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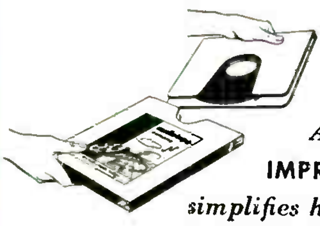

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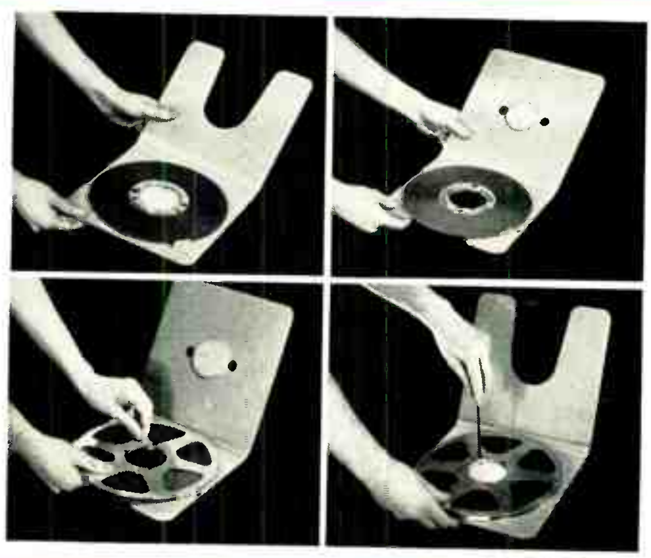

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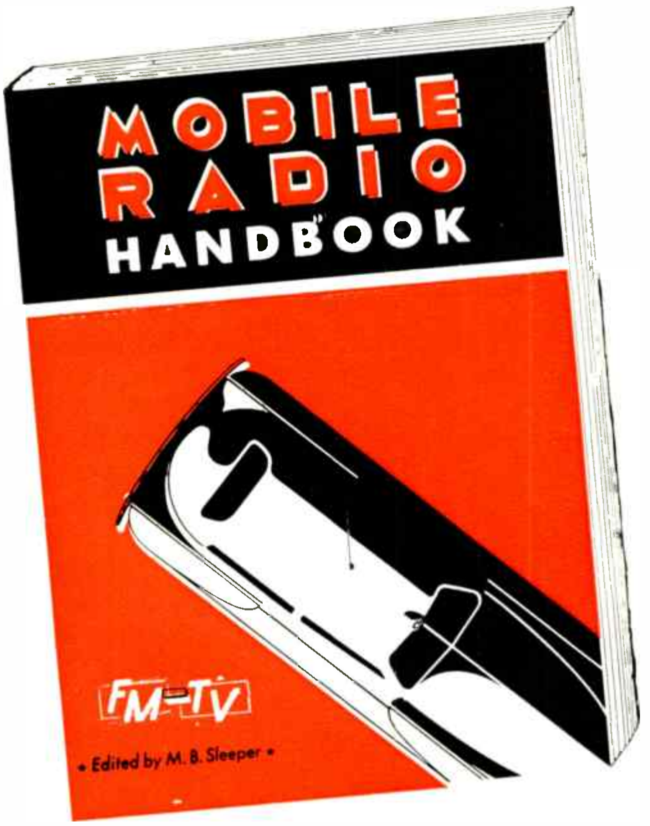

THE ONLY BOOK OF ITS KIND!

A COMPLETE AUTHORITATIVE UP-TO-DATE HANDBOOK ON MOBILE RADIO & POINT-TO-POINT COMMUNICATIONS

COVERS ALL THE NEW SERVICES

BASED on the new FCC Rules now in effect, the Mobile Radio Handbook covers this field from cost figures, system planning, and license applications, to installation, operation, maintenance, and theory.

Complete information is given for all common carrier, industrial, public safety, and transportation services. It is a big book, 8¾ by 11½ ins., 184 pages, profusely illustrated with photographs and diagrams covering the very latest developments in communications. Following is a list of chapters:

PLANNING: How to plan a mobile or point-to-point system. This chapter covers the overall problems of power and topography, interference, city ordinances, public liability, operation, maintenance, expansion, and interconnection.

FREQUENCIES: Complete details of the new FCC Rules and Allocations cover all the different communications services.

LICENSES: How to apply for a construction permit, license, and renewal. All FCC forms, filled out in the correct manner, are shown.

EQUIPMENT: Three chapters are devoted to the problems of selecting the right equipment for a particular system; specifications on transmitters and receivers of all makes; selective calling and fleet control, and adjacent-channel operation.

ANTENNAS, TOWERS: The problems of planning antenna installations are covered in two chapters which explain the various special purpose radiators, and the correct method of erecting a standard guyed, steel tower.

MAINTENANCE: How to keep a system at peak performance. Methods and record forms, perfected by years of experience are explained, and proper balance between essential and superfluous maintenance.

OPERATORS: The FCC is becoming increasingly strict about rules relating to operators. Official information is given, with a detailed explanation by FCC Secretary T. J. Slowie.

HOW FM WORKS: Advantages of FM over AM, coverage, interference, static elimination, and circuit functions are explained pictorially in 83 illustrations. The use of mathematics has thus been avoided in this clear, practical presentation.

While the Mobile Radio Handbook is a complete reference volume on the technical phases of radio communications, its arrangement is planned to meet the needs of non-technical company executives and government officials, as well as communications engineers, system supervisors, maintenance experts, and operators.

Milton B. Sleeper, whose experience in the mobile radio field goes back over a period of 16 years, is the Editor of the Handbook. The Assistant Editors are Jeremiah Courtney, former FCC Assistant General Counsel, and Roy Allison, Associate Editor of *FM-TV* Magazine.

Use the coupon below to order your copy of the Handbook TODAY.

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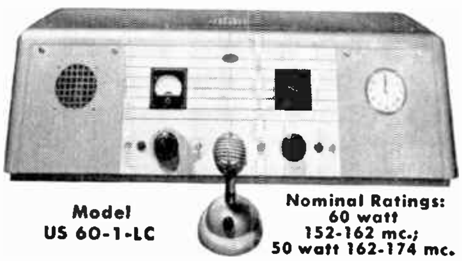

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SPOT NEWS NOTES

(Continued from page 6)

system was abandoned by the company to which the patent applications was assigned. The problem that proved difficult of solution was to locate the entire speaker system in the cabinet, but no question was raised as to the efficacy of the system for custom installations. Licenses can be obtained, and if you are interested, we'll be glad to give you the name and address of the company.

R. P. Clausen:

Has succeeded M. A. Acheson as chief engineer of Sylvania's radio tube division. Mr. Clausen resigned from the U. S. Navy with the rank of Commander, to join Sylvania in 1946. Mr. Acheson has been transferred to the staff of E. Finley Carter, vice president in charge of engineering at New York.

More FM in Washington:

According to the American Research Bureau, the number of FM-equipped receivers in Washington, D. C., on October 1 was 114,000, an increase during the past year of 112%. This figure exceeds the 1949 BMB count of AM families in such cities as Atlanta, Columbus, Rochester, New York, St. Paul, and Omaha.

New RRN Affiliate:

WHDL-FM, Olean, N. Y., has joined Rural Radio Network. Operated by the Olean *Times-Herald*, this 43-kw. station delivers 1,000 microvolts to 240,000 population in 5,100 square miles, and 50 microvolts to 2 million in 17,000 square miles. RRN programs will be carried, plus WQXR news and music. This is the 13th station in the net.

John N. Dyer:

Named director of research and engineering at Airborne Instrument Laboratories, Mineola, N. Y. Before joining AIL in 1945, he had been director of the American British Laboratory in England.

Progress in Compatible TV:

Starting December 5, RCA will demonstrate its improved color TV receivers in Washington, D. C. The sets to be shown at this time will represent progress made since the last showing in March.

Report on UHF Television:

Engineering report on coverage from NBC's UHF station at Bridgeport, presented before the FCC by Raymond F. Guy, was summed up by him in this way: "Based on the facts and not any loose conclusions, it will be most unfortunate if the television expansion has to go into the UHF band." Dumont, Philco,

(Concluded on page 11)

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SPOT NEWS NOTES

(Continued from page 10)

and CBS engineers are more optimistic. Our comment: It's going to be a very serious matter if TV *can't* expand into the UHF band!

Annual AES Awards:

Audio Engineering Society's annual John Potts Memorial Award was made to Howard A. Chinn, CBS chief audio-video engineer, while Chester A. Rackey, NBC manager of audio-video engineering, received the AES award.

UHF Research Facilities:

William F. Hoisington has built elaborate facilities for UHF research and propagation observations at Red Hill, Claryville, N. Y. This 3,000-ft. elevation is 90 miles northwest from New York City. Use of space and supervision of equipment are available to manufacturers of equipment and antennas.

Components Data:

A 130-page catalog of radio and electronic components has been issued for the use of purchasing agents, schools, laboratories, and servicemen by Sun Radio, 122A Duane Street, New York City. Complete technical data is supplemented with dimension drawings.

TV Frequency Allocations:

The FCC has our sincere sympathy in its problems of undertaking the new VHF and UHF channel allocations for television. It seems as if each applicant wants something special that involves changes in allocations to other stations, or in the proposed rules. By the way: The complete table of proposed VHF and UHF channels for each city, and for the cities assigned to each channel, together with a summary of the proposed Rules, were published in a 10-page section in *FM-TV* for August, 1949. Copies are still available. The data presented in that issue forms the basis of the FCC hearing now in progress on television rules and frequencies.

Lawrence C. F. Horle, 1892-1950:

The industry has lost another old-timer with the passing of Larry Horle. We knew him first as an expert radio aide, at the time of World War 1. Later he was chief engineer for deForest Radio and Federal Telephone & Radio Corporation. He was president of IRE in 1940, and in 1948 was awarded the Institute's Medal of Honor for his work on standardizing radio terms and ratings. Larry was taken to St. Barnabas Hospital, in Newark, on October 26th, suffering from a sudden heart complaint, and died on the 28th.

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These Registries, revised annually from FCC records at Washington, list the name and address of each licensee, frequencies, call letters, make of equipment, number of mobile units operated by each system.
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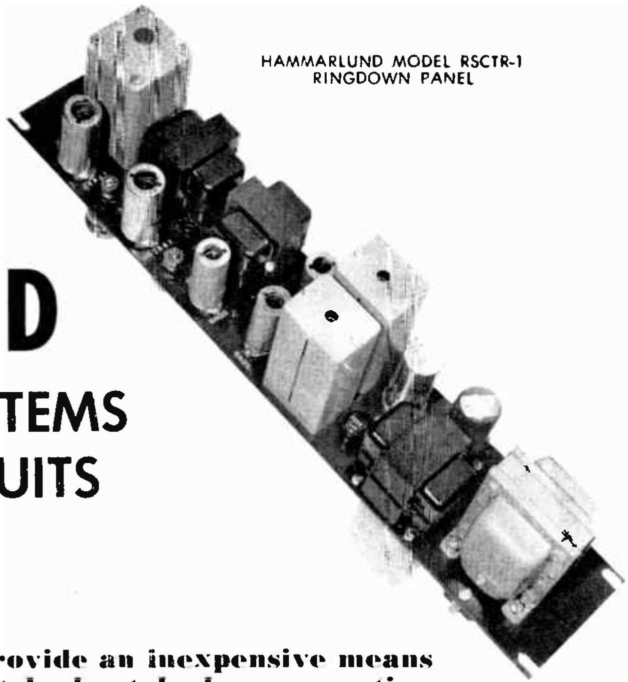

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DUPLEX SIGNALING SYSTEMS FOR MICROWAVE CIRCUITS

Hammarlund Signaling Systems provide an inexpensive means of establishing simple and efficient duplex telephone operation over radio circuits.

Hammarlund Duplex Signaling Systems allow for shared-channel operation.

Simplicity and versatility of duplex signaling permit wide utility in microwave applications:

1) **The exclusive carrier-lock feature precludes actuation of point-to-point and relay circuits by extraneous noise and skip signals.**

2) **Particularly applicable to ring-down signaling functions as applied to channelizing operations.**

3) **Elimination of both cost and annoyance of blaring monitor amplifier units.**

4) **Fail-safe fault-tone alarm indication.**

5) **Multiplexing of voice channel to obtain additional telegraph or teletype channels.**

6) **Provision for telemetering and supervisory control circuits.**

Hammarlund engineers will assist in planning duplex signaling equipment for all types of microwave channelizing applications.

Write for literature on Hammarlund Selective Calling, Multi-Gate* remote supervisory controls, and duplex signaling systems.

* Trade Mark applied for

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World Radio History

WHAT'S NEW THIS MONTH

OUR 10TH BIRTHDAY — NEW REGISTRY READY — COMMUNICATIONS SERVICE BUSINESS — 450 MC. FOR CHICAGO TAXIS — CBS-RTMA ON COLOR TV

THIS issue marks our 10th birthday, and the start of our 11th year of service to management and engineering in the radio industry. We are very proud indeed of the comments received from a great number of our readers. Some of the most gracious remarks have come from those with whom we have differed sharply. We have been amazed and delighted to have so many of the leading figures in broadcasting, manufacturing, and communications remind us that they first subscribed to this publication in 1940.

What pleased us most was the appreciation expressed for our efforts to serve and advance the interests of our readers. These letters have made us wish that editorial space would permit us to publish at least excerpts from them. However, a magazine must speak for itself to each reader; even these few lines are taken from space that should be devoted to editorial information.

So, to our many friends and readers whose loyalty has built the success of this Magazine, we offer our heartfelt thanks, and the sincere promise that we shall undertake to benefit by our experience and the helpful criticism of past errors to the end that, during our second decade, we shall serve our readers still more effectively.

AS in the past, November is the month for publishing the annual revision of our Registry of Transportation Communications Systems. This listing includes all systems operated by taxicabs, trucks and buses, urban transit, railroads, and automobile emergency services. Each listing shows the company name and address, operating frequency and call letters of each fixed transmitter, number of mobile units, and the name of the equipment manufacturer. These are the only registries of their kind, and they are used wherever communications systems are engineered or operated. It is one of the services provided by this Magazine, dating back to the early 40's. Next, coming up in January, will be the Registry of Common Carrier, LCC, and Industrial Systems. In May, we shall add a new Registry. That will list all air-ground operational communication systems.

The most complete study of year-by-year increase in the number of systems and mobile units, and their distribution in the USA is available in the November issue of our Market Bulletin. It has been prepared specifically for the use of sales and advertising executives. Copies are available on request, without charge.

IT is interesting to note that communications service companies are rapidly growing to the proportions of big business. Reason is that, in so many areas, there is a large number of small systems. Within a radius of 50 miles there may be a dozen police installations, an even larger number operated by taxicabs, and a few more in other categories. The largest may not have more than 10 cars, but the total may exceed 200 which, at a service fee of $5 per car per month and $25 for each new car installation, adds up to a tidy income. This is augmented by the sale of such replacement items as tubes, vibrators, microphones, relays, antennas, and capacitors. Some of these companies also handle complete transmitters and receivers.

Most important is that the servicemen are licensed operators, as required by the FCC of those who make frequency adjustments on transmitters.[1] This is emphasized because the Commission has been shutting down systems which are serviced by men who are not licensed operators.

A recent check of our readers in the dealer-servicemen group disclosed that such a large number are working on communication equipment that we are now preparing to carry a monthly department devoted to their particular interests.

SURPRISE development in taxicab communication is the plan of the Yellow Cab and Checker Cab companies to install 450-mc. systems in Chicago. Link Radio Corporation has developed the main-station and mobile equipment. Authorization has been asked for 16 fixed transmitters and 3,666 car installations. The former will have an output of 100 watts, and the latter 10 to 20 watts. There are 20 100-mc. channels assigned to this service at 452 to 454 mc., in contrast to the 8 channels now used between 152.27 and 157.71 mc.

There is no doubt but what the solution to the present crowding of taxi communications lies in the use of 452 to 454 mc. It has been established that adequate coverage can be obtained at those frequencies. Only the equipment has been lacking. Now, the initial Link installations are being made to check performance under operating conditions in Chicago. As soon as the tests are completed, the plan for the entire system will be finalized, and the units installed as fast as they can be delivered. Details of this very important development will be presented in an article by Frederick T. Budelman, chief engineer of Link Radio, to be published in a forthcoming issue of *FM-TV*.

[1]For detailed information on this point, see "Mobile Radio Handbook," first edition page 90.

HEARTENING news for FM broadcasters came to us in a letter from one of the receiver manufacturers building moderately-priced FM table models of very fine performance:

"It will be interesting for you to know that we doubled our production on this set starting in October, and it appears now that there is a market for two of these sets for every one that we can build. We again plan to double our production, starting in January, and we hope by this process we will be able to catch up on the demand for this unit."

This will be a welcome addition to the steady increase in production of highly-sensitive FM sets capable of effective noise limiting. As for catching up with demand, that is another story, for we are getting reports from many sections which indicate that every good FM receiver that is sold creates two new prospective purchasers, and two more listener-families.

If NRBA negotiations with Cuba and Mexico result in cutting AM channels down to 9,000 cycles from their present 10,000-cycle width, the demand for sets that really do justice to FM broadcasting will go skyrocketing.

AS a publicity and promotion stunt, Columbia's entry into color television will achieve an all-time high rating of success even though their system is never used to transmit a single commercial program. The plan to make capital of the FCC's color decision at the expense of the radio manufacturers emerged in the network address by CBS president Frank Stanton, on October 15.

Space does not permit publication of the Stanton text in full[1], but the following excerpts reveal the manner in which

(Continued on page 40)

[1]Copies of the full text can be obtained by writing Columbia Broadcasting System, 485 Madison Ave., New York 22.

FM MODULATION MONITOR

THIS UNIT, CONTINUOUSLY TUNABLE, CAN MEASURE DEVIATION DUE TO MODULATION AT ALL MOBILE RADIO FREQUENCIES — *By* PAUL LEVESQUE*

FCC rules concerning mobile services now in effect, require that transmitter deviation due to modulation shall not exceed 15 kc.; that means for limiting deviation to this amount be incorporated in all transmitters of 3 watts or more; and that peak deviation be checked on all transmitters at least every six months or whenever adjustments are made that might affect peak deviation. The Browning MD-25 modulation monitor, described in these pages, not only provides a simple means to meet the last requirement but is so designed that other systems operating in the same vicinity can be monitored and checked also.

This important advantage is gained through two simple design characteristics: First, the accuracy of the instrument, well within FCC limitations, is not dependent upon crystals. Thus, continuous tuning was made possible, and the MD-25 can be tuned to any frequency within 4 switched bands covering 30 to 40 mc., 40 to 50 mc., 72 to 76 mc., and 152 to 162 mc. Second, the sensitivity is such that modulation measurements can be made on any FM signal generating 1 millivolt or more at the antenna terminals. These two factors permit quick measurements on any transmitter, fixed or mobile, in the vicinity.

*Engineering department, Browning Laboratories, Inc., Winchester, Mass.

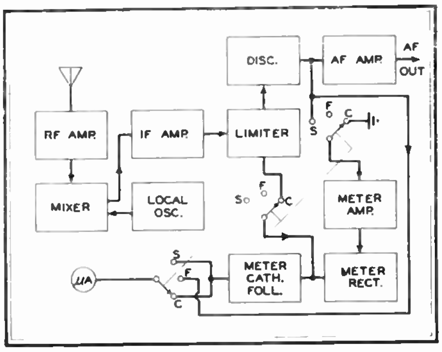


Fig. 1. Basic circuits of the monitor

General Operational Description:

Fig 1 is a simplified block diagram of the MD-25. It can be seen that the monitor is basically an exceptionally-stable communications receiver, tunable over a wide range, to which have been added precise metering facilities. Fig. 2 shows the front panel operating controls.

The large knob just to the right of the tuning dial is the band switch. This is a turret-type control, which changes RF and oscillator coils, padders, and trimmers for each of the four bands covered. Details of the turret switch can be seen in Figs. 3 and 4. A separate scale is provided on the tuning dial for each frequency band. The coarse tuning control is at the bottom of the tuning dial.

Directly above the band switch is the vernier control. The power ON-OFF switch and the peak flasher indicator can be seen below the band switch. Three knobs are below the meter at the right. They are, from left to right, a zero-set control, the meter selector switch, and the audio gain control.

The indicating meter has three scales, corresponding to the three positions of the selector switch. These are COARSE TUNING, FINE TUNING, and PEAK SWING.

With the meter selector switch in the COARSE TUNING position, Fig. 1, the meter is connected in the first limiter grid circuit as a VTVM. The coarse tuning control is adjusted to obtain a dip in the meter reading, which indicates the presence of a carrier. A monitor audio amplifier stage, suitable for use with earphones or to drive an external power amplifier, is provided so that the desired carrier can be identified.

In the FINE TUNING position of the selector switch, the discriminator output is DC-coupled to the meter. In this, the most sensitive position, the meter indicates zero at center-scale. The monitor is tuned for zero DC discriminator output, which occurs at the exact center-frequency of the FM carrier. Finally, the selector switch can be put in the

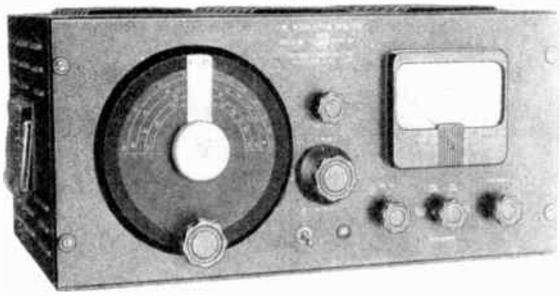
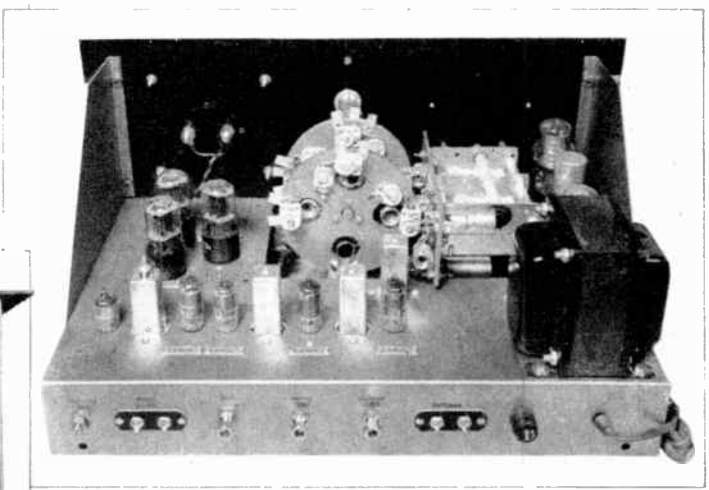
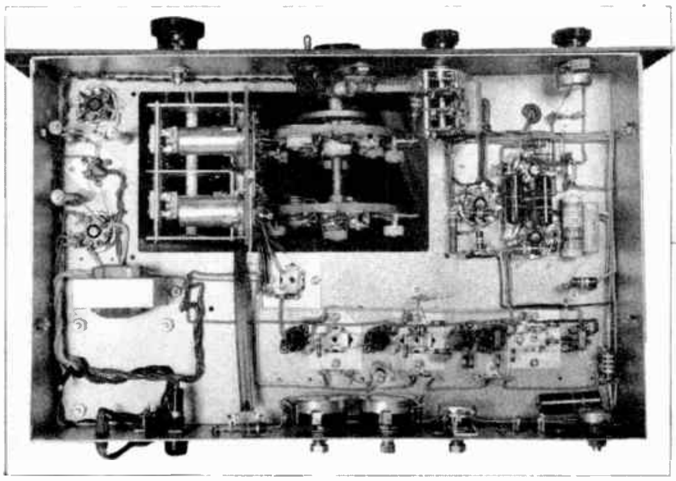


Fig. 2, left: View of the front-panel operating controls and 3-scale meter





Figs. 3, above, and 4, left. Rear-panel controls for meter and peak flasher adjustments. Turret band switch can be seen at top

World Radio History

PEAK SWING position for a direct indication of deviation.

In this position, the AC output from the discriminator is amplified, rectified, and applied to the meter. Modulation swing is read directly on the meter scale as kilocycles deviation. Full-scale deflection corresponds to a 20-kc. swing. Accuracy is maintained to within 1 kc., or 5% of full-scale reading.

With voice modulation, the meter reading is inaccurate for peaks of short duration. For this reason a peak flasher light has been provided. Instantaneous modulation peaks exceeding 15 kc. trigger a one-shot multivibrator, which lights a neon glow tube for the peak duration.

