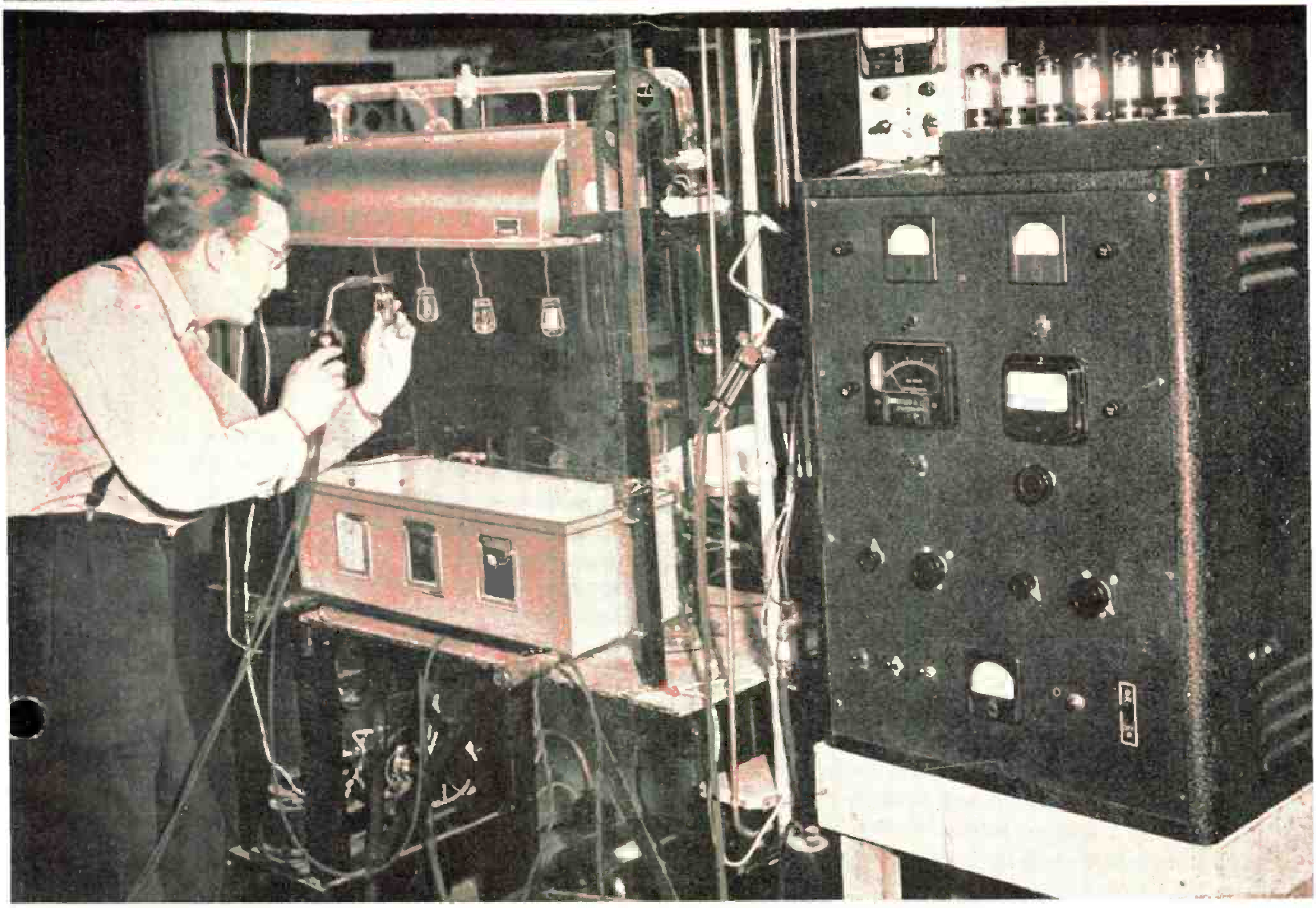
COMMUNICATIONS

INCLUDING "RADIO ENGINEERING" AND "TELEVISION ENGINEERING"



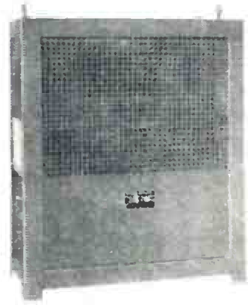
MARCH 1948

★ TEST INSTRUMENTS IN BROADCASTING
★ INTERFERENCE FILTERS FOR COUPLED ANTENNAS
★ MOBILE AND FIXED ANTENNA PATTERN MEASUREMENTS

3-Phase Regulation

MODEL	LOAD RANGE VOLT-AMPERES	*REGULATION ACCURACY
3P15,000	1500-15,000	0.5%
3P30,000	3000-30,000	0.5%
3P45,000	4500-45,000	0.5%

• Harmonic Distortion on above models 3%. Lower capacities also available.



Extra Heavy Loads

MODEL	LOAD RANGE VOLT-AMPERES	*REGULATION ACCURACY
5,000+	500 - 5,000	0.5%
10,000+	1000-10,000	0.5%
15,000+	1500-15,000	0.5%

General Application

MODEL	LOAD RANGE VOLT-AMPERES	*REGULATION ACCURACY
150	25 - 150	0.5%
250	25 - 250	0.2%
500	50 - 500	0.5%
1000	100-1000	0.2%
2000	200-2000	0.2%

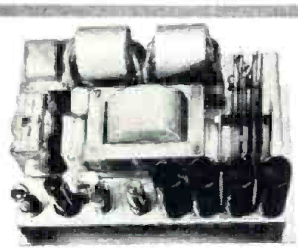
400-800 Cycle Line

INVERTER AND GENERATOR REGULATORS FOR AIRCRAFT.

Single Phase and Three Phase

MODEL	LOAD RANGE VOLT-AMPERES	*REGULATION ACCURACY
D500	50 - 500	0.5%
D1200	120-1200	0.5%
3PD250	25 - 250	0.5%
3PD750	75 - 750	0.5%

Other capacities also available



The NOBATRON Line

Output Voltage DC	Load Range Amps.
6 volts	15-40-100
12 "	15
28 "	10-30
48 "	15
125 "	5-10

• Regulation Accuracy 0.25% from 1/4 to full load.

SORENSEN

The First Line of standard electronic AC Voltage Regulators and Nobatrons

GENERAL SPECIFICATIONS:

- Harmonic distortion max. 5% basic, 2% "S" models
- Input voltage range 95-125: 220-240 volts (—2 models)
- Output adjustable bet. 110-120: 220-240 (—2 models)
- Recovery time: 6 cycles: + (9 cycles)
- Input frequency range: 50 to 65 cycles
- Power factor range: down to 0.7 P.F.
- Ambient temperature range: —50°C to +50°C

All AC Regulators & Nobatrons may be used with no load.

*Models available with increased regulation accuracy.

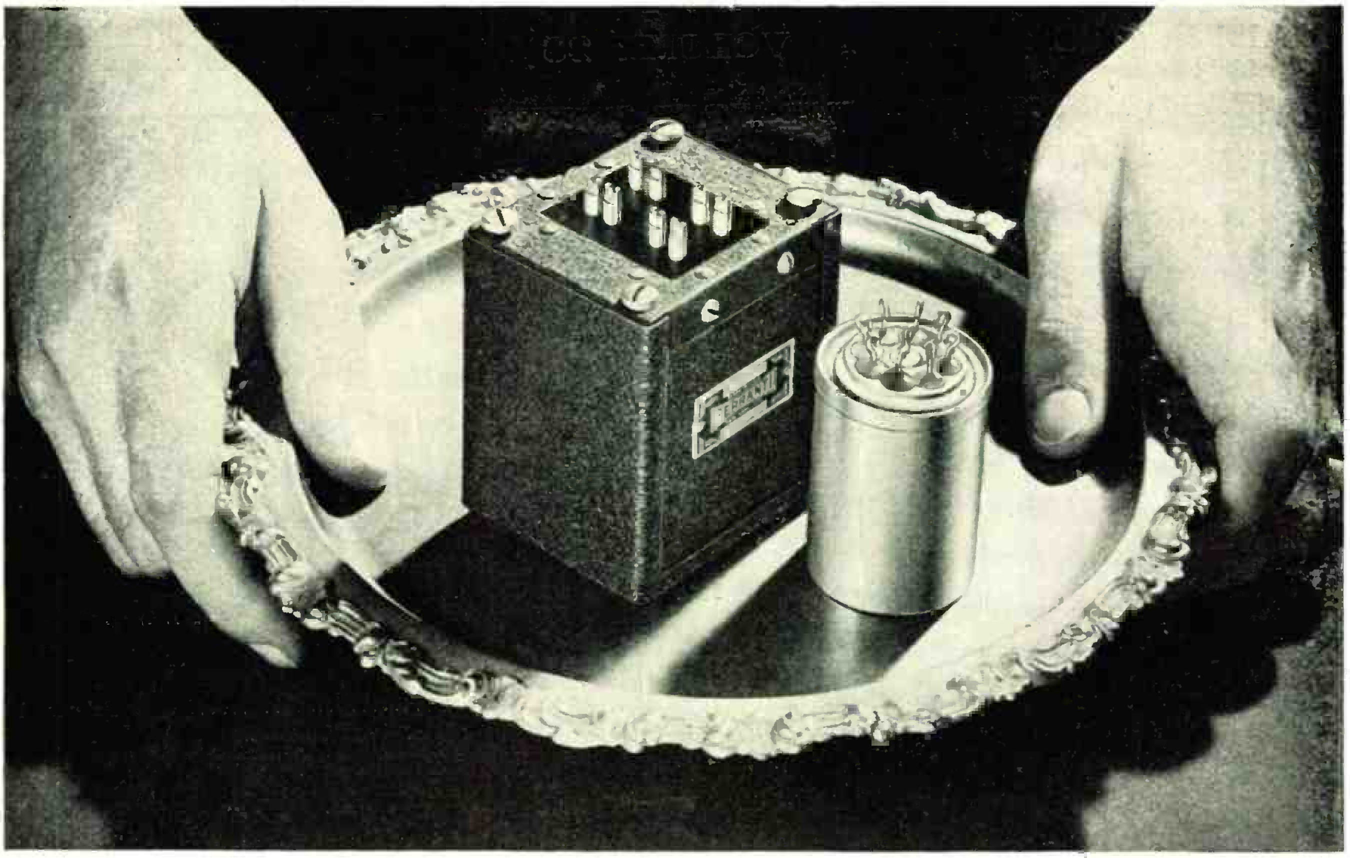
Special Models designed to meet your unusual applications.

Write for the new Sorensen catalog. It contains complete specifications on standard Voltage Regulators, Nobatrons, Increvolts, Transformers, DC Power Supplies, Saturable Core Reactors and Meter Calibrators.

SORENSEN & CO., INC.

STAMFORD CONNECTICUT

Represented in all principal cities.



For quality and service

choose FERRANTI transformers

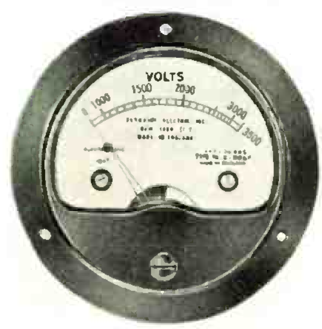
From our more than 20 years' experience as transformer specialists, come precision transformers of every type—custom-made for YOUR new applications. FERRANTI facilities permit unusual service to each customer, whether large or small, and insure prompt deliveries.

AUDIO TRANSFORMERS	AUDIO FILTERS
POWER TRANSFORMERS	REACTORS

HERMETICALLY SEALED WHEN SPECIFIED

We also build power supply units and electronic assemblies to specifications at prices comparable to those of stock assemblies. We invite your inquiries.

ALSO FOR MODERN HIGH VOLTAGE DEVELOPMENTS WHERE ZERO CURRENT DRAIN IS IMPERATIVE



THE FERRANTI ELECTROSTATIC VOLTMETER

Types available for maximum readings from 150 to 3500 volts. 2½ in. dial, flush mounting, projecting and portable models. Write for informative literature.

• *Ferranti Electric, Inc.* RCA BUILDING •

30 Rockefeller Plaza • New York 20, N. Y.

MARCH, 1948 VOLUME 28 NUMBER 3

COMMUNICATIONS

Including Television Engineering, Radio Engineering, Communication & Broadcast Engineering, The Broadcast Engineer. Registered U. S. Patent Office.

LEWIS WINNER
Editor

F. WALEN
Assistant Editor

Bryan S. Davis, President
Paul S. Weil, Vice Pres.-Gen. Mgr.
F. Walen, Secretary
A. Goebel, Circulation Manager

Cleveland Representative:
James C. Munn
2253 Delaware Dr., Cleveland 6, Ohio
Telephone: Erieview 1726

Pacific Coast Representative:
Brand & Brand
1052 W. Sixth St., Los Angeles 14, Calif.
Telephone Michigan 1732
315 Montgomery St., San Francisco 4, Calif.
Telephone Douglas 4475

Wellington, New Zealand: Te Aro Book Depot.
Melbourne, Australia: McGill's Agency.

Entered as second-class matter Oct. 1, 1937 at the Post Office at New York, N. Y., under the Act of March 3, 1879. Subscription price: $2.00 per year in the United States of America and Canada; 25 cents per copy. $3.00 per year in foreign countries; 35 cents per copy.

COVER ILLUSTRATION

Quality control testing of diode tubes used in voltage regulators.
(Courtesy Sorensen & Co., Inc.)

Published monthly by Bryan Davis Publishing Co., Inc.
52 Vanderbilt Avenue, New York 17, N. Y. Telephone MUrray Hill 4-0170

PROFESSIONAL PERFORMANCE—that keeps the original sound alive!

Make Each Record a

"Personal Appearance"!

—with precision control of recording quality

Listen critically: Your station is on the air. There's your announcer's voice . . . the opening music . . . the song . . . the chatter. Is it a 'live' or a 'recorded' program? Not even your trained ears should be able to tell!

Today, truly professional recording reproduces all of the quality and natural beauty of music or speech with full naturalness. It keeps the original sound alive.

You can sum up the reasons for the unexcelled 'live' performance of the Fairchild Unit 523 Studio Recorder in one simple statement: It provides a maximum flexibility of mechanical operation that permits the operator to secure unexcelled quality of reproduction. Fairchild provides instant, infinite variation of pitch from 80 to 160 lines-per-inch by means of a unique planetary-driven lead screw. Operation is controlled by a single, easily accessible knob, as illustrated at the left. This makes it possible to record a very loud passage at 90 lines-per-inch and to follow it with soft passages at 120 or 130 lines-per-inch without dial twisting or the danger of overcutting the next groove.

Timing is accurate to a split-second. Operation is 'WOW'-free. Turntable noise, rumble and vibration are non-existent. And the performance of the Fairchild Unit 541 Magnetic Cutterhead—which is standard equipment on the Unit 523 Studio Recorder—has been engineered for full dynamic range; minimum distortion content and broad frequency range. Want more details? Address: 88-06 Van Wyck Blvd., Jamaica 1, N. Y.

Studio Recorders
Magnetic Cutterheads
Transcription Turntables
Portable Recorders
Lateral Dynamic Pickups
Unitized Amplifiers

Fairchild CAMERA AND INSTRUMENT CORPORATION

AM SOUND EQUIPMENT FM

Corn Belt Electric Cooperative Central Station operator in contact with lineman in the field via Motorola Radiotelephone.

CORN BELT COOPERATIVE REPORTS NEW EFFICIENCY THROUGH MOTOROLA RADIOTELEPHONE

Recognizing the fact that outages result not only in lost revenue, but in subscriber dissatisfaction, more and more progressive power companies are turning to Motorola Radiotelephone to get at trouble *fast*. Users report that dependable Motorola equipment pays for itself in a few months in time and miles of driving saved.

Mr. T. H. Hafer, Manager of the Corn Belt Electric Cooperative of Bloomington, Illinois, says that Motorola Radiotelephone has materially improved the company's service while decreasing wasteful "dead mileage" driving.

When you decide to install radiotelephone in your supervisory and maintenance cars, decide on Motorola. Motorola communications equipment has been *proved* in thousands of mobile installations—*proved* more dependable, longer lasting. Motorola equipment is *years ahead of the field* in basic design and exclusive features—a fact that you can prove to yourself by comparing Motorola *with any other* communications equipment.

WRITE TODAY—A Motorola Field Engineer will call to give you the complete time-saving, cost-saving story and to make specific recommendations concerning your particular communications problem.

Motorola Inc.

COMMUNICATIONS DIVISION • CHICAGO 51, ILLINOIS

In Canada: Rogers Majestic, Ltd., Toronto—Montreal

ONLY Motorola HAS P.S.

P. S.—"PRECISION SELECTIVITY" assures you of conversations uninterrupted by the multitude of spurious responses picked up by ordinary communications equipment. P. S. gives you full bandwidth protection—does not sacrifice a high signal-to-noise ratio by cutting the channel in half.

So carefully designed is "PRECISION SELECTIVITY" that signals 20 KC off resonance (alternate channel) have a rejection of 86 db. P. S. protects you from signals of 20,000 microvolts while you are receiving your own signal—which could be as low as 1 microvolt. Remember—when you consider the installation of radiotelephone service—

ONLY Motorola HAS P.S.

Instant Contact!

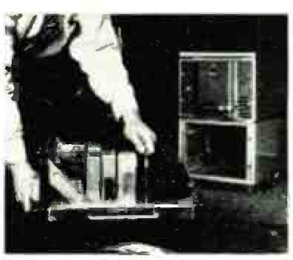
Mobile Radio-Telephone Provides Quick Contact with the Job, Saves You Time and Money!

When the man on the job needs you, or you need him, you're in contact in a flash — with Mobile Radio-Telephone! In emergencies, or for routine orders and routing, your own Mobile Radio-Telephone System speeds communication, avoids delays, saves time and money. Helps you provide better service, too!

Kellogg Mobile Radio-Telephone Units are easy to install, simple to operate, and designed for quick maintenance. One compact mobile unit mounts in each of your vehicles. The base unit is located in your office or any other convenient point. You get clear, dependable, private communication at the snap of a switch—anywhere, anytime!

Kellogg Mobile Radio-Telephone is trouble-free, proved by service under all conditions. Write Kellogg *today* for complete information!

Mobile transmitter and receiver require minimum space in vehicle.



Drawer-type, plug-in chassis makes maintenance easy and fast.

These Advanced Features Prove Kellogg Mobile Radio-Telephone Is Better!

- Kellogg Mobile Radio-Telephone Equipment conforms to both the present and proposed requirements of the Federal Communications Commission and the Radio Manufacturers Association.
- Advanced circuit design and components assure interference-free communication because of superior rejection of unwanted signals in adjacent channels. No listening-in by any other mobile stations!
- Uniform volume-level regardless of strength of incoming signal.
- Positive modulation control prevents distortion.
- Unexcelled performance over wide ranges of temperature and humidity.
- Drawer type, plug-in chassis permits quick, easy maintenance.
- Very low stand-by drain from power source. Easily adaptable to various power sources.
- Rugged, shock-proof mounting assures long, trouble-free life of the equipment.

1897 1947 Fifty Years

KELLOGG Mobile Radio-Telephone

Built by Philco—Distributed Nationally by:

KELLOGG SWITCHBOARD & SUPPLY CO.
6650 South Cicero Avenue • Chicago 38, Illinois

.022 .0047

Funny Numbers?

. . . perhaps, but they are more evidence of SPRAGUE LEADERSHIP!

New Phenolic-Molded Sprague Tubular Capacitors Produced in Decade Ranges and Color-Coded!

With the recent introduction of its sensational new *molded* tubular capacitors, Sprague now announces standardized capacities, and color-coding for ready identification of these new units. For example, starting with the number 1, the next numbers in the 20% tolerance decade are 1.5, 2.2, 3.3, 4.7, 6.8 and on back to 10.

Established decade ranges and color-coding have proved their efficiency and acceptability in the resistor industry over a period of years.

Now, for the first time, this same practice will allow capacitor manufacturers the many advantages of standardized production—advantages which we feel will be cumulative through the years.

In the firm conviction that these steps toward standardization will prove mutually beneficial, Sprague Electric Company solicits your co-operation and invites your inquiries for information, samples and application data concerning the new SPRAGUE MOLDED TUBULAR CAPACITORS. WRITE FOR ENGINEERING BULLETIN NO. 210A.

.15 .033 .068

THE FIRST TRULY PRACTICAL PHENOLIC-MOLDED PAPER TUBULAR!

Highly heat- and moisture-resistant • Non-inflammable • Conservatively rated for —40°C. to 85°C. operation • Small in size Completely insulated • Mechanically rugged Moderately priced.

SPRAGUE MOLDED TUBULAR CAPACITOR COLOR CODE

			Black	Brown	Red	Orange	Yellow	Green	Blue	Violet	Gray	White
1st BAND	Capacity in MMFD	First Significant Number	0	1	2	3	4	5	6	7	8	9
2nd BAND		Second Significant Number	0	1	2	3	4	5	6	7	8	9
3rd BAND		Decimal Multiplier			100	1000	10,000	100,000				
4th BAND	TOLERANCE		±20%			±30%	±40%	±5%				±10%
5th BAND	RESERVED FOR ARMED SERVICES											
6th BAND	Voltage in Hundreds (x 100)	First Significant Number	0	1	2	3	4	5	6	7	8	9
7th BAND		Second Significant Number	0	1	2	3	4	5	6	7	8	9

SPRAGUE ELECTRIC COMPANY North Adams, Mass.

