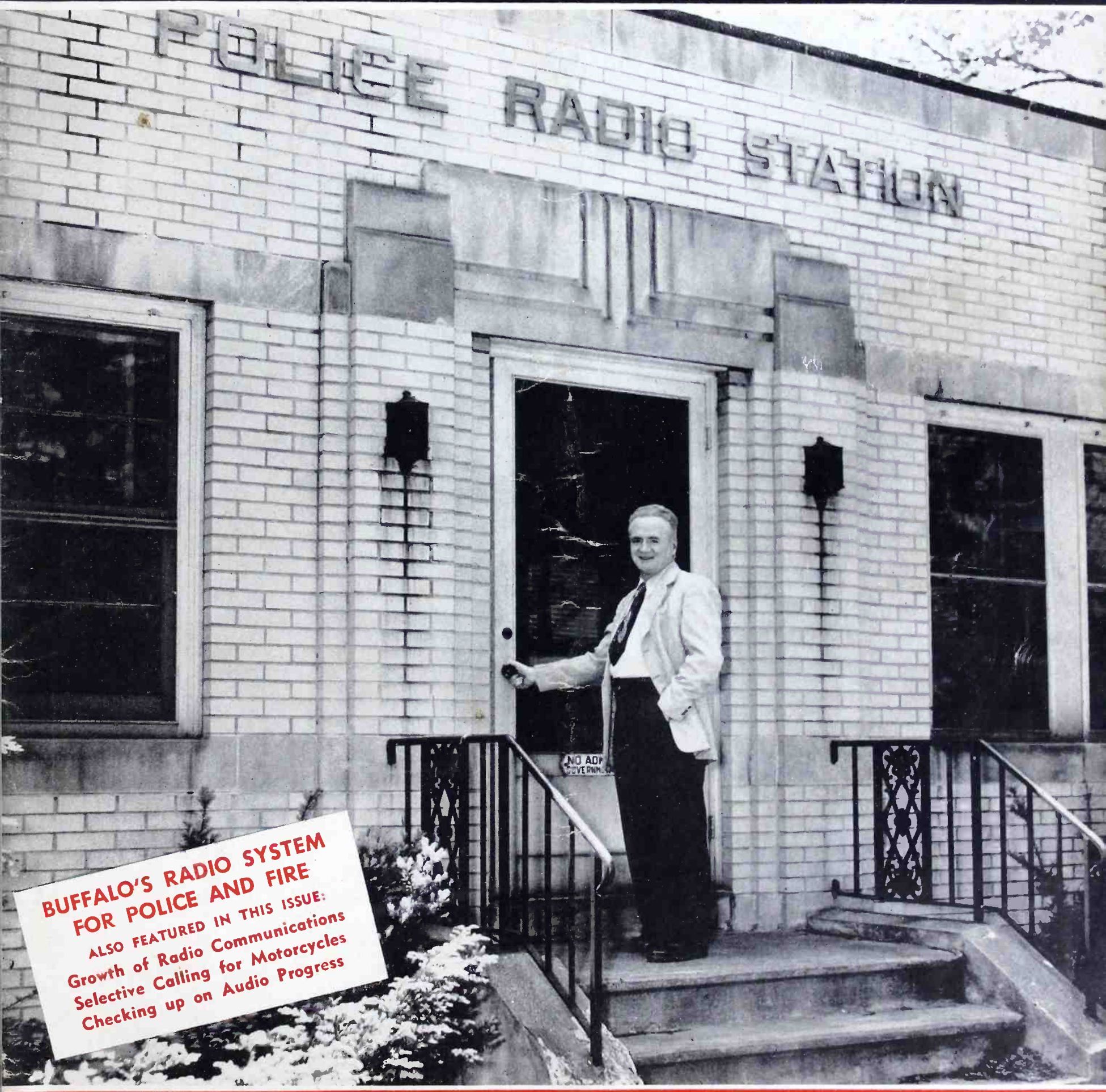
Price 35 Cents

July '51

FM-TV RADIO COMMUNICATION

★ ★ Edited by ★ ★
Milton B. Sleeper



BUFFALO'S RADIO SYSTEM FOR POLICE AND FIRE

ALSO FEATURED IN THIS ISSUE:

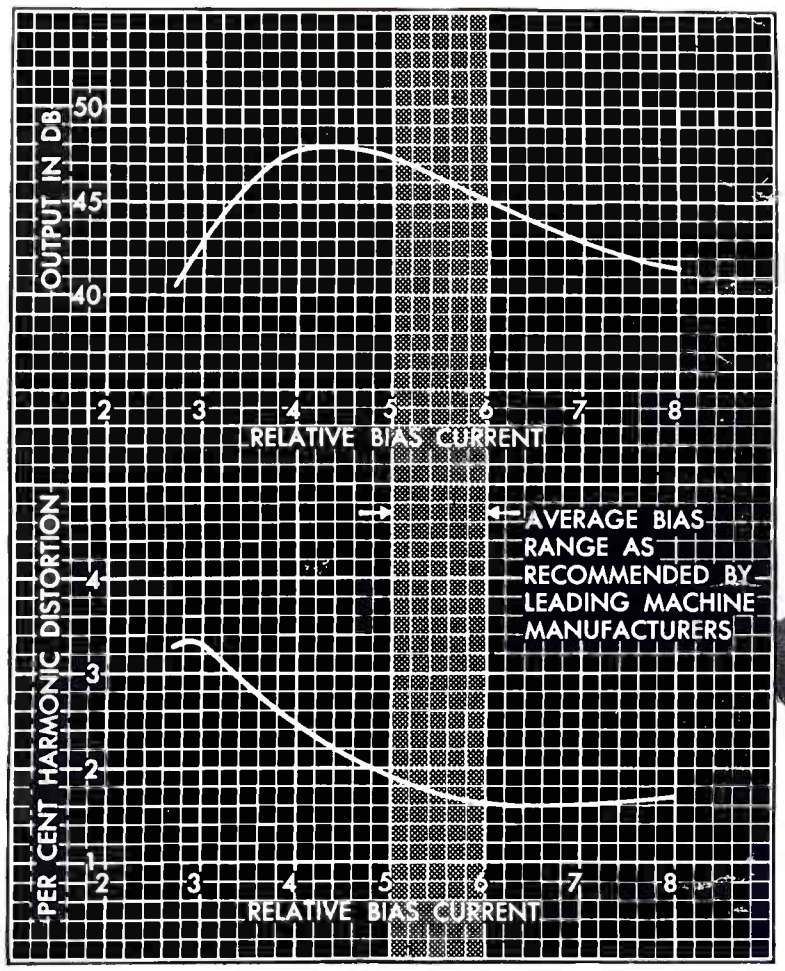
Growth of Radio Communications

Selective Calling for Motorcycles

Checking up on Audio Progress

11th Year of Service to Management and Engineering

For MAXIMUM OUTPUT with MINIMUM DISTORTION



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As all professional recordists know, the proper operation of any tape recorder involves a compromise between *decibels* and *distortion*. And Audiotape has been especially formulated with this important relationship in mind—to give you higher output (and thus better signal to noise ratio) and lower distortion in the normal bias range of all machines.

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That's just one of many reasons why more and more professional recordists are specifying Audiotape for their most exacting magnetic recording requirements. Remember—Audiotape is made *by* audio engineers, *for* audio engineers. *It speaks for itself.*

AUDIO DEVICES, Inc.

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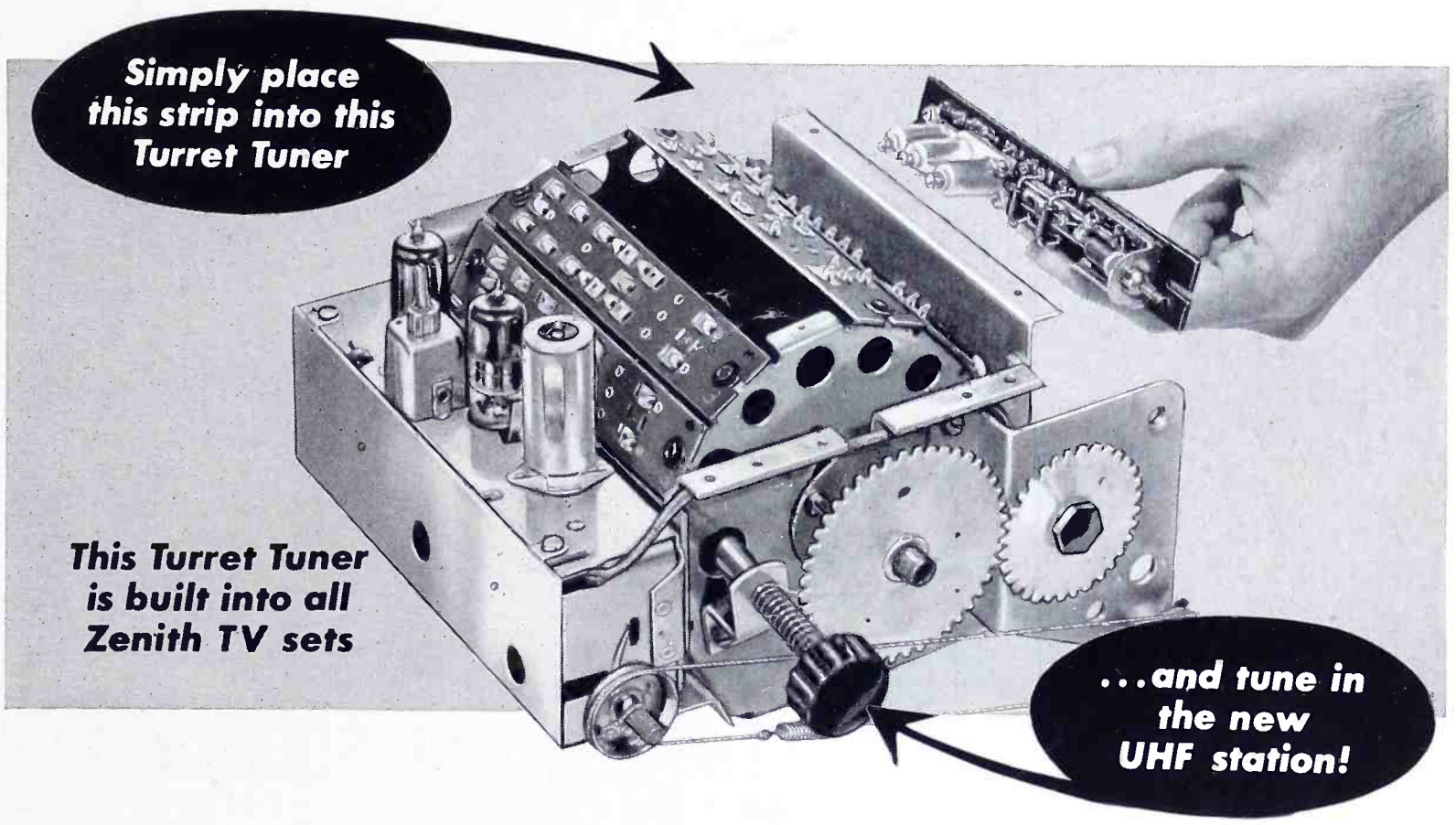
UNEQUALLED UNIFORMITY
in Every Package

YOU GET an Esterline-Angus output curve in every five-reel package of plastic-base Audiotape. This curve, made from one of the reels in that package, actually measures the output characteristics of all five reels, since they are all slit from the same roll after coating. Now you can *see*, as well as *hear*, the exceptionally high output uniformity that you get only in Audiotape. What's more, every 1250-ft. and 2500-ft. reel is guaranteed FREE FROM SPLICES!

THERE'S NOTHING WRONG WITH TV SALES that *UHF* won't cure– and Zenith has provision for it!



remember...

with UHF on the way, the goodwill of your customers is at stake. The sets you sell today, they'll expect to use tomorrow.

More TV stations... more TV programs ... and better-than-ever television entertainment! With all this on the way —and TV inventories at an all-time high—you've plenty of reason to put UHF to work making sales for you.

And Zenith alone guarantees that every television set it has ever built and sold to the public has built-in provision for tuner strips to receive the new UHF channels without a converter.

Tie-in with this sales-making bonus! And start boosting this coming new era of television entertainment today ... using Zenith's provision for UHF to build more sales, greater profits for you —now, and in the days ahead!

Learn the facts on UHF by writing today, *now*, for your free copy of Zenith's easy-to-read booklet titled "UHF Television—What It Is—What It Means To You." Mail this coupon now!

ZENITH "LONG DISTANCE" RADIO and TELEVISION

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6001 West Dickens Avenue, Chicago 39, Illinois

Please send your free booklet "UHF Television ... What It Is ... What It Means To You."

Name of Dealer.....

Address.....

City & State.....

Your Name.....

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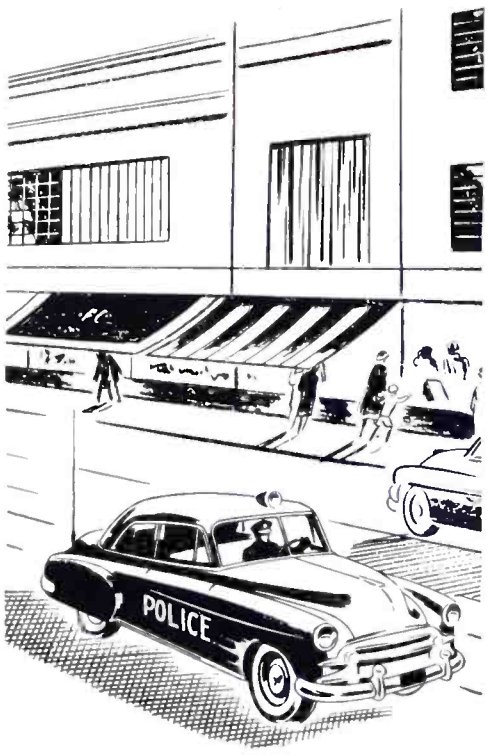

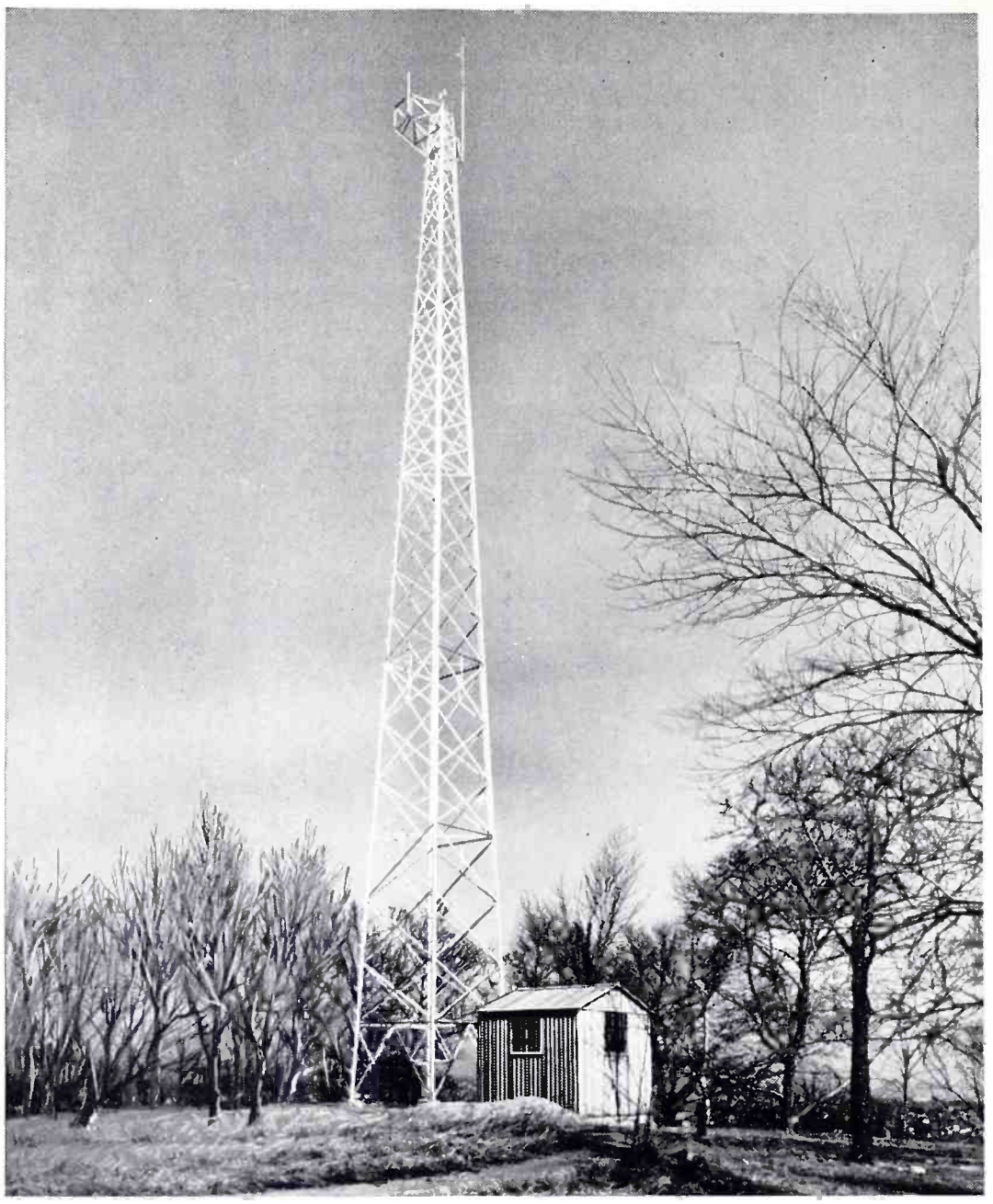

TOWERS THAT "TALK" TO THE STATE OR SQUAD CARS

Mobile Communications Systems naturally require no thousand-foot towers to cover their "beat." But isn't it good business to do business with a concern that makes both? There's no need to compromise on the antenna towers for your UHF system when you can be sure with a Blaw-Knox Tower *designed* especially for this important radio field. Scores of these self-supporting towers are now providing safe support for high-gain antennas that give maximum signal strength and soft-pedal the high noise level of metropolitan areas. The cost? No more than for "make-shift" structures.
For complete technical data just drop a note to

BLAW-KNOX DIVISION OF BLAW-KNOX COMPANY
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BLAW-KNOX *ANTENNA* TOWERS

FM-TV RADIO COMMUNICATION

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

VOL. 11 JULY, 1951 NO. 7

INDUSTRY NEWS

COMMUNICATIONS

APPARATUS DESIGN

AUDIO SECTION

SPECIAL DEPARTMENTS

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Published by: RADIOCOM, INC.

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

Chicago Office: 3035 Lake Avenue, Wilmette, Ill. Tel. Wilmette 5654

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

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

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

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

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

CPA AUDIT

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

Set Production

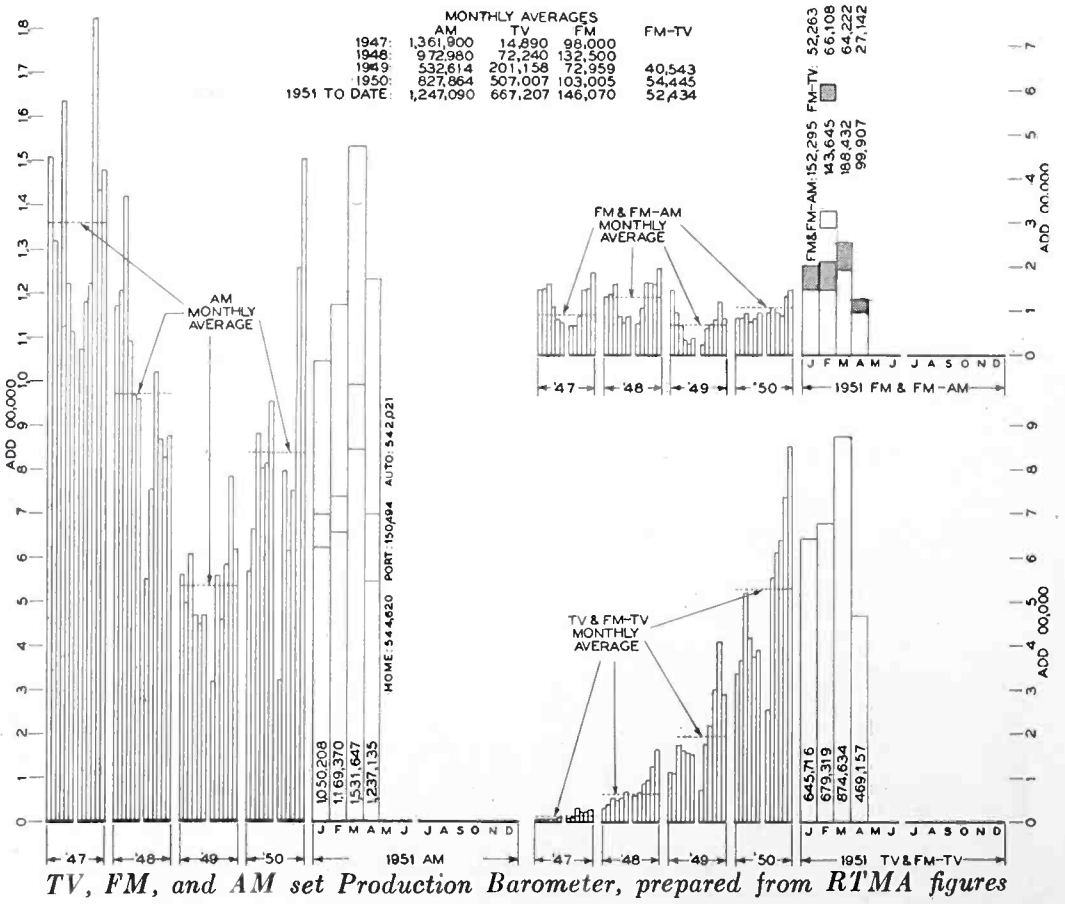
IT'S very difficult to make rhyme or reason from the picture of home radio set production as it develops from the monthly barometer. For four successive months, AM receivers have run about 50% ahead of the corresponding period of 1950. FM sets dropped off in May, but the average production this year is almost 50% above the '50 level. Meanwhile, despite all kinds of high-pressure promotion, TV models have become almost a drug on the market. In Charlotte, N. C., for example, one dealer has been offering a week's vacation free to purchasers of TV sets.

It's the volume of set purchases, and not the volume of promotion, that builds audiences. Nevertheless, networks and many broadcasters continue to discount audio in an apparent effort to convince themselves of the relatively greater importance of television.

Nor is there much conviction in announcements from manufacturers that TV production is being cut to shift facilities to military production, or because of limited supplies of essential materials. Military radio contracts that swamped manufacturers during the last war are not large compared to the capacity that was built up subsequently for civilian set production. And a considerable part of the radio contracts released currently is going into plants that never produced consumer products, or new plants that have been or will be built specifically for military equipment and components. This is borne out in the RTMA report that Government contracts placed with member companies for radio and communication equipment, including radar, fire control, and sonar apparatus amounted to only $184 million in the first quarter of 1951 as compared to $41 million in the same period last year.

Picture tube sales in April dropped 54% below the March figure. Sales to manufacturers were 278,955 units, amounting to $6,869,181, compared to 608,396 units or $16,064,425 in March. Of the April production, 89% of the tubes sold to manufacturers were rectangular, and 95% were 16 ins. or larger.

Receiver tube production continued at a high level, though somewhat below the all-time record established in March. The total of 35,883,627 units was divided as follows: 22,453,223 to radio manufacturers; 2,831,167 to manufacturers of non-radio equipment; 9,052,251 for replacements; 1,317,647 for export; 229,339 for Government agencies.