Carrier-shift due to unsymmetrical modulation can be detected easily with this monitor. The modulated carrier is tuned in exactly as before, with a zero meter-reading in the FINE TUNING position. Then, the modulation is removed. Any carrier-shift caused by unsymmetrical modulation will show as a change in the meter reading.

Circuit Details:

The complete circuit diagram of the modulation monitor is given in Fig. 5. As can be seen, 17 tube functions are obtained with only 13 envelopes through the use of double-section types.

The RF stage, mixer, oscillator, and tuning assembly are constructed on a single sub-chassis, Figs. 3 and 4. A turret-type band switch is used to change RF and oscillator coils as indicated. Tuning within each band is accomplished by C1A and C1B.

A standard pentode amplifier is employed for the RF stage. On the two lower bands, the plate load is a tuned circuit which is capacitively coupled to one grid of the mixer. On the higher bands, however, a non-tunable, broadly-resonant plate circuit is used.

The oscillator is a miniature triode in an ultraudion circuit. Proper feed-back phasing from plate to cathode is accomplished by C2 and L1, since the reactance of L1 is many times that of C2. The grid is at RF ground potential, bias being supplied by a grid-leak circuit.

An unusual feature of the mixer circuit is that the oscillator is coupled to both mixer grids by stray capacity. Excellent mixing is obtained in this manner over the wide frequency range which must be accommodated.

IF and Limiter Stages:

Two high-gain IF stages are employed, operating at 10.7 mc. They are followed by a two-stage cascade limiter. Decoupling networks are used in both IF stages as extra precaution against instability.

Limiter stages are both of the grounded-cathode, grid-leak bias type. Reduced anode voltage is applied to the second stage for more effective limiting action. Because of the .675-microsecond time constant in the grid circuit of the second stage, extremely fast impulses, such as ignition noises, are virtually eliminated.

Discriminator and AF Stage:

A standard Foster-Seeley discriminator circuit is used. Circuit constants were selected to provide a response curve linear out to 80 kc. each side of center frequency. Thus, if the carrier being measured should drift off the discriminator center-frequency after tuning, accurate deviation measurements can still be made.

The audio stage is a conventional triode voltage amplifier. A .1-mfd. capacitor couples the AF output to the audio terminals on the rear of the chassis. R1, the volume control, is located on the front panel under the lower right corner of the meter, Fig. 2. Maximum output is 12 volts across 5,000 ohms. This is sufficient for headphones or to drive an audio power amplifier.

Indicating Circuits:

A single meter is used to provide three distinct types of indication. In the COARSE TUNING position of meter selector switch S1, the meter is connected as a DC VTVM across the grid circuit of the first limiter. When a carrier is tuned in, the limiter grid draws current and becomes negative. Since a cathode follower drives the meter, the indication is that of a dip in the meter reading. However, the meter is a center-zero microammeter. Therefore, in this switch position a bucking voltage must be applied to cause the meter to read full scale with zero input. This voltage is supplied by a bleeder network. R2 is the coarse tuning zero-adjustment, and is located at the rear of the chassis, Fig. 3.

In the FINE TUNING position of S1, the meter circuit is that of a DC voltmeter of 10,000 ohms-per-volt, with center-scale zero. It is connected to the dis-

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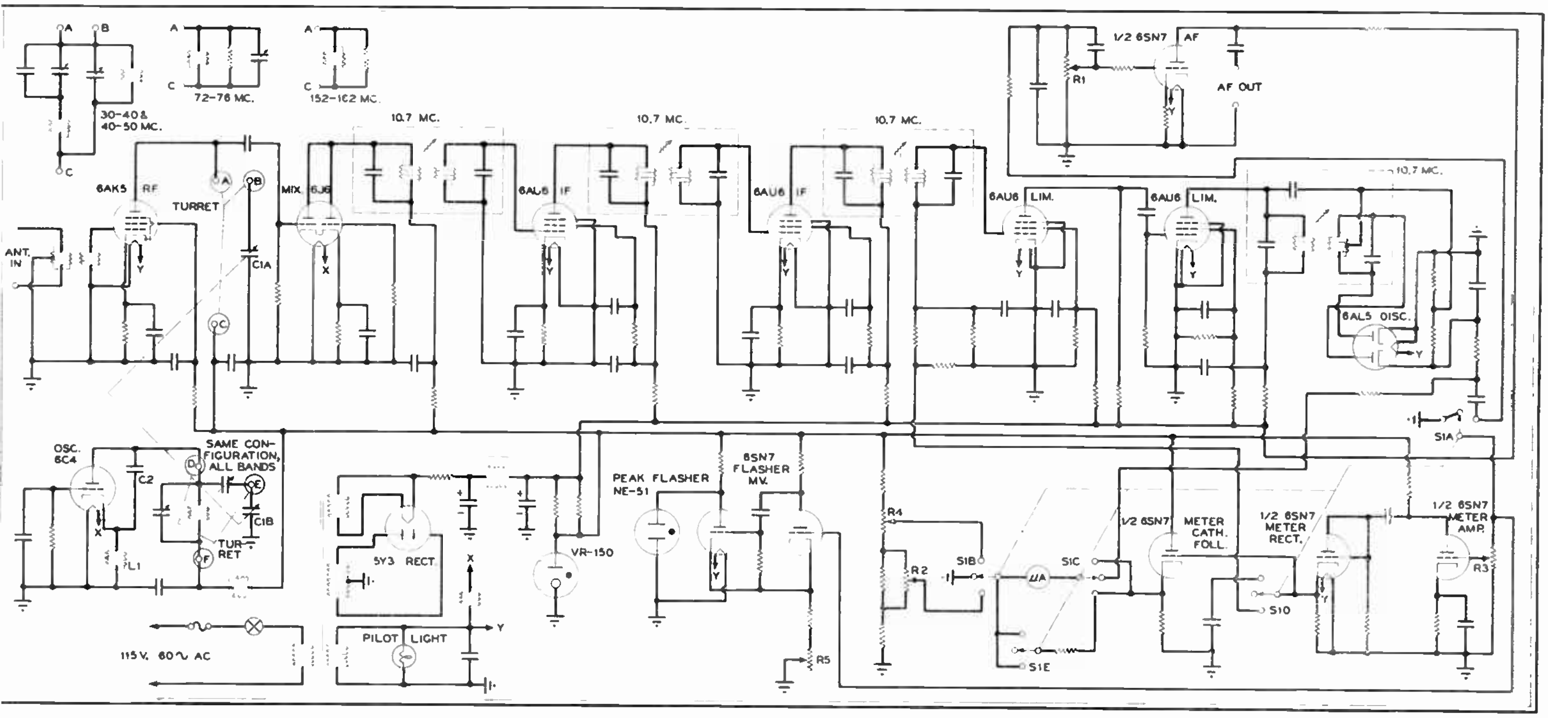


Fig. 5. Complete schematic of the MD-25 monitor. A turret band switch provides coverage of all mobile-service frequencies

MULTIPLEX DESIGN

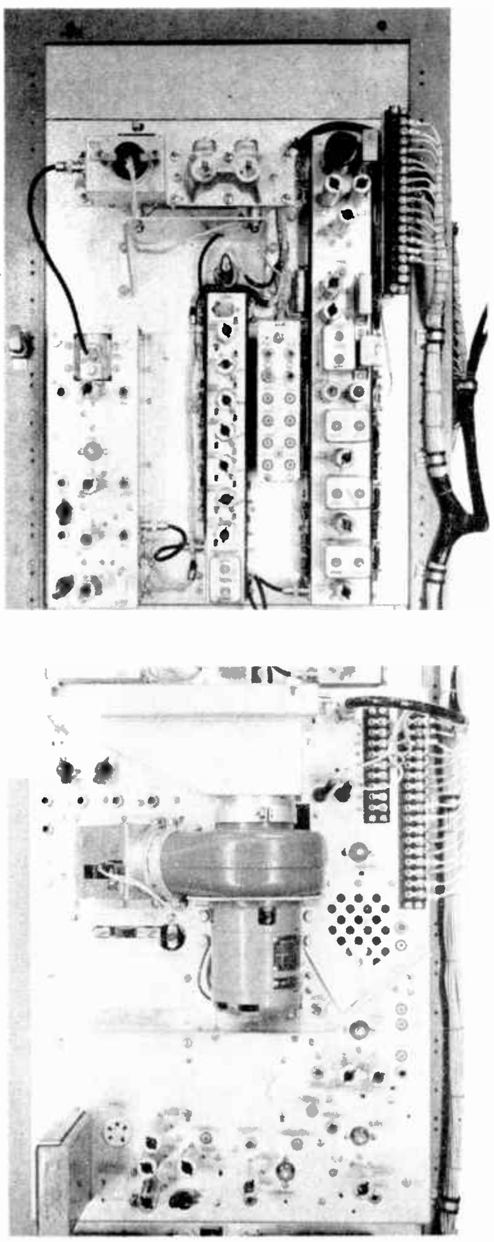
NEW TECHNIQUES EMPLOYED IN THE DESIGN OF MICROWAVE EQUIPMENT—*By* FRANK B. GUNTER*

MICROWAVE equipment design practices have changed rapidly in recent years to keep in step with demands for better, more dependable performance at lower cost. It is the purpose of this paper to show some of the techniques being employed in the design of new microwave point-to-point equipment. To facilitate this presentation, the Westinghouse type FB transmitter-receiver, operating in the 960-mc. band, will be analyzed.

Frequency Stability:

As frequencies are increased, a point is reached where crystals cannot be made to operate at transmitter output frequencies. Therefore, multiplier stages must be utilized. These have disadvantages in that they multiply the error in center frequency, and also generate many undesired frequencies which can interfere with other services.

Fig. 2. FB receiver and transmitter panels



Similarly, as frequencies are increased with ordinary LC circuits, the circuit elements become so small that the changes due to thermal expansion alone are often sufficient to cause excessive drift in carrier frequencies. It is necessary to make those elements of materials having high dimensional stability or, alternatively, to provide elaborate circuits to compensate for the undesired variations.

When the transmitter carrier frequency and the receiver local oscillator frequency vary, two ill effects result. First, fewer channels can be placed in a given bandwidth. Second, the acceptance band of the receiver must be greater, thus increasing receiver noise.

Even with relatively good frequency control, the amount of spectrum wasted at higher frequencies because of variations in transmitter center frequency becomes very large with respect to that required for intelligence transmission. Further, the wide receiver bandwidths necessary to make allowance for these variations cause excessive noise acceptance. The inefficient utilization of spectrum with single-channel AM is one of the reasons why single-channel microwave equipments are seldom used. When several communications circuits are multiplexed, and this composite signal is employed to modulate one microwave carrier, much better use is made of the spectrum.

In the design of the FB equipment, crystal control was used for both transmitter and receiver. The receiver crystal operates at about 28 mc., and the transmitter crystal at about 6 mc. The variations in transmitter output and receiver local oscillator frequencies, for a 50° variation in ambient temperature, are each plus or minus 15 kc. This requires a total increase in receiver bandwidth of ± 30 kc., or .003% of center frequency.

Modulation Methods:

In contemporary microwave systems, phase or frequency modulation is ordinarily used when the number of signal channels is less than 10. This is true no matter what the bandwidth of the signals. When the number of channels is greater than 10, pulse systems are generally used.

When selecting the type of modulation to be used in the FB equipment, it was decided that a maximum of 7 voice-frequency channels would meet most of the industrial applications for which the

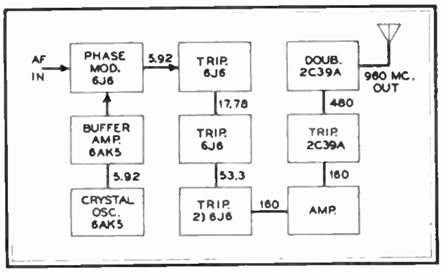


Fig. 1. The transmitter employs phase-to-frequency modulation, at 960-mc. output

equipment was intended. Crystal control was desirable for the reasons outlined previously. An analysis of methods for obtaining suitable modulation with crystal control led to the conclusion that phase-modulating a low-frequency crystal, and multiplying its deviation to obtain the desired deviation in the transmitter output, would be the simplest and most fool-proof system.

To minimize cross-talk and intermodulation, it is necessary that the distortion introduced by modulation be held to a low level. Usually, variable reactance circuits are employed in phase modulators. Very accurate tuning of the reactance circuit is required to obtain low distortion with such circuits. The phase modulator used in the FB equipment is a variable-conductance type, which is not difficult to adjust for distortion of less than 1%. This type of modulator shifts the phase of the current in a plate tank circuit which is common to the modulator and a buffer amplifier driven by the crystal oscillator. The transmitter block diagram is given in Fig. 1. Fig. 2 shows the FB transmitter and receiver chassis. Power supplies are shown in Fig. 3.

Multiplier Stages:

To keep distortion at a minimum, phase deviation in the modulator must be kept small. This requires several subsequent multiplier stages for a reasonable output deviation ratio. In type FB equipment, the transmitter crystal frequency of 6 mc. was determined by the low-distortion requirement and the necessary deviation ratio. Tests showed that 1) a frequency deviation of about 200 cycles is the maximum permissible for the allowable distortion limit, and 2) an output deviation of approximately 35 kc. is required for the desired signal-to-noise ratio. These two factors fix the required

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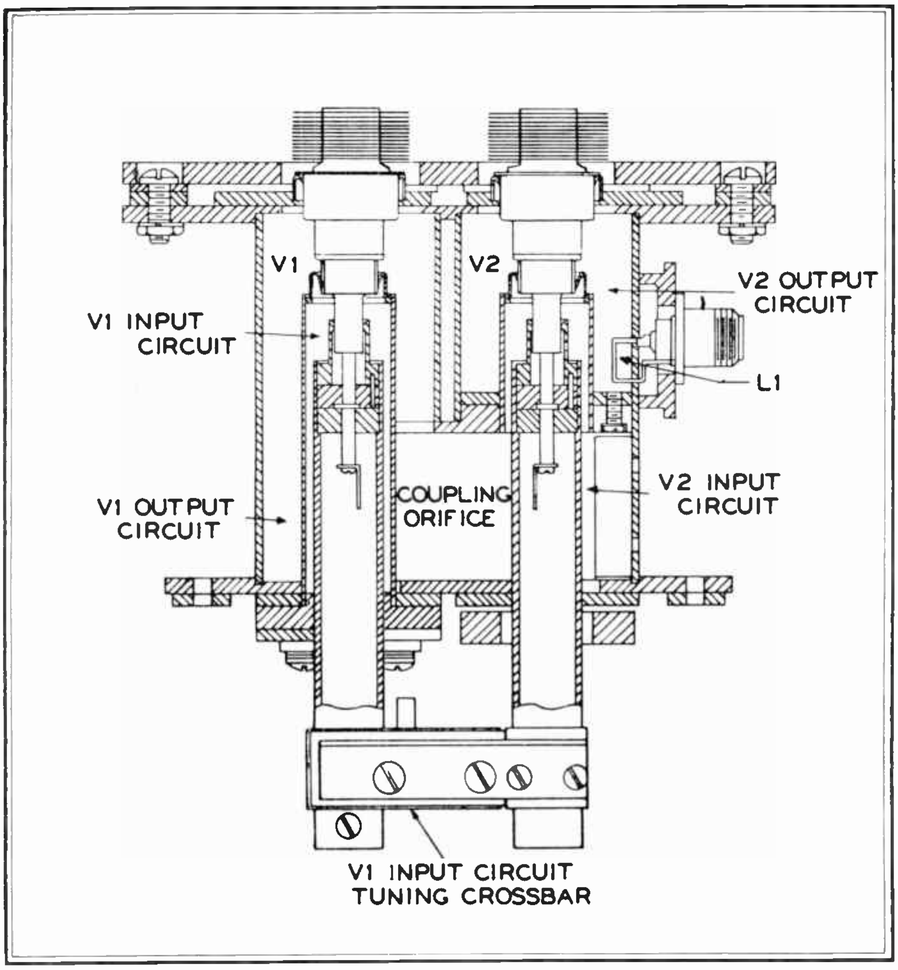

Fig. 5. Final transmitter stages are grounded-grid tripler and doubler circuits

frequency multiplication at about 160 times.

However, as was shown, multiplication increases the probability of spurious radiation and increases the error in crystal frequency. Consequently, push-pull type tripler stages, shown in Fig. 4, were used in the transmitter wherever possible. This practice provides multiple advantages. First, even-order harmonics are cancelled out. Second, the operating frequencies of successive stages are separated widely. Thus, circuit constants can be selected to obviate the possibility of tuning to the wrong harmonic. Third, the use of push-pull circuits with a small amount of positive feedback permits high-efficiency operation with tubes of low rating.

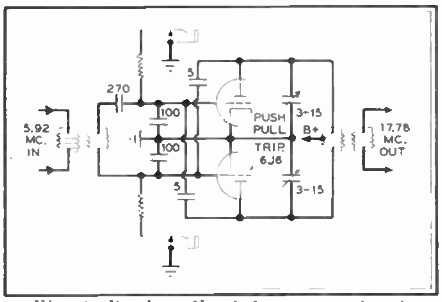

Fig. 4. Push-pull tripler stage circuit

Transmitter Output:

Three tripler stages and a buffer amplifier of conventional design increase the crystal frequency to approximately 160 mc., as shown in Fig. 1. At frequencies higher than this, conventional circuits are inefficient and are not generally used. The two final multiplier stages of the transmitter employ re-entrant coaxial circuits as tuned elements. Tubes having very close electrode spacings and low interelectrode capacity are utilized, with mechanical configurations which permit convenient application to coaxial tank circuits. The first of these tubes is a tripler stage with an output frequency of 480 mc. The second is a doubler stage with an output in the 940- to 960-mc. band.

The mechanical construction of the last two transmitter stages is illustrated in Fig. 5. The cathode circuit of V1, the tripler-driver stage, is fed from an outside extension. A coupling orifice connects the output of V1 to the cathode circuit of the doubler output stage, V2. About 5 watts of RF is coupled to the antenna by loop L1 inserted in the output cavity of V2. Positive feed back is employed in both stages.

Propagation Characteristics:

Path losses at microwave frequencies are very high. It is possible, however, to achieve economical transmission over fairly long distances because of two factors. First, because of the short wavelengths involved, relatively small antennas with high power-gain can be built. The gain of an antenna is directly proportional to its area and inversely proportional to the square of the operating wavelength. Formulas showing the relation between free-space path loss and antenna gain are given in other papers.[1, 2, 3] It can be shown that increasing the antenna size decreases the apparent path loss between communications terminals.

Second, at microwave frequencies there is practically no man-made or natural static. The limiting noise is usually generated by the receiver itself. This provides satisfactory signal-to-noise ratios at signal levels much lower than is practical at lower frequencies.

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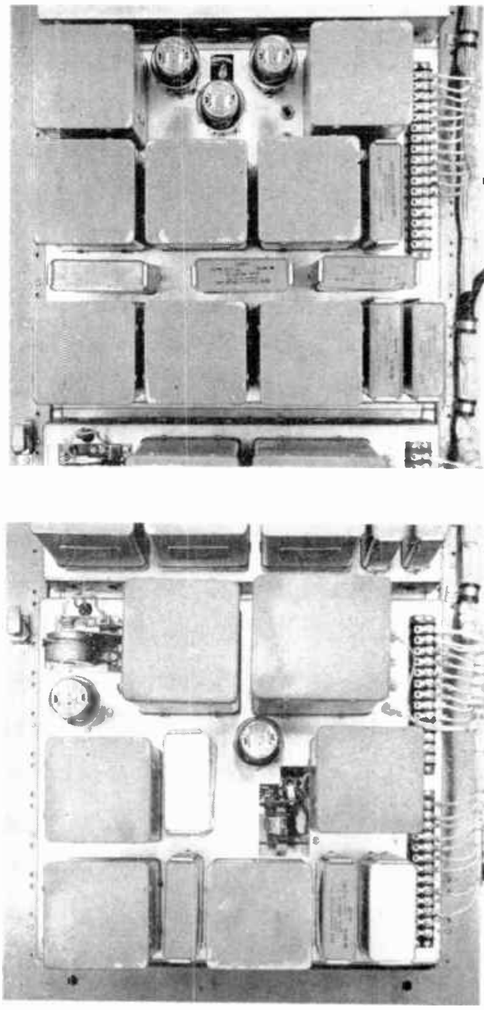
[1] "Propagation of Very Short Waves," by D. B. Kerr. *Electronics*, January, 1948, pages 124-129. February, 1948, pages 118-123.

[2] "Planning Relay Installations," by Roy Allison. *FM-TV*, June, 1950.

[3] "Field Testing a Microwave Channel for Voice Communication, Relaying, Telemetering, and Supervisory Control," by D. R. Pattison, M. E. Reagan, S. C. Leyland, and F. B. Gunter. A technical paper prepared for presentation at the summer general meeting of the AIEE, Pasadena, California, 1950.

Fig. 3. Power supplies for FB equipment



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Receiver Noise:

Most receiver noise is generated in the first high-gain stage. It is important, therefore, to give serious thought to the design of this stage. Amplifiers operating at microwave signal frequencies usually have poor noise characteristics. Thus, it is advantageous to decrease the frequency by means of a low-noise converter which can be followed by amplifiers having better noise characteristics. A synthetic crystal diode is generally used as a mixer for this purpose.

Fig. 6 is a block diagram of the FB microwave receiver. A 1N25 crystal, which has a low noise figure and good overload characteristics, is used as the mixer. The crystal is fed a signal from the receiver antenna and from a crystal-controlled local oscillator multiplier chain. This local oscillator signal, about 67 mc. higher in frequency than the incoming signal, is mixed with the signal in the crystal detector. A tuned amplifier, indicated as the HIF amplifier in Fig. 6, passes the difference frequency only. The first two stages of the HIF amplifier are connected in a circuit which has the low-noise characteristic of a triode and the high-gain characteristic of a pentode tube.[4] These two stages act in combination as the first high-gain stage of the receiver. The low noise figure thus obtained gives the entire receiver a low noise output.

Spurious Responses:

Since a mixer with a relatively wide frequency-response characteristic is used in most microwave receiver input circuits, there is some danger of undesired signals being accepted. Interference may be produced, or the input circuits may be saturated so that the desired signal cannot be received.

A tunable cavity-type preselector precedes the mixer crystal in FB equipment. This preselector, together with the last stage of the local oscillator multiplier chain and the crystal mixer, are shown schematically in Fig. 7. The upper part of Fig. 7 represents the preselector, and the lower part of the multiplier stage. The incoming and local oscillator signals are fed by L4 to the crystal mixer. To give increased protection against undesired-signal acceptance, an additional low-pass filter comprising C5, L6, and C4 is included in the circuit to the mixer.

Receiver Gain:

As pointed out previously, low noise at microwave frequencies make it possible to operate with satisfactory signal-to-noise ratios at very low signal levels. In order to realize maximum range capabilities, these low input signals must be amplified considerably. Thus, the IF amplifiers employed must have very high gain. In amplifiers for microwave systems using wide-band modulation, it is not possible to realize a large gain-per-stage for two reasons. First, the gain-per-stage must be kept low enough to prevent oscillations caused by feed-back through tube inter-electrode capacity. Second, for a given tube-type and circuit, the product of gain and bandwidth is a constant. For a 6AK5 tube, this gain-bandwidth product is approximately 62. Thus with a bandwidth of 6 mc., a gain per stage of only 10 can be realized.

In the FB receiver, a gain of 90 db. in the HIF amplifier and 70 db in the LIF amplifier have been obtained. The 67-mc. IF amplifier has a bandwidth of 1.2 mc., and the 10.7-mc. IF amplifier has a bandwidth of 0.3 mc.

When designing such high-gain amplifiers, extreme caution must be observed to provide safeguards against oscillation. Lead lengths must be kept to an absolute minimum. The reason for this is apparent when it is considered that a 1-in. length of No. 20 wire has a reactance of 8 ohms at 60 mc. Each IF amplifier stage in the FB receiver is on a separate sub-chassis, whose dimensions are such as to keep lead lengths to a minimum. This can be seen in Fig. 2. Each chassis acts as a section of wave-guide operating below cutoff frequency, in order to attenuate feedback radiated from one circuit to another.

Input Level Variations:

There are relatively wide variations in microwave receiver input levels, caused primarily by differences in path length, multi-path transmission, and fading. In practically all systems, some device is used to keep the input to the detector essentially constant. These amplitude variations can be eliminated completely in an FM receiver, without any loss of intelligence, by a limiter of one or two stages.

