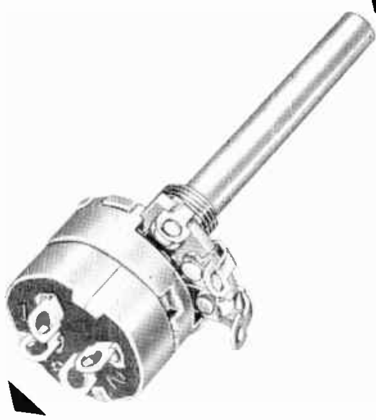
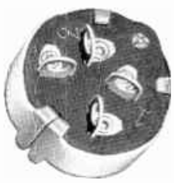
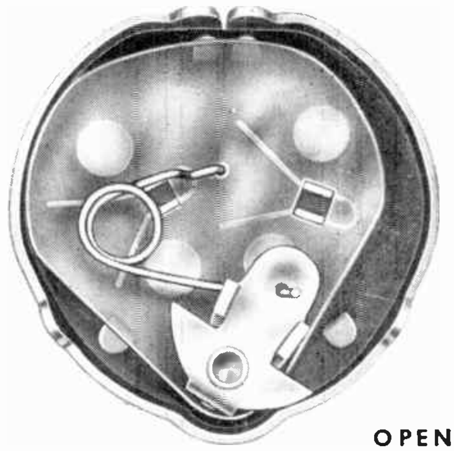
a simplified, outstandingly dependable LINE SWITCH for Stackpole Controls

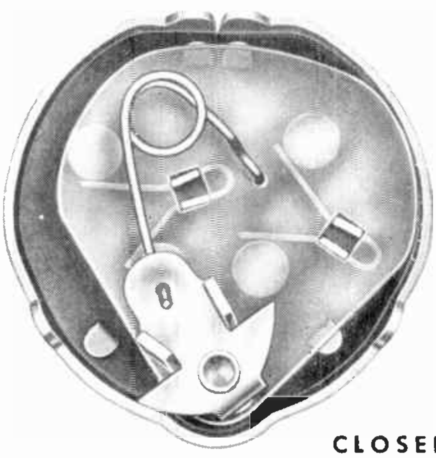






OPEN

(Interior views approximately 2½ times actual size of switch)



CLOSED

Only .888″ in diameter by .312″ thick, this Type A-10 double-pole, single-throw line switch fits even the smallest Stackpole controls. Rated 1 ampere at 250 volts AC-DC or 3 amperes at 125 volts AC-DC, it combines outstanding ruggedness of design with ample-sized contacts and positive contact wiping action. Stationary contacts are mounted on a fiber surfaced Bakelite base to reduce arc tracing. The base is held securely in the can. Throughout, the switch is constructed for long, trouble-free service and in suitable ratings for portable and auto radios and numerous other applications. A similar single-pole design (Type A-11) with dummy terminal is also available.

Write for Stackpole Bulletin RC-7

ELECTRONIC COMPONENTS DIVISION

STACKPOLE CARBON COMPANY, ST. MARYS, PA.

STACKPOLE

VARIABLE RESISTORS FOR MODERN RADIO AND TELEVISION NEEDS

1950 Zenith "Black" Tube Television With New "Super-Range" Chassis

Of Course, Zenith Has a Built-In Antenna—the Amazing "Picturemagnet"—Plus the New Super-Sensitive Circuit—Giant-Picture Screen and Many Other Zenith "Firsts"

$269⁹⁵*

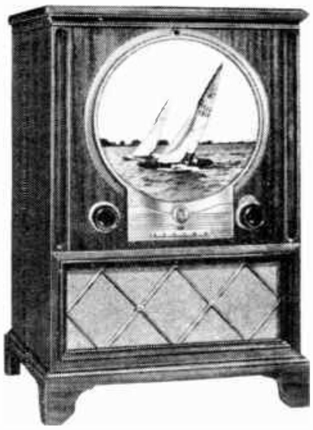
Plus Federal Excise Tax

New Zenith "Adams"
An unprecedented value in television entertainment. With new Glare-Ban "Black" Tube—television's greatest picture improvement! Has "Big B" Giant Circle Screen and sensational new "Picturemagnet" built-in aerial. Plus Zenith's exclusive One-Knob Automatic Tuning and convenient Duo-Picture Control Switch. In handsome cabinet of genuine mahogany veneers.

ZENITH TELEVISION

New Zenith "Lincoln"
Quality television at its finest! New Zenith Glare-Ban "Black" Tube—gives greatly improved picture clarity in lighted rooms. With "Giant C" Giant Picture Screen and Zenith's exclusive built-in "Picturemagnet" aerial. Simplified One-Knob Automatic Tuning and convenient Duo-Picture Control Switch. An exquisite console in genuine mahogany veneers. $359⁹⁵*

Plus Federal Excise Tax



Never before have there been such amazing television improvements available to you as in these new Zeniths! Zenith† gives you pictures with great depth and detail—photographic realism. Sensational Zenith Glare-Ban "Black" Tube (Blaxide) increases picture clarity—eliminates objectionable blur and glare. And now in many locations, no need for a separate aerial inside or out with Zenith television . . . just plug in, and Zenith's exclusive "Picturemagnet" does the rest.

Yes, of course Zenith has a Built-In Antenna—

PLUS These Sales-Proven Zenith Features

★ **One-Knob Automatic Tuning**—one twist brings in station, picture, sound. Does automatically what on many other sets takes up to 5 or 6 manual tuning operations.

★ **"Gated" Automatic Gain Control**—Zenith's exclusive, automatic protection against "picture flutter."

★ **Genuine Armstrong FM Sound**—the FM of the experts. Gloriously toned, static-free, even in worst storms!

★ **Giant Circle Screen with Picture Control**—gives you a choice of circular or rectangular pictures at the flick of a finger!

ZENITH TELEVISION

Zenith has the great values

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

†®

ZENITH RADIO CORPORATION
6001 West Dickens Avenue, Chicago 39, Illinois

New Zenith "Van Buren"
Television FM-AM Radio-Phonograph Combination. With new Glare-Ban "Black" Tube and "Big B" Giant Circle screen. Has Zenith's new built-in "Picturemagnet" aerial plus exclusive Duo-Picture Control and Simplified One-Knob Automatic Tuning. Matchless radio reception with Zenith's new Super-Sensitive FM and famous Long-Distance AM. Revolutionary new 3-Way Cobra† Tone Arm and Record Changer plays all records, all sizes, all speeds—automatically! All exquisitely combined in a superb "Queen Anne" cabinet of genuine mahogany veneers. $489⁹⁵*

Plus Federal Excise Tax

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

FM-TV

Formerly, FM MAGAZINE and FM RADIO-ELECTRONICS

VOL. 10 FEBRUARY, 1950 NO. 2

CONTENTS

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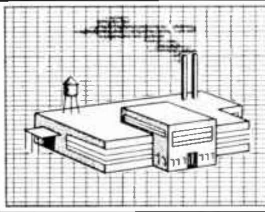
CPA AUDIT

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



Set Production

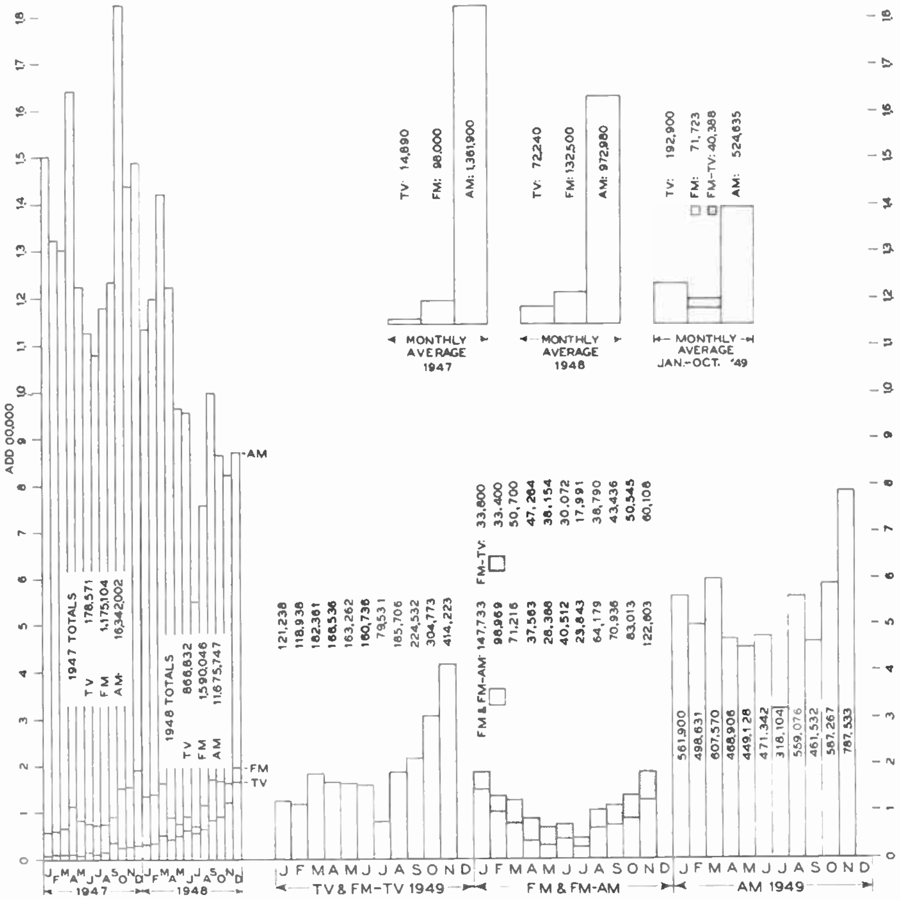
NOVEMBER was the third consecutive month in which television receiver production set a new high figure, climbing to 414,223 units. FM sets continued to rise, also, but at a slower rate, while AM models reached a high for this year.

Further price reductions and the availability of 16-in. tubes in larger quantities have given added impetus to TV sales. It is significant to note that November tube sales showed a drop in the sizes under 9 ins. to only 3.9%, while tubes over 14 ins. accounted for 19%, exceeding the 17.9% sale of sizes from 9 to 11.9 ins. Most popular sizes, representing 58%, were 12 to 13.9 ins. Total sales in November showed 485,312 units, valued at $12,516,077, up slightly over October.

FM sales reflect a healthier condition than a year ago, even though production has run at a lower level than in '48. The difference is that a great many of the '48 models delivered very inferior FM performance, so poor, indeed, as to kill off repeat orders on those models. Practically all sets being produced now have high-sensitivity FM circuits with effective noise limiting. In areas where AM reception has been so seriously affected by co-channel interference from new Cuban stations, there is an acute shortage of good FM models. Production is up sharply on FM and FM-AM tuners, also. These are not included in RMA figures on which the accompanying Production Barometer is based.

Reports from the dealers indicate that the November increase in AM sets may have been due more to tie-in sales than to any active public demand. In fact, complaints have been filed with the Department of Justice against companies that have made the purchase of AM sets a requirement of deliveries of TV models. It could be that the November AM figure will not be reached again.

Next month, we shall have complete figures on the detailed breakdown of 1949 sales.



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

THIS MONTH'S COVER

Just outside Bridgeport, on Success Hill, Stratford, Conn., NBC has erected an experimental UHF television station, employing RCA equipment. Using the call letters KC2XAK, programs will be retransmitted from WNBT on 329 to 535 mc. O. B. Hanson, NBC vice president in charge of engineering, will be responsible for the project, and the detailed work of gathering data will be directed by radio and allocations engineer Raymond F. Guy. Test receivers have been built by RCA under the supervision of D. D. Cole.

SPOT NEWS NOTES

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

Excise Tax on Tuners:

The Treasury Department has ruled that the excise tax on complete radio receivers applies also to tuners which include power supplies. Decision is based on the fact that such tuners, with headphones, permit reception of signals. One manufacturer is now faced with the likelihood of digging up over $100,000 back taxes on this account.

FM-TV Antenna 1,055 Ft. High:

WCON Atlanta will have a 1,000-ft. Ideco guyed tower, topped by a 12-layer RCA television antenna and a 4-section Pylon for FM. An elevator will run to the 800-ft. level.

Record Speeds:

RCA has announced that it will produce 33⅓ RPM records. That's good news because it will give the public a chance to render a decision as to which of the three speeds should be eliminated. It may happen that only one will get a vote of confidence.

Mobile Selective Calling:

Standard mobile selective calling systems provide only for operation from the headquarters station. However, experience has indicated the need in many cases for selective calling from mobile installations. A new unit for this purpose is now being produced by Hammarlund Manufacturing Company, 460 West 34th Street, New York 1. It is contained in a case similar to their mobile decoder, requiring only a conventional telephone-type dial for dashboard mounting, and a cable to the mobile transmitter.

Picture-Tube Size:

Apropos of our comment last month on the trend toward larger picture tubes is this prediction from Sylvania president, Don C. Mitchell: "Judging from the current demand, the [1950] market should be 90 per cent or better in 12½-in. and larger sets."

Communications Research:

Motorola has started construction on a building of 40,000 square feet at 1100 N. Central Avenue, Phoenix, Ariz., to house a research laboratory and special production facilities. This operation will be directed by Dr. Noble, who will spend half his time at Phoenix, although he will still make Chicago his headquarters.

B. K. V. French:

One of the old-timers who has had a hand in the development of many components, including the Mallory-Ware Inductuner and the mercury-type dry cells used by our Armed Forces, has joined Du Mont as application engineer. He will collaborate with manufacturers who use Du Mont parts in their TV sets.

Components Research:

Erie Resistor Corporation, Erie, Pa., has set up a new research and development department, headed by J. D. Heibel, to investigate principles, methods, and materials applicable to component design and production. Nello Coda will succeed Mr. Heibel as chief electrical engineer, and J. C. Van Arsdell has been advanced to the post of manager of the sales engineering department.

Low-Power Communications:

Doolittle Radio has two new stunts to add new uses for their Littlefone transmitter-receiver. One is an adapter for charging the Littlefone storage battery from a 6-volt automobile battery. The other is a car antenna with a 3-ft. lead

(Continued on page 6)

SPOT NEWS NOTES

(Continued from page 5)

(the maximum length allowed by FCC rules for low-power equipment) which can be plugged into the unit in place of the regular antenna. This gives increased range. When the Littlefone is taken out of the car, the lead is disconnected, and the regular antenna replaced.

TV to Start in Canada:

Canada has approved an appropriation of $4,500,000 for government-owned stations in Montreal and Toronto, to be operated by CBC.

Southwestern Branch:

Gates Radio Company has opened a factory branch at 2700 Polk Avenue, Houston, Texas, with Wayne E. Marcy in charge. A complete stock of Gates equipment and components will be carried.

TV Tuner Improvement:

The 3-section Du Mont Inputuner has been succeeded by a 4-section design of increased gain and selectivity. The number of revolutions to cover 54 to 216 mc. has been reduced from 10 to 5.9, and a transformer has been added for matching either 300- or 72-ohm line. Even with the added section, mechanical dimensions have been reduced substantially.

Dr. W. R. G. Baker:

Discussing television as it looks from G. E.'s Electronics Park: "In my opinion, color television will not be available on a national scale for at least five years. UHF will develop much faster. It has been said before, but bears repeating, that the public can buy present-day sets without fear of obsolescence."

Miniature Terminals:

Six types of silver-plated lugs suitable for miniaturized equipment have been brought out by U. S. Engineering Company, 521½ Commercial Street, Glendale 3, Calif. Designed to be riveted to terminal plates or strips, there are three feed-through types, two of which, have split tops, two two-section lugs, and one single-section design. A new data sheet from U. S. E. lists 29 different types of lugs.

FCC Commissioner E. M. Webster:

Addressing the American Taxicab Association at Chicago on November 7, 1949: "Experience has shown that expansion of any radio service is always upward, frequency-wise. That as the service expands, frequencies in the higher bands are utilized. My advice to those of you who are operating in areas where there

(Continued on page 7)

Professional Directory

SPOT NEWS NOTES

(Continued from page 6)

is a severe shortage of frequencies is to contact all the manufacturers and tell them of your need of equipment that will operate in the band from 450 to 460 mc. That is the region where, I believe, that expansion will take place. The Commission will cooperate to the fullest extent in authorizing developmental stations in that band." FCC allocations provide twenty 100-kc. channels for land transportation from 452 to 454 mc.

Laboratory Standards:

Twenty instruments, ranging from standard signal generators to field strength meters and bridges are described in a 44-page catalog issued by Measurements Corporation, Boonton, N. J. Included are signal generators covering 2 to 400 mc. and 300 to 1,000 mc. for TV and communications use.

Officers of San Francisco AES:

Ross H. Snyder of KJBS-FM has been elected chairman of the San Francisco Chapter of the Audio Engineering Society, with Walter T. Selsted of Ampex as vice chairman, Frank Haylock secretary, and Harold W. Lindsay of Ampex as the treasurer.

Color TV Committee:

FCC Chairman Coy, in a letter to Dr. W. R. G. Baker concerning the formation of the National Color Television Systems Committee, stated that "the Commission will welcome its participation" in the TV hearings. However, "the Commission does not believe that the formation of a national television systems committee should be dependent upon the Commissioner's approval." Reason is "the desire to avoid any implication that a national television systems committee, such as you propose, is to be regarded as an advisory committee named by the Commission."

