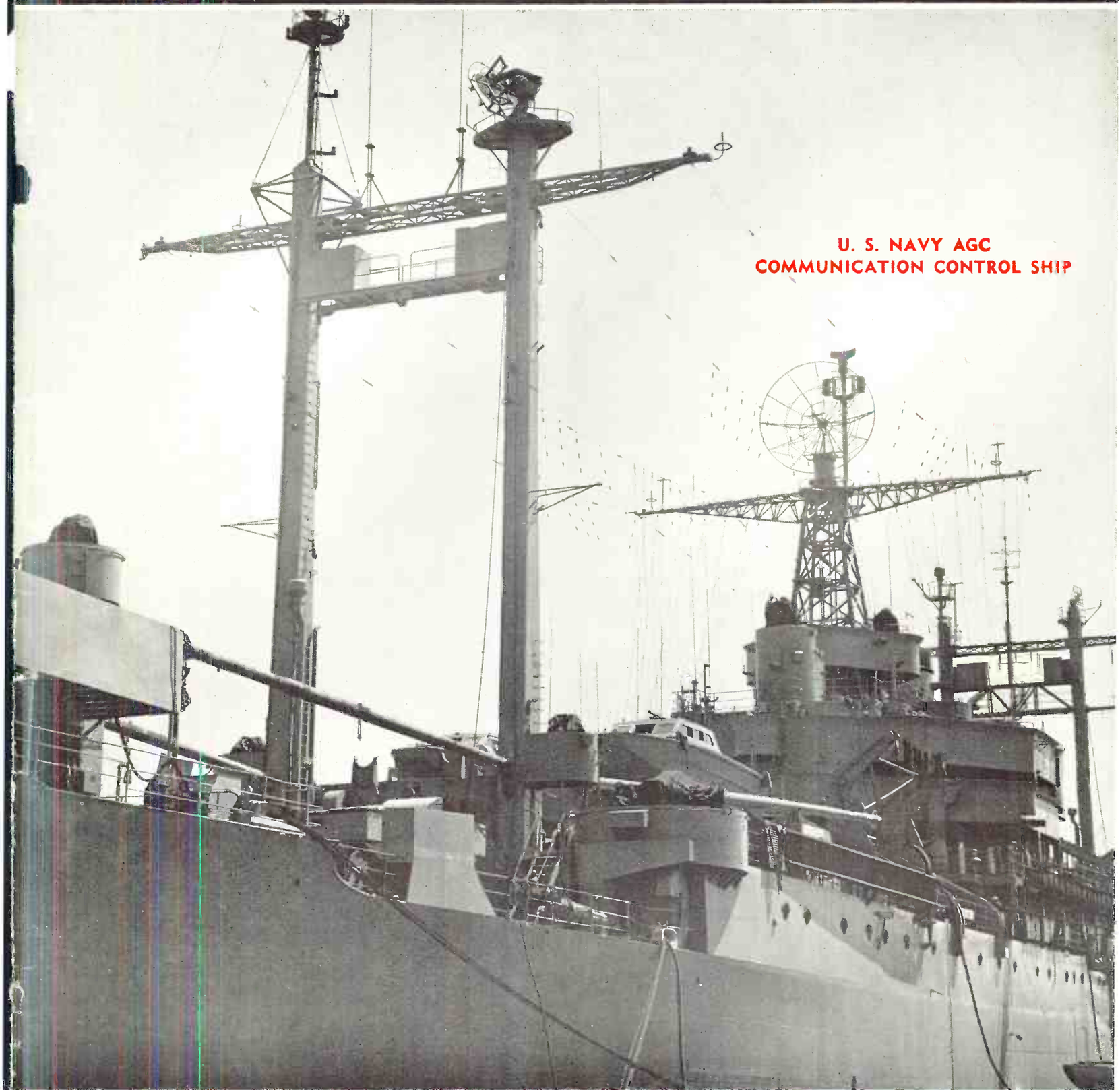
Price 35 Cents
Mar. '51

FM-TV RADIO COMMUNICATION

★ ★ Edited by ★ ★
Milton B. Sleeper



U. S. NAVY AGC
COMMUNICATION CONTROL SHIP

THIS ISSUE: OVER 12,000 COPIES

11th Year of Service to Management and Engineering

Wherever Magnetic Recordings Are Made

THE TREND IS TO audiotape*

made by audio engineers for audio engineers

THE EVER GROWING PREFERENCE for Audiotape is largely a matter of *experience*.

Professional recordists started the trend to Audiotape because they knew, from long experience with Audiodiscs®, that Audio could always be depended on for consistent, uniform quality — to meet the most exacting requirements.

And the trend is continuing, in every field of sound recording, because *experience* with Audiotape proves its unequalled uniformity of output and freedom from background noise and distortion.

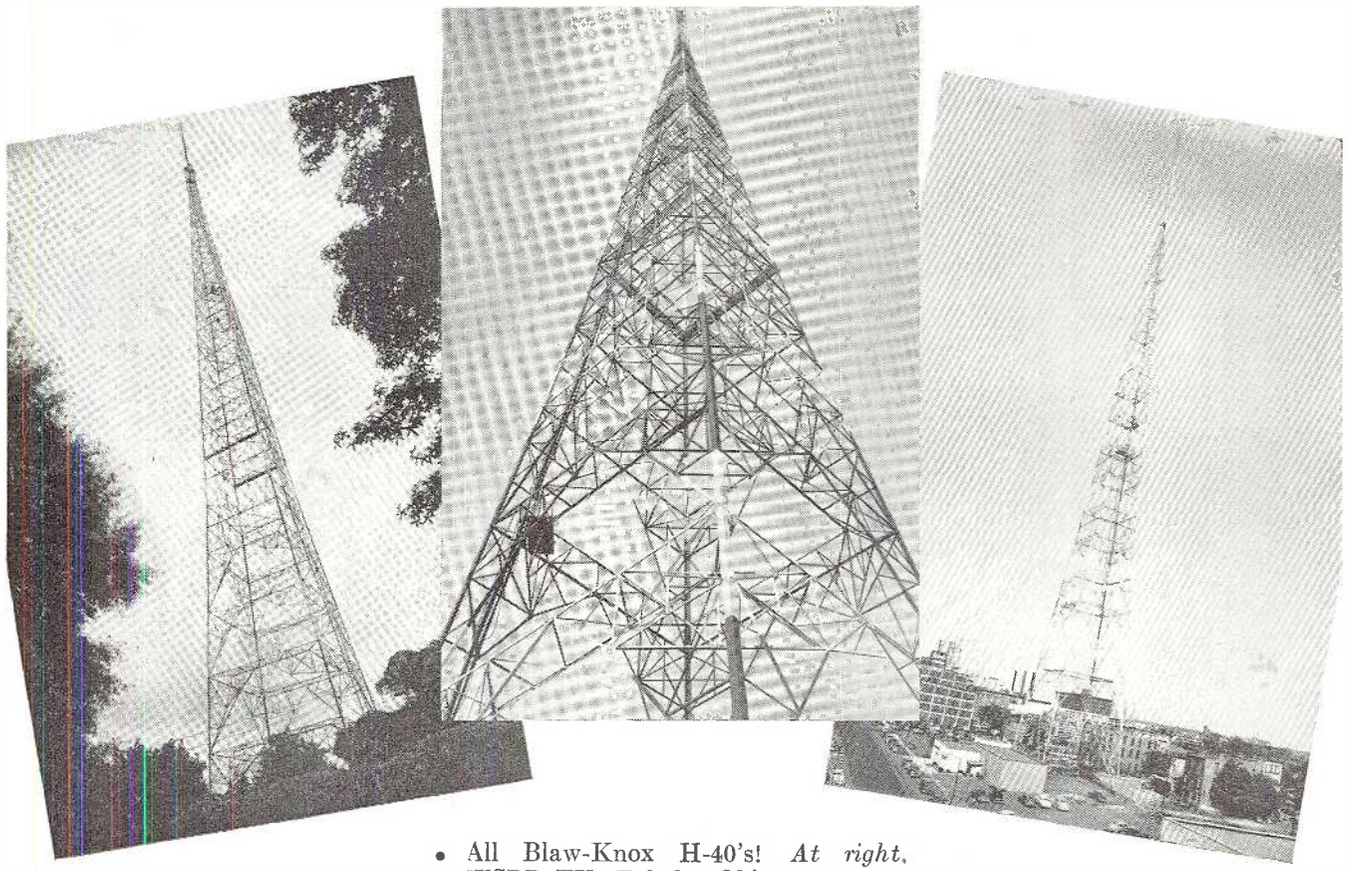
The superior magnetic and mechanical properties of Audiotape are the *result* of experience, too — more than a decade of engineering and production know-how by the *only* company in America devoted solely to the manufacture of fine sound recording materials — discs, tape and film.

That's why the Audiotape line has grown so large and so fast. In addition to the standard ¼" tapes, Audio is now supplying a wide variety of special sizes — up to 8" in width — for specialized applications of sound reproduction. The new Audiofilm*, developed for the motion picture and TV industries, is a typical example.

Whatever your magnetic recording requirements — for standard or special tapes — remember that you can always depend on Audiotape. Get in touch with your nearest Audiotape distributor, or write to our New York office.

**Trade Mark*

AUDIO DEVICES, INC. 444 Madison Ave., New York 22, N. Y.
Export Dept.: ROCKE INTERNATIONAL, 13 East 40th St., N. Y. 16, N. Y.

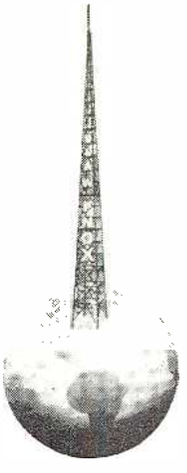


- All Blaw-Knox H-40's! *At right,* WSPD-TV, Toledo, Ohio
- *Above center,* Station WJBK-TV, Detroit, Michigan
- *At left,* Station WAGA-TV, Atlanta, Georgia

"WE'RE PROUD OF OUR BLAW-KNOX TOWERS"*

And Blaw-Knox is proud of the fact that this compliment from *The Fort Industry Company was prompted by the performance of all 13 Blaw-Knox Antenna Towers now in the service of this successful broadcasting organization.

Whether you contemplate light-weight towers for mobile communications or a sky-raking TV support, you can depend on Blaw-Knox engineered structures to get the most out of your transmitting equipment.



BLAW-KNOX

ANTENNA TOWERS

Distributed by GraybaR — OFFICES IN 100 PRINCIPAL CITIES

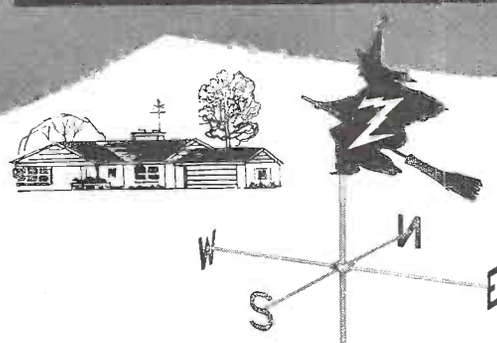
BLAW-KNOX DIVISION
OF BLAW-KNOX COMPANY
2062 Farmers Bank Building, Pittsburgh 22, Pa.

There's a Ready Market

a fine PROFIT for you...in

Zenith's spectacular new

Hollywood Antenna Vane

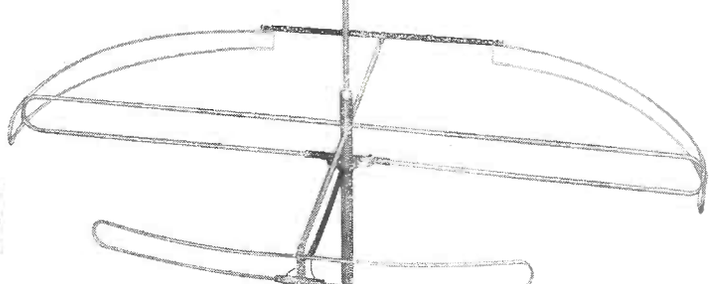


a unique combination of weather vane and antenna

ZENITH DOES IT AGAIN . . . with the Hollywood Antenna Vane that outmodes unsightly antenna installations. Yes, here's really a BRAND NEW item that's both artistic and efficient . . . and that's bound-to-SELL . . . for it reflects one's pride of ownership in his home.

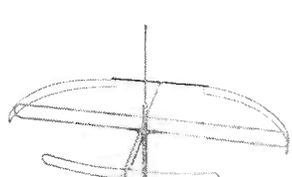
STRIKINGLY NEW . . . GENUINELY UNIQUE . . . there's a large and immediate market for the Hollywood Antenna Vane, for present TV home owners everywhere will want it. AND TV prospects will ask you about this decorative installation every time! Stock it . . . PROMOTE it . . . and you'll realize a mighty handsome PROFIT from carrying it!

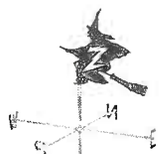
The Weather Vane unit is topped by a legendary witch of storybook fame and "rides high" over the inconspicuous IN-Line Antenna which fits parallel to the chimney top or roof. The antenna functions efficiently on both high and low television bands.



the ANTENNA. Skillfully engineered in Zenith's laboratory . . . the antenna insures fine television reception in suburban areas and metropolitan centers.

the WEATHER VANE. A sturdy Black Anodized Aluminum unit . . . it stands 13 inches high. The cross arms measure 23 inches across . . . and the entire unit, of course, is rust-proof.





Your sales will come from these 4 groups...

1 TV purchaser who is sales-receptive to a new and beautiful antenna and can be "stepped up" on the difference on installation cost.

2 TV Owner who prides himself on the appearance and beauty of his home.

3 TV Owner who would like to replace the unsightly antenna installation that mars his home.

4 TV Owner who would otherwise prefer "poor reception" to having an "unsightly" outside antenna.

ZENITH RADIO CORPORATION
6001 Dickens Ave.
Chicago 39, Ill.

FM-TV RADIO COMMUNICATION

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

VOL. 11 MARCH, 1951 NO. 3

INDUSTRY NEWS

TELEVISION

FM BROADCASTING

COMMUNICATION

CIVIL DEFENSE

AUDIO SECTION

SPECIAL DEPARTMENTS

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CPA AUDIT

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

DECEMBER production figures on home radio sets, released by RTMA, add up to a highly successful year for the radio industry. In this 5-week month, all records for the year were broken.

AM receivers reached the astonishing total of 1,505,600. the highest figure since 1947. It was made up of 957,100 home models, 453,500 auto sets, and 95,000 portables. Since most of the home types were very inexpensive table models, this demand probably reflects the great public interest in news programs, heightened by the international situation.

Television, up for the fifth successive month, hit 858,500, representing the major slice of dollar volume, with most promotional effort being put on expensive models.

Dollar-wise FM was not far behind AM home sets, despite the fact that, numerically, the total of 147,535 receivers was much lower. Steady gain in demand for FM reception is indicated by the fact that December production was 50% above the monthly average for the year. FM-AM phonographs accounted for a large part of these shipments, indicating the preference for FM among listeners primarily interested in music.

A comparison of December production with the same month of '45 shows:

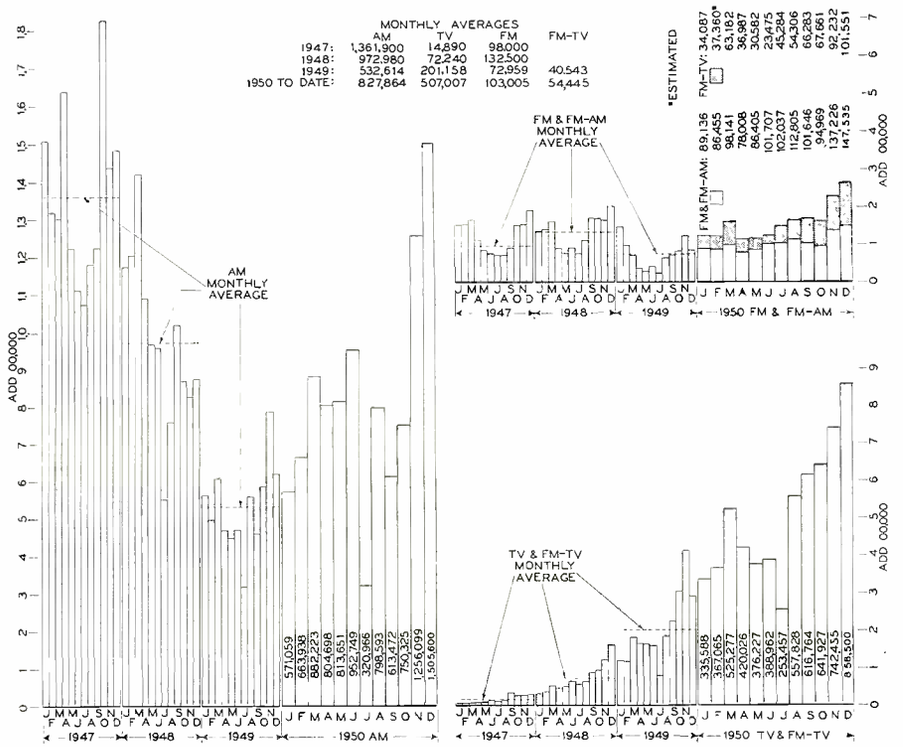
FM	Dec. '50	85%	above	Dec. '49
AM	"	118%	"	"
TV	"	206%	"	"

A broader picture is given by comparing average monthly production in 1950 with 1949. It works out this way:

FM	'50 average	41%	above	'49
AM	" "	55%	"	"
TV	" "	152%	"	"

December shipments of picture tubes to manufacturers totaled 686,815 units, of which 95% were 16 ins. or larger in size. The trend to big tubes is indicated by the fact that in '49 only 16% of the tubes were 14 ins. or larger, while 72% of '50 production was 16 ins. or larger. All types, including those for oscillographs and TV cameras came to a 1950 total of 7,530,849 units, valued at $200,016,051.

Sale of receiving tubes in 1950, up 93% from '49 amounted to 383,960,000, of which 301,483,000 went to set manufacturers, 69,324,000 for replacements, 10,767,000 for export, and 1,384,000 for Government agencies. December sales of 38,723,601 were down 600,000 from November, but they exceeded December '49 by 14,916,000.

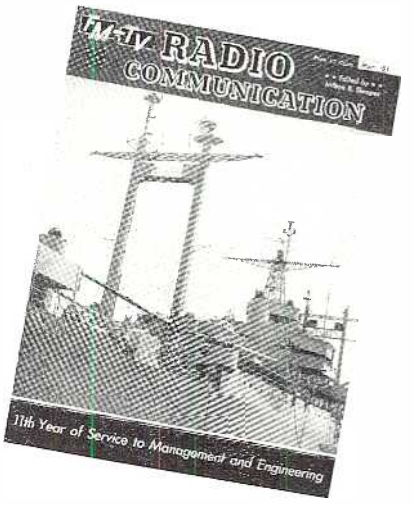


TV, FM, and AM Set Production Barometer, prepared from RTMA figures

THIS MONTH'S COVER

The more you look, the more antennas you can see on this US Navy AGC. This is a communication control ship, used for coordination of landing operations, and the radio control of fleet maneuvers.

Relatively unarmed, it is crammed with radar, IFF, sonar, countermeasure, and communication equipment. This type of ship was widely employed in World War 2, and is now in service in Korean and Formosan waters. Surprisingly, none has ever been sunk. The AGC is a marvel of communication engineering, for it carries more equipment and antennas than ever crowded into such a small space before.



SPOT NEWS NOTES

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

High-Fidelity:

We're inclined to go along with the idea that "high-fidelity" indicates the direction of a trend in listening preference, rather than specific specifications of performance. Maximillian Weil of Audak presented the thought in this way: "After all the reams are written about kilocycles and other laboratory data — when the chips are down — only you can decide what sounds best and most pleasing to your ears."

Utica, New York:

General Electric will spend $15 million to build and equip a new plant for producing military electronics equipment. Floor space of 338,000 square feet will accommodate 2,500 workers. It is expected that this will become a permanent addition to GE facilities.

Antennas and Towers:

A 16-page bulletin on receiving antennas and towers has been issued by La Pointe-Plascomold Corporation, Windsor Locks, Conn. Towers are intended for communication and TV services. The miltiple-bay and Yagi antennas are designed primarily for TV reception, although they have uses in communication systems also.

Arthur L. Reese:

Appointed marketing manager of Motorola's microwave and carrier control section. He joined the Company as a sales engineer in 1936.

IRE Cincinnati Conference:

To be held on April 14 at the Engineering Society Building, Woodburn and McMillan Streets. Papers will be given by Raymond Guy, NBC; R. G. Clapp, Philco; Harold Brouse, Crosley; R. B. Dome, GE; A. V. Loughran, Hazeltine; and Jerry Minter, Measurements.

New Capacitor Mounts:

Subminiature capacitors in DC ratings of 100 to 1,000 volts are now available from Sprague Electric Company, North Adams, Mass., in hermetically-sealed metal cases with tiny threaded necks or studs, and brackets for vertical or horizontal mounting. Purpose is to eliminate vibration and shock experienced in military gear when capacitors are mounted by their leads. Bulletin 213A, giving complete details, is available on letterhead request only.

The Matter of DO Ratings:

NPA report of a telephone and telegraph industry conference on material shortages, February 20: "A few of the (company) representatives recommended that they be authorized to use DO ratings on some of their orders for materials to be used in defense-connected projects. NPA officials, however, told the group that the use of DO ratings is being kept to a minimum until a Controlled Materials Plan can be put into effect. NPA pointed out that all its orders contain provisions for adjustment in case of undue hardship."

Salvage Value on Tubes:

Eitel-McCullough has established salvage values on their 3X2500A3 and 3X2500F3 tubes and the cooler assemblies. They must be shipped prepaid to San Bruno.

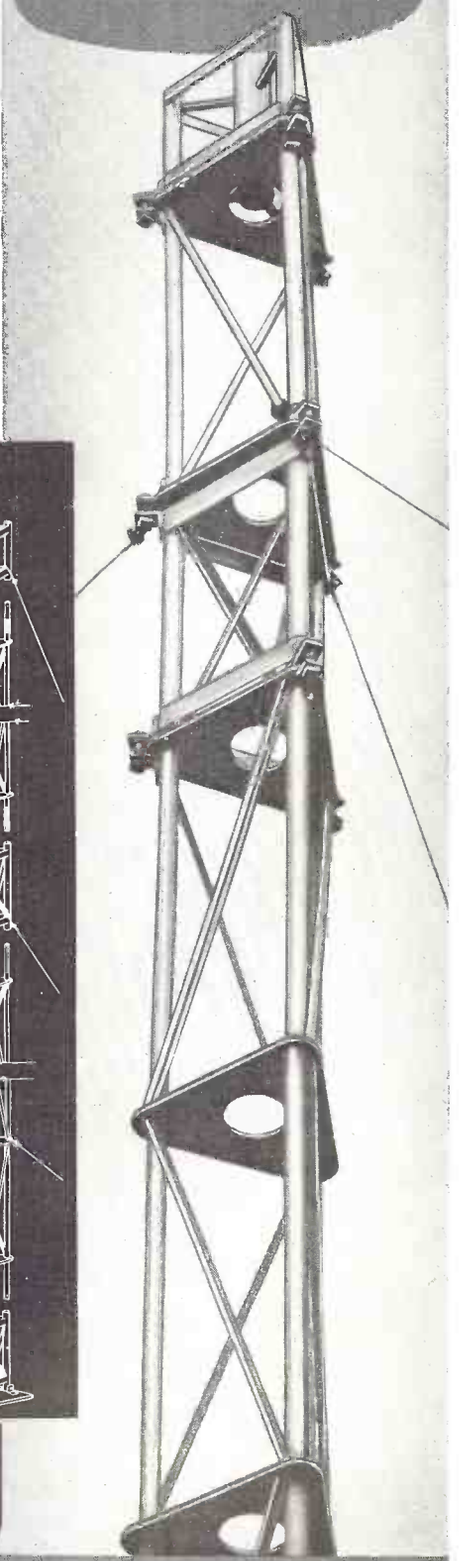
450 Mc. for Taxicabs:

The FCC's 16th annual report to the Congress states: ". . . on July 1, 1949 . . .

(Continued on page 8)

THE POWER OF STRENGTH

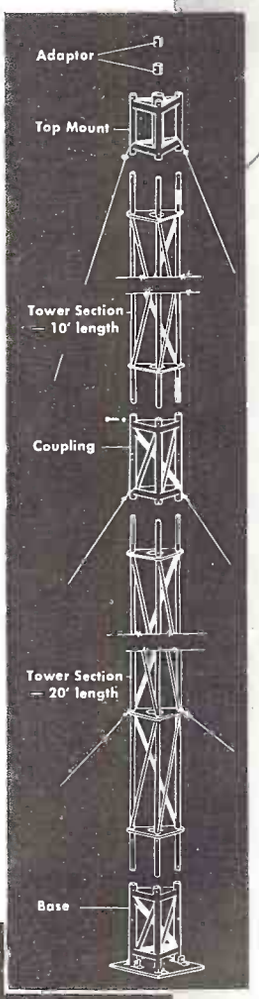
IDEAL FOR
COMMUNICATIONS
MICROWAVE
TELEVISION
LIGHTING



Superior construction features give LOW COST Vee-D-X sectional towers the highest safety factor of any tower in its price class.

If you have an elevated installation problem, absolute permanency of your installation is assured when you use a VEE-D-X sectional tower. Strength is a major factor. Don't take chances with structural failure. Be sure with VEE-D-X!

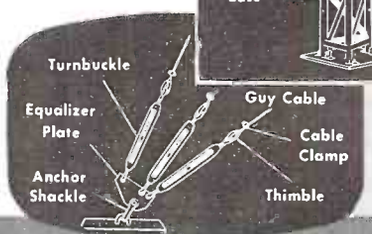
- *Rugged, all-welded construction diagonally laced with angle iron for maximum rigidity.*
- *Can be erected on ground or on flat or peaked roof.*
- *Patented plate spaced at two foot intervals prevents twisting and affords rigidity found in no other tower.*
- *Safe and easy to climb.*
- *Completely galvanized, light weight tubular steel . . . 20 ft. section 72 lbs.*



PRE-ASSEMBLED
for fast, inexpensive installation

VEE-D-X towers are designed for use at any height from 10 to 140 feet. They are self-supporting up to 20 feet and, where space is limited, *semi-guyed** type installations may be used at 30, 40, and 50 foot heights. Sketch at right shows the basic parts and necessary accessories for a complete installation. Three types of top mount are available. VEE-D-X towers may be ordered in separate units or as a complete package for a specific height. (Either guyed or semi-guyed.) Write the LaPointe-Plascomold Corporation of Unionville, Conn. for complete information.

*Semi-guyed towers employ one set of guy cables attached at a height of 10 ft. up the tower and anchored at a 6 ft . radius from the base.



