to prevent proper clipping action. Should this occur, however, it is readily spotted as a change in the waveform of the signal observed on the scope).

Gain measurements now become merely a matter of determining the output signal level. Since the input signal is of known amplitude and unvarying, actual gain is a matter of simple calculation.

Frequency and transient response checks: The rectangular wave signal obtained from the sine-wave clipper may be used in a fashion similar to square waves for rapidly checking the over-all frequency response of an amplifier, attenuator, or filter network (see "Wide Frequency Range Square-Wave Clipper," March, 1950, RADIO & TELEVISION NEWS.)

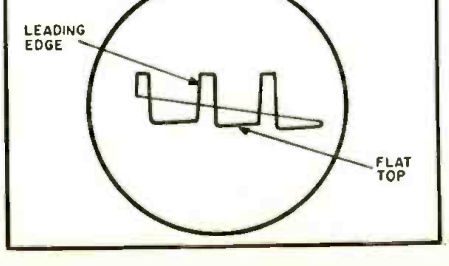
The high frequency response of a circuit or network is determined by applying a high frequency rectangular wave to its input and observing the output signal waveshape on the screen of an oscilloscope. Poor high frequency response will cause excessive rounding at the peak of the "leading edge" of the sharper rectangular pulse (see Fig. 7). Poor transient response or "ringing" will cause a signal overshoot at this point.

A low frequency signal is used to check the low frequency response of the circuit, but, in this case, the broader "flat top" (again, refer to Fig. 7) is observed. Excessive "tilting" of the flat top indicates phase shift at lower frequencies.

When using the rectangular wave in checking a circuit's response, it must be remembered that the rectangular wave's narrow pulse is representative of a *square wave* of somewhat higher frequency than the actual repetition rate of the signal.

In a similar fashion, the wider portion of the signal is representative of a *square wave* of somewhat lower frequency.

Fig. 7. Poor high frequency response causes rounding at the peak of "leading edge."



If an analysis of the signal waveshapes is qualified with these facts in mind, then the techniques of square-wave testing may be applied directly to the use of rectangular waves in circuit analysis.

Pulse signal source: Since a pulse is basically a rectangular waveform, the output of the sine-wave clipper may be used in the same fashion as the signal obtained from a pulse generator. If narrower pulses are desired, an *RC* or *RL* differentiation network may be used after the clipper.

Conclusion

The sine-wave clipper circuit described, although designed for a specific application, is basically nothing more than an overdriven transistor amplifier, operated without bias. Because of this, the basic circuit given should offer the experimenter ample opportunity to become familiar with the operation of the basic resistance-coupled transistor amplifier.

However, those experimenters who have not previously worked with transistor circuits should exercise reasonable care when experimenting with modifications of the basic circuit given. Be sure the maximum ratings of the transistor are not exceeded. Transistors are both relatively expensive and easily damaged.

—30—

Photocell Relay

(*Continued from page* 65)

source may be arranged to fall across a doorway so that anyone entering the room interrupts the light beam. This, in turn, may cause a chime, doorbell, or buzzer to sound. Such an arrangement is particularly useful for small stores, small offices, etc.

Door Opener: The photocell relay may be arranged in a garage so that light striking the unit from an auto's headlights acts to operate a door-opening motor. In this application, the long tube (see Fig. 3) should be used to prevent operation due to extraneous light from passing cars, street lamps, etc.

Counter: A light source may be arranged to fall across a hall or areaway so that anyone passing interrupts the light beam. An electromechanical counter can be used to keep a record of the number of persons passing a given spot in a day or for any other period of time.

Light Switch: The photocell relay may be arranged so that daylight falls on it, and connected so that when the light level falls, due to clouds or the approach of evening, room lights are automatically switched on.

Smoke Alarm: If the light source and photocell relay are arranged across the top of a room, smoke from a beginning fire will interrupt the beam and operate the unit. An alarm signal could be sounded if such an arrangement seems desirable.

—30—

Parts Show Exhibitors

(Continued from page 32)

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*Trade Papers

OREGON HAM MEET

THE 1953 Oregon Amateur Radio Association (O.A.R.A.) Convention will be held in Salem's Marion Hotel May 23 and 24.

A full program of entertainment is being planned for visiting amateurs, including lectures by eminent authorities, contests, equipment displays, swap and shop room, etc. The prize list is headed by a Johnson Viking II wired and ready to operate and includes dozens of useful items.

