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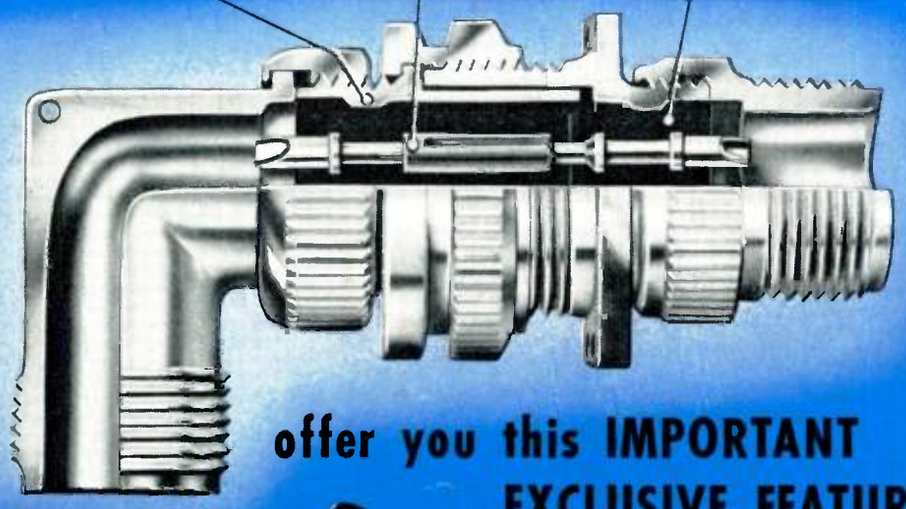

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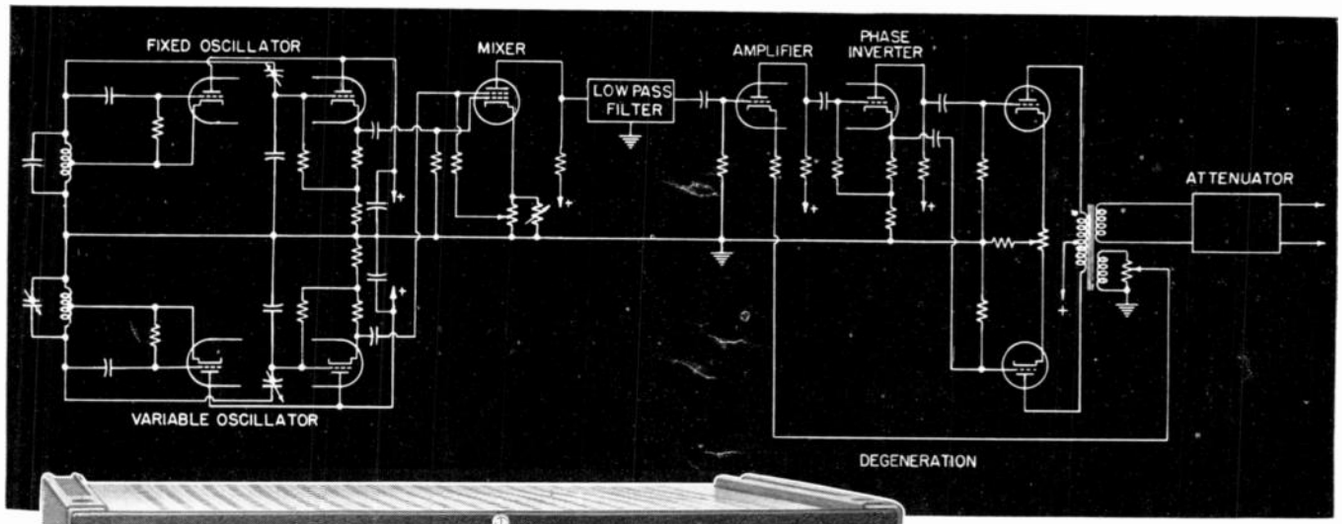

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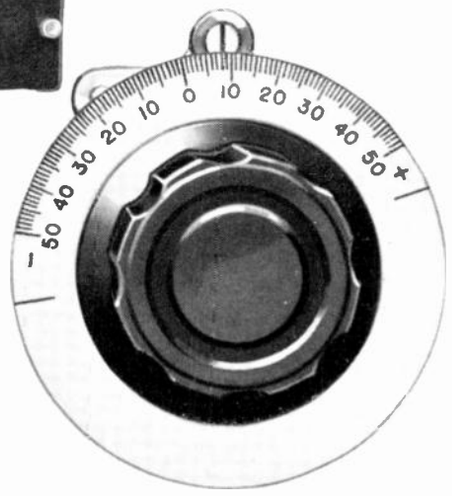

The frequency-increment dial, calibrated from +50 to −50 cycles is a great convenience. The main dial is engraved from 20 to 20,000 cycles with a true logarithmic scale; the calibration is accurate within ±(1% + 0.5 cycle). The total scale length is 12 inches over an angle of rotation of 240°. This dial can be coupled to a recorder to record frequency characteristics.

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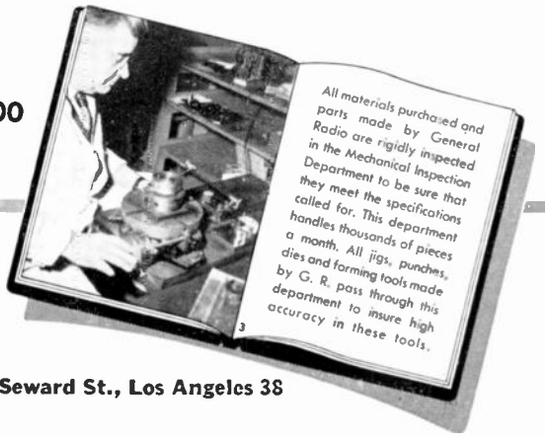

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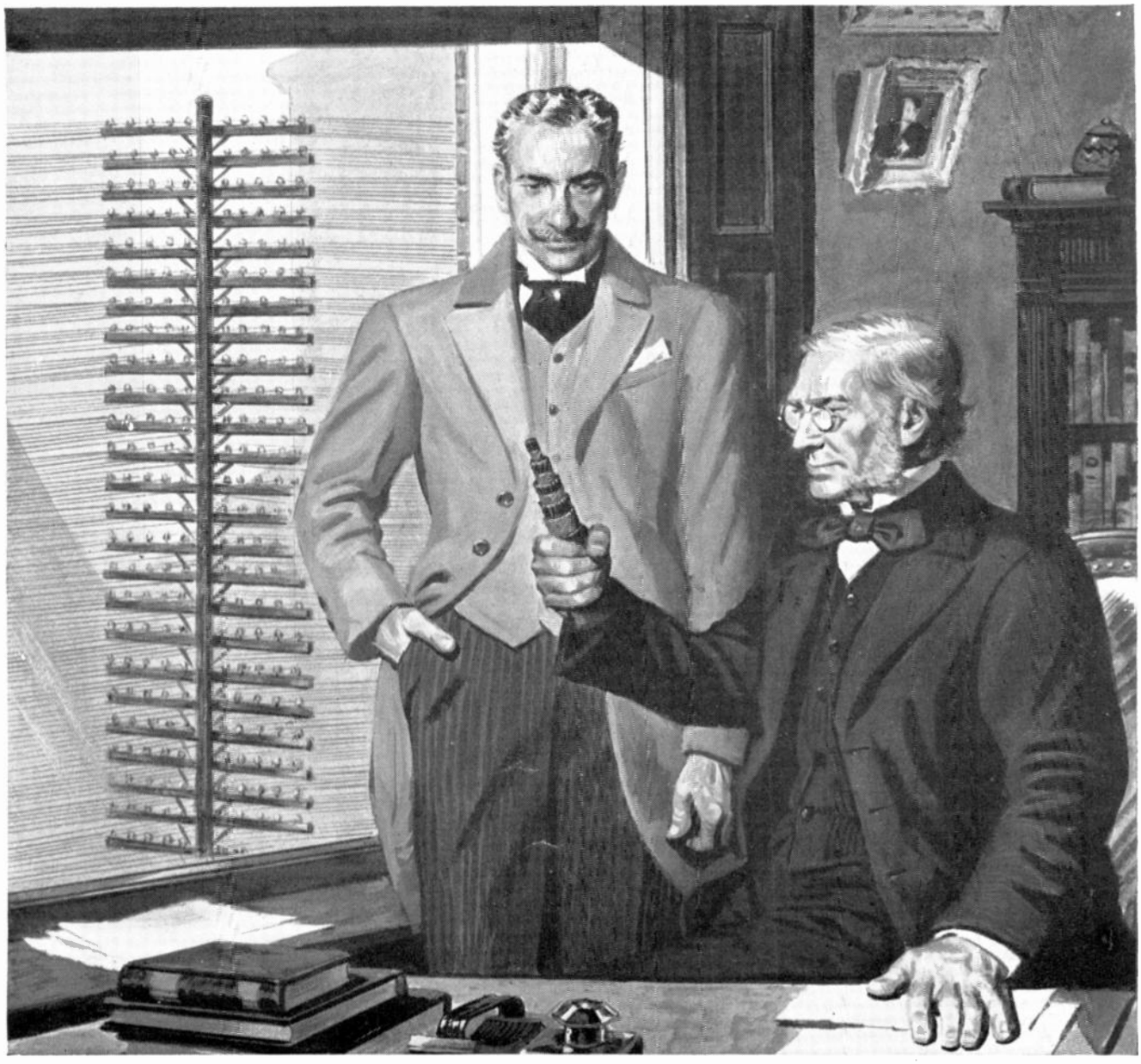

They Packed a Pole Line Into a Pipe

Back in the eighties, telephone executives faced a dilemma. The public demanded more telephone service. But too often, overloaded telephone poles just couldn't carry the extra wires needed, and in cities there was no room for extra poles. Could wires be packed away in cables underground?

Yes, but in those days wires in cables were only fair conductors of voice vibrations, good only for very short distances. Gradually cables were improved; soon every city call could travel underground; by the early 1900's even cities far apart could be linked by cable.

Then Bell scientists went on to devise ways to get more service out of the wires. They evolved carrier systems which transmit 3, 12, or even 15 voices over a pair of long distance wires. A co-axial cable can carry 1800 conversations or six television pictures. This is another product of the centralized research that means still better service for you in the future.

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FM-TV

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

VOL. 9 DECEMBER, 1949 NO. 12

CONTENTS

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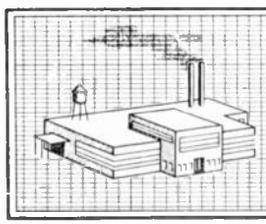


Set Production

TV set manufacturers who were wondering last summer if they could sweat out the condition of small demand and big price cuts which beset them then are now in a sweat over getting enough components to assemble into sets they can't ship fast enough to fil their orders. Well, that's the radio business! It always was that way, and there's no reason to expect that it will change in the future.

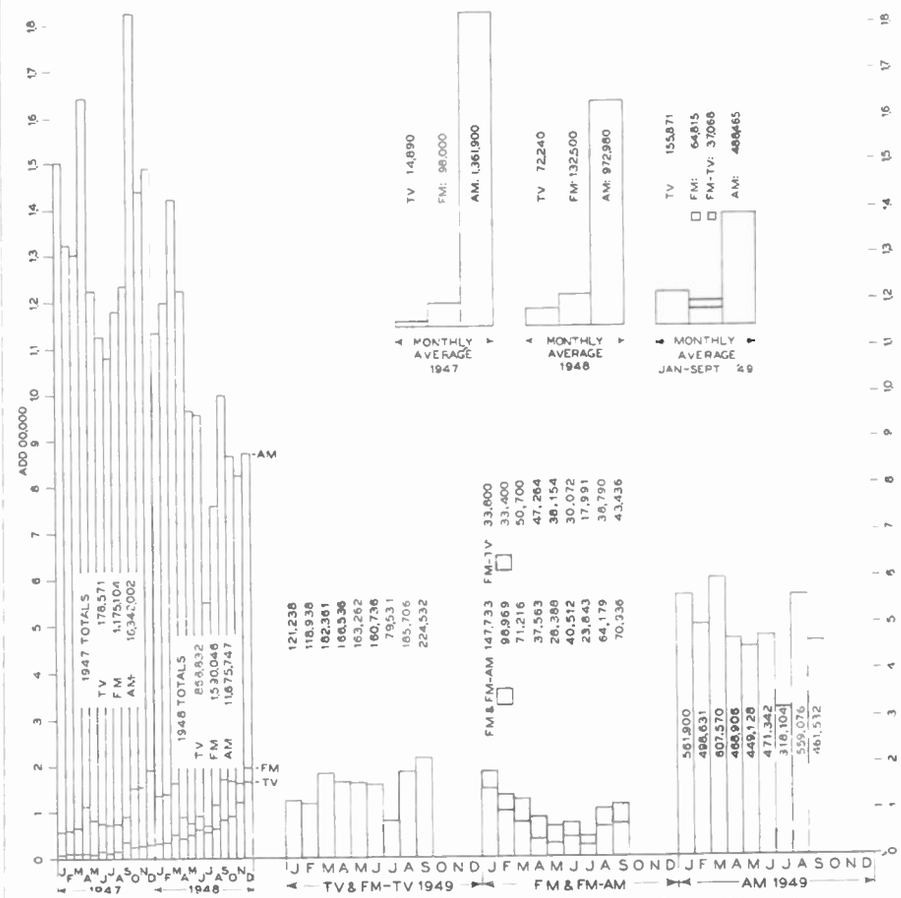
Current demand for video sets is in the nature of a windfall, since it was expected that the continuation of the freeze, and emphasis being put on color at the FCC hearings would discourage public buying. Probably the fact of the World's Series broadcasts in black-and-white made a far greater impression than the speculative issue of color which the Commission saw fit to develop into such disproportionate magnitude.

The weekly TV production rate in September jumped 50 per cent above August, as the accompanying RMA figures show. Also, the rate for FM sets upped 35 per cent, but AM sets, which have normally climbed in September, remained virtually unchanged.

To get a long-range picture of the postwar trend, let's compare September '49 with the same month in 1947. During that 2-year interval, September AM production dropped 63 per cent, a loss of $^3/_4$ million units. FM sets lost 10 per cent, or 9,610 units, while TV production multiplied 14 times, climbing from 15,728 to 224,532 units.

Third quarter financial reports show that the summer slump was very expensive to the larger companies. Now, however, with their lines in full swing again, the last quarter should show a substantial recovery. Small concerns, on the other hand, are feeling the pinch of competition for the available supply of components. Thus, their situation has not improved to the same degree.

At least, the bottleneck created last winter by the picture-tube shortage has been removed, and the larger sizes should be available now in ample supply.



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

THIS MONTH'S COVER

The very unusual photograph reproduced on this month's cover represents a new method of variable-area recording for 16-mm. film, developed by J. A. Maurer particularly for television broadcasting use. The background pattern is an enlargement of the sound-track. An examination of the picture shows that six identical tracks are produced, totaling the same width as occupied by the conventional, single track. Details of this method will be explained in a forthcoming paper by Mr. Maurer.

WHAT'S NEW THIS MONTH

1. Audio & Video 2. Trucking Problem 3. A New NTSC 4. FM for UHF Video

1. We have commented previously in this section on the misuse of "radio and television" as a means of distinguishing between audio and video broadcasting. In that connection, the following account is both amusing and interesting. It was written by the Broadway director Elia Kazan, and published in the theatrical section of *The New York Times*. We quote:

The other day I was walking down Forty-fourth Street when I came alongside of the Belasco Theatre. The street exit doors were thrown open and inside there was considerable activity. Four or five rows of seats had been taken out of the orchestra and a structure was being erected, based on a frame of cinder blocks. Something drastic and foreign was taking place on stage, too.

