Price 25 Cents

May '49

FM—TV

★ Edited by ★
Milton B. Sleeper

FCC FREQUENCY ALLOCATIONS

Released May 6, 1949 — Effective July 1, 1949 — For 25 to 30000 MC.

AERONAUTICAL
29.80-29.89
29.91-30.00*
108.00-132.00
328.60-335.40
960-1215
1300-1660
2700-2900*
2900-3300
4200-4400
5000-5650
8500-9800

AMATEUR
26.96-27.23
28.00-29.70
50.00-54.00
144.00-148.00
220.00-225.00
420.00-450.00
1215-1300
2300-2450
3300-3500
5650-5925
10000-10500
21000-22000

BROADCAST
152.84-153.38*
450.00-452.00
475-500
890-952
6875-7125

CITIZENS RADIO
460-470

COMMON CARRIER
35.22-35.66
43.22-43.66
152.51-152.81
157.77-158.07

FACSIMILE
Multiplexed on FM
470-475

FREQUENCY MODULATION
88-108

GOVERNMENT
24.99-25.01
25.33-25.85
26.48-26.95
27.54-28.00
29.89-29.91
30.00-30.56
32.00-33.00
34.00-35.00
36.00-37.00
38.00-39.00
40.00-42.00
132.00-144.00
148.00-152.00
157.15-157.35
162.00-173.00*
173.20-173.40*
216.00-220.00
225.00-328.60
335.40-400.00
400.00-406.00
406.00-420.00
1700-1850
2200-2300
4400-4500
7125-8500
9900-10000
13200-16000
18000-21000
22000-26000

INDUSTRIAL
Power Utilities
35.06-35.18*
37.46-37.86
47.70-48.54
153.41-153.71
158.13-158.25
456.05-457.95*

Motion Pictures
49.70-49.82*
152.87-152.99*
173.22-173.38*
456.05-457.95*

Press Relay
173.22-173.38*
456.05-457.95*

Petroleum
25.02-25.30
30.66-30.82*
33.18-33.38
48.58-49.18
153.05-153.35*
158.31-158.43*
456.05-457.95*

Special Emergency
27.31-27.47
30.58-30.62
43.02-43.18*
49.54-49.82*
49.86-49.98
152.87-152.99*
154.49
154.57*
456.95-457.95*

Low Power Industrial
27.51
33.14
35.02
42.98
154.57*

Forest Products
29.73-29.77
49.22-49.66*
153.05-153.35*
158.31-158.43*
456.05-457.95*

INTERNATIONAL FIXED PUBLIC
26.95-26.96
29.80-29.89*
29.91-30.00*

LAND TRANSPORT
Urban Transport
30.66-31.14*
44.34-44.58
453.05-453.75

Highway Truck
35.74-35.94

Railroad
159.51-161.79*
453.05-453.75*

Special Emergency
157.47
161.85
161.91*
161.97*

Taxis
152.27-152.45
157.53-157.71
452.05-452.95

Intercity Bus
43.70-44.30

Auto Emergency
35.70
453.85-453.95

L.C.C.
152.03-152.21
158.49-158.67

MARITIME MOBILE
35.04-35.20*
43.00-43.20*
156.25-157.15*
157.35-157.45*
161.85-162.00*

METEOROLOGICAL
1660-1700
2700-2900

PUBLIC SERVICE
Police
37.02-37.42
39.02-39.98
42.02-42.94
44.62-46.02
154.65-156.75*
158.73-159.21
159.51-161.79*
454.05-455.95*

Fire
33.42-33.98
46.06-46.50
153.77-154.46
159.51-161.79*
166.25
170.15
454.05-455.95*

Forestry Conservation
30.86-31.98*
46.54-46.82
156.87-156.93*
159.51-161.79*
170.42-172.38
454.05-455.95*

Highway Maintenance
33.02-33.10*
37.90-37.98*
46.86-47.38
156.99-157.11*
157.41
159.51-161.79*
454.05-455.95*

Special Emergency
33.02-33.10*
37.90-37.98*
47.42-47.66
159.51-161.79*
454.05-455.95*

SCIENTIFIC, MEDICAL, INDUSTRIAL
27.12
40.68
915
2450
10600
18000

TELEVISION
54-72
76-88
174-216
500-890

* Indicates channel shared by other services.

Channel allocations in the frequency ranges: 72.02-74.58, 75.42-75.98, 952-960, 1850-2200, 2450-2700, 3500-3700, 6425-6875, 11700-12700, 16000-18000, and 26000-30000, are shared by Public Service, Industrial and Land Transport services.

FM BROADCAST MONITOR

MODEL 335B

CONTINUOUS, ACCURATE MEASUREMENT OF FREQUENCY AND MODULATION LEVEL

(No Adjustment During Operation)

SPECIFICATIONS

FREQUENCY MONITOR

Frequency Range: Any channel, 88 to 108 mc.

Deviation Range: +3 kc to −3 kc mean deviation.

Accuracy: Better than ±1,000 cps (±.001%).

Power Drive: Approximately 2 watts.

MODULATION METER

Modulation Range: 100% at 75 kc deviation; 133% at 100 kc deviation.

Accuracy: Within 5% over entire scale.

Characteristics: Meter damped in accordance with F.C.C. regulations.

Frequency Response: Flat within ±½ db, 50 to 15,000 cps.

External Meters: Circuit provided to operate remote modulation meter.

PEAK LIMIT INDICATOR

Peak Limit Range: 50% to 120% modulation (75 kc = 100%).

AUDIO OUTPUT

Frequency Range: 20 cps to 20 kc. Response flat within ±½ db.

Distortion: Less than 0.25% at 100% modulation.

Output Voltage: 10 v into 20,000 ohms.

Noise: 75 db or more below audio output level resulting from 100% modulation (low frequencies).

Monitoring Output: 1.0 mw into 600 ohms, balanced, at 100% modulation (low frequencies).

Size: Front panel 10½" x 19" x 13" deep.

Power: 115 v 50/60 cps primary power. Requires approximately 150 watts.

Data subject to change without notice

EASY TO OPERATE • HIGH STABILITY
REMOTE MODULATION METER • LOW DISTORTION
LOW NOISE LEVEL • INDEPENDENT OF SIGNAL LEVEL
MEETS F. C. C. REQUIREMENTS

The *-hp-* 335B FM Monitor is a Frequency and Modulation Meter combined. It monitors FM broadcast transmitters accurately, reliably, day after day. It doesn't depend on a tuned circuit for accuracy, so it is never necessary to re-set the carrier level.

The instrument is independent of signal level, tube characteristics or tube voltages; and requires adjustment only at infrequent intervals. It gives continuous indication of broadcast frequency and modulation level at all times.

An audio output signal of less than 0.25% residual distortion is provided for measurement purposes. A high-quality 1 mw demodulated signal is also provided for remote or local aural monitoring. The instrument includes provision for external or remote modulation meters, as well as a remote peak modulation indicator lamp. An amplitude modulation noise detector permits measurement of transmitter AM noise.

The compact *-hp-* FM Monitor can be supplied in a cabinet, for relay rack, or in special panel colors matching station installations. Construction throughout is in accordance with engineering practices proved satisfactory for broadcast equipment. Components are rigidly mounted on bakelite cards; bathtub, mica and oil-filled condensers are used where voltages exceed 50 volts.

For complete details, see your local -hp- representative, or write direct to factory.

HEWLETT-PACKARD CO.
1877-F Page Mill Rd., Palo Alto, Calif.

Export: FRAZAR & HANSEN
301 Clay Street, San Francisco, California, U. S. A.
Offices: New York, N. Y.; Los Angeles, Calif.

hp laboratory instruments
FOR SPEED AND ACCURACY

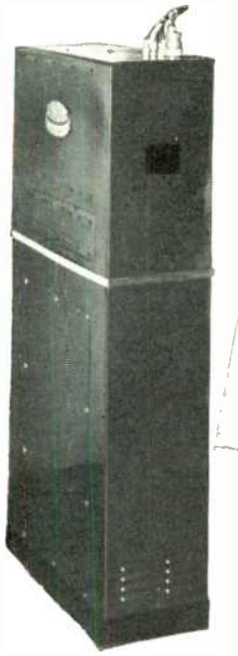
The Du Mont Types 5130-B and 5130-C 16 mm. television projectors are designed and built for the rugged requirements of film telecasting. Greater reliability for day-in-day-out operation. Readily accessible mechanism. Easily replaceable parts. Feature-length reel capacity. Maximum optical resolution. Greater light output. High-fidelity sound. Either type recommended, based on style and feature preference.

Du Mont Type TA-105-A Film Pickup Control Console. Includes saw-tooth, parabola and sine-wave shading with 5" waveform monitors for both line and frame. 12" picture monitor. Instantly accessible chassis. Integral design with the Du Mont Type TA-108-B Video Mixing Console and associated equipment which will handle four separate video or composite input channels with automatic or manual "fades" and "lap dissolves" between any video input channels.

For 16 mm. sound-film economy . . . maximum pictorial resolution . . . high-fidelity sound . . . good audience reaction and real sponsor satisfaction—

PLAY SAFE WITH A DU MONT

Iconoscope Film Pickup SYSTEM



Here's fully-coordinated engineering. From projector to control console, there are no weak links. Each unit does its job as thoroughly as that job can and should be done.

First, a choice of two types of Du Mont projectors designed from scratch and built by specialized craftsmen to insure superlative images and sound from 16 mm. films. Then the Du Mont Iconoscope Film Pickup Head to translate pictorial resolution into precise electronic signals. Finally, the Du Mont Control and Video Mixing Equipment to monitor the pickups for a smooth-flowing program.

"Portions of this program have been on motion picture film" takes on new meaning when handled with Du Mont equipment throughout.

Details on request. Remember, Du Mont means "First with the Finest in Television" from camera to transmitter, and again to the finest telesets* made.

*Trade Mark

Du Mont Type TA-103-A Iconoscope Film Pickup Camera. An ideal pickup head for film or slides, using the high-resolution Iconoscope Type 1850-A. Special rim light and back lighting arrangement. Available with fixed pedestal or sliding-track mounting for handling two or more image sources. Mechanical construction such that all components are readily accessible.

DUMONT *First with the Finest in Television*

ALLEN B. DU MONT LABORATORIES INC. • TELEVISION EQUIPMENT DIVISION, 42 HARDING AVE., CLIFTON, N. J. • DU MONT NETWORK AND STATION WABD, 515 MADISON AVE., NEW YORK 22, N. Y. DUMONT'S JOHN WANAMAKER TELEVISION STUDIOS, WANAMAKER PLACE, NEW YORK 3, N. Y. • STATION WTTG, WASHINGTON, D. C. HOME OFFICES AND PLANTS, PASSAIC, N. J

Zenith Challenges Any Comparison

WITH THIS

The Most Sensitive FM Radio Ever Built

FOR THE PUBLIC

ONLY ZENITH GIVES YOU THIS

Most Sensitive Performance
Superb reception even on weak signals.

Longer Distance
Because of high sensitivity, brings in stations in fringe areas others miss.

No Interference
No whistles, no overlap, no cross-talk, no background hiss.

No Static
Even in the worst storms. Only rich, glorious tone.

No Special Antenna
With Zenith's patented Power-Line Antenna, just plug in and play.

Whatever has been your experience with FM—whatever FM radio you have ever heard—Zenith† now asks you to listen to a new marvel of Radionic† science.

This *all*-new Zenith Model is the climax of years of acknowledged leadership in *genuine* Zenith-Armstrong FM—that hundreds of thousands know as *true* FM—the FM radio that leading FM stations over the nation rely upon to monitor and test their own broadcasts—*truly the FM of the Experts!* Now, in a new *Super-Sensitive* circuit that gives perfected performance even on signals too weak for ordinary sets to catch.

So we say—hear, compare! Be prepared to hear the most sensitive FM receiver you have ever listened to—a genuine Zenith-Armstrong receiver at a sensationally low price.

The lowest price ever for genuine Zenith-Armstrong FM! . . . only $39.95*

ZENITH
•LONG DISTANCE• RADIO and TELEVISION
THE ROYALTY OF RADIO
†®

*Suggested Retail Price. West Coast prices slightly higher. Prices subject to change without notice.

ZENITH HAS THE GREAT VALUES

FM-TV

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

VOL. 9 May, 1949 NO. 5

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INDUSTRY NEWS

FM BUSINESS

TV BUSINESS

AUDIO SECTION

SPECIAL DEPARTMENTS

MILTON B. SLEEPER, *Editor and Publisher*

CHARLES FOWLER, *Business Manager*
LILLIAN BENDROSS, *Circulation Manager*
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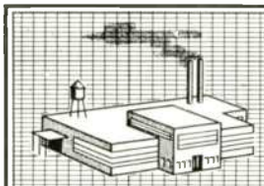
MEMBER, AUDIT BUREAU OF CIRCULATIONS ABC



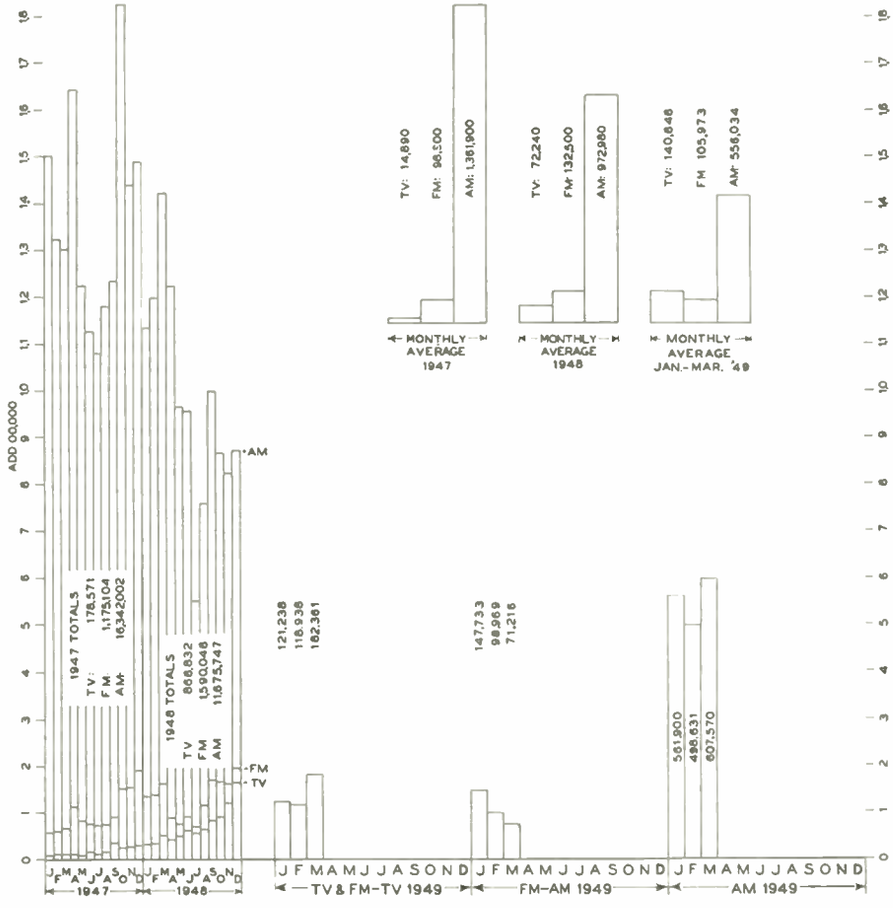
Set Production

SET production reported by RMA for March, covering a period of five weeks, shows a healthy gain for TV receivers. The March figure for AM sets is up only because an extra week's production is included. FM receivers dropped to the lowest level since July '47.

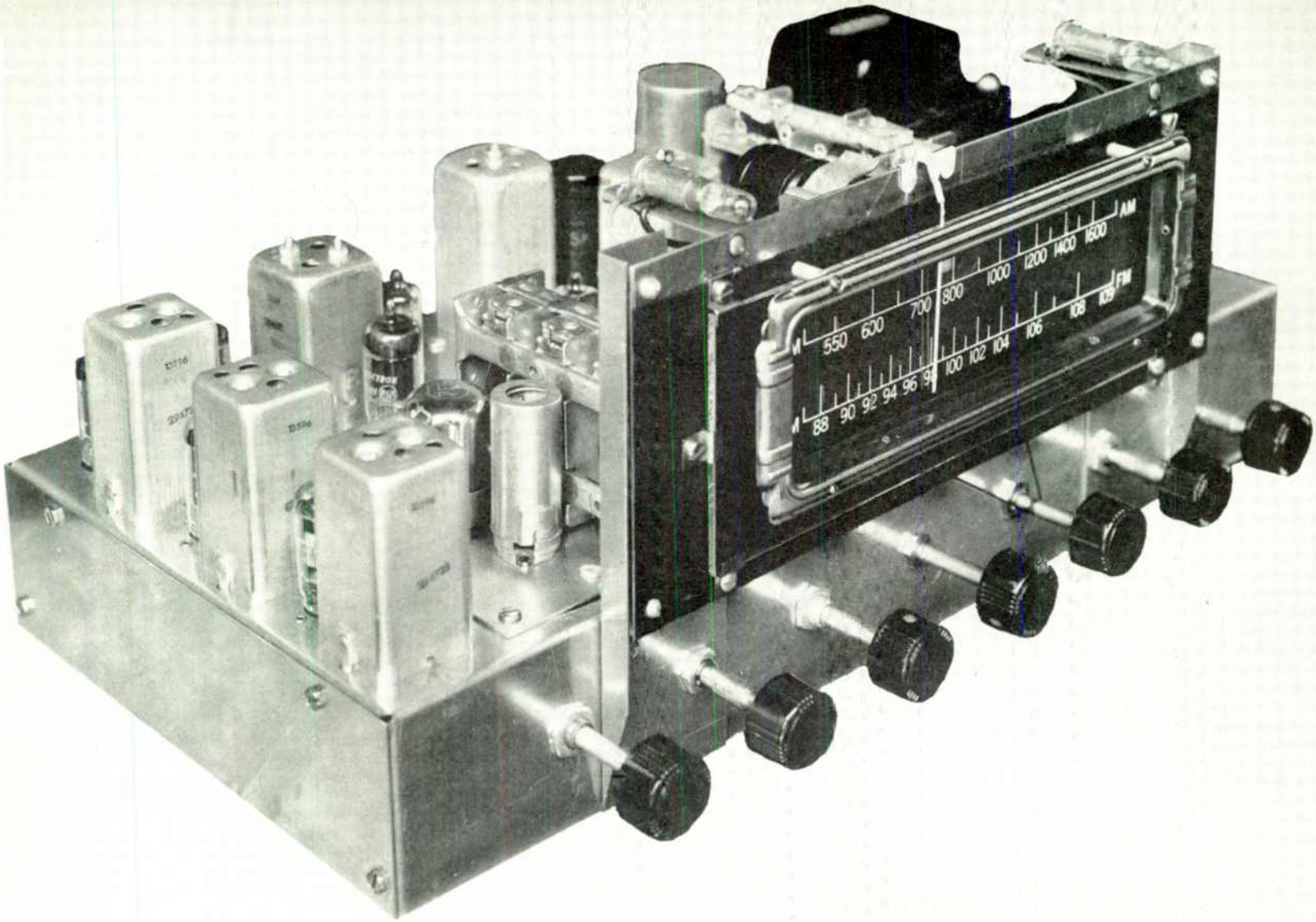
TV production in the first three months of '49 is just double the average for '48. For AM, March '48, was the highest month last year, and March has probably set the record for the current year, since there is no condition that would tend to sustain the demand. In March '48, AM totaled 1,420,000 sets, compared to 607,570 in March this year, a drop of 812,430, or 58 %.

The decline in FM was predicted here last month. Production of low-sensitivity FM sets has virtually ceased. Now, engineering of improved circuits is being pushed feverishly but is far from being completed. Meanwhile, in the high-sensitivity, low-priced brackets, Zenith has the field all to itself, and will undoubtedly make the most of this head start. Not one company that has featured low-priced AM models in the past has an FM or FM-AM set to compete with Zenith's series at $39.95, $49.95, and $59.95. However, these sets only began to show up in March FM production, and shipments represented only a trickle compared to the demand.

It is difficult to appraise the TV situation at this time. New markets are still being opened as more stations go on the air. In the 7 months since the freeze, 24 new stations have started operations, each creating an added demand for sets. But in areas where television is well established, dealers have overbought so heavily that most of them are in serious need of liquidating their inventories. However, the freeze has not affected total set production adversely, and the new allocations will be ready before all stations now authorized are on the air. Thus set production should continue to climb during the coming months.



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



IF YOU KNOW HOW TO GET IT—

As one of our dealers put it: "There's no demand for medium quality any more. People in my section want either the cheapest small sets or the best performance I can give them in custom-built jobs. Sure, I sell some AM table models, but my profit is in custom installations with BROWNING tuners."

Sales of BROWNING tuners are climbing week by week. Many are replacing out-of-date AM sets in fine old cabinets too good to be discarded. A great number are being fitted into furniture pieces. And in new homes, where economy of space is important, they are being arranged ingeniously in storage walls, closets, cupboards, and shelves.

There's the RJ-20, illustrated, to use where there is ample room, or the RJ-12A FM-AM and RV-10 FM models conveniently designed with separate power supplies, so they can be put in crowded spaces.