Registration fees are $7.00 for general and advanced class amateurs; $5.00 for Novice class hams; and $3.00 for non-licensed guests. Advanced registration is now underway.

Reservations and requests for additional information should be sent to James W. Simmons, W7KVV, 1790 N. 24th St., Salem, Oregon. —30—

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57	Electro-Voice, Inc.
58	Irving Greene
63	JFD Manufacturing Co.
67, 68, 69 (Figs. 3 & 4), 70 (Fig. 6)	Allen B. Du Mont Laboratories, Inc.
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SPST 3A 250V.....29c; 4 for $0.98
SPDT 3A/250V.....35c; 4 for 1.00
DPST 15A/125V.....89c; 3 for 2.50
DPST CH CSD 8A/125V, 65c; 5 for 2.95
DPST 20A/250V.....$1.25; 3 for 3.25
DPDT Center Off 1A/115V.....75c
SPDT Momentary Bath Slides.....85c
DPDT Cntr Off Mom.....98c; 6 for $5.00

CHROME VANADIUM SPEED DRILLS

29PCS CHROME VANADIUM SPEED STEEL. Top Quality for Machinists or all purpose use. Standard Full Length 1 1/16" to 1/2" by 64ths. With Hand Drill Index.....$9.69
12 PCS SET 1/16" to 1/2" Less Index.....$3.49
60 PCS DRILLS #1 to 60. With Drill Index..$7.98
13 PCS 1/16" to 1/4" w/Index.....$2.69
¼ SPEED ELECTRIC DRILL w/Jacobs Wormgear Chuck & 60 Pcs Drills & Index. "TAB" SPECIAL.....$22.00
½ SPEED ELECTRIC DRILL w/Jacobs Wormgear Chuck & 29 Pcs Drills & Index. "TAB" SPECIAL.....$39.00

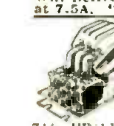
VARIAC

Made by General Radio. Model 200CU. Rated 0-135 Volts at 7.5A. Reconditioned. Tested and "TAB" Guaranteed.....$15.98
"GR" 100B/0-230V/2KW/9A.....30.00
"GR" 50B/0-270V/7KW/28A.....110.00
BRUSHES 200CU & 116/116U..49c; 5/$2

STEP UP TRANSFORMER

Primary 7.5KW, W/110V Input. Two Secondaries DUAL 220V at 7.5 Amp Each, or One 440V at 7.5A. Same but 220V Prl. Will Deliver 2KVA at 7.5A Each, or 880V at 7.5A. "TAB" SPECIAL.....$110.00

CONTACTOR



G. E. CR 2811 C 22 AQ. Heavy Duty Electric Starter. Transmitter or Motor Starter Switch. For Single or 2 or 3 Phase Appl. Rated 1 Phase 3HP/110V, 7½HP220V 10 HP 600V. Rated 2 or 3 Phase 7½ HP/110V, 15HP220V & 25HP 600V. Control Input, 220V/1PH/60 Cy. Enclosed 45Amp Open 50 Amp.....$19.00; 2 $36.00

SOLDERING IRONS & GUNS

"WELLER" Gun 115VAC 100 Watt.$8.69
"WEN" Gun 115VAC 250 Watt.....9.49
"PRIMAX" Gun 115VAC Soldless Tip 7.69

Tool Set FROM 120V AC/DC

55Watt/⅜Tip 11½Lng...3Lbs.....$1.25
60Watt/⅛Tip 12"Lng/3Lbs.....1.91
100Watt/⅜Tip 12"Lng/5Lbs.....2.55
130Watt/⅛Tip 12"Lng/5Lbs.....3.17

ESICO INDUSTRIAL CONST. USE IRONS 120VAC/DC—Similar to American Beauty types as shown

61A60/60W ⅛Tip 7"Lng 2.5oz.....$3.20
=38 AM.Beauty:1138 100W ⅜Tip.....3.29
Element=38 Am.Beauty:1138/100W.....2.00
=58 Am.Beauty:1158/200W ⅝Tip.....6.30
Element=58 Am.Beauty:1158 200W.....2.75
=78 Am.Beauty:1178 300W ⅞Tip.....8.18
Element=78/Am.Beauty:1178 300W.....3.65
=98 Am.Beauty:1198 500W 1¼Tip.....10.08
Element=98 Am. Beauty 3198 550W.....4.55
Esico Temp Regulating Stand.....4.20
Kester Solder, 1 lb...062 Roll.....$1.29 or
With any soldering Iron, Special.....90c