Standing alongside were two men in trim brown gabardine, the uniform of the Madison Avenue advertising executive. "What's going on here?" I asked. The more imposing of the two, a youngish man with an efficient smile, turned and looked at me. I was dressed for the country and looked even less impressive than usual. "Something wrong?" he asked. "Yes," I said, "What's happening here?" "Audio," he said. I could see that he had sized me up as a foolish fellow who wouldn't know what Audio was. He was right. I didn't. "What's that, Television?" "No, Audio. Don't you believe me?" The efficient smile again. "Sure I believe you, but what is it?"

"Why there is Video—what you call Television—and there is Audio. One you see, the other you hear." "Oh," I said still trying hard, "You mean Radio." He smiled and finished me off. "We call it Audio now." I only report this conversation because there might be others who aren't yet aware that Radio is no more. It's Audio now.

2. According to Cities Service Company, losses from hijacking trucks amounted to considerably more than $25,000,000 in 1947. Recoveries by the FBI, which only enters cases involving Government property or stolen trucks taken from one state to another, totaled only $674,000.

While trucks and cargoes can be insured, the rates are high. Only the large operators can afford blanket insurance. It is not unusual for smaller operators to suffer such losses from thefts that they are forced into bankruptcy. One eastern concern reported 6 hijackings last year.

The one new weapon against this increasing hazard is radio communications, by means of which aid can be summoned, in many cases, even before a holdup actually takes place.

Of course, there are many situations when it would be impossible to use the radio as, for example, when the driver is stopped as he leaves a roadside diner or gas station, and before he climbs into his truck. Sometimes, too, a tractor is driven up to a terminal and hooked onto a loaded trailer.

Most thefts, however, take place in cities or on highways. The hijackers follow the truck until it comes to a full stop at a traffic light. Usually, in those cases, the driver knows he is being followed, and has time to report his suspicions by radio.

Perhaps there are faster, more practical methods. However, with urban and highway radio systems being extended at a rapid rate, FM communications can be used as effectively on trucks as on police cars for crime prevention.

The cost of truck radio service is small compared to annual insurance premiums. It is quite possible that lower rates will be quoted for radio-equipped trucks, as time goes on. With an increasing amount

WHAT'S NEW THIS MONTH

(Continued from page 5)

of such items as cigarettes, meat, liquor, textiles, nylon hosiery, and candy transported by trucks, hijacking is becoming more profitable because these goods can be sold easily. Radio seems to be the most effective means to protect them from theft.

3. The brightest spot on the television horizon at this moment is the RMA announcement of November 17 that its Television Committee will present to the FCC a plan for the immediate establishment of an industry-wide National Television Systems Committee.

It is proposed that this Committee will present technical data relative to 1) allocations in the UHF band, 2) lifting the VHF freeze, and 3) basic standards for the future development of color. Said RMA president Cosgrove:

"Our action is based on the industry's experience with a similar Television Systems Committee which, in 1941, drafted and recommended to the FCC standards for present black-and-white television. At the request of the FCC, the industry at that time formulated standards for a service which has met with the approval of the public and which has permitted steady growth and improvement in the art of television. We believe that a similar proceedure for color television, while it is still in the experimental stage, will have equally constructive results.

"While it is clear that color television is not ready for commercial application, at present, it is equally clear that progress is being made, and that the time for a meeting of minds within the industry is at hand so as to expedite the ultimate solution of various problems with which the FCC is confronted."

The RMA will initiate and finance the engineering study, but engineers from all branches of the industry will participate, including non-RMA companies, broadcasting interests, and qualified technical organizations. The FCC will be invited to send representatives to all Committee sessions, and will receive regular progress reports on the Committee's operations.

4. One source of trouble underlying the TV hearings was brought out by Raymond Wilmotte in his testimony before the FCC concerning the possibilities of frequency modulation. He said:

"It has been very difficult to arouse interest in the use of FM for UHF television, for many feel that the Commission would never give it favorable consideration. Moreover, many in the industry have gone on record against it and, for reasons best known to our sub-

(Concluded on page 7)

WHAT'S NEW THIS MONTH

(Continued from page 6)

conscious minds, it is easier for men when they find they may have been in error to spend time and energy defending the error than to search for the basic truth."

He expanded on this in his testimony, from which the following is quoted:

The advantages of FM in sound broadcasting are well known. These advantages lie largely in the ability of a properly-designed FM receiver to separate the desired signal from noise and other interfering signals far better than an AM receiver. It might be expected, therefore, that similar advantages would exist if video replaced sound.

Some years ago, tests were made with FM for television, and reported. It was considered by many that they showed conclusively that, with FM, ghosts were intolerable. Many years have passed, and many men have forgotten, although it was correctly reported and published in the records of the test, that the receiving sets were ordinary AM sets, without the limiters which are a well-known key requirement for good FM reception. (See page 261, Television Standards and Practice, edited by Donald G. Fink, McGraw-Hill, 1943.) Such testimony cannot be conclusive. In fact, it does not indicate anything at all. No FM field test can be considered to mean anything unless properly designed FM receivers are used.

Very recently, under the direction of Mr. Chapin, additional tests were made by the FCC, with very different results. Anyone who has seen some of these demonstrations cannot help but be impressed by them. In nearly all respects, that is, in co-channel interference ratio, adjacent-channel interference ratio, and short-time ghosts, FM appears superior to AM. Only in long-time ghosts does there appear to be a question as to which is superior when compared to offset-carrier AM.

This work on FM is only a start, but it shows such striking results that it should not be discarded without serious consideration. It should be pointed out that this work was carried out by engineers who were not specialists in the complicated theory of FM, and who were not trained in these circuits as are many engineers in industry who have specialized in circuit design. Moreover, very little time has been available for this work. Mr. Chapin and his engineers are to be congratulated on their remarkable achievement. The results seem sufficiently important that they might with advantage be given publicity to make the industry fully aware of the possibilities of FM television on the UHF band.

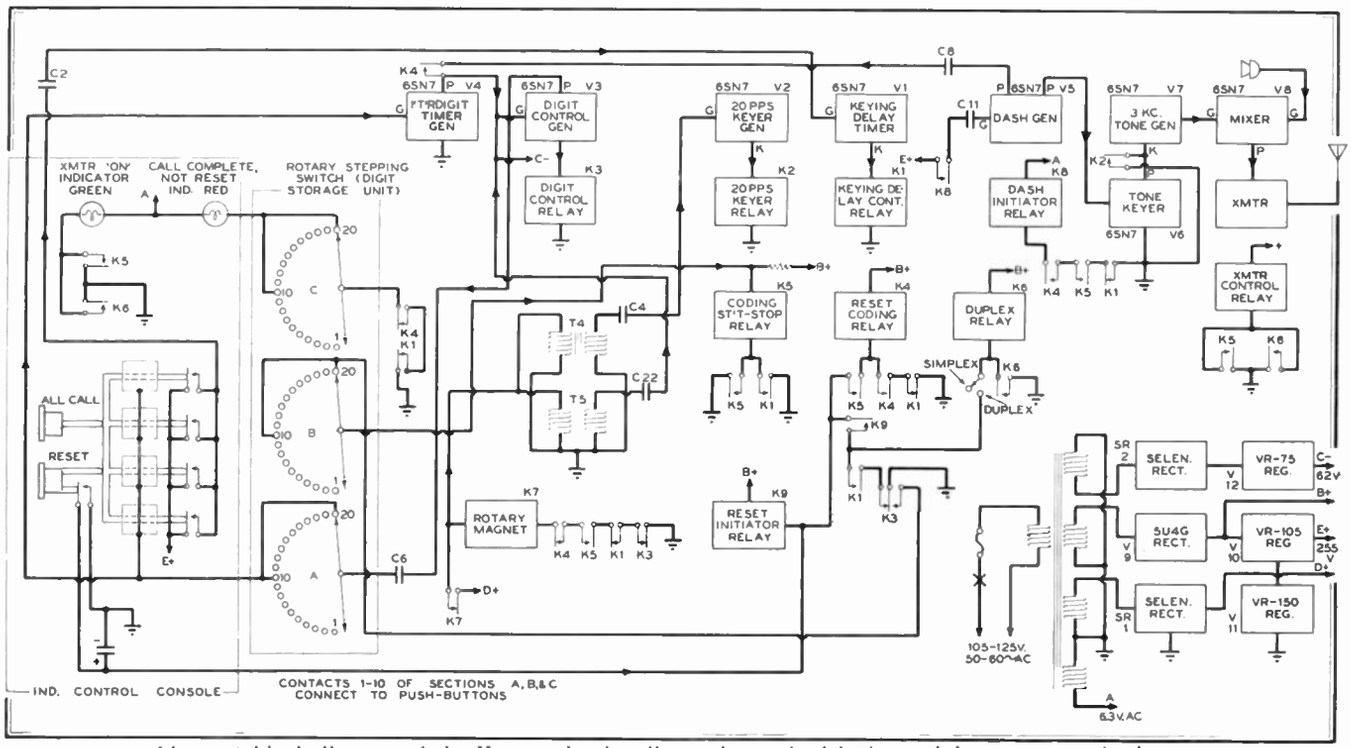


Fig. 1. A block diagram of the Hammarlund coding unit, used with the push-button type of selector

PRIVACY FOR MOBILE PHONES

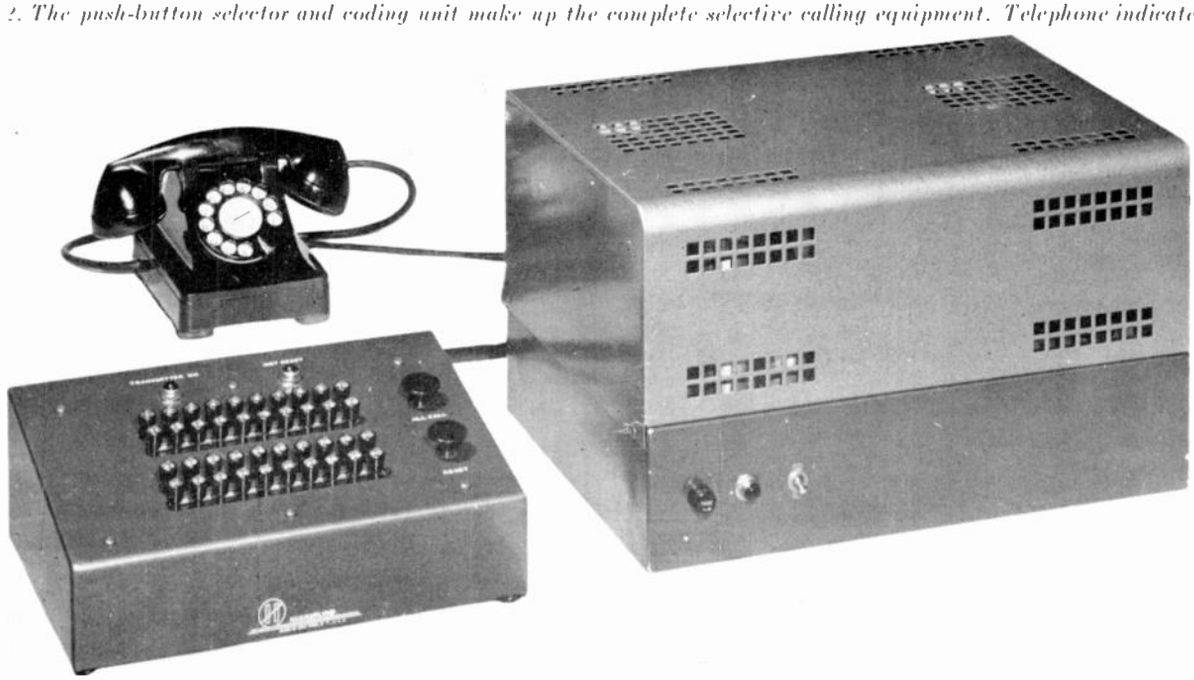
THE HAMMARLUND SYSTEM, USING A SINGLE AUDIO FREQUENCY TO ACTUATE STEPPING RELAYS, LOCKS OUT INTERFERENCE. PART 1—*By* J. K. KULANSKY*

LONG before the self-starter was invented, the automobile had won a permanent place as a popular means of transportation. But today, the idea of cranking an engine by hand is unthinkable. We have a parallel case in mobile radio operation. This method of communication has gained a permanent place as a means of safeguarding life and property, and of reducing costs by saving time in many essential services. The many disadvantages resulting from lack of privacy are accepted, like the old automobile crank, only because nothing has been done about them.

Actually, a great deal of progress has been made in the development and perfection of selective calling as a means of

*Mobile Systems Engineer, Hammarlund Manufacturing Company, Inc., 460 West 34th Street, New York City.

Fig. 2. The push-button selector and coding unit make up the complete selective calling equipment. Telephone indicates size



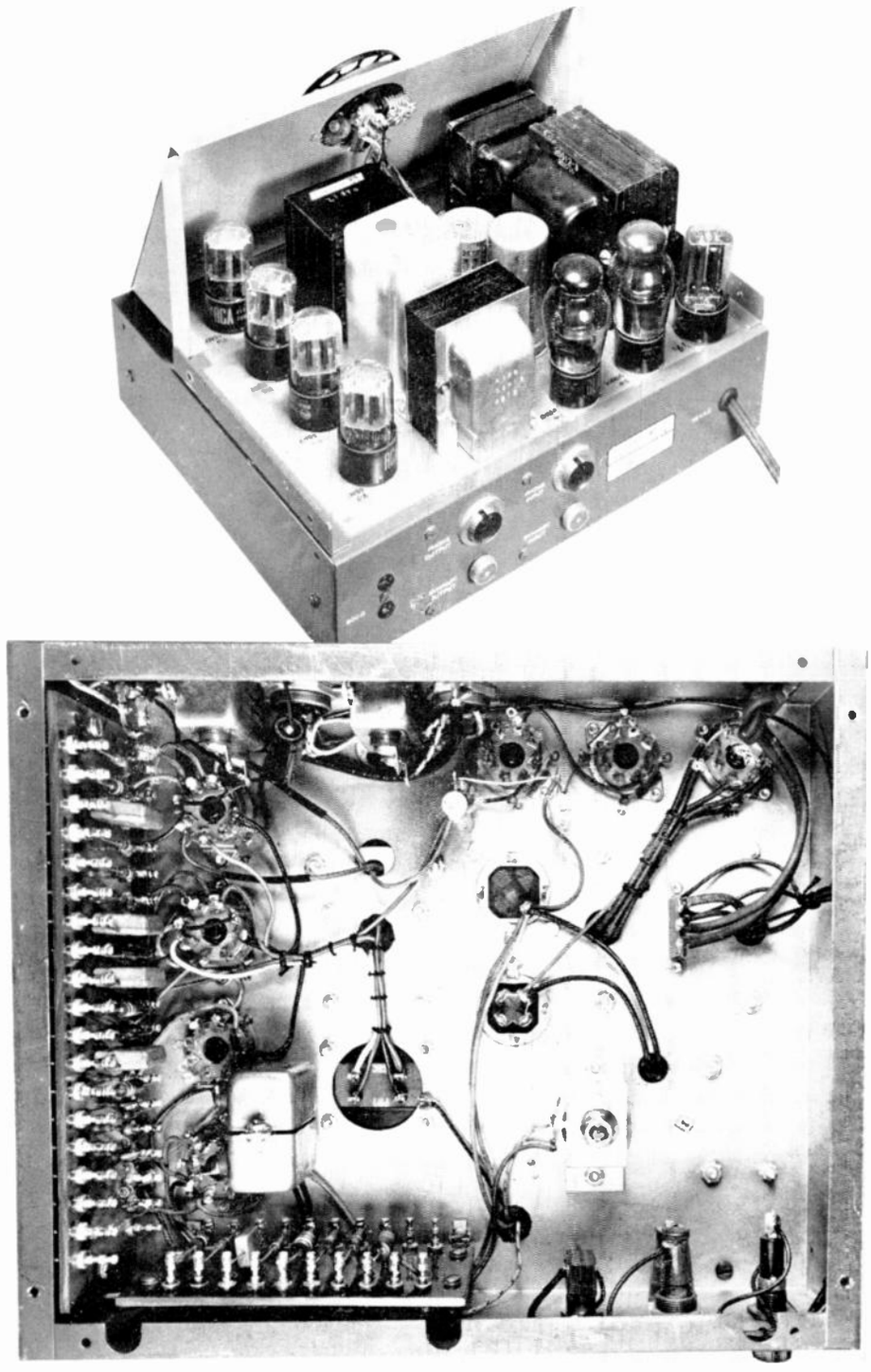


Fig. 3. Rear and bottom views of dial instrument with self-contained coder

securing privacy for radio communications. In fact, the equipment has been proved out in actual operation at a number of radio systems. But it is only now that standard central station coders and mobile decoding units, adaptable to all existing headquarters and mobile radio installations, have become available.