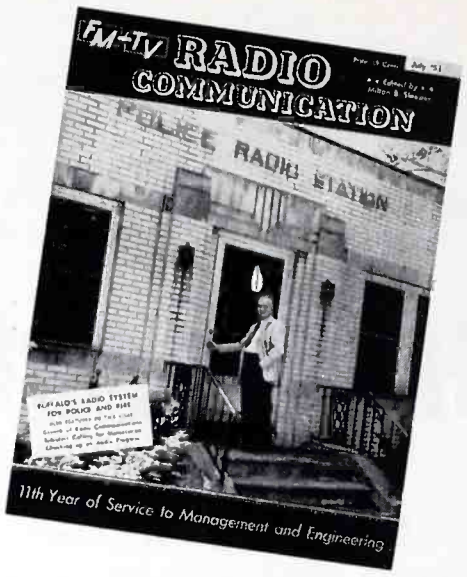


TV, FM, and AM set Production Barometer, prepared from RTMA figures

THIS MONTH'S COVER

This month's cover shows Lawrence Geno, Buffalo's Supervising Radio Technician, at the door of one of the most modern police and fire radio stations in the U. S. We are very pleased to present his description of this system, for it incorporates many ideas which should be useful to radio engineers concerned not only with this but all the other radio services.

Buffalo has had police radio since 1928. Thus the plan of this Motorola installation represents 23 years of operating experience. Larry Geno has been on this job since 1932, with time out to do a Captain's job in the Air Force during the last war.



SPOT NEWS NOTES

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

Leroy A. Wilson, 1901-1951:

On June 28, only three years after his election as president of the American Telephone & Telegraph Company, and scarcely a month after signing a certificate for the Company's millionth stockholder, Leroy A. Wilson passed away at the New York Presbyterian Hospital. He had been ill for two weeks.

Coming up through the ranks of the Telephone Company he assumed the burden, as president, of the tremendous new financing necessary to meet the postwar demand for added telephone service and plant facilities. His success is indicated by the fact that the number of stockholders increased by one-third in the brief period of three years. This accomplishment was not one of financial wizardry, however. It was attained, rather, through the concept of public service achieved by sound management and continuous technical progress.

This was emphasized in a message from Mr. Wilson to the supervisory staff of Bell Telephone Laboratories, delivered in January, 1950, in which he said: "Telephone service begins with technology, and continuously through the years it has been the widening of technical horizons that has made possible the expansion and improvement of the service. The greater the range and usefulness of the service, the more extensive and intricate our technical knowledge and physical equipment have first had to be. But I would emphasize that although technology must come before the service, the service *idea* comes before technology. The great success of the Bell Telephone Laboratories in advancing the art of telephony has come out of the continuous underlying motive of providing telephone service — more service, more dependable and steadily improving service, and new services which make possible the communication of intelligence in more and more ways. The service motive has always been the foundation of everything we do, and I am sure that this will continue to be the foundation of your success in the future."

Mr. Wilson posed for the photograph reproduced here on the occasion of the inauguration of television service over the AT & T cable between New York and Chicago. This exclusive picture appeared as a full page illustration in our issue of February, 1949.

LEROY WILSON AT OPENING OF CHICAGO RELAY

Stereophonic Broadcasting:

The NBC report on page 34 of this issue refers to the use of stereophonic transmission and reception. This prompts the thought: Why not use John V. L. Hogan's very inexpensive method of multiplex transmission, described last month, Seems like a natural for this purpose.

Poor FM Quality:

We are getting many letters complaining that FM reception of records is far below the audio quality that can be ob-

(Continued on page 7)

SPOT NEWS NOTES

(Continued from page 6)

tained by playing the same records in listeners' homes. Probability is that tone controls are adjusted for AM transmission, and the output fed to both AM and FM transmitters.

Attention Mr. Kinzie:

According to Sylvania engineers, "Deviation from transducer responses represents infidelity, some of which may prove tolerable and even expedient."

Wasted FM Coverage:

Many broadcasters not only give away FM time, but they don't realize that they are providing solid FM signals far beyond their AM range. For example, it is not unusual to hear on FM such sponsor identification as: "Thompson and Jarrett Company, 570 Lake Street." But Lake Street, in what city? No doubt the AM signals only get out to the city limits, but the FM transmission may be solid at 30 or 40 miles, and there may be several cities in an area of 3,000 to 5,000 square miles!

TV Center for WOR:

New York City studio building now under construction will occupy the entire block bounded by Broadway, Columbus Avenue, 67th, and 68th Streets. Occupancy is scheduled for January, 1952.

FM Sets for Schools:

Although sets have been offered as meeting the specifications of the U. S. Office of Education, the fact is that no such specifications have been issued from this Office, nor has approval been given to any FM sets for use in public schools.

Compatible TV Color:

RCA's demonstration of compatible TV color transmission at New York during the week of July 8 brought unanimous praise from the press, industry, executives, and owners of black-and white receivers. Said Dr. Allen B. DuMont: "It was a lot better color televison than RCA showed us in Washington last December. The picture was good enough, in fact, to start commercial operations immediately. This summed up the opinions of such observers as William Balderson of Philco, Dr. W. R. G. Baker of G. E., Jack Binns of Hazeltine, Robert Galvin of Motorola, Roy Durst of Hallicrafters, and W. H. Meyers of Crosley. This was the first public demonstration with RCA's 21-in. tricolor tube.

Nathaniel B. Nichols:

Appointed manager of Raytheon's research division at Waltham, Mass. Mr. Nichols is particularly distinguished for

(Continued on page 8)

SPOT NEWS NOTES

(Continued from page 7)

his work on servo mechanisms and automatic controls.

New Company Name:

Air King Products Company of Brooklyn, merged recently with CBS, is now known as CBS-Columbia, Inc.

Annual ATA Convention:

Convention of the American Taxi Association will be held this year at Hotel Sherman, Chicago, September 10 to 12. Information can be obtained from the executive secretary, 4415 California Avenue, Chicago 25.

UHF Channels for TV:

Now that FCC Chairman Coy has stated officially that the FM broadcast band will not be carved up to make additional VHF channels for TV, it's beginning to look as if the decision makes sense for the television broadcasters. In our next issue we shall offer for our readers a review of information, well-authenticated by some 10 years of practical operating experience and engineering research, which indicates that 1) the advantages of VHF channels may be overrated, 2) the advantages of UHF may be underestimated, and 3) when the hysterical struggle for VHF channels is ended by final allocations, it may develop that reception from UHF stations will be substantially more satisfactory than from those operating on VHF. This is not offered as a prediction, but there is much evidence to support it.

Microwave Relay:

A T & T has applied to the FCC to extend its microwave relay to include a link between Rochester and Syracuse, N. Y. Rochester now gets TV programs by radio relay from Buffalo. Another link is planned to start from the New York-Washington relay at Garden City, Va., extending to Charlotte and Atlanta.

More Military Production:

To accommodate additional Government orders, RCA is converting another Camden factory unit from civilian to military radio production.

Radio Handbook:

The 13th edition of the Radio Handbook, now grown up to 736 pages without advertising, has just been published by Editors and Engineers, Ltd., Santa Barbara, Calif. Price is $6.25 postpaid.

Vibrator Replacements:

A vibrator replacement guide, listing base wiring diagrams and equivalent James, Mallory, and Radiart types is

(Concluded on page 9)

SPOT NEWS NOTES

(Continued from page 8)

available from James Vibrapower Company, 4036 N. Rockwell Avenue, Chicago 18.

Wallace R. MacGregor:

Former common-carrier engineer on the FCC staff, has joined Lenkurt Electric Sales Company as manager of government sales on carrier telephone and telegraph systems. He will have offices at Washington and Monmouth County.

UHF Converters:

On June 29, at Bridgeport, Conn., RTMA gave the FCC a highly successful demonstration of UHF reception, using converters to pick up the NBC station. Companies participating were: Hallicrafters, G-E, Motorola, Stromberg, Du Mont, RCA, Zenith, Capehart, Philco, and Mallory.

Power Tube Plant:

Raytheon is building a $2 million plant of 144,000 square feet at Waltham, to augment its power tube production. Construction is scheduled to be completed this fall.

FM Set Shortage:

According to RTMA, there is no shortage of FM broadcast receivers. Survey figures released show 145,059 sets in distributors' inventories, and 42,872 in factory inventories. Suspicion is that most of these are inferior in performance, and may never be sold. Figures did not show how much Zenith and G-E are behind in deliveries, or the shortage of high-quality FM chassis.

Edward W. Allen, Jr.:

Appointed Chief Engineer of Federal Communications Commission. In 1935, he left the post of assistant examiner at the Patent Office to join the Commission as an assistant technical engineer. He moved up in the organization until, in 1946, he was made Chief of the Technical Information Division.

Tube Plant:

To provide increased production of high-reliability tubes, G-E will build a $6 million plant at Anniston, Ala., of 150,000 square feet, giving employment to over 2,000 people. Completion is scheduled for early 1952.

Laboratory Equipment:

NPA has provided in Order M-71 a self-certification system whereby laboratories can obtain controlled materials and equipment. Purpose is to eliminate the spot assistance from NPA on which they have had to depend in the past.

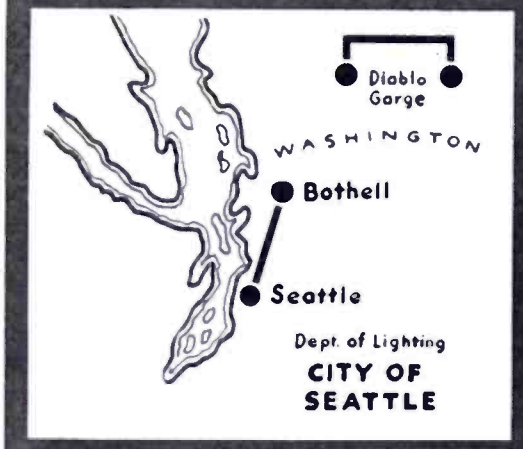
Federal
PTM MICROWAVE

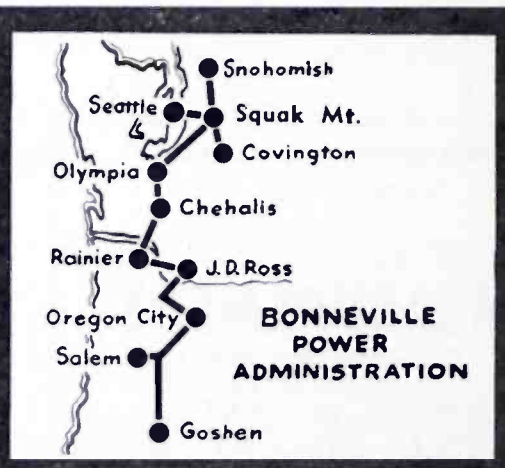
Provides Complete Communications For Power Utilities . . . plus

Centralized Operation!

INSTANTANEOUS, CONTINUOUS SERVICE

Federal has the system that offers the most positive basic channels for telephone, telemetering and remote control circuits . . . with tie-in of all mobile radio units.





PROOF OF PERFORMANCE!

These four great utilities have selected Federal Pulse-Time Modulation Microwave—the first system to serve a power utility. Two have recently re-ordered.

Detroit-Edison's efficiently-operating system will install extra channels and a 42-mile extension . . . Bonneville Power Administration's present successful system will be extended 128 route miles.

Here is gilt-edged proof of the reliability, continuity and quality service provided by all-purpose, all-weather PTM systems engineered by Federal . . . pioneer in modern microwave techniques . . . world leader in systems of simplest design, highest power and lowest maintenance.

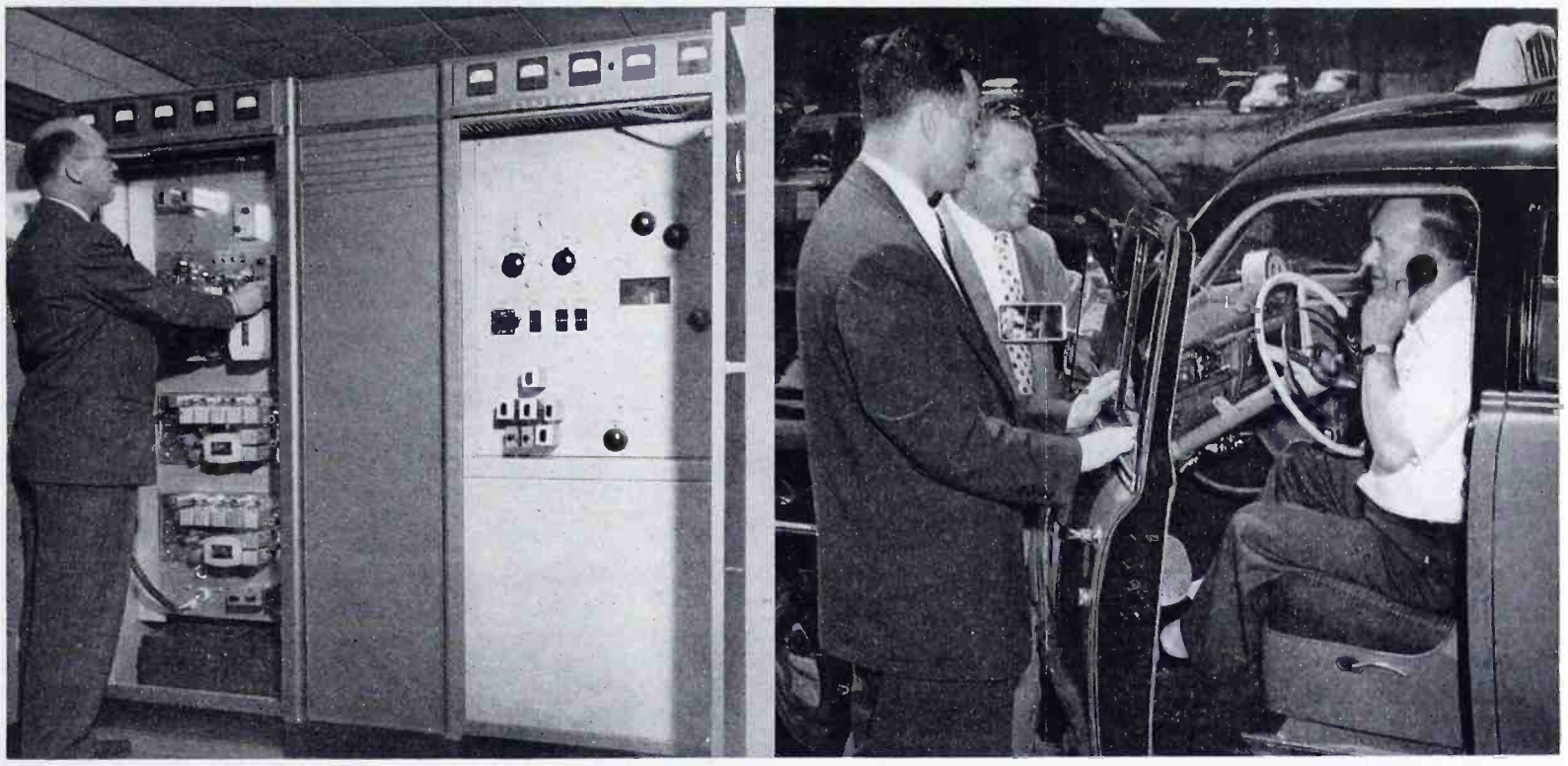
Write, wire or telephone today for complete, up-to-the-minute proof-of-performance information on Federal PTM Microwave. Address: Wire and Radio Transmission Systems Division, Dept. 2-420.

FEDERAL TELECOMMUNICATION LABORATORIES, Nutley, N. J. . . . . a unit of IT&T's world-wide research and engineering organization.

Federal Telephone and Radio Corporation

100 KINGSLAND ROAD, CLIFTON, NEW JERSEY

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



LEFT: GE3-KW. FM TRANSMITTER FOR THE KANSAS HIGHWAY COMMISSION RIGHT: IN NEWARK, N. J., 250 TAXIS WILL USE 450-MC. LINK MOBILE UNITS

IMPORTANT NEWS FROM THE FCC

CHAIRMAN COY'S LETTER CONCERNING THE FM BROADCAST BAND — THE FCC DECIDES AGAINST COMMON CARRIERS ON 470 TO 500 MC., IN FAVOR OF TV

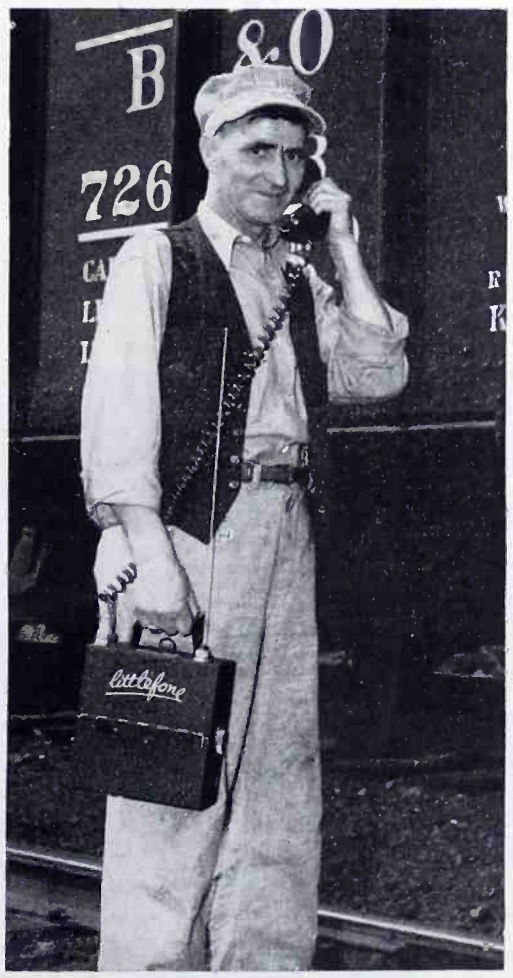
ANY idea that the FCC plans to reduce the width of the FM broadcast band has been dispelled by the Chairman's reply to a letter addressed to him by Josh Horne, of station WFMA, Rocky Mount, N. C. Following is the text of Mr. Horne's letter to Chairman Coy, dated July 10:

You have probably noticed the editorial in *Broadcasting* just issued, wherein it suggest that FM have 18 of its 20 megacycles taken from it and allocated to television, and that the 700 FM stations be re-allocated into 2 megacycles.

The best engineering I can get feels that this is nonsense from a technical point of view, and that there are large areas where FM even now needs all the spectrum space it has. However, as an attack on FM, a system that refuses to be killed off and which is beginning to make progress against vested interests, the editorial is not so foolish. Editorials such as these hurt FM in about the only way that is left open to its enemies to hurt it — by discouraging the production of FM sets by the manufacturers, and leaving a buying public in a dilemma, and inclining the interest of the time buyer away from this medium.

The first paragraph of the editorial reads as follows:

"Whenever trouble brews, there's always the quest for a whipping boy. FM is a trouble area now in sharp focus — much more than most FM-ers realize.



B & O RAILROAD RADIO INSTALLATION INCLUDES DOOLITTLE PORTABLE UNITS FOR TRAIN CREWS

Simply stated, the FCC is pondering what it should do about the vast expanse of spectrum space assigned to, but not being used by FM."

You will see from this that *Broadcasting* states as a fact that the Commission is considering cutting down FM's space. I cannot believe this statement is true and I ask you, as Chairman of the Commission, to put in the public record a statement of what the facts are. I think the Commission owes such a statement to the public and to those of us who invested their money in FM to give the people what the Commission has called the finest of aural broadcast service. In the light of your persistent denial in private letters to me and in personal conference, I hope you will now issue a public statement.

Kindest personal regards,

Yours sincerely

JOSH L. HORNE

On July 13, the following letter to Mr. Horne from Chairman Coy was released by the FCC as a public notice:

I have your letter of July 10 referring to an editorial in a recent issue of *Broadcasting Magazine* wherein it is suggested that FM have eighteen of its twenty megacycles taken from it and allocated to television. The editorial further states that "The FCC is pondering what it

(Continued on page 22)

FIG. 1. IN ST. PAUL, IF AN OFFICER LEAVES HIS BIKE, A SIGNAL LIGHT FLASHES WHEN POLICE HEADQUARTERS WANTS TO TALK TO HIM

NEW USE FOR SELECTIVE CALLING

UTILITY OF POLICE MOTORCYCLES IS INCREASED GREATLY BY THE ADDITION OF SELECTIVE RADIO CALLING TO ACTUATE SIGNAL LIGHT OR HORN

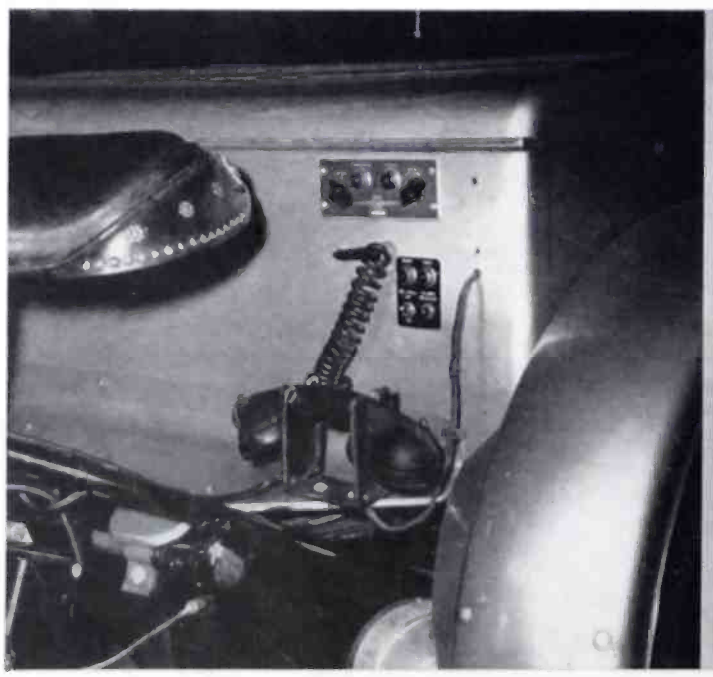
WITH the advent of 2-way radio, many police departments gave up the use of motorcycles and tricycles in favor of cruising cars. This came about because the lack of radio communication outweighed certain advantages of the motorcycle. On the other hand, it became necessary to send out patrol cars with two men on many occasions when only one man was actually needed.

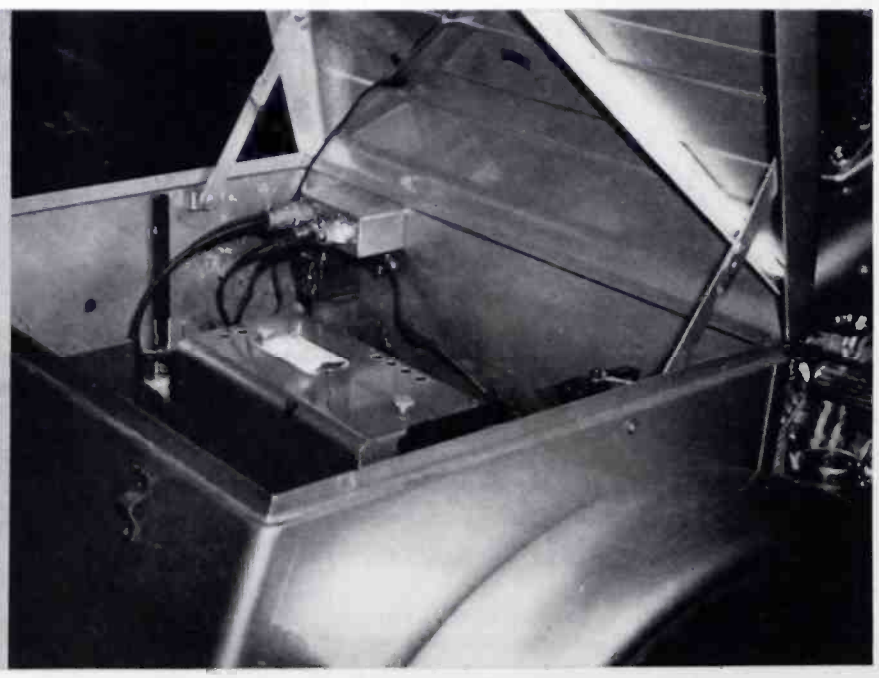
This applies particularly to special traffic duty when there are unusually large crowds to be handled, during rush hours at busy intersections, or at times when children are going to and from the schools.

