FM AND TELEVISION

Price 25 Cents

May 1948

★ ★ *Edited by Milton B. Sleeper* ★ ★

WEST COAST FM STATION

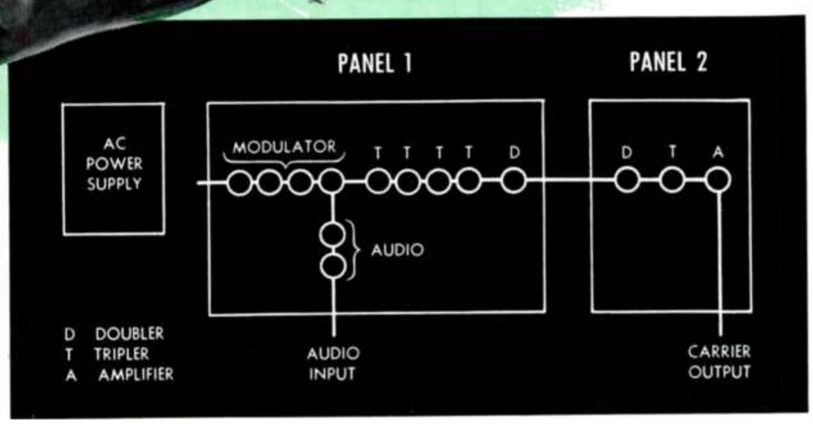
8th Year of Service to Management and Engineering

Super Phase Shift Modulation

THE REL SERRASOID MODULATOR

CHARACTERISTICS:

1. The signal to noise ratio for 75 KC deviation is approximately 80 db.
2. Harmonic distortion over the audio range from 50 to 15,000 cycles is substantially less than .25%.
3. Employs only 11 receiving type tubes from crystal oscillator to carrier frequency in the 88 to 108 mc band. No special or expensive tubes are used.
4. Direct crystal control—no complicated electronic frequency correcting circuits nor mechanical gadgets are required.
5. The total power drawn from the AC lines is less than 125 watts.
6. The two units comprising the modulator, occupy only 19¼" of standard rack space.
7. The approximate weight of the two units combined is 70 lbs.
8. Can be used as an exciter for any make of FM Broadcast Transmitter.



SPECIFICATIONS:

1. Direct crystal control.
2. Modulation process involves 4 receiving type tubes operated at saturation, and aperiodically (no tuned circuits).
3. FM noise—approximately 80 db. below 100% modulation.
4. FM distortion less than 0.25% for all modulating frequencies from 50 to 15,000 cycles at 100% modulation. Intermodulation products negligible.
5. Carrier frequency stability ±.0003%.
6. Frequency response ±0.5 db. from 50 to 15,000 cycles.
7. Modulation input +10 dbm. (±2 db.) for 100% modulation.

Unquestionably the *SERRASOID MODULATOR* is one of the most significant advances in FM equipment ever announced. Employing an entirely new approach to the generation of FM signals under the Armstrong Phase Shift principle, the *SERRASOID MODULATOR,* virtually eliminates the individual transmitter as a factor in controlling the quality of an FM system.

The separate and distinct functions of modulation and carrier frequency control are secured with only four tubes and without the use of critical circuits or adjustments—the balance of the RF portion of the unit comprises simple frequency multiplier stages. Convincing evidence of the outstanding performance and economy of this unit is presented in the list of characteristics above.

That REL developed this equipment is in keeping with the established tradition of REL *Reliable Engineering Leadership.* This leadership, acknowledged throughout the industry, is the direct result of over 14 years of application to the exclusive task of advancing the art of FM transmission and reception. Literature covering REL equipment will be supplied promptly on request.

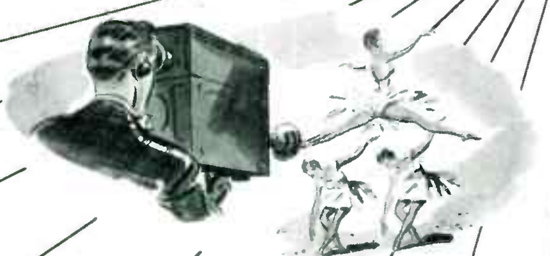
REL RADIO ENGINEERING LABS • INC

LONG ISLAND CITY 1 • NEW YORK

WELDON & CARR

CONSULTING RADIO ENGINEERS

WASHINGTON, D. C. DALLAS, TEXAS



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★ ★ Edited by Milton B. Sleeper ★ ★

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

VOL. 8 MAY, 1948 NO. 5

CONTENTS

MILTON B. SLEEPER, *Editor and Publisher*

CHARLES FOWLER, *Business Manager* RICHARD H. LEE, *Advertising Manager*
STELLA DUGGAN, *Production Manager* LILLIAN BENDROSS, *Circulation Manager*

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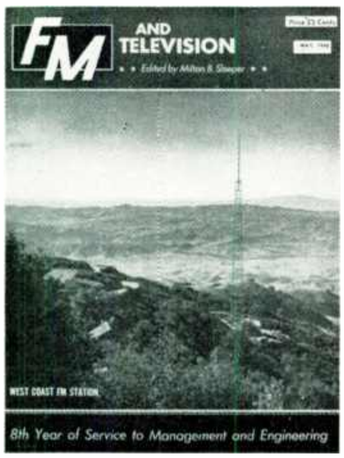

THIS MONTH'S COVER

When FM broadcasting first started, west coast operators generally expressed the view that AM conditions there were so good that FM would offer no advantages.

During the last year, however, that attitude has changed completely. Soon there will be more FM stations in the west than in the east!

An outstanding contributor to FM progress is Eitel-McCullough, from whose plant in San Bruno, near San Francisco, have come essential tube developments. The station shown on this month's cover atop Mt. Diablo, engineered and owned by Eimac, is the first 50-kw. transmitter on the air in the upper band.

Entered as second-class matter, August 22, 1945, at the Post Office, Great Barrington, Mass., under the Act of March 3, 1879. Additional entry at the Post Office, Concord, N. H. Printed in the U. S. A.

MEMBER, AUDIT BUREAU OF CIRCULATIONS ABC

WHAT'S NEW THIS MONTH

1. March Set Production
2. Radio Production in 1947
3. BBB Looks at Repair Racket
4. The American Way

1. RMA figures on the production of home radios show a total increase for FM, AM, and TV models during January, February, and March, 1948 of 29,791 as compared to the same months in 1947. The increase is in FM and TV, however, for AM sets are down 335,560 in this 1948 period, compared to 1947.

On this quarterly basis, TV sets climbed 99,708, while FM models are now up 265,643, as indicated in this month's Production Barometer. FM sets produced since January 1, 1947 are 1,612,000, and TV sets total 296,000. These totals do not include TV kits and FM tuners.

FM and TV continue to gain in dollar volume over AM. In consoles and phono combinations, the March FM production was 98,382, exceeding the combined figure of 14,304 for TV and 75,143 for AM. Thus, with only 5% of the AM sets in console cabinets, it is clear that AM has degenerated definitely to cheap table models of indifferent performance.

2. RMA figures just released for 1947 broadcast transmitter and studio equipment sales - FM, AM, TV - total $24,915,000 for domestic use, plus $1,853,000 for export. Domestic sales were made up as follows: FM $4,471,000; AM $5,762,000; TV $5,304,000.

Sales to the U.S. Government by RMA members came to $85,782,000 for shipboard use; $26,563,000 for aircraft; and $23,278,000 for other purposes.

Domestic sales of transmitters to airlines came to $3,071,000 for aircraft and $212,000 for ground use.

Reports on communications equipment are incomplete, since some of the principal manufacturers in this group are not RMA members. The published figure is only $5,309,000 for VHF equipment. There is no informa-

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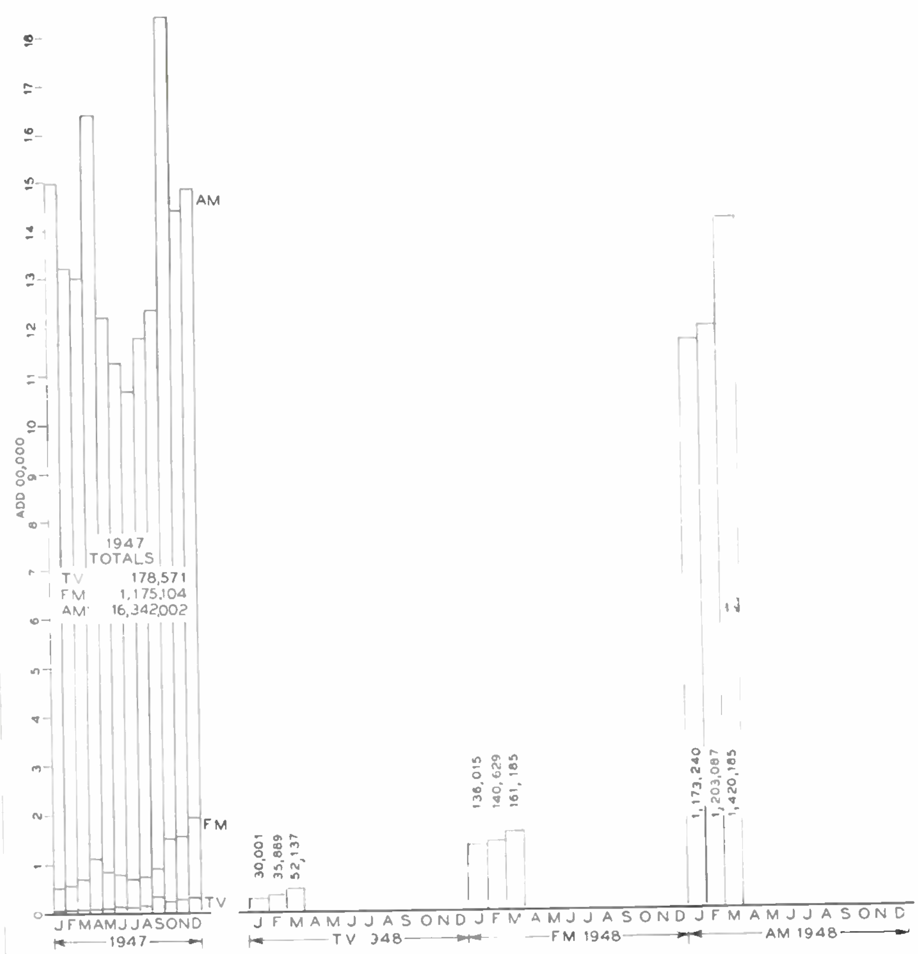
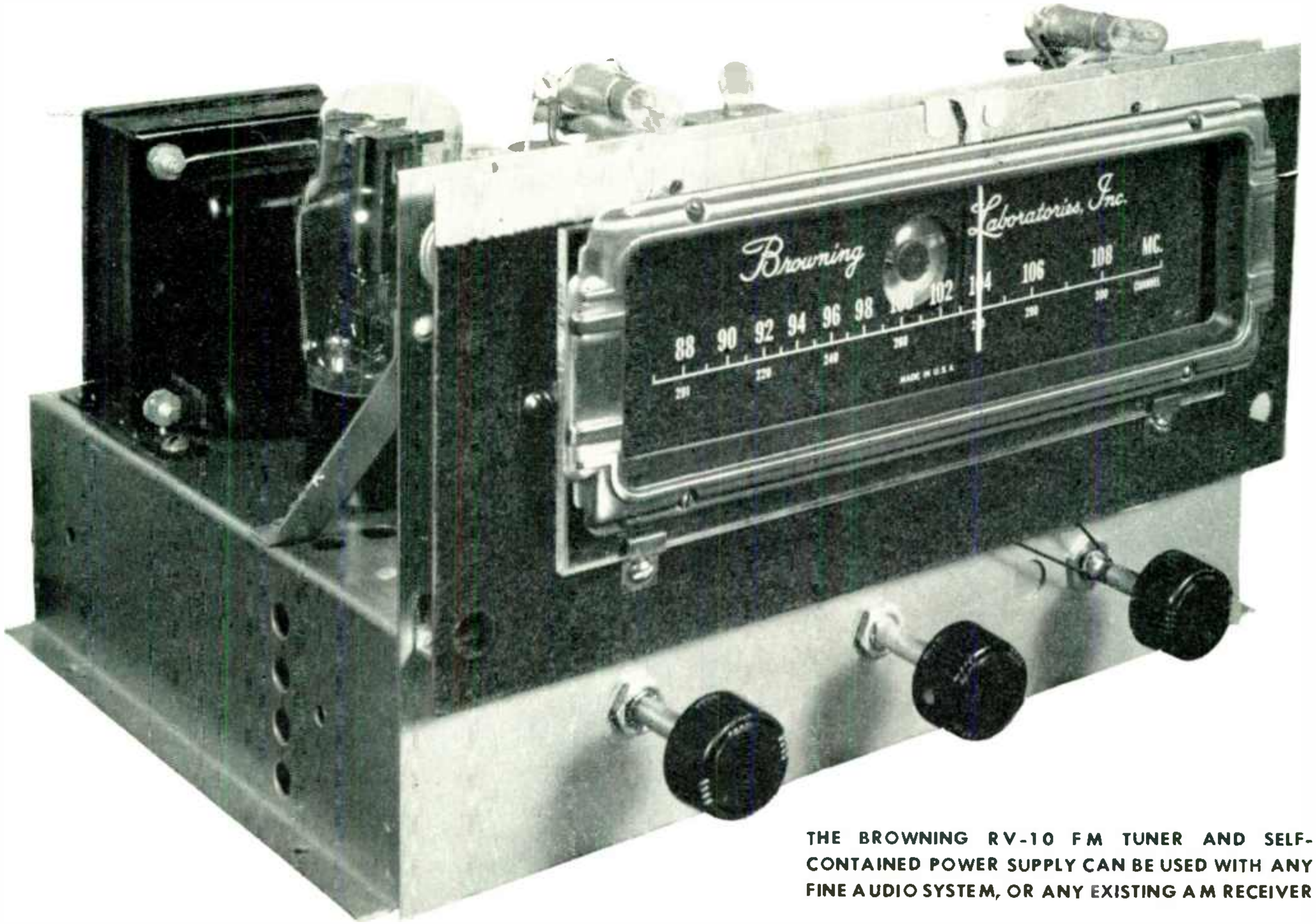


FM-AM-TV Set Production Barometer, based on monthly figures released by the RMA



THE BROWNING RV-10 FM TUNER AND SELF-CONTAINED POWER SUPPLY CAN BE USED WITH ANY FINE AUDIO SYSTEM, OR ANY EXISTING AM RECEIVER

There Are Good Reasons Why the Browning RV-10 Will Give You

FOUR-WAY IMPROVEMENT ON FM

HERE'S AN EASY WAY to prove to your own satisfaction the 4-point superiority of the BROWNING RV-10 FM Tuner:

Connect the output of the RV-10 to the phonograph input of any receiver, regardless of price. Then listen to the same programs on the same amplifier and speaker, switching from the BROWNING Tuner to the other. Hear for yourself the superiority of the RV-10 on these 4 points:

1. More Stations, because BROWNING design, engineered for engineers, gives a degree of sensitivity that responds to signals that can't be heard on ordinary FM sets.

2. Less Noise, because the perfected circuits of the RV-10 give full limiting action on 7 microvolts signal input. In other words, signals too weak to operate the limiter on other sets come in clear and clean with the BROWNING Tuner.

3. No Drift, because the RV-10 has a compensating circuit that offsets detuning as the components are warmed by the heat of the tubes.

4. Better Audio Quality, because the Armstrong circuit in the BROWNING Tuner delivers a clean signal to the amplifier. While it is not generally recognized, the tuning circuits make a vast difference in tone quality. You'll be surprised when you switch to the RV-10!

Add to these advantages the very moderate cost of this finer performance, and you'll have five reasons for getting complete details and prices on BROWNING Tuners for cabinet or rack mounting. Write TODAY.

BROWNING LABORATORIES, INC.

750 MAIN STREET, WINCHESTER, MASSACHUSETTS

In Canada, Address: MEASUREMENT ENGINEERING, Ltd., Arnprior, Ontario

TELENOTES

WTVR Richmond:

Havens & Martin station at Richmond, Va., is on the air from Tuesday through Sunday. Test-pattern transmission starts at 3:00 p.m. and the final program signs off at 9:30 each evening.

TV Transmitting Equipment:

Raytheon has announced a complete line of television studio and transmitting equipment. Three packaged designs are offered: 1) 500-watt repeater station costing about $50,000, 2) a similar installation plus a single camera chain and film projector at about $75,000, 3) a complete basic station with more elaborate studio equipment at $95,000, and 4) a de luxe installation including microwave units for remote pickups at about $135,000. A 5-kw. amplifier unit can be added for higher power.

Syndicated TV Newsreel:

WPIX is offering a daily syndicated newsreel to TV stations outside the New York area. Production will start about June 15, when WPIX is scheduled to go on the air. The 16-mm. film, accompanied by script and music cue sheets, will run nine minutes.

Price-Cutters Get Cut:

Three dealers have been disfranchised by DuMont recently for cutting prices and transshipping sets. Said general manager Ernest Marx of DuMont's receiver division: "The strangest part of the situation is that these malpractices have occurred where the demand for telesets has been greater than the supply!" Those old price-cutting habits are deeply ingrained in some dealers.

WBZ-TV Boston:

When WBZ's new tower is completed, it will be the tallest man-made structure in New England. The tower will be 572 ft., on top of which there will be an 84-ft. mast carrying both TV and FM antennas. Construction was delayed by the severe winter weather, but it is now going ahead rapidly.

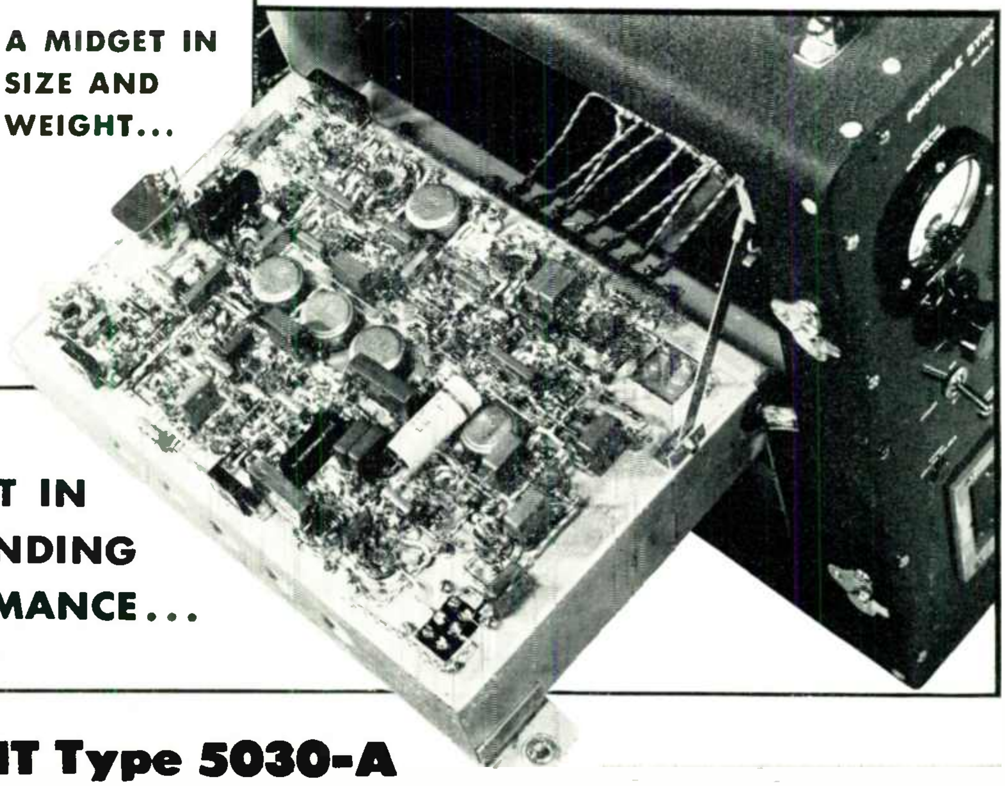
Frederick D. Ogilby:

Appointed to the newly-created post of manager of television sales at Philco. For the past year, he has been sales manager of Philco's radio division.

WBEN-TV Buffalo:

TV dedication program was transmitted on May 14 from the first station north of Schenectady. Regular programming will continue.

A MIDGET IN SIZE AND WEIGHT...



A GIANT IN OUTSTANDING PERFORMANCE...

DU MONT Type 5030-A

Portable Synchronizing Generator

Here's the smallest commercially available R.M.A. type television synchronizing generator. Notwithstanding its small size, it embodies the most advanced engineering design currently featured in equipment of this type.

No compromise in performance has been made in order to obtain portability. Also, its inherent stability, performance standards and ease of operation make it ideally adapted for field use.

In addition, it can serve as the source of synchronizing signals for all types of television work, such as testing transmitters, experimental television development, and laboratory work of an allied nature.

The *miniaturized components* and *careful construction techniques*, as well as *extreme accessibility*, make the Du-Mont Type 5030-A Portable Synchronizing Generator not only ideal from an engineering standpoint, but mark it as a dependable unit of television equipment.

Technical details on request. Let us collaborate on your television problems and requirements.

FEATURES...

Completely self-contained. Requires only a-c power. Provides mixed driving, blanking and synchronizing signals.

Master oscillator can be locked to the 60 cycle line or run completely free.

Complies with all important R.M.A. recommendations for television synchronizing generators.

Provides half-line driving pulses for utilization of differential delay techniques necessary for long camera cable hookups.

Stability of countdown and pulse width of composite signal are essentially independent of tube changes.

Rise time of pulses equal to or better than that of all other commercially available equipment of this type.

Regulated power supplies and autotransformer primary inputs make the unit independent of line voltage variations.

Construction techniques and availability of components without equal for portable synchronizing generators.

Dimensions: 9¼" w., 17⅛" h., 19½" l. Weight: approx. 50 lbs.

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. • DU MONT'S JOHN WANAMAKER TELEVISION STUDIOS, WANAMAKER PLACE, NEW YORK 3, N. Y. • STATION WTTG, WASHINGTON, D. C. • HOME OFFICES AND PLANTS, PASSAIC, N. J.

PRODUCTS & LITERATURE

So many new instruments, components, and materials are being brought out that space does not permit us to publish illustrated descriptions of them all. Accordingly, rather than selecting a few each month, we have established this new department of Products & Literature so that a great number of brief descriptions can be published. From these, you can select items which interest you, and send for catalogs or bulletins. We'll appreciate it if you will mention FM and TELEVISION in your requests.

NOISE-SUPPRESSING AMPLIFIERS: Three new types employing H. H. Scott dynamic noise-suppressor circuits. Bulletin 8. Minnesota Electronics Corp., 200 Openheim Bldg., St. Paul, Minn.

TELEVISION RECEIVER: Table model type GV260, television only. Bulletin 19, Farnsworth Television & Radio Corp., Ft. Wayne, Ind.

TOWER-LIGHT SWITCH: Automatic type, with photo-electric cell operated by sky illumination. Bulletin A110. Fisher-Pierce Co., 72 Ceylon St., Boston 21, Mass.

PLUG-IN RELAYS: Small DC series, octal base, series J. Bulletin 961. C. P. Clare & Co., 4719 W. Sunnyside Ave., Chicago 30.

COMPONENTS: 80 pages of dimension drawings and design details on condensers, rectifiers, resistors, contact points, tap switches, jacks, plugs, and vibrators. Catalog 88B. P. R. Mallory & Co., Indianapolis 6, Ind.

SCREWDRIVERS: All types for all purposes. Also plastic hammers, screw-holders, nut-drivers. Catalog 17. Vaco Products Co., 317 E. Ontario St., Chicago.

TELEVISION SERVICE MANUAL: Volume 1, containing manufacturers' data on TV sets and kits, 1,350 pages. Price not announced. John F. Rider, Publisher, 404A Fourth Ave., New York 16.

TIME SWITCHES: Heavy-duty types, single, double, triple pole, single or double throw. Bulletin TS31. Sangamo Electric Co., Springfield, Ill.

BROADCAST EQUIPMENT: Catalog of over 250 pages listing AM, FM, TV, transmitters, studio equipment, and associated apparatus. Catalog BE250. RCA Victor Division, Camden, N. J.

FM-AM CHASSES: Models 512 and 511, designed for custom-built installations. Bulletin FA5. Espey Mfg. Co., Inc., 528 E. 72nd St., New York 21.

COAXIAL BARRETTER MOUNTS: For VHF power measurements. 4 frequency ranges from 2,500 to 3,300 mc. Bulletin BCV. Sperry Gyroscope Co., Great Neck, N. Y.

FM-AM RECEIVER: Table model employing miniature tubes. Plastic cabinet. Model H-182. Bulletin 652. Westinghouse Electric Corp., 306 Fourth Ave., Pittsburgh 30.

SHAKEPROOF TERMINALS: Catalog showing several hundred types of self-locking terminals, with dimension drawings of each. 72 pages. Catalog TS. Shakeproof, Inc., 2501 N. Keeler Ave., Chicago 39.

LOUDSPEAKERS: Two new wide-range designs, models SP8JW and SP12LW, 8 and 12 ins. in diameter, respectively. Bulletin 12B. Utah Radio Products, Huntington, Ind.

SPECTRUM ANALYZER: Has 3-in. oscilloscope and associated circuits for analyzing FM and TV signals on 30 to 300 mc. Sensitivity of 200 microvolts permits operation directly from antenna. Bulletin VHA. Kay Electric Co., Pine Brook, N. J.

LOUDSPEAKERS: New models listed as 604B Duplex, 603B Multicell Diacone, 600B Diacone, and 8-in. Diacone. Bulletin 98. Altec Lansing Corp., 250 W. 57th St., New York 19.

152-MC. ANTENNA: Car-top design for mobile communications transmission and reception. Features easy installation and water-tight mounting. Bulletin LWA. L. S. Brach Mfg. Corp., Newark, N. J.

COMPONENTS: 46-page catalog with dimension drawings and design data on

(Concluded on Page 13)

For Certified Performance...

PERFORMANCE CERTIFIED BY MORE THAN 400 MAJOR INSTALLATIONS

SEAL-O-FLANGE*
AIRCORE*
TRANSMISSION LINES

*TRADE MARKS REGISTERED

...for AM-FM and TV

Seal-O-Flange Transmission Lines incorporate exclusive features that have practically revolutionized previous concepts of coaxial line installation and operating efficiency. They eliminate special sections—anti-creep devices, anchor sections, differential expansion fittings — completely. Gas-tight seals are attained without the use of torches or painstaking cleaning operations. The only tool required to assemble these lines is a pair of small hand wrenches—an important factor when working on a tower. Seal-O-Flange performance is time-proven in over 400 major installations all over the world.

Seal-O-Flange Transmission Lines are sold by RADIO CORPORATION of AMERICA and GENERAL ELECTRIC COMPANY. They are distributed nationally by GRAYBAR ELECTRIC CO., and internationally by WESTREX CORPORATION.

Small hand wrenches are the only tools required to assemble a SEAL-O-FLANGE line.

Differential expansion is automatically compensated at 20 foot intervals in SEAL-O-FLANGE lines.

Gas seals are permanent weather-proof, immune to temperatures from -40°F to 150°F.

Inner conductor is securely anchored inside each section for fixed electrical characteristics.

Communication Products Co., Inc.

KEYPORT · NEW JERSEY

C-P

C-P PRODUCTS ON DISPLAY See them at Room 2217, Biltmore Hotel in Los Angeles. NAB Convention May 17 to 21st

You get feedback at its finest . . . in Western Electric equipment

WHILE stabilized feedback is now accepted as an indispensable technique in the communications art, *actual design* of a stabilized-feedback amplifier calls for painstaking mathematical analysis and control of phase and gain characteristics over a wide frequency spectrum. *Without such control, feedback may introduce new faults more objectionable than those eliminated.* The extensive experience of Bell Laboratories engineers gives to the users of Western Electric equipment assurance that the outstanding advantages of feedback will actually be realized.

Assurance of Quality Performance

As used in all Western Electric Audio Amplifiers (except one-tube pre-amplifiers) properly applied stabilized feedback insures flatter gain-frequency characteristic and automatic suppression of noise and distortion arising from sources within the amplifier. In new loudspeaker amplifiers (which include the output coil within the feedback loop), output impedance is so low that matching to multiple loudspeakers is as simple as adding lamps to a lighting circuit.

Flat Frequency Response

Flat frequency response is maintained in Western Electric AM Transmitters by stabilized feedback actuated by the final radio frequency output. Hence attenuation of high modulating frequencies is virtually eliminated. No hum suppression circuits are needed, because of reduction of noise and distortion from all sources, including final amplifiers.

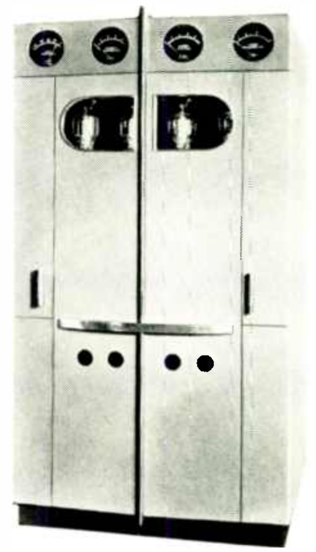
Stabilized feedback, correctly applied, is just one of the factors in the outstanding performance of Western Electric Amplifiers and AM Transmitters. For *full* information on all operating features, call your local Graybar Broadcast Representative, or write Graybar Electric Company, 420 Lexington Avenue, New York 17, N. Y.

