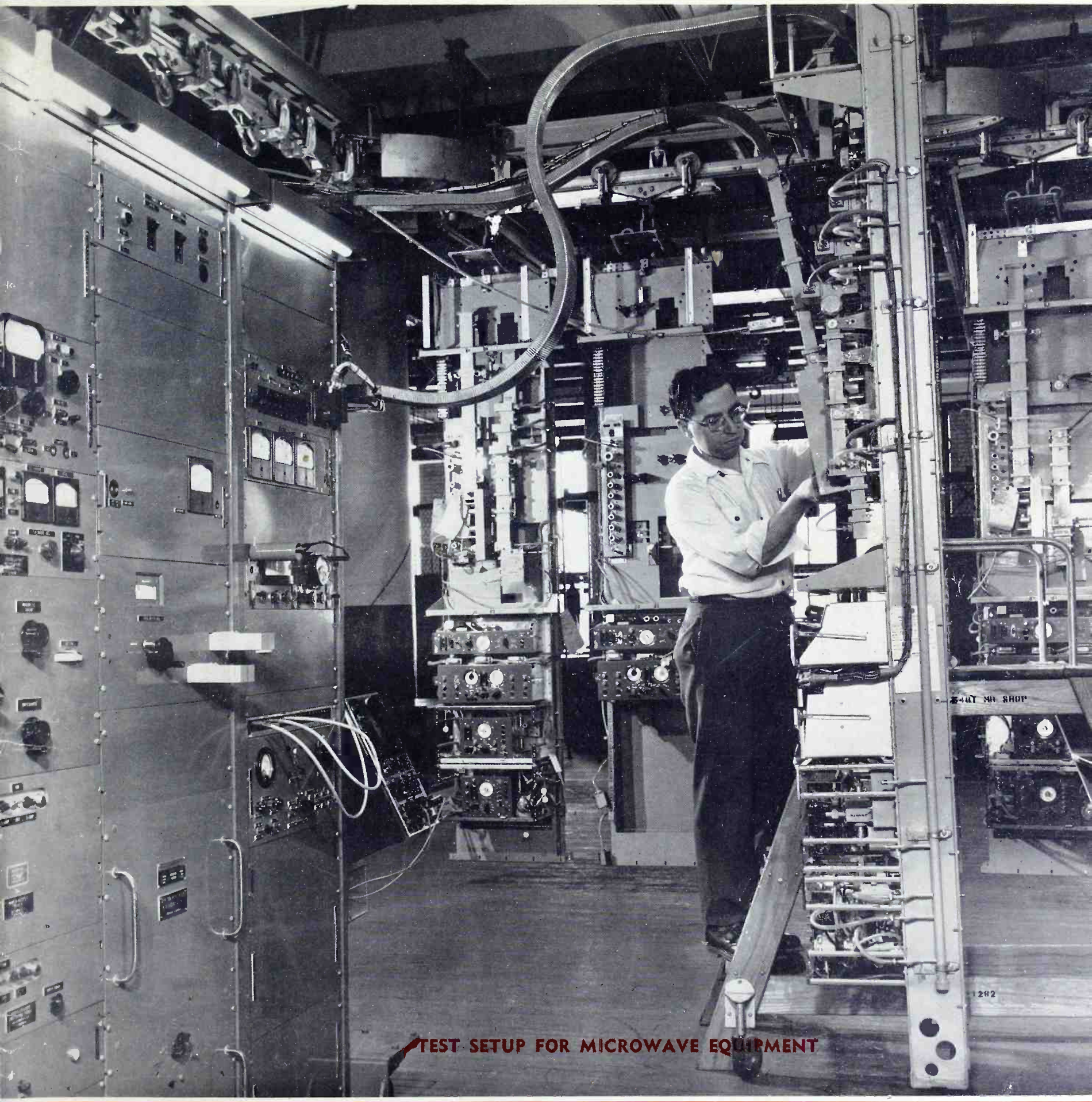
Price 35 Cents

Jan. '51

FM-TV RADIO COMMUNICATION

★ ★ Edited by ★ ★
Milton B. Sleeper



TEST SETUP FOR MICROWAVE EQUIPMENT

11th Year of Service to Management and Engineering

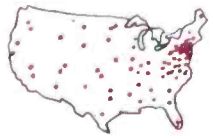
Here's What These audio "Firsts" Have Done for You

. . . to lower the cost and improve the quality of magnetic recording tape

First **with liberal discounts to professional users**

—enabling radio stations, recording studios and educational institutions to save as much as 33⅓% on the cost of magnetic tape.

First **with attractive resale discounts**



— and a nation-wide network of helpful, cooperative sound-equipment distributors in principal cities from coast to coast.

First **with red oxide tape on paper base**

— offering recordists a high-quality tape designed to match the characteristics of the vast majority of recorders, at *lowest possible cost.*

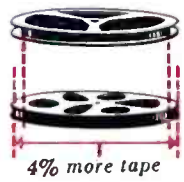
First **with supercalendered kraft paper base**

— providing maximum smoothness of texture and minimum noise, without the use of fillers which tend to come out or stiffen the paper.

First **with all-aluminum 7-inch reels**

—mechanically strong, light in weight, and permanently free from warping or twisting even under adverse conditions.

First **to give extra footage on standard size reels**



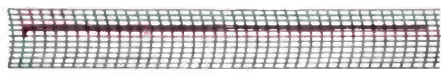
Audio's "full measure" of 1250 ft., 2500 ft., and 5000 ft. give *4% more tape* on every reel.

First **with black oxide tape on plastic base**

— offering highest fidelity of recording and reproduction for machines designed to use a high coercive-force oxide.

First **to offer paper base tape in 2500 and 5000 foot rolls**

—permitting maximum economy for professional applications where premium quality recordings are not required.



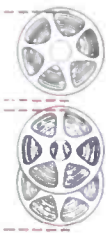
First **to produce a constant output tape**

—made possible by Audio's specially designed coating machinery which controls coating thickness to within 5 *millionths* of an inch.

First **to guarantee output uniformity of**

± ¼ db for 2500 ft. reel

± ½ db from reel to reel in 2500 ft. size



First **to produce a splice-free 2500 ft. roll**

— to *guarantee* that the tape is all one piece, with absolutely no splices in the entire length.

First **to develop the safe-handling package for professional-size rolls**

—permitting tape on hub to be transferred to or from turntable without danger of spilling—and simplifying the attachment of side flanges.

These "Firsts" are proof of the continuous research and development that keeps Audiotape foremost in the field. They are the result of more than a decade of experience — by the only company specializing solely in the manufacture of fine recording materials — both tape and discs.

That's why you can always look to Audio for the latest developments in the recording art. A trial order of Audiotape will speak for itself. Or send today for a free 300-foot sample.

**Trade Mark*

AUDIO DEVICES, INC.
444 Madison Ave., New York 22, N. Y.

Please send me a free 300-foot sample reel of ☐ plastic base or ☐ paper base Audiotape.

NAME.....

COMPANY.....

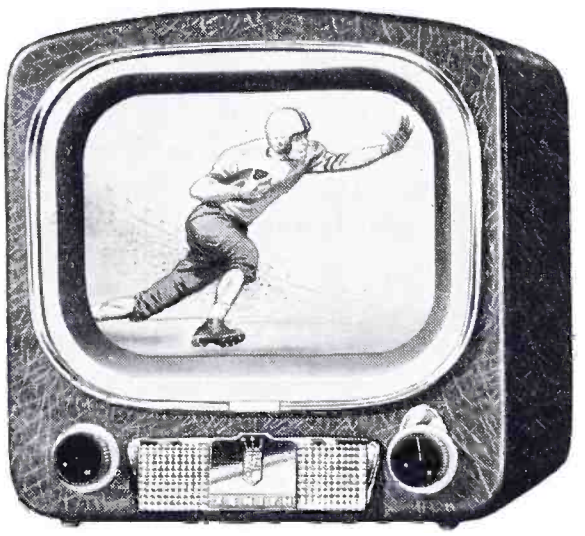
ADDRESS.....

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

It's Here...Zenith's Brilliant, All New

All-American TV Line-Up

Sure to Score! Sure to Win!



New Zenith "Burton" TV Table Model. Beautifully finished Mahogany Pyroxylin cabinet with gracefully curved top and sides. New 154 sq. in. Rectangular "Blaxide" Tube.

With the BIG Line . . . BIG Pictures . . . BIG Features America Wants Most in Television

HERE'S THE "kickoff" for the fastest selling television you've ever known!

Thrillingly new 1951 Zenith TV . . . with superbly designed cabinets—the most beautiful in television—each one a masterpiece of quality and good taste . . . new, exclusive "years ahead" Zenith features . . . and big, new, amazingly life-like pictures that make this the most exciting Zenith line ever!

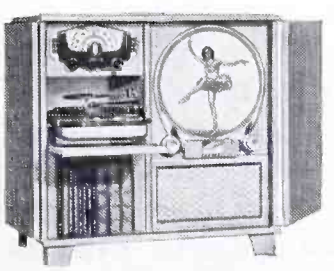
Here—available on *all* models—is the sensational Zenith® "Lazy Bones" Remote Control to change station, picture and sound *automatically* from clear across the room. Here the spectacular Zenith 2-in-1 Screen—with TWO picture shapes, Giant Circle or Rectangular Type, in ONE set. Here also is the super-powerful, "Super-Range" Chassis . . . transforming even weak and distant signals into pictures of outstanding new clarity, definition and steadiness. ALL in competitively priced models that make Zenith quality—the finest in television—easy for everyone to own.

Heavily, Powerfully Advertised in the Nation's Leading Magazines

The biggest and best magazines in America will carry the "big value" story of these magnificent new Zeniths. So don't wait. Call your Zenith Distributor now, today. Get your order in. Get your sales promotion material. Get excited because you're ready for your biggest year with ZENITH!

New Zenith "Hawthorne" TV-Radio-Phonograph. Cabinet of genuine Mahogany veneers with full length doors. 165 sq. in. Reflection-Proof Screen.

New Zenith "Byron" TV Console. Distinguished 18th Century cabinet of genuine Mahogany veneers and selected hardwoods. Giant 238 sq. in. Reflection-Proof Screen.



New Zenith "Wordsworth" TV-Radio-Phonograph . . . Blonde modern cabinet in Gold Coast Afara solids and veneers. 165 sq. in. Reflection-Proof Screen.

Team Up with these "Most Wanted" Television Features. You'll find them ALL in Zenith and Nowhere Else!

Zenith's new Giant 238 sq. in. screen—wider than a newspaper page!

Zenith's "Super-Range" Chassis—reaches out for stations. Tunes even weak signals into clear pictures!

Zenith's Reflection-Proof Screen—bans window and room light reflections!

Zenith's Blaxide Picture Tube—brings out far richer contrast and clarity!

Zenith "2-in-1" Screen—gives you *two* picture shapes in *one* set—Giant Circle or rectangular type!

Zenith Pre-Tuned Built-in Antenna—works where many others fail!

Built-in Provision for Tuner Strips to Receive Proposed Ultra-High Frequencies on Present Standards.

Zenith is No. 1 for '51!

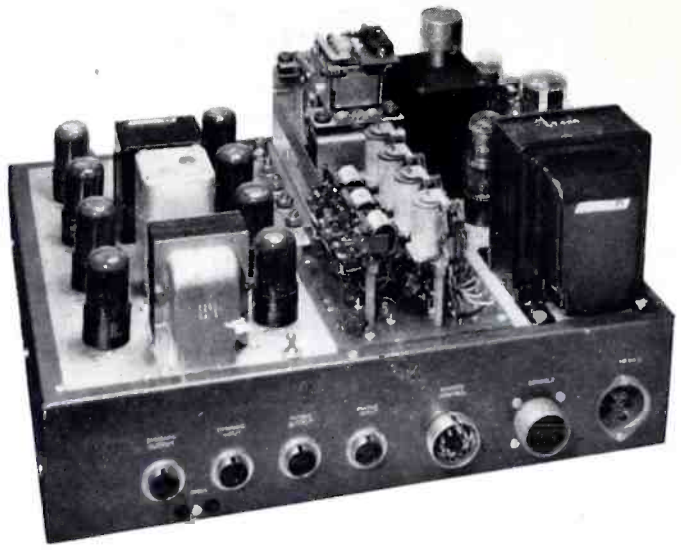
Superiority you can see
Quality you can *trust*

ZENITH
•LONG DISTANCE• RADIO and TELEVISION
THE ROYALTY OF RADIO AND TELEVISION

Zenith Radio Corporation, Chicago 39, Illinois • *Over 30 Years of "Know-How" in Radionics® Exclusively*
Also Makers of America's Finest Hearing Aids

HAMMARLUND

DATA TRANSMISSION AND REMOTE CONTROL SYSTEMS



Hammarlund offers the largest and most complete selection of equipment for Data Transmission and Remote Control Systems. Some of the commercial equipments now available are listed below:

RCR and RCT remote control receiver and transmitter units: Standard signals provide up to 420 on-off switching functions, protected against failure by circuits employing the exclusive Multi-Gate principle. Signaling time is approximately 0.45 second.

RSCTR duplex signaling unit: This is a combined transmitter and receiver, providing up to 20 signaling channels in the 2- to 3-kc. range. Unit is AC-powered, and has adjustable operating range to -32 db. Carrier-lock and ringing-voltage facilities are included.

FRC and FTC fleet receiver and transmitter control: These units provide up to 20 signaling channels in the 2- to 3-kc. range. Automatic pulse transmission provides selection and carrier-lock facility.

SCM-30T telephone-type pulse-counting selector: Five-digit code provides up to 126 individual codes per tone channel, with channels spaced 75 cycles apart in the 2- to 3-kc. range. Lockout and in-use facilities provided. Features provision for individual, group, or all-call selection. Pulsing time up to 0.8 second for five-digit code.

Common applications for above types of equipment include selective signaling, selective calling, fleet calling, channel-sharing for mobile radio systems, remote control and selection of transmitters and receivers, remote on-off switching functions of industrial equipment, return-beacon verification signals, pipeline control, telemetering, and microwave channelizing. Consultation on these and other applications is invited. Address all inquiries to:

HAMMARLUND MFG. COMPANY INC.

460 WEST THIRTY-FOURTH STREET, NEW YORK CITY, N. Y.

FM-TV

Formerly *FM* MAGAZINE, and *FM* RADIO-ELECTRONICS

VOL. 11 JANUARY, 1951 NO. 1

CONTENTS

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Published by: RADIOCOM, INC.

Publication Office: 264 Main St., Gt. Barrington, Mass. Tel. Gt. Barrington 500

FM-TV Magazine is issued on the 10th of each month.

Subscriptions: Should be addressed to 264 Main St., Great Barrington, Mass.

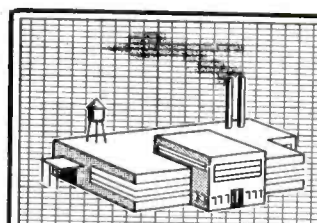
Single copies 35c—Subscription rate: $6.00 for three years, $3.00 for one year in the U. S. A.—Canada, add 50c per year postage—foreign, add $1.00 per year postage.

Contributions will be neither acknowledged nor returned unless accompanied by adequate postage, packing, and directions, nor will *FM-TV* Magazine be responsible for their safe handling in its office or in transit.

Entered as second-class matter August 22, 1946, at the Post Office, Great Barrington, Mass., under the Act of March 3, 1879. Additional entry at the Post Office, Boston, Mass. Printed in the U. S. A.

CPA AUDIT

CIRCULATION AUDITED BY
HENRY R. SYKES
CERTIFIED PUBLIC ACCOUNTANT
SYKES, GIDDINGS & JOHNSON
PITTSFIELD, MASSACHUSETTS



Set Production

TELEVISION and audio receiver production by RTMA member-companies continued at a high rate in October. Special pressure was put on TV shipments because of heavy demand in this period immediately preceding the imposition of a 10% Federal excise tax which became effective on November 1.

Production of all sets has been running far ahead of last year. Monthly averages for 10 months in 1950 against 1949 averages show gains as follows:

AM, '50 average,	up	34%
FM, " "	up	31%
TV, " "	up	123%

A comparison of the set production figures for October with those of the same month last year show:

AM,	844,534 up	28%
FM,	94,969 up	12%
TV,	641,927 up	111%

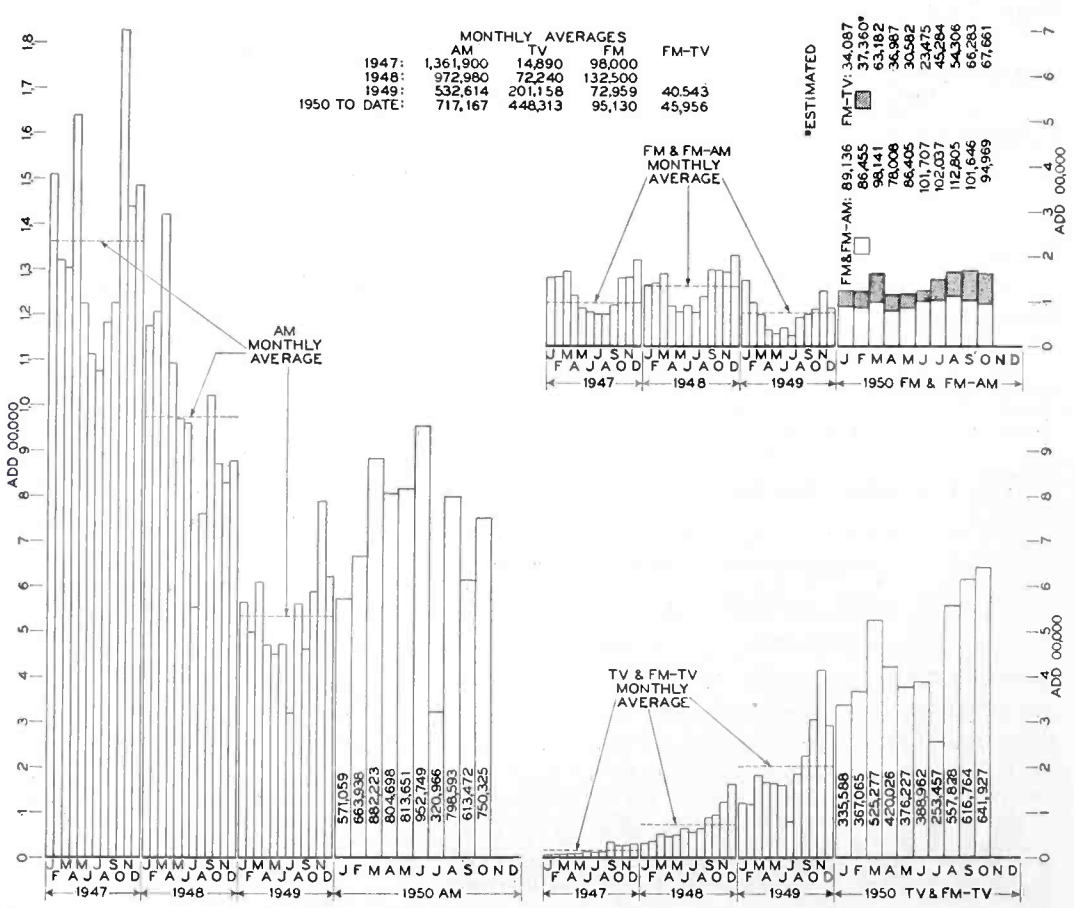
After the general jitter that followed the announcement of cuts in consumption of essential materials for consumer goods, the radio industry has settled down to the serious business of making readjustments, and preparing to substitute military contracts for distributors' orders. There is considerable speculation as to whether or not the shift can be made quickly enough to avoid some intermediate unemployment.

Reason is that the production of home sets is at a much higher level now than in 1941, compared to probable military requirements. Also, a substantial amount of Government business will go to companies that have not been making civilian goods.

October shipments of TV picture tubes to set manufacturers amounted to 848,387 units, up 83,474 from September. Of these, 92% were 16-in. or larger, and 58% were rectangular in shape.

Receiving tubes set a new, all-time high for the third consecutive month, up 3,074,238 over September, to reach a total of 40,105,611. This is 65% above October last year, when the record was set for '49. In spite of this enormous domestic production, many tube types are in such short supply that they are being purchased in Canada, England, France, and they are being flown into the United States.

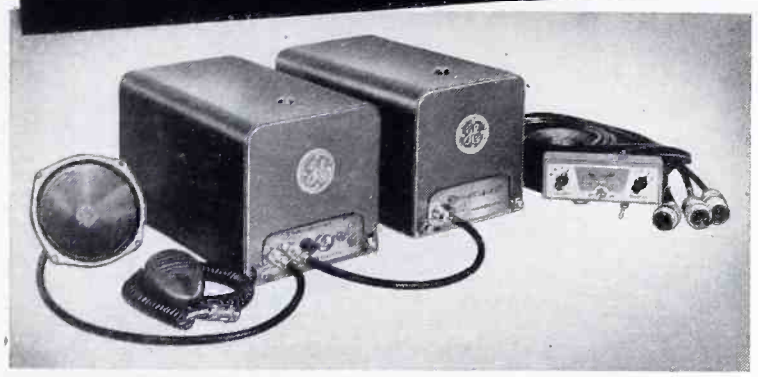
A breakdown of the October report shows 32,305,648 tubes sold for new sets; 6,699,448 for replacements; 918,338 for export; and 182,177 for Government agencies.



TV, FM, and AM Set Production Barometer, prepared from RTMA figures

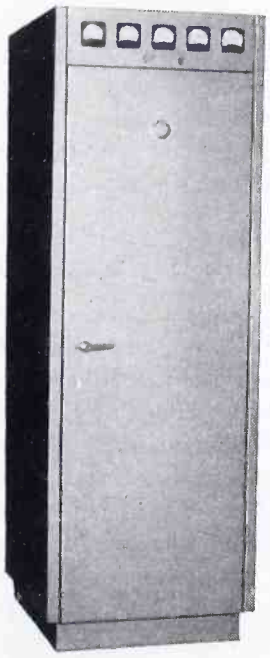
G-E 2-WAY RADIO

FOR TIME-SAVING COMMUNICATION



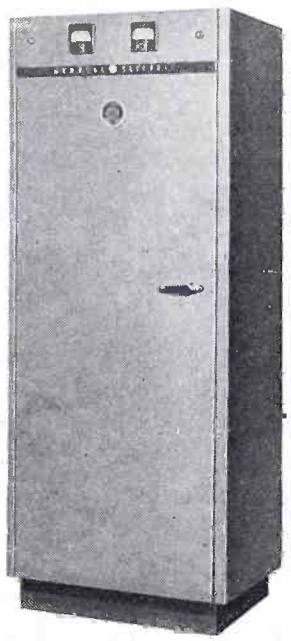
MOBILE COMBINATION, 25-50 MC. Operates with a power output of 30 watts (MC-1) or 50 watts (MC-3), narrow or wide band. Features practical adjacent channel operation. Consists of receiver, transmitter, loudspeaker, microphone with retractable cord, antenna control unit, power and control cables.

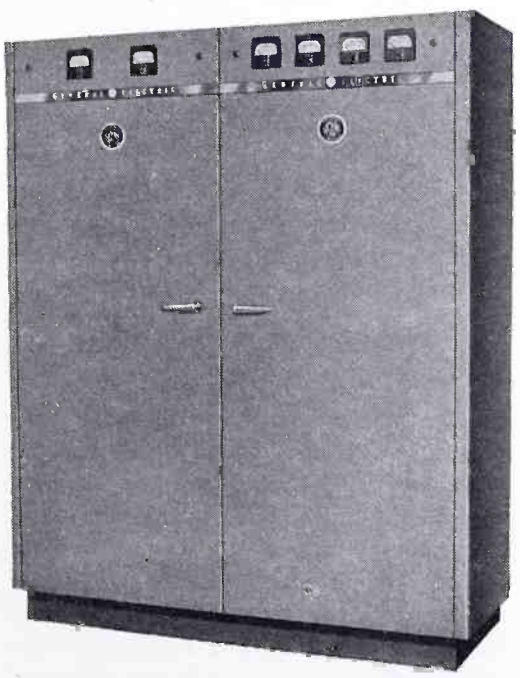
MOBILE COMBINATION, 148-174 MC. Operates with a power output of 10 watts (MC 203) or 50 watts (MC 204). Features adjacent channel operation and single unit design. Consists of receiver, transmitter, loudspeaker, microphone with retractable cord, antenna, control unit, power and control cables.



SINGLE UNIT 250 WATT STATION—for operation in the 25-50 mc or 148-174 mc band. Consists of transmitter, receiver, local or remote terminal equipment. Height 78"; width 26½"; depth 22".

G-E 50 WATT STATION—for use in the 25-50 mc or 148-174 mc band. The cabinet contains transmitter, receiver, local/remote control terminal equipment. Height 66"; width 24"; depth 20".





G-E 250 WATT STATION—for the 25-50 mc or the 148-174 mc bands. The cabinet contains a 250 watt power amplifier, 50 watt exciter, receiver, local/remote control equipment and space for additional receivers or accessory equipment. Height 66"; width 48"; depth 20".

MICROWAVE—Complete microwave radio relay systems are designed, engineered, built by General Electric. Operating in the 2000 mc band and employing pulse time division multiplex, microwave provides multiple speech channels plus telemetering, remote control, and teletype services.

Call the radio and microwave communications man at the G-E office nearest you for full details on the systems or equipment described here.

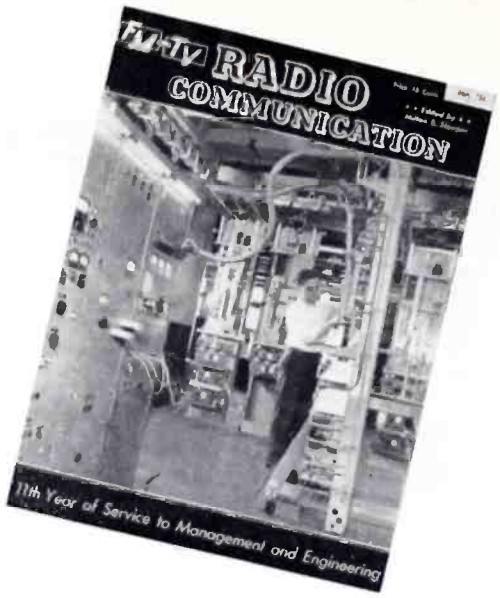
NEW BULLETIN will be sent to you on request. Photographs, descriptions, information on G-E radio communication. Write *General Electric Co., Electronics Park, Syracuse, New York.*

You can put your confidence in—

GENERAL ELECTRIC

THIS MONTH'S COVER

Despite the out-of-this-world aspect of this month's cover photograph, it's an all-in-the-day's-work scene at the Western Electric Kearney Works, where equipment for the AT & T radio relay systems is manufactured. The setup is for final tests on microwave gear. With the continual extension of communication service on microwave frequencies, it has been necessary to develop completely new instrumentation for performance measurements and tests, some of which can be seen in this view.