More recently, with special 2-way radio equipment available, the use of motorcycles has been coming back. There has remained one handicap, however. When an officer leaves his motorcycle, he cannot be reached by radio.

The City of St. Paul has worked out a very practical answer to that problem by adding selective calling to the tricycle radio equipment. Fig. 1 shows such an installation. Fig. 2 is a close-up of the hand piece mounting and controls, while Fig. 3 shows the standard Link radio equipment. The Hammarlund selective calling unit is carried in a small steel case, mounted adjacent to the radio chassis. At police headquarters, when the button is pushed corresponding to the tricycle called, a red signal shows at the tricycle until the call is answered.

FIG. 2. RADIO AND SELECTIVE CALLING CONTROLS, AND MOUNTING FOR THE HANDPIECE. FIG. 3. INSTALLATION OF THE COMPLETE RADIO EQUIPMENT





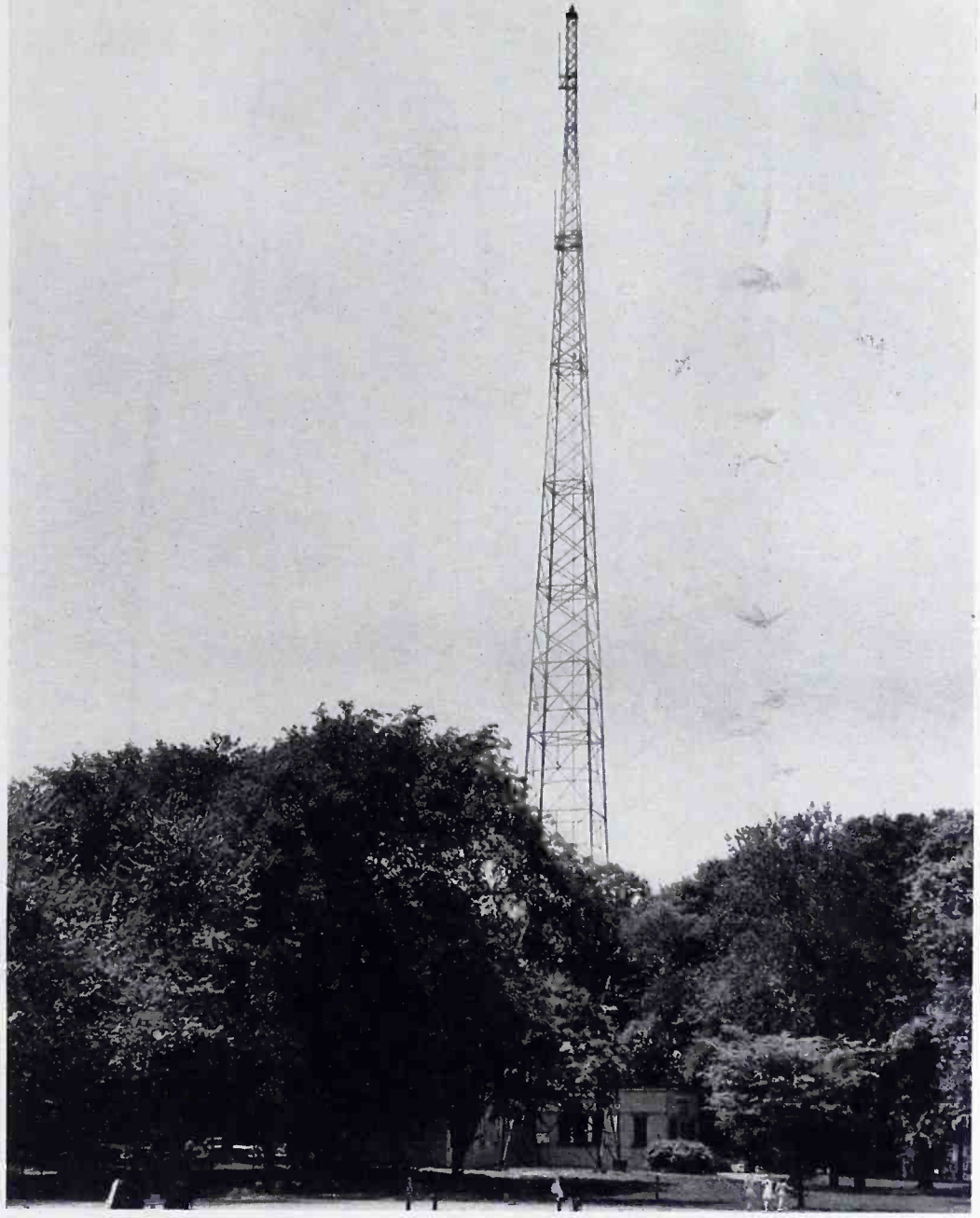


FIG. 1. ANTENNAS ARE MOUNTED AT THE SIDE OF THE 225-FT. BLAW-KNOX TOWER TO GIVE A CARDIOID RADIATION PATTERN. STATION IS LOCATED AT DELAWARE PARK

POLICE AND FIRE RADIO SYSTEM AT BUFFALO

NEW INSTALLATION REPRESENTS 10 YEARS OF OPERATING EXPERIENCE — *By* LAWRENCE GENO*

AN unusual combination of circumstances create conditions in Buffalo that require the very highest type of public service on the part of the police and fire departments. Radio has contributed conspicuously in making it possible for these departments to meet the needs of the community.

Buffalo's population of 600,000 is concentrated in a highly industrialized area of only 42 square miles. It ranks 11th in manufactured output, producing over $1 billion annually from a great number of widely diversified plants. Most of these are relatively small, but the total includes the world's largest flour-and-feed mill (General Mills), tremendous steel plants, and factories that produce Wurlitzer jukeboxes, AM & F pretzel-benders, Sylvania TV sets, Irving parachutes, Westinghouse motors, and Bell Aircraft guided missiles and rocket engines.

To the problems of protection involved in such an industrial concentration are those created by enormous rail traffic (second only to Chicago) and the largest volume of inland port cargo. This explains what may seem to be a disproportionately large number of radio-equipped police vehicles, and the thoroughly integrated use of radio communication by the fire department. The first radio system at Buffalo was installed in 1928. The present installation, completed in the spring of this year, employs Motorola equipment in a system designed in accordance with the most modern methods and practices.

Almost every communication engineer who visits the headquarters building of our police and fire radio system for the first time remarks: "What a beautiful location you have for your station." And then he is sure to ask: "But why do you have your antennas on the side of the tower?"

The site in Delaware Park, Fig. 1, was chosen for purely function reasons, and the mounting of the antennas was neither an accident nor a mistake. Actually, the Park location was selected because it was more free from electrical disturbances than any other spot where the station could have been erected. As for the antennas: the City of Buffalo is approximately rectangular in shape, about 14 miles long and 3 miles wide. The location of the radio building within this area is such that a cardioid radiation pattern gives us the required coverage with minimum signals outside. Unlike many of the larger cities, we do not provide service to any adjacent towns because they prefer to operate their own radio systems independently.

However, the Buffalo police and fire departments share the same radio facilities in a manner that assures highly efficient coordinated operation, yet allows a degree of independence that should exist between two such municipal organizations.

Plan of Operation:

The police base transmitter operates on 155.73 mc., while the cars talk back on 155.97 mc. Mobile transmitters can also use 155.73 mc. for car to car communication. The fire department also has two frequencies, but they are used in a dif-

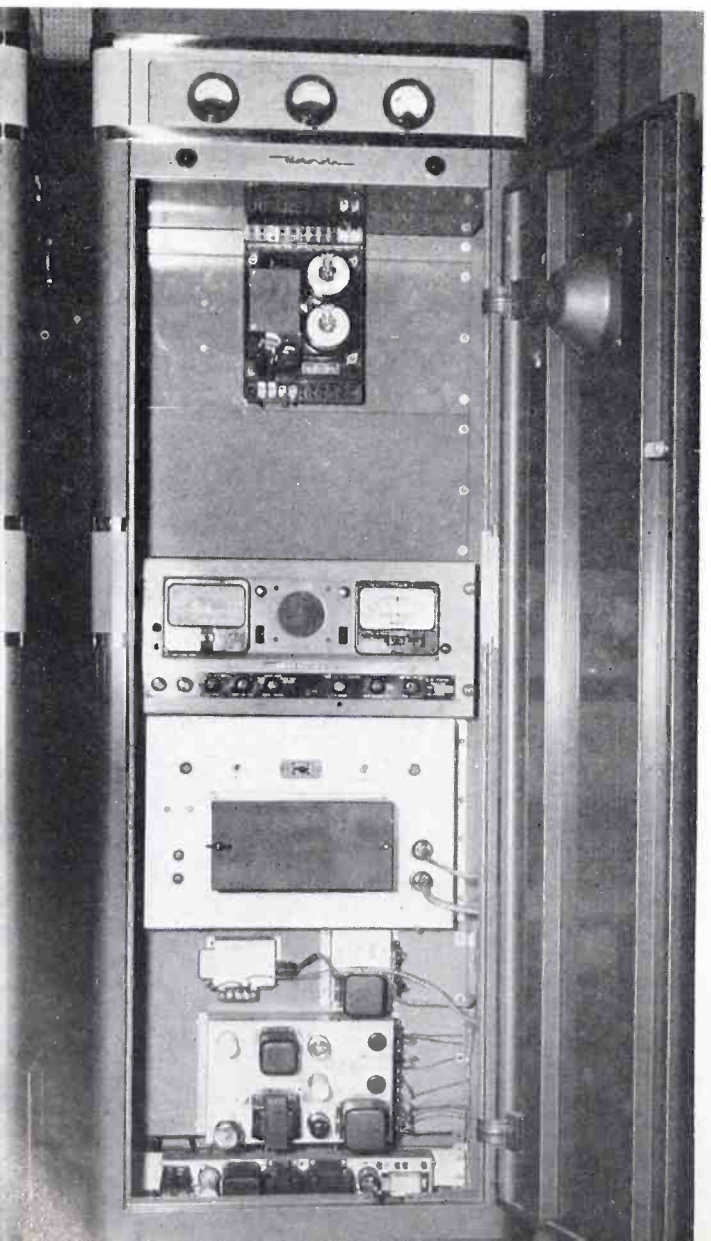
POLICE COMMR. MICHAEL NOEPPEL: "RADIO REDUCES CRIME, BUILDS PUBLIC CONFIDENCE."

* Supervising Radio Technician, Buffalo Police Department, Buffalo, N. Y.

FIG. 2. THE MASTER CONTROL CONSOLE AT THE HEADQUARTERS STATION PROVIDES FOR OPERATING THE LOCAL POLICE AND FIRE SYSTEMS, AND ALSO THE BUFFALO STATION OF THE INTERCITY POLICE RADIO TELEGRAPH NETWORK. VOICE AND CODE TRANSMITTERS CAN BE SEEN AT THE REAR

ferent manner. Normally, the cars and the base station use 154.19 mc. A frequency assignment of 153.89 mc. is held in reserve to provide for future expansion of the system.

FIG. 3. THIS CABINET CONTAINS THE TOWER LIGHT CONTROLS, MONITORS, AND TEST CONTROLS



Altogether, there are 110 radio equipped police vehicles. These are: 99 cars used by the Police Commissioner, Deputy Commissioner, Chief of Detectives, inspectors, detectives, officers assigned to the narcotics, arson, auto theft, accident investigation, and vice and gambling squads, and the patrolmen, two of whom always ride together.

4 tow cars
1 signal repair truck
4 motorcycles
2 ambulances

The department also has 2 pack sets and two Handie-Talkies. Receivers have been installed at 21 station houses.

Mobile units have been installed on 25 fire department vehicles. These are: 14 cars used by the Fire Commissioner, Deputies, Superintendent of Signals, Master Mechanic, and 9 Battalion Chiefs

1 fireboat
1 emergency truck used as a mobile headquarters station
1 fire prevention bureau car
1 car for the C-D coordinator
6 rescue squad cars
1 radio service truck

In addition the fire department has 2 pack sets and 4 Handie-Talkies. Radio equipment has not been installed on fire apparatus up to this time. This will be done later.

Duplicate police and fire transmitters are located at the main station. In addition there is a 50-watt transmitter with a separate antenna for use in any emergency that might affect the tower or the regular transmitters.

Normally, incoming messages are picked up on receivers installed in duplicate at the City Hall, and connected by telephone lines to the main station. However, there are also receivers at the latter location for use in case of line failure. Direct telephone connections are provided to police and fire headquarters, as well as to the Bell System control office.

Police traffic is handled by operators at the main station. Two operating positions, Figs. 2 and 4, are provided for this purpose. The fire traffic is handled independently from a console installed at fire alarm headquarters, Fig. 12. Although not shown in that illustration, the telephone switchboard is just at the left of the console.

Main Station Details:

The ground floor of the main station contains the transmitter room, Fig. 2, where the master control console is located; a dispatcher's room, Fig. 4, directly across the hall; an office for the supervisor; and a drive-in service shop, Fig. 9. The basement is largely occupied by a service shop, shown in Figs. 7 and 8.

There are 7 transmitters shown in Fig. 2. At the extreme left are the duplicate police transmitters, and similar units at the extreme right for fire. The two cabinets at the center contain 3 CW code transmitters, each connected to its own antenna and capable of operating on any one of 3 frequencies. Finally, the two remaining units are test cabinets for use in conjunction with the police and fire

FIG. 4. ROUTINE OPERATION OF THE POLICE MESSAGE TRAFFIC IS HANDLED FROM THIS CONSOLE, LOCATED ACROSS THE HALL FROM THE ROOM SHOWN IN FIG. 2. ASSISTANT SUPERVISING RADIO TECHNICIAN JOEL L. CRANDALL IS SEATED AT THE CONSOLE, WITH CONSULTANT HAROLD F. IRR AT THE LEFT

transmitters, as will be explained later.

Buffalo is the western terminal of the New York state-wide police teletype system. This system is connected by radio to a 12-state interzone network. This explains the CW transmitters and the Collins 51J receivers built into the master control console, Fig. 2. During the daytime, these receivers are used to monitor 5195 and 7935 kc., and 5195 and 2804 kc. at night. Those are the calling frequencies of the intercity police radio telegraph network. Traffic is handled on

2804kc.	5135kc.	7480kc.
2808	5140	7805
2812	5195	7935

The controls are so arranged that a message can be transmitted on one frequency in each band simultaneously, if desired.

The use of duplicate FM voice transmitters is in accordance with what is becoming widely-adopted practice for mobile radio systems. However, our routine of using and testing the transmitters has some features that are unusual. Instead of using one transmitter of each pair continuously, and switching over only in case of failure, we switch transmitters every Monday. Thus, each transmitter is operated during alternate weeks. This is done because we know from experience that failures may occur when a transmitter is out of service, and by swapping over each week we can often anticipate trouble.

There is a test cabinet, Fig. 3, for each pair of transmitters, located on either side of the CW units. On Monday mornings, the transmitters which have been out of service are checked on the air, by connecting them to their respective antennas. Meters in the test cabinets show frequency deviation and modulation swing. Also, control circuits are provided so that if it is necessary to go on the air while a transmitter is being checked, the high-voltage is cut off auto-

FIG. 5. ALL CARS ARE EQUIPPED WITH LEECE-NEVILLE ALTERNATORS FOR BATTERY CHARGING

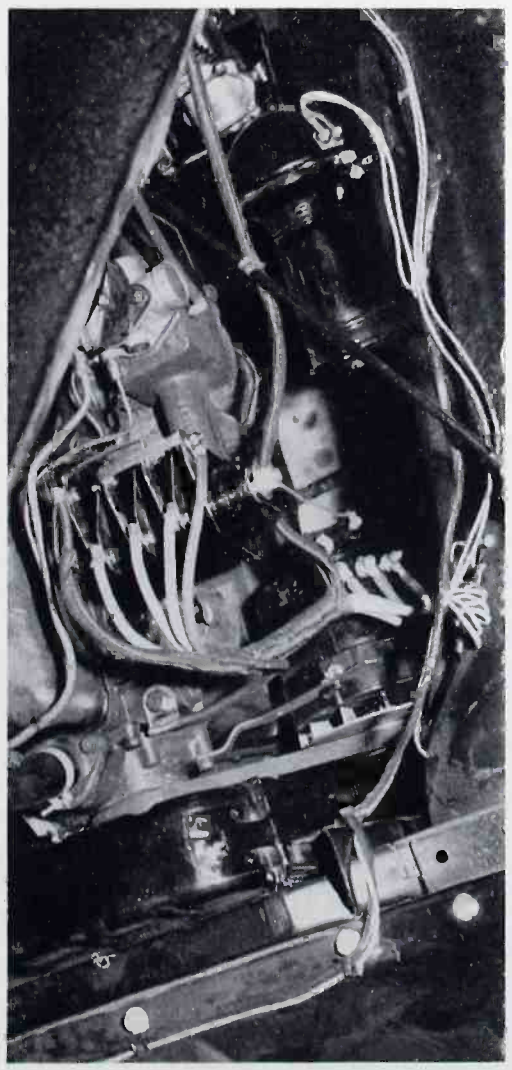
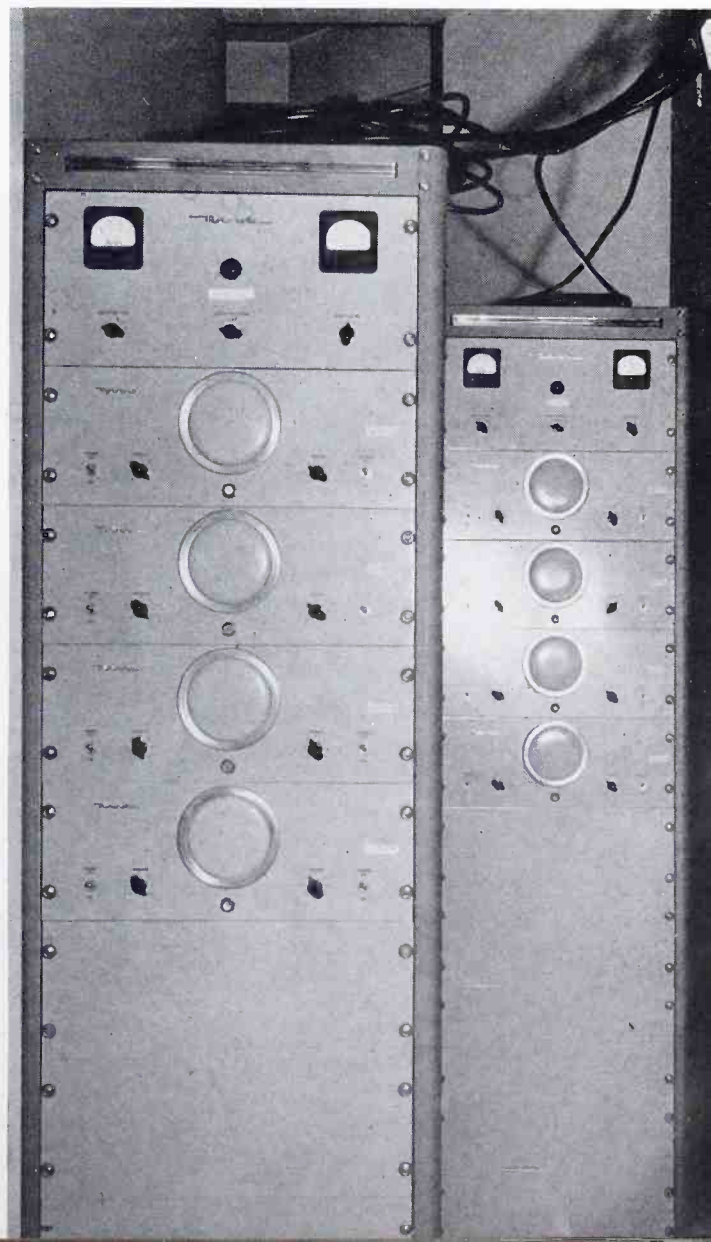


FIG. 6. RECEIVERS ARE LOCATED AT CITY HALL TO ELIMINATE MUTING DURING TRANSMISSIONS



matically, and the antenna is cut over so that the other transmitter can be operated. Without that automatic control, time would be lost if an emergency call came in while one transmitter was disconnected, and the other was undergoing adjustment.

The upper panel in the test cabinet shown in Fig. 3 is the photo-electric tower light control. It has one relay to turn the lights on, and another to turn them off. Operation of the beacon light and obstacle lights is indicated by the three meters across the top of the cabinet. The first shows the current drawn by the obstacle lights, the second shows the line voltage, and the third the current drawn by the flashing beacon lights.

The corresponding cabinet at the right is for testing the fire transmitters. Meters across the top show the gas pressure in the coaxial lines to the two antennas and in the main line from the pump.

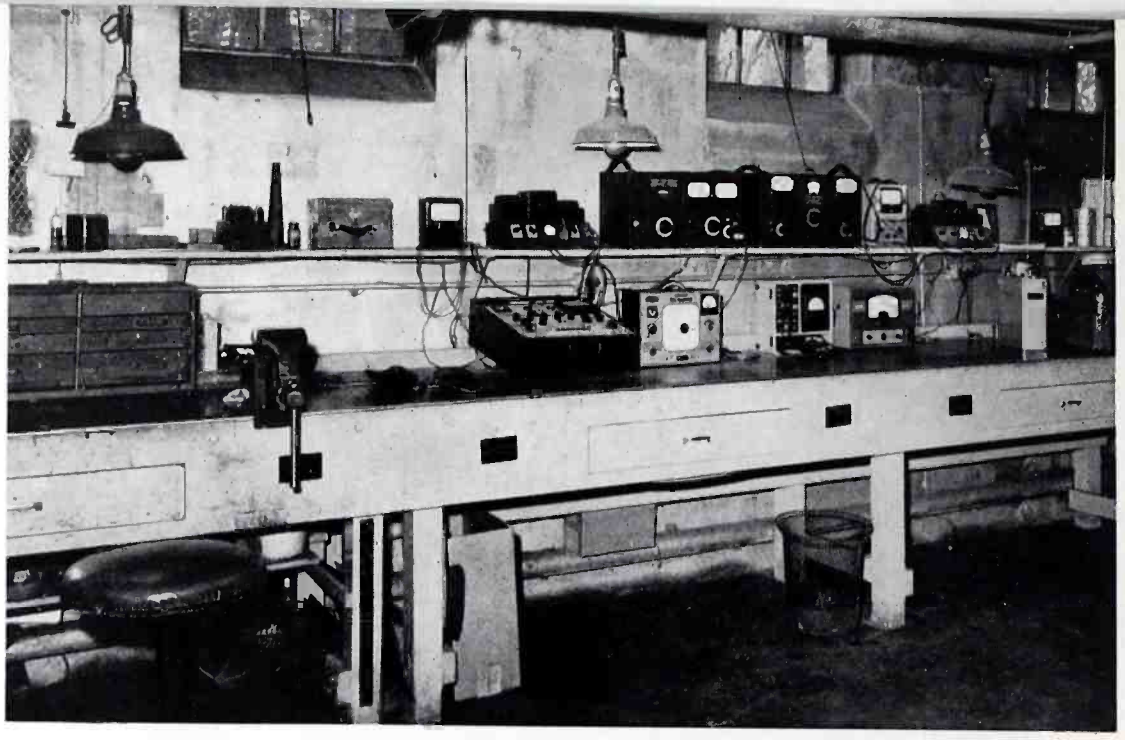


FIG. 7. RADIO TEST BENCH LINES ONE SIDE OF THE POLICE SERVICE SHOP AT THE MAIN STATION

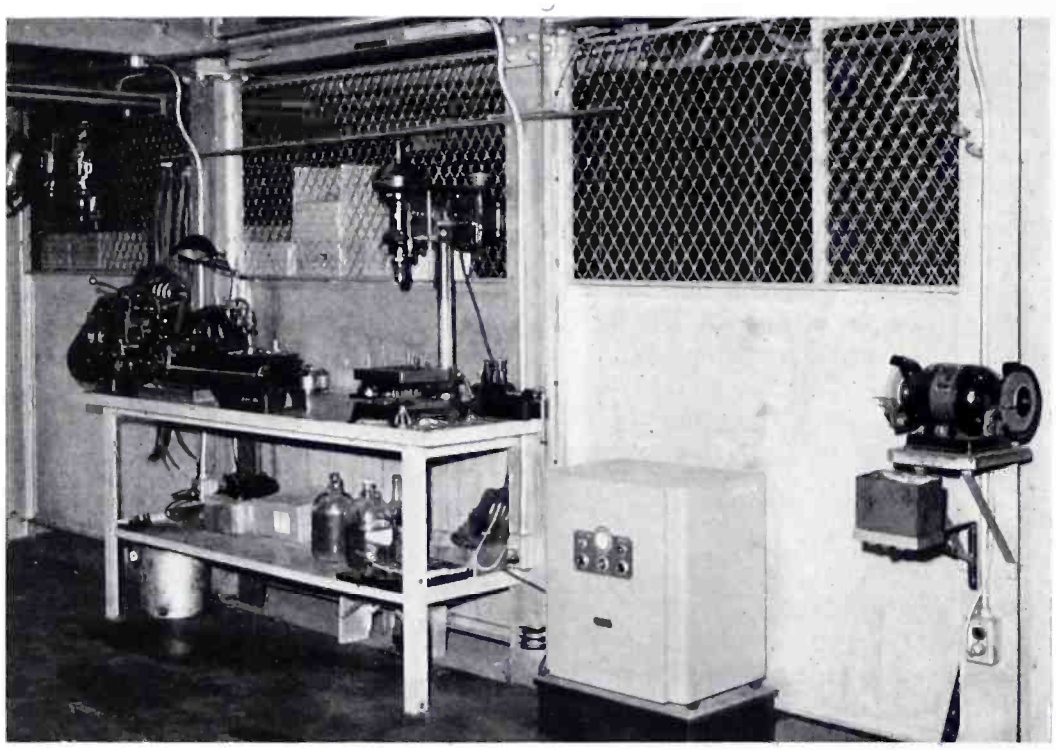


FIG. 8. SERVICE SHOP ALSO HAS TOOLS FOR REPAIRS AND BUILDING ANY SPECIAL EQUIPMENT

Controls on the U-shaped master control console, Fig. 2, were laid out with the greatest care to enable the operator to meet those emergencies when everything breaks loose at once. Thus, related functions of the mobile police and fire systems are grouped on the side panels, with the intercity network receivers and telegraph key at the center.

