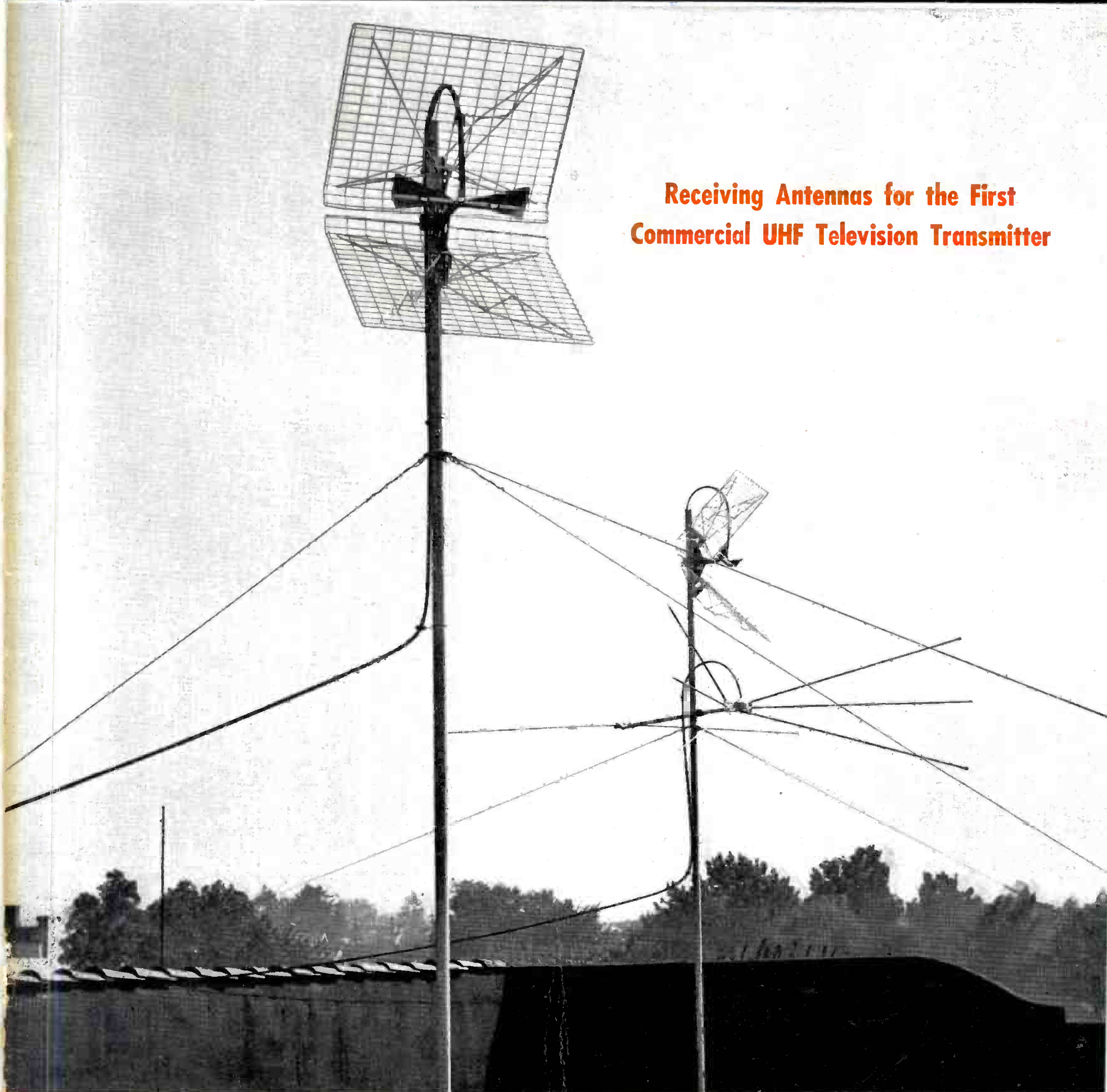
Price 35 Cents Oct. 1952

FM-TV THE JOURNAL OF

RADIO COMMUNICATION

★★Published by★★
Milton B. Sleeper



Receiving Antennas for the First Commercial UHF Television Transmitter

12th Year of Service to Management and Engineering

The Tree of Progress Bears Fruit

DURING the past year, the rapid increase in communication and television engineering activities has divided the readers of RADIO COMMUNICATION into two separate groups.

One group wants a magazine devoted exclusively to communication engineering. The other insists upon a magazine concerned only with television and radio engineering. Advertisers have expressed similar views.

This has confronted us with the problems—and there are many of them—of splitting RADIO COMMUNICATION into two separate magazines. We recognize the need for this change. We know we must anticipate the requirements of our readers and advertisers.

Accordingly, the decision has been made to divide RADIO COMMUNICATION into two separate magazines, to be called

COMMUNICATION ENGINEERING. and
TV & RADIO ENGINEERING

Each magazine will be published on an every-other-month schedule. So many readers have mentioned the fact that the monthly papers arrive in such rapid succession that they can only scan one issue hurriedly before the next appears. Advertising managers and agency executives have told us that they could get greater impact from two pages in a bimonthly, because of its greater active life than from one page in each issue of a monthly magazine.

Starting in 1953, therefore, we shall publish COMMUNICATION ENGINEERING on the 15th of January, March, May, July, September, and November. TV & RADIO ENGINEERING will come out on the 15th of February, April, June, August, October, and December.

If this schedule proves satisfactory to readers and advertisers, it will be continued. But if we find subsequently that there is a reason to put either magazine on a monthly schedule, we shall respond to the demand if and when it develops.

COMMUNICATION ENGINEERING

This magazine will carry articles, news, and engineering data of specific interest to:

1. Manufacturers' engineers engaged in the development, design, and production of military and civilian communication equipment and instrumentation

2. Manufacturers' field engineers

3. Officers and civilian engineers in the Armed Services who are concerned with military communication equipment

4. Prospective customers for new communication systems or replacement equipment

5. Engineers employed by telephone and telegraph companies

6. Consultants engaged in system engineering

7. System supervisors, operators, and maintenance men

8. Independent organizations handling the sale of equipment, and system maintenance on a contract basis.

The editorial contents will cover all subjects related to the developments in equipment, system engineering, operation and maintenance of industrial, public safety, transportation, air-ground, and common carrier services. Listing of new applications will be continued, and FCC actions will be reported.

TV & RADIO ENGINEERING

This magazine will be devoted specifically to articles, news, and engineering data of interest to:

1. Manufacturers' engineers engaged in the development, design, and production of television and radio receivers, transmitters, and the related equipment

2. Manufacturers' field engineers

3. Management and engineering executives of TV and radio stations, and of new applicant companies

4. Engineering consultants and development laboratories

5. Engineers employed by telephone companies operating network facilities or local TV distribution systems

6. Prospective users of industrial televison installations.

The editorial contents will cover all subjects related to television transmitters and receivers; antennas, towers, and lighting; studio, audio, monitoring, and measuring equipment; relay and remote pickup facilities; and station and studio design and construction. Each issue will carry information on new applications and FCC actions.

INFORMATION FOR ADVERTISERS

Following are the advertising rates for each publication:

	1 page	2/3	1/2	1/3	1/6
6 times	$240	180	145	105	55
1 time	300	230	185	130	70

INFORMATION FOR SUBSCRIBERS

After the December issue of RADIO COMMUNICATION, your subscription will be completed with either COMMUNICATION ENGINEERING or with TV & RADIO ENGINEERING, as you choose. Shortly, you will receive a card on which you can advise us as to your preference.

The subscription rate for each magazine will be $3.00 per year; the single-copy price 65c. Both magazines will present a new type of format which, we believe, will set a new standard among engineering publications. These separate magazines, each devoted exclusively to its special field, will serve you much more effectively than a single publication divided in editorial coverage between two virtually unrelated subjects.

When you see the new magazines, we'd like to have your opinion of them, and your suggestions as to changes or additions which will add further to their value to you.

MILTON B. SLEEPER, *Publisher*

The Ideal Dielectric

FOR NEW UHF-TV APPLICATIONS

MYCALEX

Glass-Bonded Mica INSULATION

—for low loss at low cost!

- LOW-LOSS FROM 60 CYCLES/SECOND TO 24,000 MEGACYCLES/SECOND
- MAXIMUM EFFICIENCY, UTMOST ADAPTABILITY, LOWEST COST
- AVAILABLE MOLDED TO PRACTICALLY ANY SHAPE OR SIZE WITH OR WITHOUT METAL ELECTRODES OR INSERTS

FCC Approval of UHF TV has introduced an era of engineering and manufacture to standards seldom before attained in mass production. Many materials, dielectrics in particular, fail to meet these more critical requirements. MYCALEX 410 is one exception. This dielectric can be molded to close tolerances with or without metal inserts—high efficiency to well over 24,000 megacycles. MYCALEX 410 can be molded in volume at low cost. It can be produced to closer tolerances than higher priced ceramics. Electrically and mechanically, MYCALEX 410 is the ideal dielectric for tube sockets, tuners, condensers, switches, coil structures and many other UHF components.

CHARACTERISTICS OF MYCALEX GRADE 410

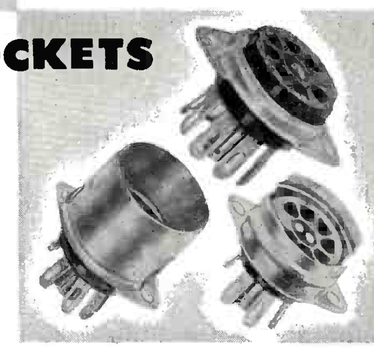
Power factor, 1 megacycle	0.0015
Dielectric constant, 1 megacycle	9.2
Loss factor, 1 megacycle	0.014
Dielectric strength, volts/mil	400
Volume resisfivity, ohm-cm	1×10^{15}
Arc resistance, seconds	250
Impact strength, Izod, ft.—lb/in. of notch	0.7
Maximum safe operating temperature, °C	350
Maximum safe operating temperature, °F	650
Water absorption % in 24 hours	nil
Coefficient of linear expansion, °C	11×10^{-6}
Tensile strength, psi	6000

WRITE FOR 20-PAGE CATALOG
This comprehensive compilation of technical and manufacturing data includes complete dielectric information.

TUBE SOCKETS

MYCALEX glass-bonded mica sockets are injection molded to extremely close tolerance. This exclusive process affords superior low-loss properties, exceptional uniformity and results in a socket of comparable quality but greater dimensional accuracy than ceramics—all at no greater cost than inferior phenolic types. These sockets are available in two grades, featuring high dielectric strength, low dielectric loss, high arc resistance and fully meet RTMA standards.

Write for Tube Socket Data Sheets

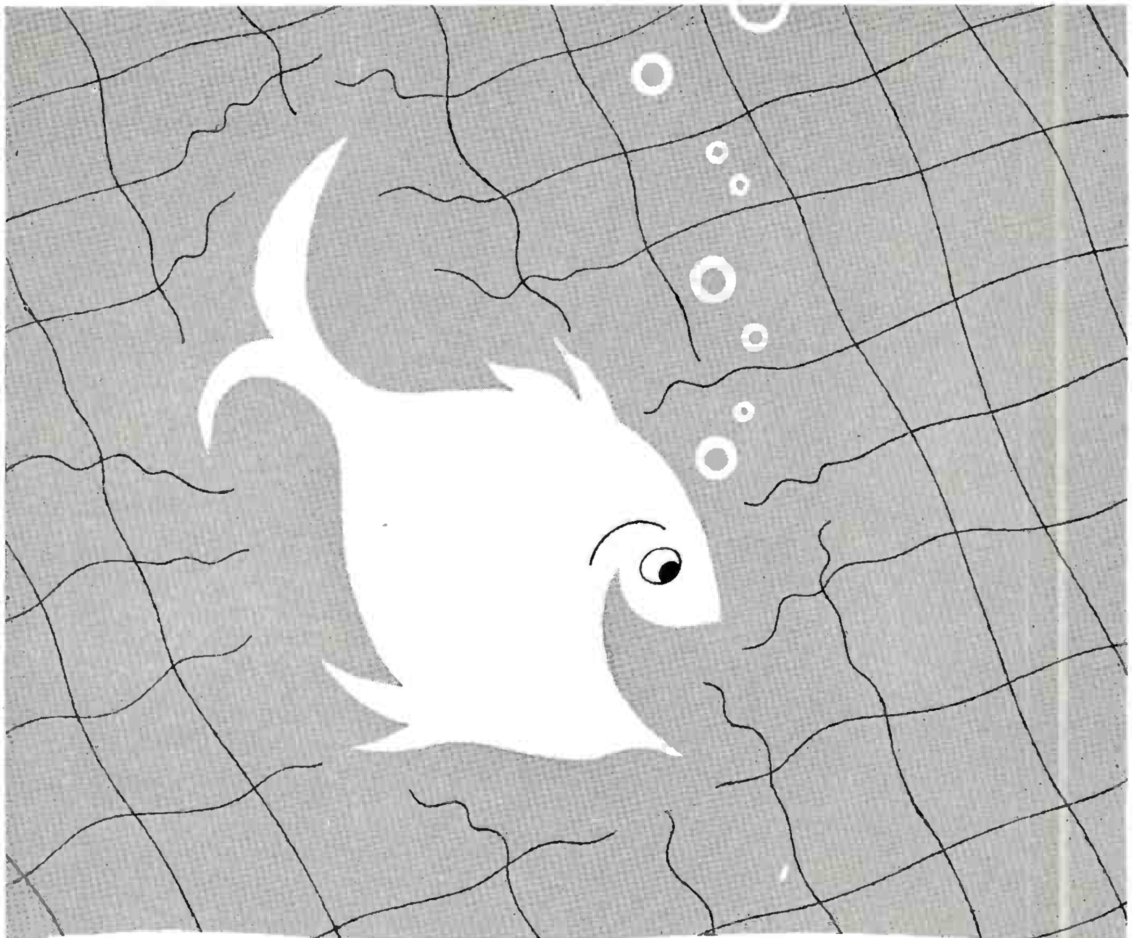


MYCALEX 410 is priced comparable to mica-filled phenolics. Loss factor is only .015 1 mc., insulation resistance 10,000 megohms. Fully approved as Grade L-4B under N.M.E.S. JAN-1-10 "Insulating Materials Ceramic, Radio, Class L."

MYCALEX 410X is low in cost but insulating properties greatly exceed those of general purpose phenolics. Loss factor is only one-fourth that of phenolics (.083 at 1 mc.) but cost is comparable. Insulation resistance 10,000 megohms.

SINCE 1919 MYCALEX THE INSULATOR TRADE MARK REG US PAT OFF

MYCALEX CORPORATION OF AMERICA
Owners of 'MYCALEX' Patents and Trade-Marks
Executive Offices: 30 ROCKEFELLER PLAZA, NEW YORK 20 — Plant & General Offices: CLIFTON, N.J.



FM-TV RADIO COMMUNICATION

TELEVISION ENGINEERING

Formerly *FM* MAGAZINE and *FM* RADIO-ELECTRONICS
Now incorporating TELEVISION ENGINEERING Magazine

VOL. 12 OCTOBER, 1952 NO. 10

INDUSTRY NEWS

TELEVISION

AUDIO

DESIGN

COMMUNICATION

SPECIAL DEPARTMENTS

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MILTON B. SLEEPER, *Publisher*

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

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

CPA AUDIT

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

Set Production

SET production figures compiled by RTMA indicate a fair level of activity in August, substantially higher than for the same period in '51. Nevertheless, the radio industry as it exists today is in a very unhealthy state of dependency on military orders. Total manufacturing facilities have been built up so far beyond the level of civilian demand that if Government orders should begin to taper off, even at a gradual rate, probably 90% of the equipment and components manufacturers would have to close their doors within 12 months' time.

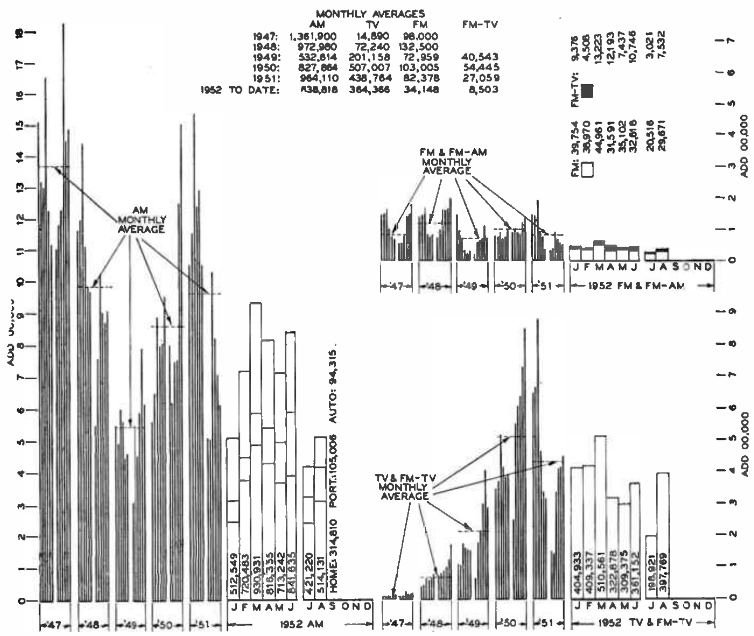
Part of the trouble derives from the fact that there are so many companies that they cannot work and plan together within a perimeter of predictable consumer demand from year to year, as is done in the automotive business. And the number of companies is so large because 1) this industry holds such fascination for so many men as an outlet for creative effort, and 2) because it is possible to launch a new venture with very little capital.

It appears, therefore, that a company's cash reserves, and the experience and resourcefulness of its executives offer a fairly accurate measure of the length of time the company will survive in the NMGO period. (In the language of the alphabeticians, NMGO stands for no more Government orders.)

It's fortunate that the start of UHF television has come at this particular time. The design of successful UHF receivers is not going to be a simple matter. And this observer ventures to predict that UHF converters are not going to provide satisfactory reception for present owners of VHF sets. To make matters more complicated, a number of set manufacturers are depending on the components companies for front-end designs, instead of assuming engineering responsibility for this critical part of their sets. Some set manufacturers are bound to take a licking before they have models that perform satisfactorily on UHF. With a backlog of military orders, they may be able to afford some losses.

Note about AM receivers: Production of clock models in August was 108,753, or more than one-half the 206,057 standard home models produced in that period. That is a pretty poor showing for the latter. And even the total of clock and standard home-type AM sets did not equal the 397,769 TV sets.

Anticipating quantity production of UHF television sets, RTMA is preparing to show separate figures for VHF-UHF and VHF-only receivers.



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

IT'S NEW . . . IT'S CLEAN . . . IT'S RUGGED

. . . the Revolutionary New Bendix 2-Way Radio!

Here's miles ahead mobile radio performance. In spite of the many revolutionary advantages . . . this Bendix Trafficmaster doesn't pull any more amps than a headlight, and it works as good as it looks.

Compact

Let's start with the big box on the left. It contains the transmitter, receiver and power supply . . . all in one compact package. The whole unit slotted for easy 3-way removal . . . it's easier to service . . . easier to maintain. It pivots . . . comes straight out . . . or straight up.

Electronic Squelch

Bendix engineers have perfected an amazing new electronic squelch . . . with a delaying action that gives you all the message . . . none of the noise. No chopped up signals in fringe areas. Clear as a home radio from 20 miles and farther out! You get performance never before possible on 152-174 mc.

Longer Life

Your new Bendix Trafficmaster has been field tested under the most difficult conditions. Longer life of tubes and components is assured. Another big feature is that Bendix uses Selenium stacks . . . instead of rectifier tubes. They almost never wear out!

From hand sets to land stations

In addition to the latest type of mobile equipment . . . Bendix offers a complete line of fixed stations from 2¼ to 250 watts. As well as accessories from hand sets to speakers, antenna to shock mounts . . . plus all technical help in obtaining license and complete system engineering.

Write today . . . because you too can now afford the best in 2-way radio. Bendix costs you no more than ordinary equipment. Get all the information.

Buy on Installment Plan

Bendix has developed with local banks, what has been called one of the finest financial plans anywhere. You pay for your new Bendix 2-way radio . . . as you use it and as it makes money for you. Write for complete details.

Bendix
AVIATION CORPORATION

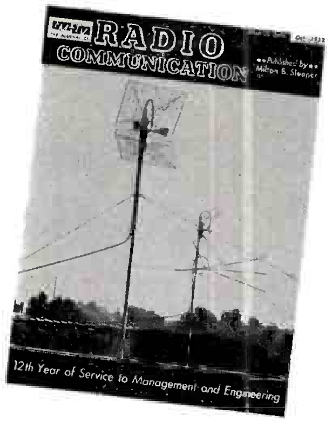
Division of Bendix Aviation Corporation
BALTIMORE 4, MARYLAND
Export Sales: Bendix International Division, 72 Fifth Avenue, New York City

Bendix MOBILE Radio

THIS MONTH'S COVER

The receiving antennas shown in this month's cover picture signalize the arrival of commercial UHF television. These were among the first to be erected at Portland, Ore., where Empire Coil Company's KPTV is the first UHF station to go on the air.

The initial supply of receivers was bought up quickly, but there were not enough UHF antennas to go around. For all the companies making TV antennas, none had anticipated this demand. RCA developed and produced the corner reflector type illustrated, and has released the design to the antenna manufacturers.



SPOT NEWS NOTES

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

UHF Television:

The RCA-NBC transmitter used for UHF television tests at Bridgeport, Conn., was shipped to Portland, Ore., installed for Empire Coil Company, and put on the air ahead of the original timetable. A test pattern, with the call letters KPTV, was switched on at 12:01 A. M., September 18. This is the first UHF station authorized for commercial operation. The present 1-kw. transmitter will be upped later to 5 kw., and an effective radiated power of 88 kw. Initial tests showed excellent coverage in the adjacent cities of Vancouver, St. Helens, and Oregon City. RCA and Zenith receivers performed in a highly satisfactory manner, but the immediate demand far exceeded the initial supply. Some of the sample sets shipped out by several manufacturers did not do so well, suffering from interference caused by local taxicab radio transmissions. Redesign of the UHF tuning strips was indicated.

WDRC-FM, Hartford:

One of the early FM pioneers, this Connecticut affiliate of CBS is now carrying WQXR programs on its FM transmitter. While this change has been welcomed by many listeners, others are disappointed because WDRC-FM had picked WCBS-FM off the air for rebroadcasting, providing full audio quality of CBS programs originating in New York City. Now, while the station is rebroadcasting signals from WQXR-FM, there is very little live-talent music.

Harold A. Jones:

Promoted by Motorola to the newly-created post of manager of the technical information center. In this capacity he will handle technical publications, public relations, and service activities of the communications and electronics division.

RTMA Activities:

Newly elected president and board chairman is A. D. Plamondon, Jr., who will serve without salary. Glen A. McDaniel, who resigned as paid president to return to law practice, was named general counsel. General manager James D. Secrest was elected executive vice president.

Dr. J. M. Pettit:

Received the first Western Electronic Achievement Award from the 7th IRE Region for his major contributions to electronics. Dr. Pettit, an associate professor of electrical engineering at Stanford University, had a major part in the development of radar search receivers, served in India and China as a technical observer with the 20th Air Force, and in England as associate technical director of ABL-15, a laboratory associated with the Radio Research Laboratory. The award was made during the show and convention sponsored by the West Coast Electronic Manufacturers Association and the IRE at Long Beach, Calif.

TV Studio Lighting:

A planning manual on studio lighting is available from Kliegl Bros., 321 W. 50th Street, New York 19. This manual presents illustrations of equipment now in use at TV studios, and suggested plans for lighting installations. Copies are available on request.

Communication Conference:

Third annual conference of the IRE professional group on vehicular communication will be held at Hotel Statler, Washington, D. C., December 3 and 4. Four sessions, each of three papers, will be de-

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SPOT NEWS NOTES

(Continued from page 6)

voted to spectrum economy and related subjects, including a report of JTAC work on split-channel operation. Further details can be obtained from convention chairman Waldo Shipman, Box 215, Falls Church, Va. Last year's conference at Chicago was highly successful, and a very large attendance by communication engineers is expected at Washington.

To Our Subscribers:

As announced on the inside front cover of this issue, RADIO COMMUNICATION will be divided into two separate, bimonthly magazines, effective in January, 1953. This change is being made in response to letters from our readers who feel that the time has come when the growing activities in the communication and television fields require such a change. To complete your present subscription, you may have either COMMUNICATION ENGINEERING or TV & RADIO ENGINEERING, according to your particular interests. Shortly, you will receive a card on which you can indicate your preference. Please return it promptly, so that we shall know which magazine to send you after the December issue of RADIO COMMUNICATION.

Jack Poppele:

After 30 years with WOR New York, he has resigned as vice president in charge of engineering for MBS, and has established a consulting firm to specialize in the TV broadcasting field. At Mutual, he will be succeeded by E. M. Johnson, who will also continue in charge of station relations.

D. R. Edge:

Manager of government sales for Graybar at Washington, D. C., has also been named manager of communication equipment sales.

Records and Hi-Fi Equipment:

While audio broadcasters are busy worrying about TV competition to the neglect of their own programming, the sale of phonograph records and hi-fi equipment has grown to the point where RTMA held a Phonograph Industry Conference at New York on September 17, and set up a committee under J. A. Berman, of Shure Brothers, to promote the sale and use of records for home entertainment. Also, plans were approved for setting up statistics for the Parts and Amplifier, and Sound Equipment Divisions of the Association.