Correctly applied feedback gives you these advantages

IN AMPLIFIERS

Feedback *as you want it* keeps gain virtually constant in Western Electric Audio Amplifiers — cuts noise and distortion down to a minimum.

IN AM TRANSMITTERS



Feedback designed by Bell Laboratories does away with need for hum suppression circuits — maintains flat frequency response.

–QUALITY COUNTS–

Western Electric

Manufacturing unit of the Bell System and the nation's largest producer of communications equipment.

Distributed by GraybaR — OFFICES IN 95 PRINCIPAL CITIES

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

PRODUCTS & LITERATURE

(Continued from Page 8)

sockets, plugs, jacks, terminal strips, binding posts, knobs, photocells, and relays. Bulletin EH. Hugh H. Eby, Inc., 4768 Stenton Ave., Philadelphia.

CATHODE-RAY TUBE: Type RCA-5WP15 flying spot type for transmitting station call letters and test patterns from interchangeable slide transparencies or from opaque surfaces. Bulletin BSR. RCA Victor Division, Harrison, N. J.

ALIGNMENT GENERATOR: For visual alignment of TV sets on all 13 channels. Has self-contained marker frequencies. Model 610. Bulletin RN. Hickok Electrical Inst. Co., 10530 Dupont Ave., Cleveland 8, Ohio.

MICROPHONE: Employs carrier-frequency phase modulation, described as free of any measurable distortion. Case is 1 in. in diameter and 1¼ ins. long. Virtually shock-proof construction. Model C-1. Bulletin MPF. Stephens Mfg. Corp., 10416 National Blvd., Los Angeles 34.

TV POWER SUPPLY: Design data for pulse-operated, high-voltage power supply for TV receivers. Bulletin FEB. RCA Victor Division, Harrison, N. J.

CAVITY FREQUENCY METERS: For VHF precision laboratory measurements and production tests. Five types for frequencies of 2,570 to 9,660 mc. Bulletin CPR. Sperry Gyroscope Company, Great Neck, N. Y.

AUDIO TRANSFORMERS: New line of audio transformers described as flat within 1 db from 20 to 20,000 cycles. Mounted in sealed steel cases. Bulletin 257. Peerless Electrical Products Div. Altec Lansing Corp., 6920 McKinley Ave., Los Angeles 1.

SOUND-POWERED HANDSET: For use in orienting FM and TV antennas. Can be connected from roof to set by leadin cable without interferring with reception. Bulletin USC. U. S. Instrument Corp., Summit, N. J.

REGULATED POWER SUPPLY: Mounts on standard 19-in. rack. 1, 2, or 3 outputs adjustable at 600 to 1,500 volts, 1 milliampere DC. Bulletin R2. Furst Electronics, 800 W. North Ave., Chicago 22.

BANTAL TUBES: A new series of receiving tubes featuring 8-pillar construction for long life and increased ruggedness. Advantages of GT, metal, and lock-in tubes are incorporated. Eight types now available. Bulletin RR. Raytheon Mfg. Co., 60 E. 42nd St., New York 17.

AIR-SYSTEM SOCKET: Provides for the introduction of air to the 4-400A, 4-250A, and 4-125A power tetrodes. Bulletin EMC. Eitel-McCullough, Inc., San Bruno, Calif.

METAL RACKS & CABINETS: 16-page catalog of standard and special racks, cabinets, control desks, and enclosures for radio sets, transmitters, and associated controls and test equipment. Catalog 462. Karp Metal Products Co., Inc., 129 30th St., Brooklyn 20.

Special Services Directory

WHAT'S NEW THIS MONTH

(*Continued from Page 4*)

tion to show whether that was for fixed transmitters only, or if it included mobile transmitter-receiver units. A figure of $20,000,000 for all fixed and mobile communications equipment would probably be nearer the total for the entire industry.

3. For all that's been said and done about cleaning up the radio repair racket, it still flourishes to a very alarming extent. Robert Dalzell of Westinghouse sent us a copy of *The Pittsburgh Press* for April 6 which carried a front-page story captioned " Radio Repair Racketeers Dupe the Public". Under the direction of George H. Dennison, manager of the local Better Business Bureau office, ten new table-model sets were checked for perfect performance. In each set one wire was opened, or two wires were shorted, or the audio circuit was opened.

Two shoppers, one as a witness, took the sets out to be repaired. Of the radio shops visited, one out of three handled the necessary repair in a legitimate way. Two out of three servicemen worked " with larceny in their hearts", according to Mr. Dennison.

The record of this survey showed that " new condensers, tubes, resistors, oscillator coils, loudspeakers, pilot lights, and a variety of complicated parts were installed. In some cases, shops charged for new condensers without installing them. In other, poor tubes were substituted for good ones. Repair charges ranged from 25¢ to $6.50 for a loose wire; $2.00 to $9.50 for an open circuit; and $1.35 to $9.50 for a short circuit."

This situation is liable to become worse before drastic action is taken to remedy it. The remedy may be for the larger set manufacturers to step into the picture by organizing their own service stations. Whether this is the answer, or municipal licensing, or some other form of regulation, we don't know. Each has its disadvantages, each invites new forms of abuse by dishonest servicemen, and works hardships on the legitimate ones.

The real test will come in television service work. There's trouble already. Some of it is due to lack of competence; some to the fact that now dealers have an opportunity to really go to town on television set owners. Harry Kalker, sales manager for Sprague Products Company, our neighbor in North Adams, Mass., has this to say to those who want to build a legitimate business in television service:

Television has been variously billed as the saviour of the radio industry, a brand new bonanza for the the radio dealer and serviceman and, by some who live in territories already served by television, a bust. Actually, of course, television is none of these extremes. The television industry is growing - its future is assured. It is big business. It *will be bigger*. There is no reason to get hysterical about television, one way or the other. There is every reason, however, to realize that this is a big new business still in its infancy. You must analyze its possibilities, and plan to get your share of the profits that are bound to be available.

First of all, television is similar to, but considerably more complicated, than everyday radio. This means that, as a service technician, you have a natural head start in understanding television and fitting yourself to be a competent television technician. It also means that your first step should be to equip yourself technically to do competent television repair work.

Remember that television is spreading out. In those areas that are now served by television, more and more antennas are going up on every street every day. As relay stations and coaxial cables are completed and installed, the areas served by television will increase until we have virtually nation-wide coverage. The market is taking shape. It's a really big one. Regardless of what you hear or read *remember that whenever a complicated product becomes widely distributed, a local independent serviceman or organization is required to service it and keep it operating satisfactorily.*

Assuming that you are interested in getting your share of this new business, the first question is: " How can I equip myself to service television receivers properly?" The answer is not hard to find. More and more manufacturers are developing training courses, printed literature, and material to help you get the information and experience you need. Television schools and correspondence courses are available to all who are interested enough to really go after the necessary information. Many books and publications offer comprehensive technical coverage of this relatively new field. Your radio trade papers bring you up-to-the-minute technical articles detailing the latest authentic information.

The required information is available. All you have to do is decide to take advantage of it, and then conscientiously devote the necessary

(*Continued on Page 16*)

COMING IN JULY

The special semi-annual Communications Directory issue of *FM* and TELEVISION. This issue will contain:

1. The only directory listing published of all railroad, marine, police, fire, and forestry systems.

2. Engineering details of new 2-way equipment and installations, released for the first time.

BE SURE TO GET YOUR COPY WITHOUT DELAY

★ *These Issues Are Always Sold Out Quickly* ★

WHAT'S NEW THIS MONTH
(Continued from Page 14)

time and energy to make television servicing a job you can attack with confidence.

In addition, you will probably need more test equipment, too. However, the increased cost of satisfactory television receivers means that you can collect better than your usual hourly rate for service, thus justifying the cost of added equipment. When you are in television servicing you are in a bigger business, a business that will pay you increased profits for your investment in shop equipment and your very real investment in knowledge.

The television replacement market will be bigger than it ever was in radio. Realizing this, many manufacturers are developing a special line of television replacement parts right now. At Sprague, for instance, we are developing capacitors to meet the requirements of television circuits calling for units which will perform satisfactorily under high-voltage, high-temperature conditions not encountered in the average radio set.

These special requirements serve to accent another point in which I have always believed. Any service technician who is trying seriously to build a successful business should guard his reputation just as jealously as a doctor or a dentist. A good reputation - a list of satisfied customers - is the best possible advertisement any service shop can have. This being the case, it follows logically that every service technician should use only the best of reliable replacement parts. A reputation is too valuable to risk for the few pennies that might be "saved" by buying bargain or inferior merchandise. After all, most radio parts *look* about the same. You can't tell by looking at a resistor, a tube, a transformer, or a capacitor how long it will last in the circuit.

There are, however, some things you *can* bank on. First of all, deal only with reputable distributors whom you know handle dependable merchandise. Next, buy only those parts which are made by manufacturers who have wide experience in the field, and have established a reputation for quality. If you follow these simple rules, you'll be building a reputation for quality work, and more profitable business at the same time!

4. In case you have ever wondered whether David Sarnoff, now president of RCA, started in engineering or sales, or just how, here is the

(Continued on Page 17)

WHAT'S NEW THIS MONTH

(Continued from Page 16)

story as he told it recently in The American Magazine. (RCA is, in effect, the successor of the old American Marconi Company, referred to in the following text.):

The fact that I was born in Europe has given me a far keener understanding of what it means to be an American.

Born Americans, I find - especially young men and women of today - are inclined to take their blessings for granted. They fail to realize how greatly they are envied, not only for their material possessions, but for their opportunities, by the youth of other countries.

Only if a boy or girl has lived a part of his life under conditions of autocracy and repression can he or she appreciate the abundance of freedom, democracy, and opportunity here in the United States.

I was 9 years old before I set eyes on America. I had my first look at my adopted country from the deck of a Hudson River steamer, back in July, 1900. My mother, my younger brothers, and I had arrived in the New World via steerage to Montreal and rail to Albany. There we boarded the night boat for New York to join my father, who had preceded us to the great new world.

Manhattan's skyscrapers, including the fabulous 29-story Park Row Building, then the tallest office structure in the world, sparkled in the morning sun. The harbor was crammed with shipping. The people on the pier looked happy, purposeful, prosperous. Here, indeed, I thought, is the Land of Promise. Two days later I was peddling papers on the streets of this Land of Promise to help support my family; but I was full of hope.

That fall I entered a school building for the first time in my life; free schools were unheard of in the part of Europe I came from. Each morning I got up at 4 o'clock to deliver my papers before starting off for class.

The public school taught me more about the meaning of America. There I made the acquaintance of the life of Abraham Lincoln - a boy who also lacked money, position, influence, but who nevertheless rose to be the President of the United States. Lincoln became my inspiration. Evenings after finishing my paper route I would hurry to the public library and borrow one of the many books about the Great Emancipator.

When I was 15, my father died. It then became necessary for me to quit school and find a full-time job. I

(Concluded on Page 62)

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NEW SLANT ON FM PROGRAMMING

THIS DISCUSSION OF MEETING AM COMPETITION WITH BETTER FM PROGRAMS HAS SOME SOLID IDEAS FOR THE TELEVISION BROADCASTERS, TOO—*By* MILLARD D. FAUGHT*

I HOPE the fact that I have been present at most of the meetings held since FMA was formed will be taken as evidence of my enthusiasm for the organization and the swell folks in it. Indeed, there is ample evidence that most all the FM'ers welcome these opportunities to get together and agitate the ether. There is high-fidelity good fellowship all over the place.

But to insure against the possibility of this becoming a mutual admiration society, I think it is about time someone arose in meeting and talked like a Dutch Uncle about some of the slightly-less-than-wondrous non-technical aspects of the FM landscape. So, cousins, I now switch you to the Dutch Uncle Program.

First the Revolution:

FM, we are all agreed, adds up to a technical revolution in the science of radio broadcasting. Static, unlike the poor, need no longer be with us. But there is still an awful lot of poverty in radio when one comes to evaluate radio programs and the thinking that is behind them. This observation could be stretched to include the whole of the service which a good many radio stations, FM or AM, offer to their listening communities.

An onion by any other name still smells, and the greater fidelity of FM merely makes a stinker of a radio broadcast smell the worse.

Now the Insurrection:

We've had the *technical* FM revolution. Now what we need is a revolution — or at least a sizeable insurrection — in the *application* of the new and better and more abundant facilities offered by FM broadcasting.

If we are realistic, we must concede that there are a few sensitive, opinionated, or otherwise unreconstructed people around who feel that old fashioned AM radio suffers from such maladies as soap operas, singing commercials, spot announcements, and a general constipation of progressive program ideas.

And, you know, there are not a few sensitive, opinionated, and otherwise unappreciative people who think that FM also suffers from the same maladies. I must confess to a certain amount of this heresy myself. As for television, I shudder at the prospect that, when I can afford a set, my household may have to put up with visible *blots* compounded with audible *spots*. The triumphs of science can indeed prove hazardous and foreboding.

Be that as it may, I did not come here to quibble. Nor did I come here to tell you megacycle magicians how to achieve the New Listen in radio. While I've used up a good many hours of air time and written a few pounds of radio scripts, I've certainly never tried to run a radio station and probably won't.

Problem of Community Relations:

So I'm now going to harangue you as another kind of expert, but maybe that's good for a change. In the expert department, I'm supposed to be a doctor of the philosophy of socio-economics. It says so in my sheepskin-made-of-genuine-paper, right over the signature of Nicholas Murray Butler. And sometimes I manage to exact small fees from people as a so-called authority on community relations.

Now, I have the perhaps naive notion that community relations have some relation to the success and prosperity of radio stations; and if a few more radio stations — and especially new FM stations — would wake up to that fact, we wouldn't have so many unhappy people at both ends of the broadcast signal.

It may come as something of a surprise to some folks, but this great mechanized mass-production country of ours is still a nation of communities. Even our biggest cities are made up of many neighborhoods and communities within communities. The family patterns and human relationships of the people who live in these communities haven't changed much since that radio ham, Benjamin Franklin, was experimenting with his specialized type of windy-day antennas.

And I invite your attention to this fact: The radio stations in our communities, large and small, besides being legal persons are also *citizens* of the communities covered by their primary signals, just the same as anybody else who lives and works in the community. Any given station can be a good neighbor or a community nuisance in just about the same fashion, one way or the other, that the rest of the folks in Hometown can. The main difference is that the radio station has special facilities for being an exceptionally good citizen, or agregiously nauseating to its neighbors.

Now with this approach in mind, I would like to discuss some of the things that I would do, as a community relations expert, instead of a radio station expert, assuming that I were about to begin operations of a new FM station in a fairly typical American community.

People vs. Statistics:

I would begin by getting a suitable map and actually staking out my listening area so that I could see it and study it. If I weren't already familiar with the area, I would get in my car and spend as many days as necessary in driving all over it and stopping to talk to most everybody I met who had time to chew the fat with me. In other words, I would like to get the feel of the place and something of a subjective reaction to people who live in my community. If I'm going to be talking to them 24 hours a day — or at least a good many hours every day — for what I hope will be a long time, then it certainly behooves me to start out with a pretty good idea of the folks I'm talking to. I emphasize the word *folks* as opposed to the mere statistics which too often make up the bulk of most market analyses!

Following this preliminary impressionistic survey, I would then get down to business and begin to accumulate a veritable encyclopedia of every kind of information I could think of about my audience community. Starting with the physical geography of it, I would go right on down the list through the economics, social aspects, politics, history, and assorted peculiarities of the place and the people who live in it, always with emphasis on the *people*.

What Makes the Audience Tick:

I would want to know how many people live in my community; where they came from; why they came there in the first place; why they continue to live there; or why they would like to leave. I would want to find out what they do for a living; what kind of houses they live in; how many kids they've got; what kind of cars they drive. I would want to go into a lot of their homes to see what kind of furniture they use; what kind of meals they serve; what kind of hats the women wear; and what syndicated comic strips the kids read. I would also like to know what else the family reads; whom they listen to in the way of national commentators; what kind of movies do best in town; what their politics are. In short, I would like to get as neighborly-nosey as is respectfully possible.

Next, I would begin to diagram the community in terms of its identifiable components. In doing this I would start with the government and find out who the people are who make it tick. I would get acquainted with the Mayor and the Chief of Police and the Sheriff and the

* Executive Vice President, Young & Faught, Inc., 342 Madison Avenue, New York City. An address before the FM Association, Washington, D. C., May 5, 1948.

Fire Chief and the Superintendent of Schools and all of the little people around City Hall who collectively operate the public services. Then I would begin to X-ray the various departments to find out who the people are in the educational system, from the Superintendent of Schools right on down to the janitors. I'd like to take a look at some of the textbooks, visit some classes, and certainly go to some PTA meetings.

When I thought I was sufficiently acquainted with those personalities and forces in the community, I would then turn my attention to the area's economics. Where does Hometown's income originate? What are the products that produce the jobs in my listener community? If my town is the home office of the Consolidated Thumbtack Company, that's probably an important fact to a lot of folks who listen to my station.

I would soon want to find out who the leading businessmen in the town are. What they consider the town's chief economic and business problems. Who belongs to what service clubs? Who are their officers and when do they meet? What kind of speakers do they have? When do they go on their annual picnics? Who is the best checker player in the Elks Club?

And I would quickly want to find out essentially the same kind of things about Women's Clubs. What crusades are the womenfolk carrying on? How is the town's health, and how many kids got run over last year as compared to the number who had the mumps? Who is the President of the Garden Club? And which woman raises the biggest chrysanthemums in town? Women like to know about such things.

Irrespective of my personal piety, I would get acquainted with all of the religious leaders in the community, visit their churches and find out what kind of church programs they have in addition to regular Sunday meetings: and which particular denominations are struggling to build themselves new churches. I would be careful to note their aspirations and those of all the other groups in town. The information might come in handy some day.

And when I came to the kids in the community, I would really bear down on my research. There is probably nothing in society as important a common denominator of community life as the kids in town. I would want to meet all the Scout Masters, the Girl Scout Mistresses — or whatever you call them — and everybody else in town who had a real interest in the children. And when I found out, I would plan to tailor some of my local broadcasts to fit the interests of these kids. I'd want to put on every kind of kid show from baby gurgling contests right on up to forums on why high school seniors should, or should not, go to college.

Continuing Study:

When I finally got my basic research on the community done, I would then begin to *organize* it, and I would constantly continue to try to keep it up to date and *add* to it. I would see that every member of my staff *studied* it regularly. I would give everybody the extra-curricular assignment of keeping on the lookout for data to add to the files.

But I wouldn't just keep it in the files. Every day my station was on the air I would try to *merchandise* my fund of community information, always with as much of a human touch as possible. I would try to weave into my daily news broadcasts and public service programs an endless flow of stories about the everyday folks in Hometown.

Program Material:

I'd tell 'em about the Jones family on Elm Street whose cat had five kittens that they were willing to give away to interested kids; I'd report that the freight station manager broke his arm yesterday morning unloading a shipment of baby turkeys. If Susie Jones, Secretary to the Highway Superintendent, is marrying one of the rookie cops and the girls are going to give her a shower tomorrow night at the firehouse, that's news. It's the same kind of news that pulp magazine stories are made out of, and the best part of it is that it's happening to *real people* in Hometown.

If Local 13 of the Hair Trimmers and Whisker Shavers Union is having a meeting tonight at the Main Street Barber Shop with quartet singing afterwards, that's also news. And so is the fact that there is going to be an Open House next Saturday at the Consolidated Widget Company, so that Ma and the kids can go through and see where Pop works all day. If a new delicatessen is opening in the old harness shop on the south side, that's news to a lot of women who do their shopping in the neighborhood, and it will certainly make a friend of the guy who is hanging out his sign as a new little-business man in town.

One of my first investments would be a suitable sound-recording truck to prowl my community constantly to find out what's going on in Hometown. Before long I'd have a network of folks around town, at the drugstores and the firehouse and the City Hall and the bus station, who considered themselves unofficial correspondents of *their* radio station. The only major precaution I would insist on would be to sift carefully the rumor and gossip from the legitimate human interest community news, as should any good reporting medium.

Besides reporting the news in as neighborly fashion as possible, I'd cook up a lot of promotion ideas and features, every one of which had its roots in the daily life patterns of Hometown. I'd sponsor essay contests on the best reasons for planting trees; or not robbing birds nests; or "What I Would Do If I Were The Mayor of Hometown". I'd put on "Be Kind To School Teachers" weeks, and if the oldest trolley conductor in town retires, I'd have him on the air to talk about the people he's been hauling back and forth across town for fifty years.

Substitute for Crime & Slime:

I'd cook up a series reporting on a day in the life of typical community people like the grocery clerk, and the mail man, and the milk man. And if the canned soap operas fed me by the nets got to be too nauseating, I'd try cooking up some local ones based on real family problems, *bona fide* juvenile adventures, and genuine romances going on right in Hometown. Many a small town newspaper has for years made prime readership material of the human interest struggles and adventures of Hometown's families, using good taste and getting positive results.

For instance, there is a story in the current Reader's Digest about how the neighbors in a little Maine town rebuilt a veteran's burned-out house. There are stories like it on the newswires and in Hometown papers every day. And still radio seems to have to depend on hucksters' hallucinations for most of what it calls human interest material.

Huckleberry Finn and Little Women will be around for a long time after some of the current crime-and-slime radio series on family life and juvenile adventure are happily forgotten — if you get the idea. It has always struck me as ironic that soap companies sponsor some of the radio programs most in need of strong detergents. I live in hope that FM will somehow contribute some Fresh Mentality in the family and youngster departments of radio, at least at the local-station level.

Building Confidence:

And to get back to my station-community relations program, I would try to make the whole process add up to building a reputation for my station that would prompt people to say, "If you want to know what's going on in this town, listen to Radio Station ABCD-FM." I would try to build an attitude in the community such that if the town were ever inundated by a flood, the first place everybody would turn would be to the radio station with the confident feeling that somehow the station would be right in there putting up the first sandbags to protect the town and the people who live in it.

I might have to compromise with some of the suggestions I have tossed out here, but I am firmly convinced of the practicability of the principle involved. If you build a reputation that your station is everybody's friend, everybody will listen to it. And, needless to say, if everybody

(*Continued on Page 42*)

NOTES ON RADIO TOWERS

PRESENTING A LIST OF ITEMS WHICH, EXPERIENCE SHOWS, ARE OFTEN OVERLOOKED, SOMETIMES CAUSING SERIOUS DELAYS OR UNEXPECTED COSTS—*By* WELLS CHAPIN *

ENGINEERS who specialize in towers can design any type or variation that individual customers choose to specify. While this latitude has its advantages, it also opens the way for the station engineer in charge to lead himself astray, with the end result that he may get what he asked for, only to learn later that what he asked for wasn't exactly what he needed!

This is another way of saying that practical, working knowledge of radio tower requirements is just as important as the ability to predetermine structural stresses and strains.

The following notes are not intended to cover the entire subject of radio tower design and erection. Rather, they were selected to bring out essential points which are frequently overlooked, often to the subsequent dismay of the engineer in charge. Accordingly, after the obvious considerations have been discussed and settled, it would be well to check the items presented here to see if some one of these elusive details has been neglected.

CONSTRUCTION POINTERS:

Before approving the design of a radio tower, make a final check of these items:

1. TELEPHONE COMMUNICATIONS: It is very difficult to make one's self heard from the top of a tower, even on a calm day. When the wind blows, it is impossible. Signalling to the ground by hand is only a makeshift, and is definitely out on a foggy day or at night. Telephone connections, with weatherproof outlet boxes should be provided at the top and at several levels. There should be a phone jack at the final amplifier of the transmitter, so that direct communication can be carried on between the engineer and a man tuning the antenna. The Navy uses a weatherproof, sound-powered phone that will fill the bill adequately.

2. TOWER LIGHTING: CAA regulations are sometimes subject to interpretation. It's much cheaper to get exact information at first than to change the lights later. Check with the Civil Aviation Authority, Washington, D. C. By all means, read the FCC Regulations, section 7.83 and section 2.82 concerning tower lights. If possible, install a photo-electric turn-on device in addition to the manually-operated switch. FCC Regulations call for a means to tell if the lights are on when fog obscures them from the ground. A burn-out meter, comprising a simple transformer and ammeter, is indicated.

3. SAFETY FEATURES: It is advisable to have ladder protection and adequate rest platforms. One of the engineers, perhaps an older man, may have to climb the tower, and he may not be able to make the grind hand-over-hand. Some city and state regulations require ladder protection. Safety features reduce the cost of insurance.

4. AC OUTLETS: Heavy-duty outlets at several levels are desirable. An electric drill or welder may be needed. Lifting several hundred feet of heavy-duty extension cable is a man's size job at any time, and in bad weather it is impossible.

5. WORKING PLATFORM: A platform at the top of the tower, large enough to accommodate tools and to give workmen a chance to rest, is a highly useful feature. There should be a railing to carry a canvas cover to protect the men from the wind. This is also useful when using a blowtorch or soldering iron.

6. FUTURE CHANGES: See that the tower will handle an ample overload. There is still plenty of room to improve antenna designs. Future changes should be anticipated as a matter of protection against obsolescence. Ultra high-frequency relaying is in the offing. Later, it may be necessary to enclose one level of the tower for a parabolic antenna and its associated equipment.

7. CITY REGULATIONS: Be extra careful about city ordinances concerning towers. Don't take a chance of overlooking some point that will stop the construction and leave you with a tower on your hands that can't be erected.

8. WINDS: Check with the local Weather Bureau to find out the highest wind velocities ever encountered in your area. Check possible icing conditions, the effect of icing on the tower and the performance of the antenna. Be sure you specify de-icing equipment if it may be needed.

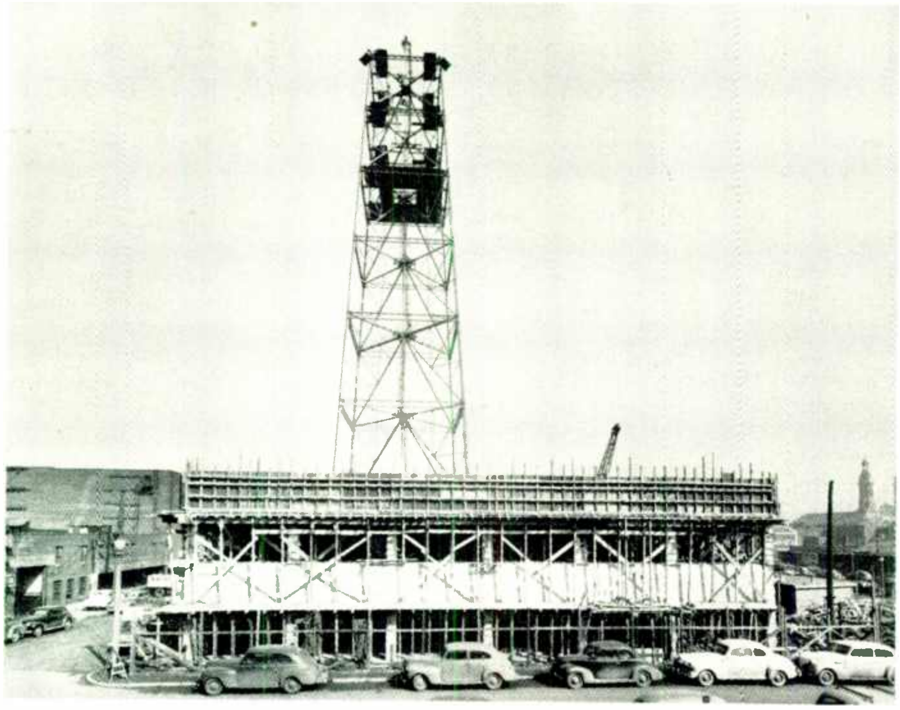
9. BOLTS: If bolts are not properly designed, wear results and, in time, all the small deviations will add up to a tilt in the tower. Anco rib bolts are suggested. They are driven into place, and then the nuts are put on.

10. PAINTING: Check the tower design to be sure that it will be easy to paint. Painting, it must be remembered, is a major item of tower maintenance. Also, look for inaccessible spots that can't be painted, and will therefore rust.

11. GALVANIZING: Consider the relative merits of plain steel *vs.* galvanizing. All galvanized parts must have an acid bath before painting. Since a tower must be painted regularly, you may find that galvanizing has no important advantage over plain steel.

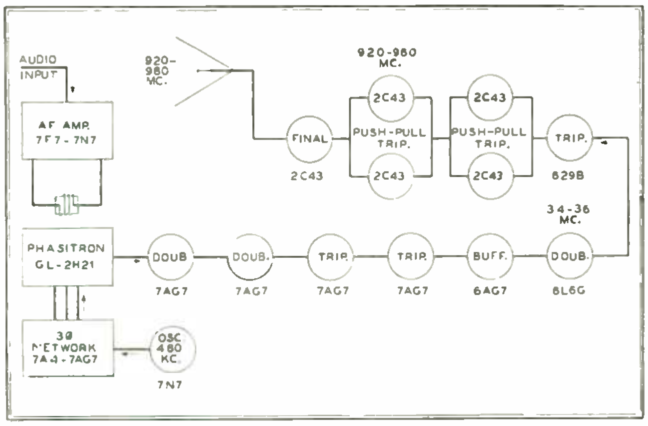
12. ELEVATORS: Elevators are expensive, but should be considered. Some city

(Continued on Page 60)



This tower will carry KWGD's FM antenna, with an effective output of 218.5 kw.

*Chief Engineer, Station KWGD, Globe-Democrat Publishing Company, St. Louis 1, Mo.