FIXTURES FOR QUANTITY PRICES

TOOL KIT

High Quality Forged, Tempered Tool Steel. 6½" Adj Wrench. 5¼" Long Needle Nose Pliers, 5¾" Cutters. With Carry Case.....$2.25
8 Screw Drivers. Assorted High Quality. Magnetized. Tool Steel. Hammer-Proof. Unbreakable Plastic Handles, 12" & smaller. Incld Phillips Type.....$1.25
6 Screw Drivers, 8" & Above.....1.10

RHEOSTATS

15 ohm 25 W w/knob, 1.98; 3 for $5.00
20 ohm 50 W Model J, 2.35; 6 for 12.00
60 ohm 50 W w/knob, 2.49; 3 for 7.00
100 ohm 50W Model K, 2.25; 3 for 6.00
250 ohm 25 W ea. 1.39; 4 for 5.00
300 ohm 225W Model P 3.98; 2 for 7.00
350, 500, 5000 ohm Slotted shaft, 25 watt.....79c; 3 for 2.00
1000 ohm 25W Model J 2.10; 5 for 10.00

SOCKET ASSEMBLY

For 10 slide Jumps. Excellent on-off indicator for control panel. Illustrated with lamps SPECIAL.....$2.98

SLIDE LAMP, type T-2, 2½V.....18c; 10 for $1.50
SLIDE LAMP, type T-2, 2½V Rc; 10 for $1.50
PILOT LIGHT SOCKET 1" Jewel High Polish Finish.....75c; 10 for $6.49
1" LIGHT SOCKET, w/115V6WattBulb.85c

LO-VOLT PHOTOFLASH KIT

Includes DX Flash Lamp Rated 150 Watt Sec. Flash Lamp Holder & 8" Reflector & Cable. Power Transformer & CD Flash Capacitors. 200 MFD 15V Output and 100 Watt Sec. All Resistors, Capacitors, Rectifiers & Sockets.....$29.98
Extra Flash Lamp Holders W/8" Reflector & Cord $3.98; W/Lamp DX.....$12.98

TAB "SUN-FLASH" LAMPS

"Tab" No.	Replaces	W/Sec. Max.	Each
DX	SPRG FA 100	150	9.00
U5W	GE FT 105	100	5.98
U10	GE FT 114	100	7.25
No. 1	AMGLO 5804X	100	10.98
25GT	GE FT 210	200	9.98
53GT	GE FT 303	500	13.50
VA	SYLV. 4330	200	9.98
23MT	FT 214	250	9.98
22ST	FT 110	200	9.98
V4X4	X400	200	10.98

PHOTOFLASH CAPACITORS

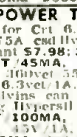
100MFD 500WVDC.....$1.98
200MFD 450WVDC.....2.89
300MFD 450WVDC.....4.39
16MFD 600VAC, 2800VDC Intmit't.6.95
32MFD/1.2KVDC/23W, Sec.....7.49
27MFD/460VAC/2KV Int. 54W. Sec. 8.95

"TAB" THAT'S A BUY

FILTER CHOKES

Dual 30 Hy/60ma Csd.....$ .98
15Hy/40ma AC DC sets.....3 for .98
12Hy/80ma/HSld/3KVins.....2.25
10Hy/125ma UTC Csd H Sld/1KVins.1.69
5Hy/125ma Csd HSld.....1.89
2Hy/300ma or 15Hy 400ma/12KVins 8.95
13.5 HY 1 Amp./17KVins/Raytheon.39.95
12HY 300ma, Hmsld 5KVins.....4.95
10HY 100 MA Freed.....1.49
6HY/175ma 250ohm....$1.49; 2 for 2.49