Audio Equipment:

An excellent compilation of data on high-fidelity reproduction, entitled "1950 Audio Equipment," by Irving Greene, has been published by Sun Radio & Electronics Company, 122 Duane Street, New York 7. The book covers FM-AM tuners, pickups, records, amplifiers, speakers, and construction features of custom installations. Copies are available on request, without charge.

Opinion Poll on FM Bus Radio:

After a 2-week test of public opinion on bus radio, conducted by KBON-FM and the Omaha & Council Bluffs Street Railroad, 23,632 votes showed 94% in favor of the service. Work has been started,

(Continued on page 32)

Special Services Directory

RCA Remote Amplifier
Type BN2A
—with self-contained battery kit

Now—this remote amplifier

✓ operates from a self-contained battery
✓ operates from an a-c line

Here it is—RCA's Portable Remote Amplifier type BN2A, with the new self-contained battery kit. It is the same in every respect as the standard BN2A amplifier, but it provides instant selection of a-c or battery operation—with everything in one package, *batteries and all.*

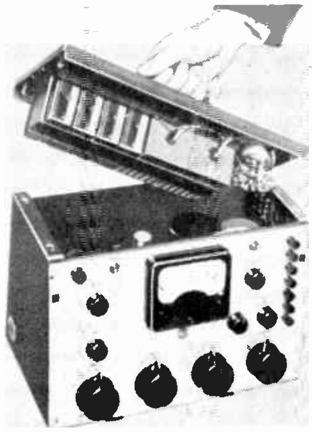
The new self-contained battery kit is actually a top cover which replaces the one on the standard amplifier. The kit includes: a-c receptacle, ac-dc selector switch, battery holder, new cover, and handle—yet the assembly is so compact that it adds only ⅝-inch to the overall height of the original amplifier.

NEW LOW PRICES* Type BN2A

- **With standard cover . . . $425.00 (*less tubes*)**
- **With self-contained battery kit . . . $462.00 (*less tubes and batteries*)**

Take advantage of the best buy in remote amplifiers . . . at new low prices. Order your BN2A Remote Amplifier . . . either the standard or the self-contained battery model . . . from your RCA Broadcast Sales Engineer. Or order from Dept. 38 B, RCA Engineering Products, Camden, N. J.

SPECIAL! New Battery Cover Kit—



—for owners of the standard BN2A Remote Amplifier

✓ Remove present cover
✓ Slip new kit cover into place
✓ No tools needed

PRICES*

Battery Cover Kit (less batteries), MI-11279 $37.00

Standby Battery Kit, MI-11281 $7.66

**Prices apply only within continental U. S. A.*

AUDIO BROADCAST EQUIPMENT

RADIO CORPORATION of AMERICA

ENGINEERING PRODUCTS DEPARTMENT, CAMDEN, N.J.

In Canada: RCA VICTOR Company Limited, Montreal

A MULTI-PURPOSE FM RECEIVER

REL'S MODEL 646B IS SUITED TO A VERY WIDE RANGE OF APPLICATIONS IN BROADCAST STATIONS, LABORATORIES, AND PRIVATE HOMES—*By* JAMES R. DAY*

THE REL 646B receiver is a general-purpose, high-performance FM set built for commercial and private use in the range of 88 to 108 mc. It began as a project for the benefit of our own engineering department. That is, it was to have been used exclusively in the course of our firm's main activity, which is designing and building FM broadcast transmitters and communications systems. The general design objectives evolved as a matter of course in canvassing our requirements. Since we were interested only in FM broadcast reception, our hands were quite free.

When Major Armstrong first set out to demonstrate the virtues of wide-band FM broadcasting, one of his early steps was to develop a high-performance receiver specifically proportioned to his needs. The requirements were very similar to those for the current REL receiver, so I'll list the most important ones:

1. The amplitude limiting system should be so nearly perfect as to provide substantially the full theoretical FM gain in noise suppression.

2. The total amplification from antenna to limiter input was to be great enough that measurements of FM performance could be made with signals down through the improvement threshold.

3. Amplitude and frequency distortion in the recovered modulation should be negligible throughout the audible spectrum.

4. What we now call the noise factor should be low: *i.e.*, the output signal-to-noise ratio should be minimally limited by first-tube noise.

These sets were made for Major Armstrong in the general engineering laboratories of the General Electric Company, from designs furnished by him. Since use was paramount, they were not beautiful in appearance; but, electrically, nothing was spared. They had 16 tubes including audio and power supply rectifier. In many respects they could accurately be called engineers' receivers, and they were certainly a pleasure to use.

We needed about the same thing at REL when we got into our post-war transmitter business. Soon, too, outside interest warmed up considerably. Broadcasters needed monitor and relay receivers. Various commercial and Government laboratories wanted receivers for test and comparison purposes, and propagation measurements. Also, with due respect to the fine work done in the home receiver field, there still remained a substantial number of very interested persons who had yet to hear FM as it can and should be heard. So, before we knew it, we were setting out to design and manufacture this limited-market type of receiver in substantial quantities.

General Design Considerations:

The following specifications were set up as a goal to be reached in the design of the 646B receiver:

1. Lowest practical input circuit noise.
2. Adequate limiter action, allowing a sufficient margin to permit full theoretical FM gain.
3. Sufficient amplification to ensure limiter operation on signals equal in amplitude to the input circuit noise.
4. Combined selective circuit and detector distortion less than ½% for modulating frequencies up to 15 kc., at 100% modulation.
5. AC hum 75 db below full audio output at 100% modulation.
6. Relative response down 60 db at 400 kc. off resonance.
7. Image and other spurious responses down at least 50 db.
8. Total drift, after 1 minute, less than 50 kc.

The Armstrong limiter-discriminator circuit was used as a matter of course. Double superheterodyning was considered at first, but it was discarded. A single IF frequency permits the use of simpler circuitry, provides easier tracking, and gives greater control of spurious responses. Fig. 1 is the complete schematic.

RF Section & Mixer:

The RF and mixer section is constructed in one unit, including the first IF stage, as a head-end. It can be seen in Figs. 2 and 3 as a separate rectangular section, mounted directly behind the tuning dial.

As Fig. 1 shows, the RF amplifier consists of a cathode follower directly coupled to a grounded-grid amplifier. Two halves of a 7F8, identified as V1, are used for that purpose. The selection of a cathode follower for the first stage was the result of careful experiment with noise levels produced by various types of input circuits. The cathode follower circuit was found to have the lowest inherent noise level, about 2 microvolts peak, referred to the input circuit.

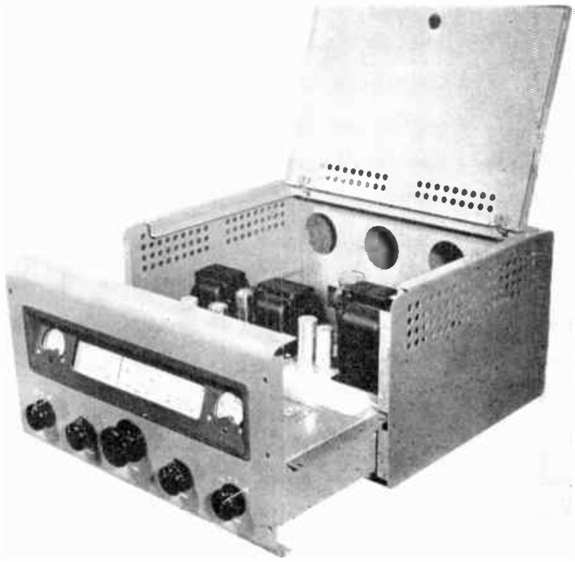


Fig. 4. A rack panel is also available

The gain of the input transformer is about 4. The primary, L1, is adjusted to present an impedance of 150 ohms, a convenient mean between the common transmission line values of 72 and 300 ohms. The secondary, L2, is trimmed by capacitor C1. This is not set closely at the factory, and should be adjusted after the receiver has been installed, for very weak signals at about the center of the scale, or for any particular operating frequency especially desired. C1 is accessible at the top of the chassis.

One half of V2, another 7F8, is used as a mixer, and the other as a Colpitts oscillator. The oscillator operates at 10.7 mc. above the signal frequency. Drift was held down to a maximum of 50 kc. after one minute.

The oscillator is capacity-coupled to the grid of the mixer, and no grid current is drawn. Mixer bias is secured from a cathode resistor. Plate voltage is low, about 70 volts, and plate current is 2 milliamperes. This gives the required conversion conductance and low mixer noise figure.

Iron-core inductance tuning is used throughout. This means of tuning was chosen primarily because of its freedom from thermal drift. Also, it is inherently immune to microphonic effects. A worm-gear drive, with as tight linkage as possible, is used for gang tuning. This is shown in Fig. 2, in the head-end section.

The RF stage, by the use of a small but constant amount of regeneration, provides a gain of about 7. The total gain from the antenna coil to the grid of

*Director of Engineering, Radio Engineering Laboratories, Inc., Long Island City, N. Y.

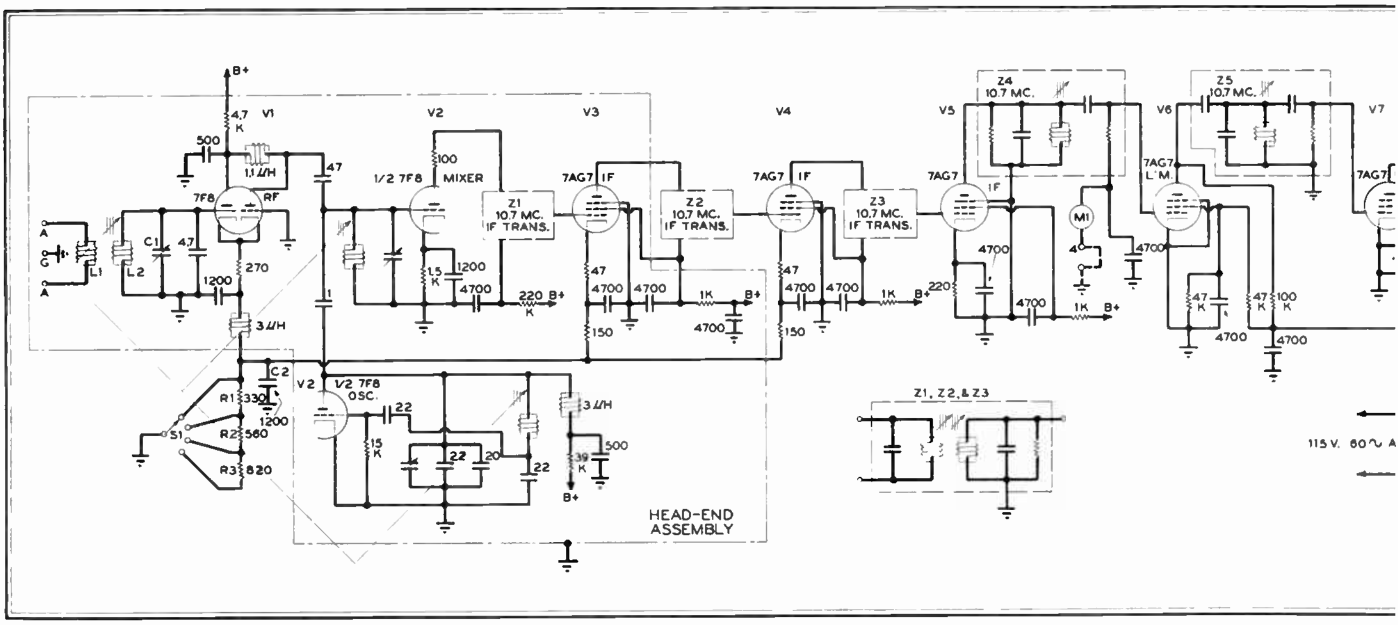


Fig. 1. Schematic of the REL model 646B receiver for the broadcast band, operating on 115 volts, 60 cycles. Model 648B is similar

the 1st IF stage is about 150. The maximum gain for good stability is theoretically 225, so that a gain of only 150 gives a good safety margin.

IF Section:

Since a signal of 2 volts is necessary to saturate the limiter, and the minimum useful signal at the antenna coil is 2 microvolts, the overall gain before the limiter must be 1 million. By using 3 stages of IF with carefully-designed coupling transformers, it was possible to obtain a gain of 14,000 with consistently good stability. With the gain of 150 before the IF section, the overall gain is more than 2 million. This is twice the maximum gain necessary — certainly a safety factor sufficient to assure satisfactory performance.

The necessity for high gain and wide bandpass at once in an FM receiver poses a different design problem. However, a combination of theory and experiment provides a simple rule: if all individual resonant circuits are damped, so that the impedance of each is at least 70 per cent of peak impedance at plus or minus the absolute sum of the peak deviation and the highest modulation frequency (plus or minus 90 kc. for broadcast), and if the coupling of all circuits is 1.0 to 1.2 times critical coupling, then the tuned circuit distortion will be less than 0.25 per cent for all modulating frequencies.

This amount of distortion is negligible. At 10.7 mc., the individual circuit Q cannot be greater than 60 to meet these requirements. Hence the need for 3 IF stages. The mixer plate coupling unit and those in the plate circuits of the first 2 IF stages are double-tuned. Only the two limiter input coupling units are single-tuned. All circuits are operated at resonance, damping resistors being used to obtain the required bandpass in accordance with the rule stated above. This eliminates the need for staggered tuning, with the attendant alignment difficulties.

The RF gain control, S1, is graduated roughly in gain steps of 10 to 1. This is the extreme right-hand control knob on the front panel. S1 determines the resistance in the cathode circuits of V1, V3, and V4 and, therefore, controls the bias on these stages.

Limiter & Discriminator:

A cascade limiter, V6 and V7 in Fig. 1, is used not only for its low threshold but because two limiter stages are much more efficient in noise suppression than a single stage. Adjacent-channel selectivity is tremendously improved, also, with a 2-stage limiter.

In the grid return of the first limiter is the signal strength meter, M1. This is a 0-1 milliampere meter, whose scale is approximately linear. For rough measurements it can be used in conjunction with the RF gain control or, since connections for the meter are brought out to a terminal board at the rear, an external recorder or measuring device can be used for more accurate measurements.

The limiter stages are coupled by a single-tuned circuit of very low Q. Since

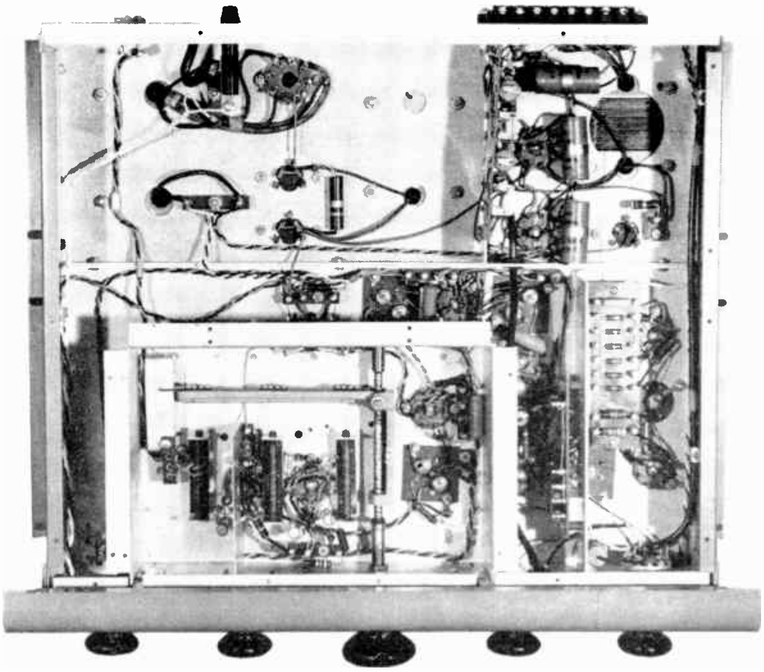
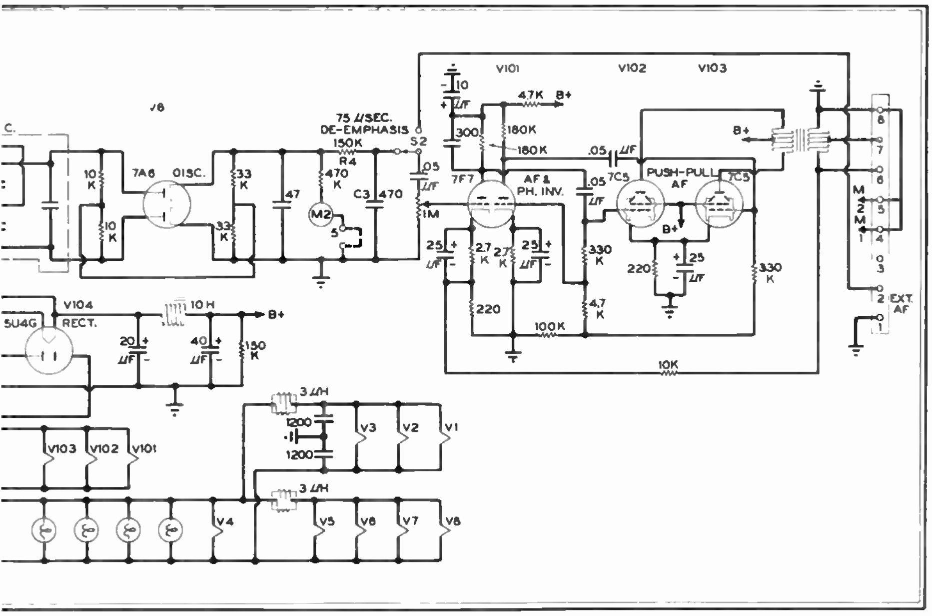


Fig. 2. Permeability tuning is controlled through a worm drive from the tuning knob



except for a 6-volt supply. Note connections for meters and external audio source

both stages are pentodes, the limiting action is quite efficient, and the action of the second stage can be compromised somewhat without danger. This is done to procure fairly high drive for the discriminator.