CAPACITORS **SPRAGUE** *KOOLOHM RESISTORS

*Trademark reg. U. S. Pat. Off.

PIONEERS OF ELECTRIC AND ELECTRONIC PROGRESS

COMMUNICATIONS

LEWIS WINNER, Editor

MARCH, 1948

A Hornet's Nest

THOSE VITAL DECISIONS on the recently concluded 3-year FCC probe of clear channels, which were expected any day, may not be made for months now. Congress having decided to conduct an investigation of this complex problem with its own hearing by their Senate Interstate Commerce Committee. The sudden intervention of the Congressional committee was prompted, to some extent, by pressure criticism of some groups against, in particular, the proposed 20 clear-channel 750-kw plan. As a result, Senator Edwin C. Johnson, of Colorado, introduced a bill which would limit power to 50 kw. The bill also proposed that 50-kw stations shall not be protected to a contour less than 500 microvolts per meter half of the time based on measurements made during the second hour after sunset for all seasons of the year. The Senator said that his bill was being proposed because of the political, social and economical ramifications of superpower. The committee's action followed the proposal of the bill with Senator Charles W. Tobey, acting chairman of the committee, mailing a letter to all a-m broadcasters and other radio groups, stating that since his committee "has a responsibility for radio and communications" they wanted to study the problems that may arise should high power be approved and are thus anxious to have "the facts, all the facts" from the broadcasters. The letter continues to state that the committee believes "that licensees themselves are the best authority on these facts."

On dozens of occasions, broadcasters covered the points mentioned in Senator Tobey's letter. One wonders what facts are still to be uncovered. The reams of testimony presented before the FCC provided a detailed picture of the problem; shall the FCC permit 20 clear-channel stations to operate with 750 kw; or keep the 50-kw limit on power and break down clear channels; or maintain the present arrangement; or rearrange network affiliation if power increases are granted, or provide for break downs on a channel-to-channel basis. This involved problem requires the judgment of communications experts who are thoroughly familiar with the technical and economic aspects of the case. The FCC have these experts who are well qualified to provide the clear-channels answers!

A decision must be made by May 1 to setup an allocation plan for presentation before the North American Regional Broadcasting Agreement conference scheduled for August in Canada. If the clear-channel decision is not made by that date, it may be necessary to postpone the conference which is not a simple matter, it being necessary to secure postponement agreement among the participating countries. We must appear before the conference with a definite allocation plan to guarantee effective use of our channels.

The next few weeks will be anxious ones for broadcasters!

Tv Broadcast Transmitter Standards

THE FIRST SET of electrical performance standards for tv broadcast transmitters operating in channels one to thirteen, were recently released by the RMA engineering department.

Extremely complete, the standards cover the television transmitter (visual and aural sections) and antennas and transmission lines. Recommended standards for the visual transmitter include peak-power output adjustment, carrier-frequency stability, lower sideband attenuation, phase versus frequency-response characteristics, amplitude versus frequency characteristic, transmitter-input polarity, pedestal level, carrier reference white level, and output polarity and voltage for composite tv-picture signal-monitor characteristics. Recommended standards for the aural transmitter include a-m and f-m noise level on carriers, modulation capabilities, audio-input impedance and input level for ±40 kc swing, audio-frequency response, intermodulation distortion, and r-f coupling impedance range. The recommended standards for antennas and transmission lines, include polarization, patterns, gain, antenna-input impedance for single-ended and double-ended inputs, sizes of coaxial rigid air-dielectric transmission lines, surge impedance of coaxial transmission lines, etc.

Methods of measurement are prescribed for many of the standards. In the cross-talk between visual and aural transmission case, for instance, the specifications call for measurements to be made on the radiated signal since the presence of an unwanted signal on the transmission line is not necessarily an indication of remodulation. When the unwanted modulation is of the same type as the transmitter under consideration, 1,000-cps modulation is to be applied, at full level, alternately to one transmitter and then the other. Carrier level for the unmodulated condition of the visual transmitter should be black. The listening tests are to be made with an a-m/f-m receiver provided with an accurately-calibrated output meter, located near the antenna, but not near enough to permit saturation or direct pickup. Receiver is to be tuned to one transmission and the modulation level determined when that transmitter is modulated. Reduction level is then measured while the other transmitter is modulated, but the first transmitter is unmodulated.

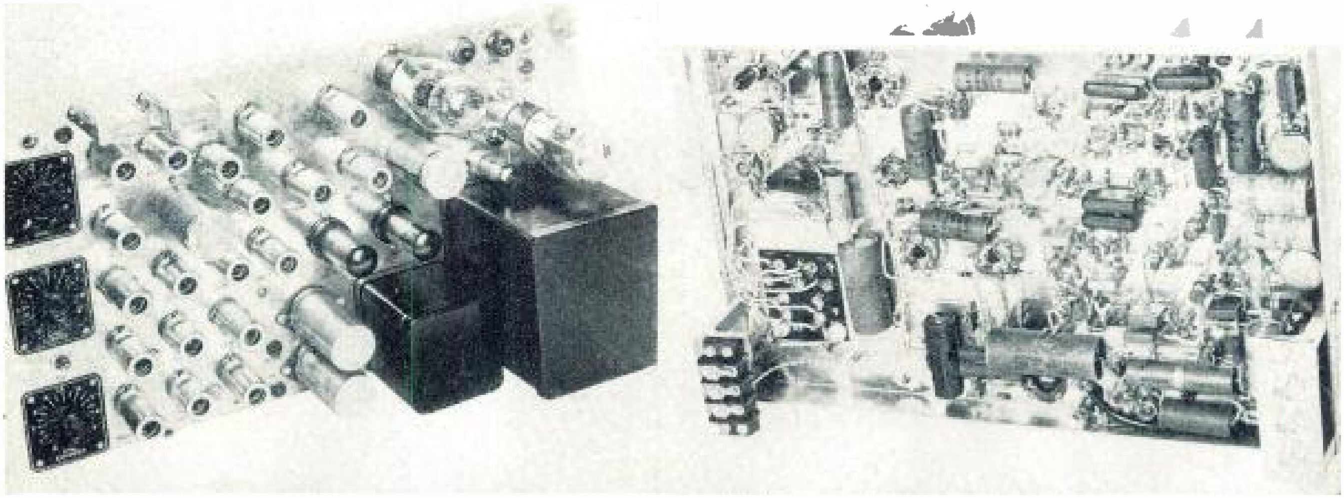
These standards are available from RMA headquarters at a nominal price.

On the Development Front

CONVENTIONAL TUBES such as the 6V6s were recently found capable of generating substantial powers on microwaves. The excessive transit time and grid conductance problems appear to have been overcome by a unique waveguide-tube system, with the transit time between cathode and plate made to correspond to some multiple of 360° phase shift.

The equipment used in this new system will be on display at the IRE National Convention in the Grand Central Palace, March 22-25.

By the way, we'll be at the Show, too, at Booth 290. Hope to see you there.—L. W.



Figures 1 and 2
Front and rear views of the sync stretcher.

A TV Sync Stretcher

THE NEED FREQUENTLY ARISES in tv studios for a unit which will emphasize the *sync*hronizing portion of the composite video signal. This *stretching* of the sync may be necessary to compensate for previous sync compression such as might arise in a relay transmitter or to pre-emphasize the sync to overcome compression in a succeeding part of the station equipment. Further, it is often required to remove hum from the signal, restore its low-frequency response, or to remove transients which may be introduced into the system, such as may arise from switching.

Requirements

The requirements of stabilization against transients, hum removal, and low-frequency restoration may be most effectively met through the use of a clamping circuit. An additional very important advantage to be secured by use of a clamp is that the degree of sync stretching can be made independent of the character of the picture signal.

The degree of stretching should be such that RMA output (75% picture, 25% sync) may be obtained when the input signal has as little as 15% sync. The gain should be sufficient to provide an output of 2.5 volts peak-to-peak from an input as small as 0.2 volt. It should be possible to provide as much as 40% sync in the output signal to extend the usefulness of the device to unusual or exacting applications.

Inasmuch as some relaying systems may deteriorate the signal, the clamp should operate dependably even if the input signal has overshoot, poor rise time, or sync-tip modulation, and any sync-tip modulation should be removed. The sync stretcher itself should not deteriorate the quality of the signal, and accordingly should have a high-frequency response extending to at least 5 mc.

In Fig. 3 appears a block diagram of a sync stretcher[1] designed to meet the foregoing specifications. The sync stretcher consists of two channels; a sync expansion channel and clamp-pulse derivation channel.

The input signal, after passing through the first stage of amplification, V_1, is split to provide inputs for the two channels. Considering the sync-expansion channel, the signal is amplified by V_2 and then clamped by V_3 to remove extraneous low-frequency interference and transients. Clamping is done at this relatively low level to insure removal of interference before overloading and subsequent modulation onto the signal can occur. The clamped signal is further separated into two channels, a video channel and a sync amplification channel. The video channel operates at a low gain and is fed to amplifier V_4, where it is clamped by V_5 during the back porch interval. The sync channel is operated at as high a gain as may be obtained with the necessary bandwidth to preserve the shape of the sync pulses, is clamped by V_7 during the back porch interval and fed to the sync amplifier, V_8. The two channels are recombined in the common plate circuit of V_6 and V_8. V_8 is biased exactly to cutoff by means of the clamp and the sync clip control which varies the operating bias. Inasmuch as the clamping is done at the pedestal level, and since the signal is black positive at the grid of V_8, only the sync portion of the signal is amplified in this stage. Consequently, the combined signal at the plate of V_8 contains a much higher percentage of sync than the input signal. Since the pedestal level is fixed by the clamps V_5 and V_7, a simple direct-connected shunt diode clipper is used to limit the amount of sync expansion.

The signal is further amplified by V_9, which drives the paralleled output stages, V_{11} and V_{12}. The dual output pemits monitoring of the output signal without interference to the line output circuit. Each of the output stages is degenerated to provide good linearity up to approximately 2.5 volts peak-to-peak output. Circuits handling video

[1]DuMont 5057-A.

Self-Powered Unit Has Dual Outputs, Sync Expansion and Line-to-Line Clamping, and H-F Response Extending to 5 Mc. Clamps Are Four-Diode Bridge Type Which Is Relatively Insensitive to Balance Between Positive and Negative Clamp Pulses. Sync Clips Clipped by Shunt-Crystal Diode. Rapid Clamp Action Provided.

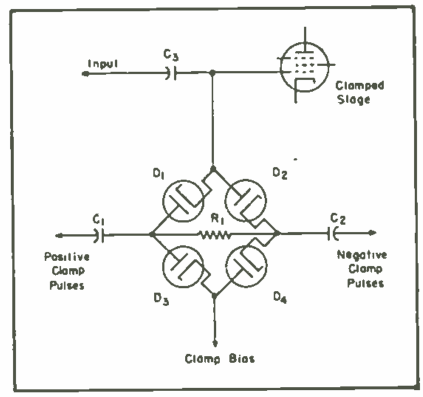


Figure 4
Four-diode bridge-type clamp used in sync stretcher.

by R. C. PALMER

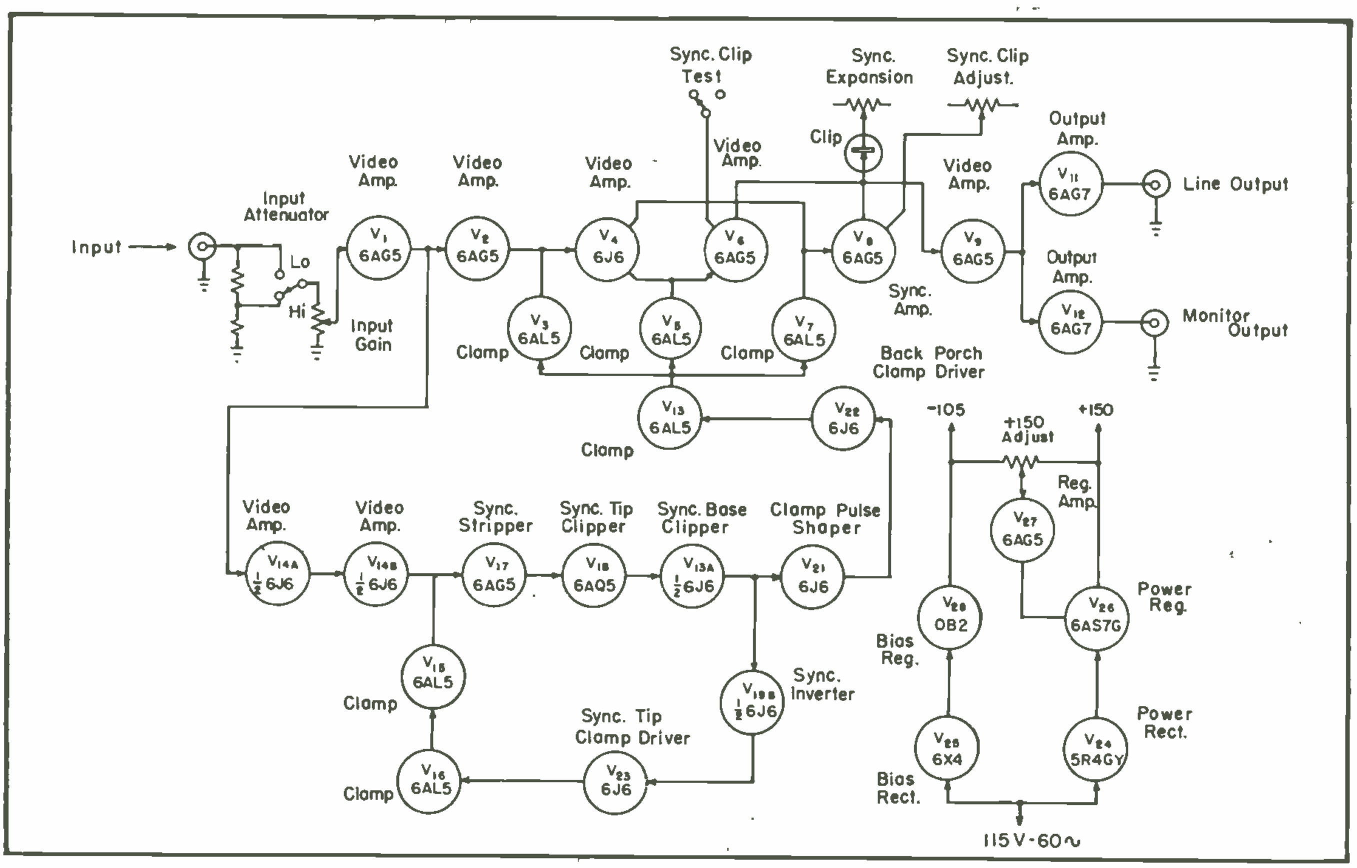
Head, Advanced Development Section
Television Transmitter Department
Allen B. DuMont Laboratories, Inc.

signal are compensated to provide flat response to 5.5 mc.

The clamp pulse derivation channel secures its input from V_1, and employs two cascaded stages of amplification in V_{14}. The first stage of V_{14} has a relatively low gain to avoid overdriving of the second stage when the input signal has a large interfering signal added to it. The second stage provides a large output signal to facilitate sync clipping in the succeeding stage, V_{17}. The signal is clamped by V_{15} during the sync interval so that the sync tips are at a constant level irrespective of input interference or deteriorated low-frequency response. The sync portion of the signal is then stripped off by V_{17}, a pentode operated at low screen voltage to insure sharp cutoff. The stripped sync present at the plate of V_{17} is then applied to V_{18} in such amplitude that the tips of the sync pulses extend below cutoff, removing any irregularities that may be present on the sync signal. This provides a very clean-topped sync at the grid of V_{19}, which is self-biased by the positive polarity sync signal input. The signal at the grid of V_{19} is of such amplitude that the base of the sync is clipped as well, providing clean sync of negative polarity and high amplitude at the plate of V_{19}. This signal is used in two ways: (*1*) It is differentiated and applied to V_{21} which shapes the positive portions of the differentiated sync to provide suitable timed and shaped pulses for the back porch clamps in the sync expansion channel. Phase inverter V_{22} supplies the clamp driving pulses for the back porch

(*Continued on page 32*)

Figures 3
Block diagram of the sync-stretcher circuit.



Enlarged WOAI/WOAI-FM Studio Technical Facilities

The master control room showing a part of the console, turntables and equipment racks. Rack on left contains the preset switching equipments, while the others contain the equipment for the large auditorium studio (*A*), medium music studio (*B*), a-m announcing studio (*C*), and f-m announcing studio (*D*).

When WOAI, NBC affiliate in San Antonio, Texas, prepared for the installation of an f-m transmitter, with requirements of separate programming, complete revamping of studio facilities was necessary.

Existing facilities were installed in 1938, when the station's studios were rebuilt throughout. At that time the plan consisted of one large control room and three studios: a large auditorium studio; a medium music studio; and an announce studio. One studio was located on each of three sides of the control room, permitting control of program origination in any studio from a single, custom-built console, having three separate control positions, one for each studio. All network, remote and transcribed programs were handled through the control panel for the announce studio.

By means of relay switching, any or all of the studio output amplifiers could be switched to a line amplifier feeding the WOAI transmitter located at Selma, some 17 miles from San Antonio. Recording and outgoing network feeds were handled by means of two bridging amplifiers equipped with rotary input switching. Since, normally, all programs originating in the studios were carried on the WOAI transmitter, this system proved very flexible and quite satisfactory.

In the planning for the new dual operation, a number of other factors were taken into consideration in order that the new facilities would provide for future expansion. The final plan called for a second announce studio for the f-m operation, a larger recording room to handle more conveniently

Figure 1
The control panel for studios *C* and *D*, the a-m and f-m announce studios.

the increasing recording load, a control booth for the auditorium studio[1] and a preset-type switching system in the master control room.

The initial planning on this construction was started in the fall of 1946 and completed one year later, the rather long time being due principally to delays in the delivery of materials and equipment. Further, it was impossible in 1946 to secure a custom-built preset switching equipment, which necessitated our assemblying and wiring this equipment in our shop.

The second announce studio was obtained by dividing the fortunately large announce studio into two studios. A sound lock was provided between the entrances for better sound isolation. To provide for a more desirable recording room, the end of a large and little used rehearsal room was made available with a single wall. This permitted moving the recording equipment out of the 5-kw auxiliary transmitter room, thereby providing room for an interim operation 3-kw f-m transmitter. Space for the last construction, the auditorium studio booth,

Installation of F-M Transmitter Required Complete Revamping of Studio Facilities for Dual A-M and F-M Operation. Additional Facilities Include Second Announce Room, Larger Recording Room, Additional Control Booth and Preset-Type Switching System in Master Control Room.

by CHARLES JEFFERS

Technical Director

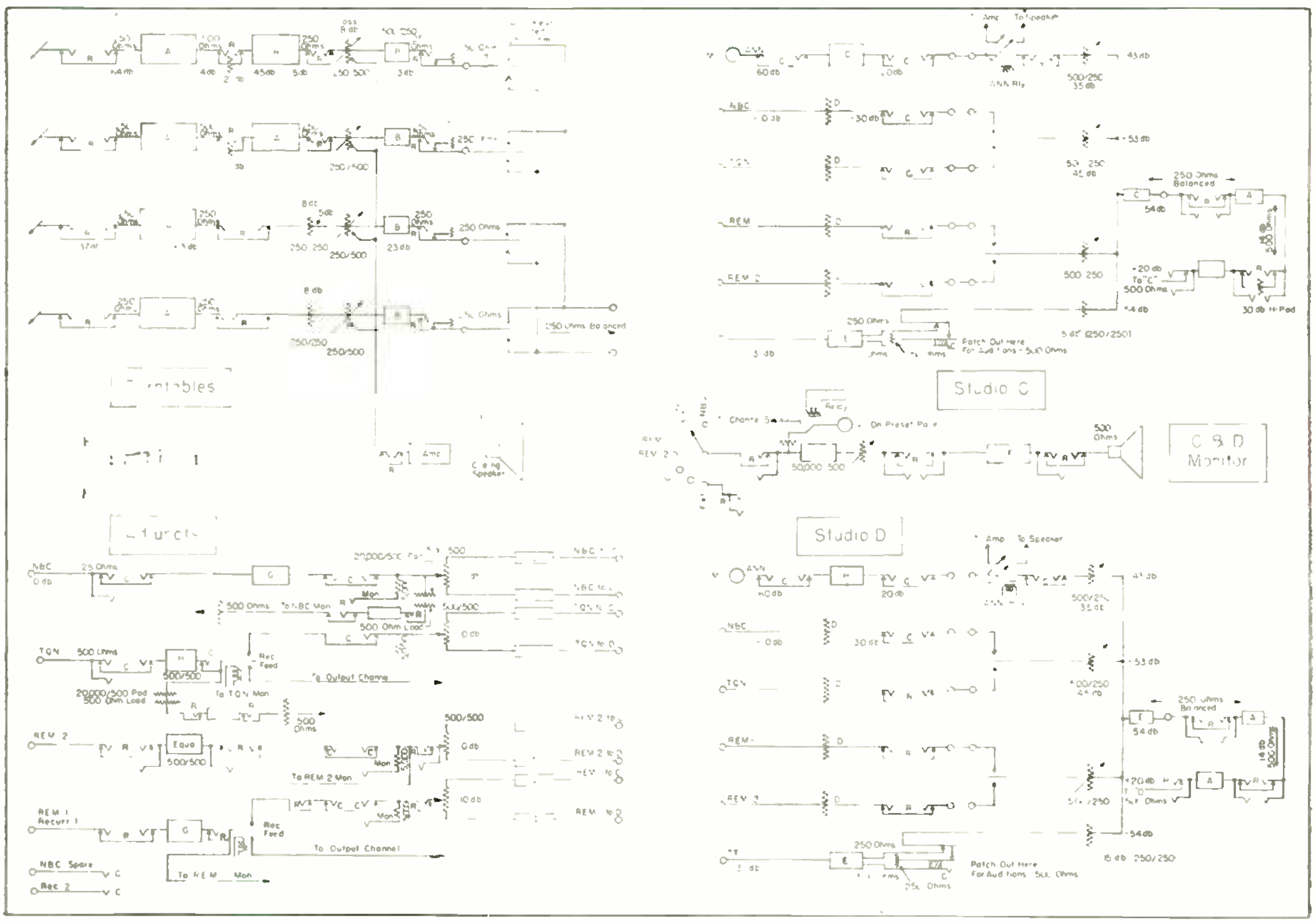
was secured from a store room adjoining the auditorium studio.