And the use of selective calling has already proved so successful that, in the not very distant future, we shall think back and wonder how mobile radio reached even its present state of development without benefit of this extremely important refinement and convenience.

Advantages of Selective Calling:

Radio telephone communication is such an essential service to those who use it that perhaps you have never stopped to think of its shortcomings, or the improvements that can be achieved by selective calling. Some of the advantages are more important in certain mobile services than in others, but every type of service can be improved by the use of selective calling. Therefore, rather than list the features, let us review the operation of a mobile system that employs the Hammarlund Push-Button selective calling method of operation.

1. Car Standby Condition: In the normal standby condition, all loudspeakers are completely silenced. This eliminates the continuous background noise that drivers find so objectionable, as well as the distraction of hearing messages from other radio systems which sometimes come in over great distances, as well as messages from the driver's own transmitter which are intended for other cars. Thus, as is the case with a private land-line telephone, the only calls which come in over any mobile radio receiver are those intended to be heard over it.

2. Calling from Headquarters: When the headquarters operator wants to call car 50, for example, he does not have to call and wait for an acknowledgment before proceeding with his message, as is done in many cases. He simply pushes button 50 on his control coder. By the time he has released the button, he knows that the driver in the car called has seen the green signal light on his control box, and is ready to listen. Also, he knows 1) that he can talk to the driver of car 50 without being overheard by any other driver in the fleet, and 2) he knows that no other car can call in until he has finished talking to No. 50. This interference lock-out will be explained later, in detail.

3. Reception at Car Called: When the headquarters operator calls car 50, a green call light is turned on at the dashboard control unit. If required, the control unit can be supplied with a buzzer, also, or a bell can be furnished which rings when the call light goes on. The bell is for service trucks, in case the driver may be working at some distance from the vehicle.

As the driver picks up the microphone or handset, the call light and buzzer or bell are cut off, and he is ready to receive the message. He uses his press-to-talk microphone switch in the usual manner. The selective calling system does not alter the conventional procedure in any way.

4. Condition at Other Cars: Of course, all cars in the fleet receive the selective calling impulses. When No. 50 is called, to continue our example, the decoding unit in each of the other cars 1) turns on a busy-signal light, and 2) opens the press-to-talk microphone switch circuit, disabling the transmitter. Thus, even though a driver disregards the busy signal and tries to call headquarters, his transmitter cannot operate as long as the light is on.

5. Headquarters Reset: At the end of his conversation with No. 50, the headquarters operator presses a reset button. This transmits a signal to clear the interference lock-out in all cars, switching off the busy-signal light in each one, and restoring the microphone-switch circuit to its normal condition.

6. If Car Called Does Not Answer: There may be occasions where a car is called but the driver does not answer, as in the case of a delivery or repair truck. If the headquarters operator does not get a prompt response, he presses the reset button. This restores the entire system to normal operation, but the green call light remains on at the car that was called. When the driver returns and sees the light, he knows the operator wants him. The light will go out as soon as he picks up his microphone.

7. Speed of Calling: Using numbered push-buttons corresponding to the number of cars in a fleet, the time required to signal any car is less than 1 second. This high-speed operation is extremely important in taxi systems, for example, where expert operators can handle 20 complete calls per minute. A slower method of calling, even though it took only an extra second to signal the car wanted, would reduce the number of calls per minute by 25 per cent. Such a reduction could not be tolerated, and would offset all the advantages gained by selective calling.

However, a less expensive but slower dial calling unit is available for use where split-second speed is not required.

The H-P-B System:

There are various types of operating signals and mechanisms that can be used for selective calling. The problem of determining the most advantageous method was the subject of a research program initiated by Hammarlund in 1945. This resulted in the decision to use a single audio frequency to actuate the mobile units, and the highly-perfected Clare telephone-type stepping relay to accomplish the actual selection.

The soundness of these basic elements has been demonstrated beyond any question by use in telephone circuits, the most severe operating test to which they could be put. Telephone practice, however, calls for a continuous tone, interrupted to actuate the relay. Radio requires the transmission of audio-frequency pulses. Experience shows that the stepping relay can be operated dependably even though the signal-to-noise ratio is so low that intelligible conversation is impossible. No greater degree of dependability is necessary for any selective calling system.

The use of a single audio frequency and stepping-relay selection makes possible an essential and unique feature, namely, the interference lock-out. This, as previously explained, not only turns on a busy light at every car except the one called, but locks out all the other transmitters, so that calls cannot be interrupted.

The number of cars which can be called selectively with a single audio frequency works out in this way:

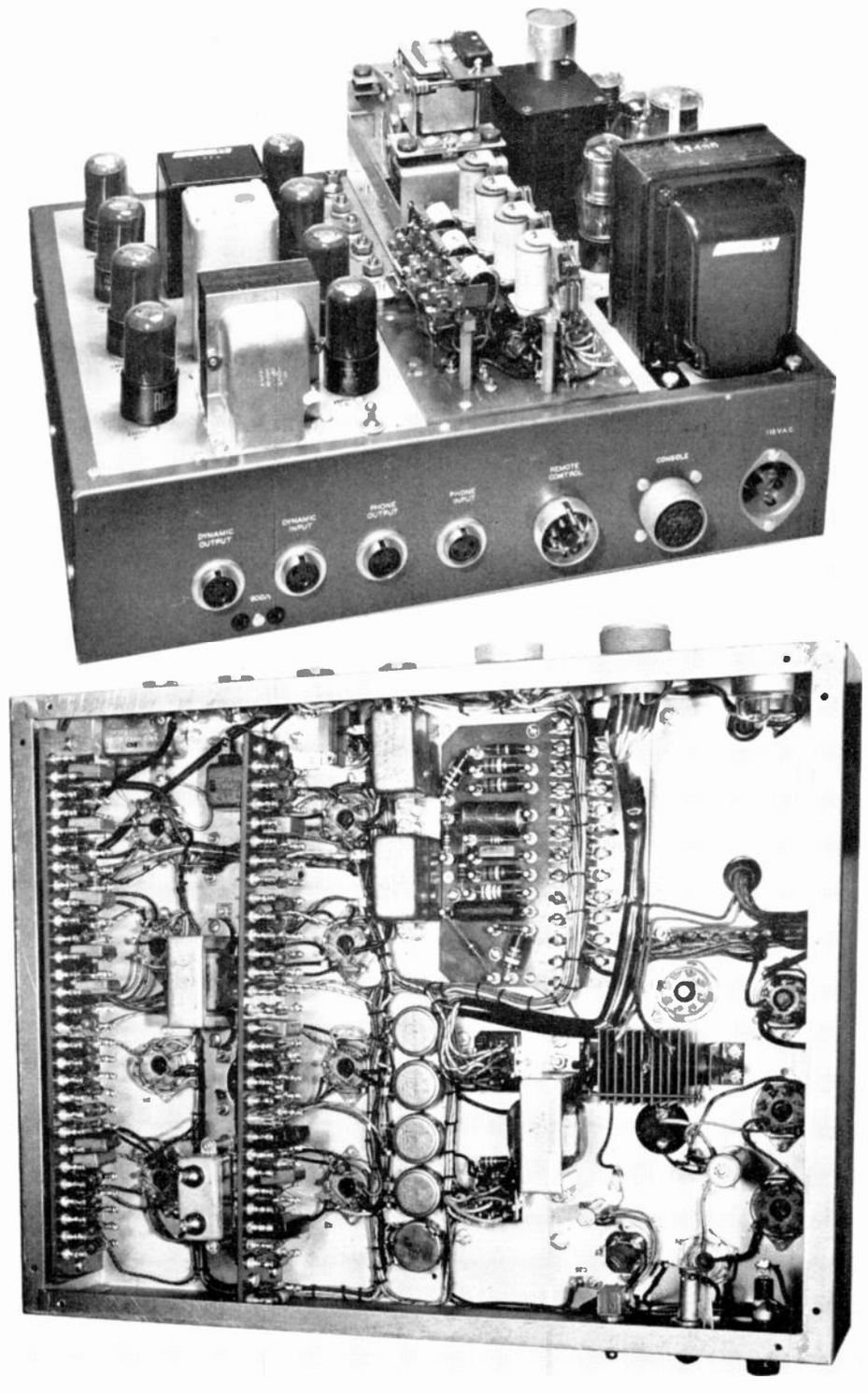
3 digits will call 37 cars
4 digits will call 84 cars
5 digits will call 126 cars.

If the number required is still greater, additional audio signalling frequencies can be employed, repeating the same code numbers. A 3,000-cycle tone is used ordinarily. When several frequencies are required, a spacing as low as 50 cycles can be used. Thus the number of selective calls that can be made is virtually unlimited.

Central Station Control:

Two types of central station controls are

Fig. 4. Rear and bottom views of the coder used with the push-button selector



shown in the accompanying illustration.

The model SCPB-3080 push-button central station control transmits a complete code number automatically in less than one second. Figs. 2 and 6 show the 40-button type, while the 10- and 80-button types are illustrated in Fig. 5. Coding is accomplished by a separate unit, Fig. 4. When a button is pressed, the transmitter is turned on automatically, the code signals sent out, and the transmitter is switched off again. At the end of the message, the operator presses the reset button. Taxi installations and others requiring extremely fast operation use a 2-position foot-operated switch to replace the hand-actuated push-to-talk and reset buttons.

The less expensive unit is the dial-type model SCF-30-C. Fig. 5 shows the front

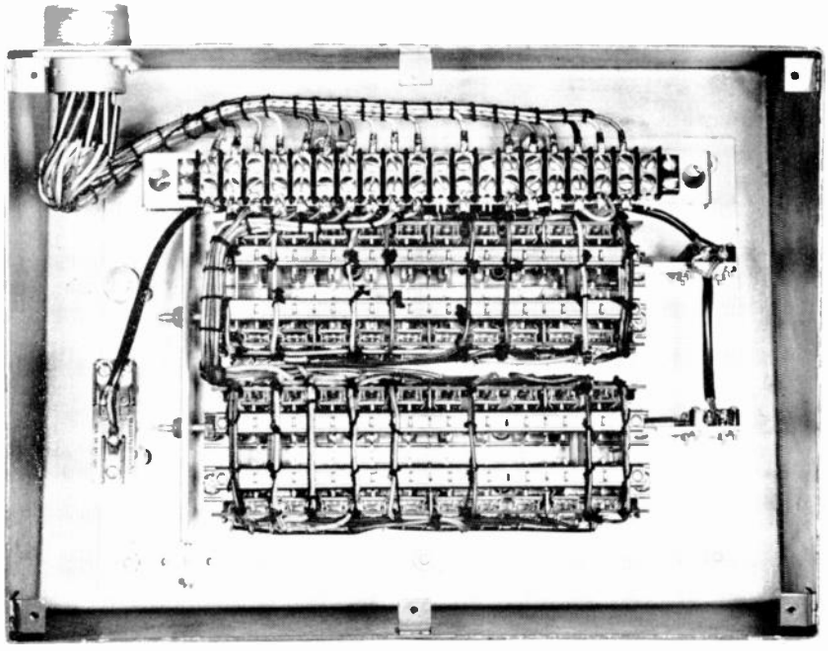
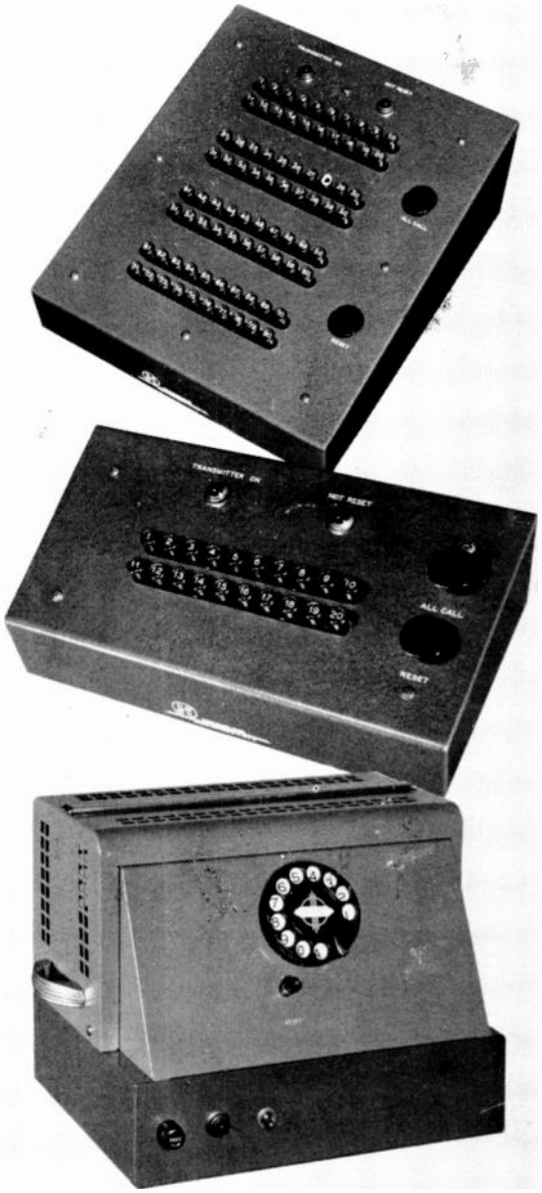


Fig. 6. A view underneath the chassis of the 40-button selector unit

Fig. 5. Below: A completed dial Selector. Above: The 10- and 80-button units



of the instrument, with the rear and bottom views in Fig. 3. It is used in installations where speed of selection is not a prime factor, as 3½ seconds are required to dial 4 digits. The press-to-talk switch is pressed while the number is being dialed. Then the conversation is carried out in the usual way, and the reset button pressed at the conclusion.

For those who are interested in the circuit functions of the automatic coder, a block diagram is given in Fig. 1.

Headquarters Installation:

The addition of either the dial or push-button type of selective calling unit at a headquarters station does not require any modification of existing equipment. The coding unit is plugged into the transmitter in place of the microphone or, where the transmitter is at a remote location, the coder is bridged across a 600-ohm line. Power for the coder is required from an AC line of 105 to 125 volts.

Connectors are provided in both the dial and push-button coders for using a high-impedance crystal or dynamic microphone, or a standard carbon type of 50 to 100 ohms.

Thus the work of setting up the selective calling equipment is merely a matter of making a few plug-in connections. Then the system can be used as soon as the first mobile installations are made, and without waiting until all the cars are equipped with decoders.

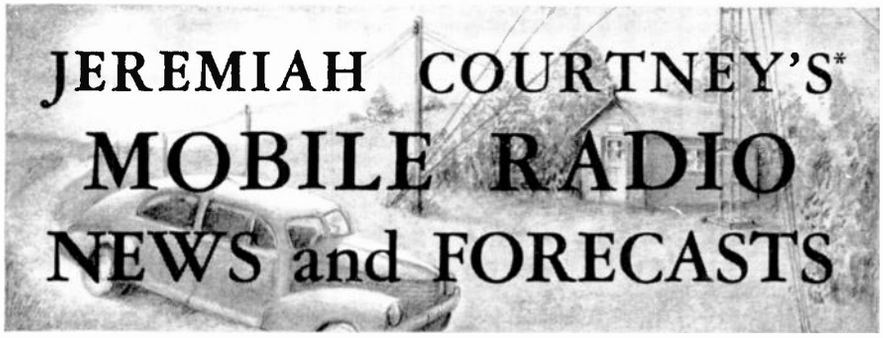
EDITOR'S NOTE: *The concluding Part 2 of this paper, to appear in a forthcoming issue, will present a detailed description of the mobile control units, and explain the method of installing them and setting up the code for each car.*

IDEAS FOR CUSTOM SETS

The best collection of ideas for professional builders of custom radio and phonograph installations we have seen so far is presented in a 12-page brochure entitled "High-Fidelity Music Guide," just published by Lafayette Radio, 100 Sixth Avenue, New York 13. Some very practical comments on FM and record reproduction are offered in the introduction by David Randolph, former CBS music annotator and current producer of "Music for the Connoisseur" over WNYC-FM. The remaining pages are devoted to illustrations and data on FM and FM-AM tuners, amplifiers, speakers, turntables, and pickups recommended for their high-fidelity performance, and to various cabinets for these units.