Severe damping, with proper design of the discriminator coil, gives a discriminator output curve very wide between peaks and extremely flat. The 646B output curve has peaks at plus and minus 300 kc. For plus and minus 100 kc., the slope distortion is less than 0.6 per cent. Using a broad discriminator reduces the output in terms of volts per kilocycle deviation, but this is partially overcome by the limiter compromise.

Beside reduced slope distortion, there are other advantages of broad discriminator curves. Tuning, for instance, does not have to be so precise, since the discriminator is preceded by a relatively selective IF section. By using a small portion of the curve, the amplitude modulation of the diode currents is held to about 30 per cent at maximum deviation. This avoids typical AM detector distortion at high modulation frequencies, with the concomitant risk of intermodulation products.

A tuning meter, M2, is connected at the output of the discriminator. This is a sensitive galvanometer movement, deflecting full-scale left or right at plus or minus 25 microamperes. It is connected as a voltmeter. Circuit loading is slight with a 40,000 ohms-per-volt movement. Since the DC output of the discriminator is zero when the carrier frequency is tuned in exactly, a center-scale reading on M2 indicates perfect tuning. When the receiver is tuned above or below center carrier frequency, however, a DC potential exists at the discriminator output and M2 will read right or left of center-scale accordingly. The meter is calibrated roughly. A small division corresponds to a frequency error of about 20 kc.

As with M1, the connections for external operation of M2 are brought to the terminal board at the rear. In Fig. 4, M2 can be seen at the left of the tuning dial, and M1 just to the right.

A standard 75-microsecond de-emphasis network, R4 and C3, is included at the discriminator output.

Power Supply & Audio:

The 646B has two companion receivers, the 647B and the 648B. They differ only in power supply and audio sections, the RF and IF sections of each being identical. The audio section of the 647B is a voltage amplifier only. The 648B is designed to operate on 6 volts DC, delivering an audio output of 4 watts. For this reason, the RF and IF stages are included in one main chassis section. Power supply and audio stages of each type are built into another chassis section, and one of these is bolted to the RF-IF unit.

The 646B has a 5U4G rectifier used in a full-wave capacitor-input circuit. This supplies B voltage to the RF-IF chassis as well as to the audio section.

S2 is the control knob at the extreme left, Fig. 4. With this, the feed to the audio amplifier can be taken either from the discriminator or from an external AF source such as a phonograph pickup, connected to the terminal board at the rear.

From S2 the signal is coupled to the volume control, and then to the grid of the first half of V101, a voltage amplifier and phase inverter. V101 drives a push-pull power amplifier, V102 and V103. Degenerative feedback is brought from the output transformer to V101. This enables the two 7C5's to deliver a full 10-watt output with negligible distortion to an 8- or 500-ohm speaker.

Mechanical Design:

Ample tolerances have been allowed in the mechanical design as well as in the electrical circuits. The weight of 35 lbs. justifies the statement that the 646B is built like a battleship. For rack mounting, it is furnished on a standard 19-in. panel. The enameled steel case, shown in Fig. 4, is optional. The dimensions of the latter are 19 ins. wide, 16⅝ ins. deep, and 10⅜ ins. high.

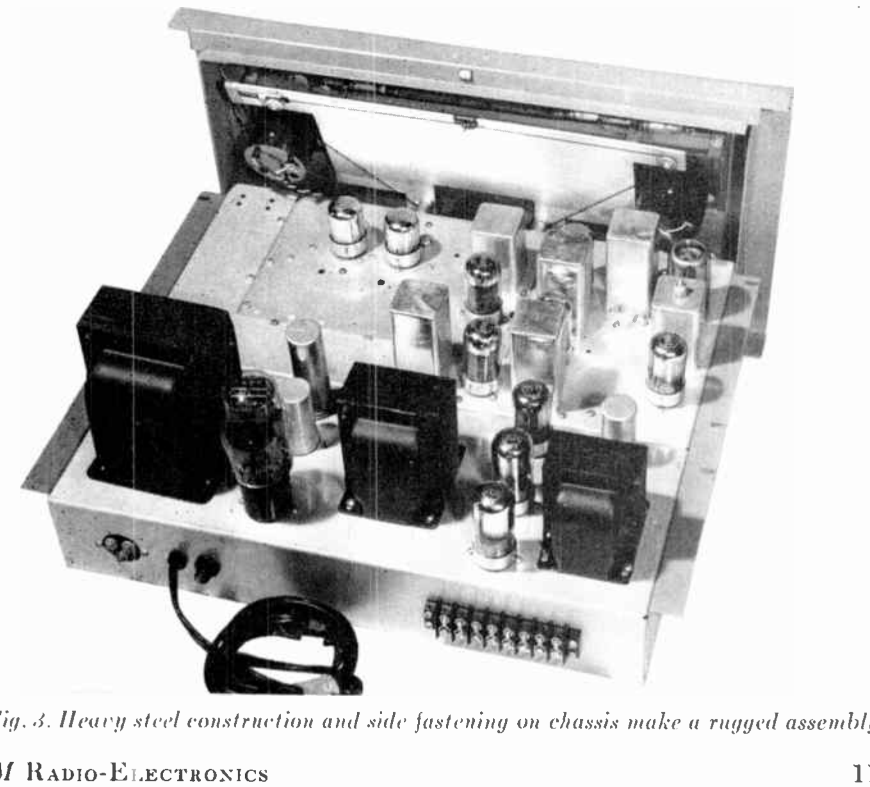


Fig. 3. Heavy steel construction and side fastening on chassis make a rugged assembly

ATTENUATION DUE TO RAINFALL

A METHOD FOR PREDICTING PROBABLE DURATION AND MAGNITUDE OF MICROWAVE ATTENUATION, EMPLOYING AVAILABLE STATISTICS—*By* HOWARD E. BUS*

MICROWAVE radio signals decrease in intensity as they travel through the earth's atmosphere because they are absorbed and scattered by oxygen, water vapor, or precipitation. The attenuation increases sharply for microwave frequencies above 10,000 mc., and quantitative information on this effect is important in the selection and allocation of microwave radio frequencies.

Annual probability curves for the expected duration and magnitude of atmospheric attenuation at microwave frequencies for both 1-kilometer and 50-kilometer path lengths have now been obtained by the writer at the National Bureau of Standards. These attenuation statistics have been derived from meteorological records, using accepted theoretical and experimental coefficients for converting rainfall values into radio attenuation values.

Rainfall and water vapor are the only attenuating components of the atmosphere which have significant variations. The attenuation by oxygen for a given radio frequency is assumed to be constant, because daily and seasonal variations in pressure and temperature alter the concentration of oxygen in the atmosphere only slightly. Water vapor statistics for particular points are obtained from ordinary meteorological observation. Because air masses are essentially homogeneous in the horizontal plane, it is reasonable to assume that statistics of water vapor concentrations along a path can be derived directly from observations at a point. The severest attenuation, however, is caused by rainfall. Such attenuation cannot be calculated immediately from rainfall rates at a single point, for rainfall intensities are not usually uniform in the horizontal plane. Previously there has been no definite basis for using point rainfall data to calculate attenuation for extended lengths of path. Now, an approximate relation of point data to instantaneous long-path data has been obtained.

As a reasonable approximation, point rates have been treated as though they were path rates for distances up to 1 kilometer. Thus, the hourly point rates of the U. S. Weather Bureau may be interpreted as mean, 1-hour, 1-kilometer path rates. However, hourly means of such a rapidly changing variable as rate of rainfall are not too useful, and effective instantaneous rates are desirable. Fortunately, the Soil Conservation Service of the Department of Agriculture has tabulated point rates in this form. These tabulations give the rates in successive intervals within which the rates are uniform. Approximately instantaneous path rates for a 1-kilometer path were readily derived from these data.

To obtain rates on a longer path, it is necessary to obtain data from a dense, synchronized network of rain gages. The best of such data has been published by the Soil Conservation Service for the Muskingum area of Ohio. Successive half-hourly maps show the precipitation at approximately 450 rain gages in an area roughly 90 miles in diameter. Useful statistics for microwave radio propagation purposes were obtained from these maps through the selection of definite paths for study.

Since a 50-kilometer path length was considered representative of microwave communication distances, two 50-kilometer paths at right angles to each other and intersecting approximately as a T were selected for analysis. With the aid of a transparent overlay to locate these paths, mean 30-minute, 50-kilometer path rates were estimated for each path over a whole year. About 7,000 half-hourly maps made up the year's data, and about 2,500 of these showed a trace or more of rain on each path. At the same time, mean 1-hour point rates were obtained by adding successive half-hourly depths. The duration of the path rates exceeds that of the point rates by about 12 per cent at low rates, but for moderate and heavy rainfall the duration of point rates slightly exceeds that of path rates.

Again, instantaneous rather than mean path rates would be desirable, but instantaneous rates on a long path have not been observed. They can be obtained for these 50-kilometer paths by the same procedure used for a 1-kilometer path. On this basis, it is concluded that an annual distribution of 1-hour point rates is nearly identical with an annual distribution of instantaneous 50-kilometer path rates. This is a useful result, especially so if it is found to hold in other locations, for the hourly point rates available everywhere may then be readily interpreted in calculating attenuation over long radio paths.

It does appear reasonable to extend this relation between mean point data and instantaneous path data to most locations at middle latitudes. Obviously, some caution must be used in such an extrapolation. For example, where the annual rainfall depth shows a sharp hori-

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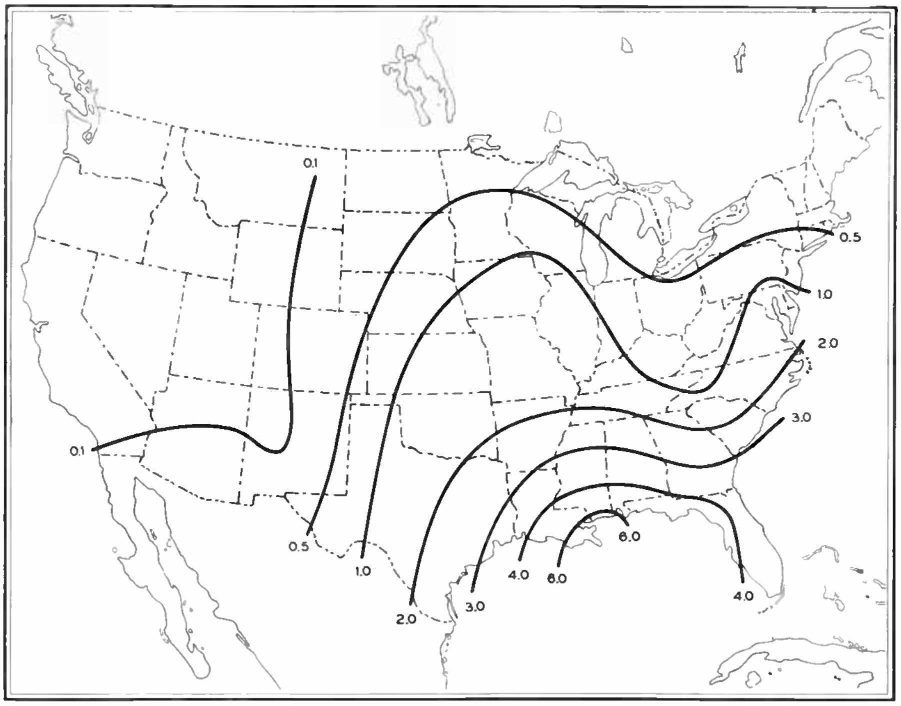

Fig. 1. Number of hours per year that it rains 1 in. per hour or more in the USA

*National Bureau of Standards, U. S. Department of Commerce, Washington 25, D. C.

JEREMIAH COURTNEY'S* MOBILE RADIO NEWS and FORECASTS

FEW people would disagree with the proposition that a rigid national system of frequency allocations for the mobile radio services is wasteful of frequencies in particular areas.

The best that can be said for any plan of national allocations without spot variations is that it accords a measure of rough justice to the various services contending for space before the Federal Communications Commission in an over-all allocations hearing. That this is all a national assignment plan accomplishes adequately appears in the following excerpt from the views of Commissioner E. M. Webster in the FCC's mobile radio allocation decision, May 3, 1949:

"In voting for the remainder of the Report and Order, I wish to make clear that I do not consider that the frequencies and service rules are adequate in all respects for all the services involved. The net result is a matter of compromise. . . . As experience is gained by the services operating under the rules of this Report and Order, proceedings can be instituted as the situation demands to modify the rules so as to allow additional sharing without the danger of creating chaos in the basic allocation pattern."

It is illusory to suppose that the rough justice accomplished by a national system of frequency assignments will long prove acceptable to the public, or the manufacturers now scrambling for equipment sales in bitterly competitive markets. There are too many businesses which could use radio to advantage in non-congested areas which are not now eligible to do so. And this situation exists despite the fact that the frequency assignments made on a national basis by the FCC will never be utilized fully by eligible users in non-congested areas, of which there are many.

Effect on Industrial Use:

The impact of these conditions is perhaps greatest in the industrial radio field, probably the second largest sales area awaiting exploitation. Nevertheless, the rules for industrial radio use have been very tightly drawn. Two prerequisites have been established by the Special Industrial Radio Service Rules:

(1) The applicant must be engaged in an industrial activity the primary function of which is devoted to production, construction, fabrication, manufacturing or similar processes, not service or distribution activities.

(2) The applicant must, in addition, be able to show that he will use the radio facilities applied for in a remote or sparsely settled area; or for construction projects of a public character; or within the yard area of a single plant.

If an electrical supply house in a sparsely settled area wants to use radio, it is ineligible under these rules because it is engaged in activities of a service or distribution nature. While the prohibition of private radio facilities for distributive or service activities may be entirely sound in our large metropolitan areas, where the supply of frequencies is insufficient to meet the total of such demands, this is certainly not the case in the many sparsely settled areas.

Similarly, if an electrical contractor engaged in construction activities desires to use radio in a city of 40 to 50 thousand population, he may be found ineligible because he is not operating "in a remote or sparsely settled area." Yet scarcely any one would contend that all the mobile frequencies in the 152- to 162-mc. band will be exhausted by eligible users in cities of 50,000 or less. It is more probable that there will be a number of frequencies assigned to various other services not used or likely to be used.

The foregoing illustrate but a few of many cases resulting in wasted frequencies, decreased industrial efficiency, and lost equipment sales.

The task of attaining maximum frequency utilization in all areas is obviously a large order. Its national importance, however, warrants the best thought of the members of the FCC and the industry. Some procedure must be worked out that will permit individual adjustments to be made in the national pattern of assignments.

Suggested Procedure:

To start the ball rolling, it is suggested that the FCC establish a procedure whereby ineligible applicants under the present rules may request modification of the eligibility provisions of the Rules for a particular service to permit the use of a selected frequency in a specified area. This is no more than is presently permitted in the broadcast field when spot variations are requested from the national plan for assigning frequencies to FM broadcast stations.

Here is the way the procedure would work: the Electrical Supply House of Roseburg, Oregon, (1940 population 5,000, 1948 estimated 12,000) would file its application in the normal way. Attached to it would be an exhibit setting forth the proposed use of the radio system applied for, the population of the area, the present use in that area of the frequency applied for, and any other facts that would show a grant of the application to be in the public interest.

Upon receipt of the application, the FCC would issue a simple notice of proposed rule-making to modify the eligibility provisions of the Rules involved by the addition of a one-sentence footnote permitting the Electrical Supply House to use a specified frequency in Roseburg. All interested parties, including the Commission's General Counsel, would have a period of twenty days to object to this proposal. If no objections were filed within the 20-day period, the application could then be granted. If any meritorious objections were filed, the applicant would be given an opportunity to request a hearing, failing which the application would be dismissed.

Where an application requested the use of a frequency not available under the Rules of the particular service involved, the notice of proposed rule-making would include a footnote modification of the Part 2 table of allocations. (It is this type of application that might result in objections from the FCC General Counsel, but at least through such objections the industry would be informed of the criteria to be satisfied in presenting such applications.) The number of these footnotes would furnish a good index through the years of the extent to which the Commission was attaining maximum frequency utilization.