VEE-D-X

BUILDERS OF THE WORLD'S MOST POWERFUL ANTENNAS

SPOT NEWS NOTES

(Continued from page 6)

10 frequencies in the 450- to 460-mc. band were allocated for developmental operation looking toward the eventual establishment of these frequencies for regular taxicab service assignment. Tests conducted on 450 to 460 mc. indicate that . . . use of these frequencies will materially reduce the interference currently caused by the simultaneous operation of several taxicab systems on the same frequency in congested or thickly-populated areas. Every effort is being made to encourage the manufacture of equipment for operation in these bands, and it is felt that the continued healthy expansion of this service rests on the ultimate use of these higher frequency assignments."

Glen McDaniel:

Former vice president and general counsel for RCA Communications has been elected the first full-time president of RTMA. Robert Sprague has resigned as president, but will continue as chairman of the board, and James D. Secrest will remain in his present capacity as general manager and secretary.

Data on Components:

A 42-page catalog of design data on components has just been issued by Stackpole Carbon Company, St. Marys, Pa. New items, including single and dual-shaft and special-purpose volume controls, 3-ampere slide switches, and Ceramag deflection yokes, are listed for the first time, together with current component designs.

The Road Ahead:

Frank Freimann, president of Magnavox: "It is highly possible that we can maintain and improve our present standard of living and uphold our present levels of income, and still produce to satisfy military requirements in full. We will be working in a part military and part civilian economy for the next several years." This, he predicted, will be a "long, tough grind in which anything can happen."

Old Timers' Round-Up:

Annual event will be held by the Delaware Valley Radio Association, Stacy-Trent Hotel, Trenton, N. J., April 21. Turkey dinner starts at 6:30. For details, write Ed G. Raser, W2Z1, 315 Beechwood Avenue, Trenton 8.

Red Heads in Technicolor:

Note from Albert Weinstein of *Television Digest* about our comments on dreaming in color: I remember, during

(Continued on page 9)

SPOT NEWS NOTES

(Continued from page 8)

the color hearing, that Commissioner Jones once got started on the beauties of color, and ended up by saying: "Why, I even dream in Technicolor." When I got back to my office that evening, I happened to mention what he'd said. One of the girls remarked: "Why, you know, that's supposed to be a definite indication of a psychotic."

Kurt Appert:

Vice president and chief engineer of Lenkert Electric since the Company was founded in 1934 has become director of engineering. The post of chief engineer has been filled by George M. Labedeff.

Standard Noise Measurement:

A standard test code Z24.7-1950 for apparatus noise measurement has been issued by the American Standards Association, 70 E. 45th Street, New York 17. It establishes uniform methods of conducting and recording sound-level tests. Copies can be obtained at 50c each.

This Is Hot Stuff:

If this column is missing from some future issue, it will be because we have been simply overwhelmed and laid low from reading TV press releases. This one blew in straight from Wilshire Boulevard: "Sudsy Amonia this week joined the parade of household products being glamourized in television film spot commercials by Broadway musical comedy star Dona Balli . . . Her glamourization of household products includes deft handling of lighting, sharp photography, and high-fidelity double system sound recording. Ed Chandler, the TV actor, is seen in apron gaily mopping a kitchen floor. He then gives sales talk on advantages of product while camera lens trucks in for close-up of bottle being enveloped in foam. Clarity of overall effect is that salespitch is being made right in home viewer's living room." Hm, is that smell ammonia?

Woburn, Massachusetts:

New plant of 100,000 square feet will be built by Sylvania for production of tubes and military equipment. Cost will be about $1 million. On completion, approximately 600 people will be employed.

Will Baltin:

Has resigned as secretary-treasurer of Television Broadcasters Association, a post he has held since TBA was founded in 1944, to join Screen Gems, a Columbia Pictures subsidiary.

Miniature Insulated Terminals:

A wide range of terminals, stand-offs,

(Continued on page 10)

SPOT NEWS NOTES

(Continued from page 9)

and feed-through connectors, insulated with molded melamine or MTS-E1 phenolic and designed to JAN P14 specifications, has been announced by U. S. Engineering Company, Commercial Street, Glendale 3, Calif. Engineering data and samples are available on request.

Antique Brass:

From the Army's top level comes the proposal that, in times of emergency, FM and TV stations should be closed down, and only AM broadcast transmitters be allowed to stay on the air. But we seem to recall that Jap planes shot down in the attack on Pearl Harbor were found to have receivers tuned to one of the local AM stations.

Airborne Electronics Conference:

Meeting at Biltmore Hotel, Dayton, Ohio, on May 23 to 25 will be sponsored by the Professional Group on Airborne Electronics and the IRE Dayton Section. Papers will range from components and antennas to radar and airborne television. Inquiries should be addressed to G. Rappaport, Far Hills Post Office, Box 44, Dayton.

James Moir:

Along with the manuscript for his article in this issue came a brief note saying that he has become the father of twins, and he added that Mrs. Moir is doing well. However, he didn't say if the twins are boys or girls.

Railroad Radio:

Northern Pacific will spend $150,000 for Bendix equipment to be installed on 14 engines and 33 cabooses for through freight trains operating on the 410-mile stretch between Dilworth, Minn., and Glendive, Mont. Also, 10 wayside stations on the Fargo division will be equipped for radio communication with the trains. Mr. F. L. Steinbright, superintendent of telegraphs, is in charge of this project.

Camden, New Jersey:

RCA's report for 1950 shows total sales that top $.5 billion for the first time. At the year-end, the Company employed 54,409 people. Purchases of $290 million were made from 4,800 concerns in 42 states, of which about one-half have less than 100 employees.

Miniature Relays:

A new hermetically-sealed series, 1¼ ins. in diameter and 1½ ins. long, capable of withstanding ambient temperatures up to 200°C., has been brought out by Struth-

(Concluded on page 11)

Special Services Directory

SPOT NEWS NOTES

(Continued from page 10)

ers-Dunn, Inc., 150 N. 13 Street, Philadelphia 7. Up to 6-pole, double-throw contacts are available.

FCC's Eager Beaver Lawyers:

We view with distrust the purposes of the FCC's inquiry into the activities of functional music stations WLRD Miami Beach, WFMF Chicago, KDFC Sausalito, and WACE-FM Chicopee, Mass. Every time the Commission's legal department winds up to do a job of this sort, it reminds us of the dismay expressed by one of the bright boys who wanted to handle the first inquiry into AT & T rates. "What a reputation I could have made for myself," he sighed, "if they had let me handle that case." It's our not-always-humble opinion that a lot of the FCC's activities are dreamed up by lawyers whose real objective is self-promotion.

SMPTE Expands Activities:

Peter Mole, president of the Society of Motion Picture and Television Engineers has announced new plans which will include expansion of the New York headquarters, a 72% increase in the Society's Journal, new procedures to accommodate a substantial increase in membership among those concerned with motion pictures, TV, and high-speed photography, and a 100% increase in the budget for technical activities.

Sub-Contract Business:

Up to February 15, Bendix Radio placed $22 million in sub-contracts on orders on their prime military contracts. This is in line with Government policy, which favors the plan of using facilities of smaller companies for sub-contracts, thus decentralizing military purchasing. Manager of sub-contracting at Bendix is Robert E. Wine, Towson 4, Md.

Equipment and Components:

A very elaborate catalog for the use of research laboratories, schools, broadcast stations, and industrial concerns has been issued by Sun Radio & Electronics Company, 124 Duane Street, New York 7. Many special items are listed with complete application data, in addition to standard test instruments, components, and replacement parts. Copies are available on letterhead request.

Richmond, Indiana:

An addition of 211,000 square feet will be erected at the present Crosley plant. It is scheduled for completion by the end of next October. Space will be used for manufacturing military radio and electronic equipment.

Announcing RADIOPAK

EXTRA **Radiotelephone News** EXTRA

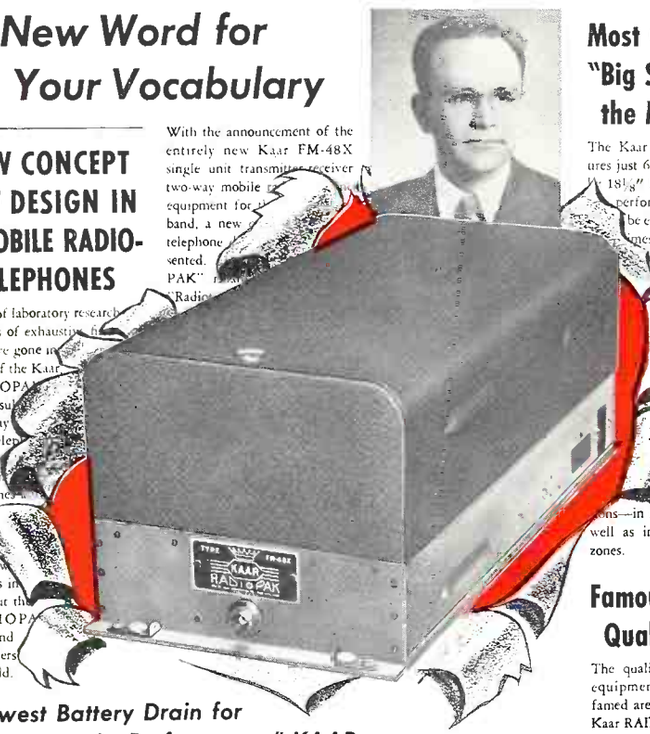
KAAR RADIOPAK

A New Word for Your Vocabulary

NEW CONCEPT OF DESIGN IN MOBILE RADIO-TELEPHONES

With the announcement of the entirely new Kaar FM-48X single unit transmitter-receiver two-way mobile [illegible] equipment for [illegible] band, a new [illegible] telephone [illegible] sented. [illegible] PAK" [illegible] "Radio [illegible]

Years of laboratory research [illegible] months of exhaustive [illegible] ing have gone into [illegible] ment of the Kaar [illegible] RADIOPAK. [illegible] The result [illegible] two-way [illegible] radiotelep[illegible] for the [illegible] mc ban[illegible] combine[illegible] featu[illegible] Kaa[illegible] has [illegible] noted w[illegible] vations in[illegible] that put th[illegible] RADIOPA[illegible] head and [illegible] shoulders [illegible] the field.



"Lowest Battery Drain for its Performance:" KAAR

John M. Kaar, president of the Kaar Engineering Company, in announcing the new Kaar RADIOPAK, states that the new [illegible] features the lowest [illegible] diotelephone designed for the 152-174 mc band. This feature permits operation on standard 6 volt systems without the installation of expensive special [illegible] supply.

Competitive in Price

With no sacrifice in quality or performance, the Kaar RADIOPAK is priced to compete with ordinary radiotelephone installations.

Most Compact "Big Set" on the Market

The Kaar RADIOPAK measures just 6¾" high by 8" wide by 18⅛" long, yet includes all [illegible] performance features that [illegible] be expected in equipment [illegible] mes its size. Among the [illegible] tures to be found in [illegible] unit Kaar RADIO[illegible] reater stability and [illegible] ious emis[illegible], and [illegible] ther ex[illegible] he RA[illegible] is ideally [illegible] uited for [illegible] rucking, lum[illegible] ustrial and [illegible] ons. Its per[illegible] ding in the [illegible] erating condi[illegible] ons—in me[illegible] politan areas as well as in arctic and tropical zones.

Famous KAAR Quality thruout

The qualities for which Kaar equipment has always been famed are included in the new Kaar RADIOPAK. Ruggedness to withstand extreme temperature changes and rough operating conditions; simplicity of design; and lowest possible battery drain are all features that will be found in this new Kaar Engineering Company achievement.

RADIOPAK is an entirely ***new*** mobile communications "package" that combines features for which Kaar equipment has long been noted with innovations in design that put the RADIOPAK far ahead of the field.

Write for complete technical information!

KAAR ENGINEERING COMPANY
Middlefield Road · Palo Alto, California

KAAR ENGINEERING CO.

WHAT'S NEW THIS MONTH

C-D COMMUNICATION SYSTEM FOR NATION'S CAPITOL — NEW YORK STATE'S YELLOW-SIGNAL RULES — DESIGN OF THE PRC-10 — ALUMINUM FOR DISCS

FIRST word of a finalized plan for Civil Defense radio communication system comes from Washington, D. C. While it does not cover all the services required, it will undoubtedly provide a planning basis for systems in other cities.

The Washington plan was worked out by the Communications Advisory and Planning Committee, under the chairmanship of Herbert A. Friede, Superintendent of Communications in the District of Columbia police department. Ross H. Beville, technical director of AM and FM stations WWDC also had an active part in this effort.

Focal point of the system is a 250-watt FM transmitter at the Communications Command Center, operating on three frequencies. Channel 1 will be used for transmission to 34 receivers and high-power amplifiers in strategic parts of the city. The amplifiers will be activated by the transmission of a supersonic signal. A siren-tone can be directed into the microphone at the Command Center, or voice instruction can be given over the speakers.

Channel 2 is intended for communication between the Command Center and four Control Center locations which will have 50-watt FM talk-back transmitters.

Channel 3 will provide communication with hand-carried and pack-type transmitter-receivers, and mobile units.

All three channels will be in the 40- to 50-mc. band. The use of radio not only eliminates the use of wires which might be cut by sabotage or bombing attack, but reduces the cost of operating and maintaining the system. Further, radio provides an instantaneous method for mass communication with fixed and mobile installations. Transmitting range of the main station is sufficient to cover surrounding communities which have been invited to join the District of Columbia's setup.

Approval has been given by John E. Fondahl, acting director and chairman of the Metropolitan Area Civil Defense Committee, and Col. Thomas Hayes, assistant Engineering Commissioner. Application for formal approval has been made to the Board of Commissioners.

The one remaining link in this plan that has not been settled is the means of giving advance warnings to Civil Defense personnel. The FTB alert-alarm system has been under consideration, but no decision has been made at this time of writing. In fact, not all the equipment is ordered, although it is expected that the installation will be completed in May. The Office of Civil Defense is located at 2001 East Capitol Street, Washington 3, D. C.

COL. Lawrence Wilkinson, acting chairman and director of the New York State Civil Defense Commission, has issued a new regulation specifying those authorized to receive the yellow alert signal. They are:

1. New York State C-D director and such staff members as he may designate.
2. All local C-D directors, and such members of their staffs as they may designate.
3. Hospitals having a capacity of 100 beds or more.
4. Institutions for infirm and incompetent persons.
5. Public utilities (electricity, gas, water, telephone, and transportation).
6. Heads of departments or bureaus of Federal, State, county, municipal, or other sub-divisions of local government which have C-D functions, or who may be engaged in work which may require such confidential information in order to prepare safety measures for classified material or information.
7. Such other persons, organizations, or agencies as may be specifically designated by the State C-D Commission.

The new regulation also requires that each local director "shall require a written plan specifying the precise action to be taken by each recipient of the yellow alert, and shall satisfy himself that such action is necessary, and will not result in public knowledge of the alert."

The importance of alerting key personnel without transmitting any public alarm has been discussed previously in these pages. Specific information on this point is contained in a New York State C-D circular which explains that the transmission of the yellow alert signal is considered confidential information "in order to minimize confusion and needless curtailment of essential industry and services." Further:

"Widespread or careless distribution of the yellow alert could cause such conditions, and disrupt the normal functions of government and industry. It could also prove highly predjudicial to carefully-planned C-D preparations which must follow the yellow alert.

"In general, the yellow alert will be communicated only to those persons or organizations having emergency responsibilities which cannot be safely deferred until the red alarm."

"The yellow alert, when received, will indicate that the system of plane detection has identified hostile planes over or approaching a point on the North American continent. This could be either relatively nearby or from far away. The interval between the yellow alert and the red alarm may be hours, or it may be of rather short duration."

NEXT month, a special section will be devoted to the Army's AN/PRC-10 transmitter-receiver, a remarkable achievement in miniaturization.

UNDER the restrictions placed on the use of aluminum by NPA order M22, it looked as if the supply of aluminum-base recording discs would shrink rapidly. Not only were the disc manufacturers cut to 65% of their base-period use of new aluminum, but they were forbidden to purchase scrap in the form of used discs. That meant a serious loss of poundage to the recording industry.

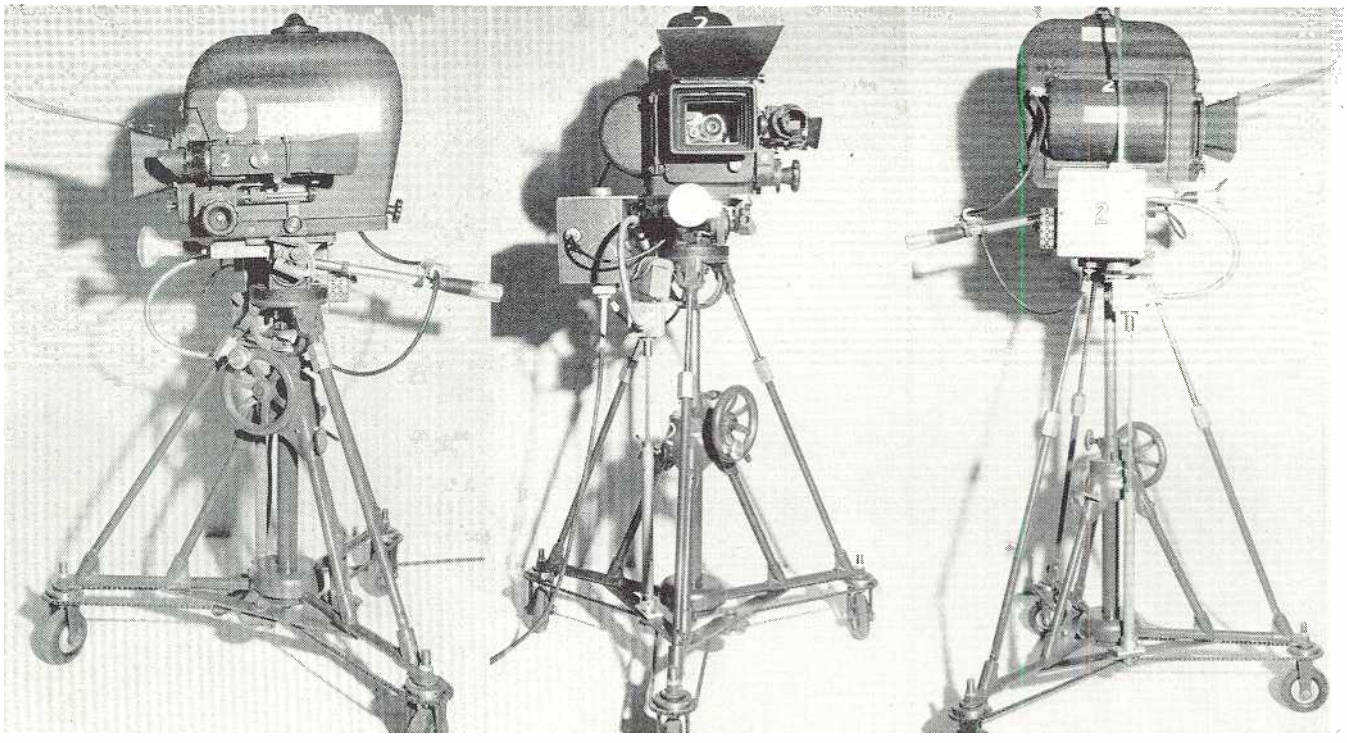
Fortunately, the situation has been resolved in favor of continuing the established practice of reprocessing the aluminum bases.

The official answer is contained in a letter from N. H. Bell, Director, NPA Light Metals Division, to Harry F. Scheirer, vice president, Reeves Soundcraft Corporation, dated February 14, which is quoted here in full:

"Your letter of January 29, 1951, requesting authorization to continue your practice of processing used aluminum discs in your production of transcription recording blanks has been carefully reviewed.

"Inasmuch as your manufacturing process appears in no way to disturb the metallurgical composition or alloy of these discs by melting or smelting, but consists principally of applying to the previously discarded discs a new process whereby they can be restored to usefulness, it is the belief of this office that the provisions of NPA Order M22 governing the utilization of scrap aluminum do not apply to your operations."

If broadcast stations and recording studios keep their files of inactive transcriptions at a minimum by returning them promptly for reprocessing, it seems certain that the development of a serious shortage of new discs can be averted.



FIGS. 1, 2, AND 3. A CAMERA FOR MULTICAM FILMING, MOUNTED ON A TRIPOD WHICH CAN BE STEERED FROM THE PANNING, AND TILT HANDLE

PRODUCING LOW-COST TV FILMS

NEW MULTIPLE-CAMERA TECHNIQUE PROVIDES MOTION PICTURES FOR TELEVISION AT KINESCOPE-RECORDING COSTS — *By* JERRY FAIRBANKS*

DEVELOPMENT of a new technique of motion-picture filming now makes it possible to produce motion pictures at costs heretofore considered unlikely. The perfection of a multiple-camera system cuts tremendously the time required to film all types of motion pictures, greatly lowers production expenses, and makes it possible for television film producers to compete, from a budget standpoint, with kinescope-recorded shows.

The Multicam System, developed in our research laboratories, utilizes three or more 16-mm. or 35-mm. Mitchell cameras which can operate simultaneously, filming 3 or more different angles of a scene and getting long, medium, and close-up shots at the same time. The procedure is similar to the use of 3 cameras in telecasting live video.

Combining the best advantages of both television and film shooting, the system permits a picture to be photographed in continuous action, including cuts from one camera to another. During the shooting of numerous productions we have found that the new technique cuts previous production schedules by sometimes as much as 80%.

*Jerry Fairbanks, Inc., Hollywood, Calif. From a paper presented at the SMPTE Convention, Lake Placid, October 17, 1950.

Track Synchronization:

Numerous technical problems were surmounted during 36 months of experimentation in perfecting this system. Among the foremost of these was the invention of a marking device to synchronize pictures and sound tracks. This was required because the new system called for cameras to be turned on and off many times during the filming of long, sustained scenes. The only other alternative was to let all cameras run continuously from the start, necessitating a tremendous waste of negative film.

The problem was surmounted by the development of a device in each camera that leaves a synchronizing mark on the action film when the camera is up to speed, identifying the camera. Also, a similar device on the sound recorder exposes a line or lines on the sound film, identifying the cameras in operation throughout the scene. In this manner, the sound film becomes the key to the cutting and inserting of all scenes shot by the different cameras. The marking and synchronizing devices are entirely automatic and do not require cameramen to operate additional equipment.

The synchronizing devices are operated through the camera motor circuits and load-actuated time-delay relays. When the cameras are started, lights fog a small spot on each frame of the film passing through the cameras for a period of one second. One dot is marked on the negative for camera 1, two dots for camera 2, and three dots for camera 3. At the end of the one-second period, the time-delay relays switch off the action-film fogging lamps automatically, and instantly switch on the sound-film fogging lights. One line is marked on the sound film for camera 1, two lines for camera 2, and three lines for camera 3. The film editor can tell which cameras were in operation during any one scene merely by glancing at the sound film.

The action film is marked by exterior fog lights that are reflected from the blimp glasses through the lenses. In 35-mm. filming with Mitchell BNC cameras, the synchronizing fog lights are mounted in the interior of the cameras. Three lamps are mounted in the sound-recorders in light-proof housings, with small apertures adjacent to the film, just under the main drive sprockets. The motion of the film over the apertures marks the fog lines which identify the cameras and the synchronous start. In 35-mm. filming, a different relay box is used because of the

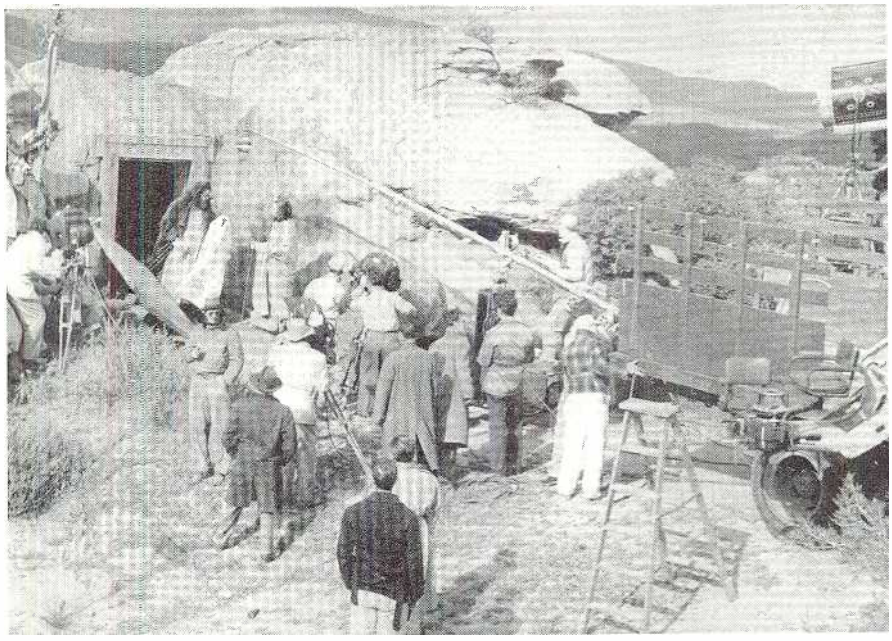


FIG. 4. THREE CAMERAS ARE USED FOR CONTINUOUS MULTICAM FILMING OF THIS OUTDOOR SCENE

heavier motor of the BNC, but the principle is the same.

Only one extra wire is required to complete the synchronizing circuits to the cameras. This line is carried on the standard four-wire cable for the three-phase, 220-volt synchronous motor used to operate the camera.

Two pairs of wires comprise the signal circuit from the relay to the recorder. During location filming, this synchronization is carried by two signal channels leased from the telephone company. These channels, of course, are in addition to the equalized recording channel and order wire which are furnished also by the telephone company during shooting at broadcasting auditoriums or locations. Portable equipment, featuring the synchronizing device, can be used when it is not feasible to lease telephone lines and when such lines are not available.

Perfection of 16-Mm. Cameras:

Another obstacle faced in developing the new system was the perfection of 16-mm. cameras that could follow focus at all times, and a view-finder that would give cameramen the exact image in the exact focus that was being recorded on film. Equipment was especially constructed by the Mitchell Camera Corporation to our specifications. Finders were coupled with camera lenses, so that an adjustment of the finder focus would correct for parallax and camera-lens focus. This can be seen in Fig. 1, which shows the finder on the side of a Multicam camera.

The cameras were mounted initially on standard tripods which, in turn, were mounted on three-wheeled dollies equipped with caster wheels. Experience showed, however, that when the tripods were moved forward and then reversed or moved at a slight angle, the caster wheels caused an irregular movement of the cameras as the wheels shifted in position. This was undesirable, as it caused a shift in the pictures being photographed during the camera movement. As a result, new tripod structures, Fig. 1, 2, and 3, were perfected which permit steering of the tripod wheels from the panning handles of the cameras. The improved camera-supporting tripods can be steered for movement in any desired direction at any desired moment.