A careful check of the items listed and their prices confirms the currently-repeated contention that custom-built installations cost less and afford much finer musical performance than factory-built console instruments, in addition to being more flexible in design, and eliminating the problem of conventional radio furniture. Copies of the Lafayette brochure are available on request, without charge.

Are you missing one or more copies of *FM-TV* from your files? We have on hand extra copies of all 1949 issues and most previous ones as far back as January, 1941. Price per copy, 25 cents.



JEREMIAH COURTNEY'S* MOBILE RADIO NEWS and FORECASTS

COMMISSIONER George E. Sterling opened up a meaty subject in his recent address to the National Association of Taxicab Owners, when he dealt with the extent to which the Federal Communications Commission would recognize industry frequency-coordinating committee actions in the taxi field.

These committees are now operating in all the various land mobile services: public safety, land transportation and industrial. Their object is to prevent interference between systems by recommending suitable frequencies to new users applying to the FCC for licenses.

In some cases, the committees are operating with commendable dispatch and are clearly doing a good job. In other cases, however, there are long delays before the applicant receives the frequency clearance requested of the committee.

Coordinating-Committee Actions:

These delays are serious because the legal basis for the actions of all committees is quite tenuous. As Commissioner Sterling stated in his Buffalo speech: "The Commission, under the Communications Act of 1934 as amended, cannot delegate its duty of assigning frequencies to organizations or committees of licensees." It is crystal clear, therefore, that unless these frequency-coordinating committees operate efficiently and in such a manner as not to delay the filing of applications with the Commission, the whole structure may topple.

The trouble, of course, is that most of the committee members are occupied with their own business, and the amount of time they are in position to devote to these voluntary committee matters varies. In the case of the petroleum and power utility industries, where the companies generally have full-time technical advisors who serve on the committees, the frequency clearances are promptly made. In other cases, however, long delays are not unusual.

The principal cause of these long delays seems to be directly related to the extent to which the committee undertakes to examine the applicant's need for the use of a particular channel. Suppose, for example, that an applicant desires to use a 40-mc. frequency. The frequency-coordinating committee involved may confine itself to the recommendation of a suitable frequency in that band which will not cause interference to other users in the same or distant areas; or it may undertake to examine the applicant's need for a 40-mc. frequency, calling for the reasons why a channel in another band will not serve the purpose and even for the submission of a sketch or diagram showing the locations of the proposed base stations.

As soon as the committee attempts to examine into applicant's need for the use of a particular band, a long delay is almost inevitable. This would not be so bad if, when the frequency has been cleared by the committee and the necessary application then filed with the FCC, an immediate grant was made; but application processing within the Commission now requires about 60 days in most of the services. If the frequency-coordinating committees are going to concern themselves with the applicant's need for a particular band, many applicants will thereby be faced not with one long processing delay, but two.

Unless the committees are so organized as to be in position to act promptly on all material submitted, it would seem wiser for them to confine their consideration to the recommendation of a suitable frequency in the band desired by the applicant, leaving to the FCC the question of the applicant's need for the particular band selected. In this way the longest delays that are encountered would be avoided and the basic purposes for which these committees have been set up not unnecessarily imperiled.

Government's Channel Needs:

Welcome news to all mobile radio users throughout the country was Senator Ernest W. MacFarland's announcement of Senate Interstate Commerce Subcommittee probe into government frequency assignments and use. Investigation undoubtedly stemmed from many industry complaints that government agencies are putting valuable frequencies on ice. As Senator McFarland said in announcing the probe:

"Each service apparently thinks it must have its own frequencies to be operated by itself for command, tactical and just plain, everyday communications, although in peacetime no circuit is ever used to anywhere near capacity; some in fact are merely reserved without any use. . . . FCC cannot allocate what it does not have."

More than a year ago this department listed the basic faults in present U. S. frequency assignment practices. Topping the list of faults (some of which have since been corrected) were:

"(1) The dual system of allocations pursuant to which the Interdepartment Radio Advisory Committee is empowered to assign frequencies to government radio stations, while the Federal Communications Commission does likewise for non-government stations, both agencies enjoying equal and plenary authority over the entire spectrum.

"(2) The practice of IRAC in making frequency assignments on the basis of government-agency statements of frequency need without any or sufficient proof of need, and without recurring independent examination of frequency utilization by such agencies."

Article in question pointed out that so long as the FCC and IRAC could both legally assign the entire spectrum, the natural result of this plenary power in the hands of each would result in an approximately equal division of the spectrum between government and industrial users, regardless of relative needs.

The only time government frequency needs can ever be properly weighed against industry needs, on merit and by application of the same standards, will be when all frequency assignment powers are centered in one agency. It is to be hoped, therefore, that Senator McFarland's subcommittee will make a thorough and searching inquiry into the relative spectrum need and occupation of government and non-government users, as there are many mobile services already painfully short of frequency space for expansion purposes. Particularly suitable for mobile purposes would be the 162- to 174- mc. government band, adjoining the highly popular 152- to 162-mc. non-government mobile band. Widespread belief exists, furthermore, that this government band is not nearly so heavily occupied as adjoining non-government band.

Limited Common Carriers:

After six-month freeze in issuance of any limited common carrier authorizations for new facilities, the Commission broke the ice on October 12th by authorizing a new system in Hawaii. Since

(Continued on page 30)

*Courtney, Krieger, and Jorgensen, Washington 6, District of Columbia.

SPOT NEWS NOTES

NOTES AND COMMENTS ABOUT SIGNIFICANT ACTIVITIES OF PEOPLE & COMPANIES

Portables for Profit:

Illinois Central Railroad cut $1700 a month from the payroll at its Kenner, La., freight yards by using four Doolittle Littlefones to handle communications between the tower and the yard men. The Illinois Department of Conservation spent $2,800 for Littlefones, and collected $2,000 in fines the first week they were in use. The units were used to coordinate the work of spotters in planes and wardens in boats.

IRE Officers for 1950:

President, Raymond F. Guy, NBC manager of radio and allocations engineering; vice president, Sir Robert Watson-Watt of London, England. Directors-at-large, William R. Hewlett and James W. McRae. Regional Directors, Prof. Herbert J. Reich, north Atlantic; Prof. Ferdinand Hamburger, Jr., central Atlantic; John D. Reid, central; Prof. Austin Eastman, Pacific.

Mobile Radio Handbook:

With engineers working even harder than during the war, completion of the Mobile Radio Handbook has been delayed beyond our original publication date. However, it is in the home stretch, and it looks now as if copies will be mailed soon after the first of the year.

That Video-Audio Question:

Prophesies that video will replace audio programs have inspired the broadcasters to careful study and appraisal of the value of straight audio broadcasting. They have been asking themselves: "Is audio here to stay?" A very sound answer was given by David R. Milsten at the NAB Program Clinic: "The appeal of music is not intellectual as much as it is emotional. The strains of beautiful music pierce the under-currents of life, and express far better than the spoken word the basic emotions of mankind that underlie all human experience." If that is true, then audio broadcasting is secure as to the future, to the extent that the stations seek to raise the standards of talent they employ, and the quality of both their transmission and its reproduction in the homes of their listeners.

Roy F. Allison:

Has taken over a substantial part of the editorial load at *FM-TV*, in the capacity of Associate Editor. An alumnus of the U. S. Navy and the University of Connecticut, he moved to Great Barrington with his wife and son and started looking for something to do with his considerable ability and experience just when we were

TV engineer and enthusiast Roy Allison has joined FM-TV as Associate Editor

in great need of augmenting our editorial staff. His knowledge of both radio engineering theory and application makes him particularly well equipped to take an active part in our expanded editorial program for 1950. By way of introduction to our readers, his picture appears above.

More FM Broadcasting:

FCC has announced a proposed rule-making which will require FM-AM stations to operate as many hours on FM as AM. Of the 740 FM transmitters operating, about 85% are affiliated with AM stations, most of which carry network programs. Under the proposed rule, solid FM reception will be available to many thousands of listeners outside the primary AM coverage areas, particularly at night. Also, FM-only stations will be required, over a period of two years, to step up operations to twelve hours. These requirements apply to Sundays as well as week-days. The plan, proposed by FMA last August, will give a great impetus to FM listening. It is expected that the proposed rule will be made effective next January.

Frank B. Powers:

Former assistant vice president in charge of production at American Car and Foundry has joined Federal Telephone & Radio Corporation as director of manufacturing operations. He will be responsible for telephone, radio, selenium rectifier, cable, and vacuum tube production.

Phonevision on Illinois Bell:

Despite rumors to the contrary, Illinois Bell Telephone has contracted with Zenith Radio to provide facilities for Phonevision tests. A copy of the contract has been filed with the FCC.

N. Y. to Have Big Mobile System:

Consolidated Edison Company and its Westchester subsidiary will have 14 main stations and 135 radio-equipped vehicles. Later N. Y. Steam and Yonkers Electric, also subsidiary companies, will have radio communication. Link equipment will be used. Also, Link service stations in New York City and Westchester will handle the maintenance of the entire system.

Transitcasting Gets OK:

At a hearing held by the District of Columbia Public Utilities Commission, citizens' associations were unanimously in favor of transitcasting on 65 of Washington's buses, and 148 street cars. Police Department records revealed that radio reception had not affected the operation or safety of the public vehicles. In short, transitcasting was given a clean bill of health. Now, 1,500 more sets will be installed.

No Profits, No Color:

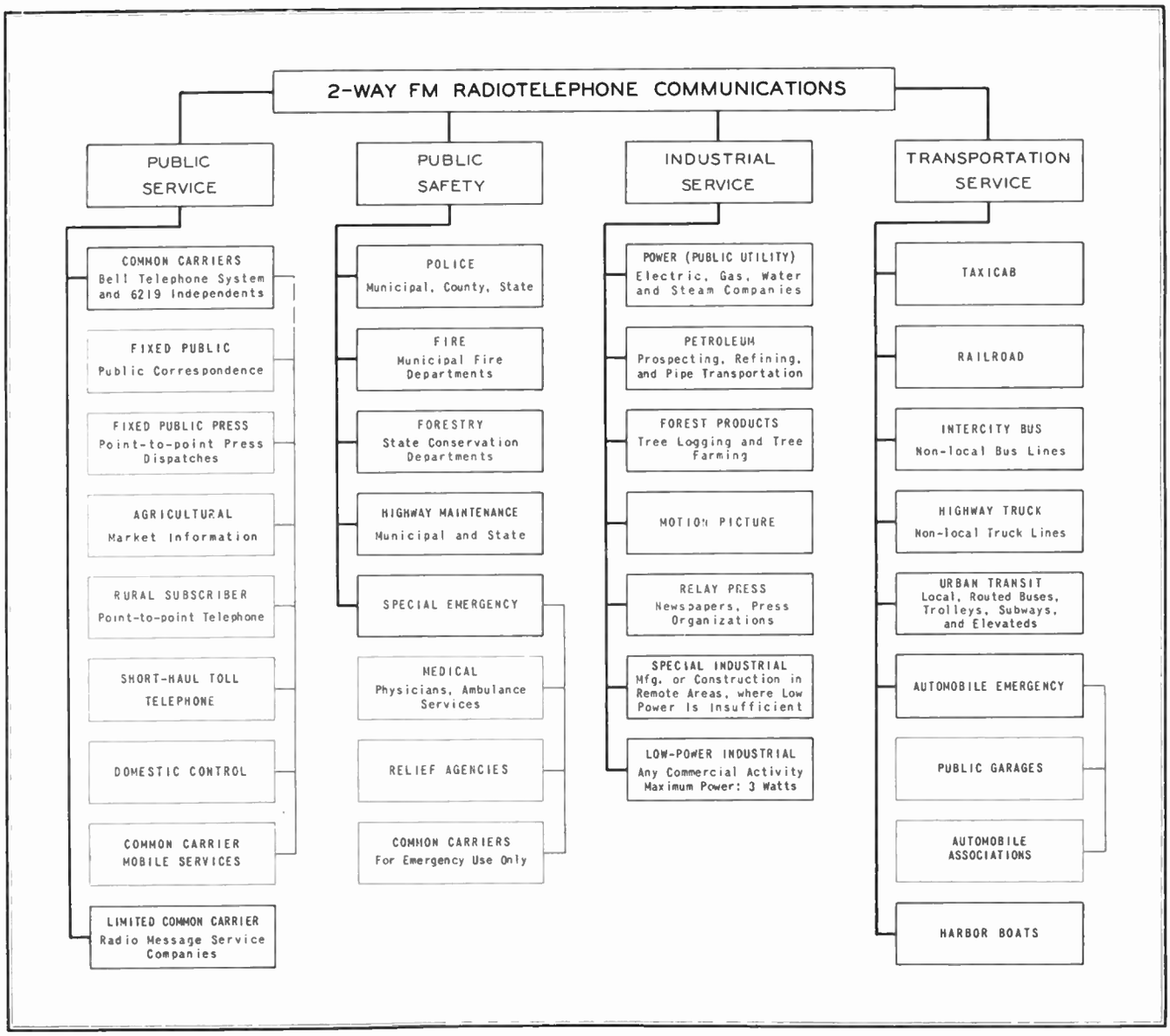
With ABC's loss from video operations this year estimated at $3.5 million, a figure exceeding the probable profits of the audio department, it's easy to guess how much interest this network would have in the purchase of color transmission equipment.

History Repeats Itself:

Last summer, in a letter to Hugh Pocock, editor of the British *Wireless World*, we referred to the keen price competition that was then disrupting the TV receiver market. In reply, he wrote: "Curiously enough, I was only today having occasion to look through *Wireless World* of 1922, and I came across an article by you explaining how the radio business on your side in the early days of broadcasting was heading for a crisis as a result of overproduction before there were enough stations to give a proper coverage." Yes, and that was only the first of a series of crises that the industry has gone through in this country.

Railroad Wreck Averted:

Six miles from the Philadelphia station, an unidentified man hailed a police car. "Looks as if that piece of track down there has taken a terrific banging," he said. While the officer was calling police radio headquarters, a Pennsylvania express was pulling out from Philadelphia, bound for New York. Railroad officials were reached just in time to flag the train two miles short of the broken track.



Here is a complete picture of 2-way FM communications services as set up by FCC rules and allocations effective last July 1st

NEWS PICTURE

THE dollar sales volume of FM mobile communications equipment in the first half of '49 exceeded the total sales of AM, FM, and TV broadcast transmitters, plus all the studio equipment, towers, and antennas. Although that statement may surprise you, it tells only part of the story of what is going on in the mobile and point-to-point communications field. Every month this year, more new FM headquarters transmitters were installed than all the new audio and video broadcast stations that went on the air this year and will go into service in 1950! The gas and electric utilities group alone put up nearly 1,000 stations this year, and equipped over 11,000 vehicles with mobile transmitters and receivers!

Communications equipment business wasn't very good in the first six months of 1949, incidentally. Frequencies available at the end of the war became jammed to capacity as soon as restrictions were lifted. The FCC undertook a very complete survey of the situation last year, and held a long series of hearings to consider the present and future needs of all the services that wanted channels. Finally, last May, the new rules and allocations were released. Under the new setup, the FCC expanded the number of channels and provided for so many additional services that we devoted a total of 14 pages in our June, July, September and October issues to the allocations tables and a summary of the rules.