It will be noted that the procedure suggested would give all eligible users full notice of what the Commission proposed to do. It would thus test prior professions of need against actual use, so that frequencies would not be put on ice by any industry. The procedure would operate to correct erroneous estimates of frequency needs in particular areas, such as attend any national plan of frequency assignments. The mechanics could be kept as simple as outlined above, and are certainly no more burdensome than the

(Concluded on page 28)

WHAT'S NEW THIS MONTH

A VERY SIGNIFICANT STATEMENT OF FCC POLICY WITH RESPECT TO THE FUTURE OF FM AND TV BROADCASTING — *By* THE HONORABLE ROBERT F. JONES*

Editor's Note: It is obvious that Commission thinking on video and audio broadcasting has been carried forward under the administration of Chairman Coy. However, no pronouncements have been issued such as were contained in the Blue Book prepared while Charles Denny was Chairman.

In a field as dynamic as radio, official attitudes must change, because scientific progress sets up new conditions, new goals, and calls for the solution of new regulatory problems. The first indication of FCC thinking which may be expressed later as official policies is contained in the text of Commissioner Jones' address before the AMA. While it has been quoted briefly and commented upon in the press, it appears that this address was carefully prepared to indicate the possible course of future FCC actions. Accordingly, we are presenting the complete text. It bears careful reading. Space limitations made it necessary to divide it into two parts. Part 2 will appear next month.

YOU know there is one very important fact about the travel of radio signals through the channels in the sky: that is the fact that they land or do not land in specific places on earth. In other words, radio only takes on real significance when it is reviewed from specific locales, and I should like to draw as the background for my discussion of "Channels in the Sky" a single locale — a county in northwestern Ohio where I was born, bred and buttered. The little town where I first made myself heard was a quaint little village three-fourths of a mile long and 350 people wide. At the turn of the century, social life, religious life, and education were confined to a town hall, three churches, and an old two-story red school house, period. Occasionally the town dressed up for a debate in the town hall, but the real earthy public forums were held around a cracker barrel, boxes of dried fish, and bags of beans in a country store my father operated. I listened from the inside of an empty sugar barrel where my mother and father placed me so I'd be out of the candy counter while they waited on the carriage trade. And just so I make myself clear, *carriage trade* in Cairo didn't have the same connotation that people in New York might attach to it. They were not Saks Fifth Avenue customers.

> **NEW ARRANGEMENT**
>
> Starting with this issue, we have exchanged the accustomed positions of the Spot News Notes and What's New This Month.
> Hereafter, the more detailed discussions of special industry events and activities will appear opposite the News Pictures page, while the shorter notes about people and companies will be found up front, in the neighborhood of page 6.
> Under this arrangement, we can accommodate items which have been crowded out in the past. Also, we shall include notes on new products of special interest to our readers.

Community Life in America:

I don't mean to leave the impression that we didn't hear about the outside world. The local railroad telegraph office brought the news that McKinley had been assassinated in 1901, that San Francisco had an earthquake in 1906, even that the Titanic sank in 1912. But the daily grist of news came from three newspapers published at the county seat just a short six miles away at Lima, a city then of 30,000 people, but to us a large metropolitan center.

During as much as I can remember of the first 15 years of the 20th century, the characterizations *Republican* or *Democratic* on the masthead of those three newspapers were a wanton waste of printer's ink and space. There was real competition among those masters of political lexicography, starting with news and ending with politics. Only the forgetful think Pegler is tough. A glance at those pages would convince you that they slugged out their objects of scorn without any of the innuendo which has developed these days into a lucrative network asset. The county seat newspapers were vital organs of culture. Unwittingly, I changed my position from that of an enforced prisoner to a voluntary spectator around the cracker barrel. The influence of these newspapers upon the lives of the people was only matched by the high respect of the populace. They reached down into the youthful population of the homes. Children were made aware of national and state elections. I didn't need a Gallup Poll to tell how the male population was going to vote come election day, because kids automatically reflected the views of their parents which had been nurtured by the editors. Let me tell you those editors hurt me plenty. I lived three blocks from the school house, and, come Leap Year, in November, that was good for three fights on the way home from school. The bloody noses, the cuts and bruises I've carried home satisfied me long ago that these Democrats are the huskiest and most prolific bunch of critters that have lately come upon the American scene.

There were seven or eight important events in the lives of this midwestern community: Sunday, with church two or three times, Christmas, Thanksgiving, Memorial Day, the Fourth of July, circus day, the last day of school, and election day. The railroad telegrapher's service was inadequate to let off the steam that newspaper editors had generated. It called for a trip to the center of the political universe to get the election returns. I can remember as if it were yesterday bumping over the chuckholes in a Model T Ford to stand by my father in between the two newspaper plants while two magic lanterns flashed Who's Winning on screens on opposite sides of the street. The News, Democratic, flashed the victory of Wilson over Hughes in Missouri, and the Republican Gazette flashed the shellacking Hughes gave the incumbent in New York. I have no doubt that the flashes were delayed or timed to dramatize a neck and neck fight for the carniverous satisfaction of the gaping multitude.

I don't mean to overemphasize the political scene, although I think it fair to say politics was the impetus that brought about a fourth newspaper to Lima. The competitors were vigorously gathering, printing, and circulating the news. The daily struggle of these four local publishing giants, that is to say, four big toads in a little puddle, infected the readers so that there was plenty of hell raised if the news boy missed one of his customers on his daily rounds. When one of those papers missed a story, the others weren't slow about displaying a two-page facsimile of the competitor's front page by the side of their own. Soon afterward you could be sure that the circulation manager sent out a crew of salesmen to steal customers away from his erring competitor by showing them the layout with the story that wasn't there.

(Continued on page 29)

* Commissioner, Federal Communications Commission, Washington, D. C. An address before the American Marketing Association, Hotel Commodore, New York, January 17, 1950.

NEWS PICTURES

HERE is a preview of UHF television antennas. This one, operating on 529 to 535 mc., is for the NBC-RCA experimental transmitter KC2XAK at Bridgeport. It has a gain of 17 to 20.

The RCA audio transmitter, left, and the video transmitter at KC2XAK. Front end of each is a standard 500-watt unit, including the FM modulator in the lower part of the third bay from the left. WNBT programs will be rebroadcast from this station. Purpose is to gain UHF experience and propagation data.

Detroit FM station asked its listeners to insure a supply of Christmas cards for children in hospitals and institutions, by sending one card addressed to Kiddie, in care of WLDM. The result was an avalanche of cards, and a dramatic measure of the station's audience.

Philco station WPTZ is using a Mole-Richardson mike-boom perambulator to

mount a TV camera for picking up sports events. To the ease of moving the camera, this rig adds the advantage of raising both camera and operator above the heads of spectators.

Rollie Sherwood and Bill Halligan compare Hallicrafter sets using a 16-in. round tube and the equivalent rectangular tube. Cabinet bulk is reduced by nearly one-half, and the price by $40.

Developments in UHF television and FM communications require new laboratory and field measuring equipment. One of the first new instruments brought out to meet this demand is Measurement's UHF oscillator, covering 300 to 1,000 mc. Accuracy is rated ± .5%. Output dial is calibrated in db.

Bar Harbor, Me., nearly wiped out during the forest fires of '47, now has 10 mobile radio units under the direction of Fire Chief David Sleeper. System ties in with adjacent towns, two lookout towers, and the local police.

. . . and do you remember the fight against AC?

THERE has been much discussion in the press recently concerning FM's place in the sun. Is FM, for all practical purposes, superior to AM? We thought that old question was settled. It is admitted that FM has the advantages of 1) freedom from interference, 2) better fidelity, and 3) greater dynamic range.

Why, then, are the advantages of FM being questioned now? The only reason is that FM has created a problem of economics, due to the fact that stations are not deriving additional income from the simultaneous broadcasting of their programs by FM and AM. But this is not a problem that is beyond the resourcefulness of the broadcasters. Surely they can find a way to make the advantages of FM available to the American public.

FROM the beginning of radio, natural and man-made static were considered one of the industry's foremost problems. Engineers all over the world have worked on devices to reduce or eliminate static. Are we to believe that static interference on AM has suddenly ceased to exist since Major Armstrong invented the FM system of transmission and reception? Interference elimination on FM is not limited to thunderstorms and summertime atmospherics, although these are serious in the midwest and southern states. Genuine FM receivers also eliminate the steady background noise even with their tone controls adjusted for full audio response.

Much of the man-made interference eliminated by FM is created in the home, by electric razors, vacuum cleaners, mixers, fluorescent lights, oil burners, and other appliances.

Now, AM listeners are being plagued with another trouble which, in many areas, is cutting off important stations they previously enjoyed. That is due to the reception of two or more AM stations on the same frequency. Fading and whistles caused by co-channel interference have become serious enough since, following the war, the number of transmitters on the AM band was more than doubled. But with the expiration of the North American Treaty, that type of interference is developing into an AM tragedy, for Cuban stations have opened up on regional channels and clear channels previously reserved for U. S. broadcasters, and Mexican stations may follow suit.

We might as well face the fact that natural and man-made static, and co-channel interference on AM are like death and taxes. They will always be with us. Why not go entirely to FM broadcasting, and do away with these problems of AM once and for all?

I, FOR one, cannot believe that the majority of people are indifferent to reception of natural, clear quality, free of background noise. For what other reason did the public respond to the change from mechanical to electrical recording of phonograph music? Or, more recently, to new types of records that feature reduced needle-scratch and higher fidelity?

Certainly listeners are not less responsive to improved radio reception. Increasing public demand for the best in musical entertainment is shown by the attendance at operas, orchestral performances, and recitals. Why not go to FM entirely for broadcasting so that we can have the finest quality of music in our homes, as well?

MUCH AM broadcasting has an unreal and unnatural quality due to the necessity of maintaining the volume level within prescribed limits. Whispers must be over-amplified; loud sounds must be held down. FM delivers a true range from utter silence to the loudest passage of a great orchestra, exactly as the program is heard at the studio. Why should we not have the same realism in our homes?

ONE of the keenest industrial battles was waged against the introduction of alternating current. The greatest setback experienced by our railroad pioneers was the defeat of a locomotive in a race against a horse-drawn carriage. The automobile was denounced as a creation of the devil because men were not ordained to travel at the ungodly speed of 25 miles per hour.

Our great American public has a wonderful way of demanding, and getting, what is new and better. The profits of industry have always gone to those who implemented the expansion of improved methods and services—not to those who clung to the old, and stood against the tide of progress. Why should we settle for less than the best means of audio broadcasting?

USE OF DC LEVEL CONTROLS

WHY IT IS NECESSARY TO VARY THE DC LEVEL OF VIDEO SIGNAL INFORMATION, AND HOW THIS CONTROL IS ACCOMPLISHED—*By* EDWARD M. NOLL*

THE picture-forming components of video signals are originated by the differences in light intensity at various points in a televised scene. If only these relative light changes were included in the video signals, the darkest part of a scene might appear as black, or the lightest part as white. Some provision must be made for establishing the light level of the picture as a whole with relation to black, which represents zero light level. Therefore, it is important to establish in the picture information not only relative changes in light intensity, but also the true relation of these values to black. It is the purpose of this article to show how this is accomplished in TV picture transmission.

The Need for DC Level Control:

The instantaneous voltage output of an image orthicon tube is directly proportional to the light intensity at a point on the light-sensitive surface where the scanning beam is directed at that moment. In the usual televised scene, this instantaneous output is varying continuously from point to point, and these variations provide the picture intelligence. In other words, it is the rapid changes in camera-tube output which delineate the picture on the receiving kinescope.

When the brightness of a scene is changed, all the elements composing that scene are affected in the same manner. Every point within the scene, corresponding to a camera tube scanning-beam position, will have a similar increment or decrement of brilliance, and this will produce a corresponding change in orthicon output for all beam positions. Thus, although the relative differences in output may be the same as before, changes in brightness of a televised scene are accompanied by changes in average output of the camera tube. Therefore, the video section of the modulating waveform can be considered as in two combined parts: a DC average-brightness component and the AC picture-resolving information, rising above and below this level.

It is obvious that changes in average brightness must be conveyed to the receiving equipment along with the picture-delineating information. For the sake of realism, the television system should be capable of response to light-intensity changes accompanying shifts from indoor to outdoor scenes, or from sunlit to shady scenes.

To accomplish this, changes in brightness are made to cause corresponding changes in the average amplitude of transmitted signal, as shown in Fig. 1. For convenience, only the positive half of the transmitted signal is shown. When these signals are detected in the receiver, the background brightness of the kinescope is set according to the DC component of the video envelope.

The sync tip and blanking levels are held constant at 100% and 75% peak signal amplitude respectively. For very dark scenes, the DC video component is close to the 75% level of the blanking voltage, Fig. 1D. For bright scenes, the instantaneous picture variations are centered around a DC value close to the 15% white level, as in the waveform represented by Fig. 1B. This is referred to as negative transmission, whereby a decrease in light intensity causes an increase in transmitted power.

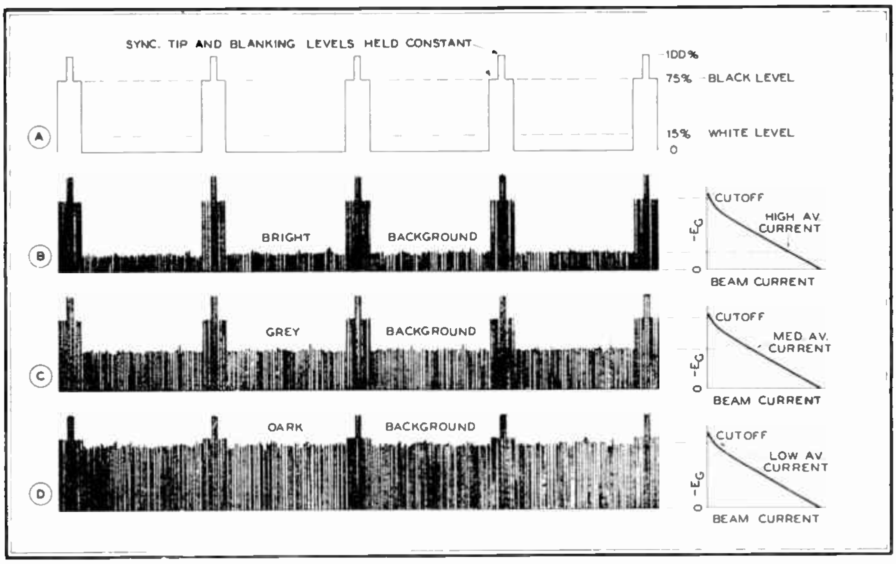

Fig. 1. Average signal amplitude must be changed as the average brightness changes

Special Circuit Functions:

It is more difficult to keep the peak levels of the signal constant while permitting the average levels to vary, as we must for television, than it is to keep the average signal amplitude constant and allow the peaks to vary, as in standard AM broadcasting. Consequently, special circuit techniques are used in television transmitters to retain the average brightness level of the signal, or to restore it to its proper level after it has been lost or partially compressed. These special circuits are located in the television equipment as indicated in Fig. 2, a functional block diagram of the major units of a transmitting system.

The output of a camera tube is at a very low level and contains many high-frequency components. It is the function of the camera amplifier to increase the amplitude of this feeble signal, and to provide a low-impedance output, so that the high frequencies will be retained in the transmission line to the camera control unit. When instantaneous variations in the signal are increased in amplitude, the brightness level of the signal must be held and amplified correspondingly. Associated with the camera amplifier, therefore, is a special circuit called a DC setter or line-to-line clamp, which retains the average brightness level of the picture signal.

The output of the camera amplifier, which is a part of the camera proper in the studio, is passed through cables to the control room where it is brought to its camera control unit. Here it is customary to add the blanking signal to the picture information. Special circuits must be incorporated to add the blanking signal, and to set precisely the level of the blanking pulse in relation to the black amplitude of the signal present. Again, this particular circuit is important in establishing the average brightness of the scene, because it determines the level of the picture information with respect to the level of the blanking pulses which, in

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turn, determine the black level of the received picture information. In most installations, two or more cameras are in use, and each camera has its own control amplifier. Thus, blanking must be added to the signal from each camera.

Picture and blanking signals from all the cameras are brought to a switcher unit. Technical continuity of the show is controlled at this point. From the switcher, signals of the camera selected are passed to the stabilization or line video amplifier, at which point a composite sync signal from the sync generator is added to form the complete television signal. Special control circuits are needed to set the sync pulse at its proper amplitude with respect to the rest of the signal. After the composite signal has been formed, a DC restoration circuit is inserted to hold the average brightness level of the scene. Once the sync pulse has been added to the signal, the sync tip can be used as a fixed voltage level.

At the transmitter, a final series of video amplifier stages step up the signal to the amplitude required at the modulator stage. A sync expansion circuit is included, so that the transmitter operator can set the final sync pulse amplitude in accordance with television signal standards.

The modulating section differs from a conventional AM modulator in that it is capable of DC as well as AC modulation. Therefore, the modulating system is such that not only do instantaneous variations of the signal cause momentary transmitter power changes, but any shift in the DC level produces a corresponding change in the average power output of the transmitter.

Each of these special circuits is described in detail in the following sections. Operation and influence on the signal are explained fully.

The DC Setter:

The DC setter, or line clamper, is installed in the television camera, with the pre-amplifier. Its functions are to re-set the DC video component after it has been shifted by RC coupling, and to restore the lower frequencies attenuated in the stages of the pre-amplifier.