The first panel at the left carries speakers for incoming calls from the police and fire transmitters. Buttons across the bottom of the panel select the monitor receivers at City Hall. There is also a receiver for monitoring the intercity point-to-point frequency of 155.37 mc.

Buttons for controlling the three transmitters and selecting their respective frequencies are mounted on the second left hand panel.

Next around the console at the right is a panel with three telephone dials. The first is for a connection directly to police headquarters which does not go through the telephone exchange office, the second is for dialing through the telephone exchange, and the third provides connections directly to fire alarm headquarters.

The remaining panel on the right has 3 groups of 3 keys. First is the police radio group: No. 1 is to switch operation to the master console or the dispatcher's console; No. 2 to operate one transmitter or the other; and No. 3 to modulate the transmitter from the receiver when it is necessary to broadcast from one of the cars.

Keys in the second group are: No. 1 in the up position is for the intercom off the air, and in the down position to operate the police radio transmitter; No. 2 shifts the transmitter to the 155.37-mc. intercity point-to-point frequency; and No. 3 in the up position is an intercom connection to fire headquarters, and in the down position to operate the fire radio transmitter.

No other microphone switch is used. In the third group No. 1 is blank; No. 2 is to operate one fire transmitter or the other; and No. 3 connects the control of the fire transmitter to the dispatcher's console, to the console at fire alarm headquarters (the normal position) or to the master control console.

Normally, message traffic with the

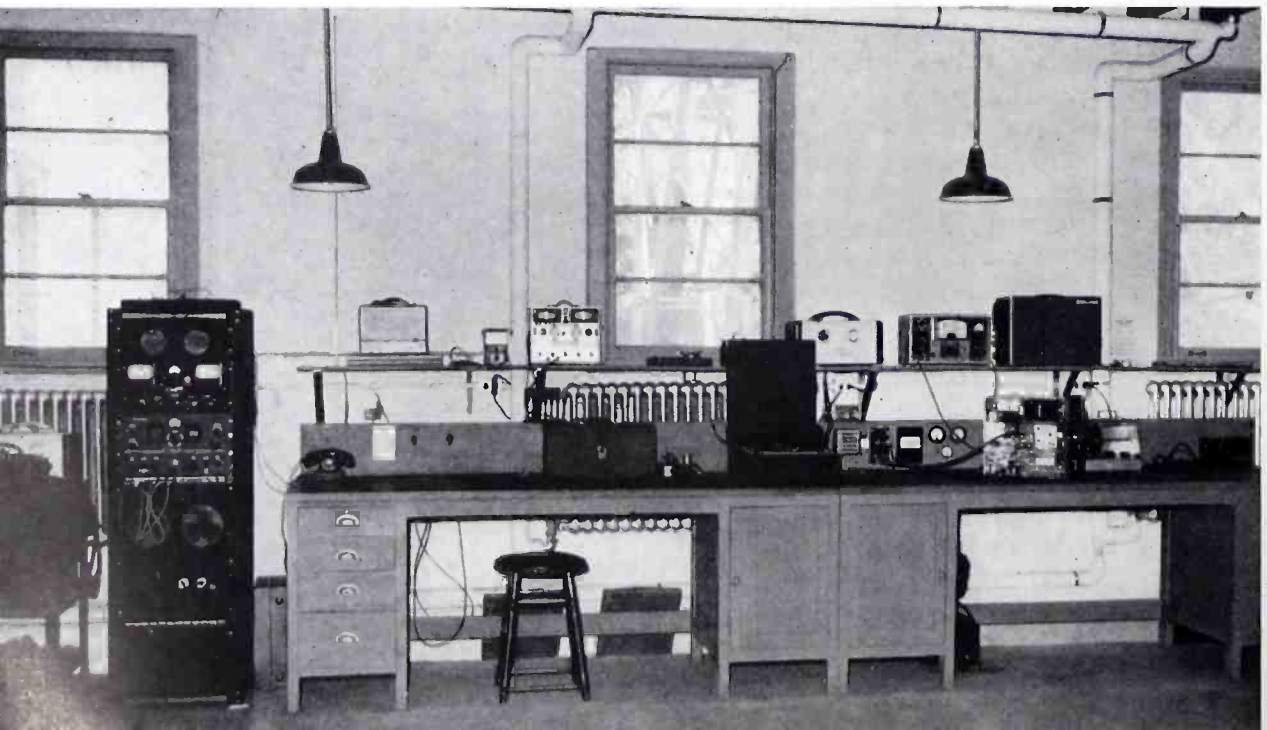


FIG. 9. DRIVE-IN SHOP AT THE MAIN STATION IS USED FOR INSTALLING AND TESTING MOBILE UNITS

FIG. 10. RADIO SERVICE TRUCK IS USED FOR EMERGENCY REPAIRS, AND AS A FIELD RADIO STATION

police cars is handled at the dispatcher's console, Fig. 4. A simple control panel at the right provides monitoring speakers and the necessary switches for both police and fire systems. All the telephone bells are muted while the microphone is in use, but colored lights above the wall map flash when a call comes in on any line. The indicating lights and switches on the console were originally installed to show which cars were in or out of service. That system was employed widely in the earlier days of police radio, but we do not find it necessary to use the lights any more.

The service shop facilities illustrated in Figs. 7, 8, and 9 are an important part of our operations. We can do a large part of our own mechanical repair work, and we can handle all the service and adjustment of our fixed and mobile equipment. As the illustrations indicate, we have a substantial investment in precision signal generators, tube testers, oscilloscopes, audio oscillators, vacuum-tube voltmeters, frequency meters, and modulation monitors. This does not represent an extravagance, however, but an assurance that our equipment will be maintained at maximum efficiency, and in conformance with FCC regulations.

Fire Radio Operation:

Fig. 12 shows the operating position at fire alarm headquarters. The console is of standard Motorola design, located immediately adjacent to the telephone switchboard. On the right is a recorder with the dual bands which is switched on automaticilly to record all incoming and outgoing radio messages. This is a great convenience for fire communication, since it eliminates the work of keeping a detailed log.

The fire department takes the responsibility for maintaining its mobile equipment, and has its own radio technician and service shop. Since the radio-equipped vehicles are stationed at the fire houses, the department has a service truck, Fig. 10, so that the radio technician can go out to the cars, instead of having them go to the shop. Thus, if a mobile unit develops trouble, he takes out a chassis, substitutes it for the defective one, and brings the other back to the shop to work on it there. This cuts the outage time to an absolute minimum, for one chassis can be removed and another slipped in in a matter of seconds.

FIG. 11. FIRE DEPARTMENT HAS ITS OWN RADIO MAINTENANCE MAN, AND SEPARATE SERVICE SHOP

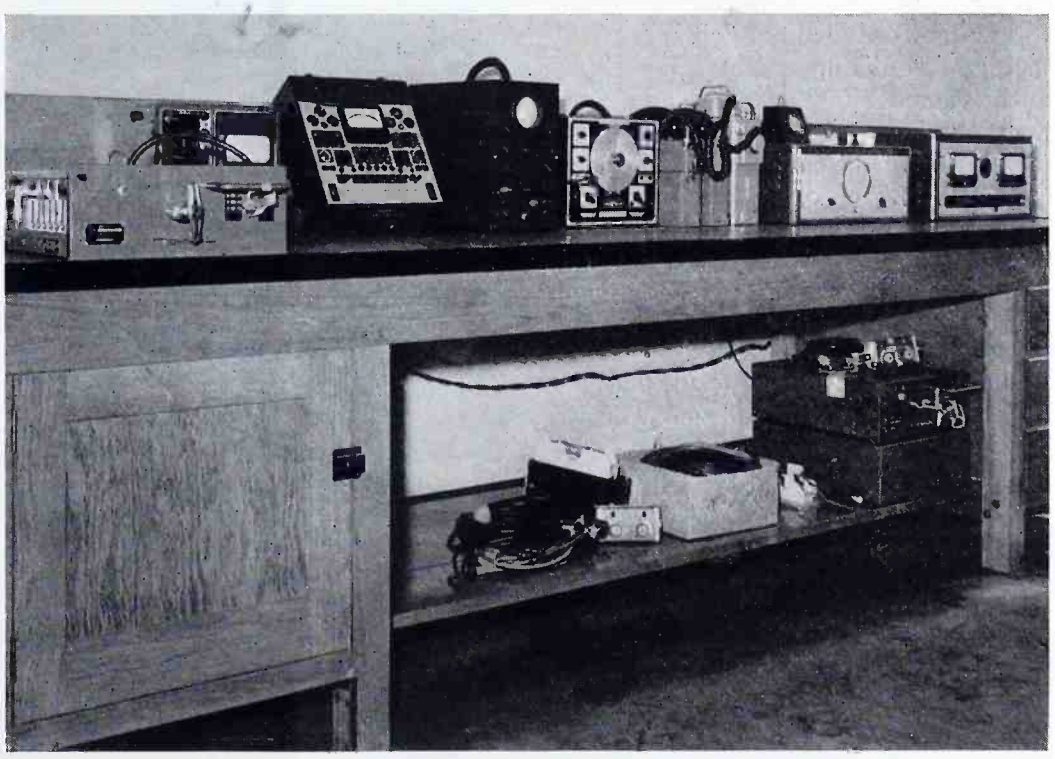


FIG. 12. AT FIRE HEADQUARTERS, DISPATCHER ARTHUR E. DAVID TAKES A CALL WHILE TECHNICIAN FRANCIS O'BRIEN CHANGES RECORDER BELT. SUPT. OF FIRE ALARMS LEO H. O'HARA STANDS AT REGISTER

FIRE COMMR. BECKER: "WE'RE MAKING MORE AND MORE USE OF OUR SYSTEM."

NBS GRASSHOPPER

AIR-LAUNCHED RADIO STATION AUTOMATICALLY REPORTS TEMPERATURE, PRESSURE, AND HUMIDITY

NEW and highly ingenious design engineering is constantly adding to the number of services being performed by radio communication equipment. An unusual example is the "Grasshopper," an air-launched weather station transmitter which automatically reports temperature, barometric pressure, and humidity. Operating in the 5-mc. region, this 5-watt battery-operated transmitter has a reliable range of over 100 miles, and operates at 3-hour intervals for more than 15 days. This device was developed by Percival D. Lowell and William Hakkarimen of the National Bureau of Standards, for the U. S. Navy Bureau of Ships.

Designed in the shape of a bomb, and packing its own parachute, the Grasshopper is carried aloft in the bomb rack of an aircraft. When the unit is dropped, the parachute is opened by a line rigged to the plane. Simultaneously, an electric clock, which controls the subsequent functioning of the equipment, is switched on. The impact of landing sets off a small explosive charge which disengages the parachute, and prevents the unit from being dragged along the ground. Fig. 1 shows the unit after it had freed itself from the parachute.

If it had not landed upright, it would still assume that position because another explosive charge releases six spring-loaded legs, which snap down into position, as in Fig. 2. At the same time, a third charge extends the telescopic antenna to 20 ft. A closeup of the assembly is presented in Fig. 3.

A variable resistor is associated with each of the mechanisms which respond to changes in atmospheric conditions. At predetermined intervals, the electric clock turns on the transmitter and cuts one resistor after another into the transmitter circuit.

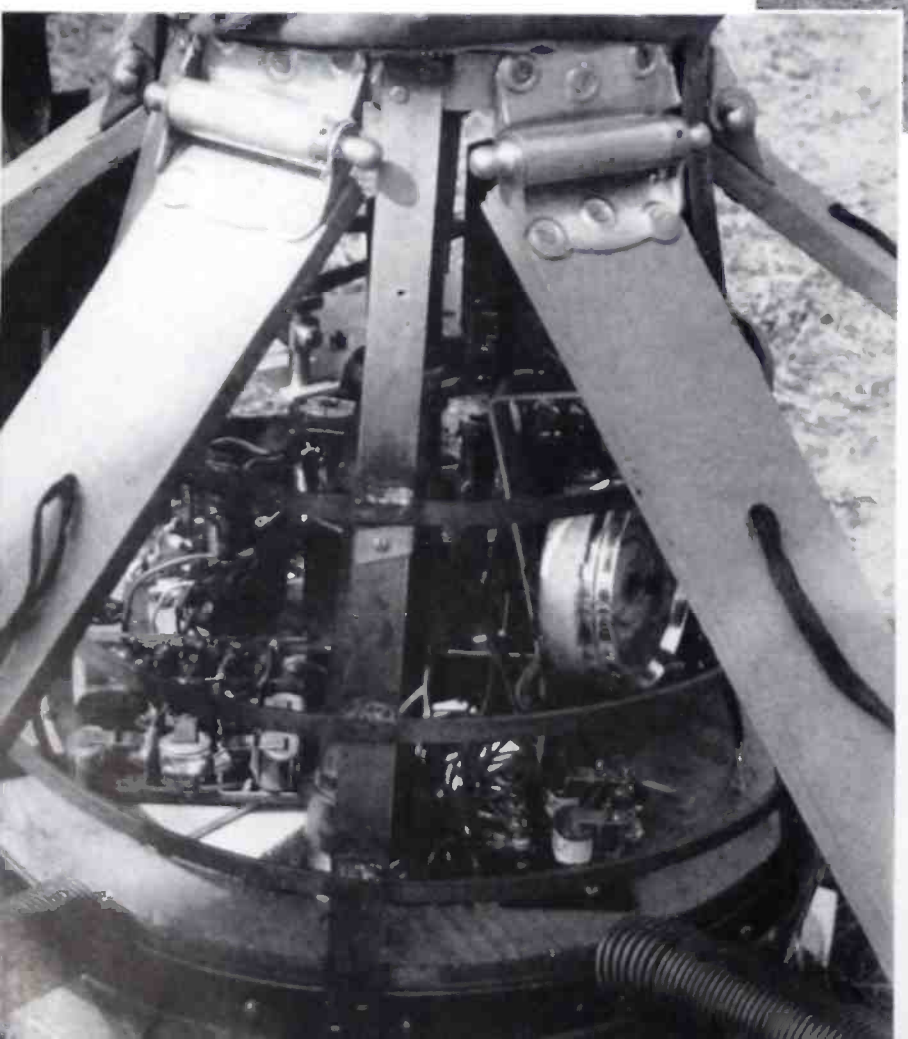


FIG. 1, ABOVE: THE GRASSHOPPER AS IT APPEARS WHEN IT LANDS, AFTER THE FIRST EXPLOSIVE CHARGE HAS THROWN OFF THE PARACHUTE. IF IT DOES NOT LAND ERECT, THE SIX LEGS BRING IT TO AN UPRIGHT POSITION

FIG. 2, RIGHT: TWO SUCCEEDING CHARGES RELEASE THE LEGS, AND EXTEND THE ANTENNA TO ITS FULL LENGTH. AT THE SAME TIME, THE ELECTRIC CLOCK IS STARTED, BY WHICH THE VARIOUS FUNCTIONS ARE SWITCHED ON AND OFF

FIG. 3, LEFT: A CLOSEUP OF THE EQUIPMENT. THIS INCLUDES THE RADIO TRANSMITTER, TELEMETERING CIRCUITS FOR THE WEATHER-SENSITIVE INSTRUMENTS, AND RELAYS WHICH ARE ACTUATED AT INTERVALS BY THE CLOCK CONTROL. TRANSMITTING RANGE IS MORE THAN 100 MILES

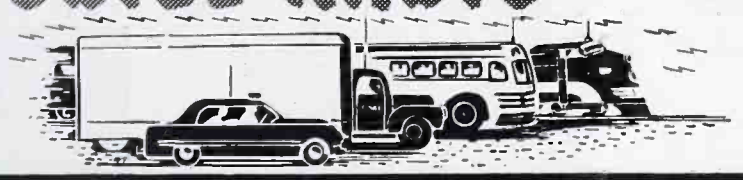
The transmitter consists of a crystal oscillator and an RF amplifier stage. A relay in the plate circuit of a separate relaxation oscillator turns the crystal oscillator on and off at a rate proportional to the value of whatever resistor is temporarily inserted in the relaxation oscillator. The unit is calibrated before use by subjecting it to known values of temperature, pressure, and humidity, and measuring the resulting rates of pulse transmission. Therefore, weather conditions at the transmitter site can be determined by the pulse rates.

Because aging or damage to the transmitter upon landing might alter the calibrated pulse rates, the time clock also cuts in a fixed reference resistor. When the equipment is tested, the pulse rate of the reference resistor is observed. Any deviation from that rate during actual use warns the receiving station that a correction factor must be applied to the pulse rates of the weather-responsive resistors. Also, because the impact of landing may cause deformation of the indicating instruments, each one is vibrated for a short interval before its resistor is cut into the relaxation oscillator curcuit. There is also a fixed identification resistor, to transmit a pulse rate to indicate which transmitter is reporting at any time.

The basic principles employed for this method of weather reporting can be applied to telemetering over radio circuits for a wide variety of purposes.

JEREMIAH COURTNEY'S

MOBILE RADIO



NEWS AND FORECASTS

MAYBE, it's the effect of those TV crime programs, but our thoughts have been turned toward the police of late. Thus we are reminded that the entire radio communication industry owes a tremendous debt of gratitude to the police personnel throughout the country who pioneered the use of radio for communication between patrol cars and headquarters stations.

Many of the first fixed transmitters were built by police personnel or local amateurs. Those stations, along with mobile AM receivers working on B batteries, have disappeared long since. But their effectiveness in protecting lives and property proved the value of police radio service, and won public confidence so completely that adequate appropriations have been generally available to maintain equipment at high efficiency, to expand facilities, and to adopt new methods in step with the technical progress of radio communication.

In this respect, the FCC is to be commended for keeping its regulations governing police radio stations particularly flexible, and for the liberal interpretations it puts on these regulations. For example, the police have been able to explore the use of unattended stations to provide two-way coverage over large areas and in mountainous terrain. They have been operating relay systems to extend coverage to mobile units for several years, and the success of these operations has persuaded the Commission to consider similar use by the industrial and land transportation services. Proposed rule making looking toward mobile relay operation in these services is now pending.

Intersystem Communication:

Another achievement that should be credited to the police is the innovation of intersystem communication. The police had long felt the need for a simple and reliable form of network communication by which any department could broadcast a general alarm to all its neighbors. From the early days, many police departments monitored frequencies used by adjacent cities. This finally resulted in the absurd situation where some police dispatchers were listening to some 10 or 12 receivers, in addition to their own. The confusion was almost as bad as the AM broadcast band at night.

To correct this, the police evolved a plan whereby one frequency in the 155-mc. band is reserved for intersystem communication. Each participant installs a two-frequency base station—one frequency to talk out to his own cars; the second is the intersystem frequency. The result is that each operator need listen only to two receivers.

In California, intersystem operation has been developed still further. To overcome the difficulties presented by the numerous mountain ranges, intersystem communication is accomplished through a relay station located on a convenient mountain top. One very ambitious installation has recently been completed in the vicinity of San Francisco.

The State of California has also installed an unattended relay station receiving on 155.67 mc. and transmitting on 73.26 mc. on Mt. Diablo, elevation 3,859 ft., some 27 miles east of San Francisco. Approximately 25 police agencies in the San Francisco-Oakland Bay area have installed intersystem transmitters on 155.67 mc. Each police department monitors 73.26 mc. In addition, the state is installing a microwave link on 6,800 mc. between Mt. Diablo and State Police headquarters at Sacramento, a distance of 55 miles. When completed, this will provide instantaneous intercommunication between any of the participating police departments. In addition, each department will be able to talk directly to the State Police at Sacramento.

The TV Problem:

The police are still faced with many problems. One of the most prominent is TV interference. The police are involved in at least three ways. First, second harmonics resulting from police operations around 39 mc. fall in TV channels 5 (76-82 mc.) and 6 (82-88 mc.). This is a relatively minor matter, and applies almost entirely to older installations, since newer equipment is built to conform to the Commission's revised rules, with 40 to 80 db suppression of harmonics, depending on power rating of the transmitter.

The second part of this problem is the limitation imposed on police use of the fixed frequencies between 72 and 76 mc. in areas where TV channels 4 (66-72 mc.) or 5 (76-82 mc.) are in use or reserved for use. Channels between 72 and 76 mc. are commonly used for repeater and control stations associated with remote, unattended base stations. The only other frequencies permanently allocated for this operation in the police service are in the microwave region. Microwave equipment to do this job would cost the police four to five times the price of a 72-mc. installation. In addition, while 72-mc. signals show a tendency to bend around obstacles, microwave signals are strictly line-of-sight. This brings up a second difficulty, namely that microwave operation commonly requires more stations to do the job.

The Commission has conceded these difficulties and permits the police to use their land-mobile frequencies above 152 mc. for repeater and control purposes. However, authorizations are granted in the form of STA's and are subject to cancellation if the frequency is required for other purposes in the area. It would seem that the Commission could liberalize its attitude in the police service as it has done in the industrial services, and permit use of the land mobile frequencies in the 455-mc. band on a regular basis. Equipment in this band is now generally available at a reasonable price. The ability to get a 4-year license would be a boon to any police department, not counting the reduction such action would make in the Commission's application backlog.