SPOT NEWS NOTES

ITEMS AND COMMENTS, PERSONAL AND OTHERWISE, ABOUT PEOPLE AND COMPANIES CONCERNED WITH RADIO COMMUNICATIONS

Out a Mile:

Commissioner Hennock was certainly off base when she called audio broadcasting "television's poor, blind sister." FCC figures show that audio revenues in '49 not only paid the TV deficit but netted a profit besides. As for being blind, Fred Allen has this to say: "None of the visual modes of dramatic expression — the stage, screen, or television—can use the imagination of the audience the way radio can. . . . You merely plant a suggestion in the listener's mind, and his imagination supplies all the details, all the scenery, props, extras, and costumes."

Roy F. Allison:

Our Associate Editor, who was scheduled to take over as Editor effective with this issue, reported for duty in the Naval Reserve on January 2. No plan has been made to replace him, because we hope he can continue as a contributor, at least.

Phonevision Tests on the Air:

The 90-day test of Zenith's Phonevision system started January 1, with full-length, feature movies on the air at 4:00, 7:00, and 9:00 P. M. A picture shown at 4:00 on one day will be run at 7:00 the next day and at 9:00 the day following, so that each family can see each picture at the most convenient time. Also, children can see each picture in the afternoon, without interfering with evening studies. Viewers in Chicago area will see scrambled Phonevision pictures on channel 2. However, those who have unscrambler connections to the Telephone Company will see clear pictures if they ask the operator for the key signal. For each "admission request" the Telephone Company will charge the subscriber $1.00. FCC has authorized this test for 90 days only. Data on public acceptance will then be analyzed and submitted to the Commission in order that a decision can be reached as to authorization of regular Phonevision broadcasting on its merits as a public service.

Capt. David R. Hall:

Elected a vice president of Raytheon Manufacturing Company, and manager of the equipment division. He was appointed to the Naval Academy by Henry Cabot Lodge, graduating in 1925. When his picture appeared on our front cover of September 1943, he was Head of the Design Branch, Radio Division, Bureau of Ships. Later, he became Assistant Chief, Bureau of Electronics. He first joined Raytheon in May, 1949.

Nylon and Styron Bushings:

Standard and special sizes are being produced by American Products Company, 1652 N. Honore Street, Chicago 22. Samples are available on request.

That Blurb Eliminator:

Note from George P. Adair, Washington engineering consultant, refers to an item in this Department for last November concerning a device to silence radio commercials. Mr. Adair is of the opinion that patents issued to him in 1934 and '39 read on Dr. Jones' method, and also on the Chapin-Roberts arrangement for TV color-monochrome switching.

Closed-Circuit Color TV:

Use of color TV for industrial and demonstration purposes, and in classrooms and retail stores opens up new markets for equipment sales. Beautiful detail and

(Continued on page 10)

The Famous REL 646-B Receiver

The latest production release of the famous REL 646-B FM receiver is nearly exhausted. This model was intended originally for use specifically as a broadcast station monitor. However, since it was first advertised in this Magazine one year ago, sales to designers of custom installations and to leading parts jobbers have climbed to a level far beyond anything we ever anticipated.

Simultaneously, our volume of commercial communication equipment for domestic and foreign use has grown to such an extent as to tax our production facilities.

We were faced, therefore, with deciding whether we should discontinue the 646 type of receiver, or redesign certain features to simplify its manufacture.

Because the 646-B has won so many new friends for us, and has introduced the distinctive quality of REL engineering to so many who might not otherwise have become acquainted with us, we decided to bring out a new model to be designated as the 646-C. We do not know, at this time, exactly when deliveries will start on the 646-C. That depends upon the availability of engineering man-hours and the components. Accordingly, we offer this suggestion:

Place your Reservation Order now. Do not send your remittance, however, until we notify you that we are ready to make shipment. Reservations Orders will be filled in the order received. Your Reservation Order can be cancelled at any time without obligation. Use your company order form or the coupon provided below:

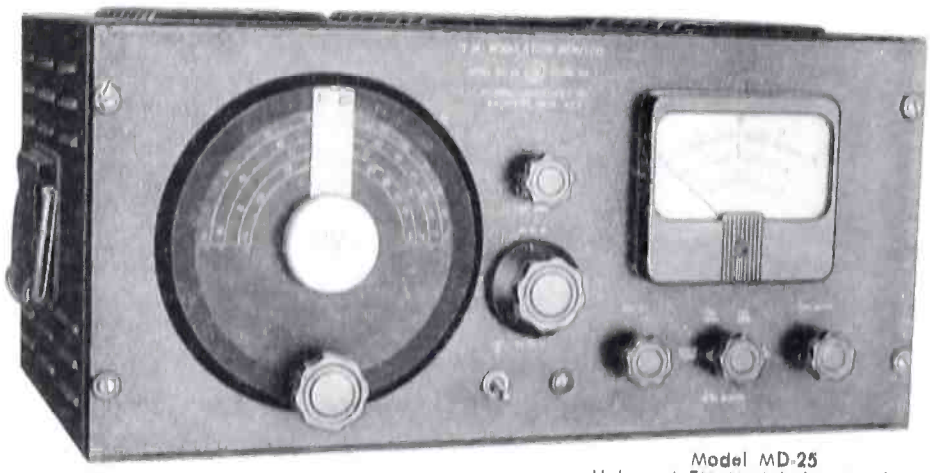
RADIO ENGINEERING LABORATORIES, INC.
36-40 Thirty Seventh Street
Long Island City, N. Y.

Please enter my Reservation Order for ..... model 646-C receiver(s), and notify me as soon as you are ready to ship, in accordance with the Reservation Number of my order. It is understood that I may cancel this Reservation Order at any time prior to shipment, without obligation.

Name .....

Address .....

ONE Modulation Monitor for ALL Mobile Frequencies



Model MD-25
Universal FM Modulation Monitor

THE distinctive feature of the BROWNING FM Modulation Monitor is its universal coverage of all frequencies between 30 to 50 mc., 72 to 76 mc., and 152 to 162 mc. Consider the convenience and economy of such an instrument compared to those which can measure modulation only on three or four frequencies!

With the BROWNING model MD-25, you are certain of being able to make measurements at all frequencies required now in those bands, or additional frequencies you may encounter at any time in the future.

This is particularly important to radio maintenance organizations, for it is assurance that added customers can be served without the expense of buying more modulation monitors to check additional frequencies.

And remember that the BROWNING model MD-25 represents the engineering skill and precision manufacture that have made BROWNING Frequency Meters the standard of the communication services since 1940. Before you buy any type of modulation monitor, send for information on the MD-25, and check its ease of operation, flexibility, and the economy of all-band operation in a single instrument.

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

IN CANADA, ADDRESS: MEASUREMENT ENGINEERING, LTD., ARNPRIOR, ONT.

MD-25 SPECIFICATIONS

The BROWNING model MD-25 Universal FM Modulation Monitor permits the measurement of modulation swing at all frequencies within the mobile radio bands of 30 to 50 mc., 72 to 76 mc., and 152 to 162 mc.

Calibrated, stable discriminator is used to determine modulation swing up to 20 kc. Frequency swing can be read to better than 1 kc.

Measurement can be made on signals generating less than 1 millivolt at the antenna terminals.

An audio output is provided which permits attachment of an audio amplifier or phones for aural monitoring.

Four-inch panel meter indicates frequency swing. Also used as a tuning meter for indicating limiter voltage or total discriminator voltage.

Voltage-regulated supply for local oscillator and metering circuits. For use on 115 volts, 60 cycles.

Tube complement: one 6AK5, one 6J6, one 6C4, four 6AU6, one 6AL5, two 6SN7, one 5Y3, one VR-150.

Flashing lamp indicates instantaneous modulation peaks exceeding 15 kc.

Antenna and audio output terminals, and the screwdriver-adjusted potentiometers are located at the rear of the chassis.

Ventilated, rigid steel cabinet has black wrinkle finish.

Dimensions: Height 9 ins., width 20½ ins., depth 12 ins., weight 40 lbs.

BROWNING LABORATORIES, Inc.
750 Main Street, Winchester, Mass.

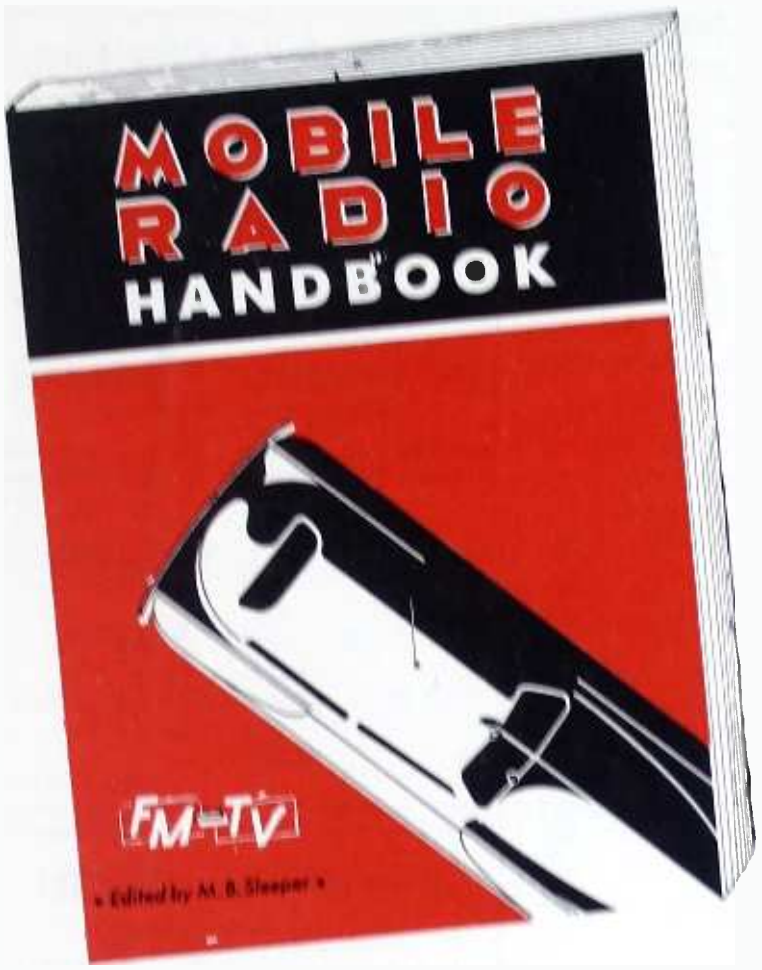
Please send technical bulletin and information on prices and delivery for the MD-25 Universal FM Modulation Monitor.

Name .....

Address .....

.....

Company .....



THE ONLY BOOK OF ITS KIND!

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

COVERS ALL THE NEW SERVICES

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

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

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

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

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

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

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

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

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

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

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

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

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

FM-TV MAGAZINE
Box 600, Great Barrington, Mass.

Please enter my order for a copy of the MOBILE RADIO HANDBOOK, for which my remittance is enclosed:

$2.00 Paper Bound Volume
$4.00 Cloth Bound Volume
(Add 25c postage outside U. S.)

Name

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SPOT NEWS NOTES

(Continued from page 6)

color fidelity is possible in closed-circuit systems because an 18-mc. band can be used. No FCC license is necessary. Du Mont Laboratories, 1000 Main Avenue, Clifton, N. J., has just issued a brochure illustrating such equipment, and describing some of the many applications.

Marvin Hobbs:

Appointed Chief of the Electronics Division of the Munitions Board, Department of Defense, Washington 25, D. C. He is also Government Chairman of the Electronics Equipment Industry Advisory Committee.

Short Memories:

We guess the broadcasters have forgotten the shortage of newsprint that diverted so much newspaper advertising to audio broadcasting. And apparently they haven't heard that a new shortage is impending come next June. That's the only way we can explain all the talk that's going around about cutting rates on audio time.

CC Signal Generator:

A new signal generator for checking carrier current telemetering and load-control circuits has been brought out by Link Radio Corporation, 125 W. 17th Street, New York 11. A telephone dial pulses 60 or 800 cycles. Frequency range is 30 to 210 kc., divided into 6 individually calibrated ranges, with check points every 30 kc.

Sydney E. Warner:

Appointed director of engineering and research for LaPointe-Plascamold Corporation, Windsor Locks, Conn. A radio engineer of wide experience, he is best known for his work as radio supervisor for the Connecticut State Police, when he was in charge of the first 2-way statewide FM system.

Knobs and Dials:

A new line of Instrument controls, available in standard types or with special modifications, is now available from E. F. Johnson Company, Waseca, Minnesota.

CBS Color at Philadelphia:

In cooperation with WCAU, CBS color TV is being demonstrated to the public at 1118 Chestnut Street, Philadelphia.

TV Tube Production:

Eitel-McCullough, Inc. turned out the 100,000th 19-in. metal-cone picture tube at its Salt Lake City plant on December 6, 1950.

(Concluded on page 11)

Special Services Directory

SPOT NEWS NOTES

(Continued from page 10)

Reorganization:

Entire capital stock of Airborne Instruments Laboratory, Mineola, N. Y., has been purchased from Aeronautical Radio, Inc., by AIL executives and employees together with Laurance S. Rockefeller and certain of his associates, and American Research & Development Corporation of Boston. There will be no change in the officers. Board of directors is comprised of Hector R. Skifter, D. M. Miller, John N. Dyer, Stuart N. Scott, Joseph Powell, Jr., George Doviot, Randolph B. Marston, and Harper Woodward.

High-Fidelity:

That's the name of a new magazine which we shall bring out on April 15. Edited at the consumer level, it will cover all the subjects of interest to the devotees of high-fidelity radio and phonograph music and home recording. It will be published by Milton Sleeper, and edited by Charles Fowler, with the support of an outstanding editorial advisory panel. Original plan was to publish HIGH-FIDELITY as a monthly. However, prevailing conditions dictated the decision to start it as a quarterly, changing later to a monthly. Publication dates will be: April 15, September 15, November 15, and February 1. This schedule is not exactly that of a true quarterly publication, but is adjusted to conform to the periods of maximum activity in the audio world. Latest and most pertinent developments in high-fidelity equipment can thus be covered in a thorough, easy-to-understand way. HIGH-FIDELITY will serve the consumer well. Publication office will be at the Savings Bank Building, Great Barrington, Mass.

FCC Forgot This One:

The Underwriters Laboratories has announced that UL approval of any TV set will be withdrawn if it is altered in the field for CBS black-and-white or color reception. There's too much danger of fire and shock from such conversion jobs. Further, factory conversions cannot carry UL approval unless they are resubmitted and accepted.

New Corporation:

Since the inception of this Magazine, it has been published by FM Company, under the ownership of Milton Sleeper. Effective this month, the entire property has been taken over by RADIOCOM, INC., whose stock is owned by Milton B. Sleeper, president, Charles Fowler, treasurer, and Ethel V. Sleeper, who is secretary of the new company.

Important Books

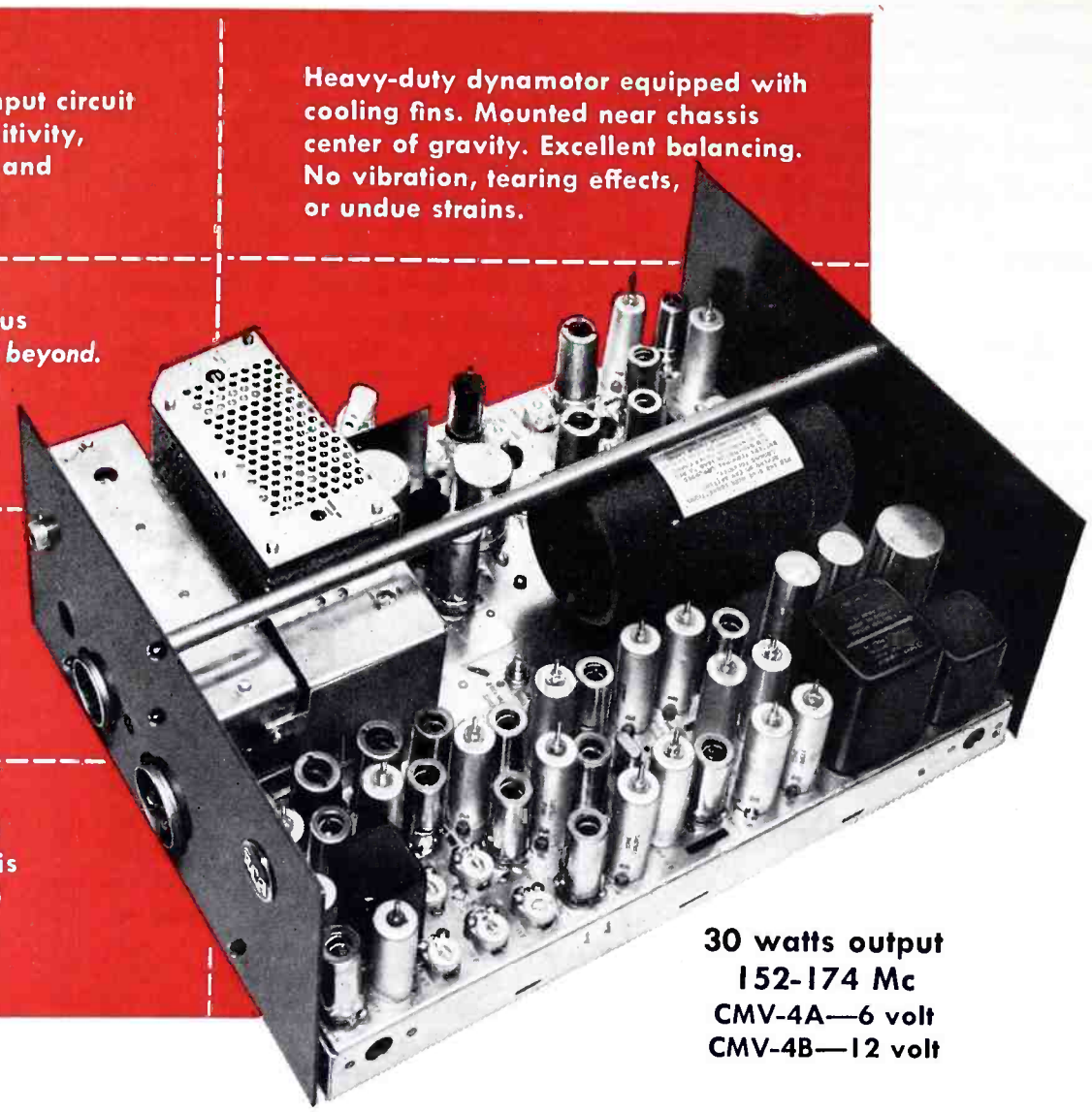
Unique grounded-grid r-f input circuit provides high receiver sensitivity, greater frequency stability, and simplified tuning.

Heavy-duty dynamotor equipped with cooling fins. Mounted near chassis center of gravity. Excellent balancing. No vibration, tearing effects, or undue strains.

Built-in filter reduces spurious emission to 1000 Mc. —*and beyond.* All spurious emissions and harmonics in the band down at least 85 db.

Convenient pin jacks provide easily accessible points for servicing and tuning.

Frequency stability is within 0.001% (without an oven); is within 0.0005% (with oven) between −22° and +140° F.



30 watts output
152-174 Mc
CMV-4A—6 volt
CMV-4B—12 volt

NOW *the 30-watt SUPER Carfone*

A revolutionary new 2-way radio for police, fire fighting, public utilities, taxis, pipelines, and construction services

- ☑ Clear reception assured *within a few feet* of adjacent-channel stations because of superior circuit design.
- ☑ Message intelligibility improved by raising average modulation to 70% (ordinary transmitters give 10 to 35%).
- ☑ Spurious emissions at any frequency down at least 85 db (20 times better than required by FCC). Meets all RMA requirements.
- ☑ Economical to operate (low current drain on stand-by; high-efficiency amplifier takes less power). Tubes are operated for optimum life; at least half of them idle at 1/5 of maximum rating.
- ☑ Excellent performance in crowded metropolitan areas, as well as farther out in the suburbs where the going is tough.
- ☑ Cuts down interference *within the band* at least 100 db (100 times better than required by FCC regulation).
- ☑ Balanced construction reduces vibration—extends equipment life.

The Super Carfone 30 package— (1) single-unit transmitter, receiver, and power supply; (2) control box; (3) microphone and antenna; (4) loudspeaker.

MOBILE COMMUNICATIONS SECTION
RADIO CORPORATION of AMERICA
ENGINEERING PRODUCTS DEPARTMENT, CAMDEN, N.J.

In Canada: RCA VICTOR Company Limited, Montreal

WHAT'S NEW THIS MONTH

CIVIL DEFENSE NEEDS ARE A CHALLENGE TO RADIO ENGINEERS, PARTS JOBBERS, SERVICEMEN — THE NEED FOR EMERGENCY POWER AND RADIO LINKS

THE system of wire and radio communication in our United States of America is without parallel in any other country. In time of peace, it has served to unite our forty-eight states with a common understanding and a universal language by which we have built up the social and commercial intercourse necessary to national solidarity. In time of peril, our communication facilities are a powerful weapon of defense, by means of which we can alert any area instantly, and bring up aid by air, and over railroads and highways.

It is interesting to consider that the communication systems now available to us for our protection were post-war, peacetime developments. There is probably not a town of 5,000 population in the United States without at least one communication system with a range of 20 miles or more. These systems, more-over, are within range of state-wide police radio systems which, in turn, can relay messages from one to another. On a local, state, and national basis we are served by police, fire, public utility, industrial, transportation, Red Cross, and various emergency radio services that can be organized and expanded readily to meet defense needs.

In, fact, Government plans for civil defense are built around these radio communication facilities. The accompanying illustration, reproduced from "United States Civil Defense,"[1] shows the method by which the various agencies are integrated under command of an Area Control Center. We took the liberty of adding to this picture a symbol representing one or more key radio stations, for reasons which will be developed later.

FTB ALARM SYSTEM

ONLY one link in our chain of equipment for Civil Defense Control communication has been missing. That is an adequate alert alarm system to operate signal lights, call bells, and sirens.

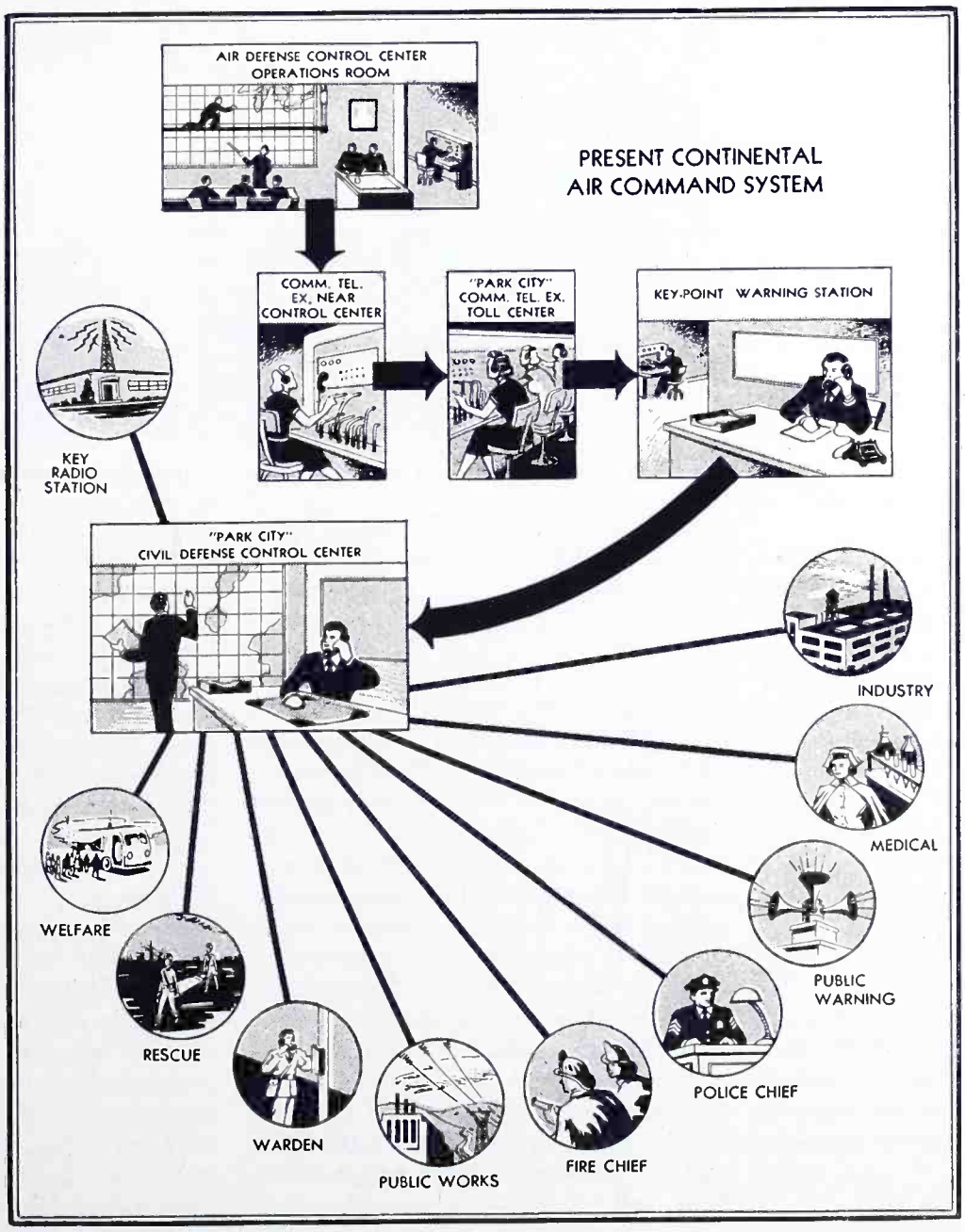
Recently, however, that essential was supplied by Frederick T. Budelman, vice-president in charge of engineering at Link Radio Corporation. Called the FTB alarm system, it is receiving highly favorable consideration on the west coast and in the east for use with radio systems and wirelines. The units are fail-safe in operation, and simple enough to be built by station engineers or servicemen. They will be described by Mr. Budelman in a series of three articles:

FEBRUARY: Description of the overall system, and design of the transmitting device.

MARCH: Details of the fail-safe alarm for use with any suitable receiver.

APRIL: Design of a miniature fixed-frequency receiver intended specifically to actuate the FTB alarm.

Mr. Budelman's system is so straightforward and so readily adaptable to existing facilities that we expect it to be employed universally for civil defense services.



Operational details of defense communication may vary in different areas in accordance with local requirements, but they must be planned around the use of radio or the telephone. It seems logical that messages coming in to the top command should be handled by telephone and teletype. Radio, on the other hand, offers important advantages when alert warnings and instructions must be fanned out from headquarters to agencies and passed on to individuals.

We know from past experience that, despite public notices to the contrary, people will rush to their telephones even during practice alerts. Radio transmission is not affected by telephone congestion, and can reach any number of people instantly, and without interference.

With addition to radio communication transmitters for local coverage there are some 700 broadcast stations capable of delivering solid signals at ranges of 40 to 80 miles or more. It is not generally known, but, during the last war, all broadcast stations in New England were required to monitor the FM transmitters at Mt. Washington and Paxton. Those two stations blanketed the entire New England area except for the northern tip of the Maine coast. Since comparable interference-free service cannot be delivered by AM stations, FM broadcast transmitters will undoubtedly be used for large-area coverage.