This new three-wheel dolly and tripod stand is fitted with semi-solid doughnut tires, 5 ins. by 1.5 ins. To steer it, the operator rotates a motorcycle-like grip handle which causes all three wheels to turn at the same direction, thus permitting a complete 90° movement of the tripod. Fig. 3, the right-hand view of the camera, shows the panning handle and the wheel-turning mechanism. The stand also can be used as an improved tricycle-type dolly, by locking the two rear wheels and steering with the front wheel.

The steering handle is mounted on the right side of the standard panning and tilt head so that the follow-focus knob can be operated by the cameraman. The steering handle is also the panning and tilt handle, and the motor switch is conveniently mounted on the handle.

For quickly raising and lowering the stand, a screw-actuated elevating device is operated by a hand wheel. Telescoping support-rods make for rigidity at all operating heights.

Eyelights have been mounted below the matte box on each camera blimp as well as over the blimps, to be used or not as the operator desires. Each has a control mechanism to regulate the intensity of the light, so that it will match the general set lighting. A transformer operated from the motor circuit with a rheostat control supplies the electricity.

Each camera blimp is equipped also with an action light, so that the cast and technicians will know exactly which cameras are in operation and the director will know if the scene is being filmed according to plan. The action lights operate only if the camera motors are actually running. Thus they are used, too, as an instrument to notify the operator if the camera motor develops trouble during a scene. Camera cables, in many instances, are suspended overhead in sets to eliminate as many ground cables as possible.

(Continued on page 18)

FIG. 5. MARKINGS ON THE SOUND TRACK SHOW WHICH CAMERA IS IN USE AT ANY GIVEN TIME

U. S. EDUCATIONAL STATIONS

AUDIO BROADCAST STATIONS ARE NOW OPERATED IN 34 STATES BY SCHOOLS AND COLLEGES. SOME SELL TIME. MOST OF THEM TRANSMITION FM

FOR all the dramatic possibilities of educational radio stations, experience has proved that such operations only succeed in a substantial way when the management is on a par with that of commercial broadcasting. Funds must be available to maintain the equipment in perfect working order at all

(Concluded on page 41)

	ALABAMA			
Tuscaloosa	Univ. of Alabama	WUOA	4.8 wk.	91.7
	ARIZONA			
Phoenix	Phoenix College	KFCA	10 w.	88.5
Thatcher	Gila Jr. College	KGIA	10 w.	88.1
	ARKANSAS			
Siloam Springs	John Brown Univ.	KUOA	5 kw. ad*	1,290
Siloam Springs	John Brown Univ.	KUOA	2.6 kw.*	105.7
	CALIFORNIA			
Long Beach	Bd. of Education	KLON	10 w.	88.1
Los Angeles	Univ. of S Calif.	KUSC	2.9 kw.	91.5
Los Angeles	Supt. County Schools	KSCS	1.5 kw.	89.1
Oceanside	Union High School	KOEN	10 w.	89.7
San Diego	School District	KSDS	3.3 kw.	91.7
San Francisco	Bd. of Education	KALW	1.25 kw.	91.7
Santa Monica	School Board	KCRW	460 w.	89.9
Stockton	Col. of the Pacific	KCVN	3.4 kw.	91.3
	FLORIDA			
Gainesville	Univ. of Florida	WRUF	5 kw. a*	850
Lakeland	Fla. Southern College	WFSI	10 w.	88.1
Miami	Tech. High School	WTHS	400 w.	91.7
	GEORGIA			
Atlanta	Bd. of Education	WABE	4.8 kw.	90.1
Atlanta	Ga. School of Tech.	WGST	5 kw. a*	920
Atlanta	Univ. System of Ga.	WGST	345 kw.*	94.1
	ILLINOIS			
Chicago	Bd. of Education	WBEZ	15 kw.	91.5
Elgin	Bd. of Education	WEPS	10 w.	88.1
Evanston	Technical High School	WDLJ	10 w.	88.5
Evanston	Northwestern Univ.	WNUR	10 w.	89.3
Urbana	Univ. of Illinois	WILL	5 kw. ad	580
Urbana	Univ. of Illinois	WIUC	320 kw.	89.9
	INDIANA			
Bloomington	Indiana University	WFIU	33 kw.	90.9
Evansville	Evansville College	WEVC	1.9 kw.	91.5
Greencastle	De Pauw University	WGRE	10 w.	88.1
Huntington	Huntington School	WVSH	10 w.	88.1
Indianapolis	Jordan Col. of Music	WAJC	820 w.	91.9
Lafayette	Purdue University	WBAA	5 kw. ad*	920
			1 kw. an*	920
Muncie	Wilson Jr. High School	WWHI	10 w.	91.5
New Albany	New Albany School	WNAS	10 w.	88.1
	IOWA			
Ames	Iowa State College	WOI	5 kw. ad	640
Ames	Iowa State College	WOI	15.5 kw.	90.1
Boone	Biblical College	KFGQ	250 w. ad	1,260
Decorah	Luther College	KWLC	250 w. ad	1,240
Iowa City	Univ. of Iowa	WSUI	5 kw. a	910
Iowa City	Univ. of Iowa	KSUI	17.5 kw.	91.7
	KANSAS			
Lawrence	Univ of Kansas	KFKU	5 kw. ad	1,250
			1 kw. an	1,250
Manhattan	Kans. State College	KSAC	5 kw. ad	580
			500 w. an	580
Wichita	Municipal Univ.	KMUW	10 w.	89.1
	KENTUCKY			
Lexington	Univ. of Kentucky	WBKY	2.3 kw.	91.3
Louisville	Free Public Library	WFPL	63 w.	89.3
Louisville	Baptist Theo. Sem.	WSDX	10 w.	90.3
	LOUISIANA			
Baton Rouge	A. & M. College	WLSU	1.8 kw.*	91.7
New Orleans	Loyola Univ.	WWL	50 kw. a*	870
New Orleans	Beauregard School	WBEH	10 w.	89.3
	MARYLAND			
Baltimore	Balt. Junior College	WHJC	10 w.	88.1
	MASSACHUSETTS			
Boston	Boston Univ.	WBUR	380 w.	90.9
Boston	Emerson College	WERS	330 w.	88.9
	MICHIGAN			
Ann Arbor	Univ. of Michigan	WUOM	44 kw.	91.7
Detroit	Bd. of Education	WDTR	2 kw.	90.9
East Lansing	Mich. State College	WKAR	5 kw. ad	870
East Lansing	Mich. State College	WKAR	9.7 kw.	90.5
Kalamazoo	Western Mich. College	WMCR	400 w.	91.1
	MINNESOTA			
Minneapolis	Univ. of Minnesota	KUOM	5 kw. ad	770
Minneapolis	Univ. of Minnesota	KUOM	4.4 kw.	91.7
Northfield	St. Olaf College	WCAL	5 kw. ad	770
St. Paul	N. W. Vocational Inst.	WNOV	10 w.	89.1
	MISSISSIPPI			
Meridian	Municipal Jr. College	WMMI	10 w.	88.1
	MISSOURI			
St. Louis	Bd. of Education	KSLH	12.5 kw.	91.5
St. Louis	St. Louis Univ.	WEW	68.8 kw.*	95.1
	NEW JERSEY			
Newark	Bd. of Education	WBGO	2.5 kw.	91.1
South Orange	Seton Hall College	WSOU	2 kw.	89.5
	NEW MEXICO			
Albuquerque	Bd. of Education	KANW	350 w.	89.1
	NEW YORK			
Brooklyn	Bd. of Education	WNYE	20 kw.	91.5
Floral Park	Bd. of Education	WSHS	350 w.	90.3
Ithaca	Cornell University	WHCU	1 kw. ad*	870
Ithaca	Cornell University	WHCU	40 kw.*	97.3
Ithaca	Ithaca College	WITJ	10 w.	91.7
Springville	Bd. of Education	WSPE	10 w.	88.1
Syracuse	Syracuse University	WAER	690 w.	88.1
Troy	Rensselaer Poly. Inst.	WHAZ	1 kw. ad	1,330
Troy	Veterans Voc. School	WEVR	460 w.	91.3
New York	Fordham Univ.	WFUV	3.5 kw.	90.7
	NORTH CAROLINA			
Greensboro	Administrative Unit	WGPS	10 w.	89.9
High Point	Bd. of School Commissioners	WHPS	10 w.	89.3
	NORTH DAKOTA			
Grand Forks	Univ. of N. Dakota	KFJM	1 kw. ad	1,440
			500 w. an	1,440
	OHIO			
Athens	Ohio University	WOUI	10 w.	88.1
Cleveland	Bd. of Education	WBOE	10 kw.	90.3
Columbus	Ohio State Univ.	WOSU	5 kw. ad	820
Columbus	Ohio State Univ.	WOSU	14 kw.	89.7
Kent	Kent State Univ.	WKSU	10 w.	88.1
Oxford	Miami University	WMUB	10 w.	88.1
Toledo	Bd. of Education	WTDS	730 w.	91.3
	OKLAHOMA			
Norman	Univ. of Oklahoma	WNAD	1 kw. ad	640
Norman	Univ. of Oklahoma	WNAD	7 kw.	90.9
Oklahoma City	Bd. of Education	KOKH	700 w.	90.1
Stillwater	Okla. A. & M. College	KOAG	10 kw. ad	840
Stillwater	Okla. A. & M. College	KAMC	42 kw.	91.7
Tulsa	Univ. of Tulsa	KWGS	1.1 kw.	90.5
	OREGON			
Corvallis	State Agric. College	KOAC	5 kw. a	550
Eugene	School District	KRVM	400 w.	90.1
Oretech	Oregon Tech. Inst.	KTEC	10 w.	88.1
Portland	Public Schools	KBPS	100 w. a	1,450
	PENNSYLVANIA			
Grove City	Grove City College	WSAJ	250 w. ad	1,340
Havertown	Haverford T. Sr. High School	WHHS	10 w.	89.3
Philadelphia	Wireless Tech. Inst.	WPWT	125 w.	91.7
Pittsburgh	Duquesne Univ.	WDUQ	2.75 kw.	91.5
Scranton	Univ. of Scranton	WUSV	10 w.	88.1
	RHODE ISLAND			
Providence	Bible Institute	WPTL	2.9 kw.	91.5
Providence	Providence College	WDOM		89.9
	SOUTH DAKOTA			
Rapid City	School of Mines & Tech.	WCAT	100 w. ad	1,230
Vermillion	Univ of S. Dakota	KUSD	500 w. a	920
	TENNESSEE			
Knoxville	Univ. of Tennessee	WUOT	3.4 kw.	91.9
Memphis	Harding College	WHBQ	250 w. a	1,400
	TEXAS			
College Station	A. & M. College	WTAW	1 kw. ad	1,150
College Station	A. & M. College	KAMT	2.8 kw.	94.5
Dallas	Texas Trade School	KVTT	780 w.	91.7
Dallas	So. Methodist Univ.	KSMU	10 w.	89.3
El Paso	Univ. of Texas	KVOF	10 w.	88.5
Fort Worth	S. W. Baptist Theo. Sem.	KFTW	10 w.	88.9
Houston	Univ. of Houston	KUHF	9.6 kw.	91.3
Plainview	Wayland Baptist Col.	KHBL	10 w.	88.1
Port Arthur	Port Arthur College	KPAC	5 kw. ad*	1,250
			1 kw. an*	1,250
Port Arthur	Port Arthur College	KPAC	*	101.9
Waco	Baylor University	KWBU	50 kw. ad*	1,030
	UTAH			
Ephraim	Jr. College of Utah	KEPH	10 w.	88.9
Mt. Pleasant	N. Sanpete School Dist	KSNA	10 w.	88.1
	WASHINGTON			
Pullman	State College of Wash.	KWSC	5 kw. ad	1,250
Tacoma	Tacoma School Dist.	KTOY	3.5 kw.	91.7
	WISCONSIN			
Chilton	Wis. Radio Council	WHKW	51 kw.	89.3
Colfax	Wis. Radio Council	WHWC	50 kw.	88.3
Delafield	Wis. Radio Council	WHAD	52 kw.	90.7
Holmen	Wis. Radio Council	WHLA	25.5 kw.	90.3
Madison	Wis. Radio Council	WHA	9.3 kw.	88.7
Wausau	Wis. Radio Council	WHRM	114 kw.	91.9
Madison	Univ. of Wisconsin	WHA	5 kw. ad	970
Stevens Point	Dept. of Agriculture	WLBL	5 kw. ad	930

NOTES: The following references are indicated after the figure for effective radiated power.

a Indicates AM transmission. All other stations operate on FM.

d Station operates during daytime only, or shares time with other stations.

n Authorized power for nighttime operation.

* Station sells time.

Converting the Sun AFC-10 to an

FM STATION TUNER

HOW AN INEXPENSIVE FM TUNER CAN BE MODIFIED FOR BROADCAST STATION USE—*By* WILLIAM MARON*

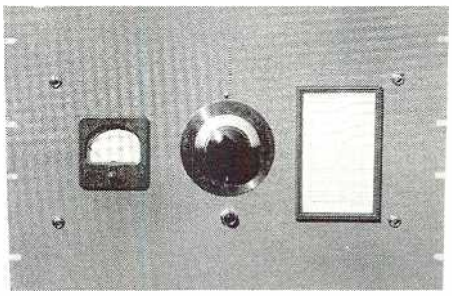


FIG. 2. REVISED TUNER, MOUNTED ON RACK PANEL

A HIGH-QUALITY FM turner, calibrated for frequency and input signal strength, is virtually a necessity for operation of an FM station. It is needed for interchanging programs with other stations and, in addition, can be used to conduct experiments with various types of receiving antennas, to check reception of distant stations, and to make propagation studies. However, receivers for station use are expensive. They usually contain 10- or 15-watt audio amplifiers, which are unnecessary in most cases and add to the cost, weight, and size. Conversion of a home-type FM tuner for station use can be done easily and inexpensively. This article shows how it is possible, at a total cost of less than $100 to obtain an excellent FM station receiver by making a few alterations in a Sun model AFC-10 tuner.[1]

Electrical Modifications:

The Sun tuner was selected primarily because its roomy, open construction provides plenty of space to make the necessary modifications. In addition, it has the following desirable electrical characteristics:

1. Exceptional freedom from osciliator drift.
2. High sensitivity.
3. Good noise rejection and capture effect.

Only minor changes in the circuit were necessary, as can be seen in Fig. 1. Modifications are shown in dashed lines.

To facilitate tuning and to permit observation of relative signal strength and fading, a low-range DC microammeter was inserted in the first limiter grid return. The meter used had a 0-100-microampere movement, but was shunted to extend the range to 0.5 milliampere.

The AFC is undesirable at times, especially when an attempt is made to tune a weak signal fairly close to a strong one. The stronger signal, of course, tends to pull the oscillator frequency. Therefore, provision was made for disabling the AFC. A single-pole, single-throw switch, Fig. 1, shorts the DC control voltage at the grid of the AFC tube to ground.

As the tuner is sold, the audio output is taken directly from the discriminator at high impedance. Since most remote input lines are of 600 ohms, it was decided to add a low-gain audio stage working into a plate-to-line transformer. The tuner output, as shown in Fig. 1, was fed directly to the grid of a 9002 triode. A broadcast type transformer, RCA No. 55824, was used for the output. The plate reactor is included within the can. Since no DC flows in the transformer primary, response to 15,000 cycles is obtained.

Mechanical Alterations:

To obtain vernier tuning drive and to permit precise resetting of the tuner, a gear drive and a National type N dial were installed. Also, because the dial does not read directly in frequency, a tuning calibration chart was required.

The dial, dial cord wheel, and dial lights furnished with the equipment were removed, as were the combination switch-volume control and the tuning shaft. This left the front of the tuner completely bare, with two holes in the apron. The chassis was mounted in a steel cabinet which, in turn, was attached to a standard rack panel. Fig. 2 shows the front of the panel, on which the dial, calibration chart, and signal-strength meter are mounted.

Leads to the meter and a pilot light were brought through the holes in the front apron, as shown in Fig. 3. A detail of the tuning drive is given in the insert.

An RMA audio output jack was installed on the rear apron originally. This was removed and the volume control put in its place. Three additional holes were drilled, Fig. 4, to accommodate an AC on-off switch, the AFC disabling switch, and a female two-wire balanced audio output connector. Thus, by having all controls except the tuning dial at the rear of the

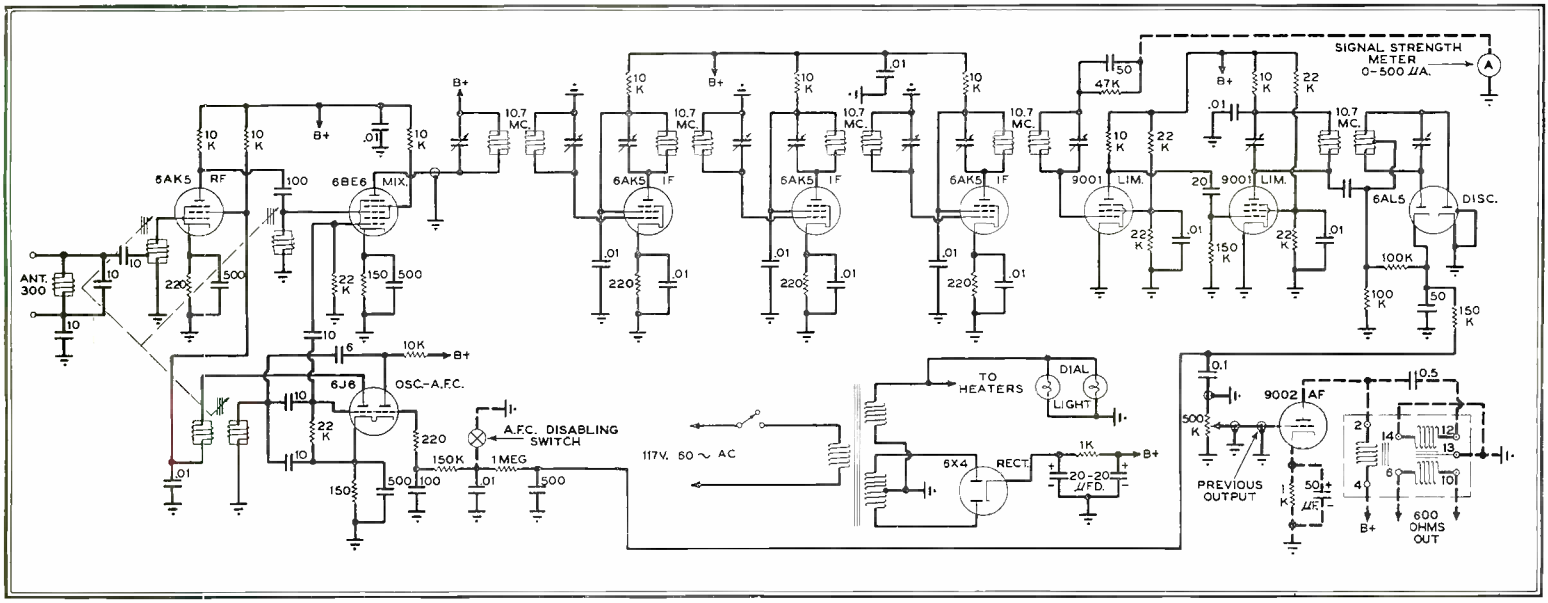


FIG. 1. THE ORIGINAL CIRCUIT WAS MODIFIED BY THE ADDITION OF A SIGNAL STRENGTH METER, AFC SWITCH, AND AN OUTPUT STAGE

* Chief Engineer, WPOE (FM), 1143 E. Jersey Street, Elizabeth 4, New Jersey.

[1] This tuner was described fully in "A Straight FM Tuner With AFC," by Irving Greene, *FM-TV*, Dec., 1949.

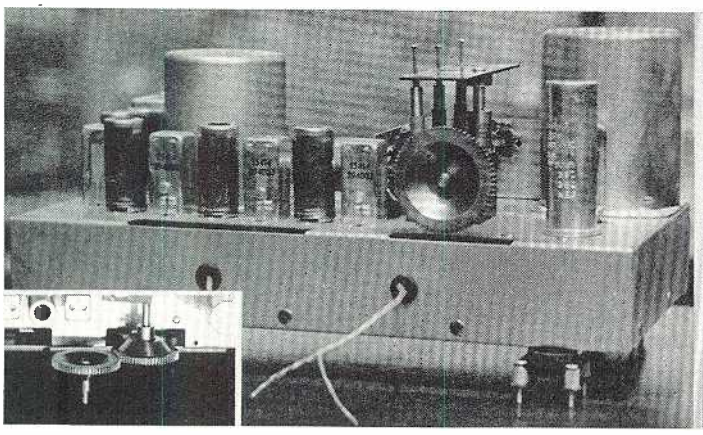


FIG. 3. FRONT OF THE REVISED CHASSIS. GEAR TRAIN IS SHOWN IN INSERT

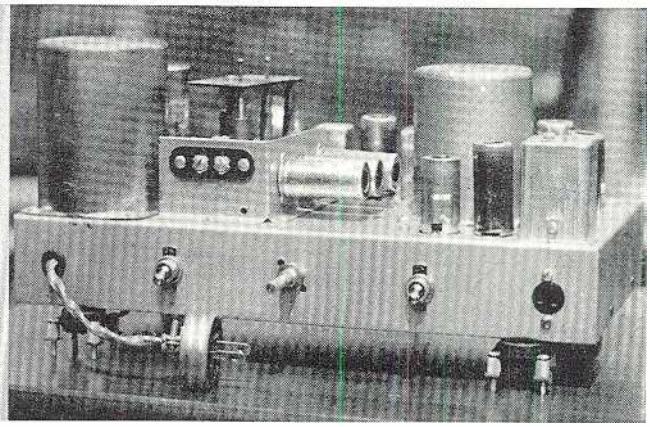


FIG. 4. CONTROLS WERE MOVED TO THE REAR OF THE CHASSIS

rack, the possibility of unauthorized changes in settings was reduced.

The tubes and IF and discriminator cans are arranged in a row along the outer edge of the chassis, leaving a large open space in the center. This was an ideal place for the plate-to-line transformer. It can be recognized as the large round can at the right in Fig. 4. Directly in front of it are two tubes. The small one at the left is the 9002, added for the audio stage.

Four small shock-mounts were installed to reduce noise from mechanical vibration. Fig. 5 shows their placement clearly. Since the shock-mounts insulate the chassis from ground, a piece of wire braid was connected from one of the mounting screws to the chassis.

Conclusion:

The tuner dial can be calibrated with a signal generator, or by tuning in various FM stations, plotting each station's frequency and the dial reading, and drawing the resulting curve. Each tuner will, of course, require individual calibration for frequency.

The cost of parts for these modifications was approximately $40. This brings the total cost to a figure somewhat less than $100, excluding labor.

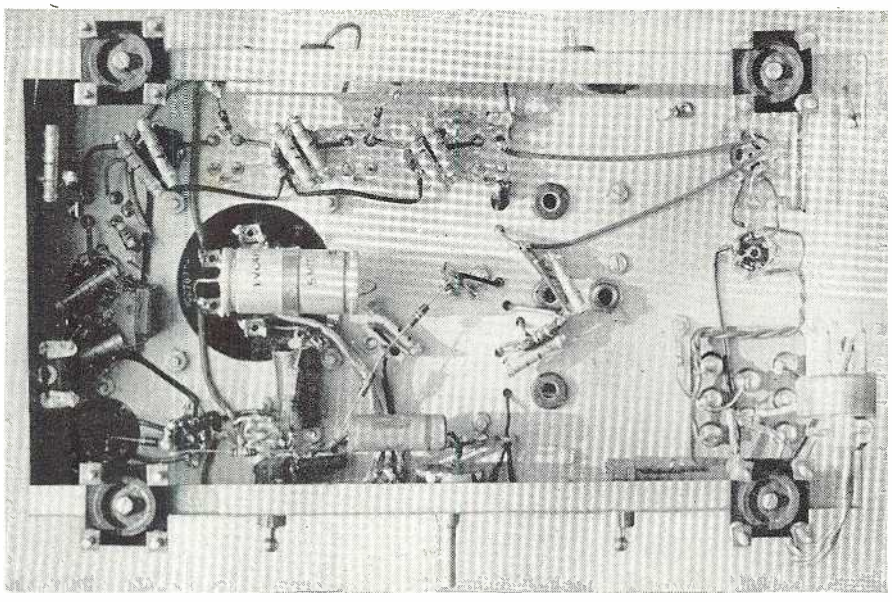


FIG. 5. UNDERNEATH VIEW AFTER CHANGES WERE MADE. NOTE THE ADDITION OF SHOCK ABSORBERS

LOW-COST TV FILMS

(Continued from page 15)

Staging and Production:

A departure from previous motion picture methods, the new process required the development of a much faster and more efficient stage-operation technique and production system. General procedure, heretofore, has been to set up a tentative timetable of scenes to chart the course of production. This served more or less as a guide to the construction department and set decorators. Players seldom memorized lines more than a day in advance of shooting, and usually only for the scenes to be filmed. Camera angles were determined on the spot, and rehearsals held while the technical crew stood by. The director, in many instances, was the only one who had knowledge of the master plan. Details were left until the night before shooting. Technicians and cast members learned about them the day of filming.

Under the Multican System every detail is completely planned in advance. Sets and decorations for the entire screen play are constructed and dressed beforehand. The cast, which has rehearsed on another stage, is as prepared as it would be for the opening night of a stage play. Every camera movement is planned long in advance on paper, and all lighting is ready. One rehearsal is held on the stage, as in Fig. 4. Its purpose is to give the camera operators the opportunity of executing what has been planned for them. The entire scene is then filmed, with the three cameras getting the various angles and long, medium, and close-up shots. The average scene, under the Multican System, runs many times longer than the average scene under the conventional methods. Rarely is the footage under 5 minutes, and 7 to 8 minutes is the average. In some instances, when a minimum of sets and complicated action is called for, 30 minutes of finished film can be photographed in 30 minutes.

A set of production scripts, prepared for every technician and player, is the key to the entire stage-operation technique. These script layouts outline in detail every camera movement and cues for cutting in and out of scenes. Each camera is designated with a number and color to identify it. Cameramen and technicians study their scripts in advance just as thoroughly as do the players. While individual cameramen receive layouts covering only their own schedules of operations, the director and cast are given a master production script that shows the plan for the three or more cameras. Relative markings in the story script also show the cameras that will be in operation at any particular time in the story continuity. Thus the whole operation is closely coordinated.

(Concluded on page 45)

FIG. 1. CHIEF WILLIAM H. MATTOCKS, THE FIRST TO USE SELECTIVE CALLING AT FIRE STATIONS

THE NEW ST. PAUL MOBILE RADIO SYSTEM

PART 2: THE FIRE DEPARTMENT USES SELECTIVE CALLING TO 19 FIRE HOUSES, AND NOW HAS 37 MOBILE RADIO UNITS — *By* ROBERT F. PETERSON*

THE idea of installing fire alarm boxes at frequent intervals on city streets was conceived long before the telephone became a household appliance and a business necessity. Over the years, people have acquired certain habits with respect to the telephone, because its use is a part of their day-to-day activities. Making a telephone call is almost an automatic response, for example, to the need for help in any emergency, as in the case of fire.