To get this extra-profit business, the first step is to have a BROWNING tuner on demonstration in your store, hooked up to an outside, non-directional antenna. Remember: when you're selling performance you must be ready to demonstrate it.

And when your prospects want quality performance, a BROWNING tuner with a fine amplifier, speaker, and changer will do your selling for you. *Get started today.* Send for a set of FMT-5 data sheets now.

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

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

TELEVISION NEWS

TV Tuners:

Transvision, Inc., New Rochelle, N. Y., has been appointed the national distributor for Du Mont Inputuners through jobbers and dealer channels. This unit, used in all Du Mont receivers, is a complete RF head-end, tuning continuously through the TV and FM bands.

Training Course:

Is being offered by G. E. in the principles and practice of TV receiver maintenance. The course, comprising 8 lessons, can be taken by correspondence or by group study methods. For information, address General Electric Tube Division, Schenectady, N. Y.

Another Line of TV Sets:

Federal Telephone & Radio is showing a line of 20 models at 137 Duane Street, New York. Using what is described as a simplified tuning system, the models range from a table set with 12½-in. tube at $425, to an FM-AM-phono model with a 15-in. tube in a breakfront cabinet at $1,795. All have FM reception, but only two have AM. One table type has a 15-in. tube and FM at $525. Another is coin-operated.

Price-Cutting & Trans-shipping:

Du Mont is shopping dealers to check price-cutting. This practice, and supplying Du Mont sets to unauthorized dealers, will be dealt with "summarily," according to a notice sent to all franchised retailers.

Anti-Clouding Feature:

Motorola TV sets are now provided with an air-tight rubber seal between the tube face and safety-glass window. Purpose is to prevent sweating or clouding on the tube during damp weather.

TV Studios and Offices:

WOR-TV has purchased the New York City block bounded by Broadway, Columbus Avenue, and 67th and 68th Streets. This is to be the site of a new television center. No announcement has been made as to when construction will start.

Remote Control:

New RCA model 9PC41 projection receiver has a remote control for brilliance and contrast. This offers the advantage of permitting adjustment from the point where the screen is actually viewed, rather than at the set itself.

NEW CATALOGS & DESIGN DATA

THE products listed here are described in new catalogs and bulletins now available. Unless otherwise noted, they will be sent on request without charge.

Relays and Accessories: Data on a wide range of relays and timers is presented in a new catalog, grouping various types according to their functions. *Struthers-Dunn, Inc., 150 N. 13th St., Philadelphia.*

Sealed Transformer Cases: New transformer case of mu-metal has hermetically-sealed terminals designed to meet JAN-T-27 specs. Ceramic bushings, small enough that 10 can be used in a case cover 1¾ ins. in diameter, withstand temperature changes, entrance of moisture, mechanical fracture, and potentials up to 1,000 volts. Available to manufacturers of military and commercial equipment. *Chicago Transformer Division, Essex Wire Corp., 3501 Addison Ave., Chicago 18.*

Technical Books: Catalog of 20 pages describes 47 books on radio, audio, and electronic theory, practice, design, and equipment. Of these, 18 are new books or new editions. *John Wiley & Sons., Inc., 440 Fourth Ave., New York 16.*

Twin Tetrode for Mobile Service: GL-5670 is 9-pin miniature type, designed for long life under mobile service conditions. Gold-plated grids and modified heater withstand effects of repeated on-off cycles. Factory test run of 50 hours reduces early failures in service. Heater takes .35 ampere at 6.3 volts AC or DC; plate, 300 volts maximum. *General Electric Co., Tube Division, Schenectady, N. Y.*

Dynamotors for Mobile Use: Design data, mechanical details, and performance charts for dynamotors, Magmotors, and Genemotors for all types of mobile transmitters are given in a 24-page bulletin. *Carter Motor Co., 2641 Maplewood Ave., Chicago.*

25-Watt Amplifier: Enclosed unit has detachable preamplifier which can be used as remote control. Adjustments are provided for frequency cutoff, bass and treble boost, volume, and 2-position input. Response rated flat within 1 db from 40 to 20,000 cycles. Output impedances are 4, 8, 16, 250, and 500 ohms. *Rauland-Borg Corp., 3523 Addison St., Chicago.*

Small Voltage Regulator: Rack mounted or cabinet type has 2 KVA output adjustable from 110 to 120 volts, with 3 seconds recovery time on input excursions from 95 to 135 volts. *Superior Electric Co., 3 Hannon Ave., Bristol, Conn.*

FM-AM Signal Generator: Moderate-price type for servicemen covers 80 kc. to 120 mc. in 7 bands. Designed for aligning FM sets by the point method, or with an oscilloscope. Harmonic output permits use on 120 to 240 mc. *Sylvania Electric Products, Inc., 500 Fifth Ave., New York 17.*

Antennas for Amateur Radio: A manual of design and construction of antennas for amateur communications. 288 pages, 831 illustrations, paper cover 6½ by 9½ ins. Price $1.00 published by the *American Radio Relay League, W. Hartford, Conn.*

Klystron Supply Unit: Provides adjustable regulated voltages, and CW, square-wave, saw-tooth, and external modulation for such klystron tubes as the 2K39-44 and QK-140-142 series. Circuits are carried on two rack-mounting panels. *Polytechnic Research & Development Co., 202 Tillary St., Brooklyn 1.*

Resistance Bridge: Compact, inexpensive design of high precision combines Kelvin range of .001 to 11.11 ohms, and Wheatstone range to 11.11 megohm. Accuracy is plus or minus .3% to .1 megohm and 2% at higher values. Built-in galvanometer has sensitivity of 1 microampere per division. *Shallcross Mfg. Co., Collingdale, Pa.*

Materials and Components: Dealers' catalog lists RF cables and connectors, polystyrene sheet, rods, and tubes, cable connectors, sockets, FM and TV antennas, masts, insulators, and accessories. *American Phenolic Corp., 1830 S. 54th Ave., Chicago 50.*

Random Noise Generator: Source of noise conforming to "noise of a general character" specified by ASA, for research and production testing. RF range is 30 to 500,000 cycles; AF range 30 to 20,000 cycles. Type 810-A. *H. H. Scott, Inc., 385 Putnam Ave., Cambridge, Mass.*

Audio Amplifiers: Two types, designed for exceptionally high efficiency, rated at 15 and 50 watts output with noise down 85 db. Units plug into rack mounting. Output 500 ohms balanced, or 4, 8, 16, and 32 ohms balanced or unbalanced. *McIntosh Engineering Lab., 710 14th St., N. W., Washington, D. C.*

Data on Converters: Bulletin 349 contains 16 pages of electrical and mechanical specifications on converters of various capacities for mobile communications, TV, recording, and sound projection equipment. *Carter Motor Co., 2641 N. Maplewood Ave., Chicago.*

Rotary Switches: Designed to meet high-quality specifications of broadcast, communications, and laboratory equipment. *Daven Co., 191 Central Ave., Newark, N. J.*

TV Replacement Transformers: Bulletin lists data on 15 types of transformers including a new horizontal output transformer, designed as replacements for the leading TV receiver models. *Standard Transformer Corp., Chicago 18.*

Interpolating Frequency Standard: For use with heterodyne frequency meters on measurements up to 3,000 mc. Using a frequency meter accurate to .1%, overall accuracy of measurements is improved to about .001%. Type 1110-A *General Radio Co., Cambridge, Mass.*

Coaxial Switches: Manual or remote-controlled solenoid drive, designed for RG-8/U and RG-11/U cable, with type N connectors. Single-pole types, with 2, 3, 4, or 6 positions. Standing-wave ratio rated at less than 1.25 to 1 and cross-talk attenuation not less than 60 db at 3,000 mc. *Designers for Industry, 2915 Detroit Ave., Cleveland 13, Ohio.*

THIS MONTH'S COVER

The usual small reproduction is missing from this page because, although we were able to get the data on the new communications channels in time to set it up for the front cover, there wasn't time to make the plate which appears customarily in this space. However, the important thing is the news that the revision of the communications frequencies has been completed.

There may be some complaints. So many different operators in such a large number of services are involved that it would be impossible to please everyone. But the total job is highly constructive in its end result, and will release a flood of applications for licenses and orders for equipment such as the industry has never seen before. Particular rejoicing will be heard among the taxi companies for, if they seek through co-operation and co-ordinated planning to use their frequencies to best advantage, they will have ample spectrum space to operate with greatly increased efficiency.

Also, as announced on page 9 of this issue, a related service, citizens radio, will soon be given the green light. Altogether, the remainder of 1949 will see the communications business at a new level of activity, expansion, and prosperity.

WHAT'S NEW THIS MONTH

1. The broad impression we carried away from the April NAB Convention in Chicago can be expressed in a single sentence: The greatest problem faced by management today is to make profitable use of the achievements of engineering. In other words, the physical means are at hand for better audio and video services, but before they can be made available to the public, difficult and complicated questions of application and finance must be solved.

Thinking back on the subjects discussed at the NAB meetings, it seems as if the individual problems of receivers, transmitters, station plans and policies, time sales, and programming are so great that no one person is able to comprehend them all, and to organize these separate factors into a coordinated activity. As a result, the timing of effort and progress in the separate departments creates conflicts that are frequently aggravated by management policies.

By all convention standards, the week-long NAB session was highly successful. The smooth manner in which the events clicked off was a credit to those responsible.

But an examination of the proceedings gives emphasis to the cleavage that exists particularly between engineering and management. Witness: From Wednesday to Saturday, the engineers took over. Twenty-six important technical papers on TV, FM, and audio facilities were delivered by some of the ablest men in the industry, representing consultants, manufacturers, and broadcasters. Then all the engineers went home. After they left, the management and sales group took over for four days. And what did this group talk about? Well, one of the principal speakers extolled the virtues of our democratic American system of broadcasting; another, who had previously urged AM operators to get into FM, held forth on the losses sustained in 1948 by FM and TV stations; and one promised that no tyrannical dictators will be able to hush the voice of radio. Other, more specific addresses, were concerned with such subjects as news reliability, public relations, department store advertising, and time sales promotion.

The foregoing is not a complaint against the conference agenda. It is only offered to illustrate the complete separation that exists between thinking on the part of management and engineering. Yet management must serve, if you please, as the medium through which technical advances are made available to listeners and sponsors alike.

This situation may explain in part, at least, the feeling of apprehension as to the future which pervaded the management session. Some executives were concerned over the rate at which the capital investment in new technical facilities is exceeding any expectation of immediate returns. Others were worrying over the possibility that competitive conditions may call for capital investment beyond their resources.

Is there a broad plan of action that can be adopted to correct the basic cause of this condition? Probably not. It looks as if the whole industry must work its way through a period of uncertainty and insecurity until stability is restored by a leveling off of technical progress. It would be hazardous to predict the time required to reach that point. When the AM-FM problem is settled, the audio-

(Continued on page 9)

Special Services Directory

WHAT'S NEW THIS MONTH

(Continued from page 8)

video question must be met. Then there will be VHF vs. UHF, present picture standards vs. higher standards, and black-and-white vs. color. And through it all, the public must be pleased and the sponsors kept happy. No wonder that some of the starry-eyed newcomers are giving up construction permits!

2. Proposed rules for citizens radio service, issued last August, will be adopted as final on June 1, 1949. This opens up the use of 10-watt and 50-watt transmitters, operating on 460 to 470 mc., for communications on farms, industrial plants, building projects, and between construction camps and work crews. The equipment may be used at fixed points, carried by hand, or mounted in vehicles. Use is also authorized for the remote control of gates, doors, display signs, and model airplanes.

It should be noted that transmitters must be type-approved by the FCC. Licenses will be valid for a period of five years, and only the station license will be required normally for authorized operation. Under the simplified licensing procedure, no examination will be required. Applications will be filed on single card forms, soon to be available at FCC field offices and at the Washington headquarters.

Citizens radio is defined as a "fixed and mobile service intended for use for private or personal radio communication, radio signaling, control of objects or devices by radio, and other purposes not specifically prohibited." Operators will not be allowed to charge for messages, to carry broadcast programs, or to transmit directly to the public.

While the name suggests the personal use of pocket-type sets, it is generally expected that the principal application will be in business operations, industrial plants, and construction projects.

3. Broadcasting, both audio or video, is an extension of printed words and pictures. So there's a thought for all of us in the text of a recent advertisement from the John Hancock Mutual Life Insurance Company:

"He came a few boats behind the *Mayflower* and his name was Stephen Daye.

"He unpacked his types and his crude wooden press. And for the first time on American soil, a man with something to say could speak to other men beyond the range of his voice.

"He turned up in Philadelphia and his name was Ben Franklin, an ink-stained youngster getting out a newspaper. And then a farmer, home after the day's work.

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Professional Directory

WHAT'S NEW THIS MONTH

(Continued from page 9)

could learn what was going on in the world and in other men's minds.

"He worked behind bolted doors under the name of Bobbie Bell, printing the words of a ragged prophet called Paine. And out into the world went *Common Sense*, a little book that reminded Americans what they had here, and made them stand up to save it.

"He loaded his press on a Conestoga wagon and rolled west with the frontiersmen. He piled it on a dog-sled and followed the trail breakers to the Klondike.

"He was a laughing man named Mark Twain and an angry one named Horace Greeley. He was a poet, mechanic, teacher, scholar, wanderer, handyman, preacher."

"He's the American printer, and his press is the voice of a free people — free to speak up, free to listen, free to argue, free to agree."

We intend that *FM-TV* shall be one of the voices of a free radio industry, through which its members are "free to speak up, free to listen, free to argue, free to agree."

4. We're coming to think that the broadcasters' definition of radio programs is "something that makes a noise in people's homes." If that seems to be an exaggeration, just run over the dial tonight and see if you can hear any pleasant, agreeable sounds.

Is it possible that Hooperatings can be earned only by the yells and screams emitted on giveaway programs, by crooks who talk from the sides of their mouths, bands that play mostly on one's nerves, announcers who repeat and repeat unconvincing claims in tones that would get them tossed out quickly from any home or office, and the general run of harsh voices, discordant music, and strident sound effects which make up the current program fare?

We're probably all wrong, but we can't help wondering if these are the optimum techniques for gaining and holding the interest of radio listeners.

There seems to be some support for our side in the conclusions drawn from a study by Dr. Paul F. Lazarsfeld and Mrs. Helen Dinerman of Columbia University's Bureau of Applied Social Research. They report that there is a large and unfilled demand for programs that:

1. Cheer, soothe, and divert the listeners attention from their own troubles.

2. Specifically avoid annoying listeners with noise and aural stimulus, whether by tone of voice or type of music.

3. Employ an outstanding personality or distinctive program idea to insure

(Continued on page 11)

WHAT'S NEW THIS MONTH

(Continued from page 10)

day-to-day listening, rather than suspense and tension.

Perhaps this is asking too much of the breathless, wild-eyed sort of genius that rushes and swirls around the eyries where program plans are hatched. Or does it explain the demand for records and phonographs?

5. Engineering consultant Garo Ray, of Stratford, Conn., has a plan for reducing co-channel TV interference which offers interesting possibilities. He explains it in this way:

Channel 4, to take a specific example, is used in New York, Boston, and Schenectady. At points within the fringe areas of all three stations there is interference from one or two stations not intended to be received at those points. It is my opinion that such interference can be reduced considerably or eliminated entirely by the application of some frequency differential within a given channel. That is, the video and audio channels of WNBT New York might be left unchanged, but WGRB Schenectady shifted just below its assigned frequencies, and WBZ Boston moved up slightly. This would call for touching up receivers in the Schenectady and Boston areas, but such field adjustments are generally required for close-tolerance operation anyway.

We won't presume to comment on Garo Ray's suggestion, but we do know that he is making a thorough study of TV interference, and specifically of the offset-frequency method of reducing it.

6. In a report on Dow-Corning No. 200 Silicone Fluid for coating ceramic sockets, Amphenol engineers list these the advantages of the silicone film:

1. It provides a water repellent surface.
2. Is effective up to 150° C.
3. It does not collect dust.
4. Withstands normal handling and cleaning. It adheres effectively to the ceramic piece even when immersed in sea water for days.
5. Causes the surface moisture to break up into isolated drops, preventing a continuous film of moisture and maintaining high surface resistance under moisture condensation conditions.
6. Improves corona and flashover levels.
7. Has a power factor of the order of .005 and a low dielectric constant over a wide range of frequencies.
8. It is non-corrosive.
9. Is not removed by contact with organic solvents.
10. It is inert and provides no nutrients for fungus growth.

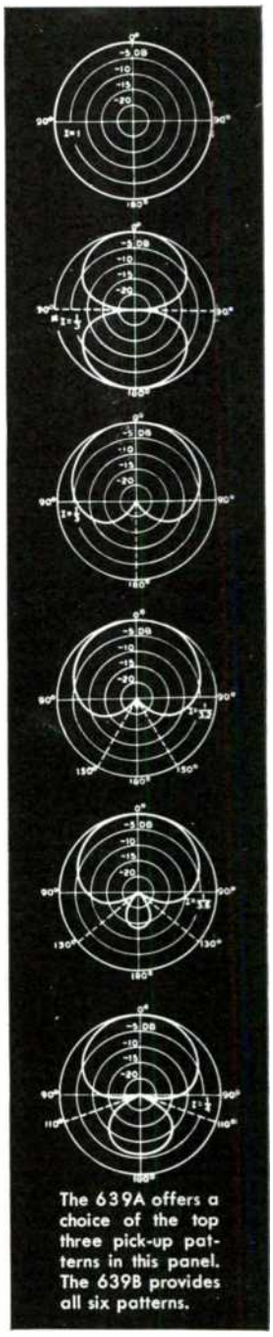
639 TYPE CARDIOIDS ARE BETTER FOR

AM-FM-TV

***BETTER** Front to Back Discrimination*
***BETTER** Signal to Noise Ratio*
***BETTER** Frequency Response*

The popular Western Electric Cardioids deliver quality performance —are attractive in appearance. The 639A offers three pick-up patterns, the 639B provides six. They are ideal for any pick-up assignment in AM, FM or TV. For immediate delivery, get in touch with your local Graybar Broadcast Representative, or write Graybar Electric Company, 420 Lexington Ave., New York 17, N. Y.

—QUALITY COUNTS—



The 639A offers a choice of the top three pick-up patterns in this panel. The 639B provides all six patterns.

Distributed by Graybar — Offices in 100 Principal Cities

Western Electric

DISTRIBUTORS: IN THE U. S. A.—Graybar Electric Co. IN CANADA—Northern Electric Company, Ltd.

BETTER MOBILE RADIO SERVICE

COORDINATED PLANNING UNDER EXPERT GUIDANCE IS NECESSARY IN ORDER TO SOLVE MOBILE RADIO INTERFERENCE PROBLEMS—*By* JEREMIAH COURTNEY*

IT is common knowledge that the last few years have witnessed a phenomenal increase in the use of two-way radio systems for operational communication purposes. One only needs to check the directories of communications systems in *FM-TV* to realize this.

Peculiarly enough, however, the very rapidity of this growth has operated to obscure the need for putting increased reliance on competent engineering and legal advice, and in keeping abreast of technical and regulatory developments. Manufacturers have been so busy filling the postwar demands, and new applicants in getting into radio use (and often a position of equality with competitive radio-equipped operations) that insufficient time has been given to questions of systems planning, coordinated cost-sharing operations, and various other ways of making the best use of the available frequencies.

Utilization of Channels:

This initial lack of proper systems planning may seriously limit the effectiveness of almost any two-way radio communications system today. For there is no escaping four fundemental facts of life in the non-broadcast sphere. The first of these is that the supply of mobile frequencies is vastly less than the demand. Commissioner Frieda M. Hennock put it succinctly, if humorously when, after hearing the recent oral argument of all claimants to the mobile service band of 152 to 162 mc., she dryly observed that there was no longer any doubt as to the most popular band in America: "Everybody wants the 152- to 162- mc. band."

Second, frequencies in the non-broadcast services are not assigned on an exclusive, interference-free basis. Instead, a block assignment of frequencies is made to all users of a certain class who must then share the available frequencies.

Third, unlike the AM, FM, FAX, and TV broadcast services, the non-broadcast radio services operate without benefit of any separate FCC engineering standards. In consequence, problems of adjacent channel interference and spurious emissions are greatly aggravated.

Fourth, the principal band assigned for mobile radio service use, that from 25 to 50 mc., is subject to destructive, long-distance skip interference. Excluding aeronautical assignments, the only presently-available mobile radio service band above 25 mc. that is not subject to skip interference is between 152 and 162 mc. This single characteristic alone accounts for its new-found popularity.

Add these four fundamental facts together—a shortage of mobile frequencies, necessity of sharing available frequencies, an absence of detailed FCC engineering standards for the equipment, and the possibility of destructive long-distance interference on most of the frequencies employed for mobile communication purposes—and you have an imperative need for highest-grade systems engineering.

Why Coordination Is Needed:

With a few notable exceptions, mobile systems are generally installed without benefit of any independent engineering advice. The present confusion is the logical result. It was described graphically by the general manager of the Boston Cab Company before the FCC in tracing his experiences from the time the Company enjoyed an exclusive channel to the time it shared that channel with 20 different cab companies in the same Greater Boston area:

"The Boston Cab Company installed two-way radio, in September 1946. We started with an experimental group of 15 units. The results were most satisfactory in providing better service to the public, particularly during the rush periods. For several months we enjoyed a clear channel; then a cab operator in the neighboring city of Cambridge, across the river, installed 6 or 7 units. With the total of only 22 units, it was possible to cooperate. By making our messages very brief and allowing the other operator on this party line to give his message, we got along very well.