POWER TRANSFORMERS

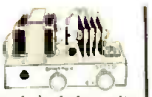


2500V for Crt 6.3V/6A, 2.5 V/1.75A csd Hvins 4/BC412 Rectifiers.....$7.98; 2 for $14.98
1000VCT/45MA, 705vct, 8ma, 360vct 55ma, 385V/3A, 6.3vct/1A, 6.3vct/3A csd Hvins can be used as Pigtail conv.....$4.98
950VCT 100MA, 5V/5A, 5V/2.5A, 45V/1A, 10V/1.5A.....$5.49
900V 35MA, 2x2.5V/2A, selnt 1800-2KVins csd Hvins 4/BC412 Rectifiers.....3.49
900V 3MA, 6.3V/2A, 2.5V/3A.....2.98
840VCT 110MA, 530vct 21ma, 285V 5A, 6.3vct 1A, 6.3vct 3A.....4.98
780VCT/250MA, 5V/6A, 12.6V/5.5A 7.95
770VCT/200MA, 5V/6A, 12.6V/5.5A 6.95
760VCT/120MA, 2.5vct/10A, 6.3vct/2A 5V/3A, 10V/3.25A.....6.98
700VCT 120MA, 280,3V/3A, 6.3V/1A.....$3.98; 2 for 7.25
550VCT 150MADC, 5V/1A, 6.3V/3A. 3.49
500VCT/60MA, 6.3V/4A Hsld.....2.98
420VCT/90MA, 6.3V/1.9A, with INPTS 6, 12, 24, 115VDC & 115 230VAC Vibrator Trans.....1.98

FILAMENT TRANS.

2.5V/2A @ 79c; 2 for $1.49; 10 for $6.49
2.5VCT/10A 125KVins.....3.59
5VCT/10A 12KV INSUL. C.T.....8.25
5V/115A CSD KENYON HVINS.....16.95
7.5VCT 12A CSD KENYON 15KVINS 10.95
12.6VCT/1.25A CSD HMSLD.....1.98
24V/1.25A CSD HSld.....3.49
2x12V 2A or 24V 2A @ $3.89; 2 for 6.98
42.5V/2A SEL RECT TRANS.....4.85

"HO" RAILPACK



0 to 12 VDC/2 Amp. Variable DC supply, uncased and completely built—Input 115v/60 cy. Usable 1.AB supply, filament D.C. plating, battery charging, model railroad. Includes voltage or speed control and center off reversing sw. Ideal for two "HO" locomotives.....Ideal for two "HO" locomotives. "TAB" SPECIAL....$10.95; 2 for $20.00

SELENIUM RECTIFIERS

We specialize in Rectifiers and Power supplies to your spec's. Immediate delivery.

Current (cont.)	18/14 Volts	36/28 Volts	54/40 Volts	130/100 Volts
1AMP	1.35	2.15	3.70	7.50
2AMP	2.20	3.60	5.40	10.50
4AMP	4.25	7.95	12.95	25.25
6AMP	4.75	9.00	13.50	33.00
10AMP	6.75	12.75	20.00	40.00
12AMP	8.50	16.25	25.50	45.00
20AMP	13.25	25.50	39.00	79.50
24AMP	16.25	32.50	45.00	90.00
30AMP	20.00	38.50		
36AMP	25.00	48.50		

Full-Wave Selen Rect & Trans. In Kit Form. All 60 cy inputs up to 14VDC at 12 amps.....$ 23.98
up to 28VDC at 12 amps.....31.98
up to 28VDC at 48 amps.....117.00

RECTIFIER XFMRS

18-12-9-CT-9-12-18V/4 Amp.....$ 8.75
18-12-9-CT-9-12-18V/12 Amp.....16.75
18.8-12.2-20.4-21.4 Volts/12A.....12.25
21-12-9-CT-9 Volts/12A.....21.98
18 Volt/2 Amp.....$1.98; 3 for 5.49

CIRCUIT BREAKER FUSES

PUSH TO RESET
Amps 3—5—7—10—15—20
Each 27c; 4 for.....$1.00
25 for $5.00; 100 for..$18
Circuit Breaker Fuse Clip.....39c
Mounting Clips.....25c
3 for $1.00; 20 for $5.98; 100 for...$25
Fuse is 3AG Size. Operates up to 24 Volts
Please specify current (amps) desired.
Heinmann Magn Bkrs, Amps: 0.22, .3, .7, 9, 12, 15, 20, 30, 35, 40, 80, 180.
Each $1.69; 10 for $15.98

BATTERY CHARGER RECTIFIER

10-0-10V (CT) 120 Amp., fan cooled. Replace your old inefficient sulfide rectifier w/new selenium type. SPECIAL...$11.98