In contrast, fire alarm boxes are something that most people are not called upon to use in the course of a lifetime. People may pass them a dozen times a day without being conscious of their location except once every few years when they are hung with Wet Paint signs.

While fire alarm boxes afford the advantage of automatic operation, they cannot transmit information as to the exact location or the particular nature of a fire. When an alarm of fire comes in by telephone, the operator can get that information and, from his knowledge of the neighborhood, he has immediately a fairly accurate idea of conditions which will confront the firemen when they arrive at the scene.

Alarms of Fire:

Before the new radio communication system was installed at St. Paul, our Fire Department followed the conventional practice of transmitting box numbers to the fire houses by setting up each number on an automatic transmitter. This was connected by wires to individual gongs in the stations.

Recognizing that essential information received over the telephone was not passed on by this method, it was decided to provide radio communication from headquarters to each fire house. This plan, plus the use of selective calling, was set up in the following manner:

Whether an alarm of fire comes in on a box or over the telephone, it is received at fire headquarters, Fig. 2. Two operators are on duty at all times, one to handle the telephone, and the other the radio. On the radio console, Fig. 3, there are 40 selective-calling buttons available, of which 19 are now used to call the individual fire houses.

There is a radio receiver in continuous operation at each station, but the speakers are normally silenced. When the operator at headquarters pushes a calling button on the console, the speaker at the

FIG. 2. THE RADIO CONTROL CONSOLE AT FIRE HEADQUARTERS TRANSMITS ALARMS OF FIRE TO THE STATIONS BY SELECTIVE RADIO CALLING

*Commissioner of Public Safety, Public Safety Building, St. Paul, Minn. The first part of Commissioner Peterson's article appeared last month.

corresponding fire house is turned on, and a gong is sounded to call the firemen. Then the radio operator announces the location of the fire, and gives any other information necessary. Before the apparatus pulls out, the call is acknowledged by telephone.

Later, it is planned that calls will also be acknowledged by radio on the apparatus as soon as it pulls out of the station, and we may eventually use only the radio for this purpose.

A complete record of incoming and outgoing radio messages is made at headquarters on a Dictaphone recorder. This is set up behind the console, as shown in Fig. 3.

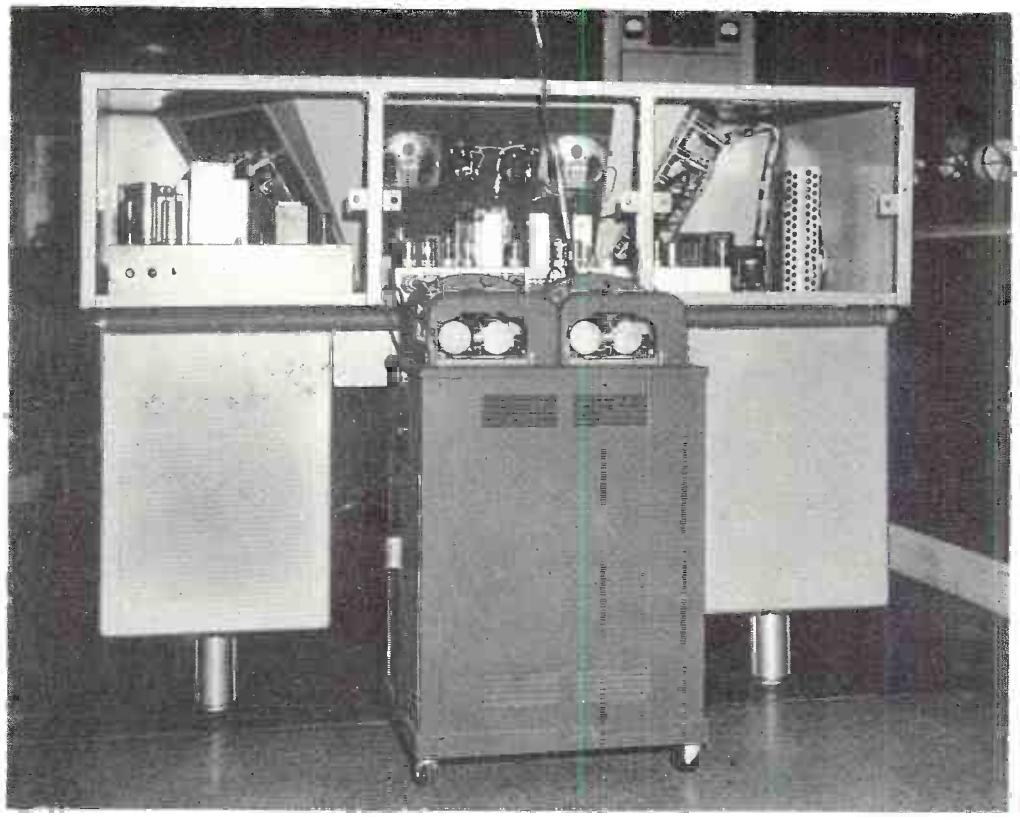


FIG. 3. REAR OF CONSOLE, WITH COVER REMOVED. THE SIGNAL-GENERATING UNIT IS AT THE LEFT

Radio on Fire Apparatus:

We have provided 2-way radio for all our fire apparatus. These installations include:

19 engines
7 hook and ladders
1 rescue squad car
1 Fire Chief's car
1 Assistant Fire Chief's car
5 District Fire Chiefs' cars
1 Supt. of Alarm's car
2 repair trucks

In addition, the fire department has two portable pack sets. Later, we shall have 10 new pumpers and 3 aerial trucks. These will be radio-equipped, too.

If anyone needed to be convinced as to the soundness of this plan, his doubts were answered by the handling of a 3-alarm fire which resulted last February from an explosion at the minerals building of the Minnesota Mining & Manufacturing Company. The blast killed 11 people and injured 59. It was necessary to call out 10 engine companies, 4 trucks, and a water tower. Without radio, both the fire and police departments would have been seriously handicapped, for telephone lines were cut by the blast. Our portable radio equipment was of great value in clearing out employees in adjacent buildings. This was necessary because of the threat of additional explosions. The portables were also used to spot danger areas, and to get doctors and ambulances where they were needed. One mobile unit was set up as a field station, to clear calls for doctors, ambulances, and the Red Cross. Police traffic at the scene was handled without interference, because that operates on a different pair of channels.

FIG. 4. LINK RADIO CONSOLE HAS CALLING BUTTONS AT RIGHT, IN-SERVICE LIGHTS AT LEFT

The problem of grass fires in the spring and fall is familiar to every fire department. Our calls amount to 5 to 12 a day or more at the height of the season. With radio communication from headquarters to the fire stations, the operator can pass on the information that the call is a grass fire. Then, with radio on the apparatus, it is often possible to send it from one fire to another, without the necessity of returning to the station.

At major fires, extra men and hose are often needed, but the pumpers are not. After the rigs have been emptied of hose, they can be called back and manned by the off shift, if necessary. Another important advantage is the use of radio for talking between the scene of a fire and a pumper that may be three blocks away. Now, instead of sending a man on foot to the pumper when a

change of pressure is required, radio provides instantaneous communication.

Fig. 5 shows a typical Link Radio receiver installation at one of the fire houses. The cabinet, at the right of the table, houses the set as well as the selective calling controls and signal lights. This is in interesting contrast to the tape register, at the back of table, which rings a bell as it punches out box numbers. The latter system has been in use for so many years that the change to radio telephone communication is a radical departure from long-established practice. However, it is another example of giving up something that has become a habit, in favor of a new development resulting from the progress of science.

Future Requirements:

Our experience with the new St. Paul system has been highly reassuring, particularly at a time when we are confronted with the study of conditions which the police and fire departments would be called upon to meet in case of an air-raid attack.

Fortunately, our radio facilities were planned to permit expansion, so that we are confident of being able to provide adequately for the future. Even now, we are considering the extension of our service to include the city water department.

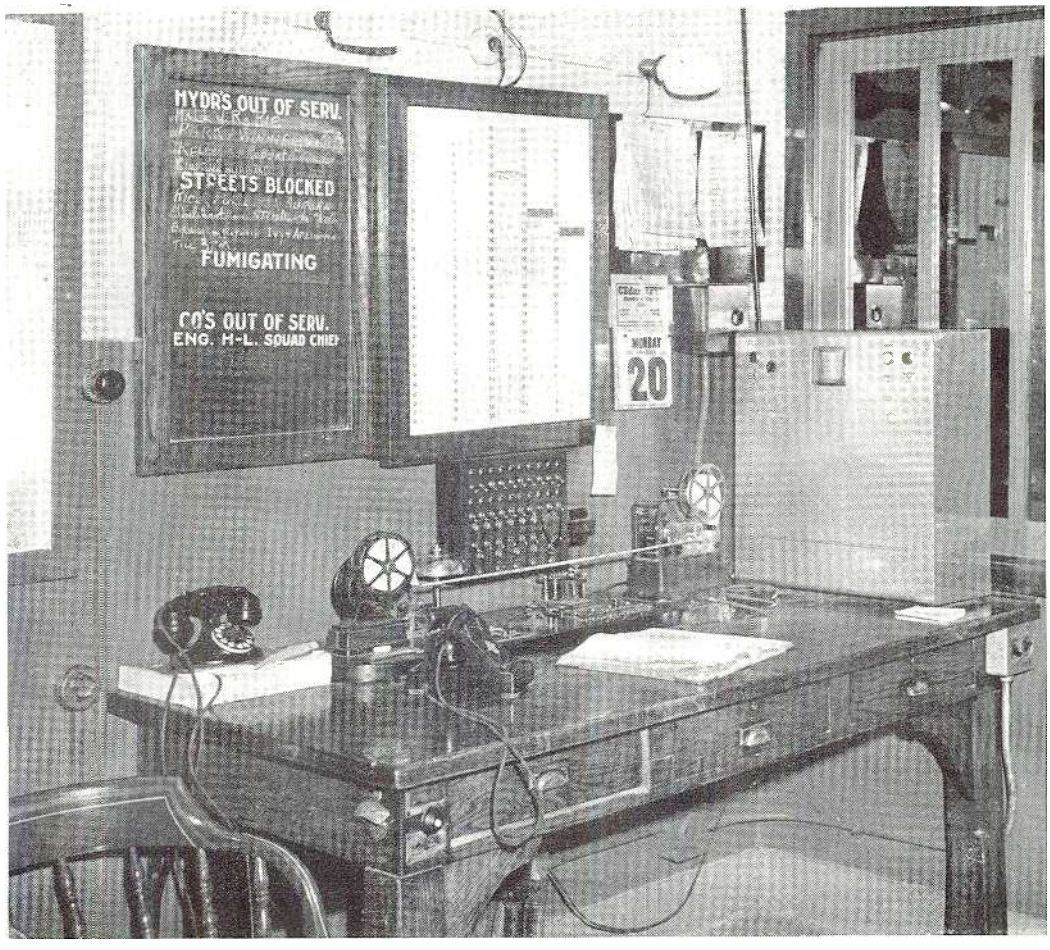


FIG. 5. AT THE RIGHT IS A SELECTIVE-CALLING RECEIVER INSTALLED AT ONE OF THE FIRE HOUSES

EFFECTS OF ENDING THE TV FREEZE

AS this issue goes to press, the FCC is engaged in completing the new allocation plan for VHF television stations, and preparing to open up the UHF band.

Final action, which may come in March, has been heralded in some publications as opening up enormous station construction activity, and permitting the immediate realization of potential development that has been restricted by two and one-half years of the TV freeze. This is completely at variance with industry opinion that such expansion must await the release of materials and production from military priorities.

Accordingly, we inquired of official sources as to the possible effects of this FCC activity. The score adds up in about this way:

First, some VHF stations now on the air will be shifted to new channels. That will not be a serious matter, however, since the changes will be within the lower and higher sections (channels 2 to 6 and 7 to 11). No shifts from one section to the other are planned. At worst, some receivers might require checking if tuning circuits not used previously are found to be out of alignment.

The only new VHF station construction that will be authorized is for Alaska and Hawaii.

In continental USA, UHF construction can be authorized in the near future in cities where there are no contests over conflicting applications, or where such conflicts can be resolved readily. Whether transmitters, towers, and studio equipment can be obtained is a matter of uncertainty at this moment. Some manufacturers are ready with designs for UHF receivers, but it is too early now to decide if it will be possible to put them in production.

Altogether, it does not appear that the Commission's action, when it is announced, will have any immediate, far-reaching effect on the radio industry. Hearings on TV station applications will be started but, judging from past experience, the FCC's legal wheels will turn slowly. It may be many months before even decisions on non-contested UHF applications will be reached, and construction permits issued. The future for VHF is even more uncertain.

Thus the impending action by the FCC can do no more than launch TV on a new phase of its growth. By the time this can materialize into orders for new transmitters and for either VHF or UHF receivers, industry conditions may undergo radical changes which no one can foresee at this time. As one manufacturer remarked: "When the time comes, we'll do it, whatever it is, if it can be done. Meanwhile we have enough headaches from day to day without trying to see what new problems we'll have to meet if and when more stations are authorized."

Others seem more interested in the outcome of the color controversy than in the termination of the freeze, feeling that this will be a factor of transmitter and receiver design by the time there can be any appreciable increase in the number of TV stations. Right now, the only thing certain about the issue of compatible vs. non-compatible color is that time is running against CBS and the FCC. From the point of view of public interest, convenience, and necessity, it would seem that the Supreme Court must decide against an incompatible system. On the other hand, the Court may disregard the practical advantages of compatibility, and simply find that, as CBS, FCC, and the Department of Justice have asserted, the decision by the FCC was "an admittedly difficult one, but one of exactly that nature which is within the informed competence of an administrative agency."

JEREMIAH COURTNEY'S MOBILE RADIO NEWS AND FORECASTS

EVERYONE recognizes the importance of promoting the safety of air travel. To ensure this while at the same time safeguarding the rights of the radio industry, the Federal Communications Commission recently promulgated a new set for rules: Part 17 "Rules Concerning the Construction, Marking, and Lighting of Antenna Towers and Supporting Structures." Now, for the first time, there are written standards and criteria by which a prospective applicant can judge for himself if a proposed radio tower will be considered a hazard.

Heretofore, there were innumerable conflicts between prospective radio licensees and the Civil Aeronautics Administration with respect to locating radio towers near airports and airport approach areas. To resolve the conflicting requirements of the radio industry and the aviation industry, a study was made by a committee comprising representatives of CAA, FCC, Department of Defense, and others concerned with the development of aviation. The result, after some two years of study, is new Part 17 of the Commission's Rules.

Part 17 became effective February 15, 1951. Applications processed after that date will be subject to the requirements of these rules. Antennas erected or approved prior to that date are not affected.

Applications to Be Speeded:

Basically the rules provide for a more detailed study of proposed antenna towers before applications are filed with the FCC. In this way it is hoped that most application processing will be speeded without jeopardizing the safety of air navigation. It will probably also save licensees money and time, since in many cases the applicant will know in advance that the location selected will be approved. He can thus proceed with the details of acquiring the site or arranging for a lease with reasonable assurance that the FCC will not turn down his application because the tower is considered a hazard to air navigation.

Part 17 is divided as follows: Subpart A contains general information. Subpart B contains the criteria for determining when aeronautical study is required, and Subpart C specifies the tower painting and lighting requirements.

Form 401A Still Required:

The general information of Subpart A defines the technical aeronautical terms used in the Rules. This Subpart also describes how an application shall be filed, and the procedure to be used by the FCC in processing the application. The new rules do not abolish Form 401a—Description of Antenna Towers—but change the conditions under which the form is to be submitted. Under the new Part 17, Form 401a must be attached to the application for construction permit in each of the following cases:

1. When the proposed tower will be higher than 170 ft. above ground (formerly 150 ft.);

2. When the proposed tower will be higher than 1 ft. above ground for each 200 ft. of distance from the nearest boundary of any landing area (formerly 1 ft. for each 100 ft.).

New Application Procedure:

Subpart A also describes the procedure to be followed by the FCC. Applications involving towers that do not require aeronautical study will be deemed not to constitute a hazard to air navigation and will be processed accordingly.

Applications involving antenna towers that require aeronautical study will be referred to the appropriate regional Air Space Subcommittee for an opinion. The Air Space Subcommittee is a unit of the Air Coordinating Committee (ACC) which was created by Executive Order to provide for the development and coordination of aviation policies. The Air Space Subcommittee of the ACC deals with problems involving conflicting uses of the navigable airspace.

The Air Space Subcommittee functions through regional groups located in New York, Atlanta, Chicago, Fort Worth, Kansas City, Los Angeles, Seattle, Anchorage, and Honolulu which may be reached at the CAA regional offices in these cities. Each regional Air Space Subcommittee is composed of experts in the aeronautical field familiar with the local requirements of air safety.

The Secretary of the regional committee will endeavor to obtain informal clearance from the members. If no objection is raised, the application will be sent back to the FCC with a recommendation for approval.

If any objections are raised, the case will be put on the agenda for the next meeting of the regional committee. At this meeting both the applicant and the objector will be expected to appear in person and present their reasons. If agreement is reached, a recommendation for approval will be sent to the FCC.

If no agreement can be reached, or if the proposed antenna tower is disapproved a report of the Committee's findings will be submitted to the FCC which will in turn notify the applicant and take such further action as it considers appropriate.

At this writing there is no indication as to the position the Commission will take in the case of a lack of agreement among members of the regional Air Space Subcommittee. In the case of a report recommending denial, there is no doubt that the FCC will also deny the application. But it is hoped that, in the case of a division of opinion, the FCC will assert some of its statutory authority and make a firm decision instead of supinely catering to the whims of a single objector by refusing to grant a construction permit until his objections have been met.

Antenna Criteria Specified:

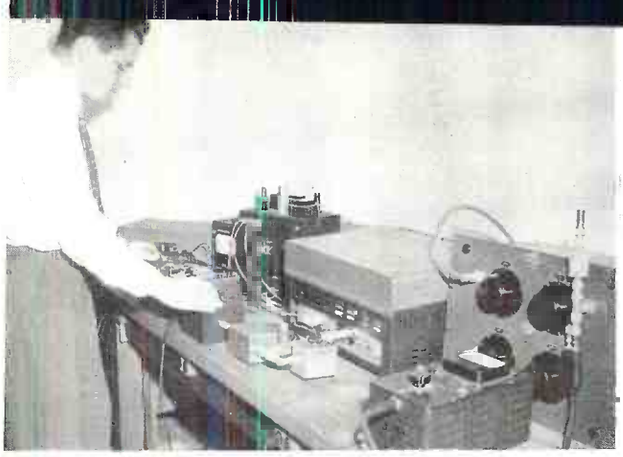
Subpart B of Part 17 contains the criteria for determining when aeronautical study is required. An antenna tower over 500 ft. will always require special study. On the other hand, an antenna mounted on a mast not more than 20 ft. above a natural formation or an existing man-made structure is always exempt from aeronautical study. Other towers are divided into two groups, those under 170 ft. and those over 170 ft.

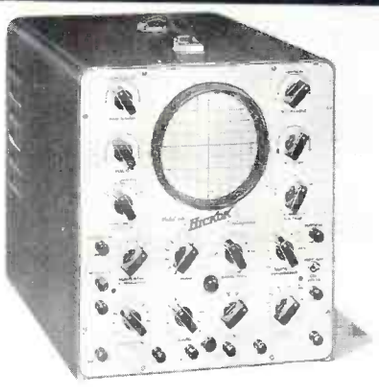
Towers under 170 ft. high require aeronautical study only when located near airports and airport approach areas. Towers between 170 ft. and 500 ft. high require study when near airports or approach areas, when within certain coastal corridors established by the Department of Defense, or when located within any of the Civil Airways or designated air traffic control areas in which the minimum flight altitude may have to be raised if the proposed tower is erected.

Most towers used in the land mobile services fall into the two groups below 500 ft. Recognizing this fact, the FCC has prepared a question and answer manual to accompany Part 17. This

(Continued on page 36)

*1707 H Street, N. W., Washington, D. C.





1: B. OF S. NOISE-FIGURE CALIBRATION 2: FIVE-INCH HICKOK OSCILLOSCOPE 3: MASTER CONTROL ROOM AT PROVIDENCE FM STATION WPJB

NEWS PICTURES

1. Because noise is the limiting factor of reliability, sensitivity, and range of all communication systems, the National Bureau of Standards is now offering a calibration service for the noise figure of equipment in the range of 500 kc. to 30 mc. Later, this will be extended to 300 mc.

4: BOONTON UNIVERTER FOR 202-B GENERATOR

2. Hickok Electrical Instrument Company, 10530 Dupont Avenue, Cleveland, has a moderately-priced 5-in. oscilloscope of high stability and extended range. Frequency response is 0 to 1 mc. and 0 to 4.5 mc. at the 3-db point. Sensitivity of vertical DC and AC amplifier is 10 or 25 microvolts per inch.

3. Master control room at WPJB Providence, R. I., one of the leading FM stations in New England. Console is designed to handle programs from 3 studios and an auditorium, as well as auditions and the recording equipment. Chief engineer George Sharpe is at the console, with engineer Victor Laboissonniere at the rack.

4. Boonton Radio Corporation, Boonton, N. J., has a type 207-A frequency converter of unity gain to extend the range of their 202-B FM signal generator so as to cover .1 to 216 mc. The Univerter has a dial calibrated in increments of 5 kc. from 300-0-300 kc. to permit making measurements on narrow-band receivers.

5. This vacuum-tube voltmeter, rated accurate to 2% on a frequency range of 10 cycles to 250 kc., has been brought out by the Daven Company, 191 Central Avenue, Newark 4. High stability and a regulated power supply make the readings independent of line-voltage fluctuations. Input impedance of the meter is 500,000 ohms.

6. The Missouri Pacific is extending its use of radio communication to include the greater part of its main lines. The present program calls for equipping a total of 312 freight and passenger diesels, and 285 cabooses. The latest order for radio equipment placed by this road amounted to $324,000.

7. Belmont Radio is setting up a plan to help its distributors and dealers by farming out sub-assemblies. Purpose is to keep them in business if the requirements of military production threaten their survival by cutting off the supply of consumer merchandise.

8. GE's Civil Defender FM communication receiver is designed for C-D systems. All sets or individual groups can be activated by selective calling from headquarters. A signal lamp is switched on when a message is received, and a special circuit can be provided to stop and start air-raid sirens or other warning devices. In this photograph are Civil Defense coordinator Neal Harmon and Charles Race who designed the receiver.

5: DAVEN VOLTMETER FOR 10 CYCLES TO 250 KC.

9. Data is now available on this antenna for 450 to 470 mc., produced by Workshop Associates, Needham Heights, Mass. It consists of six half-wave dipoles, giving a gain of nearly 8 db. Impedance is 50 ohms, with a VSWR of less than 2 to 1.

6: RADIO FOR 312 MO.-PAC. DIESELS 7: BELMONT TO FARM OUT SUBASSEMBLIES 8: GE CIVIL DEFENSE RECEIVER 9: WORKSHOP 450-MC. ANTENNA

FTB AIR-RAID ALERT ALARM

PART 2: DESIGN, CONSTRUCTION, AND ADJUSTMENT OF THE INDICATOR, AND ITS OPERATION FROM STANDARD RECEIVERS — *By* FREDERICK T. BUDELMAN*

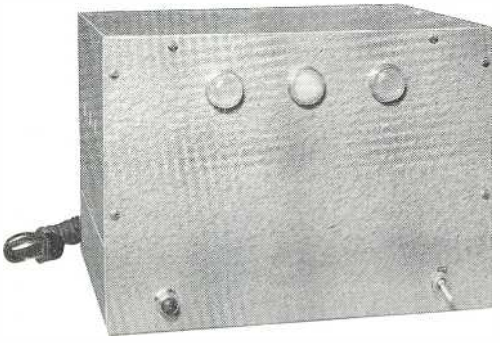


FIG. 1. THE FTB AIR-RAID UNIT HAS LIGHTS AND REAR TERMINALS FOR AUXILIARY ALARMS

THE whole concept of the requirements and effectiveness of Civil Defense planning is undergoing a complete revision. Plans for underground retreats and communal shelters are being abandoned in the light of figures on construction costs and data on the time required for a given number of people to move from offices and shops to bomb-proof locations.

New C-D Planning:

Authorities are coming to understand that the real problem of protecting our cities in case of attack by air is not to provide shelters for the maximum number of people, but to enable the maximum number of people to survive an attack which would probably come too swiftly for an orderly evacuation of offices and factories.

For example, it has been determined that about 30 minutes are required to empty the population of the Empire State Building in New York City under normal conditions. If, after a general air-raid alarm, it was attempted to evacuate these people to an underground shelter, more might be injured and killed than if they remained at their posts.

It has been estimated by the Federal Civil Defense Agency that casualties can be reduced as much as 50% by properly organized action, implemented by an adequate communication system.

Furthermore, the $3.1 billion plan for shelter protection blueprinted at Washington, when broken down by critical target areas, proved to be an intolerable burden of expense for some states and cities, even with the Federal Government paying 54% of the cost.

And that sum, it was found, would afford protection to only 1% of the population in the areas where it was proposed to spend the money.

Thus the realities of the situation have developed the philosophy of preparing to provide the most effective public service in case of actual attack, rather than attempting to provide protection against attacks which may never materialize.

The key to success of this plan is fast, dependable communication, which only radio can provide. Since there are over 17,000 communication systems now operating and available for C-D use, very complete service can be established at little more expense than the cost of radio receivers and radio-operated alarm devices.

That the importance of speed in alert-

*Vice President in Charge of Engineering, Link Radio Corporation, 125 West 17th Street, New York City.