"As a result, our enthusiasm became very high. We bought more radios ourselves and told other cab operators this wonderful new tool was the greatest advance in the taxicab industry since motor cars replaced horse-drawn vehicles. Perhaps we would have been wiser in telling them that it was a complete failure because then we would have continued to enjoy a clear channel.

"The pioneers of this development are frank to admit that their own enthusiasm for two-way radio spread like wild-fire, and within the year we began to realize that interference of the various base stations with each other as well as with the mobile units increased the length of time to transmit an order, and that because of repetition we were losing the time which we originally saved.

"The Boston Cab Company has a total radio investment of $40,000. The radios might as well be in the stock room in the garage as in the taxicabs today. The interference is so great that it is impossible to transmit a message during the busy period when 20 base stations and the 250 mobile units are all trying to talk on the same party line. It is true that it is possible to transmit a message during the quieter periods of the day and night, but the radio was installed to take care of the public during periods of excessive demands."

Better Service, Less Cost:

The taxicab service, to which only one channel had been made available so far, represents an aggravated situation. But there is little doubt that coordinated systems planning, even in that case, could have reduced the present taxicab interference. More important, this kind of planning will do much to safeguard the value of such additional channels as may ultimately be assigned to the taxicab service, through such obvious engineering measures as proper location of base stations to minimize adjacent channel interference, the use of directional antennas, and reduced power and lower antenna heights to minimize present co-channel interference without sacrifice of needed coverage.

The possibilities for coordinated service for several users from a single land station have been but barely scratched.

Bus Lines Cooperate:

One notable exception is found in the intercity bus industry. A half-dozen intercity motor bus carriers operating into the Chicago area are today taking service from a single land station of the communications organization, National Bus Communications, Inc., formed for that purpose. Results from a service and frequency-conservation point of view have been so gratifying that the Commission's proposed Intercity Bus Radio Service Rules specifically provide:

"16.202 COOPERATIVE USE OF FACILITIES. Only one base station will be au-

(Continued on page 30)

*Courtney, Krieger and Jorgensen, 1707 H Street, N.W., Washington 6, D. C. EDITOR'S NOTE: Mr. Courtney was the first Assistant General Counsel to head up the FCC Safety and Special Services Division. He has had an active part in the progress of mobile communications, and has made important contributions to the expansion of this service.

The opportunity of getting experience in actual broadcasting has developed the keenest interest among the students at Beloit

FM AT BELOIT COLLEGE

PROGRAMMING FOR CAMPUS SYSTEM IS EXTENDED BY HOOKUP WITH STATION WBNB—*By* DAVID MASON*

BELOIT COLLEGE has contributed a new angle to broadcasting by educational institutions. Since last fall, when almost one-tenth of the student body tried out for positions on the campus system by which programs are piped to the dormitories, an exchange arrangement has been worked out with FM station WBNB. That is, the campus system carries a number of WBNB features and, in turn, WBNB airs programs originating in the college studio.

This plan gives the students the opportunity of getting experience in all phases of broadcasting. Under the direction of speech professor John M. Clark, the students practice script writing, devise their own sound effects, learn the mechanics of studio operation and, as a part of their regular class work, they produce and act a regular weekly show on WBNB.

As the illustrations show, complete studio facilities have been set up in the basement of the music and dramatic arts building. In addition to a studio of ample proportions there are an office and reception room and a fully-equipped control room.

Senior Dave Hanaman is sports announcer. Another senior, Paul Yaeger, college dramatic star, is a regular WBNB newscaster, besides conducting his own man-on-the-street program and several disc-jockey shows. The most popular show with the off-campus listeners is the Thursday night program of the Beloit College Radio Players. Classical as well as modern plays and original scripts are produced on this half-hour show, for which the students handle all the directing and details of production.

Another popular program is the Sunday vesper service from the Chapel. Distinguished guest speakers are featured, with the 80-voice college choir directed by Dr. Sumner Jackson.

WBNB is currently taking the lead in establishing a network of FM stations to include Dubuque, Iowa, Freeport and Woodstock, Illinois, and others in Milwaukee and the north shore suburbs of Chicago.

As this plan materializes, listeners in all the cooperating areas will be treated to an exchange of the best features originating in the group. A number of Beloit College programs will have regular spots on the network. WILA, Woodstock, already takes the dramatic and musical programs regularly. Other stations which have expressed an interest in the plan are WFJS, Freeport, KDKH-FM, Dubuque, WEAW, Evanston, and WKRS, Waukegan. The first two are exchanging programs regularly with WBNB now.

In boosting the proposed off-campus broadcasting, college officials point out that it covers an area where such a large percentage of young people plan to attend college. Thus it is an ideal public relations medium, since it covers the natural geographic area from which to draw students for the college.

Also, reports from listeners who hear the Beloit College programs over WBNB show that the campus studio is providing an excellent means of maintaining contact with the alumni.

Beloit College has provided complete studio facilities for student productions

*Beloit College Radio Workshop studio, Beloit, Wisconsin.

THE FMA SALES CLINIC

THE INDUSTRY LOOKS AROUND THE CORNER TO SEE WHAT FURTHER PROGRESS FM MUST MAKE BEFORE IT CAN REPLACE AM FOR AUDIO BROADCASTING SERVICE

COMPARED to the NAB conference in Chicago last month, FMA's one-day clinic at Hotel Commodore, New York, on April 1 seemed like a vest-pocket edition. There was one important difference, however. Broadcast station management represented at NAB seemed a little old, tired, uncertain, querulous, and discouraged. At FMA, the atmosphere was that of confidence and certainty. True, the FM'ers have a long way to go. But they know they have a better means of audio broadcasting. Given just a little success, just a little encouragement in the form of profit they can plow back into their operations, and they can make short work of AM.

The Transmitter Situation:

That encouragement may be coming, too, but from a source they haven't counted on. Right now, warehouses are bulging with high-power FM transmitters manufactured on firm orders, yet gathering dust because the customers don't want to take it "just yet."

Why not? For the simple reason that the transmitter manufacturers are too busy on television receivers to give any large-scale support to FM broadcasters through the promotion of high-sensitivity FM sets.

As the situation stacks up right now, some $1.5 million tied up in undelivered transmitters are going to stay tied up unless and until more companies join Zenith in building sets that give the kind of reception the public expects on FM. The dealers have been explaining away the poor performance of insensitive sets, generally installed without outside antennas, by saying: "The stations are still operating on low power. When the transmitters are perfected so they can use full power, you'll get good reception. In the meantime, you can tune to the AM stations." That story has come home to rest on the doorsteps of the transmitter manufacturers. And it's beginning to hurt.

National FM Coverage:

Also, there is a strong feeling that the RMA passed up the FM broadcasters when its last campaign for A Radio Set in Every Room was directed primarily to pushing AM receivers. As Everett Dillard pointed out: "More than 100,000,000 persons live within the primary service range of existing FM stations. This is better than two-thirds of the population of the United States." So there is no lack of programs to support large-scale efforts to promote FM set sales.

Still, millions of people listen patiently to whatever they can get on AM, not knowing that network and independent programs are available, day and night, free of noise, free of fading, and free of interference.

Ted Leitzel, of Zenith Radio, discussed this in great detail. Here are some of the highlights of his address:

Ted Leitzel's Report:

In November, 1948, Zenith decided to break with traditions and increase FM set production in January, rather than cut back sharply as you who follow production figures know the rest of the industry did. From where we sat, it seemed as if FM was in a somewhat precarious position, teetering in the balance, as it were, with many broadcasters hanging on the ropes, and advertisers ignoring the wonderful new coverage that FM gave them in many areas. We also believed that it would not take much of a nudge to push FM over the top, and put it on a solid base from which it would inevitably expand to become the great medium that its superior qualities should make it. So we scheduled new high levels of FM production, and launched our campaign in January.

We proceeded on the basic proposition that it was just as much in the broadcasters' interest to promote the sale of our sets as it was in our interest to promote the various FM stations. On January 10, I wrote to every FM station in the country, giving a broad outline of our plans, promising adequate production to back up worthwhile promotions, pointing out that we were not asking for a free ride but were, instead, planning to use all promotional tools including newspapers, AM, and FM, and asking their help in getting things started.

Selling Sets to Build Audiences:

The great majority of the replies I received from FM stations were filled with wholehearted approval. Some wrote and broadcast news stories based on my first letter; others sent their advertising salesmen out to arouse dealer enthusiasm; most of those with newspaper connections began or expanded their own publicity programs.

We sent to our distributors copies of every letter that went out, urging them to get in touch with stations in their territory, just as we urged the stations to contact our distributors. Then things began to happen, and almost overnight we found ourselves in the midst of an amazingly effective, grass-roots campaign. Within a month, our entire concept of FM broadcasting began to change. Today, our various distributors are running, or are preparing to launch, more than 100 promotion campaigns, and our activity has just begun.

As a by-product of these promotions, we have already established two fundamentals of great interest to anyone who is considering the use of FM as an advertising medium. The first is that there are already areas in these United States where FM stations with alert, promotion-minded management represent a better buy for advertisers, and will do a better job for them, than AM stations in the same cities. I stress the need for alertness and promotion by station management because FM is still so young that a station without this kind of management is not likely to have any substantial share of the FM audience. Also, where there is no consistent FM station promotion, there is seldom a large concentration of FM sets, and many owners of FM-AM receivers do not use their FM bands.

The second fundamental, of equal importance, is that advertisers who buy network time without valuing above AM the FM outlets he gets for little or nothing is just as crazy as a silver miner who throws away his by-products of gold and platinum.

Facts about FM and AM Coverage:

Let's forget all about AM coverage as it appears on the maps, and consider the facts that the maps don't show. Here's one that few time-buyers and agency executives know:

In roughly half the area within 250 miles of mid-town Manhattan, the majority of the people cannot get enjoyable radio service after dark except on FM receivers. There are thousands of square miles within this area where there are no primary AM signals at all, but these sections are well served by FM.

Would you believe that one of our dealers within 200 miles of New York City jammed traffic in his town last month by putting a radio set outside his store and tuning it to an FM broadcast of an important local basketball game? The same thing is happening over and

over again in many sections of the country. During the last World's Series there were large sections of the Ohio Valley where good FM sets brought black market prices. Throughout the baseball season last year, supporters of the St. Louis Cardinals and the Cincinnati Reds kept our dealers perpetually out of stock on good FM sets. Why? Because FM gave them their only dependable, static-free reception of the baseball games.

Had you been with me during an automobile trip I made last February from Chicago to Dallas, or on some more recent week-end jaunts through Wisconsin, Indiana, and Illinois, you would throw away your AM coverage maps, for you would have discovered that in many areas you must use FM. My car was equipped with an FM demonstration rig, designed by our engineers for the use of FM station executives, for listening to FM on a standard household type of set installed in my car. Mind you, the area I traveled has a much lower saturation of FM stations than the sections east and south of Chicago, and this was in February, weeks before summer static gets down to business. Even so, the results were startling.

I drove through one stretch of nearly 200 miles where the only way I could hear two of the major networks was by FM. In one considerable area I could get no network programs at all on AM, but I heard one perfectly on FM. On one long highway that curved in a great semicircle around a city where AM programs were duplicated on FM, I held good FM reception for 150 highway miles, but there was intelligible reception from the AM affiliate over only 60 highway miles. In another case, I heard an FM station in three states, but never did get close enough to pick up the AM outlet.

Even powerful AM stations are in many cases finding that they get better coverage with FM than with AM. I talked recently to one broadcaster who, through the years, has seen the service area of his AM station shrink as a result of rising interference. He has now increased his FM power until its coverage surpasses his AM transmitter, and is equal to the AM coverage he had years ago, when there were few AM stations on the air.

Promotion Is a Local Matter:

We have found that promotion of FM is distinctly a local proposition. One pattern develops where the chief advantage of FM is its vastly superior quality of reception; another where good FM management provides distinctive, exclusive programs. Have you, for example any idea of what a sales force FM reception of the standard network programs can be in many large sections of the country? Or how many people buy FM sets in order to hear local broadcasts of high school sports events?

Good FM Sets and Bad Ones:

Unfortunately, there are many FM sets in the stores that are so deficient in sensitivity, tone quality, and freedom from noise that they are no better than the cheapest AM receivers. These contraptions do no good for FM's reputation. I do not mean to give our products a sell, but this picture of FM will not be complete without a brief discussion of quality. I referred to the large number of so-called FM sets that will receive FM if the signal is strong enough, but are deficient in the major advantages. These sets have given FM a black eye in many areas. They have no appeal for those who want good tone quality, and in areas at some distance from stations, their low sensitivity and inability to suppress noise make them a liability to FM broadcasters.

Facts about Sensitivity:

When we tested 16 competing makes of FM sets, we found they had an average sensitivity of 106 microvolts, and some were worse than 200. That means that, on the average, these sets required a signal strength of 106 microvolts to give acceptable reception.

There is no more reason for building sets like that than there would be to power heavy automobiles with motor cycle engines. We run a continuing spot check on FM sets we produce, and have no difficulty in maintaining an average of 30 to 35 microvolts, which is three times as good as the industry average. There is no magic about it. Any Armstrong licensee who realizes the importance of high sensitivity can do the same.

The new FM set we have just announced is going to bring about a revolution in the industry. This little set has better than three times the sensivity of our present models, and better than ten times the average sensitivity in the industry. Moreover, this high sensitivity is now being put into most of our line of FM-AM receivers.

Why Sensitivity Is Important:

Out in the fringe areas of a station's coverage, this added sensitivity will improve reception as much as would a ten-fold increase in the station's power. If you compare this sensitivity on the same basis with sets of 106 microvolts rating, the figures seem fantastic. Its fringe-area reception from a 1-kw. station will be as good as the other sets would deliver from an otherwise identical station with a power of dozens of kilowatts.

Here is what this progress means to the broadcasters and advertisers: FM is already beginning to come into its own at such a rate that other manufacturers will soon be out there fighting for a share of the growing market. In order to compete, they are going to demand that their engineers produce sets capable of competing with ours. Soon we manufacturers will be in a competitive free-for-all that will hasten the day when FM becomes the dominant system of aural broadcasting.

There Are Changes Ahead:

Time-buyers are going to revise their yardsticks. Instead of measuring in terms of primary AM coverage they are going to think of the much larger, better coverage that FM delivers.

Is it not better to buy certain coverage of 10,000 square miles where only one home in four has an FM set, than to buy uncertain coverage delivered by a low-power AM station over a few hundred square miles?

Linnea Nelson's Report:

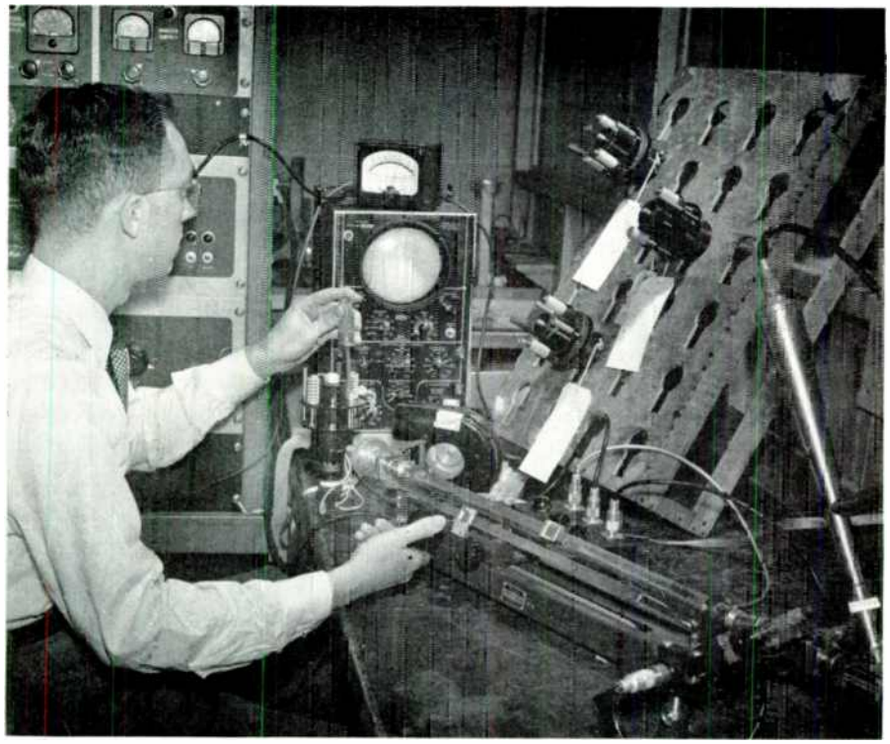
There's a lot of work to be done before the time-buyers see eye to eye with Ted Leitzel. This was made clear in a very interesting address by J. Walter Thompson's Linnea Nelson. While her remarks disclosed the fact that there are many things that time-buyers don't recognize about the deterioration of AM coverage, and a great many more that the AM salesmen claim which might be properly challenged, it is still true that the pattern of agency thinking has been built around statistical data that can be put into charts and graphs or marked on maps for presentation to clients.

These are the tools of the advertising agency business. As Miss Nelson pointed out, the FM stations have not supplied them. Network stations could, but then they would discredit their AM bread and butter. Independent stations haven't, partly because they lack the necessary research staffs, and partly because even complete data would not present a picture strong enough to be convincing at this time. Miss Nelson said in part:

Agencies Must Have Data:

Let me assure everyone right now that the advertising agency is never in a position to avoid the use of any medium that will be profitable for its clients. I emphasize this because any number of people who have come in to talk with us about the use of their FM facilities seem to assume right from the start that we are against FM. More FM station owners have asked me how they should sell and operate their new acquisitions than have told me how my clients could

(Continued on page 36)



Setup for checking the performance of the SRL-17 reflex klystron tubes

KLYSTRONS FOR FM

THE SPERRY SRL-17 FOR FM TRANSMITTERS AND RECEIVERS ON 920 TO 990 MC.—*By* WILLIAM HENDERSON*

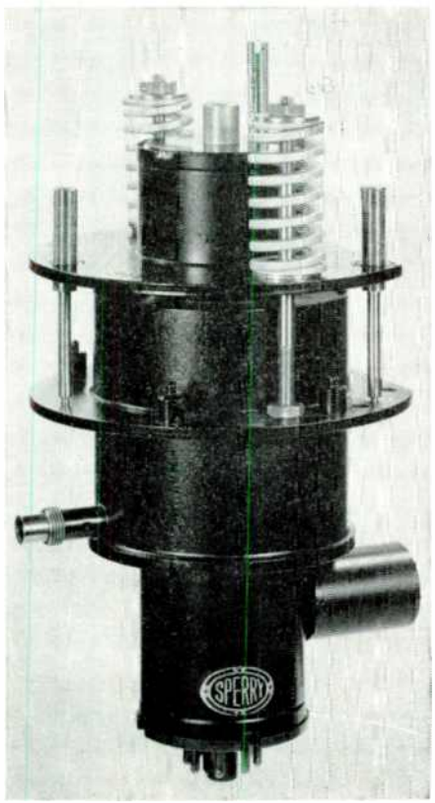
KLYSTRONS, originally a secret invention responsible for many microwave developments in World War 2, have become an important tool of the modern broadcasting industry. Since the war, new klystrons have been developed expressly for commercial applications, because of their advantages over other tubes for microwave relay transmission. Their production in quantity by the Sperry Gyroscope Company marks Sperry's departure from strictly military development. Of the new, commercial applications of klystron tubes, those related to microwave relay links for FM, TV, and message traffic show the fastest rate of development. Transmitting types of reflex klystrons are receiving the bulk of present-day attention in relay links.

Most recent of the new klystrons to earn acceptance in the broadcast industry is the SRL-17 reflex oscillator, Fig. 1, used in Federal Telephone & Radio Corporation's new microwave relay link for FM studio-to-transmitter service. This tube is used both as the transmitter power oscillator and the local oscillator of the receiver. It was chosen for this service because of its availability, inherent frequency stability, and ease of modulation and tuning-characteristics applicable to klystrons in general.

Design of the SRL-17:

Klystron is the name given to a family of tubes that use one or more cavity resonators and employ velocity modulation. Klystrons are made with one, two, three, and even six resonators. They can operate as amplifiers, oscillators, or frequency multipliers, and are used normally at frequencies between 750 and 30,000 mc. They can be modulated as to frequency, amplitude, or phase, and can operate in CW or pulse service. Power outputs range from a few milliwatts to several hundred watts.

*Director, Industrial Department, Sperry Gyroscope Company, Great Neck, Long Island, N. Y.