Another aspect of the TV problem stems from the action of the Radio Television Manufacturers Association, which recently adopted 41.25 mc. for TV sound and 45.75 mc. for video signals. These frequencies lie in the band reserved for state police use, on which high-power operation is now permitted. The RTMA has recently approached both the police representatives and the Commission with the proposition that high-power police operation between 42 and 46 mc. makes it impossible to provide protection from such interference in TV sets at the low prices prevailing. RTMA has proposed, therefore, that the police assignments be shuffled to put high-power state police operation on 37 to 39 mc. band, and lower-power municipal operation between 42 and 46 mc.

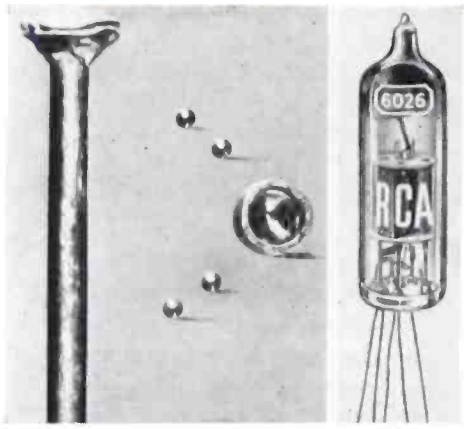
At this juncture, it appears that the Commission does not propose to protect the television IF channels, nor make any changes in the police assignments. The Commission's reply to the RTMA pointed out that police operation between 42 and 46 mc. with high power an-

(Concluded on page 24)

*908 20th Street, N. W., Washington, D. C.

REVIEW OF NEW COMPO

INTERESTING DESIGN TRENDS, PARTICULARLY TOWARD SMALLER DI



FAR LEFT: TINY BEARING

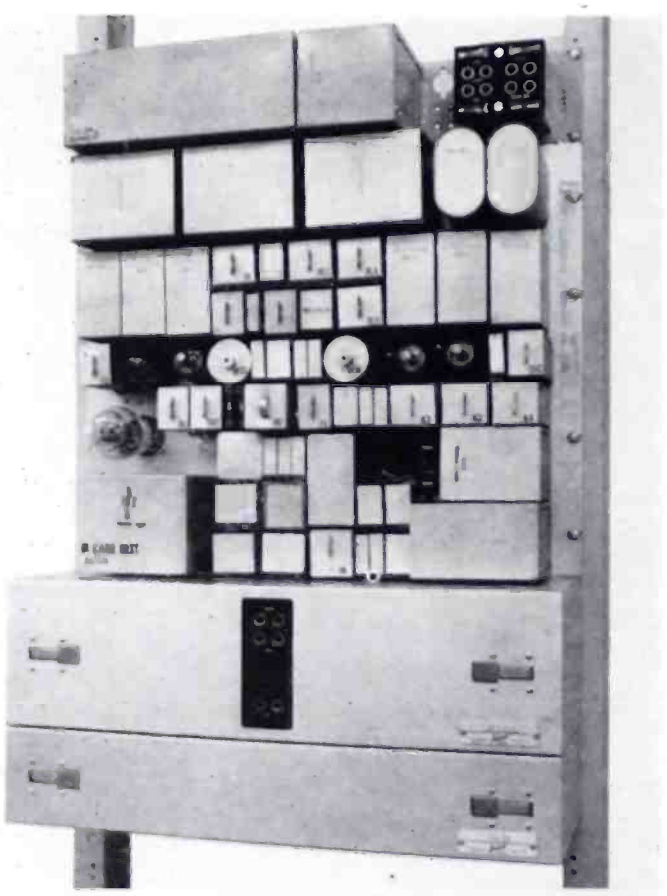
These small pivot ball bearings, 1.5 mm. outside diameter, are shown compared with a common pin. Held to strict tolerances, they are for use in precision instruments and mechanisms. Miniature Precision Bearings, Keene, N. H.

LEFT: SMALL TRIODE

The subminiature oscillator triode shown is designed for transmitting service at 400 mc. and is capable of delivering 1¼ watts of useful output. It features short transit time and low interelectrode capacitance. Tube Dept., Radio Corp. of America, Harrison, N. J.

LEFT: MINIATURE WIRE

Low-voltage shielded lead wires and small flexible cables can be made from these wires. Here 350 wires are shown being passed through a paper clip. New process makes possible the production of small conductors which are at the same time well insulated. Tensolite Insulated Wire Co., Tarrytown, N. Y.



LEFT: DIALING AUXILIARY

Facilities for dial signaling can be added inexpensively to existing Western Electric carrier systems by use of this new equipment. One terminal, as illustrated, occupies less than nine inches of space on one side of a standard 19-in. rack. The unit provides dial-signaling pulses at rates of 10 to 14 pulses per second on frequencies not essential to the voice channels. Power is supplied from existing equipment. Lenkurt Electric Co., 1105 County Road, San Carlos, Calif.

LEFT: FREQUENCY AND SHIFT MONITOR

Designed as a secondary standard to monitor the frequency and shift of transmitter carrier outputs, this system features the ability to measure a mark and space signal both during set-up and keying conditions. The system consists of a monitor and a frequency meter. The stability of the monitor is better than 2 cycles/mc. Range is 2.5 to 30 mc with 10 crystal-controlled frequency. Fast damping in the frequency meter permits measurements while keying. Northern Radio Co., Inc., 143 W. 22nd St., New York 11.

RIGHT: CORNER HORN ENCLOSURE

This small-size corner enclosure is said to achieve full distortion-free bass reproduction down to 35 cycles. It also increases the power-handling capacity of a 12-in. speaker by as much as 50% because the voice coil operates in the optimum flux area and because cone excursion is held to minimum by the large air load. This unit is designed so that it can also be used in a ceiling corner position for public address utility. Fully licensed by Klipsch. Electro-Voice, Inc., Buchanan, Mich.

RIGHT: VIDEO GENERATOR

Shown here is an all-purpose video generator designed as a test instrument to identify and localize trouble in any section of a TV receiver. It is crystal-controlled for electrical accuracy and is exceptionally stable. The RF output is directly calibrated in microvolts for sensitivity checks. Horizontal and vertical sawtooth voltages can be directly substituted for vertical and horizontal oscillators. Hickok Electrical Instrument Co., 10530 Dupont Ave., Cleveland 8, Ohio.

RIGHT: DYNAMIC HEADPHONES

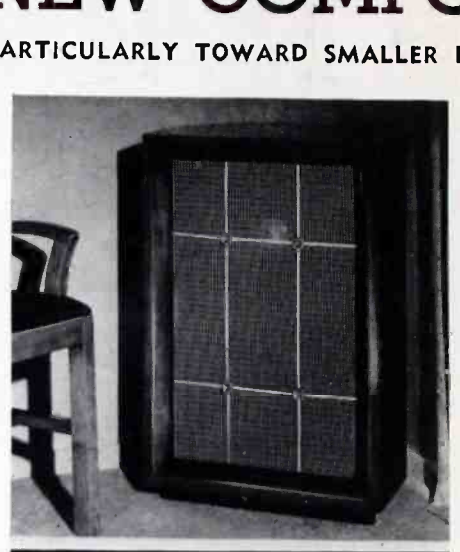
The dynamic headphones pictured here have a flat frequency response from 100 to 2000 cycles. Civilian applications include: broadcast, television, and recording uses, monitoring audio metric work, and auditory training. Sound reproduction is said to be free from irritating blasts and rattles. These sets are claimed to have wide frequency range, uniform response, and high intensity sound output. Permoflux Corp., 4900 W. Grand Ave., Chicago 39, Ill.

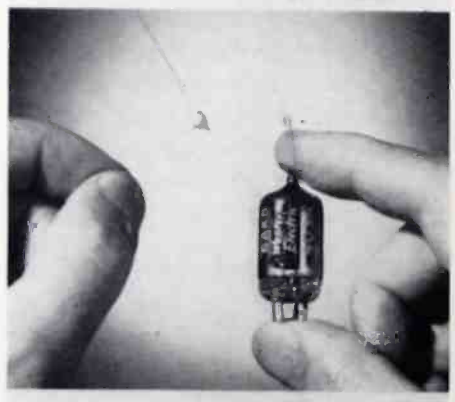
RIGHT: NEWEST TRANSISTOR

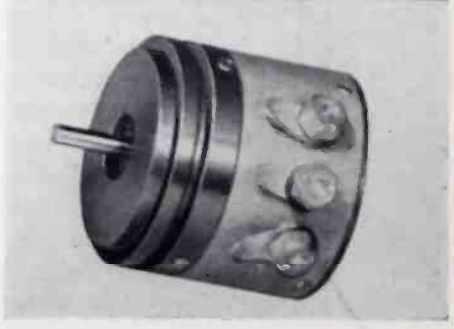
The spidery object shown here is the newest type of transistor, a tiny amplifier invented at Bell Telephone Laboratories. For size comparison, it is shown with a miniature vacuum tube which performs approximately the same functions. It requires much less power than miniature tubes, yet it will amplify electrical signals a million times. As an amplifying device it has many outstanding properties. Bell Telephone Laboratories, 463 West St., New York 14, N. Y.

RIGHT: MINIATURE POTENTIOMETER

This new miniature potentiometer measures ⅞ in. in diameter and weighs .56 ounces. It features a low starting torque of only .005 ounces. These potentiometers are available in resistances from 1,000 to 100,000 ohms, single or in ganged assemblies with single or double shaft extensions. They are rated at ½ watt. They permit an active electrical rotation of 355 degrees and continuous rotation without stops. Helipot Corp., South Pasadena, California.







NENTS AND EQUIPMENT

MENSIONS AND THE USE OF HIGHER FREQUENCIES, ARE INDICATED

LEFT: NEW PORTABLE OSCILLOSCOPE

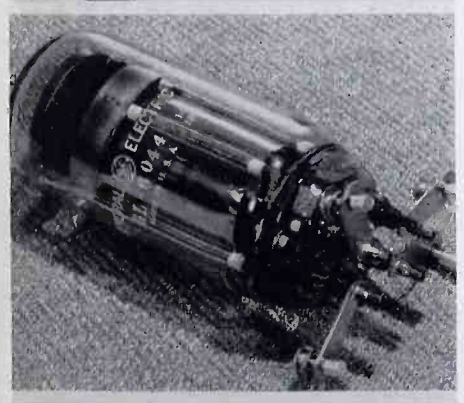
Pictured here is a new portable 3-in. oscilloscope which combines compactness with accuracy. It has a frequency coverage to 2.5 mc. with a sensitivity of .1 RMS volts per inch. Provision has been made for Z-axis modulation. It is shock mounted and housed in a strong moisture-proof aluminum case 6 by 9 by 13¼ ins. The instrument weighs only 14 pounds. Hickok Electrical Instrument Company, 10530 Dupont Ave., Cleveland 8, Ohio.

LEFT: REPLACEMENT PICKUP STYLI

To help dealers solve the troublesome problem of keeping a complete stock of replacement phonograph needles on hand, this manufacturer has devised this unique storage and display container. As each needle is removed, the information on what to reorder appears on the bottom of the case. The case, made of clear plastic, contains a balanced assortment for all standard types and makes of phonograph pick-ups. Jensen Industries, Inc., 329 S. Wood St., Chicago 12, Ill.

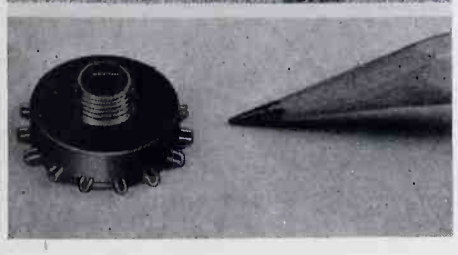
RIGHT: TV MONITOR

This new TV picture monitor permits a station to monitor video signals without cutting into the picture signal resolution. Circuits provide adequate resolving power for operation beyond the minimum 600-line resolution. Picture size is 14 ins. The high-voltage supply provides 16 kv. Deflection circuits are independent of the separately driven pulse high-voltage supply. Federal Telecommunication Laboratories, Inc., Nutley, New Jersey.



LEFT: SINGLE-CHANNEL TV BOOSTER

Two views are shown of a single-channel TV booster designed for use in areas where only one station can be received. It can be connected to any make of TV receiver. Each unit is factory-adjusted to a specific channel. This design provides much greater pre-amplification (up to 18 db) than can be obtained from all-channel designs, and covers the full 5-mc. band. The lower view shows interior construction. LaPointe-Plascomold Corp., Windsor Locks, Conn.



RIGHT: HALF-WAVE DIPOLE ANTENNAS

Pictured is a new line of antennas for two-way mobile transmission and reception. Their power-handling capacity is limited only by the power rating of the transmission line. Each type consists of two coaxially arranged elements, cut to approximately ¼ wave-length and center fed with 72 ohm transmission line. The entire assembly is vertically mounted by means of a staff tube. Communications Products Co., Broadway and Clark, Keyport, N. J.

LEFT: HEAVY-DUTY THYRATON

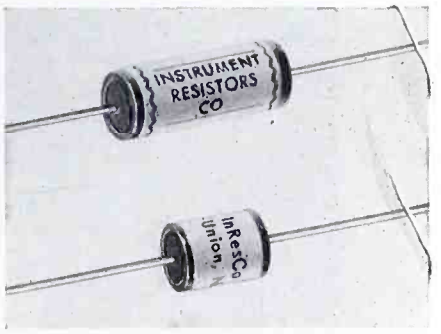
The tube shown here is a new heavy-duty thyraton tube for applications in airborne electronic-control equipment. The heavy-duty basing arrangement used provides both electrical and mechanical support. Instead of the conventional prong-type base for insertion into a socket, the tube has contact terminals extending at right angles from heavy support rods at the bottom of the tube. Tube Divisions, General Electric Co., Schenectady, N. Y.

RIGHT: VHF TELEVISION TRANSLATOR

This unit, designed to operate with all types and makes of television receivers, enables the VHF set owner to receive UHF programs. A separate UHF antenna must be used with this device, however. A power outlet socket is provided on the back of the translator. When the receiver power cord is plugged into the outlet, a control on the translator switches both instruments on and off. General Electric Co., Electronics Dept., Syracuse, N. Y.

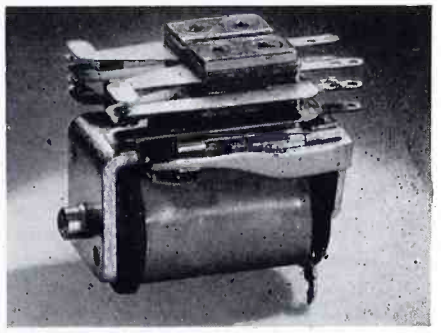
LEFT: MINIATURE ROTARY SWITCH

A new miniature rotary switch, developed to meet the requirements of airborne electronic equipment is shown here. These switches are ⅝ in. in diameter. Insulation between shaft and contact arms will withstand 2,500 volts AC. Plastic parts are compression molded of a new electrical insulator, said to be 9 times more resistant to arcs than commonly used phenolics. Electronic Development Corp., 6014 W. Washington Blvd., Culver City, Cal.



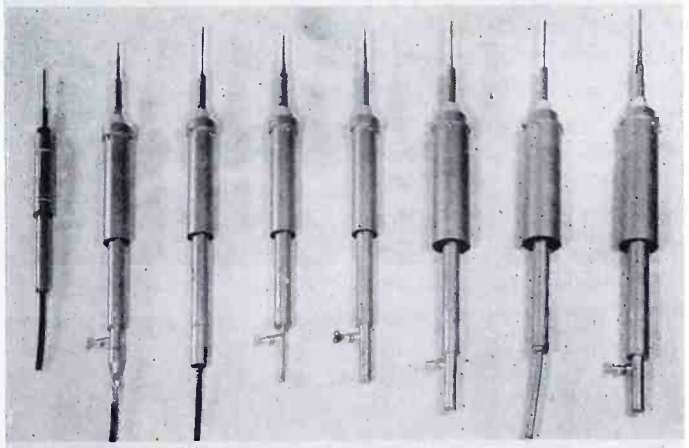
RIGHT: NEW RESISTORS

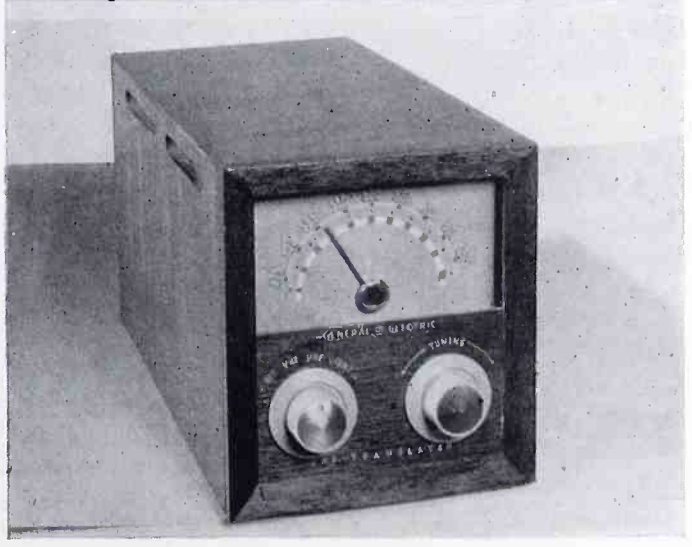
The subminiature resistors shown here are both 5/16 in. in diameter. The upper type is ¾ in. long, has a power rating of .30 watts and maximum resistance of 400,000 ohms. The second is rated at .15 watts, 200,000 ohms. Standard tolerance is 1% but .1% can be supplied. Instrument Resistors Co., 1036 Commerce Ave., Union, N. J.

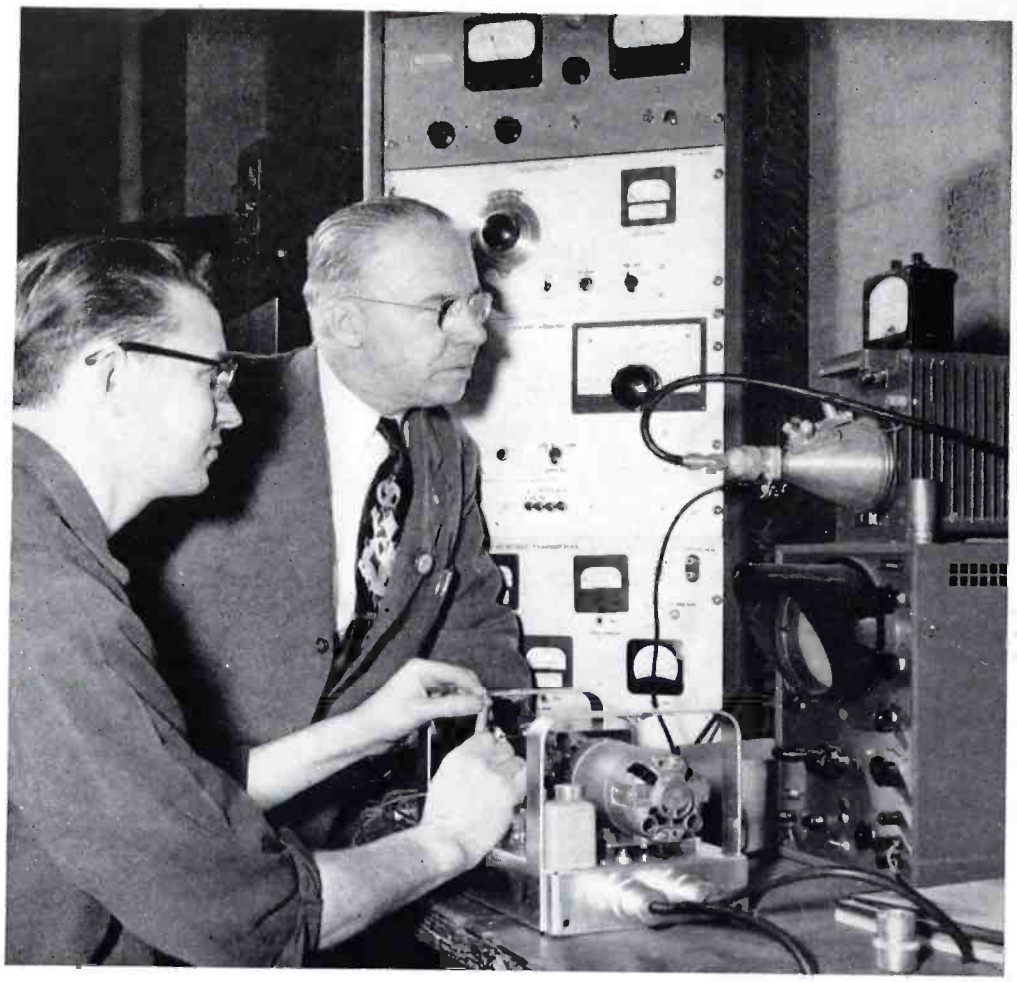


RIGHT: DC RELAY

The small, lightweight relay pictured has high sensitivity and resistance to vibration. It is supplied with single or double-wound coils and single or double-arm armature, and is suitable for operating voltages to 230 volts DC. Its weight is approximately 2 ounces. C. P. Clare & Co., 4719 W. Sunnyside Ave., Chicago 30.







CHARLES KLAUBERT, RIGHT, IN CHARGE OF RADIO AT MANCHESTER, N. H., IS INSTALLING ADDITIONAL UNITS ON CITY'S FIRE APPARATUS. SOON, HE WILL HAVE EQUIPMENT ON A TOTAL OF 26 VEHICLES

NEWS FROM THE FCC

(Continued from page 11)

should do about the vast expanse of spectrum space assigned to, but not being used by FM."

As I have told you repeatedly, the FCC is not considering the deletion of the FM band or any part of it. The FCC is not considering allocating the FM band or any part of it to any other service. The approximately seven hundred stations now operating in the FM band is real testimony to the strength of the service, particularly when one considers that many manufacturers do not make sets and none of them has carried on continuously aggressive sales campaigns. In almost every area in the country there is an unfilled demand for FM receivers.

By Direction of the Commission
WAYNE COY
Chairman

ON July 11, the Commission released its Fourth Report in the television proceedings, and issued an order under which the band from 470 to 500 mc. is assigned to television, thereby denying its use for mobile common carrier service. Because of the importance of this decision, and the interesting discussion of evidence, the report is published in full, except for legal references:

On May 6, 1948, the Commission issued certain Notices of Proposed Rule-Making relating to the allocation of frequencies in various portions of the spectrum, including the band 450 to 460 mc. The proceeding relating to that band was identified as "Allocation of Frequencies Between 450 and 460 Mc." All the proceedings were interrelated and dealt with frequencies to be allocated to various non-broadcast radio services, including one which is now identified as the Domestic Public Land Mobile Radio Service. As an incident to such rule-making proceedings, interested parties were invited to file comments. In that connection, Bell Telephone Laboratories, the research and development subsidiary of the Bell System, filed a petition requesting the establishment of a multi-channel broadband common carrier frequency allocation of 40 mc. somewhere in the spectrum between 400 and 500 mc. This petition was associated with the proceedings in connection with any allocation which might be made of the frequency band 450 to 460 mc.

The subject petition was filed because the Bell System believed that the frequencies proposed to be allocated to the Domestic Public Land Mobile Radio Service in the frequency bands 35 to 44 mc., 152 to 162 mc., and 450 to 460 mc. would not be adequate for the anticipated future development and expansion of that service.

In a Report and Order of the Commission, dated April 27, 1949, we said:

"The solution to the problem of pro-

(Continued on page 26)

PEACETIME VERSION OF THE HANDIE-TALKIE IS USED BY THE CIVIL DEFENSE AND MUNICIPAL OFFICIALS TO DIRECT FIRE APPARATUS AND WARDENS DURING MOCK BOMB TEST AT EVANSTON, ILL.

In 2-way radio

G.E. MAKES MORE OF ITS COMPONENTS THAN ANY OTHER MANUFACTURER!

THIS is important to users of 2-way radio because it means you get a complete General Electric product from the chassis up . . . tubes, transformers, dynamotors, crystals, capacitors—all designed, engineered, and manufactured by G. E. to insure rigid quality control and a superior product.