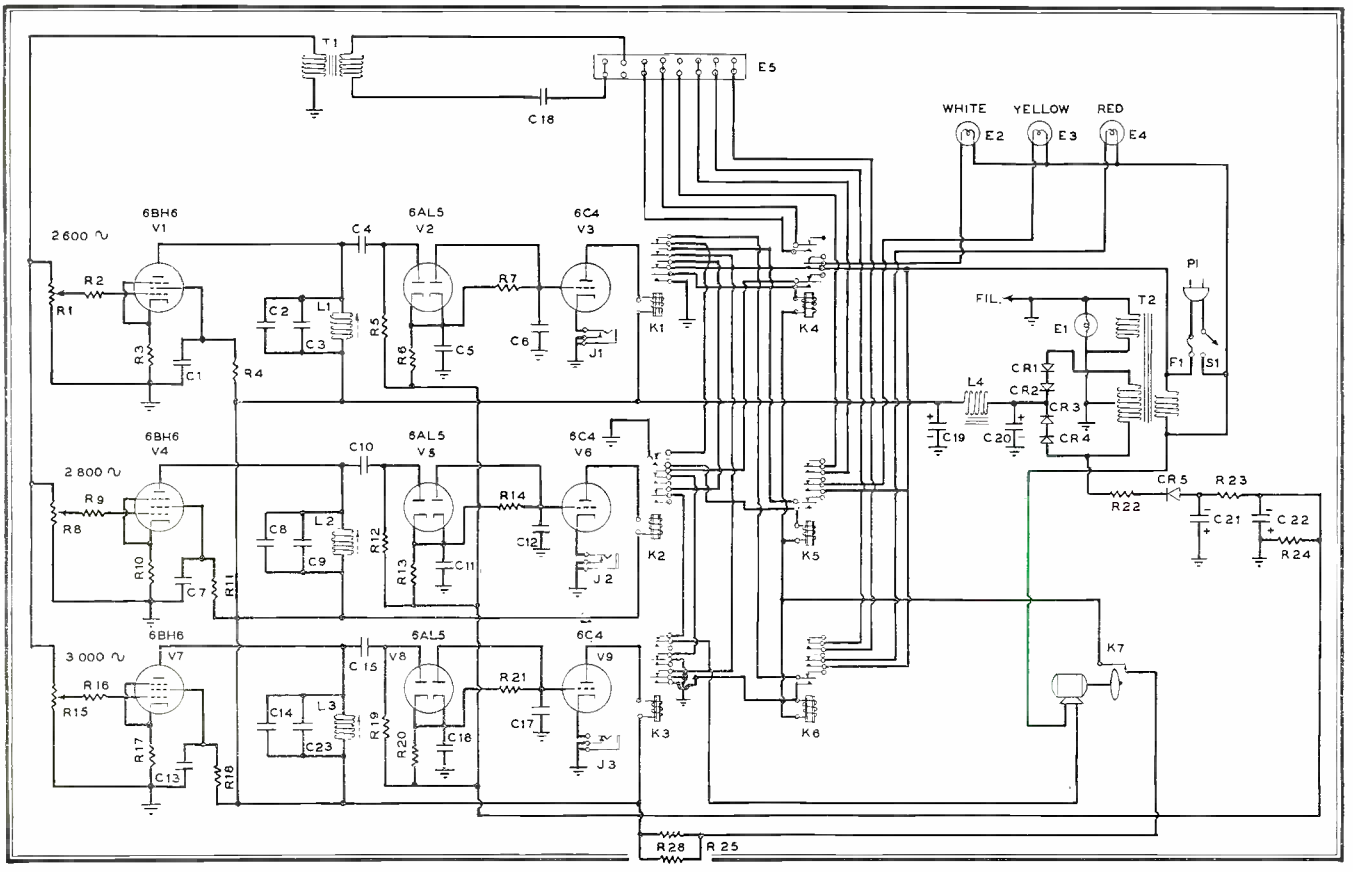


FIG. 2. COMPLETE CIRCUIT DIAGRAM OF THE DEVICE WHICH PROVIDES FAIL-SAFE OPERATION OF THE WHITE, YELLOW, AND RED SIGNAL LIGHTS

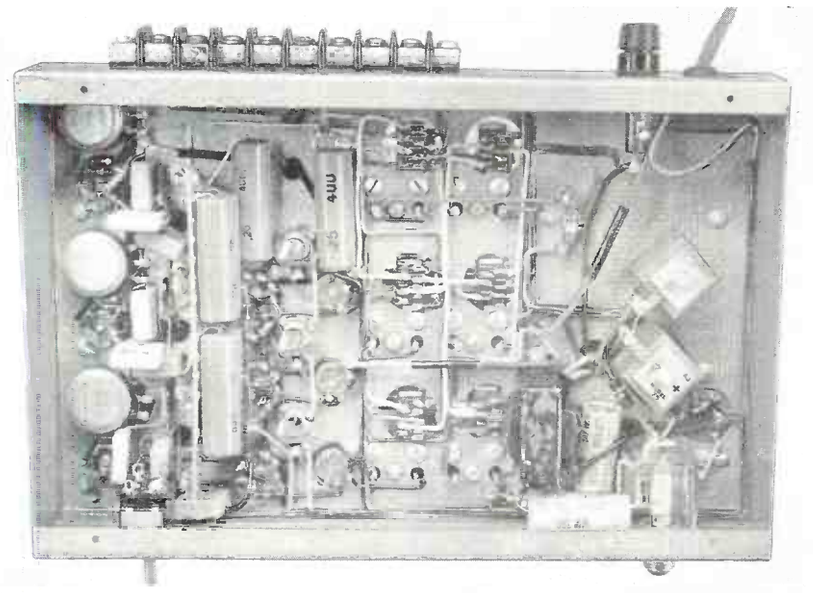


FIG. 4. BOTTOM VIEW SHOWS WIRING TO BE MUCH SIMPLER THAN IT APPEARS IN THE SCHEMATIC

ing C-D personnel has not been overemphasized is indicated by the fact that, because Nagasaki was warned of our atom-bomb attack, there were only one-half as many casualties as at Hiroshima.

Simplicity of FTB Units:

The proposal that equipment for Civil Defense can be assembled by communication and broadcast engineers, as well as servicemen and expert amateurs seems to have surprised some readers who, apparently, assume that devices suitable for such service must be factory-built. That is necessary, of course, in the case of equipment that requires elaborate tests and inspection with precision instruments.

The FTB air-raid alert alarm units, however, employ simple, non-critical circuits which can be assembled from standard components. As for testing, the only instruments required are a milliameter, signal generator, and an audio oscillator, the basic tools found in every service shop.

The Alarm Indicator

Fig. 1 shows the complete alarm indicator, designed for use with any suitable receiver. There is a complete schematic diagram in Fig. 2, with top and bottom views of the chassis in Figs. 3 and 4.

In discussions of this system, one of the first questions asked is usually: "How much of a signal from the receiving set is required to operate the indicator?"

That depends somewhat on the way the indicator is operated. If it is used with a communication receiver, the speaker will probably be turned up to audible volume at all times. However, it may be necessary to change the volume level during the day and night, according to the amount of noise in the room where the indicator is installed. Under such circumstances, the alarm indicator input should be taken from the detector circuit of the FM receiver. Then adjustment of the speaker volume will not affect the signal fed to the indicator unit. This arrangement is recommended for private homes or offices where the speaker would be turned down normally. However, as soon as the yellow light shows, the volume control can be turned up for reception of voice instructions from the control transmitter.

Under this arrangement, an input signal to the indicator of about .5 volts is required. The input transformer shown in Fig. 2 would not be used. Instead, the audio input would be connected directly to the top of the three gain controls, through a .01 mfd. blocking capacitor.

On the other hand, the alarm unit can be bridged across any voice coil or 500-ohm circuit without affecting the audio level or frequency response, since the input transformer T1 has a primary impedance of over 5,000 ohms. A blocking capacitor C18 is used in the audio input circuit, in the event that the input is bridged across a line having a DC control voltage superimposed on it.

Tone Relay Channels:

Since the tone relay channels are identical in function, it is only necessary to describe one in detail. In the top 2,600-cycle, white-light channel, Fig. 2, resistor R2 is in series with the grid of V1, serving to limit the audio input to the 6BH6, thus preventing strong, undesired signals from forcing their way through the tone filter, and actuating the relay circuits.

The 6BH6 tube, V1, amplifies the incoming audio signals but, because of the high Q tuned circuit L1, C2, C3 in its plate circuit, only a tone at the resonant frequency of the tuned circuit appears with any appreciable amplitude in the

(Continued on page 30)

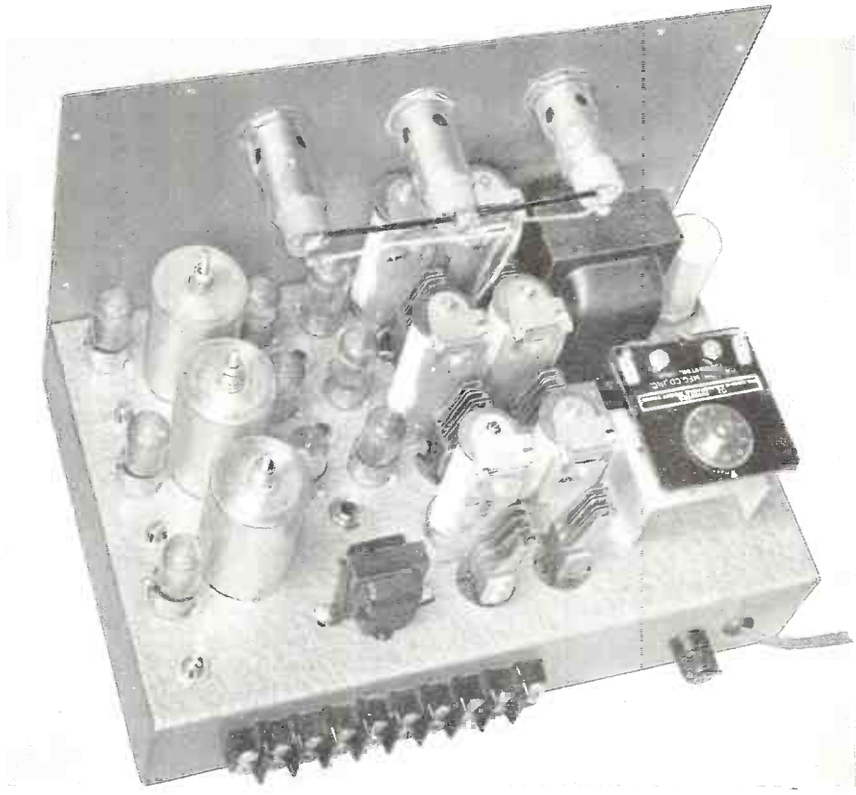


FIG. 3. IN THIS REAR VIEW OF THE CHASSIS, THE TIMING DEVICE IS ON THE RIGHT CORNER

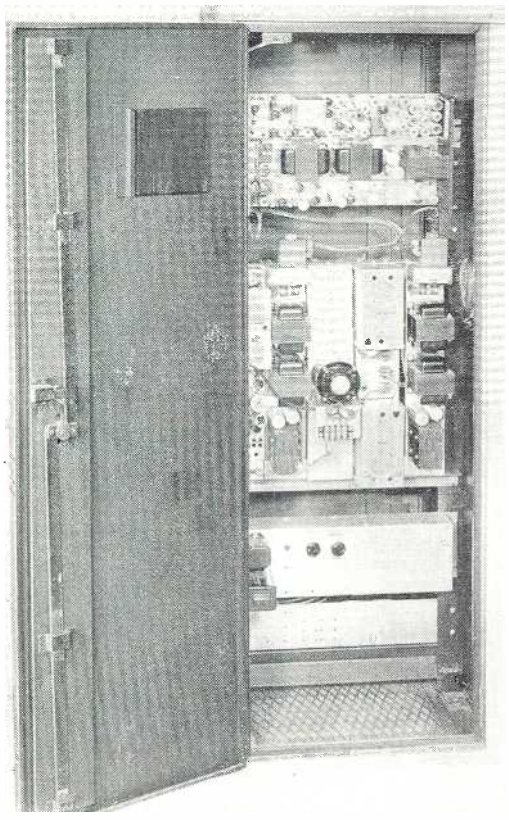


FIG. 1. HOUSING DESIGNED FOR POLE MOUNTING

EQUIPMENT FOR 450 MC.

CONGESTION ON LOWER BANDS CAN BE RELIEVED BY USE OF 450 TO 460 MC. — *By* LLOYD P. MORRIS*

ONLY a short time ago, 40 mc. was considered to be about the top limit of frequencies useful for the communition services. When the 118-mc. Motorola installation was put in service at Miami[1], the opinion was widely held that operation at such a high frequency would not prove successful. As for 152 to 162 mc., that band was considered out of the question for any practical use and its assignment to the mobile services was not regarded with any enthusiasm.

Even when propagation research and field tests showed conclusively that the 152 to 162-mc. band was entirely suitable for communication services, operators were reluctant to invest in equipment for new frequencies with which they had no experience.

Accordingly, the first 152-mc. units were built with 30-mc. transmitters and receivers to which converters were added. The cost of the equipment was somewhat higher than that of transmitters and receivers for the lower frequencies, but the performance was so good as to confirm the most optimistic expectations.

In this way, manufacturers were able to supply the initial, limited demand until the communication engineers had gained complete knowledge of the 152 to 162-mc. band. Then, as more and more systems moved into this band, the demand for equipment made quantity production possible, and justified the development of units designed specifically for 152 to 162 mc.

*Chief Engineer, Systems Engineering Department, Communications & Electronics Division, Motorola, Inc., 4545 Augusta Boulevard, Chicago 51, Ill.

[1]See "Miami Police Have First 118-Mc. System" by Lieut. Ben Demby, *FM-TV* MAGAZINE, May, 1945.

First Units for 450-460 Mc.:

Today, history is being repeated in the 450 to 460-mc. channels. The usefulness of this band for communication purposes has been established, and its characteristics have been determined to the point where predicted performance has been confirmed by installations now in service.

Following previous practice, converters are being used with standard 152-mc. transmitters and receivers. To system operators, this represents a hedge against any new Rules that may be imposed by the FCC. While specific assignments have been made for 450 to 460 mc., past experience indicates caution in the early use of a new band. The Commission is currently given to adopting new Rules without considering all the economic problems created thereby. Thus, if 152-mc. basic units are used with converters, the most serious consequence of changes imposed by the FCC would be that the converters might be made obsolete.

This approach to the initial, shakedown period has other advantages. Before out-and-out 450-mc. designs are finalized, the manufacturers want an opportunity to gain further long-time operational experience. Also, it is expected that more efficient output tubes, giving longer life, will be developed. Improved

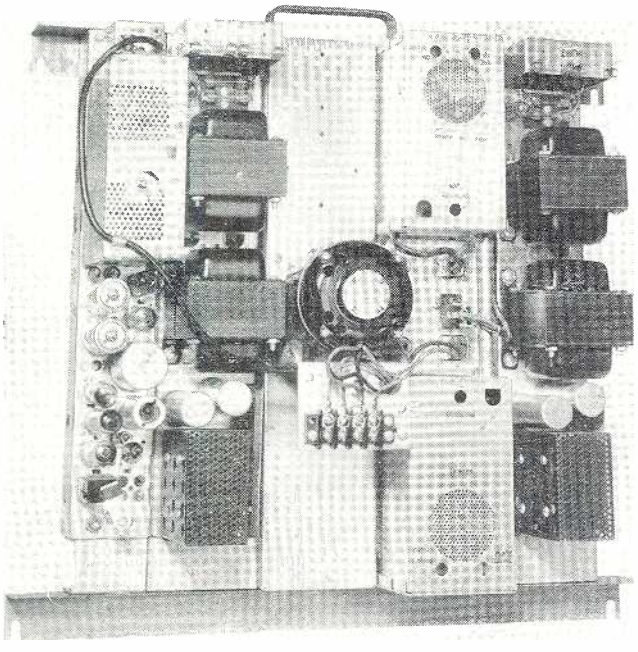


FIG. 2. A COMPLETE 150-MC. TRANSMITTER AND 450-MC. CONVERTER

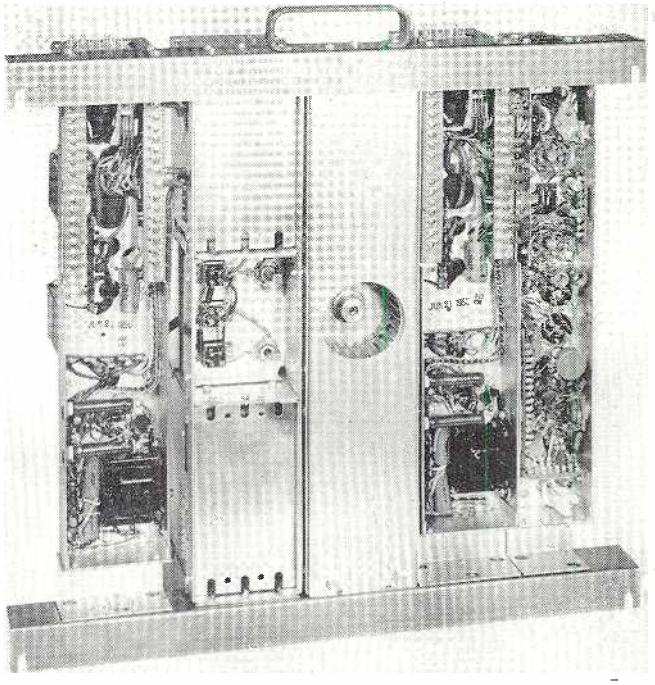
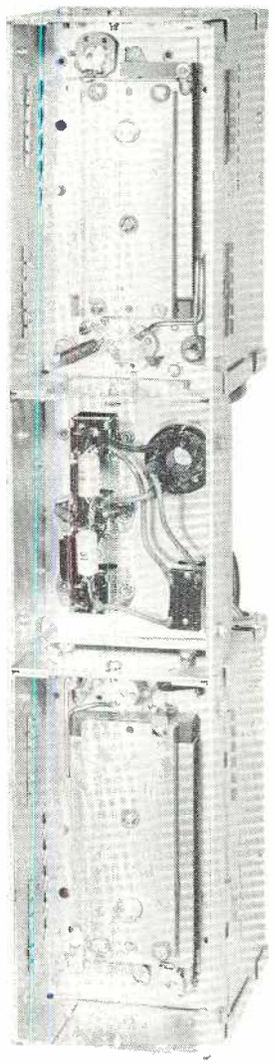


FIG. 3. REAR VIEW OF THE ASSEMBLY. CENTER CHASSIS CARRIES A BLOWER



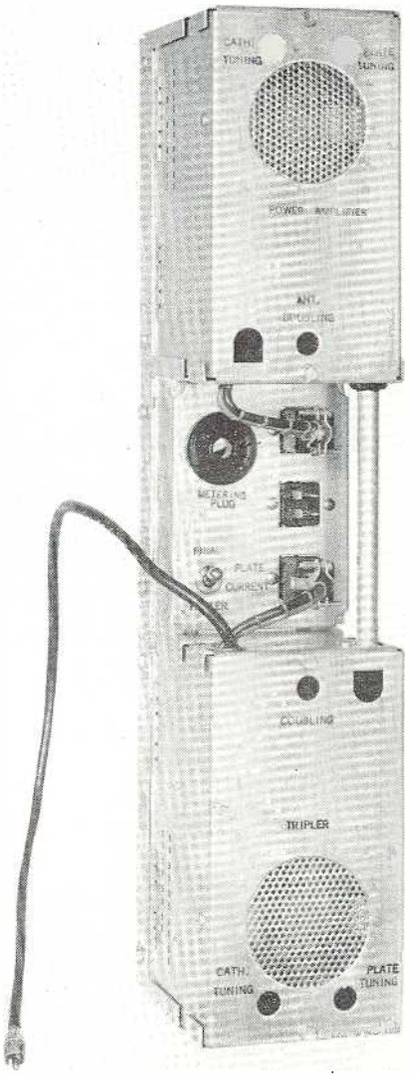


FIG. 4. BOTTOM OF CONVERTER CHASSIS SHOWS TUNING ELEMENTS FIG. 5. TOP OF THE CONVERTER

efficiency will reduce the cost and simplify the overall design.

Initial 450-Mc. Installations:

The first Motorola installations on 450 mc. have been for point-to-point, relay, and control use. Fig. 1 shows equipment intended for pole-mounting, an arrangement which minimizes transmission-line losses and the cost of equipment housing, since the weather-proof cabinet can be set up immediately adjacent to the antenna support.

This particular assembly is intended for repeater service, receiving and transmitting on 450 to 460 mc. The three horizontal sections across the top are the 152-mc. receiver, power supply, and the narrow 450-mc. converter section. The vertical transmitter sections are, from left to right, a 152-mc. transmitter strip, power supply, blower unit, 450-mc. output section, and its power supply. All the units are of standard designs except for the converters and the blower. The latter is only necessary in cases where high ambient temperatures are encountered. A squelch-operated relay turns the transmitter on and off.

Other combinations of standard equipment can be used, in accordance with system requirements. For example, only the standard transmitter and converter output section with its power supply are needed for a central station installation. One of the most common uses of 450 mc. is as a link to a remote low-frequency repeater, to provide extra coverage in areas of low signal intensity. Then a standard receiver is combined with a standard transmitter and converter output section for the 450-mc. link. These and other arrangements are made possible by the use of converters.

Transmitter Converter:

Figs. 2 and 3 show front and rear views of the transmitter section which can be seen in Fig. 1. Extensions are used on the 152-mc. transmitter and the power supplies so that all five chassis can be made up as a single 19-in. rack assembly for mounting in the cabinet. This includes a tripler stage and an output stage delivering 6 to 8 watts.

There are bottom and top views of the 450-mc. tripler-output section in Figs. 4 and 5. In Fig. 6, the shields have been removed to show the final tripler and out-put tubes in place, while in Fig. 7 they have been removed so that the mountings can be seen.

Both tubes are 2C43 lighthouse types, so mounted that they are actually inserted through tank circuits which are flat, low-impedance lines. The tank circuits can be seen in the bottom view, Fig. 4. They are complete within themselves, so that the chassis is not used for the return side of the oscillating circuit. The high-current, low-voltage portions of the tanks toward the center section are coupled to the co-axial output lines through heavy wire loops in series with variable capacitors to ground, visible in Fig. 4. The condenser in the tripler stage is used to balance out reactance that may be presented by the amplifier.

At the outer ends are conventional air tuning condensers and, adjacent to them, thermo tuning vanes in the form of flat, bi-metallic strips. These compensate for changes in tube capacity with operating and ambient temperatures. They operate against a screw adjustment which determines the amount of compensation introduced.

Alignment and service on the tripler-amplifier is very simple, following conventional techniques for the lower frequencies. Individual circuits can be checked by plugging a meter into the socket in the center section.

Figs. 6 and 7 show holes in the side of the chassis directly below the tube sockets. These match with openings on the blower chassis when the units are mounted side by side, as in Fig. 3.

Receiver Converter:

The receiver converter, Fig. 8, converts the incoming 450-460 mc. signal to an equivalent modulated signal in the 152-162-mc. band. This new signal can be referred to as the 1st IF frequency. It is fed to a standard 152 to 162 mc. receiver which, in turn, makes two additional conversions to reduce the frequency of the signal to a value where the major IF amplification and the desired selectivity can be introduced.

The receiver converter is made up of four different functional units as follows:

1. RF amplification
2. Local signal generation
3. Mixing
4. 1st IF amplification

The RF amplification at 450 mc. is obtained with a one-stage grounded-grid amplifier, using a line cavity between

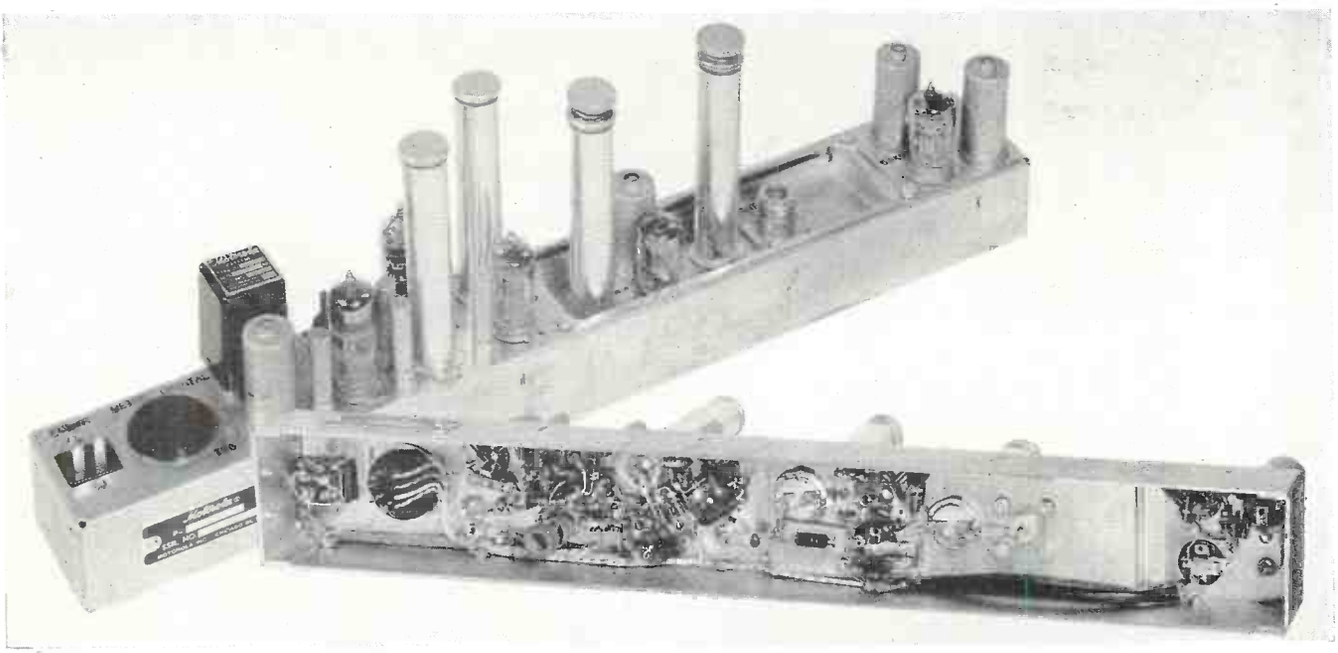


FIG. 8. THIS IS THE CONVERTER STRIP USED AHEAD OF A STANDARD 150-MC. RECEIVER. IT INCLUDES RF STAGE, OSCILLATOR, MIXER, AND FIRST IF

the antenna and the amplifier input. The local signal is generated by a temperature-controlled crystal oscillator and a 24-times multiplier chain having an output frequency in the range of 300 mc. This local 300-mc. signal is then mixed with the incoming, amplified 450-mc. signal in a crystal type mixer to give the 1st IF frequency of 150 mc. One stage of 150-mc. amplification is provided in the converter unit.

The overall performance of the converter is improved through the use of a total of four line cavities. These can be seen in Fig. 8. When the converter is used with a 150-mc. Motorola receiver, an overall sensitivity of 1.5 microvolts is obtained. The converter has an input and output RF impedance of 50 ohms, which simplifies the interconnecting problem. The overall selectivity characteristic is primarily determined by the characteristic of the associated 150-mc. receiver. In the Sensicon receiver, the desired selectivity can be obtained by replacing the Permakay filter with a filter having a wider band width to accommodate the inherently wider drift tolerances of 450-mc, transmitters.

Interest in the 450- to 460-mc. band is increasingly apparent as the lower bands become more and more crowded. The equipment described here was developed in response to this interest. Transmitter and receiver converters for standard 150-mc. equipment have proved to be both practical and economical for the users who wish to pioneer this new and promising band of frequencies.

One of the most-needed contributions to operation in this band is output tubes of longer life and lower cost, for both fixed and mobile use. This will come along as fast as the demand justifies the development work and preparations for production. Also, improvements in mobile antennas can be expected.