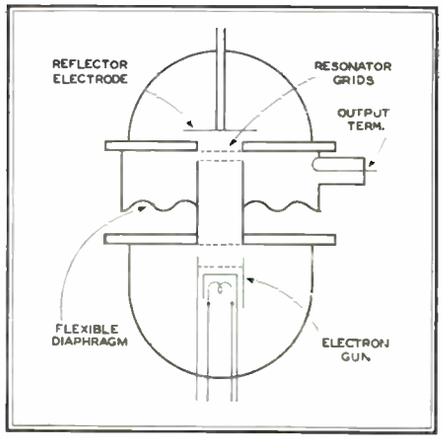
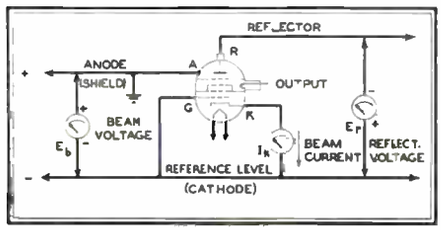
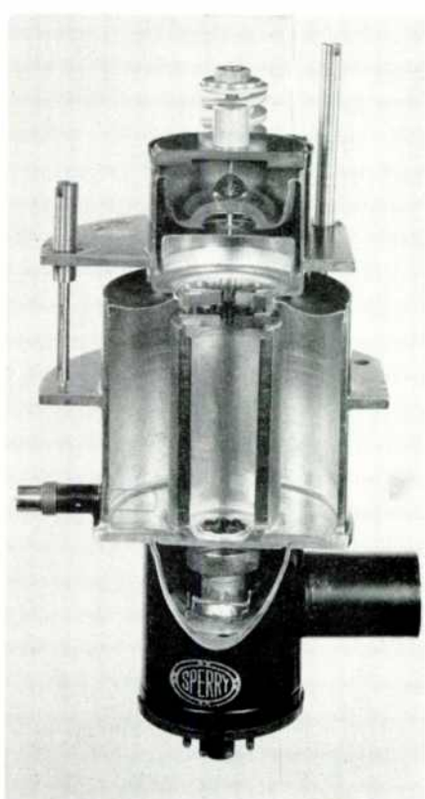


Fig. 1, left: The SRL-17 reflex klystron. Fig. 2, right: Interior construction. Fig. 3, above: Simplified cross-section: Fig. 4, below: Electrode voltages required





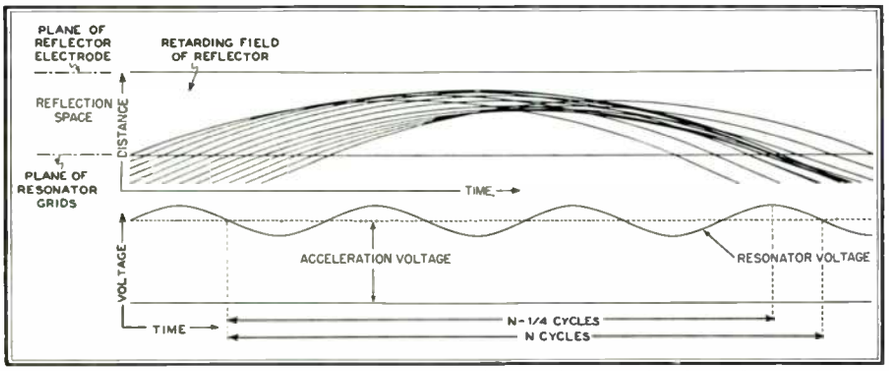


Fig. 5. Illustrating the space-time trajectories of electrons in the reflector field

Types that employ only one resonator, like the SRL-17, are called reflex klystrons. They operate only as oscillators, and produce moderate amounts of microwave power. The SRL-17 operates at frequencies between 920 and 990 mc., and can deliver 3 watts CW output.

The SRL-17 resonator, shown cut away in Fig. 2, is tunable to any frequency between 920 and 990 mc. The *Q* of the resonator is 500, as high as that of a good search wavemeter. The bottom of the cylindrical cavity resonator is folded upward to form a central tube within the cavity. This gives the cavity a reentrant shape, the resonator being formed by the space between two concentric cylinders. Holes in both ends of the central tube and the top of the resonator permit an electron beam to pass. These holes are provided with fin-shaped grid structures. The grid at the bottom of the resonator functions only to accelerate and focus the electron beam. The two grids spaced closely at the top of the resonator form a gap that is essential to operation of the tube.

In addition to the resonator, other essential parts of the reflex klystron, Fig. 3, include an electron gun, like the kind used in a cathode-ray tube, producing a focused electron beam of uniform velocity, and a negatively-charged reflector electrode which decelerates and reflects the beam back towards the resonator again. The accelerating field for the beam is provided by a positive voltage on the shell or anode, of the tube, Fig. 4. As the electron beam passes through the resonator, the velocity of the electrons is modified slightly, or modulated, by the RF voltage on the two grids that form the gap at the top of the resonator. Electrons passing these grids are alternately speeded up and slowed down in phase with the RF cycle of the resonator.

Beyond the resonator, the retarding field of the reflector electrode reflects the beam back towards the resonator gap. As a result of their differing velocities, the electrons in the beam crowd up and form bunches during their transit time in the reflector field as shown in Fig. 5. When the strength of the reflector field is adjusted to one of the necessary values, the bunches reach their maximum density at the time they arrive back at the resonator gap. If the phase of the RF voltage across the resonator gap is such that the bunches are slowed down at their time of arrival, then the bunches will transfer some of their energy to the resonator. Part of the kinetic energy of the electrons

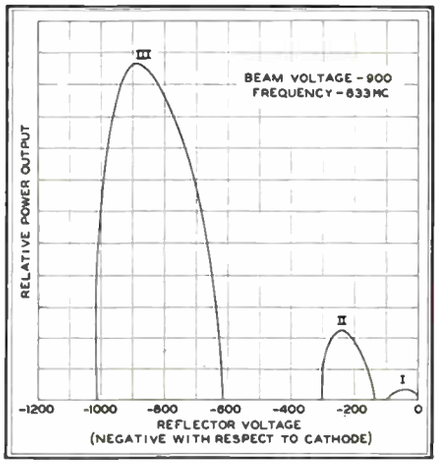


Fig. 6. Typical reflector characteristics

thus converted to RF energy sustains oscillation, and the remainder is coupled to any external load by means of the small loop on the coaxial output line shown at the bottom of the resonator in Fig. 2.

How the Klystron Is Tuned:

The frequency of oscillation in a klystron is governed primarily by the tuning of the resonator. Tuning can be accomplished by changing the gap between the two resonator grids. This is done mechanically by the threaded tuning struts that spread the flanges on the tube. Changing grid spacing essentially changes the effective capacity of the resonator and tunes the resonator in much the same way that a variable capacitor tunes a conventional LC tank circuit.

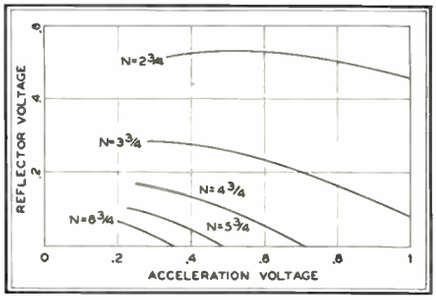


Fig. 7. Constant-mode characteristic

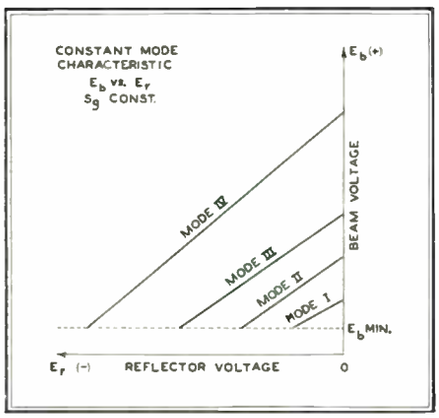
Frequency is also dependent on the transit time of the electrons in the reflector field. If the bunches are caused to arrive at the grids slightly earlier in the RF cycle, the frequency will be increased. Transit time can be controlled by the beam and reflector voltages. Increasing the reflector voltage, for example, will decrease the transit time and increase frequency because the stronger reflector field, not permitting electrons to penetrate so deeply into the reflector region, reduces their traveling distance and causes the bunches to arrive earlier. Similarly, but not so easily explained, an increase in beam voltage will also cause the frequency to increase.

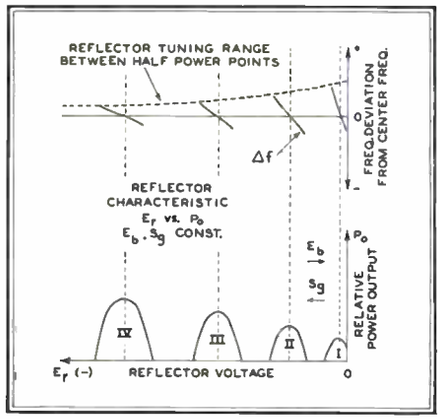
Tuning by changing the beam or reflector voltage is limited to certain ranges because the tube will stop oscillating when the voltages are changed beyond certain limits. These limits are determined by the fact that the resonator obtains the energy necessary to sustain oscillation by decelerating electron bunches. Changing the transit time beyond certain limits would cause the bunches to arrive at a time in the RF cycle when they would no longer encounter the retarding field at the grids necessary to sustain oscillation.

Operating Characteristics:

By examining the process of bunching, shown in Fig. 5, more closely, it can be seen that the electron bunch can take several RF cycles of time to travel in the reflector field before reaching the resonator grids. The shortest transit time that a central electron of a bunch can take and still arrive in the correct phase to sustain oscillation is approximately ¾ cycle. Bunches can also spend 1¾, 2¾, 3¾, to *N*-¼ cycles in the field and still maintain oscillation. At intervals between these times, however, the bunches will not meet the RF phase conditions at the grids necessary to sustain oscillation.

The foregoing transit time requirements show that the klystron will oscillate only within certain separated voltage ranges. In Fig. 6, for example, if the negative reflector voltage is increased from zero, a particular voltage will be reached where the tube will begin to oscillate. As the voltage is increased from this point, the power output will increase to a peak and then fall off until the voltage reaches a value where the





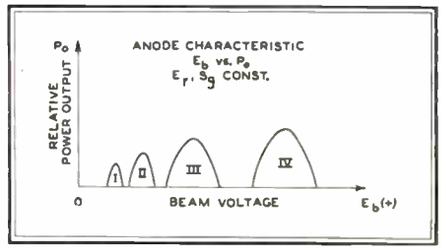


Fig. 8, left: Effect of changing beam voltage and reflector voltage. Center: Effect of changing reflector voltage. Above: Effect of changing beam voltage

tube stops oscillating. Further increase beyond this point has no effect until a still higher voltage is reached where the tube will oscillate again.

At higher reflector voltages, several more of these voltage modes can be found within which oscillation will occur. Each of these modes corresponds to a particular number of cycles in transit time. The mode corresponding to the highest reflector voltage at which oscillation can occur represents the ¾ cycle transit time.

The reflector characteristics shown in Fig. 6 are for a klystron very similar to the SRL-17. If the SRL-17 were operated at 833 mc., Fig. 6 would be nearly an average characteristic of the SRL-17.

In addition to reflector voltage modes, a series of anode voltage ranges exists at which the tube will oscillate for a given reflector voltage. This anode characteristic, shown in Fig. 8, is similar to the reflector characteristic. The effect of reflector and beam voltage can be combined, and a change in one can be compensated for by a change in the other The dependency of the reflector and beam voltage effects is shown in the constant-mode characteristics in Figs. 7 and 8. The numbers on the curves in Fig. 7 refer to the transit time associated with each mode.

Note that the maximum power and the reflector tuning range for each reflector mode are different. For higher reflector voltages, maximum power in the modes is greater and electrical tuning range is smaller than for lower reflector voltages. Within any single mode, frequency increases when reflector voltage is increased. For symmetrical modes, the frequency change within the mode is most linear at the center of the mode.

SRL-17 for S-T Service:

Used as the transmitting tube in the Federal S-T link on 950 mc., the SRL-17 is operated at +1000 volts beam voltage, and -1300 volts reflector voltage to deliver 3 watts. For local oscillator service, on lower power, the SRL-17 in the link is operated at +250 volts beam voltage and at -150 volts reflector voltage.

Modulation of the reflex klystron is simple. The signal can be applied directly to the reflector to frequency-modulate the output, Fig. 9. In fact,

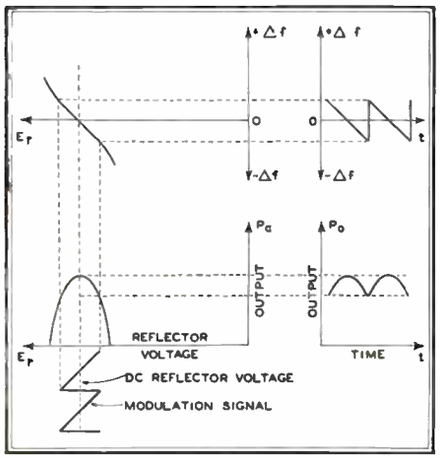


Fig. 9. FM by varying reflector voltage

microphone signals have been applied directly with satisfactory results. Simple FM transmitters with ±0.01% frequency stability have been constructed with only a reflex klystron, microphone, power

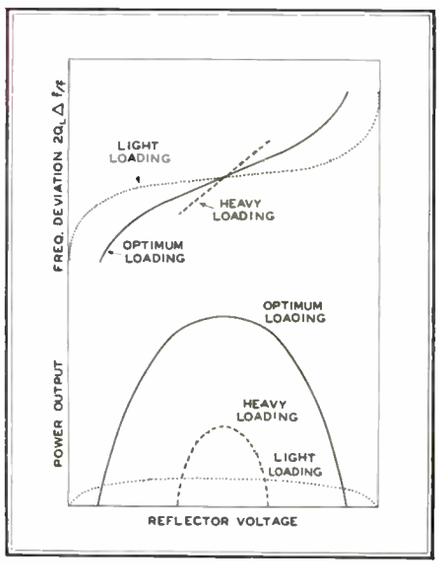


Fig. 10. The effect of varying the load

supply, and conventional VHF antenna.

In the Federal link, a very simple modulator is possible because of the ease of modulating a klystron. Using the equivalent of a single 6SJ7, a deviation of ±200 kc. is obtained with a reflector swing of ±28 volts peak, with negligible non-linearity. The modulation capacity of the Federal link is specified at ±600 kc. or ±84 volts peak. Negligible distortion is indicated by the report that an FM carrier has been transmitted through a series of six links with only ½% distortion resulting in the comparison between original and received intelligence.

Under no circumstances must the reflector be driven positive. If this were to happen, the reflector electrode would draw current. The reflector current characteristic has negative resistance due to secondary emission and because of this the current, when once started, will increase to destructive values. To guard against the possibility of positive reflector voltages, a diode clipper is usually designed into the reflector circuit.

Since frequency depends upon the electrode voltages of the tube, the DC power supply must be free from noticeable ripple. Otherwise, the ripple would frequency-modulate the tube. Good regulation of the power supply is important also to preserve frequency stability of the oscillator even though the tube is inherently stable.

Long-time frequency stabilities of the order of ±0.01% can be obtained by merely holding the ambient temperature to within a few degrees. A crystal reference AFC like the one in the Federal link will hold the tube to ±0.005%. More elaborate schemes can hold klystrons in general to 0.0001% over long periods.

Power output and modulation characteristics are affected by the loading of the klystron. Fig. 10 shows how the shape of a reflector mode and reflector tuning curve change with the output load match. Stub transformers are often built into systems to take care of changes in load and insure optimum characteristics. The life expectancy of the SRL-17, as indicated by performance reports, is several thousand hours.

SPOT NEWS NOTES

NOTES AND COMMENTS ABOUT SIGNIFICANT ACTIVITIES OF PEOPLE & COMPANIES

"—so I went up to see his television."

They Stole the Show:

Yes, that's what the tiny Altec-Lansing microphones did at the Chicago NAB Conference. Throughout the meetings and luncheons, they provided the easiest listening we have ever heard under such circumstances. The engineers seemed more interested in these mikes than in some of the speakers who used them.

Plant Expansion:

Leece-Neville, Cleveland manufacturer of rectified AC generators for car batteries, is enlarging its plant at 5109 Hamilton Avenue and is constructing an addition to the building at 5351. Their generators are used widely to handle the extra load of mobile radio equipment.

Miscalculation:

Last January 21, FCC Chairman Coy said in an address at Boston: "We hope to unfreeze the processing of television applications by April, or early in May." As of now, even if the proposed plan is announced by the end of May, it will not be possible to issue CP's until August or September at the earliest, for a hearing must be called, then the final plan must be released, and 30 days allowed for appeal. If no appeal is filed, CP's might be issued in September, provided nothing happens to delay the normal procedure.

Information on KDFC-FM:

Quickly picking up Linnea Nelson's complaint that agencies do not have sufficient data on FM stations, KDFC-FM Sausalito, serving the San Francisco Bay area, has compiled data from a recent station survey in a brochure now ready for agencies and time-buyers.

TV Frequency Problems:

While opinions differ, there's strong support for Zenith's position, expressed by Commander McDonald, that: "It is ridiculous to assume there will be separate markets for VHF and UHF. If many satellite cities like Waukegan, Illinois, near Chicago, or Camden, New Jersey, near Philadelphia, are assigned stations in the new UHF only, it does not mean that they will provide a market for single-band UHF receivers. People in these cities will insist on reception from VHF in their areas and will demand two-band receivers."

Radio Set Advertising:

W. P. Lillard, sales promotion manager fo General Foods, speaking of generalities and far-fetched comparisons: "People are building an immunity to advertising in both the printed and spoken form." If he's right, a reexamination of copy on audio and video broadcast receivers is in order. Such claims as "cathedral tone" from a 4-in. speaker, are being joined by promises of "long-distance" TV reception.

New Executives:

Edward W. Butler has joined Federal Telephone & Radio as director of the radio division, following his resignation as general manager of Sylvania's electronics division. Raymond S. Perry, former president of Eicor Corporation, has been appointed general sales manager.

Broadcasters Want to Know:

How will TV effect the future of FM broadcasting? As we see it, if FM'ers are merely relying on the superiority of FM over AM, they are going to be in a weak position. To survive, audio broadcasting must meet video at the program level, using FM as a means of providing the most enjoyable reception. The danger to audio broadcasting is not TV competition, but in failure to entertain.

Everett Gilbert:

Special projects engineer at Radio Frequency Laboratories, Boonton, N. J., elected vice president for engineering.

Four Horsemen of the FCC:

When Senator Edwin C. Johnson (D-Colo.) charged on April 20 that the "bewildered Commissioners . . . are captives of their own staff," he didn't identify the "plow horses" who have "usurped the plow handles and seized the whip." However, it is presumed that he referred to Messrs. Plotkin, Goldman, Solomon, and Cottone. The full text of Senator Johnson's remarks concerning actions by the FCC occupied 10 pages of very interesting reading in the Congressional Record.

Communications Business:

Under recent revision, Motorola communications equipment field engineering and sales will be handled by P. R. (Red) Kendall in Maine, Massachusetts, New Hampshire, Vermont, and New York except the metropolitan New York area. Lowell E. White has been moved north, to take over metropolitan New York, Jersey, Rhode Island, and Connecticut.

Frank H. Norton:

Formerly with Curtis-Wright and Bell Laboratories, has been appointed chief engineer for the radio division of Bendix Aviation Corporation.

Market for FM Antennas:

Nearly 100 companies are competing in the sale of TV antennas. However, although FM set production since January '47 is three times that of TV, very little promotion effort has been put on FM antennas. Seems as if the antenna people don't know that FM sets need antennas for the same reason that TV sets do, since FM operates right in the middle of the TV frequencies. Performance of 90% of the FM receivers now without antennas can be greatly improved by the use of omni-directional outdoor antennas.

New C-R Tube Plant:

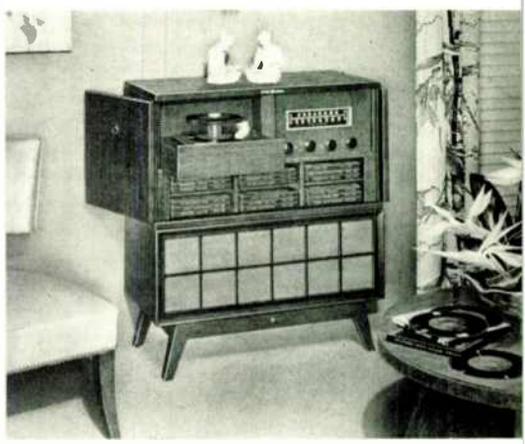
General Electric will spend over $1 million for facilities to manufacture cathode-ray tubes at Syracuse. Production of 8½-in. metal-cone tubes is expected to start in August.

Ad Hoc Headache:

No official word has been released, but it appears that the Ad Hoc Committee still hasn't reached conclusions on TV allocations for the VHF band that can be expected to satisfy the broadcasters. The original FCC plan provided for 394 stations in 140 metropolitan areas. Last summer, the FCC proposed to increase the allocations to provide for 955 stations in 459 areas. Now, confronted with the realities of interference, it appears that the experts haven't yet approved of a plan that will assure good reception from as many as 200 stations.

More Coaxial Cables:

The Bell system has added two TV channels to carry programs from Philadelphia to Chicago. This makes a total of 3 west-bound and 1 east-bound now.