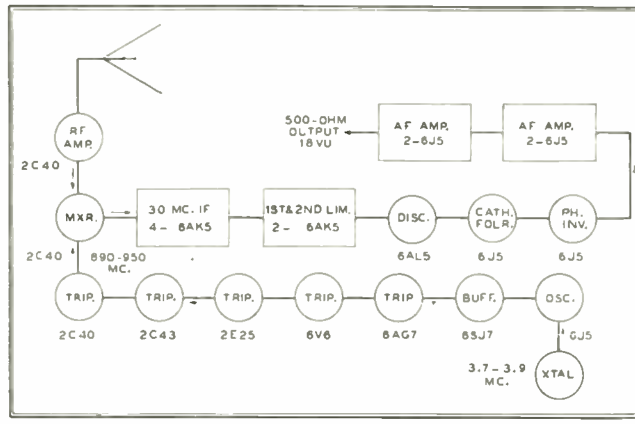


FIG. 1. *Elements of the 920- to 980-mc. S-T transmitter.* FIG. 2. *Composition of the associated receiver, employing crystal control*

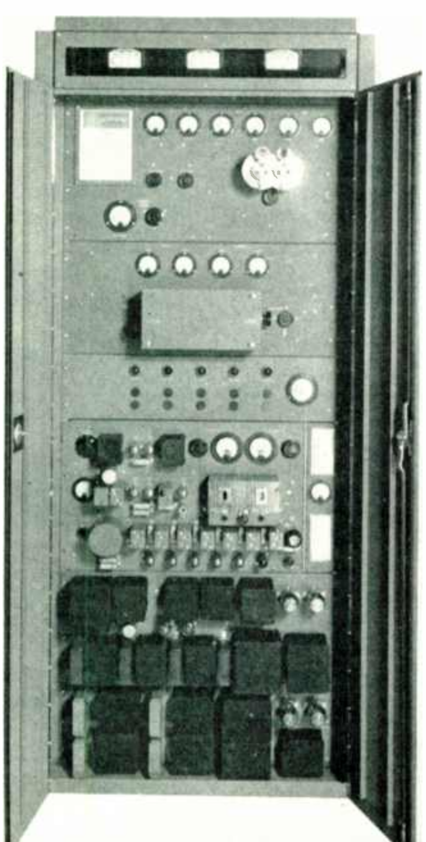
S-T LINK ON 920 TO 980 MC.

A TRANSMITTER AND RECEIVER DESIGNED TO OPERATE IN THE BAND NOW ASSIGNED TO CARRY PROGRAMS FROM STUDIOS TO REMOTE TRANSMITTERS—*By* R. H. DeWITT*

The studio-transmitter link equipment shown in the accompanying illustrations was designed by Harvey Radio Laboratories to meet the FM broadcasters' need for equipment to relay programs from studio to transmitter in instances where, for one reason or another, wire lines are not feasible, either because facilities are lacking, or because rental charges make lines uneconomical.

*Contract Engineer, Harvey Radio Laboratories, Inc., 447 Concord Avenue, Cambridge 38, Mass.

FIG. 3. *Front view of the S-T transmitter*



FCC Specifications:

FCC standards set forth the characteristics required of equipment used in this service. These are:

Frequency Range: 920–980 mc.
Frequency Stability: .005%
Frequency Deviation: ±200 kc.
Antenna Directivity: Such that, at all azimuth angles more than 30° from the line of maximum radiation, the field strength is not more than 20% its maximum value, based on gain of 10 db over a half-wave dipole
FM Noise & Hum Level: At least 70 db down
AM Noise & Hum Level: At least 50 db down (transmitter)
Audio Distortion: Less than 1% from 50 cycles to 15,000 cycles.

Accordingly, this S-T equipment was designed to deliver performance equal or superior to that specified by the FCC. The basic circuits employed in the transmitter and receiver are shown by block diagrams in Figs. 1 and 2.

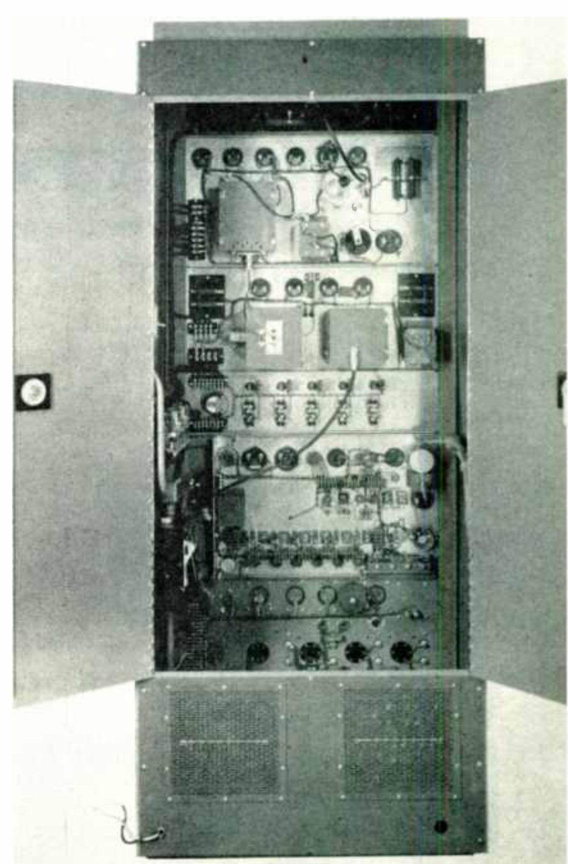
Transmitter Design:

In order to meet the specifications, it was decided to use the basic exciter unit employed in our FM broadcast transmitters, with a slight modification. This unit utilizes the Phasitron system, as indicated in the block diagram, Fig. 1. For the S-T link, the normal crystal frequency of 200 kc. was changed to 400 kc., since the frequency stability tolerance could still be met easily, and one stage of frequency multiplication eliminated.

The general construction of the transmitter is shown in the front and rear views, Figs. 3 and 4. At the bottom of the rack are the three power supplies, one for the final amplifier, and first and second drivers; another for the first and second power triplers; and a regulated supply for the Phasitron, oscillator, and multipliers. Heavy-duty components have been used throughout, allowing continuous operation without danger of component failure.

Just above the power supply section is the exciter panel, which includes the audio input circuits, the crystal oscillator, Phasitron, and frequency multipliers.

FIG. 4. *Rear of the S-T transmitter unit*



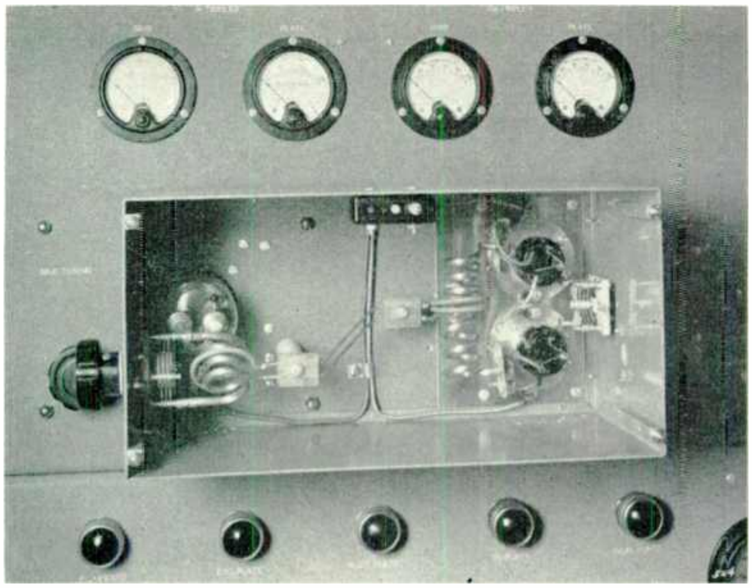
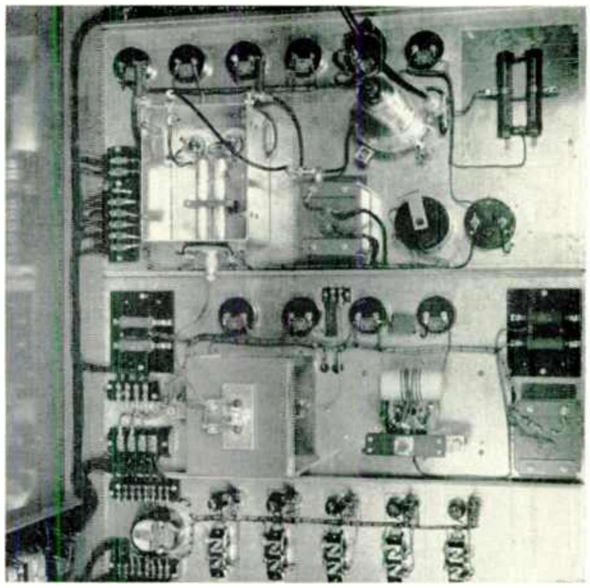
 

FIG. 5. *The 829B tripler, in a lumped-constant circuit.* FIG. 6. *Third tripler, left, and final 2C43 amplifier in its tunable cavity*

Conventional circuitry is used, with complete metering of all circuits included for ease in tuning and quick maintenance inspection. As shown in Fig. 1, the output from this panel is at 34 to 36 mc.

Next above the exciter is the power control panel with push-button circuit controls, corresponding pilot lights, and a running-time meter.

The power tripler panel is above the power control panel. This includes an 829B, operating Class C. This triples the 34 to 36 mc. to 102 to 108 mc., driving a pair of 2C43 lighthouse triodes in push-pull to triple from 102 to 109 mc. to 306 to 327 mc. The 829B stage, a conventional, lumped-constant circuit, is shown in Fig. 5. The input circuit of the second tripler is also a lumped-constant circuit, but the plate is tuned by parallel lines.

On the top panel of the transmitter is the third tripler and final amplifier, shown at the upper left and right respectively in the rear view, Fig. 6. The input circuit of the third tripler is a parallel line circuit, while the plate circuit utilizes precision cavities which appear in Fig. 3 on the right side of the top panel. The final amplifier is a grounded-grid 2C43 lighthouse tube in a tunable cavity circuit, having an output of 5 watts. The filament transformer which supplies all lighthouse tubes is mounted with its Variac control and voltmeter just below the final amplifier cavity. The three meters at the extreme top of the rack are, from left to right: voltmeter for final plate voltage; milliammeter for final plate current; and AC line voltmeter.

Measurements in the laboratory and in the field have shown that the transmitter does indeed meet the requirements laid down by the FCC. The tuning range is 920 to 980 mc.; frequency stability is better than the requirement, being .001%; frequency deviation is ±200 kc.; FM hum and noise level are better than 70 db below 100% modulation; AM hum and noise level are more than 50 db down; the frequency response of the audio system matches the standard 75-microsecond pre-emphasis curve to within 1 db from 50 cycles to 15,000 cycles; audio distortion is less than .5% between 100 cycles and 7,500 cycles, and less than 1% from 50 cycles to 100 cycles and from 7,500 cycles to 15,000 cycles.

Receiver Design:

A block diagram of the receiver is shown in Fig. 2, while Figs. 7 and 8 show the general construction of the receiver. The lower panel carries two low-voltage supplies, a high-voltage supply, and a DC filament voltage supply. The heavy-duty components are in interesting contrast to those employed in more conventional receivers, but they are essential to continuous and virtually unattended service.

Above the power panel is the local oscillator section, a rear view of which is shown in Fig. 9. The local oscillator con-

FIG. 7. *Front view of the S-T receiver*

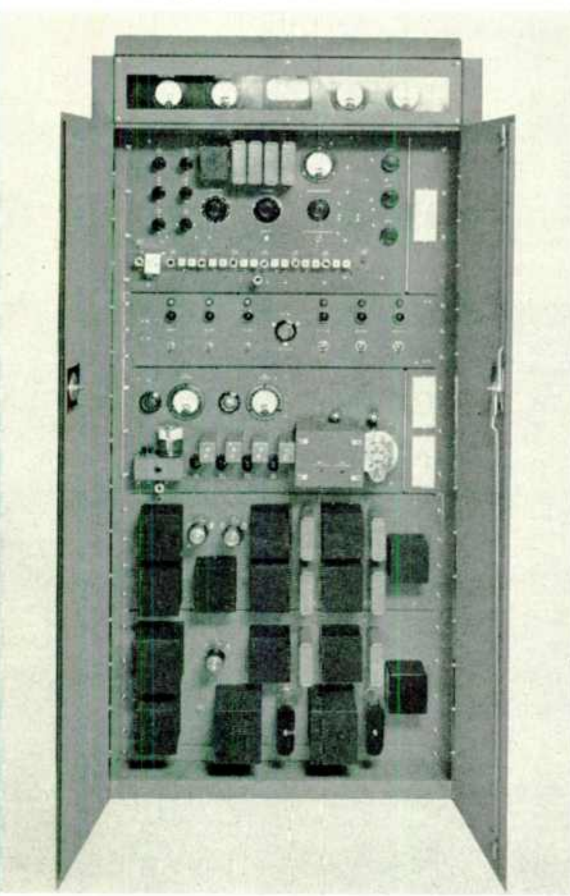
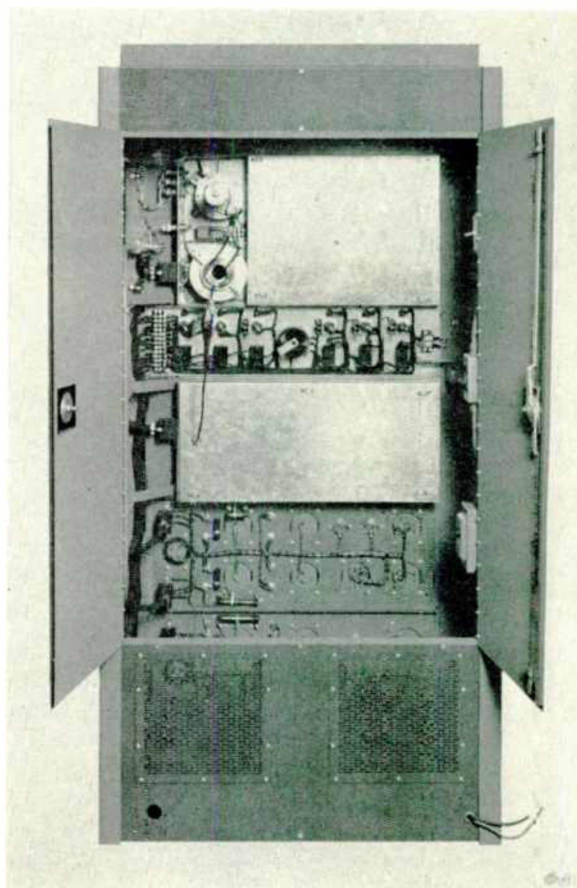
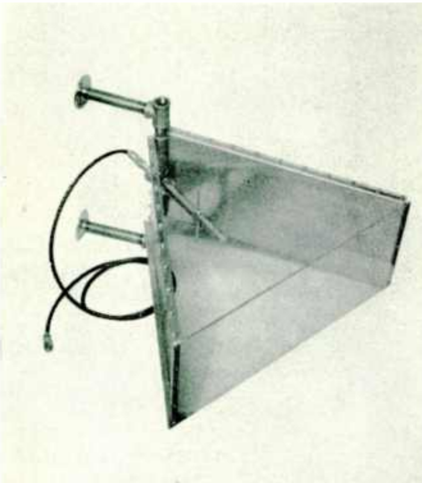


FIG. 8. *Rear view of the S-T receiver*





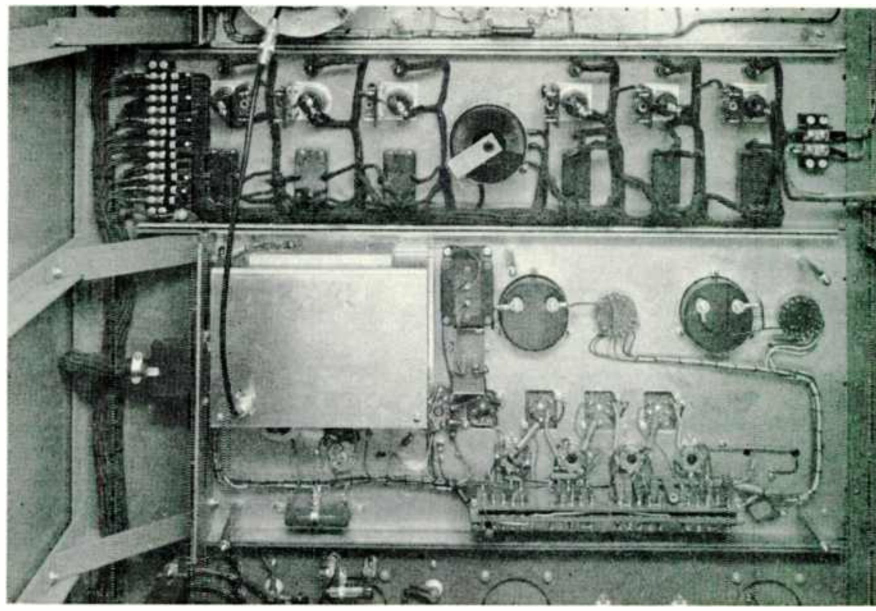
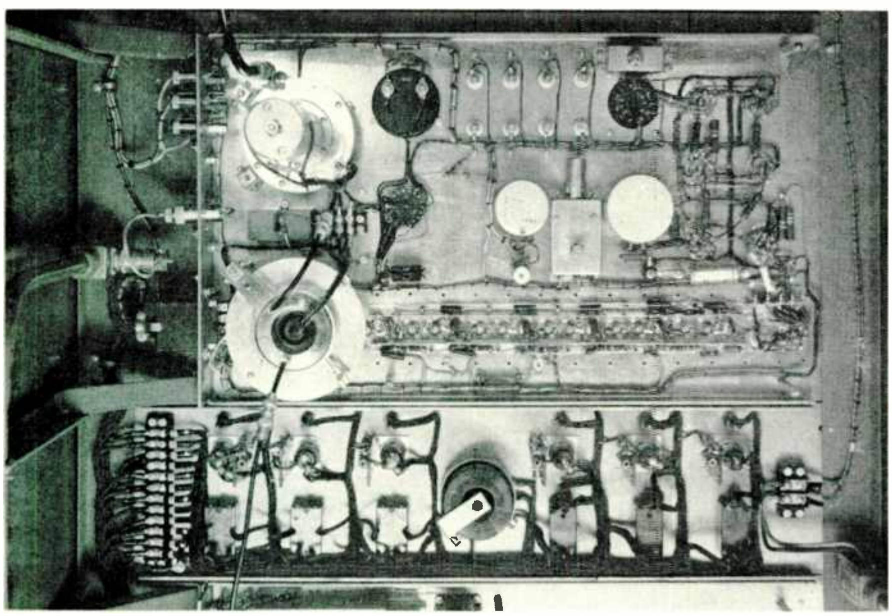


FIG. 9, *right: Local oscillator section of receiver.* FIG. 10, *below: The audio system is at the upper right.* FIG. 12, *above: The corner reflector type of antenna*

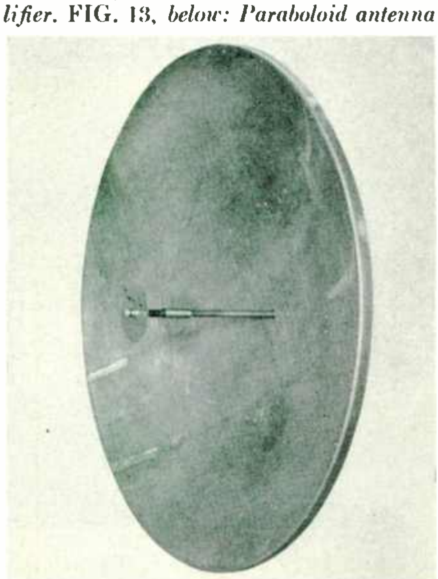


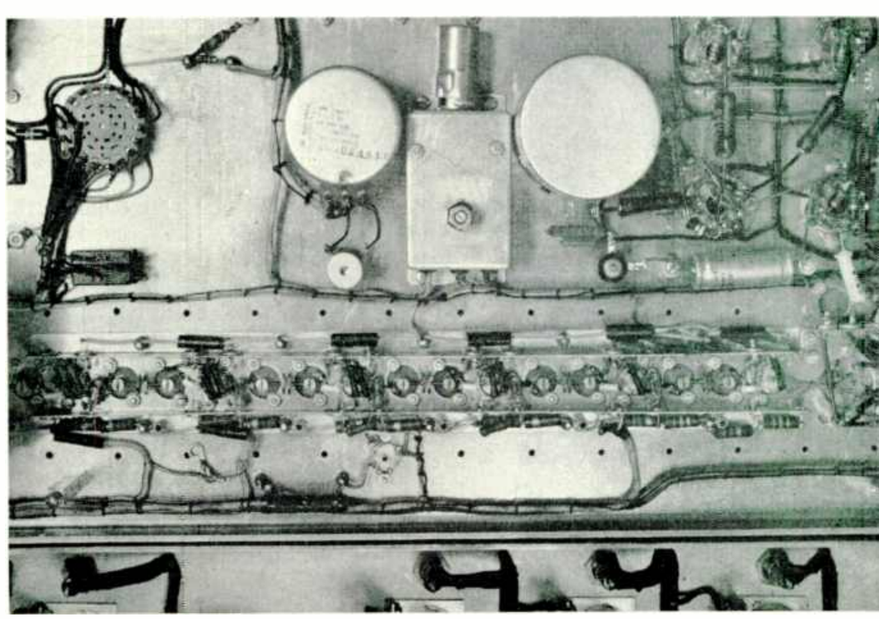
sists of a crystal-controlled oscillator. using a temperature-regulated crystal operating in the vicinity of 3.8 mc. This is provided with a vernier control to allow precise tuning to the transmitter frequency. Conventional frequency multipliers with double-tuned, critically-coupled circuits prevent spurious radiation following the crystal oscillator. A lighthouse-tube multiplier in a parallel-line circuit is used for the 100- to 300-mc. tripler. The last tripler is also a lighthouse tube, mounted in a precision tunable cavity circuit, providing output between 890 and 950 mc.

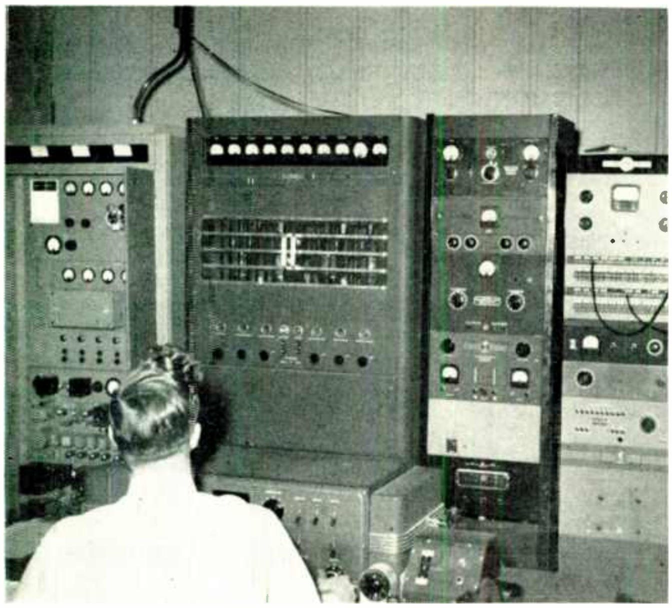
The power control panel, just above the local oscillator section, includes a control for the DC filament voltage on the audio stages, the local oscillator, the RF amplifier, and the mixer.

Above the power control panel is the balance of the receiver. Referring to Fig. 10, at the upper left is the RF amplifier, a

FIG. 11, *right: The 4-stage, 30-mc. IF amplifier.* FIG. 13, *below: Paraboloid antenna*







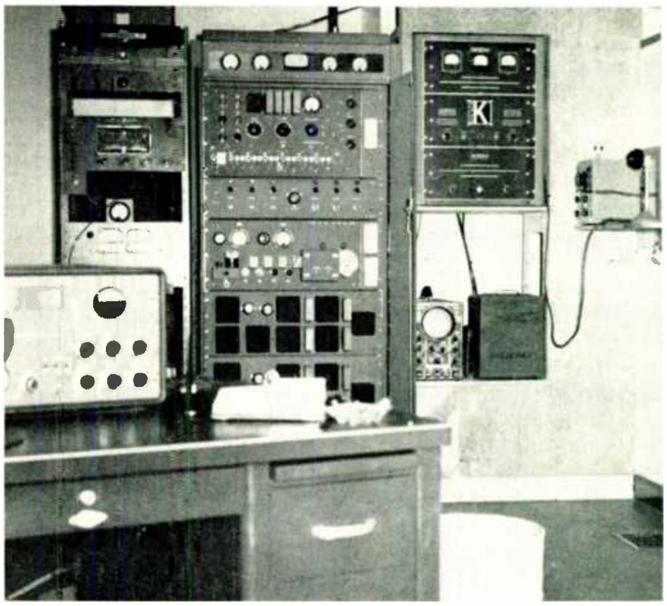


FIG. 14. *The S-T transmitter at WFMI's station is at the extreme right.* FIG. 15. *S-T receiver at the studios in Portsmouth. This is probably the first installation to go into service since the FCC assigned 920 to 980 mc. for S-T operation*

grounded-grid lighthouse tube in a tunable cavity circuit. Another lighthouse tube is used for the mixer. Its cavity is mounted just below the RF stage. Adjustable local oscillator injection is provided into the mixer cavity.

To the right of the mixer is the IF amplifier. This is a 4-stage, 30-mc. amplifier using double-tuned, iron core transformers to provide a bandwidth of 600 kc. The amplifier has a flat-flat response characteristic over the band-pass. Fig. 11 shows a close-up of the amplifier.

Following the IF are cascaded limiters which feed the discriminator. A cathode follower isolates the low-impedance de-emphasis circuit from the discriminator, providing loading which does not vary with frequency. A VTVM measures discriminator output, to provide a reading of kilocycles-off-resonance.

The audio system, shown at the upper right in Fig. 10, consists of a phase inverter followed by two push-pull stages. Triodes are used throughout for minimum distortion. A precision gain control having 45 steps of 1 db each is used to control the output. Maximum output is +18 VU. This is monitored by a VU meter. Balanced 500/600-ohm output is provided. Audio frequency distortion is less than .5% from 50 cycles to 15,000 cycles.

The panel at the top of the rack contains, from left to right, meters for: AC line voltage; DC filament voltage; audio output in VU; kilocycles-off-resonance; and first limiter grid current.

Measurements in the laboratory and in the field show that the receiver is quieted by an RMA quieting signal of 3 microvolts, that its noise figure is 10 db, and that the hum and noise level is more than 70 db. down. Because of the high frequency stability of the receiver, it is possible to use it as a partial frequency monitor.

S-T Link Antennas:

The antennas used with the transmitter and receiver are shown in Figs. 12 and 13. The corner-reflector type, Fig. 12, has a gain of 12 db. Its directivity characteristics are such that at all azimuth angles greater than 30° from the direction of maximum directivity, the power is down 15 db. The open end of the reflector measures 22 ins. It is enclosed with Plexiglas to exclude sleet and snow. The paraboloid antenna, Fig. 13, uses a 72-in. reflector which provides a gain of 23 db.

Using standard corner reflector antennas at each end of the circuit, satisfactory performance at line-of-sight distances of 10 to 15 miles can be obtained. For ranges in excess of about 12 miles and up to about 25 miles, the use of a paraboloid antenna at one end of the circuit will probably be necessary. For circuits over distances greater than 25 miles, or short paths where line-of-sight conditions do not quite exist, paraboloids are recommended at both ends. Maximum circuit distance for reliable operation is about 35 miles.

WFMI, Portsmouth, N.H.:

As far as we know, the S-T equipment installed for WHEB, Inc., is the first to be operated in the 920- to 980-mc. band. The transmitter and receiver are shown in Figs. 14 and 15 respectively. WHEB, Inc., of which New Hampshire's Governor Charles M. Dale is president, operates FM station WFMI, licensed for 20 kw. on 107.3 mc.

The FM transmitter is located on Saddleback Mountain, an elevation of 1,180 ft., in line of sight to Portsmouth, N. H. at a distance of 21 miles. The elevation of Portsmouth is only 50 ft. above sea level. Saddleback, in Deerfield, is almost half way between Portsmouth and Concord, N. H.

Power lines were run 8 miles to the FM transmitter site. In addition, a 50-kw. emergency plant was installed. However, the problem of getting programs from the studio presented difficulties. Preliminary estimates from the Telephone Company involved some 7 miles of new construction. According to general manager Bert Georges, the figures were very discouraging. Nothing was settled on this point until, in September, 1947, the FCC assigned the new band to permanent S-T service.

The Harvey Radio Laboratories equipment went into experimental operation on March 25, 1948, just 120 days after the order was placed. In Fig. 14, the S-T transmitter can be seen at the extreme left, adjacent to WHEB'S AM transmitter.

The receiver installation, in the control room of the two-story building on Saddleback Mountain, appears in Fig. 15. It is interesting to note that a 50-watt Kaar unit, operating on 152.87 mc., is used for two-way phone service with the Portsmouth studios. This can be seen at the right. Mounted at the left is a Browning FM tuner for picking up programs to be rebroadcast.

By way of contrast with this ultra-modern equipment, chief engineer Paul G. Lindsay likes to call attention to the fact that, 20 ft. from the new transmitter house, there are some iron pegs still standing which, about 100 years ago, supported a reflectograph, used to signal from the mountain to ships at sea!

The June issue of *FM* AND TELEVISION will feature a summary of FM and TV receivers, with a collection of photographs of outstanding, custom-built installations. You'll find a wealth of new ideas in these exclusive illustrations, and valuable information on new cabinet styling.