(Continued on page 37)

[1]This book can be obtained from the Government Printing Office, Washington, D. C., at 25c per copy. Do not send stamps.

RECORDERS AND REPRODUCERS

RECORDING MEDIA AND TECHNIQUES EMPLOYED BY THE BBC — DESCRIPTION OF LATEST ENGLISH LIGHTWEIGHT PICKUPS — *By* JAMES MOIR*

BECAUSE there is only one broadcasting organization in England, a discussion of British recording and reproducing practice is almost entirely a discussion of BBC practice. Some commentary will be added on the apparatus that is available to the public, though not used by the BBC. About 20 alternative designs of pickup are available in England but, having made a choice of design, BBC practice is naturally to standardize that one model throughout the country to the complete exclusion of all competition.

Standard 35-mm. photographic film, Philips Miller engraved film, lacquer disks, and magnetic recording on steel wire and plastic tape are all used to some extent by the BBC at present. The 35-mm. film is not used very widely, steel tape has been almost superseded, and the ¼-in. plastic tape so popular in America has not yet been introduced to domestic broadcasting, as it is not considered good enough to go into service in England. This statement is probably very surprising, after all the claims that have been made for tape recorders; but print-through is a defect still considered sufficiently serious to justify delaying the introduction of magnetic recording to British domestic service. It can be taken for granted that most of the reputable makes of tape recorders of British and American design have been investigated but, as magnetic recording practice over here is to be reviewed at a later date, nothing more will be written on the subject right now.

Lacquer discs and commercial gramophone records account for a large part of BBC air time. Commercial records are run on a group of disc-jockey programmes under such titles as *Housewives' Choice* and *Record Serenade*. Most of the remainder of recorded programmes, utilizing about 5,000 discs per week, are cut by the BBC on equipment designed and produced by one British and one American manufacturer, and adapted to BBC requirements.

Type D Recording Channel:

A rapidly-increasing proportion of the recordings, however, are being cut on equipment designed by the BBC Research Department and manufactured by E. M. I. This is known as the Type D recording channel. As its performance is undoubtedly outstanding, the equipment will be covered in some detail. The complete equipment, shown in Fig. 1, is designed to absorb programme material continuously. The items numbered 1 are two recording desks, 2 are swarf-absorbers, and 3 is the control desk. This centralizes the recorder controls so that the complete channel can be operated by a single engineer, though two are required normally. The individual units are described in greater detail in the following paragraphs:

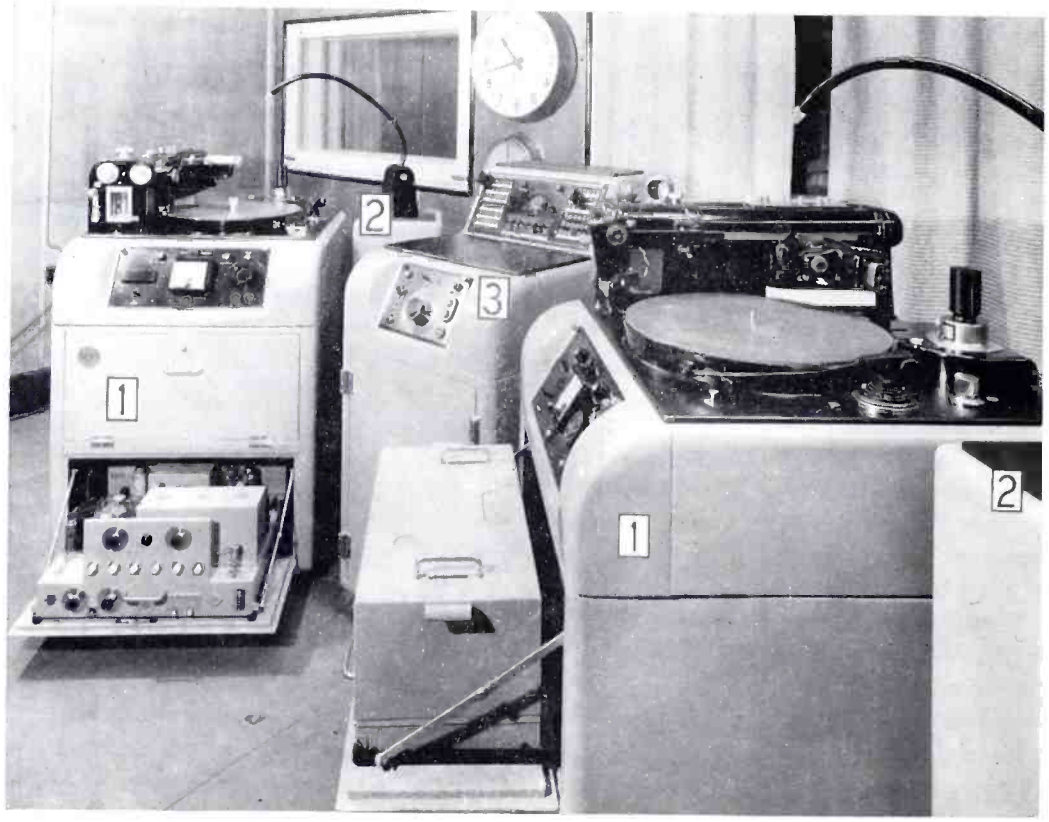


FIG. 1. COMPLETE EQUIPMENT FOR BBC TYPE D CHANNEL FOR HIGHEST-QUALITY RECORDINGS

Control Desk:

All operations are handled at the control desk except lowering and lifting the recording heads. The top panel carries the main gain control, the volume indicator, and the changeover switch to divert the signal to left, right, or both machines. There is also a monitoring switch to connect an internal amplifier and monitor speaker across the input signal or across the pickup, thus permitting the recorded signal to be compared with the input signal while recording is in progress. Push buttons control the main drive motors, the swarf-removal motors, and the scrolling motors, to which reference will be made later. Two pre-amplifiers and two line amplifiers are built into the body and are mounted on slides, electrical connections being carried through plugs to permit rapid replacement of defective units.

Recording Machine:

Two turntable speeds, 78 and 33⅓ RPM, two directions of traverse, and any groove pitch between 95 and 130 groves per inch can be obtained by simple adjustments. Discs up to 17½ ins. in diameter can be accommodated. The cutting pressure can be adjusted over a wide range, a scale being provided to make any setting repeatable. The turntable shaft is supported on a single ball bearing submerged in oil, and carries the 54-lb. friction wheel and the 25-lb. turntable. Drive for the friction wheel is obtained from a neoprene idler wheel, linked with the starting lever in order to lift it clear of the friction wheel when the machine is stationary.

On pressing the starting lever, the neoprene idler moves into engagement before power is applied to the motor through limiting resistors which serve to reduce the starting torque. In this way, wear or flattening of the rubber faces is avoided. Two motors are used, a main driving motor of ⅛ hp., and a separate scrolling motor arranged to produce a momentary increase in the groove pitch when a Cue Marker push button is de-

* 87, Catesby Road, Rugby, England.

pressed. This provides a cue mark which is easily located without any special devices.

The recording head is of the moving-iron type, incorporating a second winding to provide a negative feedback voltage for an early stage of the recording amplifier. From 20 to 30 db of feedback is normally used.

Swarf Absorbers:

Swarf removal is a difficult problem, for which no completely satisfactory solution is yet available. In this machine it is accomplished by blowing a jet of air across the disc, which drives the swarf towards the centre. It is then drawn by suction into the long curved flexible nozzle on the swarf-removal unit.

Type D Performance Data:

The quality of any reproducing system is not indicated completely by a set of figures, but the following results are obtained in practice:

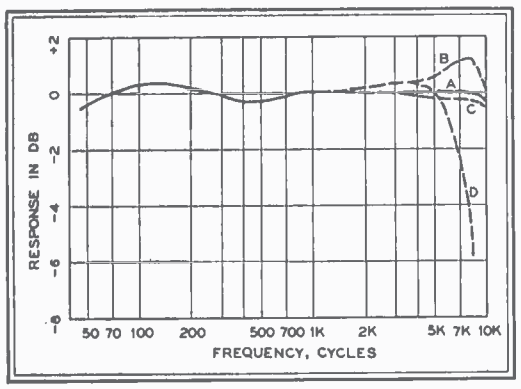


FIG. 2. AMPLITUDE LINEARITY CURVE OF TYPE D RECORDING CHANNEL USED BY BBC STUDIOS

Signal-to-noise ratio — better than 60 db weighted

Total wow and flutter — lower than .05 per cent

Amplitude linearity—see Fig. 2

Temperature dependence — between 60 and 100° F., the 8-kc. response changes about 3 db

Freqency characteristic — see Fig. 3

The writer is greatly impressed by the performance of this equipment. On comparing recordings of the same signal on the Type D channel and a K7 Magnetophon, I had no doubt that the Type D discs scored on all points up to about 7 kc. Above this frequency, the usual tracing distortion limits the performance. However, this is a fundamental defect in all disc recorders.

Recording Characteristics:

British and American practices diverge somewhat on the point of pre-emphasis, British practice being to use 6 to 8 db less rise at 10 kc. than the NAB recording characteristic. The two are compared in Fig. 4. The relative merit of the two is a point of opinion, but we feel that if extended frequency-range reproduction is really obtainable, it is advisable to curtail the amount of pre-emphasis that is used. If this is not done, the intermodulation distortion in the upper ranges is felt to be a serious limitation to the fidelity obtainable.

Decca introduced ffr (full frequency range) recordings to the British public some years ago, using a small amount of pre-emphasis and extending the frequency range to a claimed 13 kc. The

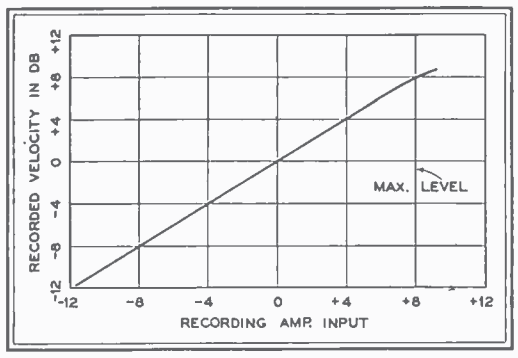


FIG. 3. FREQUENCY CHARACTERISTICS OF THE TYPE D CHANNEL FOR BBC DISC RECORDING

recording characteristic is constant-amplitude below the 250-cycle turnover frequency, constant velocity between 250 cycles and 3 kc., and rises steadily at 3 db per octave between 3 and 13 kc. Among the quality enthusiasts in England these recordings have a good reputation, and I know that they have been well-received in America.

The H. M. V. and Columbia organizations prefer to record with constant-velocity (a flat frequency-characteristic) up to their top limit. They have demonstrated recordings flat to 20 kc., but this frequency range is not normally used for commercial pressings. As a purely personal opinion, I feel that attention needs to be devoted to reducing amplitude distortion rather than to extending the frequency range, once the important band from 50 to 8,000 cycles is covered smoothly.

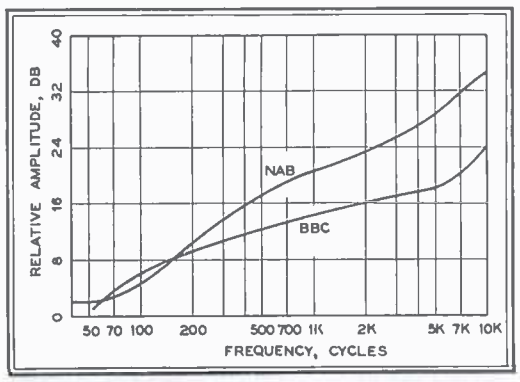


FIG. 4. THESE CURVES SHOW THE DIFFERENCE IN BBC AND NAB STANDARDS OF PRE-EMPHASIS

Decca has introduced 33 1/3 LP recordings to this country, substantially to American standards. These have had a favorable reception but their use is probably restricted by the price which, with purchase tax, ranges between $3. and $5. per disc.

Reproducing Characteristics:

To the man in the street, one of the most irritating faults of the ordinary gramophone record is the needle scratch. There can be no doubt that the ordinary listener prefers to sacrifice some of the highs in order to reduce scratch. When reproducing recordings made on the Type D channel, or on some of the other high-quality recorders, no compromise on frequency range is necessary and the reproducer is run substantially flat to 10 kc. For ordinary commercial pressings, cho en for their programme content rather than their intrinsic technical merits, some compromise is necessary. Fig. 5 indicates the two frequency characteristics used. To a somewhat more-critical-than-average listener, there is no doubt that the Type D discs are far superior to the average commercial pressing, but this difference may not be so noticeable to the owner of an ordinary commercial radio receiver.

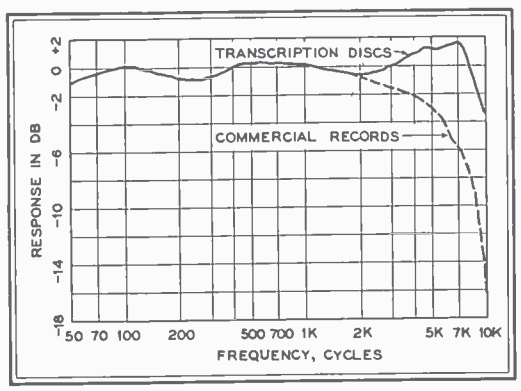


FIG. 5. DIFFERENCE BETWEEN CHARACTERISTICS FOR TRANSCRIPTIONS AND COMMERCIAL DISCS

British Reproducers:

There are many light-weight pickups available to the public, with just about all the known types of construction. Single-and multi-turn moving coil, moving-iron, and piezo pickups are common but, rather surprisingly, there is no equivalent to the GE or Pickering variable-reluctance type. Two of our typical pickups will be described: the E. M. I. type 12, a slightly-modified version of which is employed by the BBC; and the Decca type XMS, developed for use with their ffr recordings and available in the USA through London Records.

The E. M. I. Type 12 Pickup:

With slight modifications to raise the upper resonance to 9 kc., this is the light-weight pickup being used by the BBC as replacement for the earlier BTH needle-armature type. It is a miniaturized moving-iron pickup, construction of the moving element illustrated in Fig. 6. The needle is held in a V-slot without a clamping screw, thus reducing the mass of the moving parts. Steel, sapphire and

(Continued on page 28)

COURT DECISION ON TV COLOR

TEXT OF THE DECISION EXPLAINS WHY THE CHICAGO COURT CONTINUED ITS ORDER RESTRAINING THE FCC FROM ADOPTING CBS COLOR STANDARDS

On December 20, the United States District Court at Chicago handed down its decision on RCA's suit to enjoin the FCC from adopting the non-compatible CBS standards for color television. This decision, and the reasoning of the Court are of such interest that the text is presented here in full, except for the review of details already familiar to the industry, and the legal references in the introduction.

The opinion was written by Circuit Judge J. Earl Major, with District Judge Walter J. La Buy concurring. The dissenting opinion of District Judge Philip S. Sullivan is included.

AS we evaluate the situation, there are two courses open, 1) to allow defendants' motion for a summary judgment, and 2) to vacate the order and send the proceeding back to the Commission for further consideration in view of recent developments in the color television field as well as the rapidly changing economic situation. A pursuance of the latter course, assuming we have such authority, of which there may be doubt, would inevitably result in the prolongation of the controversy which badly needs the finality of decision which can be made only by the Supreme Court. In other words, the interests of all, so we think, will be better served with this controversy on its way up rather than back from whence it comes.

Even though we propose to allow defendants' motion for a summary judgment, it does not follow that the temporary restraining order heretofore entered should not remain in effect. In fact, we are definitely of the view that it should, until such time as the controversy is before the Supreme Court. While there may appear to be some inconsistency in pursuing this course, we think such procedure is within our discretion. . . .

Thus concluding that the matter of a further stay of the Commission's order is discretionary, we shall state some of the reasons which move us to preserve the status quo. Of the nine million black and white television receivers in the hands of the public, there are none capable of receiving a picture either in color or black and white, broadcast under the proposed standards. In order to receive a black and white picture, it is necessary that a receiver be equipped with an adapter estimated to cost $50.00, plus the expense of installation. In other words, it would cost the American public nearly one-half billion dollars to equip existing sets to receive, under the proposed system, black and white pictures, and even then admittedly they would be of a grade inferior to present black and white pictures. In addition, in order to receive a picture in color, it will be necessary to add to an existing receiver a converter, estimated to cost about $100.00, plus the expense of installation. Thus, this will cost the public nearly one billion dollars. In other words, upon an expenditure by the public of one and one-half billion dollars, adapters and converters can be added to existing receivers so as to receive, under the proposed system, pictures in black and white and in color.

But this is only a part of the story insofar as it relates to the public. It was here stated in oral argument and not disputed that there are no adapters or converters on the market and that manufacturers would require a period of from six to eight months before they could be made available. So it seems reasonable to conclude that if the instant order was now in effect, there would be no broadcasting under the proposed standards for many months, for the simple reason that there would be no sets capable of receiving such programs. And it does not square with common sense to think that manufacturers would rush into the business either of manufacturing adapters and converters for existing sets or manufacturing sets with built-in adapters and converters while this controversy is pending. And to maintain that the public in any considerable number would purchase adapters and converters, assuming they were available, under the existing state of doubt and uncertainty, is to cast a reflection on the intelligence of people.

Another matter which does not escape our attention is the insistence displayed by the defendants, including CBS, that this order at all hazards must become effective November 20, 1950, the date fixed by the Commission. This apparently was a magic date, so much so that defendants opposed a postponement until this court could have an opportunity to study and decide the issues presented. Perhaps the most substantial attack made upon the Commission's order is the adoption of standards which call for an incompatible system which, as admitted by all the parties including the defendants and CBS, is less desirable than a compatible system. Of course, the Commission's position in this respect is predicated upon its conclusion that no satisfactory compatible system was demonstrated, while the incompatible system which it approved was satisfactory. And the main argument against a stay of the order is that incompatibility is and will rapidly increase as the public continues to purchase existing receivers. As is stated in defendants' brief, "The grant by this court of an interlocutory injunction will encourage the increased sale of receivers requiring outside adaption to receive CBS color transmission in black and white. The difference between this cost and the cost of adapting receivers at the factory is the price the American public will pay if the Commission's decision is finally upheld." This argument is based on the assumption that the Supreme Court will sustain the validity of the order. It ignores a contrary possibility. Certainly this court is possessed of no such omnipotence, and we doubt if the Commission is. Even if the order was in effect, the owners of existing receivers could not within the next several months obtain the equipment which would enable them to receive the authorized broadcasts. But assume that they could and did so. Where would the public find itself in the event the order was held invalid by the Supreme Court?

In our view, the public interest in this matter has been magnified far beyond its true perspective. We are even told that this suit is a contest between television manufacturers and the public on some theory that it is to the financial gain of the former to refuse and delay the manufacture of television sets capable of receiving the broadcast authorized. Any merit in this contention, so we think, is completely over-shadowed by what appears to be evident, that is, that the contest is mainly between two great broadcasting systems for a position of advantage in this rapidly developing field of television.

Another reason why this order should be stayed is the existing economic situation, recognized by Commissioner Sterling in his dissenting opinion, wherein he stated, "The problems confronting manufacturers today in terms of production, procurement and manpower to

(Continued on page 28)

RADIO SPEEDS RESTORATION OF NORMAL SERVICE AFTER FLOOD WATERS SUBSIDE

Use of FM Communication by

POWER UTILITIES

OHIO POWER COMPANY HAS 20 BASE STATIONS AND 218 MOBILE UNITS — *By* WILLIAM M. PHILLIPS*

TO expedite the handling of line repairs and service restoration problems, the seven-state American Gas and Electric System, of which The Ohio Power Company is a part, is equipped with two-way radio facilities. The Ohio Company alone has 20 base stations, 218 mobile units, one airplane set, and one portable pack set. The entire American Gas and Electric System has 59 fixed stations and 596 mobile units.

Expansion of Radio Use:

The first use of radio by the American Gas and Electric System was inaugurated in 1939. Two-way AM equipment was installed to maintain contact between headquarters and service trucks, to assure priority on repair jobs. The radio-equipped trucks were used principally for the maintenance of distribution circuits serving customers. Thus, the first main stations were located in areas of greatest customer concentration. These comprised five 250-watt transmitters at Bellaire, Canton, Shelby, Tiffin, and Kenton. In 1941, based on the success of the FM system which had been installed by the Connecticut State Police, we changed over to FM.[1]

At that time, however, the very restricted use of radio permitted under the emergency operating rules of the Federal Communications Commission made it very doubtful whether a utility could justify further investment for expansion of this equipment. Every man using equipment had to be licensed by FCC. Submission of birth certificate, fingerprints, and proof of American citizenship were required, and a written examination had to be taken under an FCC inspector at a time and place designated by the commission. For Ohio Power employees, this required a trip to Cleveland, Detroit, or Pittsburgh involving a man's time, meals, and transportation.

After the war, the utilities formed a nation-wide organization to gather data on this type of radio use, and to present it to the FCC. Subsequently, additional channels were assigned to this service, and the rules were relaxed so that only those men responsible for the actual maintenance and repair of the equipment were required to have radio operator licenses. Under these favorable circumstances, Ohio Power and its affiliates immediately expanded their use of radio communication.

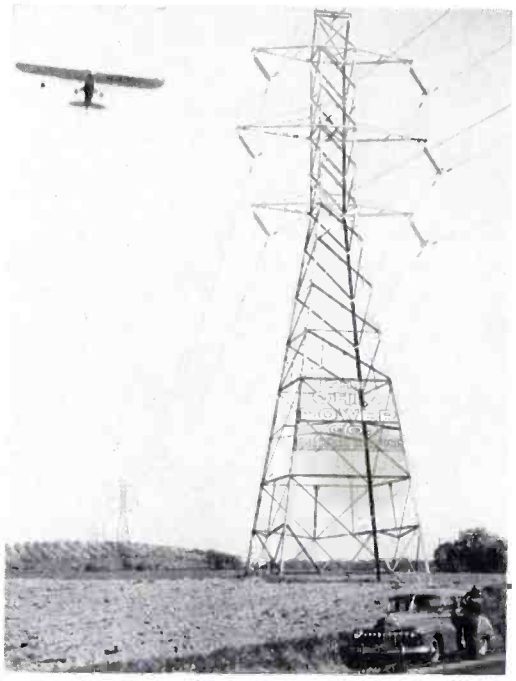
It is believed that the American Gas and Electric System now has more two-way FM radio facilities for service maintenance than any other power system. All this equipment is operated at a frequency of 37.7 mc.

The line and service trucks which are equipped with two-way FM can communicate with each other at considerable distances, and with some one of the base stations from almost anywhere in the service area of the system. Base stations are of 50 to 250 watts output, while the

RADIO DISPATCHING ELIMINATES THE NEED OF RETURNING TO HEADQUARTERS FOR NEW ORDERS

*Communications Engineering Department, The Ohio Power Company, Canton, Ohio.

[1]This installation was described in "2-Way FM for Power Maintenance" by G. G. Langdon, *FM* Magazine, May, 1941.



RADIO IS USED FOR MAINTENANCE SURVEYS

mobile transmitters are 25- to 30-watt types.

Tests have shown that the FM equipment can communicate through man-made and natural static, including lightning storms, whereas communication with AM systems is poor or virtually impossible during lightning storms when most needed by power utilities.

Value of Radio Communication:

Two-way communication has proved its value in meeting emergencies, answering trouble calls, restoring service, handling routine maintenance, and improving power service by reducing operating expenses, traveling time, and service outage. Radio facilities of our sister company, Indiana & Michigan Electric Company, were given a real workout during the severe sleet storm which struck its service area in 1948. Wire-line telephone services were disrupted for as long as 12 days in some cases. During this time, radio service had to handle instructions to the field crews engaged in repairing the damaged lines. By providing immediate contact with mobile units, it eliminated lost motion of returning to headquarters, expedited requests for equipment and assistance, and aided dispatching of crews and material.

On another occasion, Ohio Power experienced heavy sleet conditions in its adjoining Lima Division. Three crews in radio-equipped trucks were dispatched to Indiana to assist in repairing the storm damage. This cooperation was possible because the Ohio Company and the Indiana & Michigan Electric employ the same frequency. Three other Ohio mobile units, patrolling the Lima-Fort Wayne tie line, were able to report directly to the Indiana & Michigan on the effect of sleet-melting current applied to that line.

Twice last year, the Lima Division had severe service conditions — a tornado and a sleet storm — which tested the FM system under adverse conditions. The base stations transmitted supervisory instructions to men on the line and service trucks, making it unnecessary for them to travel to supervisory headquarters and back to the scene of action, thus saving time and mileage.

For major disasters, mobile units can be called in quickly from affiliated companies. In that respect, the use of the same frequency throughout the American Gas & Electric System operates to great advantage. Men and equipment can be concentrated in a stricken area, and the length of service interruptions is reduced substantially.

Our sister company, Appalachian Electric, demonstrated the value of radio

RADIO INSTALLATION ON A REPAIR TRUCK

communication in restoring service when power feed to either end of an 18-mile line was automatically disconnected by a ground somewhere on the line. This interrupted service to one medium-sized town and several coal mines. About half of the 17 intermediate sectionalizing switches were accessible by vehicle and a short walk in dry weather, but the remainder required considerable walking.