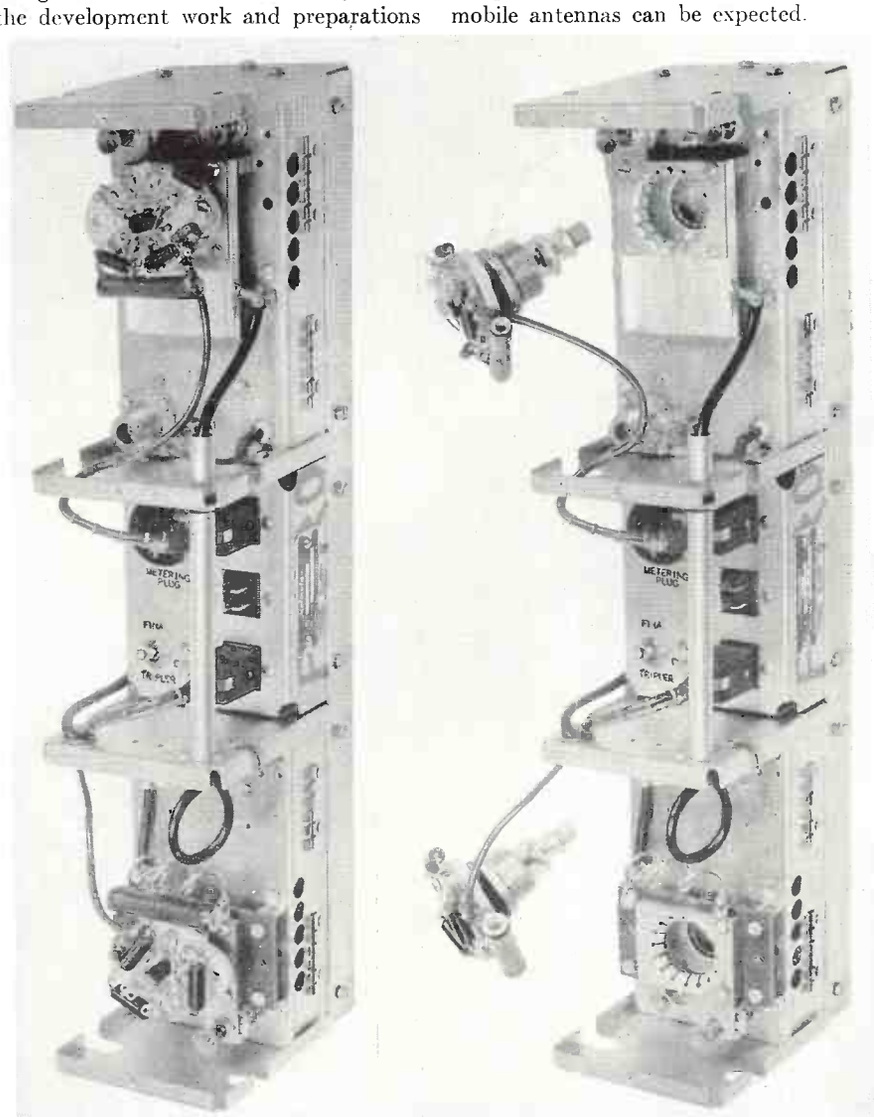
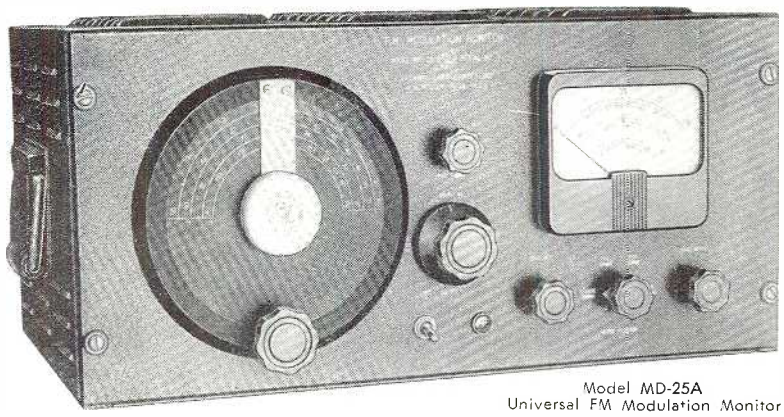


FIG. 6. THE TUBES ARE MOUNTED UPSIDE DOWN FIG. 7. TUBES REMOVED TO SHOW THE SOCKETS

Model S4, S5, S7
Frequency Meters



Model MD-25A
Universal FM Modulation Monitor

Increased Range and Reduced Interference for Mobile Radio Systems

Three Frequency Meters

Browning model S-4 is calibrated at any one to five points between 1.5 and 70 mc. Model S-7 is calibrated at any one or two points between 72 to 76 and/or 152 to 162 mc. Model S-5 is calibrated at any one to three points between 30 and 500 mc. Hand-calibrated crystal control meets all FCC requirements.

Modulation Monitor

It is not necessary to buy separate monitors and crystals for each operating frequency. A single Browning Universal Modulation Monitor covers all mobile frequencies between 30 and 50 mc., 72 to 76 mc., and 152 to 162 mc. Simple to operate, direct reading, low in cost. One instrument takes care of all your present requirements, meets all your future needs.

Your investment in these instruments will return big dividends in increased transmitting range and reduced adjacent-channel interference.

Off-frequency operation of mobile transmitters is like running automobiles with defective spark plugs. Both show up in loss of power. The simple way to keep your car transmitters at peak efficiency is to check each one regularly with a BROWNING Frequency Meter. This easy, inexpensive routine overcomes trouble from dead spots and bad weather by increasing power output.

Adjacent-channel interference can be overcome by checking your transmitters with a BROWNING Modulation Monitor. Remember, when you experience interference from other systems, it's not always the fault of the other fellow. It may be caused by over-modulation in your own transmitters. First, be sure your own are adjusted correctly.

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.....mc.....mc.....mc.....mc

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FTB ALERT ALARM

(Continued from page 25)

output. When a tone of the proper amplitude and frequency is applied to V1, a large AC voltage is developed across the tuned plate circuit, and applied to one-half of duo-diode V2 through blocking capacitor C4. The AC voltage is rectified and appears across load resistor R6, polarized so as to change the grid voltage of relay tube V3 in a positive direction.

When no tone signals are being received, relay tubes V1, V5 and V9 are biased nearly to cut-off, so that not more than .5 milliampere of plate or cathode current is flowing, and the associated relays are not energized. Bias of approximately −25 volts is obtained from a separate selenium bias rectifier CR3, operating from the main high-voltage winding of power transformer T2.

The second half of duo-diode V2 may or may not be used, depending upon the tone frequencies chosen for the system and upon what other intelligence is also transmitted over the same circuit with the alarm signals.

When the correct tone is applied through one of the relay channels, the rectified tone is applied as positive bias to the relay tube through a time-delay circuit shown in channel 1 as R7, C6. The purpose of this RC combination and the diode (second half of V2) connected across the resistor is to prevent any type of modulation except a steady tone on the correct frequency causing relay operation. As random speech or other audio inputs are impressed on the tone-relay channel, certain audio components are likely to occur on the selected tone frequency. If the relay circuit were fast acting, a transient of this nature might cause a false operation. With a delay of approximately 1 second in the time-delay circuit, most possibilities of erroneous operation are eliminated.

The diode across R7 completes the action by providing a low impedance discharge path for C6. Thus if a series of undesired audio components get through the filter and tend to charge up C6, the capacitor is prevented from adding up these charges, and is discharged quickly between every pulse. This diode is important only in certain cases where heavy voice traffic is carried over the same audio circuit.

When relay K1 is energized by its corresponding tone signal, it completes the coil circuit, momentarily, of relay K4 which is locked in by a pair of its own contacts, through back contacts on relays K2 and K3 of the other tone-relay channels, as well as the contacts on the interval timer K7.

Fail-Safe Circuit:

The internal timer, by means of which fail-safe operation is obtained, is a synchronous motor-driven device which, through a clock-type gear train, drives a cam to open the K4, K5, K6 relay holding circuits after a lapse of about 4½ minutes. The cam-operated contacts on K7 are normally closed when the 110-volt, 60-cycle motor is de-energized. Voltage is applied to the motor, however, at all times unless one of the tone-operated relays K1, K2 or K3 is actuated. When power is applied to the timer for

(Continued on page 32)

PARTS LIST FOR THE FTB ALARM INDICATOR

CAPACITORS

C1, C7, C13	Ceramic button type. .01 mfd.
C2*, C8*	Mica, .0025 mfd. plus or minus 20%
C3*, C9*, C14	Mica, .0051 mfd. plus or minus 20%
C4, C10, C15	Mica, .01 mfd. plus or minus 20%
C5, C6, C11, C12, C16, C17, C18	Molded paper, .25 mfd., 400 v.
C19, C20	Dual electrolytic, 10 mfd. each section
C21, C22	Tubular electrolytic, 8 mfd., 150 v.
C23	Mica, .0015 mfd.

* Note: For supersonic operation, substitute one .001-mfd. mica for C2 and C3; substitute one .00075-mfd. mica for C8 and C9.

RESISTORS

R1, R8, R15	Potentiometer, .5 megohm
R2, R4, R5, R9, R11, R12	
R16, R18, R19	1 megohm, ½ watt
R3, R10, R17	1,000 ohms, ½ watt
R6, R13, R20	.47 megohm, ½ watt
R7, R14, R21	2 megohms, ½ watt
R22	.1 megohm, ½ watt
R23	470 ohms, 1 watt
R24	56,000 ohms, 1 watt
R25, R26	68,000 ohms, 1 watt

TRANSFORMERS

T1	Audio input, plate-to-grid 5,000 to 250,000 ohms
T2	Power, 200-0-200 volts at 45 milliamperes; 6.3 volts and 6.3 volts at 1.8 amperes

TUBES

V1, V4, V7	Type 6BH6
V2, V5, V8	Type 6AL5
V3, V6, V9	Type 6C4

FILTERS

L1, L2, L3 for audio operation	Freed Transformer Corp., type 18830
L1, L2, L3 for supersonic operation	Freed Transformer Corp., type 16763
L4	Choke, 5 henries, 50 milliamperes

RELAYS

K1	C. P. Clare, type C frame, 3,300 ohms, 1A, 3B contacts
K2, K3	C. P. Clare, type C frame, 3,300 ohms, 1A, 1B, 1C contacts
K4, K5, K6	C. P. Clare, type C frame, 3,300 ohms, 3A contacts

PILOT LIGHT ASSEMBLIES

I1	E. F. Johnson, type 147-404
I2, I3, I4	E. F. Johnson, type 147-1002, clear, yellow, red

MISCELLANEOUS COMPONENTS

S1	Switch, SPST
F1	Fuse, 1 ampere
E1	Pilot lamp, 6.3 volts
E2, E3, E4	Pilot lamps, 230 volts, type C-7 candelabra base
J1, J2, J3	Phone jacks, closed circuit
CR1, CR2, CR3, CR4, CR5	Selenium rectifiers, 75 milliamperes

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In time of emergency, only Policalarm & Monitoradio can tune to any FM communications band!

This means that existing fire, police, taxi cab and other 2-way Radio Communications Systems can become, with advance planning, vital centers for the dissemination of messages to your civil defense personnel . . . Only Radio Apparatus Corporation makes available to you, at such low cost, rugged and dependable communications equipment of the type that tunes instantly to each and every emergency channel used by these presently established 2-way radio systems that are so important in your defense planning today . . . and Policalarm and Monitoradio are already proved through use by hundreds of municipalities throughout the country from Boston, Mass., to Alhambra, Calif. . . . To keep your official and volunteer civil defense personnel alert and informed, both at home and in cars, rely on Policalarm and Monitoradio—readily adaptable to most alarm signalling systems!

MONITORADIO

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A 6-VOLT MOBILE

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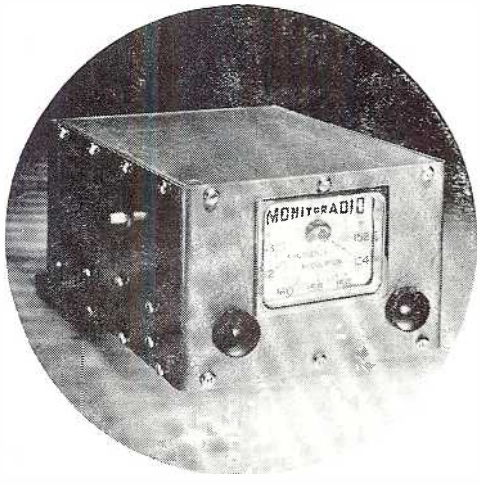
30-50 MC

Model M-101
152-163 MC



POLICALARM

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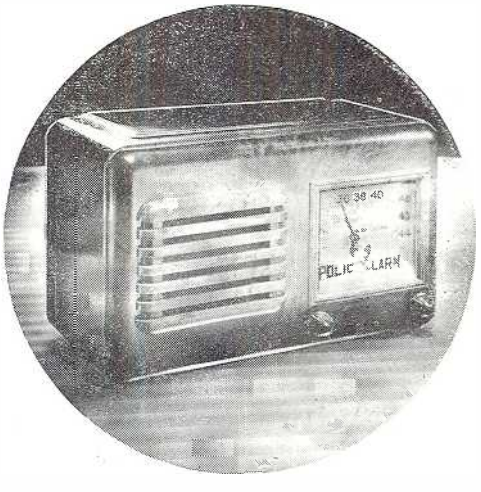
115 Volts AC-DC

Model PR-31
30-50 MC

Model PR-8
152-163 MC



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FTB ALERT ALARM

(Continued from page 30)

4½ minutes the cam progresses far enough to open the timer contacts. This opens the coil circuits of holding relays K4, K5, or K6, causing any lamp that may be illuminated to go out.

If, however, a tone relay is energized before the 4½-minute interval is up, power is removed from the timer motor and the cam and gear train are reset by spring action and made ready to start a new timing interval. Thus, as long as a tone is received before the 4½-minute interval is up, the particular lamp circuit in service will not go out. Additional interlocking contacts on the tone-operated relays K1, K2, and K3 are provided so that if a different tone channel is energized at any time, the lamp or alarm circuit being energized will immediately be changed without waiting for the end of the timing interval. In the model shown, separate contacts on the holding relays K4, K5, and K6 are brought out to the terminal strip for the actuation of external signals or warning devices such as bells, horns, or sirens.

An analysis of the circuit will show that practically any possible type of circuit failure, including power failure, tube deterioration or burn-out, lack of signal, failure in the power supply, capacitor short, relay failure, and lamp burnout, will cause the normal lamp signal to be extinguished, indicating a failure of the system and calling for a check on its operation. It is recommended that a routine check be made of the overall system at least once a day, by sending out white, yellow, and red test signals at a specific hour, to prove that every part is operating normally.

Components:

The parts values shown for the circuit in the parts list are not critical. In some cases typical sources of supply are indicated in the parts list, but it is obvious that substitutions can be made. The relays shown are standard telephone types, but other relays of comparable sensitivity can be used. The 6C4 relay tubes will supply well over 10 milliamperes of current to actuate the tone relays.

Selenium rectifiers are indicated in the power supply because they have proven very reliable and long lived, but conventional rectifier tubes are equally suited to this purpose. Any power supply combination can be used that will supply 200 to 250 volts B+ and about 25 volts bias. Standard 220-volt lamps are specified for the indicator lamp circuits because experience has shown that they give ample illumination and very long

(Continued on page 34)

FTB ALERT ALARM

(Continued from page 32)

life when operated on 110 volts. Alternately, 110-volt lamps with series resistors or even 6-volt lamps operating from the filament supply could be used. The resonant circuits used as tone filters require inductances of reasonably high Q (about 20) to insure sufficient selectivity. Those used in the original design are special coils in adjustable, powdered-iron pots, but coils of roughly comparable inductance and Q will serve.

The rear view, Fig. 3, shows the recommended arrangement of the components. At the extreme left are the three input gain controls, R1, R8, and R15 adjacent to the three tone-amplifier tubes V1, V4, and V7. To the right are the tone-filter inductances L1, L2, and L3 followed by the rectifier tubes V2, V5, and V8, and the relay tubes V3, V6, V9. Next are the tone-operated relays K1, K2, and K3, with the three holding relays K4, K5, and K6 in the second bank. The interval timer, a standard commercial product, is at the right hand side of the chassis, viewed from the rear. The bottom view gives details of the sub-chassis parts arrangement and the wiring.

Adjustment and Service:

Adjustment of the Alarm Indicator can be best accomplished by the following steps:

1. Turn all gain controls completely off.

2. Plug a milliameter (0 to 25 milliampere range) into J1, associated with the White tone channel. The current should not exceed .5 milliampere, and the relay K, should be de-energized.

3. With the White tone signal (2,600 cycles) being transmitted or furnished from a modulated signal generator, advance gain control R1 slowly until a current of about 2 milliamperes is indicated by the meter.

4. Readjust tone filter L1 for maximum relay current.

5. Advance R1 slowly until relay K1 pulls in, noting the current value at which it is activated. Then continue to advance R1 until the relay current is about twice the pull-in value, to insure positive operation.

6. Change transmitted tone signal to the Yellow signal (2,800 cycles) and repeate steps 2 to 5 for the second channel.

7. Change the transmitted tone signal to the Red signal (3,000 cycles) and repeat steps 2 to 5 for the third channel.

Thus it will be seen that all initial adjustments and service checks can be

(Concluded on page 36)

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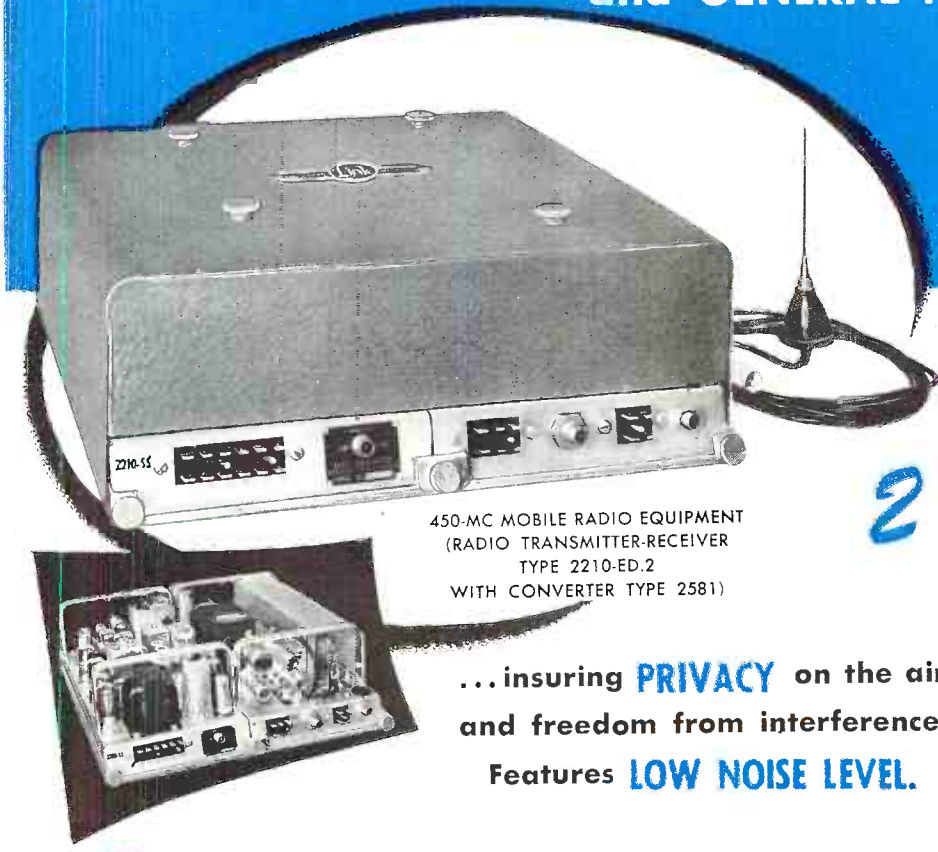
Link



450-MC MOBILE RADIO EQUIPMENT
(RADIO TRANSMITTER-RECEIVER
TYPE 2210-ED.2
WITH CONVERTER TYPE 2581)

450 megacycle 2 WAY-RADIO

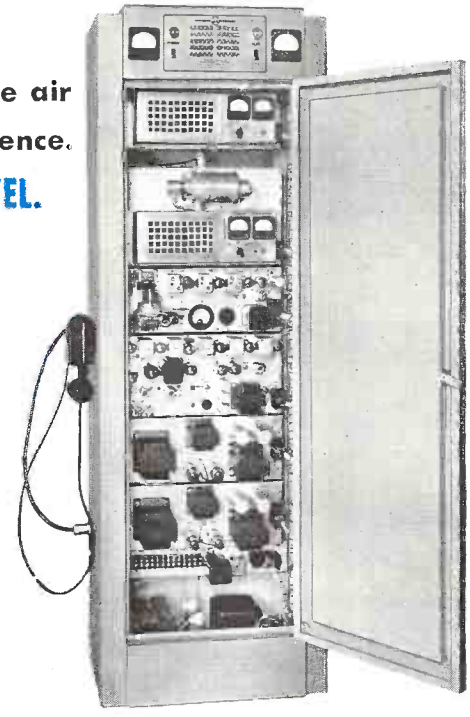
...insuring PRIVACY on the air and freedom from interference. Features LOW NOISE LEVEL.

EXCEPTIONAL PERFORMANCE has been obtained with the *new* LINK 450 megacycle land-mobile radio equipment, rating it as definitely *superior* to equipment operating in the 152-174 mc. band in urban areas such as New York City. The low man-made noise level on the 450 megacycle band is especially noticeable and contributes appreciably to the excellent performance in metropolitan areas.

LINK RADIO'S years of experience in building equipment in this frequency range are now applied to developing and producing the first commercial mobile equipment on the new band for use by the general mobile service.

Encouraged by the F.C.C.'s whole-hearted approval for the manufacture of 450 megacycle equipment, LINK RADIO is now in full production on two-way land-mobile radio systems operating in the 450-460 mc. band allocated by the F.C.C. to the Land Transportation, Public Safety, Remote Pick-up Broadcasting, Industrial and Domestic Public services.

For full particulars, please write to Dept. F, Link Radio Corporation.



100-WATT 450-MC
MAIN STATION
TYPE 2340-TR (100 W)

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SALES OFFICES IN THE PRINCIPAL CITIES OF THE UNITED STATES

FTB ALERT ALARM

(Continued from page 34)

made easily, quickly, and with equipment at hand in every service shop.

Use of Supersonic Signals:

The foregoing description was given in detail for alarm units actuated by audio frequencies because it is logical to expect that systems of this sort will be operated from communication transmitters for the most part. Such transmitters and the associated receivers are designed to cut off sharply above 3,000 cycles, thus establishing the upper operating frequency. Voice frequencies, which will be picked up by alarm receivers, are of minimum amplitude at the upper limit. Hence the selection of 2,600, 2,800, and 3,000 cycles for the alarm signals.

However, supersonic operating signals can be used from FM broadcast stations. Very successful tests have been conducted with 16, 18, and 20 kc. There is nothing new involved in supersonic operation, since the principles involved are the same as are now employed in storecasting and musicasting to cut out speakers and change the volume level.

The only modification required in the alarm indicator circuits is a change in the tuning filters, and in the associated capacitors, as indicated in the parts list. The filters are available from the same source, and in the same mechanical form.

EDITOR'S NOTE: *Part 3 will describe the three-frequency control units for connection with any communication or FM broadcast transmitter, and Part 4 will be devoted to the design of a simple, fixed-frequency receiver.*

MOBILE RADIO NEWS

(Continued from page 22)

manual will help the applicant determine whether his radio tower requires aeronautical study. The manual is available from the FCC, Washington 25, D. C. Ask for Mimeograph 57498 "Supplemental Data for Use in Connection with Part 17—Radio Towers."

To assist the user, the manual contains three tables showing how close an antenna can be located to an airport and still be exempt from aeronautical study. However, these tables apply only to a Department of Defense Airbase, which is the most restrictive type of airport. For other airports the antenna can be located closer in, but these cases must be worked out by the applicant from the general criteria in the Rules. To show how these tables are used three illustrative examples are worked out in detail.

In order to apply the criteria, the applicant will have to refer to one or more of the following publications:

1. Sectional aeronautical charts
2. Local aeronautical charts
3. Instrument Approach and Landing Charts
4. Radio Facility Charts
5. Flight Information Manual
6. Airman's Guide (a Bimonthly publication)

The charts can be purchased from the U. S. Coast and Goedetic Survey, Washington 25, D. C. The Flight Manual and the Airman's Guide may be purchased from the Government Printing Office.

Proposed Rule Changes:

The Commission has issued a proposed amendment to Section 13.61 of its Rules Governing Commercial Radio Operators, to make the 50-watt power limitation prescribed by the Atlantic City Radio Regulations applicable to ship and aircraft radiotelephone stations in the case of the Restricted Radiotelephone Operator Permit and the Aircraft Radiotelephone Operator Authorization. The limitation would not be applicable to outstanding licenses but would apply to all new ones issued May 1, 1951 and thereafter.

(Concluded on page 38)

BULLS-EYE !

You hit the bulls-eye when you call upon Sprague application engineers to help you with critical capacitor problems.

Skilled in applying the essentials of capacitor design to save space and cost in complex military and civilian electronic equipment, Sprague engineers are ready to serve you.

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SPRAGUE ELECTRIC COMPANY

NORTH ADAMS, MASSACHUSETTS

PIONEERS IN ELECTRIC AND ELECTRONIC DEVELOPMENT

MOBILE RADIO NEWS

(Continued from page 36)

The Commission has postponed the effective date of Part 18 of its Rules and Regulations Governing the Industrial, Scientific and Medical Service, insofar as they apply to welding equipment using radio frequency energy, from Jan. 31, 1951 until July 31, 1951.

The Commission has also issued a far-reaching proposal to authorize mobile relay stations in the industrial and land transportation radio services on frequencies above 47 mc. The low-power industrial, taxicab, and automobile emergency services are excluded from the proposal, which will be analyzed in detail in next month's issue. The FCC deadline for comments is March 21 and for reply comments April 2.

NAB CONFERENCE

The fifth annual engineering conference of the National Association of Broadcasters will be held at Hotel Stevens, Chicago, from April 15 to 18. Registration starts on Sunday; technical sessions and the exhibits of equipment open on Monday, and run until Thursday.

Following is the list of papers, to which some additions are expected:

Unattended broadcast transmitters in Canada: George Chandler.

Five-kilowatt UHF transmitter using klystrom tubes: Howard M. Crosby.

Transmitter maintenance in an emergency period: RCA Services Company.

Maximum-economy television broadcasting: Carl Lee and Trevor H. Clark.

Trends in audio equipment: W. Earl Stewart.

Single system motion picture photography for film recording: John Battison.

Television and television network: Dr. M. E. Streiby.

A new high-gain UHF television antenna: Lloyd O. Krause.

Engineers and management: Richard P. Doherty.

Video switching for television stations: John Brush.

Groundwave field strength variations with temperature: Stuart L. Bailey.

Results of the RCA-NAB ultra high frequency project in the Bridgeport area: Raymond Guy.