A two-stage limiter is used in the FB receiver. The first stage utilizes 1N34 crystals. The second is of the grid-bias type, having a very short time constant. This enables it to remove the high-frequency amplitude modulation caused by adjacent-channel signals.

Detectors:

The detector employed in a microwave system depends, of course, on the type of modulation used. Generally speaking, the much greater signal bandwidth encountered, and the necessity for eliminating harmonic products and intermodulation of the multiplicity of signals which may be transmitted over a single channel, demand very great care in the design of detectors. System distortion in the order of 4 or 5%, ordinarily acceptable with low-frequency equipment, would cause prohibitive intermodulation and cross-talk on many microwave equipments.

Pulse-time, pulse-width and pulse-code modulation methods are completely different in philosophy to systems normally used in low-frequency equipment, and require radically different types of detectors.

In the FB receiver, however, the incoming signal is of the frequency modulation type. The frequency detector is linear out to ± 400 kc. over wide temperature variations. The distortion in a complete system consisting of an FB transmitter and an FB receiver is less than 1%.

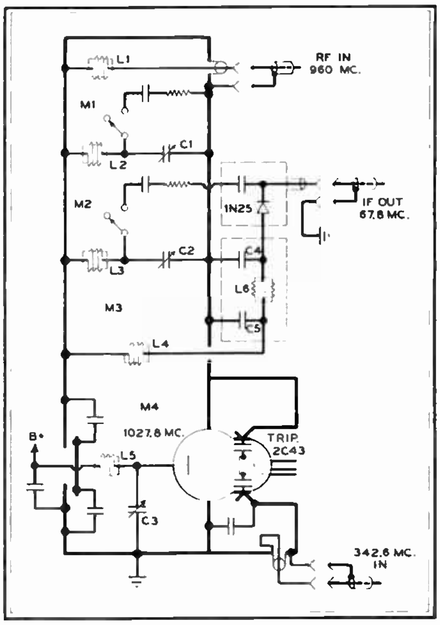

Fig. 7. The cavity preselector and mixer

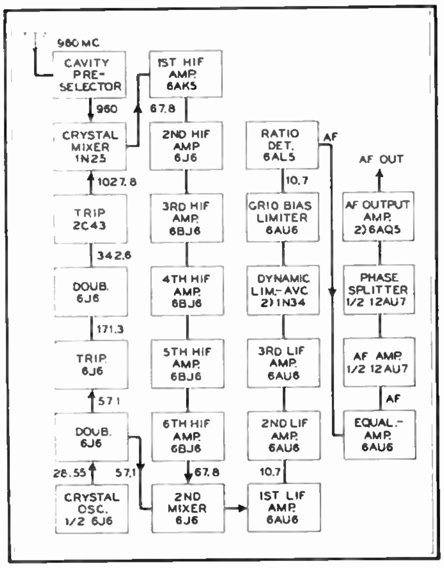

Fig. 6. Double-superheterodyne receiver

[4] "A low Noise Amplifier," by Henry Wallman, Alan B. MacNee, and C. P. Godsdon. *Proceedings of I. R. E.* January, 1948

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STANDING WAVE RATIO BRIDGE

HOW THE USEFUL RANGE OF 2-WAY FM SYSTEMS CAN BE EXTENDED BY PROPER IMPEDANCE-MATCHING — *By* R. W. CAYWOOD AND R. A. BRADBURY*

OPTIMUM performance in a 2-way FM communications system can be realized only when transmitter, receiver, transmission line, and antenna are matched in impedance. Perfect matches are almost impossible to obtain in practice, primarily because antenna impedance varies with height above ground and proximity to surrounding objects. However, system performance is affected so adversely by high standing wave ratios in transmission lines that every effort should be made to avoid them. In order to facilitate transmitter and antenna impedance-matching adjustments in the field, a portable and simple-to-operate instrument is required for SWR measurement. The Millen standing wave ratio bridge, illustrated in Fig. 1, was developed to fill this need. Its operation and use will be explained in this article.

Line Attenuation:

Attenuation in an RF transmission line is at a minimum when the line is terminated by an impedance equal to its characteristic impedance. When the terminating impedance is higher or lower than the correct value, energy normally delivered to the load is reflected back down the line. This results in standing waves, or the formation of alternate high- and low-current points along the line. High- and low-voltage points, displaced by ¼ wavelength from the current maxima and minima, are formed also. The ratio of maximum to minimum voltage or current is called the standing wave ratio. Its magnitude is directly proportional to the degree of mismatch.

Line dielectric losses are proportional to the square of the impressed voltage, and resistive losses to the square of the current. It can be seen that both losses are increased by larger standing wave ratios. Thus, attenuation increases rapidly with the degree of mismatch. The magnitude of this effect is shown by the following example:

Suppose that the normal attenuation of a matched transmission line is 3 db. With a SWR of 2, which represents a good practical match, the additional attenuation would be .4 db. With a SWR of 5, however, the additional attenuation would be 2 db. This is not an uncommon situation. Assuming the same conditions at transmitter and receiver, reducing the SWR from 5 to 2 would effectively *double* the transmitter power. The importance of achieving the best possible match is apparent.

SWR Bridge Circuit:

The impedance at the open end of a transmission line depends on the terminating impedance. This fact permits determination of SWR by measurement of the RF impedance of the line and attached load. A modified Wheatstone bridge circuit, Fig. 2, is used for this purpose.

RF power from the transmitter or a signal generator is applied to the input jack. The input resistor, R1, is provided

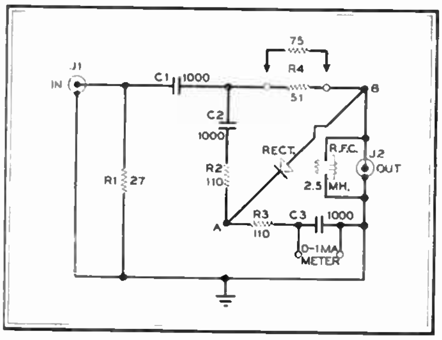

Fig. 2. Complete circuit of the bridge

to improve the regulation of the RF source. This maintains the accuracy of the bridge at high standing wave ratios, and makes it unnecessary to readjust the input power for changes in load.

The ratio arms on one side of the bridge are identical. R2 and R3 are matched to within .1%, as are C2 and C3. These capacitors are required to provide an RF path around the milliammeter.

The other side of the bridge is composed of R4 and J2. The transmission line with its termination, usually an antenna or a receiver, is attached at J2. R4 is exactly equal to the characteristic impedance of the line. When the line is terminated correctly, the impedance at J2 is also equal to the characteristic impedance. Thus, the bridge is balanced and no DC current flows, indicating a SWR of 1.

When the line is not terminated correctly, however, the impedance at J2 is not equal to R4. Therefore, the potential at B is not equal to that at A, Fig. 2, and rectification of the RF difference occurs, causing DC current flow through the meter. Current flow is proportional to the degree of mismatch, and, accordingly, to the SWR.

Meter readings can be calibrated in terms of the impedance, reflection coefficient, or SWR. A calibration chart for SWR is given in Fig. 3.

Binding posts for connection of the meter are shown in Fig. 1. The use of

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*Engineering Department, James Millen Manufacturing Company, Inc., Malden, Mass.

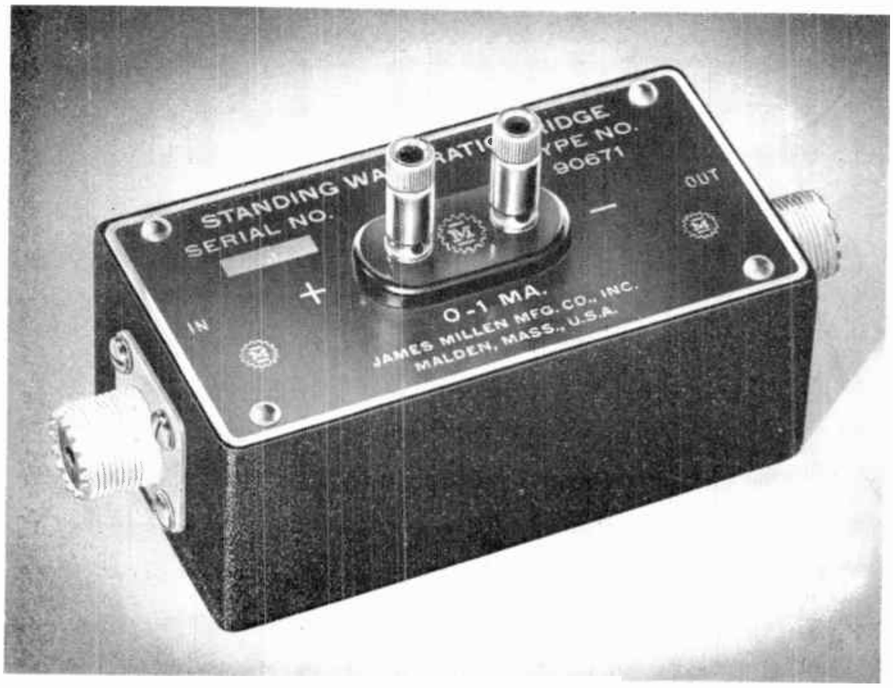

Fig. 1. Because meter is external, all SWR bridge parts are contained in this small box

World Radio History

JEREMIAH COURTNEY'S* MOBILE RADIO NEWS and FORECASTS

MOST-visited mobile radio dispatching quarters in the United States are probably those of Radio Flash Company in Chicago, which lives up to its slogan: "A cab for you in a moment or two."

So popular have these headquarters become for visiting taxicab company officials that the fame of the organizer, Arthur Dickholtz, has spread far and wide. In fact, he was recently invited to supervise the setting up of a mobile radio dispatching system in England.

Contributing to the flow of visitors is the fact that the conventions of the largest taxi association, the American Taxicab Association, are held in Chicago every year. Each convention brings a new stream of taxi officials to the dispatching headquarters of Radio Flash for the purpose of observing the methods which have permitted this organization to handle as many or more calls each day than any cab company in the country. Accompanied by Colonel White, new head of FCC mobile activities, your reporter visited this installation during the October ATA convention.

High-Speed Dispatching:

On a normal day, Radio Flash completes about 3,000 calls for cabs, each one of which involves several separate transmissions. On a busy or rainy day, the average number of calls completed runs between 4,000 and 5,000.

To handle this staggering number of completed dispatches with a fleet of approximately 250 radio-equipped cabs is no easy matter, as any taxi dispatcher will agree. The task has required no less than eight revisions of the dispatching procedures employed by Radio Flash. Although Dickholtz would be the last to suggest that the present routine of call handling represents the final revision, the system is universally regarded now as the best that can be employed in a large city where more than 150 mobile radio-equipped units are used.

The principal problem that confronted Dickholtz in setting up procedures to handle calls to such a large number of mobile units was that of limiting the driver's response when a call is sent out by the base station dispatcher. Otherwise, an unintelligible flood of responses would descend on the dispatcher. This fundamental problem was licked by the company's institution of what is now referred to as the "post" system. Dickholtz divided the city originally into 80, later 40, areas. Each area has a centrally-located post position. These locations within the post areas were carefully designated by street intersections and location description.

For example, Post 1 is the northwest corner of the intersection of Smith and Elm Streets. When a call is received from a customer in that area, the telephone operator taking the call records the customer's name and address on the message slip and, in the upper left hand corner of the message blank, indicates that the address is within the Post 1 area. The base station dispatcher then calls out over the air only two words: "Post 1." No driver in that area may answer that call unless he is standing at the designated street intersection for the Post 1 station. If there is more than one cab at the post, the first cab on line is the only one that may answer the call. He answers only: "Post 1, 133," to indicate the number of his cab. The customer's address is then given cab 133, without repeat or acknowledgment, and the number of the cab is put on the message slip in case of call-backs. The message slip is then time-stamped. This system prevents flooding the base station by anxious drivers all seeking to get a call in their general area, and limits the number of words per transmission to the absolute minimum.

Extension of Response Area:

If there is not an immediate response to the base station's Post 1 call, the dispatcher knows there is no cab at the post location. The dispatcher then calls: "Post 1 open." This signifies that any cab within twelve blocks of the specified post may answer the call. If more than one cab answers the "Post 1 open" call, then the dispatcher establishes the location of each driver, and gives the assignment to that cab nearest the customer.

If both the "Post 1" and "Post 1 open" calls go unanswered, the final call is "Post 1 within 10." This means that any cab which can make the Post 1 area within ten minutes may have the call. Again, if more than one cab answers the "Post 1 within 10" call, the dispatcher establishes the nearest cab to the customer and gives that cab the call.

The system is strictly policed by the company, and any driver who takes a call to which he is not entitled, or which he cannot fill in ten minutes, is appropriately disciplined. The most severe punishment, of course, is to deny the driver the use of radio for a specified number of days, because there is a substantial difference in the booking of the radio-equipped and non-radio cabs. This is especially true in Chicago, where the average cab trip is 20 minutes and the average cab fare about $2.00.

Dispatching Personnel:

The Radio Flash organization has three or four girls answering incoming telephone calls, depending on the period of the day. These girls are separated from the radio dispatchers by a glass partition. The incoming calls are passed through the partition to another girl who divides them into north- and south-side calls. The north-side calls are handed to radio dispatcher A who transmits over the north-side base station transmitter. The south-side calls are handled by radio dispatcher B, who transmits over the south-side transmitter. Although both transmitters are not employed simultaneously, not a second is lost between calls. The moment the A dispatcher completes a message, the B dispatcher begins his transmission. In the slow periods, only one radio dispatcher and the north-side transmitter is used.

Perhaps the most remarkable tribute to the company's radio use is the fact that they have not taken business away from the older companies. By giving good and dependable call service they have increased the total demand for taxi service in Chicago.

Proposed Marine Rules:

The FCC at long last has issued its proposed rules to govern the marine radio services, new and old. They occupy 188 single-spaced pages and defy succinct summarization. They were published in the Federal Register of September 22, 1950, which may be obtained from the Government Printing Office for twenty cents. Interested parties have until November 15 to comment on the proposed Rules.

Since marine radio is one of the most widely used radio services in existence,

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MULTIPLEX RINGDOWN PANEL

DESCRIBING A DUPLEX SIGNALING SYSTEM FOR TRANSMITTING AND DETECTING SIGNALS ON 2-WAY MULTIPLEX CHANNELS — *By* J. K. KULANSKY*

IN a simple telephone circuit running between two points, a system of ringing must be provided so that, if a party at one end wants to talk to someone at the other end, he can signal over the line by causing a bell to ring, or some other signaling device to be actuated. This particular function is known in telephone parlance as ringdown signaling.

Some equivalent arrangement is required for multiplex microwave communication systems which provide up to 32 individual 2-way channels, each capable of handling voice or operational signals of 300 to 3,500 cycles. To provide such calling facilities, Hammarlund Manufacturing Company has developed a simple and inexpensive ringdown panel for universal application to both simplex and multiplex radio systems.

Purpose of the Ringdown Panel:

Basically, it is a terminating panel for one transmitting circuit and the associated receiving circuit. The use of the ringdown panels in a typical system is illustrated in Fig. 1. This shows the multiplex microwave transmitters and receivers at the two terminals. There might be, of course, intermediate repeaters if the distance to be covered is great enough to require their use.

If a particular circuit is for direct communication from a dispatcher's desk at one end to a maintenance operator at the other end, each would have a ringdown panel for incoming and outgoing signaling. Another circuit might be terminated at a telephone switchboard, so as to provide connections to any extension. Thus, each panel has circuits for generating 3000-cycle calling signals, and for responding to signals of that frequency. It also has terminals for a calling switch to control the audio frequency generator, and for a bell or signal light actuated by signals initiated at the other end of the circuit. An important function of the ringdown panel is to eliminate the necessity for the use and expense of a monitoring loudspeaker and associated amplifier for each circuit.

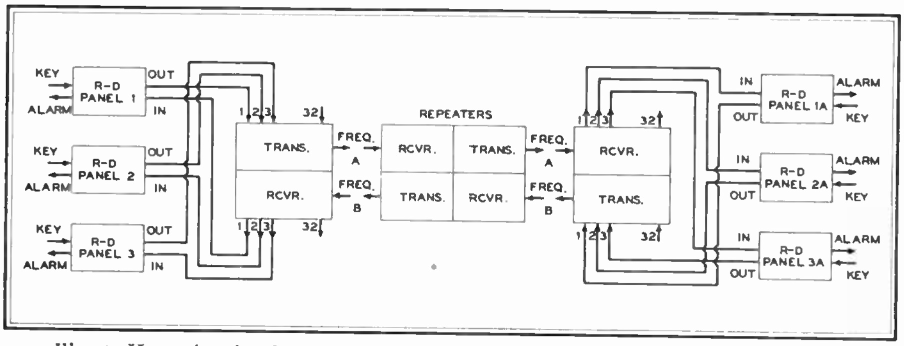

Fig. 1. How the ringdown panel can be used for multiplex channel signaling

Details of the Panel:

Fig. 2 shows a block diagram of the Hammarlund model RSCTR-1 ringdown panel. It is divided into three sections, comprising the transmitter unit, receiver unit, and power supply operating from 105 to 125 volts, 50 to 60 cycles. The components are carried on a standard rack panel, 19 by 3½ ins., illustrated in Figs. 3 and 4.

The transmitter unit consists of a 3-kc. tone generator V2, dash generator V8, buffer amplifier V1, and line-bridging transformer T1. Terminals 1 and 2 are provided for connections from a switch, S2, or keying device. The use of the dash generator is optional as it is employed only where automatic transmission of intermittent signals of 1 second duration is required.[1]

There are also terminals for switch S1, required to close the circuit for the keying relay K2 which, in turn, is connected across terminals 1 and 2. This is the timing arrangement for transmitting the 1-second signals.

The audio output, terminals 3 and 4, can be adjusted from zero to .7 volts RMS when bridged across a 600-ohm line.

Terminal 5 and 6 are for the input to the receiving section. T2 is a bridging transformer for a 600-ohm line. This feeds the selective line amplifier V3, having an input sensitivity of −30 db. The signals are then applied to a 3-kc. bandpass transformer Z1, a limiter amplifier V4, and a second 3-kc bandpass transformer. This provides a highly selective signaling channel, having an effective bandpass of less than ±50 cycles.

The pulse-detector relay tube V5 operates the alarm relay when the signal voltage overcomes the static guard-voltage maintained on V5.

The signals must have a minimum duration of approximately .25 second in order to operate the relay, because a time-constant network is provided to prevent actuation by random impulses.

In some cases, it may be necessary to lock the alarm relay until the circuit is opened manually. Therefore, a carrier lock-in bias generator is provided on the ringdown panel.

Operating voltages for both transmit-

[1]Details of the circuits and their operation are explained in "Low-Cost Mobile Fleet Control," by J. K. Kulansky, *FM-TV* MAGAZINE, March and April, 1950.

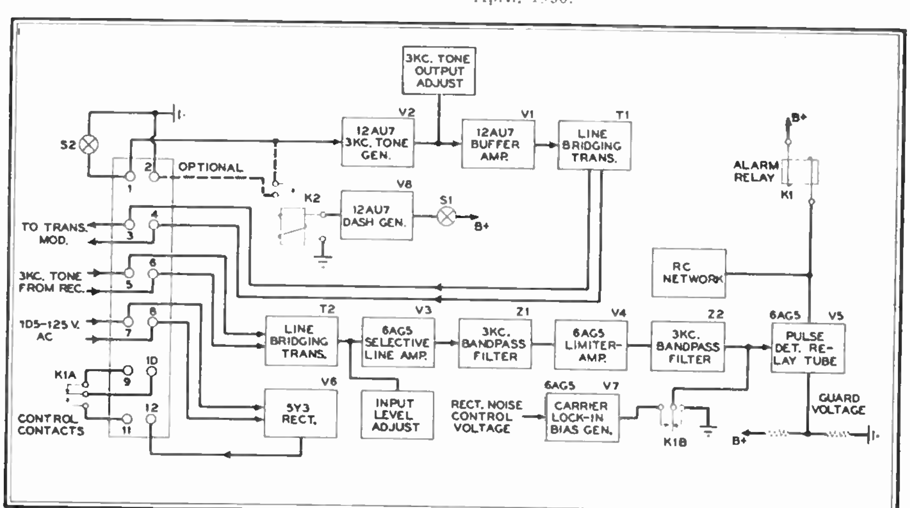

Fig. 2. Ringdown panel circuits. A panel is required at each end of each channel

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ter and receiver sections are finished by
the 5Y3 power supply. Also 6.3 volts

FALLACIES OF THE COLOR DECISION

WHY THE BRACKET STANDARDS DECISION IS AN UNREALISTIC APPROACH TO COLOR TELEVISION SERVICE — *By* FCC COMMISSIONER GEORGE E. STERLING*

IN the First Report of the Commission on the color television issues, I joined with the majority in the proposal for bracket standards with the understanding that if an insufficient number of assurances were received from manufacturers concerning their plans for incorporating bracket standards in their receivers, the Commission would issue a final decision adopting the CBS color standards.

Since the responses were not in accordance with the Commission's proposal, the majority have adopted the CBS color standards. I dissent from this premature action taken by the majority at this time for the following reasons:

The subject of bracket standards was not at issue in the hearing, nor was the subject even advanced during the hearing. There is no doubt in my mind that manufacturers were taken by surprise at the Commission's proposal on this subject as set forth in the First Report.

I do not agree with the majority in their Second Report that the responses of the manufacturers were merely a restatement of the parties' contentions made during the hearing, since the subject of bracket standards was a new concept in field and line scanning proposed after the hearing record closed. It came as a surprise to industry and was not based upon information appearing in the record of this proceeding.

Several manufacturers were confused by the Report as it related to bracket standards, and representatives of different manufacturers communicated and met with the staff at various times for the purpose of securing an interpretation of the Commission's intent. The exchange of correspondence with the Philco Corporation subsequently made public is a classic example of the confusion aroused in the minds of manufacturers who evidenced a sincere interest in the problem.

The Columbia Broadcasting System found it necessary in this respect to voice its concern as to the interpretations that might be made of paragraph 5 (c) [1] and therefore consulted with the staff for clarification of the language. CBS also suggested that the Commission make clear by public statement what was intended by the language of paragraph 5 (c).

Because bracket standards were new, I am now of the opinion that the Commission should have treated the subject at greater length in its First Report. Because of the time lost in seeking clarification of the Commission's intent and the necessity of meeting the September 29th deadline, manufacturers were unable to make a full appraisal of how they could build in bracket standards, and when.

The response of Capehart-Farnsworth Corporation, I think, truly poses the problem confronting manufacturers who are desirous of cooperating with the Commission, since it encompasses not only design and production of TV receivers embodying bracket standards capable of meeting the Commission's requirements as to geometric linearity and brightness, but also points up the necessity of procuring signal generating equipment for the purpose of testing receivers incorporating bracket standards.

The Capehart-Farnsworth Corporation's response stated, in part, as follows:

"We are having some difficulty in obtaining pictures of geometric linearity and brightness on the higher frequencies and, in particular, we are faced with problems such as return time of the horizontal sweep and consequent reduced scanning efficiency. Other problems involve the loss of high voltage due to high frequencies with the deflection components now used, and it is evident that new components, such as the deflection yoke and transformer, will have to be designed in order to meet the requirements stated in paragraph 151 of the Commission's Report 50-1064.[2]

"Also, until adequate signal generating equipment becomes available and until such time as the composite signal standards have been set, with particular reference to horizontal and vertical blanking time, we would be unable to produce a product design which would assure satisfactory operation for both the monochrome and color television transmissions."

The serious problems that confronted the Belmont Corporation, who also expressed a desire to cooperate, are stated, in part, as follows:

"We have been unable to find any record in technical literature nor in our past experience of an attempt to produce a linear sweep for electro-magnetic deflection systems covering the wide range of the proposed bracket requirements and at the same time adhering to the proposed requirements of constant picture size and brightness. Moreover, the major effort of our engineering department since the publication of Notice 50-1065 has failed to indicate any method of accomplishing the bracket standards. The standards as called for by the notice create a far different problem from that of incorporating in television receivers dual sweep systems permitting switching between specific standards, a system which probably could be engineered in the present state of the art.