When the outage occurred, the operator of the attended line-terminal promptly tried to close the oil circuit breaker, but it reopened, indicating line trouble between the terminals. Immediately, the base-radio operator dispatched an operator to the unattended switching terminal, instructed line-truck crews in the vicinity of the trouble to isolate it by opening two sectionalizing switches, radioed foot patrolmen to locate

(Continued on page 32)

DISPATCHING POSITION AT A FIXED STATION

EXAMPLE OF TORNADO DAMAGE THAT PUT A PREMIUM VALUE ON RADIO COMMUNICATION SERVICE

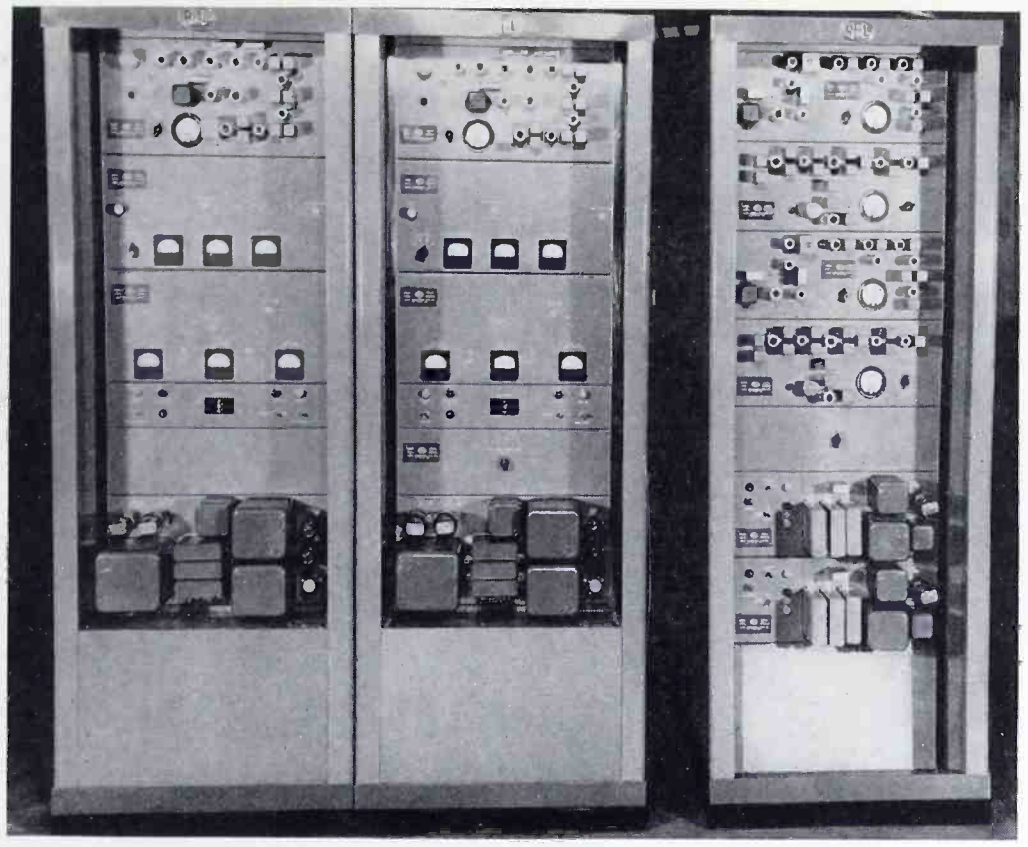


FIG. 2. DUPLICATE TRANSMITTERS AND RECEIVERS FOR 150-MC. RELAY OR POINT-TO-POINT USE

MULTIPLEX FM DESIGNS

UNITS FOR 150 TO 900 MC., DESIGNED TO MEET TELEPHONE STANDARDS — *By* FRANK A. GUNTHER*

TWO basic developments in radio communication are beginning to exert a strong influence on the electrical and mechanical design of transmitters and receivers. One is the use of radio relay systems, comprised of successive repeaters which multiply the effects of signal deterioration or electro-mechanical failures. The other is the use of radio for point-to-point or relay links in wire-line telephone circuits, where the radio section must deliver performance which meets established standards of multiplex telephone practice.

Both these applications set up requirements that are new to radio communication engineers, whose efforts have been devoted principally to mobile systems. The extent to which current criteria of performance must be revised is indicated by the quality of speech which one hears in radio equipped taxicabs, since it is typical of the mobile services. The average person is surprised that taxi drivers can understand anything at all that is said in the brief messages. No telephone subscriber would pay for service that provided such a narrow margin of intelligibility. As for relay operation, the speech would become complete gobbledegook if it were put through one repeater! Many point-to-point radio links and all relay systems call for multiplex operation, thereby adding new requirements of telephone practice to the problems of radio circuit design.

New Performance Requirements:

It is to this new kind of radio communications that much of the facilities of the Radio Engineering Laboratories are devoted. Service requirements, modulation bands, and operating frequencies vary widely, but the end result called for in the specifications is that the radio circuit performance must be equal or superior to that of standard multiplex telephone terminal equipment. In other words, the radio link must not be the limiting factor of system performance or reliability.

Here, for example, are some of the specifications that are met in the REL transmitter-receiver units:

MODULATION FREQUENCY RESPONSE: Plus or minus .5 db from 12 kc. to 120 kc., with no inflections. Response from .25 kc. to 12 kc. within plus or minus 1 db of response of an R-C high-pass filter having a time constant of 250 micro-seconds.

AMPLITUDE DISTORTION: RMS total of harmonics measured to 120 kc. not exceeding .25% of the fundamental for

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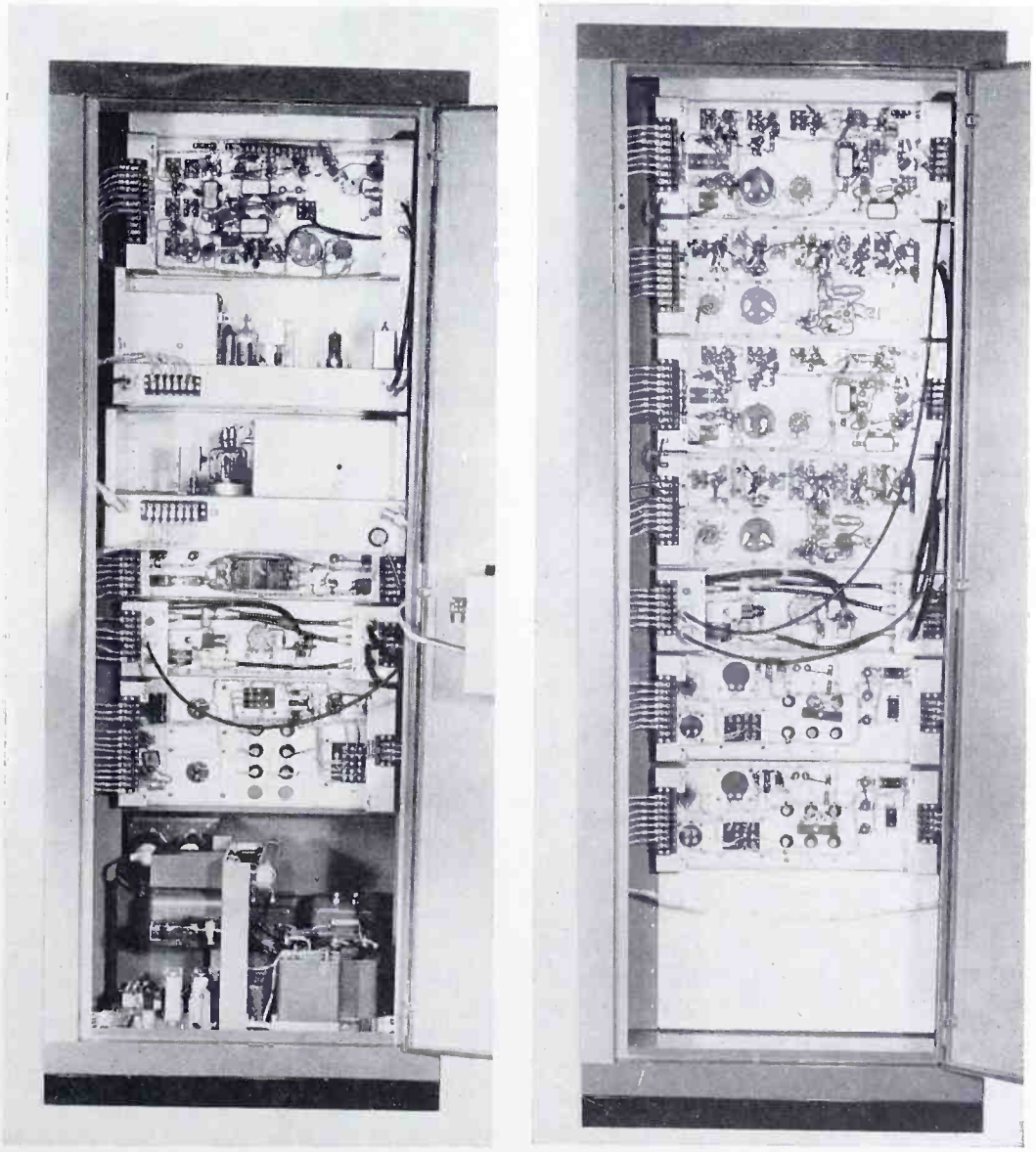


FIGS. 2, 3. REAR VIEWS OF A 150-MC. TRANSMITTER AND TWO RECEIVERS ON ONE RACK

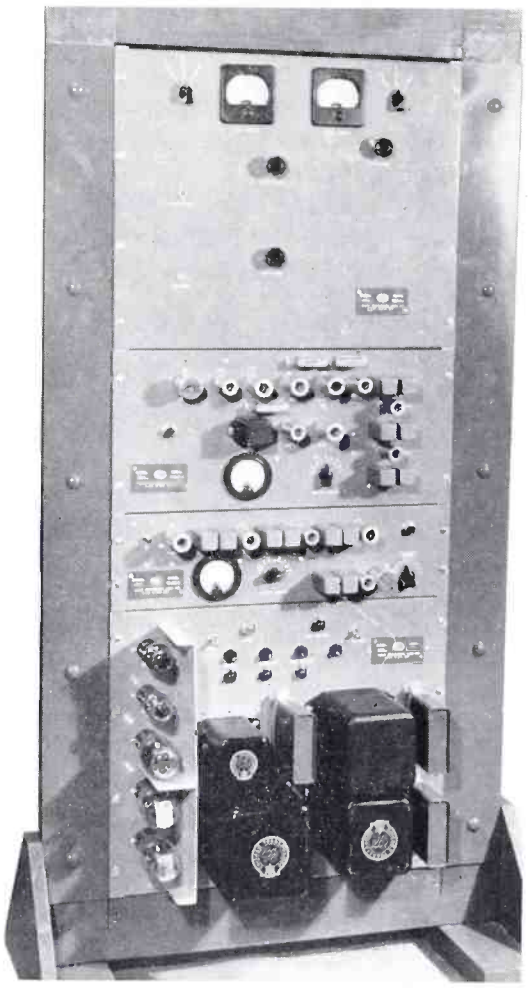
single tones lying between 12 kc. and 60 kc. applied at test-tone level.

INTERMODULATION: Level of the A minus B tone at the receiver output not exceeding a level of –60 dbm for any pair of tones applied at test-tone level, and lying between 12 kc. and 120 kc.

SYSTEM NOISE: Unweighted noise output of the receiver not exceeding a level of –65 dbm per 3-kc. interval from 12 kc. to 120 kc., with an RF signal applied to the receiver not smaller than 65 db below 1 watt.

SECULAR TRANSMISSION STABILITY: Test-tone transmission from 12 kc. to 120 kc. must show a gain of 20 db plus or minus 1 db from transmitter input to receiver output during a period of 3 months, while operated within nominal, specified ranges of ambient temperature and primary power.

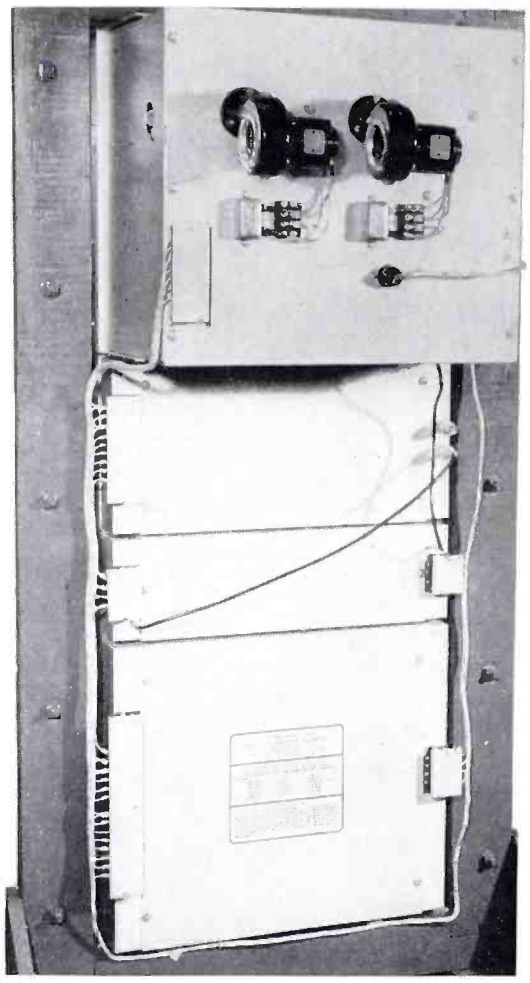
The foregoing examples of performance specifications are sufficient to illustrate the difference between the requirements for radio apparatus used in conjunction with telephone channelizing equipment and conventional simplex communication types.



Standard Radio Units:

Typical REL equipment for multiplex service is shown in the accompanying illustrations. Design details vary of course, in accordance with the number and quality of the circuits to be multiplexed, and special features such as automatic fall-back to standby units, time-delay starting of the standby units, and supervisory circuits.

Standard equipment is designed as a 4-terminal network, equivalent to two pairs of wires, one for transmission and one for reception. Operation may be at frequencies in the bands around 70, 150, 450, and 900 mc. Output power is 25 watts at 70 or 150 mc., 15 watts at 450 mc., or 8 watts at 900 mc. Amplifier units of 100 watts output are available for 70 and 150 mc., or 80 watts for 450 mc.



FIGS. 4, 5, 6. FRONT AND TWO REAR VIEWS OF THE 900-MC. TRANSMITTER FOR USE WITH STANDARD TELEPHONE CHANNELIZING EQUIPMENT

Corner reflectors of 10 db gain over a standard dipole are employed as antennas for the lower frequencies, and parabolas with 15 to 27 db gain for the higher frequencies.

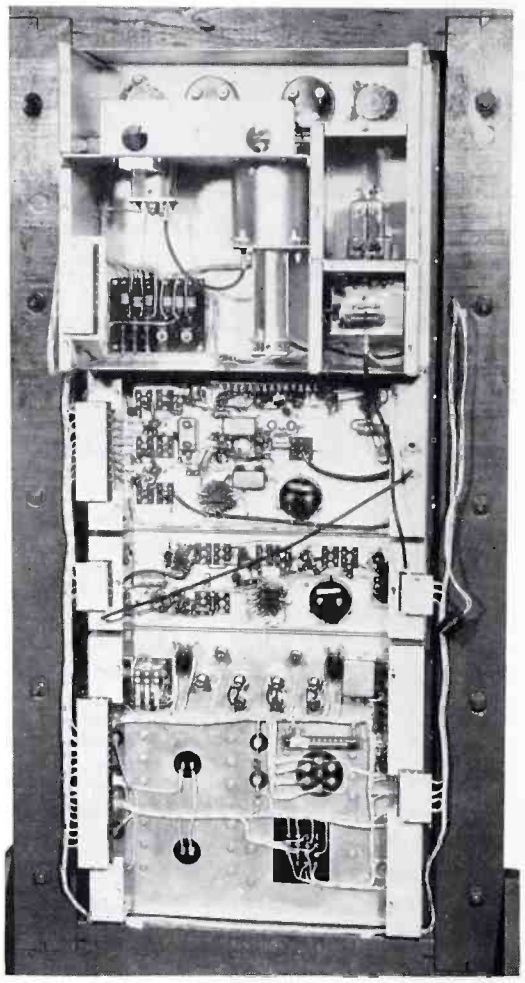
It is interesting to note that tube types have been selected to be interchangeable with those in the Airinc ruggedized series.

Each of the transmitter-receiver units is designed to give performance exceeding the specifications for use with standard telephone channelizing equipment. To achieve the required operating characteristics and stability over long periods of time in the field, continuous-wave FM direct crystal-controlled circuits were developed. The heart of the system is the REL Serrasoid modulator.[1]

This provides:

1. Extremely high signal-to-noise ratio,
2. Very low distortion, permitting the use of a substantial number of repeaters,
3. Long-time stability, made possible by the fact that no tuned circuits are employed in the modulator proper.

Because of the low noise and low inherent distortion in the relay units, demodulated signals from the receiver are used to modulate the associated transmitter. Thus, drop-outs can be taken off at any relay point. This is an important advantage over RF repeater circuits, particularly in systems where channels are used for transmitters and receivers installed at relay points for communication with mobile units, as in the case of oil and gas pipe-line systems. When RF repeaters are employed, drop-outs



are generally considered impractical because of the expense for added equipment, supervision, and maintenance.

150-Mc. Equipment:

Fig. 1 shows a typical 150-mc. installation for multiplex point-to-point or relay service. The left and center cabinets are 100-watt transmitters, the latter equipped with a changeover panel for standby operation. The cabinet at the right contains 2 receivers and a changeover panel.

There is a rear view of the transmitter in Fig. 2. The high-voltage power supply is located at the bottom, with the low-voltage supply on the panel above. Next are the changeover and control panels. The panel at the top carries the audio

[1] "A Simplified Modulator for FM" by James R. Day, *FM-TV*, January, 1949.

input, Serrasoid modulator, and multipliers. Additional multipliers and the intermediate power amplifier are on the next panel, with the final output amplifier below.

In case of failure in the first transmitter, the second is cut in automatically. Application of the high voltage is delayed, however, to allow time for the filaments to reach operating temperature.

Fig. 3 shows the rear of the receiver cabinet. The first receiver is divided between the two top panels, and the second between the third and fourth panels. Next below is the changeover panel, with duplicate power supplies at the bottom.

900-Mc. Equipment:

Views of the 900-mc. transmitter will be seen in Figs. 4, 5, and 6. The audio input, Serrasoid modulator, and first multipliers are carried on the second panel down. Just below is the heterodyne panel, which also carries additional multipliers. Details of the top panel are shown in Fig. 6. Input to the 9903X 1st tripler is at 50 mc. This feeds a 2C39A 2nd tripler, the output of which is at 450 mc. The output stage is a 2C39A operating as a doubler. Fig. 5 shows the rear with the covers and the two blowers in place.

Circuit functions are indicated by the following list of tubes:

Mod. Amp.	6AK5	Amp.	6AK5
Mod. Amp.	5670	Doubler	5763
Subcarrier Osc.	6AK5	Doubler	5763
Disc.Pulse Shaper	5670	Tripler	X9903
Sawtooth Gen.	5670	Tripler	2C39A
Phase Shifter	6AK5	Doubler	2C39A
Doubler	6AK5	Reg.	VR105
Amp.	5670	Reg.	VR105
Het. Crys. Osc.	5670	Rect.	2) 5U4G
Mixer	5670	Bias Reg.	6A57

Although both the transmitter and receiver are installed in cabinets, they were photographed in shipping frames.

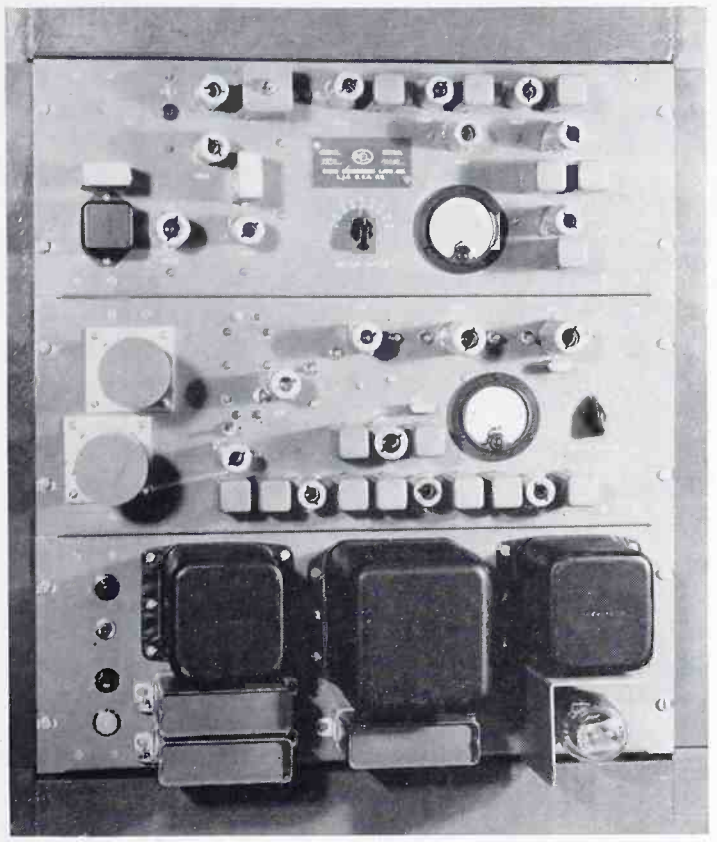
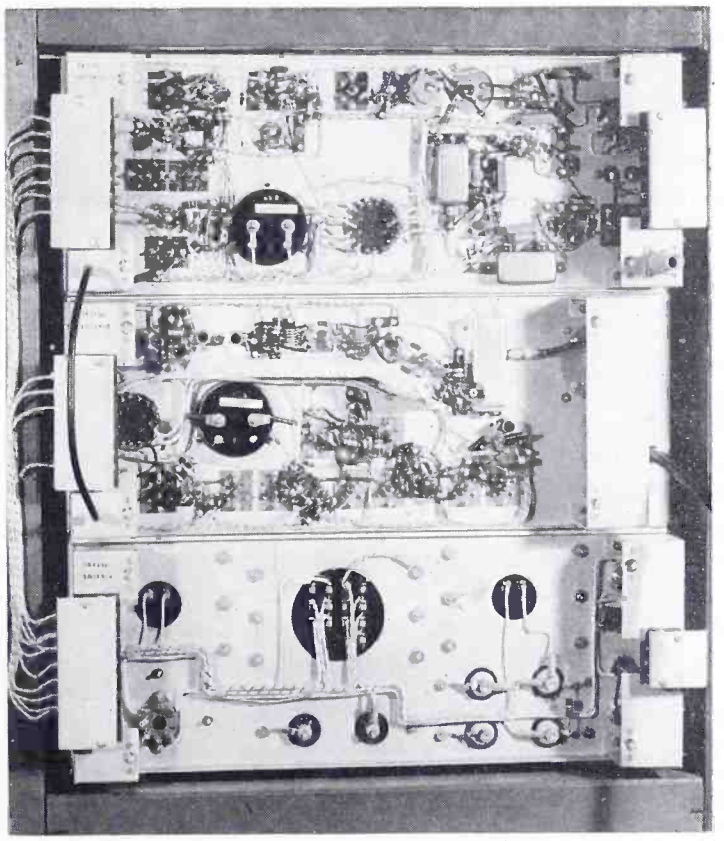


FIG. 7. LEFT, THE 900-MC. RECEIVER, DESIGNED FOR MULTIPLEX TELEPHONE CIRCUITS, CAN BE USED FOR RELAY AS WELL AS POINT-TO-POINT COMMUNICATION SERVICES



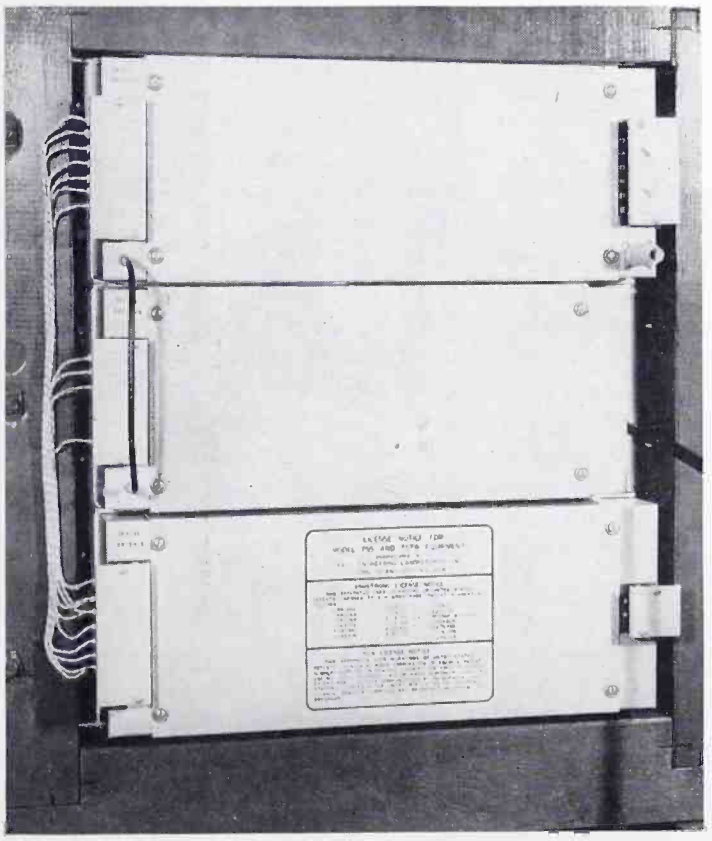


FIG. 8, ABOVE. REAR VIEW OF THE 900-MC. RECEIVER SHOWS THAT THE MECHANICAL DESIGN IS RELATIVELY SIMPLE IN ITS ARRANGEMENT

FIG. 9, LEFT. REAR OF THE RECEIVER, AS IT APPEARS WITH THE DUST COVERS IN PLACE, AND MOUNTED ON A SHIPPING FRAME

The receiver, Figs. 7, 8, and 9, comprises three panels, of which the bottom is the power supply. The center panel has the head-end circuits. At the left in Fig. 7 are two tuned-cavity preselectors, followed by the mixer, oscillator chain, and 1st IF stages. The 2nd IF stages, limiter, detector, and audio stages are at the top.

Following is the list of tubes:

1st Mixer	1N21B	Limiters	2) 6AK5
Het.Crys.Osc.	5670	Disc. Driver	6AK5
Tripler	6J6	Detector	6AL5
Tripler	6J6	Mod. Amp.	2) 6AK5
Doubler	6J6	Mod. Amp.	5670
1st IF	2) 6AB4	Carrier Relay	6AK5
1st IF	6AK5	Loop Test Osc.	6AK5
2nd Mixer	5670	Plate Rect.	5U4G
2nd IF	3) 6AK5		

Total amplification in this receiver is above 150,000 times from the antenna terminals to the limiter, with a tuning stability of ± .001% in an ambient temperature range of 0 to 45° C.

JEREMIAH COURTNEY'S MOBILE RADIO NEWS AND FORECASTS

IT would require surpassing clairvoyance to attempt to predict what 1951 holds in store for the mobile radio world. It is an understatement to say that the year opens on a down-beat. Manufacturers' delays in deliveries of new equipment are growing longer—two and three months in many cases. A shortage of parts and tubes is already being felt in certain sectors of the country, principally, it appears, on the West Coast. Defense contracts will almost inevitably slow up manufacturer experimentation in the use of the higher bands and channel-splitting work in the lower bands.

FCC's Solicitous Attitude in '46:

The FCC's 1950 record in the mobile radio field is not such as to inspire any confident predictions either. The Commission's recently announced policy with respect to 60-kc adjacent-channel operation by common carriers in the 152-mc. mobile radio band offers an illustrative case in point. It was the practice of previous Commissions to endeavor scrupulously to protect the investment in mobile radio equipment, the use of which it had previously authorized. For example, when the Commission of 1946 was considering a new plan for 20-kc. separation in the 30-mc. band, the attitude that governed FCC approach to the problem at that time can be gleaned from the following extracts from the public notice accompanying its proposal:

"This proposal, as it is incorporated herein, or as it may be modified as the result of the oral argument which will be held on December sixteenth, 1946, will become effective on January 1, 1947. Licensees operating equipment now in use which is incapable of meeting the requirements of a 20-kc. channel width, in general, will be permitted to continue to use their existing equipment for the remainder of its normal life expectancy, but in no case after July 1, 1953. . . .

"The foregoing time schedule of effective dates and compliance with the service-allocation plan proposed has taken into account these factors as they relate to the life expectancy of radio equipment for mobile services, and thereby the Commission has indicated its intent to allow the full utilization of equipment which now is in operation or which has just been purchased. The Commission recognizes that many of the services affected by this proposal are not in a position to be able to purchase new equipment immediately and is therefore proposing this liberal implementation policy."