1. Demonstration bus equipped with fixed-frequency FM. 2. Complete test equipment display. 3. Latest FM-AM-phono unit

NEWS PICTURES

1. A new FM radio receiver, designed specifically for installation in buses, has been announced by G. E. The new unit will operate up to eight 6½-in. speakers, enabling low level operation of each and is crystal tuned to the frequency of any one FM station desired. The range of operation depends upon the signal strength of the transmitter. Tests conducted in the Syracuse area have shown reception to be satisfactory with the bus operating up to 20 miles from the transmitter. The speakers are in round metal housings mounted on the ceiling at intervals throughout the length of the bus. The set incorporates a crystal controlled local oscillator, a vibrator power pack, and 10 tubes. Double limiters are used for optimum quieting of man-made static and other interference. The crystal employed is a new design, operating on the third mechanical mode and requiring a frequency multiplication of only three.

2. Sun Radio of New York has set up a complete test equipment display room in which engineers and servicemen can examine and try out equipment under actual use conditions. Display includes fully equipped test benches and two live TV receivers. All types of equipment and all leading makes are displayed.

3. New RCA Victor console combination features a two-band AM-FM radio and 45-rpm record changer in roll-out drawer. Storage space is provided for 24 albums of the new-type records or 189 single records. A 9-tube-and-rectifier circuit is used, and all equipment is housed in a single 34 by 30 by 16-inch cabinet.

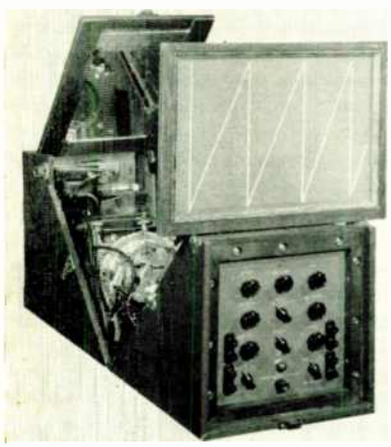
4. Portable projection oscilloscope by Beta Electric provides a 16- by 12-inch oscillogram with a trace bright enough to be viewed in normally lit classrooms and demonstration halls, and has all the controls of a normal oscilloscope. Yet the folded-up size is only 13 by 16 by 19 inches. Weight is 60 pounds. Vertical deflection sensitivity is 60 millivolts rms per inch; vertical amplifier response is good to 50 kc. and usable to 100 kc. Horizontal sweeps are good to 2 kc. and usable to 5 kc.

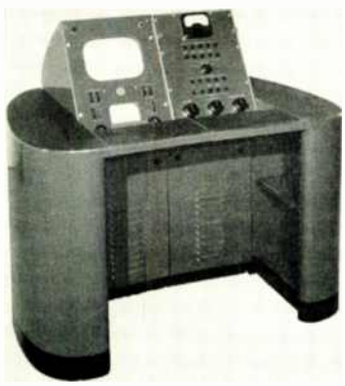
5. The basic unit of the new RCA universal television transmitter control console provides a centralized control of all mixing and primary switching operations. Block-type construction is styled to match the company's TV, FM, and AM transmitter and auxiliary equipment.

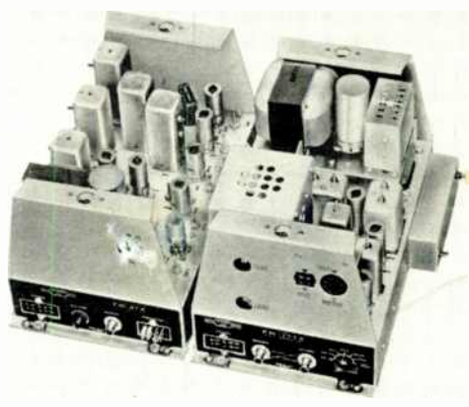
6. Kaar Engineering has completed the first production run of their new mobile radiotelephone equipment for the 152-162 mc. bands. More than two years of research have gone into the development of units which feature lower, standby battery drain than has been possible heretofore. Transmitter consumes no power from the battery during standby periods, and the receiver uses only 4 amperes.

7. First low-cost camera equipment designed expressly for the Image Orthicon pickup tube has been announced by Television Equipment Corporation of New York. Extreme sensitivity and high definition make this unit adaptable to either wired industrial systems or to broadcasting. Up to 1,000 feet of cable can be used between cameras and control equipment, and although basically a single camera system, as many as four cameras may be used. Intercommunication between units is provided.

4. Portable oscilloscope. 5. TV transmitter control console. 6. Low-drain 152-162 mc. mobile unit. 7. Sensitive TV camera







FCC PLAN FOR TV EXPANSION

BY THE USE OF LOW-COST REPEATER INSTALLATIONS, OPERATED WITH MINIMUM STAFFS, TV COVERAGE CAN BE EXPANDED GREATLY— *By* THE HON. WAYNE COY*

IN the metropolitan areas where television has already started, it has met with sensational acceptance. But don't think that the people outside the metropolitan areas are going to be content to grow old gracefully while television passes them by. The day of the hinterland, the provinces, the backwoods, the sticks has passed in America. Radio itself helped to hurry that process. The wartime prosperity and the dispersion of our industrial plants took us farther along the road toward greater equality of opportunity.

Many of you have pointed out to me that your city cannot afford to support an investment in a television transmission station of half a million dollars or more. In addition, you have cited annual operating costs approximating the initial investment. I can't disagree with that argument on those assumptions. I just cannot accept the assumptions as valid. I know that contrary thinking flies in the face of my own figures taken from the experience of 14 of the 17 stations operating all of 1948.

The need is for simplication and reduction in cost both as to plant and operating expenses. There is still entirely too much emphasis on glamorous buildings, and too little on sound plans to get television service to everyone in America.

Each large metropolitan area can support one or more major stations with studios and field pickup equipment, and management, operating and sales staffs. These major cities will be interconnected with coaxial cables or radio relay circuits, and will form the core of television programming.

Talent, shows, exhibitions, and other features which make up the regular program service are available in these cities. There are, of course, possibilities of other shows or events originating outside these points but, for the time being, because of the cost of irregular operation, these would be unavailable.

The service of each major station is definitely limited by the transmission characteristics of the frequencies used. This can be fairly accurately calculated. For purposes of illustration, the service area can be assumed to be a circular area with a radious of 40 to 50 miles. This service area usually includes the uniformly dense population, but at the edge, the population is generally concentrated aromnd secondary cities and towns. Each of these cities and towns can be served by a simple secondary station, with location and power properly selected to serve the area. The number, location, and radiated power of such secondary stations is determined by the population distribution. Thus, cities like Chicago, New York, and Philadelphia might have three to five secondary stations surrounding them.

These secondary stations must be simple in construction and operation to give minimum investment and operating cost. The stations must be, as nearly as possible, automatic in operation, thus requiring minimum staff. The program service must be supplied directly from the central program source, and such secondary stations should not be expected to provide program material. These stations should not require studios, management, sales, or programming staffs. In all respects this type of secondary station should simply be a repeater for the program source in order to extend the coverage for the program, thus dividing it among a larger number of audience units.

The second step is to serve the cities and towns along the connecting lines. The same type of secondary station transmitter can be used. Taps on the connecting circuit can be made along the line at any point of amplification. The company operating the connecting lines (AT&T) should develop simple terminal equipment to be connected at any convenient point of the circuit to give service to a local station.

The third step is service off the connecting line. From each of the stations on the line, secondary stations can pick up and repeat the program. The quality of the picture may permit a second repeat, but with simple apparatus it is improbable that acceptable service beyond this can be obtained. Simple radio relay spurs of one or several hops can be provided, and technical improvements will make it possible to extend these spurs and maintain quality. If costs can be supported, more elaborate relays or coaxial lines may fan out from the main line.

Thus, one can build up a network very similar to the network of a railroad system — major terminals, intermediate stations, short side spurs, and secondary lines. The analogy differs in that in the television service every station can have the same service to it, but no service can be provided in the reverse direction without large capital and operating expenditures.

This network can be justified and expanded only if the costs are geared to the audience added. Competition can be provided by parallel networks. The only limits to the number of competing networks are economies and availability of frequency bands. It is probable that, in most of the U. S., the former will be more limiting.

A secondary station such as I have described, and particularly those not satellite stations on the edge of large metropolitan areas, can provide local programs as well as network programs. The transmitter can be designed so that field equipment can be connected to it directly or by a simple radio circuit. Thus local sports events, local speakers, local forums, and local dramatic production can be added to the service. The same field equipment can be used to

(Concluded on page 26)

RCA model of a television installation suitable for use as a repeater station such as Chairman Coy describes

*Chairman, Federal Comunications Commission, Washington, D. C. This text is part of an address delivered at the NAB Convention, Hotel Stevens, Chicago, April 11, 1949.

Fig. 1. Eye-level television screen is hidden when unit is not in use

TV FURNITURE IDEAS

DESCRIPTION OF INTERCHANGEABLE UNITS FOR TV INSTALLATIONS: — *By* HERBERT D. SUESHOLTZ*

AN examination of television cabinets on the market today leaves little doubt that many designers are still thinking in terms of audio programs. In the rush of keeping up with the expansion of television, they have not had time to redirect their artistry, from a cabinet which was to be heard but preferably not seen, to a piece of furniture which is the central point in today's living room.

In addition, many sets show a holdover from AM mechanical design. The loudspeaker, always as near the floor as possible, has been pulled out and replaced by the television screen. Here again, the fact that television is to be looked at has been ignored.

Finally, experience has shown that one of the major obstacles in television sales is the housewife's reluctance to rearrange her furniture to accommodate a new and often inharmonious cabinet in her living room.

An awareness of these considerations led Transvision, Inc., to collaborate with Charles Allenbrook, the eminent designer, in the creation of television furniture which could become focal point of living room furniture arrangement and at the same time be mechanically suited to television viewing.

Starting with no preconceived ideas of how the finished product would look, certain fundamentals were considered essential. They are:

1. That television would eventually become the dominant point in the room.

2. That it would supersede fierplaces and other previous centers of activity and become the hub around which settees, chairs, and furniture could be arranged.

3. That it would be flexible, so that owners could add to existing equipment, or install new equipment as needed.

4. That the designs should meet the need of both small and large homes, and be styled to harmonize with existing furniture.

5. That the television screen should be correctly placed for comfortable viewing, and yet be hidden when not in use.

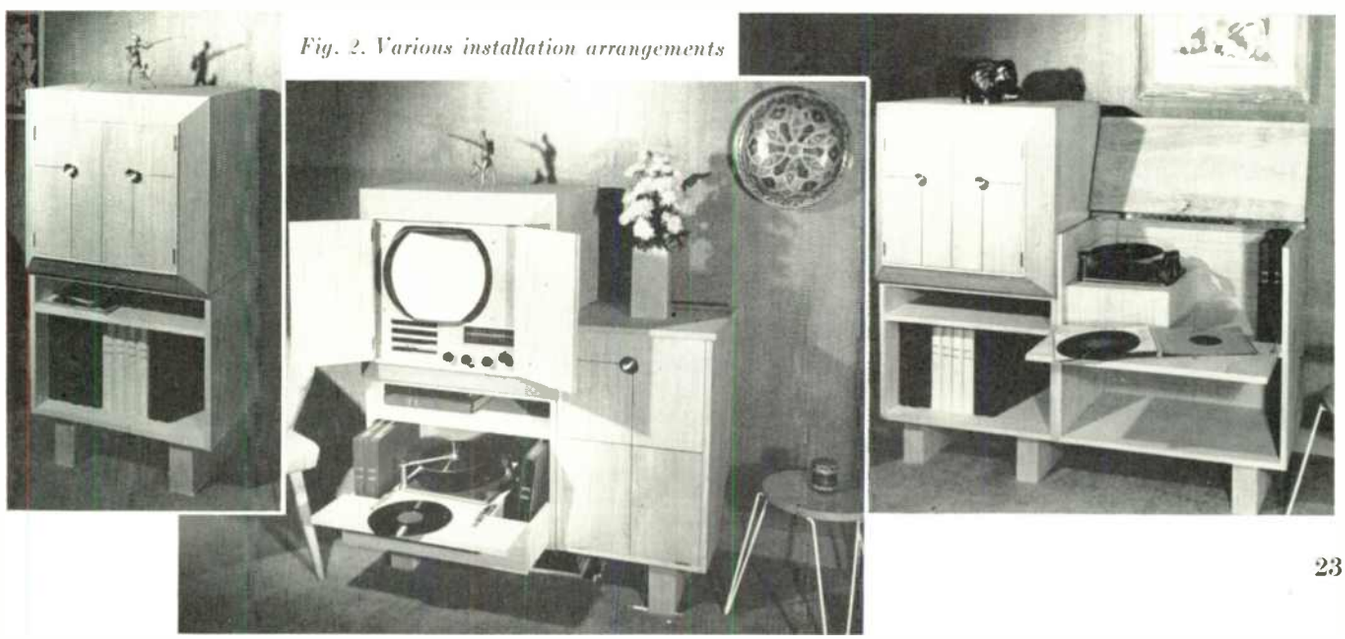
The final result of a long period of planning and research is shown in Figs. 1 and 2. All units in the basic ensemble are semi-standardized and inter-changeable. The television screen and dial panels are removable and can be replaced easily. Present radio and phonograph equipment can be modernized by installation, along with television equipment in any one of several units. In all cases, the television screen is kept at eye-level height for fatigueless viewing. Record changer, album storage, cellarette, and magazine shelf units have been designed for use in conjunction with the basic television unit. For corner positions, the interchangeable series include two corner units.

Although the designs illustrated are functional modern in style, substitution of carved, hand-finished mouldings, handles, and period type legs convert them economically into period pieces. At present, finishes include blonde, ebony, rift oak, mahogany, walnut and silver grey.

It is believed that the series of units described in this article represent a major step forward in styling television furniture to meet the requirements of the living room as well as those of the individual watching a TV program.

*General Manager, Transvision, Inc., 460 North Ave., New Rochelle, N. Y.

Fig. 2. Various installation arrangements



PROGRESS ON UHF TELEVISION

A REVIEW OF EQUIPMENT WHICH HAS BEEN USED FOR TESTS ON UHF, AND THE PROBLEMS WHICH REMAIN TO BE SOLVED— *By* DR. THOMAS T. GOLDSMITH, JR.*

COMMERCIAL broadcast television as we know it today utilizes the VHF region of the spectrum employing twelve channels beginning at 54 mc. and going, with some skips for other services, to 216 mc. These twelve channels are rendering an excellent service and some sixty-one television stations are currently carrying broadcasts on them. However, they are insufficient to provide a completely competitive network service throughout the United States. Because of co-channel interference, it is impossible to supply the entire demand for stations, so that each city capable of supporting television can have a sufficient number of channels to furnish four or five network programs.

VHF and UHF Allocations:

Several years ago, the Federal Communications Commission recognized the shortage of channels in the VHF region and therefore set aside an experimental band of frequencies for television in the ultra-high frequencies. This television band encompasses the region from 475 through 890 mc. It is particularly with reference to this UHF region that I shall make my comments.

We are currently involved in a television freeze which the FCC and the industry agreed necessary in order that the most efficient utilization possible could be planned for the twelve VHF channels. Previously, an allocation plan had been put into effect which separated co-channel stations, in some cases, only 100 miles. When the stations began operating even 200 miles apart, it was found that the interference due to tropospheric fluctuations in signal strength was so severe that a restudy of the propagation characteristics and the consequent rearrangement of allocations even with these first 12 channels was highly desirable. An analysis of data concerning propagation has been completed to the extent that a new allocation plan can be drawn up so that the freeze may be lifted.

However, the FCC now finds that the policy problem of sufficient channels is almost as serious in the consideration of the lifting of the freeze as the purely technical interference problem. Thus, they find that consideration of VHF alone is impossible and, therefore, UHF and VHF must be considered together, so that some decision can be reached that will provide a satisfactory over-all, long-term television program for the nation.

Status of UHF Transmitters:

A number of companies have been engaged in experimental investigation of the ultra-high frequencies. The frequencies between 475 and 890 mc. are somewhat of a no-man's land. The development of equipment for lower frequencies in the present television and FM channels has produced tubes and apparatus capable of delivering considerable power. On the other hand, the wartime use of radar produced apparatus and tubes capable of delivering high power in the microwave region beginning at 1000 mc. and up. However, high-power tubes for the UHF region set aside for television have not been made available. Some experimental work in this region, nevertheless, has gone forward. The Columbia Broadcasting System carried on color tests several years ago with a transmitter on the Chrysler Building, and made field observations throughout the New York area. In that project, a bandwidth of some 16 mc. was employed to obtain high-definition sequential color. Consequently, performance with this wide bandwidth was somewhat limited by the obtainable signal-to-noise ratio.

Du Mont Laboratories, in the summer of 1948, initiated transmissions from its experimental station W10XKT in New York City, located at the site of its low-band transmitter, WABD. While the transmitter does not have high power, being limited to 40 watts effective radiation, it is sufficient to illustrate the quality of program and signal-to-noise performance which can be achieved in the UHF region.

Using the 6-mc. standards currently employed on the twelve VHF channels, this station, carrying the same programs as WABD, has produced pictures of quite acceptable quality within reasonable distances from New York. Transmitters of higher power for pictures and sound are nearing completion, and will be installed at 515 Madison Avenue, New York City. These transmitters, also operating experimentally at W10-XKT, will make possible a more complete field coverage study in the New York area. They will operate on a picture carrier frequency of 609.25 mc., and a sound carrier frequency of 613.75 mc. Using an omni-directional radiating antenna having appreciable power gain, it is expected that a peak effective radiated power of several kilowatts will be available.

Tests on UHF Transmission:

RCA, through its NBC affiliates in Washington, has installed sight and sound transmitters at the Wardman Park Hotel to carry programs in parallel with its WNBW station at that location. RCA has made rather extensive field tests on this equipment in the Washington area. Du Mont and Philco, independently, have made field studies in Washington from this same transmitter. All the measurements generally indicate the need of higher power for UHF than for VHF because of the substantial shadow cast by the hills. Nevertheless, nearly all observers agree that the ghost problem at UHF is considerably less severe than is now encountered in built-up areas where VHF television stations are operating. The tests indicate that ignition-type interference and many other forms of man-made static such as are now encountered from electrical machinery, transformers, and flashing signs, are considerably less evident at UHF than at VHF.

A number of other experimental stations in Boston, San Francisco, Chicago and elsewhere have been carrying on tests in the UHF region.

Tubes for Higher Power:

Several approaches have been made to the tube problem at UHF. Transmitters for this region may require tube structures such as the Resnatron, a high-powered tube in which resonant circuits are fundamentally a part of the tube structure itself. The Resnatron proved quite successful in the war as a jamming device. Development work has been continued by Collins Radio under the direction of Dr. Salisbury, and by others. The use of multiple tubes in a ring circuit is another method. Results of work along this line by Eimac engineers looks very encouraging. RCA's use of multiple tubes excited in a balanced manner, with their outputs combined in a diplexer form of mixer circuit is also very promising. Dr. Doolittle of the Machlett Laboratories has given a paper bearing upon tube problems at these frequencies.

It seems likely that transmitters delivering approximately 5 kw. will be available in the entire frequency range of 475-890 mc. With further development,

*Director of Research, Allen B. DuMont Laboratories, Inc., 2 Main Ave., Passaic, N. J. A paper presented at the annual NAB Engineering Conference, Chicago, April 9, 1949.

the Resnatron approach or multiple tube approach may lead to transmitters capable of delivering something like 50 kw. Then, by use of an antenna power gain of say 10 in the radiating structure, it will be possible to deliver the necessary 500 kw. of power to cover nearly any metropolitan area with a sufficient television signal for excellent service.