But even that didn't show the scope of this market. We found that a great number of radio men still thought of it as being only a police activity. So we made up a chart to present the complete picture of 2-way FM telephone communications. This chart follows the FCC practice of grouping the various uses in four major classes. These are identified above as public, public safety, industrial, and transportation services. Of these, only public service systems are permitted to make their facilities available to the general public, and to charge for the service.

One reason that so few men in the industry are aware of the rate of growth in this field is that the RMA figures on equipment sales are far from complete, since some of the large manufacturers are not members. Complete data on the systems is available, however, in the Registries published in *FM-TV* Magazine. These show the name and address of each operating company or government department, frequencies, call letters, number of mobile units, and the make of equipment used.

In 1950, the Registry of public and industrial service systems will appear in our January issue; public safety in July, and transportation in November.

ADJACENT-CHANNEL EQUIPMENT

HOW THE PROBLEMS OF MOBILE RADIO OPERATION ON ADJACENT CHANNELS ARE BEING SOLVED IN NEWLY-DEVELOPED EQUIPMENT, PART 2—*By* HAROLD A. JONES*

THE operation of the Motorola instantaneous deviation control requires first, the differentiation of the modulating wave, followed by a clipping action, and then by an integration operation. Fig. 8 shows the circuit. The initial differentiation process emphasizes voltages associated with steep wave fronts or steep slopes and, as a result, the clipping action clips off that portion of the wave directly related to steep wave fronts. Since the differentiation results in emphasizing the high frequencies in relation to the low, it follows that undesirable voice pre-emphasis results, and there also remains a distribution of frequency characteristics of the wave which would result in overmodulation. Since the clipper is followed by an integration circuit, the wave characteristics are restored to normal, and any undesirable transients introduced by the clipping action are further reduced. Observing the action of this I.D.C. system on an oscilloscope while subjecting the transmitter modulator input to approximately 30 db overload, the voice wave appears to strike an invisible barrier. The scope is connected to a calibrated discriminator circuit, so that the excursion viewed is a direct indication of the instantaneous deviation.

It is quite true that the control of instantaneous deviation in a phase modulation system does not prevent modulation products from extending beyond the limits of the instantaneous deviation maximum. In other words, there will appear beyond the limits of deviation side bands or products of modulation which may extend into the adjacent or the alternate channel. Field tests show, however, that because the energy content in a voice wave is low, and interference capabilities of these transient modulation products in the adjacent and alternate channels are also low, while under certain conditions a degree of monkey chatter and some undesired noises may be produced, there is little or no actual interference with the reception of the desired station. Where the instantaneous deviation is not controlled, the excursion of the carrier outside of the pass-band of the receiver not only decreases the signal-to-noise ratio in the receiver, but it also adds considerably to the interference energy in the adjacent and alternate channels. The combination of superior receiver characteristics in a system where instantaneous deviation control is employed appreciably enhances the practicability of maximum channel utilization.

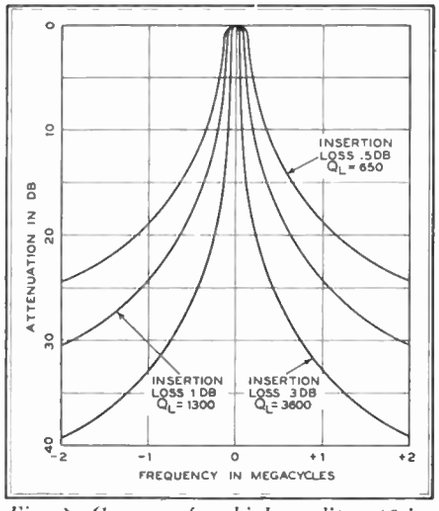


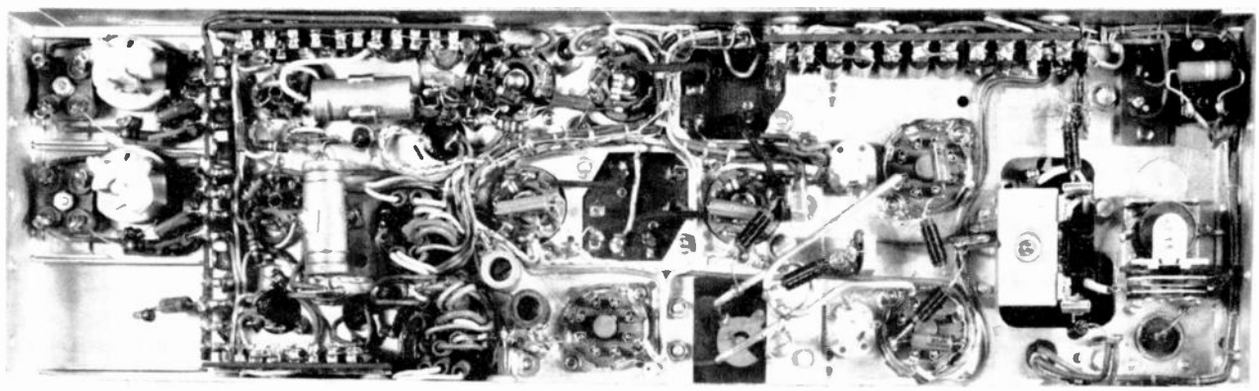
Fig. 7. Curves of a high-quality, 10-in. cavity tunable from 152 to 162 mc

Today, normal channel operations require and allow ± 15- to 20-kc. frequency excursions for optimum 100% modulation levels. Generally speaking, energy in the modulation excursion beyond the normal band acceptance of the receiver is rejected and, therefore, wasted. It is a fair rule-of-thumb to say that energy beyond the 10-db down limit of the selectivity curve is not useful energy. Obviously, then, as the bandwidth of the associated receiver becomes narrower, the transmitter deviation must be held within tighter limits. The narrow-band receivers, exhibiting minus 100 db at ± 20-kc. characteristics, require only ± 7.5 kc. deviation at 100% modulation for full audio output. Most assuredly, future split-channel operations will decrease the deviation limit still further. Progress achieved in recent years is indicated by Fig. 9, illustrating bandwidth reduction.

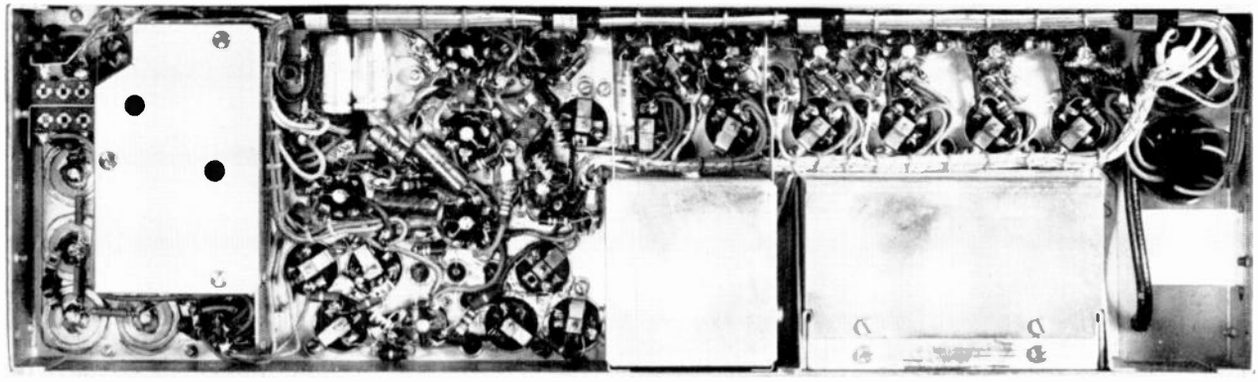
Mechanical Design:

Electrical design is paramount in the actual achievement of adjacent-channel performance. However, the mechanical, production, and perhaps even more important the economic considerations are of interest to the ultimate user. How long will the equipment be modern and abreast of current developments? How soon will it be made obsolete by advances in the art, or how much will it cost to keep the performance characteristics in compliance with federal legislation

Sytems Engineering Dept., Communications & Electronics Division, Motorola, Inc., 4545 Augusta Blvd., Chicago, Ill.



An underside view of the complete 30-watt transmitter section. This illustration should be compared with the views of the chassis and separate decks shown in Fig. 2. The output end of the transmitter is at the right hand side in this view



This picture of the under side of the complete receiver section can be more readily understood by comparing it with Fig. 2, which shows the chassis and separate decks. In this view, the RF tuner is at the left, and the meter socket at the right

which may be made effective before the equipment completes its useful life?

In the mechanical design and packaging of the transmitter and receiver unit, those basic circuits and components which are not likely to be changed drastically over a reasonable period of time can be incorporated in a foundation or basic chassis unit. Those other circuit elements which are subject to change as the industry progresses toward full adjacent-channel or even split-channel operations should be concentrated on separate plug-in or sub-chassis units.

To allow complete flexibility, the receiver unit discussed here, Fig. 2, has a basic chassis incorporating the IF amplifier stages, limiter circuits, and audio section. On separate sub-assemblies are those elements which vary from one application to another. The RF tuner deck contains the controlling elements of RF selectivity, frequency stability, intermodulation, and desensitizing control, as well as single- and multiple-channel operation. The IF wave filters furnishing the selectivity-determining element are interchangeable to allow 60-kc., 40-kc. or even narrowed-band operation as desired.

The associated transmitter, also shown in Fig. 2, represents an equally versatile unit. RF oscillator decks containing the frequency-stabilizing crystal assemblies provide for operation on 1, 2 or 3 frequencies. Changing from one channel to another is accomplished by a simple switch, with absolutely no circuit readjustments required. Crystal assemblies are heated or unheated units, depending upon the over-all frequency stability required. The final RF power amplifier is designed as a separate unit, to provide whatever output is required. In addition, a level adjustment is available in the deviation control circuit to allow maximum deviation-limit settings to match the bandwidths of the associated receivers.

Integrated Solution Required:

While tremendous strides in equipment design have been demonstrated, continued care must be exercised in the

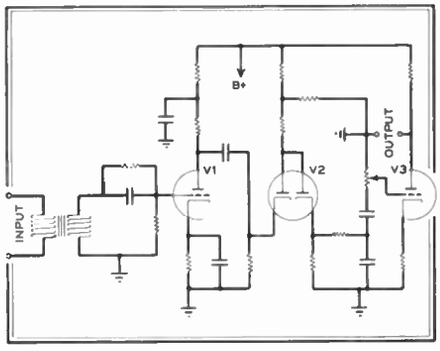


Fig. 8. The basic Motorola IDC circuit

evolution of system combinations. To measure the merits of the advances attained, comprehensive tests and rigorous performance standards must be set.

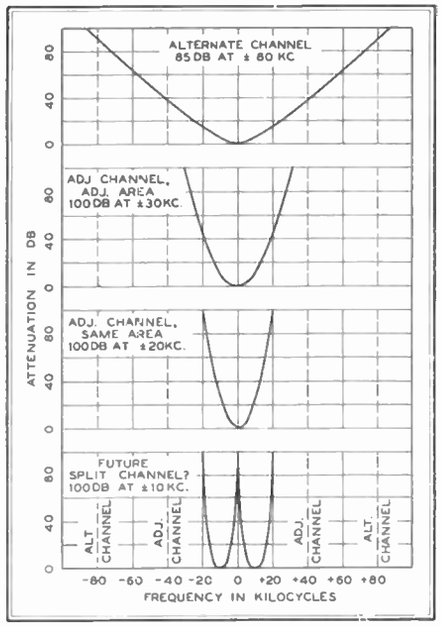


Fig. 9. Steps in reducing bandwidth

It is generally recognized that the day of practicable adjacent-channel operations and maximum channel-utilization is upon us. Substantial improvement in the receiver intermodulation characteristic has been accomplished. IF design for the 100-db protection against adjacent-channel signals has been made physically and economically possible. Frequency stability has been improved to a degree allowing even further tightening of channel bandwidths. A carefully-planned program for the geographic assignment of channels will produce efficient spectrum conservation. Such integration will result in a solution of the problems of the mobile radio services.

CERAMIC DIELECTRICS

CERAMIC dielectric plates, almost as thin as condenser paper, are now being produced for small capacitors, particularly in applications involving operating temperatures up to 500°C., or where a reduction in cubic contents per microfarad, as compared to paper or mica, is required.

According to investigations made by the Porcelain and Pottery Section of the National Bureau of Standards, plates .003 to .006 in. thick can be formed by dry-pressing a mixture of calcines and bonding agent in a hardened steel mold under a pressure of 10 tons per square inch. The powder must be fine enough to pass through a No. 50 sieve.

Despite their thinness, the plates are strong enough to be ejected from the mold without cracking. They are then transferred to glass sheets for drying, and the green plates are stored in stacks until they are fired.

The plates are dusted with air-floated zirconium dioxide so they will not stick together at high temperatures. To prevent warping, they are fired in weighted stacks. This requires about one hour at 1,445 C.

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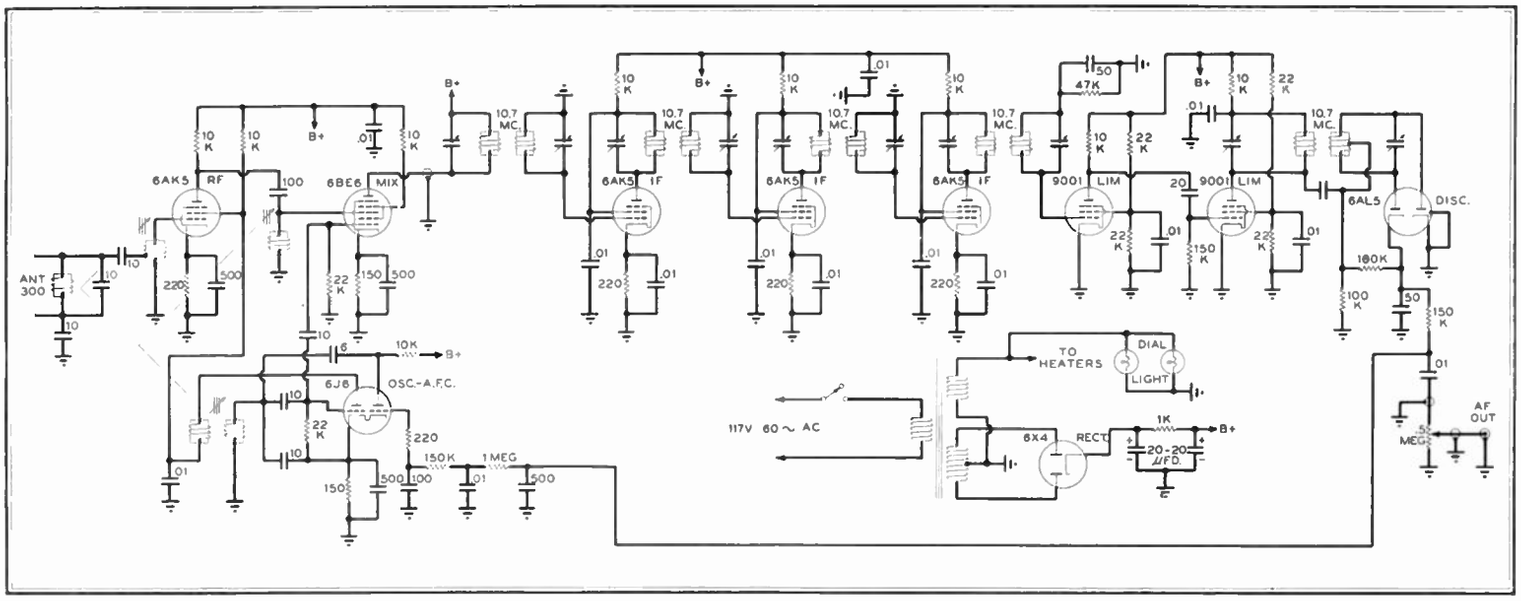


Fig. 1. The complete schematic diagram of the Sun Radio FM tuner, showing the AFC circuit and the built-in power supply

A STRAIGHT FM TUNER WITH AFC

A DESIGN INTENDED FOR USE WITH A HIGH-QUALITY AMPLIFIER AND SPEAKER, TO AFFORD THE FULL ENJOYMENT OF FM BROADCASTING—*By* IRVING GREENE*

INTEREST in FM transmission is growing to the point where, as this observer sees the trend, AM sound broadcasting will become a thing of the past within the foreseeable future, and all audio programs will be carried on FM. The frequency-modulation method of transmission has proved to be far superior to amplitude modulation with respect to coverage, freedom from noise and interference, and as a source of high audio quality. The only difficulty with FM lies in sub-standard performance of many receivers advertised as giving "static-free reception." Their main deficiencies are drift, low sensitivity, and distortion. These faults are especially prevalent in the FM section of many home-type radio receivers. Many people have sampled FM reception from such sets and have gone back to AM, completely unaware of the advantages that FM offers. Within the author's experience, literally thousands of listeners have been astonished by the superior quality of FM reception available from properly-designed receivers, and once they have heard the difference, no amount of persuasion will cause them to go back to AM reception.