To obtain as great a flexibility in operation as possible, the old announce studio control panel was replaced with the panel shown in Figure 1. This single panel contains two separate but identical control positions, the first, for the announce studio of WOAI and the second for the announce studio of WOAI-FM. The mixer circuit of each half, as shown in Figure 2, upper and lower right, has six inputs. These are announcer microphone, National Broadcasting Company or Texas Quality Networks, remote 1 or 2, and turntables. The volume level of any channel except the turntables is adjustable on the panel. The selection of the network or remote line is made by panel keys and the announce micro-

[1] Contains a custom-built console and two turntables. All amplifiers and associated equipment are in lower part of console.

Figure 2

Mixer circuits for the announcing studios, C and D, and circuits of the turntable and adjunct systems. In these schematics, R indicates the jacks mounted on the rack, and C the jacks mounted on the console. The 500/500 ohm pads are 20 db Daven 950 types, identified as D in the circuits. The secondary of the coil in position E is loaded with a 500-ohm resistor. TQN are symbols for the Texas Quality Network.



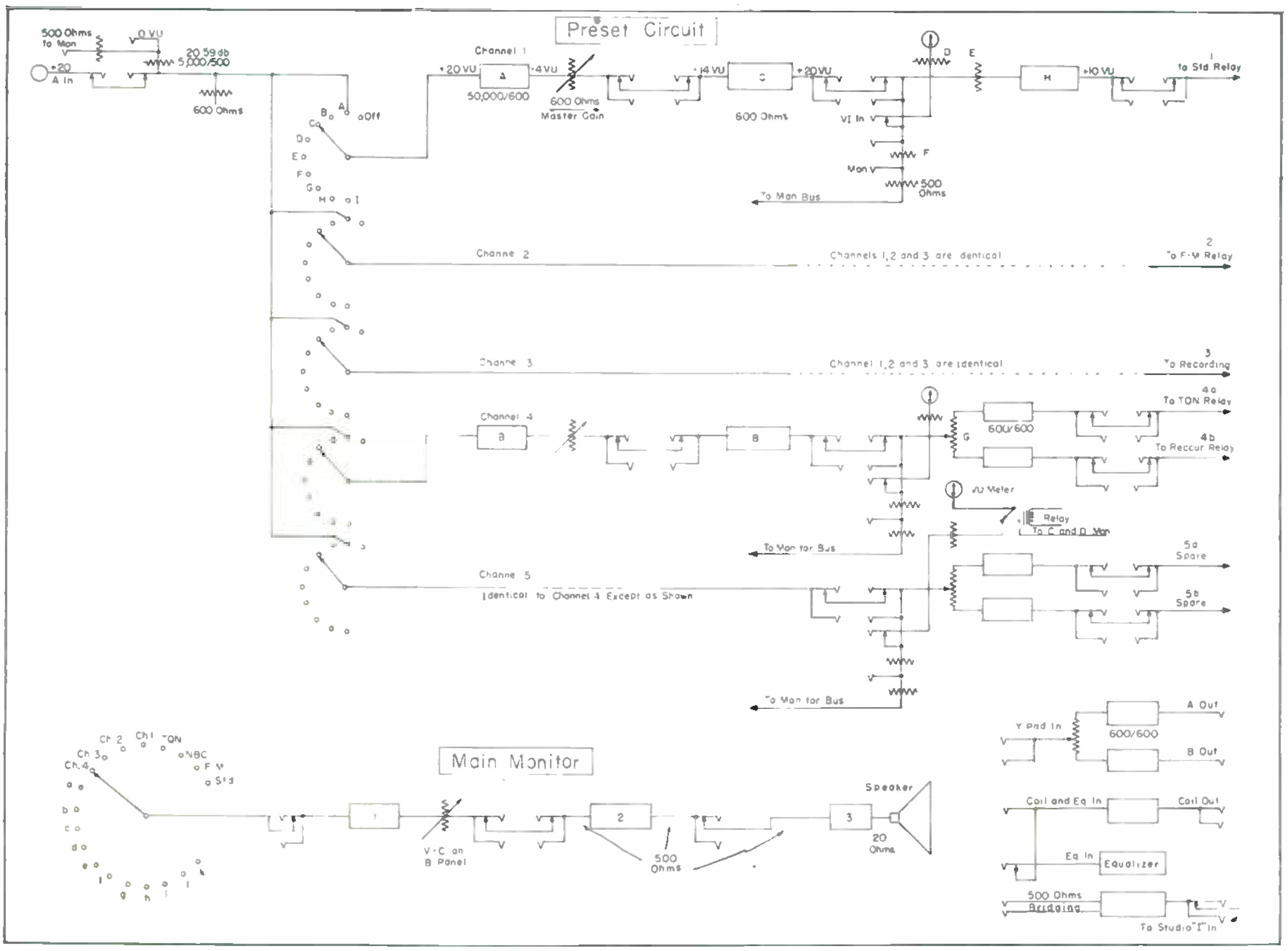


Figure 4

Schematic of the preset and main monitor circuits. This circuit shows how the number of amplifiers, normally required for monitoring, was reduced by using pads on studio as well as channel outputs. The pad used in position *D* is a Daven 1031 and 991. The pad used in position *F* is a Daven H-154, 20.59 db unit, with the value of 5000/500 ohms. Pad shown in position *E* is another Daven 600/600, 10 db model 1030. The pad in position *G* is an RCA type MI 111705.

phone off-on relay is operated by push buttons in the studio.

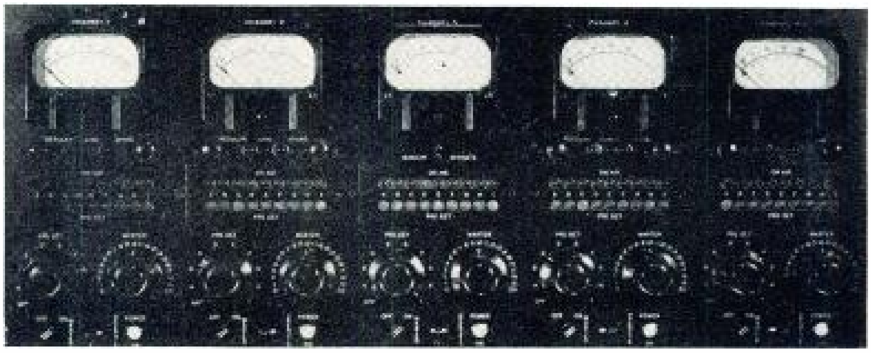
The volume output from the four turntables is controlled by individual faders, mounted in the turntable cabinets. These faders are of the cueing type for easier cueing of transcriptions. The selection of the desired turntables for the announce studios is made with the four keys in the center of the panel; this is shown in the upper left portion of the schematic of the turntable circuits. Since it is often necessary to play a musical background or an e-t spot on programs originating in the auditorium and medium-music studios, two means of patching the turntables into these mixers were provided. If only a single table is required, its output is secured by patching into the mixer out pack (through a L S-30 coil) and if more than one is required, by patching into the announce turntables-out jack, shown in lower input line of the anounce-studio mixers. Proper choice of amplifiers and pads provides the correct levels for operation into the studios with the table fader at the same attenuation setting.

The mehod used in dividing the incoming network and remote lines to provide the two necessary outputs is shown in Fig. 2, lower left. The two way pads are of the wheatstone type, providing 60 db isolation between outputs.

The TQN and remote 1 lines are reversible by means of push-button operated relays, so that a program can be either received or fed on these lines without the use of any patch cords. Remote 2 is normally used for local remote pickups and an equalizer is permanently wired into this circuit.

The monitoring circuits for the NBC and TQN lines are conventional in that bridging isolation amplifiers are used. However, since remote 1 and 2 are not carried in the main

Figure 3
The master control panel.



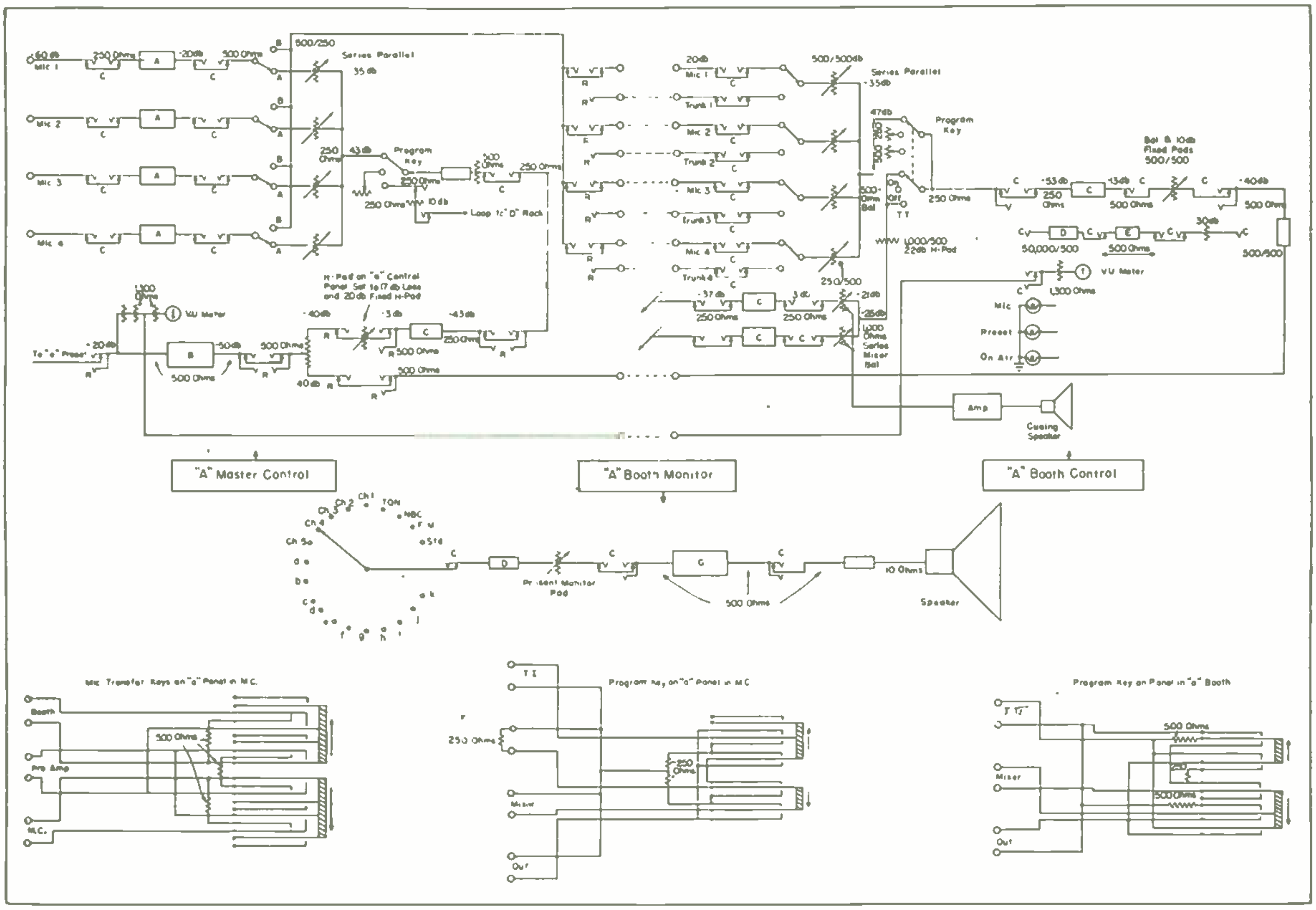


Figure 5

Control circuits for the auditorium and booths. In the microphone transfer key circuit, the bottom key makes contact with the four microphones. The transfer keys are wired in series to actuate a microphone light in the booth when all keys are in up position. The two mixer outputs are amplified by booster amplifiers and combined in a two-way pad to feed the program amplifier. The four-channel mixer system can, by means of keys, be switched from the microphone circuits to anyone of the four trunks for remote or network feeds.

monitor bus, but show up only on the monitor selector switch on the announce-studio panel, isolation was not considered necessary. The announce-studio monitor, Fig. 2, right center, has a bridging input across which a *VU* meter may be relay switched to permit both aural and level checking of incoming programs.

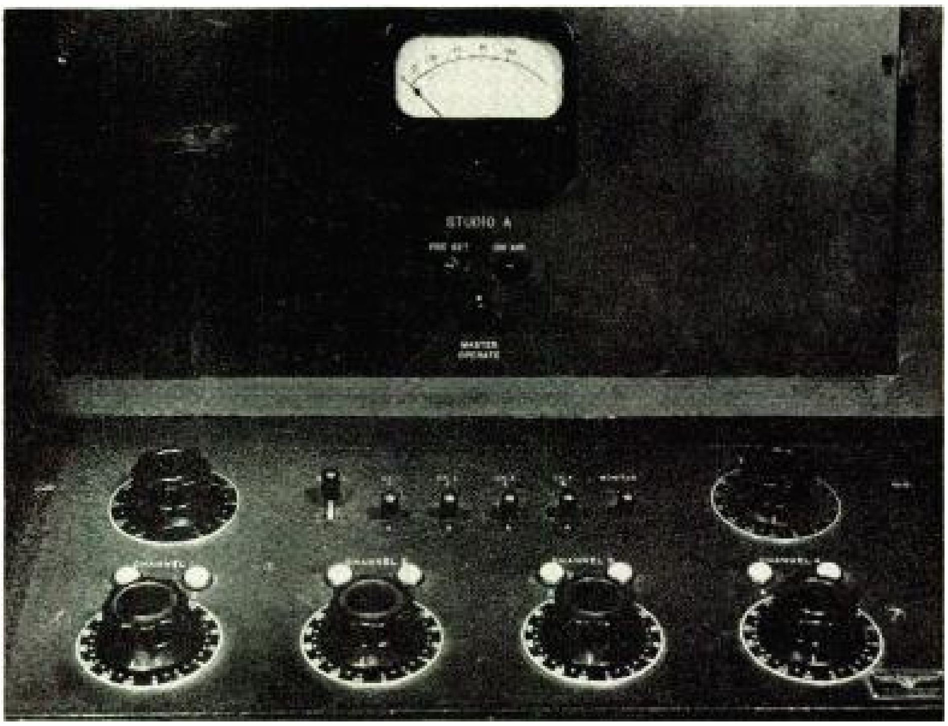
Figure 3 shows a view of the master control panel.

A switching system provides for nine inputs to five outgoing channels, with two channels being divided to feed two lines each. The switching system is relay operated and permits presenting the programs for the next period. The individual channels can be switched independently by throwing a key associated with that channel to *operate* or several can be switched simultaneously by throwing the same keys to *master* and then operating the *master operate* key at the correct time. Three *master-operate* keys are provided, one

(*Continued on page* 35)

Figure 6

The meter panel of studio *A*, which is the large auditorium studio. The three master keys are used to switch channels. The key on the left of the mixer panel operates the talk-back relay. Next four keys are for the microphone circuits and the key on the right switches the output of the mixer. When the key is down, the mixer is connected to the amplifier. In the center position, the mixer is off and when up, a trunk is connected to the booster amplifier. This trunk is used to patch to a turntable mixer out for *electrical-transcription* spots.



11 NEW INSTRUMENTS IN 2 POST-WAR YEARS

PROGRESS REPORT

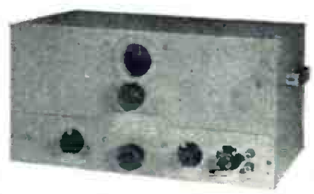
Here are the 11 new -*hp*- instruments – developed, announced, and put into production since the war's end. Each fills a definite need. Each is the product of painstaking research and advanced manufacturing methods. Each helps make simpler, easier, the measurement problems of the electronics industry.

Brief specifications appear here. For complete details on these and other -*hp*- laboratory instruments, write or wire today!

HEWLETT-PACKARD COMPANY
1513E Page Mill Road • Palo Alto, California

1

201B AUDIO OSCILLATOR



Meets every requirement for speed, accuracy, wave-form purity, ease of operation in FM and other fields where high fidelity is most important. Provides 3 watts output into 600 ohm resistive load. Distortion held to 1% or less at 3 watts, ½% at 1 watt output. Excels in testing high fidelity amplifiers, speakers, and in comparing frequencies. Output controlled by volume control ahead of amplifier, or attenuator controlling amplifier output. Attenuation approximately linear from 0 db to 40 db.

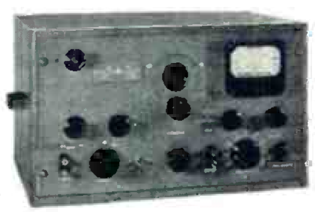
2

410A VACUUM TUBE VOLTMETER

This -*hp*- voltmeter employs a special -*hp*- diode probe which places a low capacity of approximately 1.3 uuf across circuit under test. Combination of this low capacity and high input resistance results in great measuring accuracy without detuning or danger of loading circuit. Frequency response is ± 1 db throughout the instrument's range. Six voltage ranges provide full-scale sensitivities from 1 to 300 volts. Besides covering frequencies from 20 cps to 700 mc as an a-c voltmeter, this -*hp*- 410A is a d-c voltmeter with 100 megohms input impedance. It is also a precision ohmmeter for resistances, 0.2 ohms to 500 megohms.

3

330B DISTORTION ANALYZER



-*hp*-'s newest and finest distortion measuring instrument. Unusually valuable for the measurement throughout the audio spectrum in broadcast, laboratory or production problems. Measures average value of "total" distortion at any frequency from 20 cps to 20,000 cps. Accurately makes noise measurements as small as 100 microvolts. Linear r-f detector makes possible measurement direct from modulated r-f carrier. As voltmeter, measures voltage level, power output, amplifier gain; or serves as high-gain wideband stabilized amplifier with maximum gain of 75 db.

THESE -*hp*- REPRESENTATIVES ARE AT YOUR SERVICE

CHICAGO 6, ILL.: Alfred Crossley, 549 W. Randolph St., State 7444 • HOLLYWOOD 46, CALIF.: Norman B. Neely Enterprises, 7422 Melrose Ave., Whitney 1147
HIGH POINT, N. C.: Bivins & Caldwell, 134 W. Commerce St., High Point 3672 • NEW YORK 7, N. Y.: Burlingame Associates Ltd., 11 Park Place, Worth 2-2171
DENVER 10, COLO.: Ronald G. Bowen, 1886 S. Humboldt St., Spruce 9368 • TORONTO 1, CANADA: Atlas Radio Corp. Ltd., 560 King St. West, Waverley 4761
DALLAS 5, TEXAS: Earl W. Lipscomb, 4433 Stanford Street, Logan 6-5097

4

450A WIDE BAND AMPLIFIER

Here is a new, wide-band instrument for laboratory or production use. Provides exceptional stability at 40 or 20 db gain. Gives freedom from spurious responses. Low phase shift assured by straightforward, resistance-coupled amplifier design, together with inverse feedback. Frequency response flat within ½ db between 10 and 1,000,000 cps. Varying tube voltages or aging tubes have no appreciable effect on gain or other characteristics. When used with *-hp-* 400A Vacuum Tube Voltmeter, increases voltmeter's sensitivity to 100 times. Increases bridge and recorder sensitivity.

5

710A POWER SUPPLY

Light, compact, inexpensive, this *-hp-* power supply is an excellent all-around source of d-c power. It replaces batteries for temporary setups, or serves as permanent installation. Output varies approximately 1% with changes in load current to 75 ma or normal line variations. Noise and hum level exceptionally low. Output unusually stable over long periods of time. Instrument also contains auxiliary center-tapped 6.3 volt source providing 5 amperes a-c. Output is continuously variable, 180 to 360 volts, and is practically independent of either line voltage or applied load.

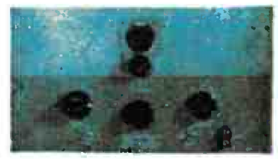
6

610A UHF SIGNAL GENERATOR

This new *-hp-* generator is an extremely stable general-use laboratory standard for measurements between 500 and 1350 mc. Throughout those frequencies it gives accurately known voltages ranging from 0.1 microvolt to 0.1 volt. R-f output may be continuous, amplitude modulated, pulsed or square-wave modulated. Pulse length can be controlled between 2 and 50 microseconds. Pulse rate is variable 60 to 3000 times per second. Instrument is particularly valuable for determining gain or alignment, antenna data, standing wave ratios, signal-to-noise ratios or circuit "Q."