Robert F. Jones:

After serving as a Commissioner in the FCC since June, 1947, Mr. Jones pre-

(Continued on page 8)

SPOT NEWS NOTES

(Continued from page 7)

sented his resignation to President Truman on September 19. He will resume the practice of law, in the firm of Scharfeld, Jones, and Baron of Washington, D. C. Prior to his FCC appointment, Mr. Jones, a lawyer by profession, served for 10 years as Republican Congressman from the Lima, Ohio, district. Following the interval of speculation during which William Massing, Benedict Cottone, and Frank Dunham were among those discussed as possible successors to Mr. Jones — if indeed the President did not decide to let the appointment ride until after Election Day — Mr. Truman announced in a speech at Salt Lake City that he had named Eugene Hyde Merrill as a recess appointee. Mr. Merrill, a Democrat from Utah, is an enthusiastic admirer of the President. After graduation from the School of Mines & Engineering, University of Utah, he was engaged in public utility matters. He has been in Government service since 1940, now in the Defense Production Administration.

Communication Consultants:

A new firm of consultants in the communication field has been organized as Microwave Services, Inc., 45 Rockefeller Plaza, New York 20. Dr. S. J. Begun is chairman of the board, with S. K. Wolf president, Emile Labin vice president, and Victor J. Nexon vice president and treasurer. The directors include Max Delson and F. Vinton Long. Engineering services provided by this new firm will include system analysis, specifications, purchasing, installation, and supervision, as well as the management of all types of communication systems in the U. S. and foreign countries.

Lawrence J. Straw:

Appointed mobile radio sales manager for Bendix Radio. Mr. Straw was previously service manager at Capehart-Farnsworth, and project engineer on telemetry for Raymond Rosen Engineering Products.

Surprise:

A Directory of Communist and Communist-front organizations published by the National Research Bureau, Inc., 415 N. Dearborn Street, Chicago, lists Consumers Union as having been cited by the Committee on Un-American Activities of the U. S. Congress, Committee on Un-American Activities of the California Legislature, Special Sub-Committee of the U. S. House of Representatives' Committee on Appropriations, New York City Council Committee, and the Pennsylvania Commonwealth Council.

(Concluded on page 9)

SPOT NEWS NOTES

(Continued from page 8)

Hi-Fi Sales & Service:

This new magazine, previously announced in this Department, is being readied for publication. However, plans were somewhat delayed to give precedence to separating RADIO COMMUNICATION into two bimonthly magazines, as explained elsewhere in this issue.

Multiple Miniature Connectors:

A new series of very small multiple connectors with gold-plated contacts and nylon insulation is described in bulletin D-1, issued by Cannon Electric Company, 3209 Humboldt Street, Los Angeles 31. Smallest connector in this series has 15 contacts carried on mounting plates 1 17/32 by 31/64 in. outside dimensions. Largest has 50 contacts. with mounting plates 2⅝ by 39/64 in.

Educational FM in New York:

According to the New York Board of Education, more than 40,000 classes in grade and high schools will listen to programs from municipal station WNYE (FM) during the current school year.

Merlin H. Aylesworth 1886-1952:

The first president of NBC passed away at St. Luke's Hospital, New York City, on September 30. Born at Cedar Rapids, Iowa, July 19, 1886, he received his law degree in 1908 from Denver University. Joining NBC in September 1926, he established many of the basic principles of broadcasting during a tenure of office which continued until his resignation in June, 1936. Subsequently, he was chairman of RKO, and publisher of the New York *World-Telegram*. After serving as consultant to the Office of the Coordinator of Inter-American Affairs during the last war, he established a legal and business practice at Rockefeller Center.

TV Station Count:

Up to October 1, there were 110 VHF and UHF stations on the air. Counts issued since the thaw totalled 13 VHF and 55 UHF, of which 2 VHF and 7 UHF were for educational stations.

INSTALLED IN 1941 AND STILL GOING STRONG...

DELTA AIR LINES
INCORPORATED

General Offices: Municipal Airport - Atlanta, Georgia

June 16, 1952

Eitel-McCullough, Inc.
San Bruno, California

Gentlemen:

From time to time in your advertisements, I have noticed reports of Eimac tubes that have served an exceptionally long life. You may be interested in the 450TL statistics at our Atlanta, Georgia, station.

The transmitter in this station uses eight 450TL's in RF service. Of the eight, seven have been in operation since the transmitter was installed in October, 1941. Our Dallas, Texas, transmitter installed about the same time still has five of its original 450TL tubes.

The most important factor in the operation of an airline is safety. This is determined largely by the dependability of the equipment it uses. Delta Air Lines, like any business operating on a sound financial basis, must obtain the most value for every dollar spent. It would appear, in the case of our radio tubes as well as many other products, that the two factors, safety and economy, go hand in hand.

Very truly yours,

DELTA AIR LINES, INC.

J. B. Kramer
J. B. Kramer
Supervisor of Ground Radio

JBK:dg

...reports DELTA AIR LINES of EIMAC Tubes

This story of dependability through more than a decade of day in, day out operation is typical of what leading users of electronic equipment are finding whenever Eimac tubes are employed. Write our application engineering department for information about the complete line of Eimac transmitting power tubes.

EITEL-McCULLOUGH, INC.
SAN BRUNO, CALIFORNIA
Export Agents: Frazar & Hansen, 301 Clay St., San Francisco, California

Eimac REG. U.S. PAT. OFF. **TUBES**

Closed-Circuit TV Operation

HOW CLOSED-CIRCUIT TELEVISION DISTRIBUTION EQUIPMENT CAN BE USED TO ADVANTAGE IN BROADCASTING AND INDUSTRY—*By* J. B. KLINDWORTH*

THE Television Transmitter Division of Du Mont Laboratories, Inc. has, in recent months, been staging closed-circuit television demonstrations throughout the Country. They have been conducted in TV, fringe, and non-TV areas in order to acquaint industrial plants, stores, and other business firms with the potentialities of industrial TV, to familiarize purchasers of Du Mont equipment with its operation, and to promote receiver sales in cooperation with local dealers.

Because the techniques and the problems encountered in closed-circuit TV work are somewhat different than those of conventional studio telecasting, and because the demonstrations have been so successful, descriptions of the equipment and operating procedures are given here.

Response of Viewers:

It should be stated at the outset that one of the more interesting features of the closed-circuit demonstrations has been the tremendous interest they aroused and the disproportionate crowds they attracted. In fringe and non-TV areas alike, it is evident that the public is more eager to have television than is generally realized.

For example, four closed-circuit TV demonstrations were staged last autumn, in cooperation with four radio stations, at agricultural fairs in the fringe and non-TV areas of Illinois, Iowa, and North Dakota. The AM stations concerned were KCRG Cedar Rapids, WMBD Peoria, KSJB Fargo, KXEL Waterloo.

*Television Transmitter Division, Allen B. Du Mont Laboratories, Inc., 1000 Main Avenue, Clifton, New Jersey.

During the first day of the demonstration at the Red River Valley Fair in Fargo, North Dakota, the visitors numbered 12,000 in a record-breaking 5 in. rainfall, even though it was advertised that the demonstration was to continue for three days. Over 35,000 witnessed the demonstrations at the All-Iowa Fair in Cedar Rapids; 59,000 came to the exhibit at the Heart of Illinois Fair in Peoria; and 130,000 visited the demonstrations in one week at the National Dairy Cattle Congress in Waterloo, Iowa. These figures represent the numbers actually attending the TV demonstrations, and not the total fair attendance.

In each area, the participating station erected a tent exhibit at the fair, furnished musical, variety, and similar entertainment, and aired many of its regular AM radio programs as remotes from the fair grounds. Visitors were able to watch the actual radio programs and general entertainment, and to see it on nearby TV sets of various makes furnished by Du Mont and by local TV receiver dealers. In areas which did not have regular TV coverage, dealers intending to handle sets at a later date exhibited receivers obtained from distributors in the nearest TV areas.

Equipment Setups:

The amount of equipment required for a closed-circuit television demonstration varies according to the circumstances and the size of the demonstration. In general, however, the following equipment provides the basic units needed to put on a good show under a wide variety of local conditions:

1) Portable synchronizing generator, which furnishes the necessary sync, blanking, and drive signals for the camera sweep circuits and for making up the composite video signals.

2) Low voltage power supply, which

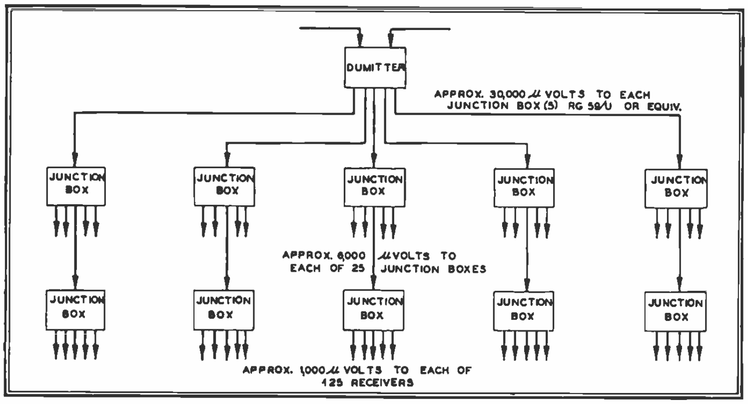


FIG. 1. PLAN OF A DUMITTER CLOSED-CIRCUIT TV SIGNAL DISTRIBUTION SYSTEM, FEEDING 125 SETS

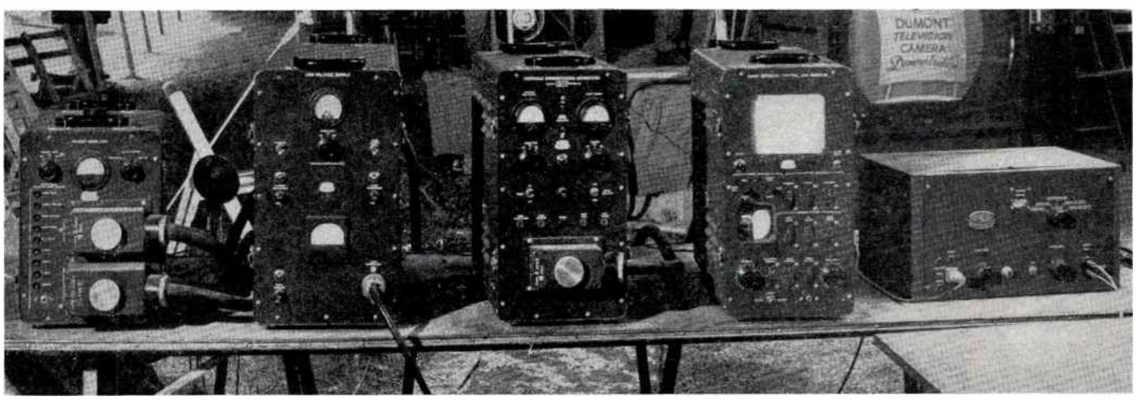


FIG. 2. EQUIPMENT AT VIDEO CONTROL TABLE FOR SINGLE CAMERA CHAIN FEEDING A DUMITTER IN A TYPICAL CLOSED-CIRCUIT TV DEMONSTRATION

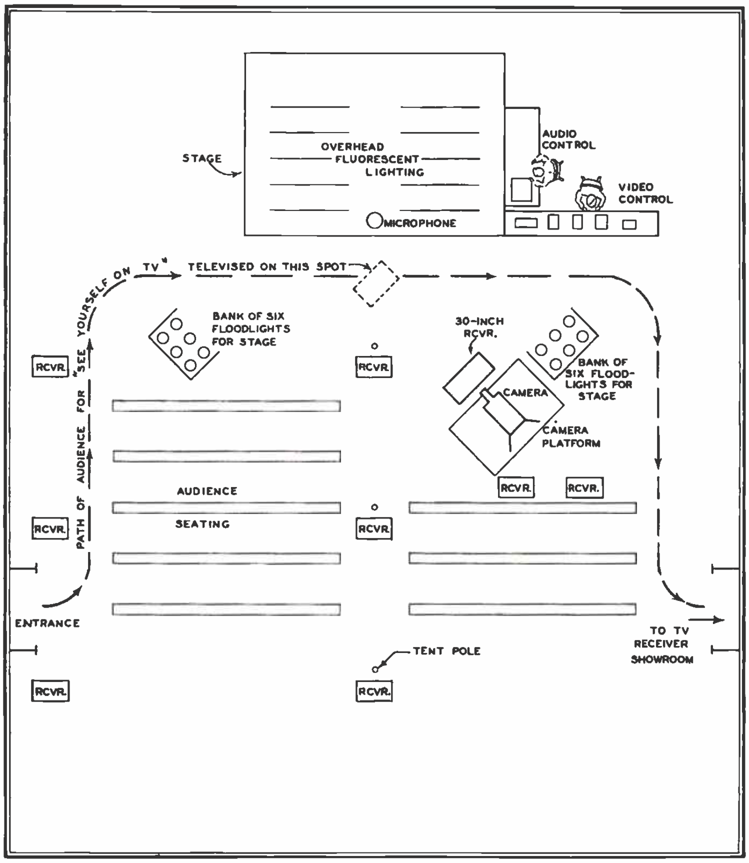


FIG. 5. HOW A CLOSED-CIRCUIT SYSTEM CAN BE SET UP IN A DEMONSTRATION TENT AT A FAIR

furnishes all the DC voltages necessary to operate the camera and its controls.

3) Camera control unit and monitor, which contains all the camera controls and is operated by the video technical director. This operator is provided with a picture monitor, and can set up the picture by varying the image orthicon tube operating voltages.

4) Pick-up auxiliary unit, containing a cable delay circuit which compensates for various lengths of camera cable, and focus coil current control circuits for the cameras.

5) Pick-up head, which mounts on a balanced head and tripod. This unit houses the image orthicon tube, and the necessary sweep, high-voltage, and video amplifier circuits for the camera tube.

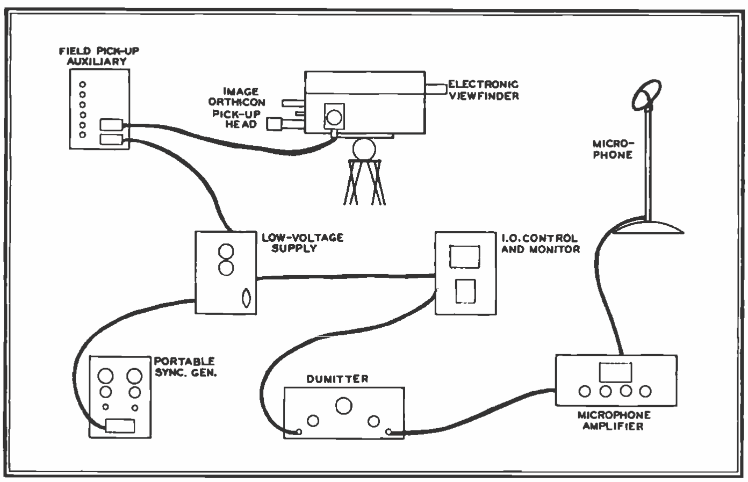


FIG. 3. EQUIPMENT REQUIRED FOR A SINGLE CLOSED-CIRCUIT CAMERA CHAIN AND ONE MICROPHONE

6) View-finder or picture monitor for the cameraman.

7) An audio-video distribution amplifier, into which are fed audio and the composite video signals from the field camera chain. A Dumitter, diagrammed in Fig. 1, was used for these demonstrations. Its output is a standard signal of 30,000 microvolts on channel 2 or channel 3, on each of five output connectors. Each output can be fed, in turn, to 25 junction boxes. This provides 125 outputs, each of which can feed a receiver. The signal levels indicated in Fig. 1 are computed for minimum-loss interconnecting cables. It is quite feasible to feed 125 receivers with a satisfactory signal-to-noise ratio.

The first 4 units are located at the control position, and need not be near the camera or in full view of the camera coverage area. Fig. 2 shows a typical video control setup in the foreground. From left to right, the units can be identified as the pickup auxiliary, the low-voltage power supply, the sync generator, the camera control and monitor, and the Dumitter. The camera and viewfinder operate together and should be set up so as to provide complete coverage of the program to be televised.

For a typical demonstration, the equipment is unloaded and set up near the stage. The interconnecting cables supplied with the camera equipment are connected between units of the camera chain as shown in Fig. 3. RG59/U coaxial cable connects the camera chain video output to the Dumitter video input. A microphone and its amplifier are set up on the stage, and one amplifier output is connected to the audio input of the Dumitter.

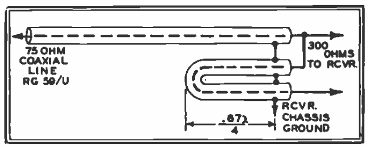


FIG. 4. A 75 TO 300-OHM IMPEDANCE MATCHER

The power cord of the camera chain is connected to 115-volt source with at least a 20-ampere capacity, so that a soldering iron or test equipment can be connected to the same circuit. On temporary power circuits such as those often used at fairs, there may be radical voltage changes or complete losses of power at times. Fortunately, the voltage can be varied from about 90 to 120 volts without loss of picture or sync. Once the power circuit is connected, the equipment should be turned on and permitted to warm up. A picture can be obtained in about 10 minutes, but it is advisable to give the complete system about a half-hour warmup before it is put in operation, so that all the receiver oscillator circuits will have settled down and the Dumitter stabilized in frequency. This will also be sufficient warmup time for the camera, so that its alignment can be checked.

The receivers should be located for good viewing by the maximum number of people. To keep the cabling to a minimum, the receivers are usually placed in groups of 5, which can be fed from one junction box with minimum lengths of cable. The next group size should be that of 25 sets, so that 5 junction boxes can be in a group, and all the junction-box outlets can be used.

All coaxial leads should be terminated properly. If they are left open, they may radiate and cause interference with a local TV broadcasting station on that frequency. This, of course, is illegal. Also, a line improperly terminated may cause serious reflections, degrading pictures on receivers connected to the same junction box. To avoid these difficulties, it is advisable to terminate all unused junction box outputs with 75-ohm resistors.

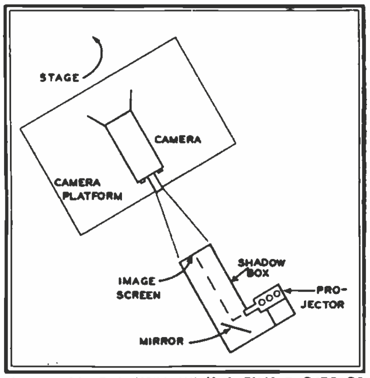


FIG. 8. CAMERA USED WITH A FILM PROJECTOR

All the connecting lines must be of 75-ohm impedance. Therefore, it is necessary to utilize some form of impedance transformation for a set having a 300-ohm input. This can be accomplished by a matching transformer, a resistance bridge, or a transmission line with a folded section connected as shown in Fig. 4.

Demonstration Area:

In most closed-circuit demonstrations for the general public, a stage is set up and entertainment is provided. This is watched live by the spectators and is televised as well. Between programs, it is advisable to have an arrangement whereby people can see themselves on a television screen. To allow for such operation, the camera is usually placed about 15 ft. from the stage, as shown in Fig. 5, either in the center or at one end. If the demonstration is held in a tent, the camera must sometimes be placed off-center because of the center tent-poles. The camera should be mounted at about stage height and can be set up permanently, without a dolly, in most cases. It can then be panned across the stage or out to a seated audience. Between programs, the audience can walk across the stage or in front of the stage to be televised individually. A receiver is located near the camera so that a visitor can see his image on the screen and face the camera at the same time. Such an arrangement can be seen in Fig. 6.

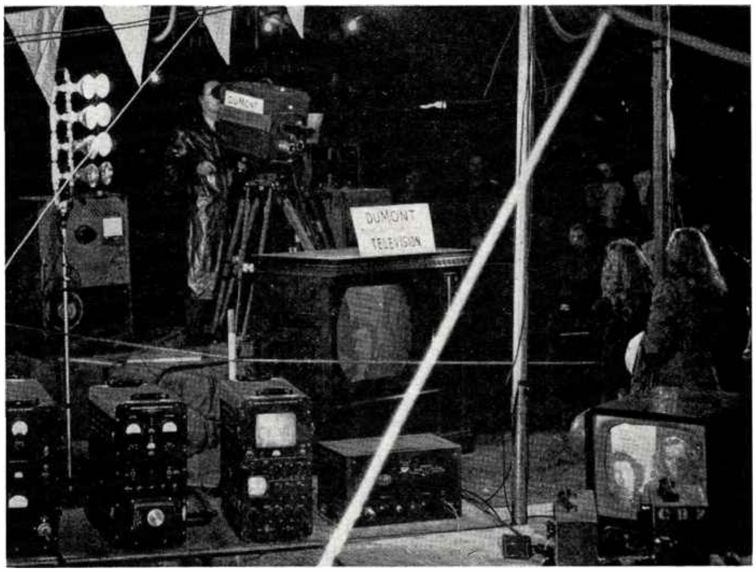


FIG. 6. SET IS PLACED IN FRONT OF CAMERA SO THAT VISITORS CAN SEE THEMSELVES ON SCREEN

Adequate lighting is obtained with a bank of photofloods placed near the camera, so located that light is available for both stage work and for spectators walking in front of the camera. If more stage lighting is desired, a second bank of floods can be installed at the end of the stage opposite that of the camera, as in Fig. 5. Some top lighting on the stage is helpful also. It can be obtained with either incandescent or fluorescent lamps, provided they are shielded carefully so that direct light does not fall on the camera pickup head. A total of 150 to 200 footcandles is sufficient for a good picture.

All outside light sources within range of the camera must be eliminated. In

(Continued on page 31)

FIG. 7. EXHIBITORS ARE PROVIDED WITH CLOSED-CIRCUIT SIGNALS FOR SETS IN TENT SHOWROOM

PATTERN FOR TV PROFIT

PART 4 — RADIATION CHARACTERISTICS OF TV ANTENNAS, AND HOW TO USE THEM TO BEST ADVANTAGE — DESCRIPTIONS OF VHF AND UHF-TV ANTENNAS

By Roy F. Allison, *in collaboration with* A. B. Chamberlain, Rodney D. Chipp, Raymond F. Guy, Thomas E. Howard, *and* Frank L. Marx*

ANTENNAS

The simplest type of transmitting antenna which can be used at television frequencies is the half-wave dipole radiator, shown in Fig. 6. It consists of a tuned element (usually a pipe or bar), one-half wavelength long at the operating frequency, which is broken at the center. The transmission line is connected to the two quarter-wave sections at the break. Television receiving antennas are made up of combinations of dipoles in one form or another.

Although a single dipole element is an efficient radiator, and would be inexpensive to manufacture for television broadcasting applications, it must be used in combination with other elements for best efficiency. This is made clear by consideration of its horizontal and vertical radiation patterns,[2] which are shown in Fig. 6 also.

Horizontal Pattern:

The bottom illustration in Fig. 6 shows the radiation pattern of a dipole in the horizontal plane; that is, the relative radiation in all horizontal directions. It can be seen that, for a dipole oriented as shown, maximum power would be radiated toward the east and west. Theoretically, no power whatever would be radiated due north and south. This is almost always undesirable, since many potential listeners could not be served by a station with such an antenna.

In most cases, equal coverage in all horizontal directions is desired. This can be approached closely, although not perfectly, by utilizing two dipoles mounted at right angles and fed 90° out of phase (in quadrature). Such an antenna has a horizontal pattern similar to that shown in Fig. 7. While not perfectly circular, it is very much better in this respect than a single dipole. Manufacturers of antennas designed according to that principle (turnstile antennas) claim horizontal circularity within ±2 db or better. Other means for achieving circular horizontal radiation patterns have been developed, and will be described later.

As a matter of fact, very few commercial antennas have perfectly circular horizontal radiation patterns, and the few that do are special types of UHF antennas. Some antennas have more variation than ±2 db. This may not be troublesome if care is exercised in mounting the antenna, and it may even be advantageous in many cases. For instance, the antenna can often be installed so that one of the pattern maxima is aimed in a direction where coverage is likely to be difficult because of terrain, or in the direction of a nearby city it is desired to cover solidly. As little as 35 to 45° rotation of a ±2 db antenna can result in an effective increase in power of 2½ times in a desired direction. While the FCC does not permit the use of directional antennas for the purpose of altering station assignments, it may permit them in certain cases in order to improve service, provided that the ratio of maximum to minimum power radiated in the horizontal plane does not exceed 10 db, and that the ERP limitations are met in all horizontal directions. However, ±2 db antennas are not considered to be directional.

Vertical Pattern:

A single dipole, or a single layer of dipole elements, has a substantially circular vertical radiation pattern, as can be seen in the center illustration, Fig. 6. It will be noted that as much power is radiated straight upward (where there cannot possibly be any receivers to utilize such a signal) as in any horizontal direction. When the height of a typical transmitting antenna tower is compared with the distance away from the station at which the average receiving antenna is located, it is apparent that the ideal direction of maximum power propagation would be toward the horizon or at some very small angle below the horizon. Power radiated at angles above the horizon (which represents 50% of all the power radiated by a single-bay dipole-type antenna) serves no useful purpose whatever; in fact, it is distinctly undesirable because it increases the probability of interference to co-channel stations during periods of abnormal propagation conditions. In the same way, it is not advantageous to radiate as much power at very low angles as toward the horizon, because the receivers served by low-angle radiation are much closer than those served by the radiation at higher angles.