The foregoing is not an expression of personal opinion. On the contrary, it expresses the composite opinion of the great number of listeners with whom the author has had the opportunity of talking from day to day, over a period of years. These people have included not only residents of New York City and the suburbs, but from all over the U. S. A.

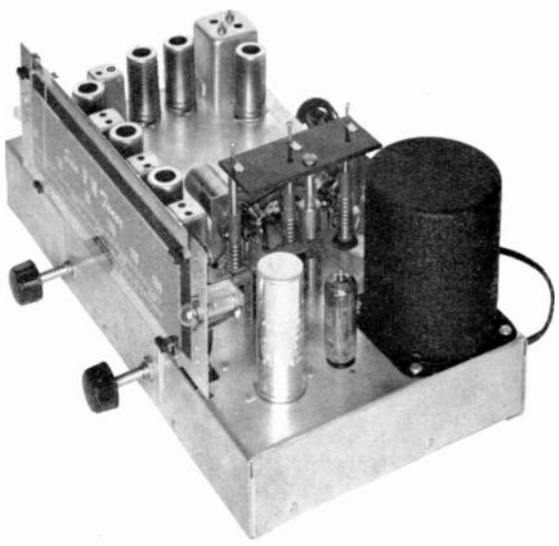
What People Want:

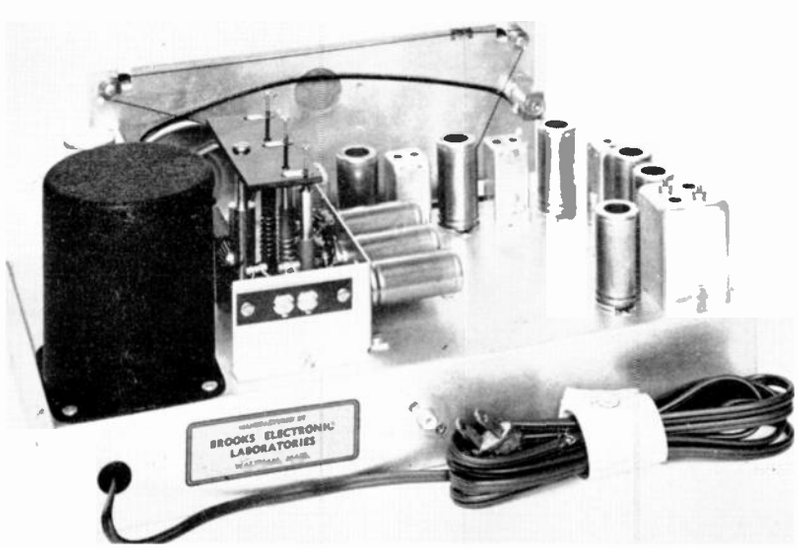
Among the features of receiver design necessary to the full enjoyment of FM reception are:

1. Absolute freedom from frequency instability caused by oscillator drift.
2. High sensitivity, to provide reasonably long-distance reception.
3. Self-contained power supply, to simplify installation.
4. A high degree of noise rejection and capture effect.
5. Stability in the tuned circuits, so that frequent realignment is unnecessary.
6. Circuitry adaptable for use with any high-quality audio amplifier.
7. Simplicity of operation, so that any member of a family can tune in stations accurately.
8. Compact size readily suited to any type of installation.
9. A minimum of parts, easily accessible for adjustment and repair.
10. A price somewhat under $75.

*Manager, Audio Department, Sun Radio & Electronics Company, Inc., New York, N. Y.

Fig. 1. Front view, showing the tuning mechanism. Fig. 2. The tuning gear and rack can be seen at right of power transformer





FM Tuner with AFC:

These considerations have been met in the Sun Radio AFC-10 FM tuner designed by Edgar Brooks of Waltham, Mass., chief test engineer in the quality control division of the Raytheon Manufacturing Company. Mr. Brooks tackled the problem of meeting our specifications with typical Yankee "can do" spirit, and came up with the very successful model shown in Figs. 1, 2, and 3. This tuner has the amazing sensitivity of 2 microvolts for complete limiting of set noise. It is equipped with automatic frequency control so that off-resonance drift is impossible. Furthermore, the AFC simplifies adjustment to the extent that stations can be tuned in perfectly even by a novice. The only other knob on the front panel is the volume control. No tone control is necessary on a good FM receiver. The high-impedance audio output is suitable for use with any high-fidelity amplifier.

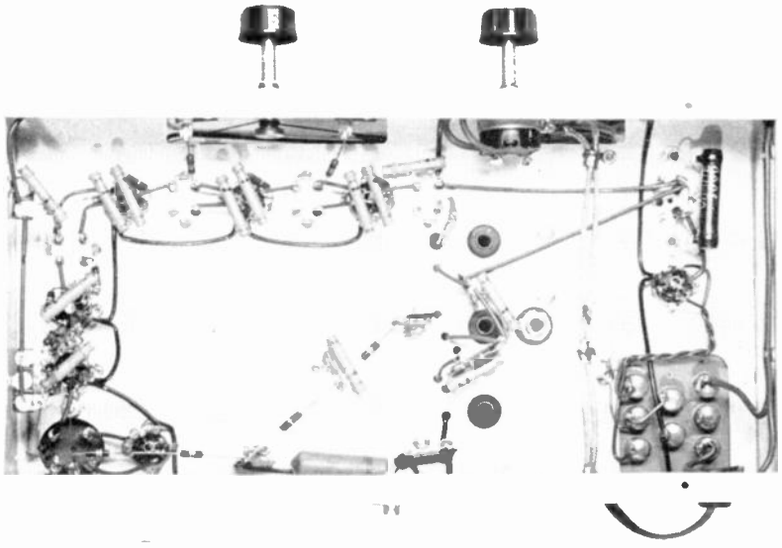


Fig. 3. The under side of the chassis, showing the surprisingly simple circuit

Circuit Details:

Fig. 4 shows the circuit of this tuner, with the chassis layout in Fig. 5. The antenna input impedance of 300 ohms matches most FM antennas. The antenna input circuit consists of a coil and capacitor in parallel, the Q of which is adjusted to give a broad-band impedance, matching a 300-ohm lead in. It is balanced to ground. A capacitor couples the energy to the resonant grid circuit, and from a resistive load in the plate circuit a capacitor transfers the signal to the No. 3 grid of the 6BE6 pentagrid mixer tube. This is a miniature tube, especially designed as a mixer for FM receivers. The use of a tuned RF stage greatly reduces RF noise, provides gain for better limiter action, and practically eliminates image interference.

One-half of the 6J6 double triode is used as a separate oscillator in a tickler feedback circuit. The second half of the 6J6 tube is used as a reactance tube for the AFC. It is arranged so that it appears as a variable capacitor shunted across the grid circuit of the oscillator. A DC voltage obtained from the discriminator is used to vary the effective capacity of the reactance tube. The DC control voltage is passed through high-frequency and low-frequency filter networks, and is applied to the grid of the reactance tube. The oscillator output is connected to the No. 1 grid of the 6BE6 mixer.

All the tuned circuits in the front end of the receiver make use of inductive tuning. That is, their resonant frequency is varied by changing the position of brass slugs inserted in the coil forms. They can be seen in Figs. 1 and 2. These illustrations also show the rack and pinion tuning mechanism which moves the slugs. The use of inductive tuning provides excellent stability, and freedom from microphonics and noise produced by wiping contacts.

The RF amplifier, mixer, and oscillator-reactance tubes are mounted horizontally on an L-shaped metal subchassis, providing extremely short leads and a compact assembly.

The 10.7-mc. IF amplifier consists of three stages using 6AK5 tubes. The 6AK5 is an RF amplifier pentode tube with very high transconductance, low input and output capacities, and low input conductance at high frequencies. The low-drift miniature IF transformers designed for this tuner are made by F. W. Sickles Company. Each transformer is of the double-tuned type. The L-C ratio and coefficient of coupling values were chosen for maximum gain consistent with a bandwidth of 200 kc. Thus, transmitter swings on peak signals are accepted without distortion. Decoupling resistors are used on each stage, so there is absolutely no trace of degeneration to cause distortion of the IF response characteristics. No AVC is employed. Electrode voltages on the 6AK5's are arranged to realize the full amplification possible with these tubes. There is sufficient gain in the IF amplifier to insure complete limiting with signals only slightly above the noise level.

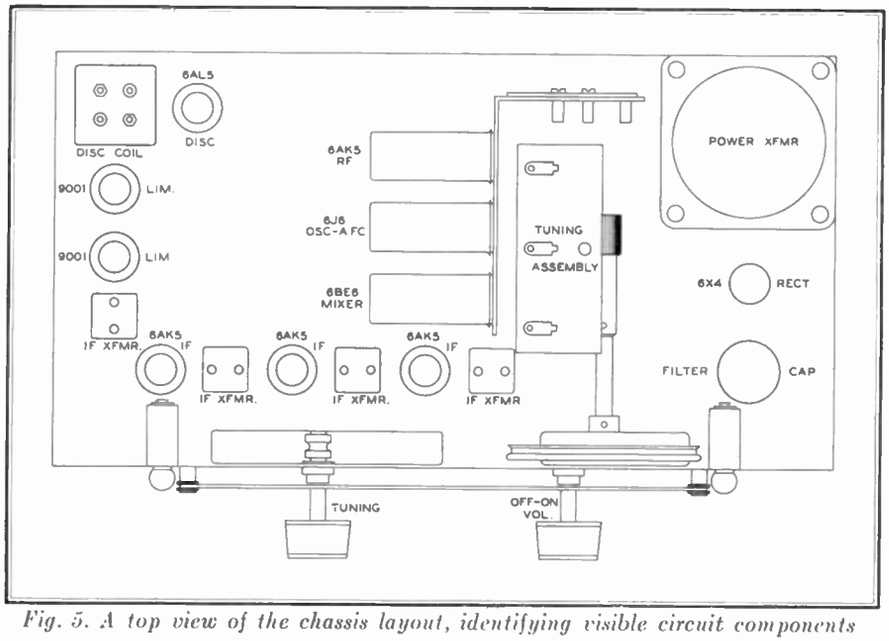
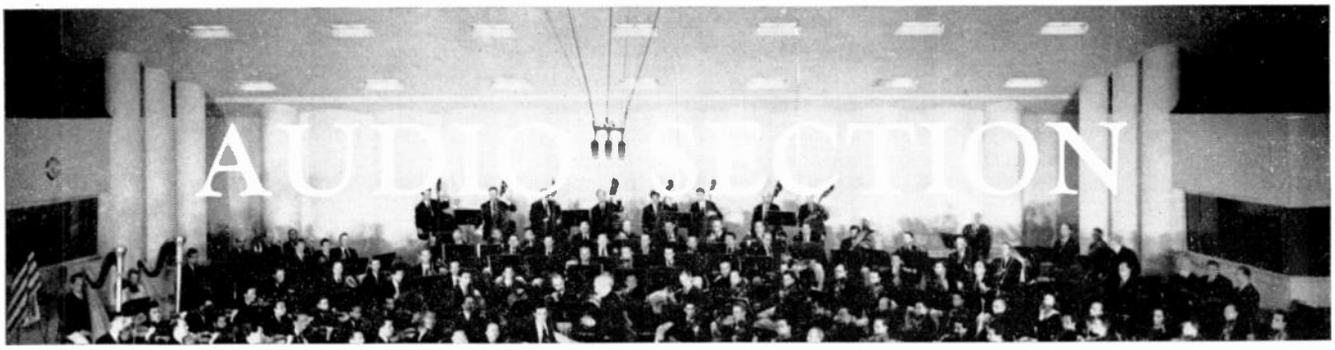


Fig. 5. A top view of the chassis layout, identifying visible circuit components

The AFC-10 employs the tried and proven Armstrong FM circuit. There has been much controversy regarding the relative merits of the ratio detector versus the Armstrong limiter-discriminator circuit. It has been the author's experience that in spite of all claims, ratio-detector receivers are much more suscep-

(Concluded on page 26)



AUDIO IS ON THE MEND

AES CONVENTION SHOWS INCREASING EMPHASIS ON IMPROVING AUDIO QUALITY—*By* MILTON B. SLEEPER

As we have pointed out in these pages before, the advent of FM broadcasting, making noise-free, 15,000-cycle program quality available for reproduction, put the first real drive behind engineering effort to raise audio standards.

Before the war, high-fidelity reproduction existed only as a generality in advertising-copy phrases. There could be no noise-free, full-range reproduction because there was no such source of music to reproduce. The higher frequencies, whether recorded on discs or transmitted on AM, mixed with and were lost in background noise at some point below 5,000 cycles. The lower end of the audio spectrum was either missing completely or was evident only in a one-note, beat-the-barrel effect. Then came FM to set a totally new musical standard, and to offer at the second-detector output the possibility, at least, of full-range audio reproduction.

Before the war, there were very few qualified audio engineers, and even less need for their services. They were, as Norman Pickering put it, the men who worked on the rear ends of radio sets. The positions of importance went to the RF engineers. They brought in the signals. What happened to program material after it was reconverted to audio frequencies didn't matter much as long as it was intelligible.

Stromberg made a sincere effort back in those days to build better audio systems, but it all came to naught because listeners still used their tone controls to reduce background noise, thereby limiting reproduction to perhaps 3,500 cycles!

This brief review is offered because many engineers now devoting themselves to disc, tape, and film equipment are so newly come to this field that a great number do not know that FM broadcasting gave the initial impetus to the public interest in better audio quality which has created a great demand for their services.

Today, tape most nearly approaches FM as a noise-free, full-range program source. Discs and film are about on a par, with the best film recordings probably offering a slight advantage as to signal-to-noise ratio at the highest frequencies. The use of all these media is increasing rapidly, however; tape and film because of their adaptability to professional needs, and FM and discs because of their accessibility to the general public.

This progress has stimulated the study of audio phenomena and circuits, calling for new measuring instruments. The availability of instruments has accelerated the development of recorders, reproducers, amplifiers, and speakers.

The big job remaining is the education of listeners in the appreciation of fine musical quality. This involves two intermediate steps. One concerns the broadcasters and record manufacturers, as the source of much of the musical entertainment; the other, the dealers through whom high-quality audio equipment moves into the hands of the public.

As we see it, much of the educational work must be done and can be done by the individual members of the Audio Engineering Society, and by the organized efforts of the Society as a whole.

This must necessarily be a long-haul project. Broadcast station management is naturally more concerned with the revenue-producing interludes between musical selections than with the quality of the music that is the vehicle of the commercial announcements. As for records, if they sell, it is assumed that the music they produce is good enough. And the dealers, well, their job is not to educate their customers, but to stock what people want.

At a quick glance, these elements of resistance seem to represent insuperable obstacles. Actually, they do not. The fact that a considerable number of companies are specializing in fine amplifiers, pickups, and speakers indicates that a substantial demand already exists for really good equipment.