But quality alone is not enough. More General Electric 2-way radio equipment was bought last year than in any similar period in the company's history. To meet this growing demand a new plant has been established at Utica, N. Y., devoted exclusively to the manufacture of our complete radio communication line.

When you buy a 2-way radio system, consider the years of service you expect to get out of it. Examine all makes—then put your money into lasting quality, backed by a name you can believe in—General Electric.

TUBES—Receiver types and transmitter types—made at G-E plants at Owensboro, Kentucky, and Schenectady, New York.

TRANSFORMERS AND CHOKES—Two mighty important reasons why G-E station transmitters are rated for continuous duty cycle. Made by General Electric at Fort Wayne, Indiana.

SPEAKERS—With the famous aluminum voice coil for all-weather performance. Made at Electronics Park, Syracuse, N. Y.

DYNAMOTORS—Another G-E product from Fort Wayne. They're built for 100,000 starts!

PYRANOL CAPACITORS—The last word in component dependability. A G-E specialty from Pittsfield, Mass.

WIRE & CABLE—From the Bridgeport Works of G. E.

WHAT A PERFORMANCE PACKAGE—HERE'S WHAT YOU GET!

Selectivity in a class by itself—new 4-coil IF transformers . . . minimum intermodulation and high image ratio . . . sensitivity that stays up even when the battery's down . . . lower tube replacement cost and lower standby battery drain than other makes. It's the best 2-way radio performance your dollar can buy!

General Electric Co., Section 4371
Electronics Park—Syracuse, N. Y.

Yes, send me your FREE INFORMATION KIT on General Electric 2-way radio equipment.

NAME .....

ADDRESS .....

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

You can put your confidence in—

GENERAL ELECTRIC

MOBILE RADIO NEWS

(Continued from page 19)

tedated the RTMA selection of 41 mc. for television IF; that as a practical matter it is not believed that high power will be used in every state; that high-power state police stations are generally located away from centers of population; and, finally, that it is impractical to re-arrange police assignments as proposed by the RTMA. Looks as if RTMA will have to buckle down and build good TV receivers.

The 2-Mc. Dilemma:

Another problem facing the police is what will happen with the 2-mc. band in which the police now have channels. Hearings on re-allocations were held more than six years ago, in September to November 1944. A proposed report was released in May 1945, but no final action has been taken. It is known that, under the international regulations adopted at Atlantic City in 1947, many changes must be made in this band. So the police are worried. While slight frequency changes within the band will be required, it is to be doubted that any police stations now operating in the 2-mc. band will be required to move out. As a matter of fact, the assignments in this band are so intermeshed between government (IRAC) and non-government (FCC), and between the U. S., Canada, and South American countries that it is doubtful whether any affirmative action will be taken in the near future. Our own guess is that a lot of new equipment will be worn out before a final order is issued on this one.

Introducing Herman Garlan:

A good deal of the FCC application-processing backlog in the mobile field, it seems to us, is directly chargeable to the kind-hearted disposition of certain of its staff to act as engineers and lawyers for private applicants well in position to hire their own. However, that does not apply to public bodies such as the police, with little or no funds available for such purposes. For them, the FCC latch-string has always been open, which is as it should be.

In the forefront of those who have helped to solve the difficulties of the police by conference, telephone, and correspondence is Herman Garlan. His labors have been as little known outside the FCC as the pioneer police contributions are to the radio industry in general.

Garlan is by training and experience one of the top engineers in the Public Safety and Amateur Division where he reports to Dan Arnold, Branch Chief, who in turn reports to G. K. (Red) Rollins, Division Chief. He received his education in New York City (B. S., CCNY and E. E. Columbia University, 1936). Later he worked as radio engineer at New York's municipal broadcasting station WNYC. He joined the Commission in August of 1940 as an assistant monitoring officer at Port Washington, Wisconsin, and a few months later became an inspector at the FCC's Chicago field office. He made security inspections of radio stations in the mid-west states until, in 1945, he was transferred to Washington.

Since then he has been busily engaged in the work of the emergency and miscellaneous services, assisting in the writing of the new rules, and in training the host of new engineers that came to the Commission during the expansion of 1946-47. In short, Herman knows the Commission inside and out; and the police service outside in. Most people in trouble call on a policeman, but policemen in trouble call on Herman. And they always get the right answer.

Annual APCO Conference:

The Associated Police Communication Officers are making big plans for their annual conference, to be held this year at the Everglades Hotel, Miami, Fla., on August 15 to 18 inclusive. Conference chairman is Lieutenant Ben Demby who is in charge of police radio at Miami and from whom complete information can be obtained.

BROWNING MODEL MD-25A MODULATION MONITOR

Suppose You Have to Check Modulation at Just

ONE ADDITIONAL FREQUENCY

THERE are several precision-type modulation monitors that meet FCC requirements for checking the modulation of fixed and mobile transmitters.[1] But before you decide which type you will buy, be sure to get an answer to this question:

"If I need to check modulation at some additional frequency, can I do it with this meter, and will it involve additional expense?"

If you choose a BROWNING Universal Modulation Monitor, the answer is simple, because this instrument is a truly *universal* type. It is not limited to use on one or two specific frequencies. Instead, the BROWNING model MD-25A can be used to monitor *all* frequencies on *all three communication bands!* Yet modulation checks can be made as accurately as with an instrument designed for single-frequency use.

Equally important is the fact that the very moderate price of the BROWNING Monitor makes it positively extravagant to buy an instrument good for one channel only, that must be returned to the factory for changing to a different frequency, and that must be rebuilt if you need even one additional frequency. For complete details on the MD-25A Universal Modulation Monitor, write:

[1] FCC Rules require that each fixed and mobile transmitter in every radio system be checked for modulation every 6 months, and whenever an adjustment is made that might affect the modulation. Records of these tests must be entered in the station log, where they can be seen by the Radio Inspector.

Browning Laboratories

700 MAIN STREET, WINCHESTER, MASS.

In Canada: Measurement Engineering, Ltd., Arnprior, Ont.

MD-25A SPECIFICATIONS

Precision measurement of modulation swing at all frequencies in the bands from 30 to 50, 72 to 76, and 152 to 162 mc.

Frequency swing can be read directly on 4-in. panel meter. Measurements can be made on signals of less than 1 millivolt at the antenna terminals.

Flasher indicates instantaneous peak modulation in excess of 15 kc.

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

Ventilated, rigid steel cabinet, of black wrinkle finish, is 9 ins. high, 20½ ins. wide, 12 ins. deep. Weight is 40 lbs.

BROWNING LABORATORIES, Inc.
700 Main St., Winchester, Mass.

Please send me technical details and prices on the following Browning precision products:

☐ MD-25A Universal Modulation Monitor
☐ Standard Frequency Meters for Mobile Systems

Name .....

Address .....

.....

NEWS FROM THE FCC

(Continued from page 22)

viding general mobile communications service on a common carrier basis, if any can be achieved, appears to be only in the development of a broad band plan of some sort which will permit the derivation of many more communications channels than could be provided in the 152 to 162 mc. band by present methods of operation. We propose to give our attention to this problem. . . .

"While we have left this proposed allocation unchanged, we have not overlooked the petition of The Bell Telephone Laboratories, requesting the establishment of a multi-channel, broad band common carrier allocation between 400 and 500 mc. As we have indicated in our comments, we are acutely aware of the necessity of providing for some form of broad band operation for the common carrier general mobile service, if that is possible. However, the Citizen's Radio Service is already established in the band 460 to 470 mc., and we do not consider it feasible to move it. Likewise, the spectrum immediately below 450 mc. is already assigned to the amateur service. Accordingly, there would appear to be no point in further delaying the finalization of the 450 to 460 mc. allocation and thus delaying its development and exploitation. In view of this, the allocation is adopted without change.

"Consideration of the basic merits of the Bell Laboratories' petition, which goes into the question of the desirability of establishing an allocation for broad band general mobile development, will be undertaken in connection with our proceeding regarding the allocation of spectrum space for UHF television service above 470 mc. and the petition will be disposed of in that proceeding."

Pursuant to the procedure established in a Commission Notice of Further Proposed Rule-Making, adopted July 8, 1949, the issue raised by the petition of Bell Telephone Laboratories was duly reached for hearing. Evidence bearing upon this issue was presented before the Commission *en banc* on various days during the period from June 5, 1950 to December 24, 1950. Evidence favoring the proposal was adduced on behalf of Bell Telephone Laboratories and the Bell System, United States Independent Telephone Association, and National Mobile Radio System. Mutual Telephone Company of Hawaii came forward with a request that the Commission defer making any firm allocation of 470 to 890 mc. insofar as the Hawaiian Islands are concerned, pending a review of the specific needs of that Territory for televi-

(Continued on page 28)

How Long Is a Month?

Well, It's a Long, Long Time If You Lose Your

LICENSED RADIO OPERATOR

IF you are responsible for the operation of a radio communication system, you have probably checked the military status of your licensed operators. If you are satisfied that they are not subject to call, and that there is no possibility that they could be hired away by one of the many new systems going on the air every day, you are very fortunate indeed. You have nothing to worry about.

But if there's the slightest doubt in your mind, here is something that deserves your most thoughtful and immediate consideration:

The Demand Exceeds the Supply:

The demand for licensed operators has become so great during the past year that it far exceeds the number of qualified men now available!

Consequently, if one of your operators resigns, or is called to military duty, you will probably not be able to replace him. To meet that situation, you will probably have to pick a man who is willing to take a study course so that he can prepare to pass the FCC radio operator examination. Only then will he have the license required by the Commission of any man who installs and services radio communication transmitters.

How long will it take to complete such a course of study? Well, that depends on the man's previous training and experience.

At the Cleveland Institute of Radio Electronics, we find that many of our students require only 10 weeks. Some take 4 or 5 months. The principal factor is the amount of time a man can study each day.

Although we are graduating more licensed operators than any similar school, an increasing number of our students have jobs awaiting them even before they enroll.

In years past, we have been able to fill requests from communication systems for operators with reasonable promptness. But that is no longer possible. Today, finding a man who is available where he is needed is largely a matter of luck. It isn't a matter of the salary you want to pay, but of finding an operator at any price!

Recognizing these new conditions, the FCC is now cooperating by giving quarterly operator examinations at 31 cities, semi-annual examinations at 23 cities, and annual examinations at 7 cities. In addition examinations are given daily at its 32 offices.

How to Anticipate Emergencies:

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

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

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

Time Required, and Cost of Training:

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

Cleveland Institute of Radio Electronics
Special Attention: Desk No. 10
4900 Euclid Ave., Cleveland 3, Ohio

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

1. Our remittance will be refunded in full if, for any reason, within 5 days after receipt of the first group of study material, we are not completely satisfied.

2. If the man we select does not pass the FCC examination after completing the course, CIRE will provide additional instruction, without further charge, until he does pass the FCC examination.

Name .....

Company .....

Address .....

.....

NEWS FROM THE FCC

(Continued from page 26)

sion broadcasting and consideration of the special needs of common carrier fixed service there.

Opposition to Bell's proposal was adduced on behalf of Philco Corporation, Philco Television Broadcasting Corporation, Television Broadcasters Association, and Allen B. Du Mont Laboratories.

Although the frequency space in issue is now allocated to broadcasting, in deciding the question before us we are faced with the alternative of assigning the frequency spectrum space involved here to either the common carrier communication service or television broadcasting. Accordingly, we have undertaken to weigh and compare the relative needs of each of these services.

The primary use to which the subject frequency band would be put would be the rendition of land mobile communication service for hire. Such service is provided by a duplex operation which necessitates the use of one frequency for communication outward from the base station and a different frequency inward from the mobile unit. Thus, two frequencies comprise a single channel of communication, and each allocated base station frequency has associated with it a predetermined mobile station frequency.

Although 12 channels in the band 35 to 44 mc. have been made available for assignment to communications common carriers, the Commission has thus far found it impractical to repeat the use of these frequencies in widely separated areas because of skip-type interference in that portion of the spectrum. The determination as to which channel may be used in any area is made according to an engineered zone plan which is set forth in Section 6.401 (b) of the Commission's Rules.

Thus, the following usable frequency assignments are now available to this service in each service area:

TELEPHONE COMPANIES

Base Station	Mobile Station
1 frequency in the 35-mc. band	1 frequency in the 43-mc. band
152.51 mc.	157.77 mc.
152.57 mc.	157.83 mc.
152.63 mc.	157.89 mc.
152.69 mc.	157.95 mc.
152.75 mc.	158. 01 mc.
152.81 mc.	158.07 mc.

MISCELLANEOUS CARRIERS

Base Station	Mobile Station
152.03 mc.	158.49 mc.
152.09 mc.	158.55 mc.
152.15 mc.	158.61 mc.
152.21 mc.	158.67 mc.

Although 2 mc. of space between 458 and 460 mc. have also been allocated to

(Continued on page 29)

NEWS FROM THE FCC

(Continued from page 28)

this service, there has not yet been any implementation thereof, chiefly because of the alleged inability of the communication common carriers to derive separate blocks of frequencies for base and mobile stations, respectively, with sufficient spectrum separation between such frequencies to permit interference-free operation.

As of May 23,1950, we note the following statistics pertaining to the common carrier mobile service:

Bell System Companies offered service in 136 cities, having installed 235 base transmitters (exclusive of test and auxiliary equipment), and having been authorized to provide service to 15,324 mobile units.

172 miscellaneous carriers offered service in 154 cities, having installed 175 base transmitters (exclusive of test and auxiliary equipment), and having been authorized to provide service to 9,473 mobile units.

18 independent telephone companies offered service to 19 cities, having installed 23 base transmitters (exclusive of test and auxiliary equipment), and having been authorized to provide service to 1,223 mobile units.

A Bell witness stated that about 250,000 mobile calls are made each month on their facilities. In addition to the public mobile service, Bell has under contract about 5,000 mobile telephones on a private system basis for such users as police, power utilities, industrial users, etc., with 477 associated base stations. These contract facilities operate on the non-common carrier frequencies assigned to their use. It is urged by Bell that the requested frequency allocation might permit the expansion of the public facilities to absorb a substantial number of the private-service customers, thus alleviating the pressure of demand for non-common carrier mobile frequency utilization.

Because of the nature of the major portion of the mobile service provided by Bell System and independent telephone company facilities, *i.e.*, through message service by inter-connection with exchange land-lines, the peak loading of a channel (frequency pair) is reached at about 85 mobile units. The peak loading of the miscellaneous carriers, which are a third party relay dispatch service (not interconnected to exchange land lines and not affording direct through service), is generally regarded as being about 200 mobile units. Thus, where the phone companies can derive a maximum of seven channels (6 in the 152 to 162 mc. band and 1 in the 35 to 44 mc.

(Continued on page 30)

NEWS FROM THE FCC

(Continued from page 29)

band), they can serve a maximum of about 595 units. If all four miscellaneous carrier channels were also loaded to capacity, an additional 800 units could be served; or a total of about 1,400 units. That capacity appears to be inadequate to serve the needs of cities like New York, Chicago, Los Angeles, Philadelphia, St. Louis, etc. Bell witnesses testified that, without advertising or pushing the sale of the service, the demand for telephone company service already exceeds available capacity in cities like New York, Chicago and Los Angeles and there are waiting lists in some of the other larger metropolitan areas. Additionally, it was stated, new requests for telephone company service are received at the rate of about 65 per month. Moreover, in certain places, like New York and Los Angeles, it is not possible for the telephone companies to utilize all 7 channels in a single service area because of co-channel interference in adjacent service areas, *e.g.*, New York-Newark, Los Angeles-Long Beach. As a consequence, the channel usage has to be split between such areas.

Bell offered evidence to show that, by 1960, there would be a need for Bell service to about 95,000 mobile units on a national basis. Thus, it was expected that about 100 channels would be needed in each of the cities of New York, Chicago, Los Angeles, Philadelphia, Detroit, Boston and San Francisco; that about 22 other medium sized cities would need 20 to 50 channels; and almost every city over 300,000 population would require more channels than are now available.

Bell indicated that the system proposed would, in the 30 mc. of spectrum space under consideration, yield approximately 100 channels. It has also been indicated by Bell that it is their opinion that the spectrum between 470 and 500 mcs. is ideally suited to such development under the present state of the art, but that portions of the spectrum at or above 1000 mc. would not be suitable, under the present state of the art, because of such factors as lack of tube development, excessive power requirements, inability to use conventional wiring, *i.e.*, need for use of wave guides at those frequencies, etc.

The bell petition has the endorsement, from the standpoint of a service allocation, of the independent telephone companies and the miscellaneous carriers, though it is recognized that there would later have to be worked out a basis for assignment and utilization of the space and facilities among the eligible carrier users.

(Continued on page 31)

NEWS FROM THE FCC

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If the expansion in this service is to take place, and if we do not make available the 470 to 500 mc. of space to common carrier service, the following alternatives are available:

1. Requiring smaller separations between frequency assignments in the bands below 162 mc., *i.e.*, 40 kc., 30 kc., or even 20 kc. frequency separation.

2. Development and use of more efficient techniques of operation such as single side band transmission, multiplex, etc.

3. Utilization of geographic frequency sharing so as to obtain utilization of frequencies assigned to non-common carrier services in critical population centers where such non-common carrier frequencise are not required for local use.

In the ten years since its commencement, commercial television has had a phenomenal growth. Although it has not yet had an opportunity for its fullest growth, it is already one of the country's most important industries and an important medium not merely for public entertainment but also for the development of an informed public.

The Commission has long been aware of the urgent need for additional television facilities and, even in 1945, in connection with its overall allocation study, it stated that the then available VHF television channels were insufficient to make possible "a truly nationwide and competitive" television broadcast system. In order to provide for the development of such a system, and to provide space for future expansion, the portion of the spectrum between 480 to 920 mc. was at that time made available for television experimentation. This band was subsequently limited to 470 to 890 mc. As a result of technical developments in television broadcasting in the UHF band, and of the rapidly growing need for additional facilities for television broadcasting, the question of utilization of the region of 470 to 890 mc. for television broadcasting on a regular basis was made part of subsequent proceedings.

By its Third Notice of Further Proposed Rule Making, adopted on March 21, 1951, the Commission proposed an assignment table which would make our television system truly nationwide by providing television channels to many communities of the country presently without provision for any television service. The Commission could accomplish this end only by making extensive use of UHF channels as well as VHF. In addition, the Commission in the Notice proposed to allocate to commercial television, at this time, all of the 470 to 890

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NEWS FROM THE FCC

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mc. band with the exception of the 30 mc. (470 to 500 mc.) here at issue. The severe handicap facing the television service, particularly in congested areas of the country, is illustrated by the Commission's proposed new assignment Table.[1] For example, in Connecticut, only two UHF assignments are proposed for Hartford, two for Bridgeport, and one for each of the other cities considered (including New Haven, New Britain and six others). Only two VHF assignments are proposed for the entire state. In New Jersey, two UHF assignments are proposed for Atlantic City; only one UHF assignment is proposed for Trenton, and one for each of five other cities. The one VHF assignment for New Jersey is already in use in Newark. Only four assignments each (including both VHF and UHF) are proposed for the entire states of Delaware and Rhode Island.

Although the Commission has discouraged the filing of applications for new television stations during the pendency of the current television proceedings, more than 400 such applications are now on file. And despite the utilization of the UHF band for this service in the future, a large number of these applications could not be granted under the new Table because the demand in the various cities exceeds the number of proposed channels, VHF and UHF combined. The Commission has received approximately 1,000 comments, oppositions and petitions from interested parties relating to the Notice of March 21, mentioned above. A substantial number of these pleadings propose changes and additions to the assignment Table in an attempt to obtain additional facilities in various communities.

Additional assignments, not specifically provided for in the Table, could be achieved in many areas only by the use of the channels in the portion of the spectrum above 782 mc. (UHF Channel 52), which the Commission has designated as flexibility channels, *i.e.*, channels in which no city by city assignments have been proposed but whose use is provided for on a flexible basis. If 470 to 500 mc. is not available to television broadcasting, only 13 flexibility channels would be available. On the other hand 18 such channels will be available if this portion of the spectrum is allocated to television. But even the exact number of assignments cannot now be determined because of the purposes for which the flexibility channels must be em-

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[1] For details, see "Analysis of the New TV Plan" by Milton B. Sleeper, RADIO COMMUNICATION, April, 1951.

NEWS FROM THE FCC

(Continued from page 32)

ployed. One thing appears certain, however, the flexibility channels would soon be exhausted in congested areas. Moreover, such techniques as stratovision and polycasting would, as outlined in the Third Notice, be compelled to utilize the flexibility channels for additional experimentation, and would have to find their eventual home in this portion of the spectrum. Both these techniques would, of necessity, require extensive spectrum space and each one, if authorized, would require a substantial number of the flexibility channels.

Thus, it appears that the entire space between 470 and 890 mcs. is urgently needed to obtain full development of television broadcasting, and that the loss of any of this space to other services would severely handicap the attainment of an adequate nationwide and competitive television system.

At present the frequencies 470 to 475 mc. are allocated to facsimile broadcasting. The frequencies 475 to 500 mc. are allocated to broadcasting, although the exact form of broadcasting is not specified in the Commission's Rules.

With respect to the 470 to 475 mc. band, no one has objected to the deletion of facsimile broadcasting from this band. Further, the Commission believes that if facsimile broadcasting is to be conducted it will be accomplished on existing broadcasting stations such as the FM broadcast stations in portions of the spectrum in which those stations are assigned. Accordingly, the Commission has concluded that facsimile broadcasting, as such, should no longer be permitted in the 470 to 475 mc. band.

Provision for the use of the whole band 470 to 500 mc. is, therefore, made in accordance with our conclusions:

CONCLUSIONS: Upon consideration of the record in these proceedings, we have concluded that the allocation of the frequency band 470 to 500 mc. should be made to the television broadcasting service. In arriving at this conclusion we are forced to resolve a conflict between two socially valuable services for the precious spectrum space involved. We find that the needs of each of the two services are compelling.

But while we find and conclude that there is, on the part of the common carrier mobile service, the need for further expansion of service beyond that already provided by our Rules and Regulations and by techniques now being employed, we do not conclude that the only available solution to the common carrier land mobile service lies in the utilization of the frequency band 470 to

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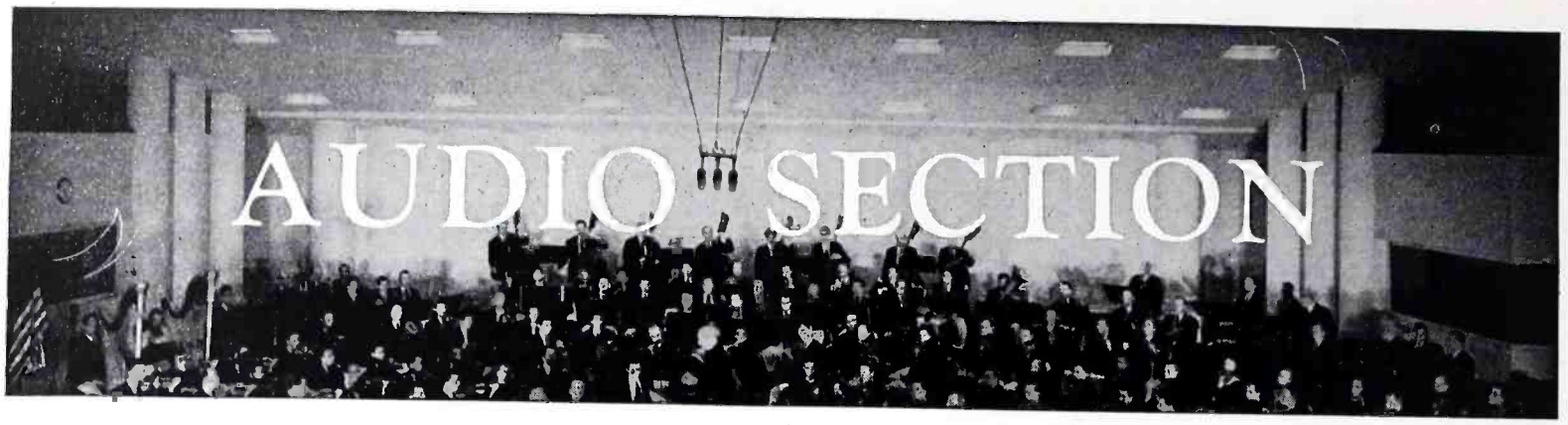

CHECKING UP ON AUDIO PROGRESS

G. M. NIXON, C. A. RACKEY, AND O. B. HANSON* WROTE THIS NBC STATEMENT ON HIGH-FIDELITY REPRODUCTION IN 1944. WHAT IS YOUR OPINION TODAY?