SPOT NEWS NOTES

ITEMS AND COMMENTS, PERSONAL AND OTHERWISE, ABOUT MANUFACTURING, BROADCASTING, COMMUNICATIONS, AND TELEVISION ACTIVITIES

J. H. Stickle:

Advertising manager for the Westinghouse radio division: "We have radio, records, and now, God bless the new arrival, television. Things look good for the future." However, warns Mr. Stickle, "Radio dealers are sitting in the corner with the shakes when they should be up celebrating the birth of a son. Instead, they think they see a great, colorful industry being knocked out of the ring by a powerful newcomer. Radio has a definite, deep-rooted place in the American way of life. Neither television, moving pictures, nor anything else can disturb it as a great and universal form of entertainment, and a necessary advertising and merchandising force."

New Headquarters:

Western Electric has purchased the largest single plot of land now available on Manhattan Island, bounded by Varick, Hudson, and Laight Streets and Ericsson Place. Area measures 440 by 405 ft. This plot, where horsecars operated until 1861, was purchased from Trinity Church by Commodore Vanderbilt in 1866 for $1,000,000. W. E. offices now scattered in 14 New York City buildings, will be located eventually at this new address.

Reproduction vs. Simulation:

FM set manufacturers, with a few notable exceptions, are still justifying audio and speaker systems that merely simulate the original speech and music with the ready answer: "Why, the public doesn't *want* high fidelity!" Still, we've never seen anyone in a studio audience listening to a portable radio. Seems to us that people generally like what they hear going into the microphone.

Now It's Coming out:

And speaking of program quality: Remember the report on those CBS tests which purported to show that listeners preferred to have the upper audio frequencies cut off? Well, it has come out now that what listeners objected to was noise and distortion in the audio system. After CBS engineers cleaned it up, people wanted the higher frequencies. But CBS didn't release that information.

Census of FM & TV Sets:

We're not sure that a 1950 census of FM and TV sets would be wise now. Taken at a time when the number is zooming up but is still small compared to AM sets, those figures would be used against FM and TV for the following 10-year period. We'd rather see the RMA work out a continuing distribution breakdown from figures supplied by manufacturers.

Films for Television:

Frank Capra is the latest movieman to endorse a pay-as-you-go plan such as Phonevision for making feature films available on television. Opinion seems to be that producers must make use of television, regardless of its competition with the theatres.

Electronics Conference:

The National Electronics Conference will be held at the Edgewater Beach Hotel, Chicago, on November 4, 5, and 6. For information, address J. A. M. Lyon, Electrical Engineering Department, Northwestern University, Evanston, Ill.

50-Kw. FM Transmitter:

WTMJ-FM Milwaukee will have the first 50-kw. transmitter to be delivered by RCA. Its performance will afford some interesting comparisons with AM coverage in the flat midwest area.

Anthony Wright:

Former chief television engineer for RCA has taken over a similar post for Magnavox, Fort Wayne, Ind.

TV Stations on the Air:

The following TV stations are now transmitting regular program schedules:

WRGB Schenectady
WNBT New York City
WABD New York City
WCBS-TV New York City
WBEN Buffalo
WPTZ Philadelphia
WFIL-TV Philadelphia
WCAU-TV Philadelphia
WTTG Washington
WNBW Washington
WMAL-TV Washington
WBAL-TV Baltimore
WMAR-TV Baltimore
WTVR Richmond Va.
WLWT Cincinnati
WEWS Cleveland
WWJ-TV Detroit
WBKB Chicago
WGN-TV Chicago
WTMJ-TV Milwaukee
KSD-TV St. Louis
KSTP-TV St. Paul
KTLA Los Angeles

New Address:

Gray Research and Development Company has moved from Elmsford, N. Y. to larger quarters at 16 Arbor Street, Hartford. A sales office has been opened at 565 Fifth Avenue, New York City.

Dr. J. Howard Dellinger:

Chief of the Central Radio Propagation Laboratory of the National Bureau of Standards retired on April 30, after 40 years of Government service. He will spend this summer attending sessions of the International Radio Consultative Committee in Stockholm, and the Provisional Frequency Board in Geneva.

Sets for Phonevision:

According to Comdr. E. F. McDonald, Jr., Zenith plans to have sets on the market this year which will receive both free and Phonevision TV programs. Cost of the PV unit will not add more than $10 to the retail price, and will assure the owners of being able to get paid programs whenever and wherever the PV system is put into operation. (PV system was described in *FM* & TV, April, 1948.)

Microwaves for Communications:

The following bands have been assigned by the FCC for "control, repeater, and fixed circuits in the fixed service not open to public correspondence, which are operated by and for the sole use of those agencies operating their own communications facilities in the public safety, industrial, and land transportation services, and in the aeronautical fixed and mobile services":

1,850–1,990 mc. 2,110–2,200 mc.
2,500–2,700 mc. 6,575–6,875 mc.
12,200–12,700 mc.

Among other uses, these bands are ideal for operating point-to-point facsimile.

KCRK Cedar Rapids:

Gazette's FM station, operating on 3 kw. since last November, has now installed a 10 kw. transmitter. Now an increase to 275 kw. effective radiations from a 50 kw. transmitter has been authorized. George C. Bigger is general manager, and Wayne L. Babcock is chief engineer.

Patent Suit:

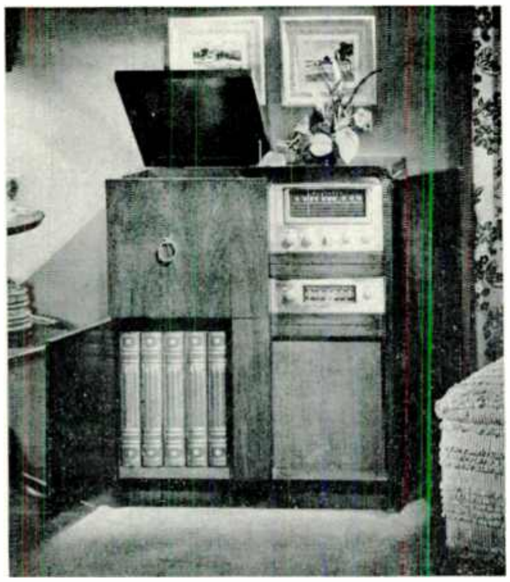
Du Mont Laboratories, which has never been an RCA licensee, has instituted antitrust proceedings against RCA in the Federal Court at Wilmington, Del. Du Mont charges that RCA is seeking to "intimidate and coerce" manufacturers into taking out licenses "under massed patents on excessive and unconscionable terms." It looks as if expiring AM patents and new patents on video equipment may take a lot of unscrambling if they get into the courts.

New FM Stations:

FM Association's bulletins list new FM stations coming on the air. This service is of particular value to set manufacturers, since it enables them to make advance plans for distribution. For further information, address 101 Munsey Building, Washington 4, D. C.

Network Programs on FM:

It's surprising that many people in the radio industry still do not know that AM network programs have been available on FM since February 1st. According to the FM Association, of the stations affiliated with NBC, CBS, ABC, and Mutual, 84% of those operating FM transmitters are broadcasting network programs. Consensus of opinion is that this has increased FM listening and FM set sales substantially.



1. *Motorola plans export communications sales.* 2. *Magnavox has separate FM tuner.* 3. *Federal system calls volunteer firemen*

NEWS PICTURES

1. While FM broadcasting is moving slowly in foreign countries, purchases of U. S. 2-way FM communications equipment are increasing steadily. Motorola has just appointed the Phillips Company of Eindhoven, Holland, world-wide distributor of their 2-way equipment. This photograph was taken when Jill Schelling, right, of Phillips was at Chicago to discuss engineering and sales problems with Motorola's Prof. Daniel Noble, center, and communications export manager Gordon Suor.

2. This Magnavox phonograph combination has a separate compartment to hold an Armstrong circuit FM tuner. The instrument can be bought with AM only at $219.50, and the FM tuner added at any time for an extra charge of $65. There is also a similar model, with FM and AM on a single chassis, listing at $268.50.

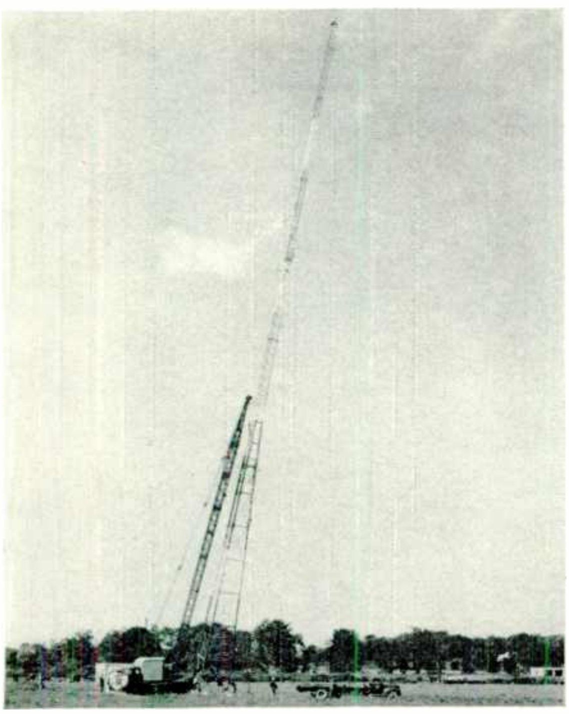
3. More and more fire departments are installing FM communications. Sudbury, Mass. has a new Federal system with selective calling. Moreover, each member of the volunteer fire department has a receiver in constant operation at his home, thus eliminating the delay of telephoning each one in case of need.

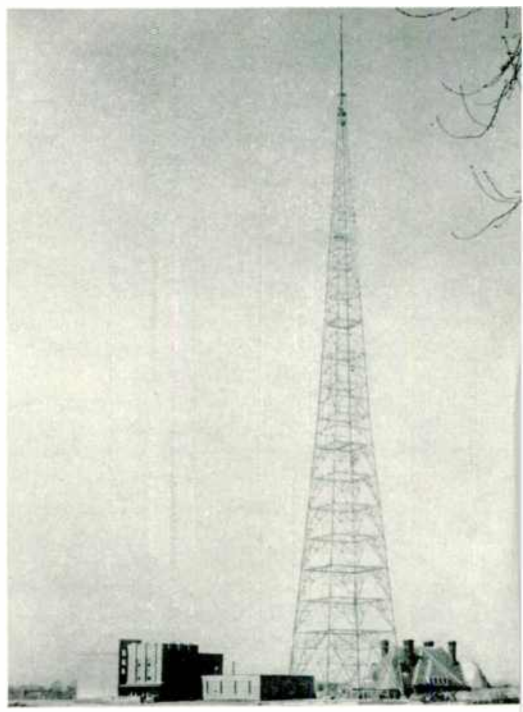
4. Believe it or not, that little Moto crane with a 90-ft. boom is lifting an assembled 200-ft. radio tower into place. It looks much easier than assembling the tower in the air. This photograph was taken during the construction of station WRAC, at Rochester, N. Y.

5. Here is the business end of the *Daily News* Building, East 42nd Street, New York, where studios and an antenna are being erected for TV station WPIX. Work is progressing so rapidly that scheduled transmission is expected to start this summer.

6. Crosley TV station WLWT is expected to have a range of 75 miles now that the transmitter has been stepped up to an effective radiation of 50 kw. from this new 571-ft. antenna. FM coverage of affiliated WLWA is up, also, for the mast at the top of the tower carries an FM antenna as well as the two required for television.

4. *A 20-ton crane lifts 200-ft. tower.* 5. *Location of TV station WPIX New York.* 6. *New tower increases FM and TV coverage*





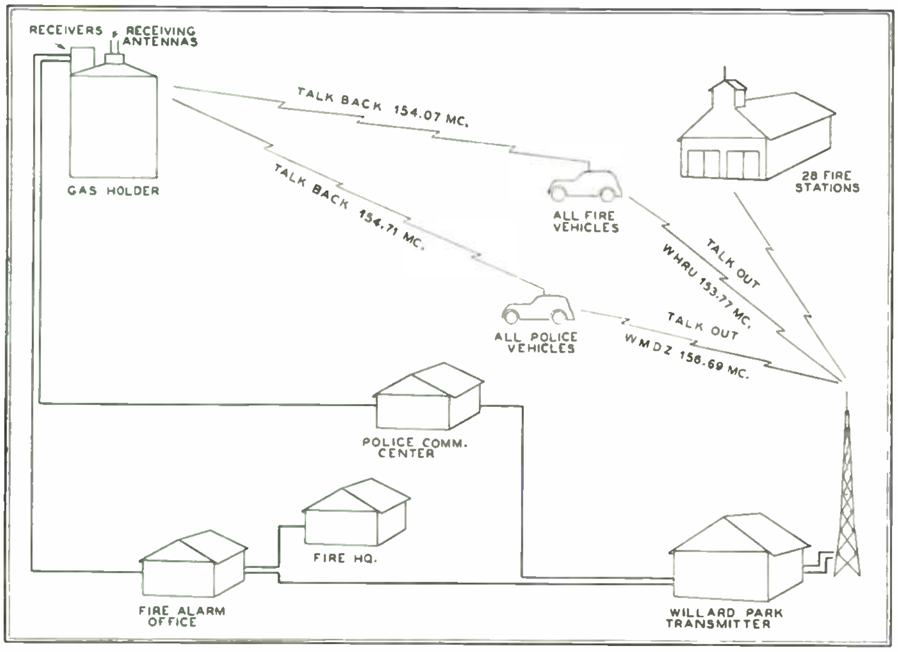


FIG. 1. *Plan of the Indianapolis police and fire FM radio communications system*

FM FOR INDIANAPOLIS

UNIFIED RADIO DIVISION OPERATES AND MAINTAINS POLICE & FIRE RADIO SYSTEMS—*By* JAMES P. CODY*

ONE of the most modern fire department radio systems is now operated by the city of Indianapolis. To be more exact, it is operated by the Indianapolis Police and Fire Radio Division, made up principally of personnel from the original Police Radio Division.

This change came about following the modernization of the Indianapolis police radio system, over a year ago. At that time, the AM equipment was replaced by 88 Motorola FM mobile units and a main transmitter installation. Fire Chief Harry Fulmer cast a speculative eye on the new police gear, and made up his mind that his department should be similarly equipped. In cooperation with Capt. Robert L. Batts, head of the Police Radio Division, the two departments worked out a plan for a fire department communications system calculated to save the City approximately $100,000 during the first year of operation, and $40,000 a year thereafter.

The plan called for separate police and fire radio systems, to be maintained by a joint radio division, with all headquarters equipment, except for the dispatching offices, housed in one building.

Need for Fire Communications:

The city area of Indianapolis covers 54 square miles with a population of 387,000. In 1947, there were 4,691 alarms of fire, requiring the use of 17,935 pieces of apparatus that traveled 40,859 miles. Chief Fulmer argued: "I agree with others who have said that the 2-way radiotelephone is the greatest fire-fighting innovation since the installation of motor-driven vehicles. I can't begin to figure the unlimited possibilities for the use of radio. It will save invaluable time in dispatching runs. We can stop false runs and reroute equipment to live fires. It will save tracing hundreds of feet of hose back to the pumper to give orders. We'll find something new every day for which to use our new radio equipment."

Chief Fulmer won his argument. The police-fire radio service was inaugurated on December 30, 1947. Eleven days later, the Chief's predictions as to the value of 2-way FM were corroborated when equipment from five Companies, including 8 pumpers, 2 rescue trucks, an aerial tower and a water tower were called out to fight one of the largest fires in the City's history.

Sure enough, radio proved its value on this occasion by speeding calls for more pressure from the pumpers. Said master mechanic Frank Braun: "Twenty-one hose lines criss-crossed the streets in a maze, and thousands of spectators jammed the fire-block area around the blazing building. We would have wasted time and manpower tracing those lines back to the pumpers."

Details of the System:

Fig. 1 shows the plan of the combined system in block diagram form. Any possible confusion between the police and fire departments is eliminated by using separate transmitters and receivers, operated on different frequencies. Thus, when an emergency arises involving both departments, each has the full use of its own facilities.

Fire calls from headquarters go out on 153.77 mc., and the mobile units answer on 154.07 mc. Police calls go out on 156.69 mc., and come back on 154.71 mc.

Both headquarters transmitters are located in a building at Willard Park. The use of Motorola cavity filters makes it possible to operate both transmitters from

FIG. 3. *Retiring Chief Fulmer sent out the first call on the new fire radio system*

*Communications Division, Motorola, Inc., 4545 Augusta Blvd., Chicago 53, Ill.

FIG. 2. *Technical Sergeant Severin Barstad checks the antennas atop the gas holder*

a single antenna on a 224-ft. steel tower outside the building.

The fixed receivers and their antennas are mounted on a 408-ft. gas holder, Fig. 2, four miles northwest of the transmitter site. In addition to the 154.71- and 154.07-mc. receiving antennas are those for the old AM and the state-wide 155.37-mc. point-to-point police systems. The receivers are connected to the police communications center, and to fire headquarters through the fire alarm office. Other lines connect these points to the respective transmitters at Willard Park.

Standby equipment is provided for emergency use. There are duplicate transmitters and receivers at the Park, and duplicate receivers on the gas tank. A flip of a switch at the Willard Park station activates any piece of the emergency equipment. Current for the transmitters can be supplied by an engine-driven generator in case the outside power line fails.

An important feature of the system was contributed by Capt. Batts. Whenever the central station operator realizes that a call from one of the mobile units should be rebroadcast, or if it is necessary for one car to communicate with another, the operation of a control switch actuates a relay which turns on the associated transmitter and feeds the incoming call into the audio input. This arrangement is used for long-distance, 3-way calls, and is particularly valuable in a police chase, and in controlling the activities of different pieces of fire-fighting apparatus from the Chief's car. Thus there is a considerable reduction of time-on-the-air, since the operator is not required to do any rebroadcasting.

The Police System:

At present, the police system consists of 71 cars and 4 ambulances equipped for 2-way radio, and 5 motorcycles and 9 three-wheeled cycles equipped for reception only.

The Indianapolis police also handle calls for 9 two-way installations in cars operated by the Marion County sheriffs, and for single police cars in adjacent Beech Grove and Crows Nest.

During 1947, there were 90,648 complaints to the police handled by radio. This involved a total of 392,209 messages.

The Fire System:

At this time, 32 two-way units have been installed on fire apparatus and cars. Eventually, the fire department will increase this to a total of 75 vehicles of all types. The 27 fire stations have FM receivers.

Fire dispatching is done wholly by radio. First, an attention signal is transmitted, followed by verbal instructions. The message is acknowledged by pushing a button on the joker-desk at the station called. This lights a light on the radio dispatcher's switchboard. If this acknowledgment does not come immediately, the dispatcher calls by phone to learn the reason for the delay.

Fig. 3 shows the remote control console used by the fire department. This photograph was taken when retiring Chief Fulmer transmitted the first message over the new system. Standing, from left to right, are Lieut. Curtis C. Springer and Capt. Robert L. Batts of the Police and Fire Radio Division, and the new Fire Chief Roscoe A. McKinney.

(*Concluded on Page 60*)

FIG. 4. *Lieut. Lich handles the special microphone on No. 7 pumper.*

FIG. 5. *The fire radio system was initiated at this record blaze*

MEASURING WOW

A DISCUSSION OF WOW-MEASURING METHODS, AND DESCRIPTION OF A COMMERCIAL TYPE OF WOWMETER — *By* U. R. FURST*

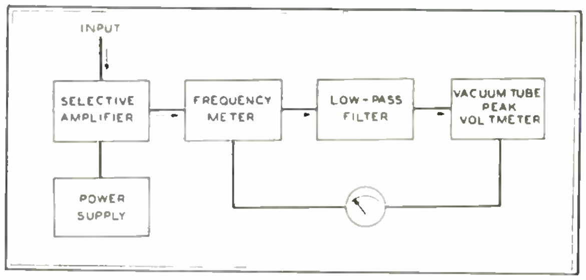


FIG. 1. *Block diagram of the Furst direct-reading wowmeter*

BECAUSE of the increasing use of records and transcriptions, broadcast stations have made very large investments in fine recording and reproducing equipment. Unfortunately, the performance of the best equipment is no better than the driving motor and mechanism, and these do go wrong at times. The result is unintended sound effects which, particularly on sustained notes, are both weird and annoying to the point that listeners respond by tuning to another station.

In other words, preventative maintenance is just as necessary for the mechanism of recording and reproducing equipment as for the associated electrical circuits. It was to meet this specific and highly essential maintenance need that the Furst wowmeter was developed.

Since it was made available to the stations, we have learned that it serves another useful purpose: It is sometimes difficult for a chief engineer to present the front office with a convincing argument for replacing obsolete equipment. The general manager is liable to say: "It sound all right to me." And so it may, because it is characteristic of defective motors and mechanisms to work perfectly when they are expected to show up their faults, and to go wrong when they ought to be on their good behavior.

With a wowmeter, exact measurements of faulty operation can be made and entered on the operating log. Thus the development of trouble can be anticipated or, if it is being experienced already, the extent of the fault can be determined.

FIG. 2. *Commercial wowmeter can be used with oscilloscope or harmonic wave analyzer*

Requirements of a Wowmeter:

The transmission of recorded programs requires the use of motor-driven mechanical devices such a turntables, wire or tape machines, or film recorders and reproducers. Thus distortion caused by mechanical imperfections of this equipment is added to inherent electrical distortion. The purpose of the wowmeter is to measure the component due to mechanical faults. The most annoying distortion from the latter source is a frequency modulation of the audio signals recorded or reproduced, resulting from variations in the operating speed. The expressions *wow* and *flutter* are commonly used to describe this type of distortion.

It is just as necessary to reduce wow and flutter to imperceptably low values as it is to reduce other types of distortion. Obviously, little can be done in that direction without an instrument to express the degree of wow or flutter. The requirements for such an instrument can be stated briefly as follows:

1. It should produce a direct reading on the scale of an indicating meter which is an integral part of the instrument.

2. Reading should be independent of the signal amplitude.

3. The indication should be independent of the damping of the meter, and a steady reading should be obtained in the shortest time possible after connecting the signal source to the instrument, and after a variation of the wow content of the signal.

4. Response should be flat for all wow frequencies over a range which includes all significant frequencies that may be encountered in practice.

5. It should use a type of signal that can be produced readily in the station.

6. A relatively simple means for calibration should be provided, as signals with an accurately known amount of wow are difficult to obtain.

In addition, the following features are desirable:

7. The instrument should be light and small enough to be transported easily.

8. Optional means should be provided to determine which wow frequencies are predominant, in order to give an indication as to which component of the equipment under test is causing the distortion.

An instrument meeting these requirements will be essentially a calibrated FM detector, similar to those used in FM receivers. The main difference is the low frequencies involved. The carrier frequency is usually between 1,000 and 3,000 cycles, while the modulating frequency runs as low as ½ cycle per second in the case of an irregularity occurring once per revolution on a turntable running at 33⅓ RPM. It is mainly due to those low frequencies that the design of a commercial wowmeter is a rather difficult undertaking.

Circuit Considerations:

The first thought in designing this type of instrument is to use one of the many well-known frequency-discriminator circuits employed in FM receivers. However, all these arrangements require tuned circuits with chokes having a high *Q*. At the frequencies involved, this calls for ferro-magnetic cores which are subject to non-linear saturation, hum pickup, and other undesirable effects. For this reason, a frequency meter circuit of the cycle-counter type was chosen for the instrument to be described. This circuit is similar to that used in frequency deviation monitors, except for modifications required by the low frequencies.

A block diagram of the Furst wowmeter is shown in Fig. 1. The signal produced by a constant frequency test record, wire, tape, or film is fed into the preamplifier, the frequency response of which is peaked at the nominal frequency of the instrument (for instance, 1,000 cycles).

(*Concluded on page 50*)

* Furst Electronics, 800 W. North Avenue, Chicago 22, Ill.

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- **Does away with need for extra tower**
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The lower part of the antenna you see in these pictures is a high-gain, heavy-duty Pylon. It can support a 6-section RCA high-gain television antenna . . . *without a single guy.* No need for a separate tower for FM . . . with the expense of putting up another tower later for TV. *Here, one does it!*

For long-term protection of your tower investment, be sure to figure your FM-TV antenna requirements in terms of a Heavy-Duty Pylon—TV Super Turnstile combination. Your RCA Broadcast Sales Engineer has the facts. Call him, or write Section 38-E, Engineering Products Dept., RCA, Camden, N. J.

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The "Heavy-Duty" antenna is simplicity itself. No dipoles. No external loops. No appendages of any kind . . . and no adjusting.

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The Heavy-Duty Pylon with a High-Gain TV Super Turnstile atop it. Two antennas in a single self-supporting unit that can be mounted anywhere—tower or building. This radiator provides simultaneous FM transmission and wide-band TV services—both aural and visual. Power gain for the Super Turnstile is 3.8 to 7.

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Choose the unit or the combination to meet your special requirements.

FREQ. RANGE (MC)	POWER GAIN	NO. OF SECTIONS	OVER-ALL HEIGHT (FT.)	WEIGHT (LBS.)	TYPE NO.
HEAVY-DUTY PYLONS					
88-96	3	2	27	4,322	BF-12E
96-108	3	2	27	4,322	BF-12F
88-96	6	4	54	10,497	BF-14C
96-108	6	4	54	10,497	BF-14D
TELEVISION SUPER TURNSTILES (for installation on Heavy-Duty Pylons)					
55-66	3.3 to 3.7	3	56′ 3″	4,666	TF-3B
66-88	3.3 to 4.1	3	48′ 1″	3,120	TF-3B
174-216	6.4 to 7.1	6	44′ 8″	2,770	TF-6B

TELEVISION HANDBOOK

CHAPTER 3: PRIMARY COMPONENTS OF EQUIPMENT—PART 4: DISCUSSION OF THE COMPOSITE TYPES OF PHOTO-ELECTRIC PICKUP TUBES—*By* MADISON CAWEIN

(5.) Camera Deflection Circuits:

In order to present the operation of the various simplified types of camera deflection circuits, it will be necessary to digress in order to enlarge upon the brief introduction to the theory of complex waves given at the beginning of Chapter 2. The subject of the meaning of differentiation and integration of complex waves will be discussed in some detail. This discussion will be started with reference to the circuit and operation of a simplified type of oscillator, known as the relaxation oscillator, and to an analysis of the circuit parameters, as these affect the generated waveforms of current and potential.

(5.1) Relaxation Oscillators:

A relaxation oscillator is a generator of electric current and potential waves whose amplitudes vary between negative cutoff and positive overload, as limits. In essence, a relaxation oscillator is a violently regenerative device for which many circuit arrangements exist in practice. For purposes of illustration, a simple two-tube circuit will be discussed here, as shown in the accompanying Fig. 57.

(5.11) Static Characteristic:

The periodicity of the current waves is dependent in a complex manner upon the time constants of the associated circuit elements. The direct coupling path from plate to grid to plate to grid produces violent regeneration of any electrical disturbance sufficient to start the flow of plate current on the static characteristic of the discharge tube, shown in Fig. 58. The dynamic characteristic of a triode operating in the discharge position D, Fig. 57, is shown in dotted line on Fig. 58. This curve was plotted by analyzing the circuit in Fig. 57 in conjunction with the solid curve of Fig. 58.

(5.12) Dynamic Characteristic:

Assume that B = 127 volts (Fig. 57), that the circuit constants are such that the grid potential of tube D is 43 volts, and that K, the cathode potential of D, is 65 volts. Let R = 200,000 ohms, C = 0.17 mfd. so that the time constant of discharge of the cathode circuit is RC = 34 milliseconds, then K will decrease exponentially with time along the solid curve No. 1 of Fig. 59. When K is approximately 50 volts (G_1 of Fig. 58) I_p starts to flow in the plate circuit of tube D. If the regeneration is so adjusted that the highest potential which the grid of the discharge tube *can* receive is 62 volts, then this grid, except for a delay due to the transit time of electrons in the circuits, will immediately assume this potential and the static characteristic will shift from curve No. 1 of Fig. 58 to curve No. 2.

(5.13) Cycle of Relaxation:

A reference to Fig. 58 shows that there will

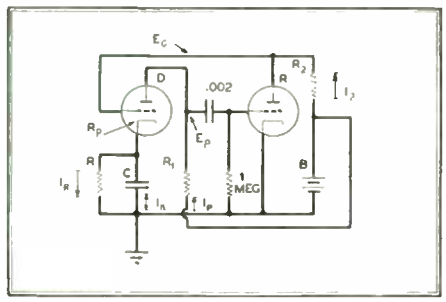


FIG. 57. *A simple relaxation oscillator circuit, producing violent regeneration*

be approximately 5 milliamperes flowing from plate to cathode of tube D, which acts to charge the condenser C. The current flowing out of the condenser C through the resistor R is always less than 65/200,000 = 0.325 milliampere. The potential of K will rise until the plate current has fallen from 5 to less than 0.325 milliampere. The time constant of this charging circuit is determined by the product of C, in microfarads, and of R_p, the apparent plate resistance of tube D, in ohms. R_p is approximately 127/.005 = 25,000 ohms. If I_p were maintained at 5 milliamperes, the cathode potential would rise exponentially with time, according to the dotted curve No. 3 of Fig. 59. K will continue to rise until K = G_2 (= 65 volts) at which point plate current ceases to flow in D as is shown by the static characteristic. Immediately the grid of the discharge-tube will resume its static

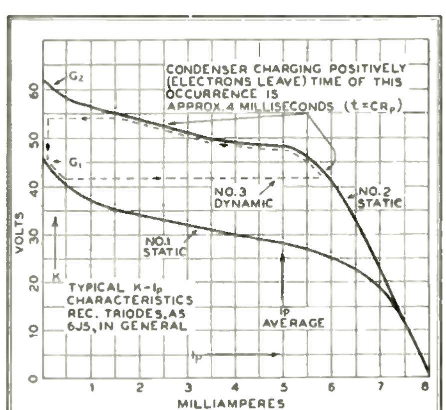


FIG. 58. *Typical characteristics of tube D, in the circuit shown at Fig. 57*

potential of 43 volts, since there is no longer a regenerative signal to maintain it at 62 volts.