Sidebands and Neutralization:

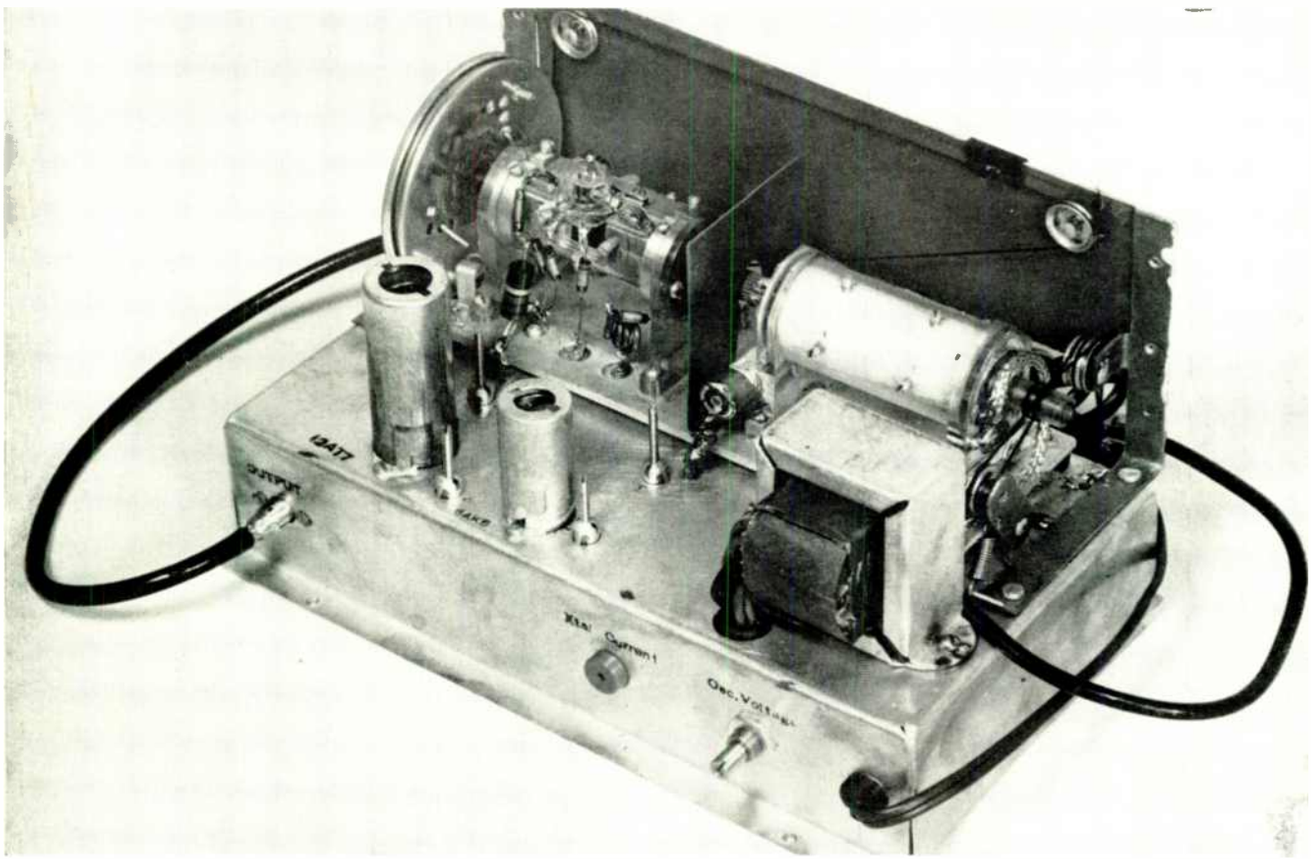
One of the problems at the transmitter has to do with the sideband characteristic. It is expected that filters can be built for this region of the spectrum that will give adequate performance. Most of the experimental transmitters to date have been broadband transmitters, and the designers have not been faced with this particular problem because there was no co-channel or adjacent channel operation with which to contend. A fixed percentage stability at UHF results in a considerable increase in kilocycles of absolute drift than at VHF. Another serious problem having to do with transmitters is the neutralization of power stages at UHF. These stages must be satisfactorily neutralized in order that the transmitter can be modulated to a depth as low as 15% on peaks of white. Phase modulation must be minimized on such transmitters if it is desired to employ the inter-carrier method of sound reception in the receivers.

UHF Converters and Receivers:

UHF receivers to cover the entire range take several forms. Experimental receivers built to date employ the converter principle, where a separate local oscillator and mixer are used to heterodyne the received signal into the range of existing television sets. Such a double superheterodyne method of reception is reasonably adequate, although with full occupancy of the channels a number of spurious oscillations can be expected. For example, at certain frequencies the desired signal will be received and converted to an existing VHF channel. The regular VHF receiver operating to accept such signals would then have a local oscillator whose harmonics would fall in the UHF band being received. The consequent presence of both the UHF signal and the harmonics of the local oscillator cause interference one with the other, with consequent distortion in the picture being received.

Converters of this type are quite feasible, however, when used with a VHF television receiver employing the continuous-tuning Inputuner method of station selection. With such a device, it is possible to heterodyne the UHF station to Channel 1 and receive it on a channel where no other television station is operating. If interference should occur on this particular channel, by a retuning of the UHF converter the signal can be converted to a region between Channels 1 and 2. Then, by simply adjusting the continuous tuning of the Inputuner, the signals can be received at the new point on the dial. With such fine adjustment it is quite possible to avoid most of the spurious birdies which would otherwise result from the use of a converter.

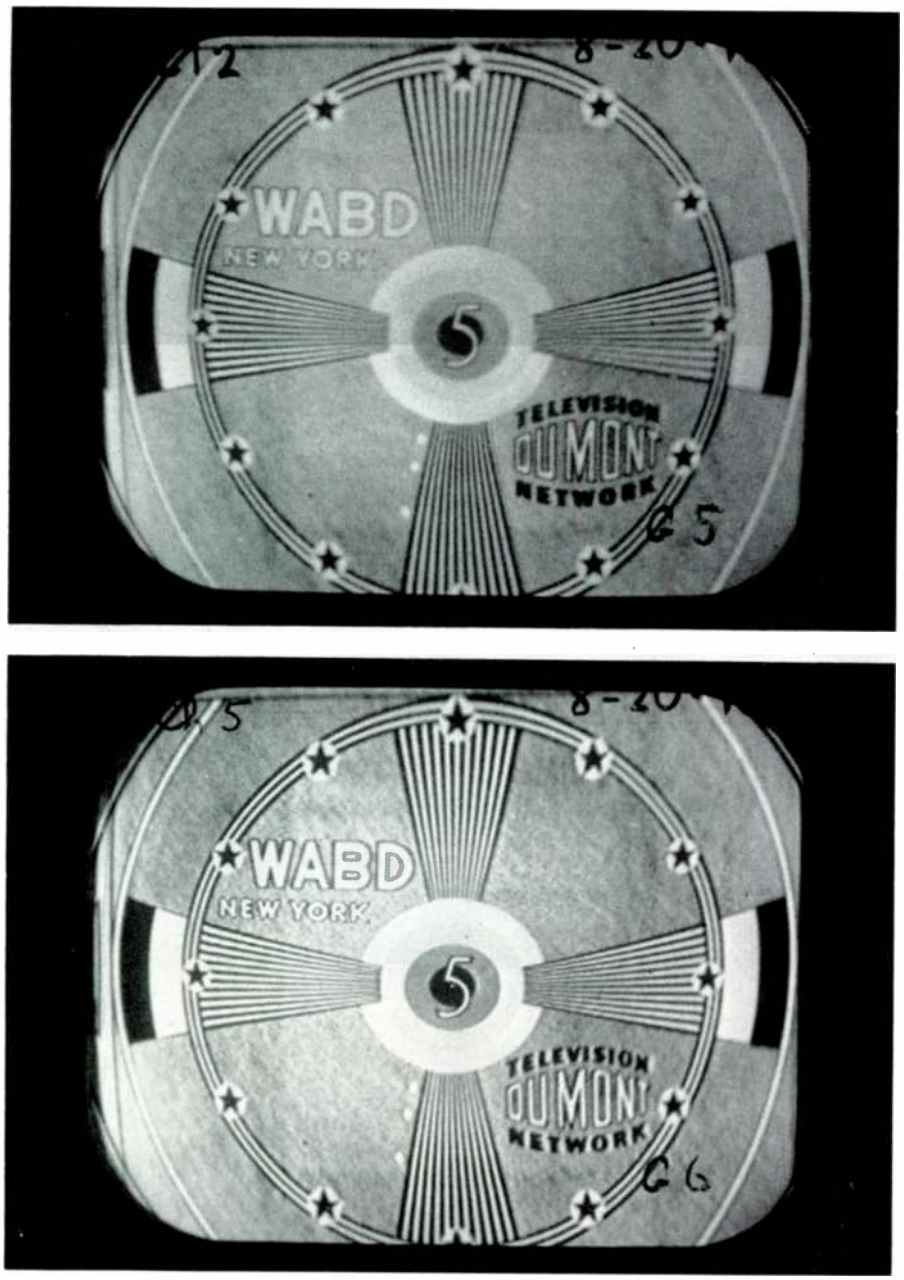
The most satisfactory means of reception for the UHF channels, however, is a single super-heterodyne circuit. Du Mont has constructed such RF head-end assemblies for use with its present receivers. The receiver is provided with a switch so that the regular RF Inputuner head end is employed for VHF, but the special UHF head end assembly can be switched to the IF input. In some cases we have found it quite satisfactory to utilize the current 21.9-mc. sound IF and associated 26.4-mc. video IF. With such a device it is possible to get an image rejection of something better than 10 db. For such image rejection an RF tuned cavity is employed ahead of the crystal detector. Another tuned cavity serves for the local oscillator. The output of the crystal detector is then fed through a single IF stage tuned to the desired intermediate frequency channel. Next, this signal is led over a short length of cable to the VHF receiver which is being adapted so as to include both VHF and UHF.



This Du Mont UHF tuner has cavity-type RF preselector and local oscillator, feeding a crystal mixer. Range is 475-890 mc.

Standards for UHF Television:

Now a word about the standards which might be employed in the UHF region. Obviously if the UHF service is to be simply a supplement to the existing 12 VHF channels, then exactly the same standards should be employed. Analysis of the characteristics of these higher frequencies indicates that these standards are entirely feasible. Perhaps some tightening of tolerances within the basic standards is desirable. One case, for example, is a smaller percentage drift allowance with respect to the stability of the crystal in the transmitter. Consideration has been given to frequency modulation of the video transmitter as a possible means of reducing co-channel interference. However, the tests made in 1941 with regard to frequency modulation for the video transmitter indicate a serious multipath distortion of much greater proportions when using FM for video signals than is present when using AM. This practical field problem, therefore, pretty well rules out FM video, particularly inasmuch as it would require a very substantial change in standards from VHF. The recent employment of synchronization of carriers between closely-spaced co-channel stations promises considerable relief from the co-channel interference problem. It is quite possible that the same principles can be employed in the UHF stations.



Above: Field intensity of 300 microvolts, 13.8 miles from 612-mc. transmitter with 40 watts effective radiation. Below: Field intensity of 47,000 microvolts, at the same distance from a 77.25-mc. transmitter with 14,900 watts effective radiation

UHF Frequency Allocations:

Color television, using a wider band and employing either simultaneous or sequential standards, is under investigation, and might use a portion of the UHF spectrum. It is likely that nearly all the channels will be required for a truly nation-wide service, even employing the 6-mc. bandwidth. Thus, probably black-and-white television will employ the major portion of the UHF spectrum now assigned for television.

Approximately 69 additional 6-mc. channels are available in this entire region. A number of allocation plans have been worked out to determine the number of stations which could be gained by adding this region of the spectrum to the existing, permanent 12 VHF channels. Some plans indicate that nearly 40 of these 69 channels will be necessary.

Summary of UHF Progress:

To summarize, transmitters of reasonable power sufficient to serve smaller communities would be available shortly after authorization of commercial service in this region of the spectrum. Receivers could be made available as soon as such transmitters are in position to render service. We strongly recommend that UHF stations be employed in those regions not now having any VHF service. Then, as the power available in UHF is increased, it may be necessary to do some mixing of UHF and VHF, but a minimum of intermixing will lead to a much more orderly processing of television applications, the equipping of transmitters, and the sale of receivers to the public.

FCC PLANS FOR TV

(Continued from page 22)

pick up local shows or add local advertisers.

The people on Main Street know about television, are excited about television, and if they don't see signs of getting it in a reasonable time, they are going to start asking questions. They will start asking embarrassing questions of you, their local broadcaster.

And they are going to look inquiringly to the government agency charged with making communications available "to all the people of the United States."

I think you all know that the Commission has in recent months been intensifying its study of methods of making more channels available.

I am certain that before many months we can establish our ultra high frequency allocations, and thus open up this new frontier of the spectrum so that it may be possible, given imaginative leadership rather than Maginot Line leadership, to take television service to all of America.

Fig. 1. Cross-section of cable and connector, with the coupling ring pushed back

COAXIAL CONNECTORS

USE OF COAXIAL CABLE FOR ANTENNAS CALLS FOR KNOWING CORRECT CONNECTOR TECHNIQUES

COAXIAL cable is coming more and more into use for FM and TV antennas because of its ruggedness, its ability to withstand wind, rain, and smoke fumes, and because it can be lashed directly onto masts and metalwork without introducing electrical losses.

The principal objection to it has been the need of using coaxial connectors at the antenna and, frequently, at the set as well, if a thoroughly good installation job is done. Actually, the work of preparing the cable and soldering the center conductor and shield is simple enough, once the correct method is mastered. The accompanying photographs show how the steps employed by the American Phenolic Company where, in the process of making up cables by the thousand, they have learned all the tricks.

The standard AN connector, Fig. 1, comprises a coupling ring *a*, the connector shell *b* with holes *c* for soldering to the cable shield *d*, while *e*, indicates the insulated center-pin to which the cable wire *f* is soldered. In Fig. 2, the coupling ring 3 is pushed back to show the soldering points for the cable shield at 2. The wire is soldered at 1 to the pin.

The eight steps for putting a connector on a cable are shown in Figs. 3 to 10. First, the vinyl jacket, shield, and inner insulation are cut, Fig. 3, and removed with pliers, Fig. 4, leaving the center wire, indicated as *f* in Fig. 1. Then the jacket is cut, Fig. 5, taking care not to cut into the shield. The jacket is removed by slitting lengthwise, as in Fig. 6.

At this point, the coupling ring is slipped on the cable, Fig. 7, and the shell screwed onto the jacket, Fig. 8. This brings the soldering holes in the shell over the cable shield, as shown in Fig. 1. Finally, the shield and wire are soldered as in Figs. 9 and 10, and the coupling ring is screwed onto the shell.

It may simplify the soldering to tin the cable and wire before the ring and shell are put in place. Of course, rosin-core solder must be used. Any other kind of flux will cause trouble. Since the thermoplastic insulation softens at 190° F., the soldering should be done quickly, so that the heat will be confined as much as possible to the joint.

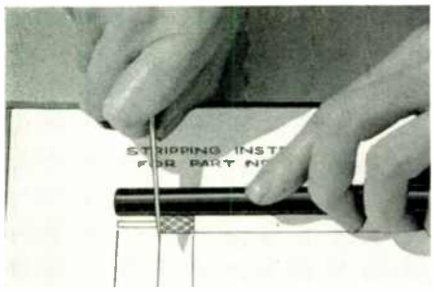


Fig. 3. Cut through to the centre wire

Fig. 2. Be sure that the coupling ring 3 is in place on the cable before the connector shell is soldered to the cable

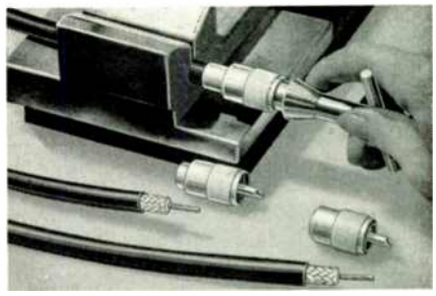


Fig. 8. Screw the shell, as Fig. 1 shows

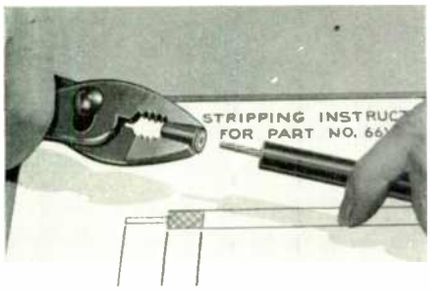


Fig. 4. Remove the insulation and shield

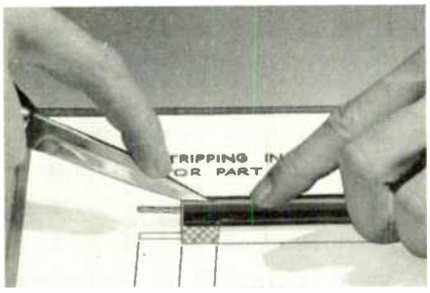


Fig. 6. Split jacket but not the shield

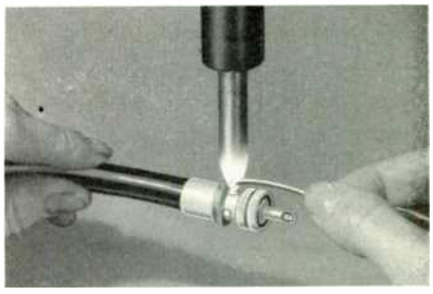


Fig. 9. Solder shell to the cable shield

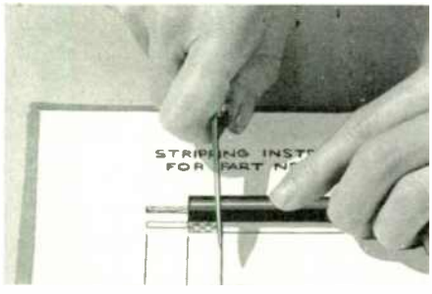


Fig. 5. Cut the outer vinyl jacket only

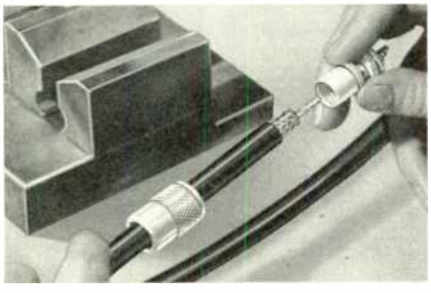


Fig. 7. Slip the shell on to the cable

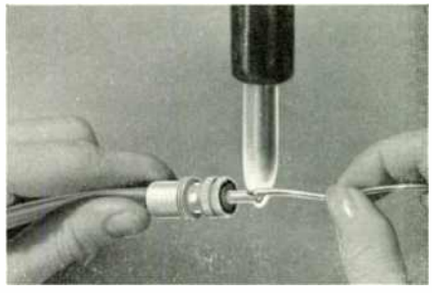


Fig. 10. Solder pin to the center wire

MAGNETIC RECORDING

PERFORMANCE CHARACTERISTICS AND STANDARDS FOR MAGNETIC EQUIPMENT — *By* DR. S. J. BEGUN*

MECHANICAL disc recording has been for many years the preferred and practically only method of instantaneous recording employed by broadcast studios. Now there are definite signs that disc recording will soon have to share its place with magnetic recording.

Features of Tape Recording:

It is one of the objects of this paper to determine why magnetic recording has been gaining so rapidly in importance for broadcast work. An appraisal of the magnetic recording method discloses the usefulness of its unique features. To mention only a few: 1. There is the easy erasability of this recording medium. 2. The practical signal-to-noise ratio is greater than is obtained in any other recording means. 3. Reproduction without quality deterioration is only limited by the life of the recording medium. 4. An uninterrupted recording period of any desired length can be provided. 5. The making of a good recording requires no particular skill on the part of the operator. 6. A coated tape as recording medium can be cut ands spliced easily.

On the other hand, the price of the recording medium for any given length of recording time is high compared to that of mechanical recording. Making copies, if such are needed, is cumbersome, and special equipment is required if it is to be done on a reasonably economic basis. The elasto-mechanical properties of the recording medium make it difficult to play a recording back with exactly the same time period in which it was recorded.

The features enumerated on the credit side of magnetic recording make this method of sound recording particularly desirable when the recording does not need to be preserved for long periods of time. Under these conditions, the erasability of the magnetic recording medium more than outweighs the somewhat lower price of disc blanks. Without any doubt, magnetic recording provides the best economical solution for time-delaying programs. Here, the repeated use of the same recording medium is only limited by the mechanical wear which eventually deteriorates the performance.

There are two other applications in which magnetic recording has already proven its value, *i.e.*, for on-the-spot recording and for editing.

Tape Equipment:

No one instrument is best suited for all these applications. For time-delayed programs, a sturdy rack and panel arrangement, preferably remotely controlled, will be most practical, since with such a layout all operations can be initiated by the attendant at the master control board.

For on-the-spot recording, lightweight portable equipment is needed. For this application, some compromises must be made. While good performance still is required, one cannot expect to obtain results which are equivalent to that from a studio installation.

Editing requires still another type of instrument. The simplicity of cutting and splicing tapes makes it extremely easy to rearrange the sequence of a program, thus providing a new tool for the program director. The console type of magnetic recorder is presently believed to be most suitable for this application. It is important in this type of instrument that provisions be made to find any section of the program with the very least delay.

Essential Characteristics:

Only a general review of the most essential requirements of these three classes of instruments has been attempted here. A detailed discussion of all the desirable features which should be associated with each of these devices is beyond the scope of this paper. One other point, however, needs to be mentioned here. A recording made on any one of these machines must be reproducible on any other type of instrument. Furthermore, equipment for various applications may be supplied by more than one manufacturer. Interchangeability of recorded program material is a must, if full use is to be made of the potentialities of magnetic recording. This calls for standardization wherever technical developments have advanced sufficiently to make agreement among the interested parties feasible.

A bird's-eye view of the present status of the art at this point might be profitable. There are four main criteria which determine the performance of sound recording equipment:

1. The Signal-to-noise ratio
2. The response vs. frequency
3. The non-linear distortions
4. Flutter and wow

In regard to the first three points, magnetic recording is at least equal to the best of the optical and mechanical recording methods. Current experience indicates that a signal-to-noise ratio in the order of 60 db might be considered as normal. Of course, this does not necessarily mean that all magnetic recorders will have such a high signal-to-noise ratio, since only careful design can assure it. Permanent magnetization of the playback head must be avoided since a DC magnetic field component can increase the background noise of the medium from 10 to 20 db. Permanent magnetization of the recording head will also affect the signal-to-noise ratio of the system adversely. Furthermore, the erasing and biasing current should be free of harmonics. Only under these conditions will the recording medium be left, in the absence of a signal, in a state of complete magnetic neutralization, which is so essential for noise-free operation.

Proper shielding of the playback head, preferably of hum-bucking construction,

*Vice President in Charge of Engineering, Brush Development Co., 3405 Perkins Avenue, Cleveland 14, Ohio. A paper delivered before the NAB Broadcast Engineering Conference, Hotel Stevens, Chicago, April 7, 1949.

is essential. Even small extraneous magnetic fields can do much damage if they are permitted to induce a voltage in the coil of the playback head.