"While Belmont has every desire to cooperate with the Commission in developing bracket standards which are feasible from both the cost and engineering standpoints, it is clear from the above and from the results of our engineering survey that this cannot be accomplished within the time contemplated in the Commission's time schedule. Before Belmont could begin to manufacture television receivers with such standards, a method feasible from the engineering standpoint would have to be developed, the new equipment designed and field tested, a re-tooling operation accomplished, additional materials obtained, and production methods revised. Hence, it would not be possible to be in production of receivers incorporating such bracket standards for a very much longer period than that contemplated by the Commission's time schedule."

The problems of industry in terms of time are also succinctly set forth in the response of Motorola, Inc., in which they stated:

"Motorola's approach to this entire matter is in the spirit of cooperation, accomplishment, and realism. Therefore, I hope that you seriously weigh what we set forth herein when you come to a decision on this subject.

"We are thoroughly convinced that the time allotted for a manufacturer to incorporate bracket standards into his production is inadequate. To further acquaint you with Motorola's situation in this matter of time and to further demonstrate the inadequacy of the proposed time cycle, we are attaching herewith a report from our Engineering Division. This report is supported with two chronological histories taken at random from our Engineering Log Books. These his-

*Complete text of Commissioner Sterling's dissenting opinion on the Second Report on Color Television, issued by the FCC on October 11, 1950.

[1] "Such receivers would be capable of producing monochrome pictures of equivalent size, geometric linearity, and brightness on each of the above two sets of standards." [15,750 lines, 60 fields, and 29,160 lines, 144 fields per second].

[2] Complete text of this lengthy paragraph will be found in *FM-TV* for Sept. 1950, page 22.

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tories set forth the mile posts of time for two engineering projects that we classify as minor modifications. The engineering principles involved in these two cases were generally known before the inauguration of the projects. Many of the technical principles involved in the integration of bracket standards require engineering development to reduce them to commercial practice. Therefore, we would like to make clear that the integration of bracket standards into our manufacturing is not a minor modification. In fact, bracket standards covering the full range require a complete chassis redesign."

The Hallicrafters Company, in their response to the Commission, stated they had made every effort to determine their ability to cooperate with proposals of the Commission and significantly pointed out:

"The design of a receiver which will operate on any combination of field or line scanning frequencies within the proposed brackets is something we do not know how to accomplish in the present state of the art. This design would follow considerable basic research for which we cannot estimate a completion date. Following the date of engineering release, a materials procurement cycle of two to four months must pass before actual manufacture can begin. These time factors coupled with whatever date the Commission might choose to release an order establishing bracket standards will determine whether we can supply bracket standard receivers within 30 days of the Order."

Several manufacturers stress the need for field testing after receivers have been made by their engineering departments. In its Report, the Commission stressed the need of adequate field testing. In its First Report rejecting the RCA system, the Commission placed emphasis on the fact that this system had not been field-tested and made mention that the system introduces entirely new techniques into broadcasting. So do bracket standards, and yet the Commission in its failure to consider a reasonable timetable deprives manufacturers of the opportunity to field-test this new device and, therefore, has taken an inconsistent stand with its enunciation of the importance of this element in the evolution of a new system. Manufacturers have a responsibility to the purchasing public, and one of the important criteria of meeting this responsibility is through field-testing its products prior to introducing them to the public. The competitive forces in this industry are tremendous and, as in all products designed for public acceptance, a manufacturer rises or falls according to the merits of his product. In my opinion, part of a reasonable timetable should include the necessity of field-testing bracket standards under varying conditions of reception, including temperature, humidity, signal strength, etc.

Neither the Commission nor its staff has the necessary experience in the design and manufacture of TV receivers. Consequently, the Commission must take the word of reliable manufacturers who were willing to cooperate but were unable to meet the Commission's short timetable. In its First Report, the Commission stated "that (it) is aware that of necessity it must rely to a great extent upon industry experts for data and expert opinion in arriving at decisions in the field of standards, our own facilities are too limited to gather much of the data." Paraphrasing this statement as it concerns bracket standards, the Commission should say that it must take the word of industry as it concerns the design and production of bracket standards, since it does not have the know-how. By providing for a reasonable timetable, the Commission would have in the end the experience of industry in this new concept of field and line scanning, and would be able to better judge what it would cost the public, and if it would provide the avenues for improvement that might be made in the art.

The problems confronting manufacturers today in terms of production, procurement, and manpower to meet the demands of national defense are serious ones. Surely the responses of such reliable manufacturers must be given credence and consideration. It is well known that there are serious shortages of tubes and resistors as well as basic materials. The situation on procurement is so acute that manufacturers have been shipping their TV receivers without a full complement of tubes, trusting to their dealers to procure them in local markets, but the local market supply has been exhausted as the result of not only the local demand but as the result of the purchasing agents and manufacturers' representatives combing every territory in their search for components in short supply. At least one company has agents in Europe attempting to purchase resistors. This condition, aggravated by others, is bound to have a serious effect on production, and will serve only to delay the availability of parts to make not only bracket standards but also parts with which to build adapters, converters and color receivers. Moreover, in many instances, industry has been required to divert its TV engineering experts to problems of production for defense because of the close relation of TV techniques to radar and other electronic devices the Government requires.

After a thorough study of the responses, and taking into consideration the current problems of industry, I am convinced that the Commission's timetable presented to industry in its First Report to build in bracket standards was unreasonable. I think much could be accomplished in the interest of all concerned if we called a two-day conference with those members of the industry who indicated a willingness to cooperate with the Commission for the purpose of exploring the problem of bracket standards, looking to a realistic timetable that could be met by industry without unduly aggravating the compatibility problem.

In the period that has passed since the manufacturers submitted their replies to meet the September 29th date line, I feel certain that they have continued their study of the problem and would be in a position at the end of a two-day conference with the Commission and staff to agree on a reasonable timetable similar to that proposed by the Commission in its First Report, had manufacturers met the requirements of the Commission's

(Continued on page 44)

WHETHER you approve or oppose the adoption of the CBS color television system, make no mistake on this point: the basic issue involved is not whether the CBS system is technically acceptable, or is the best available, but whether or not the radio industry of this Country is to be controlled by indirection under FCC decree.

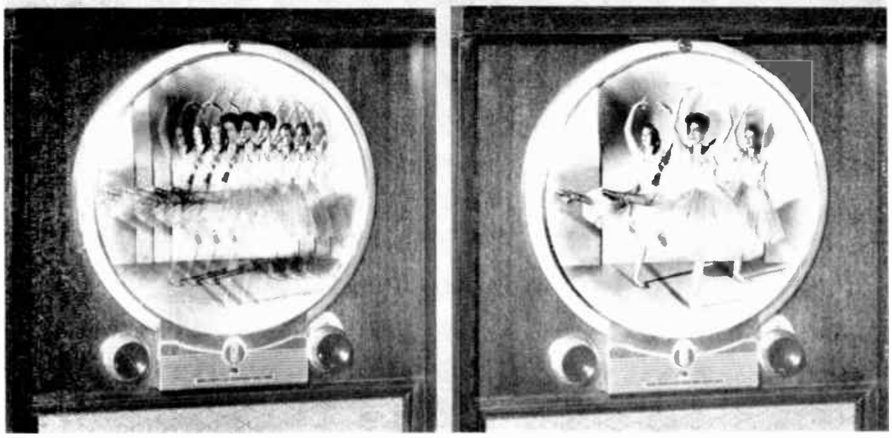
This is not the first but the second time that the manufacturers have been confronted by such a situation. The issue should have been met squarely when Paul Porter justified the shift of the FM band by saying, and without the slightest basis in fact: "The Commission is informed by transmitter manufacturers that 10-kilowatt transmitters will be immediately available for the new band." Then pointing his finger at the industry, he said "if new receivers are manufactured to cover the old band, the Commission might very well take the position that it was necessary to put an end immediately to all FM transmission in the old band to protect the public from an unnecessary expense, and to insure that the change-over to FM's new and permanent home should not be delayed." That was on August 17, 1945.

After five years, FM broadcasting is still struggling to overcome the setback which resulted from that action by the Commission.

Now the FCC, with Commissioners Hennock and Sterling dissenting, has decided to develop the Porter do-as-I-say-or-else technique, and to really do a job on the television manufacturers. Their concern for the American public is no more sincere than Paul Porter's and, as he did, they have not only rejected the advice of industry experts best qualified to give it, but they have utterly disregarded the practical problems of research, development, engineering, field-testing, production, promotion, and merchandising.

RCA's board chairman David Sarnoff summed up this situation in a statement released on October 11: "Never before has an administrative body of the United States undertaken to coerce the freedom of choice of American manufacturers in what they may build and sell under threat that, if they do not obey, drastic consequences to the public will follow. The threat has today been carried out. Because the engineers of substantially the entire industry had the courage to disagree with the Commission's impractical proposal, the FCC has adopted this incompatible ssyetm just as it threatened to do."

The only recognition of industry dislocation and public confusion which will result from the Commission's decision was expressed in the dissenting opinion of Commissioner George E. Sterling. Because his opinion brings to light important considerations which are not generally understood, and is documented with statements from radio manufacturers, his text is presented here in full.



Figs. 1 and 2. Phonevision reception before and after addition of the key signal

ZENITH PHONEVISION

PART 2: SIGNAL FUNCTIONS, ROUTING & SWITCHING, TRAFFIC LOAD PROBLEMS—*By* M. M. HUBBARD*

THE Phonevision system of television broadcasting[1] is described briefly in the following few pages, first of all in terms of the functions to be accomplished and, secondly, an attempt is made to define and analyze certain technical problems associated with such a proposed system. These are call routing, switching methods, and traffic loads.

Controlled distribution is a necessity for any successful subscription service. Television is no different. A suitable method must be devised by which the television owner may indicate his intention of seeing special programs and his willingness to pay for the privilege. Scrambling the picture offers such a system. But there are not too many methods by which the picture can be simply decoded under control.

One means of scrambling and unscrambling the picture that has been thoroughly investigated is a method of introducing a random uncertainty in the horizontal synchronization of the picture image. If uncorrected, this produces a jitter or disturbance to the composite image resulting from many successive frames. But it is still possible, as in a photograph slightly out of focus, to identify gross detail, as shown by the scrambled image in Fig. 1. To decode such a scrambled picture, electronic circuits have been developed that transmit a decoding signal. This signal needs only a narrow passband, about 100 cycles, and is therefore economical of transmission facilities. Fig. 2 shows the image seen after the decoding signal has been added.

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[1]Part 1 was published in *FM-TV* for June, 1950.

The transmission of the decoding signal to the customer is the next problem we inherited with the decision to investigate a subscription service. One first thinks of the simultaneous transmission of the key over an additional radio link. This method has several disadvantages. The first is the inherent difficulty of restricting the key to the authorized subscribers. Another is the trouble to be anticipated in maintaining interference-free reception of an additional channel, particularly in areas of low signal strength.

The method of distribution investigated in the proposed Phonevision system is to transmit the decoding signal over the regular telephone lines to each customer. At the present time many such additional signals are superimposed on intercity toll lines, the well-known carrier channels. It is only done in rare instances on lines to subscribers, though some telephone companies do use subscriber lines to transmit wired music programs when they are not needed for talking purposes. Since the key signal we require needs only about 100 cycles of spectrum space, it can be added immediately above the normal voice audio band. The attenuation at this frequency in the normal telephone subscriber plant is well within the limits required to permit sensing the decoding signal at the customer's home. Simple frequency-separation networks have been produced to do this with low insertion loss. Thus we find one possible means of delivering our decoding signal to the user.

It would, of course, be possible to set up such a service on a flat rate basis, the customer to pay a fixed monthly fee without regard to the extent of his use of the programs offered. This might very well be a satisfactory operational method. In that case, many of our problems would be eliminated. However, the number and type of programs that might be offered to a subscribing public are great. It is also clear that not all segments of the viewing public will desire to support the same types of programs. One group might prefer original first-run motion pictures prepared for television subscription viewing; a second might prefer live plays; another, sports events which might require reimbursement of the sports management. Because of such varying preferences, the economics of a possible season ticket to a subscription service is not as promising a proposition as some means preserving the right of selection to each customer.

If we seek such a solution, we are confronted with three principal problems:

1. Each customer must be able to report his desire in order to obtain the decoding information for the particular program of his choice.
2. The correct decoding signal must be returned to him during the program, or programs, which he selects, and not otherwise.
3. There must be made a record of each transaction for billing purposes.

Clearly, if we are thinking of using telephone lines to distribute the key signal, it is most convenient to use the telephone central office as a means of solving problem No. 1 above. This discussion will be limited to customers living in areas served by dial offices, since manual telephone service is a dwindling facility. It is also true that the largest segment of the potential audience for subscription service will be found in the metropolitan areas served by panel, crossbar, or step-by-step dial offices.

At first thought one might suppose that the Phonevision terminal which will record orders and attend to distributing the appropriate key signals could be assigned a telephone number like any other business, with perhaps a large number of lines, as is done for frequently-called businesses like Western Union or large department stores. As will be seen in our consideration of traffic loads, this might lead to overloads in the terminating end of a central office. If the lines to the Phonevision terminal were taken from the outgoing trunks of the originating central office equipment, as is done for calls to Information or Long Distance, further valuable advantages could be gained in means of transmitting identifying signals. Once a subscriber is connected to a Phonevision terminal, he can make known his identity and wishes verbally. Indeed, in small-scale trials, just this will be done. For a large volume of

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calls, such procedure is wasteful of valuable circuit time. Many mechanical methods can be projected.

One would be the transmission of audio-frequency pulses. A method that is much simpler, and which requires no unusual equipment for the purposes at the customer's premises, is to use DC pulses from his telephone dial. This will permit registration of his desires if the connection is set up as is shown in Fig. 3. In this, we see that a Phonevision subscriber has obtained access to the Phonevision terminal by dialing a 3-digit code. The crossbar equipment has interpreted this correctly, and routed the call to a given group of trunks on the Office link frame assigned and cut the subscriber directly through to the special Phonevision equipment without interposing a repeating coil. Thus, DC current interruptions by his subsequent dialing will be received by suitable relays in this equipment.

At this point the subscriber will receive some signal to inform him he has reached the Phonevision terminal. This could be a second dial tone, as is commonly done in outgoing trunks from private branch exchanges. On receipt of this signal he would dial about seven additional digits to perform the following functions: the first four digits (or five if more than 10,000 customers in a given office are signed up) will identify him. These might be an arbitrary number, his contract number.

During receipt of these digits, the Phonevision terminal would make selection of the auxiliary line circuit cross-wired to the particular subscriber corresponding to this contract number. It can then make positive identification, in a simple loop test, that the customer has indeed dialed the correct number to identify himself and has reached his own auxiliary line equipment, thus avoiding the mistaken ordering up of signals for another party. Thus the auxiliary equipment is made ready to respond to the order of the customer for the selection of the program he desires to receive. The auxiliary equipment can be easily designed to permit a subscriber to indicate a choice for any one of several programs, *e.g.*, Program A at 7:00 to 9:00 P.M.; or Program E at 9:00 to 10:30 P.M. Several time intervals and program choices can be designated by a one or two digit decimal code.

This auxiliary line equipment can be made up in many ways. One easy solution is to use a stepping switch with one relay and a printing tape. This solves problem 3, recording the transaction. With the completion of dialing, the customer may receive a tape-recorded announcement of the program code he has just ordered up if this seems desirable. This announcement, if provided, would be followed by timed release if the subscriber does not hang up first. Either the timed release or the customer's hanging up would clear all equipment in the originating cross-bar path, but leave the auxiliary line equipment attached to the customer's line to transmit to his set the decoding signal when the time for it is at hand. The auxiliary line equipment could be arranged so that it does not make the line test busy to incoming calls, nor prevent outgoing calls. The signal would be attached to the subscriber's line through a frequency-separating network and an attenuating pad to eliminate cross-talk from one line to another when both are attached to a common key-signal source.

The equipment can be restored to normal after the program by a common release signal initiated by the Phonevision terminal at the conclusion of the transmission interval, or a subscriber can free his line from any code previously selected by dialing, before or during a program, the same digits already described and finally dialing some arbitrary release signal, possibly zero.

Access to the Phonevision terminal to register program choice may constitute a large traffic load for the telephone central office equipment. To see how serious this might be, let us assume a typical office of the latest type, and examine the magnitude of this load for a heavy development of such subscription service, a development that is several steps removed from any initial installation. We will select a telephone office serving approximately 34,000 working terminals (numbers) of mixed business and residential service in a community adjacent to a large metropolitan area. We will assume that crossbar equipment is provided to serve this group of subscribers. We will further assume that one-third of this office's working terminals are equipped for subscription television service, roughly 11,330, and that at any one time about 60% of these might wish to receive programs coming at the same hour. These are rather liberal allowances and present the worst load condition, which might mean that 6,800 calls would be attempted to the Phonevision terminal in one hour.

To assess such telephone loads, we must measure them in terms of circuit usage. The common unit is the call-second. The load can be expressed as the product of the number of calls multiplied by the average number of seconds utilized in the connection. This is calling-rate times holding-time. All telephone trunks and central office equipment quantities are engineered by the application of mathematical theory of probability to accurate forecasts of average loads. What average holding-time should we assume for our case? Nine or ten digits are to be dialed. This could be done in 15 to 20 seconds. We will assume an average holding-time in a crossbar office of approximately 40 seconds for a subscriber sender which receives seven or eight digits. Since this 40 seconds includes allowances for calls to call-indicator offices with longer holding time, we may conclude that our allowance is reasonable. Indeed the ordinary crossbar sender will assume that trouble exists if the subscriber exceeds 40 to 60 seconds in dialing.

With the assumed 40 seconds average holding time, our load above is $40 \times 6{,}800 = 272{,}000$ call-seconds. If these were uniformly distributed throughout an hour, or distributed with the usual telephone traffic random fluctuations, we would require, as we can determine by consulting probability tables, about 105

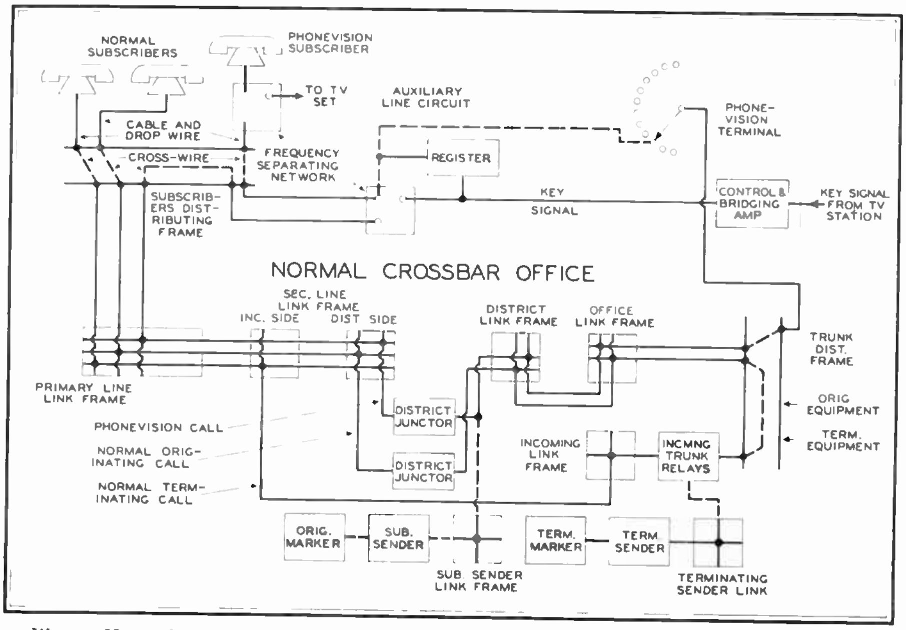

Fig. 3. How the key signal can be distributed through a crossbar telephone office

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trunks to the television terminal if one call in 1,000 is to encounter a busy condition. If we assume that the customers are not forehanded and bunch 70% of the calls in the last 30 minutes, our load rate would increase and 147 trunks will be required for the same busy trunk probability. If we wish to assume still further compression of this load, the number of trunks will be increased. The number of these trunks can be made equal to the requirements of the most probable load concentration. The relay equipment required for these trunks is part of the subscription service equipment and is, in effect, leased or paid for by the customer. While this paper will not attempt to go into the costs involved, let it suffice to say that the investment in such trunks, per customer, is not seriously high. Indeed it becomes smaller per customer as the density of the service increases.

If this trunk equipment is not our ultimate bottle-neck, where shall we find load troubles? Let us review the effect of this load on the call-carrying capacity of our hypothetical office. A crossbar office to serve 34,000 terminals might be expected to have 18 or 19 frames of district junctors (the equivalent of cords in a manual office). The combined capacity will be about 4,660,000 call-seconds per hour. The other elements of a crossbar office necessary to the completion of subscriber calls, senders, markers, link frames, will be coordinated with this capacity which is designed to handle the load to be expected during the busiest hour of the day for any day up to the time at which an addition is made to the office. In other words, it must carry existing loads and provide room for growth during the normal interval between office additions. For an office with business and residential subscribers of the type we have postulated, the busy hour may come in the morning, usually 10:00 to 11:00 AM or in the evening from 7:00 to 8:00 PM. Our television subscription load may be expected to coincide with the evening busy hour. How much will our postulated load add to the normal traffic which could be expected in a similar office without Phonevision facilities?

It amounts to 5.8% of busy-hour capacity represented by the junctor equipment. Such an additional load would require approximately 103 additional junctors with some increase in associated equipment such as senders, links, and the like. But this represents a considerable development of the television subscription service: remember we have assumed that 33-1/3% of the subscribers have Phonevision equipment and that 60% of these wish a program at the same hour. Naturally such a condition would not exist at the start of any such subscription service. One might assume that 5 to 6% of the subscribers might be so equipped. In this case, the added load is less than 1%, and within the limit of accuracy of our engineering of office quantities. As the subscription service grows, the calls resulting therefrom would be measured in with the normal traffic calls in calling-rate measurements, peg-counts, and the increase in capacity due to this service could be accommodated in normal growth. It should also be noted that the use of Phonevision may itself tend to reduce the office evening busy-hour by those subscribers having such equipment, so that some compensating load reduction may be expected.

If the calls are not uniformly distributed, the load is effectively worse. It is not possible at present to predict this loading in a quantitative way with the accuracy that is attainable in normal telephone traffic studies, since we have no samples with which to gauge the calling habits of the possible Phonevision customers. It may help in assessing the extremes if we consider that 6,800 calls represent less than 38% of the assumed number of equipped district junctors. If we assume 70% of the calls in the last 15 minutes (an extraordinary degree of compression) we find that our effective load is now the equivalent of 762,000 call-seconds uniformly distributed. This is 16.3% of our assumed capacity. From this we see that the office may be subject to loads that, while not negligible, do not require a major increase in originating equipment.

By taking our trunks to the television terminal from the office link frame multiple, and confining our calls to the originating equipment, we have eliminated a chance for severe overloads in the terminating equipment. If all subscribers called one published number, all the 6,800 calls would be directed to a relatively small number of block-relay number groups, and the calls would have to be handled in turn individually. This would cause a serious throttling, which might result in time-out of terminating senders held too long, effectively choking off all incoming calls to that office. By avoiding the terminating equipment completely, this direction toward a small number of relays is avoided. The trunk groups of the office link frames are designed to permit great volumes of calls to single groups, for example, to calls terminating within that same exchange unit.

In the past, telephone central offices have been subjected to severe bunching of calls in radio call-in programs which promised rewards, premiums, or which merely sought the votes of the listeners. The loads in these cases were very severe since they were synchronized and triggered by an announcer's request for votes, or the release of a final clue.

Such loads were handled with only slight temporary overloads by normal telephone dial offices. These loads were certainly much more concentrated and severe than need be expected in a television subscription service as described. If we arrange our trunks to the Phonevision terminal from the outgoing office trunk multiple, and keep calls entirely away from the terminating equipment, we can eliminate the worst "bottleneck" that plagued the radio call-in programs. Since no time limit need be set on anticipatory action by customers in calling to set up program selection, we can expect a large number of customers to signify their desires one-half hour to an hour beforehand to avoid the rush. This tendency will be augmented if it is possible to cancel without charge at any time prior to the starting of a program, and still further augmented if the policy is adopted of permitting cancellations without charge or for a very small charge in the first minutes of the program.

Since the installation of such a subscription service must begin with small numbers of customers, the initial load increment upon the telephone facilities will be trivial. If the number of trunks to the television terminal are accurately adjusted to the load, customers will become accustomed to setting up their program choices fifteen minutes to an hour in advance of the show (indeed, more foresight is usually required to see a movie or stage show). If the number of any one office reaches the degree of concentration assumed in our example above, we may view with considerable confidence the effects of this added load upon normal functioning of the telephone plant.