Changed FCC Attitude in '50:

What happened when the 1950 Commission considered the subject of 60-kc. adjacent channel operation by common carriers in the 152-mc. band? The Commission's proposal was made effective six weeks after its final report was released. Operators who had purchased equipments incapable of 60-kc. channel separation operation weren't even accorded the opportunity of oral argument on the proposal.

The technique employed to elide oral argument in that proceeding was as novel and disturbing as the substantive result reached. This is the FCC explanation:

"None of the parties filing comments herein has requested oral argument on the proposal. Regardless of the absence of such a request, it is our practice to hear such argument where it appears necessary or desirable that we undertake such procedure before making a decision. However, in this case, it does not appear that oral argument would serve any useful purpose. The parties have clearly expounded their views in their comments. Moreover, a careful study of the comments shows that there is really no basic disagreement on the proposition of providing now for adjacent channel assignments. The adverse comments are, rather, concerned with such questions as whether, and to what extent, an amortization period should be established for the retirement of non-conforming equipments, and the policies to be followed in assigning to carriers the two additional channels which will be derived as a result of adoption of the policy."

This statement is to be posed against the prior public notice of the Commission with respect to its proposal, which stated:

"The Commission will consider all comments that are received before taking final action in the matter, and if any comments are submitted which appear to warrant the holding of oral argument before final action is taken, notice of the time and place of such oral argument will be given interested parties."

The FCC's statement in its final report that any oral argument regarding the proposed change in miscellaneous common carrier channel assignments would serve no useful purpose therefore suggests that in such important matters as channel assignments for an entire service in the mobile field, the Commission's view is the controlling one and subject to change without opportunity for oral argument on the need for a transitional period.

Effect on Manufacturers:

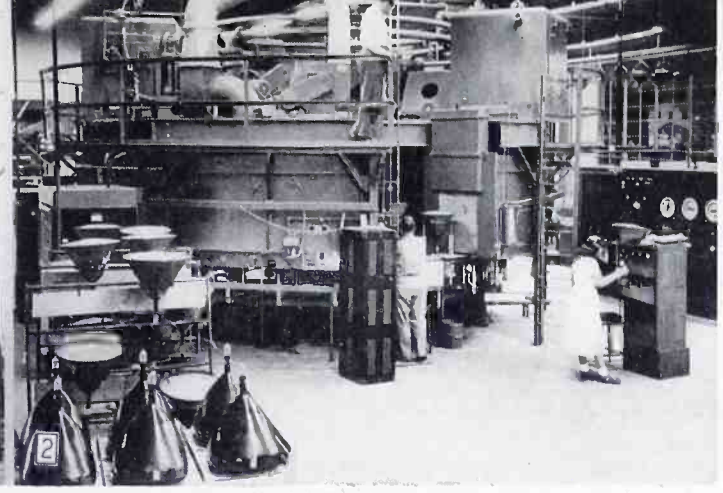
The effect of sudden changes in channel assignment policies can be as disastrous to manufacturers. The Commission's pronouncement in its common carrier decision pointed out that "it should be carefully noted that, after the effective date hereof, we shall not issue authorization for the installation of new or additional equipments in this service where such equipments are not capable of satisfactory operation on an adjacent channel basis, except where it may be shown that the service requirements of a particular area may not reasonably be expected to require the use of adjacent channels in the foreseeable future." This has closed out the new-equipment market in large cities to all but those manufacturers who have adajacent-channel equipment available. Whether the other manufacturers will be in position to change over their models under present defense conditions is not known.

The result reached and, equally important, the procedures employed in this common carrier case to elide oral argument cannot fail to elicit a feeling of apprehension in mobile radio circles generally. That feeling, furthermore, is not allayed by any brief statement that the position of the objectors to a drastic Commission proposal is clear and is understood. Though the written statement of position failed to persuade, the oral statement with the opportunity afforded of a direct exchange between the parties and the members of the Commission might. Following oral argument, the proposal for 20-kc. channel assignments in the 30-mc. band was not adopted.

Although the new procedure employed satisfied the requirements of the Administrative Procedures Act, it is a little difficult to understand why any two broadcast stations that would like to have a particular assignment in Four Corners Village are entitled, before adverse decision, to a hearing plus oral argument before the Commission, while channel assignments for an entire mobile service

(Concluded on page 37)

* 1707 H Street, N.W., Washington, D. C.



NEWS PICTURES

1. Mobile radio communication played a major part in restoring electricity to more than 100,000 customers whose service was cut off after 90-mile winds, accompanied by rain, sleet, and snow, toppled line poles and blew hundreds of trees on the wires of the Niagara Mohawk Power Corporation. Repair crews, dispatched by the company's GE radio system restored service to almost every customer within 5 days, a record for such extensive damage.

2. A part of the newly-installed machines for exhausting 24-in. TV picture tubes, now operating at Sylvania's Seneca Falls plant. Each machine costs upwards of $200,000, processes 20 tubes at a time.

3. Broadcast engineers and consultants, gathered at an RCA symposium on TV antennas, inspected the units to be assembled on the Empire State Building. Included in this group are: E. C. Tracy, RCA; R. N. Harmon, WRS Washington; P. B. Laeser, WTMJ Milwaukee; Charles Singer, WOR New York; Benjamin Wolfe, WAAM Baltimore; H. L. Dubrowski, WATV Newark; C. J. Nopper, WMAR Baltimore; Albert Preisman, Washington; and Richard Newman, James Lavorn, and E. S. Clammer, of RCA.

4. These two compatible RCA receivers represent a year's progress in TV color reception. Circuits have been simplified, controls increased in stability and reduced to two in number, tube compliment cut from 100 to 43, and definition and color values improved, with the number of phosphor dots stepped up from 350,000 to 600,000.

5. With this lighting control installation at the New Theatre, in London, one operator can control 144 circuits from a back-stage position where he has a direct view of the action. Three-position switches and miniature dimmers provide remote regulation of electronic lighting controls installed under the stage.

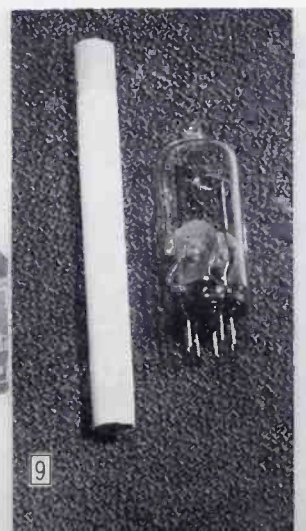
6. As a part of its FM program promotion, CJSH-FM at Hamilton, Canada, gives local listeners a chance to meet important people. At the mike in this picture is Barbara Ann Scott, World and Olympic figure-skating champion.

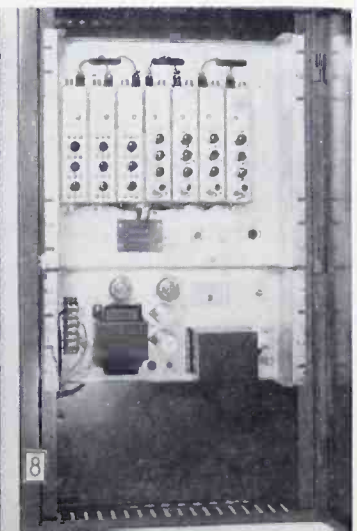
7. New FM studios at the *Providence Journal's* station WPJB are literally mounted on springs, as this view of the construction shows. Purpose is to isolate the studios from vibration set up in the building by printing presses on the lower floor.

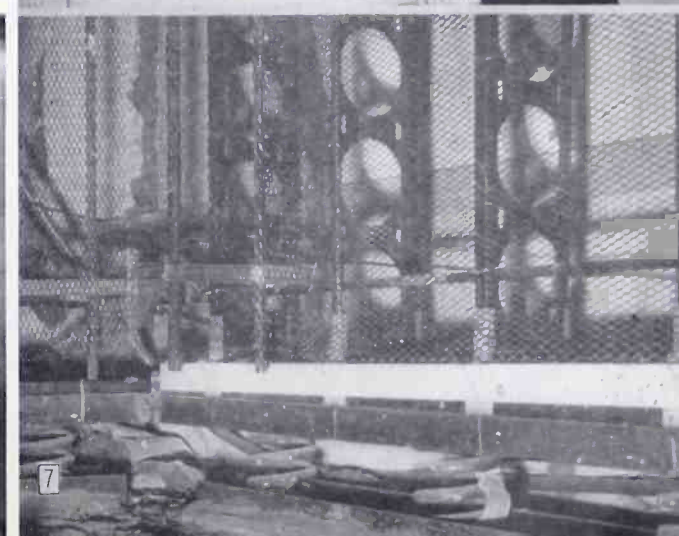
8. RCA has designed this assembly of high-gain RF amplifiers for multiple-outlet TV installations. Using individual amplifiers for each channel, as many as 350 receivers can be tuned to the same program.

9. A miniature magnetron tube has been developed by GE for UHF television receivers and other oscillator applications at 30 to 900 mc. Continuous output is rated at 250 milliwatts, making it suited to communications equipment.

10. This amplifier is produced in kit form, with a choice of two output transformers, by Triad Transformer Mfg. Company, 2254R, Sepulveda Boulevard, Los Angeles 64. Rated at 10 watts output, it includes features that make it suitable for hi-fi installations, including a preamp for magnetic pickups.







Test Procedures for Checking Performance of

VIBRATOR POWER SUPPLIES

VIBRATOR LIFE CAN BE EXTENDED GREATLY BY MAINTAINING THE ASSOCIATED CIRCUITS IN PERFECT OPERATING CONDITION — *By* MILTON S. ROTH*

THE least appreciated and most maligned section of mobile radio equipment is the vibrator which supplies high voltage DC to the tubes of the receiver and, in some cases, to the transmitter tubes.

Since vibrators are expendable, they are equipped with pins to plug into conventional sockets. Thus, since it is easy to replace a vibrator, there is a natural tendency for maintenance men to assume that trouble in the plate-voltage supply is due to failure within the vibrator.

In other words, the *fact* of vibrator failure is generally accepted, without giving any consideration to the *cause* which may be entirely external to the plug-in unit itself. Thus the vibrator, as a means of providing high-voltage DC from a 6-volt storage battery is often a victim of the ease with which it can be replaced!

If, on the other hand, vibrators were made so that circuit connections were soldered to lugs, maintenance men would check through the entire power supply circuit to locate the cause of failure. It might be said that the manufacturers gain in volume of sales because it is so much simpler to replace a vibrator than to find out why it failed. That philosophy doesn't hold, however. Much costly research has gone into the improvement of vibrator designs for the purpose of increasing their useful life. Nevertheless, a much superior design may last no longer than a short-lived type if there are faults in the associated circuits that are not corrected.

A vibrator is only an intermediate element between a primary source of DC voltage on one side, and a transformer-rectifier-filter circuit on the other. The life-expectancy in number of actual operating hours is only realized when input and output conditions are maintained within rather close limits. An examination of these conditions brings out information which should be known to every maintenance man who handles communication equipment.

Basic Vibrator Types:

Fig. 1 illustrates two conventional types of vibrators. Essentialy, this component is an electrical switch with a spring tuned to vibrate at a specific frequency, as specified by the manufacturer of the transmitter or receiver. This is usually 115 cycles, but 100, 130, 140, 150, and 180 cycles are used in some equipment. Through lack of essential replacement data, it sometimes happens that vibrators of an incorrect frequency characteristic are bought for mobile radio equipment.

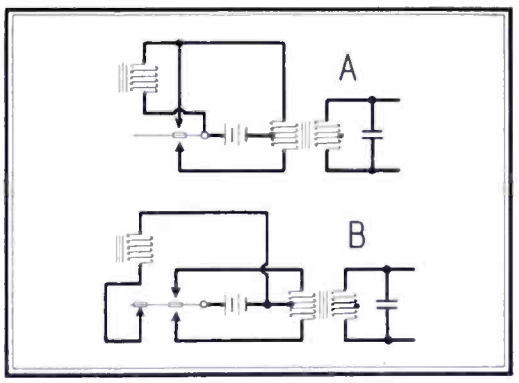


FIG. 1A, SHUNT-COIL VIBRATOR CONNECTIONS, AND FIG. 1B, DRIVING-COIL CONNECTIONS

TEST NO. 1: If a new type of vibrator does not function properly, check the manufacturer's data to make sure that it is the correct type recommended for the equipment.

The small magnet that drives the armature may be connected in either of the arrangements shown. The driving-coil circuit, used in some original-equipment vibrators, requires a hot A lead to the vibrator socket, and can be used only with a socket so wired. A shunt-coil type does not require the hot A lead, but can be used with such a connection. Consequently, replacement vibrators employ the shunt-coil circuit almost exclusively.

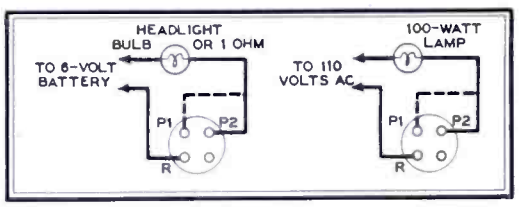


FIG. 2. IF A NEW VIBRATOR STICKS, ONE OF THESE CIRCUITS WILL PROBABLY START IT

Storage Battery Voltage:

It should be perfectly obvious that such a device as the vibrator of a power supply can deliver its rated performance only within certain limits of battery voltage. The 6-volt rating of a storage battery is liable to be anything but 6 volts under load conditions.

On a police cruiser, the radio transmitter may be operated only a few minutes out of 24 hours, and it might be assumed that the load on the storage battery would be very light. However, low cruising speeds limit the charging rate of the ordinary generator, and frequent stops and starts, plus the continuous operation of the receiver, add up to sufficient drain, particularly during winter months, to drop the battery voltage below the value required to operate the vibrator properly. Then the vibrator may seem to stick when, actually, the voltage is too low to start it.

This condition may continue until the battery goes dead. Often, the remedy applied is a readjustment of the generator which may result in applying an excessive voltage to the vibrator, and damage to the contact points.

If another make or type of vibrator is substituted, it may seem to work better under these abnormal conditions, but it may fail when the battery voltage is brought up or down to its proper rating.

TEST NO. 2: When a vibrator fails in service, the first check should be made on the battery voltage *at the radio equipment* under full load conditions. Do not measure voltage at the battery.

Failure to Start:

A new vibrator, of the correct type, may fail to start when it is first plugged in. Sometimes a film forms on the contacts during the period between manufacture and final use, particularly if the unit is stored in a damp place. Once the vibrator is started the film breaks down and causes no further trouble, unless it is taken out of service and stored away again.

There would probably be no trouble from this source if, when the vibrator is first plugged in, the full 6 volts were applied to the magnet winding. Actually, the cold tube heaters draw a heavy starting current which drops the voltage on the vibrator to about 4.5 volts. So, instead of starting instantly, the reed is pulled over slowly, and the film on the points is not broken down. However, one of the following methods will start the vibrator:

1. Plug in the vibrator, switch on the receiver (or keep the transmitter turned

* The Radiart Corp., 357 W. 62nd St., Cleveland, Ohio.

on) for at least 30 seconds. Then switch on and off several times.

2. If that does not start the vibrator, connect it to a 6-volt battery or to 110 volts AC, as in Fig. 2. One side must go to the reed contact R of the vibrator, and the other to the vibrator point P_1 or P_2, whichever closes the circuit through the actuating magnet. When the vibrator starts, keep it running for about 30 seconds. Two minutes of subsequent operation in the equipment will clean the contacts, and make the unit ready for service.

Excessive Current Drain:

Any one of several faults external to the vibrator may cause excessive current to be drawn, thereby shortening the life of the vibrator. Principal trouble spots are indicated in Fig. 3. One most likely cause is excessive leakage in electrolytic condensers across the B supply, due to aging. Or an output tube may be drawing a heavy current due to being gassy, or because a defective cathode resistor or a shorted by-pass condenser has caused loss of bias.

TEST NO. 3: The amount of current drawn by the vibrator varies with each type of mobile transmitter and receiver. The nominal value should be determined for equipment operating properly, with 6 volts from the battery under load conditions both with the vibrator plugged in, and removed from the equipment. Then, when a vibrator appears to be defective, or wears out too quickly, the vibrator current should be measured, and compared with the nominal value.

Oscilloscope Tests:

The most complete information about vibrator performance can be obtained with an oscilloscope. Presentations of the wave forms of the current and voltage disclose more information on the performance of the vibrator and its associated circuits than can be obtained by the usual meter testing methods. A simple setup for this purpose will pay for itself many times over.

TEST NO. 4: To check the voltage wave, connect the oscilloscope as in Fig. 4. If the conditions are normal, the presentation will be similar to wave A when the radio equipment is switched on, with very little change after the tubes are warm and the full load is applied. Wave B is an indication that the vibrator is worn, or that the buffer does not have sufficient capacity.

TEST NO. 5: Other checks can be made by connecting the oscilloscope as in Fig. 5, to show the current wave. This will be similar, under normal conditions, to the wave shown in Fig. 5A. The successive pulses are set up as the vibrator contacts feed each side of the transformer primary alternately. Therefore, the pulses should be of the same height, indicating a balanced load.

If one half of the transformer primary is open, no current will flow when the corresponding vibrator contact is closed, and the wave form will be similar to that

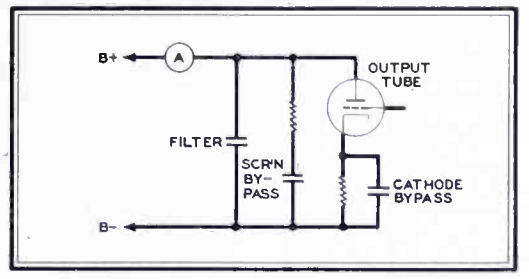


FIG. 3. THE PRINCIPAL SOURCES OF TROUBLE EXTERNAL TO THE VIBRATOR ARE SHOWN HERE

shown in Fig. 5B. Under this condition, the output voltage will be nearly normal, but the life of the vibrator will be shortened substantially.

If the open side of the transformer winding happens to be in that portion of the circuit carrying the energizing

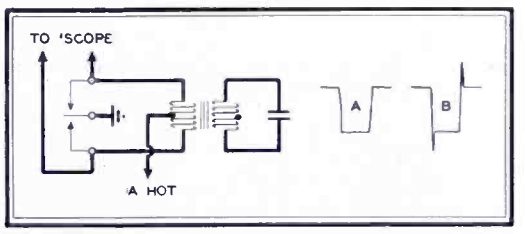


FIG. 4. THE OSCILLOSCOPE CONNECTIONS USED TO CHECK THE VOLTAGE WAVE OF A VIBRATOR

When one half of the transformer secondary is open, or if one plate of the rectifier is not conducting, the current wave form will have the appearance of Fig. 5C, since only one set of points is loaded, while the other is carrying the magnetiz- current to the shunt magnet coil, the vibrator will not operate at all.

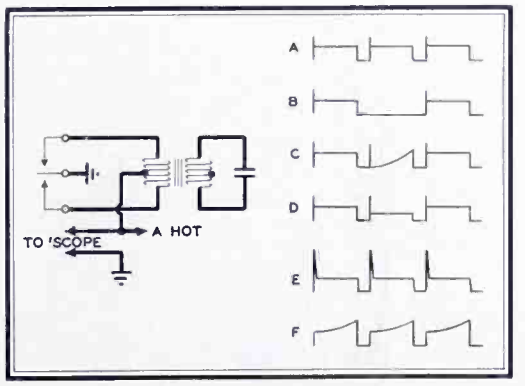


FIG. 5. CONNECTIONS FOR CHECKING CURRENT WAVE, AND TYPICAL TYPES OF WAVE FORMS

ing current. This situation also reduces vibrator life.

Weak emission to one rectifier plate, or high resistance at one set of vibrator contacts produces a wave as in Fig. 5D, where pulses are alternately high and low.

Replacing a buffer condenser with one that has a capacity greater than the correct value causes peaks at the front of each pulse, similar to those shown in Fig. 5E. The result is hum in the loudspeaker, and a shortened life for the vibrator.

Sometimes, through a confusion of type numbers, a vibrator is used that has an operating frequency lower than the required value. In such a case, the contacts stay closed so long that saturation occurs in the power transformer. This produces a current wave form with a curved top, as in Fig. 5F.

Buffer Condenser Trouble:

The most frequent failure associated with a vibrator occurs in the buffer condenser. This condenser takes a high voltage and must withstand harder service than any other in mobile equipment. Since it has a direct effect on vibrator performance, replacing the buffer whenever a vibrator is replaced has become standard practice in servicing mobile units, as a matter of preventive maintenance. That is because buffer condensers cannot be depended upon to outlast two vibrators.

Longer Vibrator Life:

This review shows clearly 1) that short vibrator life is generally due to faults external to the vibrator itself and 2) the importance of checking circuit conditions before replacing a vibrator that has not delivered normal life expectancy. It is easy to plug in another unit, but it, too, will not give the full number of operating hours if the defect in the associated circuits is not corrected.

One final word: The useful life of a vibrator in a transmitter power supply must not be measured from the time it is plugged in until it finally quits, but by the number of hours the transmitter is on the air. These units seem to last longer in some types of service than in others. Actually, the difference lies in the fact that the mobile transmitter may be used very frequently, as in the case of taxi radio, or rather infrequently, as in police communication.

Any comparison of vibrator life in mobile communication service must not only be made between installations using the same make and type of equipment, but under identical conditions of transmitter and receiver use. For example, comparisons should not be made between vibrator performance in a taxicab and a supervisor's car.

Probably the most accurate check on comparative life would be to install new vibrators in each of two cars, and switch them back and forth from one car to the other each day. The information thus obtained might well show a profit on the effort involved.

450-MC. MOBILE RADIO TESTS

DIRECT COMPARISON TESTS IN NEW YORK CITY SHOW BETTER PERFORMANCE AT 450 MC. THAN AT 150 MC. — *By* A. J. AIKENS AND L. Y. LACY*

FROM theoretical considerations it had been predicted that frequencies as high as 450 mc. might be useful for providing mobile telephone service. In order to determine whether such frequencies could be used for telephone transmission to vehicles in urban areas, a series of tests was undertaken with measuring equipment located in a test automobile and with transmitting equipment atop the Telephone Building at 32 Avenue of the Americas, New York, circled in Fig. 1.

An FM transmitter operating at 456.090 mc.[1] was located on the roof of the Telephone Building. Bandwidth and frequency deviation of the system were made the same as in the present 150-mc. system (i. e., ±10 radians at the final frequency) wherein the transmitter is also located on the roof of the Telephone Building. Both antennas were about 460 ft. above street level. The effective radiated power of the 450-mc. system was equivalent to about 100 watts from a coaxial dipole (24 watts actual power plus 6-db antenna gain). Direct comparison tests were made between the experimental system and one of the channels of the regular 150-mc. system, which uses a coaxial dipole antenna radiating about 200 watts. Effective radiated power was thus about 3 db less at 450 mc. than at 150 mc.

Both transmitters were modulated simultaneously by the same speech source and were adjusted for equal phase deviation maxima of about ±10 radians at the final frequency. The speech sources were from talkers using standard telephone instruments. The volume was regulated to ±4 vu by regular mobile radio-telephone control terminal equipment. Arrangements were provided for removing modulation during noise measurements.

The experimental 450-mc. receiver consisted of a radio-frequency preamplifier and mixer, the mixer output being fed into a standard Western Electric 38B mobile radio receiver operating at an input frequency of about 160 mc. A standard 38B radio receiver was used directly for the 150-mc. tests so that the bandwidths of the receiving systems, which are determined entirely by the 38B radio receivers, were closely comparable for the 450- and 150-mc. tests. The noise figures[2] for both receivers were measured as about 8 db; this value implies good receiver design and alignment.

A survey was made of reception at both frequencies in a car equipped with quarter-wave whip antennas. At many locations in Manhattan, at some points in the Bronx, and at a few spots in Westchester County, the strengths of the RF signals across the radio receiver inputs were measured, as well as the AF signal and noise outputs of the two receivers; the same AF modulation was used in the two transmitters. On a separate series of test runs, judgments of circuit merit were made at several locations by four different observers. All measurements were made with the car in motion at normal driving speed.

Comparative Results:

The RF signal strengths and circuit merits found in Manhattan are shown in Fig. 1. Signal strengths are given in the form of equal-signal contours, ex-

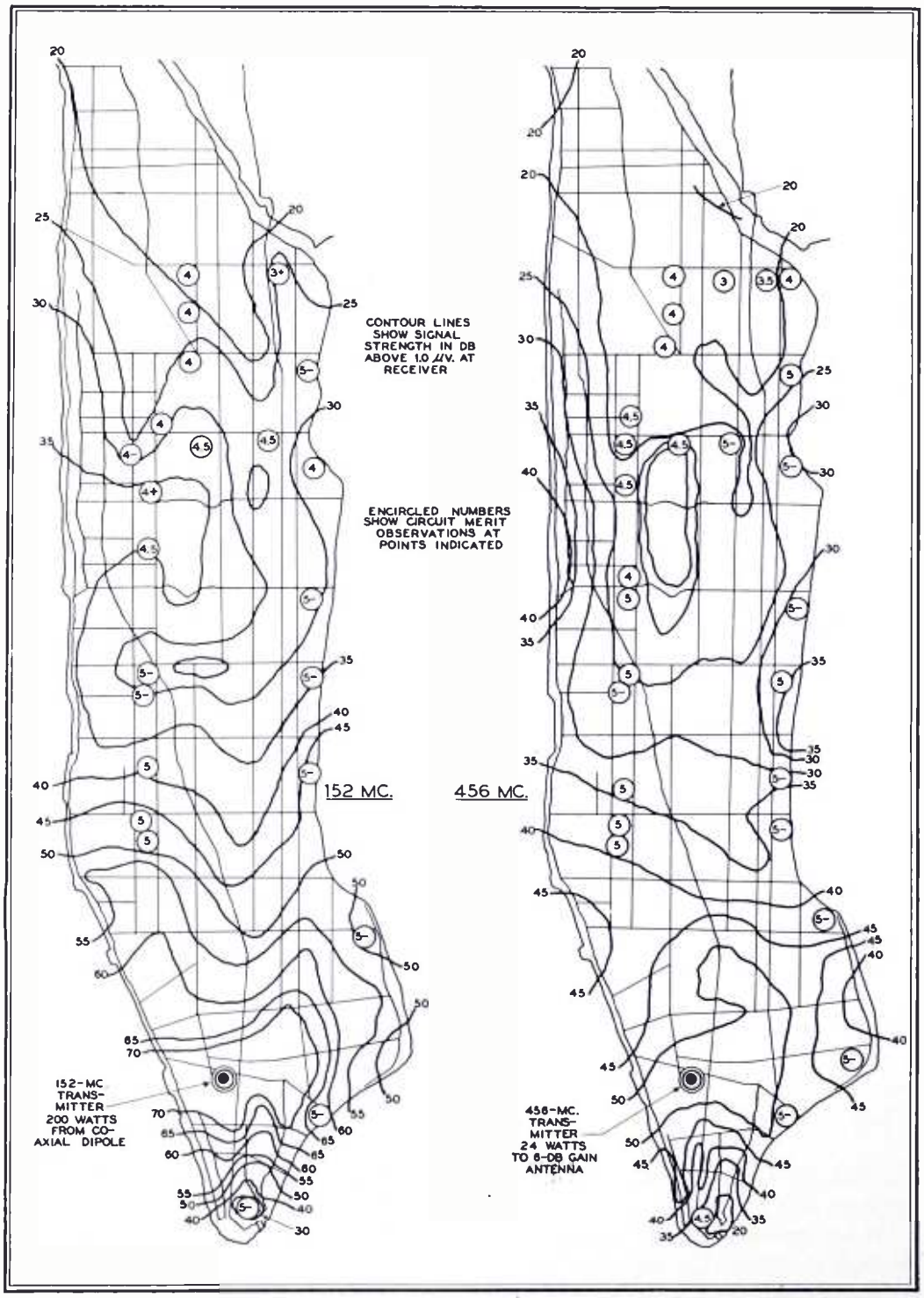


FIG. 1. COMPARATIVE TRANSMISSION DATA AT 152 AND 456 MC. IN THE NEW YORK CITY AREA

* Bell Telephone Laboratories, Inc., 463 West St., New York City. This paper appeared originally in the *Proceedings of the I. R. E.*, November, 1950.