Response vs. frequency is associated with the speed of the medium, and also depends upon its magnetic properties. In addition, it is a function of the playback head gap-length and the choice of the value of the biasing current. Proper adjustment of the recording and playback head are imperative, since the response at the high-frequency end of the spectrum suffers if the recording head gap is tilted with respect to the playback head gap. Maintenance of intimate contact between the recording medium and the pole pieces of the recording and playback head is another necessary condition.

Experience has shown that, with available coated tapes, a flat response can be obtained, with proper equalization, until a frequency is reached which is equivalent to a wavelength of .001 in. In other words, with a speed of 15 ins. per second, the response vs. frequency can be made essentially flat up to 15,000 cycles per second. A suitable tape is one which has a coercivity between 200 to 300 oersteds, and a remanence between 600 to 900 gausses.

Distortion can be kept to a minimum by proper adjustment of the value of the biasing current. With the biasing current too low, the transfer characteristic is non-linear; with the biasing current too high, the response at high frequencies deteriorates. The biasing frequency should be at least 4 to 5 times higher than the highest audio frequency to be recorded. It is, of course, unnecessary to state that the recording current associated with the maximum signal must not exceed a given value since, otherwise, overloading occurs.

The amount of distortion is also a function of the magnetic properties of the recording medium, and of the dispersion of the magnetic powder in the binder. Each medium must be tested carefully. In general, for a signal-to-noise ratio of 60 db, not more than 2 to 3% harmonic distortion can be tolerated.

With regard to flutter and wow, no better performance than obtainable with other methods should be expected. Well designed disc, film, and magnetic recording equipment can be made to meet the specified requirements.

Cost of Equipment:

But let nobody be fooled into thinking that a high quality magnetic recorder of the studio type can be built less expensively than instruments for other recording methods. If price is an important factor, the purchaser of magnetic recording equipment will have to make concessions in one or in another respect. In many cases where high performance standards are mandatory, it will prove to be worthwhile to pay a high price for the proper equipment.

Merits of Tape & Disc Methods:

In the course of this paper, reference has been made from time to time to disc recording. It is of particular importance to the broadcast engineer to appreciate where mechanical recording falls short of magnetic recording. The advent of the cellulose nitrate record blank brought about the era where the recordist thought that the crest of performance had been reached. But only most careful attention during the cutting process gives good results. After the disc has been cut, most meticulous protection against dust particles is required to insure the maximum signal-to-noise ratio of the system. An excessive stylus force coupled with a high mechanical impedance of the moving elements of the pickup cartridge often destroys the modulated groove after the first playing. The eternal problem of translation loss adds an additional difficulty, but worst of all, the tracing distortions are of considerable magnitude, particularly when the recorded wavelength approaches the stylus tip dimension of the reproducing device. Mechanical recording also suffers from the fact that the mechanical vibrations, always present during recording and reproduction, lead often to an unwanted relative motion between the recording medium and the recording and reproducing stylus, causing modulations which are reproduced as rumbling noises.

In contrast, magnetic recording is free of most of these difficulties. While there is a gap length effect in magnetic recording which in some respects might be compared with the tracing problem in disc recording, the gap length effect does not cause non-linear distortion even if the wavelength approaches the gap length of the reporducing head. Only the frequency response is affected by short wavelengths of the recorded signal.

Expansion and Contraction:

All this is not meant to imply that magnetic recording is the wonder elixir which solves all problems. In fact, magnetic recording introduces difficulties of its own. The recording medium, particularly when it is a coated tape, is usually extremely elastic and stretches during operation. Its dimensions are also changed by the effects of humidity and temperature. Expansion and contraction of the medium will lengthen or shorten the playback period compared to that of the recording time, if no special provisions are made to decrease or increase the speed of the drive mechanism to compensate for the variations of the length dimension of the tape. The use of sprocket holes has been suggested, but appears to be impractical, since it would require considerable strengthening of the base material, and result in bigger reels for accommodating a given recording period.

Hum and Noise:

The amount of magnetic energy which can be stored on the thin layer of magnetic material is relatively small. Therefore, the impressed signals can only develop weak magnetic fields which must generate the useful voltage in the playback head. The design of a highly sensitive amplifier responsive to the small signals with the necessary signal-to-noise ratio challenges the ingenuity of audio engineers. The small fields generated by the recording medium are sometimes comparable to the magnitude of external fields. Thus, it is difficult to reduce hum to an appropriately low level. But even though problems are still to be solved, there is good reason to believe that they do not represent unsurmountable barriers in future developments.

Some question might be raised with regard to modulation noise. Modulation noise is that which exists only in the presence of a signal. Its magnitude depends upon the strength of the recorded signal. The modulation noise is a phenomenon which is not unique with magnetic recording, since it is found at least to some extent, in mechandical recording and is particularly present in film recording. Because of the other outstanding performance characteristics of magnetic recording, modulation noise is now looked up as the one factor which limits the ultimate capabilities of this recording method. It causes fuzziness in reproduction, with a corresponding annoyance to the listener. Various statements have been made regarding the order of magnitude of the modulation noise for different types of magnetic recording mediums. Values of 30 to 40 db have been reported, but it is doubtful whether great significance can be assigned to these figures. No specific measurement procedure has been agreed upon as yet.

Variations of Level:

Level variations are another objectionable deficiency in magnetic recording. They occur in the playback process, being particularly pronounced in the reproduction of the higher frequencies. Such level variations are usually brought about by contact variations between the recording medium and the pole pieces of the recording and playback head, and are re-

ceived by the listener as noise and fuzziness. Careful design of the equipment, cleanliness of the heads, smoothness of the recording medium surface and of the pole pieces will all tend to reduce level variations to a minimum.

Standards of Performance:

The need for standardization has been stressed already. Various technical organizations and societies have established committees to review the available information and to see if an agreement can be reached with regard to certain design features, so that interchangeability can be accomplished for the benefit of the users of magnetic recording equipment. The NAB Magnetic Recording Committee has drawn its membership from industry active in the field of magnetic recording, and from broadcasting organizations interested in employing this method. Thus, there is assurance that the designers' and consumers' viewpoints are being considered.

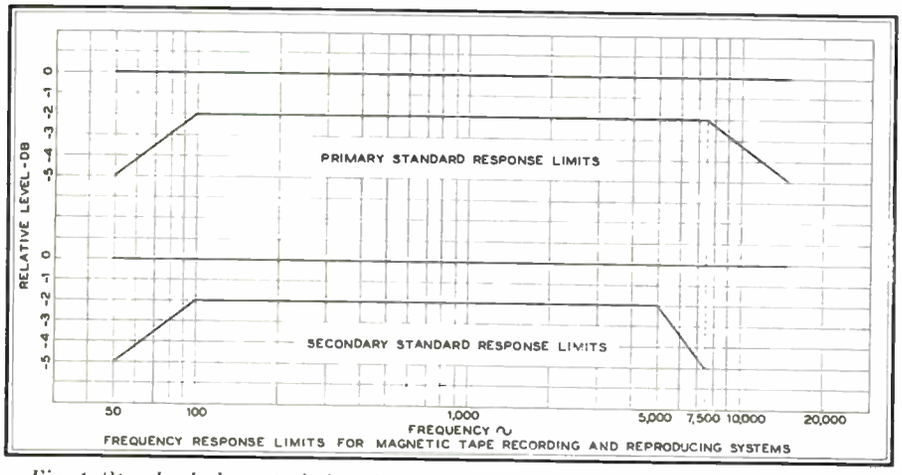
A brief review of some of the problems confronting the committee will underline the magnitude of its task. First of all, there must be agreement on the speed and physical dimensions or the recording medium. This requirements is so basic that no further explanation is needed here. Second, signals must be so recorded that the remanent magnetic induction in the recording medium at any frequency within the specified spectrum should have a definite relationship to the remanent induction at any other frequency. Only under such conditions is it possible to obtain the desired response vs. frequency with one setting of post equalization, independent of equipment on which the recording has been made. Furthermore, tape reels must be so designed that they can be attached easily to any instrument.

Very definite progress has been made in establishing standards for the physical dimensions and for the speed of the recording medium. After considerable deliberation, 3 tape speeds were chosen:

1. 15 Ins. Per Second (Primary Standard): Where high fidelity performance is required.

A magnetic recorder operating at 15 ins. per second shall provide a response which should lie between two limits. The upper limit is represented by an equal-level line from 50 to 15,000 cycles per second. The lower limit is an equal-level line from 100 to 7,500 cycles per second, but 2 db down with respect to the upper limit. From 100 to 50 and from 7,500 to 15,000 cycles per second the lower limit is permitted to drop uniformly and progressively an additional 3 db.

2. 7.5 Ins. Per Second (Secondary Standard): Where limited performance, as far as frequency range is concerned, can be tolerated.



FREQUENCY RESPONSE LIMITS FOR MAGNETIC TAPE RECORDING AND REPRODUCING SYSTEMS

Fig. 1. Standard characteristics of magnetic recorders at 15- and 7 1/2-in. speeds

Response vs. frequency of a magnetic recorder employing a tape speed of 7.5 ins. per sectond shall be similar to that of 15-in. per second equipment, only in this case the 2 db allowable level variations are restricted to the band from 100 to 5,000 cycles, while beyond 5,000 cycles to 7,500 cycles the response can drop an additional 3 db. The requirements from 100 to 50 cycles per second for 15-in. and 7.5-in. recorders are the same. Fig. 1 shows the permissible tolerances of response vs. frequency for tape speeds of 15 and 7.5 ins. per second.

3. 30 Ins. Per Second (Supplementary Standard): Wherever special requirements make an increase in speed desirable.

A few explanatory words seem to be in order here. Speeds with a ratio of 1 to 2 to 4 can easily be obtained from presently-available hysteresis motors. Should it become desirable at any later time to provide markings on the tape for speed correction to compensate for elongation or contraction, such ratios which are based on multiples will greatly simplify the problem. Furthermore, speeds of 7½ and 30 ins. per second had wide use prior to the final proposal made by the NAB Committee.

With regard to the physical dimensions of coated tape, its thickness shall not exceed .002 in., and its width shall not exceed .250 in., nor shall it be less than .0244 in. Only an upper value has been set for the thickness of the tape. There is no objection to the use of a thinner tape, as long as its mechanical strength is high enough to withstand operational stress, and as long as the coating permits sufficient storage of magnetic energy. The maximum permissible thickness of the tape determines the dimensions of the reels for any given recording time, and thus controls certain important dimensions of the equipment.

The work on standardizing reels has not been completed. This problem is aggravated by the fact that there are instruments in use which require different reel designs for proper operation. After many months of deliberation, it seems that the committee can now propose a reel which will be acceptable to all.

Much more work must still be done in setting standards for remanent induction values vs. frequency. There are so many factors which tend to change conditions that only careful consideration can bring about a satisfactory agreement.

MOBILE RADIO SERVICE

(Continued from page 13)

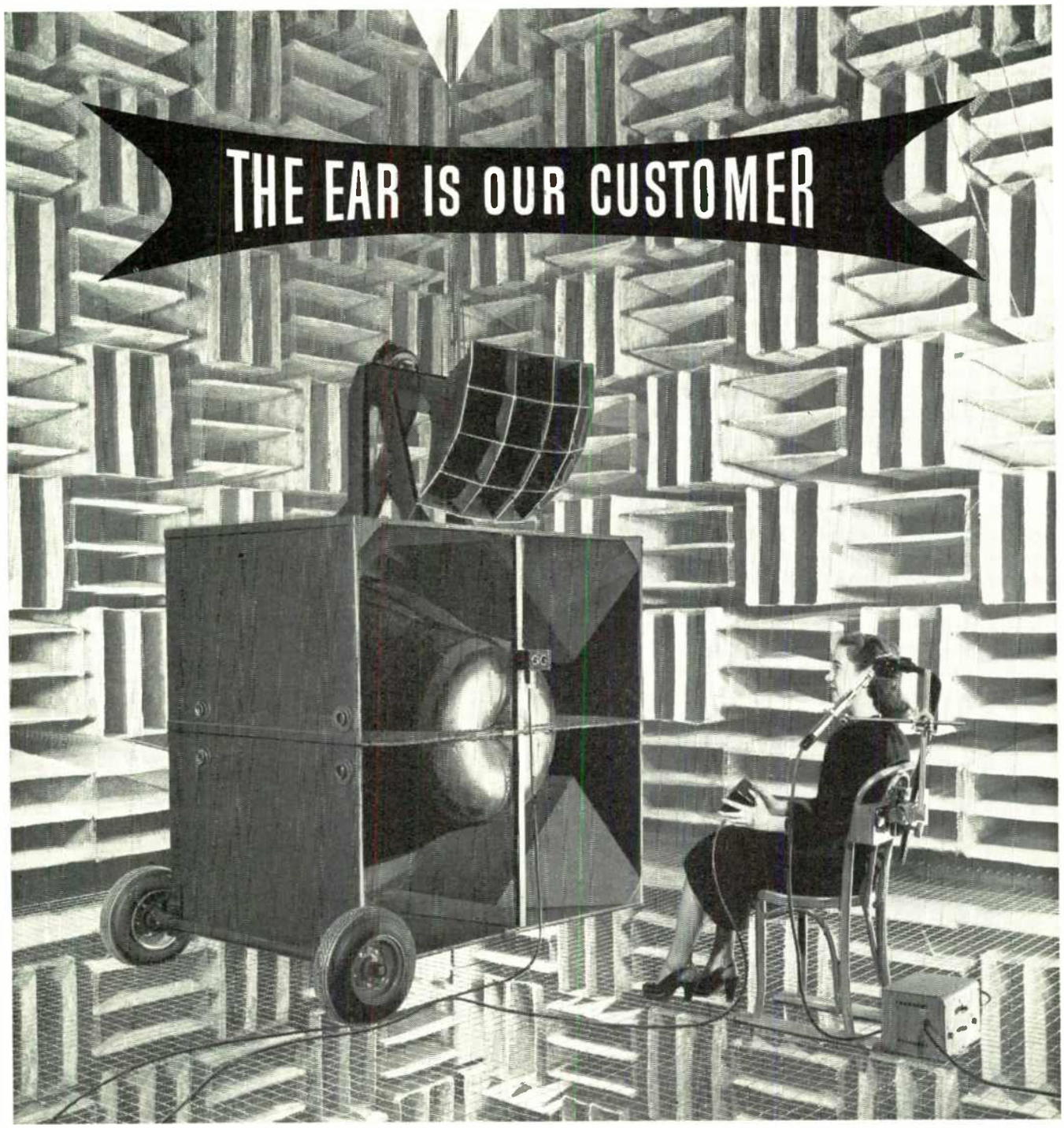
thorized to serve a particular portion of a highway, and such a station will be required to provide service without discrimination but on a cooperative maintenance basis to all bus common carriers eligible for service. A licensee rendering such service may accept contributions to capital and operating expenses on a cost-sharing basis from persons to whom such service is furnished."

Like their engineering brethren, communications counsel can help promote the most efficient spectrum use by recommending and exploiting to the fullest these arrangements for coordinated service use. Not only will such arrangements produce better frequency utilization, but experience has shown that total operating costs to all users will be substantially reduced under such arrangements.

The Value of Counsel:

As yet, there has been no particular concentration of either engineering or legal counsel in any one city, as there has been in Washington of both engineers and lawyers in the broadcast field. However, an increasing number of industrial radio users are now employing Washington counsel to keep abreast of FCC changes

(Concluded on page 36)



What happens when you hear? What happens *inside* your ear when sound waves come in from a telephone conversation?

Bell Telephone Laboratories scientists have developed special apparatus to help answer these questions, for the telephone system is designed to meet the ear's requirements for good listening.

In the test pictured above, the young lady sits before loudspeakers in a soundproofed room with a small hollow tube, reaching just inside the ear canal. Sounds differing slightly in frequency and intensity come from a loudspeaker. The subject seeks to tell one from another, recording her judgment electrically by pressing a switch.

Meanwhile, the same sound waves pass down the hollow tube to a condenser microphone, and a record is made of the exact sound intensities she identified. Results help reveal the sound levels you can hear clearly and without strain—the sounds your telephone must be designed to carry.

Scientists at Bell Telephone Laboratories make hundreds of tests in this manner. It's just one part of the work which goes on year after year at the Laboratories to help keep Bell System telephone service the finest on earth.

BELL TELEPHONE LABORATORIES

PIONEERS IN THE RESEARCH OF FM RADIO AND TELEVISION, AND ACTIVE IN DEVELOPING IMPROVEMENTS IN BOTH FIELDS TODAY.

TV STATIONS ON THE AIR

	CALIFORNIA		
LOS ANGELES	Don Lee Bcstg. Co.	W6XAO	2
	NBC	KNBH	4
	Paramount Television	KTLA	5
	Earle C. Anthony	KFI-TV	9
	Times-Mirror	KTTV	11
	KMTR Radio Corp.	KLAC-TV	13
SAN FRANCISCO	Assoc. Bcstrs.	KPIX	5
	CONNECTICUT		
NEW HAVEN	Elm City Bcstg. Co.	WNHC-TV	6
	DISTRICT OF COLUMBIA		
WASHINGTON	NBC	WNBW	4
	Allen B. Du Mont	WTTG	5
	Evening Star Bcstg.	WMAL-TV	7
	Bamberger Bcstg. Co.	WOIC	9
	FLORIDA		
MIAMI	South. Radio & Tele.	WTVJ	4
	GEORGIA		
ATLANTA	Fort Industry Co.	WAGA-TV	5
	Atlanta Journal	WSB-TV	8
	ILLINOIS		
CHICAGO	Balaban & Katz	WBKB	4
	NBC	WNBQ	5
	ABC	WENR-TV	7
	WGN, Inc.	WGN-TV	9
	KENTUCKY		
LOUISVILLE	WAVE, Inc.	WAVE-TV	5
	LOUISANA		
NEW ORLEANS	Stephens Bcstg. Co.	WDSU-TV	6
	MARYLAND		
BALTIMORE	A. S. Abell	WMAR-TV	2
	Hearst Radio	WBAL-TV	11
	Radio-Television	WAAM	13
	MASSACHUSETTS		
BOSTON	Westinghouse	WBZ-TV	4
	Yankee Network	WNAL-TV	7
	MICHIGAN		
DETROIT	Fort Industry Co.	WTVO	2
	Even. News Assn.	WWJ-TV	4
	WXYZ, Inc.	WXYZ	7
	MINNESOTA		
ST. PAUL	KSTP, Inc.	KSTP-TV	5
	MISSOURI		
ST. LOUIS	Pulitzer Pub. Co.	KSD-TV	5
	NEW JERSEY		
NEWARK	Bremer Bcstg. Corp.	WATV	13
	NEW MEXICO		
ALBUQUERQUE	Albuquerque Bcstg.	KOB-TV	4
	NEW YORK		
BUFFALO	WBEN, Inc.	WBEN-TV	4
NEW YORK	CBS	WCBS-TV	2
	ABC	WJZ-TV	7
	NBC	WNBT	4
	Allen B. Du Mont	WABD	5
	WPIX, Inc.	WPIX	11
SCHENECTADY	Gen. Electric Co.	WRGB	4
SYRACUSE	Merideth Pub. Co.	WJTV	8
	OHIO		
CINCINNATI	Crosley Bcstg. Co.	WLWT	4
	Radio Cincinnati	WKRC-TV	11
CLEVELAND	NBC	WNBK	4
	Scripps-Howard	WEWS	5
COLUMBUS	Crosley Bcstg. Co.	WLWC	3
DAYTON	Crosley Bcstg. Co.	WLWD	5
	Miami Valley	WHIO-TV	13
TOLEDO	Fort Industry Co.	WSPD-TV	13
	PENNSYLVANIA		
ERIE	Dispatch, Inc.	WICU	12
PHILADELPHIA	Philco	WPTZ	3
	Phila. Inquirer	WFIL-TV	6
	WCAU, Inc.	WCAU-TV	10
PITTSBURGH	Allen B. Du Mont	WDTV	3
	TENNESSEE		
MEMPHIS	Memphis Pub. Co.	WMCT	4
	TEXAS		
FORT WORTH	Carter Pub. Co.	WBAP-TV	5
HOUSTON	W. Albert Lee	KLEE-TV	2
	UTAH		
SALT LAKE	Intermountain Bcstg.	KDYL-TV	4
	VIRGINIA		
RICHMOND	Havens & Martin	WTVR	6
	WASHINGTON		
SEATTLE	Radio Sales Corp.	KRSC-TV	5
	WISCONSIN		
MILWAUKEE	The Journal Co.	WTMJ-TV	3

IN A RADIO SET

how small can you get?

Sylvania's four tiny new tubes hold the answer

The miniature radio set shown here is an example of what can be done through the use of Sylvania's new subminiature tubes.

These specially designed and engineered T-3 subminiatures are battery-type receiving tubes perfect for very small radios or amplifiers. Short tube leads provided in conventional pin arrangement permit these tubes to be plugged into appropriate subminiature sockets. They can be operated over a wide range of battery voltages. Low current requirements result in battery economy.

Send for complete ratings and characteristics. Sylvania Electric Products Inc., Advertising Dept., R-1605, 500 Fifth Ave., New York 18, N. Y.