7

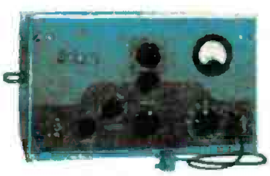
202B LOW FREQUENCY OSCILLATOR



This newest *-hp-* oscillator gives maximum speed and accuracy for tests between ½ and 1000 cps. Particularly designed to test performance of electro-cardiograph and electro-encephalograph equipment, check vibration or stability of mechanical systems, simulate mechanical phenomena, check geophysical equipment. Throughout frequency range provides excellent wave form. Frequency stability within 5%, including initial warm-up drift. Output is 10 volts maximum into 1000 ohm resistive load. Four frequency ranges. Cps read direct on large illuminated dial. Tuning is controlled by direct or 6 to 1 micro-drive vernier.

8

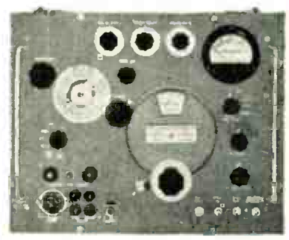
650A WIDE BAND OSCILLATOR



Continuous frequency coverage 10 cps to 10 mc, is provided in this stable, new *-hp-* oscillator. Output is flat within 1 db. Voltages available range from .00003 to 3 volts. 94" scale-length, 6 to 1 micro-controlled tuning drive, 50 db output attenuator variable in 10 db steps. Output voltage divider provides 6 ohm internal impedance. *-hp-* 650A is specially designed for testing television amplifiers, wide-band systems, tuned circuits, receiver alignments, and checking filter transmission characteristics. And, this precision-built *-hp-* oscillator serves admirably as a power source for bridge measurements or as a signal generator modulator.

9

616A UHF SIGNAL GENERATOR



Here for the first time is a precision instrument making possible fast, direct output and frequency readings between 1800 to 4000 mc, *plus* simplified controls and a choice of c-w, pulsed, delayed or limited f-m output. No calibration charts are necessary. R-f output ranging from 0.2 volt to 0.1 microvolt is available. Output continuous, pulsed or frequency modulated at power-supply frequency. Wide selection of pulse rates, internal and external synchronization. Stability approximately 0.005% per degree centigrade change of ambient temperature.

10

-hp- 335B FM MONITOR

This new *-hp-* 335B is the finest FM monitor ever developed. Requires no attention during operation. Provides continuous measurement of carrier frequency and modulation swing. Approved by F.C.C. for FM broadcast service. Frequency range 88 to 108 mc. Audio output has less than 0.25% residual distortion. Audio output supplied with 75 microsecond de-emphasis circuit, flat within ½ db of standard curve, 20 cps to 20 kc. Residual noise and hum in audio output at least 75 db below 100% modulation. Modulation may be monitored at control console or other remote point.

11

AUDIO SIGNAL GENERATOR -hp- 206A

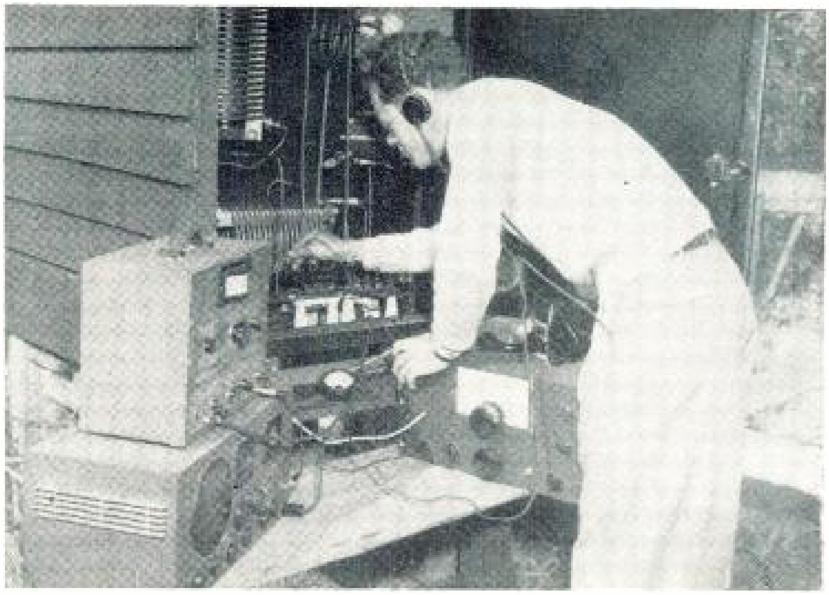
Here is a source of continuously variable audio frequency having total distortion or less than 0.1%. High stability, frequency response flat within 0.2 db beyond output meter. Output impedances are 50, 150 and 600 ohms. Instrument provides continuously variable frequency range, 20 cps to 20 kc, tunable throughout, 3 bands with a 47" micro-controlled dial. Precision attenuators vary output signal level in 0.1 db steps over 111 db range. Both *-hp-*206A generator and *-hp-*335B Frequency Modulation Monitor can be supplied in special colors to match transmitter installations.

hp laboratory instruments

FOR SPEED AND ACCURACY

James A. Hudson, chief engineer of WHMA, at the coupling unit.

(Right) Raymond C. Watson, Jr., chief engineer of WOOB, at the interference coupling unit.



Eliminating Interference Resulting From Coupled Antennas

Solutions to Interference Problems Prompted by Simultaneous Operation of Transmitters Whose Antennas Are Close Together. Filter System Evolved for 250-Watt 1450-Kc WHMA and 250-watt 1490-Kc WOOB, with Towers 560′ Away from Each Other.

by F. E. BUTTERFIELD

The Andrew Company

As the a-m and f-m bands are occupied by an ever increasing number of stations it becomes more and more difficult to provide physical separation between the antennas of these stations. Simultaneous operation of two transmitters whose antennas are close together will create interference problems of considerable magnitude, problems which will be intensified if the operating frequencies are also close together.

Typical Problem

An example of this problem appeared in the recent WOOB-WHMA installation in Anniston, Alabama. WHMA has been operating on 1,450 kc with 250 watts for a number of years. WOOB had been granted a construction permit for a 250-watt 1,490-kc installation, chose a transmitter site adjacent to that of WHMA, and erected a new 150′ tower 560′ from the 190′ WHMA radiator. The mutual impedance between these towers was found to be about 11 ohms. In analyzing this coupling, it was found that: (1) Part of the antenna current measured at the base of the tower was produced by the other transmitter, and (2), a large voltage was produced in the plate circuit of one final amplifier by the other transmitter. The first of these effects prevented accurate measurement of power input to the antenna and the second produced intermodulation and the radiation of spurious signals. In this case the most important modulation products occurred at 1,410 and 1,530 kc, the second harmonic of one station minus the fundamental of the other.

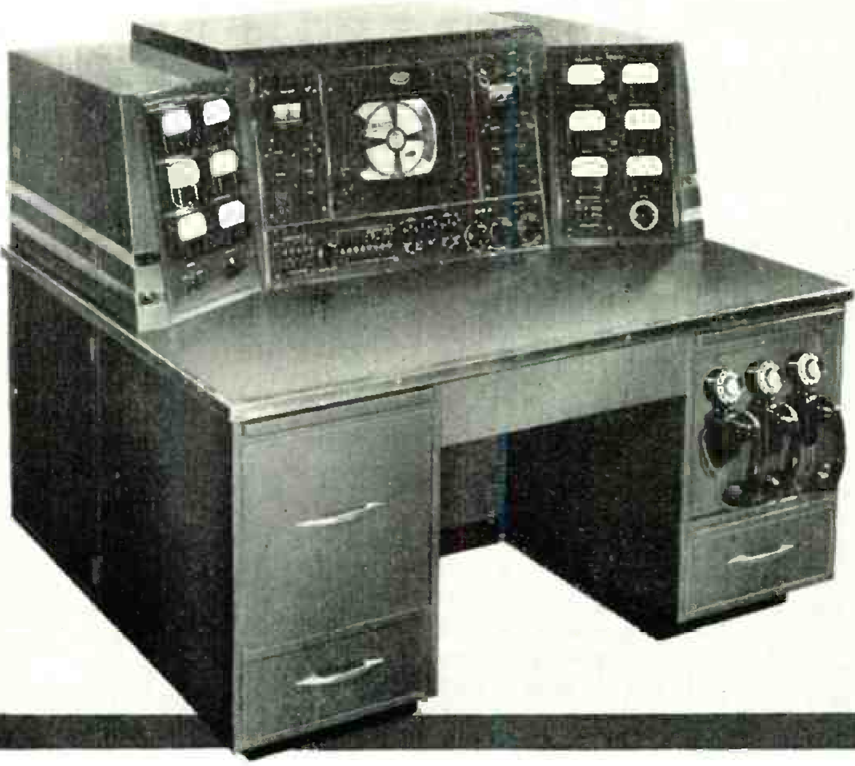
There are other less serious aspects of the problem, but they may be of practical importance in certain cases. For instance, the audio equipment of one station may be in a strong r-f field from the other. Unless the installation is carefully shielded and grounded, the modulation of one station may appear in the audio equipment of the other. Further, the antennas will have base impedances when placed together in this manner different from their impedances when widely separated. If one is erected after the other redetermination of the impedance of the original tower may be necessary.

To eliminate the coupling trouble of WOOB and WHMA it was decided to build filters into the tuning units to reject the interfering frequencies.

Circuit of a tuning unit normally used with a single antenna, is shown in Figure 1, and Figure 2 shows the same unit with the filter circuits added. The complete filter is composed of two elements. The first is a series element of high impedance at the frequency to be rejected and low at the frequency to be transmitted. This element reduces the interfering frequency current flowing in the tower and power measurement by the direct method becomes possible. The series element gives some reduction of voltage at the

At the operator's finger tips . . . every vital indicator and control...for maximum operational convenience...

DU MONT Type TA-129-A *Transmitter Control* CONSOLE



Convenience of the streamlined order marks the advanced design of this Du Mont Transmitter Control Console. Transmitter meters and controls are duplicated immediately in front of the seated operator. The smartly styled metal desk holds all monitoring equipment at optimum viewing angle; provides storage space for drawings, memos, logs, typewriter, telephones, etc.; and is complete with all visual and aural monitoring facilities. Space is provided for additional amplifying equipment if required.

The Du Mont Transmitter Control Console is just another link in the chain of Du Mont equipment from camera to transmitting antenna insuring the "First with the Finest in Television."

LITERATURE ON REQUEST. LET US WORK WITH YOU ON YOUR TELECASTING PLANS AND PROBLEMS.

FEATURES . . .

12-inch Picture Monitor and Power Supply.

Line and Frame Waveform Monitors, and High- and Low-Voltage Power Supplies.

Station Monitor Receiver.

Visual Frequency Monitor.

Aural Frequency and Modulation Monitor. Aural Frequency Monitor Power Supply.

Visual Meters: PA Plate Ammeter, PA Plate Voltage, Transmission Line Voltage, Carrier Frequency Deviation, Input Level, and Test Meter.

Aural Meters: PA Plate Current, PA Plate Voltage, Transmission Line Voltage, Center Frequency Deviation, Modulation Percentage (KC Swing), Input Level (Vu Meter), and Line Voltage (Single- and Three-Phase).

Pilot lamp flashes when modulation level exceeds any preset positive or negative modulation percentage.

Visual and aural input line switching and previewing selectors.

Visual and aural monitoring keys enable the operator to monitor sight and sound from almost any circuit.

Space available for additional facilities such as room-lighting switches and other desired accessories.

Adaptable for use with any make or model transmitter.

START AS SMALL AS YOU WISH, WITH THE DU MONT *Acorn Package*

DUMONT *First with the Finest in Television*

ALLEN B. DU MONT LABORATORIES, INC., TELEVISION EQUIPMENT DIVISION, 42 HARDING AVENUE, CLIFTON, N. J.
SEE OUR DISPLAYS AT BOOTHS 244-248, I.R.E. NATIONAL CONVENTION

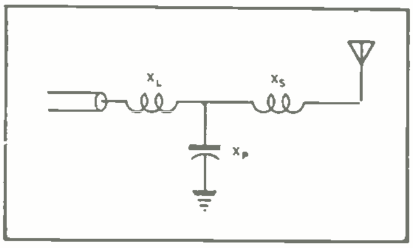


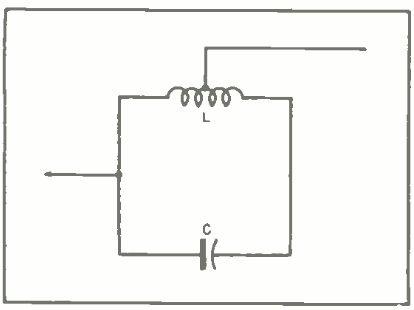
Figure 1
Tuning unit circuit normally used to match single antenna.

junction point in Figure 1, but this voltage can be reduced a great deal more by adding the second element of the filter from this point to ground. This element is series resonant at the interfering frequency and of some high reactance value at the frequency to be transmitted. The transmission line is effectively short circuited at the interfering frequency. With careful design and adjustment, the reactance obtained from this circuit at the frequency to be transmitted will form part or all of X_P in the tuning circuit.

In the WOOB-WHMA case, the coupling between antennas was sufficient to cause an interference current in one of towers of about 20% the normal indication when the filters were not used. The interference voltage at the transmitter was also about 20% of the normal value. Very strong signals were found on both 1,530 and 1,410 kc. Second harmonic traps at the transmitters had no effect on output at these spurious frequencies, indicating that only suppression of fundamental interfering frequencies would be an effective remedy.

The difference between 1,450 kc and 1,490 kc is only 2.75%. However, great changes in impedance over this range are required. These wide changes in impedance can be obtained with large reactances of relatively low Q in the series-resonant shunt trap, but the components are of impractical size and voltages are high. The reverse is true in the parallel-resonant series trap. The Q should be very high.

Figure 3
A tapped-tank circuit applied directly in place of the parallel-resonance series trap of Figure 2.



the reactances impractically small and currents extremely high.

The tapped tank of Figure 3, which can be made from components of reasonable size to attain a good Q, components carrying reasonable currents, may be applied directly in place of the parallel-resonant series trap[1] of Figure 2.

The tapped-tank characteristics (mutual impedance between parts of coil neglected), were:

$X_L = 213$ ohms, $X_c = 213$ ohms } at interfering frequency (1,490 kc)
$Q_L = 400$

Position of tap was at about 10% of coil.

$R_{res} = 800$ ohms.
Reactance at frequency to be transmitted = 56 ohms.
Voltage across tank, 1.65 (56) = 92.52.
$I_L = 4.65$ a and $I_c = 3$ a.
Power loss = 4.5 watts.

These data indicated that the tapped tank was preferable. The capacitor required in the trap of Figure 2 had a capacitance of .106 mfd, rated at about 60 amperes, while the capacitor used in the tapped tank was a .0005-mfd unit with a current rating of 6 amperes.

By placing a tap on the inductance of the tapped tank, we have a coil in series with the capacitor, reducing the reactance in this branch to a low value. In the series-resonant shunt trap, the process can be reversed and parallel resonance utilized to produce high reactance.

A two-element circuit for this trap would have an impedance of 100 ohms at frequency to be transmitted, 1,450 kc.

$X_L = 1{,}820$ ohms, $X_c = 1{,}820$ ohms } at frequency to be rejected (1,490 kc)
$Q = 300$
Impedance at 1,490, 6 ohms.

With a voltage at point A of 200 at the frequency to be transmitted, the current in the coil is 2 a and the power loss 24 watts. The voltage across coil and capacitor is about 3,600.

Values of a three-element trap of Figure 4, which may be substituted, are:

$X_L = 167$ ohms, $X_{c1} = 213$ ohms, $X_{c2} = 778$ ohms } at 1,490 kc, frequency to be rejected
$Q_L = 400$

[1]The data for the parallel-resonant series trap of Figure 2 are:
$X_L = 1$, $X_c = 1$ } at interfering frequency (1490 kc)
$Q_L = 200$
$R_{res} = 200$ ohms

Reactance at frequency to be transmitted is 18 ohms. With an antenna current of 1.65 amperes, the voltage across this tank is 30. The currents in L and C are 30.85 and 29.2 amperes, respectively. Power loss in the coil is 4.8 watts.

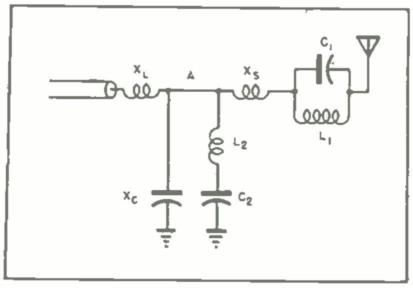


Figure 2
The circuit of Figure 1 with filter circuits added.

The impedance at 1,490 kc is about 8.5 ohms, the impedance at the frequency to be transmitted is 170 ohms and the current through the trap, 1.2 amperes. The voltages appearing across the capacitor and the tank are 960 and 756 volts, respectively, with current in the coil, 4.6 amperes. Current in C_1 is 3.5 amperes and power loss 8.4 watts.

This design, used in the WOOB-WHMA filters, permitted the use of components of reasonable size, with losses and voltages across reactances reduced. Since the frequency separation between the stations was so small, tuning of the circuits was extremely critical. It was necessary to provide the coils with clip-connected leads on both ends, capacitor C_2 being variable.

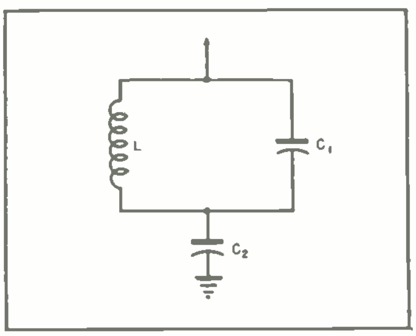
Fortunately the effects of detuning in the circuits can be recognized easily by operating personnel and retuning can be readily accomplished by adjusting the circuits to reduce the intermodulation products to a minimum.

Tuning of WOOB Unit

The parallel-resonant series trap at WOOB was adjusted for minimum antenna current with only the WHMA transmitter operating. The series-resonant trap at WOOB was adjusted for minimum line voltage with only

(Continued on page 40)

Figure 4
A 3-element shunt-trap circuit which may be substituted for the trap shown in Figure 2.

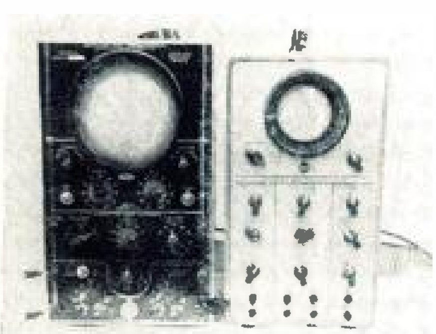


Test Instruments In The

Chief transmitter operator, Joe Davenport, with a rack of test instruments. Top to bottom, left to right: Composite signal generator, vtvm, distortion meter, audio oscillator, 'scope and communications-type receiver.

Author measuring impedances in a 5-kw Doherty amplifier with an r-f bridge, signal generator, and detector-receiver.

Two types of 'scopes used at WIS.



Good test equipment is to the broadcast engineer as the pen is to the writer, *indispensable*.

It is possible now to purchase excellent test instruments at reasonable cost, with the assurance that the investment will be a worthy one, and with care, will require very little maintenance through the years they remain in service. There is little excuse for a broadcasting station's technical personnel to be without the essential instruments to maintain a high quality of reproduction of the programs which the station airs.

Back in the good 'ole days when the frequency of the transmitter was set on the proper end of the band in the mornings with a home-made wavemeter, and no one had ever heard of a modulation monitor, test instruments were rare indeed. At an early station where the author eked out a bare living there was but one test unit, a *reflex voltmeter*. Its principle of operation was quite unique: To determine the amount of a certain potential, chalk marks were carefully drawn on the floor, twelve inches apart, in a line away from the voltage point to be measured. The hand was placed firmly on this voltage point. If an operator was knocked five feet, then the point was five hundred volts above ground, at ten feet it was 1,000 volts, etc. It was not as accurate as the sensitive voltmeter of today, but 'twas better than nothing and it toughened us up for the years ahead when we were introduced to such torments as soap operas, audience participation programs, and kid shows.

The most important, and most often used test instrument today is the volt-ohm-milliammeter. The audio oscillator is next, and the distortion analyzer follows. The oscilloscope and capacitor bridge are also found quite necessary at times. In addition, there are the vacuum-tube voltmeter, signal generator, radio-frequency bridge, decade-resistor box, and field-strength meter, the usefulness of which vary with the individual stations.

At this station we have several 20,000 ohms-per-volt volt-ohm-milliammeters,[1] and have found them unusually accurate and versatile. The db scale is quite flat from 30 to 15,000 cycles, and thus it can be used in making frequency runs; the scale is calibrated for 500 ohms. The ohm scale can be read to within .1 ohm on the low scale and to 20 millions on the highest scale. When measuring 5,000 volts of d-c, the meter consumes but 50 μa. This means that the meter resistance is equal to a resistor of 100 megohms across the 5,000-volt supply.

Photographs by Joe Davenport, Chief Transmitter Operator WIS and WISP.

Effectiveness of Sensitive Meter

The usefulness of a sensitive meter became quite apparent to the writer sometime ago during the installation of a central sound system in a large school. After all wiring had been installed, it was found that one shielded pair was open and two other pairs had one conductor grounded to the shield. Since all leads were approximately 500′ long, it was more desirable to find the faulty points and correct them rather than replace the three lines. A 100′ length of the same type of wire was cut and its loop and shield resistance carefully measured. Then, with a capacity bridge, the capacitance of the conductors, to each other and then to shield, was measured and noted. The resistance per foot and capacitance per foot was then calculated, and it was found that the shorted spot could be determined within plus or minus five feet. Using the bridge on the open line, the accuracy of location was approximately the same value. Without sensitive test equipment this problem could not have been solved. These same faults could easily occur in long control lines or microphone cables in the studios of a broadcasting station.