Flying spot scanner signal-to-noise ratio: A. J. Baracket.

New equipment for AM stations: Jack Young.

Further information concerning the conference can be obtained from Neal McNaughton, director of the NAB engineering department.

We weren't exaggerating when we warned of a serious

SHORTAGE OF OPERATORS

These facts show why it may be later than you think

TWO months ago, we warned that a serious shortage of licensed radio operators would develop in 1951. We said that this situation would develop rapidly for two reasons: 1) because of the increasing number of large communication systems to be installed this year, and 2) because the Armed Services will call up so many operators.

More New Systems and Bigger Ones:

Let's see what has happened during those two months in the field of railroad radio alone.

The Northern Pacific has placed orders for a new system to cover 410 miles of track from Dilworth, Minn., to Glendive, Mont. There will be 10 wayside stations and mobile installations on 14 engines and 33 cabooses.

Texas Pacific is putting radio in 21 diesel locomotives and 25 cabooses. The St. Louis-San Francisco is installing a new freight yard system.

The Chicago, Milwaukee, St. Paul and Pacific has ordered equipment for 50 cabooses and 3 wayside stations. Additional units will be installed by the Chicago, Burlington & Quincy, while the Atlantic Coast Line will complete their 7th yard system.

Now the Missouri-Pacific has announced that it will put radio on 212 more locomotives and 102 cabooses, and install additional wayside stations, at a total cost of nearly $1½ million.

Big as these systems are, they represent only a small fraction of the new installations to be made this year. And remember — not a single station can go on the air until licensed operators have been employed to supervise them!

Civil Defense Will Require Many Operators:

But now construction has only started to drain off the supply of available licensed operators. In Washington, D. C., the first Civil Defense radio system has been authorized at last. It will comprise 5 main transmitters and many mobile, pack, and hand-carried units.

From this start, Civil Defense installations will spread out rapidly all over the United States.

Trouble for Broadcasters:

The FCC reports 4,510 AM, FM, and TV stations now authorized. They are beginning to feel the pinch. One station reported that four of their licensed operators received notice on the same day to report for military duty!

In the light of these facts, our warning that there will be a serious shortage of licensed radio operators in 1951 appears to be an understatement. The shortage is going to become so serious that system supervisors who do not anticipate this situation may be confronted with the necessity of closing down their transmitters.

You Must Plan Now:

Right now, you may not feel that you need worry about losing even one operator. Or perhaps you know where you can get a replacement, if necessary. And you may be right.

But at Cleveland Institute of Radio Electronics, where we are training more operators than any other similar school, we have letters, telegrams, and phone calls every day from supervisors who tell us their operators are leaving, sometimes without notice. They just can't believe us when we tell them that, today, most of our students have positions waiting for them as soon as they pass the FCC exams.

That is why we make this recommendation to company executives and public officials.

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.

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. 5
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 .....

.....

Note: This CIRE Course is approved for Veteran Training under GI Bill.

FM TESTS IN ENGLAND

IN some foreign countries, FM broadcasting is making more rapid progress than in the United States. The reason is found either in interference on AM, created deliberately by Russia in some areas, or the severe static conditions in other sections of the world.

The British Broadcasting Company, with the reluctance to show interest in any new project that characterizes government-operated services, has had a rather dubious attitude toward FM. Currently, however, BBC is conducting comparative tests on AM and FM in the 88- to 108-mc. band. The following report from the BBC has just been received:

BBC engineers are now conducting experiments which may revolutionize British broadcasting. During 1945, the engineering research department began a series of tests in order to get first-hand information on the possibilities of broadcasting on very high frequencies. Though comprehensive, these tests did not show conclusively whether AM or FM would be superior for this purpose, and so it was decided, as a long-term project, to carry out comparative tests at high power.

To do this, a new transmitting station was built near London, where experimental transmissions have been made for the past few months.

The station is on Wrotham Hill, one of the highest points in Kent, about 20 miles south east of London. It consists of a single-story brick building and a 470-ft. mast, the base of which is 730 ft. above sea level. The building has two wings, in one of which are the AM and FM transmitters, a control room, and auxiliary equipment, and in the other a quality-checking room, offices, and canteen.

The FM transmitter, manufactured by Marconi's Wireless Telegraph Company, has a power of 25 kw., and operates on a mean carrier frequency of 91.4 mc. with a maximum deviation of ±75 kc. It incorporates the Marconi FMQ system of frequency modulation, in which a quartz crystal oscillator is connected through a quarter-wave network to a balanced modulator, the susceptance of which varies with the modulating signal and, in turn, varies the frequency generated by the crystal oscillator. The chief advantage claimed for this system of frequency modulation is that the circuits are much simpler than those of other systems and are, therefore, more reliable and easier to maintain.

The output of the crystal oscillator is passed through three doubling stages and one tripling stage to produce the carrier at 91.4 mc. There follow six stages of amplification. The first two are conventional push-pull stages, and the remaining four are single-ended, earthed-grid stages with coaxial-line tuning elements.

The output stage consists of two BR128 valves in parallel, giving an output of 25 kw. Supplies at 6 kv. and 3 kv. for the valve anodes are obtained from hot-cathode mercury-vapor rectifiers. The filaments of all valves are run on AC.

An AM transmitter, also manufactured by Marconi's, operates on a carrier frequency of 93.8 mc., with an unmodulated power of 18 kw.

Air-blast cooling is used throughout in both transmitters.

A concentric feeder connects the output of each transmitter to a change-over switch via a filter for minimizing harmonic radiation. By means of the changeover switch, the transmitter outputs can be connected either to the feeders leading to the aerial or to test loads. The test loads, which are identical, consist of short lengths of concentric feeder through which water is circulated. The power is dissipated in the water, which is obtained from a supply unit where its temperature is quickly raised to a predetermined value, and then kept at that

FM TESTS IN ENGLAND

(Continued from page 40)

value in order to prevent any variations in the impedance of the load.

From the change-over switch, the transmitter outputs are connected by concentric feeders of 51 ohms impedance to a combining filter which prevents power from being fed from one transmitter to the other. This filter, outside the transmitter building, consists of sections of concentric line. The FM and AM signals are carried up the mast by a single concentric feeder.

The aerial system, which is common to both transmitters, consists of 32 slots in the surface of a cylindrical section, arranged in 8 tiers, each tier having 4 slots spaced at 90° intervals around the surface. Each slot is 8 ft. high and 1 ft. wide, and is screened by backing it with a series of horizontal bars placed one above the other at 1-ft. intervals. In the center of one-half of each slot, and parallel to the edge, is a rod approximately one-half wavelength long, one end of which is connected to the surface of the cylindrical mast, and the other to the driving feeder. Each slot operates as a folded slot. This arrangement reduces the input impedance of the slot from approximately 600 to 150 ohms. All slots are fed in the same phase. Gain is about 8db.

EDUCATIONAL STATIONS

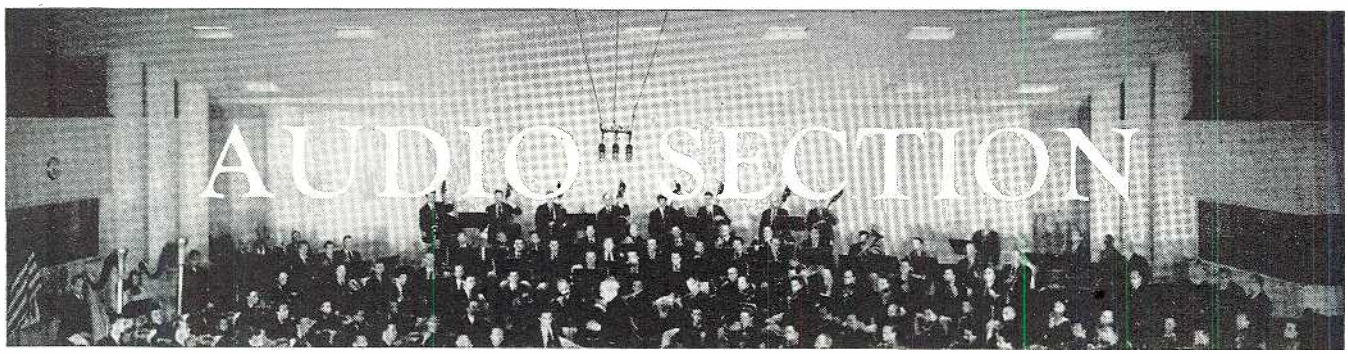
(Continued from page 16)

times, and the same continuous drive is required to keep program talent and content at a high level as at a major network.

Actually, far more skillful direction is needed for a 10-watt campus station than for the average 250-watt AM disc-jockey setup, or even at larger stations that need only to fill in spaces between network programs. Otherwise, listener interest is lost quickly, and all the fine initial plans for education and entertainment come to nothing.

Success brings its own special problems, too. When an educational station does such an outstanding job as to attract a large off-campus audience, opposition develops among the ranks of the local commercial stations. Nevertheless, many of them are expanding their services to school systems and to the public at large.

FM has helped the educational stations by enabling them to cover large areas with relatively low power. And they, in turn, have contributed substantially to building demand for FM receivers, particularly because good music accounts for a considerable part of their program content.



AUTOMATIC PROGRAM MONITOR

BBC IS USING A METHOD OF AUTOMATIC MONITORING WHICH ELIMINATES HUMAN ERRORS OF JUDGMENT AND LISTENING FATIGUE — *By* JAMES MOIR*

A BBC development that is of considerable interest not only in its present field but as a basic idea of great potential value in other related fields, is the Automatic Monitor. Initially developed for monitoring long land lines, it has already been applied to the monitoring of radio transmitters and disc recorders, though it is probably too early to suggest that all the problems presented by a recording link have been solved.

Listening Fatigue:

In Great Britain, a radio programme may be transmitted by land lines some thousand miles in length. Passing through many intermediate stations, the programme material is monitored continually by observers at many of these intermediate points. The programme is monitored and balanced, of course, at the originating point before delivery to the line network, but as the complete line involve dozens of repeater amplifiers in addition to many miles of lines and several telephone exchanges, there is ample opportunity for things to go wrong en route.

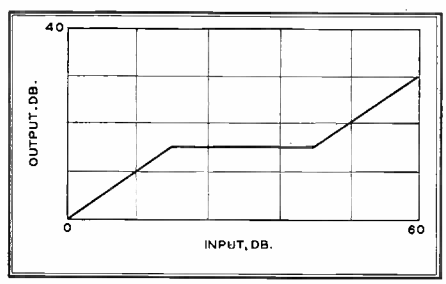


FIG. 1. THE IDEAL CHARACTERISTIC CURVE FOR A VFLA AMPLIFIER IN THIS EQUIPMENT

The intermediate monitor operators can only compare the program as they hear it with what they imagine it sounds like at the originating point. This is hardly a solid foundation for criticism, in view of the many variables that can creep in. A greater weakness of depending upon monitor operators is their susceptibility to fatigue. With no faults of a serious nature occurring for many days on end, their powers of judgment become so impaired that minor faults such as an increase in distortion or a decrease in signal-to-noise ratio can occur without their noticing the trouble. Technical personnel are expensive and in short supply in England. Thus an alternative was sought, not because an automatic

*87 Catesby Road, Rugby, England.

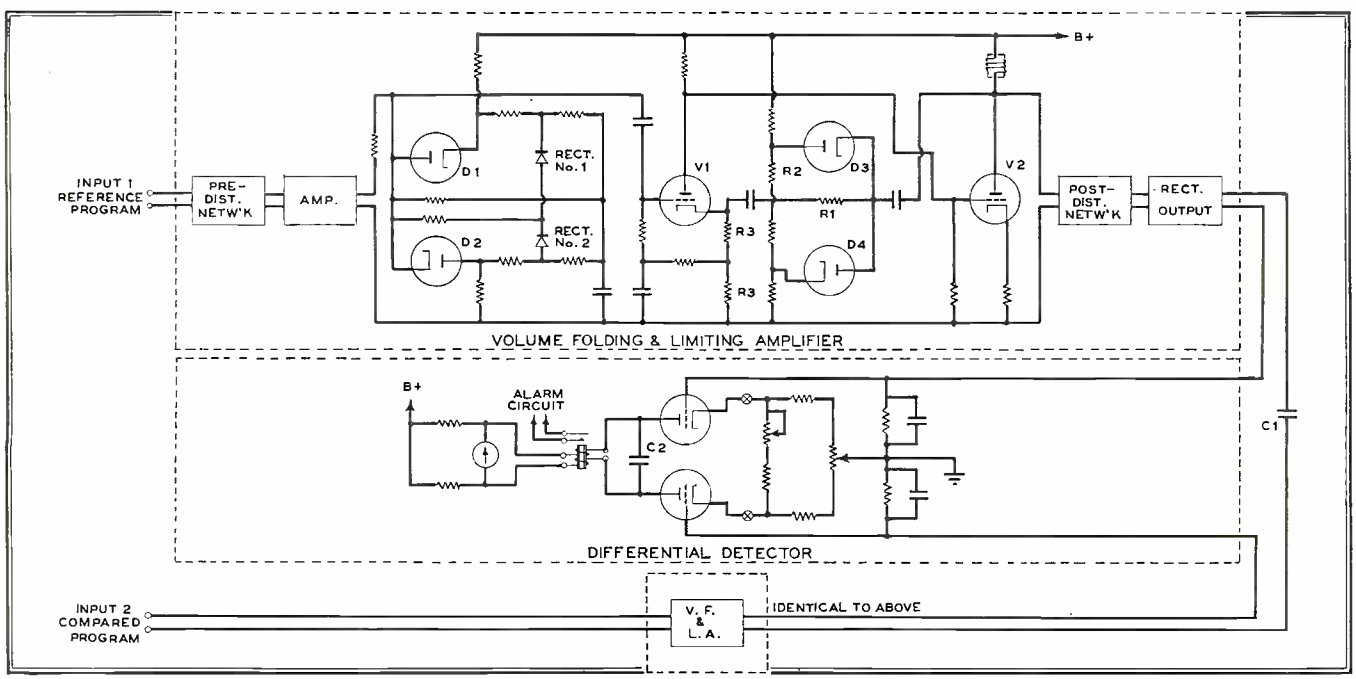


FIG. 2. BLOCK DIAGRAM OF THE AUTOMATIC MONITOR MINOR WITH TWO IDENTICAL VFLA UNITS, AS USED BY THE BRITISH BROADCASTING COMPANY

device is likely to afford performance superior to that of an alert engineer, but it may be superior to the capabilities of an engineer fatigued by several hours exposure to programme material of little interest to him.

Automatic Monitor Functions: Two forms of monitor have been developed, the Automatic Monitor Minor for use where a spare land line link is available for comparison, and the Automatic Monitor Major for use where no spare line is available and the monitor signals must be superposed on the programme circuit. The basic theory is identical, but the Minor will be considered first as the forerunner of later development.

Four fault conditions are dealt with:

1. Absence of signal, or a change in line attenuation
2. Decrease in the signal-to-noise ratio
3. Increase in distortion
4. Decrease in bandwidth

The programme material itself is used as a continuously available test signal, the output signal from the line being continuously compared with the input signal as transmitted over a second line parallel with the programme line. Such a spare line is generally available in England, being intended as a standby and for use as a communication channel between engineers during the programme.

Monitoring is achieved by an input-output comparison made in such a manner that any difference appears as signal having an amplitude approximately proportional to the amount of deterioration in performance. Appropriate alarm signals are given when the deterioration exceeds a predetermined amount, and certain other over-riding conditions are met in the monitoring circuits.

The VFLA Unit: The heart of the device is the Volume Folding and Limiting Amplifier (VFLA), a unit intended to reduce the volume range of the programme signal by removing the middle of the volume range. The only portions of the volume range that contain interesting information on system performance are the bottom end where, in the absence of signal, the ambient noise level can be checked, and the top end of the volume range where distortion components due to system overload are largely contained.

An ideal type of characteristic for the VFLA is shown in Fig. 1, comprising two linear regions at the bottom and top of the volume range. These, in total, occupy the whole output range of the amplifier. This ideal is approximated by an amplifier having the basic circuit of Fig. 2, the range-restriction portion being shown in some detail between the input circuit to V1 and the output of V2. These two valves are a straightforward resistance coupled stage with a negative feedback circuit R_1, R_3, between the output of V2 and the cathode of V1. The overall gain is controlled by the ratio $R_3/R_1 + R_3$ in the small signal region where the diodes D3 and D4 do not conduct, due to the bias derived from the potentiometer R_2, R_4, R_5, R_6.

For small signals near the noise, the gain is thus set at the maximum value required to provide adequate output signal for the amplitude comparator stage that follows. Increase in the signal input level eventually makes the diodes D3 and D4 conduct, short-circuiting R_1, increasing the negative feedback, and reducing the gain to a suitable medium level to provide the desired output required by the comparator stage. Further increase in input signal level causes the rectifiers 1 and 2 to conduct, shunting the input circuit to V1. A final step in the reduction in gain is provided by diodes D1 and D2, which operate at maximum input levels.

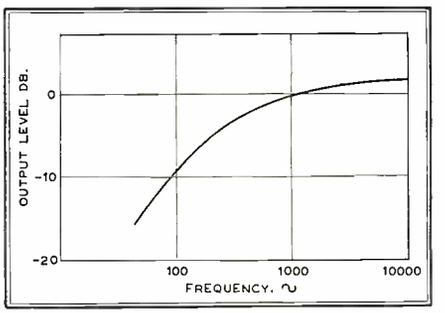


FIG. 3. PRE-DISTORTION CURVE OF THE NETWORK

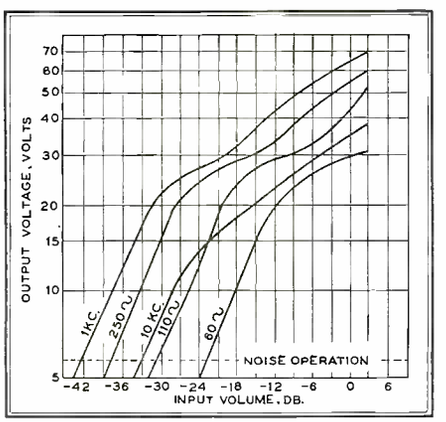


FIG. 4. INPUT-OUTPUT OF THE VFLA UNIT WITH BOTH PRE-DISTORTION AND POST-DISTORTION

Two VFLA amplifiers are used together, the respective inputs being provided by the line being monitored and the reference signal from the standby line. The outputs are connected to the differential detector circuit, set to operate an alarm when the input voltage difference exceeds 6 volts. Some pre-distortion of the input frequency characteristic is advisable if the performance at low levels is to simulate that of the human operator. Thus, a pre-distortion network is included in the input circuit of each amplifier, the transmission characteristic being shown in Fig. 3. Further distortion networks are included in the output circuit to make the sensitivity approximate to that of a human operator at normal volume level, giving the general amplitude characteristic shown in Fig. 4.

Operation of the VFLA: The circuits as discussed are in some ways too sensitive, insofar as some compression of the transmitter peaks is inevitable if economic operation is to be secured. Therefore, the monitor must not sound an alarm every time the modulation depth approaches 100%. An auxiliary circuit and relay are included to cut the monitor alarm out of circuit each time the modulation approaches or exceeds 100% but, as this would seriously reduce the value of the monitor if it operated on every peak, an integrator circuit is also included to remove the alarm suppressor if the 100% point is reached frequently.

As in many cases the comparison signal is not available over a landline network, radio receivers are sometimes employed to receive the station signal for comparison with the ingoing line signal. Static has proved to be a problem in these cases, but a reasonably satisfactory solution has been obtained by installing a second narrow-band receiver in addition to the main high-quality receiver, the narrow-band unit being tuned to a point in the band near the station being monitored, but where no programmes exist. Thus the narrow-band receiver produces a signal on static only and after rectification, this is used to suppress the alarm signal circuit when a static pulse appears. An integrator is also fitted to this unit to render it inoperative if static occurs too frequently, thus drawing the operator's attention to the unsatisfactory reception conditions.

Where identical line networks are available for working and reference signals, the phase delay in the lines is of no consequence, but in most cases this identity cannot be secured, and the transmission times of the two lines differ. In this case, two satisfactory lines may provide outputs differing only in the time of arrival of the working and reference signals. During the build-up period, the output signals may have large amplitude differences sufficient to operate the alarm, though no real fault exists. Protection against this type of spurious operation is secured by including a rectifier circuit and integrator between the output of each VFLA and the differential detector. An integration time of about 10 milli-seconds is found to be sufficient

to deal with practically all line differences of this kind, without interfering with the operation in other circumstances.

Automatic Monitor Major:

So far this discussion has been confined to the monitor applicable to those installations where a good quality reference signal is available, but this is perhaps only a minority of the installations. For the installation where the cost of a second line cannot be justified, the Automatic Monitor Major has been designed. Basically the same as the Minor in principle, it includes additional units to take the output of the VFLA rectifier circuit, modulating it on a locally-generated carrier placed above the highest audio frequency in the programme material, and feeding it back down the programme line to the originating point for application to the differential detector at that point. It will be appreciated that, as the VFLA rectifier output voltage is a function of the envelope of the audio noise and signal, it contains frequency components up to perhaps 150 to 200 cycles only, and does not require much additional bandwidth in the channel. Difficulties do arise because the harmonic components of the program material fall into the narrow band used by the envelope components, and also due to intermodulation of the programme signals and the envelope signals, but these have not proved to be unsurmountable.

Recording Monitor:

So far, discussion has been confined to the applications of the monitor to line networks and broadcast signals, but the ideas can be applied in other fields, one

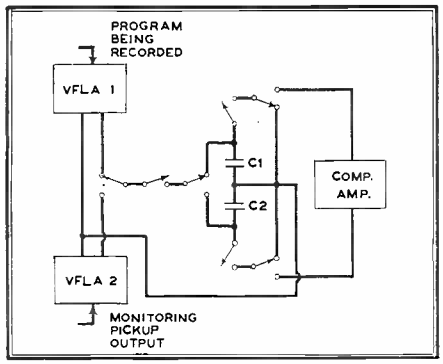


FIG. 5. AUTOMATIC MONITOR FOR RECORDING

application being to sound recording. The use of a pickup inserted behind the recording head to provide monitor signals is common practice, but human appreciation of the differences can well be supplemented by an automatic monitor, leaving the engineer free to deal with other factors. The general requirements are the same as for the land-line monitor, but two additional factors have to be taken into account. The first is the time delay introduced by the physical separation of cutter and pickup, a delay which is large compared to that due to a land line, but is at least independent of frequency. The second new factor is the presence of wow and flutter, distortion that appears to be inevitable in an electro-mechanical system.

Of the two factors, the time delay due to the physical displacement of cutter and replay head has proved the most troublesome. One method of dealing with the problem is to insert a rotary or other form of mechanically-driven switch in the output circuits of the two VFLA amplifiers, the switch serving to connect the rectifier circuit outputs to two storage capacitors, and then to connect the two condensers in series opposition to the differential detector.

The cycle of operation is as follows: The output of the $VFLA_1$, operated by the cutter signal, is connected for a fixed period to a capacitor C_1, charging the capacitor to a level proportional to the signal level. Slightly later in time, a second capacitor C_2 is connected to the output of $VFLA_2$, the time delay being equal to that produced by the separation of the cutter head and replay head. Slightly later again, the two capacitors are connected together in opposition

(Concluded on page 45)

DESIGN DATA for AF AMPLIFIERS — No. 9 Variable Equalizers

DESIGN OF A NON-RESONANT LCR TYPE OF VARIABLE EQUALIZER, PROVIDING WIDE-RANGE CONTROLS AND LOW INSERTION LOSS

THE variable equalizer circuit discussed in Design Data Sheet No. 8 employed only RC components and provided maximum boost or attenuation of 14 db at 50 and 10,000 cycles. This is sufficient for most applications. In many cases, however, it may be found desirable to provide for more treble or bass cut than can be obtained from such a circuit. Where wider ranges of control are necessary, either resonant or non-resonant LCR circuits can be employed.

A widely-used non-resonant LCR variable equalizer, developed by Thordarson Electric Company, 500 West Huron Street, Chicago, is shown in Fig. 1. The operation of this circuit is as follows:

The cathode circuit of the tube contains a high resistance, R2, and an unbypassed bias resistor, R1, which together would normally reduce the amplitude of the signal at the plate by about 15 db. In AC parallel with R1 and R2, however, are the left halves of R4 and R5. When the TREBLE control is moved to the left, C1 and C2 effectively short out the left half of R4 at the higher AF frequencies, thus decreasing the degeneration of the highs. When the BASS control is moved to the left, choke L1 tends to short out the left half of R5 to low frequencies, which decreases the total low-frequency cathode impedance and reduces degeneration of the lows.

The right halves of R4 and R5 compose parallel grid resistances for the following stage. When the TREBLE control is moved to the right, high frequencies are attenuated because of the bypassing action of C2 and, to an extent depending on the control position, by C1. Moving the BASS control to the right causes low-frequency attenuation in a similar manner, due to the shorting effect of L1.

Thus, for both BASS and TREBLE controls, the actions in the cathode and grid circuits are supplementary. As a control is moved from the cathode to the grid circuit, degeneration and attenuation both increase. At approximately the central position of either control, the bypassing effects in the grid and cathode circuits cancel, giving a flat response for all frequencies except

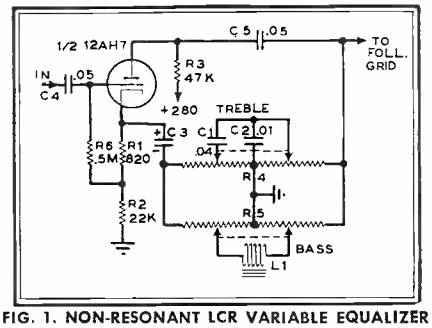


FIG. 1. NON-RESONANT LCR VARIABLE EQUALIZER

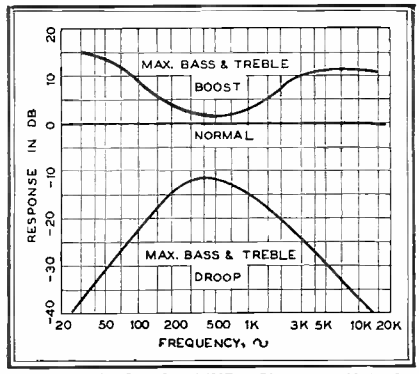


FIG. 2. RANGE OBTAINED BY THIS METHOD

those affected by the other control. Fig. 2 shows the wide range achieved by this method of equalization. Response at 60 cycles is variable from +12 to -28 db; at 10,000 cycles, from +12 to -35 db.

The boost and droop figures stated are valid for the 12AH7 tube, but will not hold for other types unless the characteristics are similar.

Other parts recommended are:
C1 — .04 mfd, 400 volts. C2 — .01 mfd, 400 volts
C3 — 10 mfd, 50 volt electrolytic
C4, C5 — .05 mfd, 400 volts
R1 — 820, ½ watt. R2 — 22 K, ½ watt
R3 — 47 K, ½ watt. R6 — .5 meg, ½ watt
R4, R5 — Thordarson R-1068X
L1 — Thordarson T-1C69 or T-20C74, or equivalent (22 henries, 220 ohms).