RELAY SPECIALS

SPST min. size 115V/60CY 3A CTS 98c; 3 for...$2.75
SPDT min. sizes 115V/60CY 3A CTS $1.39; 3 for...$3.75
SPDT 24V DC. 5A CTS 98c
SPNO 115VAC 15A CTS 2.98
DPDT & SPNO 12VDC 10A CTS.....$2.98; 4 for $10
DPDT Clare SK3010, Octal Base 18-28V, 2Amp Cts, Nitrogen Sld. $1.49; 4 for $5.00

TUBES

"TAB" TESTED & GUARANTEED
PRICES SUBJECT TO CHANGE
WRITE FOR COMPLETE TUBE LISTING

0A2	$0.95	306/1299	.69	6SD7GT	.80	FG105	17.64	723A/B	25.00
0A3/VR75	1.09	3D21A	4.98	6SF5	.77	117L/M7GT	1.59	724A	3.95
0B2	1.37	3D22	13.95	6SF7	.73	117N7GT	2.15	724B	3.45
0B3/VR90	1.09	3D23	4.90	6SG7	.72	117P7GT	1.39	725A	8.49
0C3/VR105	1.15	3E29	14.95	6SH7	.61	117Z6GT	1.19	726A	14.45
0D3/VR150	.90	4-125A	29.00	6SJ7	.70	117Z7GT	1.49	726B	45.00
1B3/8016	.81	4-250A	40.00	6SK7GT	.69	F123A	7.90	726C	79.95
1B21/471A	2.85	4-1000A	108.50	6SL7GT	.69	F127A	19.98	801A	.45
1B22	2.20	4C35	22.25	6SN7GT	.70	VT127A	3.50	803	3.89
1B23	9.90	4CS8HD	16.98	6SN7WGT	2.25	CV148	4.98	805	3.90
1B24	3.95	5C21/C6J	6.98	6SQ7GT	.63	FG166	49.00	807	1.65
1B26	2.45	5C22	42.05	6SR7	.65	FG172	29.00	808	2.59
1B27	12.75	5C30/C5B	3.95	6SS7	.75	250TH	22.25	809	2.43
1B32/532A	3.90	5D21	19.50	6ST7	.98	250TL	17.75	810	9.95
1B35	9.15	5D22		6SU7GTY	2.69	304TH	8.90	811	2.90
1B37	16.98	RK65	36.50	6V6	1.39	304TL	8.90	812	2.70
1B38	29.95	5J29	12.40	6V6GT	.57	388A	1.49	813	12.49
1B40	4.95	5R4GY	1.55	6W4GT	.57	WL417A	8.95	814	2.97
1B41	49.95	5R4GYW	1.75	12AH7GT	1.45	417A		815	2.98
1B42	18.00	6AQ5	.79	12AK5	1.98	5R42	18.50	816/866Jr.	1.07
1B46	1.98	6AG7	1.39	12AK5W	2.98	GL434A	12.60	826	.95
1B53	49.95	6AH5G	1.49	12AL5	.75	446A	1.05	829	11.49
1B56	38.50	6AH6	1.22	12AT6	.52	446B	3.89	829B	12.45
1B58	175.00	6AJ5	1.40	12AT7	.81	450TH	45.00	832	7.65
1B60	69.75	6AK5	.74	12AU6	.72	450TL	52.00	832A	9.65
1B63	50.00	6AK5W	2.98	12AU7	.63	460 MF200		833A	39.45
1B63A	75.00	6AK6	1.05	12AV6	.49		15.95	834	5.95
2C36	27.00	6AL5	.55	12AV7	.98	GL471A	2.69	836	4.75
2C39	21.00	6AL7GT	1.29	12AW6	1.79	CK501X	1.26	837	1.45
2C39A	29.50	6AN5	2.90	12AX4GT	1.20	CK501AX	2.20	838	29.45
2C40	7.29	6AQ5	.55	12AX7	.79	GL502A	1.79	R60	4.90
2C43	14.75	6AQ5W	3.98	12AY7	2.95	CK502AX	1.49	R61	23.95
2C43 464A	9.49	6AQ6	.81	12AZ7	1.49	CK503AX	1.49	R65	1.29
2C44	1.20	6AQ7GT	1.29	12BA6	.59	CK505AX	1.79	R66A	1.50
2C51	5.49	6AR5	.79	12BA7	.79	CK506AX	1.49	R67A	3.29
2D21	1.28	6AS5	.79	12BE6	1.23	RH507	9.98	CK1005	.85
2E31	1.49	6AS6	2.43	12BF6	.59	CK509AX	1.79	CK1027	2.98
2E36	1.49	6AS7G	4.65	12BH7	1.29	CK512AX	1.45	CK1028	15.98