A few short years ago the best meter available, outside of the laboratory, operated with a one-milliammeter movement. This meant the use of a battery of at least 22.5 volts for upper scale ohm measurements and a too large power consumption when measuring high voltage. For example, if 5,000 volts were being measured, the meter itself would draw five watts and if the regulation of the power supply were poor, the voltage could be much higher than the meter actually read.

The Audio Oscillator

A resistance-tuned audio oscillator[2] is used at our station.

The frequency of this oscillator is determined by the decay time of the

Broadcast Station

Characteristics and Operational Features of Typical Test Equipment Employed in Broadcasting Today . . . Volt Ohm-Milliammeter, Audio Oscillator, 'Scope, Distortion and Noise Meter, Capacitor Bridge, VTVM, Signal Generator, R-F Bridge, Decade-Resistor Box, Field-Strength Meter, etc.

by **HERBERT G. EIDSON, Jr.**

Chief Engineer, WIS and WISP
Technical Director, WIST

RC networks, R_1C_1, R_2C_2.

The formula *TC* = *RC*, where *TC* is the time constant and *RC* is the product of *R* and *C* in units, with *TC* the reciprocal of the desired frequency, explains how values of components are derived.

The resonant frequency of the *RC* network is inversely proportional to the product of resistance and capacity. Thus the change in resonant frequency of this circuit is three times as great as that of the coil and capacitor circuit. A 10:1 frequency change is easily possible with the resistance-tuned circuit.

The resistance-capacity network is operated in conjunction with a stabilized amplifier. Positive feedback is applied to this amplifier through the resistance-tuned network, resulting in a high effective *Q* for the circuit. Negative feedback is also used and operated in conjunction with a non-linear resistor (a lamp), to limit the amplitude and to decrease distortion. It also helps in providing a constant and extremely stable output over the entire audio range.

We have used the oscillator to make audio-frequency runs on transmitter-studio lines, audio amplifiers, recording equipment (both tape and disc types), transmitters, monitors and receivers. It is used also in conjunction with a distortion and noise analyzer and oscilloscope.

Distortion and Noise Meter

We selected a distortion and noise meter[3] with an r-f detector range of 500 kc to 60 mc, voltmeter accuracy of ±3% (which does not appear to be affected by changing of tubes), it being possible to use the voltmeter used independently to measure voltages from .03 to 300. The unit can measure distortion between 20 and 20,000 cps, distortion measurements being accurate to ±3%. Noise can be measured to −80 db.

An r-f diode detector is used to measure distortion in an r-f wave. This can be switched out when the audio alone is under test.

Analyzer Operation

Audio voltage is introduced into a selective amplifier, which operates in conjunction with a wein-bridge resistance-tuned circuit, to provide infinite attenuation at one frequency, while allowing all others to be passed at the normal gain of the amplifier. Negative feedback is employed to minimize distortion and provide a high order of stability.

The voltmeter section of the instrument consists of a two-stage high-gain amplifier, rectifier and an indicating meter.

When measuring distortion in the transmitter carrier the procedure is simple. The transmitter is modulated to the desired percentage, r-f diode is tuned to the r-f frequency, and the analyzer reference level is set. The selector switch is then moved to the *distortion* position on the meter and the wein bridge tuned to the frequency of the modulating oscillator. The remaining output, after the fundamental is removed, is measured on the vacuum tube voltmeter, calibrated in % rms distortion.

In checking for noise below 100% modulation, the selector switch is placed on *set level* and the amplitude is adjusted to zero with the 10-db attenuator set on 100%. The oscillator is then removed from the input of the transmitter and the latter is terminated in 600 ohms. The selector switch is moved, and the *noise* position and the attenuator control rotated until the meter reads well on scale. This reading will be in db below 100% modula-

(*Continued on page* 37)

[1]Simpson 260.
[2]Hewlett-Packard 200-B.
[3]Hewlett-Packard 330-B.

Figure 1
Basic schematic of resistance-tuned oscillator.

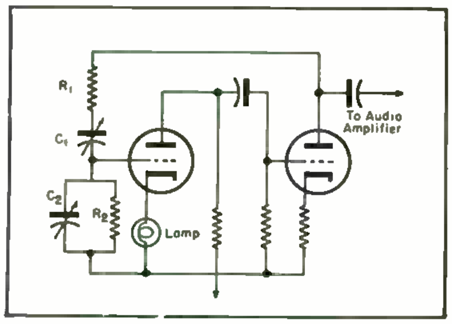


Figure 2
Block diagram of audio oscillator used at WIS (*H-P 200-B*).

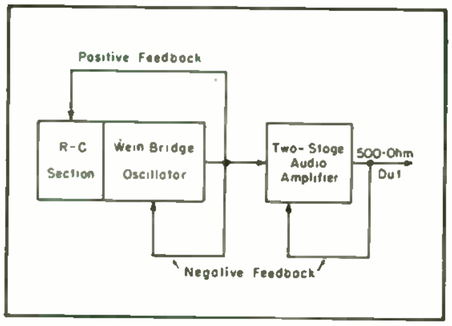
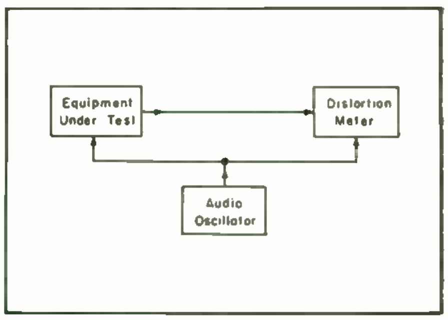


Figure 3
Setup of measuring system using one type of distortion meter.



TUBE *Engineering News*

Design and Application Features of Triode-Type Magnetic-Deflection 2½" Projection TV Tube Operating on 25 Kv.

TV PROJECTION research has resulted in many unusual picture-tube developments. An interesting example is the 3NP4,[1] a 2.5" magnetic-deflection triode producing a 12" x 16" image from a 1.4" x 1.86" picture on the tube face, with a 25-kv anode potential.

An aluminum coating on a phosphor screen of the tube increases light output and prevents ion spots, thus requiring no ion trap. A white light is provided with a color temperature of approximately 6,200° K. The second-anode inside coating covers most of the cone. Near the face of tube is a glass cup, which surrounds a second-anode contact, and into which fits a molded thermoplastic cable terminal carrying the 25-kv potential. An outside Aquadag coating is grounded and serves as a static shield. Capacitance between the two coatings serves as the final filter capacitor.

The average beam current is approximately 90 microamperes. Highlight peaks reach 500 microamperes and higher. The spot size remains substantially constant at approximately 0.003", with a peak brightness on the tube face of 3,000 foot-lamberts.

For focusing, a 1,000-ampere-turn coil is used. The total deflection angle is 40°. Full deflection can be obtained with the excitation required to deflect a 10BP4-type 10" direct-viewing picture tube, operated at 9 kv. Approximately 50 volts peak-to-peak is required for grid driving, while the filament operates at 6.3 volts, .75 ampere.

Two types of focusing coils are available for the tube. Approximate values are: Series type, r = 300 ohms; i = 120 ma, ±10%. Shunt type, r = 11,200 ohms; i = 20 ma, ±10%.

Approximate deflection yoke specifications are: Horizontal deflection, l = 8.5 mh; r = 15 ohms. Vertical deflection, l = 50 mh; r = 65 ohms.

The tube fits into a special 5-prong socket. It is 10.5" long and its neck diameter is .875".

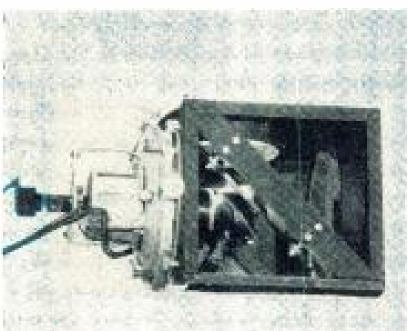
Tube provides a contrast ratio of 30:1 and a highlight brightness of 45 foot-lamberts.

To provide 25 kv for the tube, a special power system has been developed using a 6SR7 (duplex-diode tri-

(*Continued on page 40*)

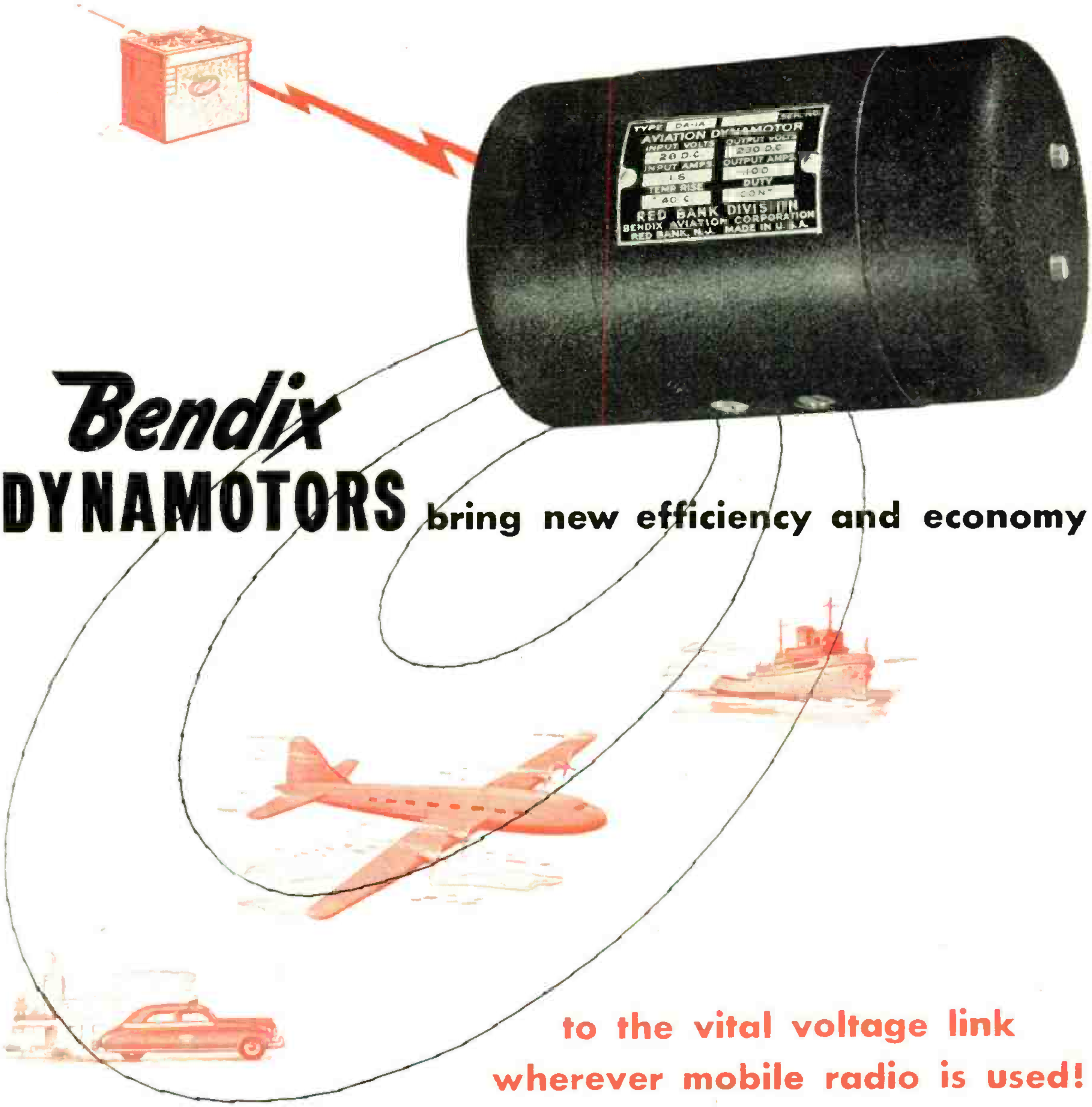
[1]Tube is used in a *Protelgram* system originated in the Philips Research Laboratories in Holland, and further developed in the engineering labs of North American Philips.

Internal view of optical unit employed with the 2½" picture tube. Note the optical triangle formed by spherical mirror, plane mirror with elliptical hole providing clearance for the tube face and the corrector lens.



The 2½" magnetic-deflection picture tube, with a base oicture size of 1.4" x 1.86".

High voltage 25-kv power supply designed as second-anode power supply.



Bendix DYNAMOTORS bring new efficiency and economy

to the vital voltage link wherever mobile radio is used!

89 DIFFERENT MODELS
Covering all frame sizes and voltages

Bendix Dynamotors cut down on service requirements—are designed for easy servicing with standard tools, and feature complete interchangeability of parts. Write for details—there's a Bendix Dynamotor tailor-made for your installation!

Wherever a mobile radio operates from a storage battery, *Bendix** Dynamotors can add materially to *efficiency* and *economy*. These precision-built units have a remarkably long life—operate day after day with virtually no service, providing the vital voltage that is the key to efficient performance. If you are designing a new mobile radio set or replacing dynamotors, specify Bendix Aviation Quality Dynamotors—they're priced right and built by the foremost producer of mobile power equipment. Available for quick delivery in all standard frame sizes and voltages.

*REG. U.S. PAT. OFF.

Dynamotors • Inverters • Convertors • D.C. Motors • Carbon Pile Voltage Regulators

RED BANK DIVISION of Bendix AVIATION CORPORATION
RED BANK, N. J.

Antenna Pattern Measurement

Aeronautical, Marine, Car and Broadcast Antenna-Measurement Procedures, Which Can Be Applied at Fixed, Mobile and Airborne Points to Facilitate Antenna-Design Work and Provide Actual Operational Performance Data. Systems Used Include Computing Aids, Scale Models, Airborne Field-Intensity Meter Tests, Polar Recorders, etc.

by H. R. SKIFTER and J. S. PRICHARD

Airborne Instruments Laboratory

THE NEED FOR MORE information on the radiation patterns of antennas is well appreciated by everyone in radio communications. Antenna directivity is often desirable to obtain the maximum effectiveness for minimum power radiated and to ensure minimum interference with other stations and services. With more and more stations and services clamoring for a share of the available radio spectrum, the need for maximum effective use by each individual station becomes more imperative. The actual radiation pattern of an antenna provides a means of evaluating the extent to which this ideal is achieved. When the radiation pattern is known, present knowledge of propagation makes it possible to calculate the field intensity at any particular receiving point. (This is particularly applicable to ground-wave propagation and is becoming increasingly so with sky-wave and tropospheric-wave propagation.)

The principle of reciprocity states that the directivity pattern of a given antenna is unchanged whether the antenna is used for transmission or reception. Hence the radiation pattern of an antenna can be determined (*1*) by measuring the radiated field in each direction when it is used as a transmitting antenna, or (*2*) by measuring the received field from each direction when it is used as a receiving antenna. It is generally simpler and more convenient to measure the field with the antenna performing the function for which it was designed; however, it is not necessary to do so.

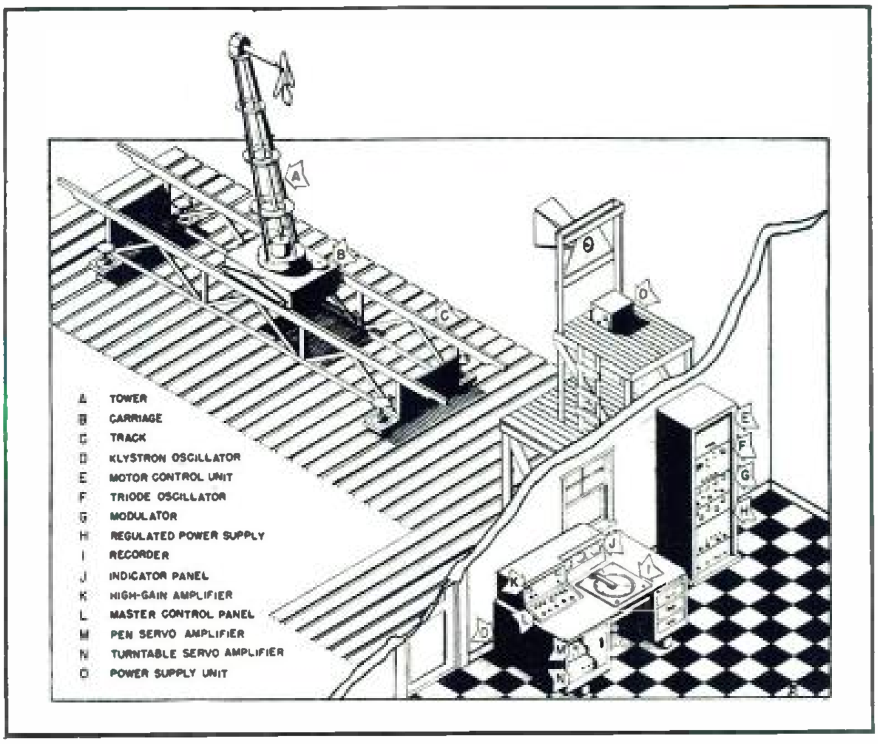
Radiation patterns are usually measured for one of two purposes: (*1*) To help in the design of a new antenna, or (*2*) to determine the actual operating performance of an existing antenna; that is, as a *proof of performance*. These two purposes are not always separate and distinct.

Design Measurements

Simple antenna systems are often designed directly from theoretical considerations; frequently, empirical relations are also used.

An explanation of the word *simple* is perhaps in order here, and it can best be illustrated by examples. A typical simple antenna may be a uniform-cross-section vertical radiator on a uniform ground-plane, a straight-wire antenna above a uniform ground-plane or in free space, or an array of uniform-cross-section vertical radiators on a uniform ground-plane. On the other hand, a simple uniform-cross-section radiator on a non-uniform ground-plane (such as an aircraft fuselage or wing), with dimensions of the order of one wavelength, constitutes a complex antenna system. Such complex antenna systems usually cannot be easily analyzed mathematically; rather, they are designed somewhat

Figure 1
Units used in model-range system for antenna measurement.



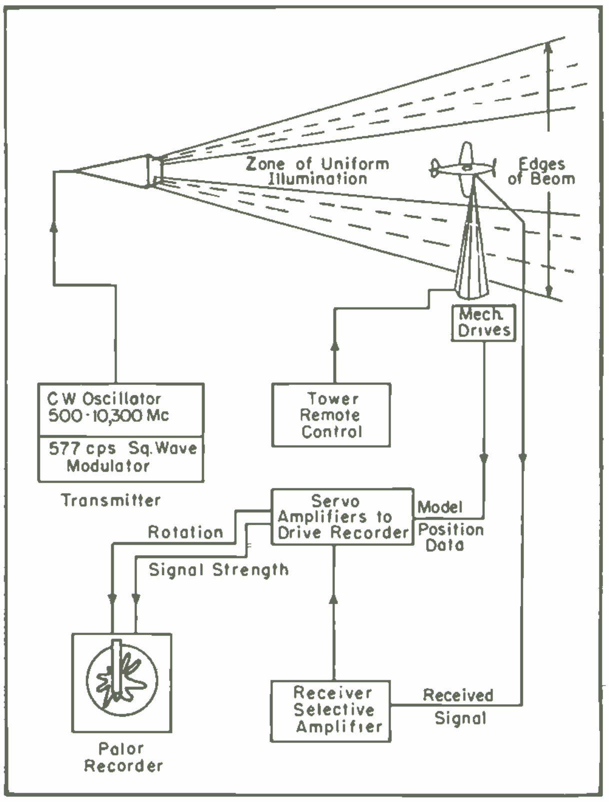
H. R. Skifter guiding a helicopter into position over the reference point to take measurements of the vertical component of a broadcast station's output.

empirically, and the actual performance is determined experimentally.

To calculate the pattern of a typical broadcast array of three or more radiators is rather lengthy and tedious; to design an array that will produce a given desired pattern is considerably more lengthy and tedious. For this class of problem, various computing aids have been devised. One of particular interest, illustrating the application of analogue computing to this field, is the *Antennalyzer*.[1] This is a device that presents the horizontal-plane pattern of as many as five vertical radiators; means are provided for varying the following antenna parameters: (*1*) Azimuth from a given base line, (*2*) distance (from the reference antenna), (*3*) current (relative to that of the reference antenna), and (*4*) current phase (relative to that of the reference antenna).

For frequencies in the v-h-f range and higher, it is often convenient to make direct radiation measurements with a full-scale model antenna that is constructed from theoretical or empirical designs. The dimensions are often such as to permit convenient experimental changes and rapid and simple pattern checks to be made. Laboratories engaged in antenna design and development work are usually equipped with one or more *pattern ranges* to facilitate these measurements. In its simplest form a pattern range is an unobstructed area in which the antenna under test is placed a suitable distance apart from a second antenna. Either antenna can be connected to a transmitter and the other

Fig. 2
Block diagram of antenna-pattern measuring system, shown in Figure 1.