The foregoing considerations point up the desirability of concentrating the

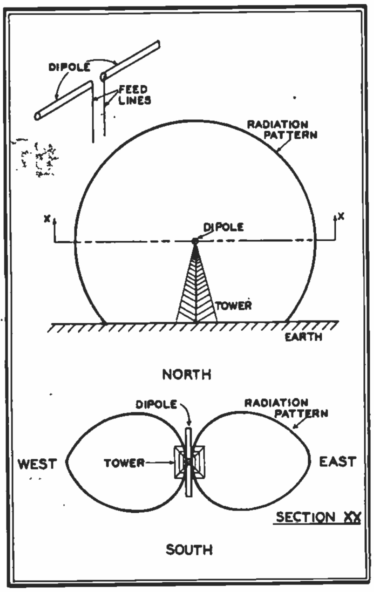


FIG. 6. HORIZONTAL AND VERTICAL RADIATION PATTERNS SIMPLE DIPOLE ANTENNA ON TOWER

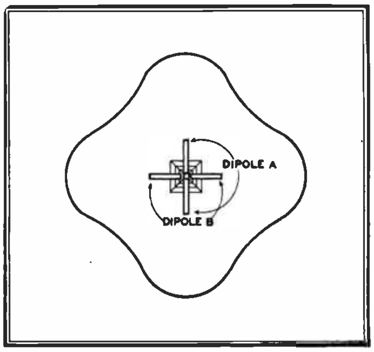


FIG. 7. PATTERN OF DIPOLES IN QUADRATURE

[2]Defined loosely, a radiation pattern is a line connecting points of equal field strength. The actual figures for field strength and distance may or may not be indicated. However, the pattern contour is the same whatever the absolute values.

*Collaborators are, respectively: Chief Engineer, CBS Television, New York; Director of Engineering, DuMont Television Network, New York; Manager, Radio and Allocations Engineering, NBC, New York; Chief Engineer, WPIX, New York; and Vice President in charge of Engineering, ABC, New York.

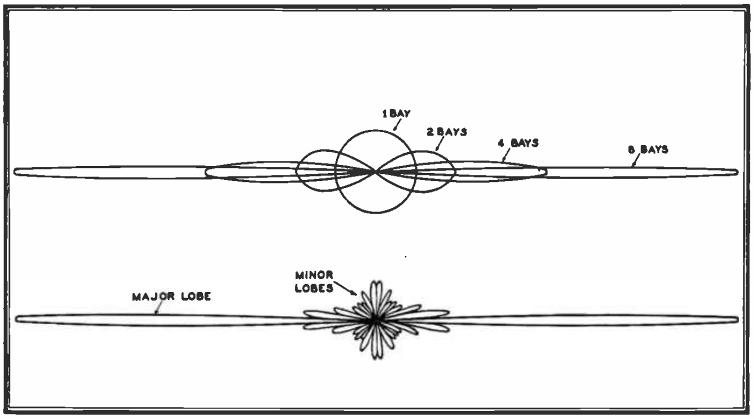


FIG. 8. VERTICAL RADIATION PATTERNS OF SINGLE AND MULTI-SECTION TV TRANSMITTING ANTENNAS

radiation from a television transmitting antenna toward the horizon, where it can be used most efficiently. This can be done by utilizing two or more layers (or *bays*) of elements, fed in phase. The individual radiations of the bays reinforce in directions at right angles to a line connecting the bays, and cancel at other elevation angles. Thus, if multiple bays are installed one above the other, the desired objective is obtained—radiation is intensified toward the horizon and diminished in other directions. The ratio of the radiated power level at any given point from an antenna to the power level that would be obtained at the same point if the antenna were replaced with a simple dipole, assuming the same power input to both, is called the power gain of the antenna in that direction. Power gain is usually maximum in directions toward the horizon, and is understood to be taken in that direction if the direction is not stated. The gain increases as the number of bays is increased.

Fig. 8 shows representative vertical radiation patterns for a single-bay antenna and for 2, 4, and 8-bay arrays. The major lobe only is shown in Fig. 8A, in order to simplify the drawing. However, in practice, several minor lobes are present in the vertical radiation patterns of all multi-element arrays. These minor lobes are not desirable in many applications, but for television broadcasting they may help, when filled in by power splitting as explained later, to provide better coverage of close-in locations that might otherwise receive inadequate signal from a high-gain antenna. Fig. 8B shows the 8-bay pattern redrawn with the minor lobes included.

It is evident from Fig. 8 that the radiated beam becomes narrower as the number of bays and the gain is increased. The area within the pattern outline may be thought of as representing the total transmitted power. Since this cannot be increased by the antenna, then the total area of the vertical pattern cannot increase no matter how far it is compressed into the horizontal beam. Thus, it must become quite narrow for high power gains.

It is convenient to express beam width in terms of the half-power angle. This is the sum of the two angles above and below the main beam at which the radiated power is equal to half that of the main beam. The power gain of an antenna can be approximated by dividing the beam width into 60. Thus, if an antenna has a beam width of 8°, then its power gain is about 7.5.

As can be seen from the diagrams in Fig. 8, an 8-bay antenna provides a gain of 8 to 9. Antennas are contemplated in the VHF bands with gains up to about 18, and to 27 or 28 in the UHF band. At such extremely high gains, the main beam must be correspondingly thinner. It is often economically more satisfactory to use a high-gain antenna and a low-power transmitter to obtain a given ERP than a low-gain antenna and a high-power transmitter, particularly on the high VHF and the UHF bands. This may not be strictly true for the low VHF channels, since the antenna elements are large and a high-gain antenna, consisting of many elements, might be expensive in itself and also require special tower construction.

For instance, if it is desired to have 100 kw. ERP, it might be less expensive to buy and operate a 10-kw. transmitter and a 12-bay antenna than a 25 or 35-kw. transmitter and a 5 or 4-bay antenna. It might be possible also, with the first alternative, to use smaller transmission line, thereby adding to the saving. And regardless of preference, it will be necessary for some time to use high-gain antennas in the high-channel VHF and the UHF bands if it is desired to reach maximum permissible ERP, because transmitters will not be available to permit the use of low-gain antennas.

Antennas of very high gain should be completely satisfactory in all respects when mounted on towers or buildings of moderate height above average terrain. If a very high tower (above 500 ft.) is employed, but it is located in a sparsely-settled area so that extreme close-in coverage is not important, then the antenna should be quite satisfactory without modification also. The only case in which a high-gain antenna might require special treatment is that in which it is mounted at a great height in an urban location. It is possible, in such a circumstance, that minor-lobe null fill-in would not provide enough signal strength at certain close-in locations to override the high city noise-levels. In special cases, part of the antenna feed system could be rephased, at a moderate sacrifice in gain, so as to tilt the main lobe downward slightly and fill in minor-lobe nulls for better close-in coverage.

A procedure for determining the optimum combination of transmitter, antenna, and tower height suggests itself, as follows:

1) Certain locations will be suitable for the transmitter and tower site. Con-

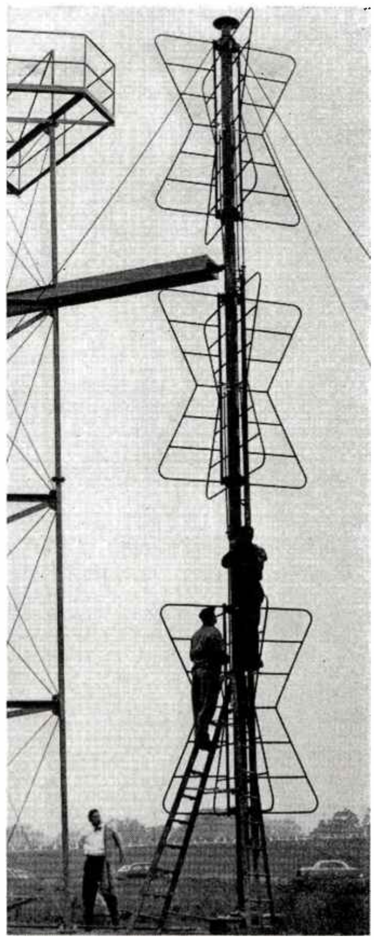


FIG. 9. A 3-BAY TURNSTILE (BATWING) ANTENNA

sult local civic and Civil Aeronautics Authority personnel to determine the restrictions on towers, so as to ascertain that ultimate approval can be obtained.

2) Select the ERP and antenna height necessary to cover the proposed service area from the site selected. FCC Rules specify certain maximum tower heights and effective radiated powers. These were noted in the preceding installment of this series. If it is not proposed to use the maximum permissible power and antenna height, it is then necessary to select those required to cover the desired area. They will be dependent upon the nature of the terrain, the obstructions which may exist, the size of the area, and the availability of suitable sites.

3) A given ERP can be obtained with various combinations of antenna gain and transmitter power, with some optimum balance between them that may result in marked savings.

4) Having determined the effective radiated power required and the amount of antenna gain most economical to obtain it, it is then possible to determine the actual power required at the antenna terminals. Certain inevitable losses occur in the transmission line between the antenna and the transmitter, and in the diplexer. The amount of power lost in these elements should be computed and added to the power required at the antenna terminals to arrive at the total transmitter power required.

If the antenna height is great and rephasing of the antenna is desirable, the antenna gain will be reduced. This must be taken into account in these computations.

Power-Handling Capacity:

The power handling capacity of the antenna must be great enough for its intended load without overheating and break-down. This data, of course, must be obtained from the manufacturing companies. Some manufacturers have indicated that they will produce antennas in two power-rating groups. Many antennas in use before the end of the freeze cannot handle enough power to provide maximum permissible ERP. Many new models will, of course, have higher power ratings.

For the most part, the power-handling ability of a television transmitting antenna is limited primarily by the feed harness and junction boxes installed originally. It may be possible in many cases to install a new feed system in order to increase the power rating of an antenna already installed. This would be difficult to do in the average installation without removing the antenna from the tower. The cost involved in lowering the antenna for the job, making the harness substitution, and re-installing the same antenna would be considerable in itself, and would involve taking the station off the air for possibly a week. In any event, the gain could not be changed by this means. It will usually be more satisfactory to choose one of the following alternatives:

1) Order an antenna for the original installation which can handle all the power it is ever contemplated to use. If it is intended eventually to reach maximum permissible ERP, it is pertinent to consider that antennas of high gain need have less total power-handling capacity to provide an ERP equivalent to that of low-gain antennas. For example, an antenna with a gain of 12 would have to handle only about 26 kw. input power to provide 316 kw. ERP, while another antenna having a gain of 3 would have to handle over 100 kw. for the same output.

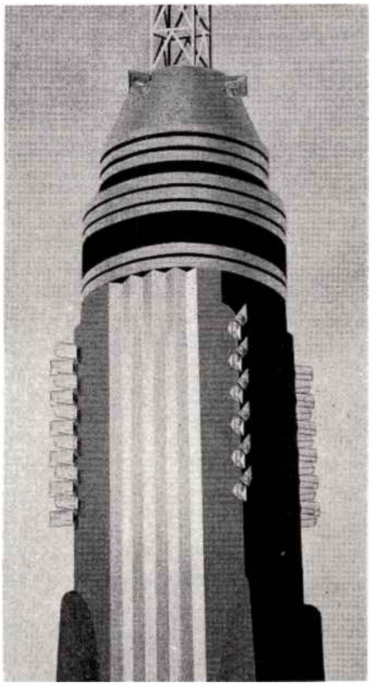


FIG. 10. TWO VHF SKEW ANTENNA INSTALLATIONS

2) If the original construction budget is tight for a station beginning operation with relatively low power (and it will be in most cases), the second alternative may be more practical. It may be better to purchase new or second-hand an antenna that will meet the immediate needs of the station. Then, after two or three years when the advisability of high-power operation can be better evaluated, a new antenna can be procured. It is quite possible that a ready market will be found for the original model.

VHF Antennas:

Most common of the VHF television antennas is the turnstile, consisting of crossed dipoles fed in quadrature, as described previously. This type of antenna is used extensively for general-purpose installations. It cannot be used where the antenna elements must be fastened to a tower directly, since a relatively thin pole or mast is required in order to achieve horizontal pattern circularity, nor can it be employed universally for applications where special directional patterns are desired.

Fig. 9 shows a typical turnstile antenna. Because of the unusual construction of the individual radiators, necessary to provide broadband radiation and uniform current distribution over the elements, it is sometimes referred to as a batwing antenna.

Turnstile antennas are manufactured by RCA under the trade name Superturnstile, and by General Electric Company. The following charts show the standard VHF turnstile antennas available from these manufacturers. It should be emphasized again that changes and modifications can be obtained on special order in most cases.

TURNSTILE ANTENNAS

CHANNELS	BAYS	AV. GAIN*
2 & 3	3	3.55
2 & 3	5	5.58
2 & 3	6	6.3
2 & 3	12	11.5
4 to 6	3	3.85
4 to 6	4	5.1
4 to 6	5	5.9
4 to 6	6	6.74
4 to 6	12	13.6
7 to 9	6	6.58
7 to 9	8	8.5**
7 to 9	12	12.55
10 to 13	6	7.0
10 to 13	8	9.0**
10 to 13	12	13.35

* Results of recent tests made with newly-developed gain testing facilities indicate that these figures may be high by the following amounts: 3-bay antennas, 30%; 4-bay antennas, 26%; 5-bay antennas, 22%; 6-bay antennas, 18%; and 12-bay antennas, 10%.

** Estimated.

RCA makes also a line of VHF antennas for special purposes called Supergain antennas. The basic element of this antenna is a dipole radiator in front of a screen reflector ½ wavelength wide. Four of these screens can be fastened to the four faces of a tower in order to provide an omnidirectional radiation pattern. The individual bays can then be stacked one above another to increase gain and vertical directivity.

A basic advantage of this arrangement is that a tower structure with a cross-sectional area great enough to support almost any practical number of bays can be employed. Thus, gain is limited only by maximum beam sharpness. Rather than adding a great number of elements to a single antenna, however, two or more antennas can be installed on the same tower if desired. An excellent example of this advantage put to use is the Empire State Building multiple antenna system.

Finally, the Supergain antenna can be operated so as to provide almost any desired horizontal radiation pattern by adjustment of feed to the individual elements.

While this antenna is more versatile, it is more complicated also and therefore more expensive. It has been pointed out that its practicality depends on unusual circumstances.

Another antenna developed for special applications is the Skew antenna, made by the Andrew Corporation. With conventional designs, it is difficult or impossible to obtain a circular horizontal radiation pattern from antenna elements placed around a supporting structure larger than a half wavelength on a side. It was found, however, that by mounting dipoles with reflectors so that the radiation from each element was aimed at a tangent from the supporting structure rather than directly away from it, thus giving a skewed pattern from each element, the total pattern from four or more elements placed symmetrically around a structure up to 10 wavelengths in diameter can be made to approach circularity closely.

At present, the Skew antenna is custom-designed and built for each application, so that no general specifications can be given. At the time of writing, one installation had been completed and one was in process. Both are additional installations on the mooring mast of the Empire State Building, as shown in Fig. 10. At the top of the mast, a 4-element single-layer auxiliary antenna for WJZ-TV can be seen. This installation has been completed. The diameter of the mast at the point where the elements are fastened is 3.6 wavelengths, and the measured horizontal pattern is circular within ±2.55 db. Below, on the square section of the mast, a 48-element installation for WATV is planned, consisting of 6 bays of 8 elements each. Although the structure is nine wavelengths on the diagonal at that point, it is claimed that the horizontal pattern circularity will be better than ±2.2 db.

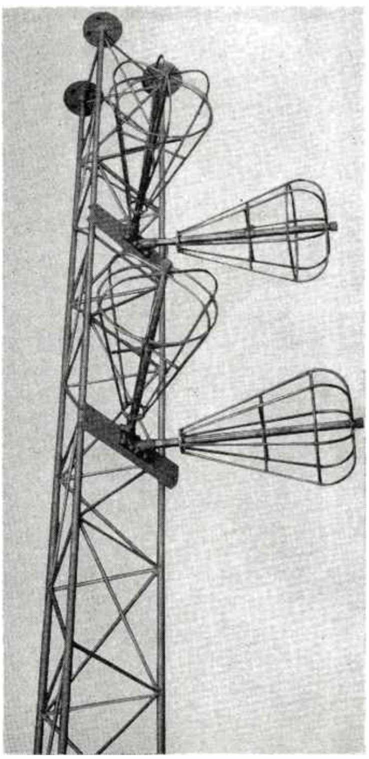


FIG. 11. TWO BAYS OF A VHF MULTI-TV ANTENNA

Fig. 11 shows another type of VHF array made by Andrew, called the Multi-TV antenna. According to the manufacturer, two objectives guided the design of this antenna: economy, so that the Multi-TV would cost considerably less than other antennas providing the same gain, and a useful directional radiation pattern, corresponding to the shapes of typical cities which are seldem laid out as perfect circles. It can be seen that the Multi-TV is a simple, lightweight assembly of two conical elements per bay. The two conical sections are mounted at an angle of 70° on one side of a triangular tower. The remaining two sides of the tower are completely unobstructed for climbing purposes. Horizontal radiation in the maximum direction is slightly less than 10 times that in the minimum direction. As pointed out earlier, it is expected that the FCC will permit this much directivity provided that its purpose is to improve local coverage rather than to solve an allocations problem.

Following are the specifications for standard antennas of this type:

ANDREW MULTI-TV ANTENNAS

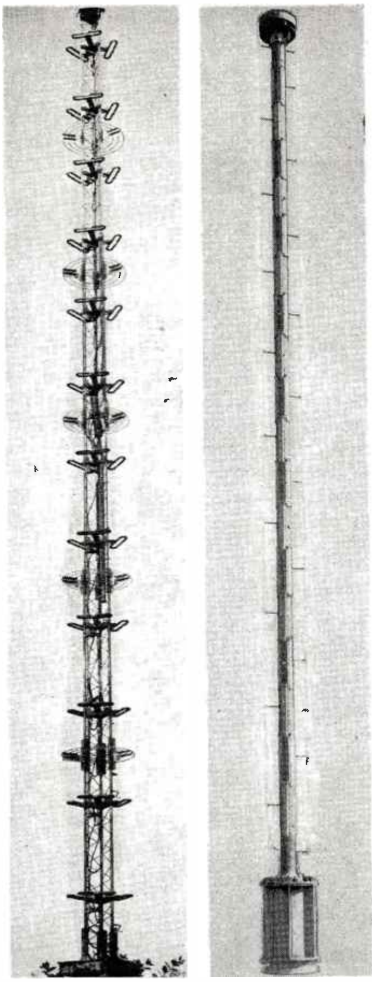
CHANNELS	BAYS	MAX. INPUT POWER, KW.	AV. GAIN
2-6	4	10	3.4
7-13	4	10	3.4
7-13	8	20	6.9

Federal Telecommunication Laboratories supplies the Triangular Loop Antenna for channels 7 to 13. Each bay of this array consists of 3 folded-dipole radiators spaced at 120° intervals around a triangular supporting structure. Horizontal circularity of this antenna is claimed to be better than ±.6 db.

The antenna can be supplied for any channel in the upper VHF band with any even number of bays up to 16. A typical 12-bay antenna is shown in Fig. 12. Standard models have the specifications listed below:

FEDERAL TRIANGULAR LOOP ANTENNAS

BAYS	AV. GAIN
2	2.0
4	4.0
8	8.4
12	12.8
16	17.1



FIGS. 12 AND 14. TWELVE-BAY TRIANGULAR LOOP VHF ARRAY AND 18-BAY SLOT ANTENNA FOR UHF

Also, for cases where high towers and high-gain antennas must be used, the following models are designed especially for good close-in coverage:

BAYS	AV. GAIN
8	7.4
12	11.8
16	16

UHF Antennas:

Transmitting antennas for UHF are considered separately because they are, in general, radically different in configuration from VHF models. At the present time, only 3 manufacturers have UHF antennas ready for production: GE, RCA, and Workshop Associates. Others have developmental models in process, but no specific information on them was available at the time of writing.

General Electric manufactures the side-fire helical antenna shown in Fig. 13.

Each bay consists of approximately 10 turns of conductor wound in a helix about a cylindrical mast. The helix is reversed at the center of the bay in order to cancel, as nearly as possible, the vertically-polarized field component. Each bay is 5 wavelengths long, and is fed only at one end of the helix.

The antenna can be furnished with any number of bays up to 5. Since each bay provides a gain of 5, any gain figure that is a multiple of 5 can be obtained, from 5 to 25 inclusive. Horizontal pattern circularity is within ±.7 db.

At 500 mc., the length of one bay is about 10 ft. Thus, a 5-bay antenna would be on the order of 50 ft. long. At 900 mc., however, this is reduced to about 28 ft. For very high installations, the beam can be tilted down electrically by rotating one part of the antenna slightly in relation to the rest of the antenna.

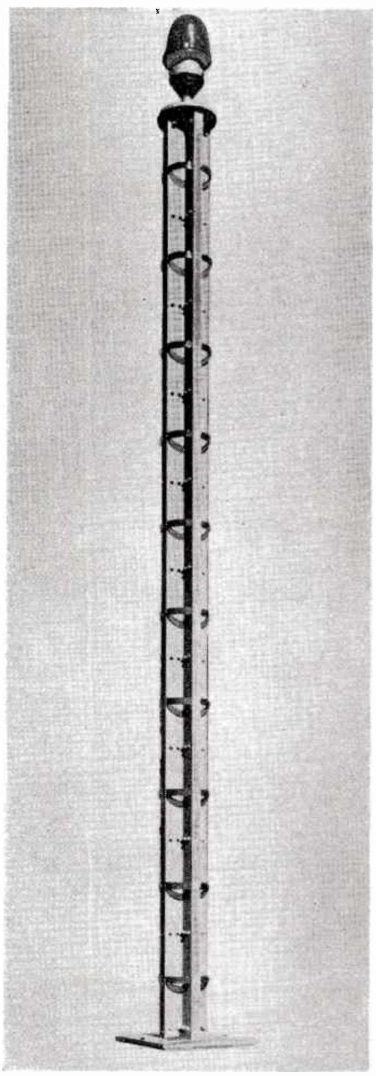


FIG. 15. BASIC SECTION OF UHF SLOT ANTENNA

RCA's UHF antenna design utilizes the slot-radiator principle. Each bay consists of 3 one-inch slots approximately 1.3 wavelengths long, spaced equally around a hollow cylinder and parallel to the axis of the cylinder. Adjacent layers of slots are rotated 60° around the cylinder to provide an almost perfectly circular horizontal radiation pattern.

Each individual slot is fed at the center. The inside of the cylinder serves as the outer conductor of the feed system, and a coaxial copper tube within the cylinder serves as the inner conductor. A coaxial line is installed within the inner conductor to provide center feed. The total length of the antenna, Fig. 14, depends on the frequency of operation and the number of bays provided. Standard models are composed of 16 to 18 bays. This provides a gain of approximately 24 from 470 to 625 mc., with a length of about 40 ft.; a gain of 26 from 625 to 750 mc., with a length of about 37 ft.; and a gain of 28 from 750 to 900 mc., with a length of about 34 ft. These figures are not exact, of course, since they will vary according to the channel frequency.

Maximum power-handling capacity of the standard antennas is 10 kw. Either mechanical or electrical beam-tilting, or both, can be accomplished easily to adjust the antenna for best local coverage. Directional antennas can be obtained on special order, as can increases in power-handling capacity.

Fig. 15 shows the UHF antenna developed by Workshop Associates. Four aluminum structural angles are joined so as to form four slots, which are fed at

FIG. 13. ABOUT 3½ BAYS ARE VISIBLE OF A 5-BAY SIDE-FIRE HELICAL ANTENNA FOR UHF-TV

one-wavelength intervals by a single conductor in the center of the antenna. The curved radiating elements form a surface essentially cylindrical in shape, providing a horizontal radiation pattern circular within 1 db. However, directional radiation can be obtained if desired.

The standard antenna structure is 10 wavelengths long, and has a power gain of 12.6. Two of the units can be stacked to double the gain.

Antenna Costs:

In order to feed the outputs of the visual and aural transmitters to the same an-

(Continued on page 31)

FCC Television Grants

RADIO COMMUNICATION Magazine, in line with its policy of providing complete information on matters of interest to the industry, is presenting each month data on television station CP's, channel changes, and power increases granted by the FCC. Actions listed below are for the period from August 16 to September 26, 1952.

Information given for CP grants consists of the city, channel number, visual and aural ERP's, estimated cost of construction, and principal owner or owners. If grantee controls audio broadcast station, call letters are given in parentheses. For existing TV stations granted channel changes or power increases. information given consists of cities, call letters, old and new channels, and old and new visual ERP's. Grants are listed alphabetically by states. A star preceding a channel number indicates that the authorization is for a non-commercial educational station.

CONSTRUCTION PERMITS GRANTED

	CH.	KW.	COST
Montgomery, Ala. Capitol Broadcasting Co. (WCOV-AM-FM)	20	88-44	$275,000
Little Rock, Ark. Little Rock Telecasters	17	22-12.5	$211,500
Fresno, Calif. McClatchy Broadcasting Co. (KMJ)	24	105-53	$626,600
Los Angeles, Calif. Univ. of Sthn. Calif.—Allan Hancock Fndn.	*28	46-26	$150,000
Denver, Colo. Mountain States Television Co.	20	89-53	$323,400
Peoria, Ill. West Central Bcstg. Co. (WEEK)	43	175-88	$518,600
Rockford, Ill. Winnebago Television Corp.	39	15.5-9.2	$180,000
South Bend, Ind. South Bend Tribune (WSBT)	34	170-88	$300,000
Fall River, Mass. New England Television Co.	46	19.5-9.8	$170,600
Ann Arbor, Mich. Washtenaw Bcstg. Co., Inc.	20	1.75-.93	$108,000
Jackson, Miss. Mississippi Publishers Assn.	25	205-105	$404,000
Syracuse, N. Y. Univ. of State of New York	*43	200-105	$251,500
Akron, Ohio Summit Radio Corp.	49	145-72.5	$352,800
Massilon, Ohio Midwest TV Co.	23	99-50	$257,900
Youngstown, Ohio Polan Industries	21	170-85	$326,000
Harrisburg,Pa. WHP Inc. (WHP)	55	240-120	$362,000
New Castle, Pa. WKST Inc. (WKST)	45	20.5-10.5	$152,600
Reading, Pa. Eastern Radio Corp. (WHUM)	61	260-135	$614,300
Reading, Pa. Hawley Bcstg. Co. (WEEU)	33	225-120	$440,900
Columbia, S. C. Palmetto Radio Corp. (WNOK)	67	680-340	$409,300
Columbia, S. C. Radio Columbia (WCOS)	25	89-45	$247,100
Chattanooga, Tenn. Chattanooga TV, Inc. (WMFS)	49	20-10	$205,300
Chattanooga, Tenn. Tom Potter	43	275-140	$313,500
Austin, Tex. Tom Potter	24	280-145	$372,800
Houston, Tex. Univ. of Houston (KUHF-FM)	*8	30.2-15.4	$600,000
Roanoke, Va. Roanoke Bcstg. Corp. (WSLS)	10	250-125	$320,000
Roanoke, Va. Radio Roanoke, Inc.	27	105-62	$264,100

AUTHORIZED CHANNEL CHANGES AND POWER INCREASES

	CALL	CH.	KW.
Schenectady, N. Y.	WRGB (TV)	4 to 6	18.25 to 98

COLOR TV GLOSSARY

AT the June 23 meeting of the National Television System Committee, chairman R. M. Bowie of NTSC Panel 19 (Definitions) submitted a list of tentative definitions for color television terms. The glossary was approved for publication recently and was distributed to members of NTSC and RTMA, and to manufacturers of electronic equipment who are not RTMA members, with the specific statement that "these definitions are tentative in form and are submitted for information only, since they may be changed from time to time as the art progresses."