2E41	1.54	6AT6	.63	12BY7	1.35	CK522AX	1.29	5654	2.79
2E43	1.49	6AT6	.63	12BZ7	1.25	CK526AX	1.49	5670	5.30
2G21	1.49	6AT6GT	1.10	12DQ7GT	.69	CK528AX	1.49	CK5672	1.29
2J31	27.00	6AU6	.59	12SA7GT	.63	CK529AX	1.79	CK5678	1.89
2J31A	79.95	6AV5GT	1.29	12SC7	.80	CK539DX	2.19	5687	5.49
2J32	37.00	6AV6	.49	12SF5GT	.72	GL530	22.00	CK5702	3.49
2J33	27.00	6AW6	1.89	12SF7GT	.49	CK531DX	1.89	CK5703	1.29
2J34	27.00	6B4G	1.23	12SG7	.83	531	6.98	Xtal Diodes	
2J36	108.00	6BA6	.63	12SH7	.63	CK532DX	1.89	1N21A	$1.55
2J37	12.70	6BA7	1.27	12SJ7GT	.59	WL532	3.98	1N21B	2.89
2J38	11.75	6BC5	.63	12SK7	.72	CK533AX	1.29	1N21C	21.50
2J39	44.00	6BC7	1.23	12SL7GT	.65	CK534AX	.99	1N22	1.25
2J40	187.00	6BD5GT	1.65	12SN7GT	.75	CK536AX	.99	1N23	1.35
2J48	24.25	6BD6	.83	12SQ7GT	.63	CK537AX	3.04	1N23A	2.20
2J49	67.25	6BE6	.59	12SR7	.63	CK538DX	.98	1N23B	3.49
2J50	21.25	6BF5	.98	FG17	3.95	CK539DX	2.19	1N25	4.98
2J52	249.50	6BF6	.65	19T8	1.09	CK541DX	1.99	1N26	8.75
2J53	85.00	6BF7	2.55	19V8	1.62	CK542DX	.99	1N27	1.55
2J56	149.00	6BG6G	1.98	RK20A	8.95	CK543DX	1.99	1N29	3.50
2J61	49.95	6BG7	1.98	24G 3C24	1.90	CK544DX	.99	1N32	23.75
2J62	49.45	6BH6	.63	25BQ6GT	1.19	CK546DX	1.99	1N34	.64
2J63	39.45	6BJ6	.69	25L6GT	.69	CK547DX	1.98	1N34A	1.39
2K22	39.45	6BK7	2.15	25Z5	.79	CK571AX/		1N35	1.65
2K23	39.45	6BL7GT	1.45	25Z6GT	.99	5886	2.49	1N38	1.43
2K25	28.49	6BN6	1.49	FG27A	8.70	CK573AX/		1N39	4.15
2K25/		6BN7	1.69	RK28A	4.89	6029	3.49	1N40	10.49
723AB	24.90	6BQ5GT	1.20	28D7	1.95	WL579	10.49	1N43	1.73
2K28	29.00	6BQ7	1.65	FG32		WL579B	12.98	1N44	1.24
2K33	259.00	6BY5G	1.45	5S5B	13.85	WL652	65.00	1N45	1.45
2K35	389.95	6C21	29.45	35Z5GT	.59	WL673	117.00	1N46	.69
2K41	126.00	6C8G	.69	RK39	2.89	WL676	39.95	1N47	4.00
2K42	139.00	6CD6G	1.69	RK48	6.85	WL6N6	35.00	1N48	.55
2K45	110.00	6D4	2.70	RK49	7.50	703A	4.75	1N51	.45
2K48	120.00	C6J/5C21	6.95	SOL6GT	.69	705A	1.98	1N52	1.62
2X2	.49	6JA8	6.66	RK61	.69	707A	1.98	1N53	.49
3B22	2.70	6J5GT	.47	RO	.69	707B	13.50	1N55	2.35
3B23/RK22	4.95	6J6	.63	81	1.69	715A	6.00	1N56	.89
3B24	5.40	6K4A	6.45	82	1.19	715B	11.90	1N57	.89
3B25	4.50	6L6	2.09	82V	1.39	715C	24.00	1N58	1.19
3B26	7.70	6L6G	1.35	83	1.45	717A	.90	1N60	.60
3B28	7.90	6L6GA	1.35	83V	1.79	718BY	48.45	1N61	2.10
3C22	89.00	6L6GAY	2.29	84/6Z4	.99	718CY	48.45	1N63/K63	2.49
3C23	9.90	6SA7GT	.63	FG95/		719A	28.50	1N64	.69
3C31/C18	3.45	6SA7GTY	3.37	5560	24.85	721A	2.49	1N67	1.95
3C33	14.98	6SB7Y	1.19	FG98	19.95	722A/287	2.45	1N69	1.19
3C34/HK24	5.49	6SC7	.90	100TH	7.83	FG104	37.98	K34	1.35
3C45	12.89			FG104		723A	11.95		