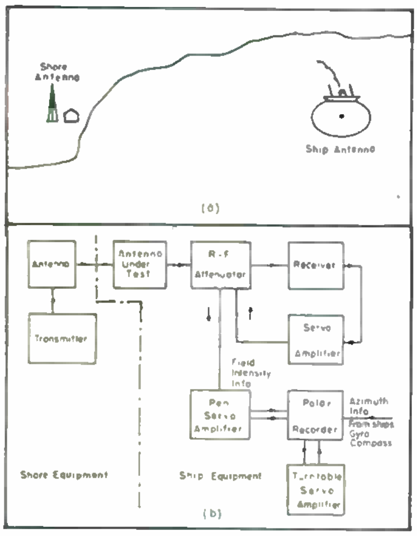


Figure 3 (*a*) and 4 (*b*)

Figure 3 illustrates a system for measuring of horizontal plane pattern of ship antenna. The ship turns in a circle of small diameter compared to distance to shore antenna. Figure 4 (*b*) shows a simplified block diagram of equipment used for the Figure 3 measurement procedure. Equipment can be used with any standard communications receiver at frequencies less than about 30 mc.

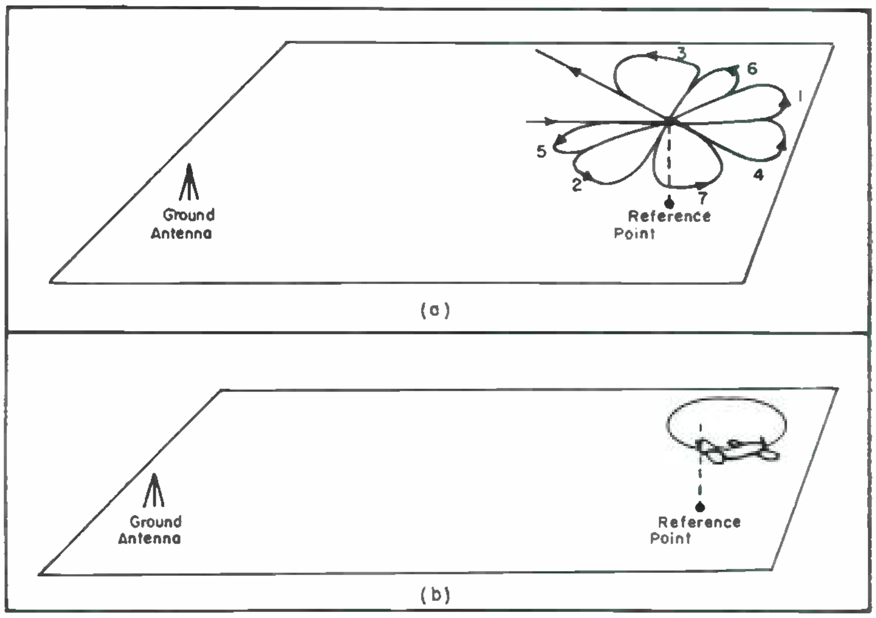


Figure 6

Commonly used flight paths for measuring horizontal-plane patterns of aircraft antenna. In *a* appears a clover-leaf flight path. Numbers indicate order in which turns are made; same type pattern may be used for other angular spacing of passes over reference point. In *b* appears a circular-flight path. Here the diameter of the circle should be small compared to distance to ground antenna. If aircraft is flown at constant bank angle, pattern obtained is in plane through longitudinal axis of aircraft inclined at bank angle.

antenna is connected to a receiver. The antenna under test is usually mounted on a turntable to facilitate its orientation; as the antenna is rotated, the relative antenna gain is measured as a function of the angle of rotation either by observing the receiver output for a constant transmitter output, or by measuring the attenuation that must be inserted in the circuit to maintain a constant receiver output. This attenuation can be inserted at either the transmitter or receiver end of the link.[2,3] Numerous improvements have been made upon this basic pattern range to facilitate its operation. For example, the turntable for the test antenna can be provided with remote position control and indication; moreover, the turntable motion can be suitably linked to some form of automatic recorder. Cathode-ray tube indicators and both polar and linear ink-line plotters are commonly used.

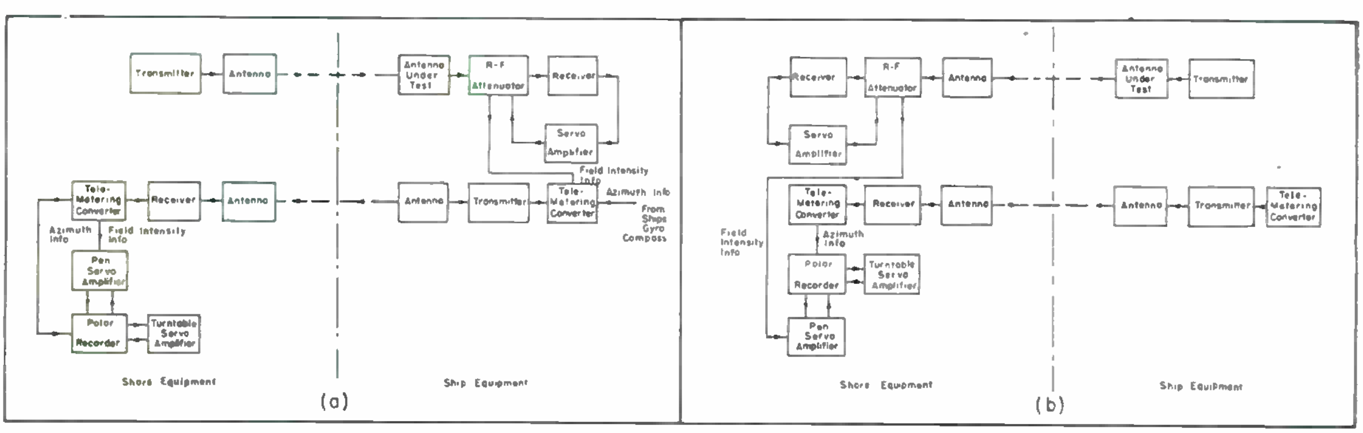
Scale Model Range

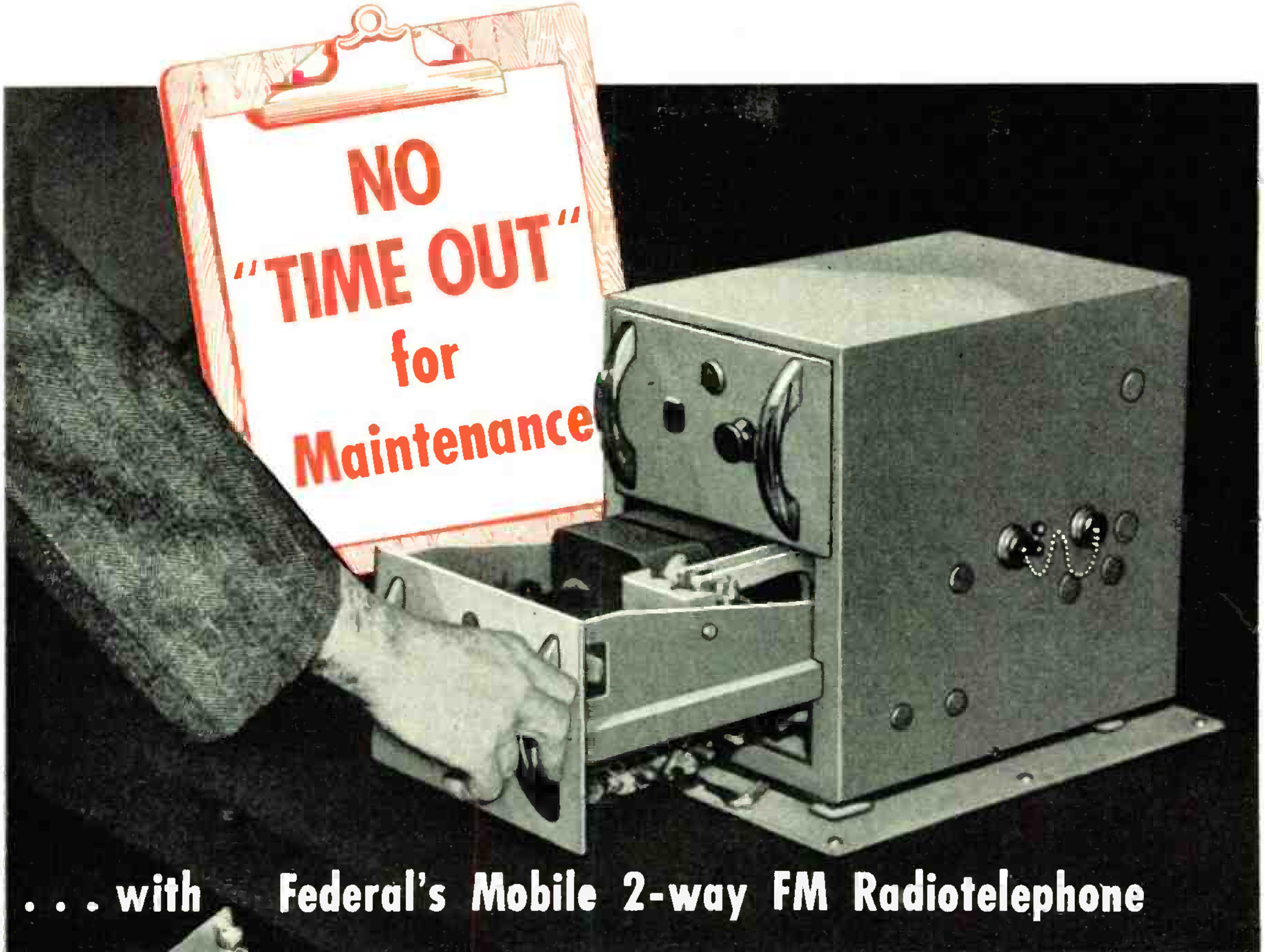
At frequencies in the v-h-f range, and lower, the physical dimensions of the antenna system often make full-scale measurements somewhat cumbersome. A recently developed technique that greatly facilitates such measurements makes use of a scale model range. The antenna system is physically scaled down to a convenient size, by linearly multiplying all dimensions by a factor *n*, less than 1. The wavelength of the test voltage is also scaled down by this same factor; that is, the operating frequency is multiplied by $\frac{1}{n}$. This technique is finding widespread application in the design and testing of numerous classes of antennas; aircraft antennas constitute a particularly important class. In the v-h-f range, the complex geometrical shape of the aircraft has an important effect upon the radiation pattern of an antenna, since the aircraft dimensions are of the order of a few wavelengths. To determine the pattern of such an antenna mathematically would be most difficult; hence, it is common practice to determine the pattern experimentally. It is difficult and costly to measure the complete radiation pattern of a

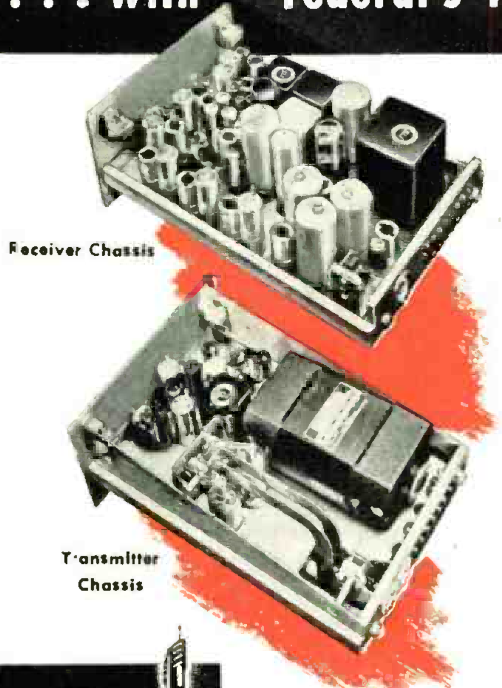
(*Continued on page 41*)

Figure 5

Simplified block diagram of two alternate modifications of setups shown in Figure 4, incorporating telemetering equipment to permit recording at radiation patterns at the shore or other ship station. In *a* we have shore recording with test antenna receiving, and in *b*, shore recording with test antenna transmitting.







Transmitter and receiver units can be removed and replaced in a few seconds.

FEDERAL'S MOBILE RADIOTELEPHONE units are especially designed to save time and money on inspection and maintenance. Both the transmitter chassis and the receiver chassis slide out like a desk drawer—can be completely removed and replaced in a matter of seconds.

All connections are made or broken automatically, by perfectly-aligned plug-in connectors on the rear of the chassis and the inside of the housing. This not only saves valuable time, but avoids the possibility of making incorrect connections when a unit is replaced.

This "instant interchangeability" is just *one* of the many outstanding features of Federal's mobile FM radiotelephone equipment. Every component is designed for the convenience and economy of the men who use it—and its dependability and performance are backed by Federal's 37 years of research and experience in building better communications equipment. Write Federal today for complete information. Dept. I710.

FTR
An IT&T Associate

Federal Telephone and Radio Corporation

100 KINGSLAND ROAD, CLIFTON, NEW JERSEY

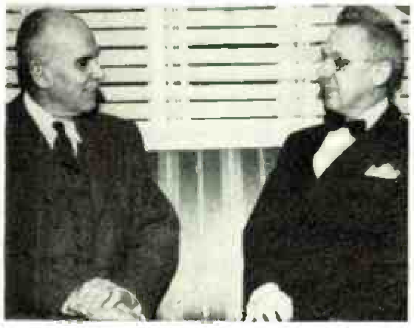
KEEPING FEDERAL YEARS AHEAD... is IT&T's world-wide research and engineering organization, of which the Federal Telecommunication Laboratories, Nutley, N. J., is a unit.

In Canada:—Federal Electric Manufacturing Company, Ltd., Montreal, P. Q.
Export Distributors:—International Standard Electric Corp. 67 Broad St., N. Y.

VETERAN WIRELESS OPERATORS ASSOCIATION NEWS

W. J. McGONIGLE, President — RCA BUILDING, 30 Rockefeller Plaza, New York, N. Y. — GEORGE H. CLARK, Secretary

At The 23rd Anniversary Dinner-Cruise



VWOA honorary member George W. Bailey and VWOA honorary member Commodore E. M. Webster, FCC Commissioner.

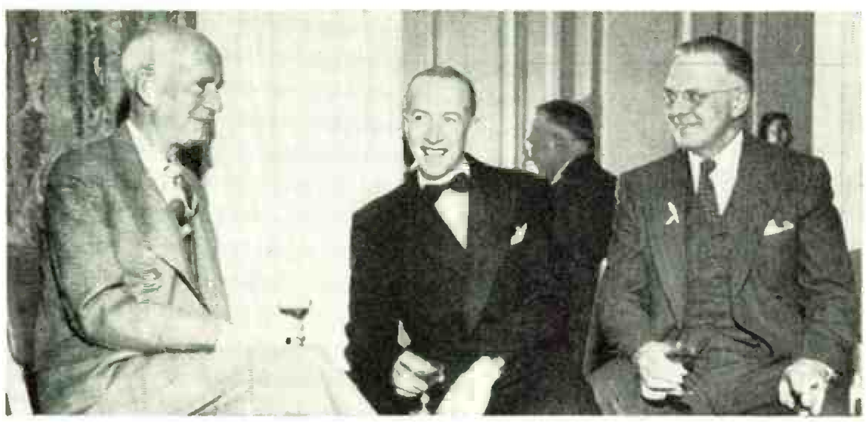
Above, left to right: VWOA first vice-president, A. J. Costigan; VWOA honorary member Major General Harry C. Ingles with W. J. McGonigle, Jr.; Eugene Rietzke, 3rd, and VWOA life member E. H. Rietzke, and ye prexy, W. J. McGonigle.

THE TWENTY-THIRD ANNIVERSARY dinner-cruise of the VWOA was held at the Hotel Astor in New York City, Saturday, February 28.

Among those at the gala affair were ye prexy W. J. McGonigle and son, first vice president A. J. Costigan, secretary William C. Simon, assistant secretary Henry T. Hayden, Jr., treasurer C. D. Guthrie, assistant to the president George W. Bailey, and George H. Clark of the VWOA board of directors.

Honorary member Major-General Harry C. Ingles, who is now president of RCA Communication, was with us, too. . . . Commander E. J. Quinby, U.S.N.R., came all the way up from Key West, Florida, to attend. EJQ is now with the research and development laboratory of the Bureau of Ordnance. . . . Life member Ted McElroy trained in from Boston to join in the festivities. . . . Life member E. H. Rietzke was there, too, from Washington, D. C., with his son, and E. A. Corey. . . . Life member J. Frank Rigby came in from Littleton, Mass. . . . Veteran member G. Porter Houston also did a bit of traveling to attend, GPH being from Baltimore.

Life member Commander Arthur F. Van Dyck was also at the dinner. . . . Life member R. J. Iverson was there, too. . . . FCC Commissioner Commodore E. M. Webster, just back from England, honored us with his presence



Above, left to right: VWOA veteran members George McEwen, R. J. Iverson (life member) and George Duvall.

Below: Life member T. R. McElroy and VWOA tresaurer, C. D. Guthrie.

VWOA life member J. Frank Rigby.

TV Sync Stretcher

(*Continued from page* 11)

clamps. (2) A portion of the output of V_{10} is applied to the second section of V_{16} which is used as an inverter to provide positive sync of high amplitude. This positive sync is then differentiated and the leading edge pulses used to supply a phase inverter, V_{25}, which drives the sync-tip clamp.

A self-contained power supply is regulated in the conventional manner. A source of bias (used also as the regulating reference) is provided by a subsidiary supply.

Circuit Details

All clamps used are of the four-diode bridge type, shown in Figure 4. At the instant the clamp pulses occur all four diodes are set into heavy conduction and the impedance of each drops to a low value (approximately 300 ohms). If the instantaneous signal level at the clamped grid, at the time the clamp pulses occur, deviates at all from the clamp bias voltage, current flows in or out of the coupling capacitor, C_3, through the diodes and the clamp bias source. This action causes that portion of the clamped signal (in the case at hand the back porch) to always be at a voltage with respect to ground equal to the clamp bias. At the conclusion of the clamp pulses, the diodes become nonconducting and are maintained in a cutoff state by bias generated on the blocking capacitors, C_1 and C_2. During this period the clamped grid may assume any potential demanded by the input signal. The clamp bleeder resistor, R_1, serves to discharge the blocking capacitors, C_1 and C_2, slightly so that each clamping pulse will cause conduction in each diode.

The bridge-type clamp is used in the sync stretcher because it is relatively insensitive to balance between the positive and negative clamp pulses and because there is less coupling between the clamp pulse source and the clamped grid than exists in other types of clamps. Inasmuch as the three clamped stages in the sync expansion channel operate at the same clamp bias, the lower two diodes of the bridge type clamp are made common to all three stages.

In the clamp-pulse derivation channel, the clamp acts on the sync tips in the interests of stability. Since the input sync to picture ratio may be any value over 15%, clamping at the back porch level would not utilize the maximum gain of the sync clipper. In this case, the clamp bias would have to be such as to accommodate the largest sync to be expected, so if the sync were small this stage (V_{17}) would operate at a very disadvantageous bias. Clamping on sync tips removes this restriction so that V_{17} operates at its maximum gain for the smallest sync signals.

Sync-Clip Control

To accommodate variations between replacement tubes used for the sync amplifier, V_8, the bias (which must be set at cutoff) is made variable. This adjustment is designated as the *sync clip* control.

Sync tips are clipped by a shunt-crystal diode returned to a source of variable potential. By varying this adjustment, designated as the *sync expansion* control, the sync may be clipped to any value irrespective of the video content of the signal. Two crystals are used in parallel to provide a low-impedance clipper.

A step attenuator is provided on the input to facilitate adjustment of the level when the input signal is of high amplitude. If the input signal is over 1 volt peak-to-peak, the attenuator is set in the *high* position. If the input signal is less than 1 volt, the attenuator is set in the *low* position.

To permit compensation for replacement tubes, the regulated supply is made adjustable by means of a *+150 adjust* control which is set to regulate the output at 150 volts.

Adjustment

The regulated plate voltage is set at 150 by means of the *+150 adjust* control. With the input attenuator and gain control set to provide 0.1 volt at the grid of V_1, the *sync clip check* switch is depressed and the output observed. The *sync clip* control is then adjusted so that only sync is visible. After releasing the *sync clip check* switch the input gain control is set so that approximately 1.5 volts of video, plus pedestal, is secured at the output and the *sync expansion* control adjusted to provide the desired sync-to-picture ratio.

Operation

Because the clamping pulses are derived from the signal input, the input to V_1 must be maintained within rather narrow limits for good clamping. The extent of input variation tolerable varies with the amount of sync on the input signal, and will be approximately as listed in table 1.

(*Continued on page* 34)

TV Sync Stretcher

(*Continued from page 33*)

Input sync/ total ratio	*Input range at grid of V_1*
15%	0.11 – 0.18 volts peak-to-peak
20%	0.08 – 0.21
25%	0.07 – 0.21

Table 1.

Accordingly, if the input signal is subject to variations in amplitude, the gain control on the sync stretcher must be adjusted to maintain the level at the grid of V_1 within the limits indicated. Alternatively, the input may be taken from a gain control which is adjusted to maintain a constant level input to the stretcher.

To avoid possible compression of the output signal, the controls must be adjusted so that the output does not exceed a level of 2.5 volts peak-to-peak.

The clamp coupling capacitors (220 mmfd) have been chosen to provide a *fast* clamp. The effectiveness of a clamp in removing low-frequency hum interference can be controlled, to a limited degree, by varying the size of the coupling capacitor. As the size of this capacitor is decreased the clamp can remove more hum, but it becomes more sensitive to high-frequency interference and noise. For very small values of coupling capacitor, streaking of the picture will occur in the presence of noise or r-f interference, resulting from the clamp restoring individual peaks or valleys of the interference. Should the input signal contain a large amount of such interference, picture streaking may be avoided by increasing the clamp-coupling capacitors from 220 to about 1200 mmfd. This procedure, however, will reduce the effectiveness of the clamp in removing large amounts of low-frequency interference.