K is at 65 volts, the starting position of the cycle, so that the cycle will repeat. The periodic shift between the static characteristics No. 1 and No. 2 constitutes what has been termed the *relaxation*, from which the oscillator derives its name. The function of the regenerating tube is merely to furnish a *polarity reversal* so that the feedback potential is in phase with any disturbance. A transformer could be used between the plate and grid of D, providing the associated resonant frequencies were sufficiently above the highest harmonic of the fundamental frequency. This occurs for all practical purposes at least above the reciprocal of the time required for discharge, as explained in Section 2 of Chapter 2, Subsection 1.

(5.14) Wave Form:

The alternate relaxations between the static characteristics of the discharge tube result in a dynamic characteristic, as is shown by the dotted line in Fig. 58. This characteristic shows that the plate current jumps from zero to maximum at a particular value of K. If K increases (as it must in the circuit of Fig. 57) after the maximum plate current is reached, then I_p must decrease as K increases further, according to the arrows in Fig. 58. It will be noted that as the plate voltage is increased, the K-I_p curve becomes approximately exponential. In the foregoing analysis it was assumed that I_p maintained its maximum value of 5 milliamperes until the cutoff relaxation took place, in order to plot curve No. 3 of Fig. 59. Actually, since I_p decreases along curve No. 2 of Fig. 58, which has an approximately exponential shape, the effect is to increase the total time of rise of K. Thus K actually rises along the solid curve No. 2 of Fig. 59.

Neglecting the transit time of the electrons, the current flowing into the condenser C is actually as shown in Fig. 60, the shape being different from that indicated by the dynamic characteristic of Fig. 59. The reason for this difference is that when the tube is operating on the second static characteristic of Fig. 58, the variation in I_p with K causes (by regeneration) a transient signal on the discharge tube grid. Thus E_g, at the end of the cycle, lies somewhere between 62 and 43 volts. In other words, static characteristic No. 2 is not a fixed curve like No. 1, but shifts toward No. 1 continually, with the elapse of time. This is to say that cut-off, as well as initiation, of I_p occurs regeneratively. The shape of the dynamic characteristic is actually very close to that of the plate-current pulse through tube D, as shown above the axis in Fig. 60.

Fig. 58 is an approximation only, for the purposes of explanation. The more nearly the rise, with time, in potential of K approaches a straight line, the more nearly the shape of the dynamic characteristic approaches that of the positive pulses of Fig. 60.

(5.15) Timing Index:

The portion of the cycle during which D is cut off is the *useful portion* of the cycle in television and oscillographic work. Cathode-ray tube screens are illuminated during this time, and the path of the cathode ray on the fluorescent screen has been referred to earlier as the trace of the beam. Let the ratio of the trace, or useful part of the cycle, to the whole cycle be designated by the symbol b which has a value always less than unity in practice. Values of the order $b = 0.9$ are representative of television and oscilloscopic design in general. Constants were chosen for Fig. 59 with this fact in mind. In long-period relaxations, values as great as $b = 0.99$ are entirely practical. The quantity $r = 1 - b$ is useful as a timing-index of the wave. This was stated in (1) Subsection 2 of Section 1, Part 2 of Chapter 1.

(5.16) Differentiation & Integration:

The potential wave of Fig. 59 can be considered as the AC potential across a capacitor into which the AC current wave of Fig. 60 is flowing. This potential is expressed mathematically as

$$e = \int idt/C \qquad (9.0)$$

where i, the current, changes with time and is said to be a function of the time:

$$i = f(t). \qquad (9.1)$$

The solid curve of Fig. 59 is called the *integral* of the solid curve of Fig. 60, and conversely Fig. 60 is called the *derivative* of Fig. 59. The meaning of integration, which is the process of taking the integral of a curve, relates to plotting the area under the curve to some significant scale of values. In this case, the saw-toothed curve No. 3, of Fig. 59, represents the shape of the AC voltage waveform generated at the cathode of tube D. The axis of this AC wave is at A. (This wave is unsymmetrical about the axis because of its curvature and unsymmetrical shape.) The pulse wave in Fig. 60 represents the shape of the current, I_k, which flows through condenser C. The axis of I_k is unsymmetrically located, also, with respect to the peak and the flat of the wave because of their dissymmetry. The area of this pulse wave has the dimensions of current × time:

$$\text{Area} = i \times t = \text{charge} \qquad (9.2)$$

Since there is no net transfer of charge into or out of the condenser averaged over a cycle (otherwise the condenser would charge up to the disrupting point over a long time), the charging current by the time it flows and the discharging current by the time it flows must balance during the cycle, so the positive area (shaded charge) is equal to the negative area (black charge). The potential produced across a condenser is proportional to the accumulation of charge:

$$V = Q/C \qquad (9.3)$$

so that if the accumulated area (charge) of the pulse is divided by C and plotted

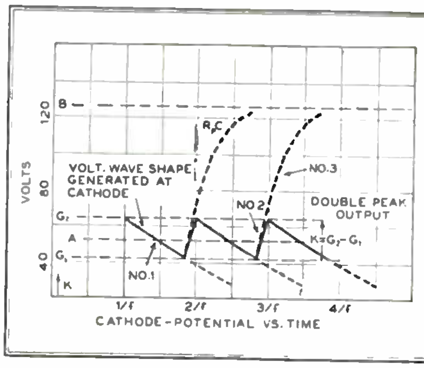


FIG. 59. *Voltage waveshape generated at the cathode of tube D, shown in Fig. 57*

against the time, the graph of the potential is obtained. Curve No. 3 of Fig. 59 is this graph, and represents the plot of equation (9.0) for the case where the current is a pulse function of the time, as in Fig. 60. Thus Fig. 59 is said (mathematically) to be the integral of Fig. 60. Likewise, Fig. 60 is called the derivative of Fig. 59. Differentiation is the reverse process of integration. By plotting the derivative of a curve, the graph of the

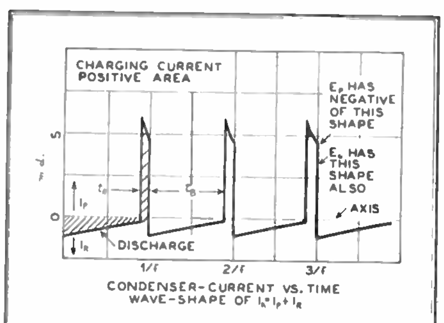


FIG. 60. *Shape of the plate current pulses occurring through tube D, in Fig. 57*

slope or rate of change, or steepness, is obtained.

The pulse is the graph of the current which is the time-derivative or rate of change of the saw-toothed voltage across the condenser in this example. The saw-toothed voltage across the condenser is the graph of the time-integral of the current, or the time accumulation of charge in the condenser. This is what is meant by differentiation and integration.

The potential wave form at the cathode of tube D is called an exponential-sawtooth wave. The plate potential E_p of D is of the same impulsive form shown in Fig. 60, except that the polarity is opposite to that of the current shown, because this current flows through a pure resistance R_1, which neither differentiates nor integrates. If tube R is a pure resistance-coupled amplifier, the plate potential of R will be reversed in respect to that of D, so that the grid signal E_g of D is a positive pulse, as shown in Fig. 60. This grid draws current during the positive portion of the cycle. The grid current merely serves to modify the exponential shape of the top of the impulse and contributes to the slight difference between curves No. 2 and No. 3 of Fig. 59.

(5.17) Effect of Circuit Parameters:

If the amplification of the regenerative circuit is increased by an increase in the value of resistor R_1, a larger AC pulse will be delivered at E_g, and the plate-current pulse into the capacitor will be increased. Since the AC pulse, E_g, determines the static characteristic No. 2 of Fig. 58, the operating characteristic for the conducting portion of the cycle, which is usually termed the retrace characteristic, will be shifted so that G_2 becomes more positive, and the difference $G_2 - G_1 = K$ increases. The time of the trace, t_b, is proportional to $\log (G_2/G_1)$, and will increase also.

The time of the retrace t_r is proportional to $\log [(B - G_1)/(B - G_2)]$, which increases as $G_2 - G_1$ becomes greater. The net result is an increase in the period of the wave, so that high gain in the regenerative circuit tends to lower the frequency of the relaxation.

(5.18) Frequency Formula:

If the amplification of the regenerative circuit is increased by an increase in resistor R_2, a larger AC pulse is delivered to the discharge-tube grid, to cause an increase in G_2 as before; but also the DC signal on the grid will be affected, so that G_1 will decrease. Thus G_1 and G_2 move in opposite directions and the spread of working voltages on the exponentials (No. 1 and No. 2) of Fig. 59 is increased. Since t_b and t_r depend upon the differences between intersections of G_1, G_2 with the exponentials No. 1, No. 2, then the period of the relaxation will be increased by a two-fold amount for an increase in R_2.

Let $S = G_2/G_1$, $S' = (B - G_1)/(B - G_2)$. (9.4)

By a proper choice of G_1 and G_2 in reference to B, S can be made equal to S'. Then, from the equations of the exponentials, it can be proved that

$t_b = RC \log S$, and $T_r = R_pC \log S$ (9.5)

and

$$f = \frac{1}{t_b + t_r} = \frac{1}{C \log S\,(R + R_p)} = \frac{b}{RC \log S} \qquad (9.6)$$

which is a practical working formula for

(*Continued on Page 56*)

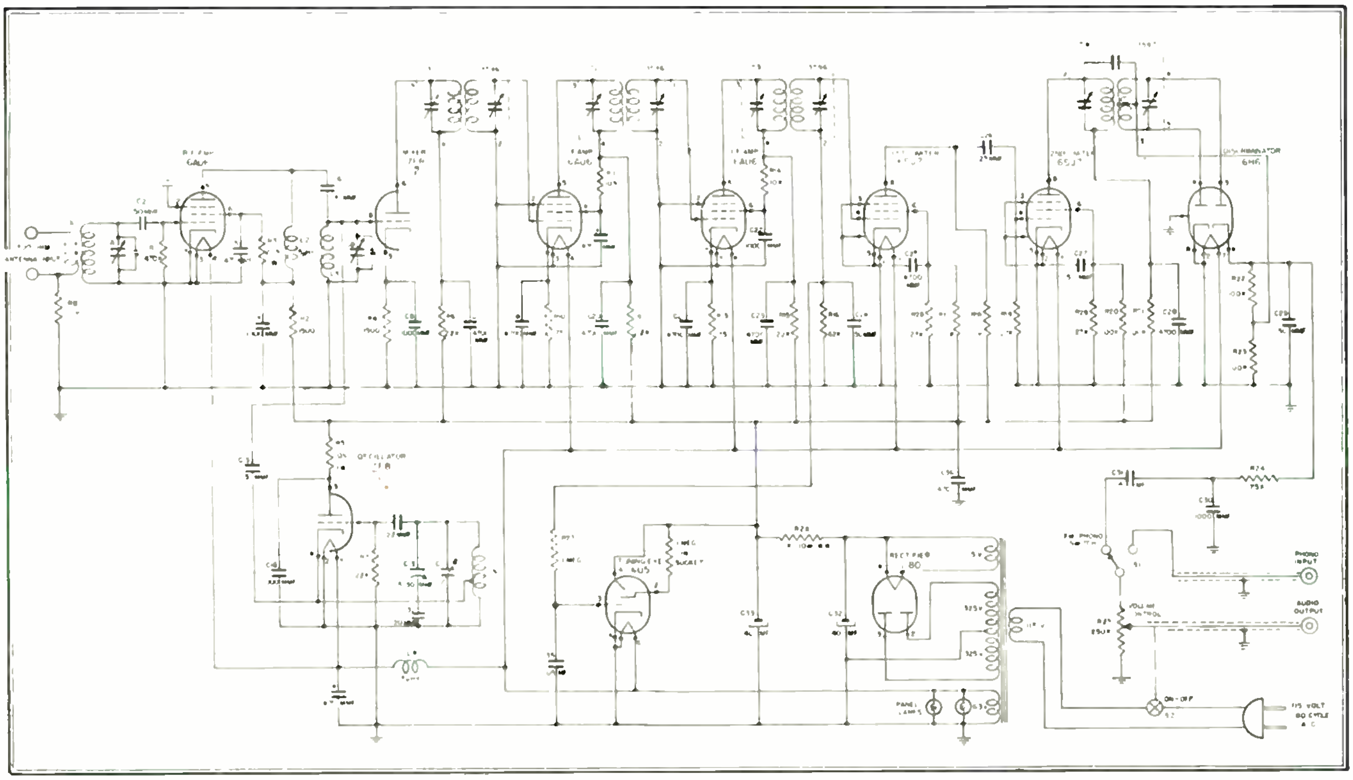


FIG. 2. *Schematic of the Browning RV-10 tuner, employing the Armstrong circuit. Phono switch connects pickup to audio input*

THE BROWNING RV-10 FM TUNER

PERFORMANCE CHARACTERISTICS, CIRCUIT DATA, AND ALIGNMENT PROCEDURE FOR A STRAIGHT FM TUNER EMPLOYING THE ARMSTRONG CIRCUIT—*By* F. A. SPINDELL

WHILE the actual service area of an FM transmitter is normally considered to extend only to the 50-microvolt field strength limit, many people interested in FM live in areas where considerably less signal strength is available. Even in urban areas, where high-intensity signals can be picked up from local stations, there are likely to be signals from many remote transmitters which are not strong enough to operate the limiter of ordinary FM receivers. These factors have influenced the development of the Browning RV-10 tuner, Fig. 1. This is an Armstrong circuit design which possesses greatly improved sensitivity, and retains full 150-kc. bandwidth. Complete engineering data for the various sections of the tuner will explain the results achieved in the design.

* Chief Engineer, Browning Laboratories, Inc., Winchester, Mass.

RF Amplifier Circuit:

As is shown in Fig. 2, a tuned RF amplifier using a type 6AU6 miniature pentode tube is fed by the standard 300-ohm antenna lead-in. The antenna link is inductively coupled to the tuned circuit in the grid of the amplifier. As there is no direct ground in the antenna circuit, a path to ground is provided by resistor R8, in order to bleed off static charges which might otherwise accumulate during snow or thunder storms. Despite the fact that the antenna link is designed for 300-ohm twin-lead connection, a 72-ohm coaxial lead can be used without serious losses provided the outer conductor of the cable is connected to the end of the coil grounded through R8.

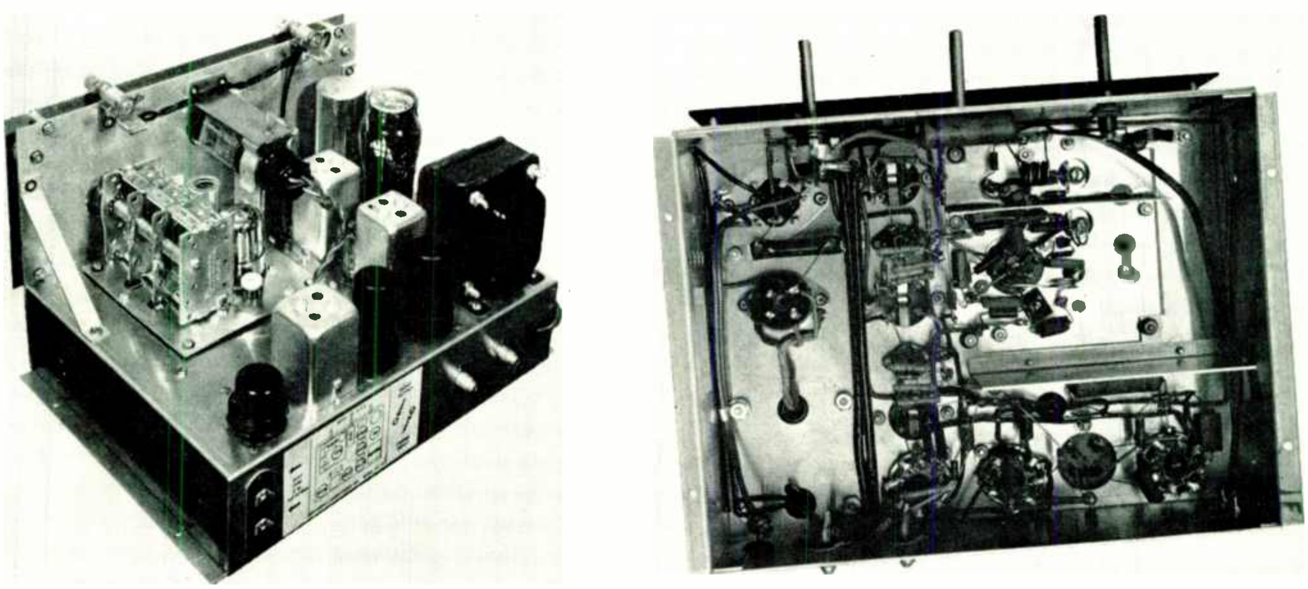
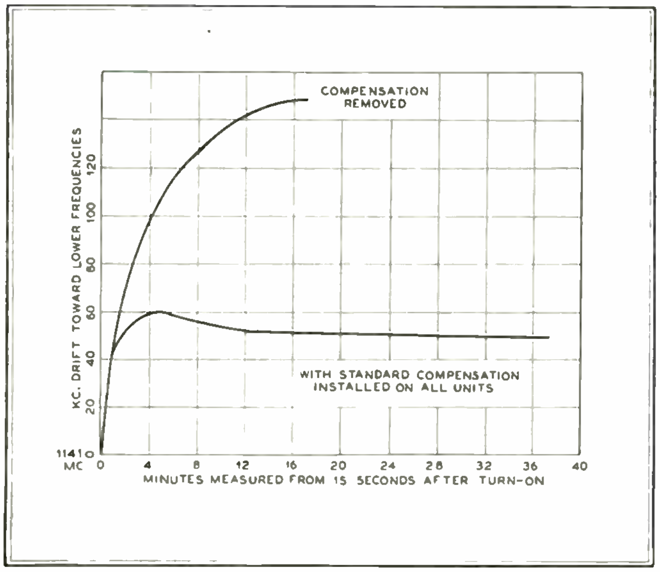


FIG. 1. *Rear and bottom views of the tuner show compact design and isolation of components affected by temperature rise*



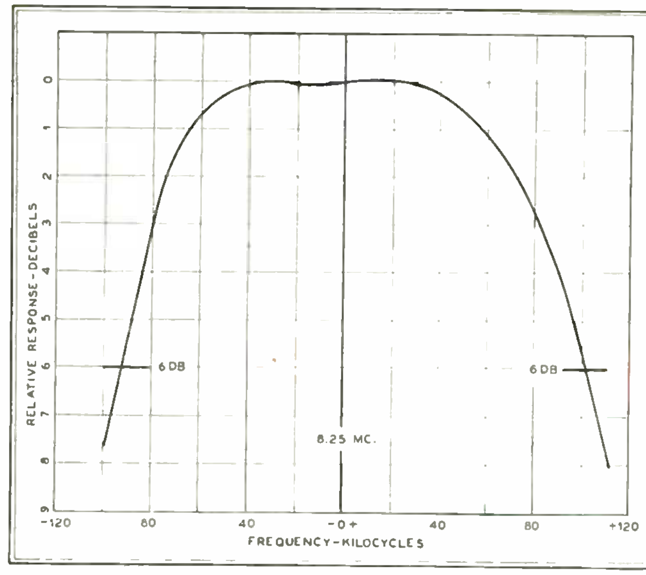


FIG. 3. *Frequency drift 15 seconds after turn-on, with and without compensation.* FIG. 4. *Response of the IF amplifier*

The RF amplifier provides an overall gain of about 5, prevents excessive local oscillator radiation, and greatly improves the image rejection. Image rejection measured at 100 mc. is approximately 34.5 db, corresponding to a voltage ratio between desired and undesired signals of about 53 to 1. The grid circuit is tuned by the front section of the 3-section variable condenser. Because of the antenna coupling and the low impedance of the tube input, the *Q* of this tuned circuit is low, and does not measurably affect the bandpass of the tuner.

Mixer-Oscillator Circuit

The functions of mixer and oscillator are performed by a 7F8 loctal twin triode. One half of the tube is the oscillator, while the other half functions as the mixer. An advantageous reduction in mixer noise results from the use of a triode for this purpose, since noise is a function of the number of tube elements involved. Thus the difference between the triode and a pentagrid tube is pronounced.

The second triode half of the tube is

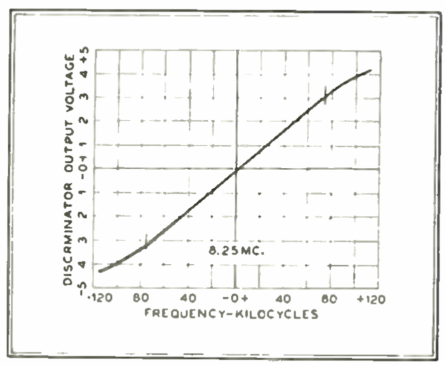
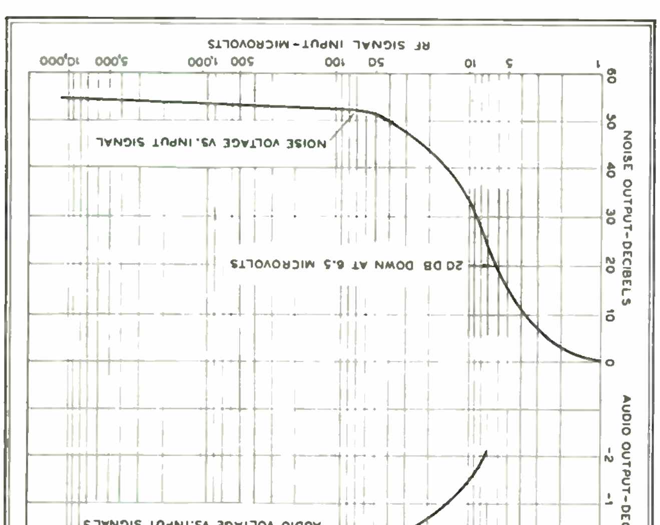


FIG. 6. *Discriminator performance curve*

used as the local oscillator. The curves of frequency vs. time after turn-on are shown in Fig. 3. It will be noted that with no temperature compensation employed, the oscillator frequency drifts a relatively large amount, and is still drifting rapidly after 10 minutes of operation. By the introduction of a ceramic trimmer having a temperature coefficient of −750 parts per million per C°, and the judicious placing of components relative to heat sources, the drift trend is stopped or slightly reversed. It can be shown that oscillator frequency-shifts up to 20 kc. are imperceptible, and do not require tuning. Referring to the curve of the compensated oscillator in Fig. 3, the total drift up and down is no more than 20 kc. after 1 minute of operation. Since more than a minute is generally consumed in tuning, selecting the desired station, and adjusting volume, stability is ordinarily reached at the outset, and drift-free performance equivalent to an AM broadcast receiver is realized.

IF Amplifier Design:

The IF amplifier has two high-gain stages with 6AU6 miniature tubes operating at



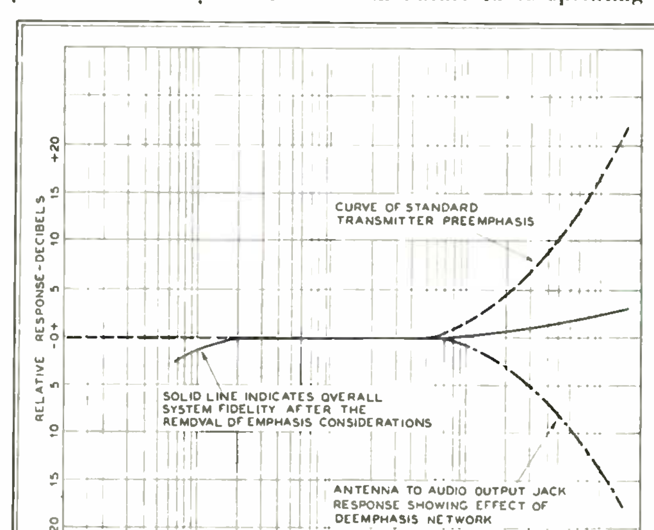


FIG. 5. *Below, noise-limiting action vs. RF input. Above, audio output vs. RF input.* FIG. 7. *Effects of de-emphasis*

a frequency of 8.25 mc. The transformers are slightly overcoupled, giving the necessary 150-kc. bandwidth with good adjacent channel attenuation. An IF amplifier response curve is shown in Fig. 4. It will be noted from the curve that the response is down only 3½ db at ± 75 kilocycles.

RF bypassing throughout the amplifier makes use of ceramic capacitors of high dielectric constant, permitting short leads, extreme neatness, and compactness. The amplifier is laid out in a straight line from the front of the chassis to the rear, making the distance from input to output as great as possible, thereby reducing feedback and maintaining a symmetrical response curve.

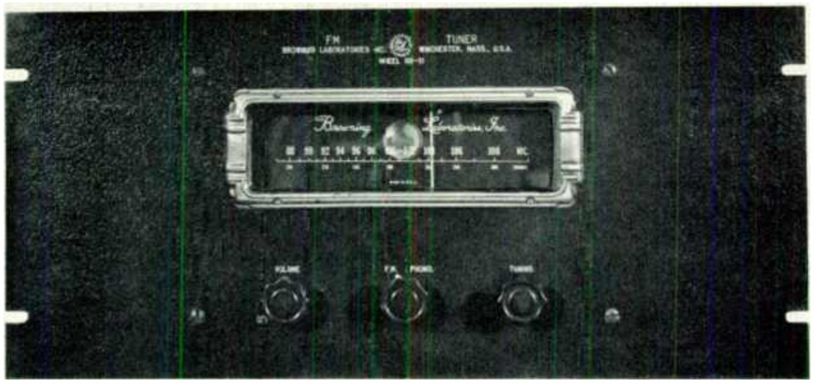


FIG. 8. *Front view of the FM tuner on a standard 19-in. panel for rack mounting*

Cascade Limiter:

Amplitude limiting in the RV-10 is performed by two 6SJ7 pentodes, operating in cascade. Low plate and screen voltages limit the output signal to constant amplitude, clipping noise peaks to the same amplitude as the limited carrier. The gain preceding these limiters is such that approximately 7 microvolts at the antenna causes complete limiting action.

A graphic illustration of limiter action appears in Fig. 5, where the curves of noise voltage and audio output versus input signal are shown. Note that the background noise is 20 db down when a 6.5-micro-volt signal is present on the antenna. Reception of distant or weak FM stations is greatly improved by this sensitivity. As shown in the upper curve of Fig. 5, the audio output voltage is sufficiently constant over the entire signal-strength range to provide practically the same audio output from a weak station as from a strong station provided the degree of modulation is comparable.

Discriminator Circuit Performance:

Translation of frequency variations to amplitude variations occurs in the discriminator circuit. For true, undistorted reproduction, the relation between frequency and output voltage amplitude should be linear over the intermediate frequency bandpass. Reference to Fig. 6 will show how well this linear relationship is maintained in the practical case of the RV-10 tuner. Measurements indicate that within the limits of experimental error, there is less than 3½% deviation from linearity over the range 75-kc. above and below the IF center frequency.

Tests made at 200 microvolts input on 100 mc., with modulation of 400 cycles and 75-kc. deviation, show that under these conditions there is present 1.06% 2nd harmonic distortion and 2.65% 3rd harmonic distortion. Higher harmonics were not measurable. With 50-kc. deviation, which more nearly approaches normal modulation conditions, only .79% 3rd harmonic distortion was measurable. Other harmonics were too small to be significant.

Fig. 5 also shows that for ± 75-kc. maximum allowable deviation of the carrier, the resulting peak audio voltage is approximately 3 volts. The average modulation on a received carrier of sufficient intensity to operate the limiter yields audio output of about 0.75 volt RMS.

The audio voltage from the discriminator is fed to the output through a filter section consisting of R24, and C30. The time constant of this RC combination is 75 microseconds. This compensates for the standard high frequency pre-emphasis which is applied at FM broadcast transmitters.

Audio Characteristics:

The overall electric fidelity of the tuner is excellent, and qualifies the performance as high-fidelity by FM standards. The overall response curve is shown in Fig. 7. Both the curve of standard pre-emphasis at the transmitter and the response of the RV-10 tuner are shown. The true overall response of the FM system from studio to tuner output is, of course, the sum of these curves. This summation curve is also shown in Fig. 7. This curve is flat to 1,000 cycles and has a very slight upward trend at the higher frequencies amounting to about 3 db. Slight treble boost was allowed, for some high-frequency attenuation is expected in the shielded output cable which connects the tuner to the amplifier. To maintain the high-frequency response, it is recommended that the cable used at this point be not more than 3 ft. in length. If more is used, and high-frequency attenuation results, it can be corrected by reducing the value of C30 somewhat. A better practice would be to reduce the cable capacitance by shortening it or making use of cable with less capacitance per unit length at this point.