EDITOR'S NOTE: The following NBC report was issued seven years ago under the title "Down to Earth on 'High Fidelity'" at the time the FCC was setting up Rules and Standards for FM broadcasting. It is published at this time because 1) it makes very interesting reading, 2) it sets forth certain ideas that have been confirmed subsequently, 3) it discloses some thinking that is slanted more toward network policy than optimium pubic service, and 4) it points up some of the limitations that have developed since the 700-odd AM stations of 1944 have been multiplied by three, as well as progress achieved by audio engineers during the past seven years.

Also, we expect that our readers will have some interesting comments to make on this paper. You are invited to express your opinions for publication in RADIO COMMUNICATION. Letters received promptly will be published in the August issue.

THE term "high fidelity," as used at present (1944) in the general radio and sound reproduction field, has come to mean an extension of the audio range to the frequency limits of audibility of the human ear, as contrasted with a range limited to the usual 4,000 or 5,000 cycles. In reality, the term high fidelity is comparative, and it would be more correct to think of it as "higher fidelity."

Today there is available to the public a new system of program transmission, using frequency modulation of the VHF radio spectrum, where suitable channel spacing has been allocated by the FCC so that a wide audio band can be transmitted. In the interest of providing the public with a better radio broadcasting service, every advantage should be taken of frequency modulation toward establishing improved standards of transmission and reception. However, in determining these standards, it is quite important to take a practical view of what constitutes *realizable* high fidelity, bearing in mind that, in the overall result, various practical mechanical and electrical limitations, some physiological and psychological phenomena and, last but not least, the actual program content, are elements fully as important as a theoretically complete sound spectrum, or perhaps more so.

Fidelity implies a faithful reproduction of the original, a condition which in audio systems cannot actually be attained but, at best, only approached. True fidelity would require that:

1. The system not discriminate in any of its component parts against any frequency within the range under consideration.

2. No component part of the entire system introduce false harmonics.

3. There be no amplitude limitation of any portion of the spectrum in either transmission or reception.

4. The system be free from phase distortion.

5. The system be free from extraneous noise.

6. The loudspeaker and its driving amplifiers be capable of reproducing without distortion the full frequency range at loudness levels suitable for all listeners.

7. The acoustics of both the pick-up and listening spaces be suitable.

8. The spatial relationships of the sources of sound be transmitted and reproduced. This last probably requires some form of binaural or stereophonic system, neither of which is economically feasible for general public service at this time.

A system as described above, with the exception of binaural or stereophonic transmission, is not too difficult of realization from a transmitting standpoint. It might be approached closely in a receiver reproducing system, but the cost would probably be beyond the value which would be placed upon it by the purchasing public, particularly if the receiver were required to reproduce frequencies from 30 to 15,000 cycles.

It is curious that the emphasis in general discussions of high fidelity thus far has been on an extension of the upper portion of the sound spectrum, and little has been said about the required *balance*[1] between the upper portion and the lower frequencies. Actually, it has been discerned on the basis of such observation that a balanced frequency response is quite essential to program enjoyment, although this balance factor has not yet been reduced to a rigorous mathematical formula. One authority has said, and our experience has confirmed this general statement, that the product of the lower and upper frequency limits should equal a number in the vicinity of 500,000. A simple example will show the approximate validity of this hypothesis, as indicating the importance of balance. A system with frequency response limits of 50 to 8,000 cycles, a total range of 7,950 cycles, is conceded as satisfactory by most authorities. If we retain this same range and compare it with a range of 250 to 10,000 cycles, there is little question that the former is preferable for reasons of general naturalness, particularly because of the reproduction of a substantial range below 250 cycles. Note that in the case of 50 to 8,000 cycles, the bulk of program energy is in the band centering approximately at 700 cycles.

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*In 1944, the authors of this report were respectively Assistant Development Engineer, Audio-Video Facilities Engineer, and Vice President and Chief Engineer of the National Broadcasting Company.

[1]*Editor's Note:* This explains, at least in part, the great number of tremendously enthusiastic reports from people who have built FAS systems, or have added Air-Couplers to their audio installations to provide bass reinforcement.

The curve in Fig. 1 shows preferred lower and upper frequency limits in which the balance between the lower and upper portions is properly maintained. It will be noted that the product of the upper and lower frequency limits, as has been specified, is approximately 500,000. As an interesting fact in this connection, many of the better home radio receivers of conventional type seem to fit surprisingly well within these frequency limits.

An extension of the frequency range to perhaps 17,000 cycles and down to 30 cycles would encompass the entire audible spectrum, but at only a small percentage of the total time would there be any appreciable energy in the region above 10,000 cycles. Reproduction of frequencies above 10,000 cycles adds only to the enjoyment, if that is the word, of such things as key jingles, footsteps, handclapping and various extraneous (non-musical) noises from musical instruments such as resin squeaks, air rush from wind instruments, and the like. These sound effects can hardly be considered essential or worth the high cost to attain them.

Experience and varius surveys have shown that, even when listeners have receivers capable of reproducing frequencies up to 5,000 cycles, they usually operate the tone control to restrict the audio range to an upper frequency cutoff of somewhere between 2,500 cycles and 4,000 cycles. Reasons given for this are that the "tone is mellower," "more pleasant," "less obstrusive," etc. Many listeners who are musically trained and who appreciate symphony and opera are, strangely enough, numbered in this class, indicating that this procedure does not stem from uncultivated tastes but has some other, more general, basis.

It has been claimed that, if distortion and noise were eliminated from the higher frequency band, the public would then prefer the extended upper range. Perhaps so, if the higher range is properly balanced by adequate bass reproduction. Distortion and noise are unpleasant at any portion of the sound spectrum.

Receivers which at present provide millions of listeners with many hours of enjoyment seem generally adequate for reproducing the intelligence and entertainment contained in the program material. The witticisms of Charlie McCarthy, for example, are just as humorous on a receiver whose frequency range is 200 to 3,000 cycles, as on a higher fidelity system.

In this connection, it should not be overlooked that the entertainment and attention-engaging factors in musical listening are not concerned with quality alone. Such matters as appreciation of technique, melody itself, rhythm and the like, are of great importance to the musical ear and all these of course can be reproduced satisfactorily within a reasonably restricted frequency range.

The average radio listener purchases the table model receiver rather than the console. The former type of receiver cannot reproduce bass frequencies adequately, the fundamental reason being lack of sufficient physical size. It is only in the console type that adequate reproduction in the low frequency range can be approached, but few even of this type have provided really good bass response free from noticeable cavity resonance. The higher frequencies, however, can be reproduced with the smaller receivers assuming proper design, but generally at the expense of an undesirable directional characteristic. This varies with frequency in the preponderant majority of loudspeakers, so that reproduction of these higher frequencies is accentuated in front of the speaker and decreases with the increase in angle from the speaker axis. This is shown in Fig. 2, and it can be seen that the response at 45 degrees is substantially less than optimum, even at frequencies as low as 3,000 cycles. A true higher-fidelity receiver must so distribute the higher frequencies that, within a specified solid angle, the response at all frequencies is substantially uniform.

The acoustical conditions of the studio and listening space can be controlled only over a frequency range approximately of 64 to 8,000 cycles, as design data and experience with materials and completed rooms is available only within those limits. At frequencies of 4,000 cycles and higher, the absorption contributed by the air itself, at usual values of relative humidity, becomes of increasing importance. At 10,000 cycles and a relative humidity of 50 per cent, the absorption of the air limits the reverberation time to about 1.5 seconds even though the walls, floor and ceiling are perfectly reflective; at 12,000 cycles the limit is approximately 1.2 seconds and at 15,000 cycles about 0.9 seconds. This factor should not be overlooked as it is one relatively fixed limit which certainly must affect consideration of higher fidelity, not only in the studio but also in the home.

The ear, the final criterion of judgment, is also to be taken into account, as the higher frequencies can only be detected by relatively young listeners, since hearing loss at the higher frequencies increases with age. The curves in Fig. 5 show the results obtained by the U. S. Public Health Service in this field. Although few measurements have ever been made above 10,000 cycles, indications are that the curves do not trend upward!

Program fidelity is also determined by the loudness level at which the speaker is operated. Curves in Fig. 3 show the frequency response of normal ears at four listening levels, "normal" ears being those of young people about 20 years of

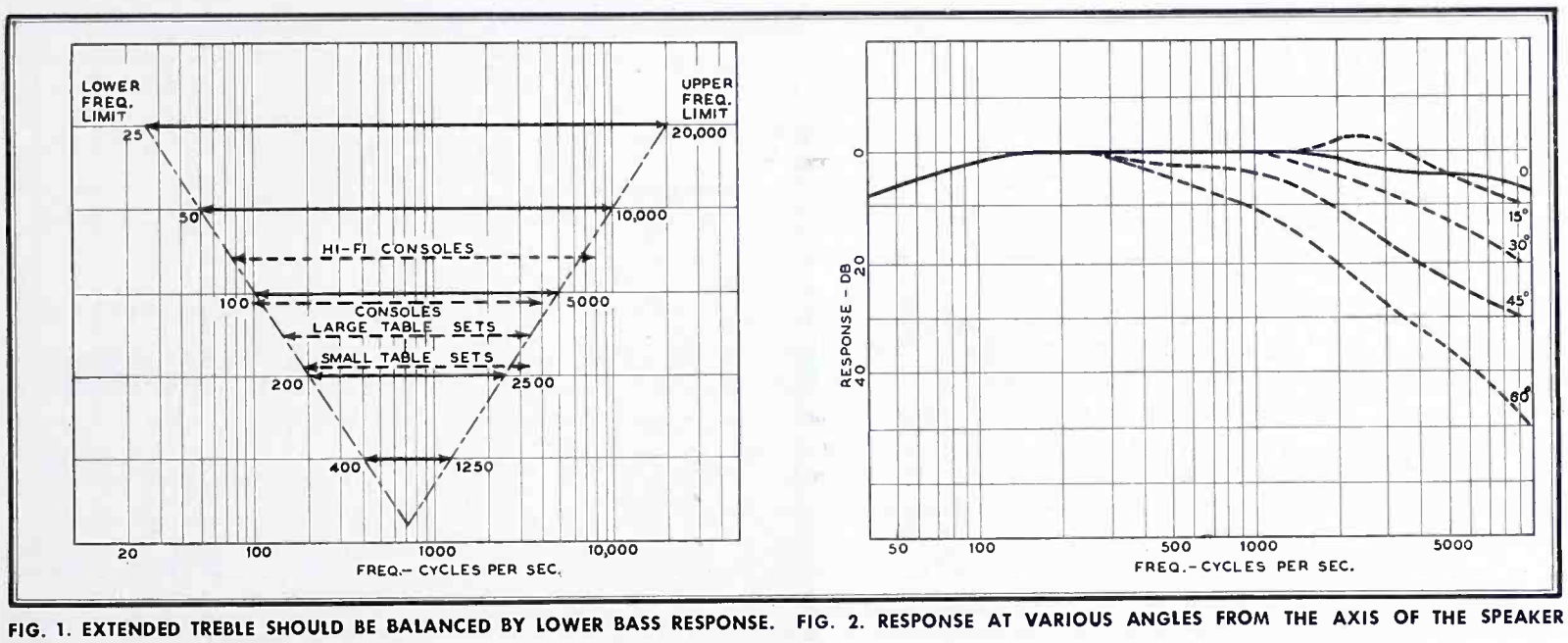

FIG. 1. EXTENDED TREBLE SHOULD BE BALANCED BY LOWER BASS RESPONSE. FIG. 2. RESPONSE AT VARIOUS ANGLES FROM THE AXIS OF THE SPEAKER

age. Note that only at the very loud and loud listening levels, 100 db and 80 db above the hearing threshold respectively, is the low-frequency response of the ear substantially flat. The decreased response of the ear at 50 cycles, 100 cycles and 200 cycles, as compared with 1,000 cycles, is tabulated below:

DB ABOVE THRESHOLD		Cycles 50	100	200	1000
Very Loud	100db	0db	0db	0db	0db
Loud	80db	- 6	- 2	- 0	- 0
Moderate	60db	-17	-11	- 6	- 0
Very Soft	40db	-30	-22	-12	- 0

In the case of the very soft listening condition, the response would further tend to be obscured at the low frequencies by local air-borne noises, as this listening level compares with average residential noise. Any decrease of more than 10 db or so below this level will generally be obscured or masked by the noise. The response of a young listener seated at 45 degrees from a radio receiver (with a reasonably uniform response up to about 10,000 cycles) operated at a loudness level of 60 db, which is a moderate listening level, is shown in Fig. 4.

Thus it is apparent that the higher-fidelity receiver should include compensation for listening level effects in the volume control used with the receiver to provide uniform loudness at low frequencies. This device could also be used to compensate partially for the directivity curve of the loudspeaker, where adequate distribution cannot be attained in the speaker design. Such a tone-compensated volume control will then discriminate, as the volume is lowered, against the middle frequencies in favor of the low frequencies and, to a lesser degree, the higher frequencies, the effect to the ear being more pleasing reproduction at the usual listening levels, which are commonly in the moderate classification.

The preponderant majority of sound systems are now, and will be for years to come as far as can now be visualized, non-aural systems, whether they are utilized for recordings or for radio broadcasting. This fact alone indicates a fundamental departure from perfection because of the absence of true space-consciousness of the sound sources.

Some other factors occurring in the general high fidelity problem, such as random noise and distortion, may also be mentioned. Since distortion components are multiples of fundamental frequencies, and since many audio devices, particularly recordings, have varying degrees of inherent distortion which are difficult to eliminate, a wider band will increase the effect of such distortion. This causes much of the upper-frequency fuzziness, generally in evidence on most attempts at wide band reproduction. The phase tortion introduced by most sound systems is not believed to be a serious problem, as the ear is apparently not sensitive to moderate phase changes. The phase characteristics should, however, be uniform. Distortion must be kept to the lowest possible value, and more attention should be directed to investigation and elimination of cross-modulation products as compared with present stress on the more simple harmonic distortion effects.

Multi-path effects resulting in distortion are observable in reception on both amplitude and frequency modulation systems. This form of distortion, when it occurs, can be more noticeable with frequency modulation, and this effect has been observed in certain instances. It is possible that some listeners will be subject to this distortion, the effects of which increase with an extension of the audio range and deviation. However, good limiting in a frequency modulation receiver should minimize this form of distortion.

Random noise is directly proportional to band width, and any increase in latter will increase the amount of noise passed. This imposes stringent design conditions on all the units in the line-up, and would be particularly difficult to get and to maintain, at a reasonable price, in the case of a practical home receiver.

Standard radio broadcasting is at present limited to an upper modulation frequency of 5,000 cycles as result of the 10,000 cycles spacing of radio channels, but most studio equipment and transmitters are capable of transmitting up to 10,000 cycles or higher. However, satisfactory reception with this wide band is not generally possible in the evening, because of monkey chatter from adjacent-channel stations, so that a restriction in frequency response in the receiver is in such case actually desirable.

Whether or not we can make full use of a complete audio spectrum depends, in the final analysis, upon the ability of the manufacturers to provide receivers which will satisfactorily reproduce the lower frequencies. Only when this is possible in the average marketable receiver can we make full use of the higher portions of the frequency spectrum, and can refer to the system as one of higher fidelity. The average price of a broadcast receiver in 1940, of which many millions were sold, was about $35, and at this price satisfactory reproduction of 50 to 15,000 cycles is not to be expected. The response of home receivers has been found to be substantially as follows:

SMALL TABEL MODEL 200 to 3,000 cycles
LARGE TABLE MODEL 150 to 3,500 cycles
CONSOLES[2] MODEL ....100 to 4,000 cycles

It must be stressed that power handling facilities in all models were quite limited at the lower frequencies due to speaker design, so that the lower limit does not actually have the meaning it implies.

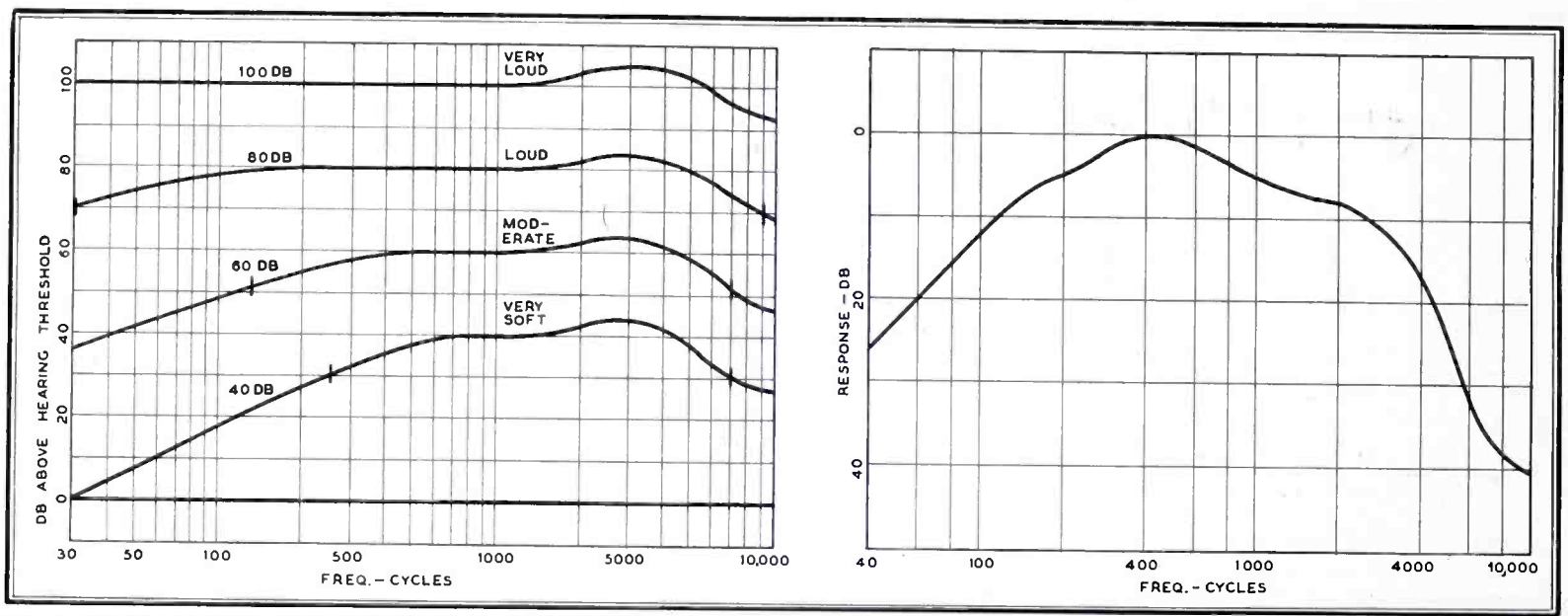

FIG. 3. THE EAR IS MUCH LESS RESPONSIVE TO LOW FREQUENCIES AT LOW VOLUME LEVEL. FIG. 4. EFFECT OF LISTENING ANGLE FROM SPEAKER AXIS

[2]A few in this class were capable of fair reproduction to 8,000 cycles.

In an appeal to common sense and practicality in the matter of fixing an audio band width for receivers, it is suggested that the range from 60 to 8,000, or possibly 50 to 10,000 cycles be considered for all types of broadcasting, including frequency modulation. There is very little question in the opinion of those who have devoted their lives to the problems of sound reproduction, that good reproduction over a practical band will provide a better service to the listener than one of controversial and indefinite quality over a theoretically complete audio spectrum. Our efforts should, therefore, be directed rather towards the provision of a balanced system of reproduction as fine as we can possibly design and build it, than solely toward extending the upper frequency limits of audibility beyond 10,000 cycles with the possible neglect of other more important factors. It is especially stressed that reproduction at the lower frequencies be investigated and improved, because it is in this direction, the direction of balance as compared with present trends, that we can best provide what unbiased observation and listeners' preference demands.

How can publicizing and creating a demand for 15,000-cycle receivers or systems be possibly justified, when a good 10,000 cycle receiver than can be made available to the greater part of the public, has not yet been designed? For the sake of technical integrity and the future of the radio industry, let's get down to earth in the matter of high fidelity. We are faced with the prospect of a post war era in which it is very likely that many claims for new materials, techniques and overall improvements will face the spotlight of public test — and fail. Let us not, therefore, in our enthusiasm, make claims that are too difficult, if not impossible, to realize.

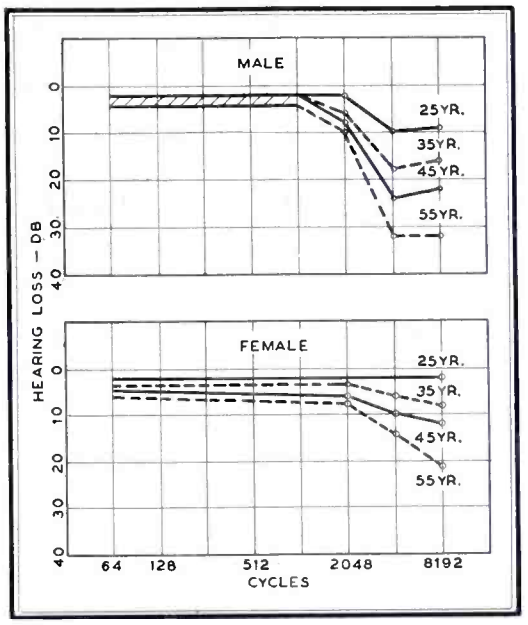

FIG. 5. LOSS OF HUMAN HEARING VERSUS AGE

FORTHCOMING ARTICLES

Two extremely interesting articles by James Moir are scheduled for publication in this Audio Section.

In August, Mr. Moir will discuss the arrangement and dimensions for a dealer's audio demonstration room. This information is also applicable to planning a home music room to obtain optimum acoustic effects.

The second article, to appear in October, is a detailed discussion of the top-rated audio amplifiers manufactured in England. Wiring diagrams, component values, and specifications will be included, together with special photographs. Because of its completeness, it may be necessary to divide this article into two parts, but we shall try to get it all in the October issue.

DESIGN DATA for AF AMPLIFIERS — No. 11 Power Amplifiers

PART 1 — TRIODES AND BEAM POWER TUBES — NOTES ON THE CHARACTERISTICS OF THESE BASIC TUBE TYPES

IN GENERAL, discussions of audio power amplifiers either attempt to ignore the relative merits of triodes and beam power tubes, or they are patently partial toward one group. It is submitted that while both attitudes are legitimate, neither is as helpful to the reader as an impartial presentation of the advantages and limitations of each category. This Data sheet is, therefore, devoted to the basic differences between triodes and beam power tubes, and the reasons for these

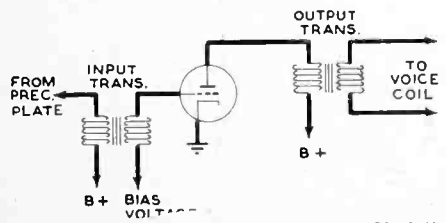

FIG. 1A. BASIC TRIODE AMPLIFIER CIRCUIT

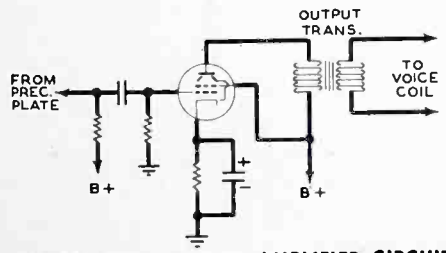

FIG. 1B. BEAM POWER AMPLIFIER CIRCUIT

differences. Sheet No. 12 will be concerned with typical circuits and performance characteristics.