The switching methods and traffic load computations were made by the author while acting as consultant for the Zenith Radio Corporation.

EDITOR'S NOTE: *In part 1 of this article, which appeared in FM-TV for June, 1950, the illustration for Fig. 7 on page 30 was incorrect and had no relation to the subject matter. The correct diagram is presented below, with apologies to the author and to our readers who were confused by the unfortunate substitution.*

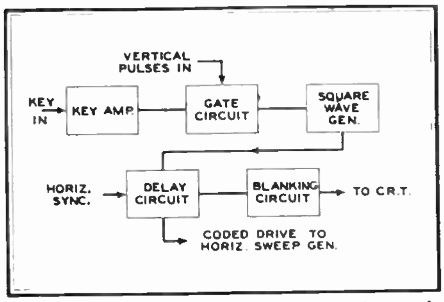

Fig. 7. Components of the decoder unit

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NEW ACOUSTIC THEORIES

STUDIES IN ENGLAND INDICATE THAT STUDIO SOUND-DECAY PATTERNS ARE MORE IMPORTANT THAN REVERBERATION TIME — *By* JAMES MOIR*

THERE are two weak links in the long chain between an original sound source and the listener and, oddly enough, both are at the very ends of the chain. In a reproducing system, the weak link is the loudspeaker. In a broadcasting station or recording studio, it is the acoustics of the room in which the program originates that cause the most trouble.

Theory vs. Results:

Initially, studio and concert-hall design was based upon the fundamental research of Sabine and Watson. As this work is well presented, and is extended in your Professor Knudsen's book, there is no need to re-examine the groundwork. Experience has shown, however, that the straightforward application of Sabine theory may or may not produce a good studio. It will be agreed also that the refinements of the Sabine theory due to Eyring, Millington, Sette, and others do not significantly improve the chances of designing a good studio.

This theme will not be pressed, but one example of British experience will be quoted because it was a rather carefully controlled comparison test. In 1936, as part of a studio building program, the BBC built two identical studios. These had the same mean dimensions but different surface shapes, one being a plain rectangular studio, the other having corrugated walls as in Fig. 1. Although the reverberation times were similar, the acoustic performance of the two studios differed radically.

Measurement of Sound Decay:

Similar experiences in cinema theatres led the writer and his associates to develop new equipment in order to study the acoustic decay process more closely. The motivating thought was that details of the decay curve are more important than the envelope of the decay, as measured by conventional reverberation-measuring techniques.

A diagram of the equipment is given in Fig. 2. Tone signals produced by a standard type of audio oscillator are switched to an amplifier and loudspeaker by a motor-driven cam switch, set to close the circuit for a period of 10 milliseconds every second. The resultant short tone-pulse is emitted by the loudspeaker in the studio under test. Simultaneously, the time base of a cathode ray tube is triggered, the spot moving from left to right across the tube in a period of about .5 second. The tone pulse travels directly from the loudspeaker to the microphone and is picked up, amplified, and applied to the cathode ray tube plates to produce an initial vertical deflection. Also, each time the pulse is reflected from a room surface back to the microphone a blip is produced, as in Figs. 3A and 3B. The time interval can be estimated by measuring the distance between the start of the trace and the leading edge of the blip. Thus, complete details of the decay curve of the reverberant sound are available.

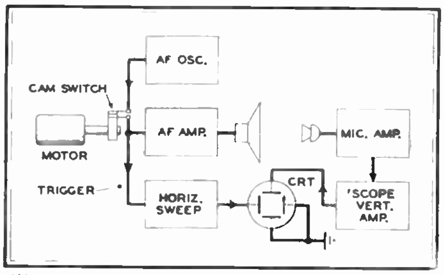

Fig. 2. Tone-pulse measuring equipment

Extensive experiences with large auditoria have confirmed that good listening conditions and, we believe, good microphone positioning, is obtained only when the CRT picture is similar to Fig. 3A, which shows a strong direct signal with relatively little subsequent reflection. A CRT picture such as shown in Fig 3B has proved to be characteristic of a poor listening position. This has been true whether the reverberation time has agreed with any optimum curve or not. In other words, reverberation time is of secondary importance.

Applications of Results:

An evaluation of results is in order. The first lesson appears to be the prime importance of obtaining the proper kind and amount of sound diffusion in a hall or studio. Notice the emphasis on the *right kind* of diffusion. We are inclined towards the view that while major diffusers such as poly-cylindrical panels are advantageous, they must be supplemented by the more detailed diffusion produced by minor coves, cornices, and similar irregularities.

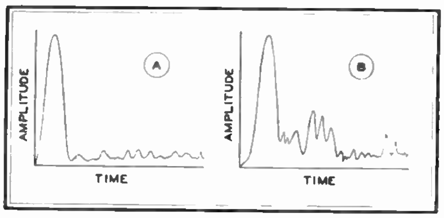

Fig. 3. CRT display of sound-decay

Major diffuser units used alone tend to produce acoustical characteristics that are not altogether aesthetically pleasing to our ears. At least, they have never found favour in Europe to the same extent that they have in your country. It is interesting to speculate on the fundamentals of this subject. Do we like this detailed diffusion because of its fundamental appeal, the appeal of a chord in just intonation, or do we like it because we have grown up heirs to a long line of concert halls having these characteristics and, in addition, are regularly exposed to domestic surroundings with the small-scale diffusion effects produced by pictures, furniture, and small ornaments?

A hall that is notably superior to the smooth-wall design is shown in Fig. 4. This is a photograph of St. Andrews Grand Hall, Glasgow, a concert hall that has a particularly good reputation in Great Britain for broadcasting. It has undergone no acoustical treatment, but has desirable diffusion characteristics resulting from the detailed break-up of surfaces by the pillars, ceiling coffering, and ornamentation. The rectangular shape, similar to that of the Boston Symphony Hall, may also be responsible in part for the good performance.

In Fig. 5 is shown the Concert Hall Broadcasting House, intended for use with an audience, and which has very good characteristics for a medium-size orchestra. The rectangular shape and irregular ceiling contribute, no doubt, to the fine results.

Optimum Reverberation Time:

A second point of interest is the gradual

*87 Catesby Road, Rugby, England.

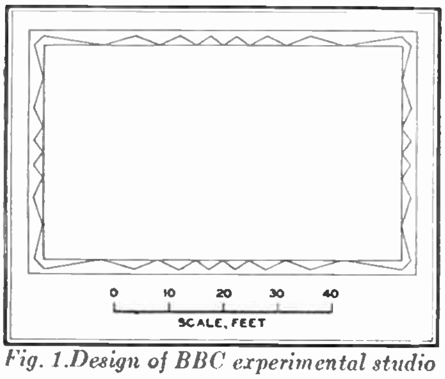

Fig. 1. Design of BBC experimental studio

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change of thought about the effect of frequency on optimum reverberation time. In past years the McNair-Knudsen characteristic, Fig. 6, was in favour over here as it was in America, and in fact it was supported by considerable experimental evidence. Recently, however, there has been a distinct trend away from designing for a rise in the bass, and towards a more level characteristic at the lower end of the frequency scale. In rooms intended mainly for speech, the result appears to be a distinct improvement in cleanness, but the advantages for a music studio are not so well defined.

The McNair-Knudsen characteristic is generally produced by the ordinary types of building construction. Special steps must be taken to obtain the low-frequency absorbtion not generally provided by the usual type of acoustic treatment. In England this effect is generally achieved by the installation of resonant absorbers of the linoleum-covered box type. A typical example of this treatment can be seen in Fig. 7, which shows studio No. 1 in the BBC West Regional station at Bristol.

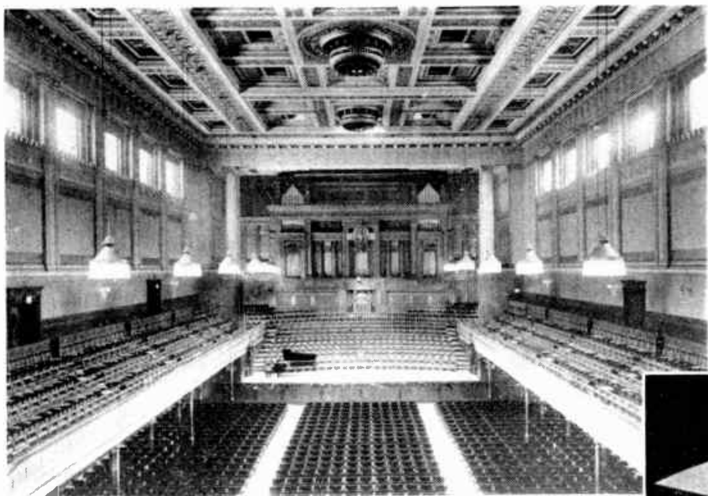

Fig. 4, left: St. Andrews Grand Hall, Glasgow. Intricate architecture gives excellent diffusion with a smooth decay

It is always difficult to give credit for developments of this kind, but it is believed that the initial work was done by Mr. C. W. Goyder while chief engineer of All India Radio. Mr. Goyder is now with the BBC.

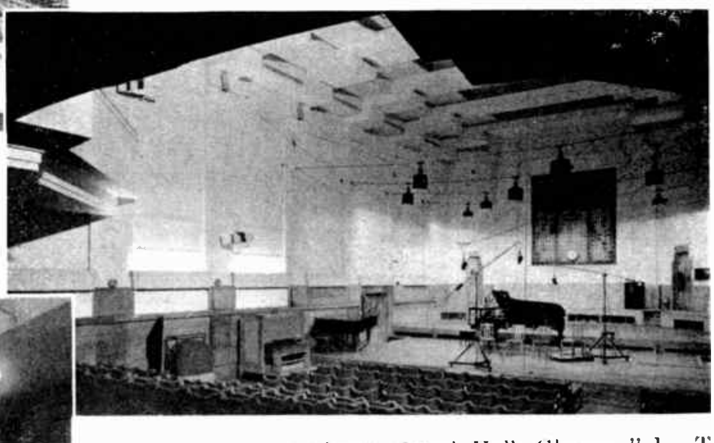

Fig. 5, left: A concert studio for broadcasting purposes

There is evidence to show that bass absorption was probably the main purpose of the acoustic vases found in the remains of old Greek ampitheatres. Bass absorbers of the vase type, fundamentally Helmholz resonators, have been extensively studied in Sweden and Denmark and have been incorporated in the design of several European studios. There is one notable instance where ordinary glass milk bottles were found to be of the correct dimensions, and were cast into the concrete ceiling of the studio.

Structural Resonance:

A third significant development is the increased attention being given to the problem of structural resonance. For many years, the importance of the decay time of energy stored in the air as sound has been appreciated, but more recently it has become evident that the energy absorbed from the initial sound by the walls, ceiling, and floor of the studio and returned at a later time in the decay period can be of prime importance. There is no doubt that this effect can modify appreciably the overall acoustic performance of a studio. Thus, great care should be taken in the actual construction of building, before acoustic treatment is even considered. Structural resonance cannot be avoided. The most satisfactory current approach is to make certain that the structural elements do not all resonate in the same frequency region.

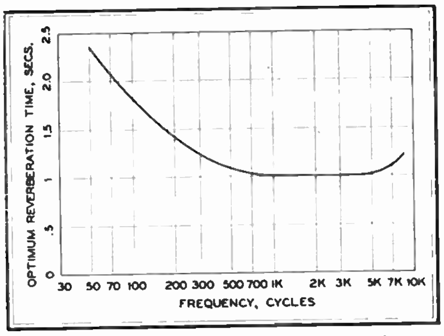

Fig. 6. Optimum reverberation time

Conclusion:

The problem of obtaining pleasing acoustic performance is one of such immense complexity that a brief survey of this type cannot attempt to do more than outline the various approaches. For the essential details, the following references are suggested:

1947 Symposium of the Acoustic Group, obtainable from the Physical Society, 1 Lowther Gardens, Prince Consort Road, London, England.

Transaction of the Danish Academy of Technical Sciences, No. 10-1949, Kobenhavn, Denmark.

"A comparison of the Acoustics of the Philharmonic Hall, Liverpool, and St. Andrews Grand Hall, Glasgow," by T. Somerville, BSc., A.M.I.E.E., *BBC Quarterly*, April, 1949.

"The Acoustical Planning of Broadcast Studios," by John McLaren, *BBC Quarterly*, January, 1947.

"Acoustics of Small Rooms," by J. Moir, *Wireless World*, London, England.

"Acoustics of Cinema Auditorium," by C. A. Mason and J. Moir, *Jour. Inst. Elect. Engrs.*

Fig. 7, left: A studio provided with resonant bass absorbers. These are long boxes fastened to the ceiling and the walls

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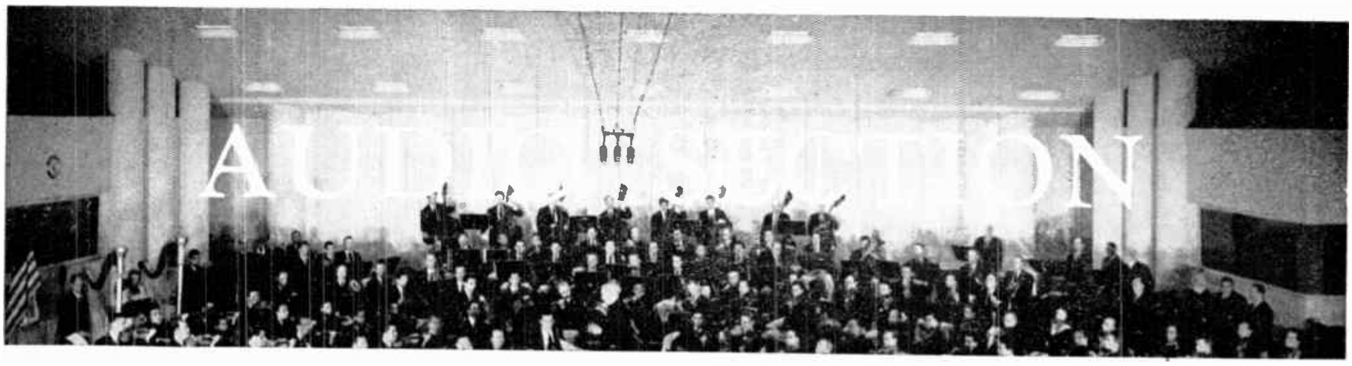


THE FAS AUDIO SYSTEM

PART 2: THE FAS SPEAKER SYSTEM — CONSTRUCTION OF AIR-COUPLER — WINDING CHOKES FOR THE CROSSOVER NETWORK — *By* MILTON B. SLEEPER

THE discussion of the FAS speaker system to be presented here was in course of preparation at the time of the Audio Engineering Society's annual convention in New York. This gave us an excellent opportunity to check our own observations against the reactions of several thousand audio engineers and audiophiles who visited our demonstration setup, and listened critically to its performance. The equipment we used was the amplifier described in Part 1, and the speaker and turntable arrangement illustrated in these pages.

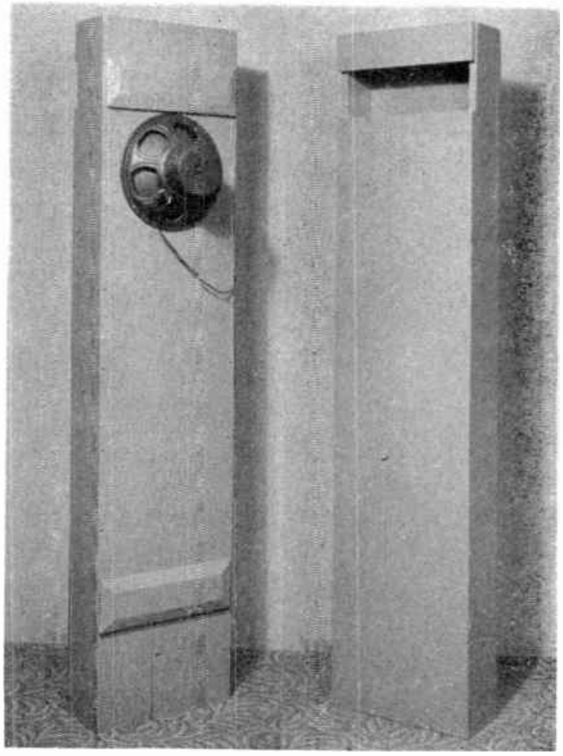
For three days, our demonstration room was crowded to capacity almost continuously with professional and lay people who came in to listen skeptically, then attentively, and finally with amazement and admiration. Over and over, we heard them say, "It's beyond belief!" and, "It's incredible!" Many people brought in their own records for us to play. Others listened, went out, and came back with records they bought just to try on the FAS. And every one of them said that they heard music they didn't know was on their records.

Some of our friends came to heckle us good-naturedly by asking: "What's good about the FAS?" Our stock answer was: "The FAS is as good as what you hear. You don't listen to circuits, or tube types, or resistance values. So the system is only as good as the music it produces." Then they'd listen. Perhaps they'd ask for an organ record, something with percussion instruments, or a vocal selection. We'd play what they asked for. Each one, before he left, stopped to say, "You've really got something new in this FAS," or, "I've never heard anything like it. It's simply wonderful."

Several asked: "Is this the Flewelling equipment?" We explained that the FAS represents the work that he started, and that our Fowler-Allison-Sleeper group at *FM-TV* MAGAZINE carried forward from the point where he stopped. Thus it should be understood that Mr. Flewelling took no part whatever in the design and construction of the FAS system which we demonstrated, and which is described in this series. The FAS amplifier is decidedly different from his design, and the speaker system also, since we have reduced the number of loud speakers required. In Mr. Flewelling's system, the use of inexpensive speakers is permissible, but we feel that better results are obtained in the new FAS system by using as good a grade of speaker as possible.

There were many questions about the substitution of other components, speakers, and amplifiers. We explained that

Fig. 1, right: Construction of the FAS Air-coupler. One extra brace across back and two across front of cabinet are usually required. Model shown is of 1-in. pine, but ¾-in. plywood can be used



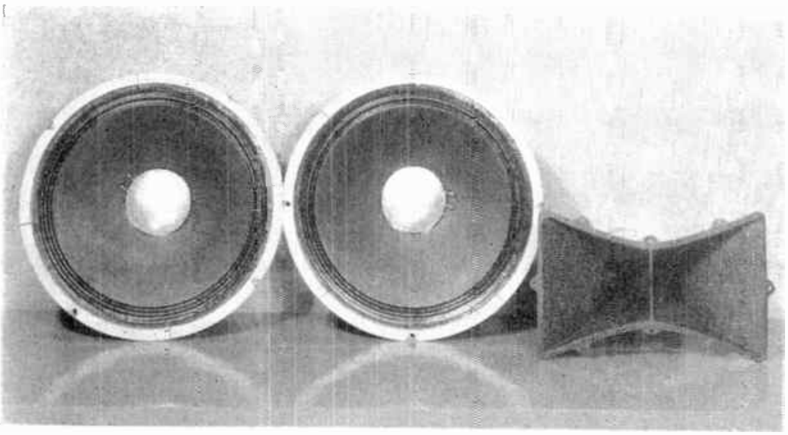


Fig. 4. Two 12-in. Altec speakers and Racon tweeter, used in FAS system

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others of equivalent characteristics could be used, but the point of equivalence was stressed because the whole system could be upset by using a single component of inferior performance. That is the only limiting factor in substituting other parts for those in the equipment demonstrated at the convention and illustrated here.

Others wanted to know about the amplifier, and how such extraordinary reproduction was obtained from an apparently straightforward design. That will be discussed subsequently here, and in detail. At this point, it is sufficient to explain that any high-quality amplifier can be used with the FAS speaker system, but if treble- and bass-boost controls are provided, they should be set at zero positions. As for compensation on the volume control, you will probably prefer to disable it. Such devices are not needed in the FAS system.

Some questions we just couldn't answer. There are many points that our Fowler-Allison-Sleeper group hasn't had time to investigate. There are others, particularly concerning acoustic theory, that we shall leave to the engineers who are in a better position to dig out the answers. In fact, we hope to include articles in this series from readers who find out things that we don't know about the FAS system.

Plan of the FAS Speaker System:

We have said that the FAS system is mysterious and intriguing. Moreover, it opens up entirely new techniques for custom radio-phonograph installations. There was general agreement on that point at the AES convention. In fact, the majority of those who visited our demonstration room did not have an opportunity to learn the secret of the bass reproduction.

Perhaps the best way to explain the extraordinary bass reproduction is to describe the setup used on that occasion. The room was square, with the entrance door on the south side. Against the north wall was a tweeter speaker at the right, and at the left a 12-in. speaker in a small, tightly enclosed cabinet of 3 cubic feet. On the south wall, adjacent to the door, there was a long table.

Most of the people as they came in stood in front of the table or leaned against it, facing toward the two speakers against the north wall. When they heard the pedal notes of the organ roll out, or the deep tones of bass passages in orchestral music, they tried to figure out how it was possible to get such quality from a conventional 12-in. speaker in such a cabinet.

There wasn't time or opportunity to explain it to everyone, but the fact was that the bass was coming from a third speaker on the floor behind them, tucked back under the table. The sound output from that speaker had such a non-directional characteristic, however, that no one was aware of the source! The same effect is obtained when an FAS system is installed in a private home.

Basically, the FAS uses three speakers, with crossover networks at 350 and 1,200 cycles. It has been our experience that the optimum listening pleasure is obtained by locating the three speakers in such a way that they are 5 to 10 ft. apart. In practice, this means putting the intermediate- and treble-range speakers along one end of the room. The bass speaker, or Air-coupler, as we call it, can be located wherever it can be concealed to best advantage, as long as it is well separated from the other two.

Since the Air-coupler can be planned for concealment in various ways, as will be explained, the speaker system has the advantage of being most inconspicuous, a feature which earns the approval of women who object to the use of large enclosures in their living rooms.

This brings up the question of mounting the intermediate speaker and the tweeter in the same cabinet, or combining the two in a coaxial type of speaker. As to the former arrangement, we have found the musical quality somewhat improved by separation. This is entirely a matter of personal opinion. We haven't tried a coaxial speaker yet. It's another one of the questions we can't answer from having tried it out, and we'd like to hear from those who use a coaxial speaker in combination with the Air-coupler.

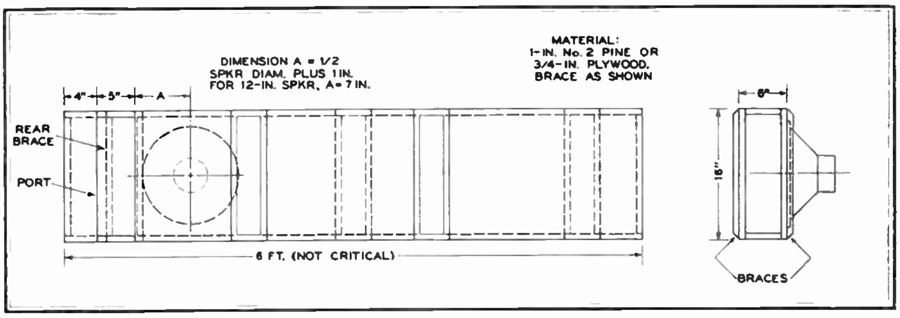

Fig. 2. Dimensions of the Air-coupler, which are apparently not at all critical

Air-coupler Construction:

Fig. 1 shows two views of the Air-coupler and the mounting of the speaker, with dimensions in Fig. 2. We're inclined to tread warily in making any statements that involve the theory of its performance. For example, there may be certain optimum dimensions for it, but it appears that they are not critical. Frequency test records indicate that there is no noticeable resonant frequency down to 30 cycles, at least. This is in spite of the fact that the Altec 600B speaker used has some resonance effect at about 75 cycles.

This observation was confirmed by people who brought their own records to play. Their only comment was that the Air-coupler produces a musical bass, with a fidelity on the lowest organ pedal notes such as they had never heard before from any type of loudspeaker.

Also, it should be noted that the vibration of the wood itself is not a factor. As Fig. 1 shows, there are two heavy pieces screwed across the back to stiffen it. If the Air-coupler is set down lengthwise on the floor, it must be fastened down with heavy angle-irons. If it is not fastened, it must be weighted on the top with a load of 50 to 75 lbs. The performance falls off if the Air-coupler stands freely on end.