[1]The actual test frequencies of 456.090 and 152.63 mc. have been rounded off to 450 and 150 mc. for convenience in this discussion.

[2]H. T. Friis, "Noise Figures of Radio Receivers," *Proc. I. R. E.*, pages 419 to 422, July 1944.

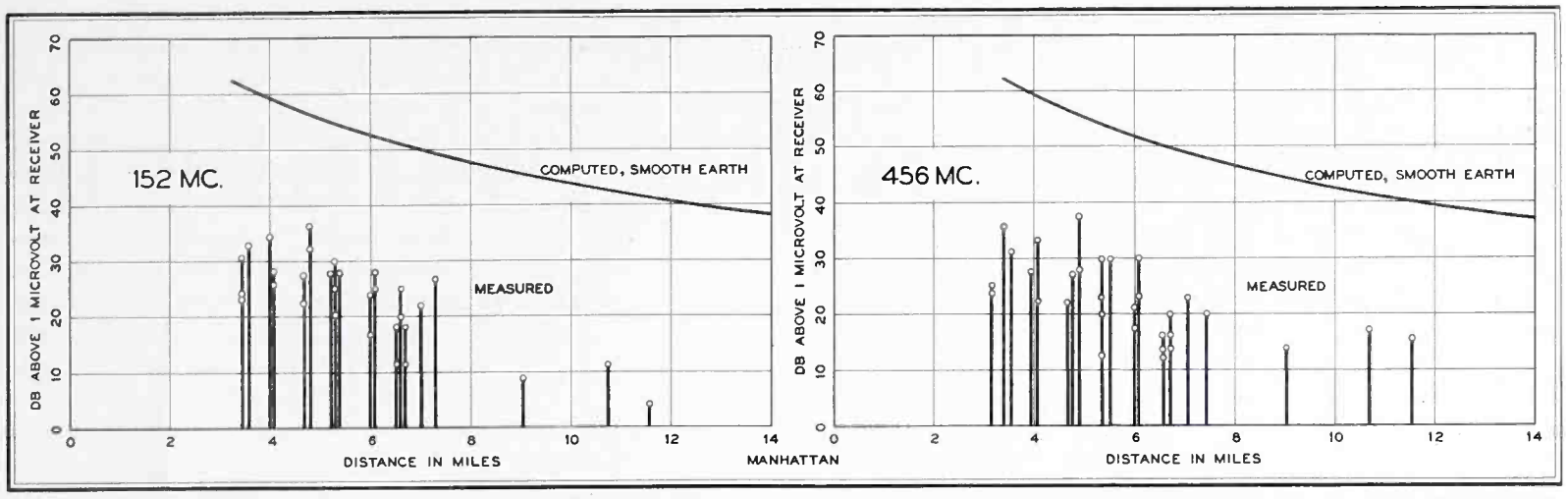


FIG. 2. IN MANHATTAN, AVERAGE DIFFERENCE BETWEEN MEASURED AND COMPUTED SIGNAL VALUES WAS ABOUT 30 DB AT BOTH FREQUENCIES

pressed in db above 1 microvolt across the radio receiver inputs. Circuit merits are shown by circles with numbers inside them.

The scale of circuit merits is as follows:

MERITS	DESCRIPTION
5	Excellent
4	Good
3	Just commercial
2	Poor
1	Hopeless

The signal strength contours must be interpreted in a rather special way. Each value represents an average over a distance of 200 to 300 ft. On the perimeter of Manhattan, the values noted represent the signals received on West Street below 72nd Street, on Riverside Drive between 72nd Street and 125th Streeet, on the Henry Hudson Parkway above 125th Street, and on South Street and the East River Drive on the other side of Manhattan. Inland, however, the values represent the signal strengths found on east-west streets in the middle of the blocks. These signal strengths are of interest because they are measured in the spots to which transmission is most likely to be marginal. It was observed that the received signals averaged about 15 db higher at both frequencies on the inland north and south avenues than in adjacent crosstown streets. This latter detail is not shown on the contour maps.

Comparison indicates that the average received signal at the car at 450 mc. was about 4 db weaker than at 150 mc.

This is an overall average for urban and suburban locations at distances greater than about 2 miles from the transmitters. At shorter distances, the difference in vertical directivity of the two transmitting antennas tends to depress the 150-mc. signals.

Difference in radiated power accounted for 3 of the 4 db. Close correspondence of the average received signals, when taken on an equal radiated power basis, below the corresponding 150-mc. values.

Performance of the radio circuit also depended on the ambient RF noise. In many locations in Manhattan, and at all the test points in the Bronx and in Westchester County, measurements were made of the amount of RF signal required to override ambient noise and produce a specified audio signal-to-noise ratio at the receiver output. On the average, 10 db more RF signal was required at 150 mc. than at 450 mc. Test car ignition noise was suppressed.

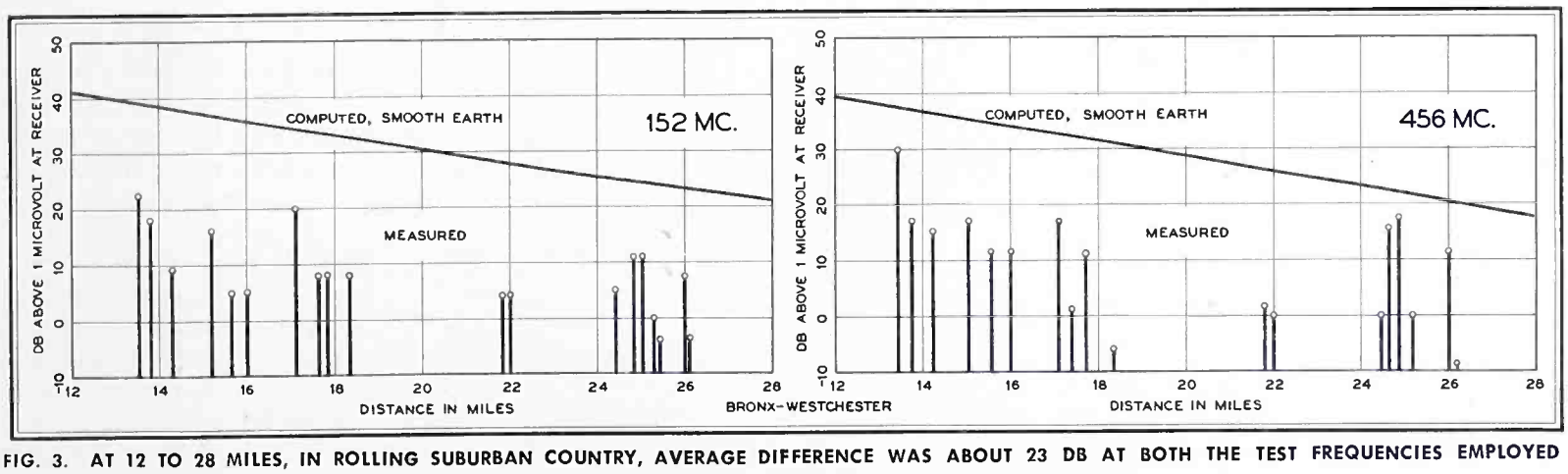


FIG. 3. AT 12 TO 28 MILES, IN ROLLING SUBURBAN COUNTRY, AVERAGE DIFFERENCE WAS ABOUT 23 DB AT BOTH THE TEST FREQUENCIES EMPLOYED

indicated little difference in the net effect of city buildings at the two frequencies.

In tests at 21 suburban locations in the Bronx and Westchester, on parkways and numbered routes, from 13 to 26 miles from the transmitter, the received signal voltage averaged the same at the two frequencies on the basis of equal radiated powers; individual values at 450 mc. ranged from 8 db above to 14 db

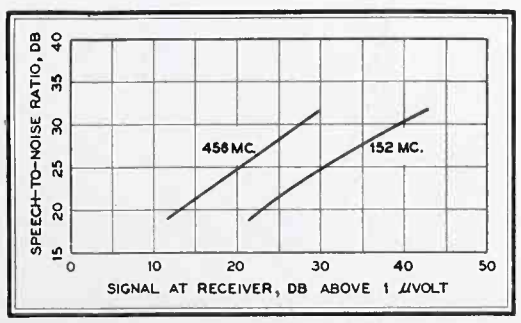


FIG. 4. DATA FROM THE MANHATTAN TESTS

The factors of signal strength, ambient noise, and signal fluctuations are all combined in the judgment of circuit merit. Judgments of circuit merit were made at several locations in Manhattan. As noted in Fig. 1, the circuit merits at the two frequencies were estimated to be about the same (4 observers). This indicates that for equal transmitted powers, the reception would have been slightly better at 450 mc. than at 150 mc.

All of the factors taken together tend to confirm the expectation that transmission at the higher frequency would be suitable for mobile telephone coverage in large cities.

Comparison with Computed Values:

The test results are compared with computed received signal voltage across a 100-ohm receiver in Figs. 2 and 3. The

(Continued on page 34)

DECISION ON COLOR

(Continued from page 16)

meet the demands of national defense are serious ones. . . . It is well known that there are serious shortages of tubes and resistors as well as basic materials. . . . Moreover, in many instances industry has been required to divert its TV engineering experts to problems of production for defense because of the close relationship of TV techniques to radar and other electronic devices the government requires." It is a matter of common knowledge that the situation thus described becomes more acute with each passing day, and the prospects are that it will be far worse before it is better. It is hardly conceivable that either the Commission or the government would under such circumstances desire, much less insist, that the order in controversy be made effective.

Our purpose is to restrain the effective date of the order until the aggrieved parties have had an opportunity to perfect an appeal to the Supreme Court. Therefore, the temporary restraining order heretofore entered will remain and continue in force until April 1, 1951, or until terminated by the Supreme Court. And we re-adopt the findings heretofore made in support of the continuation of such order.

A summary judgment will be entered in favor of the defendants and against the plaintiffs, and the complaint dismissed. No testimony having been heard or considered other than the record made before the Commission, no findings are required in support of such judgment.

Judge La Buy Dissented:

It is conceded by all and it is selfevident that the best system of color television is a compatible one; that is, a system requiring no change whatever in existing receivers for the reception of black and white as well as color pictures. Indeed, compatability is the coveted goal of all engineers and scientists engaged in the television industry.

In its order of October 11, 1950 (F3), the Commission stated:

". . . that the state of the television art is such that new ideas and new inventions are matters of weekly, even daily occurrence; . . ."

And again, in recognizing the rapid developments in the field, the Commission said (B92, First Report):

"The third matter we refer to is the possibility of new color systems and improvements in existing color systems which have been informally called to our attention since the hearings closed. Of course, these are not matters of record and cannot be relied on in reaching a decision unless the record is reopened. In considering these developments the Commission is aware that the institution of these proceedings stimulated great activity in the color field and that since fundamental research cannot be performed on schedule, it is possible that much of the fruit of this research is only now beginning to emerge. . . ."

Commissioner Sterling, dissenting with what he characterised the "premature action taken by the majority," also stated among other reasons for his disapproval of the action of the Commission "new developments came fast in the closing days of the hearing and immediately thereafter." Commissioner Hennock, who also disagreed with the Commission's speedy action, expressed her views as follows,

". . . in the light of the progress made in the development of color television since the start of the instant proceeding,

(Continued on page 30)

AUDIO EQUIPMENT

(Continued from page 15)

diamond points are available for these pickups. The frequency characteristic of the BBC version is flat within $\pm 1\frac{1}{2}$ db to 10 kc.

The Decca XMS Pickup:

This is of the half-rocker needle-armature type, views of which are given in Fig. 7. A sapphire stylus is employed in a single piece with the suspension, re-

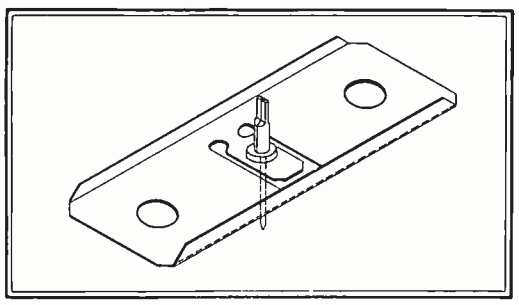


FIG. 6. THE MOVING ELEMENT OF THE PICKUP NOW USED IN ENGLAND BY THE BBC STUDIOS

quiring that the suspension and needle be changed after 500 to 1,000 playings. The point load is 8 grammes. Separate plug-in interchangeable heads are provided for 33 1/3- and 78-RPM discs. The output voltage is approximately 180 millivolts across a 4,000 ohm coil, at 1,000 cycles on a 78-RPM recording. The upper resonance is claimed to be in the region of 15 to 17 kc., making the response curve flat within 1 db up to 10 kc.

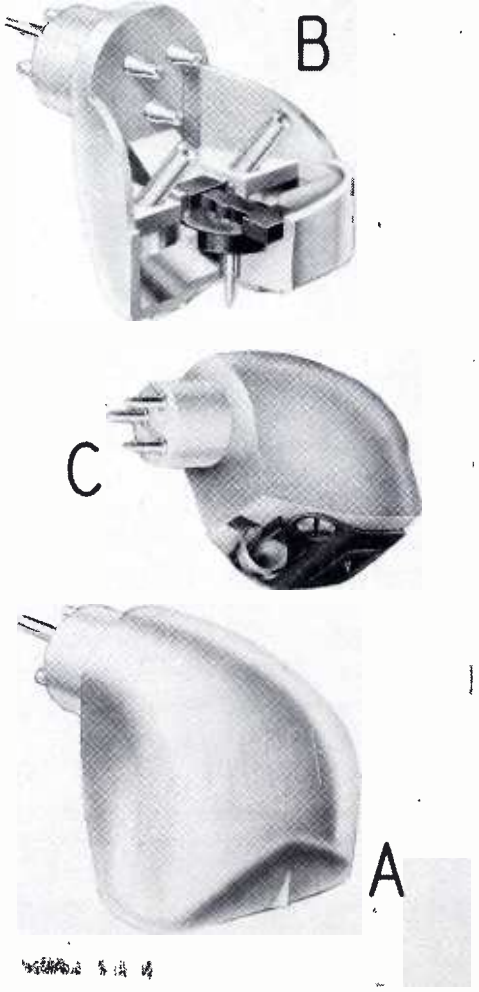


FIG. 7. DETAILS OF THE ENGLISH DECCA XMS PICKUP. NOTE THE CAM ROLLER SHOCK-ABSORBER

A unique feature is the eccentric cam, suspended under the pickup head, which acts as a shock-absorber when the arm is dropped. This can be seen clearly in Fig. 7C. A cutaway view of the interior construction is given in Fig. 7B.

Conclusion:

This completes a rather brief summary of disc recording and reproducing practice in England. I intend to return to the subject at a later date, and will fill in some of the detail. For those engineers interested in the BBC Type D channel, the original paper by Mr. H. Davies in the *Journal of the I. E. E.*, Part III, July 1947, is well worth consulting. The *BBC Quarterly* for Autumn, 1949, contains an interesting article by J. W. Godfrey, entitled "The Reproduction of Disks and Records."

EDITOR'S NOTE

The preceding article is one of a series by James Moir, appearing every other month in RADIO COMMUNICATION. Mr. Moir ranks as one of the leading authorities on audio development in England. It is particularly interesting to observe the differences and agreements between practices and opinions held there and in the U. S. On several occasions, Mr. Moir has asked for suggestions as to particular activities in England on which our readers would like to have detailed information. You may write him directly at 87 Catesby Road, Rugby, England, or in care of RADIO COMMUNICATION Magazine.

In 1951, There Will Be a Serious Shortage of Licensed

RADIOPHONE OPERATORS

This Situation Calls for Your Immediate Attention

THERE seems to be considerable misunderstanding about the authority of FCC Radio Inspectors to close down communication systems which are not maintained by licensed radio operators.

An Official Explanation:

To clarify this point, the following explanation is quoted from FCC Secretary T. J. Slowie:

"Regardless of whether a given station may be operated during the course of normal rendition of service by an unlicensed individual or whether the holder of at least a Restricted Permit is required . . . any tests or adjustments coincident with the installation, service, repair, or maintenance of the transmitting apparatus must be performed under the immediate supervision and responsibility of the holder of a valid first- or second-class radiotelephone or radiotelegraph operator license.

"In the case of a station licensee who does not have in his employ on a full-time, regular basis an operator holding a license valid for the unlimited performance of all operating duties at that station, such an operator must be available to perform those duties which only he is authorized to perform, *or the station must be shut down until such an operator can be obtained,* whenever conditions require any adjustments, repairs, or maintenance which might affect the proper operation of the station.

"It may be emphasized that the independent serviceman who may be on call or under contract to perform installation, repair, service, or maintenance duties *may not perform adjustments or tests that might affect the proper operation of the station unless he holds at least a second-class radiotelephone or radiotelegraph operator license, or unless he performs those duties under the immediate supervision and responsibility of an operator holding such license.* The mere fact that an operator holding this grade of license is employed by the station licensee is not sufficient; at least one such operator must be responsible for any transmitter adjustment and tests during or coincident with the installation, servicing, and maintenance of any radio station which may affect the proper operation of that station, and such properly-licensed operator must either perform those duties or they must be performed under his immediate supervision and responsibility. It is the sense of this requirement that the responsible licensed operator will be near by and within hearing and immediately available to the other person whom he is supervising. The licensed operator may not undertake to exercise his supervision and responsibility by means of telephone or similar devices."

The foregoing makes clear the seriousness of the increasing shortage of licensed operators. The number of new operators being licensed is not enough to meet the needs of new radio systems being authorized by the FCC from day to day. Moreover, operators are being called into the Armed Forces every month.

How to Anticipate Emergencies:

The situation is now critical to the point that we strongly urge company executives and public officials to anticipate such emergencies without delay. Here is our recommendation:

Select a man, preferably within your organization, to be trained as a 2nd class radiophone operator, in accordance with FCC requirements. He should be at least a high school graduate who received high marks in mathematics and physics, and who has had radio experience as an experimenter, amateur operator, serviceman, or with the use of military radio equipment.

Then enter him for the CIRE correspondence course in Radio Communication. On request, we will send you our enrollment application. If we accept his qualifications, the Institute will guarantee that, upon completion of the course, should he fail to pass the FCC examination for 2nd class radiophone operator, he will be given further, special instruction without any extra charge, until he does pass. Our records show, however, that CIRE students are almost invariably successful the first time. Many pass the examination before they complete the course.

About 200 hours of study are required. Many companies are now putting their men on half-time schedules so that they can complete the course within 10 weeks. The total cost of the course is $89.75, payable in advance. This amount is subject to refund in full in case of any dissatisfaction within five days after receipt of the first group of study lessons. Currently, most employers are standing the full expense as an inducement to the men they select for training. Others are paying one-half, and making a small weekly payroll deduction to cover the balance. In either case, the cost is a minor matter compared to the security of having a licensed operator available to meet any emergency. The important thing is to act now to protect your radio system against being closed down before an emergency situation arises. The coupon below is provided for your convenience.

Cleveland Institute of Radio Electronics
Special Attention: Desk No. 4
4900 Euclid Ave., Cleveland, 3, Ohio

Please forward enrollment application for CIRE Course, preparatory for FCC 2nd class radiophone operator examination. If you accept the qualifications of the man we select, we will promptly forward check for $89.75 to cover the total cost of the Course, subject to the guarantee that:

1. Our remittance will be refunded in full if, for any reason, within 5 days after receipt of the first group of study material, we are not completely satisfied.
2. If the man we select does not pass the FCC examination after completing the course, CIRE will provide additional instruction, without further charge, until he does pass the FCC examination.

Name .....

Company .....

Address .....

.....

Note: This CIRE Course is approved for Veteran Training under GI Bill.

DECISION ON COLOR

(Continued from page 28)

I think it is essential to defer final decision in this matter until June 30, 1951.

". . . It is of vital importance to the future of television that we make every effort to gain the time necessary for further experimentation leading to the perfection of a compatible color television system."

In its First Report, the Commission stated:

". . . two difficult courses of action are open to the Commission. The first course of action is to reopen the record. . . . The second course of action is to adopt a final decision.

"The advantage of the first course of action is that the Commission would not be compelled to speculate as to an important basis for its decision. . . . The disadvantage is that it would postpone a final decision and hence would aggravate the compatibility problem. . . . The advantage of the second course of action is that it would bring a speedy conclusion to the matters in issue and would furnish manufacturers with a real incentive to build a successful tricolor tube as soon as possible. . . . The disadvantage is that the Commission's determination on an important part of its decision would be based on speculation and hope rather than on demonstrations."

On October 4, 1950, RCA petitioned the Commission to review the progress made in developing and perfecting the various systems before a final determination. It offered to show the Commission improvements in certain phases of their system about which the Commission expressed doubts. The Commission denied the petition giving among other reasons that "delay in reaching a determination . . . would not be conducive to the orderly and expeditious dispatch of the Commission's business."

The Commission recognized and the record before the Commission is replete with evidence that rapid strides are being made toward the perfection of a fully compatible system. There is ample basis for the conclusion that the scientists laboring in the laboratories of the industry may soon resolve the problem of compatibility. In view of the admittedly fluid state of the art, it is difficult to understand why the Commission refused to hear additional evidence and choose instead a course of action, using its own words, based "on speculation and hope rather than on demonstrations."

It is estimated that the cost of conversion to the new standards set by the Commission will cost the public in excess of a billion dollars. If hope and speculation may lawfully be substituted for evi-

(Concluded on page 31)

DECISION ON COLOR

(Continued from page 30)

dence as a foundation for an important part of its decision, it was an abuse of discretion not to have indulged this speculation and hope in the public interest. The Commission chose a speedy determination of an issue of great public interest in preference to the more patient consideration which the magnitude of the question warranted. To prohibit the broadcast of color in completely compatible systems, whether it is RCA or any other fully compatible system, is a bar to competition between compatible and incompatible color and is unreasonable and arbitrary.

It is my opinion the Commission's precipitous action in entering the order, the impact of which will require owners of television sets to install equipment at a cost of many hundreds of millions of dollars, and its refusal to hear additional evidence clearly indicates an abuse of discretion and constituted action which was arbitrary and capricious.

I would overrule the motion to dismiss and for a summary judgment and would restrain the enforcement of the order.

SPOT NEWS NOTES

Color TV Is Frozen:

The TV color issue can be considered as frozen until the present national emergency is over. That is the effect of a decision of the three Judges who heard RCA's plea for an injunction against adoption of the incompatible CBS system by the FCC. The present injunction is to be continued until April 1, or until it is terminated by the Supreme Court. That means an indefinite delay in settling color standards for, as the Court pointed out, "it is hardly conceivable" that the FCC or the Government would want color TV to start now.

Radiating Receivers:

There's been much talk about reducing receiver radiation, particularly on TV sets, but little has been done by the manufacturers. If it seems to be a dormant issue, don't figure that the Commission has forgotten it. Rather, it's just simmering on the back of the FCC's stove, ready to move up to the front burner at the appropriate time. Official anger at the industry's indifference to CBS color hasn't cooled, and the spirit of reprisal still seethes at Commission headquarters. A lot of ears could be pinned back by the simple maneuver of making a Rule to limit receiver radiation.

FM FOR POWER UTILITIES

(Continued from page 18)

the trouble, and dispatched a line-truck crew to remedy the trouble. Its approximate location had been indicated by a report from a family who had observed an arc on the line.

Within 28 minutes service was restored to part of the customers, and 16 minutes later the majority of customers on that 18-mile line were being served. All customers were being served within 58 minutes after the outage. It had been caused by coal-stripping operations that tilted a tree over the power line. The upset tree was located and removed by the foot patrolmen.

Use of radio in this case shortened the outage time for all customers by at least one hour and saved costly unproductive man-hours for the coal mines.

Prompt restoration of electric service is highly important because outages mean dissatisfaction to customers and loss of revenue to the power company. Outages of long duration are damaging to steel and glass manufacturing. The effects are serious at hospitals, at water pumping stations, and wherever public necessities are involved.

Ability to divert servicemen from routine to emergency situations in their vicinity is a great advantage of radio. Housewives appreciate this prompt service, especially if an important meal is interrupted by outage of a range.

Preventive Maintenance:

Preventive maintenance of service equipment is greatly aided by two-way radio. Aerial patrol of high-voltage transmission lines by a chartered plane equipped with radio is standard practice on the Ohio system. If any unusual or hazardous conditions are observed, such as broken insulators, trees, or other conditions which threaten line operation, the air patrolmen can notify the nearest base radio station of the exact position of the trouble, because all towers are numbered. The base-radio operator, in turn, can call transmission maintenance crews to remedy the situation and get them to the scene before trouble occurs.

Construction Uses:

Radio has also been advantageously used during construction work in several ways:

1. Surveying transmission line rights-of-way and tower layouts
2. Supervising material handling during line construction
4. Test-energizing of new stations
3. Stringing conductors on towers or poles

(Concluded on page 34)

NOW!

hp quality in a low-cost monitor for FM communications systems

NO PRELIMINARY ADJUSTMENTS

NO ADJUSTMENTS DURING OPERATION!

NO DISCRIMINATOR TUNING!

DESIGNED FOR USE BY NON-TECHNICAL PERSONNEL!

SPECIFICATIONS

CARRIER FREQUENCY RANGE:
Model 337A: For use on any one frequency in range from 30 to 175 mc. Model 337B: For use on any four frequencies in range from 30 to 175 mc (circuits adjusted at factory).

SENSITIVITY:
Approx. 400 microvolts.

CARRIER METER DEVIATION RANGE:
—15 kc to +15 kc.

CARRIER METER ACCURACY:
Within 0.005% from 30 to 50 mc; within 0.002% above 50 mc.

MODULATION METER RANGE:
0 to 20 kc.

MODULATION METER ACCURACY:
Within 5% of full scale.

MODULATION METER FREQUENCY RESPONSE:
Within ½ db from 300 cps to 3 kc.

PEAK MODULATION INDICATOR RANGE:
5 to 20 kc (adjustable).

AUDIO OUTPUT:
Without de-emphasis, 5 volts into 20,000 ohms on 15 kc modulation swings; de-emphasis decreases output.

DE-EMPHASIS:
Supplied optionally.