An image orthicon camera tube can be made to give a fixed-voltage output during retrace intervals by applying blanking pulses to the target during the horizontal and vertical retrace intervals. This returns all the electrons of the scanning beam to the multipliers, and produces maximum current in the output load resistor. This represents the black level of the signal, because maximum load-current flows when picking up the black portions of a scene. Thus the top waveform in Fig. 3 represents the output of an image orthicon tube, and shows a fixed voltage output during all horizontal and vertical blanking periods. The brightness is gradually increasing, line after line. Only three lines are shown in the drawing, although this gradual increase in brightness would probably be taking place over many scanning-lines in an actual scene. This would be a low-frequency change.

When a signal with a fixed voltage level and gradually increasing peak-to-peak amplitude is applied to a series of RC-coupled video amplifiers, the signal will tend to arrange itself as an average about the bias levels of the various stages, because as much current must flow into a coupling capacitor as flows out of it. Consequently, after many cycles, as much signal area will appear above the bias axis as beneath it. This tendency is indicated by the second waveform, Fig. 3. It will be observed that the signal levels have been compressed and the DC position of the waveform relative to the fixed-voltage black level has been altered. The so-called fixed black level does not exist, because the portion of the signal which should represent the black level during all blanking intervals is no longer a constant. Although the peak-to-peak variations of the signal have not been altered, the brightness component has been changed, the black level shifted with each succeeding line, and the low-frequency change in brightness has been attenuated severely. It is the task of the DC setter to hold this signal to the same position relative to black level as it was at the camera tube output.

The DC setter, Fig. 4, is located at the low side of the grid resistor in a coupling circuit between two video amplifier stages. Both halves of a duo-diode are switched into conduction during the horizontal blanking intervals. Blanking pulses from the sync generator are applied to a triode phase inverter, producing a negative pulse in the plate circuit and a positive pulse of equal amplitude at the cathode. These two outputs are applied to the diodes in such a manner that both conduct whenever a blanking pulse occurs. The diodes function as an electronic switch, returning the lower side of the grid resistor to ground whenever blanking pulses are present, and causing an open circuit or high impedance between the lower side of the grid resistor and ground when the pulse is not present.

The diodes are not conducting during the conveyance of the actual picture information. Therefore, the time constant of the grid coupling combination is very long during this interval, and the signal is applied almost in its entirety to the grid of the video amplifier. During retrace intervals, however, when the blanking pulses turn on the diodes, the time constant in the grid circuit becomes very short. The black level pulse, which is a part of the signal present on the plate of the preceding video amplifier, is not conveyed to the grid of the succeeding video amplifier. It appears almost entirely across the coupling capacitor, because of the much shorter time constant during the conduction period of the diodes. Thus, for the duration of the blanking pulse, a fixed DC bias is present on the grid of the video amplifier. Since this occurs for every horizontal blanking pulse, the grid of the video amplifier is returned to a fixed-voltage level at the end of each line, as indicated in the third waveform of Fig. 3. When the blanking pulse is removed, the diodes cease conducting, the grid circuit time constant becomes very long, and the next line of picture information is presented to the grid of the video amplifier. It is always at its proper level, since the part of the video waveform representing black is now at a constant level. The low-frequency component of the signal has been restored also.

A balance adjustment is provided for the DC setter, to prevent the addition of the blanking pulse to the picture information. Pulses opposite in polarity appear across R1 and R2, Fig. 4, and properly setting the balance adjustment causes these pulses to cancel.

Because of the DC setter's ability to replace low-frequency components, the early stages of the video pre-amplifier need not have exceptionally good low-frequency response. Therefore, short time-constant coupling circuits can be used, and the predilection to hum pick-up, microphonic disturbances, and motor-boating is reduced. These weak-

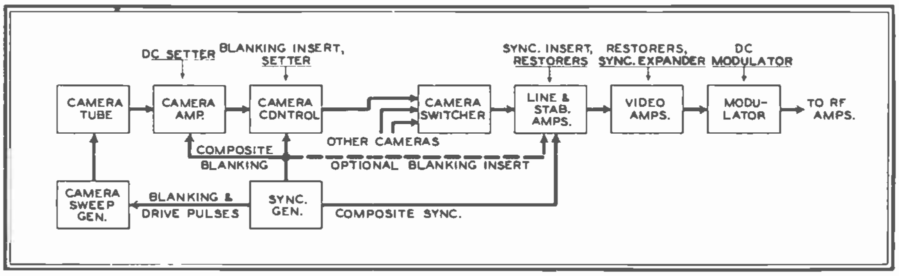


Fig. 2. Major units of a transmitter, showing the locations of the special controls

nesses are especially noticeable in extremely weak-signal stages which must pass low-frequency components. Disturbances still exist to some extent in the weak-signal stages of the camera amplifier, but are reduced markedly from those encountered in earlier designs.

Blanking-Pulse Insertion:

After the picture signal has been amplified and brought by coaxial cable to the control room, the blanking pulse is added. In some installations, the blanking pulses are introduced into each camera signal separately, before the switcher. In other instances, however, blanking is not added until the picture signal has been selected.

There are two basic methods of inserting the blanking pulses. In the first method, blanking is added at a DC setter by intentionally unbalancing the diode load circuit. The actual extent of the unbalance can be controlled by the balance adjustment, Fig. 4. A small fixed resistor can be inserted, if necessary, in the left branch of the diode load circuit. The greater the unbalance, the higher the amplitude of the negative blanking pulse added to the picture signal.

A second type of blanking insert system is shown in Fig. 5, embodying a common plate impedance for a video amplifier and the blanking amplifier. The picture signal is developed across resistors R1 and R2, but the blanking pulse appears across R2 alone. R1 serves as an isolating resistor, preventing the direct addition of the blanking amplifier capacity to that of the video stage. If this were not done, the high-frequency components of the picture signal would be attenuated severely. Provision should be made at some point for varying the amplitude of the blanking pulse brought from the sync generator, in order that the correct amount can be added.

The video amplifier stage following the blanking insert system is usually a clipper, with an average brightness control to clip the blanking pulse at the proper level. This circuit has two important functions. First, of course, it must clip the blanking pulse at the proper level for correct average brightness. Second, during the process of clipping, it removes any spurious signal riding the top of the blanking pulse after it has been added to the picture information. The iconoscope is particularly susceptible to such transient signals, introduced during the horizontal retrace interval, when the deflection coils set up a high-amplitude inductive kick. This often leaks into the picture signal, and must be removed by clipping.

Setting the average brightness is usually done by the video operator. He can do so by changing the level at which the blanking pulse is clipped. It is his job to evaluate the peak-to-peak variation of the picture signals and prevent the information from crowding either the black or white regions. For example, if portions of the picture information are

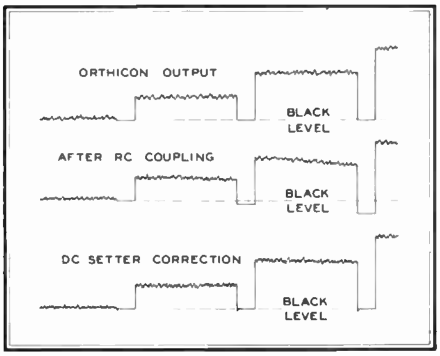


Fig. 3. Changing average brightness level

allowed to vary above the blanking level or into the region between the blanking pulse and the sync tip, parts of the scene will appear black which should normally appear grey. On the other hand, riding the instantaneous variations too far into

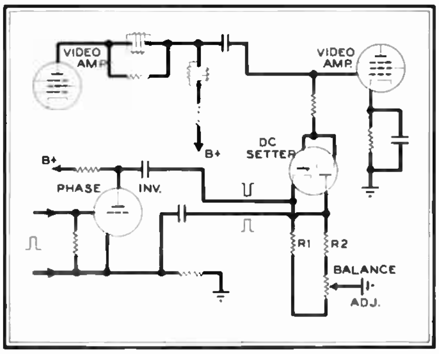


Fig. 4. Arrangement of the DC setter

the white will produce a scene with an overexposed look.

In some installations, average brightness is adjusted semi-automatically by a photocell in the studio or on a film projector. The photocell produces a DC current flow proportional to the average brightness, and this current, amplified, is

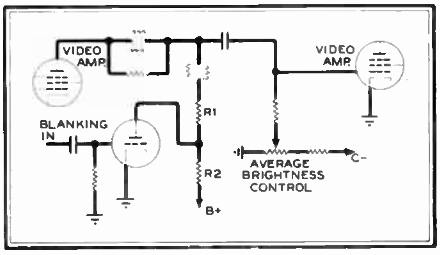


Fig. 5. A second blanking insert system

introduced to the clipper bias circuit. This changes the clipping level, adjusting the average brightness in the proper direction.

Adding the Sync Pulse:

When the composite picture and blanking signal has been formed, and all transients removed from the blanking pedestal, the sync pulses must be added. They are incorporated in a fashion similar to that employed to add the blanking pulses. They must be added not only with the proper polarity, but with the correct amplitude to become the top 25 per cent of the transmitted television signal. The sync pulses are added in the line amplifiers which follow the switching system.

During ensuing stages of amplification, the sync tips are gradually worn down. This effect occurs because of operation on the upper knees of the Eg-Ip curves and, as might be expected, is especially troublesome in the final stages of video amplification and in RF power amplifiers. To compensate for this, the original ratio of the sync pulse to picture height is 1 to 1½ or 2. Even so, a special circuit is needed at the transmitter to increase the sync pulse length to that required by TV signal standards.

The Sync Stretcher.

In the RC-coupled stages of the transmitter video amplifier, the waveform shifts around the bias level in response to changes in the average brightness level. Therefore, the sync pulse part of the signal operates on correspondingly different portions of the Eg-Ip curves. This changes the amount of sync pulse compression. Also, the DC restorer clips off a varying amount of the sync tip in accordance with changes in average brightness. In view of the uncertainty of clipping and compression action, some means of controlling the amplitude of the sync pulse, as well as increasing it, is necessary. These needs are met by the sync expander, or stretcher.

Two basic sync expansion circuits are shown in Fig. 6. Sync expansion is accomplished toward the end of the video channel, at a high signal level, where a single amplification stage may consist of two or more tubes in parallel. In the first system, Fig. 6A, the sync stretcher is an amplifier in parallel with the normal video amplifier, but biased separately. It is adjusted so that it will conduct, and contribute to the output, only on a grid voltage swing in excess of the blanking pulse.

A pickup inserted in the antenna feed line takes a sample of the transmitted signal to a rectifier. It is then applied to a waveform monitor, and can be observed by the transmitter operator. He adjusts the sync expansion circuit for the proper ratio of sync to signal.

Fig. 6B shows a second method of expansion. In this system, a diode is shunted across the normal plate load of a video stage. In series with the diode is another plate load resistor. The plate potential of the expander is adjusted so that it conducts during most of the input waveform, when the plate load of the video amplifier is the combination of both impedances. However, at a signal level greater than the blanking potential, the diode cuts off. This increases the load impedance of the video stage and, consequently, the gain is increased during the time of the sync pulse. The proper degree of added gain can be controlled by adjusting the diode plate potential.

The DC Restorer:

The function of the DC restorer is that of re-establishing the relative DC level of the composite signal after it has been lost in the video amplifier. The restorer, usually a diode, keeps all parts of the waveform above or below a fixed level determined by the external bias.

In Fig. 7A, the restorer can be seen in parallel with the grid resistor of the modulator. On a positive signal peak, the coupling capacitor is quickly charged through the diode. Because of the very short time constant presented by the diode and capacitor, the signal appears almost entirely across the capacitor, and very little across the diode. When the signal goes negative, however, the time constant is determined by the grid resistor and the capacitor alone, since it is impossible for the diode to conduct. Thus the rest of the signal, which is all negative with respect to the sync tip, appears across the grid resistor. On the next sync pulse, the capacitor, which has discharged only slightly, is recharged through the diode, clipping off a small part of the sync tip.

It should be noted that this process holds the maximum positive part of the grid signal, represented by the sync tip, at the fixed bias level or C–, as indicated in Fig. 7A. Therefore, the DC average of the signal, which is determined by the average brightness, has been added to the fixed bias. This produces the desired effect, namely, varying the DC grid potential of the modulator tube in accordance with variations in average brightness.

If the signal at the modulator grid is reversed in polarity, the diode connections must be reversed also. The basic operation is identical, except that the signal is then clamped above the fixed bias level.

DC Modulation:

In a television transmitter, whether grid, cathode, or plate modulation is used, it is necessary to convey a DC as well as an AC component of signal as modulation. At the same time, proper DC supply potentials must be present on the modulating electrode.

Three basic systems of DC modulation are presented in Fig. 7. In the first, Fig. 7A, the modulator is a cathode-follower. The DC grid bias of the modulated amplifier is the sum of the coupling bias-pack voltage and the DC voltage drop across the modulator cathode resistor. Together, they provide the class C bias necessary for efficient operation of the RF stage. When signal variations are present on the grid of the modulator, these same variations appear across the cathode resistor and on the grid of the modulated amplifier, comprising the AC modulation. A change in the average brightness of the transmitted scene results in a change of modulator grid bias, due to the action of the DC restorer. This shift in bias changes the average plate current and, therefore, the DC voltage across the modulator cathode resistor. Since this is a part of the class C grid bias of the modulated amplifier, the average power output of the transmitter changes accordingly, as it should.

In the second system, Fig. 7B, the modulator output is taken from the plate, which is below ground potential. To obtain proper plate voltage for the modulator, a separate high-voltage supply must be inserted between the cathode and ground.

The bias for the modulated stage is the sum of the coupling-pack voltage and the voltage drop across the modulator plate resistor. Again, with a change in average brightness, the DC grid potential changes on the modulator, producing a corresponding change in voltage drop across the plate resistor. This in turn shifts the RF amplifier grid bias and the transmitter power output.

Fig. 7C shows the third system, commonly used for low-power applications. A common cathode resistor is employed for a cathode-follower modulator and the cathode-modulated amplifier. A change in average scene brightness shifts the DC cathode voltage and, therefore, the component of bias it contributes to the modulated stage. External bias is also applied to the grid of the modulated amplifier, in order to reach the necessary class C bias.

The foregoing makes clear the purpose and importance of the controls, both manual and automatic, for shifting the DC component of the video signal in succeeding scenes of a television program.

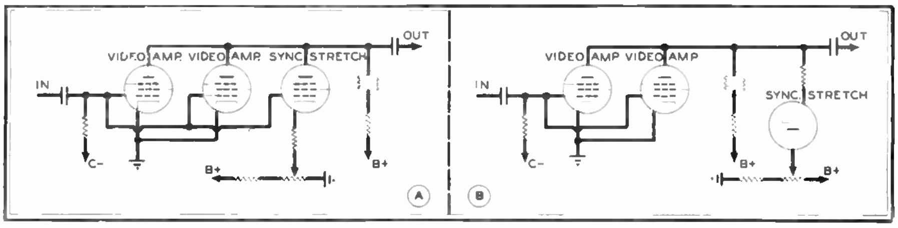


Fig. 6. Two basic types of control circuits which are used for sync expansion

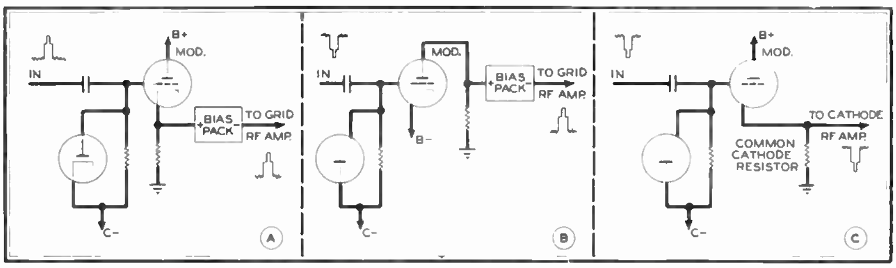


Fig. 7. Three methods of DC modulation which are used for television transmitters

COMMUNICATIONS REGISTRIES

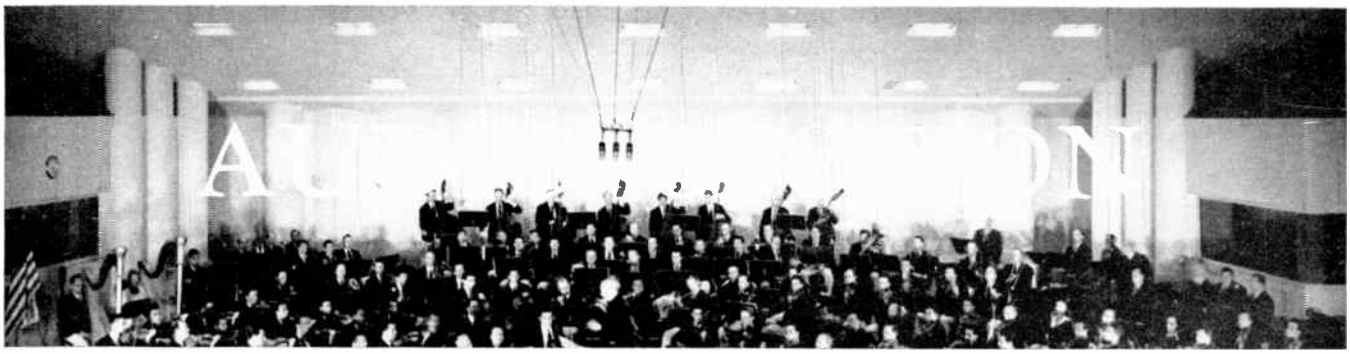
The accelerated rate at which the number of communications systems is increasing has made it necessary to change the method of handling the Registries which we have published in this Magazine for the past seven years.