ADVANTAGES AND DISADVANTAGES

The RC variable equalizer has three important factors in its favor: it is inexpensive, simple to construct, and has no chokes or transformers to pick up hum. However, its equalization range is limited, and it has the highest insertion loss of the three types.

Non-resonant LCR circuits provide wide-range equalization with fairly low insertion loss. Cost is more than that of RC equalizers but less than that of resonant equalizers. Chokes must be located carefully and shielded heavily to avoid hum pickup.

The resonant equalizer, of which UTC's model CGE-1 is a popular example, has characteristics opposite to those of the RC type. Its range is widest and its insertion loss lowest of the three types. But it is most expensive, and is susceptible to hum pickup also.

A property peculiar to the resonant equalizer is the shape of its equalization curve, which consists of two resonant peaks. The amplitude of boost or droop obtained is normally controlled by the damping of the equalizer's resonant circuits; thus, the peaks are narrowest in the undamped, or maximum boost or droop positions of the controls. The greater the equalization, the narrower is the band of equalized frequencies. This effect may or may not be desirable, depending on the application of the equalizer.

AUTOMATIC MONITOR

(Continued from page 44)

across the differential detector which operates the alarm if the difference in potential on the two capacitors is significant. After the comparison, the two capacitors are discharged and the process repeated.

There seems to be little doubt that there is a real future for automatic monitors, particularly in England, where the manpower shortage is acute. There also appears to be application in any situation that demands continuous monitoring, but where action by the supervisory staff is required only at rare intervals.

More complete information on this development will be published in the *Proceedings of the Institution of Electrical Engineers* under the title "Automatic Monitoring of Broadcast Programmes" by H. B. Rantzen, F. A. Peachey, and C. Gunn Russel. The British patent on the system is No. 649,612. The author will be glad to assist if further information is required.

LOW-COST TV FILMS

(Continued from page 18)

Lighting Techniques:

Set-lighting always has been an important factor in production time. Lighting under the Multicam System averages less than 5 minutes and, in many instances, there is no loss of production time at all as every set is pre-lighted. The lighting time saved, added to the time gained by shooting only long, sustained scenes, totals a huge saving in costs.

Perfection of the lighting techninque also required many months of experimentation. The problem was to perfect a means of lighting a set so that no matter where the actors moved, the light would be uniform. At the same time, it was necessary to devise a system that would practically eliminate cables from the stage floor. This was a must because the Multicam System requires the quick and easy movement of camera and sound boom equipment during shooting.

The floor is also used as an aid in our lighting. A very light-colored floor covering, suitable to dolly on, is used to help eliminate chin, nose and eye shadows. Where the floor is in the picture in long shots, rugs, of course, are used. The combination of this flooring and bank lighting gives an over-all modeling that is photographically pleasing. It eliminates the unflattering shadows that live television lighting seems to accentuate. It also does away with the accentuated make-up that is often used in live telecasting.

NOTES ON FAS PERFORMANCE

WITH MANY FOWLER-ALLISON-SLEEPER INSTALLATIONS NOW IN USE SOME VERY INTERESTING REPORTS ARE BEING RECEIVED — *By* CHARLES FOWLER

JUST how many letters, phone calls, visits, and telegrams we have had from readers working on FAS audio systems is impossible to estimate. Letters alone occupy a whole file. At first, they all contained questions and problems; we selected a few typical ones for answering in our January issue. Now, for better than a month, we have been receiving reports of work done, of experiments, and suggestions for handling specific problems. These, too, we want to pass along for the information of those working with FAS audio installations.

Assured Success:

We must, however, digress for a moment and take time to restate some basic principles. We recommend, once again, that when you start working with the FAS system, you build it exactly as specified. Then, if you want to experiment, you will have a standard of comparison.

There have been extraordinarily few complaints, and each has been traced down to "doing something different." Stick to original specifications, and you will, like Mr. Charles Oswald of La Plume, Pa., "find the results to be superb."

Another point which we should restate is what we mean by "high fidelity." Perhaps we should talk about high-*er* fidelity. The ideal, toward which all of us are working, is to be able to sit in our easy chairs at home and *believe* that we are at the concert hall. Since it is impossible to crowd a hundred-piece orchestra into the 10 cubic feet normally allotted to a loudspeaker, we can never achieve the ideal — but we can keep trying! And as we keep trying, we find that we need to use our imaginations less and less.

We might say that when, in our search for higher fidelity, we reach a point at which we are satisfied, when our ears are truly pleased, then we have achieved the personal goal of high fidelity. For instance, just yesterday evening, we listened to Kodaly's Sonata for Unaccompanied Cello (Period SPLP-510). It is as remarkable a recording as it is a performance, but the point is that every person who heard it agreed that it was difficult to imagine that Janos Starker, the artist, was *not* in the room. This is an instance of both recording and reproducing equipment combining to achieve what can be legitimately described as high fidelity.

The third and last point to be clarified is our attitude toward engineering data.

In our work with the FAS system, we have deliberately avoided relying heavily on the engineering or theoretical approach. First, in all audio work, the final judgment depends on the listener's ear. We commented on this last month: the response chart may look rheumatic, but the sound may be excellent. This is, of course, becuase there is such a multitude of factors involved. The vagaries of the human ear are not the least. Room acoustics, cabinet resonance, interaction between the amplifier and speaker—all these and more too are enough to drive the theorist into a spasm of higher calculus.

Second, the design of the Air-coupler is a radical departure from that with which we are familiar. It combines the characteristics of bass reflex, labyrinth, and air column. Optimum design of an enclosure of any single one of these three basic types involves major engineering as well as practical problems. Thus, in our work on the FAS system we resorted to what might be called "scientific hit-or-miss."

Theoretical Approach:

All this must not be interpreted as a negation of the value of the theoretical approach. The very essence of science is the accumulation of empirical data to the point where these data are found to follow a pattern, *i.e.,* to fit a formula. Once this point is reached, further development proceeds rapidly.

In the work on the FAS Air-coupler, that point is at hand. Along empirical lines, our own work has been supplemented by reports from several hundred audio-philes throughout the Country. Some of the general principles of Air-Coupler construction were outlined last month in connection with 15-in. speakers and 8-ft. couplers.

Now, and at last, we have a report from A. P. Yundt of Franklin, Va., who has dared to pin down Air-Coupler characteristics with a few well chosen formulas. We quote his letter in full:

"The action of the Air-Coupler would seem to be dependent on three considerations:

"1. At the higher frequencies, the sound from the speaker cone has difficulty reaching the port because of the acoustic resistance of the partial labyrinth path. Thus these frequencies are held back and hence equalized in magnitude to the radiation at lower frequencies.

"2. At lower frequencies the Air-Coupler acts as a Helmholtz resonator in the manner of an ordinary bass reflex cabinet. By using port radiation only, and discarding direct cone radiation, there is no possibility of high-frequency cancellations to be guarded against by the insertion of internal high-frequency absorbent padding, with its unfortunate absorbent effect on the lower frequencies. Instead, acoustic absorption is eliminated as far as possible, even to the extent of elaborate bracing. The anti-resonant frequency of the published design for 12-in. speakers, is 75 cycles, and it should be used with a speaker of this resonant frequency even if the associated amplifier has a high damping factor. This is because the motor-generator efficiency of even the best commercial speaker is low. Conversely, this means that to decrease hangover effects from the resonant system to a minimum, we should use a speaker of high efficiency and an amplifier of good damping factor.

"3. At still lower frequencies, the mode of resonance changes to that of a closed-end organ pipe, for which the natural resonant frequency is 46 cycles for the published design.[1] Because the excitation point is part way down the column rather than at the mouth, the coupler acts as an 'acoustic lever' in that the force on the diaphragm is increased and the required excursion is decreased. This lever effect is only slight, perhaps, but is real and helpful. The important part is the addition of the second mode of resonance, which facilitates coupling to the air even down to 35 cycles.

"With this background, the empirical design can be more widely applied and adapted to other speakers. For example, a 15-in. speaker of 50 cycles resonant frequency should use a coupler with twice the port area (for it has twice the effective diaphragm area) or 160 sq. ins. This calls for a coupler of 13.5 cu. ft. volume, according to the usual Helmholtz formula.[2] The length should be 7 ft. 10 ins. to give a closed organ-pipe type resonance of 35 cycles (from 50 cycles divided by the square root of 2).

(Concluded on page 48)

[1]Acoustic Design Charts (Frank Massa; Blakiston, 1942) has graphic data on p. 103.
[2]See *Audio Engineering,* December 1950, p. 22 for a convenient chart.

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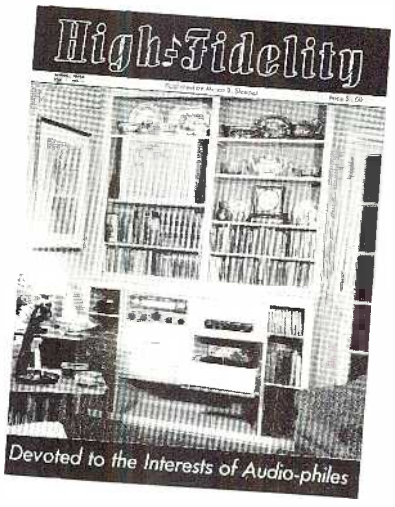

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High-Fidelity

Published by Milton B. Sleeper

Savings Bank Building, Great Barrington, Mass.

Mr. Charles Fowler, Editor, HIGH-FIDELITY
Savings Bank Building, Great Barrington, Mass.

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Recording Folk Are Good to Poke With a Joke

AL TRAVIS says the answers he gets to mail he periodically disgorges, offering transcription-recording discs, broadcast-quality magnetic tape, and grooving-saphires at practically unfair prices, are almost literature. For inkstands, pipple say things like, quote, "Ordered your tapes — good stuff. Enjoy the propaganda." . . . "To be frank, am returning your reply card because enjoy reading your stuff." *(It cost him $1,500 to date and he still happily buys).* . . . "Surely enjoy your sales pitches." . . . "Drop dead!" *(No signature, bless him).* . . . "Your stuff is as good as you claim." *(We only claim it to be sensational!)* . . . "The letters alone are worth the price."

When pipple get in such spirits or vice versa, there is likely to be a large, sinister swindle in the woodpile.

Al says he can still deliver moderate quantities same date at the following chisels. *(Big deals sprung without warning may take longer):*

16″ "PRO" Dbl Face discs, ea.....$1.49
12″ "PRO" Dbl Face discs, ea..... .85
10″ "PRO" Dbl Face discs, ea..... .52
Red Ox. Plastic Mag Tpe 1250 ft. 2.95
Sapphire Resharp Service, each..... 1.49

To get any of this rubbish, all you gotta do, Al says, is to send him an official I. O. U. on your pet bank and, abacadabra, you get not only the moderately satisfactory moichandise, but also reading matter. The latter calls for no outlay whatsoever if you just use the inconveniently small coupon below. It's perfectly safe to use because Al says he'll cut off the mail anyway after you don't order nuttin' for quite awhile.

Meanwhile, however, Al conjectures, you might enjoy sumthin' that is, if not indeed a bargain at least a *value*. Amen.

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We DO buy recording supplies from time to time so please put us on your sucker list and send back issues, too.

Company .....

Address .....

Name .....

Remarks .....

FAS PERFORMANCE

(Continued from page 40)

The cross section then must be 247 sq. ins. to get the required volume. This could be conveniently obtained by making it about 8 ins. by 31 ins. inside, with a port 5 ins. by 31 ins. in size. The speaker should be centered down from the port a distance of 1 in. plus the nominal radius from the inside edge of the port. This combination should give clean fundamentals that are only about 5 db down at 23 cycles. For best results, the 350-cycle crossover frequency should be lowered to match the other changes by the ratio of the resonant frequencies or about $350 \times 50/75 = 230$ cycles.

"The criteria of a good speaker for this coupler:

1. High efficiency
2. Sturdy cone construction
3. Highly excursive sone suspension.
4. Sufficiently deep magnet gap that the winding stays within the area of uniform field for reasonable signal levels. This is to reduce non-linear response and hence harmonic and intermodulation distortion. The coupler design itself aids in reducing the former and the dividing network aids in reducing the later.

"The coupler design should then be made to match the resonant frequency of the speaker chosen. It should not, of course, be so low that cone radiation is low at the resonant frequency."

We feel that Mr. Yundt has made a most important contribution to our understanding of the FAS Air-coupler. His analysis appears to be well borne out by reports of tests by other readers.

W. M. Nelson, Chief Engineer of Station WUSN, Charleston, S. C., writes: I have just completed the FAS audio system and find it quite an interesting listening experience. My amplifier is a duplicate of your model with the exception of the output transformer which is a 35-watt Stancor. I found it necessary to use a corrective high frequency network across the primary in order to prevent phase shift. I use 12 db of negative feedback. The low-frequency woofer is a 25-watt 12-in. heavy duty job. This unit seems to be free of peaks from 30 to 300 cycles. I did notice an anti-resonance effect at 40 cycles. A slight peak of the order of 1 db was noticed at 70 cycles.

Distortion measurements were made on the system terminated into a resistive load at 2½, 10, and 18 watts output, and were also made at 10 watts output from 30 to 300 cycles with the amplifier loaded by the low-frequency Air-coupler. It is interesting to note the slight difference in distortion of the system with resistive load and speaker load.

(Continued on page 49)

FAS PERFORMANCE

(Continued from page 48)

I am well satisfied with the Air-coupler. It does deliver a true musical note with good efficiency and power. It is to be recommended to all who appreciate musical reproduction of the highest order.

Mr. Nelson enclosed a series of test curves with his letter, two of which are reproduced in Fig. 1. Curve B shows

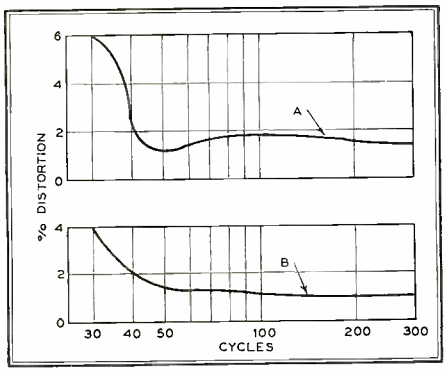

FIG. 1. DISTORTION MEASUREMENTS ON THE FAS

amplifier distortion (all harmonics to 45 kc.) at 10 watts output with an 8-ohm resistive load, whereas Curve A shows identical data except that it is taken across the voice-coil winding of the speaker mounted in the Air-coupler. Only the 30- to 300-cycle range has been plotted, since that is the section of maximum interest. The additional curves sent us showed the amplifier response with 8-ohm resistive load to be flat within 0.5 db. from 30 to 5000 cycles. It rose 1.5 db. at 11,000 cycles, and then dropped back to zero. Mr. Nelson also pointed out that his maximum average power level to the speaker system at normal listening level does not exceed 1 watt.

Dr. H. P. Frost of Worcester, Mass., provided us with another series of curves on the FAS Air-coupler. His installation is particularly interesting because he has suspended the coupler in mid-air. Dr. Frost writes, "I have the Air-coupler in one masonry corner suspended horizontally halfway between linoleum covered floor and unfinished ceiling. In this corner I have not been able to use my other speakers because of an acoustic peak around 4000 to 6000 cycles. However, this feature of the room seems to help the sound radiated by the back of the Air-coupler speaker. For the same reason, I am using in the high side of the network a 4-ohm Western Electric 8-in. speaker (755-A) in the recommended totally enclosed baffle. This mismatch cuts the acoustic peak at 4,500 cycles and gives a smooth response. The Air-

(Continued on page 50)

FAS PERFORMANCE

(Continued from page 49)

coupler is definitely superior. It runs about 3 or 4 db. below most of the other combinations I have tried."

Fig. 2 shows the voice coil impedance readings for Dr. Frost's bass speaker, mounted in his Air-coupler. He says "This speaker is nameless but rugged as to wattage. In an ordinary baffle it has a resonance at 70 cycles. I never considered it very efficient on lows but good in the middle range, better than average."

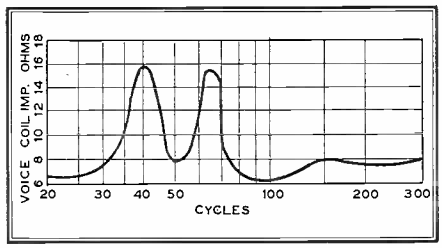

FIG. 2. BASS SPEAKER VOICE-COIL IMPEDANCE

Dr. Frost checked the response of this same speaker, using two different amplifiers, each feeding the same cross-over network which operated at 220 cycles. The response curves for the 20- to 300-cycle range is shown in Figure 3. Curve A shows results with a push-pull amplifier using 6V6's. Curve B shows the results achieved with a Williamson amplifier using 807's in the output.

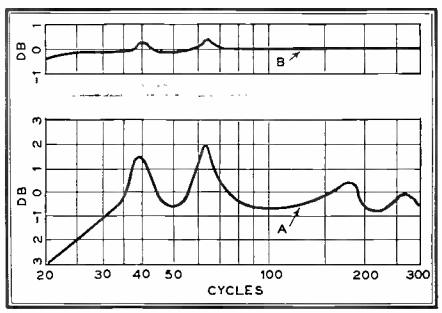

FIG. 3. SPEAKER RESPONSE WITH TWO 6V6'S IN PUSH-PULL, AND A WILLIAMSON AMPLIFIER

FAS DESIGN DATA

The demand for copies of the October, November, and December 1950 issues, containing the original design data on the FAS audio system has exhausted our supply long ago. However, reprints of these articles are available at 10c each. We still have a limited supply of January and February 1951 copies. When new subscribers ask to have their subschiptions start with October, we have been sending them the reprints without charge, and dating their subscriptions ahead to the first issue available.

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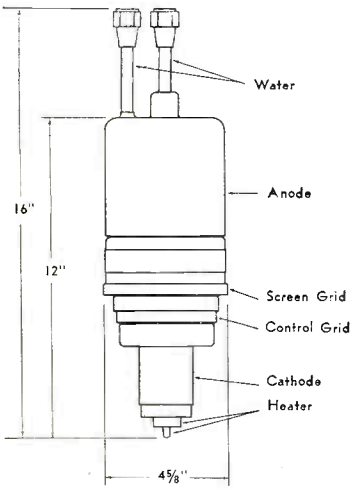

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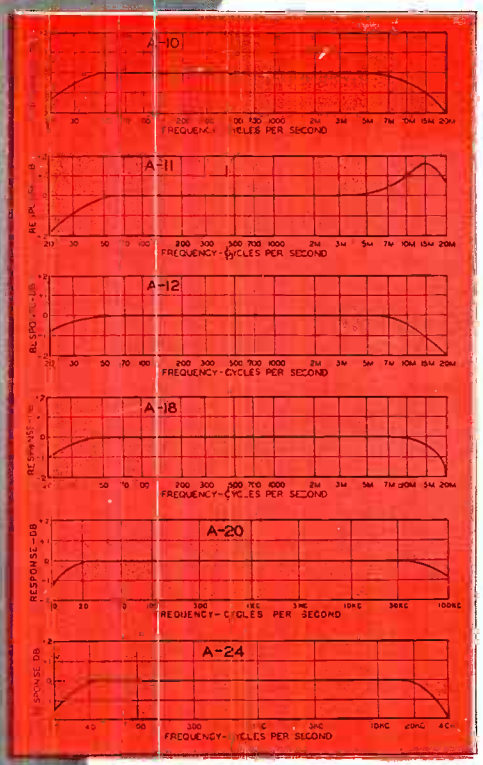

Type No.	Application	Primary Impedance	Secondary Impedance	List Price
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A-11	Low impedance mike, pickup, or line to 1 or 2 grids (multiple alloy shields for low hum pickup)	50, 200, 500	50,000 ohms	16.00
A-12	Low impedance mike, pickup, or multiple line to grids	50, 125/150, 200/250, 333, 500/600 ohms	80,000 ohms overall, in two sections	15.00
A-14	Dynamic microphone to one or two grids	30 ohms	50,000 ohms overall, in two sections	14.00
A-20	Mixing, mike, pickup, or multiple line to line	50, 125/150, 200/250, 333, 500/600 ohms	50, 125/150, 200/250, 333, 500/600 ohms	15.00
A-21	mixing, low impedance mike, pickup, or line to line (multiple alloy shields for low hum pickup)	50, 200/250, 500/600	50, 200/250, 500/600	16.00
A-16	Single plate to single grid	15,000 ohms	60,000 ohms, 2:1 ratio	13.00
A-17	Single plate to single grid 8 MA unbalanced D.C.	As above	As above	15.00
A-18	Single plate to two grids. Split primary	15,000 ohms	80,000 ohms overall, 2.3:1 turn ratio	14.00
A-19	Single plate to two grids 8 MA unbalanced D.C.	15,000 ohms	80,000 ohms overall, 2.3:1 turn ratio	18.00
A-24	Single plate to multiple line	15,000 ohms	50, 125/150, 200/250, 333, 500/600 ohms	15.00
A-25	Single plate to multiple line 8 MA unbalanced D.C.	15,000 ohms	50, 125/150, 200/250, 333, 500/600 ohms	14.00
A-26	Push pull low level plates to multiple line	30,000 ohms plate to plate	50, 125/150, 200/250, 333, 500/600 ohms	15.00
A-27	Crystal microphone to multiple line	100,000 ohms	50, 125/150, 200/250, 333, 500/600 ohms	15.00
A-30	Audio choke, 250 henrys @ 5 MA 6000 ohms D.C., 65 henrys @ 10 MA 1500 ohms D.C.			10.00
A-32	Filter choke 60 henrys @ 15 MA 2000 ohms D.C., 15 henrys @ 30 MA 500 ohms D.C.			9.00

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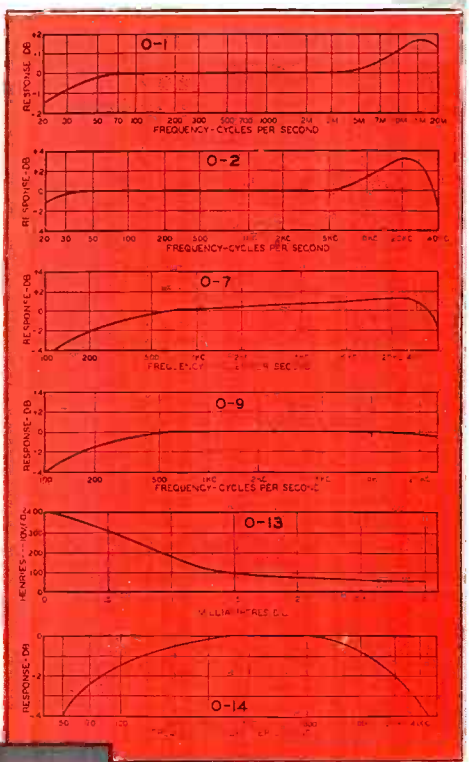
UTC OUNCER components represent the acme in compact quality transformers. These units, which weigh one ounce, are fully impregnated and sealed in a drawn aluminum housing ⅞" diameter . . . mounting opposite terminal board. High fidelity characteristics are provided, uniform from 40 to 15,000 cycles, except for 0-14, 0-15, and units carrying DC which are intended for voice frequencies from 150 to 4,000 cycles. Maximum level 0 DB.

OUNCER CASE
⅞" Dia. x 1⅛" high

Type No.	Application	Pri. Imp.	Sec. Imp.	List Price
0-1	Mike, pickup or line to 1 grid	50, 200/250 500/600	50,000	$13.25
0-2	Mike, pickup or line to 2 grids	50, 200/250 500/600	50,000	13.25
0-3	Dynamic mike to 1 grid	7.5/30	50,000	12.00
0-4	Single plate to 1 grid	15,000	60,000	10.50
0-5	Plate to grid, D.C. in Pri.	15,000	60,000	10.50
0-6	Single plate to 2 grids	15,000	95,000	12.00
0-7	Plate to 2 grids, D.C. in Pri.	15,000	95,000	12.00
0-8	Single plate to line	15,000	50, 200/250, 500/600	13.25
0-9	Plate to line, D.C. in Pri.	15,000	50, 200/250, 500/600	13.25
0-10	Push pull plates to line	30,000 ohms plate to plate	50, 200/250, 500/600	13.25
0-11	Crystal mike to line	50,000	50, 200/250, 500/600	13.25
0-12	Mixing and matching	50, 200/250	50, 200/250, 500/600	12.00
0-13	Reactor, 300 Hys.—no D.C.; 50 Hys.—3 MA. D.C.,		6000 ohms	9.50
0-14	50:1 mike or line to grid	200	½ megohm	13.25
0-15	10:1 single plate to grid	15,000	1 megohm	13.25



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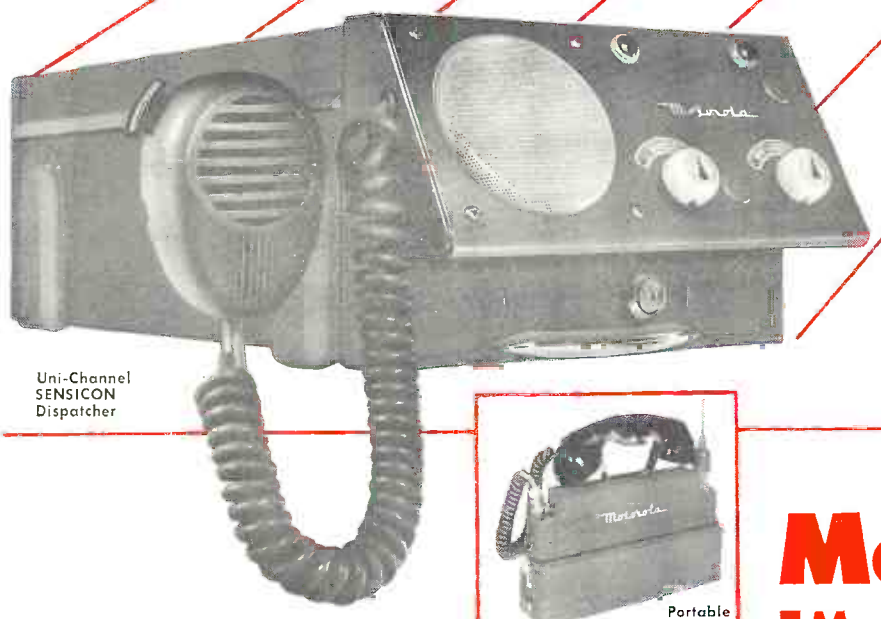


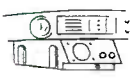
Uni-Channel SENSICON Dispatcher

Portable "Handie-Talkie"

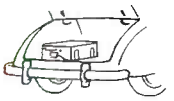
Motorola FM 2-WAY RADIO

USE AS PORTABLE BASE STATION

USE AS MOBILE DASH MOUNT



USE AS MOBILE TRUNK MOUNT



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