As the attendance at the Audio Fair indicated, much of this interest is now limited to individual enthusiasts. Commercially, this interest in being expressed by custom set-builders. They are doing more, right now, to develop public demand for fine audio quality than any other industry group.

Slowly, but very definitely, the parts jobbers are getting into this field. In that group, one of the leading exponents of high-quality reproduction is Sun Radio Company in New York City. They probably have the most complete display of audio gear in the country. You might ask Sam Schwartz: "Does it pay to do so much sales promotion on expensive audio equipment? Do enough people hear enough difference that they will spend the money for high fidelity?" If you do, Sam will probably give you a quick smile and say: "My sales records tell me so."

The broadcasters, right now, are principally concerned with developments that reduce the cost of producing and distributing audio and video shows. Among these are tape recorders used for direct broadcasting or for editing programs to be recorded on discs; improved disc recorders and play-back heads; new audio equipment to replace obsolete installations, lip-synchronous tape recording and play-back units, and 16-mm. sound-on-film.

However, at the rate that better home reproduction equipment and high-sensitivity FM receivers are being purchased and installed, the demand will work back to the broadcasters for program transmission at higher and higher audio fidelity. It will take time, but the trend has been definitely established. This was indicated convincingly by the attendance at the AES convention, numbering over 3,000, a figure twice the most optimistic expectations of the Society's officers.

Fig. 1. Reeves Studio B, showing the setup for recording the Philadelphia Philharmonic Orchestra, Eugene Ormandy conducting

DESIGN OF RECORDING SYSTEMS

PART 3: A DESCRIPTION OF THE REEVES SOUND STUDIOS INSTALLATION, THE CONCLUDING DISCUSSION OF UNITIZED EQUIPMENT—*By* LEON A. WORTMAN*

ONE of the most interesting sound recording operations in the United States is located at 304 East 44th Street, New York City. The five floors of this building, occupied by Reeves Sound Studios, are devoted to film, disc, and tape recording, operated on a 24-hour schedule. This installation, because of its magnitude, has been selected as the second example of the application of unitized audio equipment, and its adaptability to both conventional and special operating requirements of sound studios.

*Technical Data Division, Fairchild Recording Equipment Corp., Whitestone, N. Y.

TV, Film, and Sound Studios:

The first and second floors of the Reeves building are devoted principally to sound studios. Studio A, used for producing television and theatre films, is 60 ft. deep,

Fig. 2. Studio A console. Fig. 3. C. Robert Fine, chief engineer of Reeve's tape and disc division, in the channel A cutting room

54 ft. wide, and 30 ft. high. An elaborate profusion of cameras, lights, microphone booms, and props is in evidence there.

Studio B, on the second floor, is one of the largest in the country devoted to the sole purpose of recording musical groups. The back wall is 79 ft. from the observation window of the control room. Fig. 1 does not indicate the actual size of the studio, for it is actuallly 55 ft. wide and 15 ft. high. This photograph shows the setup for recording Robert Flaherty's "Louisiana Story," with Eugene Ormandy conducting. In this case, the conductor is facing the rear of the studio. Many of the scores for motion picture film are recorded there, and much of the music that is processed and pressed for broadcasting and home reproduction.

When a film is being scored, the motion picture is projected on a screen above the control room observation window so that the music conductor can synchronize sound and picture. An acoustically-isolated projection booth, shown in Fig. 1, is located at the rear. The control room is as large as the average broadcast station studio, measuring 30 by 18 ft. Complete monitoring facilities are provided at the control console, Fig. 2. Standard VU meters and an oscilloscope are built in across the top. One VU meter indicates average audio levels, while the 'scope accurately reveals the peaks. The second VU meter indicates the degree of compression, when the program-compressor is utilized. In order to simulate as nearly as possible actual theatre listening conditions, an Altec A-4 theatre speaker is mounted against the far left wall of the control room, covered by the heavy drapes which can be seen in Fig. 2. The control room monitor amplifier to drive the speaker is mounted in the control console.

On the third floor are Studio C, called the mixing theatre, and the film recording facilities. Final production for movie shorts, trailers, and travelogs is done in Studio C. All sound sources originating on disc, tape, or film are mixed here for the final sound tracks. The technicians work at a console as they watch the motion picture projected on a screen at the far end of the studio wall. The studio is designed to simulate the acoustics of the average theatre. Also located on this floor are the film vaults, 14 master film dubbers, numerous 16-mm. and 35-mm. optical recorders, dark rooms, and cutting rooms.

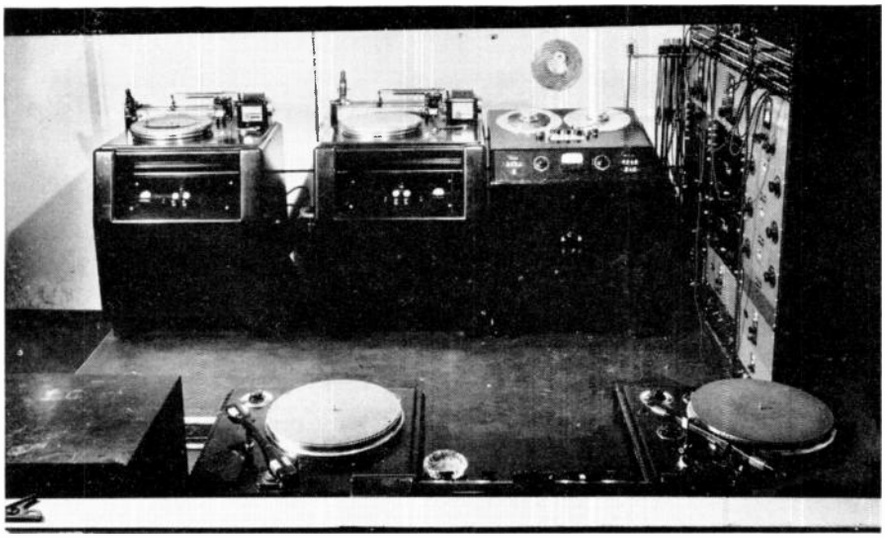


Fig. 4. Tape and disc recording equipment and turntables in channel A cutting room

Tape and Disc Recording:

Two narration studios, for voice-track recording, and the tape and disc recording facilities, Figs. 3, 4, and 5, have been installed on the fourth floor. Fig. 6 gives a block diagram of the equipment. The operating staff refer to these rooms as channels A and B. Equipment for each studio is practically identical, comprising two transcription turntables for dubbing, a compact mixing board, and a compressor feeding a program bus. Bridged across the bus are two monitor amplifiers for the loudspeakers, and two power amplifiers feeding the studio recorders. Each channel includes a tape recorder. These are not normalled through, but terminate at the patchboard. Since the audio input for the tape recorder must be at the program bus level, bridging input is used to make the unit a completely self-contained recording channel.

Input and output connections of all units, including the recorders, turntables, amplifiers, and speakers, terminate at the patchboard shown in Fig. 3. However, a normal through arrangement of these terminations is such that, with all patch cords removed, the facilities are connected automatically for dubbing from the transcription turntables to the recorders.

The only difference between the two channels is that channel B console contains two turntable fader controls and one master gain control. Channel A consolette has four faders and one master control. The two additional faders are at the output of preamplifiers for any condition that might require the use of microphones or other low-level equipment in the recording room.

These facilities are in great demand in the film and record production industries. Many of the musical scores for television and motion picture films are recorded at the Reeves studios. For example, the photograph of the Philadelphia Philharmonic Orchestra, Fig. 1, was taken during the actual recording of the musical score for "Louisiana Story." Disc and tape recording was done on channel B equipment, and played back for the director's approval.

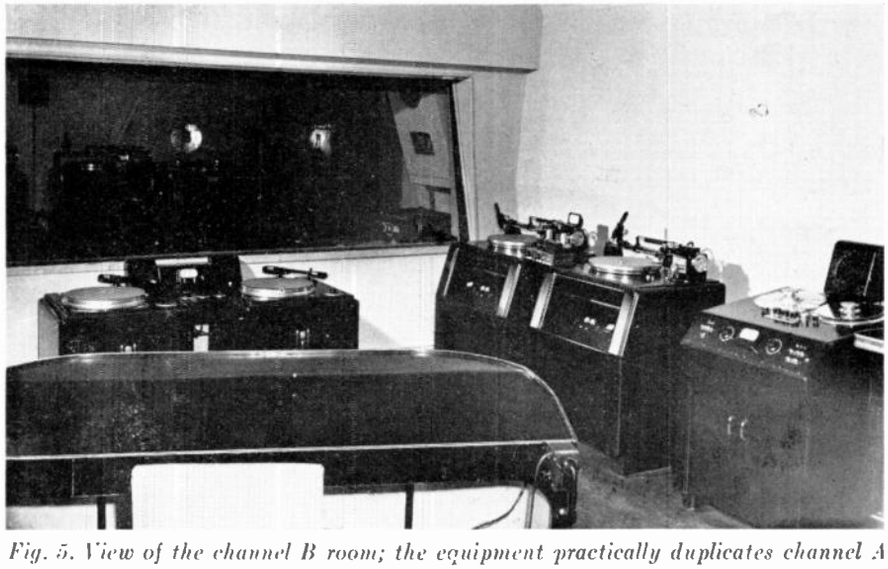


Fig. 5. View of the channel B room; the equipment practically duplicates channel A

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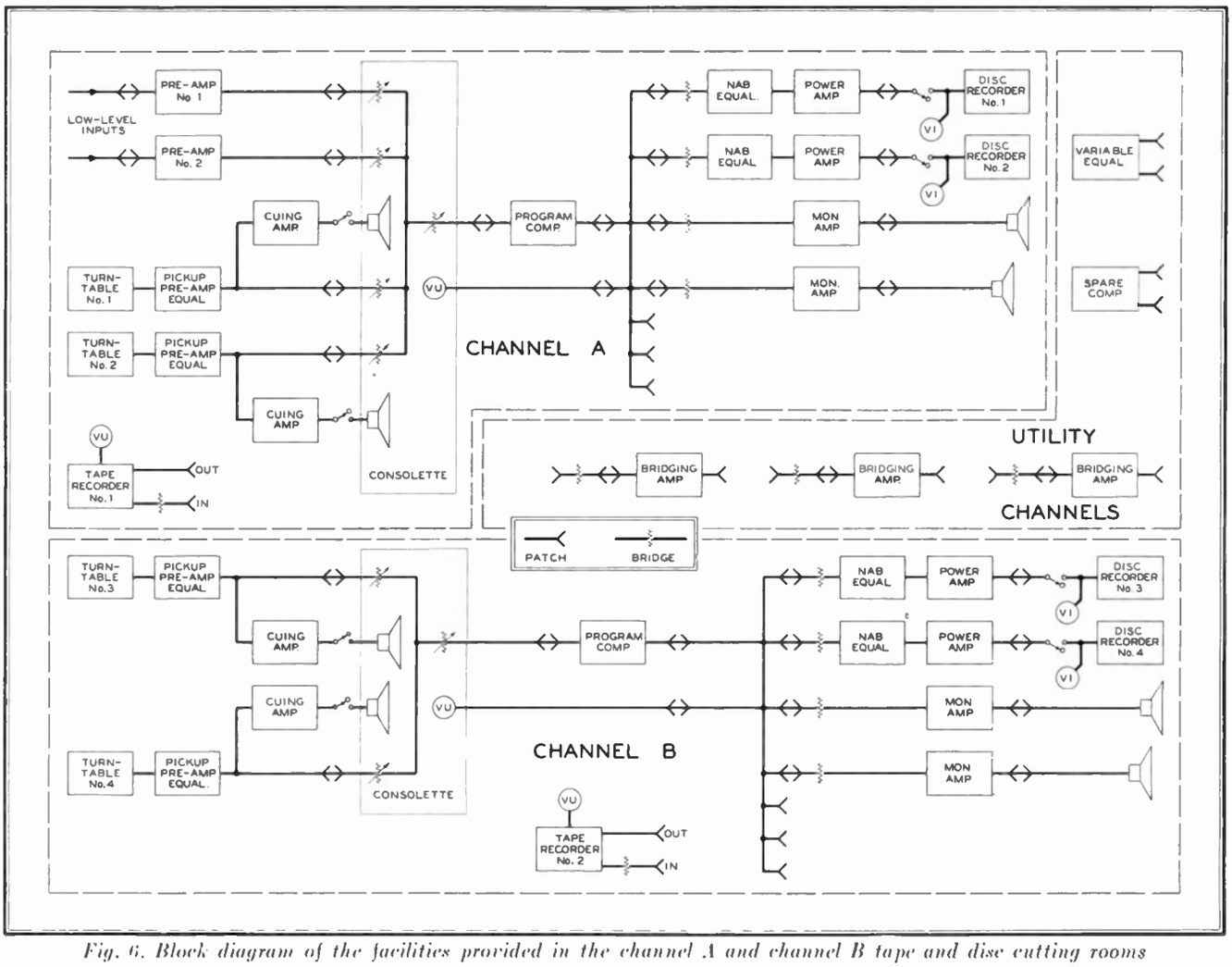


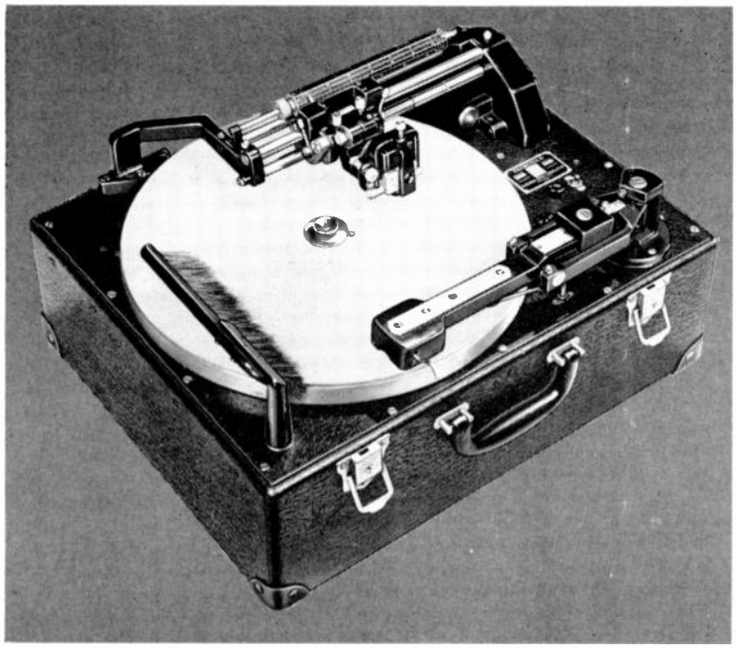
Fig. 6. Block diagram of the facilities provided in the channel A and channel B tape and disc cutting rooms

Lip-Synchronous Recording:

Recording sound tracks for motion picture film production requires recording and playback turntables that hold lip synchronism over long periods of continuous recording and playback. For this purpose, Fairchild recorders with direct-to-center turntable gear drive were used. They afford an accuracy of 1 part in 4.6×10^6 at the turntable. This means that during 20 minutes of program material, recorded and played back, the maximum time-error encountered is .0052 second. This far exceeds the requirements for motion picture productions.

The portable, synchronous unit shown

Fig. 7. Fairchild portable, lip-synchronous recorder. Fig. 8. George Piros at the control of the variable-pitch recorder



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SYLVANIA ELECTRIC

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in Fig. 7 is used in the field for location shots, and the discs dubbed to sound-on-film tracks at the studio. This eliminated most of the bulky, direct sound-on-film optical recording equipment usually required in location work.

Recording Full Dynamic Range:

Standard and long-playing Mercury records are produced in the Reeves plant. Every Mercury record label is marked Reeves-Fairchild Margin Control. These words indicate that full dynamic range is obtained through the use of the instantaneous, variable-pitch recorder described in Part 2 of this series.