No. 2 pine, ⅞-in. thick, or ¾-in. plywood should be used for constructing the Air-coupler. In the former case, the width requires the use of two boards

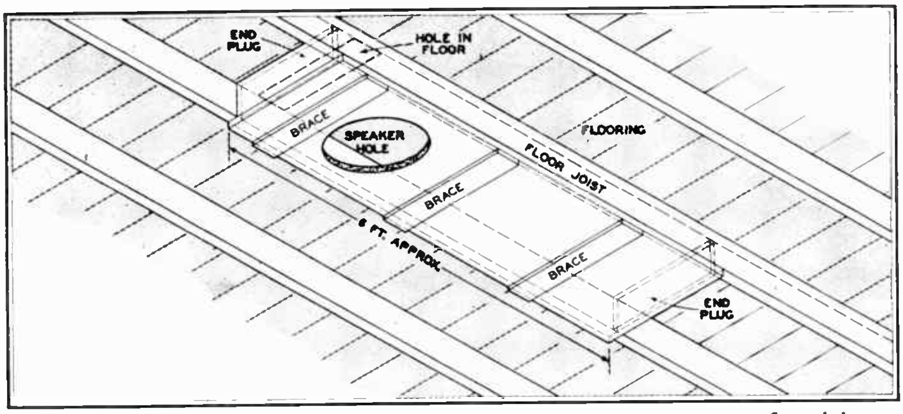

Fig. 3. How to construct an Air-coupler by enclosing space between 2 floor joists

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joined together. The joints must be glued, preferably with a spline for extra reinforcement. All other joints should be glued and screwed firmly.

Concealed Air-Coupler:

In a private home, the Air-coupler can be moved out of the living room completely, without any loss of tone quality. The method is very simple. It is only necessary to enclose a 6-ft. space between two floor joists, as indicated in Fig. 3. These beams are usually spaced 18 ins. between centers. An opening must be cut in the floor, corresponding in size and relative location to that shown in Fig. 2. The opening can be covered with a standard register grille. Also, a piece of light cloth should be secured under the grille to keep dust from settling on the speaker cone since, in this arrangement, the cone will be facing upward.

Where this can be done, it is recommended highly because low-frequency vibrations set up by the speaker are transmitted to the floor. This gives an Fig. 4 shows the lineup of the three speakers before they were mounted.

Quality of Reproduction:

The matter of volume level is extremely important. Critical listening is impossible at unnaturally high volume. Nor can an hour or more of music be enjoyed under such circumstances Irving Greene, of Sun Radio, made an interesting observation in this connection. He said that musicians are inclined to be tone-deaf because most of their listening is done from *within* the orchestra. Thus, they are unable to appreciate the effect of a full orchestra, as we can.

At high volume, it is virtually impossible to judge the relative quality of the lower, middle, and upper ranges. However, with conventional systems, the bass seems to drop out as soon as the volume is cut down to an agreeable level.

The FAS system, in contrast, maintains full bass response to about 20 cycles at any level down to audibility, and the bass is always in balance with the middle range and treble. This effect is difficult to describe, but it is quickly recognized because it contributes a new value of listening pleasure. It is doubly important in apartments and two-family houses where neighbors must be considered, or at times when some member of the family might be disturbed by loud music. To be specific, there is a passage in the Saint-Saens Symphony No. 3 in C minor[1] where the organ tones drop softly down to a point where you would expect to hear nothing more from a conventional system. Then, from the FAS Air-coupler, comes the deep roll of pedal notes with the vibration in the air that you can feel, as well as hear.

On orchestral music, the use of three speakers spaced substantially apart gives a decided stereophonic effect. There is the same feeling of placement as in a concert hall. That is particularly noticeable in solo passages, or when the melody is carried by one section of an orchestra, and in orchestral music with an organ.

Turntable and Pickups:

The front end of the FAS system, as demonstrated at the AES convention, is shown in Fig. 5. At the left is the amplifier described in Part I of this series. Mounted on the record-player cabinet are a Presto 3-speed turntable, a Shure pickup arm and crystal cartridge, and a Gray viscous-damped arm fitted with a Pickering reluctance cartridge. The crystal was employed for 78 RPM records, and the reluctance cartridge for 45 and 33's. This arrangement was used in order to demonstrate both types of pickups and all three types of records.

A Pickering 130H preamplifier was mounted directly under the Gray arm, as can be seen in Fig. 6. Two power switches were required, in order to prevent the removal of power from the preamplifier when the turntable was stopped for record changing.

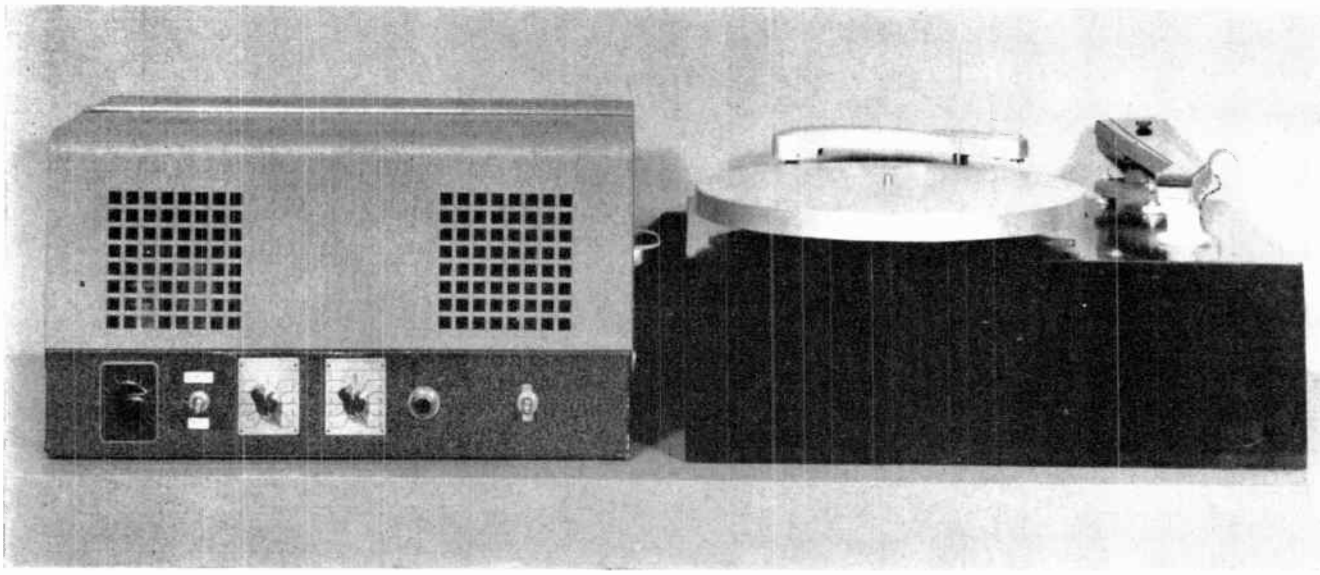

Fig. 5. The FAS amplifier and a 3-speed turntable, with crystal pickup for 78's and reluctance pickup for 45's and LP records

amazing realism to organ and orchestra music, and maintains the bass response in proper relation to the middle and upper register even when the volume is turned down to bare audibility.

Middle-Range Speaker & Tweeter:

The middle-range speaker is another Altec 600B, or an equivalent type, mounted in a closed cabinet 24 ins. high, 18 ins. wide, and 12 ins. deep, and lined with 1-in. Celotex except on the front. These dimensions are purely arbitrary. Middle-range baffling is not critical, since the crossover point is 350 cycles. For the tweeter, we used one of the new Racon designs, model CHU-2. This should be enclosed in a small case, just big enough to contain the metal horn.

Fine performance was obtained from both pickups. The Shure crystal cartridge is a newly-developed model, having high output with excellent compliance. Frequency response without equalization is good out to about 7 kc. Our equalization consists of a parallel combination of 100,000 ohms and 100 mmf.

Low-frequency response of the Pickering reluctance cartridge in conjunction with the preamplifier is excellent also. Organ pedal notes are transmitted faithfully from record to amplifier.

It should be emphasized that a good

[1]Columbia 78 album No. MM-747, or LP record ML4120.

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turntable is required with the FAS system, because any turntable rumble or wow is immediately apparent. Care should be taken to assure that the turntable is perfectly level. This tends to minimize unbalances which cause wow.

Performance of the system with an FM or TV tuner is as good or better than with records. An interesting discovery that will probably be made is that a good deal of hum is present in the transmissions of some broadcast stations, and that the hum level varies with the audio channel in use at the station.

Crossover Network:

We discovered in our early work on the FAS system that a crossover network was not only desirable, but an absolute necessity. High frequencies are not reproduced well by the Air-coupler. Distortion and undesirable directional effects become evident when much over 500 cycles is fed to the coupler. We settled on a low crossover point of 350 cycles as optimum. This is well out of the distortion region and, at the same time, is high enough so that extensive baffling of the middle-range speaker is not necessary. All that is required is a small box with some means to eliminate back radiation.

However, a 350-cycle crossover is too low for good reproduction with a tweeter alone on the high end. A triple-speaker system, with a three-way crossover network, seems to be inescapable. The high crossover point was chosen as 1,200 cycles, as recommended for the Racon tweeter we used.

A circuit diagram of the crossover network is given in Fig. 7. The constant-resistance type of network is employed for simplicity and because results are at least as good as with the filter type. Component values are given below:

L1, L2 — 2.6 millihenries
L3, L4 — 0.8 millihenries
C1, C2 — 80 mfd.
C3, C4 — 24 mfd.
R1, R2 — 15 ohms.
R3 — 20 ohms.

The potentiometers should be wire-wound, of at least 4 watts rating. R1 controls the level of the air-coupler speaker. Both the middle-range speaker and the tweeter are controlled in combination by R2. The tweeter is matched to the middle-range speaker by R3.

For reasons of economy we used electrolytic capacitors rated at 150 volts, and have experienced no difficulty with them so far. Those who can afford them will probably prefer paper capacitors, which should last indefinitely.

Winding Chokes:

Two alternative series of chokes are described, one wound with No. 26 and one with No. 16 enameled copper wire. No. 16 wire produces chokes of rather large size, too large to be incorporated into an amplifier chassis. However, there are practically no resistance losses incurred with the heavy wire. Some resistance loss is experienced with No. 26 wire, but the chokes are small enough so that they can be contained in the usual amplifier chassis, together with the speaker level controls.

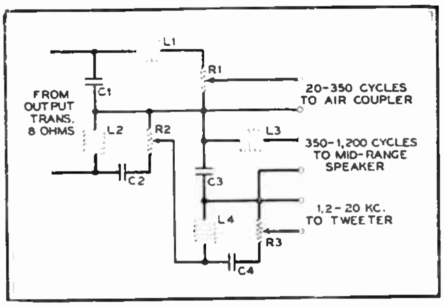

Fig. 7. The FAS 3-way crossover network

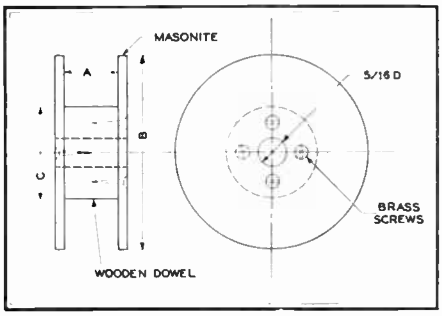

Fig. 8. Coil form for winding the chokes

The basic coil form is shown in Fig. 8. A wooden dowel is cut to the required length, and two discs of masonite or other stiff material are attached with brass screws to hold the windings in place. Coil form dimensions are given below for both wire sizes:

	DIMENSIONS, INCHES		
	A	B	C
No. 26	½	1¾	1
No. 16	1	3	1¼

Dimensions A and C are both critical. Dowels of the correct diameter can be purchased at most any hardware store. They should be cut precisely to the length given in the table above, because the length of the dowel determines the number of wire turns per layer. There should be 29 turns per layer of No. 26 wire, and 19 turns per layer of No. 16 wire. Total number of turns required for each choke follow:

	L1, L2	L3, L4
No. 26 wire	310	170
No. 16 wire	268	163

The center hole in the coil form, Fig. 8, is for the insertion of a ¼-in. bolt, which is then secured by a nut. The end of the bolt is then inserted in a hand-drill chuck, and the coil can be wound quickly and easily. The bolt must be removed after the coil is wound.

Care must be taken that the enamel insulation is not scratched in the process of winding, with the resultant danger of short-circuiting a layer of the coil.

Ideally, the chokes should be mounted on a wooden base or in a wooden box, and adjacent coils should be at right angles to each other.

EDITOR'S NOTE: *The next article in this series will describe how the FAS speaker system can be adapted for use with standard types of high-fidelity amplifiers, or the air-coupler added to an existing speaker system. Information on crossover networks for any speaker impedance will be given.*

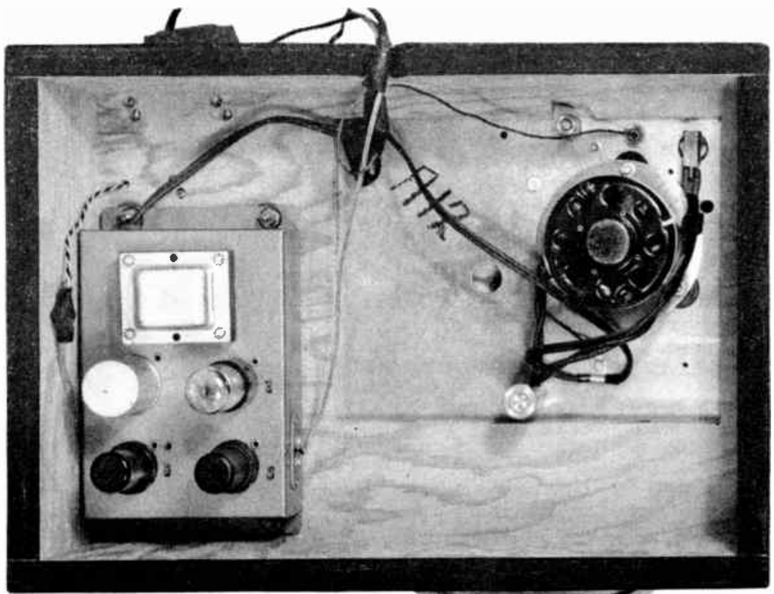
Fig. 6. A preamplifier for the reluctance cartridge is mounted under turntable base

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ACKNOWLEDGED STANDARD OF FM PERFORMANCE

This Combination Is Tops For Fine Radio-Phonograph Installations

IF you are planning a custom installation with the FAS speaker system, consider the advantages of using an REL 646-B for FM reception, and as a phonograph amplifier.

When you investigate the design and circuits of the 646-B, you will see why we make this suggestion. It provides, in a single unit:

1. The finest FM reception, both as to long-distance and the elimination of static and interference. Tuning is greatly simplified by the tuning meter and signal-strength meter.

2. The amplifier has less than 1.5% distortion at 10 watts output. This is much more power than is required for the FAS speaker system. Response is flat within 1 db from 30 to 15,000 cycles, assuring full-range musical response.

3. A panel-mounted radio-phonograph switch and rear terminals are provided to simplify the operating control and the wiring.

4. The amplifier delivers full-rated output with 1 volt RMS fed across the 500,000-ohm input.

5. Output impedance of the amplifier is 8 ohms, as required for the standard FAS speaker network.

6. The amplifier in the 646-B provides flat response, with a single audio gain control, in accordance with recommended design for driving the FAS speaker system.

7. No special mounting is required, as in the case of a bare chassis, because the 646-B is contained in a handsome steel cabinet, finished in accordance with broadcast-station requirements in two-tone green enamel and chrome.

Best of all, the custom installation engineer and the customer, too, have the assurance of trouble-free performance demonstrated by 646-B receiver-amplifiers at commercial broadcast stations and FM relay networks, where dependability is the prime requirement.

Audio engineers and custom designers are invited to write for technical data, and information about prices and deliveries on the REL 646-B FM receiver-amplifier.

FM THE ARMSTRONG SYSTEM LICENSED UNDER ARMSTRONG PATENTS

$345 WITH 19-IN. RACK PANEL, OR IN METAL CABINET, AS ILLUSTRATED

RADIO ENGINEERING LABORATORIES, Inc. 36-40 37th STREET LONG ISLAND CITY 1, N. Y.

World Radio History

Hard-to-Get Items for the

FAS AUDIO SYSTEM

Save time and trouble, and make sure of getting the correct components for the FAS speaker system. Available for immediate delivery from General Apparatus Company.

FAS AIR-COUPLER: The bass speaker enclosure in knocked-down form, ready to assemble. Speaker opening is not cut, so that you can use any type of speaker you prefer. . . . . Item No. 1: $34.50

AIR-COUPLER & SPEAKER: As above. with hole cut for an Altec 600-B 12-in. speaker, which is also supplied.
Item No. 2: $74.50

NO. 1 CROSSOVER NETWORK: For adding the Air-Coupler to an existing audio system. Consists of 2 inductors, 2 capacitors, and a variable resistor for speaker matching. Specify 8 or 16 ohms impedance.
Item No. 3: $12.50

NOS. 1 & 2 CROSSOVER NETWORKS: Components for the complete speaker system, designed for use with the Air-Coupler, a medium-range speaker, and a tweeter. Consists of 4 inductors, 4 capacitors, and 2 variable resistors for speaker matching. Specify 8 or 16 ohms impedance.
Item No. 4: $22.50

12-IN. ALTEC 600-B SPEAKER: For use in the Air-Coupler and as the medium-range speaker. Impedance is 8 ohms.
Item No. 5: $40.77

RACON CHU-2 TWEETER: The improved driving unit with a divided horn. Impedance is 15 ohms. . . . . Item No. 6: $22.50

COMPLETE FAS SPEAKER SYSTEM: Comprising items 2, 4, 5, and 6 above.
$149.50

When you order from G.A., you are protected by an unconditional guarantee that every part will arrive in new and perfect condition, shipped in the manufacturer's original carton.

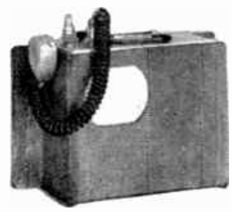
General Apparatus Co.

South Egremont Massachusetts

CEECO

Low Power

Radiotelephones for Industrial and Railroad Communication



MOBILE units for all moving equipment operated within the plant area.

PORTABLE units for all services requiring communication with men on foot.

AC units for use at fixed locations, and for the control point.

25 to 50 & 152 to 174 mc.

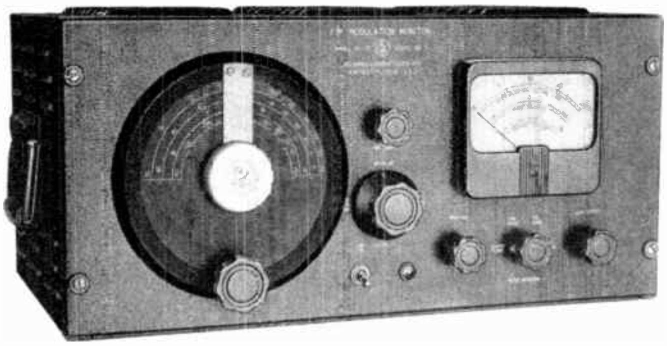
LOW POWER 2-WAY RADIO LIMITS RADIATION TO THE APPROXIMATE PLANT AREA. GIVES GOOD COVERAGE WHERE WANTED, WITH MINIMUM INTERFERENCE TO OTHERS OPERATING ON THE SAME FREQUENCY

Communication Equipment & Engineering Co.

TELEPHONE EQUIPMENT MANUFACTURERS SINCE 1930

5646 W. Race Ave., Chicago 44

For Mobile Radio System Maintenance



Model MD-25 Universal FM Modulation Monitor covers all frequencies from 30-50, 72-76, 152-162 mc.

Universal FM Modulation Monitor

With this moderately-priced, precision monitor, you can keep your fixed and mobile transmitters within the 15-kc. limit required by FCC rules now in effect.

Operation is very simple: The multi-range band selector is set at the proper band, and the unmodulated transmitter carrier is tuned in precisely. Then the carrier is modulated by voice or an audio oscillator, and the frequency swing read directly from the 4-in. panel meter calibrated to 20 kc. A flasher indicates modulation peaks in excess of 15 kc. The instrument can be set up at headquarters, and the cars checked without bringing them into the shop. NOTE: No crystals are used in the BROWNING Modulation Monitor.

The new BROWNING Universal FM Modulation Monitor is an outstanding addition to the complete line of BROWNING Frequency Meters which have been recognized as standard equipment for all communications services for over ten years.

Browning Frequency Meters for Mobile Services

MODEL S-4

Calibrated at any 1 to 5 points within the band of 1.5 to 70 mc. Hand-calibrated crystal control accurate to .0025 per cent as required by the FCC. So easy to use that any fixed or mobile transmitter can be checked in 60 seconds. Rugged construction, as illustrated, will withstand years of use. Built-in, regulated power supply for 110-115 volts AC or DC.

MODEL S-7

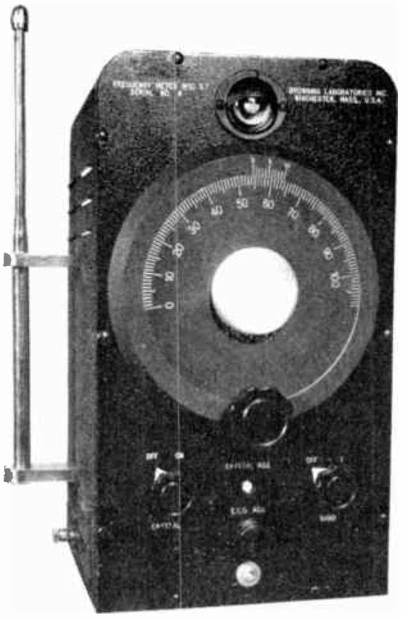
Calibrated at 1 or 2 points within the bands of 72 to 76 and/or 152 to 162 mc. For systems operating on either or both of the two bands indicated. Hand-calibrated crystal control accurate to .0025 per cent as required by the FCC. Similar in design and ease of operation to the model S-4 illustrated here. Built-in, regulated power supply operates on 110-115 volts AC or DC.

MODEL S-5

Calibrated at any 1 to 3 points within the band of 30 to 500 mc. This semi-portable meter, not illustrated, is maintained at an accuracy of .0025 per cent by the use of a temperature-controlled crystal and a temperature-compensated electron-coupled oscillator. Furnished in a steel case or for rack mounting. Front panel 8¾ by 19 ins. For use on 105-115 volts AC.

IMPORTANT INFORMATION

The accuracy of any BROWNING frequency meter can be checked in the field with WWV standard frequency signals, because the crystal frequencies employed are submultiples of WWV. *This essential feature is not found in other communications-type meters.* The BROWNING RH-10 WWV calibrator is designed specifically for this purpose.



BROWNING
LABORATORIES, INC.
WINCHESTER, MASS.
ENGINEERED FOR ENGINEERS

IN CANADA, ADDRESS:

Measurement Engineering, Ltd., Arnprior, Ont.

BROWNING LABORATORIES, Inc.
750 Main St., Winchester, Mass.
Please send me technical details and prices on the following Browning precision products:

- ☐ Model MD-25 Universal Modulation Monitor
- ☐ Frequency Meters, calibrated at the following frequencies

..........mc..........mc..........mc..........mc

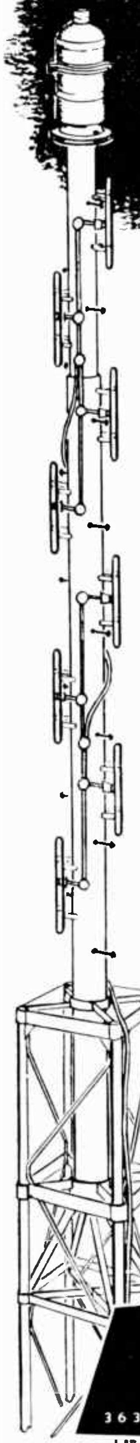
Name ....

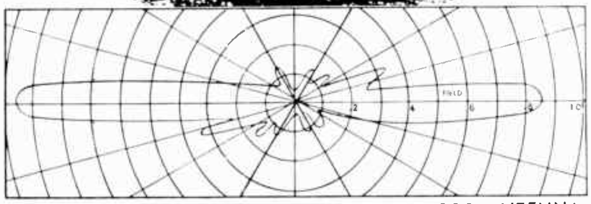
Address ....

Company Connection ....

World Radio History

NEW! THE HIGHEST GAIN COMMUNICATIONS ANTENNA EVER BUILT!