POWER SENSITIVITY

Because there are three electrodes between plate and cathode in a beam power tube, the signal grid has a relatively greater degree of control over plate current than in a triode, where plate and cathode are not nearly so isolated. In a voltage amplifier, this more rigid control would be accompanied by a greater voltage-gain capability; in a power amplifier the corresponding characteristic is called power sensitivity. Thus, a given amplitude of voltage swing applied to the grids of a beam power tube and a triode would cause a greater change of current in the beam power tube. It follows that, for equal outputs, the triode would require a larger driving voltage.

This characteristic is of practical importance, as can be seen in Fig. 1. Basic single-ended triode and beam power circuits are shown at A and B, respectively. In Fig. 1A, an input transformer is shown driving the triode, while a simple RC network is used at the grid of the beam power tube. Fig. 1B. The input transformer is used primarily because of the voltage step-up obtainable. With similar plate voltages, a triode generally requires 5 times or more the driving voltage of a beam power tube.

BIAS VOLTAGE

Another point of difference is that of bias. A triode must have appreciably greater bias in order to accommodate large grid signals, and to establish a proper operating level. This bias, in the order of 60 volts, cannot be obtained conveniently from a cathode bias resistor because the effective plate voltage would thereby be reduced by a corresponding amount. The secondary of the input transformer, therefore, is ordinarily returned to a bias source. This must be obtained from an auxiliary winding on the power transformer or from a special power-supply bleeder.

PLATE RESISTANCE

Plate resistance, the AC impedance of a tube in an operating circuit, is of great importance in evaluating differences. The plate resistance of a beam power tube is many times that of a triode, and this leads to a serious disadvantage.

Power output curves are plotted for both types of tube in Fig. 2. The output in each case is, of course, maximum when the effective load impedance is equal to the plate resistance. However, when the two are equal, the distortion is intolerably high in the case of each tube. As is shown, an effective load impedance is chosen which is the optimum compromise for low distortion and reasonably high output power. For triodes, the optimum load impedance is generally 3 to 5 times the plate resistance, while for beam power tubes it is in the range from 1/10 to 1/5 the plate resistance.

The advantage of triodes in this respect derives from the fact that when a speaker is shock-excited, it tends to oscillate at its mechanical reasonant frequency. This oscillation creates an AC current flow in the output transformer, which causes a foreign voltage to appear across the power tube. A triode, having a plate resistance much lower than the reflected voice-coil impedance, damps out this oscillatory tendency quickly. On the other hand, the high plate resistance of a beam power tube has little damping effect, and unless an excellent speaker is used, or substantial negative voltage feedback is employed, a boomy, hangover sound will result.

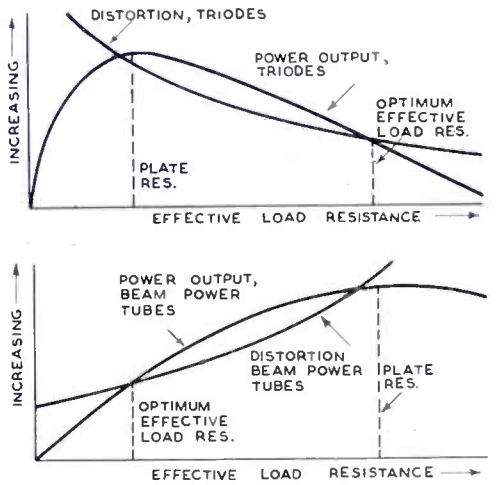

FIG. 2. CHARACTERISTICS OF THE TWO TYPES

It should be mentioned in this regard that a cathode bypass capacitor should always be employed in a single-ended power amplifier stage, whether of triode or beam power type. Its omission increases the effective plate resistance, thereby decreasing this desirable speaker-damping.

EDITOR'S NOTE: An unfortunate typographical error occurred in the caption for Design Data sheet No. 10. The caption should have been, "HIGH INPUT AND LOW OUTPUT IMPEDANCE OF A CATHODE FOLLOWER MAKES IT PARTICULARLY USEFUL WHEN FEEDING LONG CONNECTION LINES."

NEWS FROM THE FCC

(Continued from page 33)

500 mc. As we have pointed out, the following alternatives are available:

1. Requiring smaller separations between frequency assignments in the bands below 162 mc., *i.e.*, 40 kc., 30 kc., or even 20 kc. frequency separation.

2. Development and use of more efficient techniques of operation such as single side band transmission, multiplex, etc.

3. Utilization of geographic frequency sharing so as to obtain utilization of frequencies assigned to non-common carrier services in critical population centers where such non-common carrier frequencies are not required for local use.

Before considering step 3, however, it should be pointed out that it will be necessary to ascertain the relative need for frequencies in those areas by all services so as to apply the same type of analysis to other public needs.

We find and conclude that the television broadcasting service likewise requires an enlargement of its existing and exclusive frequency allocation, certainly to the extent of the 30 mc. of spectrum space here at issue, to ensure that an adequate nationwide and competitive system of television broadcasting may be established. However, unlike the common carrier mobile service, a proper television broadcast service allocation cannot be achieved through the utilization of spectrum space at some other portion of the spectrum, or through the employment of similar techniques and alternatives available to the common carrier services. If the television service is to be expanded to the extent indicated, it must expand in that portion of the frequency spectrum immediately adjacent to and comprising part of the spectrum already set aside for its exclusive use, *i.e.*, 500 to 890 mc. It is for these reasons that we are forced to the conclusion that the allocation of the frequency band 470 to 500 mc. should be made to the television broadcasting service.

Insofar as the request of Mutual Telephone Company is concerned, it is noted that we have proposed to make an overall allocation to the television service in the same manner as has been done in previous allocation actions for other services, *i.e.*, we do not propose, in this proceeding, to establish different allocations as between the continental United States and the territories and possessions. However, we are aware of the possible difference in certain instances in frequency service requirements in the continental United States and in the territories. We believe that proper attention to such matters can best be given in an appropriate separate proceeding.

INDEX OF ADVERTISERS

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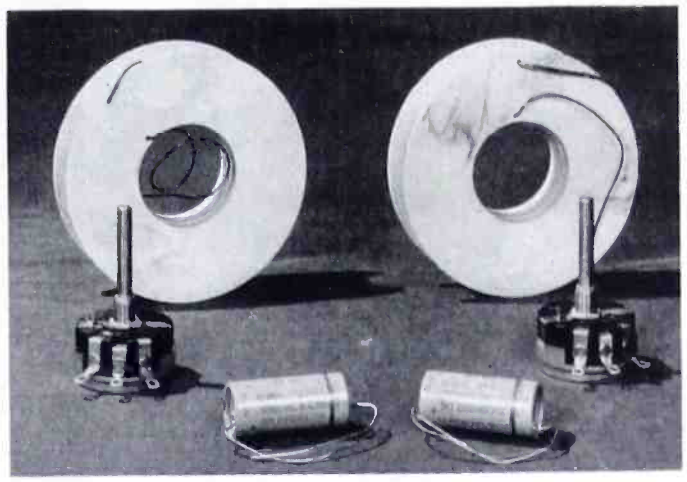

G. A. Crossover Networks for

BASS REINFORCEMENT

Choose the Crossover Frequency You Prefer

SLOW-ATTENUATION NETWORK, as described in *Radio Communication Magazine*, May, 1951: You can add an FAS Air-Coupler to provide bass reinforcement for your present speaker, operating at any crossover point listed below. Only one inductor is necessary, plus the associated condensers and level controls.

Choose the inductor according to the impedance of your bass speaker. Matching to your upper-range speaker can be accomplished with the level control after installation.

Crossover Frequency	Bass Speaker 4 Ohms	Bass Speaker 8 Ohms	Bass Speaker 16 Ohms
125 Cycles	Inductor B $6.00	Inductor A $10.00	.....
250 Cycles	.....	Inductor B $6.00	Inductor A $10.00
450 Cycles	Inductor C $4.00	.....	Inductor B $6.00

Add $4.00 for the associated capacitors and the level controls

SHARP-ATTENUATION NETWORK, as described in *Radio Communication Magazine*, December, 1950: If you prefer sharp attenuation, order two inductors of the type listed below, according to the impedance of your bass speaker and the crossover frequency you prefer. Matching to your upper-range speaker can be accomplished with the level controls after installation.

Crossover Frequency	Bass Speaker 4 Ohms	Bass Speaker 8 Ohms	Bass Speaker 16 Ohms
85 Cycles	Inductor A $10.00 each	Inductor A $10.00 each	.....
170 Cycles	Inductor B $6.00 each	Inductor A $10.00 each	Inductor A $10.00 each
275 Cycles	Inductor C $4.00 each	.....	.....
350 Cycles	.....	Inductor B $6.00 each	Inductor B $6.00 each
550 Cycles	Inductor C $4.00 each	Inductor C $4.00 each	.....
1100 Cycles	.....	Inductor C $4.00 each	Inductor C $4.00 each

Add $4.00 for the associated capacitors and the level controls

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6-ft. Air-Coupler parts, fine quality ¾-in. plywood	**$34.50**
Altec Lansing 600-B 8-ohm, 12-in. speaker	**$46.50**
Peerless S-230Q output transformer	**$26.00**
Peerless R-560A power transformer	**$16.90**
Peerless C-455A power choke	**$10.70**
English KT-66 output tube, to replace 6L6	**$5.25**

Cash must accompany your order. No C.O.D.'s. G. A. guarantees that each part will reach you in perfect condition, shipped in the original manufacturer's carton.

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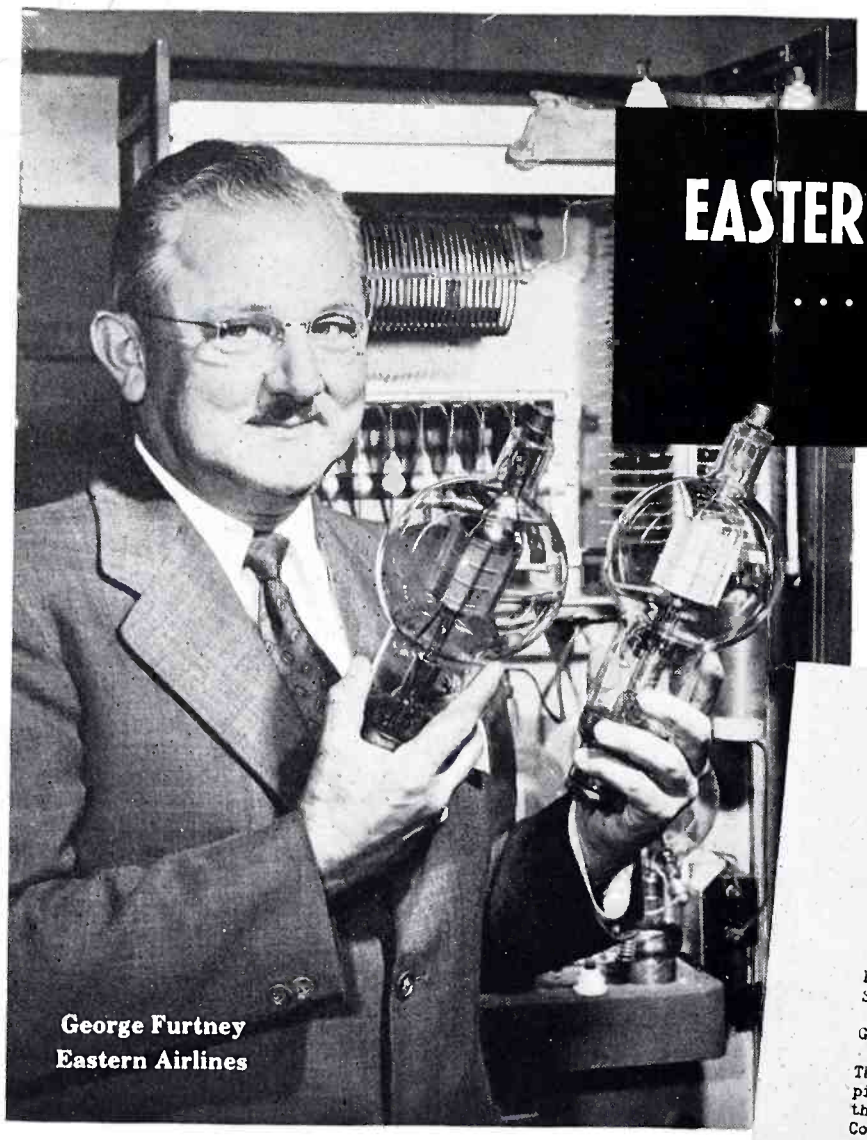

George Furtney
Eastern Airlines

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says this about Eimac tubes.

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April 11, 1951

Eitel-McCullough, Inc.
San Bruno, California

Gentlemen:

The two 450-T tubes P-169-LO and G-140-LO in the attached picture were purchased in March and September 1941. Since that time they have been installed in the Wilcox Electric Company's 96A transmitter at Atlanta. They have given almost ten years of satisfactory service and are still fit for further use.

The record of these tubes, together with 450TL F-113-LO just removed from service proves that our choice of EIMAC tubes was correct for dependable operation in the Aviation Safety Services.

Very truly yours,

G. W. Furtney
Engineering Assistant to
Director of Communications

GWF:fd
Attachments

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The statement by George Furtney of Eastern Air Lines once more proves that the workhorses of modern commercial communication systems are the Eimac 450T type triodes. Their dependability is unchallenged.

The 450T is rated at 450 watts plate dissipation, 6000 max. plate volts, and 600 ma. max. plate current at frequencies as high as 40 Mc. They are widely used as either amplifiers, oscillators, or modulators. Complete data and application notes will be furnished upon request.

The 450T type triodes and other outstanding Eimac vacuum tubes are today specified in ever increasing numbers to fill key sockets in important military, communications, and industrial equipments. Consider them for your equipment . . . they have been proved in service . . . an unbiased proof that is your assurance of undeniable dependability.

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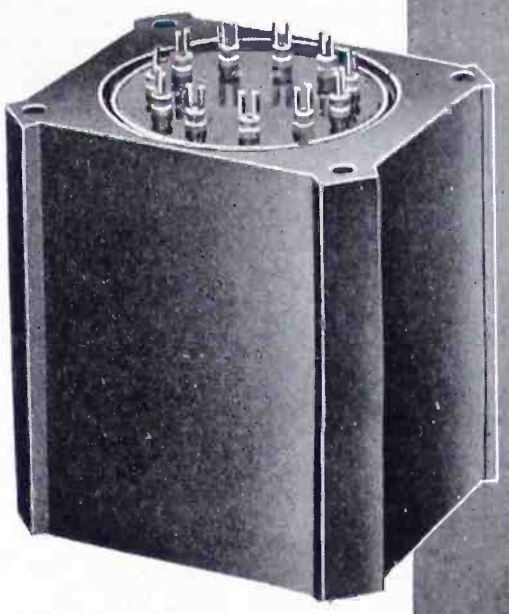
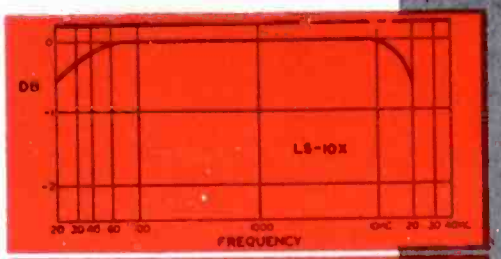
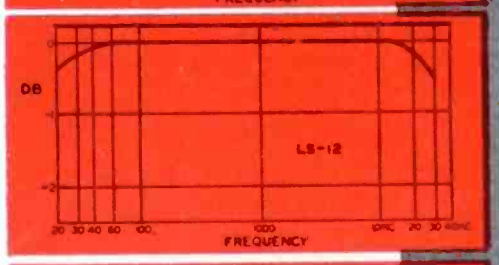
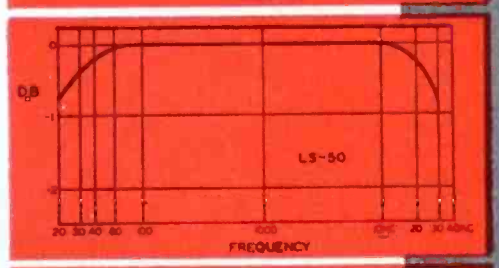


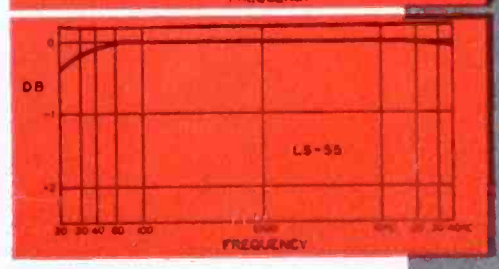
TYPICAL LS LOW LEVEL TRANSFORMERS

Type No.	Application	Primary Impedance	Secondary Impedance	±1 db from	Max. Level	Relative hum-pickup reduction	Max. Unbalanced DC in prim'y	List Price
LS-10	Low impedance mike, pickup, or multiple line to grid	50, 125, 200, 250, 333, 500/600 ohms	60,000 ohms in two sections	20-20,000	+15 DB	—74 DB	5 MA	$25.00
LS-10X	As Above	As above	50,000 ohms	20-20,000	+14 DB	—92 DB	5 MA	32.00
LS-12	Low impedance mike, pickup, or multiple line to push pull grids	50, 125, 200, 250, 333, 500/600 ohms	120,000 ohms overall, in two sections	20-20,000	+15 DB	—74 DB	5 MA	28.00
LS-12X	As above	As above	80,000 ohms overall, in two sections	20-20,000	+14 DB	—92 DB	5 MA	35.00
LS-26	Bridging line to single or push pull grids	5,000 ohms	60,000 ohms in two sections	15-20,000	+20 DB	—74 DB	0 MA	25.00
LS-19	Single plate to push pull grids like 2A3, 6L6, 300A. Split secondary	15,000 ohms	95,000 ohms; 1.25:1 each side	20-20,000	+17 DB	—50 DB	0 MA	24.00
LS-21	Single plate to push pull grids. Split primary and secondary	15,000 ohms	135,000 ohms; turn ratio 3:1 overall	20-20,000	+14 DB	—74 DB	0 MA	24.00
LS-22	Push pull plates to push pull grids. Split primary and secondary	30,000 ohms plate to plate	80,000 ohms; turn ratio 1.6:1 overall	20-20,000	+26 DB	—50 DB	.25 MA	31.00
LS-30	Mixing, low impedance mike, pickup, or multiple line to multiple line	50, 125, 200, 250, 333, 500/600 ohms	50, 125, 200, 250, 333, 500/600 ohms	20-20,000	+17 DB	—74 DB	5 MA	25.00
LS-30X	As above	As above	As above	20-20,000	+15 DB	—92 DB	3 MA	32.00
LS-27	Single plate to multiple line	15,000 ohms	50, 125, 200, 250, 333, 500/600 ohms	30-12,000 cycles	+20 DB	—74 DB	8 MA	24.00
LS-50	Single plate to multiple line	15,000 ohms	50, 125, 200, 250, 333, 500/600 ohms	20-20,000	+17 DB	—74 DB	0 MA	24.00
LS-51	Push pull low level plates to multiple line	30,000 ohms plate to plate	50, 125, 200, 250, 333, 500/600 ohms	20-20,000	+20 DB	—74 DB	1 MA	24.00
LS-141	Three sets of balanced windings for hybrid service, centertapped	500/600 ohms	500/600 ohms	30-12,000	+10 DB	—74 DB	0 MA	28.00









TYPICAL LS OUTPUT TRANSFORMERS

Type No.	Primary will match following typical tubes	Primary Impedance	Secondary Impedance	±1 db from	Max. Level	List Price
LS-52	Push pull 245, 250, 6V6, 42 or 2A5 A prime	8,000 ohms	500, 333, 250, 200, 125, 50, 30, 20, 15, 10, 7.5, 5, 2.5, 1.2	25-20,000	15 watts	$28.00
LS-55	Push pull 2A3's, 6A5G's, 300A's, 275A's, 6A3's, 6L6's	5,000 ohms plate to plate and 3,000 ohms plate to plate	500, 333, 250, 200, 125, 50, 30, 20, 15, 10, 7.5, 5, 2.5, 1.2	25-20,000	20 watts	28.00
LS-57	Same as above	5,000 ohms plate to plate and 3,000 ohms plate to plate	30, 20, 15, 10, 7.5, 5, 2.5, 1.2	25-20,000	20 watts	20.00
LS-58	Push pull parallel 2A3's, 6A5G's, 300A's, 6A3's	2,500 ohms plate to plate and 1,500 ohms plate to plate	500, 333, 250, 200, 125, 50, 30, 20, 15, 10, 7.5, 5, 2.5, 1.2	25-20,000	40 watts	50.00
LS-6L1	Push pull 6L6's self bias	9,000 ohms plate to plate	500, 333, 250, 200, 125, 50, 30, 20, 15, 10, 7.5, 5, 2.5, 1.2	25-20,000	30 watts	42.00

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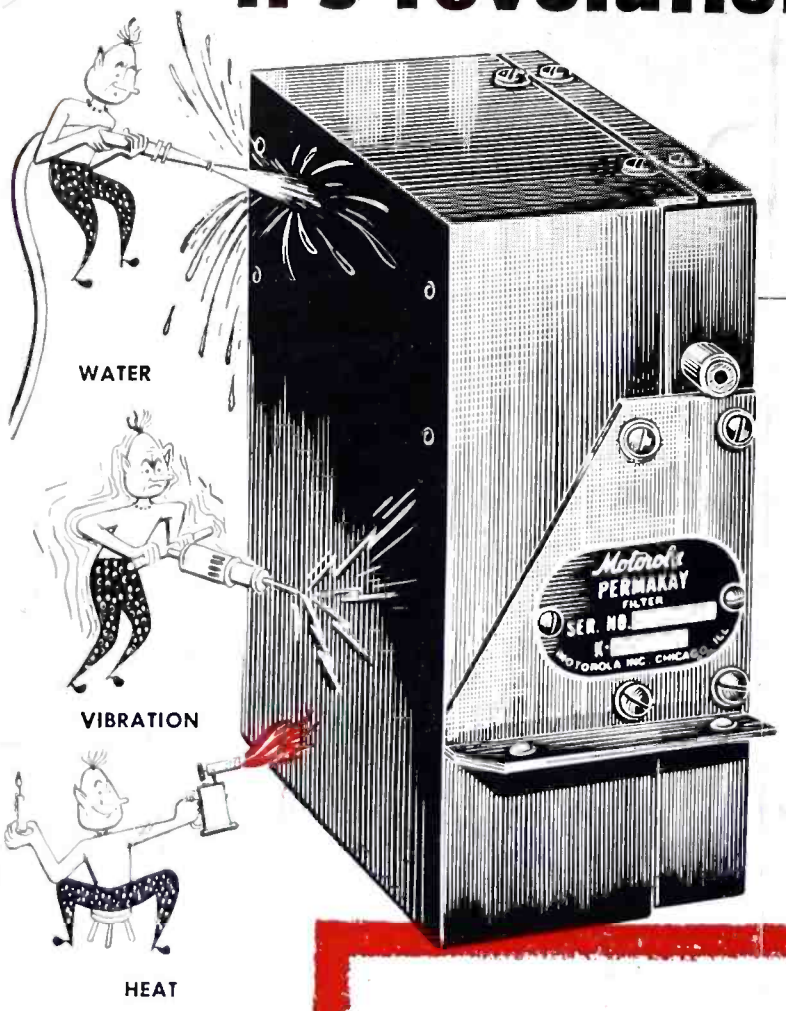

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