Limiting factors of dynamic range have been the high basic noise level of record pressings which masks pianissimo passages, and the danger of overcutting on full forte passages. Before the perfection of vinilyte processing, it was necessary to cut all sound at maximum level to override the high basic noise of shellac-composition pressings. However, now that the basic noise has been so greatly reduced, the recording studios have gone all out for life-like dynamic range. Records cut in this way are beautiful to hear, for pianissimo passages are no longer lost in background noise and, by varying the cutting pitch, to avoid overcutting as the signal level increases, a full dynamic range can be achieved. The method of operation is shown in Fig. 8, where Reeves recording engineer George Piros is listening to the orchestra on the monitor system and, using a cue sheet, rides gain on loud passages simply by varying the cutting pitch. The control knob is located at the right of the lathe mechanism. Instantaneous and continuous pitch variation is accomplished simply by rotating this knob. It is not uncommon to find that the pitch is varied from 160 to 320 lines per inch during a single selection. The actual level recorded on Mercury records through the use of this technique is not below that recorded on standard 78-RPM discs. The dynamic range recorded is claimed to be as great as 62 db.

The cutterhead used to record the full forte without distortion is illustrated in Fig. 9. Because correct armature alignment is essential in order to maintain low distortion at high recording levels, a window is provided for visual checking of alignment. The adjustment, if needed, is simple and is made without disassembling the unit.

Master Control Room:

All audio facilities in the entire Reeves building terminate in the master control room on the fifth floor. Arranged in a wide U are 20 rack bays carrying the preamplifiers, amplifier power supplies, and relay power supplies for all the control rooms, and a total of 1,922 pairs of patch jacks. Every microphone outlet, control room mixer, tie line, monitor bus and program bus terminates at the master control patchboard. Thus any on-the-air studio can be fed to the optical film recorders on the third floor and to the disc and tape recorders on the fourth floor singly by direct patching, or simultaneously by multiple patching.

Conclusion:

Elaborate as the Reeves installation is, it employs the same basic recording and playback units listed in Part 1, and described in detail in Part 2. This confirms the statement made earlier that, by selecting units that are fully coordinated in mechanical and electrical design, the simplest studio equipment can be readily revised and expanded to meet new requirements, and without discarding any part of the original installation.

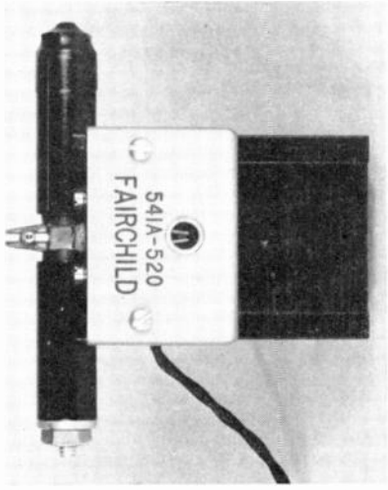

Fig. 9 High-level recording head

FM TUNER WITH AFC

(Continued from page 19)

tible to interference than the Armstrong circuit as used in the AFC-10. This is borne out by a series of experiments conducted in England by H. K. Milward and R. W. Hallows. Their findings were summarized as follows: 1) Though the difference in noise reduction is not great, the discriminator with one limiter is slightly superior in performance to the ratio detector. 2) The discriminator with two limiters is decidedly superior to the ratio detector. 3) The superiority of the limiter discriminator circuit is most marked when the noise level is high.

It was for these reasons that the Armstrong circuit was chosen for the AFC-10. A cascade limiter is employed using two 9001 tubes. The 9001 is a sharp-cutoff pentode, and makes an excellent limiter. Resistance-capacitance coupling is used between the two limiter stages. The limiters are designed to operate with very small input signals, full limiting being obtained on signals only slightly above the noise level. This limiter action is highly effective in removing noise and rejecting unwanted stations, even though they are on the same channel as the desired signal.

The AFC Circuit:

Fig. 4 shows the Foster-Seeley discriminator. The discriminator transformer has a primary resonant circuit in the plate of the second limiter. A center-tapped secondary feeds balanced signals to the two plates of a 6AL5 high-perveance double diode. In-phase signals are coupled to the secondary center tap by a small capacitor and equal and opposite DC voltages are developed across the two 100,000-ohm load resistors. The DC control voltage for the AFC circuit is obtained without any additional components. There is no net DC voltage across the two load resistors when the set is tuned to resonance with incoming signals, but a positive or negative voltage is developed when the set is detuned. The polarity of the DC voltage is dependent on the direction of mistuning. If the tuning is off resonance, the positive or negative voltage fed to the reactance tube has the effect of shifting the oscillator frequency so that the voltage becomes zero again. Thus, within limits, of course, this AFC action corrects for mistuning or drift. The control extends to each side of the center frequency of the incoming signals to the point where the selectivity of the receiver attenuates the signal so that the oscillator-reactance tube can no longer hold it. It is quite interesting to operate the dial of this receiver. As the tuning approaches the center frequency of a station, there is a "plop" and the signals are locked in. Turning the dial further has no audible effect until the station drops out.

Audio Output Circuit:

The audio frequency output from the discriminator is taken off through a 75-microsecond de-emphasis network. This compensates for the pre-emphasis of the higher frequencies introduced at the transmitter. A coupling capacitor separates the AC audio signals from the DC automatic frequency control voltage. The AC component is impressed across a .5-megohm volume control with left-hand taper.

A miniature type 6X4 full-wave rectifier supplies DC to a brute force filter which uses two high-capacity electrolytic capacitors and a resistance as a filter. Very little ripple is present in the output of the filter. The power transformer, mounted at the rear of the chassis on the right, also furnishes low-voltage AC to the cathode heaters and dial lights.

INDEX OF ARTICLES

for January to December, 1949

MOBILE RADIO HANDBOOK FIRST EDITION

Of all the radio books that have been published, here is the first complete handbook on mobile and point-to-point communications. Based on the new rules and allocations made effective by the FCC last July, the Mobile Radio Handbook covers this field from cost figures, system planning, and license applications, to maintenance, operation, and theory. Complete information is given for common carrier, public safety, industrial, and transportation services.

It is a big book, 8¾ by 11½ inches, of more than 200 pages, profusely illustrated with diagrams and detailed photographs of the latest types of equipment and installations.

This book has been planned to present practical, working information for company executives and public officials responsible for communication systems, as well as for radio engineers, supervisors, and operators. The chapters were written by men who are recognized authorities on the subjects treated. Milton B. Sleeper, publisher of *FM-TV* Magazine and one of the pioneers in mobile radio, is the Editor. Jeremiah Courtney, former FCC assistant general counsel and now a specialist in the mobile radio field, is Assistant Editor. Following is a list of the chapters, and a resume of the subjects covered:

1. PLANNING MOBILE SYSTEMS

General information for company executives, public officials and communications engineers on the layout of equipment and facilities for various types of systems, including data on the cost of equipment and towers.

2. FCC RULES AND ALLOCATIONS

Resumé of the rules, frequencies, and qualifications for each class of service, and a complete allocations table for the band from 30 to 30,000 mc.

3. HOW TO APPLY FOR A LICENSE

General instructions are given for selecting the proper FCC form, with step-by-step instructions for filling out a license application. There is also a list of FCC field offices, and the area served by each one.

4. FIXED AND MOBILE EQUIPMENT

Details of standard equipment for various service applications, and a complete table of specifications for all current types of fixed and mobile transmitters and receivers, including tube lists and current consumption data.

5. ADJACENT-CHANNEL OPERATION

A discussion of the engineering problems of adjacent-channel operation, and a description of equipment now available. This is a most important subject, in view of the new FCC rules applying to all transmitters which are installed after July 1, 1950.

6. SELECTIVE CALLING

Details of instantaneous and dial system, and their application to various types of mobile systems. This equipment deserves special attention, as the wide application of selective calling is expected to be the next big advance in mobile radio service.

7. TYPES OF ANTENNAS

Purposes and characteristics of various designs for specific types of communications systems.

8. ERECTION OF A GUYED TOWER

Detailed instructions for erecting a typical 105-ft. steel tower, with photographs showing progressive steps from start to finish.

9. POINT-TO-POINT SYSTEMS

Relays for remote transmitters, two-way communication for rural telephones, and multiplex systems, including cost-per-mile figures.

10. SYSTEM MAINTENANCE

Methods and records for routine maintenance of equipment, use of monitors, frequency meters and WWV calibrators, and FCC rules. Maintenance men will be particularly interested in the illustrations of typical service shops.

11. OPERATOR REQUIREMENTS

Training of operators, taking license examinations, FCC regulations concerning operators. Information presented on examinations for operators will be found particularly helpful.

12. FM THEORY

A thorough, non-mathematical explanation of frequency modulation transmission and reception, and the advantages of FM over AM for mobile systems.

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MOBILE RADIO NEWS

(Continued from page 13)

then, a number of grants have been made each succeeding week. Backlog was such, however, that the Commission was obliged to extend for one year from November 1st the terms of licenses expiring on that date. The extension order is applicable to all carriers whose applications for regular authorization were not disposed of by November 1 if placed on file with the Commission on or before September 1, 1949. This includes, of course, all those licensees whose applications are designated for hearing in congested metropolitan areas such as New York, Los Angeles, Philadelphia and Chicago.

In making the regular service limited common carrier grants, the Commission was apparently following its practice of assigning the channel 1 frequencies (152.03 and 158.49 mc.) in all cases where there was only one station operating in the area. In those cases where more than one station was operating in the same area, the assignment of the channel 1 frequencies depended on the plan made by the applicant for through service with other carriers, or on the relative number of mobile units in operation by both carriers.

Miscellaneous Intelligence:

The Commission has extended to May 1, 1950, the license term of all experimental Class 2 VHF specialized operational radio telephone maritime stations which would normally expire on November 1. The automatic extension was made pending preparation of rules which will place the VHF telephone maritime service on a regular basis. It was hoped that these marine rules would be issued in final form prior to November 1, but that date passed without issuance of Rules even in proposed form. As a result, all marine applications are bogged down and there is little doubt that the processing delays in this division of the Commission are, in consequence, the worst of any.

CERAMIC DIELECTRICS

(Continued from page 17)

Since the dielectric constant of the plates is 12,000 to 18,000, capacitors of 5 to 15 mfd. are attainable within a volume of one cubic inch. Capacitance variation is 11% at temperatures of −60 to +100°C. Further information on this subject is available in the "Properties of Calcium-Barium Titanate Dielectrics" by E. N. Bunting, G. R. Shelton, and A. S. Creamer, Research Paper RP2025, published by the National Bureau of Standards, Washington, D. C.

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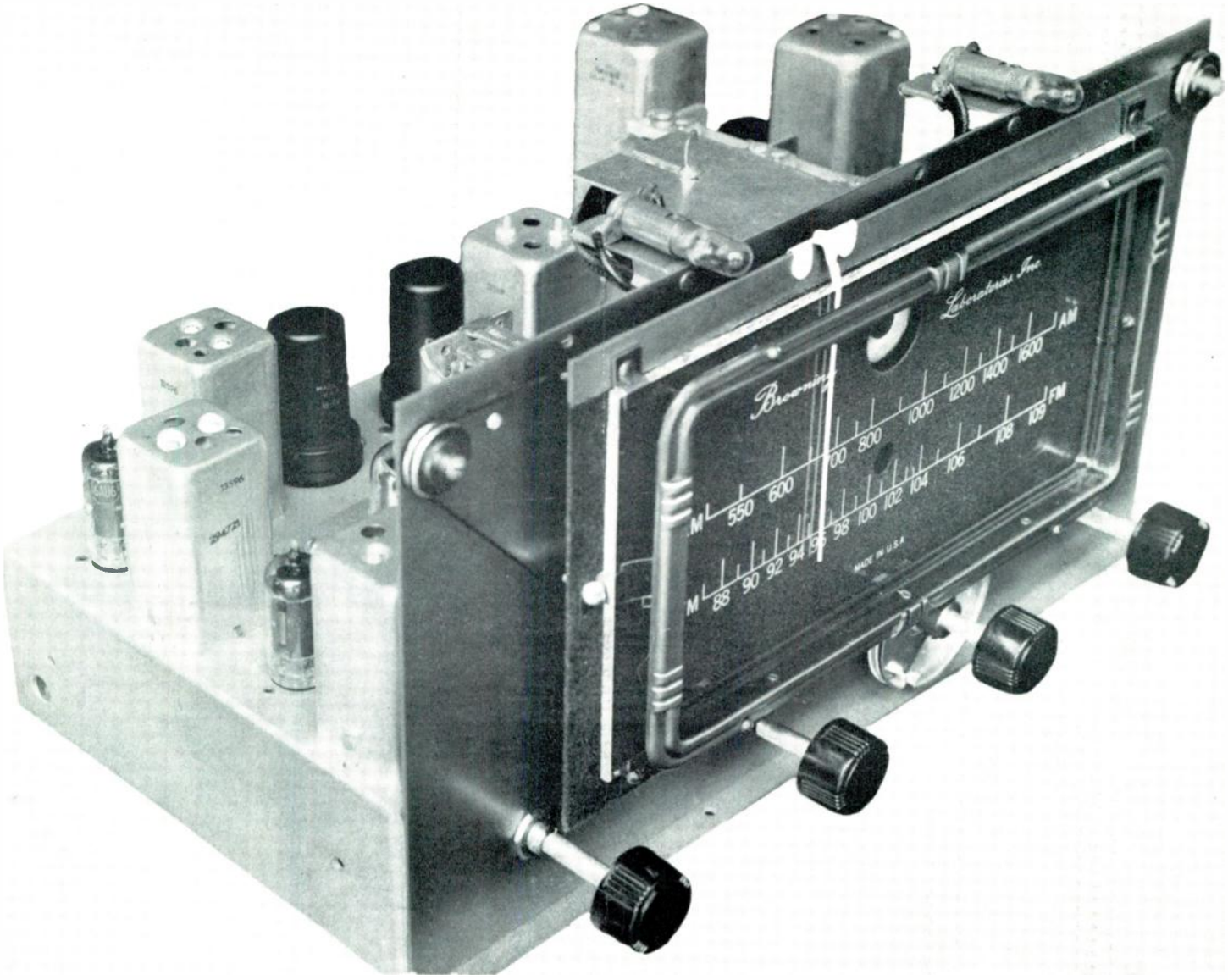

THE GENUINE ARMSTRONG FM CIRCUIT IN THIS RJ-12A FM-AM TUNER GIVES THE FINEST OVERALL PERFORMANCE OF ANY CIRCUIT AVAILABLE TODAY

Listen to the Difference!

When you plan an FM-AM installation, REMEMBER that the only thing that counts is what you hear from the loudspeaker. That's why we say: Before you buy any type of tuner, be sure you actually LISTEN to a BROWNING. Then let your own ears determine your final decision.

Long-distance, static-free FM reception requires the use of the Armstrong limiter-discriminator circuit. For the best Armstrong-circuit performance, use a BROWNING tuner. There's the FM-AM model RJ-12A without a built-in power supply illustrated above; the RJ-20, of similar design with bass and treble controls, and with power and supply, and the compact RV-10 straight-FM tuner with power supply. All Browning Tuners use the same FM circuit. For full details and performance curves, write:

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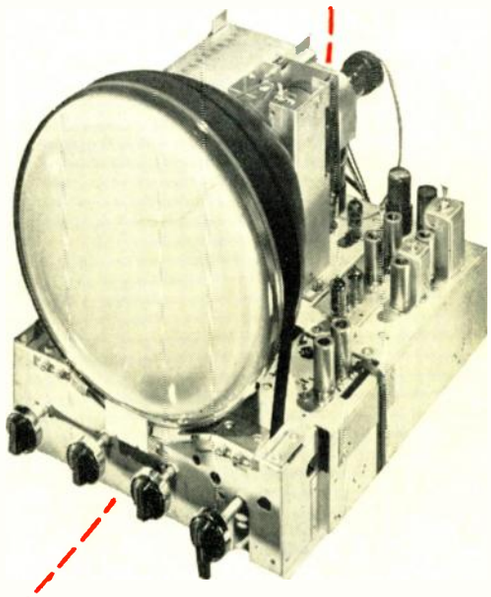

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