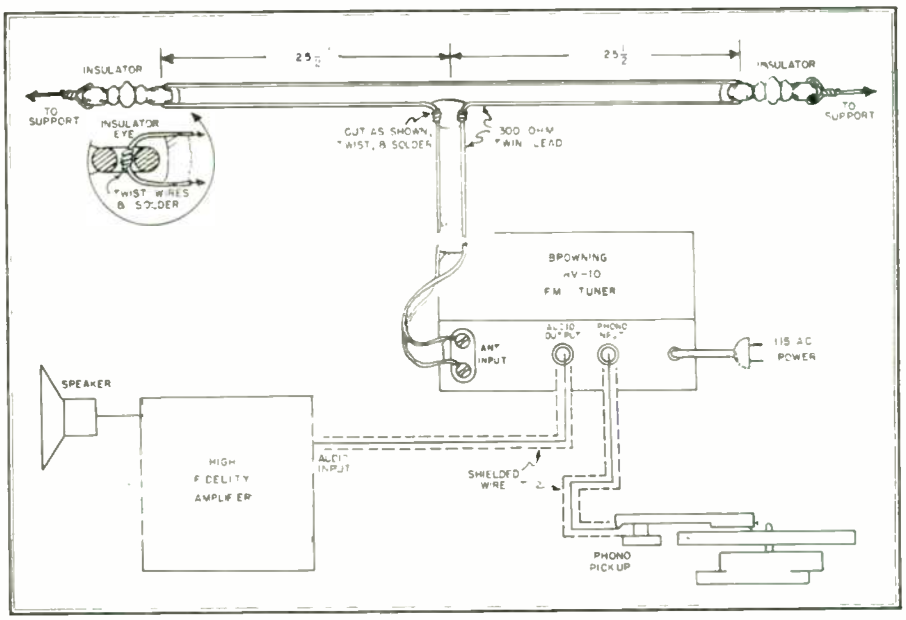
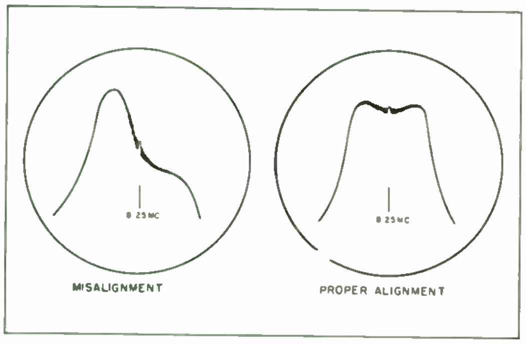


FIG. 9. *Dimensions of a folder dipole, and wiring to the amplifier and pickup*

General Considerations:

The RV-10 tuner can be used very successfully with an AM receiver having a high-quality audio amplifier and speaker. This is most easily done by introducing the audio output of the FM tuner at the phonograph input of the AM receiver. Where a phonograph is already in use, its output can be fed into the RV-10 tuner. Then either phonograph or FM reception can be selected by means of the tuner transfer switch. In this case, the volume control on the tuner adjusts the phono volume.

Some of the appeal of this tuner lies in its adaptability to mounting in confined or otherwise unusual places. To further the ends of flexibility, it was designed to occupy as small a space as is consistent with fine performance and ease of servicing.



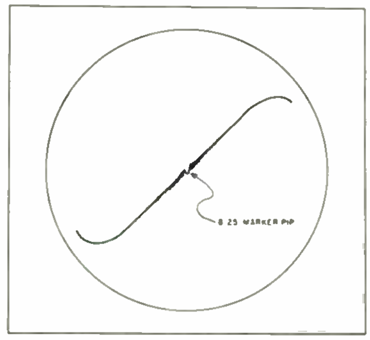


FIG. 10. *Oscilloscope curves of IF alignment.* FIG. 12. *Discriminator alignment*

The overall dimensions of the tuner are 7¼ ins. high, 10⅞ ins. wide and 9 ins. deep. The power supply is self-contained and is built on the main chassis. While Fig. 1 shows the chassis for cabinet mounting, rack mounting on a 19-in. panel is available on special order. This unit is shown in Fig. 8. Tuning is by means of a reduction drive sufficient to permit accurate adjustment. The edge-lighted scale is calibrated in frequency and channel numbers.

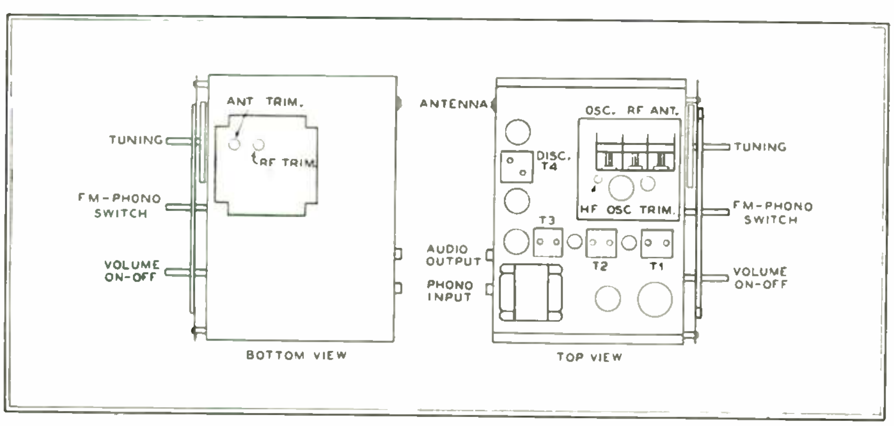


FIG. 11. *Location of trimmers, IF transformers, and discriminator on the chassis*

One of the most frequent questions arising in connection with the use of a tuner concerns the type of amplifier to be used in conjunction with it. Needless to say, any amplifier with sufficient gain will work. However, to derive full advantage from the design of this tuner, the use of a high-quality amplifier and speaker cannot be too strongly recommended. The response should be linear from at least 50 cycles to the upper activity-limit of the speaker system. The power output required depends upon the size of the room and its acoustics. For home use, no more than 10 watts are usually needed. The gain of the amplifier should be such that an input signal of 0.25 volts RMS will drive the amplifier to full output.

Choice of an Antenna:

As with any other type of UHF receiving equipment, FM results will be only as good as the antenna used. The tuner is designed for optimum performance with an FM antenna having a down-lead impedance of 300 ohms, as standardized by RMA. Any good commercial antenna having this impedance should prove satisfactory. Those who desire to use the 300-ohm flat line can construct a simple yet effective folded antenna which has surprisingly good characteristics over the entire band. The details are shown in Fig. 9. As with simple dipoles, it has a pronounced directional pattern and should be aligned with the broadside at right angles to the most important direction of reception. It is important that no part of the antenna or feeder be grounded, since a ground path exists within the tuner. Always remember the higher the antenna is mounted above the ground, the more effective it will be. Several types of non-directional antennas are now available for use in locations where the front-and-back performance of a plain dipole is not adequate.

IF Alignment Methods:

The center frequency of the IF amplifier bandpass is 8.25 mc. Overall bandwidth of the entire amplifier is about 150 kc., and may be slightly double-humped as shown in Fig. 4, because of the over-coupling in the IF transformers. Simple alignment with signal generator and meter for maximum readings does not produce accurate alignment under these conditions. If such equipment is used, a point-by-point method must be employed. A greatly superior method, and that used in our laboratory for aligning new tuners, is the visual or dynamic procedure which makes use of a Harvey[1] FM signal generator and an oscilloscope.

The Harvey FM signal generator is capable of sweeping repetitively through a range of about 8.0 to 8.4 mc. in sawtooth fashion, and simultaneously generates a sawtooth sweep voltage for horizontal deflection of an oscilloscope. A good AM signal generator of the ordinary variety is also needed in the alignment work, as will be explained.

A simplified explanation of the method and the patterns shown in Fig. 10 may assist in its application. An FM signal of constant amplitude is swept through the bandpass region of the amplifier. The spot on the screen of an oscilloscope is swept across the face of the tube horizontally at a rate proportional to the rate at which the frequency is being changed. The output of the IF amplifier is detected and applied to the vertical deflection plates of the oscilloscope as a signal. As the spot moves across the screen, its horizontal position is a measure of the frequency of the applied signal, while its vertical position is directly proportional to the amplitude response of the circuit. In this way, the picture as a whole is a graph of the response of the amplifier.

To align the IF section of the tuner using the visual method, connect the sweep voltage output of the FM signal generator to the horizontal deflection input of the oscilloscope, and adjust the controls until the horizontal sweep nearly fills the screen. Adjust the FM signal generator to sweep from about 8.0 to 8.4 mc., and apply the output to the grid of the second IF stage. Connect the vertical deflection input of the oscilloscope across C24 in the grid circuit of the first limiter.

The rectifying action of the grid circuit of this stage will provide a signal corresponding to the amplitude response of the preceding circuits. Adjusting the controls of the scope should produce a picture of the response curve. Always use as small a signal from the generator as possible consistent with a good image. In order to provide a frequency marker for alignment, apply a signal of exactly 8.25 mc. from the AM signal generator to the grid where the FM signal is applied.

(*Continued on page 50*)

[1] See "How to Align FM Receivers" by Bernard Cosman, *FM and Television*, July, 1946.

MICROWAVE HANDBOOK

CHAPTER 3 — PART 3: HOW WAVEGUIDES CARRY ENERGY AT MICROWAVE FREQUENCIES, AND HOW ENERGY IS INTRODUCED AND EXTRACTED — *By* SAMUEL FREEDMAN

3.6 Pickup and Coupling Methods:

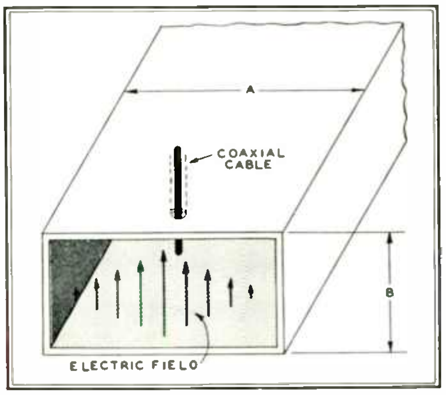
The two standard methods of introducing or extracting energy from a waveguide are the quarter wave dipole, Fig. 20, or the pickup loop, Fig. 21. The former is used to couple with the electric field, whereas the latter is used to couple with the magnetic field. Each functions at a different point in the waveguide. In the case of TE_{01} mode, the dipole is introduced at the center of the A dimension of the waveguide, either top or bottom, and is moved longitudinally until the point is reached corresponding to the maximum electric field. When a loop is used, it must be introduced at the center of the B dimension, at a point where there is the greatest concentration of the magnetic field.

Microwave test and measuring equipment techniques are based on the use of a movable probe in a waveguide having a slot along its length, so that it can be moved along the waveguide axis. In this way, energy distribution can be analyzed. For example, an indication of two energy maximums, normally obtained with a dipole probe coupled to the electric field within the waveguide, corresponds to a half-wave, or the equivalent frequency for a waveguide excited in the TE_{01} mode.

Fig. 22 is an elementary method of showing the relative magnitude distribution of the field in a waveguide for the TE_{01} mode. It must be zero at the walls corresponding to the B dimension. There is a density-wave distribution comparable to one alternation of a sine wave. The optimum point to insert a dipole for energy introduction or extraction corresponds with position 5E at the top or bottom, on the center of the A dimension.

Fig. 23 is an elementary illustration of the relative magnitude distribution of the magnetic H field in the same waveguide, but at a different point along the waveguide axis, corresponding to the maximum magnetic field. The optimum point to insert a loop is at the B dimension.

At every half-wavelength down the waveguide, the direction or polarity of the field flux is reversed in direction. For a waveguide greater than one-half wavelength wide, the mode of operation changes. The field distribution then forms the same or similar patterns but with multiple diagonal or transverse distribution patterns with respect to the longitudinal axis. This, in practice, depends on what the designer or user wants or gets, either advertently or inadvertently. Dimensions must be watched carefully or the result will be unpredictable.



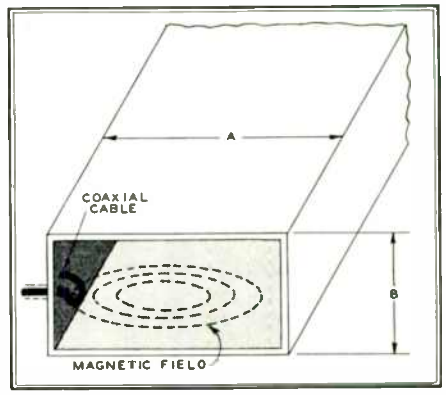


FIG. 20. *Quarter-wave dipole.* FIG. 21. *Loop for introducing or extracting energy*

3.7 Waveguide Ratings:

Although there is an optimum waveguide size for every microwave frequency or wavelength, industry and government have endeavored to standardize on the least number of sizes consistent with good performance. The following table shows the dimensions generally accepted as standard by the radio industry:

OUTSIDE DIMENSIONS

A Dimension, Ins.	B Dimension, Ins.	Wall Ins.	TE_{01} Cutoff mc.
3	1½	.080	2,079.4
2	1	.064	3,154.6
1½	¾	.064	4,304.2
1¼	⅝	.064	5,263.2
1	½	.050	6,561.7
1	½	.064	6,772.0
¾	⅜	.064	9,493.7
½	¼	.040	14,058.1
11/32	3/16	.031	20,935.1

In the case of the millimeter-wavelength band, general practice is to use solid or laminated coin silver waveguides, with a wall thickness of .03 or .04 in. The outside dimensions now in use or under consideration are:

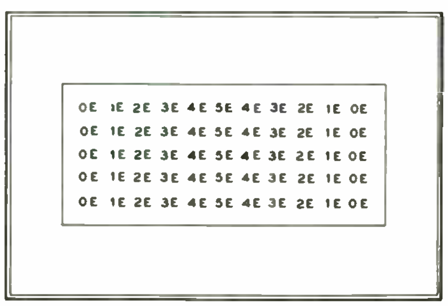
OUTSIDE DIMENSIONS

A Dimension ins.	B Dimension ins.	Range, Mc.
.42	.17	18,000–26,500
.34	.17	22,000–33,000
.28	.14	26,500–40,000
.224	.112	33,000–50,000
.188	.094	40,000–60,000
.148	.074	50,000–75,000
.122	.061	60,000–90,000
.100	.050	75,000–110,000

At 100,000 mc., a physical limit is reached where waveguide techniques begin to become impracticable. This is also true below 3,000 mc., where a limit is reached due to the physical size corresponding to the longer wavelengths involved. Theoretically, a waveguide can be used on any frequency. Practically, the limits are mechanical construction, cost, bulk, and weight.

In special applications, operations can be justified at frequencies exceeding twice the cutoff frequency. A typical example is the work done at Northwestern University, where research has been conducted in multi-channel communication through a single waveguide by utilizing each mode as a separate channel. Such work has great significance to telephone and telegraph companies where fabricated waveguides may eventually replace landlines and coaxial cables under special conditions, even where free space communication is not involved.

Once energy is introduced into a waveguide, it can be propagated into space with or without a reflecting system. For



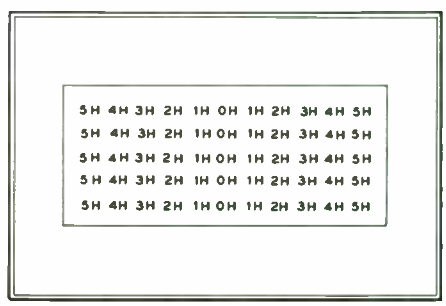


FIG. 22. *Distribution of electric field.* FIG. 23. *Distribution of magnetic field*

example, the waveguide can be flared so that it squirts the energy into space with the same sort of energy concentration and directional qualities as a man might produce by shouting through a megaphone.

Fig. 24 is a calculated graph of attenuation versus frequency for a widely used size of waveguide having a copper surface and operating in the TE_{01} mode. The minimum frequency which can be propagated is shown as 6,562 mc. The maximum frequency possible without double moding is 13,123 mc. The attenuation is total at cutoff, falling very sharply by the time the operating frequency is 20% above cutoff. Attenuation is very low in a waveguide when the operating frequency is at least 50% greater than the cutoff frequency.

Fig. 25 is a calculated graph for the same waveguide as depicted in Fig. 24, showing peak power which can be accommodated without flashover across the B dimension. Starting with negligible power at cutoff, the power handling capacity increases to a maximum of 300 kw. at the double-mode threshold.

It will be noted that the attenuation per foot for waveguide is much lower, and the power handling capacity is much greater, than for coaxial cable of comparable sizes. A typical set of data approximately correct for copper-surfaced waveguides is as follows:

Outside Dimensions & Wall Thickness, Ins.	Min. Atten. db per Ft.	Peak Power kw.
½ x ¼ x .040	.098	60
¾ x ⅜ .064	.055	128
1 x ½ x .064	.0315	272
1 x ½ x .050	.029	300
1¼ x ⅝ x .064	.023	440
1½ x ¾ .064	.015	710
2 x 1 x .064	.0092	1350
3 x 1½ x .080	.00475	3200

Such performance is only possible at close to twice the cutoff frequency, or one-half the cutoff wavelength. Attenuation increases and peak power handling capacity drops as the frequency approaches cutoff.

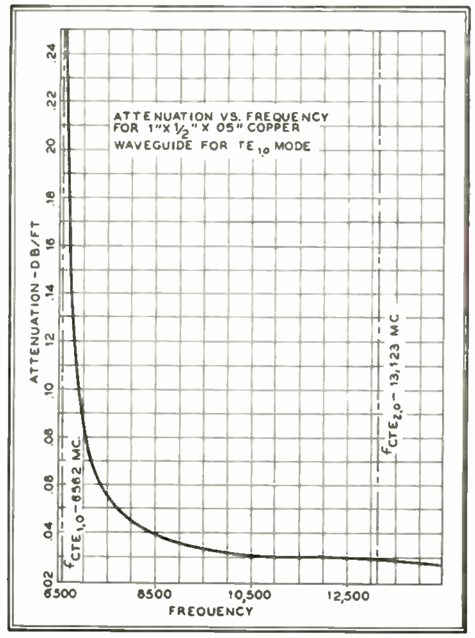
As the operating frequency is increased, the necessity for uniform dimensions and clean interiors increases. For example, a discrepancy of .001 in. in a dimension of a .1-in. waveguide, operating at 100,000 mc., would have the effect of a 1,000-mc. change in frequency. Even a speck of dust represents a constriction in the waveguide. This phenomena is the basis for much current and future work in adapting microwaves for food analysis, medical research and industrial problems.

3.8 Waveguide Velocities:

The velocity of energy propagation in waveguides differs from that in free space. Two kinds of velocities are primarily involved, namely group velocity and phase velocity. Group velocity is less, while phase velocity is greater than in free space.

Group velocity refers to the propagation down a waveguide. It must be less than free space because the waves do not travel directly down the waveguide. They bounce from wall to wall, following a zig-zag course. The length of their path is the angular length instead of the axial length. At higher frequencies, the angle is such that fewer reflections are required for a given amount of longitudinal progress. On the lower frequencies, more reflections are required for the same amount of longitudinal progress. The group velocity most closely approaches the velocity in free space when the operating frequency is furthermost increased above the waveguide cutoff frequency.

Phase velocity is the product of frequency times wavelength. The wavelength in a waveguide is actually the distance between two planes of the same phase perpendicular to the direction of propagation. In a waveguide, this distance is longer than in free space because of angular reflections. The apparent velocity is therefore greater for phase velocity than in free space.



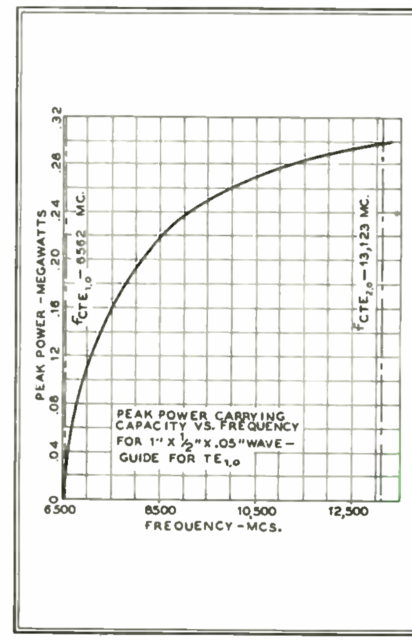


FIG. 24. *Calculated attenuation vs. frequency.* FIG. 25. *Peak carrying power*

FM PROGRAMMING

(*Continued from Page 20*)

listens to your station, you've got something to sell.

All This and Sets, Too:

To digress a moment to a slightly relevant matter: you know the best job of broadcasting ever done would go for naught if nobody heard it. And you can't hear radio signals without a set, especially if it's FM.

So I would love those radio dealers in my community! I'd either love 'em to death or drive them nuts with cooperation until everybody in my listening area who wasn't stone deaf or buried had an FM set.

And believe me there is plenty you can do to help the average radio dealer. I just wish I had time for my full 40-cent Dutch Uncle speech on how not to sell and service radios, but you could pick up most of the script by visiting a few dealers in the average neighborhood.

The modern radio, and you will recognize that as a synonym for FM, is a complex, precision-made, and fairly expensive piece of functional machinery with a considerable element of the aesthetic about it as a piece of merchandise. Now, why at least half of the merchants who purvey radios to the public act as if they are selling scrap iron or fish, and maintain stores in keeping with such commodities, is something I've never quite figured out.

A few blocks from here in the Department of Commerce files I would conservatively estimate there is at least a ton of information on the essential details of good merchandising. It's free, and there are tons more free from a variety of good sources including a long list of radio manufacturers.

So, if I discovered that the radio dealers in my community had learned their merchandising methods from Eli Whitney and/or Judge Roy Bean, I would somehow connive to teach them a few rudiments of good radio selling — and I would keep at it with continuous cooperation and/or needling through my station.

Somewhere in the process, I would haul all of the radio dealers, clerks, and repairmen up to my station, show 'em all the expensive machinery and split-second

(*Concluded on Page 52*)

WHAT'S AHEAD FOR OUR INDUSTRY?

AN EFFORT TO EVALUATE THE SIGNIFICANT SIGN POSTS THAT INDICATE THE COURSE OF COMING EVENTS IN FM, TV, & COMMUNICATIONS — *By* MILTON B. SLEEPER

WITH more and more material for speculation as to events coming up in FM and television, there is increased assurance of accelerated progress in these two fields.

Eighteen months ago, when we said that the future of the radio business lay in FM and TV developments, we evoked some very dour response from both manufacturers and broadcasters. Now, few will disagree with the statement that every nail and rivet driven home at FM and TV installations is tightening down the lid of the coffin in which AM will be buried.

At a time when you are probably trying to evaluate a number of unknown quantities in the formula for your future planning, you may be interested in the observations of a well-informed outsider who follows the proceedings more objectively than those whose business is affected directly by the uncertainties ahead.

Significant Sign Posts:

Certain current activities will set new patterns, before the end of 1948, for broadcasting, communications, manufacturing, sales, and service. These are 1) the Tobey investigation, 2) new frequency assignments to communications, 3) the September 20th hearing on the upper television band, and possibly 4) the proposed increase in TV station allocations from 400 stations in 140 markets to over 900 stations in 460 areas.

We aren't willing to make predictions concerning matters which involve such an unpredictable element as the FCC, particularly when some of the Commissioners may not survive this election year. Still, if the elements of the situation are not weighted by wishful thinking or prejudice, it is possible to draw reasonable conclusions from current events.

Tobey Investigation:

It isn't clear that any direct results will come from the Tobey investigation. FCC Chairman Coy isn't going to testify against present or past members of the Commission. It's not surprising that he couldn't find any evidence that the records of the secret FM hearing were altered, although most everyone else seems to know all about this matter.

As indirect results of Senator Tobey's efforts, however, several things may come about in time. 1) there may be some drastic changes in Commission personnel, from the top down, if a Republican is sent to the White House next November, 2) efforts to set up super-power AM stations may be abandoned permanently, and 3) action may be initiated to separate the broadcasting, communications, and manufacturing divisions of RCA.

TV & Communications:

Although our opinion has not been supported by others whom we have consulted, we have been convinced for the last year that the FCC does not consider that a mistake was made in permitting TV to get a start on the lower band, but that they failed to anticipate the enormous expansion of mobile communications and, by facilitating the start of television directly above the original 30- to 40-mc. mobile band, they cut off the natural expansion of the communications services. Now, the Commission proposed to take away the first TV channel, 44 to 50 mc., and to end low-band FM to make more, but still inadequate space for mobile services.

Simultaneously, the FCC has made two other moves: 1) more than doubling the low-band TV assignments, and 2) setting a hearing for September 20 to explore the use of the upper television band.

Equally significant are statements in the FCC Public Notice, May 6, 1948, concerning the proposed rule making on 44 to 50 mc.. "The Commission reiterated the opinion expressed in its May 25, 1945 allocations report that there is insufficient space below 300 mc. to make possible a truly nation-wide and competitive television system, and that such a system must find its lodging higher in the spectrum where more space exists." Also: "Commissioner Jones dissented in part from the report and order in Docket 8487 and related actions, holding that the Commission should now provide more than a temporary home not only for the safety and special [mobile] services, but also for the broadcast services."

Bearing these points in mind, consider the plan to more than double the number of TV allocations. If 900 stations are set up in the U. S., the FCC will be guilty of economic homicide if it then attempts to shift TV to the upper band. Or the Commission may figure that it can implement the death of low band television by allowing co-channel and adjacent-channel interference to become intolerable.

Maybe the FCC has suddenly realized that television must have a permanent place for a "truly nation-wide and competitive television system" right now, before broadcasters and the public put too much money into low-band equipment.

Or perhaps it has been forced to take this position by the needs of the communications services.

In either case, it seems as if we shall be confronted with the problem of keeping television going on the low band while upper-band equipment is developed, field-tested, and put into production, and then moving to the high band when everything is ready. It may involve some tough going, but the industry will find a way.

Two other points are worthy of note. Upper-band television networks will have to depend on radio relays because coaxial cables cannot handle the up-stairs channels if, as expected, they are set at 20 mc. wide. Also, it seems unlikely that satisfactory adapters, low enough in price to be saleable, can be developed for upper-band reception on low-band sets. The difference in channel width and lines per inch will make it very difficult.

FM Networks:

In the May 6th Public Notice of rule making, the FCC disposed of the present FM network operations in characteristic style: "As far as network programming of FM stations is concerned, the Commission believes that, in general, common carrier facilities will be used for this purpose. It is proposing a modification in its rule (Docket 8977) to permit intercity relaying of FM programs on frequencies allocated for FM studio-link-transmitter purposes (940–952 mc.). At the same time, it points out that there is nothing in its rules to prevent FM stations in the 88–108 mc. band from rebroadcasting the programs of other FM stations, as is presently being done."

As a former broadcaster, Chairman Coy should not permit himself to walk in the footsteps of Paul Porter. [August 17, 1945, "The Commission is informed by transmitter manufacturers that 10-kw. FM transmitters will be immediately available for the new band."]

Commissioner Coy should know that 1) 15,000-cycle common carrier facilities are not available, and that the rates on the Washington-Alpine line are too high for commercial use, and 2) the upper FM band cannot handle the long hops for which low-band transmission is being used now.

As for relays on 940 to 952 mc., this equipment 1) is still in the developmental stage, 2) the maximum operating range is only 25 to 30 miles, and 3) the cost per relay is upwards of $25,000.

Present network operations must cease unless certain low-band FM stations are permitted to continue until the nets can obtain 15,000-cycle lines or relays, and until they have sufficient revenue to pay the increased cost of such operation.

FIG. 13. *All the speech circuits of the studio are controlled from this console. Fig. 14 shows the circuit arrangements*

STUDIO SPEECH INPUT SYSTEMS

PART 2: PLANNING A SPEECH INPUT SYSTEM GEARED TO THE PROGRAMMING AND STUDIO FACILITIES OF FM OR AM STATIONS OF MODERATE SIZE—*By* JOHN A. GREEN

CONCLUSION OF PART 2

Fig. 13, shows the front of the 212A console, with a block diagram in Fig. 14. The line of key switches along the middle of the panel, and above corresponding level controls, make connections to channel No. 1 at the down position, and channel No. 2 at the up position. From left to right, the switches are: 1st switch REMOTE; 2nd and 3rd switches STUDIO A, for two microphones; 4th and 5th switches STUDIO B, for two microphones; 6th switch ANNOUNCE BOOTH; 7th switch CONTROL ROOM, 8th and 9th switches TRANSCRIPTION; and 10th switch REMOTE. Extra microphones in the studios and announce booth, and the third turntable can be connected, when needed, on the jack field.

The upper left hand knob controls the level of the monitors, and the adjacent knob is the VI meter switch. The two right-hand knobs are level controls for channels No. 1 and 2. Along the top of the panel, left and right, are nine input circuit push buttons and an off position. Each row is mechanically interlocked, so that only one button can be pushed in at a time. Key switches are provided to operate the talkback circuits and to switch the program lines and monitor inputs.

Fig. 15 shows a typical control room installation of the speech input console and two turntables, as described in the following text.

The relay unit which operates with the console is shown in Fig. 16. On this chassis are five relays which control the speakers in the studios, control room, and lobby. The additional relays are part of the circuit which provide automatic switchover from one power supply to another in case of power equipment failure.