POWER:
Operates from nominal 115 volts, 50/60 cps supply draws approx. 100 watts.

DIMENSIONS:
8¾" high, 19" wide, 10" deep.

MOUNTING:
For relay rack mounting.

WEIGHT
Approx. 25 lbs. Shipping weight 43 lbs.

PRICE:
Model 337A: $300.00 less crystal and oven.
Model 337B: $350.00 less crystal and oven.
Crystal and oven: $27.50 per frequency.
All prices f.o.b. Palo Alto, Calif.

Data Subject to Change Without Notice.

Continuous indication of modulation and frequency...

Peak modulation indicator...Aural monitoring output...

Monitors any 4 frequencies, 30 to 175 mc!

Now your FM communications or emergency network can have low-cost monitors that match in ease of operation and performance the finest equipment used by commercial FM stations.

-hp- FM Communications Monitors use the same pulse-counter circuits found in *-hp-* broadcast FM monitors. This eliminates troublesome tuning of discriminators and frequent adjustment of voltage levels. No IF calibration is required because the IF is low (30 kc) and circuits are not sensitive to signal level changes. The instruments will operate virtually without adjustment or attention.

-hp- Model 337 Monitors give you continuous indication of frequency deviation and modulation swing, direct in kc. They also provide an adjustable peak modulation indicator, and an audio output for aural monitoring. The instruments may be operated by sampling the transmitter output, or by antenna pickup. Mobile units may be monitored several hundred feet distance with only a short antenna; and monitoring up to 5 or 10 miles is possible with an efficient antenna.

These new *-hp-* Communications Monitors are available in two models —Model 337A operating on one crystal controlled frequency, and Model 337B operating on any four frequencies.

See your -hp- sales representative or write direct for details.

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HEWLETT-PACKARD hp INSTRUMENTS

FM FOR POWER UTILITIES

(Continued from page 32)

Portable sets provide two-way communication between the supervisors and workmen to coordinate their work. For example, radio intercommunication is used between line crews while pulling and sagging transmission-line conductors. Before these portable radio units were employed, it was necessary in mountainous regions to station several men at various high points along the line to give hand signals whenever it was necessary to stop, take up, or slack off, in order to adjust the conductors to the required sag. Signals are required to guide the operator of the winch or tractor pulling the conductor, and the man at the opposite end of the line controlling the reel brakes. Delays in transmitting hand signals permit over-runs, and made it very difficult to obtain the desired line tension.

This has been eliminated by radio communication, because both pulling and braking operations can be coordinated merely by the instruction: "Hold It." Some surveying and line crews now wonder how they were able to get along with the old hand-signal methods.

Added together, the use of radio saves time, reduces expense, and contributes substantially to improving service in the course of daily routine and under emergency conditions.

450-MC. MOBILE TESTS

(Continued from page 27)

measured values are corrected to a reference of 100 watts of power delivered to a coaxial dipole. The computed values are for 100 watts in a standard dipole 460 ft. above ground plane and assume smooth spherical earth.

In Manhattan, the average difference between computed and measured values was about 30 db, practically all the difference lying in the range 20 to 40 db. There was no significant distinction between the two transmitted frequencies in this regard, nor between receiving locations (all urban) from about 3 to 11 miles from the transmitter. In considering these values, it will be recalled that they were obtained in a city of skyscrapers, and that a large proportion of them were measured on cross-town streets, the received signals on the north and south avenues averaging some 15 db stronger than on the cross-town streets.

In Bronx-Westchester, on terrain that may roughly be described as suburban rolling country, the average difference between measured values and computed smooth-earth values was about 23 db, all the individual differences being comprised in the range 5 to 40 db; also, there

(Concluded on page 36)

450-MC. MOBILE TESTS

(Continued from page 34)

was no significant distinction between the two frequencies in this regard, nor between locations from 13 to 26 miles from the transmitter.

Short-Distance Variations:

A limited number of measurements at 450 mc. with a recording instrument in the car showed signal variations up to about 15 db in a distance of about one foot of travel (which is about one-half wavelength) on city streets; the average variation per foot of travel was probably closer to 5 db. In a car moving at normal speed, these variations tended to average out. Total variation over distances of 200 to 400 ft. was roughly 20 to 25 db, with either a dipole or a gain antenna. On flat open meadows, at 450 mc., the signal variation per foot of travel was around 1 or 2 db, and the total variation in 300 ft. was 11 or 12 db.

Noise vs. Received Signal:

The average audio speech-to-noise ratio plotted against received signal amplitude is shown in Fig. 4. These figures represent average conditions in Manhattan and cover regions of lower and higher noise and lower and higher signals.[3] Ignition noise is controlling at both frequencies. Variations of individual locations from the average values shown, for the lower signal values, would cover a range of about $\pm$ 10 db. Both speech and noise values for the speech-to-noise ratios were measured on an audio noise meter; the speech modulation was normal for the volume-regulated urban mobile radiotelephone system.

It will be seen from Fig. 4 that for equal audio speech-to-noise ratios, the required RF signal voltage input to the receiver was, on the average, about 10 db lower at 450 mc. than at 150 mc. This figure applies to urban reception, ignition noise being controlling, and assumes equal signal frequency-swings at the two frequencies. It assumes set noise low enough (noise figure of about 8 db, and a reasonable input impedance match with a quarter-wave antenna) so that the effect of the ignition noise is permitted to override set noise at both frequencies.

Acknowledgments:

The authors wish to acknowledge the assistance of J. L. Lindner in the construction of the equipment, the help of M. Aruck in conducting tests and analyzing data, and the aid of R. S. Tucker in preparing this paper.

[3] A source of noise, ahead of the radio transmitter peculiar to the particular setup, limited the speech-to-noise ratio to a maximum of about 32 db. This was removed by computation from the values given in Fig. 4.

MOBILE RADIO NEWS

(Continued from page 22)

are changed without either, as a matter of choice, by the Commission.

Marine Radio Equipment:

Much of a piece with the Commission's common carrier action is its proposal to require the use of multi-channel equipment in the marine field on and after January 1, 1952 (January 1, 1953, for ship station equipment licensed prior to January 1, 1951) for all operations within the marine assignments in the band 156.25 mc. to 157.45 mc. This proposal would put a one-year limit on the use of single-channel, 152-mc. marine equipment purchased this year. Such equipment purchased before the start of this year would be allowed in use for only two more years. Not the least remarkable aspect of this proposal is its universal applicability to every kind of marine operation in the affected band assignments.

To sell common carrier equipment today, manufacturers must have 60-kc. equipment flowing off the production lines, or be ready to change over to the new specifications. To sell marine equipment tomorrow, they must have multi-channel models in production, regardless of need for particular types of operation. Everyone appreciates with the FCC that the radio art is not static and that changes in equipment and channel assignments must come. But the speed with which they are required is quite another thing. The new get-tough-fast attitude can only lead to higher radio costs for the user and in premature retirement of equipment or unnecessarily expensive equipment.

Administrative Gains:

It would be an unpardonable omission to turn the last page of 1950 without a word for the administrative accomplishment the FCC has wrought in the mobile field. The recent reorganization of the safety and special services and common carrier staffs has matched, personnel-wise, the accomplishments of the finalization of the various mobile rules in late 1949 in bringing order out of former chaos. The new year, therefore, finds the FCC administratively geared to do the best it can with what will probably be a diminishing staff. This is a large accomplishment, and while we may not be in agreement with every individual action taken — not even the Commissioners are — the large order of things is what really counts. In the mobile field, that prespective has been definitely on the ascendant. If 1951 were to be a normal year, we could certainly look forward to a consolidation of the regulatory and administrative improvements of the past two years in the mbile field. As it is, the industry can thank its lucky stars that the FCC's mobile house is in as good order as 1951 finds it.

Purely Personal:

New Year's Resolution: To keep the last paragraph in mind.

WHAT'S NEW THIS MONTH

(Continued from page 13)

At this time of writing, many organizational details of civil defense communications are as yet unresolved. For example, the International Association of Chiefs of Police has asked the Associated Police Communication Officers to develop a plan. Their initial thinking has been concerned only with an auxiliary net of amateur radio operators, without consideration for the highly organized industrial, public service, transportation, and broadcast services which are on the air 18 to 24 hours every day.

Since the President's declaration of a state of national emergency, we can expect that comprehensive plans will be formulated and blueprinteed speedily. Already some $200 million have been earmarked for communication equipment alone. This money will be spent by local defense officials under state-wide coordination.

Radio engineers, parts jobbers, and servicemen will be required to take an active part in the procurement, installation, and maintenance of a tremendous amount of equipment that will include

WHAT'S NEW THIS MONTH

(Continued from page 37)

signal systems, sirens, public address units, and portable radio transmitter-receivers.

Alarms and communications will be required for activities related to:

Air raid warning	Emergency welfare
Manning shelters	Engineering service
Evacuation	Rescue work
Warden service	Transportation
Intercity aid	Plant protection
Fire	Supply service
Law enforcement	Civilian auxiliaries
Public health	Personnel service

All those services will head up to the local control center which, according to the plan set forth in "United States Civil Defense," will be required to handle message traffic for:

1. Receipt and dissemination of air-raid warning information.
2. Operation of sirens and public address systems.
3. Summoning key civil-defense personnel for duty.
4. Reports and requests for assistance from civil-defense units.
5. Contacts with other control centers.
6. Two-way communication with police, fire, rescue, medical, engineering, and other operating services, and with key broadcast stations.

From this brief review, it appears that the radio industry, at every level, is going to have a tremendous job and a deep responsibility in adapting and expanding our present communication facilities to meet the needs of Civil defense operations.

THE November storm which cut off electric power and telephone service in wide areas from Ohio to Maine crippled a great number of radio communication systems at the very time they were needed most. Main transmitters located on high ground are generally fed by lines that run through wooded land. As trees were blown down and fell on power and telephone lines, one station after another went off the air.

Police and public utility systems were most seriously affected in this respect. Rerouting of traffic and dispatching of repair crews were greatly hampered by loss of radio facilities.

All this was an indication of what might happen under condtions of enemy attack on our cities. Either loss of electric power or telephone connections would cripple radio communication just when it would be most useful.

Immediately after the November storm, many orders were placed for engine-driven generators and link transmitters. However, the number of systems

(Concluded on page 39)

WHAT'S NEW THIS MONTH

(Continued from page 38)

so equipped is still woefully small. It seems surprising that the FCC has not required the installation of emergency generators for mobile systems licensed for the various emergency services. That could come about in the near future, however, when Federal Government plans for civil defense are completed.

WE STAND CORRECTED

ON page 37 of our October issue, we quoted at length from a letter written by Major Armstrong to Dr. W. R. G. Baker, RTMA Director of Engineering. Major Armstrong took us to task for using a part of his communication, but not publishing the complete text. On December 22 he wrote us to set forth his views. The full text of his letter follows:

I have your letter of October 9th and am quite disappointed in your treatment of my communication. You will understand me when I say that I cannot permit the quotation of merely parts of my communication to go without challenge because of the danger of producing a warped interpretation of the points I am trying to make.

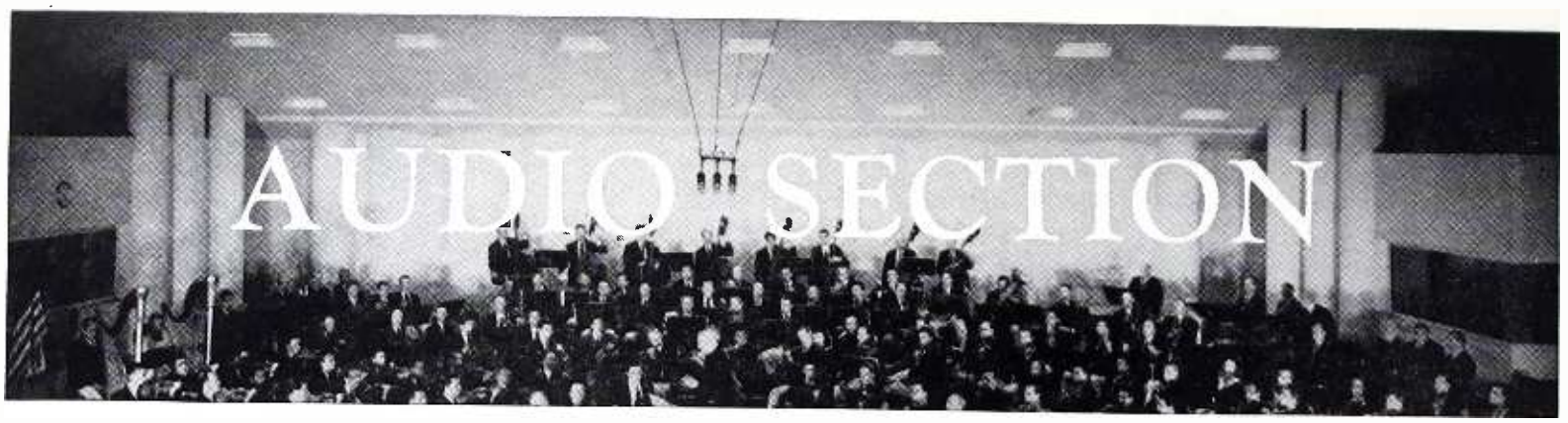
At the present time, what the world needs is access to the facts. Many of the difficulties of our times come about because the facts are complicated and difficult to find, and situations are created where it becomes easy for knaves to distort or cover them up. As you know, I have spent much time and effort to do what I can to uncover skulduggery of this sort.

Now, at present, there is being uncovered, on the part of government, facts about the operation of either an unsound law or about the operations of those who practice legal chicanery—the future will tell what it is. Your last issue brings this aspect of the radio industry's troubles well into the open.

But there is another aspect of our troubles which my letter treated, and which was supported by specific engineering facts that should likewise be brought out into the open — dishonest engineering and disregard for the public interest by some of our largest manufacturers. That part you suppress while making use of my letter to support the allegation of what is wrong in government.

To that policy, I cannot subscribe. Will you, therefore, publish the whole of my communication or run this letter in toto, in order that my position about what is wrong with the radio art may be made entirely clear.

Sincerely yours,
EDWIN H. ARMSTRONG



VIEWER'S AMPLIFIER

HOW TO GET HIGH-FIDELITY SOUND FROM ANY TYPE OF TV RECEIVER — *By* MELVIN C. SPRINKLE*

BIGGER picture tubes and lower prices have been tremendously effective as point-of-sale persuasion. In the dealer's store, only the picture counts, and a bigger picture counts more. But by the time people begin to look at the program schedule before they turn on their sets, most of them begin to realize that the sound which accompanies the picture is not even a reasonable facsimile of the original speech and music.

That's not surprising when you consider the cost of the audio end in sets retailing for $350 or even more. Prior to last November, when the excise tax applied only to audio components, it amounted to about $1.50 for most TV models, which meant that the audio section, complete with speaker, was valued at $15 in the manufacturer's selling price.

Some information has been published on improving the audio reproduction from TV sets, but this has been limited to data on changing the output transformer, usually to a larger replacement type, and perhaps introducing a little inverse feedback.

These measures do improve the quality, but only to a very limited extent. A real job calls for a high-quality output transformer, a push-pull power stage, inverse feedback circuit, an adequate power supply, and a good loudspeaker. TV cabinets haven't that much space to spare.

Design of the Viewer's Amplifier:

The units shown in Figs. 1 to 3 are the result of the writer's determination to get the full value of television entertainment that can be obtained from a moderately-priced table model, by making a small additional investment. The added enjoyment is not debatable. In fact, a demonstration of the improvement is so impressive that this unit, which has been called the Viewer's Amplifier, offers a source of considerable extra business to custom set-builders and servicemen.

Essentially, this design is intended to combine, in minimum physical size, frequency response flat within 1 db from 30 to 15,000 cycles, and undistorted power over a wide frequency range. The latter specification is a new concept to high-fidelity enthusiasts who have been concerned primarily with frequency-response curves. Fig. 4 presents the frequency response and power curves of the Viewer's Amplifier, with intermodulation plotted against power in Fig. 5.

Any good output transformer should show reasonably flat frequency response, but the power curve is actually of far greater significance. The measurement of intermodulation, which so plainly reveals the operating defects of amplifiers, emphasizes the importance of the power curve.

A plot of frequency response shows the degree to which a signal is attenuated at various frequencies as it passes through the transformer; *i.e.*, it is a measure of gain or loss. On a power curve, the zero line represents the full, rated output level of the tubes. The curve shows the maximum power of which the transformer is capable without attenuating or distorting the wave-form. Thus it shows the maximum useful power at any frequency.

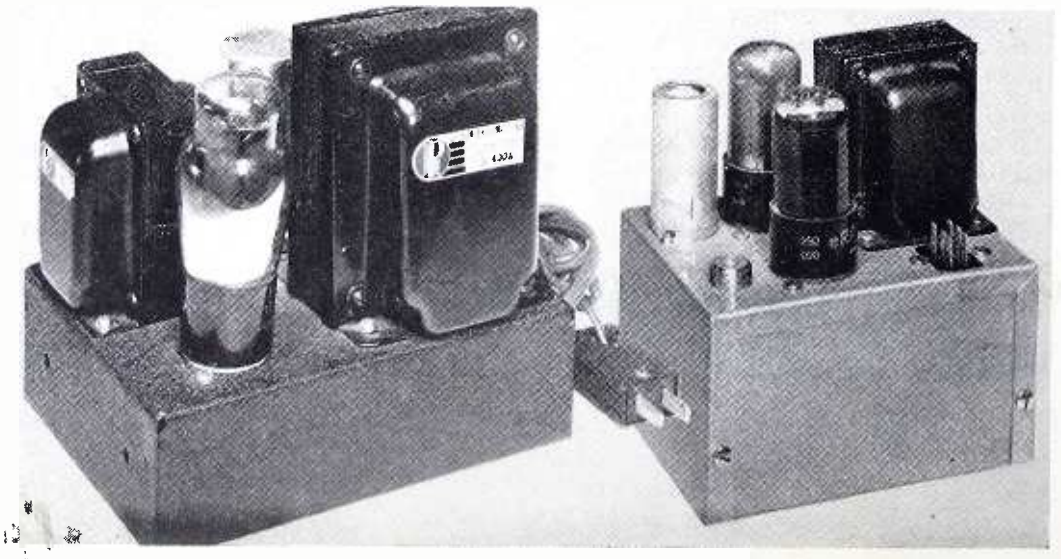
Because this factor was given special consideration in the design of the Viewer's Amplifier, a few words of additional explanation are in order:

The power curve of a transformer in general follows the frequency response curve, but droops much more at the frequency extremes. At the low frequencies, the exciting current increases, particularly when power is drawn from the transformer. When the exciting current component of the primary current attains a magnitude comparable to the load component, the distortion inherent in the exciting current causes the secondary voltage to become distorted, and terminates the useful power delivery of the transformer. In poor transformers, this effect occurs long before levels are attained that might be expected from the frequency response curve alone. At the high frequencies, magnetic leakage and shunt capacity cause the power to fall short. In the Peerless S-508A transformer specified for this amplifier, the power is not more than 3 db down at 30 and 15,000 cycles.

The intermodulation curve was made with Altec Lansing equipment. It is a very rigorous test since frequencies of 40 and 2,000 cycles were used. Usually, in the case of an inexpensive output transformer, frequencies of 100 and 2,000 cycles are used. It must be pointed out that while the IM curve shows larger numbers than harmonic measurements for the same degree of distortion, the apparently large numbers do not indicate excessive distortion. At the usual living room loudness level, where the power used is about 0.5 watt, distortion in this amplifier is practically non-

* Peerless Electrical Products Division, Altec Lansing Corp., 161 Sixth Avenue, New York 13.

FIG. 1. THE VIEWER'S AMPLIFIER IS DIVIDED INTO TWO SMALL UNITS FOR EASY INSTALLATION



existent, and it remains at inaudible values in the 10-db safety zone to handle the peaks in speech and music.

As Fig. 2 shows, the voltage amplifier and phase-inversion functions are combined in a single tube. The use of at 12AT7 miniature double triode has made it possible to keep the overall dimensions of the amplifier to 5 5/8 by 4 by 5 ins. The tube selected has high transconductance, and puts out plenty of drive voltage, with some real gain.

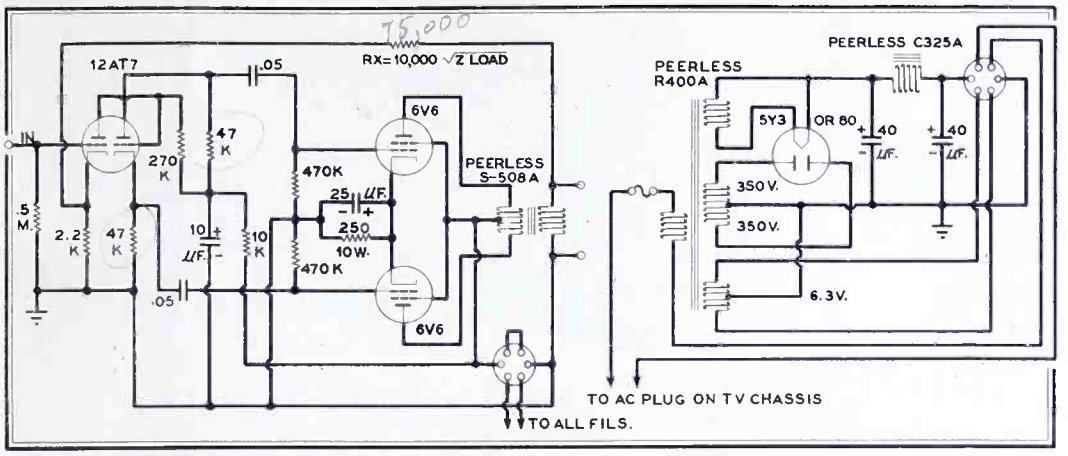


FIG. 2. SCHEMATIC DIAGRAM OF THE TWO UNITS WHICH COMPRISE THE VIEWER'S AMPLIFIER

The first section is a conventional amplifier stage, using self bias, and is direct-coupled to the phase inverter. The phase inverter is of the cathodyne or split-load type, having equal load resistors in the plate and cathode circuits. This type of circuit has several advantages, among which are almost perfect balance over wide frequency range, independence of changes in performance with tube replacement, and inverse feedback action. In addition, it lends itself readily to direct coupling from the preceding stage. The high cathode resistance in the phase inverter would produce an abnormally high bias, but this is offset by positive voltage from the preceding plate, so that both stages operate properly. As a matter of fact, the direct-coupled circuit is almost automatic in its adjustment for optimum operation. There is the additional dividend in that the direct coupling extends operation to DC frequencies, and eliminates a coupling capacitor which, unless it is of generous size, can cause low-frequency attenuation and phase shift.

The whole power amplifier chassis has only two coupling capacitors in it, one to each of the 6V6 grids from the plate and cathode of the phase inverter. Thus the low-frequency response of the amplifier is very fine, as will be seen from the performance data. Because of the few tubes, small output transformer and circuit used, the entire amplifier is mounted on a steel chassis which measures 3 by 4 by 5 ins. There is plenty of room inside for accessibility and service should it be required. All resistors for the first tube are installed immediately below the tube on a Vector socket.

Power Supply Unit:

The power supply was installed on a separate chassis because 1) two-chassis construction lends itself readily to more compact installations since the chassis can be placed side by side, end to end, or stacked, 2) hum and noise are reduced, 3) construction is simplified, and 4) there is no trouble from excessive heating. The power supply chassis measures 2 by 5 by 7 ins. There is plenty of room, but no waste space. The power transformer is a Peerless R-400A, the filter choke is a Peerless C-325A, and the filter capacitor, a double 40-mfd. Sprague type EL. The brute-force filter gives dependable, hum-free power. Hum level in the complete amplifier is 90.2 db below full output or −49 dbm. On a practical basis, there is no hum audible in the speaker at 6 ins. with an open grid.

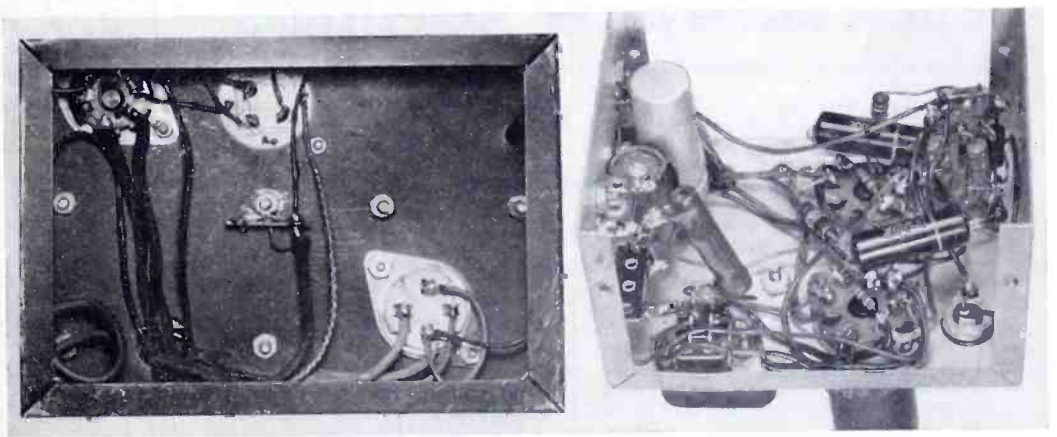


FIG. 3. BOTTOM VIEW OF THE POWER SUPPLY, LEFT, AND THE VERY COMPACT AMPLIFIER ASSEMBLY

A 6-conductor cable is used to feed power from the power supply to the main amplifier chassis. Four of the wires carry plate and heater power, the center tap of the heater winding being grounded. The two remaining wires carry the 115-volt AC line up to the amplifier and back. This procedure was adopted to prevent turning the power supply on unless the interconnecting cable is in place. A 6-pin Amphenol plug and socket are mounted on the power supply but, because of space limitations, a 6-pin Jones plug and socket are used on the amplifier. The connector is mounted on the amplifier chassis, and the socket on the power supply so there are no hot plugs. An AC line switch is not needed because provision is made on the TV chassis to turn the amplifier on simultaneously with the TV power switch.

TV Set Connections:

As for connecting the amplifier to a particular TV set, the reader must be on his own to a considerable extent, since there are almost as many TV models as there are varieties of alley cats. The author's own receiver is the type 630 chassis sold under various brand names, both in kit and wired form. Since it is one of the most popular designs, it can be considered a typical example. The instructions which follow can be easily extrapolated to include almost any TV receiver.

The audio section of the 630 receiver, Fig. 7, is of conventional design. The entire audio system from the volume control to the speaker, and including the latter, should be removed. In the 630 chassis, the heaters of the tubes are operated from a power transformer, and the tubes can be removed with impunity. In AC-DC sets, where the tube heaters are operated in series, the audio tubes must be retained or possibly a substitution of types worked out.