FEDERAL RECTIFIER KIT

"FEDERALS"—All Purpose Selenium Rectifier Kit. You can make 24 different Rectifiers ½ Wave/FW/CT/or Bridge. 8 Plates Rated 18V 12Amp each. All Hardware & Lugs. "TAB" SPECIAL.....$19.59

AUDIO AMPLIFIERS READY TO GO

Model 305MP 5 Watt Ampl. as Pictured Above Features Mike & Phono Inputs. W/Spg. Gain Ctrls. Latest Compensated Tone Cntrl. Design. Complete with Tubes. "TAB" SPECIAL $14.98
Model 200MO Mike OSC. Broadcasts Through Your Radio with No Direct Connection, W/Tubes.....$6.98
Model 100PO Phono OSC. Phonograph Broadcasts Through Your Radio. No Direct Hookup. W/Tube.....$4.98
Model 302PA 3 Tube Phono Ampl. Ideal for Custom Building Your Phonograph. W/Tubes. SPECIAL.....$4.98

AUDIO COMPONENTS

GE RPX041 Phono Cart..$ 4.49
GE RPX050 Triple Play. 5.69
Electrovoice Triple Play 2.69
Pickup Arm&Xtal Hi-Output 2.39
PM 12"GE S120ID Speaker.....19.00
PM 8" Blue 8T18-1 Permflux.....13.00
PM 10"HI-FI Woofer & Separate Horn Tweeter 10watt 40-20KC..19.98
Crystal Mike & Cable.....3.98
Crystal Mike Cartridge (Lapel type) 2.98
Crystal Mike Cart, Ceramic Welgruf 3.98

OIL CAPACITORS

Mfd	Each	Mfd	Each	Mfd	Each
50wvdc		1000wvdc		12500wvdc	
4	$0.40	1	$0.79	2	95.00
150wvdc		2	.85	15000wvdc	
1-1-0.5	.98	5	2.98	.0016	2.98
300wvdc		15	4.98	25000wvdc	
1.2	.29	1400wvdc		.00025	7.49
400 wvdc		.25	1.29	1	95.00
.1	.39	.5	1.39	AC RATED	
.5	.45	1500wvdc		220vac/	
1	.69	.5	1.49	600dc	
1	.69	.75	1.69	2	.69
4	.98	1	1.79	4	.89
6	1.08	6	1.98	5	1.29
10	1.39	2000wvdc		225vac/	
2x.1	.75	.1	1.49	630dc	
2x.5	.94	2x.1	1.69	3.3	.79
3x.1	.91	1	1.75	230vac	
3x.25	.99	2	3.98	630dc	
600wvdc		3	3.69	5	1.29
.034	.30	8	9.49	330vac	
1	.35	2500wvdc		1000dc	
.2	.37	.25	2.29	1.25	.63
.5	.42	3000wvdc		1.5	.70
1	.52	.1	2.49	1.75	.98
2	.65	2	4.45	2	.33
4	1.60	7.89		2.5	.90
5	2.25	4000wvdc		2.8	.95
2	2.59	2	8.98	3	1.00
6	2.89	5000wvdc		4	1.29
10	3.10	.2	4.49	15	3.98
2x.1	.59	4	19.98	25	6.49
2x.23	.78	6000wvdc		405vac/	
2x.5	.89	1	7.49	1200dc	
2x1	1.05	7000wvdc		.15	1.29
2x2	1.25	.002	1.69	600vac/	
2x8	3.25	.0075	1.98	1800dc	
3x.05	.75	.1	4.98	10	6.98
3x.22	.85	7500wvdc		660vac/	
3x.25	.98	.03	2.98	2000dc	
700wvdc		.05	3.49	6	4.98
4	1.50	10000wvdc		10	6.98
800wvdc		.01	3.49	16	7.98
.1	.69	12000wvdc			
		.02	4.98		