Obviously, it will be to the best interests of all concerned with television, particularly color television, to achieve nomenclature and usage standardization as quickly as possible. For that reason, the glossary is published here in its entirety in order to promote industry-wide familiarity with the terms.

APPROVED WORKING DEFINITIONS FOR COLOR TELEVISION

BLACK-AND-WHITE — Deprecated (see MONOCHROME).

BRIGHTNESS — The attribute of visual perception in accordance with which an area appears to emit more or less light.

NOTE — Luminance is recommended for the photometric quantity which has been called "brightness." Luminance is a purely photometric quantity. Use of this name permits "brightness" to be used entirely with reference to the sensory response. The photometric quantity has been often confused with the sensation merely because of the use of one name for two distinct ideas. Brightness will continue to be used properly in nonquantitative statements, especially with reference to sensations and perceptions of light. Thus, it is correct to refer to a brightness match, even in the field of a photometer, because the sensations are matched, and only by inference are the photometric quantities (luminances) equal. Likewise, a photometer in which such matches are made will continue to be called an "equality-of-brightness" photometer.

A photo-electric instrument calibrated in footlamberts should not be called a "brightness meter." If correctly calibrated, it is a "luminance meter." A troublesome paradox is eliminated by the proposed distinction of nomenclature. The luminance of a surface may be doubled, yet it will be permissible to say that the brightness is not doubled, since the sensation which is called "brightness" is generally judged to be not doubled.

BRIGHTNESS CHANNEL — Deprecated (see MONOCHROME CHANNEL, LUMINANCE CHANNEL).

BRIGHTNESS SIGNAL — See MONOCHROME SIGNAL.

BURST PEDESTAL (COLOR BURST PEDESTAL) — The rectangular pulse-like component which may be part of the color burst. The amplitude of the color burst pedestal is measured from the AC axis of the sine-wave portion to the horizontal pedestal.

BYPASS MIXED HIGHS — The mixed-highs signal that is shunted around the color-subcarrier modulator or demodulator.

BYPASS MONOCHROME SIGNAL — A monochrome signal that is shunted around the color-subcarrier modulator or demodulator.

CAMERA SPECTRAL CHARACTERISTIC — The sensitivity of each of the camera color separation channels with respect to wave-length.

NOTE 1 — It is necessary to state the camera terminals at which the characteristics apply.

NOTE 2 — Because of non-linearity, the spectral characteristics of some kinds of cameras depend upon the magnitude of radiance used in their measurement.

NOTE 3 — Non-linearizing and matrixing operations may be performed within the camera.

CAMERA TAKING CHARACTERISTICS — Deprecated (see CAMERA SPECTRAL CHARACTERISTIC).

CARRIER COLOR SIGNAL — The sidebands of the modulated color subcarrier (plus the color subcarrier, if not suppressed) which are added to the monochrome signal to convey color information.

CHROMINANCE — The colorimetric difference between any color and a reference color of equal luminance, the reference color having a specified chromaticity.

NOTE — In NTSC transmission, the specified chromaticity is the zero subcarrier chromaticity.

CHROMINANCE CHANNEL — In a color television system, any path which is intended to carry the carrier color signal.

COLOR BURST — That portion of the composite color signal comprising the few sine-wave cycles of color subcarrier frequency (and the color burst pedestal, if present) which is added to the horizontal pedestal for synchronizing the color-carrier reference.

COLOR CARRIER — See COLOR SUBCARRIER.

COLOR-CARRIER REFERENCE — A continuous signal having the same frequency as the color subcarrier and having fixed phase with respect to the color burst. This signal is used for the purposes of modulation at the transmitter and demodulation at the receiver.

COLOR COORDINATE TRANSFORMATION — Computation of the tristimulus values of colors in terms of one set of primaries from the tristimulus values of the same colors in another set of primaries.

NOTE — This computation may be performed electrically in a color television system.

COLOR DIFFERENCE SIGNAL — An electrical signal which, when added to the monochrome signal, produces a signal representative of one of the tristimulus values (with respect to a stated set of primaries) of the transmitted color.

COLOR EDGING — Spurious color at the boundaries of differently-colored areas in the picture.

NOTE — Color edging includes color fringing, misregistration, etc.

COLOR PHASE (of a given subcarrier component)— The phase, with respect to the color-carrier reference, of that component of the carrier color signal which transmits a particular color signal.

COLOR PHASE ALTERNATION (CPA) — The periodic changing of the color phase of one or more components of the color subcarrier between two sets of assigned values.

NOTE 1 — In the NTSC system, the color phase is changed after every field.

NOTE 2 — It is recommended that the term COLOR PHASE ALTERNATION be used in place of the terms OSCILLATING COLOR SEQUENCE and FLIP-FLOP, which have been used with this same meaning.

COLOR PICTURE SIGNAL — The electrical signal which represents color picture information, consisting of a monochrome component plus a subcarrier modulated with color information, excluding synchronizing signals.

COLOR SUBCARRIER — The carrier whose modulation sidebands are added to the monochrome signal to convey color information.

COLOR SYNC SIGNAL — See COLOR BURST.

COLOR TRANSMISSION — In television, the transmission of a signal wave for controlling both the luminance values and the chromaticity values in a picture.

COMPATABILITY — The nature of a color television system which permits substantially normal monochrome reception of the transmission by typical unaltered monochrome receivers designed for standard monochrome.

COMPOSITE COLOR SIGNAL — The color picture including blanking and all synchronizing signals.

CONSTANT LUMINANCE TRANSMISSION — A method of color transmission in which the carrier color signal controls the chromaticity of the produced image without affecting the luminance, the luminance being controlled by the monochrome signal.

DELAY DISTORTION — That form of distortion which occurs when the envelope delay of a circuit or system is not constant over the frequency range required for transmission.

ENVELOPE DELAY — The first derivative of the phase shift with reference to the frequency.

NOTE — If the phase is measured in radians and the frequency in radians per second, the envelope delay will be in seconds.

FIELD — One of the two (or more) equal parts into which a frame is divided in interlaced scanning.

FLIP-FLOP — Deprecated (see COLOR PHASE ALTERNATION).

FREQUENCY OVERLAP — In a color television system, that part of the frequency band which is common to the monochrome channel and the chrominance channel.

NOTE — Frequency overlap is a form of band-sharing.

GAMMA — In a color or monochrome channel, or part thereof, the coefficient expressing the selected evaluation of the slope of the used part of the log vs. log plot relating input (abscissa) and output (ordinate) signal magnitudes as measured from the point corresponding to some reference black level.

NOTE 1 — As the log vs. log plot is usually not entirely straight in the used region, it is necessary to formalize that evaluation of the slope, for example, by the use of the value at a particular point, maximum, mean, or other value. The method of evalution must be stated.

NOTE 2 — At some points the signal may be in terms of light intensity or light transmission.

GAMMA CORRECTION — The modification of a transfer characteristic for the purpose of changing the value of gamma.

LUMINANCE — Luminous flux emitted, reflected, or transmitted per unit solid angle per unit projected area of the source.

NOTE 1 — Usual units are the lumen per steradian per square meter, the candle per square foot, the lambert, the millilambert, and the footlambert.

NOTE 2 — This quantity is also called photometric brightness.

LUMINANCE CHANNEL — In a color television system, any path which is intended to carry the luminance signal.

NOTE — The luminance channel may also carry other signals, for example, the carrier color signal, which may or may not be used.

LUMINANCE SIGNAL — A signal wave which is intended to have exclusive control of the luminance of the picture.

LUMINOSITY — Ratio of photometric quantity to corresponding radiometric quantity in standard units (lumens per watt).

LUMINOUS FLUX — The time rate of flow of light. When radiant flux is evaluated with respect to its capacity to evoke the brightness attribute of visual sensation, it is called luminous flux, and this capacity is expressed in lumens.

MATRIX (as a noun) — In color television, an array of coefficients symbolic of an operation to be performed, which operation results in a color coordinate transformation. (This definition is consistent with mathematical usage).

MATRIX (as a verb) — In color television, to perform a color coordinate transformation by computation or by electrical, optical, or other means.

MATRIXER (MATRIX UNIT, MATRIX CIRCUIT, ETC.) — A device which performs a color coordinate transformation by electrical, optical, or other means.

MIXED HIGHS — Those high frequency components of the picture signal which are intended to be reproduced achromatically in a color picture.

MODULATED COLOR SUBCARRIER — See CARRIER COLOR SIGNAL.

MOIRE — In television, the spurious pattern in the reproduced picture resulting from interference beats between two sets of periodic structures in the image.

NOTE — Moires may be produced, for example, by interference between regular patterns in the original subject and the target grid in an image orthicon, between patterns in the subject and the line pattern and the pattern of phosphor dots of a three-color kinescope, and between any of these patterns and the pattern produced by the carrier color signal.

MONOCHROME BANDWIDTH (of the signal) — The video bandwidth of the monochrome signal.

MONOCHROME BANDWIDTH (of the monochrome channel) — The video bandwidth of the monochrome channel.

MONOCHROME CHANNEL — In a color television transmission, any path which is intended to carry the monochrome signal.

NOTE — The monochrome channel may also carry other signals, for example, the carrier color signal which may or may not be used.

MONOCHROME SIGNAL (in monochrome television) — Transmission of a signal wave for controlling the luminance values in the picture but not the chromaticity values.

MONOCHROME SIGNAL (in color television) — That part of the signal wave which has the major control of the luminance of the color picture and which controls the luminance of the picture produced by a conventional monochrome receiver.

MONOCHROME TRANSMISSION — In television, the transmission of a signal wave for controlling the luminance values in the picture, but not the chromaticity values.

OSCILLATING COLOR SEQUENCE — Deprecated (see COLOR PHASE ALTERNATION).

PICKUP SPECTRAL CHARACTERISTIC — The set of spectral responses of the device, including the optical parts, which converts radiation to electric signals, prior to any non-linearizing and matrixing operations.

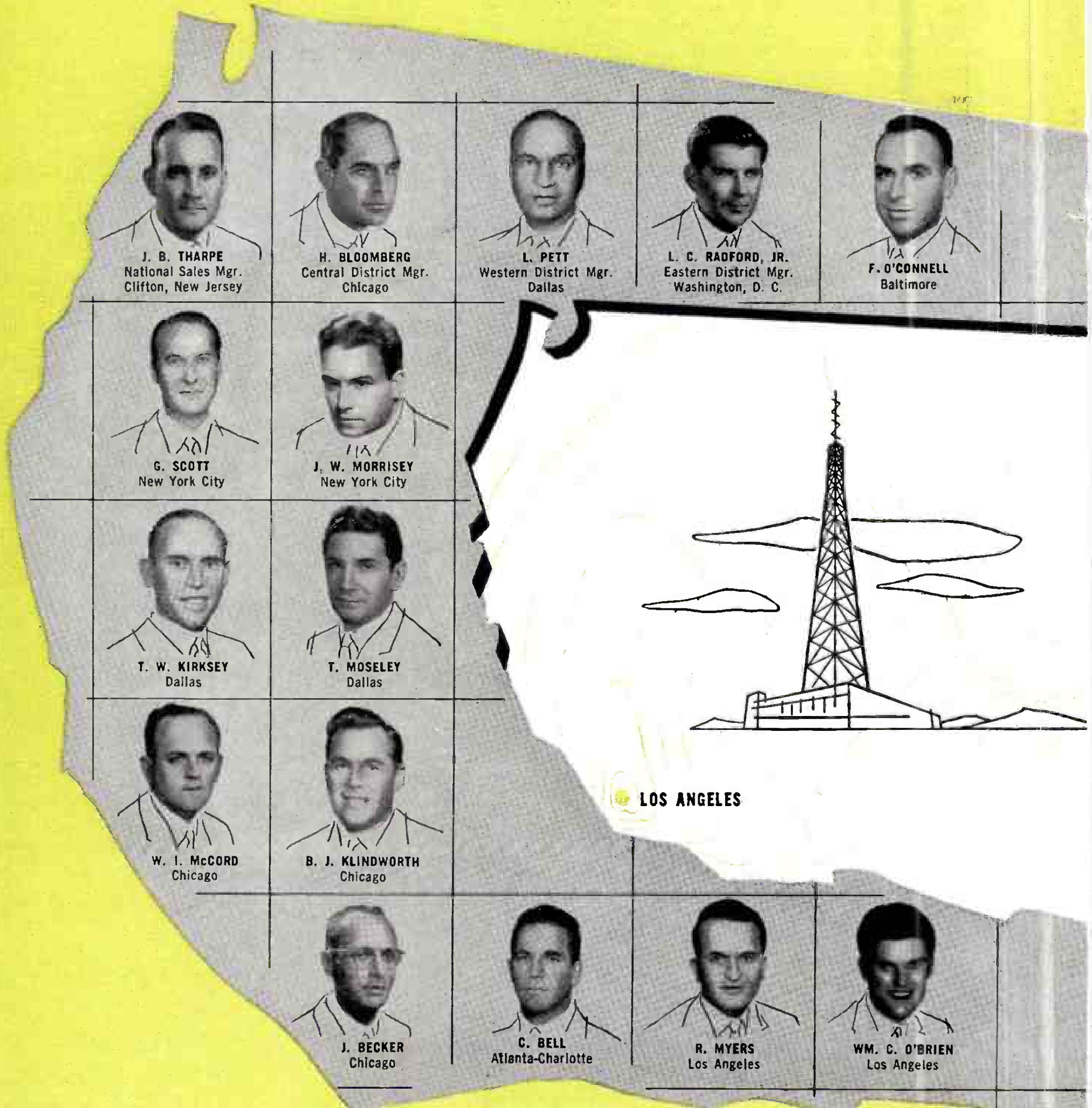
RECEIVER PRIMARIES — The colors of constant chromaticity and variable luminance produced by the receiver, which, when mixed in proper proportions, are used to produce other colors.

NOTE — Usually three primaries are used: red, green, and blue.

STATIONARY CPA AXIS — A fixed reference phase with respect to which a carrier color signal of constant chrominance makes equal and opposite angles for successive fields, this reference phase being the same for all chrominances.

TAKING CHARACTERISTIC — See CAMERA SPECTRAL CHARACTERISTICS.

ZERO SUBCARRIER CHROMATICITY—The chromaticity which is intended to be displayed when the subcarrier amplitude is zero.



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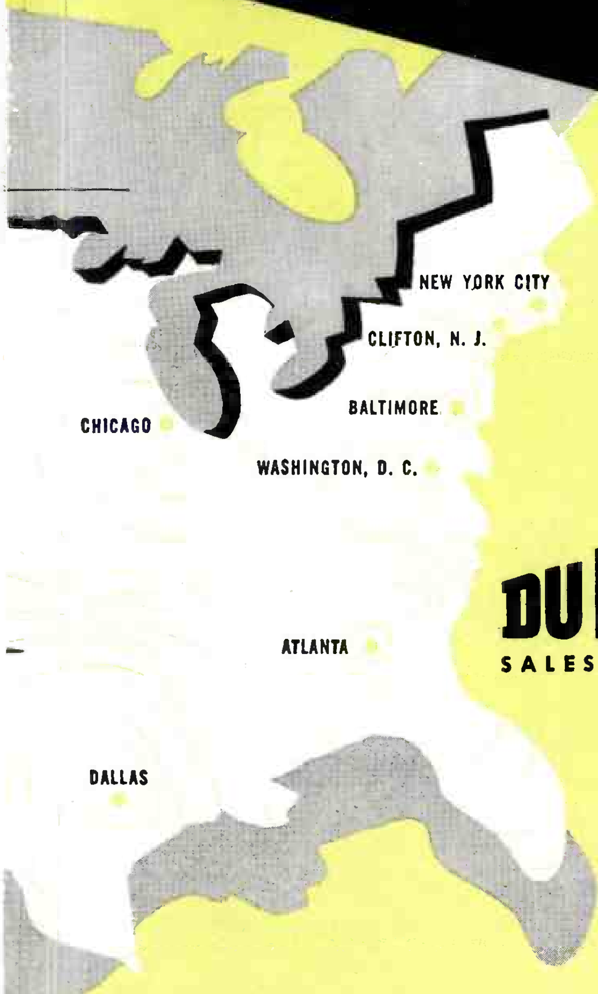

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Square Waves for Audio Testing

HOW NEW SQUARE-WAVE TEST TECHNIQUES CAN FACILITATE DESIGN AND MAINTENANCE WORK ON ALL TYPES OF AUDIO EQUIPMENT—*By* G. E. BAUDER*

SEVERAL articles have appeared recently concerning the merits of square-wave testing for audio equipment. Most, however, have dealt with theoretical rather than practical aspects of the technique, and have not mentioned the speed and ease with which the square-wave generator can be employed in audio design and maintenance work.

It is the purpose of this article to describe actual service procedures in such a way that the reader will be able immediately to put this relatively new tool to work. No attempt will be made to discuss the rather involved theory; instead, a brief description of the square wave itself will be given in order to substantiate the claims made for it, followed by interpretations of typical square-wave response curves.

The Square Wave:

In order to gain a better understanding of the square wave, the reader should plot roughly a series of sine waves. Beginning with a frequency of 100 cycles, draw sine waves of equal amplitude and with gradually increasing frequencies, starting each one at the same place on the base line. As the frequency is increased, it will be noted that the upper left-hand corner of the graph, or the leading edge, becomes increasingly sharper; that is, the time required for the voltage to rise from zero to maximum becomes progressively less as the frequency is increased. This steepness of slope is expressed as *rise time*, and it is a measure of the high-frequency content of the square wave.

Returning to the sine waves, if graphs were drawn for progressively higher frequencies up to about 10 kc., the total pattern would resemble a square. A square-wave generator has an output essentially the same. The voltage rises quickly from zero by virtue of the high-frequency components to a value which is determined by the resultant amplitude; it stays there for a period of time determined by the low-frequency components, and then falls to zero. The fundamental frequency of a square wave composed of the frequencies charted would be about 1 kc. It should be evident that the square wave is a valuable tool which can be used to determine in one test a circuit's response over the whole frequency range from one-tenth the fundamental frequency to ten times that frequency. By selecting the optimum square-wave frequency, it is possible to test the response characteristics of audio or video circuits, and the accuracy of the results is limited only by the characteristics of the square-wave generator and the oscilloscope used with it.

Test Equipment:

It would be well at this point to consider the requirements that must be met by test equipment, in order that square-wave test results be valid. Some square-wave generators produce sine waves, which are squared only once by a simple clipping circuit. The result is only a flat-topped sine wave, which is of little use in true square-wave testing. High-frequency components are not present because of the relatively slow rise time. The leading edge of the square wave is rounded somewhat, as the resultant would have been if only a few harmonic sine waves were used in plotting the square wave as discussed previously. Obviously, this sort of waveform would be useless for high-frequency testing. Other types of generators produce square waves having better rise-time characteristics because the original sine wave is first clipped severely, then amplified and clipped again. This can be repeated until the wave has quite steep sides, and the rise time may be in the order of one microsecond or less. This type of generator is quite satisfactory. It should be mentioned that some laboratory instruments have rise-time characteristics on the order of a few hundredths of one microsecond.

Fortunately, the oscilloscope requirements are not so stringent, and can be met by almost any good service-type instrument. Vertical amplifier band-pass must, of course, exceed that of any circuit to be tested. A flat response from 10 cycles to 200 kc. is necessary for audio test work. Video circuits require oscilloscope response good to 5 or 10 mc.

Checking Response:

Before starting any actual testing, it is advisable to connect the output of the square-wave generator directly into the oscilloscope, and to observe the waveform at several different frequency settings. This will give a quick check on both generator and 'scope performance. Any slight irregularities evident then can be taken into consideration when the waveform is observed with a test amplifier in the circuit. The oscillographs used to illustrate this article were made using a Tektronix model 514-D oscilloscope and a model 105 square-wave generator.

In Fig. 1, a 10-kc. square wave was fed to the input of a Williamson-type audio amplifier. The oscilloscope was connected to the 8-ohm winding of the output transformer with an 8-ohm speaker. The faithful reproduction of the original square wave indicates the smooth response to 100 kc. that is characteristic of this fine amplifier. The ripple appearing in the flat portions of the square wave, Fig. 1, is the result of a slight tendency toward ringing at a frequency of about 250 kc., and is evident because of the extremely fast rise time (.02 microsecond) of the generator. However, because it is of very high frequency and low amplitude, it is in no way objectionable.

The generator was then connected to the phono input of a preamplifier designed by this writer especially for the Williamson. It employs independent bass and treble controls which boost or attenuate either end of the audio spectrum. With various settings of these controls, it can be observed how the square wave indicates accurately any deviation from flat response. Because the bandpass of this preamplifier is 20 cycles to 20 kc., the square-wave generator was set at 2 kc. With the tone controls both set at the middle positions, the waveform shown in Fig. 2 was obtained, indicating again a flat response.

Now, if the response of the amplifier is changed by varying the tone-control settings, the square wave test gives an instant indication. Fig. 3 shows the result of boosting the high frequencies about 15 db. The bass control was left in the flat-response position. In Fig. 4 the opposite setting was used, with the bass boosted 15 db and the treble left flat. Fig. 5 shows the curve with both controls set for 15 db boost; and Fig. 6, both controls set for 15 db attenuation. The bass control of this preamplifier was designed for maximum effect at 40 cycles. Therefore, if it were desired to obtain an accurate indication of the circuit behavior at these lower frequencies, it would be necessary to reset the square-wave generator to about 200 cycles.

Upon studying the curves indicated, it can be seen that the square-wave

*Branch Manager, Tektronix, Inc., 8118 Harford Road, Baltimore 14, Maryland.

test provides an instantaneous response curve very similar to those with which everyone is familiar, with but one exception: the square-wave curves are reversed, with the high-frequency indications appearing on the left, and the low-frequency indications appearing on the right. On becoming familiar with this reversal, any type of equalizer circuit can be evaluated or adjusted quickly.

So far, only circuits operating properly have been discussed. However, square-wave testing is particularly valuable in locating obscure troubles. Fig. 7 shows ringing, a type of distortion that is quite common, yet almost impossible to detect without square-wave analysis. This effect is caused by an unwanted resonant condition somewhere in the circuit being tested, usually at a point where an inductance is used. In feedback amplifiers this condition may cause sustained oscillations, usually at superaudible frequencies, which may consume a large part of the amplifier's available power. Such a condition may not be evident at low volume levels, but often causes the amplifier to break up long before reaching its rated output.

Ringing is, many times. not severe enough to result in sustained oscillations. It occurs then only when a high-frequency signal shock-excites the circuit. Many musical sounds, particularly those of percussion instruments, have very steep wave fronts which can shock-excite a circuit not properly designed.

It is the writer's opinion that a tendency to ring, or an inability to reproduce faithfully a steep wave front, is responsible for the lack of presence noted in many amplifiers. Feedback, although beneficial in most other respects, only serves to aggravate this tendency. With a square-wave generator, this trouble can be located quickly and easily. Ordinary signal-tracing methods, using the oscilloscope probe, will serve to spot the individual stage or circuit at fault. Also, the screen of the oscilloscope shows the results immediately as steps are taken to remedy the defect.

A good example of ringing is shown in Fig. 8. This was the response curve of a popular make of amplifier as it came from the factory. The square-wave frequency used was 1 kc., indicating an undesirable resonance at 8 or 10 kc., well within the audio range. Although it was not, in this case, severe enough to cause sustained oscillations, it resulted in considerable distortion at the higher frequencies. The addition of a 300-mmf. capacitor in parallel with the feedback resistor effected a complete cure, and a marked improvement in tone quality was evident.

In conclusion, it seems necessary only to state that the square-wave generator is capable of producing the equivalent of a complex group of frequencies simultaneously, thus making extremely rapid circuit-analysis practical. The same technique is useful for testing everything in an audio system from microphone to speaker, as well as tape and disk recorders, and for testing high-frequency circuits and components as well.