Terminals on this unit permit all power connections to be made here, as well as

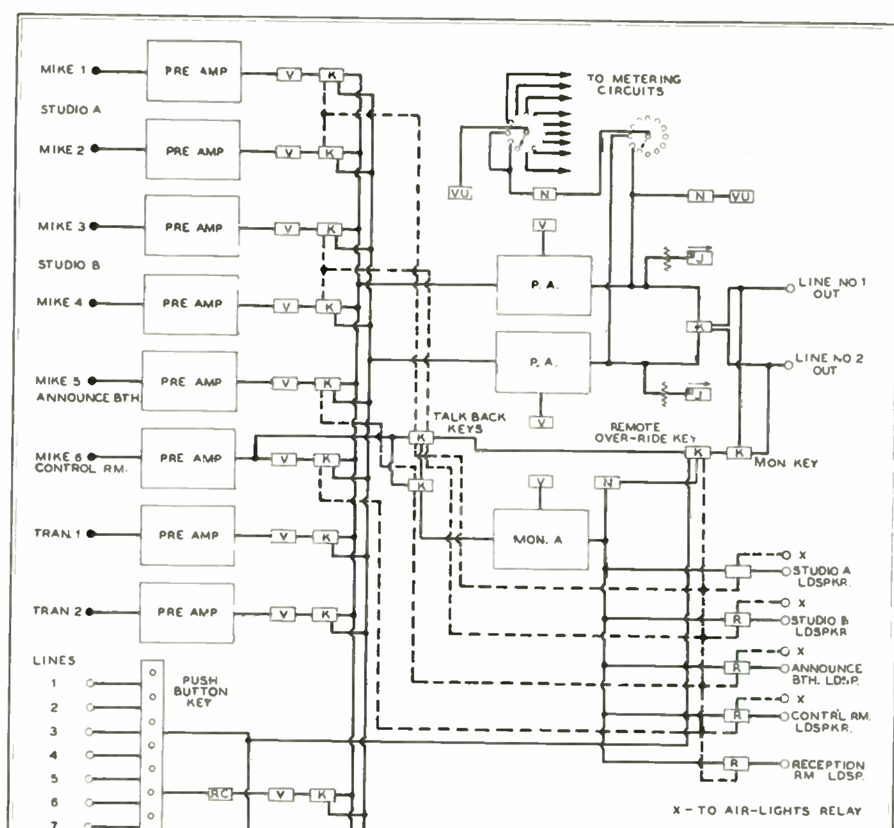
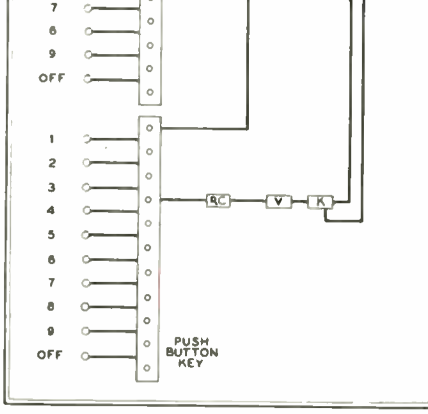



FIG. 14. *Block diagram of the console*

all circuits to the speakers and on-off air lights. In other words, this relay unit is the central termination for all circuits and the remote lines.

The power supply, Fig. 17, used with the console is actually three supplies in one. The first provides 12 volts DC to operate the relays. A second furnishes 140 volts DC for the preamplifiers, while the third supplies 325 volts DC to the program and monitor amplifiers.

In the block diagram of the studio installation, Fig. 12, a metering panel is specified. Fig. 18 shows the front and rear of this unit, with the arrangement

FIG. 15. *Here is a typical control room setup for an FM or AM station of moderate size. There is a second studio at the left, and an announce booth at the right*

of the terminals and components. It provides metering circuits for the three preamplifiers, the three isolation or line amplifiers, three metering circuits to the audition amplifier, and three metering circuits to the auxiliary amplifier.

Another piece of equipment specified is the 117N-4 repeat-coil unit, used to isolate the equipment from the telephone lines which go to the transmitters. It has two additional utility coils for special jobs. Directly below the 117N-4 are two amplifiers. One of these is used for feeding special programs. The other is for utility purposes, when different circuits must be isolated in the studio. In addition, there is a Presto type 88A amplifier for use with the recording equipment, specified in accordance with a previous recommendation that these two items be of the same manufacture to assure proper matching.

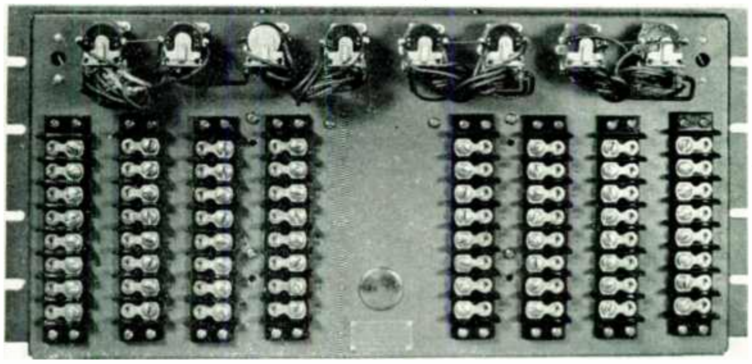


FIG. 16. *Relays on this panel control the speaker circuits and cut in the emergency power supply. All power, loudspeaker, and air-light circuits terminate here*

Fig. 19 shows the front of a VU panel used for various audio metering functions. It meters the input level to the recording amplifier, the output level of the monitor amplifier, input level to the equalizer, all being in the normal connected condition. The fourth position on the meter switch is available for various purposes which require VU metering, and is terminated on a pair of jacks. In Fig. 12, four sets of multiple jack fields are indicated, with all the necessary tie lines between cabinets, and a few spare jacks for subsequent expansion of facilities. These provisions are much less expensive when furnished with the initial equipment.

Two monitor amplifiers, Fig. 20, are required. One is an auxiliary monitor to feed the offices, while the other is an audition amplifier to be used for special purposes. The remaining pieces of equipment comprise a power supply for filament and plate voltages in the three 6P and three 6R amplifiers, Fig. 12, and the switch and fuse panel, shown in Fig. 21. The latter has ten fuse circuits to protect the various equipment in this installation, and a circuit-breaker on the main AC supply.

There are many ways in which the units can be mounted in racks. Fig. 22 shows one practical arrangement. It is always desirable to have the racks located where the operator can reach them from his seated position at the console, or at least near enough that he can reach them quickly.

In Fig. 22, left, the units are so arranged that most of those operating at the lower levels are in the left hand rack, with the balance of the equipment, operating at higher levels, on the right. This physical separation makes for better operation of the complete system. One fault, possibly, in this layout is that there are very few blank panel spaces. This, of course, will make subsequent expansion difficult. To allow for such a

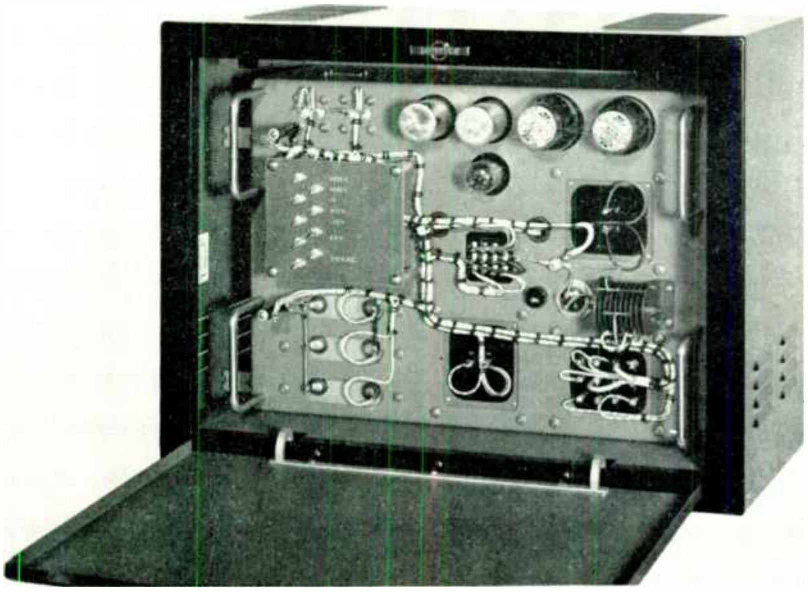


FIG. 17. *The power supply for the console furnishes three different DC voltages*

contingency, it might be found advisable to use three racks instead of two.

On the other hand, it is sometimes necessary to use one rack only, and either to omit certain equipment or to mount it separately. The single rack at the left in Fig. 22 was planned to meet such a condition.

There is a terminal assembly at the base of each rack, carrying 96 telephone-type terminals for low-level and control circuits, and 60 heavy-duty terminals for AC power and high-level circuits. This terminal assembly is shown in Fig. 23.

Decisions as to equipment arrangement and jack-strip designations are really academic questions, to be determined by individual taste and the requirements of each specific installation. It is the operating engineer who must use the equipment and he, therefore, should plan it in accordance with his personal preferences.

Fig. 24 shows a Collins transcription turntable and recording attachment, and a Western Electric pickup. A combination recorder and transcription turntable has advantages in economy of time and expense for many recording purposes. The attachment illustrated records outside in or inside out without any change in equipment, but merely the change of the gear-shift. The Collins and RCA recording heads are interchangeable on this equipment. While it is entirely practical to operate a moderate-size station with two turntables, a third, as indicated in Fig. 12, adds much to the flexibility.

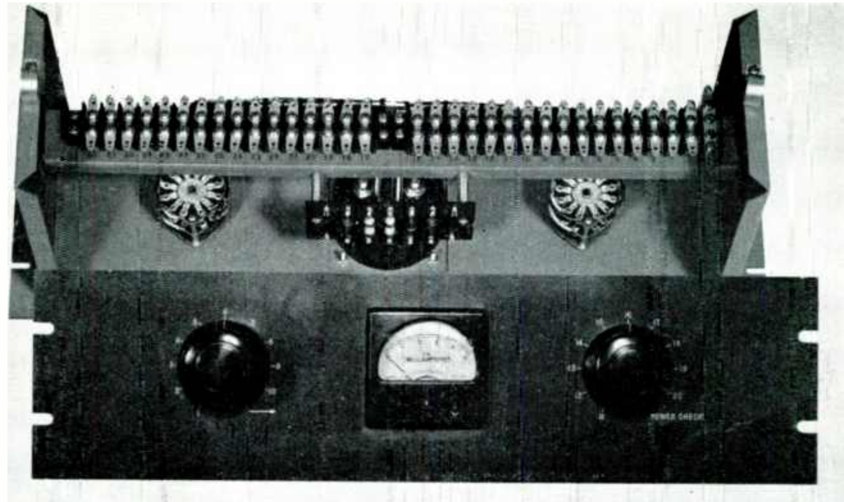


FIG. 18. *Front and rear of the metering panel, with terminals and metering switches*

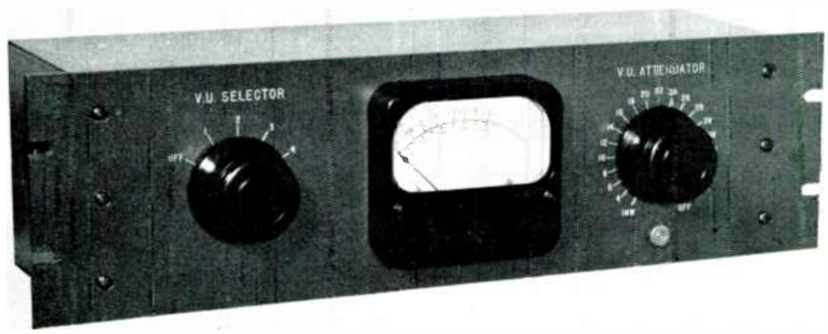


FIG. 19. *The VU meter is used to check input and output of various audio circuits*

Equipment Check List:

Equipment called for in such an installation as is shown in Figs. 11 and 12 is specified in the following check list. While many variations are possible, this list is useful as a guide to typical requirements:

FIG. 20. *One monitor amplifier feeds the office: the other is for special purposes*

FIG. 21. *This panel carries ten fuses and a circuit-breaker for the main AC supply*

Check List for Equipment Called for in Figs. 11 and 12

Studio A

1 Microphone with desk stand, 30-ft. cord and plug
1 Microphone with floor stand, 30-ft. cord and plug
1 Monitor speaker with cord and plug
3 Microphone receptacles
1 Speaker receptacle
2 Warning light assemblies

Studio B

Equipment is identical to that in Studio A.

Announce Booth

1 Microphone with desk stand, 30-ft. cord and plug
1 Monitor speaker with cord and plug
2 Microphone receptacles
1 Speaker receptacle
2 Warning light assemblies

Control Room

1 Microphone with desk stand, 30-ft. cord and plug
4 Low-level receptacles
2 Monitor speakers with cord and plug
2 Speaker receptacles
3 Transcription turntables
1 Desk for console
1 Speech input console with emergency power supply
2 Cabinet racks
2 Terminal assemblies

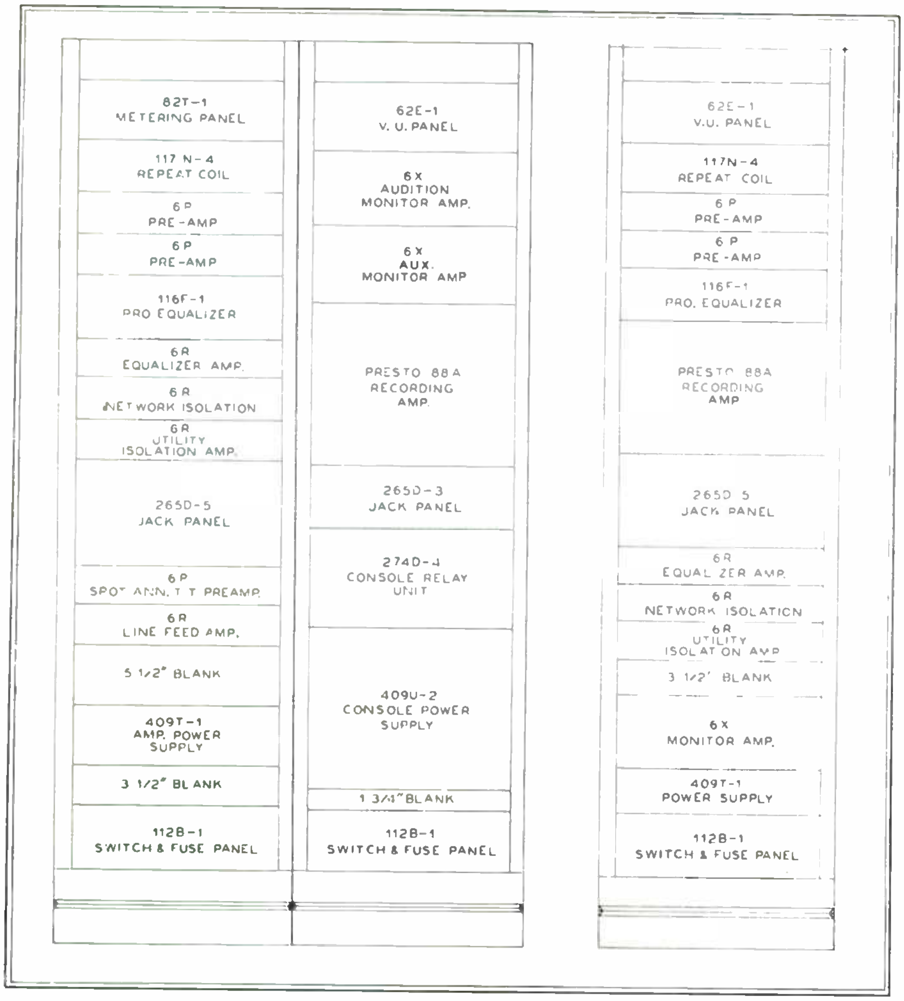


FIG. 22. *Suggested arrangement of the units on one or two equipment racks*

- 2 Switch & fuse panels
- 1 48-pair jack panel
- 1 96-pair jack panel
- 1 Preamplifier for 3rd transcription set
- 2 Preamplifiers for utility use
- 1 Equalizer
- 4 Isolation or booster amplifiers
  - 1 for use with equalizer to make up for insertion loss
  - 1 for isolating network
  - 1 for utility
  - 1 for line-fed amplifier
- 1 Power supply for preamplifier and isolation amplifier
- 1 Repeat coil panel with 4 coils
- 1 VI panel
- 2 General monitor amplifiers
  - 1 for general auditions system
  - 1 for control room monitor No. 2
- 1 Metering panel
- 1 Recording amplifier
- 2 Recorders
- 7 Warning light assemblies

REMOTE PICKUP & SPARE EQUIPMENT

- 8 Microphones with 30-ft. cords and plugs
- 2 Boom stands
- 4 Floor stands
- 3 Portable stands
- 1 4-channel remote pickup amplifier
- 2 2-channel remote pickup amplifiers
- 2 Single-channel remote pickup amplifiers
- 5 Pairs headphones

OFFICE SPEAKERS

- 4 Extra-quality monitor speakers with cords and plugs for:
  - Manager's office
  - Lobby
  - Program director's office
  - Engineering office
- 4 Standard monitor speakers with cords and plugs for:
  - Sales department
  - Continuity department
  - Music library
  - Workshop
- 8 Speaker receptacles

The remote pickup amplifiers listed above were described in Part 1 of this series. It may be necessary to modify the selection of equipment specified in the check list above. This is a matter that requires careful consideration in order to assure facilities to meet unusual and unexpected requirements of special events.

In the third and concluding part of this series, to appear in June and July, a combined FM and AM studio installation will be described, using a standard speech input console. It is a tricky problem to set up such a system without requiring special equipment but, as will be shown, it can be done, and done very nicely.

FIG. 23. *The terminal assembly carries 96 low-level and 60 heavy-duty terminals*

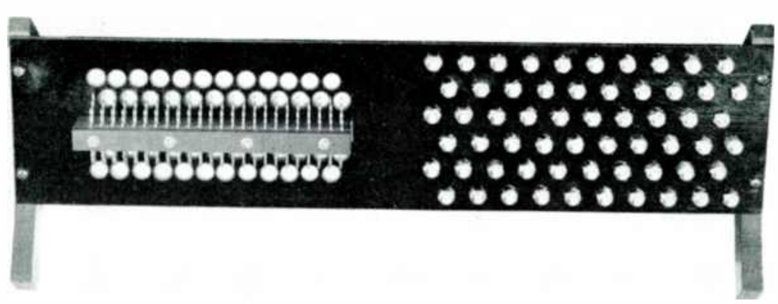


FIG. 24. *A transcription turntable and recording attachment for studio operation*

Designed for Television Use

(for operation up to 450 volts at 85° C.)

With some 7 times as many components in a television receiver as in the average radio, the possibility of service calls is greatly increased. The new SPRAGUE ELECTROLYTIC line offers the first practical solution to this problem.

Designed for dependable operation up to 450 volts at 85° C. these new units are ideally suited for television's severest electrolytic assignments. Every care has been taken to make these new capacitors the finest electrolytics available today. Stable operation is assured even after extended shelf life, because of a new processing technique developed by Sprague research and development engineers, and involving new and substantially increased manufacturing facilities. More than ever before your judgment is confirmed when you *SPECIFY SPRAGUE ELECTROLYTICS FOR TELEVISION AND ALL OTHER EXACTING ELECTROLYTIC APPLICATIONS!* Sprague Electric Company invites your inquiry concerning these new units.

WORTHY COMPANIONS FOR THE NEW ELECTROLYTICS! SPRAGUE MOLDED TUBULARS . . .

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

Write for Engineering Bulletin No. 210A

SPRAGUE ELECTRIC COMPANY · NORTH ADAMS, MASS.

SPRAGUE

Capacitors
*** Koolohm Resistors**

PIONEERS OF ELECTRIC AND ELECTRONIC PROGRESS

*Trademarks reg. U. S. Pat. Office

MEASURING WOW

(*Continued from page 30*)

In this manner, pickup hum and the higher harmonics caused by distortion of the signal have practically no influence on the reading of the instrument. The gain of the preamplifier is sufficiently high that its output is a flat-topped signal producing a square wave for all operating conditions. After differentiation, this modified signal is used to synchronize a multivibrator whose amplitude depends only on the circuit characteristics, and not on the amplitude of the synchronizing signal.

The output of the multivibrator is again differentiated and the pulses obtained are rectified so that they will all have the same polarity. As the current in each pulse is constant, and depends only on the circuit constants, an increase in the number of pulses due to a corresponding increase of the frequency of the interacting signals will produce a proportional increase in the average current through the rectifiers and their associated circuit. If the original signal is frequency-modulated, the output current, or the voltage drop caused by this current in a series resistor, will contain a steady component proportional to the average or carrier frequency, and varying components proportional to the frequency variations of the input signal. In addition to these components, high-frequency components of pulse or carrier frequency and its harmonics will be present. They must be filtered out by a suitable low-pass filter. A two-section filter is used in this instrument, the first section being a multi-stage RC circuit, with a bridge-type network in the second section to suppress the signal frequency.

The varying components of the frequency meter output are measured by a VT voltmeter after sufficient amplification by a feedback amplifier.

RMS vs. Peak-to-Peak Metering:

The question of the type of metering circuit has been discussed at length, and some experts seem to believe that an indication giving the wow or flutter content as an RMS indication is most desirable. The main argument for this type of indication is that the number expressing the total wow produced by a series of wow-producing equipment (recording, re-recording, and playback units) is simply the sum of the numbers expressing the wow caused by each device, provided the wow itself is random and not of periodic nature. This provision, however, is only partially fulfilled in actual practice.

While simple metering circuits for RMS indication are available, one important factor must be kept in mind: if a steady deflection of the pointer is desired at wow frequencies as low as ½ cycle, as is encountered in practice, the meter or the metering circuit must be highly damped. Otherwise, the meter will just follow the output signal of the frequency meter, and the skill of the user will determine largely the reading of *average* indication. This is made even more difficult because most meter movements show a pronounced resonance effect at frequencies of a few cycles per second, right in the range of greatest interest. If this resonance occurs, excursions of the pointer will exceed the correct indications, introducing a considerable error. Furthermore, it is difficult to maintain the same degree of damping properties in the meter movements from instrument to instrument. If a highly damped metering circuit is used, it is impossible to obtain fast response to sudden variations of the measured quantities as, for example, at the beginning of the test. It can be calculated that, if the damping is sufficient to reduce the oscillations of the pointer to 5% at a signal of ½ cycle per second, about 10 seconds are required before the pointer approaches its new position after a change in the quantity being measured. A similar waiting period is necessary after any disturbance, such as a scratch on the record or a kink in the recording wire. Obviously, such long waiting periods would make the use of the instrument rather awkward.

The same considerations are valid for meters and metering circuits indicating average values of the quantity to be measured.

An alternative is the use of a peak or peak-to-peak metering circuit. This type of measurement has the advantage that the indication of the instrument is proportional to the maximum frequency deviation from the average. This is preferred by many engineers. It has, of course, the disadvantage inherent in all peak measurements when complex signals are involved, namely, that the waveform error is higher, due to harmonics or other frequency components not harmonically related to the predominant frequency component.

However, peak measuring circuits can be designed so that an almost instantaneous indication of the peak value can be obtained, together with a steady deflection of the pointer, by a suitable choice of the charging and discharging time constants in the RC network of that circuit. It is possible to make the charging time-constant fast enough that a single cycle of the highest wow frequency to which the instrument responds will produce almost full deflection, while the discharge time-constant is long enough that the charge, once accumulated on the voltmeter condenser, does not leak off appreciably during 1 cycle of the component of the lowest frequency that can be measured with the instrument. Under these conditions, provisions should be made to reset the meter to zero by discharging the condenser.

In addition to these design considerations, physiological considerations should enter into the choice of the metering system for a commercial wowmeter. However, sufficient information has not been available as to whether wow and flutter of different frequency content and of equal average, RMS, or peak value sound equally obnoxious to average listeners. Until such tests, made on a significantly large scale, have been completed, it seems wiser to place more weight on the design considerations described here.

After carefully weighing the advantages against the disadvantages, it seemed that the best compromise between what is desirable and what can be obtained under reasonable conditions is the peak-to-peak metering circuit.

Commercial Design:

The standard instrument is shown in Fig. 2. The controls are, from left to right: meter-calibration circuit; zero of the metering circuit; range switch for calibration; zero set and two metering ranges; and reset for the meter.

The sensitivity of the voltmeter section can be adjusted in accordance with the average signal frequencies by using the steady component of the frequency meter output for 100% calibration. In that manner, the indication of the instrument is directly in percent peak deviation from average frequency.

Means are provided for the connection of an oscillograph or a harmonic wave analyzer so that predominant frequencies can be detected. In this manner, indications can be obtained showing which portion of the equipment is defective.

In addition to its use in broadcast stations, this wowmeter is highly useful in production testing of phonograph turntables, wire, tape, and film recorders, and other sound equipment. It can be also used to great advantage by manufacturers of equipment in which such devices are incorporated, for checking overall performance.

BROWNING FM TUNER

(*Continued from page 40*)

This is best done by using a small mica isolation condenser in series with the 8.25-mc. source. Adjust the amplitude of the 8.25-mc. AM signal until a small marker pip appears on the response pattern, as shown in Fig. 10. Use only enough marker voltage that the pip is just discernible. The location of this marker pip on the curve indicates the center alignment frequency of the amplifier. The adjustment screws of T3, shown in Fig. 11, should next be set for the desired characteristic. In all cases, the marker pip should be left at the center or axis of symmetry of the curve. Adjustment of the screws will produce varied patterns. For guidance, the curves of typical misalignment and proper alignment are shown in Fig. 10. Greater amplitude of

(*Continued on page 58*)

ZENITH AMERICA'S FM LEADER

Presents

A New Triumph in Genuine FM

Featuring Zenith-Armstrong Static Free FM

Only genuine *Armstrong* FM can give FM reception at its best—crystal-clear, static-free, true in fidelity. And *here* in this sensational new Zenith "Symphony" is Armstrong FM at its best. For here is Zenith's patented *built-in* FM aerial. Here is reception on *both* FM bands—for protection against future broadcasting changes. Here, too, is Zenith's exclusive, new "DialSpeaker" *combining* dial and speaker to permit the largest speaker *ever* used in this size set! With Zenith's powerful Wavemagnet and tuned radio frequency the "Symphony" pulls in long distance AM radio sharp and clear . . . and its new-type *maximum-fidelity* tone control intensifies the entire bass-to-treble range. It's the newest, hottest package of dynamic *selling ammunition* . . . with Zenith-*Armstrong* FM!

Keep An Eye On

Zenith Radio Corporation • 6001 Dickens Ave • Chicago 39, Ill.

FM PROGRAMMING

(Continued from Page 42)

effort it takes to produce a radio broadcast, and then say to them, "Now it's up to you people to see that it comes out of good sets well maintained in the homes of listeners in our town." It may be an interesting item to note that a lot of people selling radios today have never been inside a radio station.

It's Not Baloney:

I'm sure that some of you will say I'm just mouthing a lot of heresy and that I'd probably go broke even if I had *both* a radio station and a radio dealership. Could be, but I still say there's an awful lot of room for some radically new approaches to this whole business.

You wouldn't think there was much you could do with a bank that isn't already being done. But I've been working with a friend who is about as irreverent toward the status quo as I am, to see what we could do with a certain small-town bank. we've got the directors almost afraid to ask what we'll think up next, and they probably wouldn't want to know, except for the fact that deposits increased 95% in the past three years and the net profits were 30% for 1947.

But getting back to radio, since I have no personal stake in a radio station, I can afford the luxury of taking a disinterested, objective look at what is going on in the industry and, as I watch it, I am somehow reminded of chickens that used to run around the ranch house when I was a kid in Arizona. One old hen would find a fat grub and start clucking about it. Then every other hen in the lot would come charging after the first hen. Or if one sheep broke through a hole in the fence, all the rest of the sheep went patiently plodding through the same hole, and wander around after the lead sheep.

More Brains, Fewer Sheep:

It strikes me that that's about the way things seem to operate in radio these days. One station starts using platter turners and ad lib commercials by the hour, so every other station starts doing the same thing. One guy starts insulting sponsors, so all the other ad lib artists with a little nerve follow suit, and so on, and so on. The saddest part of the story is that the new FM boys are following just as blindly and sheep-like after their predecessors in AM. In spite of the revolutionary *technical* aspects of FM, one has to search long and patiently among broadcasters for anything even approximately a revolutionary attitude toward what to put on the FM air waves, once they get a new FM station started.

As a personal attempt to break through this follow-the-mob psychology in radio, I think that if I were undertaking a new FM station, I would much prefer to read into the history of country editors and the Horatio Alger stories of small town newspapers, rather than to grub back into the history of radio, or even to try to keep abreast of the daily trade news of what all the *other* radio stations are doing. You don't very often strike pay dirt by going back and mining the old discarded piles of previous prospectors.

And I think that anybody who entertains the naive notion that FM is going to inherit the earth simply because it is free of static is leaning on a weak reed indeed. A lousy radio program is a bad program by any method of broadcasting and it's FM's misfortune that it enables the disgusted listener to appreciate more fully just how lousy a bad program can be.

Moreover, I feel that if there were as many new high-fidelity local service ideas springing up on the radio landscape as there are new FM transmitter towers in America's hometowns, there would be less haggling, and less need to haggle, with FCC and other watchdogs of the public weal over what radio can and should do in the public interest. The public's interest should be a radio station's first interest, not a collar around its neck. Maybe we ought to look at it accordingly as we put up new FM stations.

As one final Dutch Uncle remark, I might say that, as I look over the present FM landscape, I can't get rid of the feeling that there is still far too much static in FM — and it's not the fault of the transmitters.

Simpson testers built for the future

Like any sound investment, the purchase of test equipment should return to the serviceman or service dealer the utmost aid in turning his work into dollar earnings and customer satisfaction. Every Simpson instrument is engineered to handle today's receivers in just that fashion — and to do the same for receivers that will come to market within the forseeable future.