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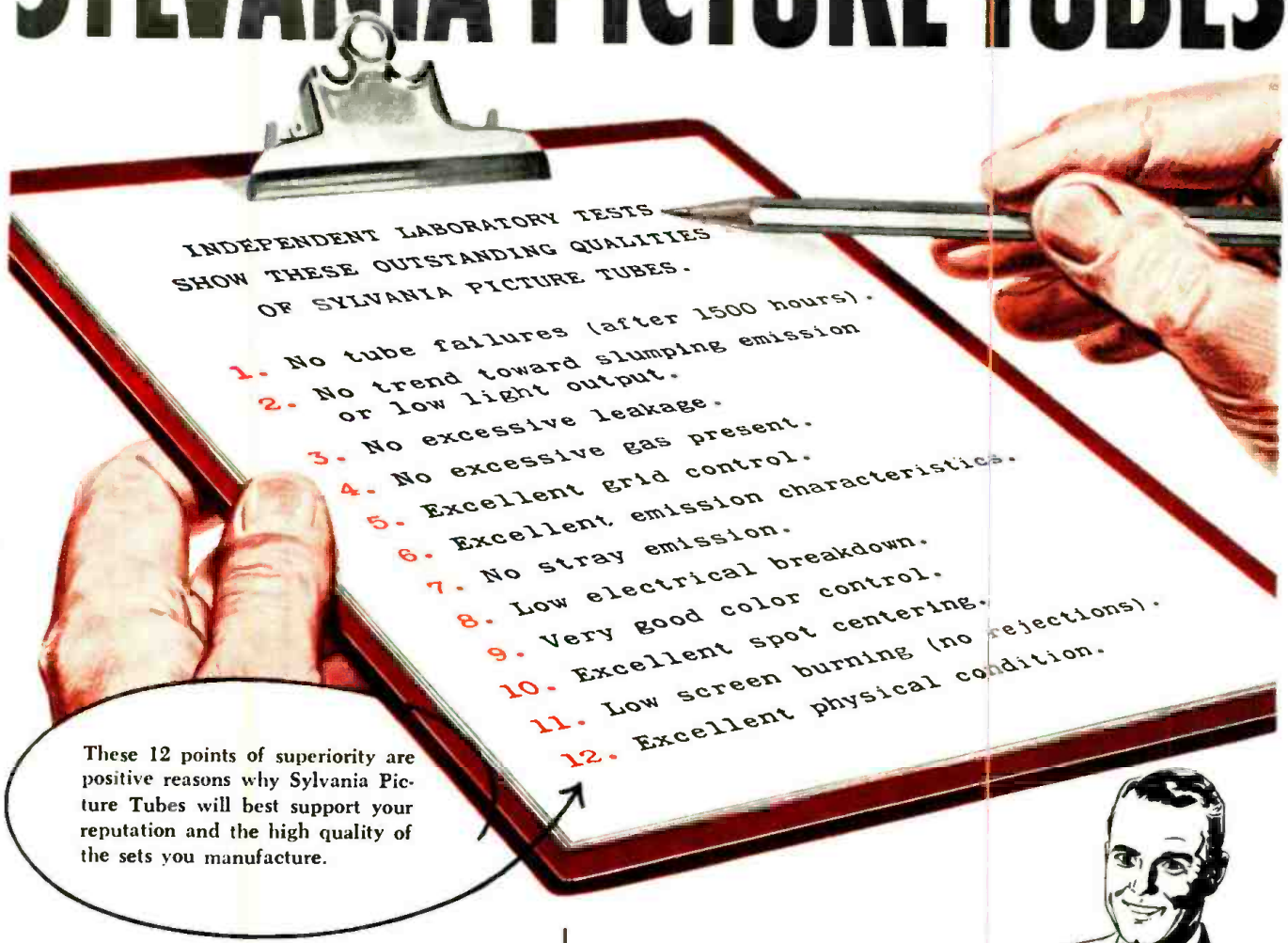

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