Last January, the amount of space required for the listings of public service and industrial systems was more than we should devote to any one feature, no matter how important. And articles of great interest were crowded out.

It has been decided, therefore, that we shall make up the Registries as separate volumes in the future. In this way, we can handle the increasing number of listings without cutting into the editorial space.

We also have the problem of meeting the cost of revising the Registries. This work, which must be done by checking the license data for each system from FCC records at Washington, is in direct proportion to the number of listings. Accordingly, the Registries will be priced at $1.00 per copy.

The Registry of safety service systems will be published in July, and the Registry of transportation services in November. These will be announced in *FM-TV*.

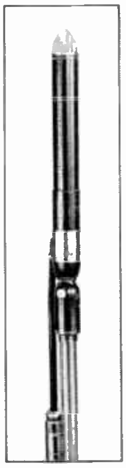


AUDIO NEWS & NOTES

OBSERVATIONS ON AUDIO QUALITY AND SOME NEW BROADCAST STUDIO EQUIPMENT—*By* ROY ALLISON

ACTIVITY in the audio field is continuing at a high level, both as to volume of business and the development of new products. Nevertheless, broadcasters continue to insist that there is no public interest in, or demand for, audio quality that extends beyond the something less than 5,000 cycles carried by the telephone network lines.

That, however, can be set aside as out and out propaganda—an expression of what they would like the public to think. It most certainly does not represent the opinion of those who have a chance to hear 15,000-cycle transmission once in a while.



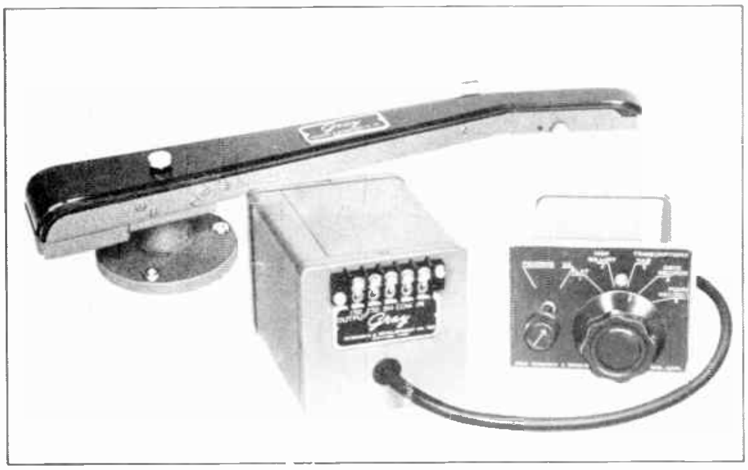


Fig. 1. New slim-type microphone. Fig. 2. Equalizer and viscous-damped tone arm

For example, we listened to Arthur Godfrey's Monday night show recently on WDRC-FM, at Meriden, Conn. Something new had been added to the program, for it came in with such brilliant clarity that Mr. Godfrey, his teapot, and his talent seemed to have been moved from New York right into our living room.

We were so impressed that we called the station, and got Robert Coe on the phone. He explained: "The show originates in New York, and we are picking it up on WCBS-FM. You're hearing 15,000-cycles quality."

Next came the Lux Theatre, and a shift to wire lines from Hollywood. And what a letdown. It sounded so dull and lifeless by comparison that we weren't interested. As luck would have it, weather conditions were favorable enough to get WNBC-FM with the Telephone Hour, another New York origination. First we listened on our REL and Jensen speaker. Then we switched to our Zenith Major. Of course the quality wasn't the same, but it was so far superior to network quality as to prompt the suggestion that any broadcast or telephone engineer who thinks there's no difference between live-talent FM and 5,000-cycle network programs as heard on a well-designed $39.95 table model should be retired for physical disability!

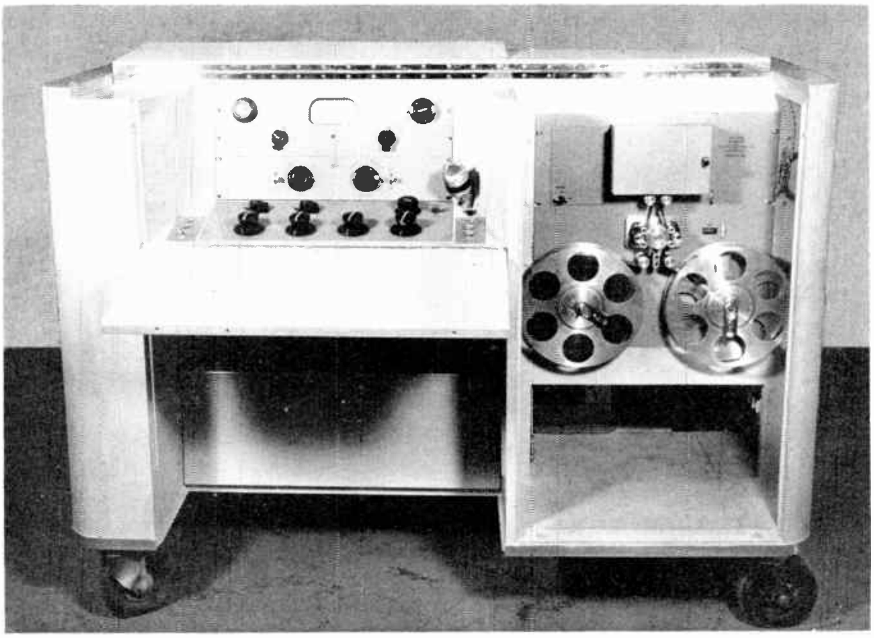


Fig. 3. Complete 35-mm. magnetic film recorder and console built into a mobile unit

ELECTRO-Voice has an intriguing new microphone, Fig. 1. We haven't heard it in use, but it arouses our curiosity. It is 8-3/4 ins. long by 1-1/16 ins. in diameter, with omnidirectional response rated flat within 2.5 db from 40 to 15,000 cycles. No closely-associated auxiliary equipment is required.

At this moment, all we can say about it is that it looks very interesting, since we haven't any detailed information.

(Concluded on page 26)

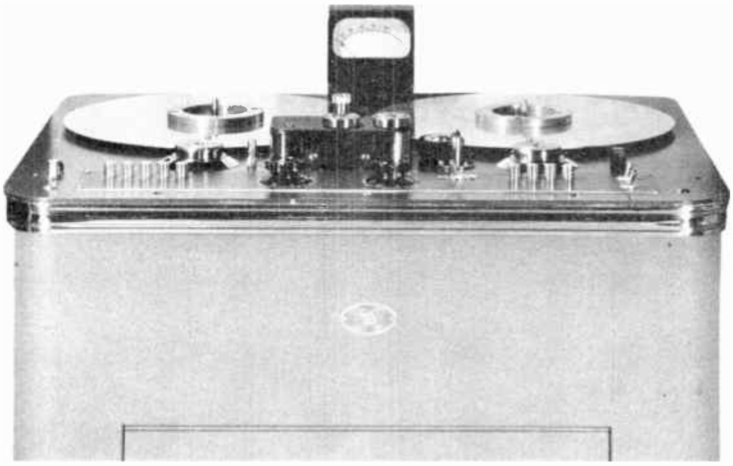


Fig. 1. Top deck of the studio recorder, ready to take the tape reels

STUDIO TAPE RECORDER

HOW PROBLEMS OF MECHANICAL DESIGN HAVE BEEN MET IN THE PRESTO RECORDER-*By* WALTER W. PAULY*

EVERY time the studio engineers take up another notch on the audio characteristics of recording equipment, they approach the limit of precision that can be built into mechanisms for that purpose. The point has now been reached in specifications of audio performance where the mechanical problems are more difficult to solve than those involved in the electrical circuits.

This situation is further complicated by the fact that practical considerations of use in broadcast and recording studios require that the mechanism of a recorder be simple, rugged, and easy to maintain. Time is generally at a premium, and retakes are costly, ruling out equipment inclined to be temperamental or tricky to operate, no matter how good it may be in the intervals when it is functioning properly.

When, to those considerations, the factor of price within competitive range is added, it is clear that considerable initial courage and even greater ultimate skill are required to undertake the development of a magnetic tape recorder that can elicit from audio engineers the comment: "This is it!" Yet that was the goal set up for the Presto SR-950 unit shown in the accompanying illustrations.

Mechanism and Controls:

Each detail of this recorder was designed to provide fast and accurate operation. The number of controls was reduced by making some adjustments automatic, and by making others unnecessary. There is always a temptation to give high-precision instruments the complicated aspect of research-laboratory equipment, but that tendency was resisted effectively by checking each design detail against the operational requirements of recording engineers.

Figs. 1, 2, and 3 show the arrangement of the controls and mechanism on the hinged top plate. This is carried on a steel cabinet 40 ins. high, 30 ins. wide, and 24 ins. deep.

The tape transport system, Fig. 2, accommodates reels carrying up to 5,200 ft. of tape. This represents 1 hour of playing time at 15 ins. per second, or 2 hours at 7½ ins.

Three motors are used for individual drives on the two reels and the capstan. The latter has a synchronous hysteresis motor, operating at 900 or 1,800 RPM. Tape speed is controlled by a toggle switch at the front of the panel. Motors which drive the reels are of the induction type, so connected that while one is winding up the tape, the other tries to run in the reverse direction on reduced voltage, thereby maintaining tension on the tape. Under this arrangement, the winding motor gradually slows down and the other speeds up, while the tape travels at a constant rate.

If the tape breaks or unwinds completely from one spool, a safety switch cuts off the power and sets the brakes. These are actuated by solenoids, supplied with DC from selenium rectifiers, just visible in Fig. 4 below the bottom right hand corner of the amplifier rack.

The two large knobs at the front of the panel are gain controls for the recording and playback amplifiers. Three of the buttons at the left control the motors, to record, play back, or rewind. The fourth button is for fast forward speed, and the fifth is the stop button. During rewind and fast forward operation, the tape is held away from the heads.

A VU meter at the back, controlled by four buttons on the right, shows recording level, playback level, bias current, or erase current. When it is used to indicate recording level, the meter is equalized to cancel the effect of the high-frequency pre-emphasis. Fig. 2 shows how the controls have been simplified and arranged for operating convenience.

* Engineering Department, Presto Recording Corporation, Box 500, Hackensack, N. J.

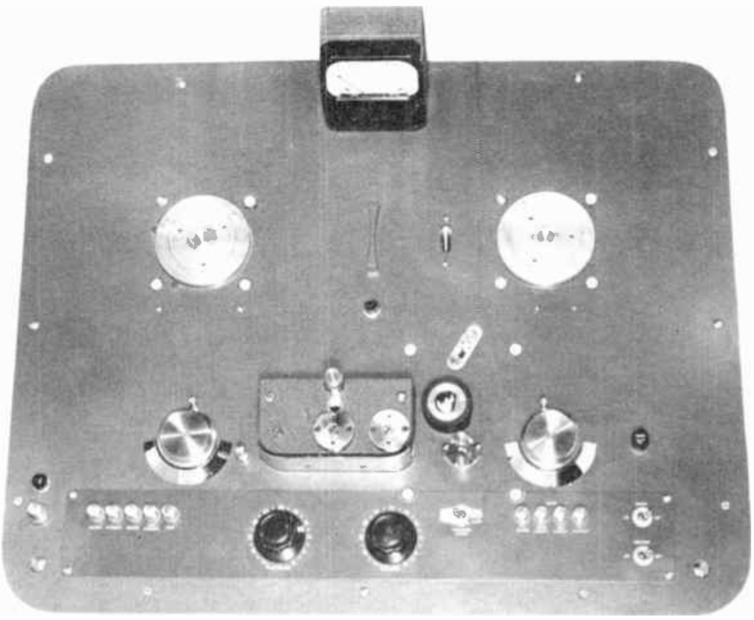


Fig. 2. Layout of the tape transport system and operating controls on the top plate

Amplifiers & Power Supplies: All the electrical circuits are built into the three units which can be seen in Figs. 3 and 4. They are mounted in a 19-in. rack, hinged to the cabinet. The chassis and tubes face inward, so that the wiring and small components are normally accessible when the front door of the cabinet is removed. However, the rack can be released and swung out, as in Fig. 3, when tubes are checked or replaced. Thus, even though the cabinet is set up against a wall, every part of the equipment is within reach from the front. Each chassis can be removed quickly, for external connections are made with separable connectors. The top chassis carries the record and play-back amplifiers. Next below is the bias and erase oscillator section, with the power supply at the bottom. The latter is voltage-regulated, and furnishes DC to the heaters of the first amplifier tubes in order to eliminate any effects of AC hum.

Audio response is rated flat within 3 db from 50 to 15,000 cycles at a tape speed of 15 ins. per second, and 50 to 8,000 cycles at 7½ ins. When the tape speed is changed, the equalization of the amplifier is adjusted automatically. Signal-to-noise ratio is better than 52 db at 1½ per cent distortion.

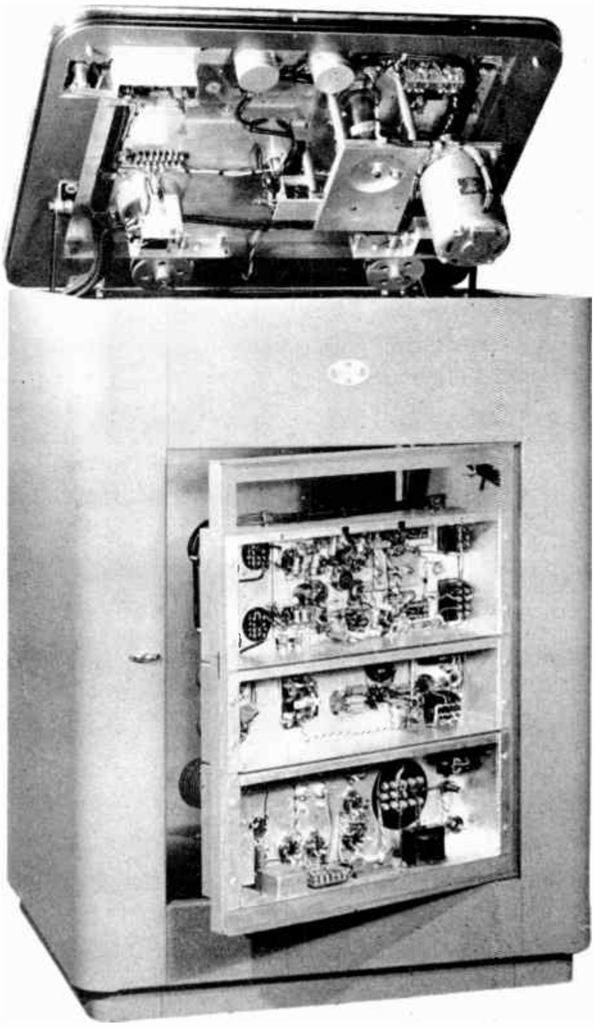
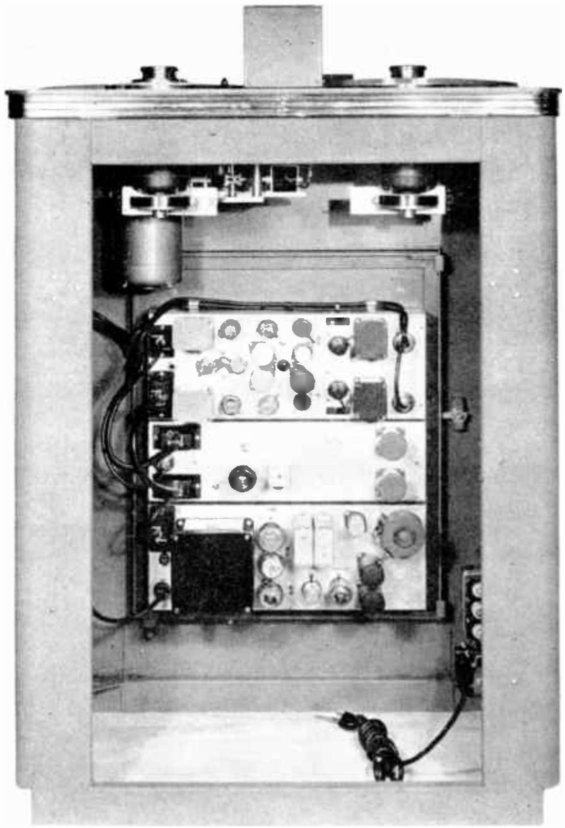


Fig. 3, left: The complete mechanism is carried on the hinged top plate. Front and rear of the chassis are accessible when the cabinet door is removed. Fig. 4, right: Rear view of the studio recorder, showing the chassis connections