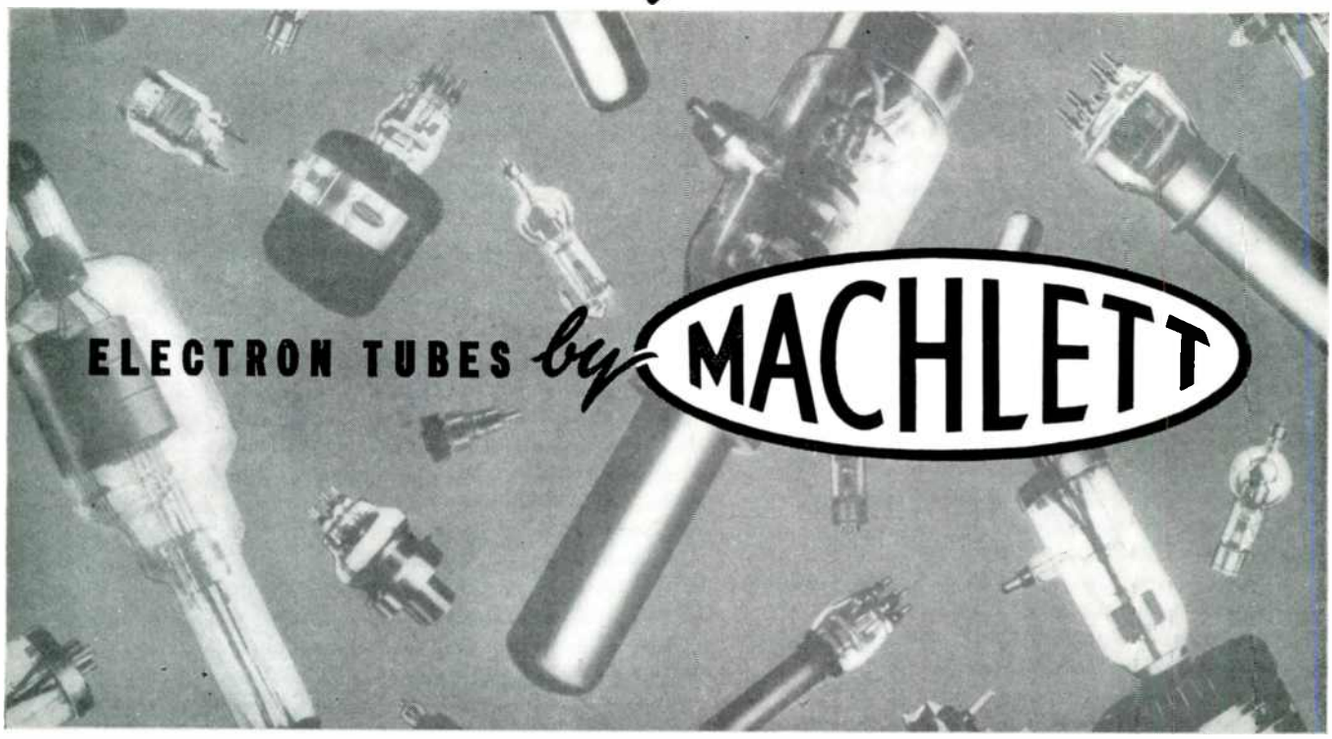
Type 1T6 (diode pentode) | Type 1E8 (converter) | Type 1AC5 (output pentode) | Type 1AD5 (RF pentode)

Four new Sylvania subminiatures shown in place in tiny radio set. Note size in relation to pencil.

SYLVANIA ELECTRIC

RADIO TUBES; CATHODE RAY TUBES; ELECTRONIC DEVICES; FLUORESCENT LAMPS, FIXTURES, WIRING DEVICES, SIGN TUBING; LIGHT BULBS; PHOTOLAMPS

Introducing A NEW TEAM



Combining Research—Development—Manufacturing Skill

Here's great news for Broadcasters. Machlett Laboratories and Graybar Electric Company have joined forces in a new distribution line-up to bring you more efficient and complete service on electron tubes.

For over 50 years, Machlett has pioneered and made notable contributions to the development of the electron tube art. Today, through its modern plant, development laboratories and skilled personnel, Machlett tubes will set the highest standard of performance in broadcast service.

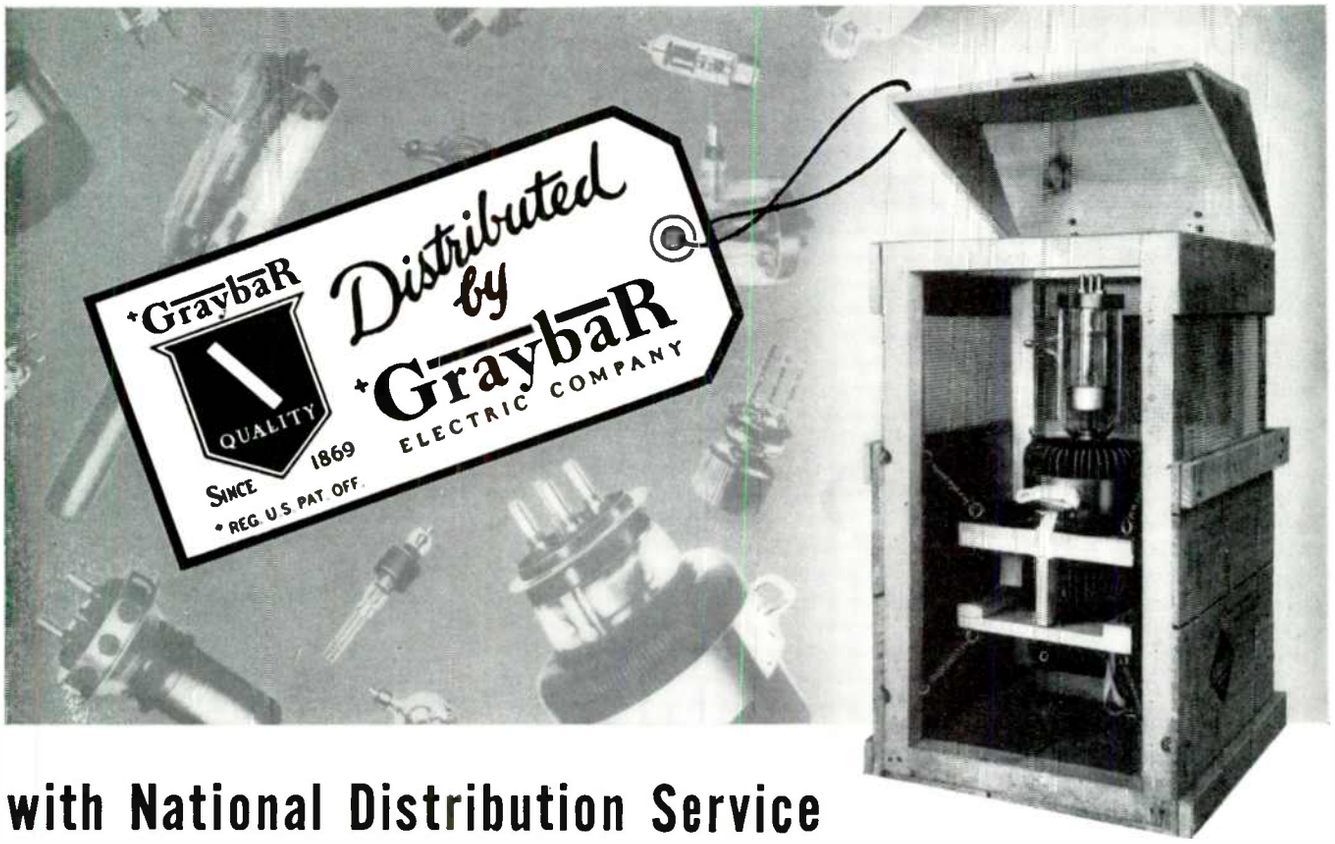
This combination of Machlett and Graybar is your best assurance of getting superior tubes. For better value—better service—try Machlett tubes now distributed via Graybar.

MACHLETT OVER 50 YEARS OF ELECTRON TUBE EXPERIENCE

Famous as the outstanding manufacturer of X-ray tubes, the name, Machlett, on electron tubes has been the mark of quality, top performance and long life for more than 50 years. Experience, skill and a "singleness of purpose" to produce the best in electron tubes have made Machlett first choice around the world.

MACHLETT LABORATORIES, INC., Springdale, Connecticut

TO SERVE BROADCASTERS . . .



with National Distribution Service

In keeping with its policy of "Bringing You Broadcasting's Best Equipment," Graybar is proud to assign its Tag—the Symbol of Distribution—to the Machlett line of electron tubes.

This new connection will bring you dual benefits: (1) products from an outstanding manufacturer of electron tubes, (2) distribution service from an organization offering specialized assistance in choosing the best type of product for your requirements.

Machlett tubes can now be quickly and conveniently ordered through near-by Graybar "Supply Stations" located in over 100 principal cities from coast-to-coast. When you order Machlett tubes "via Graybar," you'll have the right combination for extra service and performance.

Call your local Graybar Broadcast Equipment Representative. Graybar Electric Co., Inc., Executive Offices: Graybar Building, New York 17, N. Y.

EVERYTHING ELECTRICAL TO KEEP YOU ON THE AIR

via GraybaR

These are the Graybar Broadcast Equipment and Electron Tube Specialists in key cities:

ATLANTA
E. W. Stone, Cypress 1751

BOSTON
J. P. Lynch, Kenmore 6-4567

CHICAGO
E. H. Taylor, Canal 4104

CINCINNATI
J. R. Thompson, Main 0600

CLEVELAND
W. E. Rockwell, Cherry 1360

DALLAS
C. C. Ross, Central 6454

DETROIT
P. L. Gundy, Temple 1-5500

JACKSONVILLE
W. C. Winfree, Jacksonville 5-7180

KANSAS CITY, MO.
R. B. Uhrig, Grand 0324

LOS ANGELES
R. B. Thompson, Trinity 3321

MINNEAPOLIS
W. G. Pree, Geneva 1621

NEW YORK
F. C. Sweeney, Watkins 4-3000

PHILADELPHIA
G. I. Jones, Walnut 2-5405

PITTSBURGH
R. F. Grossett, Court 4000

RICHMOND
E. C. Toms, Richmond 2-2833

SAN FRANCISCO
K. G. Morrison, Market 5131

SEATTLE
D. I. Craig, Main 4635

ST. LOUIS
J. P. Lenkerd, Newstead 4700

MOBILE RADIO SERVICE

(Continued from page 30)

in rules and frequencies, as well as in handling their applications for new facilities and renewals. The FCC's more restrictive industrial eligibility Rules makes the employment of counsel of particular importance in the presentation of initial applications. This may often serve to prevent disappointment to a particular applicant who may have only a marginal case for regular radio authorizations, and needs assistance in the presentation of his qualifications. The assistance of counsel in handling applications and reporting FCC developments and requirements also serves to free the equipment manufacturers of this work which they have had to assume in the past.

The role of the trade journal in the communications field is also destined to be of ever greater significance. With communications purposes, the non-broadcast industry is fast moving into to a wide variety of users for operational greatly increased frequency assignments an area of great need for mass technical education. It is no longer sufficient for the radio supervisors of the big railroad, oil, or power utility companies to keep abreast of technical developments. Now the radio serviceman of the small lumber company or taxi company must also be considered. FCC developments must be simply and accurately reported, as well as the technical developments of the art.

If any general guidance may be vouchsafed in this field of mass radio use, it would appear to be that any prospective radio user contemplating an equipment investment of any considerable extent should consider carefully the advisability of independent engineering and legal advice on the technical and regulatory developments in this rapidly-changing and complex field. Only in that way can safety and industrial radio communications be maintained at high efficiency.

FMA SALES CLINIC

(Continued from page 16)

sell more by using them.

Wouldn't I look silly going to one of my clients and saying: "Mr. X of the fourth largest market in the country was in to tell me about his new FM station. He doesn't quite know how he is going to program it yet, nor how many sets there are in the area, nor how many listeners he has among those sets, but he'd like to carry your campaign. How about taking a percentage of our budget, say $100,000, and trying FM through the country?"

I'd be looking for a new job so fast it wouldn't be funny. We, as advertising ageney people, are supposed to make

(Continued on page 38)

FMA SALES CLINIC

(Continued from page 36)

recommendations with some authority. The days of spending just to spend money are over.

Pulling Teeth Is Easier:

There were 700 FM stations on the air as of January 1, 1949. That sounds very important, and it's my business to investigate and determine whether I should include some in my recommendations. The first thing I do is to go through the *Standard Rate* and *Data Book* to find out such facts as the locations of these stations, their costs, and any published details regarding their operation. Here is what the rate book revealed:

Of the 700 stations said to be in operation, only 326 are listed in the book. From this 326 I deduct the 156 whose AM-FM programs are duplicated, and many of which we are using; 7 that do not sell time; 1 that has ceased broadcasting; and 11 who either had not sent in listings or whose listings were received too late. This leaves 151.

It then appears that if I had a wonderful client who would let me pay with his money and ask no questions, I could use 151 stations. However, of these, 4 say: "rates not yet determined." What shall I do? Call and help them out? Next, 14 say: "consult management" or "rates on request." How do I know that Joe Doakes locally won't be paying half of what I'm quoted? Seven say: "see network listing." I'd have to take all. Eight say they are available at a percentage of the AM rate, and these percentages vary. Eighteen state that they broadcast with AM, but when they don't a charge is made (but don't mention the charge) or that a discount is allowed when both FM and AM are used.

So here I'm confused 51 times, and I just drop those 51 stations. That leaves me with 100 stations on which rates are published. Of these, 45 have no New York representatives. Twenty-four operate part time and indicate the hours; 12 operate full time; 9 do not indicate the hours they are on the air. That means I must write to 45 stations to get programming, coverage, and other information.

Of the 55 stations with New York representatives, 30 operate part time, 19 full time, and 6 show no schedule.

FM Stations Must Compete:

It has always seemed strange to me that so many owners of FM stations have so little confidence in its future. I can't see that any doors have been closed to FM by advertisers, agencies, manufacturers, retailers, or the public.

I mentioned earlier that many forms of media compete for the advertisers' dollars. This competition grows greater daily. If I were a client, I certainly wouldn't spend months making an effort to buy a specific medium on which I did not have the necessary information when, during those months, I might more easily be running on stations that could give me the facts I needed, or running in newspapers.

I don't want anyone to get the impression that I'm being super-critical of FM, nor any more critical than of any medium we investigate and analyze for our clients. And from an observation of the few things that have come my way, I would not be surprised at all to find that the FM stations have an even better story than has been told to date.

DIRECTORY OF COMMUNICATIONS SYSTEMS

Copies of **FM - TV** for January, 1949, containing the directory of radio systems operated by taxis, public utilities, and special services are still available.

This issue also contains the complete specifications of all makes of communications equipment.

PRICE 25c

FM-TV MAGAZINE
Great Barrington, Mass.

Advertisers' Index

Follow the Leaders to

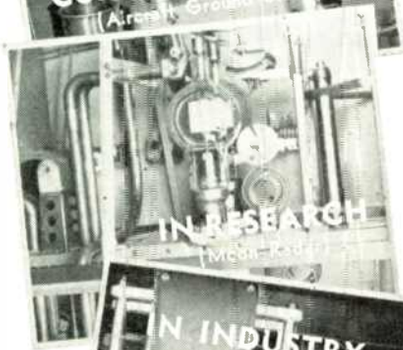
Eimac TUBES

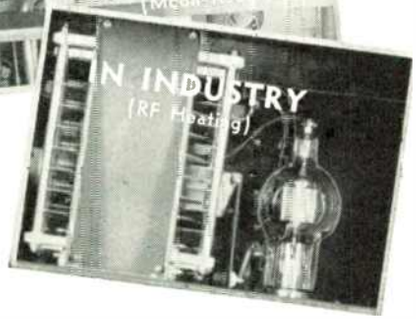
The Power for R-F

Today, ever increasing demands for the famous Eimac triodes keep assembly lines producing record-breaking quantities.

Proven Acceptance

EIMAC
TYPE 450TH





Many years of reliable service in many types of application have established the Eimac 450T as the standout triode in its power class.

Recent technical achievements make the 450T a still better tube. Adoption of the Pyrovac plate and a non-emitting grid have amplified this already rugged tube's ability to "take it." Life expectancy and overload handling qualities have been increased multifold.

Comprehensive technical data on the Eimac 450T are immediately available . . . write direct.

EIMAC TYPE 450TH
ELECTRICAL CHARACTERISTICS

Filament: Thoriated tungsten	
Voltage	7.5 volts
Current	12.0 amperes
Amplification Factor (Average)	38
Direct Interelectrode Capacitances (Average)	
Grid-plate	5.0 μμfd.
Grid-filament	8.8 μμfd.
Plate-filament	0.8 μμfd.
Transconductance (I_b = 500 ma., E_b = 4000v.)	6650 μmhos

MAXIMUM RATINGS
Radio Frequency Power Amplifier and Oscillator
Class-C Telegraphy (Key-down conditions, 1 tube)
Frequencies below 40 Mc.

D-C Plate Voltage	6000 Max. Volts
D-C Plate Current	600 Max. Ma.
Plate Dissipation	450 Max. Watts
Grid Dissipation	65 Max. Watts

EITEL-McCULLOUGH, INC.

728 San Mateo Ave., San Bruno, California

Export Agents: Frazar & Hanser, 301 Clay St., San Francisco, California

217

SHREVEPORT

another city goes ALL *Federal*

Commissioner of Public Safety A. B. "Kotton" Morris (left) and Chief of Police E. G. "Ed" Huckabay making initial call over the new Federal FM 2-way mobile radiotelephone system installed at Shreveport, La.

New Federal Mobile FM Radio System serves Police, Fire and Water Departments . . . another example of how a complete Federal system can provide efficient communications service for every type of operation.

Fire Chief Floyd Kendrick (left) and Deputy Fire Chief H. C. Winbery make their first report through the new FM radio facilities.

Federal does it again . . . installs another comprehensive system of radio protection for an entire municipality . . . in Shreveport, La.

Federal Mobile FM Radio equipment was specified as best suited in every way to convert Shreveport's AM network to modern FM operation. The new Shreveport installation, which ranks with the finest in the country, comprises a 250-Watt Federal FM Transmitter and 40 Federal Mobile FM Transmitter-Receiver Units in fire apparatus, police cruisers, official cars, maintenance trucks and Water Department vehicles. And Federal has extended coverage to police cruisers in nearby Bossier Parish.

The same comprehensive coverage, provided at Shreveport by Federal Mobile FM Radio equipment, is available for every type of communication need—not only for municipalities but for taxi companies, bus lines, public utilities, lumber camps, pipelines and other fleet operations. For information, write to Department 1-920.

Fire Alarm maintenance truck is equipped for faster service with a Federal Transmitter-Receiver unit.

A typical Federal Mobile Transmitter-Receiver Unit.

Federal's Complete Line of Communication Equipment Includes

MICROWAVE RADIO LINKS

Federal Microwave Radio Links may be integrated with existing or contemplated mobile radio systems to provide coordinated radio coverage of a large metropolis ...statewide mobile radio networks...or to extend the range of mobile operations over the entire communication circuits of pipelines, public utilities, and other government and private services.

FTR An IT&T Associate

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

Federal Telephone and Radio Corporation

100 KINGSLAND ROAD, CLIFTON, NEW JERSEY

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

what Motorola's "GOOD NEIGHBOR POLICY" means to you...

Motorola I.D.C. —Instantaneous Deviation Control

ANOTHER MILESTONE ALONG THE ROAD TOWARD ADJACENT CHANNEL OPERATIONS

Motorola Instantaneous Deviation control eliminates the severe nuisance interference that develops from channel "spill-over" by means of a new slope limiting device now an integral part of all currently manufactured Motorola transmitters. I.D.C., applied universally, will make close channel occupancy practicable. It is an *absolute solution*—not a conventional compressor amplifier or clipper-limiter compromise. Motorola's I.D.C. requires no "attack time," but controls carrier excursions instantly.

Motorola I.D.C. is available in kit form for all existing Motorola transmitters—mobile and base station. By installing I.D.C. in your transmitters—and urging your channel neighbors to reciprocate, you can enjoy new efficiency of communication.

what I.D.C. does for you

In addition to the "Golden Rule" benefits at left, I.D.C. gives you:

1. Eliminates the reduction of maximum range or received energy level normally caused by over-modulation.
2. New versatility in transmitter speech circuits. Optimum setting of modulation level will allow satisfactory modulation by female or deep-voiced male dispatchers.
3. New freedom from background noises. (Microphone can be held close to lips as I.D.C. tolerates wide ranges of volume.)

NEW PROOF OF MOTOROLA'S LEADERSHIP!

Years ahead again! Motorola I.D.C. today brings your equipment into compliance with FCC regulations drafted for effect on July 1, 1950.

MAIL THIS COUPON TODAY

Motorola Inc. Communications Div.
4545 Augusta Blvd., Chicago 51, Illinois
Dept. FM & T-Ma

Please send me additional information on Motorola I.D.C.

NAME _____

COMPANY _____

POSITION _____

ADDRESS _____

CITY _____ STATE _____

Motorola

FM 2-WAY RADIO

MOTOROLA: *World leader in mobile 2-way radio communications*

Canadian Distributor: Rogers Majestic Ltd., Toronto - Montreal