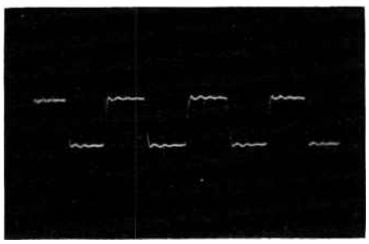


FIG. 1. 10-KC. CURVE, WILLIAMSON AMPLIFIER

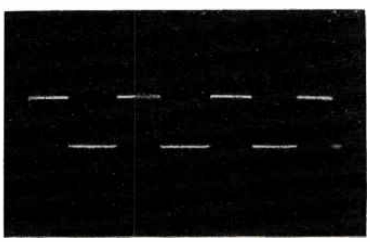


FIG. 2. 2-KC. CURVE, AMPLIFIER AND PREAMP

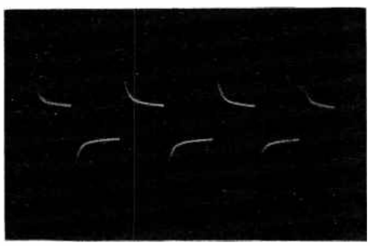


FIG. 3. HIGH FREQUENCIES ARE BOOSTED 15 DB

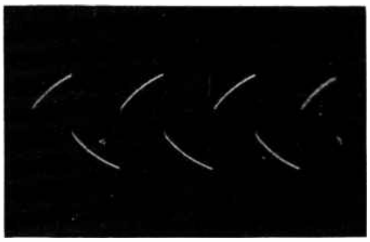


FIG. 4. BASS FREQUENCIES ARE BOOSTED 15 DB

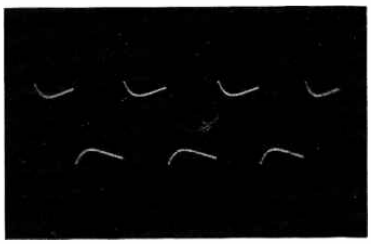


FIG. 5. BASS AND TREBLE BOTH BOOSTED 15 DB

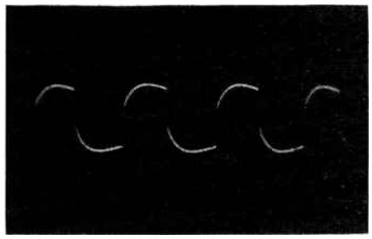


FIG. 6. BASS AND TREBLE BOTH DROPPED 15 DB

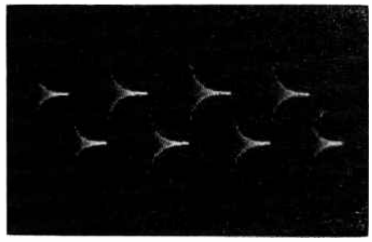


FIG. 7. RINGING DUE TO UNDESIRED RESONANCE

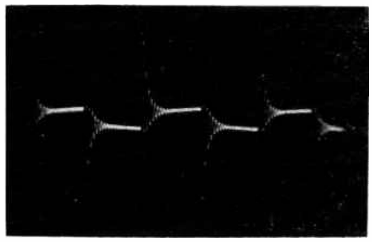


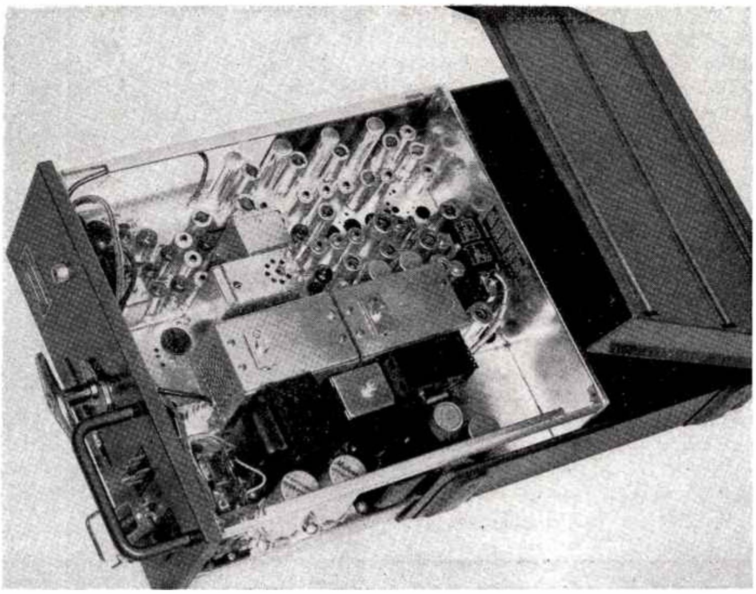
FIG. 8. 1-KC. CURVE SHOWS RINGING AT 10 KC.

Compound Diffraction PA Speaker System

A public address loudspeaker system introduced recently by Electro-Voice, Inc., of Buchanan, Michigan, incorporates several interesting new design features. Model 848-CDP compound diffraction projector consists of two coaxially mounted diffraction horns driven by the two sides of a single diaphragm. Each horn has a rectangular mouth. Dimensions of the bass horn mouth are 10½ by 20½ ins. The unit is 20 ins. deep overall, and is molded of Fiberglas.

It is claimed that this design provides better bass reproduction, extending the low range by ½ octave compared to conventional reentrant-type projectors. The upper limit has been extended also to 11,000 cycles ±5 db. Dispersion is better than 120° up to 10,000 cycles. For outside operation, the assembly is weather, blast, and splash-proof. It contains drain holes so that it can be operated shortly after complete immersion. Rated for 25 watts at 16 ohms, it can be used singly or in a multi-speaker system indoors or out. Mounting bracket is furnished for horizontal or vertical installation. Total weight is 12 pounds.

Full details can be obtained by writing for Bulletin 195.



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Communication News

FOR THOSE WHO ARE CONCERNED WITH MOBILE, POINT-TO-POINT, & MICROWAVE RELAY SYSTEMS

THREE years ago, it looked as if the use of radio for communication (non-broadcasting) purposes would soon reach a point of saturation, and that equipment sales would be accounted for principally by replacements. Actually, while annual replacements are now about 1,000 fixed stations and 20,000 mobile units, sales of fixed transmitters in 1952 will total about 6,000, with nearly 40,000 mobile units.

While it is easy enough to increase the production of transmitters and receivers, there is no simple way to step up the supply of licensed operators who, according to FCC Rules, must handle all service work involving frequency adjustments on transmitters. The shortage of licensed operators will probably become acute in 1953. And if an FCC Inspector finds that communication equipment is being serviced by unauthorized personnel, he can close down the entire system.

Channel Shortage Problem:

At the IRE convention of communication engineers to be held at Hotel Statler, Washington, on December 3 and 4, the principal topic of discussion will be frequency conservation, with emphasis on split-channel operation. While this promises a substantial degree of relief at 30 to 50 mc., it does not yet appear that it can be applied to the 152 to 172-mc. band.

The simplest, immediate remedy on that band is to move on to 450 to 460 mc., where channels are available for industrial, public safety, transportation, and domestic public services. There is still much reluctance to undertake such a drastic change, and to make the investment required to replace equipment now in use. That same attitude prevailed back in the days when the use of 152 to 162 mc. was regarded as a risky undertaking that might or might not prove successful.

But with so many more systems to be accommodated on the air during the next year, 1953 will probably see widespread use of 450 to 460 mc. In many cases, newcomers will have no choice but to move in up there.

Reorganization:

Expansion of West Coast activities in the communication field is marked by the the acquisition of Kaar Engineering Corporation by Pacific Associates, Inc. Kaar sales for 1952 are estimated at $500,000, of which 90% will be 2-way communication equipment, and the balance marine depth sounders and direction finders.

John M. Kaar, who will retain a one-sixth interest, is the vice president, chief engineer, and a director under the new setup, with Charles C. Bowen of Pacific Associates as president and a director. Other directors are Duke O. Hannaford, Dwight F. McCormack, and Edward R. Bunting. Additional capital is being made available for expansion of the company.

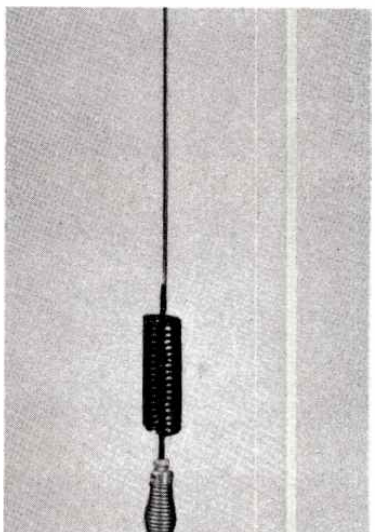
Antenna Mountings:

For buses and trucks which must use top-mounted antennas, a new design has been brought out by Ward Products Corp., 1523 E. 45th Street, Cleveland 3. The length of the whip normally used on 30 to 50 mc. has been reduced by terminating it in a coil which is part of the whip, and also serves as a spring. This section is carried by a friction-free base spring, as shown in the accompanying illustration. Thus the two springs provide sufficient flexibility that the whip is not damaged when the vehicle passes under an obstruction allowing a clearance of only 4 ins. The junction box on which the base spring is mounted carries a coaxial connector and a condenser to assure a good match to a 50-ohm line.

New FCC Application Forms:

Beginning soon after January 1, applications to the FCC for new construction or modification of existing facilities in the public safety, industrial, and land transportation services will be filed on

(Continued on page 28)



ONLY 4-IN. CLEARANCE NEEDED FOR THIS TYPE

Using Arc-Discharge Tubes in

Regulated Low-Voltage Supplies

SMALL THYRATRON TUBES ARE USABLE IN LOW-VOLTAGE REGULATED POWER SUPPLIES EMPLOYING RELATIVELY SIMPLE CIRCUITRY—*By* GAIL E. BOGGS*

The use of small thyratron arc-discharge tubes as low-voltage regulators is described.

The type 2050 thyratron provides a nominal output voltage of 10.25 volts and a tube current range of 5 to 35 milliamperes. A typical regulator using this tube is shown to have a regulation of 2.5% over a 14-milliampere load current range. Voltage regulation of 0.5 per cent can be obtained over a restricted range of load current. Circuitry for the use of these tubes is exceedingly simple, and performance is comparable to that of the glow-discharge type of regulator.

COLD-cathode gas diodes have been used widely in simple and economical circuits in order to obtain regulated voltages. These tubes are designed for fixed voltage drops of approximately 55 to 150 volts, depending upon the type of gas used, the gas pressure, electrode spacing and area, and other factors. In the VR series, the tube current can be varied from 5 to 30 milliamperes with about one volt change in the tube voltage drop.

For voltages below 55, these tubes are not used when the regulated source must deliver current to the load. The series type of regulator may be used instead. With outputs on the order of 10 volts, however, difficulty is often experienced in obtaining the correct operating voltages for the amplifier tube of a series-type regulator unless a negative voltage is available for the cathode.

Arc-discharge tubes, such as small thyratrons, can be used as parallel voltage regulators[1] in the region of 8 to 20 volts, since the arc drop is relatively constant. It should be noted that the tube voltage drop may differ by several volts among tubes of the same type. Therefore, when replacing tubes in this regulator, it may be necessary to try more than one tube if a specific output voltage is required. Lower voltages can be obtained with arc tubes because the voltage drop across the tube is approximately the ionization potential of the gas employed. In general, however, mercury vapor tubes are not recommended because of their temperature sensitivity and restricted temperature range.

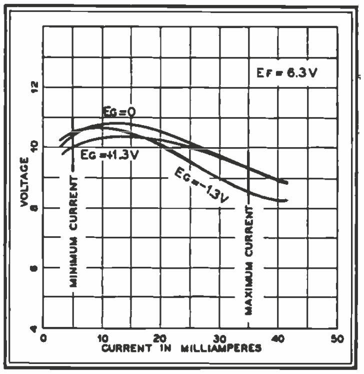


FIG. 1. REGULATOR CHARACTERISTICS FOR 2050

Type 2050 Thyratron: The regulator characteristic for the type 2050 thyratron is shown in Fig. 1. In order to ensure stable operation, a minimum tube current of 5 milliamperes should be maintained. The maximum tube current is arbitrarily limited to 35 milliamperes since, at this value, the voltage fluctuates about 20 millivolts. This fluctuation may be caused by heating of the tube electrodes, although the maximum current rating of the tube is 200 milliamperes. The firing voltage is not known with accuracy, but reliable operation is obtained with an available firing voltage of approximately 15 volts. The nominal tube drop is about 10.25 volts.

Inspection of the curves of Fig. 1 reveals that the best regulation characteristic is obtained with a slightly positive grid. A grid-current limiting resistor is recommended for this type of operation. With a grid positive by about 1.3 volts, the change in tube voltage drop is approximately one volt over the recommended current range. This value is nearly the same as that obtained with the VR series of tubes but in this case the percentage of change is, of course, much larger.

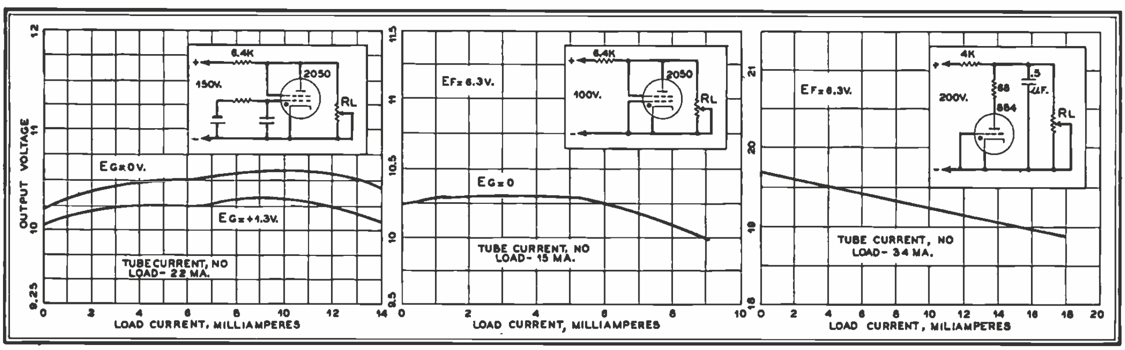
It should be noted that when the type 2050 is operated at currents as large as 150 milliamperes, the regulation is very poor, approximately 25% for a 100-milliampere current change. In addition, the random voltage fluctuation may be as great as 100 millivolts. Voltage regulation on the order of 0.5 per cent can be obtained with this tube if the current change is greatly restricted.

The regulation obtained with changing load currents is shown in Figure 2. In this case, with a slightly positive grid, the regulation is about 2.5% over a load current range of 0 to 14 milliamperes. If the load current is restricted to the range of 4 to 12 milliamperes, 0.5 per cent

(Concluded on page 30)

*Radio Engineer, Ionospheric Research Section, Central Radio Propagation Laboratory, National Bureau of Standards, Washington 25, D. C.

[1] C. S. Harrill, "Low-Impedance Bias Source for Class-B Modulators," *QST*, Vol. 35, May, 1951, page 69.



FIGS. 2 AND 3. PERFORMANCE OF 2050 FOR VARIOUS LOAD CURRENT CHANGES. FIG. 5. CIRCUIT AND PERFORMANCE UNDER LOAD OF THE 884 THYRATRON

Microwave Protective Relaying

HOW ONE OR MORE CHANNELS ON MICROWAVE EQUIPMENT CAN BE UTILIZED FOR POWER TRANSMISSION-LINE PROTECTIVE RELAYING—*By* H. W. LENSNER*

THE rapid expansion of power systems during recent years has accentuated the need for high-speed fault clearing in order to improve stability and continuity of service. Pilot-channel relaying has long been utilized for high-speed simultaneous breaker operation, and the advantages of such forms of relaying are well known. Both pilot-wire and power-line carrier channels are used widely to transmit the necessary information between stations. Pilot-wire relaying is suited particularly to large metropolitan areas where line sections are relatively short, and leased or private cable circuits are available. For longer power circuits and interconnections, power-line carrier operation has an economic advantage, and provides for additional services. In many sections of the country, however, the available carrier channels are being exhausted rapidly because of expansion and the trend toward centralized system control.

In the last few years, microwave radio has become recognized as a new means for expanding and improving the operation of a power system[1]. This new type of communication has several advantages. It is independent of the power line, so that no line traps or high-voltage coupling capacitors are needed. Furthermore, it is not necessary to take a line section out of service to check or maintain any component of the microwave equipment. Being dissociated from the power line, performance of the channel is unaffected by line noise or switching disturbances. Extensive tests in the 960-mc. band[2] have demonstrated that operation is essentially independent of weather conditions.

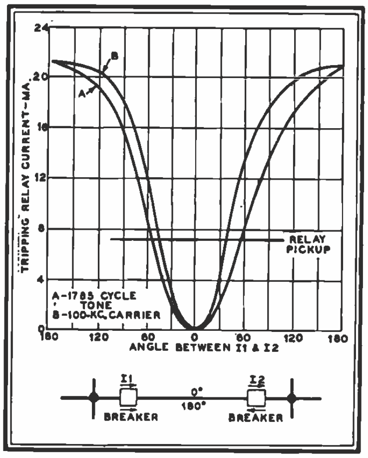


FIG. 3. OPERATION OF A PHASE-COMPARISON SYSTEM FOR AUDIO TONE AND 100-KC. CARRIER

It is the purpose of this paper to point out several methods of utilizing microwave channels for protective relaying. Adaptations of existing forms of power-line carrier relaying, and several schemes applicable only to microwave relaying, will be discussed as well as some operational problems related to microwave channel performance.

Adapting Old Systems:

The first thought that occurs when contemplating the use of microwaves for protective relaying is adapting present forms of power-line carrier relaying equipment for use over a microwave channel. For such service, an audio tone is used as the carrier rather than the microwave frequency itself, which is capable of providing many voice channels simultaneously. The term *audio tone* as used here is not restricted to a frequency audible to the human ear, but indicates any frequency within the modulation capability of the microwave equipment. Audio tones in a nominal voice channel of 250 to 3,150 cycles can modulate the microwave carrier directly, or can be impressed on one of the multiplexed voice channels.[3] If the full complement of voice channels is not used, tones of higher frequency (up to 30 kc. for 960-mc. microwave signal) can be employed to modulate directly the microwave carrier also. Such direct modulation has an advantage in that the multiplexing units in both the transmitter and receiver are bypassed. This results in considerable simplification, since fewer tubes and circuits are involved.

Both the directional-comparison-distance [4,5] and the phase comparison[6] types of relaying can be adapted readily for use with a tone carrier signal. The units required for the directional-comparison system are shown in block diagram form in Fig. 1. As in conventional carrier-relaying, the phase and ground relays control blocking signal transmission through the carrier auxiliary relay.

*Westinghouse Electric Corp., Relay Engineering Department, Newark, New Jersey. This article is an expansion of a paper presented at the 1952 Winter General Meeting of the AIEE.

[1]"Microwave Channels for Power System Applications," an AIEE Committee Report. *AIEE Transactions*, Volume 68, part 1, 1949, pages 40 to 42.

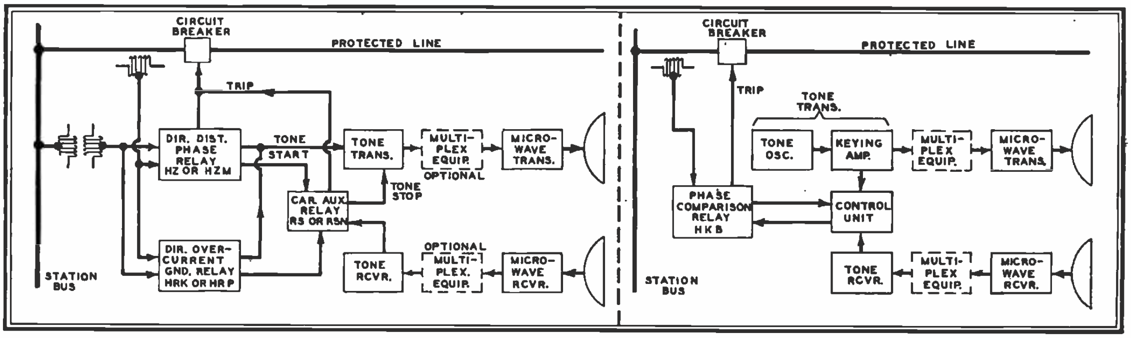
[2]"Field Testing A Microwave Channel," by D. R. Pattison, M. E. Reagan, S. C. Leyland, and F. B. Gunter, *AIEE Transactions*, Volume 69, 1950 (T-0151).

[3]"The Principles and Prospects of Microwave Communication," by F. S. Mabry, *Westinghouse Engineer*, May, 1949.

[4]"A New High-Speed Distance-Type Carrier-Pilot Relay System," by E. L. Harder, B. E. Lenehan, and S. L. Goldsborough, *Electrical Engineering (AIEE Transactions)*, Volume 57, January, 1938, pages 5 to 10, 291 to 294.

[5]"A Distance Relay with Adjustable Phase Angle Discrimination," by S. L. Goldsborough. *Electrical Engineering (AIEE Transactions)*, Volume 63, Nov. 1944, pages 835 to 838.

[6]"A New Carrier Relaying System," by T. R. Halman, S. L. Goldsborough, H. W. Lensner, and A. F. Drompp, *Electrical Engineering (AIEE Transactions)*, Volume 63, August 1944, pages 568 to 572.



FIGS. 1 AND 2. ELEMENTS OF DIRECTIONAL-COMPARISON AND PHASE-COMPARISON TONE RELAYING SYSTEMS FOR MICROWAVE CHANNEL APPLICATIONS

Because the time constants of circuits at the tone frequencies are longer than at carrier frequencies, it may be necessary to incorporate some delay in the carrier trip circuit to allow for the buildup time of the restraint current, which is derived from the received tone. This delay is in the order of only 0.5 to 0.7 cycle (on a 60-cycle basis) when using standard voice-frequency tones, and can be dispensed with entirely when wideband high-frequency tones, above the normal voice band, are used. Because of the wider pass-band of the filter, the buildup time of these tones is considerably less.

Since the tone-blocking channel is not used for any other function, as it may be with power-line carrier, the tone can be transmitted continuously, thus providing a means for supervising the channel. Even with continuous tone transmission, the tone buildup time must be considered because of the relay operation during a power reversal which takes place when non-simultaneous breaker operation occurs. When the first breaker opens, there may be a reversal in the direction of transmission of the blocking signal, at which time the delay in buildup of the restraint current must be taken into consideration for correct relay operation.

The elements of a phase-comparison tone relaying system for microwave-channel use are shown in Fig. 2. A single-phase output voltage from the phase-comparison relay energizes the control unit. This device controls the transmission of half-cycle (at 60 cycles) blocks of tone energy. The tone transmitter is made up of two parts: an oscillator, which operates continuously; and a keying amplifier, which controls the tone transmission. This arrangement is used to avoid the delay in buildup time which would result if an attempt were made to key the oscillator directly, as is done at carrier frequencies for which the circuit time constants are short enough to permit direct oscillator keying. As explained previously, the relaying tone may modulate the microwave signal either directly or through audio mulutiplexing equipment. The received tone pulses are separated from the rest of the microwave receiver output signals using a wide-band filter to minimize delay, and are compared with the phase position of the local relay output in the electronic control unit.

Again, because of the longer time-constants of the tone filters and associated circuits, the received pulses of tone-restraining voltage lag approximately 2.5 milliseconds (55 degrees on a 60-cycle basis) behind the transmitted signal. To compensate for this delay, the local operating voltage is shifted a like amount for proper operation of the comparing circuits. Without such compensation, the relay might either trip on external faults or block on internal faults. There is no particular advantage, from a relaying standpoint, of continuous transmission of the tone blocking signal with phase-comparison relaying, since the tone must be started and stopped 60 times a second during a fault. However, if continuous supervision is desired, the tone can be transmitted continuously except during the time of a fault.

The operating characteristics of a phase-comparison relaying system with a 100-kc. carrier and a 1,785-cycle tone are plotted in Fig. 3. By proper choice of circuit constants, these two characteristic curves are brought reasonably close together. The blocking angle for either type of channel is approximately the same, and the variation above the tripping relay pickup current is of no consequence.

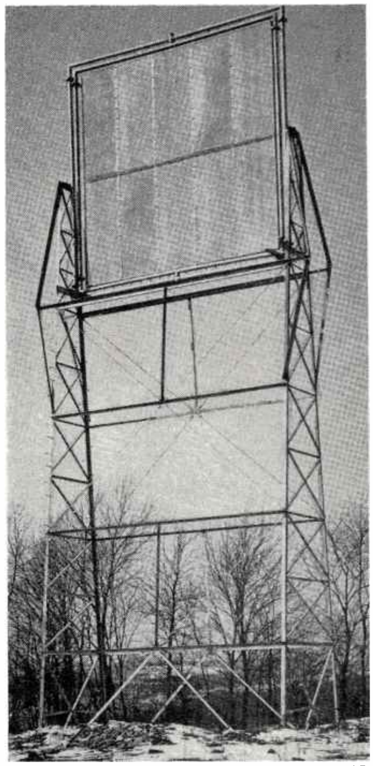


FIG. 5. A PASSIVE REPEATER, CONSISTING OF REFLECTOR ANTENNA MOUNTED ON ±10° GIMBALS

Field Experience:

A field installation of microwave equipment, operating on 960 mc. and providing for distance and phase-comparison relaying, was made on the system of the Pennsylvania Electric Company. The reliability of the microwave channel was proved conclusively over a 2½-year period of operation. During this time, the reception of the microwave signal was not affected adversely by variations in temperature or other weather conditions. In addition to the relaying, other services on the channel included three voice circuits, two telemetered quantities, and supervisory control of eight points.