AUDIO NEWS & NOTES

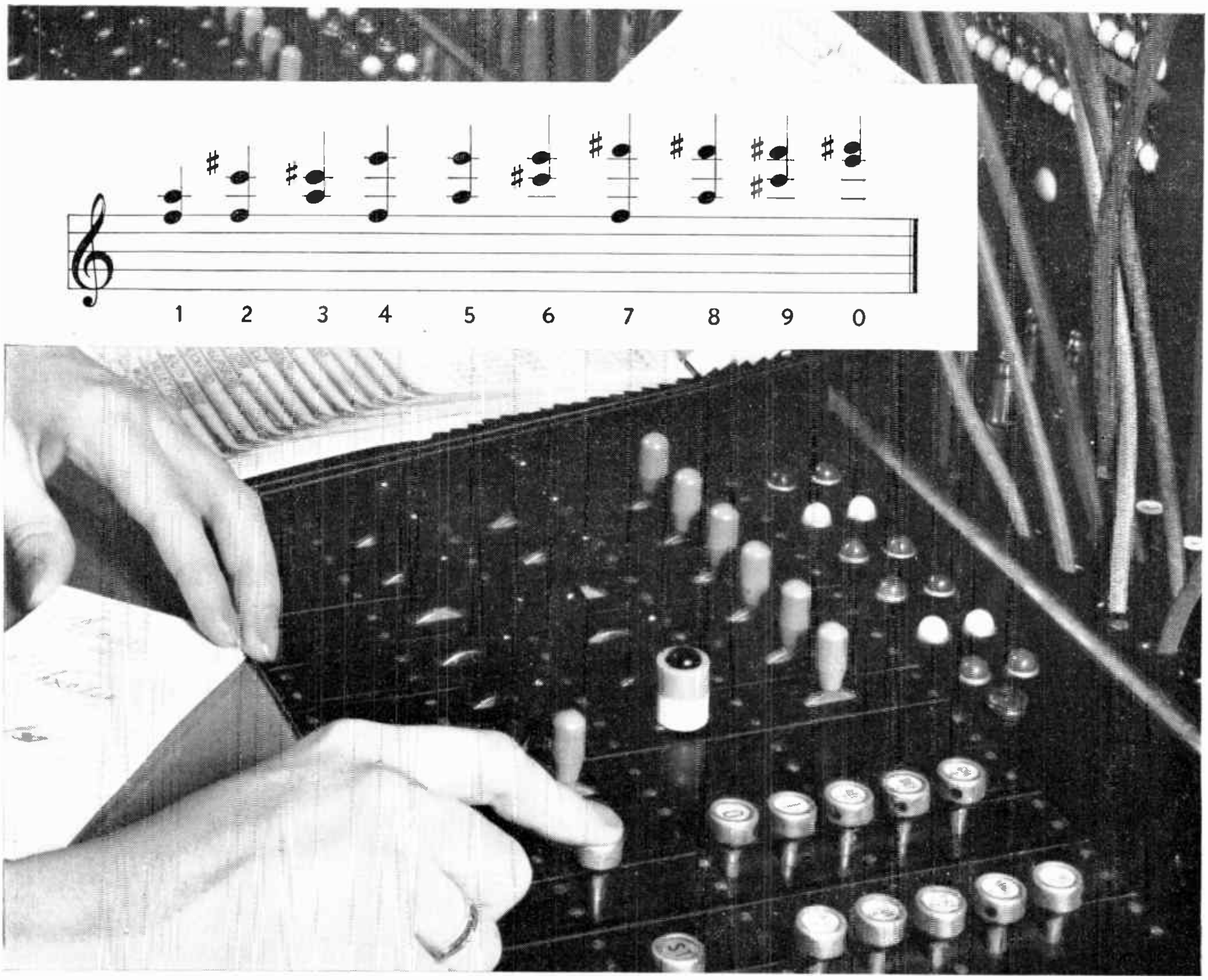
(Continued from page 24)

FIG. 2 shows two new items from Gray Research. A viscous-damping design is employed for the mounting of the tone arm. It eliminates tone-arm resonance, and the tendency to jump grooves on heavily-recorded passages. Exact degree of damping can be adjusted by the screw above the mounting. The damping is so effective that the head can be dropped on a record from any height without damage to the stylus. Also, perfect contact is maintained with badly-warped records. The arm takes both Pickering and G. E. cartridges for all record speeds. The offset ahead and arm length are designed for use with records up to 16 inches, in diameter.

Another Gray development is the equalizer also illustrated in Fig. 2. Two controls are provided. The small knob is an adjustment for the flat response of the Pickering cartridge or the G. E. variable-reluctance type which requires compensation. High-frequency characteristics are adjustable in five steps, from flat response to the heavy roll-off necessary for worn records. Output terminals offer 150 or 250 ohms impedance. The control is intended for panel mounting.

IT looks as if the use of magnetic recording on film will be stepped up this year. Film has the advantage of sprocket-wheel drive, which is important in many applications. Also, the magnetic film is somewhat more rugged than the conventional narrow tape.

Cinema Engineering Company, Burbank, Calif., is now producing the 35-mm. mobile studio recorder shown in Fig. 3. This unit, including the recorder and operating console, is self-contained, ready to be plugged into a 110-volt, 60-cycle outlet. Frequency range is rated at 50 to 10,000 cycles. No additional data is available at this time.



Above is the Bell System's new "musical keyboard." Insert shows the digits of telephone numbers in musical notation, just as they are sent across country.

Playing a tune for a telephone number

Before you talk over some of the new Bell System long distance circuits, your operator presses keys like those shown above, one for each digit in the number of the telephone you are calling. Each key sends out a pair of tones, literally setting the number to music.

In the community you are calling, these tones activate the dial telephone system, to give you the number you want. It is as though the operator reached clear across the country and dialed the number for you.

This system, one of the newest developments of Bell Telephone Laboratories, is already in use on hundreds of long distance lines radiating from Chicago, Cleveland, New York, Oakland and Philadelphia, and between a number of other communities.

It will be extended steadily in other parts of the country — a growing example of the way Bell Telephone Laboratories are ever finding new ways to give you better, faster telephone service.

BELL TELEPHONE LABORATORIES

Exploring and inventing, devising and perfecting, for continued improvements and economies in telephone service

THE MCC NETWORK

(Continued from page 15)

by the local office. Truck or bus locations and speed can be recorded by local operators as the vehicles pass through check points. This information, if required, can be sent to the central offices of the interstate bus or truck companies, enabling them to exercise greater control of their traffic operations.

Now that the FCC is processing MCC applications under the new rule, it is expected that this service can make substantial progress toward nation-wide dimensions in 1950.

MOBILE RADIO NEWS

(Continued from page 13)

thousands of OPA price increase orders that were issued during war times, raising the price of particular products above the OPA ceiling. The column is open to better suggestions.

Taxi Radio Use Broadened:

FCC has approved radio installations in supervisory taxi vehicles following trade association and individual operator petitions on subject. Broadened rule provides:

SECTION 16.403 *Limitation on Installation of Mobile Units.*—Mobile units in this service may be installed in vehicles used for the carriage of passengers, vehicles used to tow, repair and maintain such vehicles and in vehicles used in performance of emergency or safety functions by such persons as supervisors having the duty to regulate, divert and allocate cabs upon streets, to police and guide drivers and cabs and to facilitate the movements of cabs on the streets in the interest of public safety; Provided, however, that such latter vehicles shall bear the name of the cab company and an appropriate number in the same manner and type of printing used on the vehicles for the carriage of passengers.

Rule relaxation followed Commissioner George E. Sterling's address to the National Association of Taxi Operators convention in Buffalo and Commissioner E. M. Webster's attendance at American Taxicab Association convention in Chicago and first-hand day-long field examination by these Commissioners, of taxi supervisory radio use in Baltimore. Education brings understanding.

In proceeding with implications of importance to all large-city taxi operators, Toye Brothers Cab Company of New Orleans has protested grant of Cooperative Cab Company, on its channel, when other taxi channels in that city are less heavily occupied. Protest requested designation of application for hearing.

WHAT'S NEW THIS MONTH

(Continued from page 16)

What I do want to emphasize is that community life meant *participation.* School athletics included everybody. Everyone said a piece at school programs, whether he was tongue-tied or had a cleft palate. Every one took part in the Sunday School pageant, or the rod paralyzed the obstinacy. In short, life meant living — taking part, practicing expression, playing games, debating, fighting, laughing, entertaining — doing things. Raising and educating children was a job of awakening an interest, by doing everything that a community has to offer. Some of you here today learned your first sales experience, your first trading lesson, your first use of the art of statistics, as crude as they might have been, from life in towns like Lima, Ohio. I think of it as typically Main Street as Pudacah, Kentucky — as typically country as the plains of Kansas.

Some of you may have left me here. You may say that I was born fifty years too late. If you think, however, that this self-expression stuff is all outdated, you're wrong. This struggle of man for expression is as old as the ages, and it will live as long as there is life upon the face of the earth. This struggle is so persistent it gets a man into boredom if he ignores it, or it gets him into trouble if he perverts it. The tyrant behind the steering wheel is a perverted show of self-expression. Jack Dempsey's and Joe Louis's popularity and the large box office came ultimately from Main Street where men dream of knocking a local Jess Willard or a local Max Schmeling into the next yard when his dog tramps down his garden, or when his big mouth gets abusive. New Orleans' Mardi Gras, Pasadena's Flower Show, Chicago's World Fair, New York's World of Tomorrow are only bizarre, novel, and highly commercialized attempts at creative expression, not unlike the unsung, unadvertised pageants, homecomings, carnivals, flower shows and centennials in little towns and communities every year.

Commercial Use of Radio:

And here is where you came in. You deal in a great American institution: radio. You have, in a period of about 25 years, helped create a major American industry, and you have every right to be proud of your part in this accomplishment.

But in creating this wonderful thing called radio, you and the broadcasting industry in general have, I am sorry to say, all too often forgotten the great promise that radio held out for the little towns and small cities such as Lima. Radio to you is a national medium. It is the medium of mass communication which reaches out through the channels in the sky to the multitudes of the population. It is the medium which reaches the mass purchasing power of America.

Your profession is in the middle of that quest for the consumer dollar. You have made a science for private enterprise so that it can select that part of mass purchasing power it can reach efficiently by radio. For example, now you are in the process of making a science of the seasonal market. You furnish the tools to the American industry so that it may select or reject sales potentials on the basis of such factors as geography, climate, and local customs of the people. If I may borrow from the military to make clear what I mean, your group furnishes the radio sales logistics for private enterprise — the advertising agency, the network, the station — to reach efficiently and economically the mass market that they want. I see evidences of this each week in the trade press. I quote some of the stud-horse type from an advertisement in *Broadcasting* Magazine:

"More than two-thirds of all U. S. radio homes are in counties reached by these leading stations. Does this give you any big ideas. . . ."

This advertisement, I realize, is an oversimplification of what you can do professionally with your marketing statistics, but it illustrates graphically to me the niche you fill.

Let me illustrate what I mean. Let us assume that there were a reservoir of business enterprises of national scope, such as Ford, Chrysler, and General Motors, inclined to buy institutional advertising to reach *every* home in America. There would then be enough business to buy every broadcast hour. There would then be no problem for radio stations in the hinterland to operate 24 hours a day. In that case, the forces of business and economics would be thrown behind finding merely technical and administrative machinery to do that job. If that assumption were true, I think I could further assume that, so far as radio is concerned, there might be no marketing group at all.

But national advertisers don't function that way. Even national advertisers want the most for their advertising dollars. For example, they want the broadcast hours during which it can be calculated that the greatest numbers of potential customers will be at their receivers. As Mr. Robert T. Haslam succinctly put his company's marketing problem in his address to the National AMA Convention:

"Today our marketing and distribution costs are 40 per cent less than in 1933 and [this] in spite of an increase of over 170 per cent in wages, plus a substantial increase in all material costs. . . ." This indicates the practicalities of the situation with which you deal.

Your business is to take inarticulate man and reduce him to common denominators to make him an identifiable sales prospect for a given product. You classify him by areas, concentrated or sparsely populated. You separate him from his better half. Then you select or reject large groups of him for the specific kill — the potential sale. In short, you select and reject whole geographic areas and whole groups for the sale of specific products, and in this process you do not concern yourselves fundamentally with whether or not all the people of the United States have more than one reliable radio service, or perhaps whether some of them have even one. Your science is to reach the most people with the least cost to reduce the overhead in the face of increased wages, increased material costs, and the increased cost of other variables.

Statutory Objectives of the FCC:

Therein lies the difference between your objective and the Federal Communications Commission's objective. I think it was clearly stated in a letter the Commission wrote to Senator Johnson, Chairman of the Senate Committee on Interstate and Foreign Commerce. It was written by the Commission after much thought and deliberation in response to one of his inquiries concerning the famous clear channel controversy. I think you will see clearly what the Commission thinks its statutory mandate is when I read:

"The statutory objectives govering the Commission's allocation of broadcast stations are . . . to provide all people of the United States with a maximum number of broadcast signals of acceptable quality. This objective recognizes the importance of radio to the people of the United States as a medium of education, enlightenment and recreation. A second objective is to provide each community with a maximum number of radio stations. This objective is based upon the recognition of the importance of radio stations as a medium of local self-expression."

Herein lies the nub of our difference. You want to reach the masses of men by radio to do a merchandising job. The Commission wants to vouchsafe to men everywhere radio signals that will be satisfactory and reliable for their education, enjoyment, and culture. I do not want to cast any aspersions on you because you serve your clients the way you do; nor do I want to put a halo around the Commission because we must serve a different interest.

(Continued on page 30)

WHAT'S NEW THIS MONTH

(Continued from page 29)

Genesis of AM Allocations:

The important fact is that your conception of how private enterprise could use radio for the greatest net return shaped the early history of radio. At the time when network broadcasting was but a gleam in the eye of David Sarnoff, radio appeared to be growing like Topsy. Actually, however, radio was falling into a well-defined pattern. The largest facilities, the clear channels, fortunately for the people who lived in concentrated areas, were constructed in cities like New York, Chicago, Pittsburgh, Philadelphia, Detroit and Cincinnati. Some braver souls in the business world, it is true, risked their investment in 50-kilowatt stations in smaller cities. But economics, the probability of return on investment, determined where the best facilities were to be constructed rather than a public-interest concept of how all the people in America could be reliably served.

That's as natural in our picture of private enterprise as Standard Oil, United States Steel, and General Motors. Clear channels in the big cities represented facilities to tap concentrated masses of the population with the most efficient vehicle. I have no fault to find with private enterprise for selecting the locales which will bring the highest return on investment. The dollar potential *was* there; the dollar return *is* there. And the clear channels made money and grew prosperous.

Distribution of Channels & People:

But the big stations which spread their signals hundreds of miles too often did not reach the wide areas in the middle of the United States that had relatively little or no service. Instead their signals crossed each other, giving multiple service to the people along the northeast seaboard, along the Great Lakes and other heavily populated areas of the country. By the time effective regulatory distribution of facilities had been established by the Congress, the allocation of 50-kilowatt clear channel facilities, created by the industry in the natural course of economic events, could no longer be redistributed without causing chaos and perhaps the death of this newborn industry. In other words, the die had been cast. Whatever was wrong with the way industry had located these facilities, they could not be uprooted without one of the roughest Kilkenny cat fights between Government and private enterprise that could be staged in America. One doesn't have to possess much imagination to visualize the haymakers, propaganda and legal, that would be hurled to the American people in lining up forces for that fight. Why, the network regulations and their stormy trip through the courts would have been just a warm-up bout for such a main event.

Let us keep an eye on the ball we're tossing here: private enterprise, and you as servants of private enterprise, support the economic structure of broadcasting in America. You select and reject the radio homes in America to reach the American purchaser in the most efficient manner your science can develop. You furnish the statistics, and name the facilities a given manufacturer, processor, sales organization, or distributor can use to increase sales and lower his overhead per unit of sale. "Channels in the sky" are to you vehicles of trade and commerce to give private enterprise the most sales potential for the least cost. The more channels in the sky that you can capture in concentrated population areas, the more avenues are open to you to sell.

Possibilities of FM Broadcasting:

It is, therefore, not surprising that Frequency Modulation broadcasting does not have the same appeal to private enterprise that it has had to the Commission. It was a rainbow on the horizon for the Commission because its characteristics were made to order to solve the Commission's problems. It could serve everybody in the United States and it was static free. It was capable of transmission and reception of 15,000 cycles — the full range or capacity of the human ear. This was indeed the ultimate in aural broadcasting possibilities. For the first time men and women could sit in their homes and enjoy the great symphonies, the great operas and never lose one cycle of the full enjoyment that a trained ear could differentiate. And what happened to that rosy picture? Over a thousand licensees apparently caught the dream of FM's place in aural broadcasting. They invested their funds. The Commission carefully allocated its channels to metropolitan, urban, and rural areas with limits on power to insure that every American would have a choice of listening pleasure. What they could hear at the FM receiver was equal to direct contact with the human voice and instruments. The major figures in the industry, particularly the networks, promised the Commission they would utilize the full capacity of this wonder of sound. The truth is, however, that no network programs are sent over the telephone lines which have a greater sound fidelity than just plain old AM broadcasting. Even if it were true that affiliates were not interested in high fidelity, the networks themselves owed the duty of tying together their own stations in distant cities with 15,000 cycles high fidelity connections.