VERTICAL RADIATION PATTERN OF TYPE 3000 ANTENNA

Actually delivers 6 db . . . . . increases your power 4 times!

Now, for the first time, you can operate in areas previously far out of your reach. This vast extra service area is yours at *no additional operating cost* because the 6 db actually delivered by this new ANDREW antenna is equivalent to increasing your power 4 TIMES! Think of the economy! This tremendous extra power also fills in any dead spots.

It's another pace-setting ANDREW "first".

Uniformity of performance is assured regardless of supporting structure height through a NEW EXCLUSIVE ANDREW METHOD of electrically isolating the radiating elements from the support structure.

Lightning protection and quieter reception during electrical storms are achieved by a DC path which conducts static charges from the elements to ground.

SPECIFICATIONS
148-174 MC

TYPE NO.	3000	3001	3002
Gain	6 db	6 db	3 db
Height above top of tower	27½ ft.	27½ ft.	13½ ft.
Length of support mast extending into tower	5 ft.	5 ft.	5 ft.
Weight	625 lbs.	375 lbs.	175 lbs.
Moment at tower top*	9300 ft. lb.	6150 ft. lb.	1600 ft. lb.

*Based on 100 mph wind loading and ½" radial ice. Moments include loading added by 300 mm beacon for Type 3000 and double obstruction light for Type 3001.

Type 3000 is designed to support a 300 mm code beacon, and includes a suitable mounting plate. Type 3001 is designed to support a double obstruction light.

All models are designed for connection to ANDREW Type 737 transmission line, and are provided with climbing steps.

All orders filled chronologically. Deliveries begin September 1. Write, wire or phone (ask for Mr. Bickel) today.

Andrew CORPORATION
363 EAST 75th STREET · CHICAGO 19

WORLD'S LARGEST ANTENNA EQUIPMENT SPECIALISTS

TRANSMISSION LINES FOR AM-FM-TV · ANTENNAS · DIRECTIONAL ANTENNA EQUIPMENT
ANTENNA TUNING UNITS · TOWER LIGHTING EQUIPMENT · CONSULTING ENGINEERING SERVICES

MODULATION MONITOR

(Continued from page 15)

criminator output, and provides a more sensitive indication of exact tuning than when in the limiter grid circuit.

When S1 is in the PEAK SWING position, the meter circuit is that of an AC VTVM connected to the discriminator output. Since the AC output of the discriminator is proportional only to carrier deviation, the meter can be calibrated directly in kilocycles deviation.

The meter amplifier is a straight audio stage, provided with a gain control. R3 determines the sensitivity of the meter and is, therefore, a calibration adjustment. It is fixed so that a deviation of 20 kc. provides full-scale deflection. This control and R4, the zero-set control on the bleeder network, are located on the rear panel.

Following the meter amplifier is a diode-connected triode stage used as a rectifier. A .05-mfd. capacitor filters the rectified AC to its peak value. The rectifier circuit also acts as a pulse-stretching network, permitting peak readings of reasonably short-duration pulses.

The peak-flasher indicates pulses too short to be read on the meter. The discriminator output is coupled to the non-conducting half of a one-shot multivibrator. When an audio peak of sufficient amplitude to overcome the bias occurs, the second triode section is cut off. This raises the voltage across a neon glow tube and causes conduction. When the initiating pulse is removed, the circuit returns to its original condition, the plate voltage of the second triode section drops sharply, and the neon lamp is extinguished.

The bias on the first triode section is determined by its cathode resistance. Thus, the setting of R5 determines the pulse-amplitude necessary to trigger the peak flasher circuit. This control, on the rear panel, is usually adjusted so that peaks representing 15 kc. deviation are just sufficient to cause flashing.

Power Supply:

A full-wave rectifier circuit, with a resistor input and pi-section filter following, provides B voltage with very low ripple content. In addition, voltage regulation is employed for the RF, oscillator, and mixer stages, the meter amplifier, and the meter cathode follower.

Miscellaneous Notes:

The MD-25 modulation monitor is enclosed in a steel case provided with ventilation louvres. Front panel is of ⅛-in. aluminum. The panel and chassis assembly can be removed from the cabinet by taking out four 10-32 screws, in case rack mounting is preferred.

World Radio History

"Instant Communication cuts our costs 50%

2-Way Radio

Cost control in communications means more profit per cab to the Bert & Steve Cab Company, largest fleet in Fort Worth, Texas. The five owner-partners of the business tell you why:

"Since installing G-E 2-way radio in our 74 cabs, we've cut our monthly communications bill by $300. Average maintenance cost per mobile unit over the entire system is now only $4.30 a month, and this includes the salary of our own radio technician.

boosts short haul traffic in residential areas!"

"The G-E system *has completely eliminated wasteful cruising.* Radio speeds customer service, permits us to operate profitably in suburban areas we couldn't touch before. With two fixed transmitter stations and 74 mobile units, we're handling 3,000 messages a day, or upwards of 100,000 a month.

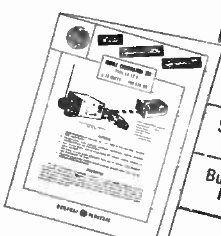
Naturally, we're adding more cabs to the fleet . . . and every one will carry General Electric 2-way radio."

YOU BE THE JUDGE — CHECK THESE ADVANTAGES

Equipment Features	General Electric	Manufacturer A	Manufacturer B
Triple-Tuned Transformers (high selectivity with fewer tubes)	Yes	No	No
At Least 2 Watts Peak Audio Output	Yes	No	No
Instantaneous Modulation Limiting	Yes	Yes	No
Adjustable IF Gain Control (prolongs tube life)	Yes	No	No
Number of Tubes	22	26	27
Cost per Set of Tubes	$32.77	$43.58	$37.46
Less than 9 amps standby battery drain @ 6.3v	Yes	No	No
Spurious Radiation at any frequency	70 db	60 db in the band only	60 db
Built-In Low Pass Harmonic Filter	Yes	No	No

This bulletin tells you...

why G-E is your best buy in radio communication equipment. Write for your copy of Bulletin X55-024—there's no charge. *General Electric Company, Section 43110, Electronics Park, Syracuse, New York.*



You can put your confidence in—

GENERAL ELECTRIC

World Radio History

SUPERIOR REPRODUCTION WITH

Gray
RESEARCH

TRANSCRIPTION ARMS

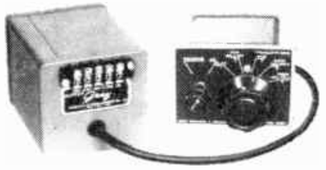
NEW VISCOUS-DAMPED 108-B ARM

For all records — 33⅓, 45 and 78 r.p.m. Radically new suspension development on the viscous damping principle for perfect tracking of records and elimination of tone arm resonances. Instant cartridge change with automatic correct stylus pressure. Solves all transcription problems. Ideal for LP records. For Pickering, new GE (short), old GE (long) cartridges. Write for bulletin. Price, less cartridges, $56.00 (effective Sept. 1st). Cartridge slides for both GE and Pickering are furnished.

MODEL 106-SP ARM

Designed to meet strictest requirements of modern highly compliant pick-up cartridges. 3 cartridge slides furnished enable GE 1-mil, 2½-mil or 3-mil cartridges or Pickering cartridge to be slipped into position in a jiffy. No tools or solder! Superb reproduction of 33⅓, 45 or 78 r.p.m. records. Low vertical inertia, precisely adjustable stylus pressure. Write for bulletin. Price, less cartridges, $45.15

EQUALIZERS



MODEL 603 EQUALIZER

Latest of the universally adopted Gray Equalizers used, with Gray Tone Arms, as standard professional equipment by broadcast stations. High-frequency characteristics obtainable comprise 5 steps — flat, high roll-off, NAB, good records, poor records. For both GE and Pickering cartridges. Price, $50.70

MODEL 602 EQUALIZER

Has 4 control positions, highly accurate response curves. Price, $49.50

Write for bulletins on Gray Equalizers.

GRAY RESEARCH and Development Co., Inc.
20 Arbor St., Hartford 1, Conn.

Division of The GRAY MANUFACTURING COMPANY
Originators of the Gray Telephone Pay Station and the Gray Audograph

WHAT'S NEW THIS MONTH

(Continued from page 13)

CBS is using the Commission as a front to confuse the public and to disorganize the sale of TV sets just as the peak season of sales is approaching. Said Mr. Stanton:

". . . present set owners can get the new color programs by having their sets adapted—that is, adjusted so that they can receive the color programs in black and white. This can be done either by the addition of an external adapter at a cost of perhaps $30 to $50 plus installation, or it can be done for somewhat less through internal changes in your present set by a competent service man.

"Unless you have actually seen color television—and I hope many of you will see it soon—it is hard to imagine just how exciting it is. The seven members of the Federal Communications Commission, whose job is to analyze and weigh the problem as representatives of the public, said, in their official report:

"'The testimony and demonstration in these proceedings leave no room for doubt that color is an important improvement in television broadcasting. It adds both apparent definition and realism in pictures. It opens up whole new fields for effective broadcasting, rendering life-like and exciting scenes where color is of the essence—scenes which in black-and-white television are avoided or, if telecast, have little appeal.'

"And less than a month ago, FCC Commissioner Frieda Hennock said of color television:

"'Until you have seen it you will not be able to grasp fully how significant a development this really is. It will bring a pictorial splendor right into your home. But it is important, aside from its beauty, in the new vistas of programming which it opens up. The entire field of fine art is automatically made a television subject. Color will make meaningful many subjects which would be drab in monochrome. It really adds a new dimension to television and it is impossible to express in quantitative terms the amount of additional intelligence which it can convey.' . . .

"It is also clear that television manufacturers had more than enough time to prepare themselves. All the information for example about the CBS system which was put into the official record of the hearing has been available to everyone in the industry.

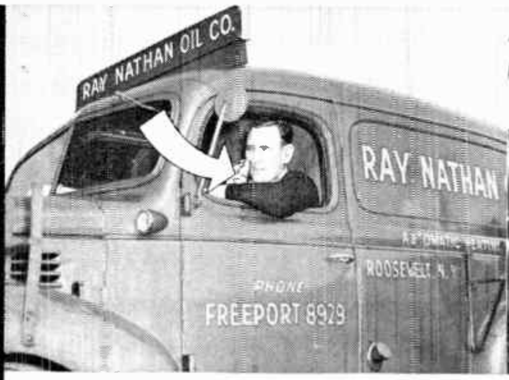
"In addition, over 7 months ago, CBS furnished sets of almost 100 detailed drawings and plans for each of 54 television manufacturers — over 5,000 drawings in all — showing how to make equipment for the CBS system.

(Continued on page 42)

SHURE

Two more good reasons why MICROPHONES are the Field-Proved Standard in Mobile Communications...

in—
POLICE
RAILROADING
TAXI
BUS
TRUCKING
MARINE
EMERGENCY
OIL
MINING



Subscribers to MCC Interstate network in northeastern U.S., are the Ray Nathan Oil Co., and Lane Refrigeration Co. Service trucks are equipped with 2-way radios for faster service to companies' Oil Burner and Refrigerator customers, respectively. Shure 100 Series Carbon Microphone is used for durability . . . dependability . . . high speech intelligibility.

it's always and reliably SHURE

Patented by Shure Brothers, Inc.

SHURE BROTHERS, Inc.

Microphones and Acoustic Devices

225 West Huron Street Chicago 10, Illinois

Cable Address: SHUREMICRO

HOTEL COMMODORE

In the SHADOW *of the* CAPITOL *At* UNION STATION

One block from Union Station. Convenient to all attractions. Moderate priced dining room. Cocktail Lounge. All outside rooms with bath...$3.50 to $8.00

OFFICIAL AAA HOTEL

WASHINGTON D.C.

UNION STATION CAPITOL PLAZA

COMING!

High-Fidelity

"The Magazine for Audio-philes"

PUBLISHED BY MILTON B. SLEEPER, GT. BARRINGTON, MASS.

NOW! A 6-VOLT MOBILE FM RECEIVER COVERS ALL 2-WAY FM RADIOTELEPHONE COMMUNICATIONS

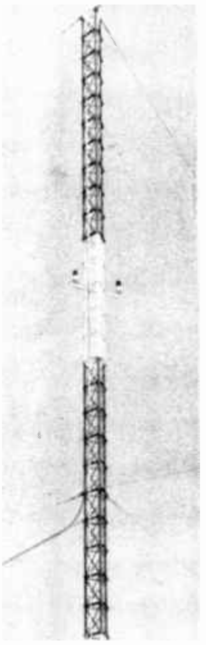
The New MONITORADIO Model M-101 is a *complete* receiver . . . Not a converter! Designed for use in areas where transmitters operate on a frequency of 152 to 162 megacycles—this Mobile FM Radio is well engineered and built of quality parts to give long, trouble-free service. For full technical information, see your parts jobber or write us today!

$72.50 NET

MONITORADIO

RADIO APPARATUS CORPORATION • INDIANAPOLIS 3, INDIANA

FOR AM, FM, UHF, VHF, MICROWAVE, TELEVISION AND RADAR



EMSCO Towers are available for all types of broadcast and comunication service. Backed by years of fabricating experience, EMSCO towers are *engineered* for safety, performance and economy. Bolted construction and hot dip galvanizing insure long life, low maintenance cost and maximum electrical conductivity. Self-supporting triangular and square towers and guyed triangular towers are available in heights up to 1,000 feet with wind loadings up to 60 lbs. RMA design.

There is an EMSCO *Engineered* Tower to meet your needs. Write our Houston plant for bulletin.

EMSCO DERRICK & EQUIPMENT COMPANY
Houston, Texas
LOS ANGELES, CALIFORNIA
Garland, Texas

Shown here is an EMSCO 20½" face, 160', type 1 RT Radio Tower with 30 lb. wind loading rating.

WHAT'S NEW THIS MONTH

(Continued from page 40)

"For reasons of their own, many manufacturers failed to use this information to prepare for the action which the Commission has now taken and which at the very least has been a strong possibility for many months.

"At this late date some of the manufacturers are complaining that the color decision will harm their business. The fact is that any harm which may result will be due to their own lack of activity, their refusal to plan ahead, and their current efforts to confuse the public with belligerent and misleading statements. . .

"The charge that the CBS system is 'mechanical,' was dismissed by FCC Commissioner Robert Jones as a myth. The plain fact is that CBS is not a mechanical system. . .

"The picture-size limitation criticism is not valid either. There is no picture size limitation inherent in the system. Large-size projection pictures have already been demonstrated. . .

". . . if the manufacturers give you their word that there will soon be available adapters and converters for the particular black-and-white sets which you are considering, you will have protection against obsolescence.

"On the other hand, I want to point out that it will be somewhat cheaper and more satisfactory to buy a black-and-white set which is already adapted, so that it has built-in compatibility. Furthermore, a new combination color and black-and-white set may be somewhat less expensive and will be more satisfactory than an ordinary black-and-white set adapted and converted for color.

"Therefore, if you wait for, say, six months, you may save some money, and you will have a self-contained set with built-in compatibility and built-in color. On the other hand, if you buy an ordinary black-and-white set now, you will be able to enjoy the black-and-white programs being broadcast. But, if you do buy such a set, buy only from a manufacturer who will give you positive assurance that there will soon be adapters and converters which will enable you to get color."

RTMA promptly requested time on the CBS net to present the set manufacturers' point of view, and on October 22, president Robert Sprague, speaking with all the assurance of an old-timer at the microphone, said in part:[2]

"Last Sunday, Mr. Stanton said that manufacturers are trying to create the impression that the public's investment in television sets is about to be wiped out.

"I don't know any manufacturer who

(Concluded on page 43)

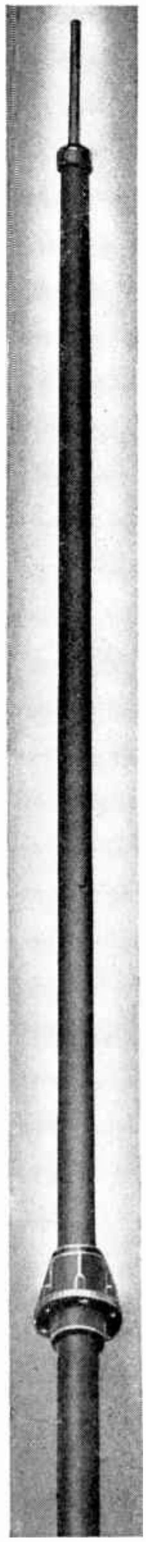
THE NEW *Improved*
MODEL 3HW-A
Workshop Antenna
will . . .

More than triple the effective power of the transmitter.

Increase the effective power of the mobile transmitter.

Increase the operating area.

Permit the use of low power, low cost equipment.



PAT. APP. FOR

Workshop High-Gain Beacon Antennas are designed specifically for the 152-162 megacycle band—taxicab, fire, police, and private fleet communications.

Design Features

- Low angle of radiation concentrates energy on the horizon.
- Symmetrical design makes azimuth pattern circular.
- Can be fed with various types of transmission lines. Special fittings are available for special applications.
- Enclosed in non-metallic housing for maximum weather protection.

Available for immediate delivery through authorized distributors or your equipment manufacturer.

THE WORKSHOP ASSOCIATES
INCORPORATED

Specialists in High-Frequency Antennas

135 CRESCENT ROAD
Needham Heights 94, Mass.

WHAT'S NEW THIS MONTH

(Continued from page 42)

believes that. I don't know any manufacturer who has said anything like that. In fact, because of the many fine television programs that are coming on the air this fall, I believe that present black-and-white television sets are a better investment today than ever before. . .

"It is true that the manufacturers could not believe, until it actually happened, that the Federal Communications Commission would approve a non-compatible color system. They believed, and still believe, that the action was unwise. . .

"There are two primary reasons why we believe black-and-white programs will continue to provide the best television entertainment for years to come. One is our profound conviction, the FCC to the contrary notwithstanding, that the right kind of color television system simply isn't here yet. The second is an equally firm belief that black-and-white television will never be obsolete, even when a sound color system has been developed. . .

"CBS has promised it will broadcast 20 hours of color per week, but most of these broadcasts apparently will be in fringe hours, when the average person is at work or asleep, and will not include the popular evening programs.

"And remember that this broadcasting schedule, in all probability, will be undertaken by only one of the nation's 107 television stations, or at the most, by those affiliated with CBS.

"To my knowledge, no other television station has, as yet, indicated any intent or desire to broadcast even *one* hour of color per week.

"The reason for their caution is, of course, that the CBS system is non-compatible with present black-and-white broadcasts. The minute any station puts on such a color program, it loses its entire audience for that period, except for the people who will have bought adapters or converters to tune in on the non-compatible color broadcast. . .

"But, are these adapter-converters going to be a mass production item?

"CBS and FCC currently believe they will, and I believe that both parties are sincere in saying so. But I point out that neither CBS nor FCC has ever been in the manufacturing business; they have never sold radio and television equipment to the public. So I am more inclined to take the opinion of the set merchandisers, who know by long experience that the public, especially the housewife, does not want any extra gadget or gadgets on her receiver, whether for radio or television."

*Copies of the full text can be obtained by writing Radio-Television Manufacturers Assn., 1317 F St., N. W., Washington, D. C.

Let's not go hog-wild!

Yes—let's not go hog-wild on advertising claims—after all, anyone with a dictionary can put a lot of words together and sound superior.

But—for superior sound—only *you*—the users of Soundcraft products are in a position to prove, for yourself, the consistent top-quality performance of all Soundcraft recording media—whether tape, discs, or styli.

All this advertisement can accomplish is to get you to *try* Soundcraft products.

Only by actually *using* Soundcraft constantly can you demonstrate, to your own satisfaction, the consistently better performance Soundcraft has to offer the recording industry.

SOUNDCRAFT'S ONLY CLAIM IS ITS PROOF OF PERFORMANCE

Dear Soundcraft:
Please send your recording media catalog.
Our favorite disc distributor is ______

Name ______
Address ______

REEVES — "20 YEARS WITH SOUND RECORDING MEDIA."

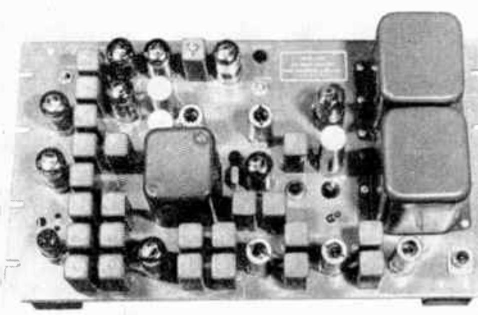
REEVES Soundcraft CORP.
35-54 36th STREET, LONG ISLAND CITY 6, N. Y.

EXPORT—REEVES EQUIPMENT CORP. • 10 E. 52ND, N. Y. 22, N. Y.

REL

RADIO ENGINEERING LABS., Inc.

PIONEERS IN THE CORRECT USE OF ARMSTRONG FREQUENCY MODULATION



722 RECEIVER FOR FM NETWORKING

For Any Specified Frequency from 88 to 108 Mc.

Model 722 is the result of an REL engineering project devoted to the study of operating conditions encountered in FM broadcast networking on 88 to 108 mc., and to the design of a fixed-frequency receiver for this specific service.

Thus the REL 722 incorporates features that are not available in any general-purpose FM receiver. It has a crystal-controlled double superheterodyne circuit of extreme sensitivity, with frequency response flat within ½ db from 50 to 15,000 cycles. Distortion is less than ½% RMS. Spurious response is more than 70 db below the desired signal. All components are designed conservatively for continuous operation.

Each receiver is adjusted to reject harmonic interference on the frequencies of transmitters adjacent to the location where it is to be installed.

The complete receiver and power supply, as illustrated, are mounted on a standard rack panel 19 ins. wide by 12¼ ins. high. Deliveries are now being made on the REL model 722. For engineering data, price, and delivery schedule, write:

Engineers and Manufacturers of Broadcast, Communication, and Associated Equipment since 1920

RADIO ENGINEERING LABORATORIES, Inc.

TEL.: STILLWELL 6-2101 TELETYPE: N. Y.40816

36-40 37th Street, Long Island City 1, N. Y.

MOBILE RADIO NEWS

(Continued from page 20)

it is unfortunate that a more concise presentation of the rules could not have been developed by the FCC draftsmen.

The definition of the term "watch" suggests the style in which the proposed Rules were written. That simple term is defined in the following language:

"*Watch.* The act of listening for or to sound produced by a telephone receiver when the electric wave energy at audio frequency supplied to the telephone receiver—

(1) results from simultaneous interception and detection of Hertzian waves of a designated radio frequency or frequencies, and

(2) is substantially equivalent in frequency to the audio frequency or frequencies generated by detection of the intercepted Hertzian waves."

To the thousands of ship radio users who regarded "watch" as a specified period of vigilant radio listening, the foregoing definition undoubtedly represents the neatest trick of the week. Well, one of the neatest.

Miscellaneous Notes:

The FCC has issued a proposal relaxing the existing requirements for control-point monitoring facilities on mobile stations installed on motorcycles in the Public Safety Radio Services. The new Registry of Transportation Services published by *FM-TV* should prove extremely useful to all taxicab companies contemplating new radio installations, and to mobile systems engineers generally, in selecting frequencies for new facilities.

(Continued from page 25)

proposal. Surely, this would be more timely than after a hearing at some subsequent date, and the Commission then decided to adopt bracket standards. If such a conference did not result in a practical solution of the problems I have discussed, I would then join the majority in authorizing the field sequential system.

If, as the result of a hearing at some later date, bracket standards are adopted by the Commission, manufacturers will be faced with the problem of redesigning and re-tooling in order to build such circuitry in receivers. Such a course of action on the part of the Commission will serve to slow up production, place hardships on manufacturers, and will compound the confusion in the public mind, particularly those of the public that purchase a color receiver having dual standards, since they will then possess receivers which will be unable to utilize the improvements made possible by the adoption of bracket standards. In the

(Continued on page 47)

Screwball Starts New Racket

Pay-off to Radio Stations and Transcription Companies

NOTORIOUS disc and tape man, Al Travis, now independent, is currently offering his BESCO line of professional quality discs and tape selected to please discriminating broadcasting and transcription recording engineers. The name BESCO is a condensation of Broadcast Engineers' Specialty Co., which while an appropriate name is nonetheless quite a mouthful.