•

Washington, D. C., Police Radio Room

Mobile radiotelephone remote-control consoles in the radio room of the metropolitan police department, Washington, D. C. Standing, left to right: Lt. Frank M. Beall, engineer; Police Supt. Major Robert J. Barrett, Capt. John Agnew and Inspectortor Floyd Truscott. (*Courtesy FTR*)

Enlarged F-M Facilities

(*Continued from page* 15)

on the *master-control panel* and one each on the auditorium and medium music studio meter panels, as illustrated in Fig. 6.

The system is interlocked to permit any one studio to feed any one or all channels at the same time, but will not permit two studios to feed one channel at the same time. When production requirements necessitate the origination of a program from two studios, the second studio is made a remote through either remote *1* or *2* to the a-m and f-m announce studio mixer panel. This operation can similarly be used for transcribed backgrounds for programs from the auditorium and medium music studios.

Green lights on the *master control panel* indicate which studios are preset, while red lights are used to show the studios on the air. Similar lights are located on the meter panels of the larger studios and in the new control booth. In addition, the *VI* meters for these positions are illuminated by the on-the-air relay circuit contacts. Since the a-m and f-m announce studios are directly opposite the *master control panel*, the signals and *VI* meters on channels 1 and *2* are used for these two studios. The usual on-the-air warning lights at the larger studio entrances are illuminated when that studio feeds a channel. For the announce studios the warning lights are controlled by the microphone relay.

To the left of the preset switches are master gain controls to regulate the outgoing levels to the lines. Directly under the *VI* meters of channels 1 and *2* are push buttons and signal lights for switching from regular to spare lines to the standard and f-m transmitters, respectively. The similar controls on channel 4 are for starting and stopping a 5 kw emergency power supply, powered by a gasoline engine, while those on channel 5 are to switch that *VI* meter to the a-m and f-m announce studio monitor.

A considerable reduction in the number of amplifiers normally required for the monitoring circuits was obtained by using bridging pads on the studio as well as the channel outputs; Figure 4. These pads drop the 20 db level to a zero level, thereby providing 20-db isolation for a single circuit and 40 db between circuits.

The addition studios (*E*, *F*, *G*, and *H*) in positions are for future expansion, while *I* is used in conjunction with an amplifier to permit placing

(*Continued on page* 36)

Enlarged F-M Facilities

(*Continued from page* 35)

any incoming program directly on this position.

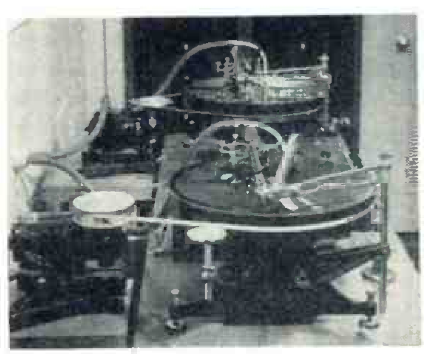
The main monitor is similar to the a-m and f-m announce studio monitor, but differs in the number of switch contacts on the selector switch. The twenty circuits provide for monitoring of the radio outputs of the standard and f-m transmitters, NBC, TQN, the five output channels, all studio positions and two spare positions, *J* and *K*. The selector switch is mounted in the console just to the right of the medium-music studio mixer panel, and the volume control is located on that panel. The same monitor circuits are carried in lead-covered cable to the new auditorium control booth and to the offices.

The signal circuits of the preset switching circuit are conventional.

Programs originating in the auditorium studio A had to be, for operating convenience, controllable either in the control room or in the A control booth. To eliminate the use of two sets of microphones or the inconvenience of a double set of microphone receptacles, the keys on the *A* control panel were rewired to switch one input to two outputs. With this revision, the four microphone preamplifiers could be switched to the mixer circuit of the *A* panel or the booth panel. Signal springs of the four keys were wired in series to a signal lamp in the control booth to indicate when the control was at that position. As shown in Figure 5, the two mixer outputs are amplified by booster amplifiers and combined in a two-way pad to feed the program amplifier.

Operational experience since improvements were completed, has proved the soundness of the modifications which more than meet the requirements of today's programming and still provide room for future expansion.

The recording room, which is equipped with two lathes, each with a complete set of amplifiers contained in two racks in the rear. The room also houses a portable recorder and a wire recorder.



Test Instruments

(*Continued from page* 23)

tion, but can be obtained as a percentage if desired.

Low-Level Measurements

When, at times, it is desired to measure distortion or to make frequency runs on low-level equipment, it is necessary to introduce loss between the audio oscillator and the input of the low-level amplifier. (Preamplifiers for microphones and turntables.) At this station all low level inputs are balanced 30-ohm type, so an *H* pad becomes necessary to match impedances as well as to introduce loss when measurements are to be made.

The pad is usually made up of a number of small loss pads (10 db and less) well shielded, and arranged in such a manner that any or all can be switched out of the circuit. The total loss in the pad is always accurately known and thus the gain of any type amplifier can be measured by adding a high resistance *VU* meter, which can be switched from output of oscillator to output of amplifier under test. By adjusting the pad loss until the *VU* meter reads the same on output of oscillator as on output of amplifier, the loss of the pad in db is equal to the gain of the amplifier.

When measuring distortion or making frequency runs, then the pad is merely used to lower the output from the oscillator to a value approximately equal to the output of a high quality microphone at the same impedance. This loss must be introduced to keep from overloading input of preamp.

One manufacturer[4] has an audio oscillator which contains a built-in calibrated attenuator. Another[5] has developed a separate attenuator panel for rack mounting.

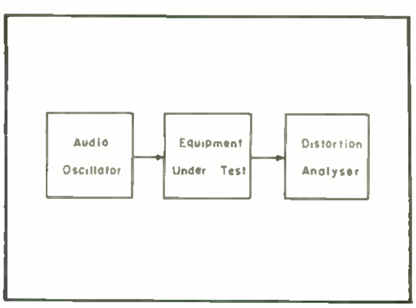
'Scopes

A 5" type 'scope[6] (using a 5LP1),

[4]Hewlett-Packard.
[5]RCA.

(*Continued on page* 38)

Figure 4
Measuring sytem hookup with audio oscillat and distortion analyzer.



Test Instruments

(*Continued from page 37*)

with an amplifier frequency response of 2 to 100,000 cps ±10%, is used at our transmitter.

The intensifier c-r tube in this 'scope is a high-vacuum type employing the principle of post-deflection acceleration of the electron beam to provide an increase in both intensity and deflection sensitivity. At one end of the long evacuated glass bulb is an electron gun which generates and focuses a beam of electrons into a fine point on the phosphor-coated fluorescent screen located at the opposite end. As the electron beam impinges on the screen, a spot of light results, whose color is determined by the nature of the chemical coating. Since the beam of electrons in motion actually constitutes an electric current, it can be deflected by a magnetic or electric field and a measure of its motion is given by the change in position of the spot on the screen. Magnetodynamic deflection is seldom used since the variation, with frequency of the field, produced by a magnetic deflection coil would not permit true delineation on the screen of the signal voltage actually being applied.

Curve-plotting generally is done with orthogonal (cartesian) coordinates and therefore the c-r tube is designed to provide such coordinates. To accomplish this, the electron beam is directed between first one pair of deflection plates and then between another pair at right angles to the first. The fields that cause deflection of the beam are produced by the corresponding potential differences applied between the plates of each pair. The actual instantaneous position of the spot is the vector sum of the two orthogonal fields and its motion over the screen is a graphical plot of the signal applied to one set of plates, as a function of that applied to the set normal to it.

Perhaps the chief trouble experienced by those using the 'scope is the lack of a proper interpretation of the pattern traced on the screen. It should be remembered that the 'scope does not offer the solution to any problem but that it merely supplies information regarding the characteristics of that problem, information which may serve as a guide to the type of reasoning required to properly analyze the phenomenon which is being studied. It should always be borne in mind that the unknown signal is plotted as a

[6]Du Mont 208-B.

function of some signal whose characteristics are known.

Another 'scope which we have used is a 3" model,[7] which is handy to move about when a larger screen is not needed.

Frequency range of amplifiers in this unit is 7 cps to 80 kc; ±20%.

'Scope Uses

The 'scope can be used to indicate:

(*1*)—Distortion in amplifiers, when of the harmonic type. Distortion must be greater than approximately 7% to be seen on the screen.

(*2*)—Parasitics and spurious oscillations.

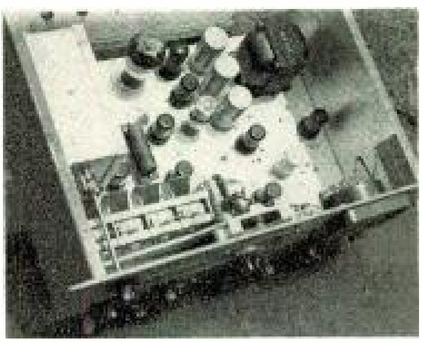
(*3*)—Phase relations.

(*4*)—Frequency response of amplifiers when using square wave oscillators or frequency modulated test records.

In addition the 'scope can be used as an a-c voltmeter, d-c voltmeter, a-c ammeter (with external shunt), alignment of r-f stages, i-f stages and f-m detectors, and measurement of frequencies.

[7]RCA 155-C.

[To Be Continued]



Top view of distortion-noise analyzer.

Setup for testing a receiver. Left to right: test set, signal generator, distortion noise analyzer, communications receiver, 'scope and vtvm.

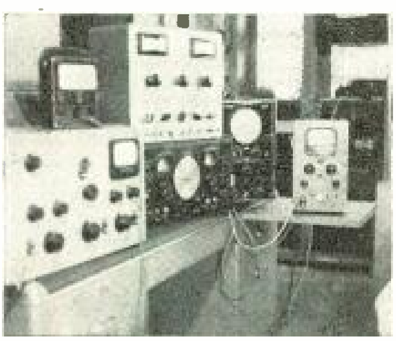
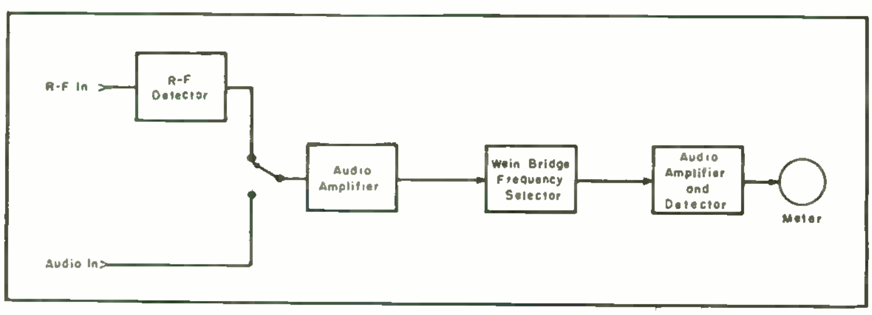


Figure 5
Block diagram of distortion noise-analyzer (*H-P* 330-*B*).



Coupled Antennas

(*Continued from page* 20)

the WHMA transmitter operating. An impedance bridge was then placed at the line terminals of the unit and the tuning elements adjusted for an input impedance of 70 ohms.

The filters resulted in a reduction of interfering signal current in the antenna to a value which could not be detected on the antenna ammeter, voltage at the transmitter output being reduced to a value unreadable on meters normally located at this point. Finally, the filters reduced the signals at the spurious frequencies to levels barely audible under the background noise in the primary service area.

The present heavy construction of a-m stations brings new interference cases of this type to light every day. The problems will be aggravated when and if it becomes possible to build stations for the same service area operating at frequencies differing by only 30 kc. In order that interference at receivers in some parts of the areas be prevented the transmitters must be located close together. Filters for these cases will not be simple. They will require careful design and extremely careful adjustment.

•

Tube News

(*Continued from page* 24)

ode), 6BG6G (beam power amplifier) and three miniature rectifier diodes.

The triode section of the 6SR7, which acts as a 1,000-cps sawtooth oscillator, drives the 6BG6G. The 6BG6G is biased near cut-off and produces 1,000 cps peak voltages in the plate circuit, which is part of the high-voltage transformer primary. The 1,000 cps 6BG6G plate pulses, which are almost equal to its maximum emission, start a 25-kc train of damped oscillations, the transformer primary being tuned to approximately 25 kc. The first oscillation peaks of about 8.5 kv charge tripler-circuit filter capacitors and are rectified by the three rectifier-diodes. By connecting the 8.5-kv output of each rectifier stage in series, 25.5 kv is obtained.

Filaments of the three rectifier tubes, requiring .5 watt each, are fed by subsequent oscillation peaks from three separate secondary windings.

Part of the 25-kc voltage is used as a negative feedback voltage which, after rectification by the two diode sections in the 6SR7, are supplied to the 6BG6G control grid. Thus, the amount of current through the high-voltage transformer primary can be controlled to improve the external 25-kv regulation characteristic.

Antennas

(*Continued from page 28*)

full-scale aircraft antenna. Moreover, with the advent of higher-speed aircraft, the design of a particular antenna has become ever more closely linked with the design of the aircraft on which it is to be installed, making it very desirable to design and test an antenna system before the aircraft is actually built. These considerations make the model range system of pattern measurement a most valuable design tool.

A sketch and a simplified block diagram of an improved model range are shown in Figures 1 and 2, respectively.[4, 5]

Operation and Measurements

Effective as the various types of design measurements may be as design tools, it is still highly desirable to make operational measurements to make sure that the actual performance is comparable with the performance predicted by design considerations. These *proof of performance* measurements are required by the FCC in the case of directional broadcast antennas.

It is convenient to consider that stations are divided into two classes from the standpoint of pattern measurements: fixed stations and mobile stations. In the case of fixed stations, it is obviously necessary that the measuring point be moved about to determine the radiation pattern (with the exception of the special class of fixed stations in which the radiation pattern itself is moved—for example, a scanning radar system or a rotating beacon system). As a typical example of a fixed station, let us consider a standard broadcast station. The desired radiation pattern is primarily governed by two considerations: (*1*) The most advantageous way of covering the desired area, and (*2*) the modifications to the pattern necessary to reduce the interference with other stations below that required by FCC standards. The primary service area results from ground-wave propagation; hence, field-intensity measurements made on the ground are sufficient to determine the extent of this area. In the case of standard broadcast stations, the usual practice is to make a considerable number of field-intensity measurements along a number of radials from the antenna. Such measurements include the effect of propagation and make possible the plotting of actual field-intensity contours on a map of the area.

Usually these ground-wave field-intensity measurements are made with measuring equipment installed in an automobile for ease of transportation and operation. It is often necessary, however, to make measurements afoot within a few miles of the transmitting antenna because the desired measuring sites are inaccessible with an automobile. In other cases, it may be necessary to use a boat or other suitable means of transportation. Airborne measurements have been made in some instances, using a blimp, helicopter, or conventional aircraft. In rugged terrain, airborne measurements appear to offer two distinct advantages over ground measurements: (*1*) Fluctuations of field intensity due to the nonhomogeneous earth are reduced, and (*2*) the time and cost of making the measurements may be somewhat reduced.

Sky-wave coverage of a broadcast station may be determined in two ways: (*1*) By measuring the field intensity at the desired sites over a period of time to obtain the statistical variation, or (*2*) by measuring the vertical radiation pattern and applying propagation information to obtain an estimate of the sky-wave field intensity. Measurements of the vertical

(*Continued on page 42*)

Antennas

(*Continued from page* 41)

radiation pattern of a broadcast station implies the use of an airborne field-intensity meter. Measurements of this type have been made by the use of conventional aircraft and of helicopters. In the first case, a large number of flights are made over the transmitting antenna and the received field at each instantaneous position is recorded. Such data, when corrected for distance, can be plotted against solid angle to yield the desired radiation pattern information. The development and improvement of the helicopter has made it possible to obtain these data by more direct means. The helicopter can be navigated to each point in space at which a measurement is desired (usually at the standard distance of one mile), and the field measured directly. Some means is again required to position the craft accurately at the time that the measurement is being taken. This may be done by ground observation with standard surveying instruments and by visual signalling or by radio-location techniques.

In the case of mobile stations, radiation patterns can be measured without moving the measuring point—a procedure that permits certain simplifications. The horizontal pattern of a ship antenna, for example, can be determined quite simply by the system illustrated in Fig. 3. A simplified block diagram of an equipment developed for this use is shown in Figure 4; this equipment can be used with any standard communication receiver at frequencies less than about 30 mc. A test signal is radiated at the desired test frequency either from a station on shore or on another ship. The voltage developed in the antenna under test is plotted as a function of the azimuth angle of the transmitting antenna, measured from the test antenna, as the ship turns in a circle of small diameter compared with the distance between the transmitting and the receiving antennas. Variations in range and azimuth (as measured from the transmitting antenna) are thus sufficiently small that they can be neglected. The input voltage to the system from the receiving antenna is measured by the position to which the attenuator is servoed to maintain a constant output voltage from the receiver. The position of the attenuator, in turn, determines the position of the recording pen of the polar recorder. The turntable of the polar recorder is positioned by azimuth information from the ship's gyrocompass. Figure 5 shows simplified block diagrams of two alternative modifications of the foregoing system: they incorporate telemetering equipment to permit recording the radiation pattern at the shore or other-ship station.

As in the case of fixed stations, where long-distance communication using sky-wave propagation or where communication with aircraft is involved, it is necessary to measure the vertical radiation pattern. This again implies the use of an airborne field-intensity meter.

It is generally more complicated and difficult to measure the radiation patterns of aircraft antennas than those of fixed stations or of mobile surface stations. Because aircraft have three degrees of freedom, it is necessary to measure the radiation pattern over a sphere (as opposed to a hemisphere for surface stations) if complete pattern information is desired. The comparatively high speed of aircraft and the restriction of the motion of conventional aircraft to a predominantly translational flight path are additional complicating factors. Because of these difficulties, techniques have not yet been developed to an extent that permits obtaining complete and reliable radiation patterns from aircraft in flight. The development of an improved model range capable of comparatively fast and convenient pattern measurements has provided a powerful design tool, but the need still exists for an operational check of a new antenna with the aircraft in actual flight.

Two variations of a commonly used technique for investigating the horizontal radiation pattern of an aircraft antenna are shown in Figure 6. In one case, the aircraft is flown in a clover-leaf pattern over some convenient reference point, making it possible to measure the field intensity at any desired number of headings with the aircraft in level-flight attitude. In the other case, the aircraft is flown in a circle of small diameter at a distance from the measuring equipment that is large compared with the diameter of the circle. By this means, the variations of range and azimuth of the aircraft (viewed from the measuring site) can be made sufficiently small that they can be neglected. This second system permits the field intensity to be recorded continuously as a function of azimuth rather than as a discrete number of points (as in the first system). The second system is sometimes extended to measurements in which the aircraft is flown in circles at various angles of bank.

A system for the measurement and plotting of the radiation pattern of v-h-f aircraft antennas over a substantial portion of the under hemisphere has recently been developed.[6] This system provides polar plots of both the horizontally and vertically polarized components. An automatic tracking radar system is used to provide position information and to orient directive receiving antennas.

References

[1]G. H. Brown and Wendell B. Morrison, *The RCA Antennalyzer—An Instrument Useful in the Design of Directional Antenna Systems,* p. 992, Proc. I.R.E.; December 1946.

[2]H. LeCaine and M. Katchky, *Microwave Antenna Beam Evaluator,* p. 116, Electronics; August 1947.

[3]C. C. Cutter, A. P. King and W. E. Koch, *Microwave Antenna Measurements,* p. 1462, Proc. I.R.E.; December 1947.

[4]O. H. Schmitt and William P. Peyser, *Aircraft Antenna Pattern Plotter,* p. 88, Electronics; May 1947. (*Detailed description of system shown in Figures 1 and 2.*)

[5]George Sinclair, E. C. Jordan, and Eric W. Vaughan, *Measurement of Aircraft-Antenna Patterns Using Models,* p. 1451, Proc. I.R.E.; December 1947. (*Description of related range systems used at Ohio State University.*)

[6]J. S. Prichard and A. H. Mankin, *System for Measurement of Aircraft Antenna Patterns in Flight.* Presented at National Electronics Conference, Chicago; November 1947.

The Industry Offers

LENKURT POWDER-IRON PRODUCTS

Powder-iron cores, core assemblies, coil assemblies to specification, and filter units in several types have been announced by the Lenkurt Electric Co. 1124 County Road, San Carlos, California.

Three standard materials, now listed, cover frequency ranges of 100 cps to 90 kc, 50 kc to 5 mc, and 1 mc to 200 mc. Features are minimum hysteresis and eddy-current losses, distortion products as low as 100 db below the fundamental, and permeabilities and Q factors to suit the particular requirements.

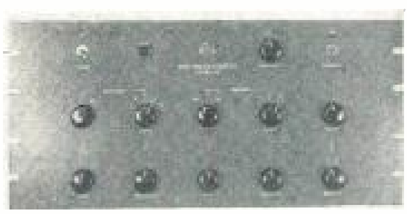
• • •

RCA TV GRATING TEST GENERATOR

A tv grating generator, type WA-3A, which produces grill-like patterns to check the linearity and speed alignment of tv picture tube circuits has been announced by the RCA test and measuring equipment section.

The generator produces on the picture tube a pattern consisting of crossed horizontal and vertical bars, similar to a lattice or a grating. The horizontal bars are used for checking vertical alignment, and the vertical bars for checking horizontal alignment.