Fig. 4 shows the microwave and multiplex equipment and the power-supply components at one terminal. The two cabinets on the left contain the audio tone equipment for relaying, telemetering, and control. The next cabinet contains audio hybrid and signaling equip-

(Continued on page 30)

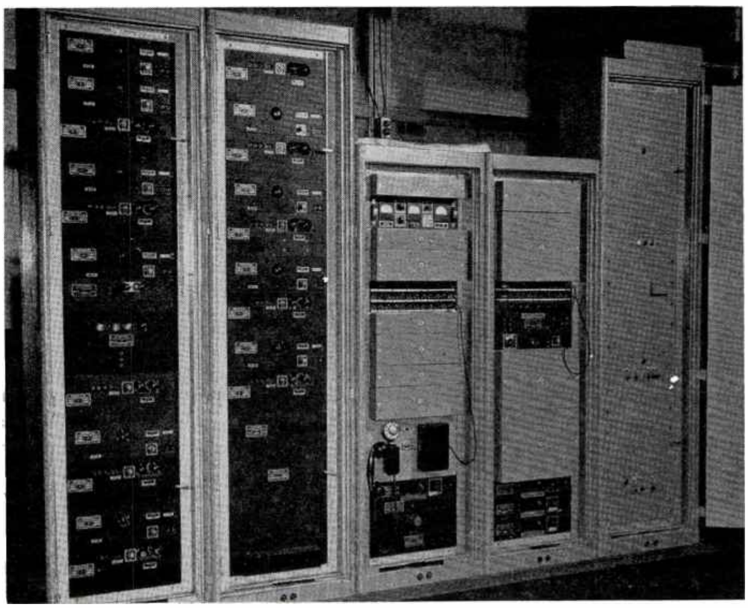


FIG. 4. COMPLETE TERMINAL EQUIPMENT FOR THE TEST MICROWAVE PROTECTIVE RELAYING SYSTEM

Field Service Notes

EXPERIENCE REPORTS ON PRACTICAL PROBLEMS ENCOUNTERED BY COMMUNICATION ENGINEERS

Transmitter Does Not Load:

SOMETIMES what appear to be the most serious troubles turn out to have the simplest solutions. That was my experience with a mobile transmitter which refused to load. The first time it happened to me, I spent many hours checking every part of the transmitter, only to find that it was in the screws holding the antenna mount. I had taken it for granted that the screws, passing through the body of the car, made a perfect ground. But they were loose and slightly corroded. A permanent repair was made by attaching a piece of copper braid for a ground connection. This has been adopted as standard practice on all installations operating in the 30 to 50-mc. band.—*William Guenneurg, Troy. Ill.*

Power Not Switched Off:

At the Public Utility District of Grant County, we have some of the older Motorola "De Luxe" FM mobile units. We have had trouble with run-down batteries because the operators leave the equipment turned on at the end of their shifts. The green indicator light in the control head did not show up well enough in the daytime to call attention to the fact that the power had not been switched off.

The answer was to install a 1-in. green jewel pilot light right next to the microphone hangup box on each car. I used Johnson No. 147-106 pilot lights, with No. 51 bulbs. One terminal lug is turned down and soldered to the frame of the mounting for a ground connection, and the other terminal is connected to the pin connector on plug No. 5 of the Motorola control head. Result is that the light is bright enough to attract the operator's attention to it when it is on during daylight hours, yet the green color is not objectionable at night.—*Carl Johl, Radio Technician, Ephrata, Wash.*

Longer Life for Tower Lights:

With the advent of taller and taller towers for transmitting antennas comes the problem of maintaining the tower lights required. Our own experience with the 1062-ft. tower at WSB-TV indicated that steps can be taken to reduce lamp failure and to provide a means of determining the condition of the lamps at each level without having to climb the tower and inspect each one. The lighting specifications for our particular tower call for illumination at seven levels. Four of these levels have flashing beacons and three have fixed obstruction lights. The 10-watt obstruction lights. give very little trouble since they are not subjected to the on-off switching which affects the life of the beacon lamps.

In order to extend the life of the beacon lamps, we have installed an arrangement which prevents the applied voltage at the lamp socket from going to zero, thereby keeping the filament from being subjected to the impact of voltage applied to cold filaments. This is handled by connecting 600-watt heater elements across each of the mercury contactors which key the voltage to the various levels. When the contactor is closed, the heater element is shorted and the beacon reaches its normal brilliancy; when the contactor opens, the heater element is inserted in the circuit in series with the corresponding beacon, and the reduced brilliancy is such that, although the lamps are not extinguished, the effectiveness of the beacon is maintained.

In order to determine whether all beacons are operating normally with no lamps out, or to determine the locations of burned out lamps, we have installed a 150-volt AC meter which can be switched so that the voltage drop across any of the four heater elements may be read and compared with a chart which had been previously calibrated by actually removing known numbers of lamps at each of the levels. During normal operation of the flasher mechanism, voltage is applied to the meter for only a short period of time, but it is easy to distinguish the difference in the swing of the meter if lights burn out.

Lamps	Voltmeter Readings			
Out	280 ft.	546 ft.	826 ft.	1053 ft.
0	88-122	95-125	93-117	77-94
1	82-103	90-115	87-107	60-70
2	73-92	80-98	77-92	0
3	55-63	60-70	55-60	
4	0	0	0	

This system is essential in determining the condition of the beacon lights when they are completely hidden by mist or low clouds, a situation which occurs quite often in this locality at altitudes of 1,000 ft. or less.—*R. A. Holbrook, Assistant Chief Engineer, WSB, WSB-TV, WSB-FM, Atlanta, Ga.*

FIELD SERVICE NOTES

Every radio system, at the time of installation or in the course of operation, presents special problems which must be solved by communication engineers or maintenance men.

To encourage an interchange of ideas and information, payment of $5.00 to $10.00 will be made for each letter published. Be sure to give your complete name and address.

COMMUNICATION NEWS

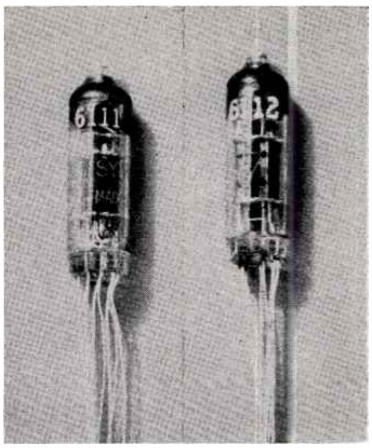
(Continued from page 24)

new forms identified as 400 and 400-A. These will replace forms 401, 401-B, 403, 702, and 703, now in use.

The make and type of equipment will not be filled in on the new forms. When they come into use, the Commission will release a list of equipments acceptable for licensing, comprising equipment previously licensed. This list will be revised gradually to include new equipment which complies with the technical requirements of the FCC Rules. Equipment now in use, on which such a showing has not been made, will be continued on the list for a limited time unless it is found that interference is caused by failure to comply with the Rules.

Reliable-Type Tubes:

Very complete data on characteristics, applications, temperature ratings, and testing methods for 11 reliable-type subminiature tubes will be found in a 40-page brochure issued by Raytheon Manufacturing Company, 55 Chapel Street, Newton, Mass. While the development program on reliable-type tubes was set up specifically in connection with aircraft service, these tubes are suitable for any purpose requiring high dependability and extended life.



6111 AND 6112 TUBES AT ABOUT FULL SIZE

Two subminiature double triodes, illustrated here at approximately actual size, have been added to the reliable-type line manufactured by Sylvania Electric Products, Inc., 1740 Broadway, New York

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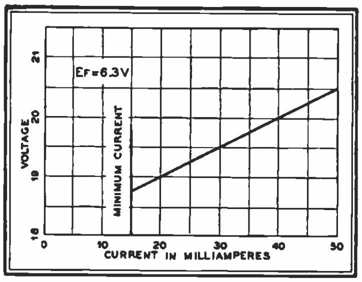

FIG. 4. REGULATOR CHARACTERISTICS FOR 884

REGULATED SUPPLIES

(Continued from page 25)

regulation is obtained. With zero grid voltage, the regulation over the 14-milliampere range is 4%. This is an example of the improvement that can be obtained by operating the tube with the grid slightly positive. Since this type of operation may be inconvenient in many cases, the performance with zero grid voltage is indicated also.

For some applications, very good regulation may be required down to zero load current. It is found that with the tube operated with a no-load current of approximately 15 milliamperes and zero grid voltage, the regulation is 0.5 percent for load currents ranging from zero to 6 milliamperes. This is shown in Fig. 3.

In order to give some indication of time stability, the output voltage of the type 2050 regulator was recorded for a 100-hour period. During this time, the regulator was turned off several times and allowed to cool for one hour. Except for a 10-minute warm-up, the maximum change in output voltage during this period was 70 millivolts.

Type 884 Thyratron: The regulation characteristic for the type 884 thyratron is given in Fig. 4. Voltage required for reliable firing is approximately 25. Minimum tube current for stable operation is approximately 15 milliamperes; the tube drop is 19 volts. Maximum rating of the tube is 75 milliamperes. At this current, voltage fluctuations were less than five millivolts. In one case, some difficulty was experienced with relaxation oscillations at high currents.

In order to reduce the possibility of oscillation, the circuit shown in Fig. 5 was used with the maximum tube current limited to 50 milliamperes. Under these conditions, the change in the tube voltage drop is approximately 1.7 volts in the recommended current range. The 884 regulator appears to provide best regulation with zero grid voltage; therefore, the results are given only for this condition of operation.

Regulation with changing load currents is shown in Fig. 5. The change in output voltage for load currents in the range from zero to 15 milliamperes is approximately 0.7 volts and represents a 3.5% change in output voltage.

This type of regulator was developed to meet the need for a regulated bias supply capable of furnishing small currents. For such applications, it appears to be completely satisfactory and much simpler than the series type of regulator. Fig. 6 shows a developmental low-current supply providing outputs of 300, 150, and 10 volts DC and 6.3 volts AC. Tubes employed are a 5Y3, two VR-150's, and a 2050.

This report is intended only to present a few possibilities of this type of regulator for low voltages. Only two tubes of each type were used in these experiments, and the results are intended only to be indicative of what can be obtained. Such questions as time and temperature stability can be answered fully after sufficient experience has been acquired in the use of arc-discharge tubes as regulators.

FIG. 6. AN EXPERIMENTAL POWER-SUPPLY CHASSIS UTILIZING A 2050 THYRATRON TUBE IN LOW-VOLTAGE SUPPLY CIRCUIT

MICROWAVE RELAYING

(Continued from page 27)

ment for the telephone communication circuits. The fourth cabinet contains the frequency-division multiplexing units, and the cabinet on the extreme right contains the microwave transmitter, receiver, and power-supply units.

A feature of considerable interest on this installation is the use of a flat metallic reflector to provide a continuous path for the microwave beam between the terminal stations. Direct line-of-sight was not available because of intervening hills. The use of such a passive repeater eliminated the need for 2¼ miles of cable planned for originally to connect one of the terminal stations to an intermediate point where a line-of-sight path to the other station was possible.

The reflector, made of perforated sheet aluminum, is shown in Fig. 5. The supporting tower is 60 ft. high, and the center of the 20-ft. square reflector is 50 ft. from the ground. The reflector and tower are designed for 100-mile winds, and for 60-mile winds with a coating of ice thick enough to close up the perforations. Because of the sharp beam of energy reflected from a surface of this size, it is of the utmost importance that the reflector be aimed properly at the antennas of the terminal stations. For ease in making this adjustment, the reflector is mounted in gimbals.

(To be concluded next month)

COMMUNICATION NEWS

(Continued from page 28)

19. Type 6111 is a medium-mu double triode in a T-3 envelope, similar in characteristics to the 6SN7GT. Filament, 6.3 volts, 300 milliamperes; plate, 150 volts, 22 milliamperes, 1.1 watts dissipation; transconductance 5,000 micromhos; amplification factor 20.

Type 6112 is a high-mu double triode in a T-3 envelope, similar in characteristics to the 6SL7GT. Filament, 6.3 volts, 300 milliamperes; plate, 150 volts, 1.25 milliamperes; transconductance 2,-500 microhos; and the amplification factor, 70.

These tubes are intended for use at frequencies up into the UHF band.

PATTERN FOR TV PROFIT

(Continued from page 18)

tenna, without causing interaction between the transmitters, some form of diplexing arrangement is necessary. A diplexer provides a proper load for each transmitter while isolating one from the other, and combines the visual and aural power for common line feed.

Most antennas are supplied with diplexers as standard equipment.. Transmission line for connecting the two is not included, since the cost varies widely according to the individual installation. Deicing equipment, if required, may or may not be included.

Unfortunately, no general cost figures can be quoted for antennas, since there are so many variable factors. However, it can be said that depending on the complexity, gain, power-handling capacity, and operating frequency, a standard television transmitting antenna will probably cost between $10,000 and $100,000. This does not include transmission line or rigging costs, but does include a diplexer. Special non-standard models may cost even more.

Addresses of antenna manufacturers are given below:

Andrew Corporation, 363 East 75th St., Chicago 19, Illinois.

Federal Telecommunication Laboratories, Inc., 500 Washington Avenue, Nutley 10, New Jersey.

General Electric Company, Electronics Dept., Electronics Park, Syracuse, N. Y.

Radio Corp. of America, Engineering Products Dept., Camden, New Jersey.

Workshop Associates Division of the Gabriel Company, 135 Crescent Road, Needham, Mass.

Next month, diplexers, towers, and transmission lines will be discussed.

CLOSED-CIRCUIT TV

(Continued from page 13)

strong winds, a tent should be sewed or tied down so that no light enters behind the stage. If the demonstration is held in a building, then entry doors close to the stage should be guarded. Light in back of the camera is not harmful except for the glare it may cause on the receiver picture tubes. It is preferable to have the complete tent or room shielded from strong outside light which may fall directly on the screens.

The lighting power and camera power circuits should be separate in order to avoid overloading and serious line voltage variations on the camera circuit.

Should an additional source of program material be required, film can be shown by means of a portable projector designed for use with the image orthicon

(Concluded on page 32)

CLOSED-CIRCUIT TV

(Continued from page 31)

camera system. A projector with a 3-2 shutter and a 1,000-watt lamp is set up to project the film picture on a flashed opal screen, as diagrammed in Fig. 8. The camera picks up this picture on the other side of the glass screen. The picture is then fed to the TV receivers just as a live picture from the stage. This system of film presentation has been used by many TV broadcasters, who have found it to be a highly satisfactory and efficient method of television operation.

At the Heart of Illinois Fair in Peoria, Illinois, station WMBD had a large tent with a stage set, which was used for originating its regular AM broadcasts. The shows were picked up by the closed-circuit TV system also, and could be viewed by the audience at the fair grounds. The tent was 40 by 100 ft. in size, with seats for approximately 200 people. In an adjacent tent, 10 television receiver dealers had individual booths, Fig. 7, for displaying their sets. Each booth was provided with five picture feeds. A total of 50 sets was fed by 2 of the 5 Dumitter outputs by means of 12 junction boxes. Two other dealers located at least 400 ft. away were supplied from a third output. The remaining two outputs were used for program distribution to receivers in the main tent. Most of those in the main tent watched a TV receiver rather than the program on the stage.

In Peoria, a non-television area, the closed-circuit TV demonstration was the most successful television promotion the station and the receiver dealers had ever enjoyed. For the first time, thousands of visitors were able to see on TV the shows they had listened to for years on AM. All the dealers had very favorable comments concerning the sales prospects they had obtained.

Conclusions:

Closed-circuit television has many features which make it valuable to both present and future TV broadcasters and industrial users. Some are listed below:

1) It is adaptable for use as a minimum-cost distribution system for both video and audio throughout a television station.

2) Ordinary receivers can be used without modification. The set is tuned exactly as for an off-the-air signal.

3) A great number of sets can be fed by the system, and they can be installed on several floors of a building or otherwise distributed widely.

4) Because the circuit is completely closed, and coaxial cable is used for interconnections, there is no possibility of noise or snow entering the system.

5) It provides a means for bringing a preview of television to a non-TV area, and is a very effective vehicle for preliminary advertising and set sales promotion.

6) The system can be used as a novel sales booster in a retail store.

7) Any event occurring in an inconvenient location or one of limited area can be displayed to a great many viewers in a nearby auditorium or other place of assembly.

8) Finally, and this is more important than it may seem at first, such a system can be of great value to a radio broadcaster who intends to enter the television field. Skilled television technicians and operators cannot be hired easily, nor can present radio personnel make a transition overnight. With a closed-circuit system, on the other hand, the future television staff can become familiar with the problems and techniques of TV equipment. The system can be incorporated later, in its entirety, into the station equipment.

New FCC Applications

This list includes applications for mobile, point-to-point, control, and relay communication facilities filed with the FCC from August 18 to September 12, 1952.

AERONAUTICAL & FIXED

	Mobile Sta.	W.	Mc.	Fixed Sta.	W.	Mc.	
Alaska Aeronautical Radio Inc Box 1121 Juneau							
Ketchikan Alaska 1277 Tongass				1	10	73.50	T
Metlakatla Alaska				1	10	73.50	T
Alaska Airlines Inc Box 2200 Anchorage Alaska							
Teller Alaska				1	100	2.922	NN
						5.622	
						5.652	
Aretic Radio Tel Co Box 1601 Ancharage Alaska				1	75	5.122	A
						5.622	
						5.652	
						5.590	
Airinc 1523 L St NW Washington 5 DC							
Columbia Mo				1	50	128.10	X

AERO MOBILE UTILITY

	Mobile Sta.	W.	Mc.	Fixed Sta.	W.	Mc.	
Tucson Airport Auth Box 1191 Tucson Ariz	1	3-5	121.9				C
National Airlines Inc 3240 NW 27 Av Miami 42 Fla	1	5	121.9				C
Glen L Martin Co Baltimore 3 Md							
Middle River Md	2	5	121.90	1	5	121.90	C
Cessna Aircraft Co Wichita 1 Kans	1	2	121.90				X

AIRDROME ADVISORY

	Mobile Sta.	W.	Mc.	Fixed Sta.	W.	Mc.	
City of Alliance Neb				1	4	122.8	NN
Dohluns Air Service Lake Tomahawk Wisc				1	4	122.8	NN
C F Sylvester Rte 1 Goshen Ind				1	4	122.8	NN
Air Service Inc Bellanca Field New Castle Delaware				1	4	122.8	NN
Kunan Aviation Co Chicago-Hammond Airport							
Lansing Ill				1	4	122.8	NN
W W Hease Fond du Lac Wis				1	4	122.8	NN
Pitman Aviation Serv Sewell N J				1	10	122.8	X
Montgomery Aircraft Corp Box 151 Pottstown Penna							
Limerick Penna				1	4	122.8	NN
State Bd of Education Div of Voc Ed Shubert Bldg							
St. Paul Minn	1	10	122.8				X
A R Doughty Gen Del Isle of Palms S C				1	...	122.80	X
Louis McCollum Vermilion Airport Danville Ill				1	4	122.80	NN
Rutland Municipal Airport Rutland Vt				1	4	122.80	NN
La Crosse Flying Service Mun Airport La Crosse Wis				1	4	122.80	NN

CIVIL AIR PATROL

	Mobile Sta.	W.	Mc.	Fixed Sta.	W.	Mc.	
CAP Alice Flight Tex Wing 506 Presnell Alice Tex				s1	75	2.374	X
						4.507	
						4.585	
CAP Grp 7 Tex Wing Kilgore Tex				1	40	2.374	X
						4.507	
						4.585	
CAP Calif Wing Pasadena Sqdn 17 Bldg 204 Presidio							
of San Francisco Calif				s2	10	148.1	U
Pasadena Calif				s1	10	148.1	U
				1	10	148.1	T
Flintridge Calif				s1	10	148.1	T
CAP Calif Wing El Monte Sqdn 13 Bldg 204 Presidio							
of San Francisco Calif				1	25	148.1	T
CAP Calif Deputy Wing Sqdn 19 Det Unit							
South Gate Calif				s1	20	148.1	T
CAP Kans Wing Hdqtrs Wichita Kans	1	6	4.507	1	6	4.507	R
			4.585			4.585	
CAP Mo Wing Kans City Sqdn 1330 Grand Av Kansas							
City Mo	4	1	5.500	1	10	5.500	TM
	1	10	148.14	1	1	148.14	
CAP Hdq Mo Wing KC Sqdn 2 18 E 32 St Kansas City	5	10	148.14	1	10	148.14	TM
	4	1	5.500	1	1	5.500	
CAP Mich Wing Grp 5 1249 W Columbia Battle Creek							
Irving Mich RR No 1				1	10	148.14	X
					63	4.507	
					63	4.585	
Battle Creek Mich 277 Greenwood				1	15	2.374	X
					15	4.507	
					15	4.585	
					10	148.14	
CAP Mich Wing Sqdn 635-1 182 N 21 St Battle Creek				s2	75	2.374	X
						4.507	
						4.585	
CAP Mich Wing Grp 5 70 Clay St Battle Creek Mich				1	10	148.14	X

POLICE

	Mobile Sta.	W.	Mc.	Fixed Sta.	W.	Mc.	
P. D. Riviera Beach Fla	16	60	155.85	1	120	155.85	M
	10	2	155.37			155.37	
P. D. Main & East Sts Bloomsburg Pa	5	30	155.61	1	30	155.61	G
Rock Eagle Prison Bks Eatonton Ga	5	60	42.02				M
P. D. City Hall 11th & Park Sts Baxter Sprgs Kans	6	60	155.13	1	60	155.13	M
						155.37	
State Highway Patrol Montpelier Vt							
Hill St on Nuissel Farm				1	150	42.86	L
State Hway Patrol 601 Sangamon Springfield Ill							
Nr Springfield Ill				1	150	155.37	M
Nr Sterling Ill					same		
Elgin Ill 254 Raymond St					same		
Blue Island Ill 139 & Cicero					same		
Nr Joliet Ill					same		
French Village nr E St Louis La					same		
Ellis C. S. Arnett Okla	3	120	156.69	1	120	156.69	M
Vermillion Parish Sheriff Abbeville La	10	124	39.50	1	124	39.50	G
P. D. Runnemeade N J 5th Black Horse Pike	5	30	155.37	1	30	155.37	R
	2	2	155.37				D
P. D. Ogden Utah c/o H L Boothe City & County Bldg	60	30	155.01				M

This listing, provided as a regular monthly feature, is made possible by the cooperation of the Federal Communications Commission. Each listing shows the name and address of the applicant. If the transmitter is to be located in a different city, the name of the city appears on the second, indented line. The number, power, and operating frequencies for mobile facilities are shown on the left, and for fixed stations on the right, together with the make of equipment for which applications have been filed. These may, of course, be changed before licenses are issued. Explanation of the code letters used in this listing appears below.

WEEKLY REPORTS

For the benefit of those who want to receive this data in advance, RADIO COMMUNICATION can furnish weekly reports. Requests for information on this service, and questions concerning these listings should be addressed to the Registry Editor.