Some of the government executives who were preaching the amazing promise of this new art changed hats and became radio executives and practitioners of law and engineering. The Commission FM evangelists of yesterday, as today's leaders of the radio industry, seemingly have lost their zeal to bring to the people this utopia of broadcasting and listening potential. Not only that, 200 FM licensees have given up the ghost and turned their construction permits back to the Commission. Although many people wait for reliable radio service, not a tear is shed by the radio industry, its new or old executives, its new or old practitioners, or by those who use radio to advertise their wares. And you continue analyzing inarticulate man, selecting the lucrative market, sometimes serving the marginal market, and rejecting the sparse reaches of the nation. FM channels in the sky go begging, and this new and superior radio service continues to be just a rainbow in the sky.

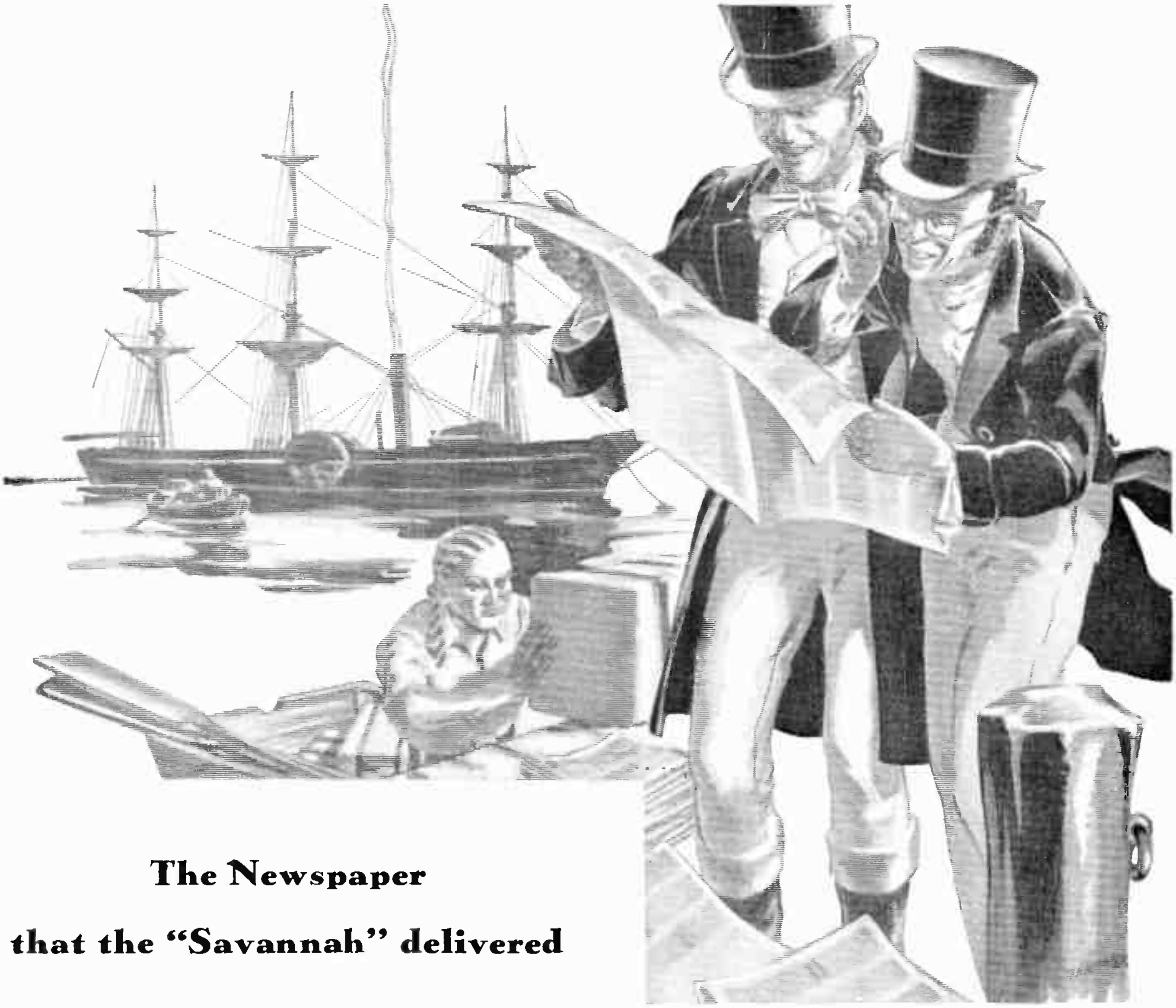
Problem of TV Coverage:

But if FM broadcasting will not be used to reach every man, woman, and child in America with reliable radio service, how about television? At the outset, I should like to say that television, like FM, has a great chance of accomplishing this feat, but I must say in the same breath that it certainly has got off to a shaky start.

It was clear from the very start, the Commission said so, and the industry must have known, that the VHF could not supply the United States with a nation-wide competitive system of television broadcasting. If television was to be made available to all of the United States, the UHF frequencies would have to be used. But the industry claimed that we didn't know enough about UHF to start operations in that region of the spectrum. It is true, the Columbia Broadcasting System proposed color television in those frequencies in 1946, and Du Mont proposed black and white television in those frequencies in 1948, but the major part of the industry not only opposed but did little or nothing to make television available in the UHF channels. So television got started in VHF alone.

What areas were to get the VHF frequencies? Well, you know who got them. It was the large cities all over again. Once more the congested cities got them, and the small towns and rural areas are still wondering if and when. VHF, the portion of the spectrum which had the relatively greater service capabilities for any given power, was again given to the cities that needed them least. The limited coverage potential of UHF was reserved for the more difficult job of providing service to the smaller cities with wide rural trade areas.

(To be concluded next month)



The Newspaper that the "Savannah" delivered

The first steamship to cross the Atlantic, it is said, brought back a newspaper containing the report of a famous European scientist "proving" that practical marine propulsion by steam was impossible.

That, of course, was in the knee-pants days of the Scientific Age. Today, it would be a rash scientist who would apply any such label to a proposed development. "Unknown" or "yet to be proved" perhaps, but not "impossible." Imagination is as much a part of modern research and engineering background as physics or mathematics.

In electronics alone, a generation of progress was crowded into a few hectic war years. Products not known — for jobs that had never been done—became commonplace. Yet all of this represents only a fresh beginning . . . not an end. As in the past, Sprague research continues on the assumption that even the best of today's components are only test models for tomorrow's even more difficult assignments.

SPRAGUE
PIONEERS IN ELECTRIC AND ELECTRONIC DEVELOPMENT

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North Adams, Massachusetts

GLASS-TO-METAL SEALS, pioneered by Sprague, have paved the way to new and higher standards of protection and efficiency in thousands of capacitor and resistor types.

SUBMINIATURE Sprague molded Prokar* capacitors, rated for —50°C. to +125°C. operation, are playing a big part in revolutionizing the engineering of ultra-small equipment.

SPRAGUE KOOLOHM* RESISTORS, wound with ceramic insulated wire, doubly protected by outer ceramic shells, have answered one difficult resistor problem after another.

* T. M. REG.

SPOT NEWS NOTES

(Continued from page 7)

accordingly, on 233 installations to cost $70,000. Breakdown of votes by age groups showed favorable opinions as follows; 15 to 20 years, 99%; 21 to 30 years, 98%; 31 to 45 years, 96%; 46 to 60 years, 86%; 61 and over, 77%.

Developments in AF Transformers:

Increased demand for high-fidelity audio systems is reflected in a new catalog issued by the Peerless division of Altec-Lansing Corporation, 161 6th Avenue, New York 13. Notable are entirely new types of transformers, and added types flat to 1 db from 20 to 20,000 cycles.

Wide-Band Amplifier Tube:

G. E. has a miniature 6CB6 for use as a wide-band RF and IF tube in FM and TV sets. It is a sharp cut-off pentode of high transconductance and very low capacity. Suppressor and cathode are brought out to a separate base pin.

FM Broadcasting in Venezuela:

Venezuela, one of the countries in the heavy-static belt, is going into FM broadcasting. First station is now on the air with a G. E. transmitter at Caracas, operated by Radio Cultura. This station is also being used as a radio link to program AM stations in the Urbanizacion Washington.

Variable Attenuators:

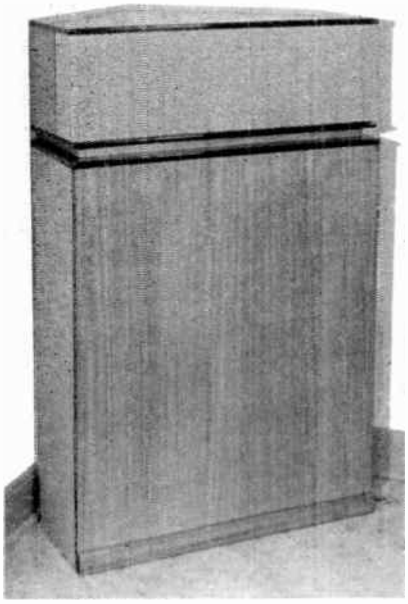
Brought out by Kay Electric Company, Pine Brook, N. J. Frequency range is 0 to 500 mc. Switch controls cut in steps of 1 db attenuation up to 42 db, in addition to a fixed insertion loss of 10 db.

TV Manual:

Copies of the book used in RCA's training course for TV engineers are now available at a price of $2.00. Seven chapters cover station layouts, field pick-up equipment, terminal equipment theory and design, transmitter theory and design, and antennas. Orders should be addressed to RCA Engineering Products Department, Camden, N. J.

Difference of Opinion:

KMBC-FM has closed down. Kansas City Star quotes Arthur Church as saying: "KMBC had no evidence that the FM broadcasts served persons who were not also served by the standard AM broadcasts." Comments Noble D. Gilkeson of 6214 East 16th Street: "I have a Scott radio, and I live about 10 miles from his tower. Static [on AM] still bothers me when the weather is stormy. And in good, clear weather I can always hear three of four stations in the background when tuned to KMBC."



Facts about the Klipschorn:

1. MUCH has been written about the performance of this outstanding sound reproducer, but little has been said about its structural quality and finish. Low obsolescence of design was deemed to dictate comparable structural life expectancy and, naturally, much thought has been given to conservative styling that will last through many modes of furniture trends.

So we, at Klipsch and Associates, have devoted ourselves to study of adhesives and fastenings, preferred materials, fade-proof stains, age-liquor- and water-proof lacquers. Here, where complete control from raw material to finished unit is under personal supervision of the originator of the system, pride of craftsmanship is as much a keynote as is the pride in excellence of the technical design.

For a lifetime of listening pleasure, you will find the authentic KLIPSCHORN to be low in cost; in terms of performance measured by years-per-dollar, the KLIPSCHORN is by far the best buy. Inquiries are invited from broadcasters, audio engineers, custom set builders, and discriminating listeners.

KLIPSCH and ASSOCIATES

LABORATORY & PLANT AT HOPE, ARKANSAS — TELEPHONE: HOPE 995

WORKING DATA for Communications Engineers

Complete data on the following subjects is available in back issues of *FM-TV*.

FCC Rules and Allocations for

Public Service Systems	June, '49
Public Safety Services	July, '49
Industrial Services	Sept., '49
Transportation Services	Oct., '49

Registry of Radio Systems

Taxicabs	Jan., '49
Police, Fire, Forestry, Railroads	July, '49

Manufacturers' Specifications for Fixed and Mobile Equipment

Part 1	Oct., '49
Part 2	Nov., '49

Adjacent-Channel Operation

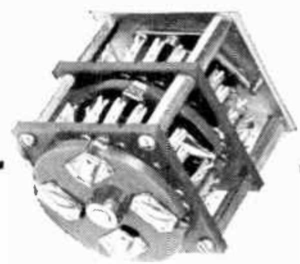
Part 1	Nov., '49
Part 2	Dec., '49

PRICE OF THESE ISSUES: 25c EACH, POSTPAID

FM-TV MAGAZINE

SAVINGS BANK BUILDING
GREAT BARRINGTON, MASS.

CAN YOU USE A ROTARY SWITCH ?



WITH

- A tamper-proof rotor arm (patented)
- Extra long life
- Low and uniform contact resistance
- Minimum thermal noise
- High resistance to leakage
- Trouble-free operation

Consult our engineering department for your special switch problems. Write for Bulletin SW-1, Dept. FM-10 for complete information on standard switches.

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191 CENTRAL AVENUE
NEWARK 4, NEW JERSEY

RAINFALL ATTENUATION

(*Continued from page 12*)

zontal gradient, as in mountainous terrain, a point would not be representative of a long path.

An explanation of the empirical relationship described above immediately suggests itself. In Ohio, the average speed of translation of storms is some 45 to 50 kilometers per hour. A rain gage on the ground would then effectively measure the rate in a slice out of a storm during any interval, the length of the slice being proportional to the duration of the interval and the speed of the storm. If the ground rainfall pattern moving with the storm were constant with time, the measured water from any slice would yield the rainfall rate exactly. Actually, the intensity pattern is changing as well as moving, but hourly depths over a period of a year would still approximate the instantaneous path rates for, say, a 50-kilometer path if the speed is 50-kilometers per hour. It thus seems consistent to identify mean point rates with instantaneous rates over appropriate lengths of path. One-minute point data represent 1-kilometer instantaneous rates, and 1-hour point data represent 50-kilometer instantaneous rates. The same reasoning suggests that 10-minute point rates should apply to an 8-kilometer path, 30-minute rates to a 25-kilometer path, and so on. Different upper wind velocities will modify the length of path, and the present method may not apply in regions where storms are stationary.

The time of day when rain will fall is of particular interest in commercial applications, and many studies give the diurnal variation of rainfall. Excessive rainfall occurrences may be of special interest in studies of microwave propagation. Fortunately, statistics on excessive rainfall are widely available.

In the accompanying illustrations, Fig. 1 presents a rainfall map showing the number of hours a year that it rains 1 in. per hour or more at various points throughout the United States. The number of hours shown also indicates the annual duration of 1 in. per hour rainfall rates for 50-kilometer paths. A rate of 1 in. per hour results in attenuation of microwave signals at 10,000, 18,000 and 24,000 mc. of 0.65, 2.1, and 3.7 db per kilometer, respectively.

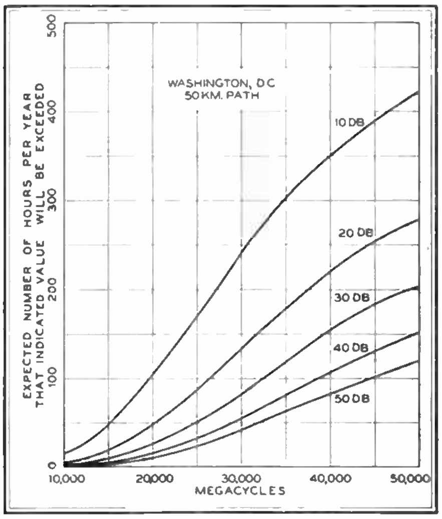


Fig. 2. Effect of rainfall on propagation

The curves in Fig. 2 show the expected number of hours per year that microwaves propagated over a 50-kilometer path near Washington, D. C., will experience rainfall resulting in attenuation values of 10, 20, 30, 40, or 50 db in the microwave frequency range from 10,000 to 50,000 mc.

It might seem that the largest market for mobile radio equipment would be among new users. However, our Directories of July '48 and July '49 show that sales were much larger to existing systems. In that period, the number of police, fire, forestry, and railroad systems increased 15.7%, but the number of mobile units increased 34.8%. A detailed analysis of this market, made by *FM-TV*, is now available on request.

Advertisers' Index

ANNOUNCING

EIMAC TUBE TYPE

4X150G

Another Engineering Achievement by Eimac

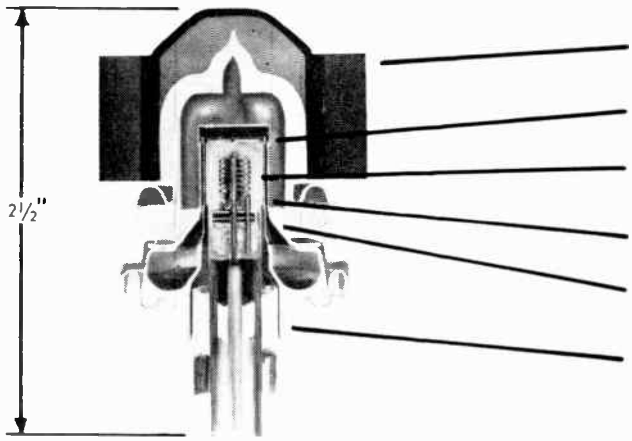
2 x
ACTUAL SIZE

The 4X150G is a new coaxially constructed UHF tetrode, a modification of the popular Eimac 4X150A. The new design has resulted in lower lead inductance, reduced the UHF grid driving-power requirements, and increased upper frequency limits of efficient performance.

The 4X150G can be operated as either a conventional radio-frequency amplifier or oscillator over a wide range of plate voltages at frequencies up to 1000 Mc. In pulse service efficient performance is obtained up to 1500 Mc.

Operating as a class-C amplifier in the 750 Mc. region, the Eimac 4X150G will provide a power-gain of 8. (100 watts output, 12½ watts driving power.) In pulse oscillator service at 1250 Mc., tests indicate peak output-powers of over 20 kw per tube.

Maximum ratings and other operational characteristics for this new tetrode are available from the Eimac Field Engineering Department.



- External Anode 150 watts dissipation
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