There is one function in the audio section that must be retained. This is the diode action in the RF and pix IF gain (picture) control. The resistors and capacitors for this circuit are bunched up near the picture control which is ganged with the sound volume control at the front section. These resistors are generally in the way and should be removed. A Miller resistor board was used to mount them together with a IN34 germanium diode which takes the place of the diode section of the 6AT6 1st audio stage. All the resistors and the diode fit nicely on the board, which is then mounted inside the

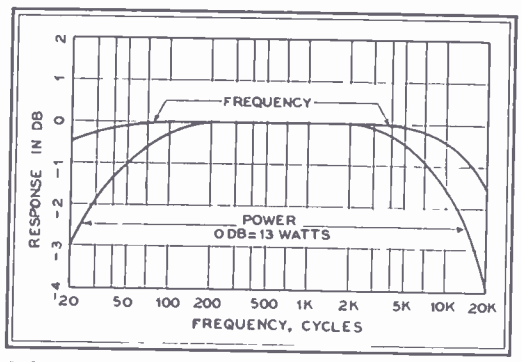


FIG. 4. FREQUENCY RESPONSE AND POWER CURVES

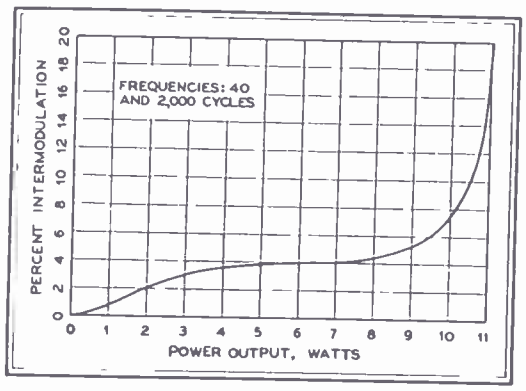


FIG. 5. CURVE OF INTERMODULATION VS. POWER

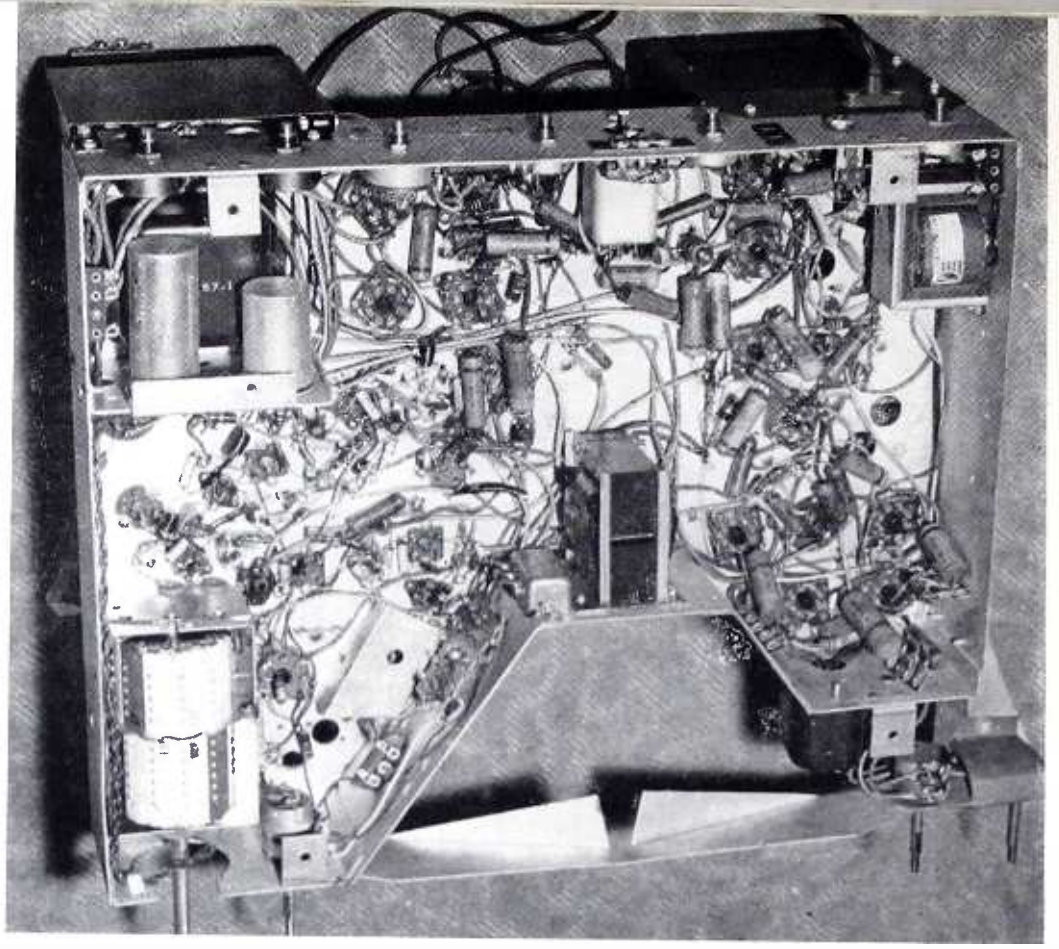


FIG. 6. UNDER SIDE OF THE MODEL 630 TV RECEIVER AFTER ALTERATIONS WERE COMPLETED

chassis just above the sound IF section. It should be pointed out that all voltages in this circuit are DC. Hence, the resistor board mounting is desirable. Three wires are then led from the board to the picture (or contrast) control. The 0.25-mfd. capacitor used to by-pass the diode (C-125) is mounted on the tie points which are installed using screws that hold the vertical sweep output transformer. This transformer is just around the corner from the resistor board location.

The original 5-in. speaker has a 62-ohm field coil which serves as the filter choke in the receiver. A Peerless C-315X choke, specifically made for TV applications, serves as a substitute. This choke has adequate wire size to handle the current with low voltage drop, and plenty of iron to give good filtering. The hum level in the TV set, after installation of this choke, was reduced substantially. A good location for the

DESIGN DATA for AF AMPLIFIERS — No. 7 Meaning of the Decibel

WHY THE DECIBEL IS COMMONLY USED TO COMPARE RELATIVE AMPLITUDES OF ELECTRICAL QUANTITIES — HOW TO CALCULATE DB RELATIONSHIPS

ELECTRICAL measurements are often concerned with power and voltage ratios which approach astronomical values. For instance, a typical audio amplifier may be required to provide a power amplification of from 1 to 100 billion times, or even more! It is obvious that some logarithmic method of measurement would make these figures less unwieldy.

In addition, the human ear is logarithmically sensitive to changes in sound intensity. The ratio of one sound intensity to another, not the absolute difference, is the criterion by which the ear judges relative loudness. Thus, a logarithmic scale for audio measurements would be more meaningful than the common linear one.

The decibel, abbreviated db, is the unit commonly employed as a measure of relative power or sound intensity. The basic relation is given below:

$$DB = 10 \log_{10} \frac{P_1}{P_2}, \text{ OR } 10 \log_{10} \frac{I_1}{I_2}$$

where P = Power, and
I = Sound intensity

Since power is proportional to the square of voltage across a given impedance, the following relation is also true where the relative voltages are measured across equivalent impedances:

$$DB = 20 \log_{10} \frac{E_1}{E_2}$$

where E = Voltage

It can be seen that decibel measurements are directly proportional to the ratio of two quantities, rather than their absolute values. A speaker power output change of 1 db can be just detected aurally, whether the change occurs from 10 watts, from 1 watt, or from .1 watt.

The chart at the right gives voltage and power ratio equivalents for any decibel value from −120 to +120. For quick estimation, it is convenient to remember that 3 db represents a power ratio of approximately 2, and that 10 db is a power ratio of 10. Doubling the db figure squares the power ratio, and tripling the db figure cubes the power ratio. Thus, 6 db corresponds to a power ratio of 4; 9 db, a power ratio of 8; and 20 db, a power ratio of 100.

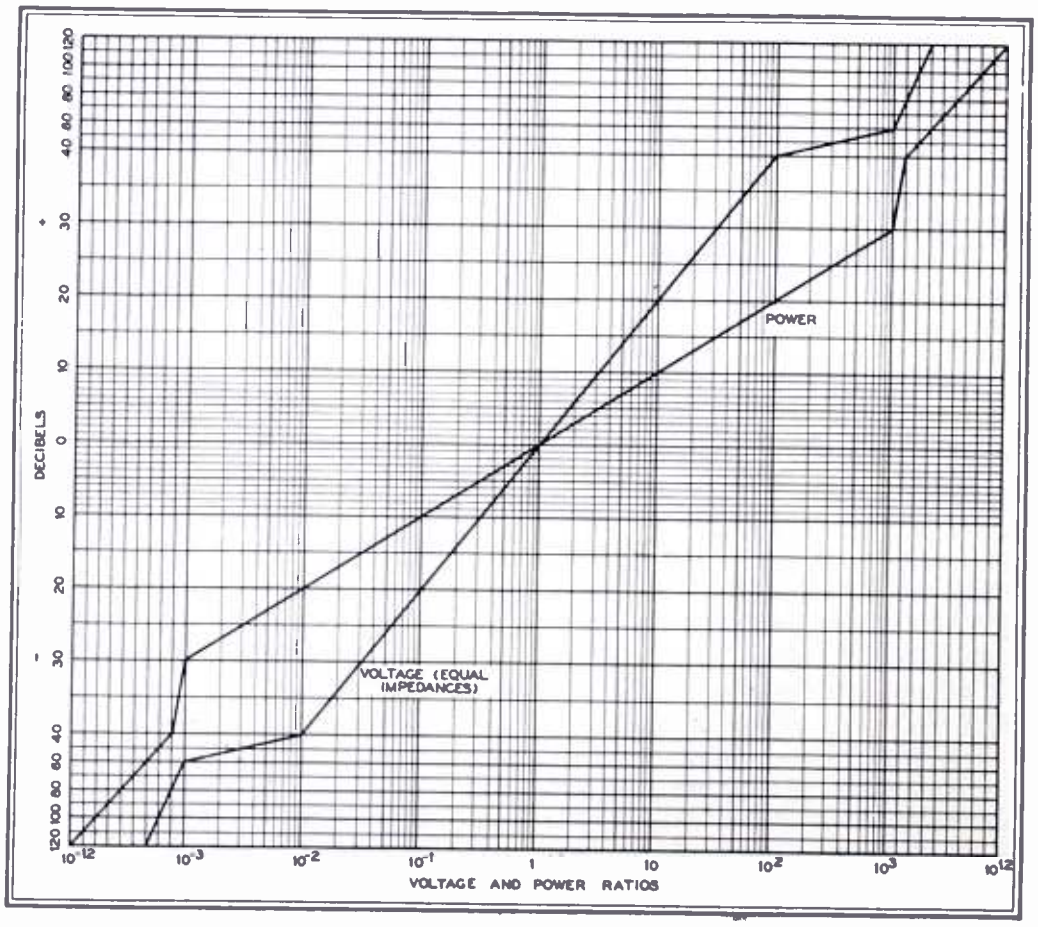


CHART SHOWS VOLTAGE AND POWER RATIOS CORRESPONDING TO DB VALUES FROM +120 TO —120

choke is inside the chassis just over (when the chassis is inverted) the horizontal output (flyback) transformer. Connections are made to the same points in the circuit as the old field coil.

It is desirable to make the audio feed from the TV receiver to the external amplifier of low impedance, by using a cathode follower, preceded by a voltage amplifier, to compensate for equalization losses. This can be done with a 6SN7 tube installed in the socket formerly occupied by the 6K6 power output stage. Fig. 7 shows the direct-coupled circuit to a follower.

Tests with an audio oscillator revealed no clipping until the output voltage from the follower reached 60 volts. The single-circuit jack indicated in Fig. 7 can be installed in an existing hole, covered by a snap plug, on the rear of the chassis. The hole may need a little reaming.

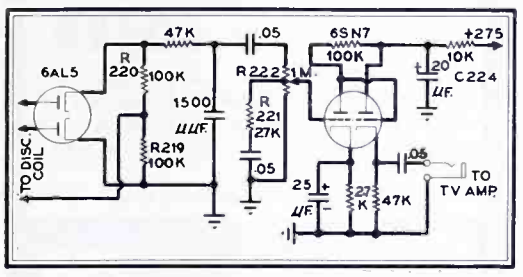


FIG. 7. AUDIO CIRCUIT OF THE MODEL 630 SET

Care must be taken to insulate the jack from the chassis. A .05-mfd. coupling capacitor must be mounted nearby on tie points and connected in series with the hot audio lead. Run two unshielded wires to the cathode of the follower and chassis ground point near the follower socket. The ground lead should be twisted loosely around the hot lead to form a low capacity shield. Absolutely no trouble should be encountered from hum or sweep pickup in the audio circuit.

In order to preserve all the advantages of the cathode follower, it is desirable to mount the blocking capacitor near the input of the next stage. The capacitor should be installed at the TV chassis, because the circuit lends itself to plugging a pair of headphones into a jack. In this way, at certain times, domestic tranquility is prompted, because the small fry can have their Hopalong Cassidy without distracting others.

Plate power for the amplifier follower stage is obtained from the filtered side of the C-315X, and is further filtered by a 10,000-ohm resistor and C-224. This capacitor is used to filter the plate supply to the original 6K6 stage and, with the 6K6 removed, it becomes available. Other resistors for the amplifier follower mount on the socket. All ground connections, including that from the output jack, go to a single

chassis tab which is near the old 6K6 socket.

Connections to an Amphenol MIP-6IF AC receptacle, mounted on the rear of the chassis near the sound output jack, should be wired in parallel with the power transformer primary so that, when the amplifier is plugged into the receptacle, switching on the TV set will also supply AC to the amplifier.

The question of equalization must now be considered. The original circuit used a 2,500-mmf. capacitor (C-207) by-passing the plate of the 6AT6 tube for the FM sound de-emphasis. As this capacitor is removed, additional de-emphasis must be provided. This can be done by increasing R-236 from 22,000 to 50,000 ohms, and then by-passing the .5-megohm control with 1,500 mmf. This gives the standard 75-micro-second de-emphasis.

The original receiver employs a tapped volume control to give bass boost action at low volume levels. The values were chosen as 27,000 ohms and 0.01 mfd. to give a 3-db turnover point at 500 cycles. With improved bass response in the amplifier and speaker, it is desirable to lower the turnover frequency. Another consideration has to do with the very close parallel between movie sound and TV sound. In both cases, at least 90% of the program material is speech, with music distinctly secondary.

Movie practice is to make the gain almost flat to 100 cycles, and then put in some bass boost beginning at 100 cycles to add richness to music. 100 cycles has been found to be the highest practical frequency for bass boost, since a higher frequency gives a boomy, barrel effect to male speech. Thus, the bass boost capacitor on the volume control tap must be changed from .01 mfd. to .05 mfd. The 27,000-ohm resistor need not be changed. Resistance - capacitance equalization, of the type employed here, causes losses, and if it is found that the gain is cut too much by the values suggested for the 630 chassis, then the 27,000-ohm resistor must be increased in resistance. Also, the capacitor must be increased so that its reactance is about equal to the resistance at 100 cycles.

Choice of a Speaker:

So far no mention has been made of a suitable loudspeaker. For obvious reasons the speaker originally furnished with the TV set is unsatisfactory and another must be used. From the standpoint of convenience, it is desirable to use a speaker that will provide satisfactory sound in as small a cabinet as possible. At this point, the reader will be left to go on his own, for the choice of a particular model is, to a large extent, a matter of individual preference.

READERS' COMMENTS ON THE FAS SYSTEM

THE extraordinarily widespread interest in the FAS audio system, described in our three previous issues, has produced a flood of editorial correspondence such as we have never known before. Therefore, this month, instead of a fourth article in the series, we're going to catch our breath, quote some of the comments, and answer a few typical questions so that our readers can benefit from each other's experiences.

One of the most common questions is, "What size should I make the Air-coupler if I use a 15-in. speaker?" To that question, we must make an honest answer: we don't know—*yet*. The FAS team spent every available minute developing the system to its present point for use with 12-in. speakers only. The "F" member of our group is now involved with 15-inchers and quantities of lumber, and he'll report in complete detail in the February issue.

E. B., Eugene, Oregon: "The new FAS system has created a great deal of interest out here in Oregon. . . . A question, please: What are the polarity markings on the electrolytic condensers associated with the dividing network?"

As we understand the technicalities, the polarity markings are not important unless you have inverse feedback in your amplifier. If you do, the positive side of the electrolytic should face that side of the voice coil from which you take your feedback loop.

L. C., New York City: "I was privileged to be among those present at your demonstration in the course of the recent Audio Fair, and was mightily impressed, especially by the bass response. I should like to incorporate the Air-coupler and middle range speakers into my system. How would I alter the values of your crossover network if I were to use a GE12O1D for the middle range, and my Stephens P-52LX on the coupler?"

How to match values is explained in full in the December article, but to start with, we'd recommend your leaving your present system alone, using the GE for the Air-coupler. The Stephens is a 15-in. woofer, which is *that* problem again. We know that the GE works very well on the coupler, because we've tried it.

S. S., New York City: "Exactly how is the Air-coupler intended to be mounted in the room? I would like to stand it up vertically near a corner of the living room, but you say performance falls off if mounted vertically."

It's not the fact that it's mounted vertically that's bad, but rather the free-standing position, unanchored. The more solidly the Air-coupler is weighted

(Concluded on page 46)

Platter and Reel Epidemic Reaches Staggering Proportions

Scores of Engineers Smitten

Al Travis, crackpot of supply, who describes his "PRO" brand tape, discs, and sapphires as being both sensationally mediocre and reliably schmuct, says that if the bespectacled wizards of the control room keep buying at the present tempo, he'll go broke keeping up enuf stock to make good his 24 to 48 hour delivery guarantee.

Whatever occult mysteries may be behind the already apparent success of his young and ungainly enterprise, be they shortages, year-end budget balances, or just plain gnuckm, he takes this opportunity to thank the scores of hot-tube changers, mixer manglers, and check book busters of the blurb-casting industry for the thousands of rocks worth of orders that still pour in and the confidence they express.

The prices of popular "PRO" items typified below, Al says, can represent yearly savings of hundreds of iron men even to small users. He particularly claims to be an FSU*.

16" "PRO" Dbl Face discs, ea.	$1.49
12" "PRO" Dbl Face discs, ea.	.85
10" "PRO" Dbl Face discs, ea.	.52
Red Ox. Plastc Mag. Tpe 1250 ft.	2.95
Sapphire Resharp Service each	1.49

Semi-monthly Al exposes some 1300 known or suspected disc and tape users by mail to new dope on trivia of the recording racket, and he feels that, if any pipple fail to get smitten, it's their own fault.

If you've been needing flowers on your desk because the mail was so dead, Al believes the coupon below will help—if only to fertilize better the flowers.

* Friend of Small Users

BROADCAST ENGINEERS SPECIALTY CO.
101-38, 121 St., Richmond Hill 19, N. Y. City

Dear Al:

We DO buy recording supplies from time to time so please put us on your sucker list and send back issues, too.

Company .....

Address .....

Name .....

Remarks .....

THE FAS SYSTEM

(Continued from page 45)

or attached, the better; it can be mounted vertically in the wall except that, for most people, that's an awkward arrangement requiring a lot of house remodeling.

S. S. also asked, "Is the 1,000-cycle crossover frequency between middle and high-range speaker critical?"

This frequency depends on the recommendations of the tweeter manufacturer. We used a Racon, and they suggest 1,000 to 1,200 cycles. If you happen to use a ribbon speaker, you may want to go as high as 5,000 cycles!

R. S., Los Angeles, Calif.: "I made an Air-coupler 7½ by 18 by 72 ins. outside dimensions, of ¾-in. plywood, and tried my Jim Lansing 15-in. speaker on it. Result was a very boxy sound. Tried a jury baffle over the 15-in. hole, using a 12-in. Jim Lansing. Much better; less boxiness. Apparently I hit a resonance with the 15-in. speaker and the particular dimensions I used for the Air-coupler. Any suggestions?"

So long as you use wood, you're bound to get a tinge of boxiness, which you may notice occasionally on male speech reproduction. Some bass reflex enclosures we have heard are terrible in this respect. Some like it: "mellows the sound." If you can, try building your Air-coupler in the floor. It reduces boxiness to a minimum.

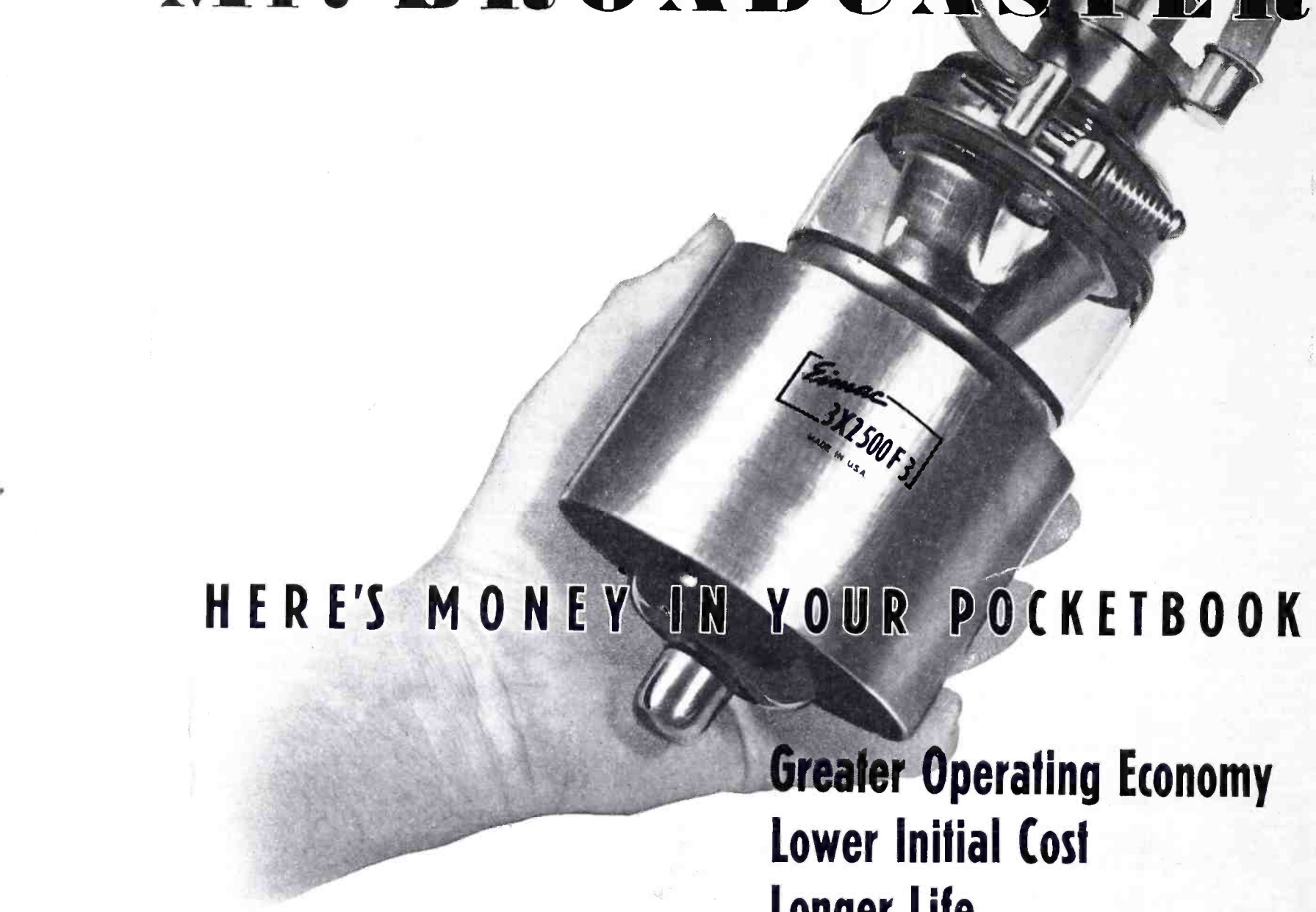
H. W., Brooklyn, N. Y.: "I built the Air-coupler and the results are terrific! To start with, I had a 3-way system arranged to achieve a stereophonic effect. Previous equipment consisted of a University dual tweeter covering 2,000 to 15,000 cycles, with a 2,000-cycle crossover, a mid-range University covering 600 to 2,000 cycles, with a matching 600-cycle crossover (attenuation rate of 6 db per octave), and a low-range Altec 600-B 12-in. speaker mounted in a bass reflex cabinet lined with 75 lbs. of plaster of paris.

"Because of the wood I had available, I had to make the Air-coupler a little shorter: 70 ins. instead of 72. Used about 40 angle iron brackets plus 16 braces across the face and rear. The top side is used as a book rack, thus providing the required weight and a practical convenience besides.

"Here is another point of interest: at the Audio Fair, you had your high-range tweeter mounted at the extreme right. I noticed there, as I had at home, that with this arrangement surface noise is emphasized. Locating the high range speaker between the low- and mid-range speakers seems to make the system sound better balanced, and also tends to decentralize the noise of surfaces and shrillness in the reproduced sound."

ADVERTISERS INDEX

Mr. BROADCASTER



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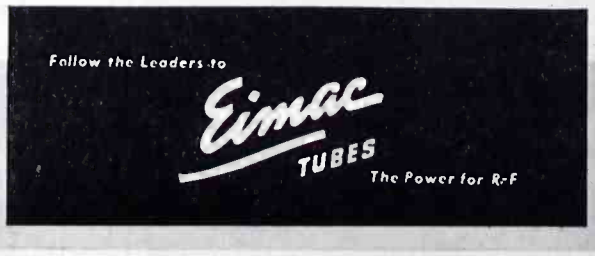
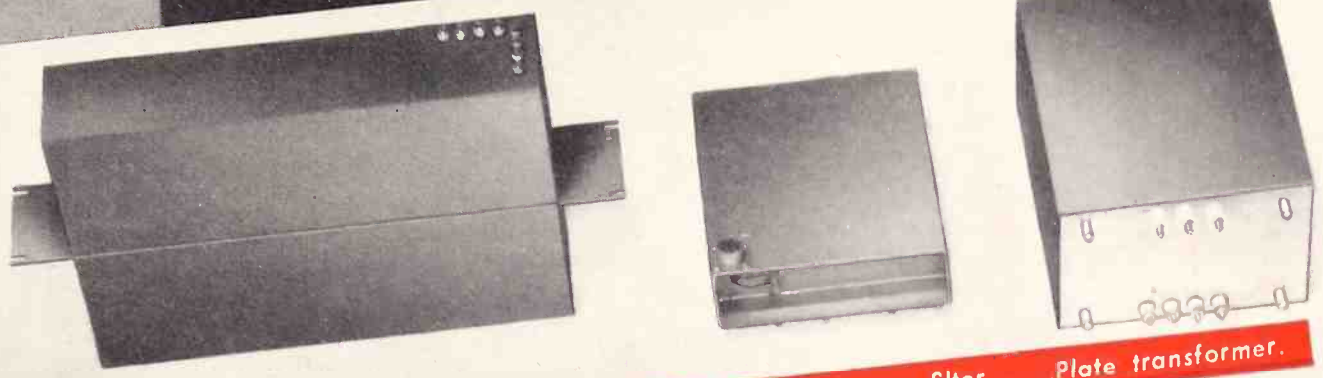


249

UTC for Military Components

UTC was the largest supplier of transformer components in World War II. Present UTC production is on a similar basis. Illustrated below are a few of the thousand military types in UTC 1950 production.



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