CODE LETTERS

The following letters indicate the type of facilities for which applications have been filed. Unless indicated otherwise, FM operation is to be employed:

a AM operation	q Control station
b Base station	r Repeater or relay
m Mobile unit	s Fixed
mm Marine Mobile	t Temporary
p Portable unit	u Operational
w Watts	

Make of equipment is indicated by one of these letters:

AA Aircraft Radio	M Motorola
A Hallicrafters	N Gen. Railway Signal
B Belmont-Raytheon	NN Ntl. Aero. Corp.
BB Northern Radio	O Farnsworth
C Comco	P Philco
D Doolittle	Q Collins
E W. Coast Electronics	R RCA
F Federal Tel. & Radio	S Railway R. & S.
G General Electric	SS Sonar
H Harvey	T Bendix
J Comm. Equipment	U Western Electric
K Kaar	W Westinghouse
L Link	WW Wilcox
X Miscellaneous	Y Budelman

P. D. New Orleans La City Hall Annex							
	100	21	154.37	2	100	154.37	R
P. D. South Sioux Falls S D							
	2	140	39.10				M
P D. Paintsville Ky							
	5	25	155.49	1	25	155.49	G
P. D. Colburn Va	1	..	39.50				G
P. D. No Towanda N Y				1	35	158.73	F
State Highway Patrol Tallahassee Fla							
Tampa Fla				1	140	155.37	M
E Palatka Fla				1	140	155.37	M
Genesee C.S. Batavia N Y							
	15	60	39.18	1	60	39.18	M
Grant C.S. Medford Okla							
	5	60	156.69	1	120	156.69	M
State Hway Patrol Box 30 Salem Oregon							
Nr Baker Ore				r1	120	154.77	L
Baker Ore Ore Trail & Estes St				q1	120	156.03	L
Klamath Falls Ore				q1	120	156.03	L
Nr Klamath Falls Ore				q1	120	154.77	L
Nr Medford Ore				q1	120	156.03	L
Nr Gold Hill Ore				r1	120	154.77	L
P. D. 32nd & Herring Sts Waco Tex							
	18	40	155.25	1	120	155.25	M
P. D. Edgeworth Pa	3	60	155.49	1	60	155.49	M
P. D. 570 2nd St Natchitoches La							
	p2	.2	2455	Speedmeter			
State Highway Patrol Rm G6 State Off Bldg Nashville Tenn							
Short Mtn Tenn				1	1kw	42.42	L
P. D. City Hall Dallas Ore							
	4	30	155.25	1	120	155.25	K
Chas Brown Atlanta Mich							
	2	60	42.58				M
			42.74				
P. D. Box 521 Manassas Va							
	30	60	39.5	1	120	39.50	M
Lower Wakefield Twp Bd of Supervisors Bucks C							
Yardley Pa	3	120	27.26				G
P. D. Little Falls N Y							
	15	10	155.61	1	50	155.61	G
Brick Twp P. D. Laurelton N J							L
	1	60	37.18				L
P. D. Woodstock Va	3	60	39.50				M
Tioga County Sheriff Oswego N Y							
	5	3	39.02	1	120	39.02	M
			39.18			39.18	
			39.24				
	25	60	39.02				M
			39.18				
			39.24				
	30	40	39.02				M
			39.18				
			39.24				
P. D. 190 Main St Cumberland Ky							
	1	25	155.13	1	120	155.13	G
Caddo C. S. 200 Bdway Anadarko Okla							
	10	120	156.69	1	120	156.69	M
P. D. 1401 Walnut St Vicksburg Miss							
	4	25	155.43	1	120	155.43	M
	6	120	155.43				
P. D. 1 Terrace Av Elkton Va							
	10	60	39.50	1	100	39.50	M
Jefferson C. S. Dandridge Tenn							
	5	124	37.26	1	124	37.26	G
P. D. Newport Tenn				1	124	37.26	G
State Hway Patrol 2583 W Flagler Miami Fla							
				1	1kw	9 ch	X
						2.804	
						to	
						7.935	
State Hway Patrol Box 1791 Baton Rouge La							
Nr Baton Rouge La				1	120	39.50	M
Nr New Orleans La					same		
Nr Minden La					same		
Nr Scott La					same		
Nr Monroe La				1	30	44.70	M
P. D. 15 E Monument Ave Dayton Ohio							
	p1	4	2455				X
State Hway Patrol Sacramento Calif							
Yreka Calif				1	150	42.34	G
Barstow Calif				1	500	42.34	G
Santa Barbara Calif				1	60	155.43	G
Los Angeles Calif				1	60	155.43	—
Nr La Jolla Calif				1	60	155.43	—
Redlands Calif				1	60	155.43	—
Oroville Calif				1	150	42.34	G
				q1	120	73.42	G
Jarbo Gap Calif				1	150	42.34	G
				r1	120	72.26	G

FIRE

N Greece Fire Dist. Lotta Rd & N Greece Rd							
N Greece N Y	8	30	154.31	1	30	154.31	M
F. D. 29 North Av E Cranford New Jersey							
	6	100	46.06	1	120	46.06	X
St Paul Blvd F. D. 433 Cooper Rd Rochester N Y							
	6	20	154.31	1	60	154.31	M
Pittsford F D Monroe Av Rochester N Y							
	10	20	154.31	1	20	154.31	M
Fire District 147 S Union Spencerport N Y							
	8	20	154.31	1	60	154.31	M
Fire District 38 Market St Brockport N Y							
	12	20	154.31	1	120	154.31	M
F. D. 202 E Wayne St South Bend Ind							
South Bend Ind	25	10	154.19	13	60	154.19	M
Vol F. D. Garfield Av & 3rd St							
West Point Pa	4	75	33.7				
F. D. Middlefield Conn							
	5	30	46.18	1	30	46.18	M
F. D. 603 Ridge Rd West Webster N Y							
	6	30	154.31	1	30	154.31	M
F. D. 13th St & 10th Av Columbus Ga							
	20	15	154.37	1	60	154.37	M
F. D. Saginaw Mich City Hall							
	40	60	154.01	1	600	154.13	M
			154.13				

(Continued on page 34)

NEW APPLICATIONS

(Continued from page 33)

McKays Beach Vol F. D. Valley Lee Md
2 30 33.94 M
Genesee C Mutual Aid Fire Adv Bd Oakfield N Y
Batavia N Y 54 25 46.10 1 60 46.10 M
46.22
F. D. Yardley Pa 8 60 46.10 1 120 46.10 M
p4 .5 46.10
F. D. 50 Whiting St Plainville Conn
10 60 33.94 1 60 33.94 R
F. D. Goose Rocks Beach Kennebunkport Me
1 30 33.70 M
F. D. City Hall Att: M J Corregan Chicago Ill
6361 S Wentworth Av 1 140 154.13 M
Hershey Vol Fire Co W Caracas Av Hershey Pa
6 75 33.90 1 120 33.90 G
3 1.5 33.90 A
F. D. Municipal Bldg Roseville Mich
10 15 154.13 1 60 154.13 M
5 30 154.13
F. D. 528 Tully Rd San Jose Calif
County of Santa Clara t1 60 154.25 M
F D Orangeburg N Y
6 30 46.18 M
p4 2 46.18 M
E Haddam F. D. Moodus Conn
9 60 46.18 1 120 46.18 M
6 30 46.18
Gates-Chili Fire Dist 2355 Ch Av Rochester N Y
6 20 154.31 1 20 154.31 M
Laurelton Fire Dist 405 Empire Blvd Rochester N Y
10 20 154.31 1 20 154.31 M
Vol F. D. 1120 Warren Av Downers Grove Ill
3 20 154.31 1 120 154.31 G
F. D. 212 So Orange Glendale Calif
10 10 153.89 1 250 153.89 M
3 30 153.89
1 60 153.89
Fire Comm 219 Pt Pleasant Rd Rochester N Y
8 20 154.31 1 20 154.31 M
Vol Fire Dept Clinton Md
4 60 33.86 M
Onondoga County Mutual Aid Fire System 104 Tamarack St Liverpool N Y
100 60 46.22 1 120 46.10
Onondaga Hill N Y r1 60 153.89 G
Mattydale N Y q1 60 153.89 G
Syracuse N Y q1 60 153.89 G

FORESTRY

Ga Forestry Comm c/o Director Civil Defense
959 E Confederate Av Box 4839 Atlanta Ga
1 60 159.39 M
Ohio Div of Forestry Chillicothe Ohio
Nr Swanton Ohio 1 75 31.34 —
31.46
State Dept of Forestry Walton Bldg Austin Texas
20 150 37.18 R
Ga Forestry Comm Box 811 Waycross Ga
Nr Jesup Ga 1 30 159.39 M
State Dept of Forestry State Capitol Sacramento
Blacks Mtn Calif (nr Milford)
mr1 120 172.375 L
Santa Ynez Peak (nr Santa Ynez)
mr1 150 172.225 R
175.375
Butte County Calif sr1 150 73.30 R
State Dept of Forestry Box 665 Broken Arrow Okla
Long Prairie Tower Okla 1 30 159.39 M
Beaver Mt Tower Okla 1 30 159.39 M
Round Mt Tower Okla 1 30 159.39 M
State Dept of Forestry Box 1269 Baton Rouge La
Mansfield La 1 75 31.38 L
Coushatta La 1 75 31.50 L
Nr Colfax La 1 75 31.50 L
31.38
State Dept of Forestry New Smyrna Beach Fla
Blountstown Fla 1 120 46.82 C
State Dept of Forestry State Capitol Atlanta Ga
Nr Grange Crossroads 1 30 159.39 M
Nr Louisville Ga same
Nr Stapelton Ga same
State Dept of Forestry Box 410 Buckhannon W Va
Nr Charleston W Va 1 500 37.90 G
37.98
r1 120 74.02 G
Charleston W Va 1340 Wilson St q1 120 72.54 G
State Dept of Forestry State House Augusta Maine
200 60 47.34 q1 120 160.17 M
Portland Me q1 120 72.02 M
Cornish Me r1 120 75.82 M
1 500 47.34 M
Rockland Me q1 120 160.17 M
Union Me r1 120 161.55 M
1 500 47.34 M
Waterville Me q1 120 160.17 M
Athens Me r1 120 161.55 M
Fayette Me r1 120 161.55 M
1 500 47.34 M
Ellsworth Me q1 120 160.17 M
Orland Me r1 120 161.55 M
1 500 47.34 M
Machias Me q1 120 72.02 M
Marshfield Me r1 120 75.82 M
1 500 47.34 M
Bangor Me q1 120 160.17 M
Garland Me 1 500 47.34 M
r1 120 161.55 M
Carroll Me 1 500 47.34 M
r1 120 161.55 M
Rumford Me q1 120 72.02 M
Mexico Me r1 120 75.82 M
1 500 47.34 M
Rangeley Me r1 120 75.82 M
1 500 47.34 M
State Dept of Forestry 100 Nashua St Boston Mass
Lexington Mass 1 124 46.90 G

HIGHWAY MAINTENANCE

Cayuga C Hway Dept Courthouse Auburn N Y
Owasco N Y 50 124 33.06 1 124 33.06 G

SPECIAL EMERGENCY

Burton Freedman MD Wesson Miss
1 10 148.— F
Bangor Implement Co Bangor Mich
8 30 47.42 1 60 47.42 M
M M Lawrence Jamestown Ky
4 60 47.66 1 60 47.66 M
H Vickers Funeral Home Gainesville Ga
10 12 47.46 10 12 47.46 M
M L Kaster Cuba City Wis
1 80 47.62 1 30 47.62 M
R R Biller Mosinee Wis
1 80 47.66 1 120 47.66 M
S D Yates Eaton Ohio
2 30 33.1 1 30 33.10 L
B T Huso Stockton Ill
2 60 47.46 1 60 47.46 M
State of Calif State Capitol Sacramento Calif
1000 3 47.62
Motion Picture Radio Serv Inc 1347 5th Ave
Los Angeles Calif t11 15 2.726 —
T C Hammond Lewisburg Pa
1 120 47.58 1 120 47.58 G
R J O'Hern DVM Cumberland Wis
1 30 47.46 1 60 47.46 M
W R Jackson DVM 7th & Pine Rogers Ark
1 60 30-50 1 60 30-50 M
J W McGinnis, P C Lambert & D L Karre Ord Nevada
3 30 47.50 1 60 47.50 M
L J Swanson Bonduel Wis
2 80 47.46 1 80 47.46 M
D J Loewith Delano & Rock Valley Rds Metamora Mich
3 30 47.58 1 60 47.58 M
V G Alexander DVM 320 Chinot Rd Lexington Ky
2 120 47.66 1 120 47.66 M
J P Lannon 1653-27 Av Columbus Neb
1 30 157.47 1 30 157.47 M
E W Frahm MD 140 W Main Milen Mich
3 30 47.5 1 60 47.50 M
C H Coy 280 S Broad St Hillsdale Mich
4 30 47.46 1 60 47.46 M
C W Ten Broeck MD 147 N Main Camden Mich
3 30 47.62 1 60 47.62 M
E G Boydston 528 Meridian Rd Hudson Mich
2 10 47.66 1 60 47.66 M
Dr Joseph E Dale DVM Box 424 Garden City Kans
1 88 47.50 1 140 47.50 M
Wm E Gladitsch DVM 1809 Priddy St Bloomer Wisc
1 30 47.62 1 60 47.62 M
Dr J A Ladson Olney Md
2 30 47.54 1 60 47.54 M
Fay Smith MD 839 Douglas Imperial Nebr
2 10 3.190 R
Dr H C Ashby Box 148 Lee's Summit Mo
3 30 47.46 1 30 47.46 M
Drs F Bushnell & R C Olmstead 573 Woodbridge
Manchester Conn 2 30 47.58 1 120 47.58 M
D C McKown Rte 78 Franklin N Y
1 40 47.66 1 120 47.66 M
J C Smith 519 S Anna St Stuttgart Ark
2 60 47.66 1 60 47.66 M
Dr W H Gibson 310 S Main Sylvania Ga
2 30 47.58 1 30 47.58 M
J R Langford DVM 137 E Mason Av Daytona Beach Fla
2 60 47.58 1 120 47.58 M
W J Ernst 71 W 14 St Clintonville Wisc
1 80 47.62 1 120 47.62 M
J T Hore DVM Augusta Wisc
1 30 47.50 1 60 47.50 M
W E Lloyd E Main St Essex Iowa
2 12 47.46 1 60 47.46 M
Dr K S Ginrich 515 E Main Richmond Mich
1 90 47.62 1 90 47.62 K
Dr A A Green 859 Cleveland Av Chambersburg Pa
2 60 47.58 1 120 47.58 M

POWER UTILITY

Suburban Pump & Wtr Co 1308 S Central Phoenix Ariz
8 15 153.65 1 15 153.65 R
Fla Power & Light Co 25 SE 2nd St Miami Fla
t4 24 450... M
Rural Electric Div 29th & Tabor Bryan Texas
10 60 48.06 1 120 48.06 M
Carolina Power & Light Co Raleigh N C
Jacksonville N C 2 150 37.62 G
New Bern N C 1 150 37.62 G
Northwestern Public Service Co Huron S D
Webster S D 1 150 37.58 G
Nr Redfield S D same
Aberdeen S D same
Highmore S D same
Nr Clark S D same
Public Serv Co of N H 1087 Elm St Manchester N H
Newport N H 8 60 158.25 1 120 158.25 M
Tri-County Rural Coop Inc 22 Main St Mansfield Pa
Sylvania Pa us1 30 75.82 M
Mountain Elec Coop Box 337 Mountain City Tenn
Shady Valley Tenn 1 60 153.71 M
New England Pr Co Shelbourne Falls Mass
Bellows Falls Vt Bridge St 1 120 37.86 M
Pacific Gas & Elec Co 245 Market San Francisco Cal
Red Bluff Calif 1 120 158.25 L
Jackson Calif us1 60 456.05 L
Nr Jackson Calif q1 60 456.05 L
Nr Pine Grove Calif sr1 60 457.55 L
1 120 158.25
Gary-Hobart Water Corp 19 & Jefferson Gary Ind
5 40 457.55 1 40 457.55 M
City Utilities 4th & Center Mesa Ariz
20 10 153.47 1 30 153.47 M
City Elec Dept 906 Texas Ave Lubbock Texas
Old Plainview Rd 1 120 153.59 M
Claverack EC Inc 507 Main St Towanda Pa
1 30 158.13 M
United Fuel Gas 1033 Quarrier Charleston W Va
15 12 153.65 1 50 153.65 G
Southern Counties Gas Co of Calif Box 2736 Terminal Annex Los Angeles Calif
Nr Santa Paula Calif qr1 20 456.05 M
1 60 153.41 M
153.47
Ventura Calif usq1 20 457.95 M
Singing River Elec Pr Assoc Lucedale Miss
Moss Point Miss 1 100 48.38 K
State Line Miss same
Amere Gas Utilities Co 1033 Quarrier St Charleston W Va
Beckley W Va 7 12 153.65 1 50 153.65 G
Cent Ky Nat Gas Co 166 Walnut St Lexington Ky
7 12 153.65 1 12 153.65 G
S C Pub Serv Auth Moncks Corner S C
Georgetown S C 1 12 47.90 M
Redwood City Utilities Redwood City Cal
20 30 153.59 1 120 153.59 M
Fla Power Corp 101 5th St So St Petersburg Fla
St Petersburg Beach Fla 1 150 48.38 R
Consumers Pub Pr Dist 14th & 25 Av Columbus Neb
Nr Hebron Nebr 1 40 48.18 M
Mun Lt & Pr Dept City Hall Alexandria La
35 40 158.25 1 60 158.25 M
15 30 158.25 B
Mun Util Board East Main St Albertville Ala
10 15 47.90 1 60 47.90 M
Cent Elec & Gas Co 114 S Main Sioux Falls S D
15 30 47.74 1 60 47.74 R
2 30 47.74 A

PIPELINE PETROLEUM

Tri-County REC Inc 22-26 Main St Mansfield Penna
Nr Liberty Pa 1 40 48.06 M
Westfield Pa same
Tide Water Assoc Oil Co Box 1404 Houston Texas
Nr Garden City Tex 1 70 48.98 G
Kerr-McGee Oil Industries Kerr-McGee Bldg Oklahoma City Okla
t4 100 2.292 R
Continental Oil Co Drawer 1267 Ponca City Okla
8 10 153.29 M
Nr Port Isabel Tex 1 500 33.38 M
Interstate Natural Gas Co Box 1482 Monroe La
t1 150 48.58 R
Pan Amer Pipeline Co Niels Esperson Bldg Houston
Nr Arden Texas us1 10 66.50 M
Mich-Wis Pipeline Co 500 Griswold Detroit Mich
Nr Lake George Mich 1 90 48.90 F
Newayo County Mich same
Nr Reed City Mich same
Salt Lake Pipeline Co Box 117 Salt Lake City Utah
t5 60 158.37 M
Humble Oil & Refining Co Box 2180 Houston 1 Tex
Nr Garden City Tex 1 150 48.86 L
Phillips Petroleum Co (Engrg Dept) Bartlesville Okla
Nr Alvin Tex 1 60 33.38 M
Union Sulphur & Oil Corp Sulphur La
Nr Crews Tex 1 12 158.43 M
Ballinger Tex 5 60 158.43 1 60 158.43 M
mr1 60 153.29 t2 12 158.43 M
Leonard Pipeline Co Box 323 Pt Pleasant Mich
Nr Oil City Mich
4 30 49.02 1 60 49.02 M
Petroleum Communications Box 284 Lafayette La
1 40 450.00 M
600 60 152.00 t35 20 450.00 M
Nr Lake Charles La same
Mermentau La same
Church Point La same
Nr New Iberia La same
Garden City La same
Gray La same
Harvey La same
Nr Lake Charles La 1 10 6585 M
1 120 152.00
Lacassine La 1 10 6705 M
6745
Church Point La. same
Nr New Iberia La same
Nr Morgan City La same
Allemands La same
Mermentau La 1 10 6625 M
6685
Lafayette La same
Garden City La same
Gray La same
Harvey same
Mermentau La 1 120 152.00 M
Church Point La same
Lafayette La same
Nr New Iberia La same
Garden City La same
Gray La same
Harvey La same
Mountain Fuel Supply Co Box 1129 Rock Sprgs Wyo
Nr Lyman Wyo 1 125 48.82 M
t1 125 48.82 M
Penna Gas Co 213 2nd Av Warren Penna
Nr Ludlow Pa 1 120 48.78 M
Nr Sackett Pa same
Nr Warren Pa 36 60 48.78 same
15 120 48.78
Sinclair Pipeline Co Sinclair Bldg Independence Kan
McCrea Pa 1 40 1965 F
Mt Union Pa 1 40 1895 F
3 40 1935 F
1 40 1965 F
Eldorado Pa 1 40 1965 F
E Pittsburgh Pa 2 40 1935 F
Greensburg Pa 3 40 1865 F
Johnstown Pa r3 40 1935 F
Altoona Pa 4 40 1865 F

THERE'S PROFIT IN HIGH-FIDELITY

More Money Do you have spare time that you can use to make additional income, perhaps as a way to start a business of your own? Or do you have a radio service shop that can be expanded to handle additional, extra-profit work? Or a radio store where you can find space for fast-moving items that show a higher net?

If so, you should consider getting into the high-fidelity field, and fast, because the time to get started is RIGHT NOW! Already, public interest has reached the point where the dollar volume of hi-fi equipment sales exceeds that of conventional AM radio sets. The attendance at the recent audio shows in Philadelphia and New York far exceeded all expectations. The new Society of Music Enthusiasts reports a veritable avalanche of applications for membership who are forming local listening and discussion groups.

How to Find Out You can see how big and important the hi-fi business has become by looking at the latest copy of HIGH-FIDELITY Magazine. You'll be amazed to see what a big publication it is, and it's getting bigger with each succeeding issue!

The fact is that everything connected with hi-fi is expanding at an almost unbelievable rate. Sales of equipment for high-quality reproduction from FM radio, records, and tape are going up and up, and there is no levelling-off point in sight. Yet for all its progress in the last two years, the public is only beginning to discover the possibilities of fine musical entertainment at home. Relatively few people have had an opportunity to hear a hi-fi system.

How can you fit into this new business? Take two or three evenings to study the new issue of HIGH-FIDELITY Magazine. Go over it carefully, from cover to cover. Read the Noted-with-Interest columns, the Letters from Readers, the elaborately illustrated articles on equipment and installations, the news about recorded music, and the Tested-in-the-Home Reports. Check the advertising. Note the companies and products represented.

By the time you have finished, you will know just what angle fits into your particular situation, and what your first move should be. For HIGH-FIDELITY covers all the aspects of this field, giving you a complete picture of the business, and the people who spend $250 to $5,000 for hi-fi installations, and they keep on spending for further improvements.

From your study of HIGH-FIDELITY, you will come to realize that this Magazine can serve you in three essential ways:

Demonstration First of all, you must be prepared to demonstrate high-fidelity, because people can only appreciate full-range tone by *hearing* it. It can't be described in words. It must be *experienced*. Only then can people realize how much it will contribute to their enjoyment and relaxation, what it will mean to their children, and how it will help to entertain their friends.

What kind of a demonstration setup do you need? You will find all kinds of answers to that question in HIGH-FIDELITY, together with information on the choice of equipment for FM, records, and tape. It covers the entire what-why-how of tuners, amplifiers, turntables, tape machines, speakers, and all the associated instruments required in a hi-fi demonstration system. That information you must have as your starting point.

Choice of Music Records provide the most convenient source of music for demonstrating high-fidelity. But you must choose your records with the greatest care. For example, if a prospect is a lover of Haydn's music, you would play the Haydn Society's HSL 2048, because it not only does justice to the composer but it is a particularly fine example of full-range recording.

Or if he prefers the melody of popular airs, you might choose Columbia's ML 4487, which is an excellent presentation of Morton Gould, or the collection of waltzes on a London LL 570, because they sound spectacular on hi-fi reproduction.

How do you find out about these things? Why, HIGH-FIDELITY has a 24-page section devoted to records in each issue, written by reviewers who are top authorities on both music and recording techniques.

System Planning When you have staged a first-class demonstration, you can expect your prospect to ask: "How can I arrange an installation like that in my living room so it will be as attractive in appearance as it is fine in performance?"

That question might give you trouble. Every home is different, and each person has his own ideas as to what will look most attractive.

But at this point, HIGH-FIDELITY performs a third essential service. In each issue there are six to eight pages of detailed photographs which show outstanding examples of hi-fi installations. They range from simple bookshelf arrangements to functional music walls, and on to elaborate cabinet designs.

Among them, any prospect will find a type of installation that can be adapted readily to his particular home, at a price he is willing to pay.

Act Today If you are interested in extra income or increased profits, look into this hi-fi business without delay. Your first step is to order a subscription to HIGH-FIDELITY. This is a large-size magazine, beautifully printed on fine paper, handsomely illustrated, published on the first of every other month. It may prove to be the biggest little investment you have ever made. It may pay back its cost to you many, many times. Use the coupon below.

High-Fidelity

MILTON B. SLEEPER, *Publisher*

"THE MAGAZINE FOR AUDIOPHILES"

Charles Fowler, Editor
HIGH-FIDELITY Magazine
1009 Publishing House, Great Barrington, Mass.
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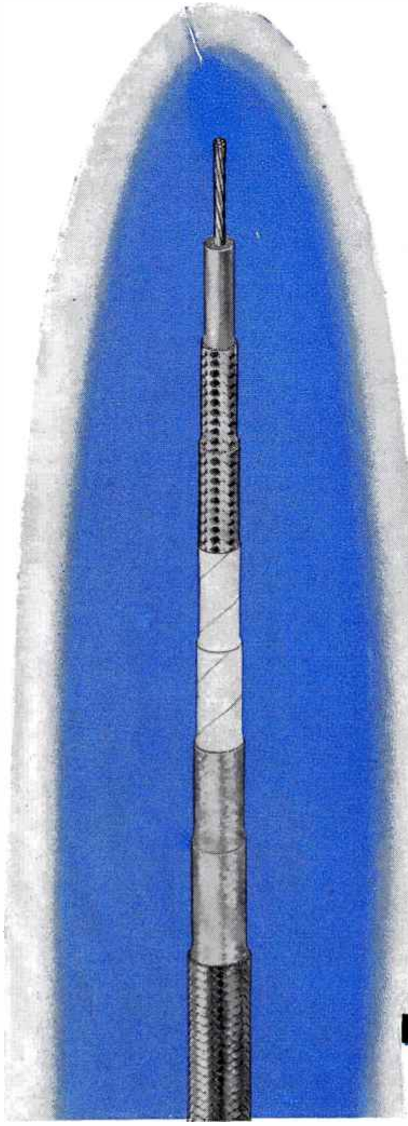

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Designed for extreme heat conditions, such as are encountered in modern aircraft, Teflon dielectric performs satisfactorily in temperatures as high as 500° F. Use of Teflon as dielectric in RF cables is an outstanding achievment of the skilled research team at Amphenol.

In addition to the important feature of high heat resistance, Teflon has electrical characteristics which exceed those of Polyethylene. Teflon is the *one* satisfactory cable for use, not only in aircraft, jet engines or guided missiles, but in covered electronic equipment or any application where temperatures might run over 185° F.

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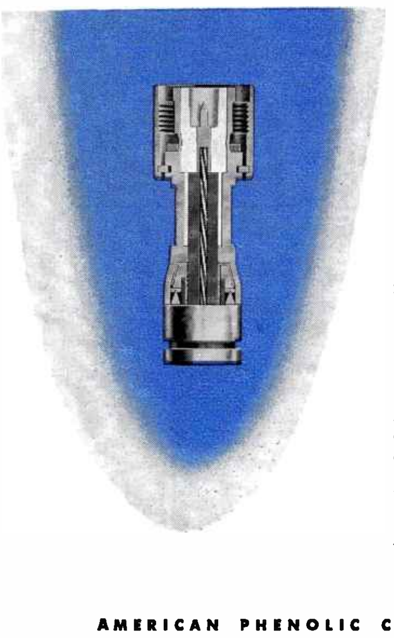
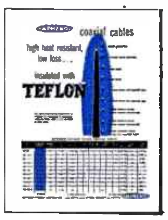


Expert engineering, highest quality materials and stringent continuous inspection make Amphenol cables the very best that can be had *anywhere!* Uniform quality and maximum performance from every foot of Amphenol cable is assured by constant checking and testing. Every shipment of cable is accompanied by a notarized affidavit certifying the guaranteed construction of the cable.

Amphenol also manufactures a comprehensive line of RF Connectors with Teflon inserts for high voltage or extreme heat applications.