To adjust the linearity of a monoscope camera with monitor equipment, the output of the grating generator and the monoscope camera are fed into a distribution amplifier. The outputs of the two amplifier channels are connected together and fed into a master monitor providing a composite image in which the monoscope camera pattern is superimposed on the grating pattern. The composite pattern permits a check of both the uniformity of distribution of picture detail and resolution, especially when the grating signal polarity is set to produce white bars. It also provides a check on the uniformity of the scanning velocity of the deflection circuits, since any observable deviation from the standard pattern denotes a need for circuit adjustment.



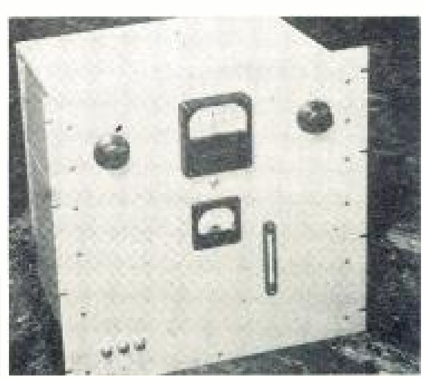
• • •

GATES A-M FREQUENCY MONITOR

A frequency monitor for a-m, type Mo-2890, has been announced by the Gates Radio Company, Quincy, Illinois.

Monitor features include a ground crystal in an anti-vibration holder, mounted in a dual chamber oven which is said to control the crystal temperature to less than 0.2° C variation over the heat cycle.

Oven insulation is laminated from cane fiber insulating board with a protecting surface of asbestos cement board. It was found that the cane fiber board indicated the least heat transmission of any rigid insulation material along with good rigidity of construction. As the asbestos cement board has a slow transmission factor, this was selected as preferable to metal. A large aluminum block with cartridge heaters serves as radiator for maintaining constant heat in the crystal chamber.



GRAYHILL RELAY

Relays with plug-type connectors, which are inserted into receptacles mounted on a panel of the machine, have been developed by Grayhill, 1 North Pulaski Road, Chicago 24, Ill.

The integral parts of the relay are mounted on a flat rectangular molded phenolic base to the bottom of which the pin type plug connectors are affixed. A removable molded phenolic cover tightly joins the mounting base, enclosing the relay, and leaves only the plug connectors protruding.

Available in single pole, single throw, and double throw; double pole, single throw, and double throw. Ranges are from 6 to 230 volts, a-c or d-c.

* * *

OHMITE DUMMY-ANTENNA RESISTORS

Dummy antennas, types D-101 and D-251, which replace the glass-enclosed types D-100 and D-250, have been announced by the Ohmite Manufacturing Company, 4951 West Flournoy Street, Chicago 44, Illinois.

Units consist of a number of noninductively wound, vitreous-enameled resistors connected in parallel and mounted inside a perforated steel cage.

* * *

MOTOROLA GROUND PLANE ANTENNA

A ground plane antenna for the 152-162 mc band, the Isoplane Antenna, has been announced by Motorola Inc., Chicago.

Antenna offers four ground plane radials at a 28° drop angle.

Isolation array of four horizontal radials beneath the ground plane reduces unwanted mast radiations which it is said normally waste 15% to 25% of the signal on the stratosphere.

Designed for mounting on common 1¼" pipe. May be clamped to a chimney or mounted on a base flange fastened to a 2" x 6" x 4' cross-piece and sand-bagged in place.

* * *

G.E. S-T RELAY LINK EQUIPMENT

Studio-to-transmitter relay equipment type BL-2-A, has been developed by the transmitter division of G. E.

Equipment operates between 920 and 960 mc.

Transmitter, type BT-9-A, has a power output of 10 watts. Audio input level is 10 dbm ± 2 db with an audio input impedance of 600/150 ohms.

Receiver, type BR-5-A, is crystal-controlled. Two antennas, type BY-11-A, used in the system are 40" parabolic types with enclosed dipoles.

* * *

ALLIED RELAYS

A single pole relay type AS, which is 1⅝" long, 1-13/16" high, and 15/16" wide, has been announced by Allied Control Co., Inc., 2 East End Ave., New York 21, N. Y. Weight is 50 grams.

With a normal power rating of 1 watt, relay is available for both a-c and d-c. Contact arrangements include normally closed, normally open or double throw. Contact rating is 5 amperes at 24 volts d-c or 110 volts a-c.

* * *

BURNELL HIGH-Q TOROIDAL COILS

High "Q" toroidal coils employed in the Scott dynamic noise suppressor are now being made by Burnell and Co. Types are TC-1 800 (.8 henries) and TC-1 2400 (2.4 henries).

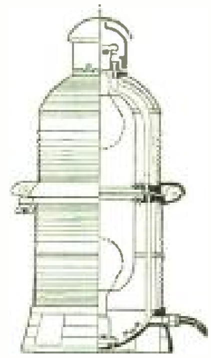
HUGHEY AND PHILLIPS TOWER LIGHTS

Guardian tower lights have been announced by Hughey and Phillips, 326 North La Cienega Boulevard, Los Angeles 36, Californnia.

A patented ventilator dome is said to provide an effective means of escape for the heat generated by the two 500-watt lamps within the beacon. As the hot air escapes, a suction is created, bringing in cool air from the outside, which results in substantially lower temperature within the beacon at all times.

Air vents said to be so designed that water cannot enter the beacon even during the most severe rainstorms. Condensation resulting from changes of temperature within the beacon, is dissipated by means of a concave base which has a drainage port at the bottom.

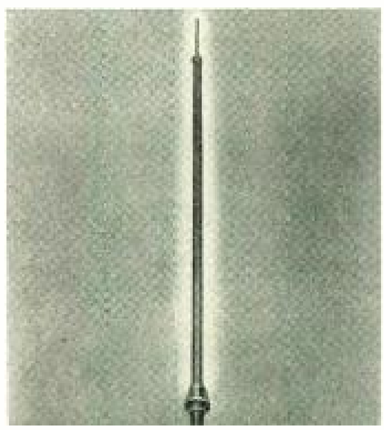
The frequency of color screen breakage, usually caused by the uneven expansion and contraction between the glass color screens and encircling metal holders, is said to be reduced by spun glass shielding.



* * *

WORKSHOP BEACON ANTENNA

A beacon antenna for 152 to 162 mc consisting of three half-wave dipoles stacked .7 wave-length apart and driven in phase, has been announced by The Workshop Associates, Inc., 66 Needham Street, Newton Highlands 61, Mass.



* * *

E. F. JOHNSON AIR VARIABLES

A line of air variables in single, differential and butterfly types, has been announced by E. F. Johnson Company, Waseca, Minnesota.

Single type is available in 1.55 to 5.14 mmfd, 1.73 to 8.69 mmfd, 2.15 to 14.58 mmfd, and 2.6 to 19.7 mmfd.

Capacities of the differential type, for switching capacity from rotor to either of two stators, and for shifting tap on capacity divider, are 1.84 to 5.58 mmfd, 1.98 to 9.30 mmfd, 2.32 to 14.82 mmfd, and 2.67 to 19.30 mmfd.

The butterfly type, applicable wherever a small split stator tuning capacitor is required, is available in capacities of 1.72 to 3.30 mmfd, 2.10 to 5.27 mmfd, 2.72 to 8.50 mmfd, and 3.20 to 11.02 mmfd.

New Briefs

INDUSTRY ACTIVITIES

The second annual New England Radio Engineering Meeting under the sponsorship of the North Atlantic Region of the IRE will be held on Saturday, May 22, 1948, in Cambridge, Massachusetts, at the Hotel Continental. The North Atlantic Region is made up of the membership of the Boston and Connecticut Valley sections of the IRE.

There will be six technical sessions, three in the morning and three in the afternoon, with papers on:

A Standard Signal Generator for FM Broadcast Service,

The Boston-New York Microwave Radio Relay Link,

Certain Aspects of Pulse Modulation;

Studio Acoustics.

The registration chairman is Harold Dorschug, WEEI, 182 Tremont Street, Boston, Massachusetts.

The Northern California FM Broadcasters was formed recently. An organizational meeting was held in San Francisco.

Wayne Coy, chairman of FCC, greeted the meeting with a message which was read by the chairman, Clay Crane of KSBR.

Offices of the group are at 582 Market Street, Room 602, San Francisco.

The Kaar Engineering Company have moved to a new plant on Middlefield Road, Palo Alto, California.

Measurement Engineering, Ltd., Toronto, will manufacture Kaar equipment in Canada under Kaar supervision, working with Kaar's two Canadian representatives, Gordon Armstrong of Vancouver and Keith Dix of Toronto.

Allied Control Company, Inc., 2 East End Ave., N. Y. 21, N. Y. had their plan for reorganization confirmed by the United States Federal Court in Chicago on February 17, 1948.

C. L. Von Egloffstein has been elected president, James McDill, controller and J. K. Holbrook, Jr., secretary.

On the board of directors are Paul E. Fenton, vice president of Scovill Manufacturing Company; Huntington B. Henry, president of Ames, Emerich & Co., Inc.; Duncan MacKenzie, consulting engineer; Coburn Musser, president of the Eberhard Faber Pencil Company and C. L. Von Egloffstein, engineer.

A mobile radio system was inaugurated recently in Honolulu as service of the Mutual Telephone Company of the Territory of Hawaii. Equipment, including 50 mobile units, a 250 watt f-m land station transmitter, and three remote fixed receivers, was manufactured by the Federal Telephone and Radio Corporation, Nutley, N. J.

Allen B. DuMont Laboratories, Inc., and the Crosley Division of AVCO Manufacturing Corporation have effected an agreement providing for the manufacturing of tv receivers under DuMont patents and the exchange of engineering and manufacturing information.

American Broadcasting Company tv stations in Los Angeles and San Francisco will be equipped with 5 kw G. E. transmitters similar to those being made for the Chicago Tribune, WOR and the Daily News in New York City, and the Yankee Network in Boston.

The Tennessee Valley Authority is installing a 154 Motorola central station and mobile unit radiotelephone network.

Twenty-four of the 154 installations will be fixed stations located at division and district headquarters and strategic points within the power system. The remainder of the 130 units will be 50-watt mobile units installed in various types of maintenance vehicles.

The West Coast Convention of the IRE will be held in conjunction with the West Coast Electronic Manufacturers Convention, at the Biltmore Hotel, Los Angeles, September 30 to October 3.

Convention chairman for the IRE is Lloyd Sigmon, chief engineer of KMPC, Los Angeles. John J. Fiske of Westinghouse Elec. Corp., is vice chairman and William U. Dent of Westinghouse Elec. Corp is papers chairman.

International Standard Electric Corporation, New York, has been merged with **Federal Telephone and Radio Corporation,** Clifton, New Jersey. Both companies are IT&T. subsidiaries. Through the acquisition of the stock of ISE Federal will control the major manufacturing subsidiaries of the I. T. & T. system throughout the world.

Fred T. Caldwell, president of International Standard Electric and vice president and director of IT&T, has been elected president of Federal. Rear Admiral Ellery W. Stone, USNR, formerly chief commissioner of the Allied Control Commission in Italy, and a vice president of IT&T, has been elected executive vice president of Federal. R. C. Blackinton has been elected vice president of Federal in charge of production.

PERSONALS

Laurence K. Marshall has been elected chairman of the board of Raytheon Manufacturing Co., Waltham, Mass., and Charles Francis Adams, Jr., president.

Dr. K. C. Black has joined Air Associates, Incorporated, Teterboro, N. J., as chief radio engineer.

K. C. Black

William Sloat and **John Merry** have been added to the engineering staff of WPIX, The New York Daily News tv station.

Sloat was formerly technical consultant for WEW and WEW-FM, owned by St. Louis University, and Merry was transmitter and studio engineer of KXOK and KXOK-FM.

Irving R. Weir has been appointed designing engineer of the Transmitter Division of G.E.

J. E. Keister has been appointed section engineer of the G.E. television and broadcast engineering section, and **H. B. Fancher** was named assistant engineer.

I. R. Weir (left, top)
J. E. Keister (left)
H. B. Fancher (above)

J. G. Crost, former counsel of the Small Business Committee of the U. S. House of Representatives, has been named assistant to Capt. W. G. H. Finch, president of Finch Telecommunications, Inc.

Rodney Duane Chipp has become assistant engineer for the DuMont tv network. Chipp was formerly with ABC as radio facilities engineer.

N. Lincoln Greene, manager of the tape division of The Okonite Company, Passaic, New Jersey, passed away recently.

H. A. Earley, who has been with Okonite for 11 years and associated with Mr. Greene in the affairs of the tape division, has been appointed acting manager of this division.

Stanley J. Ormsby has become RCA Victor radio and television sales manager of Bickford Brothers Co., 1209 Broadway, Buffalo 12, N. Y.

S. J. Ormsby

Leopold M. Kay has been elected vice president in charge of engineering of Air King Products Co., Inc., 170 53rd Street, Brooklyn 32, N. Y.

L. M. Kay

George Koch, secretary, director and sales manager of the Simpson Electric Company, passed away recently.

Mr. Koch was sales manager of Simpson Electric Company for 14 years.

W. W. Jablon, formerly of Hammarlund Manufacturing Company, has been elected vice president of the Espey Manufacturing Company, Inc. of 528 East 72 Street, New York City. Jablon will head both the jobbing and special products divisions of the company.

H. D. Johnson, formerly assistant sales manager for The Hickok Electrical Instrument Co., has been appointed sales manager, succeeding the late Robert Williams.

James G. Doughtery, treasurer and chairman of the board of J. H. Bunnell and Co., died recently.

LITERATURE

The Magnephone Division of Amplifier Corp. of America, 398 Broadway, N. Y. 13, N. Y. has published an 8-page catalog, No. 4901, describing seventeen standard and portable models, ranging in playing time for a single reel of magnetic tape from 15 minutes to 8 hours.

The Stackpole Carbon Company, St. Marys, Pa. has released a 44-page "Stackpole Carbon Specialties Booklet", describing tube anodes, battery carbons, ground rods, electrical contacts carbon piles (voltage regulator discs), chemical carbons, etc.

Par-Metal Products Corp., 32-62 49 St., Long Island City 3, N. Y., has published a 28 page catalog, No. 48, describing cabinets, chassis, panels, and racks and accessories.

The Howard B. Jones Division of the Cinch Manufacturing Corp. 2460 W. George St., Chicago 18, Illinois, has prepared a 36-page catalog, No. 16, describing plugs and sockets, barrier type terminal strips, solder terminal barrier strips, fuse mounts, terminal panels, etc.

John F. Rider Publisher, Inc. has announced the publication of "Broadcast Operators Handbook" by Harold E. Ennes of WIRE in Indianapolis.

Book has 288-pages and covers operating practice in control rooms, the master control, remote controls, and the transmitter. Sections also cover technical data for operators and technicians, including preventive maintenance instructions, etc.

Book is priced at $3.00.

American Phenolic Corporation, 1830 South 54th Avenue, Chicago 50, Illinois, are now publishing monthly technical bulletins, "Ampheno Engineering News," describing Amphenol developments.

Hazard Insulated Wire Works Division of The Okonite Company, Wilkes-Barre, Pennsylvania, have released a 48-page booklet on building wire, H-408.

ADVERTISERS IN THIS ISSUE

COMMUNICATIONS INDEX

MARCH, 1948

NEW AUDIO *and* SUPERSONIC OSCILLATOR

with LOW DISTORTION • UNIFORM OUTPUT • HIGH STABILITY

THIS new wide-range, continuously adjustable oscillator was designed to fill a need for an instrument for laboratory measurements of gain, distortion, impedance and frequency response at frequencies well above the audio range.

With a single dial and four push-button-controlled multipliers, the Type 1302-A Oscillator covers the range of 10 to 100,000 cycles. Because of its wide frequency range and flat output this oscillator is particularly suited to taking frequency response characteristics on amplifiers, telephone lines, filters and other circuit elements.

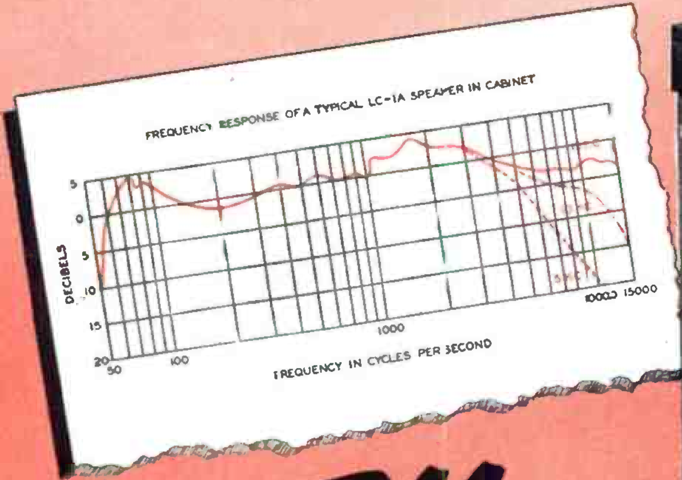
FEATURES

- **WIDE FREQUENCY RANGE**—10 to 100,000 cycles—180-degree rotation of dial covers the 10 to 100-cycle decade—panel push buttons add in decade steps.
- **ACCURATE CALIBRATION**—adjusted within ± (1½% + 0.2 cycle).
- **LOW DISTORTION**—less than 1% at any frequency.
- **SMALL FREQUENCY DRIFT**—less than 1% in first 10 minutes; less than 0.2% per hour afterwards.
- **FREQUENCY DRIFT CONSTANT PERCENTAGE OF OPERATING FREQUENCY**—particularly helpful with bridge measurements at low frequencies.
- **CONSTANT OUTPUT VOLTAGE**—within ± 1.0 db over whole range; 20 volts open circuit on 5,000-ohm output, 10 volts on 600 ohm.
- **STABILIZED SUPPLY**—compensated for transient line voltage surges and average line voltage variations between 105 and 125 (210 and 250) volts.
- **VARIABLE CONDENSER FREQUENCY CONTROL**—avoiding contact difficulties often found in variable resistance control.
- **TWO SEPARATE OUTPUT CIRCUITS**—balanced 600 ohm and unbalanced 5,000 ohm.

TYPE 1302-A OSCILLATOR . . . $365.00

GENERAL RADIO COMPANY Cambridge 39, Massachusetts

90 West St., New York 6 · 920 S. Michigan Ave., Chicago 5 · 950 N. Highland Ave., Los Angeles 38



True FM Response

FOR CONTROL ROOMS . . . OFFICES . . . AND HOME MONITORING

. . . with the new RCA LC-1A Duo-Cone Speaker

Prices To Broadcast Stations*

- LC-1A Monitoring Speaker, with Cabinet . . . **$290.00**
- Speaker Mechanism Only (Type MI-11411) . . . **$90.00**

The RCA LC-1A speaker is expressly designed for monitoring FM programs and high-fidelity recordings in broadcast stations. Its response is exceptionally free from distortion—over the full FM range. Read these highlights:

Uniform response, 50 to 15,000 cycles. Audio measurements prove RCA's new speaker free from resonant peaks, harmonic and transient distortion . . . *at all usable volume levels.*

120 degrees radiation at 15,000 cycles! The LC-1A is unique in its ability to project a wide cone of radiation through a constant angle of 120 degrees. And frequency response is uniform throughout! Advantages: It eliminates the familiar sharp peak of high-frequency response usually present in other systems. And exact location of the LC-1A in control or listening rooms *is not critical.*

Remarkably smooth crossover-response. Both cones are mounted on the same axis and have the same flare angle to place their surfaces in line. Thus the possibility of undesirable interference between H-F and L-F units over the crossover range is eliminated.

Controlled "roll-off" at 5 and 10 kc. Because of the LC-1A's exceptional high-frequency response, the surface noise and high-frequency distortion present in many recordings is accentuated. Therefore, a panel-mounted switch is provided to control and restrict the LC-1A's high-frequency range for this type of program material (see response curve).

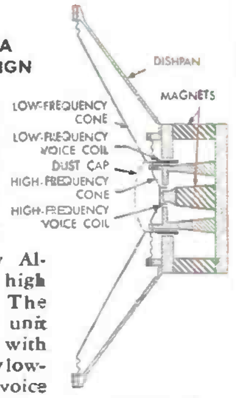
Two fine LC-1A bass-reflex cabinets (optional) are designed to match the Duo-Cone speaker. One is finished in the familiar RCA two-tone gray. The other is finished in dark walnut.

A third model . . . the LC-2A, is now available in light mahogany for executive offices and modern surroundings. Price and delivery information on this speaker is available on request.

For data and further details on Duo-Cone speakers...now in production...write Dept. 23-C.

* Effective, Jan. 1, 1948

DETAILS OF RCA DUO-CONE DESIGN



Two individually actuated cones are mounted on the same axis and flare angle, with a specially designed heavy Alnico magnet of high flux density. The high-frequency unit is a 2⅜" cone with an exceptionally low-mass aluminum voice coil. This cone follows out the shallow angle of the larger cone to radiate a pattern at full power over an area of 120 degrees at 15,000 cycles! The low-frequency unit has a massive 15" diaphragm with a high-mass voice coil of large diameter. Its resonant frequency, only 35 cycles . . . with true bass response at all volume levels.

RCA

BROADCAST EQUIPMENT
RADIO CORPORATION of AMERICA
ENGINEERING PRODUCTS DEPARTMENT, CAMDEN, N.J.

In Canada: RCA VICTOR Company Limited, Montreal