Variations in behavior of discs and tape being as they are, Al buys from the manufacturer of the best merchandise of the moment, and sells it to YOU at some most happy reductions. For example:

16" "PRO" Double Face Discs Each....$1.39

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Red Oxide, Plastic Base Magnetic Tape, 1,200 ft.......2.95
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Sapphire Resharp Service........1.49
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Al says any radio station or studio, no matter how small its consumption, can steal this stuff at these prices by simply sending a check. He guarantees 24 to 48-hour shipment, and he PREPAYS.

In addition to the above, Al says there are lots of other horrors in the line from special-purpose discs to tape-editers. Descriptions, guarantees, prices, and terms are shown in current BESCO dope sheets and price lists (subject to change WITH notice). This propaganda is all free for asking with the coupon below. If you clip and send it, Al promises that you'll get the most interesting mess of mail since Truman mentioned the Marines.

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Richmond Hill 19, N. Y.

Dear Al:

☐ We wanna live dangerously, so please note dough enclosed and ship our trial order of:

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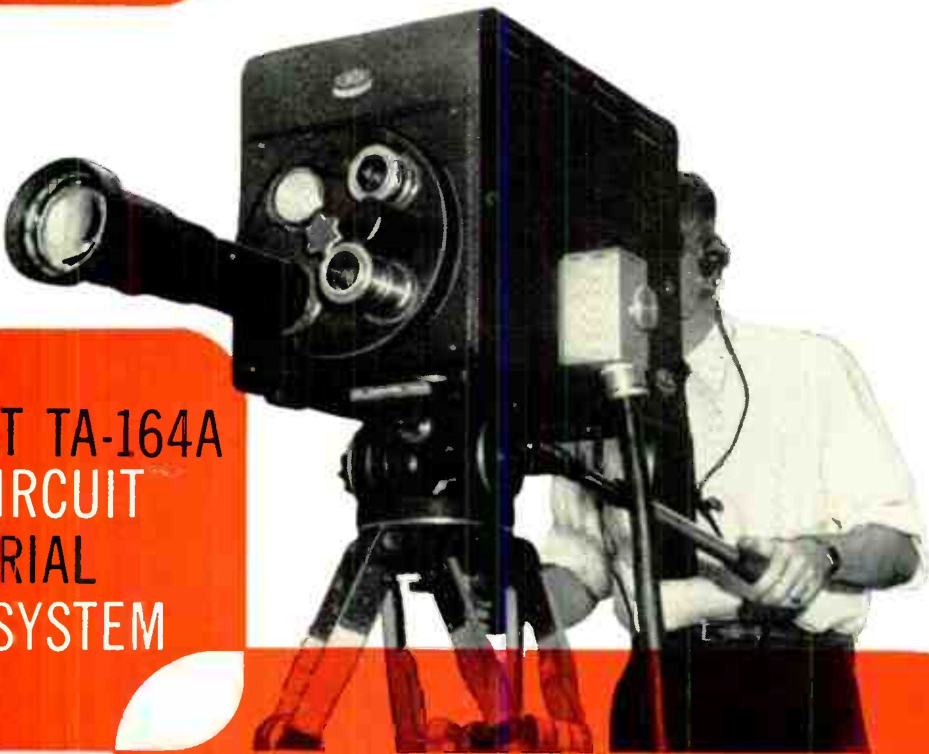
☐ We are suspicious, so please send us dope sheets, price list, etc.

Company

Address

Signed

now color tv for industry!



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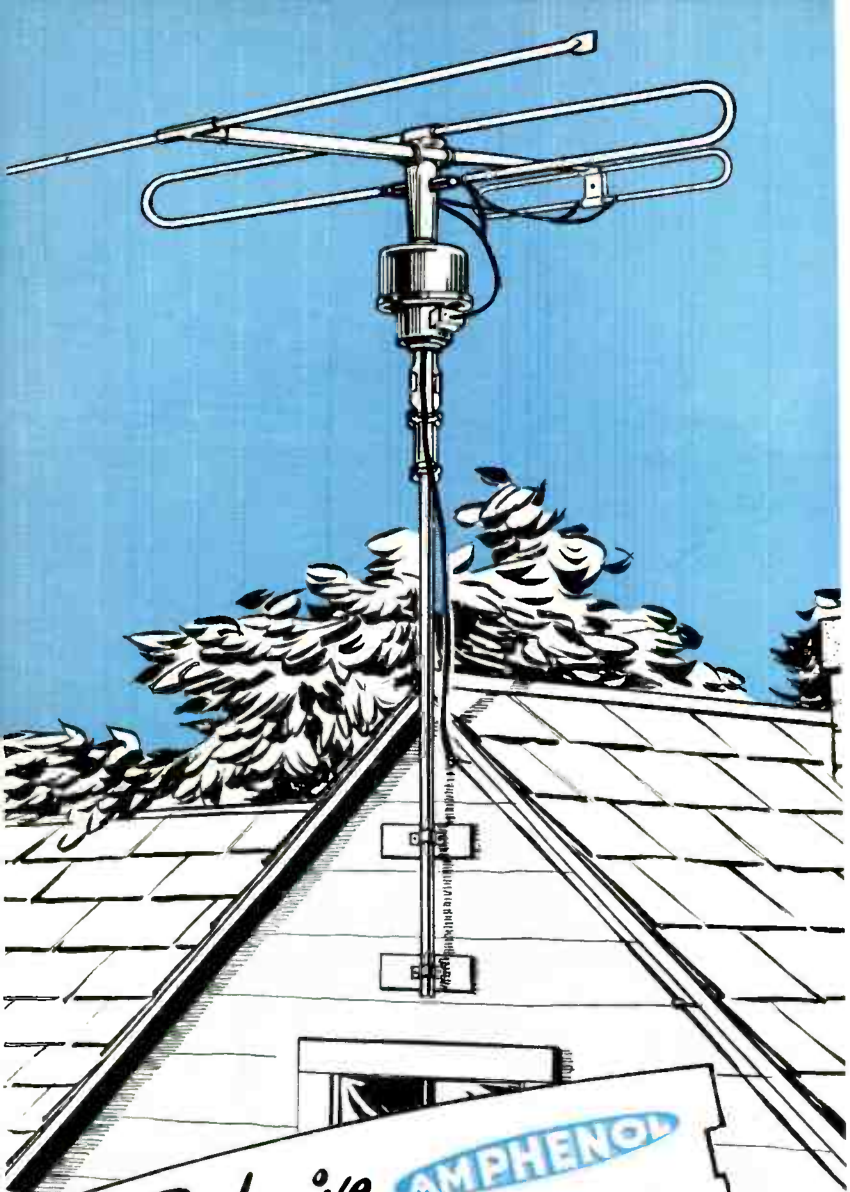

Exclusive AMPHENOL "Auto-Dial" ROTATOR

The "ear-phone and crystal" stage of television is over! With the new AMPHENOL "Auto-Dial" TV Antenna Rotator there are no tiresome buttons or switches to hold while the antenna turns—no searching over and over again for the position which provides the best picture. An effortless turn of the knob to the correct setting—as simple as tuning to a radio station—and "Auto-Dial" takes over. Automatically the antenna rotates to point directly at the TV station—then stops! Rotation is in steps of 6 degrees, accurately calibrated on the indicator. Because of this important feature, you can easily "log" the antenna positions where the best picture is obtained and then accurately return to them whenever you wish. Since the antenna can always be brought back to exactly the same direction, servicemen can now determine whether an antenna is functioning properly, whether it has the required front-to-back ratio and whether it is properly located for the best possible picture.

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The new "Auto-Dial" is made by the originators of the famous AMPHENOL "Inline" TV Antennas. The same precision-manufacturing and quality materials will be found in the "Auto-Dial." The rotator is lightweight and attractively styled yet ruggedly built for years of trouble-free service. The "Auto-Dial" Control Unit is gracefully designed to blend with any decor.

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World Radio History

THE COLOR DECISION

(Continued from page 44)

event that such improvements result in a change in scanning rates which fall outside the scope of the dual standards here adopted, those sets will be incompatible.

The Commission proposed a way to keep the door open for demonstration of new systems, improvements of existing systems that came to light after the hearing record had closed, and demonstrations of the CBS system on large-size, tri-color tubes of two or three manufacturers. Because the Commission would not take time to discuss with representatives of the industry who indicated a willingness to cooperate, the door has been closed.

In its First Report the Commission stated:

"Since there was no demonstration on the record of a direct view tri-color tube on the CBS system, the record does not contain a definitive answer as to whether direct-view tubes larger than 12½ inches are possible with the CBS system. Thus two difficult courses of action are open to the Commission. The first course of action is to reopen the record and to have a demonstration on the record wherein a tri-color tube or other technique for displaying large size direct-view pictures could be tried out on the CBS system."

The record indicates that present color phosphors such as are used with tri-color tubes would not yield the same fidelity that is possible from filters as employed with the CBS disc receivers. By providing a reasonable timetable without seriously aggravating the compatibility problem, such a demonstration could have been made on the record and the question resolved once and for all.

By closing the door at this time the Commission also passed up the opportunity to provide a means of increasing the resolution of color pictures by lowering the field rate without objectionable flicker through the use of long persistence phosphors.

As the result of the Commission's action in immediately adopting CBS standards, proponents of new or improved systems must now look to an experimental license to do their testing and demonstrating. The Commission has stated in its Second Report a new color system or other improvements will have to sustain the burden of showing that improvements which result are substantial enough to be worthwhile when compared to the amount of dislocation involved to receivers than in the hands of the public.

Therefore, we see that the public and industry at some later date again may be faced with the problem of compatibility.

The door also has been closed on the opportunity of taking one more look at

(Concluded on page 48)

P
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THE COLOR DECISION

(Continued from page 47)

compatible systems before moving to adopt an incompatible system with all its attendant problems as they relate to the 10 million receivers that will be in the hands of the public by the end of the year, as well as the manufacturers' problem of production.

I joined with the majority in the First Report with regard to what was said about the problems that seemed to confront a compatible color system and with the conclusion that no satisfactory compatible color system had been developed at the time the record closed.

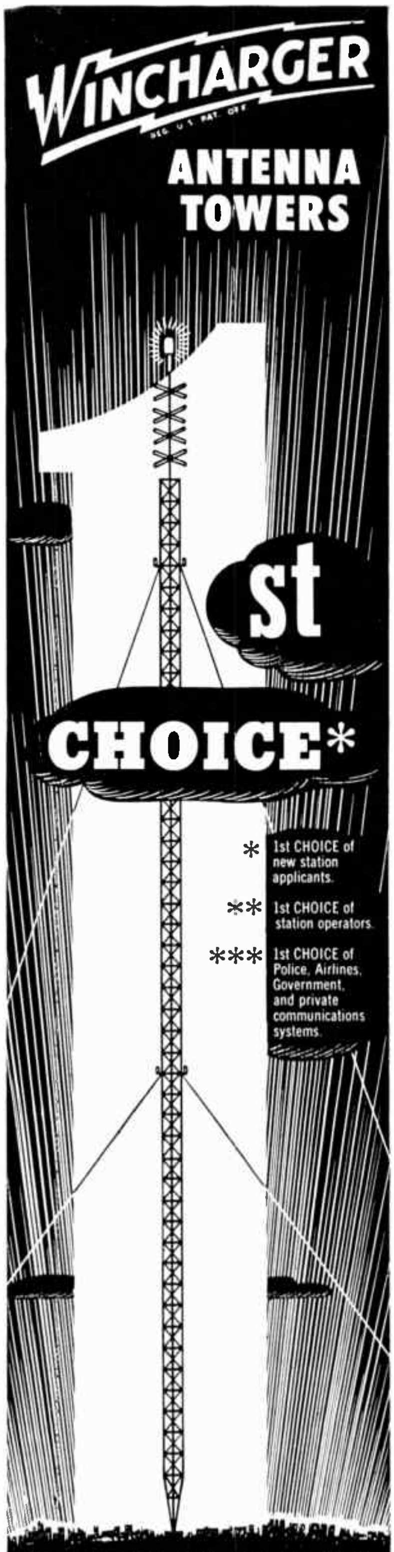
New developments came fast in the closing days of the hearing and immediately thereafter.

It was pointed out in the First Report that the Commission is aware that the institution of the color proceedings stimulated great activity in color developments, that fundamental research cannot be performed on schedule, and that it is possible that much of the fruit of this research has begun to emerge. This is confirmed by the facts, which include the announcement of two new compatible systems and by the RCA Progress Report of July 31, 1950, that the number of dots in the RCA tri-color tubes has been increased from 351,000 to 600,000 with the attendant increase in resolution. Other improvements were also made in the RCA system after the record was closed. I am convinced that it would have been prudent to have taken time out to view these recent developments before moving finally to adopt an incompatible system.

I find it necessary also to dissent from the belief expressed by the Commission in the Second Report, and which was not in the First Report, in which I joined with the majority. In paragraph 12 in the Second Report, is the statement:

"The Commission believes that the attractiveness of color pictures may be sufficiently great to cause people to prefer a direct-view receiver with a 12½-in. tube or a larger-size projection receiver if they can get color as against a 16-in., 19-in., or larger direct-view receiver that is limited to black and white pictures."

I do not agree with this belief. I believe that the rapid acceptance by the public of receivers incorporating larger-size black and white tubes as they moved from 7 to 10 to 12 ins., then to 16 and 19 ins., clearly indicates the preference of the public for large-size TV pictures, and they will not be satisfied with smaller pictures because they are in color. Due to the fact that color adds so much to television both from the program as well as the advertising standpoint, both the public and the sponsor will demand large-size color tubes.



There is a reason. VHF, FM, and standard AM broadcasters acclaim the structural excellence and all around low cost of Wincharger's performance proven towers. The precision of Wincharger vertical radiator's patterns is testified by the fact that over one hundred and twenty stations are now using Wincharger towers in directional arrays even six element arrays! Higher quality, wider versatility, lower cost have made Wincharger antenna towers America's first choice.

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Sioux City 6, Iowa, U.S.A.

World Radio History

SWR BRIDGE

(Continued from page 19)

an external meter permits carrying the bridge in a tool box, and virtually eliminates the danger of damage to the bridge because of rough handling in field service work. A 0- to 1-milliampere meter is satisfactory for most applications. For precise adjustments at low standing wave ratios, however, a microammeter can be used.

The RF choke, Fig. 2, is provided to complete the DC meter circuit. At frequencies from 1.5 to 42 mc. the reactance of the choke is satisfactorily high, and has very little effect on the line impedance. At higher frequencies, some error might be introduced because of the shunting effect of the choke. When split radiators are used above 42 mc., it is necessary to employ a choke which is self-resonant near the operating frequency.

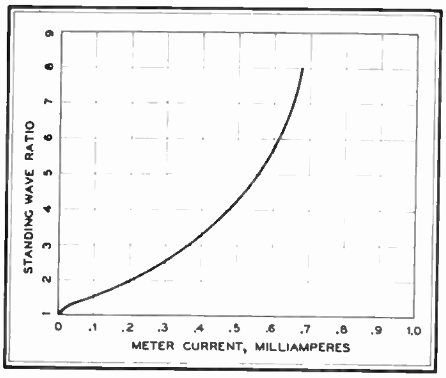


Fig. 3. Calibration chart for SWR bridge

With antennas having a completed DC path, such as the folded dipole, the choke can be eliminated entirely.

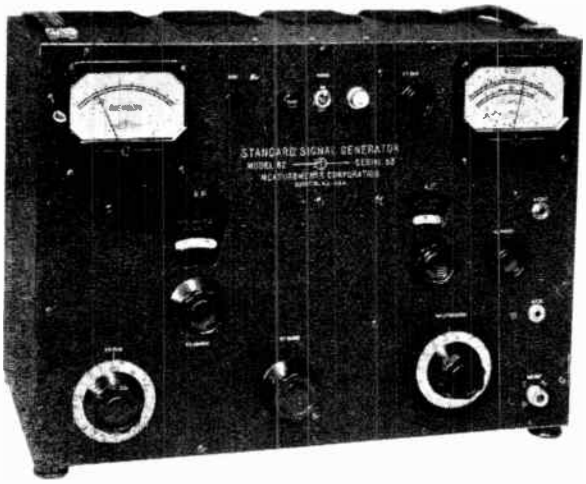
Using the SWR Bridge:

When measuring the SWR in a radiating system, the antenna should be installed in its intended permanent location. This is because the radiation resistance of an antenna is affected by its height and surroundings.

An RF source of about 5 volts at the transmission line impedance is connected to J1, Fig. 2, by a short length of cable. In most 2-way installations, the transmitter can be used as the power source. Coupling should be reduced, however, to prevent the application of excessive power to the bridge. With a 1-milliampere meter connected to the meter terminals and the test transmission line disconnected, the coupling is adjusted to give full-scale meter reading. Then the transmission line is connected to J2, and the meter reading noted. The SWR can be obtained by referring to the calibration chart. Finally, the antenna or receiver matching device is adjusted to give the best bridge balance, indicated by minimum meter reading.

(Concluded on page 50)

STANDARD SIGNAL GENERATOR



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FREQUENCY RANGE: 20 cycles to 200 kilocycles in four ranges, 80 kilocycles to 50 megacycles in seven ranges, plus one blank range.

FREQUENCY CALIBRATION: Each range is individually calibrated. 20 cycles to 200 kilocycles, accurate to ±5%. 80 kilocycles to 50 megacycles, accurate to ±1%.

OUTPUT VOLTAGE AND IMPEDANCE: 0-50 volts across 7500 ohms from 20 cycles to 200 kilocycles. 0.1 microvolt to 1 volt across 50 ohms over most of the range from 80 kilocycles to 50 megacycles.

POWER SUPPLY: 117 volts, 50-60 cycles. 75 watts.

DIMENSIONS: 15" high x 19" wide x 11¾" deep. 50 pounds.

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Frequency Regulation, ± 10% no load to full load
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AC Wave Form of all Carter Converters is exceptionally clean and usually requires NO FILTER on most audio devices. Investigate these exclusive features now!

NOW *Also* FOR TELEVISION WIRE & TAPE RECORDERS

A new line of custom designed converters for popular wire and tape recorders for 6, 12, and 115 volt input and 7" TV Receivers for 115 volt DC input.

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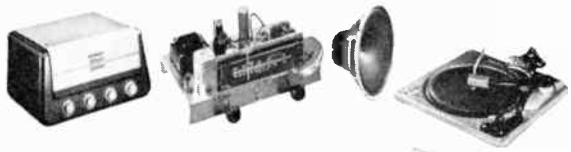

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A new book by D. T. N. Williamson, designer of this renowned audio amplifier, has been published by the "Wireless World" of London. The author, formerly of M. O. Valve Company, and now with Ferranti Research, Ltd., has added a considerable amount of information on high-fidelity reproduction, filters, and an automatic fader to reduce gain while records are being changed.

This book contains 36 pages with 31 photos and diagrams.

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FM-TV Magazine

Great Barrington, Mass.

SWR BRIDGE

(Continued from page 49)

A SWR of 2 or less after adjustment indicates a relatively good match. It may not be possible to reduce it even to that value.

Line Impedance:

The SWR bridge can be employed with any coaxial transmission line using standard connectors. It is only necessary to replace R4, Fig. 2, by a resistor equal to the line's characteristic impedance.

Balanced 300-ohm line can be adapted simply for use with the bridge. An electrical half-wave of 75-ohm coaxial cable is connected as shown in Fig. 4. This gives a perfect match to another section of 75-ohm coax, which can be of any convenient length. The bridge is then used as though the test line were 75-ohm coaxial cable.

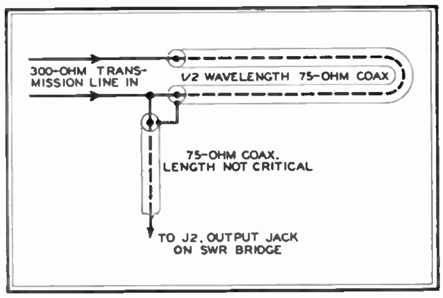

Fig. 4. Simple adapter for 300-ohm line

Bridge Calibration:

A calibration chart, as in Fig. 3, is supplied with each bridge. However, when very accurate information is required, the user can calibrate his particular bridge very easily as follows. Ten resistors, each of a value 10 times that of R4, are tied in parallel. The resistors used should be purely resistive at the RF frequency concerned. Then calibration data is obtained in the following way:

Adjust the RF input for full-scale meter deflection with no load. Then connect the ten resistors, whose total resistance has been accurately determined, across J2. The meter should read close to zero. Note the reading. Then remove one resistor, measure the new total resistance with a Wheatstone bridge, reconnect the load, and note the new meter reading. This process is repeated until only one resistor remains.

With the information obtained, standing wave ratios can be calculated for each meter reading. The SWR is the ratio of the load resistance to R4, if the load resistance is greater than R4. When it is smaller than R4, SWR is the ratio of R4 to the load resistance. Thus, SWR is always 1 or greater than 1. The measured points can be plotted in the same way as in Fig. 3.

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Protects Television Sets Against Lightning and Static Charges

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First in Television Antennas & Accessories

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Socket contacts phosphor bronze, knife-switch type, cadmium plated. Plug contacts hard brass, cadmium plated. 2, 4, 6, 8, 10, and 12 contacts. Plugs and sockets polarized. Long leakage path from terminal, and terminal to ground. Caps and brackets, steel parkerized (*rust-proofed*). Plug and socket blocks interchangeable in caps and brackets. Terminal connections most accessible. Cap insulated with canvas bakelite.

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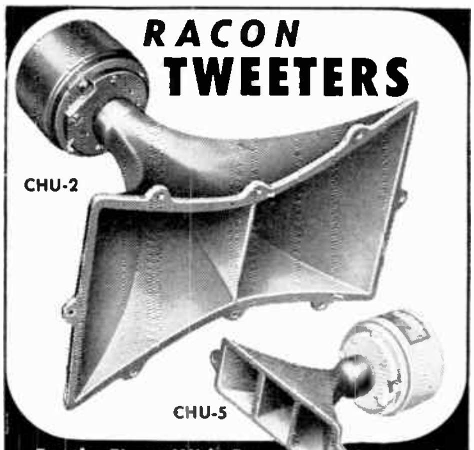

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Crossover: 1000 cycles
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Station WFAA

RADIO SERVICE OF THE DALLAS MORNING NEWS

September 18, 1950

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Gentlemen:

I thought you might be interested in knowing that we are using EIMAC 3X2500A3 tubes in the finals of our high channel TV transmitter and we are very happy with their performance. In fact, we have yet to experience a tube failure since we went on the air. Tube cost is low and maintenance problems are minimized when using this dependable air cooled tube.

It is a pleasure for me to recommend your fine product.

Sincerely yours,

Carlos L. Dodd

Carlos L. Dodd,
Chief Engineer
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The Eimac 3X2500A3 is one of the outstanding vacuum tube developments made during recent years. Consistent performance, long life, and low cost account for its filling the key socket positions in many important recently designed equipments.

The 3X2500A3 is a compact, air-cooled triode. Its coaxial construction results in minimum lead inductance, excellent circuit isolation, and convenience of use with coaxial plate and filament tank circuits. For AM service it is FCC rated for 5000 watts per tube as a high-level modulated amplifier. It has comparatively low plate-resistance, high transconductance, and will provide effective performance over a wide range of plate voltages at frequencies extending well into the VHF.

Reports from many engineers, like Mr. Dodd of WFAA-TV, confirm the outstanding transmitter performance, simplified maintenance, and low tube replacement cost made possible through the use of the Eimac 3X2500A3. Consider this unequalled triode for your applications . . . complete data are free for the asking.

Eimac 3X2500A3

GENERAL CHARACTERISTICS

ELECTRICAL		
Filament: Thoriated tungsten		
Voltage		7.5 volts
Current		48 amperes
Maximum starting current		100 amperes
Amplification Factor (Average)		20
Direct Interelectrode Capacitances (Average)		
Grid-Plate		20 uufd
Grid-Filament		48 uufd
Plate-Filament		1.2 uufd
Transconductance ($i_b = 830$ ma., $E_b = 3000$ v.)		20,000 umhos
MECHANICAL		
Cooling		Forced air
Maximum Overall Dimensions:		
Length		9.0 inches
Diameter		4.25 inches
Net Weight		5.8 pounds

RADIO FREQUENCY POWER AMPLIFIER
Ground-Grid Circuit
Class-C FM Telephony
TYPICAL OPERATION (110 Mc., per tube)

D-C Plate Voltage	3700	4000	volts
D-C Grid Voltage	—450	—550	volts
D-C Plate Current	1.8	1.85	amps.
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Driving Power (Approx.)	1600	1900	watts
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The Power for R-F

the 3X2500A3 is another Eimac contribution to electronic progress.

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