Write for this free literature describing Amphenol Teflon cable. Address Dept. 13D



AMERICAN PHENOLIC CORPORATION
1830 SOUTH 54TH AVENUE · CHICAGO 50, ILLINOIS

AMPHENOL

NEW APPLICATIONS

(Continued from page 34)

				1	40	1895	F
Upper Strasburg Pa				3	40	1865	F
				1	40	1896	F
Mechanicsburg Pa				1	40	1935	F
Service Pipeline Co Box 1979 Tulsa 2 Okla							
Nr Ft Laramie Wyo				1	60	49.14	M
Welch Wyo					same		
So Cole Creek Wyo					same		
Nr Kirby Wyo					same		
Nr Sussex Wyo					same		
Beaver Creek Wyo					same		
Salt Creek Wyo					same		
Hamilton Dome Wyo					same		
Pilot Butte Wyo				1	250	49.14	M
Lost Cabin Wyo					same		
Casper Wyo				sq2	30	72.50	M
				1	250	49.14	M
				r1	30	75.66	M
Platte Pipeline Independence Kans							
Nr Nashua Mo				usr1	2	6590	P
						6830	
						6780	
						6710	
Nr Beatrice Neb				usr1	2	6780	P
						6830	
Kansas City Mo 14th & Balt				usr1	2	6680	P
						6620	
FOREST PRODUCTS							
Oxford Paper Co Railroad St Rumford Me							
	20	30	153.17	1	30	153.17	M
Oregon Lumber Co Dee Oregon							
	B	15	153.17	1	15	153.17	C
Rice Veneers Inc McKeever N Y							
	25	60	49.50	1	60	49.50	G
Northern Redwood Lumber Co Korbel Calif							
	10	60	158.43	1	60	158.43	G
Nr Korbel Calif					same		
L N Dantzeler Lumber Co Perkiston Miss							
Saucier Miss				1	75	29.73	L
Lakeview Logging Co Box 989 Lakeview Oregon							
Nr Lakeview Ore				1	120	49.22	M
SPECIAL INDUSTRIAL							
Fort Mason Fruit Co Box 1236 Eustis Fla							
Nr Eustis Fla	10	70	49.54	1	500	49.54	G
Ward Cove Builders Ketchikan Alaska							
	10	35	154.49	t1	35	154.49	G
Magnet Cove Barium Corp 123 Oil & Gas Bldg Houston							
Houma La	80	124	30.62	1	500	30.62	G
Clark's Seed Farms Richford N Y							
	10	40	49.90				M
Brantly-Sea Inc 317 W Texas Av Midland Texas							
Midland Tex 3214 Mariana				1	60	48.74	M
	5	60	48.74	t3	60	48.74	M
Parkhill Produce Co 815 Perkins St Mission Tex							
				1	120	49.82	M
Nr Roma Tex	10	120	49.82	1	120	49.82	M
				t1	120	49.82	M
Justiceburg Sand & Gravel Co Box 1145 Post Texas							
Post Tex Hway 84							
	p8	.25	154.49	1	60	154.49	M
Nr Southland Tex				1	60	154.49	M
Radio Schlumberger Inc Box 2175 Houston Texas							
Houma La 600 Roosevelt				1	500	49.90	G
	30	125	49.90	t1	125	49.90	G
Roos Excavating Co Elyria Ohio							
	6	30	43.06	1	60	43.06	G
R B Potashnik Box 205 Cape Girardeau Mo							
	25	120	43.02	t1	120	43.02	M
Whitten Bros Drilling Co 1744 High St Delano Cal							
Nr Pixley Calif	5	30	27.39	1	30	27.39	M
Union Carbide & Carbon Corp (Electro-Metallurgical Co) 30 E 42nd St New York 17 N Y							
Dexter City Ohio Box 100							
	10	30	43.14	1	120	43.14	X
	p3	3	43.14				
P D Fulwood Co Tifton Ga				1	30	152.99	G
S W Richardson 1211 Fort Worth National Bank Bldg							
Fort Worth Texas							
Rockport Texas				1	30	152.99	G
Smith Canning & Freezing Co Pendleton Oregon							
Nr Lewiston Idaho							
	r1	120	152.93				C
Walsh Constr Co 785 Market St San Francisco Calif							
	20	60	49.82	t1	120	49.82	M
L E Farley Inc 2609 Sunset Houston Texas							
	20	120	43.02	t3	120	43.02	M
The Petan Co Tuscorora Nevada							
	6	75	43.18	1	125	43.02	M
	p3	3	43.18				M
Eddie Givens Contr Co Casa Grande Ariz							
	15	50	154.57	1	120	154.57	G
Genovese Coal & Masons Materials Co Stamford Conn							
	50	30	43.14	1	30	43.14	M
Curtis Cantrill 608 N 25 St Middlesboro Ky							
	5	150	27.35	t1	150	27.35	G
M E Mosely 1210 S 9th St Slaton Tex							
	15	60	154.49	1	120	154.49	M
Allison & Haney 1412 Bdway Albuquerque N Mex							
	10	30	43.18	1	120	43.18	M
	25	120	43.18				
Square W Ranch Box 436 Harlowton Mont							
				1	120	30.58	M
Nr Harlowton	5	120	30.58	1	120	30.58	M
Valley Sand & Gravel Corp 788 Ridge Rd West							
Rochester N Y	5	25	49.98	1	120	49.98	M
	16	60	49.98				
W S Vanadium Co (Div Union Carbide & Carbon Co) 420 Lexington Ave New York N Y							
Bishop Calif							
Nr Bishop Calif	3	15	43.18	1	60	43.18	M
	2	30	43.18	1	30	43.18	
	2	1	43.18				

Scheelite Calif	3	15	43.18	1	15	43.18	M
Ramona Calif	3	15	43.18	1	60	43.18	M
Dowell Inc Kennedy Bldg Tulsa Okla							
Nr Hominy Okla				1	600	43.18	G
Lafayette La				1	300	43.18	G
Geochemical Engrg Corp 709 S Marianfeld St							
Midland Tex	10	60	30.62	1	60	30.62	M
				t3	60	30.62	
United Elec Coal Co 307 N Michigan Chicago Ill							
Evanston Ky	5	15	154.57	1	60	154.57	M
	5	.5	154.57				
McAlester Fuel Co McAlester Okla							
Nr Rockdale Tex	15	10	154.57	1	50	154.57	G
South Dade Farms Inc Box 425 Homestead Fla							
	50	40	152.93	1	100	152.93	C
	30	10	152.93				
Micco Fla				1	100	152.93	C
Avon Park Fla				1	100	152.93	C
Monterey County Farms Inc Box 727 Salinas Calif							
Nr Salinas Calif				q1	60	75.62	M
Nr Soledad Calif				1	120	49.94	M
	20	60	49.94	r1	60	72.38	M
Climax Uranium Corp So 12 St Grand Junction Colo							
				1	42.5	2.292	X
Outlaw Mesa Colo				1	100	2.292	X
Bud Inc Box 759 Watsonville Calif							
Phoenix Ariz				1	124	43.06	G
Sullivan Co Medicine Bow Wyo							
	10	60	25-50	1	60	25-50	G
Jensen Crop Dusters Rte 8 Sacramento Calif							
	5	120	152.93	t1	120	152.93	G
Prairie Fuel & Material Sales 7601 W 79 St							
Oak Lawn Ill	3	50	44.90	1	50	44.90	G
Hardrives Co Box 207 Ft Lauderdale Fla							
	15	25	152.87	1	50	152.87	G
Eastern Engineering Co 4 No North Carolina Ave							
Atlantic City N J				1	500	43.18	G
	15	120	43.18	t1	120	43.18	G
Lone Star Constructors 1014 Mercantile Bank Bldg							
Dallas Texas	30	120	30.58	t5	120	30.58	M
	p12	3	30.58				
C O Lee Trucking Co Box 996 Farmington New Mex							
Nr Farmington N M							
	15	70	43.10	1	70	43.10	G
Max Lutz & Co 1921 Austin McAllen Texas							
	10	120	30.62	1	120	30.62	M
Warner Bros Inc Sunderland Mass							
Deerfield Mass	15	30	30.62	1	60	30.62	R
KK Sharp Co Holtville Calif							
	30	124	49.66	1	124	49.66	G
A V Taurasi Co Inc 139 Jaques St Somerville Mass							
				t6	120	49.94	M
Frontier Trucking Inc 1346 Niagara Falls Blvd							
Tonawanda N Y	10	30	43.14	1	60	43.14	R
King Engineering Co 214 Clay St Kingsport Tenn							
	5	120	49.90	1	120	49.90	M
Heldt Bros Trucks Box 1130 Alice Texas							
				sq1	50	74.46	G
Nr Freer Tex				1	300	49.82	G
				r1	50	73.06	G
Freer Tex, So Main St				q1	50	74.46	G
Sullivan City Tex	30	70•	49.82	1	70	49.82	G
Batavia Elec Constr 25 W Main Rd Batavia N Y							
	11	12	43.18	11	12	43.18	M
Hugh Bennett Ranch Box 51 Dos Palos Calif							
	12	120	49.82	1	120	49.82	G
R G Pope Constr Box 269 Bristol Va							
	20	124	43.10	1	124	43.10	G
Dowell Inc Box 536 Tulsa Okla							
Nr Mt Selman Tex	1	70	43.18	sr1	10	75.62	G
Kilgore Tex	1	10	72.18				G
LOW POWER INDUSTRIAL							
Beulah Park Jockey Club 297 S High Columbus Ohio							
	p1	3	154.57				R
Int'l Minerals & Chem Corp Box 867 Bartow Florida							
	p42	1.3	154.57				M
Andrews Tower Co 1420 Layton Av Ft Worth Texas							
	p10	2	154.57				A
R B Dickson 1900 Greenwood Blvd Evanston Ill							
	p8	3	154.57				M
Aaron Lippman Co 99-107 Newark St Newark 4 N J							
	p2	3	154.57				A
Seattle Radio Supply 2117 Second Av Seattle Wash							
	p3	3	154.57				A
Levelland Compress & Warehouse Coop Box 1937							
Levelland Tex	p5	3	154.57				M
Motion Picture Radio Serv 1347 5th Av Los Angeles							
	40	3	33.14				X
			35.02				
	10	3	154.57				T
American Airlines Inc 100 Park Av New York N Y							
	12	3	33.14				M
Northwest Syndicate Inc 711 St Helens Av Tacoma							
Washington	1	..	154.57				M
J F McKinney Sales Co 1330 N Industrial Blvd							
Dallas Texas	5	1	154.57				A
Gt Lakes Carbon Corp 526 E Catalon St Louis Mo							
	8	3	42.98				M
Haire Pub Co Inc 1170 Broadway New York 1 N Y							
	2	2	154.57				A
A C Jones 223 High St Mt Holly N J							
	p6	2	154.57				M
Sterling Radio Prod Co Box 1746 Houston 1 Tex							
	p2	2	27.51				A
Radio Wire Television 24 Central Av Newark N J							
	p4	3	154.57				A
Deltronic Corp 9010 Bellanca Av Los Angeles Calif							
	p2	3	154.57				A
Southwestern Bell Tel Co 1010 Pine St St Louis Mo							
	p2	.25	154.57				M
Merchants Del Serv 506 10th Garden City Kans							
	p6	3	154.57				M
RELAY PRESS							
Miami Herald Pub Co 200 S Miami Av Miami Fla							
Miama Fla 1425 NE Bay Shore Pl							
	10	120	173.22	1	40	173.22	M

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NEW APPLICATIONS

(Continued from page 37)

MOTION PICTURES

Motion Picture Radio Serv 1347 5th Av Los Angeles
52 .. 1.5-156 X
Fred Parrett 106 Washington Pl New York 14 N Y
p10 2 49.70 M

COASTAL & MARINE RELAY

United Towing Co Inc Box 921 Wilmington Calif
Wilmington Calif Berth 149 1 100 156.60 156.80 G

ALASKAN FIXED PUBLIC

C E Martin 626 D St Anchorage Alaska
Nr Wattamuse Alaska s1 25 21.34 M
U S Tin Corp Box 2554 Juneau Alaska
Los River Alaska 1 12 2.450 2.632 2.986 3.190 X

COASTAL & FIXED

Sitka Canning Co Box 1121 Juneau Alaska
Sitka Alaska 1 50 2.450 2.512 2.632 3.190 Q
Fisheries Research Inst Univ of Wash Hall No 2
Seattle 5 Wash
Lake Nerka Alaska 1 10 73.50 T

MARITIME FIXED

Kerr-McGee Oil Industries Inc Kerr-McGee Bldg
Oklahoma City Okla s1 100 21.10 21.34 21.66 22.06 X
t4 100 same

RAILROADS

Central of Ga Railway Co Box 527 Savannah Ga
8 60 160.65 M
Pecos Valley Southern Rway Co Box 349 Pecos Tex
Pecos Tex 212 S Oak St 1 60 159.69 M
Hoban Tex 5 10 159.69 1 60 159.69 M
p3 .25 159.69
Chicago Great Western Rway Co 303 W Harrison St
Chicago Ill 1 60 159.57 160.17 X
Farley Iowa same
Randolph Minn same
Mason City Iowa same
Austin Minn same
McIntire Iowa same
St Paul Minn same
New Hampton Iowa same
Chesapeake & Ohio Rway Co 823 E Main Richmond Va
Detroit Mich 1 120 160.29 160.41 O
Missouri-Kansas Texas RR Co of Tex 701 Commerce St
Dallas 2 Tex
Houston Tex 10 35 160.59 1 35 160.59 T
Bangor Aroostook RR Co 84 Harlow St Bangor Me
Squaw Pan Me s1 120 159.99 FO
Caribou Me same
Houlton Me same
Van Buren Me same
Atlantic Coastline RR Co Wilmington N C
Columbia S C 1 30 160.29 T
Sumter S C 1 30 160.29 T
Penn R R Co 1617 Penna Blvd Philadelphia 4 Pa
Morrisville Pa 1 60 160.71 M
Northern Pacific RR Co 176 East 5 St St Paul Minn
Stampede Wash 1 40 161.01 161.25 T
Southern Pacific Co 65 Market San Francisco Calif
Yuma Ariz 2 60 161.43 161.67 M

TAXICABS

Royal Taxi Serv 110 W Cunningham St Butler Pa
10 10 157.71 1 30 152.45 M
Terminal Cab 222 Clinton St Harriman Tenn
10 119 152.45 1 25 157.71 R
Town Cab 26 Jefferson St Wellsville N Y
20 30 157.53 1 60 152.27 M
Southside Cab Co 456 S Campbell St Daytona Bch Fla
12 12 157.65 1 12 152.39 G
City Cab Co Court St Maryville Tenn
6 25 157.71 1 25 152.45 R
Circle Cabs 1627 Fulton Crt Miami Beach Fla
25 30 157.65 1 120 152.39 T
Checker Cab 297 Calif Dr Burlingame Calif
10 30 157.59 1 30 152.33 M
Beech Grove Taxi 602 Main Beech Grove Ind
3 30 157.71 1 80 152.45 G
Silver Streak Cab 4th & D Sts Lewistown Idaho
10 .. 152.27 1 .. 157.53 M
Vet's Cab Rte 3 Shawano Wisc
4 30 157.53 1 30 152.27 M
96 Taxi 1½ N Central St Idabel Okla
6 15 157.53 1 20 152.27 B
2200 Cab Co 692 N Greenbay Rd Winnetka Ill
15 .. 157.71 1 30 152.45 M
Yellow Cab 106 Dallas Rd Willow Grove Pa
10 25 152.45 10 120 152.45 G
Ivey Cab Union S C
6 15 157.71 1 15 152.45 M
Cruze Cab Co Wilmington Ohio
8 40 157.53 1 40 152.27 M
Yellow Cab Co 7 N 2nd St Marshalltown Iowa
10 30 157.53 1 30 152.27 M

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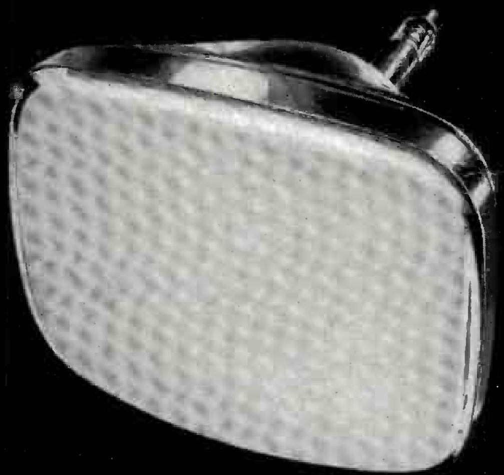
INDEX OF ADVERTISERS

FOR YOUR CONVENIENCE, TELEPHONE NUMBER OF EACH COMPANY IS SHOWN HERE

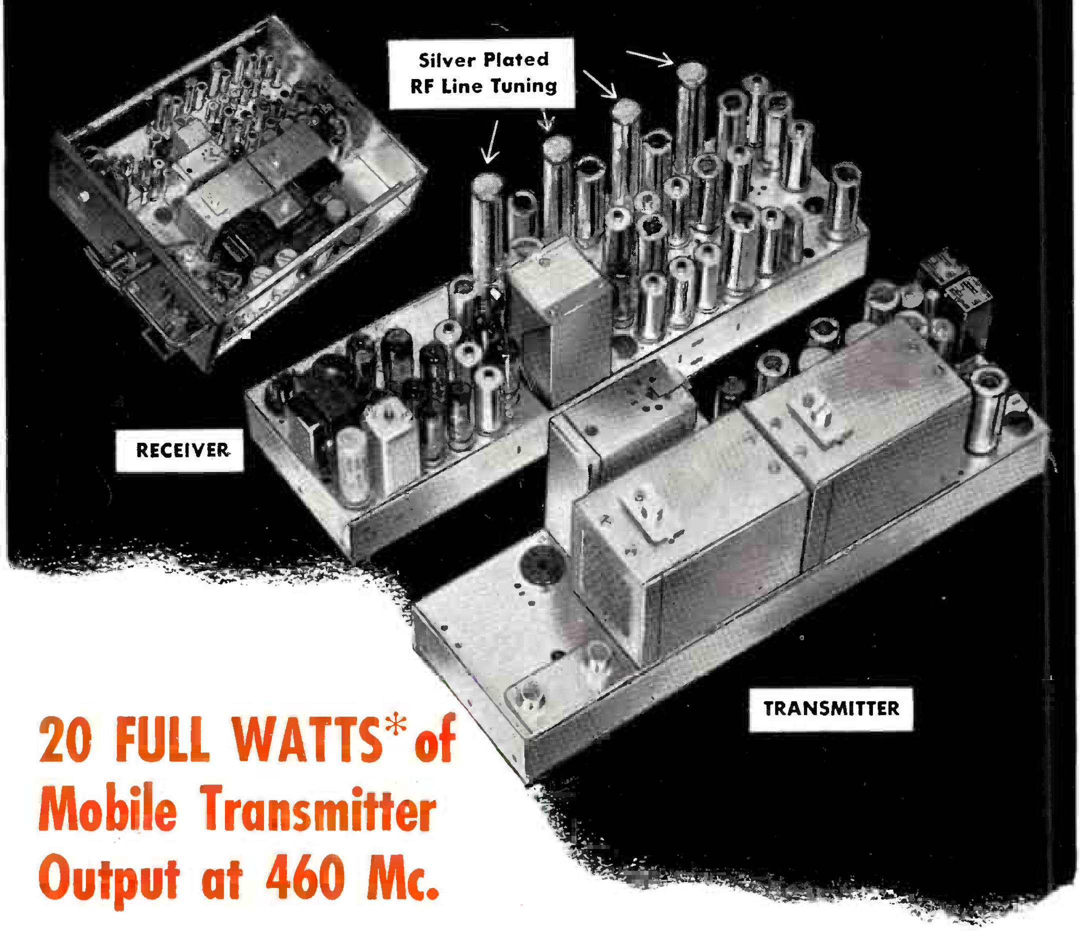
NEW APPLICATIONS

(Continued from page 38)

Hamlin's Cab Co So 4th & Main Williamsburg Ky							
	7	60	157.53	1	60	152.27	M
Jack's Cab 601 S Canton St Mexia Texas							
	6	40	157.71	1	40	152.45	M
Montgomery Taxi Co Marianna Ark							
	6	12	152.39	1	12	152.39	G
Menlo Yellow Cab Co Menlo Park Calif							
	10	30	157.53	1	30	152.27	M
Bellaire Taxi 5210 Richmond Rd Bellaire Tex							
	5	20	157.71	1	20	152.45	M
Stanley Charles Leek Jr 1403 West St Annapolis Md							
	3	21	157.71	1	21	152.45	L
Vets Cab Co 208 W 9 St Rolla Mo							
	10	30	155.71	1	30	152.45	M
Courtesy Cabs 5227 W Colfax Denver 14 Colo							
	10	60	157.59	1	60	152.33	M
Rockwell Maywell 659 State St Perth Amboy N J							
	4	10	157.53	1	10	152.27	M
Town Taxi Co 483 W Broad St Hazelton Pa							
	5	20	157.53	1	20	152.27	M
L T Baxter 431 Francis St Richmond Ky							
	4	30	157.65	1	60	159.29	M
303 Cab Assoc 1139 Greenleaf Ave Wilmette Ill							
	16	30	157.59	1	120	152.33	M
Yellow Cab Co 966 N Western Av Lake Forest Ill							
	10	10	157.59	1	30	152.33	M
Anthony J Albino 711 W Market St Orrville Ohio							
	5	30	157.59	1	30	152.33	M
People's Cab 812 Clement Av Belpre Ohio							
	6	25	157.59	1	120	152.33	M
Town Taxi 704 W Market St Orrville Ohia							
	5	30	157.71	1	30	152.45	M
Yello Cab 105 N Meridian Ravenna Ohio							
	4	10	157.65	1	10	152.39	M
Richardson & Crowley Cabs 108 A South Av							
Petersburg Va	20	20	157.71	1	120	152.45	M
Blue Bird Taxi 64 S Lexington Av Asheville N C							
				1	120	152.27	G
City Cab Co W State St Cheboygan Mich							
	5	10	157.71	1	10	152.45	M
Amer United Cab Assoc 3123 N Clark Chicago Ill							
808 Junior Terrace Chicago				1	60	152.27	M
4300 S Drexel Blvd Chicago				1	60	152.27	M
City Taxi Serv 522 North O St Tulare Calif							
	8	30	157.71	1	30	152.45	M
AUTO EMERGENCY							
Holden Motor Co 3rd & Beech Newport Ark							
	7	30	35.70	1	30	35.70	M
Turner's Gen Tire Serv 715 Texas St E lPaso Texas							
	10	60	35.70	1	120	35.70	G
H & A Service Whitman Rd & Somerset S Huntington								
Long Island N Y	4	60	35.70	1	120	35.70	G
Automobile Club of N Y 28 E 78th St New York N Y							
Brooklyn N Y Hanson Pl							
	100	50	456.85	2	75	456.85	M
Ross Inc Spokane Wash							
	10	124	35.70	10	124	35.70	G
Quigley Motors Boyertown Pa							
	6	120	35.70	1	120	35.70	G
HIGHWAY TRUCKS							
Harlan Bros Fallston Md							
	5	60	35.74	1	90	35.74	K
Parlett Gas Co Box 144 Waldorf Md							
	25	60	35.90	1	60	35.90	R
Leonardtown Md	12	30	35.90	1	60	35.90	R
Ellicott City Md	20	30	35.90	1	60	35.90	R
Tri-County Butane Co Box 588 Hollis Okla							
E City Limits	6	150	35.90	1	150	35.90	G
Bower Trucking & Crane Co Box 200 Charleston W Va							
	10	30	35.78	1	60	35.78	G
Highway Fuel Transport Box 619 Anchorage Alaska							
				1	120	35.74	M
Evan Jones Coal Mine Alaska				1	120	35.74	M
Merchants Motor Freight 2625 Territorial Rd							
St Paul Minn	15	30	35.78	1	250	35.78	R
Lawrence Butane Co 212 E Good St Quitman Texas							
	4	80	35.94	1	120	35.94	M
Truett Mayes Box 425 Crosbyton Texas							
	7	70	35.94	1	70	35.94	G
Nr Ralls Texas				1	70	35.94	G
Farm Chemicals of Oregon Inc College & First Sts							
Althena Ore	10	80	35.74	1	120	35.74	C
Kelly Matchett Butane Co Box 1796 Vernon Texas							
Nr Vernon Tex	10	150	35.90	1	150	35.90	C
RADIO PAGING							
N Y Tech Institute 207 E 8th St Cincinnati Ohio							
Mt Wilson				1	..	35.58	G
Philadelphia Pa				1	..	43.58	G
Austin Radiopage 222B Guadalupe St Austin Texas							
				1	..	43.58	M
Tel Answering Serv 3852 Turtle Creek Dr Dallas Tex							
Dallas Tex 1309 Main				1	..	35.58	X
Vale Corp Inc 45 Branford Pl Newark N J							
				1	..	35.58	Y
COMMON CARRIER							
Southwestern Bell Tel Co 1010 Pine St St Louis Mo							
Nr Great Bend Kans							
	100	..	35.00	1	..	35.00	GUM
Nr Hays Kans	100	..	35.00	1	..	35.00	GUM
Mountain States Tel & Tel Co 931 14th Denver Colo							
Nr Wolf Point Mont							
	75	..	152.00	1	..	152.00	GM
Nr Glendive Mont		same			same		
Nr Culbertson Mont		same			same		
MISCELLANEOUS COMMON CARRIER							
Radiofone Service 425 Malden Ave Seattle Wash							
	100	..	152.09	1	..	152.09	M
			158.55			158.55	



NEW MOTOROLA 460 MC. with A.F.C.



20 FULL WATTS* of Mobile Transmitter Output at 460 Mc.

AUTOMATIC FREQUENCY CONTROL

Motorola's new crystal controlled A.F.C. system provides positive barriers so that the receiver cannot jump to a strong adjacent channel signal.

This new Motorola A.F.C.technique is fortified with extraordinary system stability. The A.F.C. crystal controlled oscillator provides a full 10 to 1 correction ratio and keeps the receiver tuned on the nose to the distant transmitted carrier.

The new U. H. F. tuned circuits and research design cavities for ground grid amplifier operation provide phenomenal circuit stability, spurious rejection and extraordinary efficiency.

TRANSMITTER

The Motorola 460 Mc. system with 9 tuned circuits provides 18* to 20* Watts with *Efficiencies of more than 65%!*

SILVER PLATED SEALED TUNED CAVITIES

By use of silver plated line sections, high standards of selectivity protect the receiver from high power U.H.F., TV intermodulation.

Motorola

Communications & Electronics Division
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Rogers Majestic Electronics Ltd., Toronto, Canada