We show here four such Simpson instruments — one well-known as the world's most famous set tester, the other three new to the Simpson family. These three new testers are outgrowths of Simpson engineering of similar test equipment. Each brings you new engineering refinements that are exclusively Simpson. Each in its price class brings you quality of materials and construction you will find in no other test equipment in the world.

Every dollar you invest in these Simpson instruments will pay a rich return for many long years to come.

Ask Your Jobber.

SIMPSON ELECTRIC COMPANY
5200-5218 West Kinzie Street, Chicago 44, Illinois
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Simpson
INSTRUMENTS THAT STAY ACCURATE

World's most famous set tester

MODEL 260 IN THE ROLL TOP CASE

- **Model 260 permanently fastened in Roll Top Case.**
- **Heavily molded case with Bakelite roll front.**
- **Flick of finger opens or closes it.**
- **Built-in compartment for test leads beneath instrument.**
- **Protects instrument from damage.**

At 20,000 ohms per volt, this instrument is far more sensitive than any other instrument even approaching its price and quality. Unequalled for high sensitivity in radio and television servicing.

RANGES

- 20,000 Ohms per Volt D.C., 1,000 Ohms per Volt A.C.
- Volts, A.C. and D.C.: 2.5, 10, 50, 250, 1000, 5000
- Milliamperes, D.C.: 10, 100, 500
- Microamperes, D.C.: 100
- Amperes, D.C.: 10
- Decibels (5 ranges): −10 to +52 D.B.
- Ohms: 0-2000 (12 ohms center), 0-200,000 (1200 ohms center), 0-20 megohms (120,000 ohms center)

Dealer's net prices:

Model 260	$38.95
Model 260, in Roll Top Case	$45.95

Both complete with test leads.

A new vacuum tube voltmeter

MODEL 266 FOR AM, FM, TELEVISION SERVICING

Note these distinguishing Simpson features: the 1 volt range, for full scale deflection, necessary in low R. F. voltage measurements; the zero center switch provided for discriminator circuit alignment, a feature which embraces all D.C. voltage ranges. D.C. volt input resistance ranges from 50 megohms to 200 megohms; A.C. volt input impedance at 60 cycles is 40 megohms. The low input capacitance of the probe (approximately 4 micro-microfarads) insures the accuracy essential for the high frequencies encountered in servicing FM and television receivers. Model 266 has many other equally important features. Ask your jobber, or write, for descriptive circular.

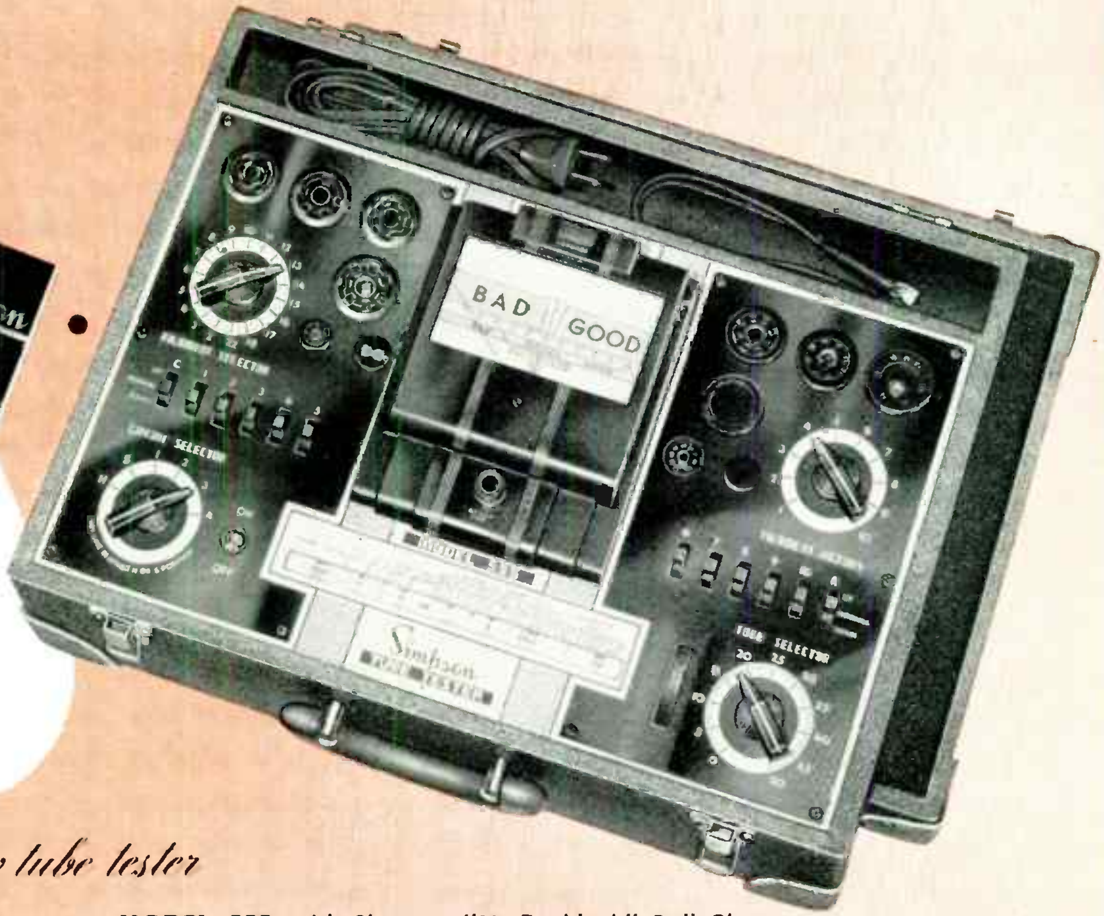
RANGES

- Volts: (A.C. and D.C.) 0-1, 5, 10, 50, 100, 250, 500, 1000, 5000
- Milliamperes: (D.C.) 0-1, 5, 10, 50, 100, 250, 500
- Amperes: (D.C.) 0-10

Ohms:	
0-1000	(10 ohms center)
0-10,000	(100 ohms center)
0-100,000	(1000 ohms center)
0-1 megohm	(10,000 ohms center)
0-10 megohms	(100,000 ohms center)
0-100 megohms	(1 megohm center)
0-1000 megohms	(10 megohms center)

Size: 8½" wide x 9½" high x 8" deep. Dealer's Net Price $79.50

There's an Operator's Manual for every Simpson tester, of a kind completely unique in the industry. Averaging 32 pages, these manuals contain circuit diagrams and schematics complete data on functioning of parts, operation, and maintenance. Printed on heavy map paper, durably bound for long usage.



A new tube tester

MODEL 555 *with Simpson "No-Backlash" Roll Chart*

This latest addition to the Simpson engineered line of quality test equipment is outstanding in its simplicity of operation and attractive appearance.

Using the basic RMA recommended circuit, it is possible to test any tube regardless of its base connections or the internal connections of its elements through the use of the new exclusive Simpson three-position lever-operated toggle switches. These switches use a molded rotor carrying silver plated contacts which are self-cleaning through their wiping action.

The Model 555 will test all receiving tubes, including the latest nine pin miniature tubes and the subminiatures as used in hearing aids, etc. Extra sockets are provided and the flexible individual element switching arrangement takes care of future tube developments. Tests can also be made on gaseous rectifiers, pilot lamps, and continuity of ballast tubes.

The panel of Model 555 is distinguished by beautiful modern styling in the shining silver and black of highly polished, enduring, anodized aluminum. Ask your jobber, or write, for descriptive circular.

Size: 16¾" wide x 12½" high x 6" deep.

Dealer's Net Price.......... **$69.85**

A new Signal Generator

MODEL 340

75 Kilocycles to 120 Megacycles Fundamentals to 30 MC

The 120 megacycle range on the dial of this new Simpson instrument makes available readings for the high frequencies encountered in servicing FM receivers. A special high output jack is provided. Electron coupled circuit assures extreme stability and output uniformity throughout the band. Standard 30% modulation at 400 cycles. Effective shielding throughout. Beautiful black and silver panel of enduring anodized aluminum.

For 105—130 volts, 50-60 cycle. Size 15" x 10" x 6". Dealer's Net Price.......... **$69.85**

TELEVISION HANDBOOK

(Continued from page 36)

computing the frequency of relaxation. R_p is usually of the order of 10,000 ohms, for the average receiving triode. When R is made considerably greater than R_p in (9.6), the frequency formula simplifies, and f is the reciprocal of the product of the time-constant of the cathode circuit, and the logarithm of the working-voltage spread. The double-peak value of output voltage may be obtained by solving equation (9.6):

$$K = G_2 - G_1 = G_1 (e^{\frac{1}{RCf}} - 1) \quad \text{(approximation)} \qquad (9.7)$$

If RC is small in relation to f, K will be large, and also quite exponential. To obtain linear waves, it is necessary to accept low output potentials with standard types of tubes. A more exact expression for K is:

$$K = B \frac{(1 - e^{-a})}{(1 + e^{-a})}, \text{ where } a = \log S \qquad (9.8)$$

(4.19) Examples:

It is desired to use a triode having 1,000 ohms internal resistance as the discharge-tube of a relaxation oscillator. What values of circuit constants will produce a 10% saw-tooth voltage wave at 10,000 cycles, with a magnitude of 50 volts at the cathode, for B + of 150 volts?

$$r = 0.1, b = 0.9$$

R_p = 1,000, plus plate circuit feed-back resistor, R_1. (A few hundred ohms is usually sufficient for R_1. Choose R_1 = 500.) Then:

$$R = \frac{b\ 1500}{r} = 13{,}500$$

$$K/B = .33 = (1 - 2.7^{-a})\ (1 + 2.7^{-a})$$

$$2.7^{-a} = 0.5$$

$$2.7^{a} = 2$$

$$a = \log_e 2 = .69 = .9/13{,}500 \times 10{,}000\ C,$$

from (9.6).

$$C = 6650 \text{ mmf.}$$

Rule of Thumb:

It will be noticed that the product of RC is approximately .00009 second. The reciprocal of this value is 11,000 cycles, which is roughly the frequency desired. Rule: Choose R on basis of timing:

$$rR = bR_p \qquad (9.9)$$

Choose C = 1/Rf. In general, the larger the choice of C, the smaller and the more linear will be the output saw-tooth voltage wave

CLASSIFIED ADVERTISEMENTS

Positions Wanted: No charge. Use either your own name and address or FM and TELEVISION box number.

Other Advertisements: 20c per word, minimum \$2.00. One-inch advertisements in ruled box, \$10.

Copy received up to the 20th of the month will be published on the 15th of the month following.

Address replies to box numbers: FM and TELEVISION, Savings Bank Building, Great Barrington, Mass.

SALES ENGINEER, 10 years operating experience, former chief engineer of AM broadcast operation, some FM operating experience, active amateur, desires position with progressive equipment manufacturer. Box 94, *FM* AND TELEVISION.

TECHNICIAN, age 28, RCA Institute graduate, 5 years experience on civilian receivers, 4 years Army maintaining FM, AM, PM transmitters, receivers and electronic equipment. 1st class telephone license. Presently employed, but seek employment in interesting field requiring technical ability and versatility. Box 48, *FM* AND TELEVISION.

CONSTRUCTION ENGINEER, 10 years broadcast station operating experience. Can take charge of new station construction and stay on as chief engineer. Box 83, *FM* AND TELEVISION.

ENGINEER, have 1st class phone, 1st telegraph, 4 years marine experience. Immediately available to travel anywhere. Will consider any offer. Age 22. Box 15, *FM* AND TELEVISION.

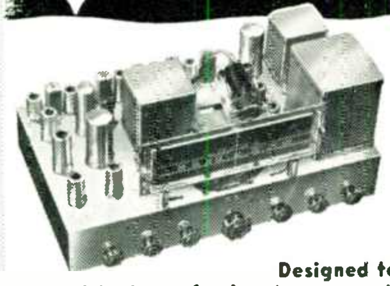
ENGINEER, Negro, 1st class license, seeks position in broadcast station. Single, free to travel. Box 298, *FM* AND TELEVISION.

WINCHARGER TOWER for sale, complete, never erected. Market price is \$5,500. Will accept reasonable offer. Box 202, *FM* AND TELEVISION.

SALES ENGINEERS wanted, capable of handling sale, planning, installation of mobile FM systems in the New York territory. Excellent opportunity for men with experience in operating and maintaining FM systems. Box 60, *FM* AND TELEVISION.

NOW COLLINS introduces...

THE "Super 20" TUBE FM RECEIVER



Unexcelled in PERFORMANCE

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Remarkably LOW IN COST

Designed to satisfy the most critical professional or amateur, the Collins "Super 20" offers unsurpassed value in an FM RECEIVER. The advanced 20-Tube circuit features: Armstrong FM, built-in stabilized power supply and audio amplifier capable of 10-watt output; new 6AL7GT tuning eye, connections for 2 types of phono pick-up, output impedances to match 4 to 20 ohm voice coils and 500 ohm line, and variable bass and treble tone controls with attenuation and boost for upper and lower registers.

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THE MOST INTERESTING COLLECTION OF PHOTOS SHOWING UNIQUE AND CLEVER CUSTOM-BUILT INSTALLATIONS YOU HAVE EVER SEEN • • • IN THE SPECIAL JUNE ISSUE OF *FM* and TELEVISION. BE SURE YOU DON'T MISS IT

REDUCE "DOWN-TIME" LOWER WIRING COSTS, SAFEGUARD PERSONNEL

WITH AMPHENOL

INDUSTRIAL SOCKETS

The advanced design of these sockets and the well known high integrity of Amphenol materials and production can save you thousands of dollars in "down-time." Another economy is the speed and simplicity of installation wiring. And these Amphenol sockets are *safe*—they guard highly trained workers and valuable tubes, so don't rely on makeshift equipment!

Included in the wide Amphenol industrial tube socket line is the Super Jumbo 4 pin socket for top or bottom mounting. The *exclusive* Cloverleaf contacts provide four full lines of contact with tube pins to carry heavy current loads. Outstanding in performance they are equally attractive in appearance—quality on all counts!

So insist on Amphenol when you buy. Write today for complete and well illustrated specifications.

AMERICAN PHENOLIC CORPORATION
1830 South 54th Avenue, Chicago 50, Illinois
COAXIAL CABLES AND CONNECTORS • INDUSTRIAL CONNECTORS, FITTINGS AND CONDUIT • ANTENNAS • RADIO COMPONENTS • PLASTICS FOR ELECTRONICS

PHILADELPHIA TV CENTER

Plans for the establishment of a Westinghouse-Philco radio and television center, to house all radio and television broadcasting activities of the two companies in this area, have been revealed in a joint statement by Walter Evans, president of Westinghouse Radio Stations, Inc., and John Ballantyne, president of Philco Television Broadcasting Corporation.

To house the joint operations of the two companies, the present Westinghouse-KYW Building at 1619 Walnut Street is being altered now.

Philco has leased the fifth and sixth floors of the building for its station WPTZ. This will provide much-needed space for Philco's expanding television broadcast operations. Present WPTZ studios in the Architects Building will be vacated as soon as possible.

Space which WPTZ will occupy in the new TV Center was designed specifically for television when the building was erected. It is already rough-finished, so that the interior construction can proceed without delay.

The entire fifth floor will be devoted to TV broadcasting, while the sixth floor will be used for business offices and related activities.

FM SERVICE DATA

Complete service data on the following FM receivers is available in the Howard Sams Photofact Folders:

MFGR.	FOLDER NO.	MFGR.	FOLDER NO.
Airline	18	Motorola	19, 29
Bendix	28, 29	Philco	12, 19, 22, 25
Brunswick	29	Pilot	12, 19, 28
Crosley	12, 25	RCA	17, 22, 23
Delco	21	Scott	14
Echophone	22	Silvertone	16
Emerson	23	Sparton	15, 29
Farnsworth	24	S-W	29
G.E.	16	Stromberg	10, 23
Knight	29	West'hse	11
Majestic	28, 29	Zenith	1, 2, 4, 7
Midwest	21		
Monitor	29		

Copies of the folders can be obtained from Howard W. Sams & Company, 2924 E. Washington Street, Indianapolis, Ind.

BROWNING FM TUNER

(*Continued from page 50*)

the pattern indicates higher gain, so adjustments should be made not only for symmetry but for optimum gain as well. Having adjusted T3 in this fashion, apply the output from the signal generators to the grid of the first IF amplifier. Next, T2, Fig. 11, should be adjusted in the same manner. Signal generator outputs should be reduced, since a stage of gain has been added. When T2 is aligned satisfactorily, apply the signal generators to the grid of the mixer tube. A fairly

(*Concluded on page 59*)

BROWNING FM TUNER

(*Continued from page 58*)

high signal level must be used because of the short-circuiting effect of the high-frequency tuned circuit. Align T1, Fig. 11, for the best response curve. The pattern appearing on the screen at this point is the overall response of the whole IF amplifier, and should be similar to that shown in Fig. 10 for proper alignment before going on to align the discriminator.

Discriminator Alignment Methods:

Alignment of the discriminator is easy with the visual method. Apply the output of the FM generator to the grid of the first limiter. Apply an 8.25-mc. signal from the AM generator to the same point. Connect the vertical input of the oscilloscope across C29 in the output of the discriminator. Make certain that the ground of the oscilloscope goes to the ground side of this condenser. Using as small RF signals from both generators as practical, adjust the discriminator transformer T4 for symetry about the 8.25 mc. and linearity above and below the 8.25-mc. marker point, as shown in Fig. 12.

RF Alignment Method:

To align the RF portion of the tuner, a signal generator covering 88 to 108 mc. and a 3-volt DC meter having an impedance of at least 20,000 ohms per volt are required. Apply the signal generator to the antenna terminals and connect the meter across C24 in the first limiter. Set the signal generator and the tuner dial to 108 mc. Adjust the RF oscillator trimmer, Fig. 11, until the signal is heard or the meter indicates maximum voltage. Set the tuner dial and the signal generator at 90 mc. With a non-conducting rod, compress or expand the oscillator inductance as needed to tune in the signal. Retune the generator and dial to the high-frequency end and recheck. Readjust the trimmer if necessary. Adjustments of the inductance and trimmer are interacting, and several adjustments of each may be required for exact alignment. Reset the signal generator and tuner dial to 108 mc. Rock the tuning for maximum voltage indication on the meter. Adjust the signal level as necessary to maintain the voltage at less than 2.0 volts. Adjust the RF trimmer for highest meter reading. Adjust the RF coil inductance with the non-conducting rod for best gain. Here again, several adjustments at both ends of the band will be necessary for the best alignment since adjustment at the one end will affect tuning at the other. The antenna circuit can simply be trimmed at the high frequency end of the band and left, since the application of an antenna or signal generator to the antenna terminals severely damps this circuit and the tuning is not critical. When this adjustment has been made the tuner is completely aligned.

FM AT INDIANAPOLIS

(Continued from Page 29)

An installation on a pumper is shown in Fig. 4. Since there is no protection against the wind and the noise of the pumper for either speaker or microphone, conventional equipment was not practical. Therefore, the usual car microphone was replaced by a noise-cancelling type, and a marine speaker, operated by an auxiliary 10-watt amplifier, was mounted behind the driver's seat. With this arrangement, two-way conversations can be carried on while the pumper is on the road, or in action at the scene of a fire.

The photograph in Fig. 5 was taken eleven days after the fire radio system was put into operation, when the department was called up to fight one of the largest fires in the history of Indianapolis. Oddly enough, as you will observe, part of the loss was sustained by the Skinner Radio Company, a Motorola dealer!

RADIO TOWERS

(Continued from Page 21)

regulations require that elevators be enclosed, thus adding items of weight, wind resistance, construction, and cost.

13. COAX LINE: Give careful consideration to the support of the coax line, with respect to expansion, contraction, and weight distribution. The rate of expansion is not the same as for steel.

CONTRACT POINTERS:

Before signing the purchase contract for a tower, see if any of the special items below has been overlooked:

1. DELIVERY: What about the cost of delivery to the site? Does the contract price include it?

2. PAINTING: The painting contract should specify the make, type, and color of paint, and the number of coats. The contractor should agree to clean any flying paint from your building or adjoining property. When paint is used 500 ft. up, the wind can carry it a great distance.

3. PERMITS: Be sure to specify that the tower must pass all city ordinances, and that the contractor must get and pay for all permits required.

4. INSURANCE: Be sure that the contractor has complete liability insurance to protect you.[1] Negligence on this point can be very costly.

5. STORAGE & ERECTION: Check with the contractor to see that adequate space is available for storing the steelwork, and for erection. In the case of a tower to be erected on a building, this is complicated by problems of raising the steel outside the building, or on inside elevators.

6. UNION LABOR: Settle all questions of labor jurisdiction with the contractor. Without labor, the steel isn't much good!

[1]See "Insurance Needs for Radio Stations", *FM AND TELEVISION*, Jan., Feb., April, 1947.

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RADIO TOWERS

(*Continued from Page 60*)

These, it should be repeated, are not the only considerations. They are only the ones most frequently overlooked. Nevertheless, neglect of these points may result in serious delays, added costs, or unnecessary expense at a later date.

TOWER FOR STATION KWGD:

The accompanying illustration shows the tower being erected for the St. Louis Globe-Democrat FM station KWGD. This tower will later support a television antenna, also. It was designed by William C. E. Becker, consulting engineer.

There are several unusual features in this design that provide important advantages.

The tower has four legs, 60 ft. apart at the base, built integral with the columns of the 2-story studio building. The design of the tower is believed to be original in that the primary framing employs trusses connecting diagonally opposite corners. A consistent pattern of bracing from the legs to the intersection of the trusses is carried all the way up the tower. The panels decrease in height upward, according to a geometrical progression which tends to accentuate the height and improves the appearance, it is believed, over that of the conventional tower. Standard rolled steel shapes are used throughout. Bent plates are employed only in connections where necessary. The antenna mounting is adjustable, making it possible to set the antenna perfectly plumb.

An interesting property of this type tower is that the tower stresses and tower leg reactions are substantially the same for any direction of the wind.

The general arrangement materially facilitates the location of the coaxial line, ladders, and platforms in the center of the tower. There are 18 central platforms, connected by separate ladders with guards. The ladder and platform arrangement is a very desirable safety feature, for it prevents a man on a ladder from falling a greater distance than that between platforms, and provides safe resting stations at increasingly frequent intervals as one climbs the tower. This feature will appeal particularly to those having to do with maintenance work.

All steel surfaces are readily available for painting. The field connections of all truss members consist of rib bolts in field-reamed holes for a perfect fit. This is the equivalent of a riveted connection, and eliminates lateral deflection caused by slip through the use of rough bolts. The steelwork was not galvanized. Instead, it was sandblasted to provide a perfect paint surface.

The tower was fabricated by the Mississippi Valley Structural Steel Company, and erected for KWGD by the Ben Hur Construction Company.

WHAT'S NEW THIS MONTH

(Continued from Page 17)

realized, though, that if I aspired to anything better than merely manual labor, it was up to me to continue my education on my own. The only business I knew anything at all about was newspapers. The nearest office was that of the New York Herald at 35th Street and Broadway. I put on my one good suit and set forth.

The first man I met was the manager of the Postal Telegraph branch on the ground floor. I asked him where to apply for a job. He eyed me somewhat shrewdly, "I need a messenger boy," he admitted. "If you'll work for $5 a week and 10 cents an hour overtime, I'll take you on."

I glanced at the clicking instrument. Perhaps while working as an office boy I could learn to be a telegrapher. Even in those days $5 a week wasn't enough to support a family of six. However, I knew that by getting up before dawn I could continue to handle my morning paper route, while my brothers were old enough by now to take care of the afternoon deliveries. I accepted on the spot.

Lincoln had said: "I will study and prepare myself, and some day my chance will come." With the first $2 I was able to save I bought a telegraph key and a book of codes. The book, I studied in spare moments during the day; the key, I kept beside my bed, where I could practice for an hour nightly before turning out the light. The manager also let me practice on the office instrument when I wasn't busy delivering messages and there was nothing coming over the line. Within 6 months I was able to send and receive Morse at a fair clip.

Meanwhile, the Marconi people had advertised for a junior operator. On September 30, 1906 - I'll never forget the date! - I walked into the wireless office on William Street and applied for the job.

"How old are you?" the traffic manager demanded.

"Fifteen."

"Any experience?"

I answered honestly.

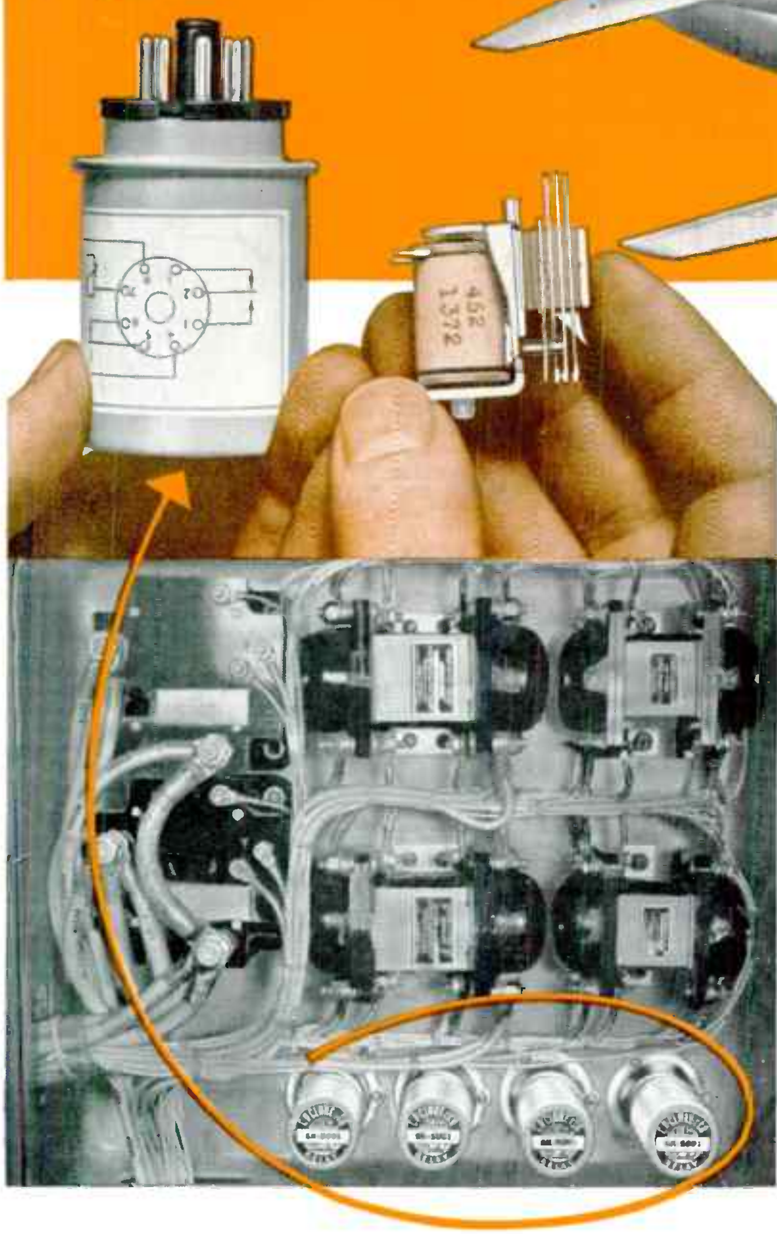
"I can't use you as an operator," he said. "But there's an opening for an office boy at $5.50 a week."

I took it, confident that in time I should be able to make the grade as junior operator. And so I did, less than one year later.

So, you see, the career that put David Sarnoff's name on the president's door at RCA didn't start in engineering or sales at all. He bossed the executive staff from the very beginning!

ADVERTISERS INDEX

CURTISS WRIGHT USES CLARE SEALED RELAYS AS "WATCH DOGS" OF PROPELLER CONTROL SYSTEM



Cutaway view of relay box of Curtiss-Wright Propellers shows (bottom) the four Clare Type "K" Relays which perform important operations. Two relays at right normalize the propeller reversing circuits; relay second from left is de-icing relay to reset the de-icing system; relay at left gives warning if propeller synchronizer motor is in an off-speed condition.

The Clare Type "K" d-c Relay is outstanding for speed of operation, resistance to vibration, and extremely small size. In the hermetically sealed cover, it is immune to the most extreme conditions of dust, moisture, air pressure and combustible gases.

Curtiss-Wright's Propeller Division has produced many "famous firsts" in aircraft propulsion . . . one of the most important being the reversible propeller which provides positive, smooth braking action under all landing conditions.

Choice by Curtiss-Wright engineers of Clare "Custom-Built" Relays to perform important functions in the control of these propellers is a tribute to the ability of Clare engineers to "custom-build" a relay which meets the most exacting specifications.

Located in a relay panel in the rear of the pilot's compartment, four Clare Sealed Type "K" Relays function automatically to normalize the propeller reversing circuits, to reset the de-icing system, and to give warning if the propeller synchronizer motor is in an off-speed condition.

Clare Sealed Type Relays are used because of their immunity to changes in atmospheric pressure, humidity, dust or dirt . . . are sealed at the factory to operate exactly as required over a long period.

Clare Relays have long been first choice of manufacturers whose products must not fail. Selection of quality materials, precise manufacture, and ability to "custom-build" just the relay for the specific requirement have made Clare Relays a "must" with engineers who insist on . . . and get . . . the best.

Sales engineers are located in principal cities, ready to show you how the Clare "custom-building" principle can give you just the relay for your most difficult requirement. They are listed in your telephone directory. Look them up there, or write: C. P. Clare & Co., 4719 West Sunnyside Avenue, Chicago 30, Illinois. Cable Address: CLARELAY. In Canada: Canadian Line Materials, Ltd., Toronto 13.

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