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Dec. 1952

FM-TV

THE JOURNAL OF

RADIO COMMUNICATION

★★Published by★★
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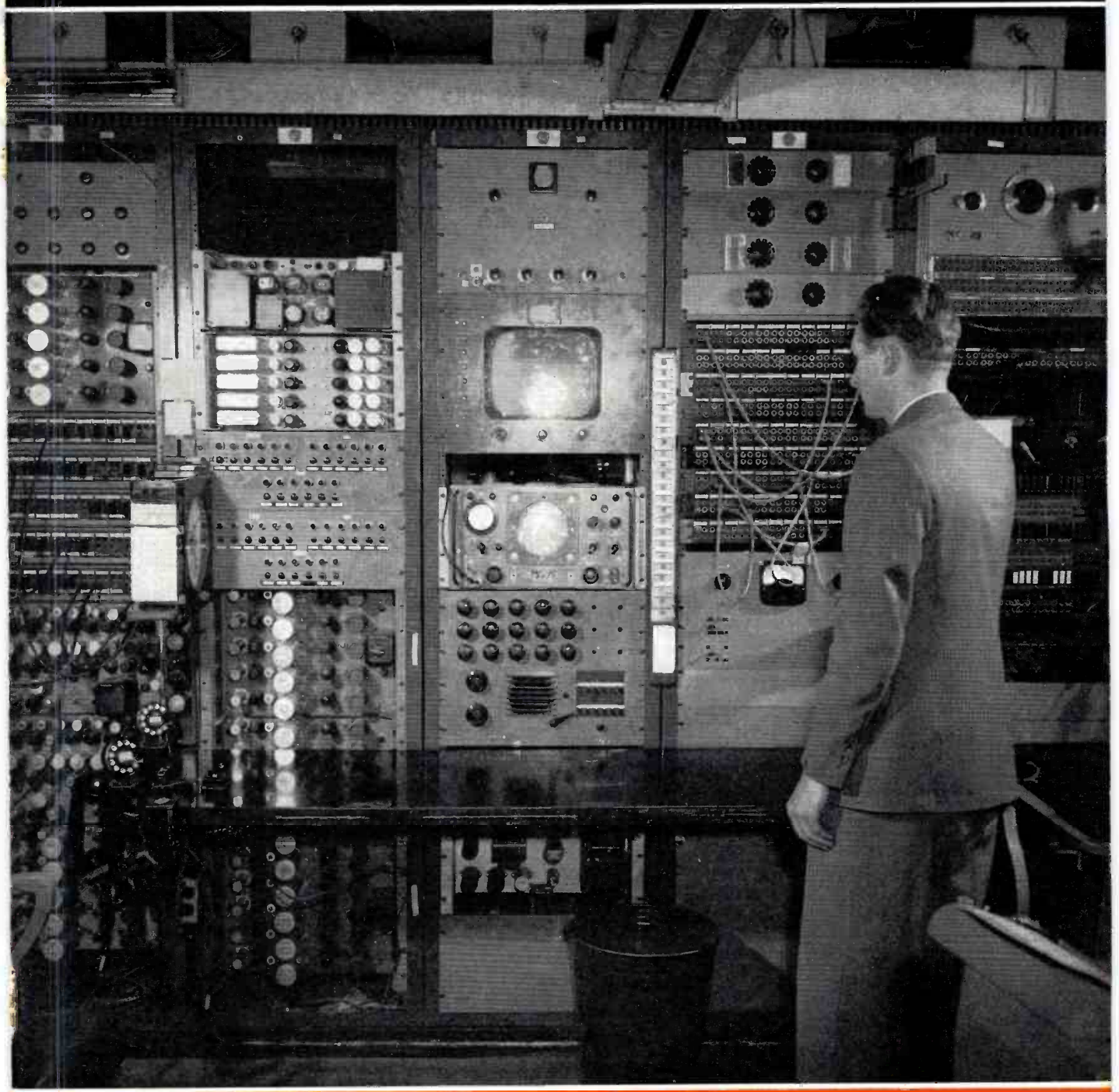

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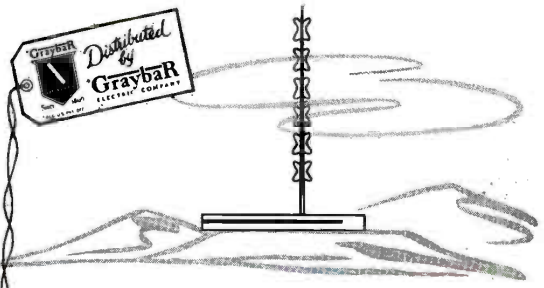

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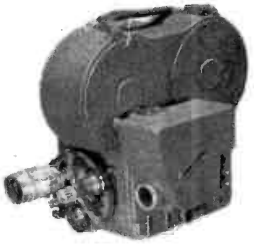

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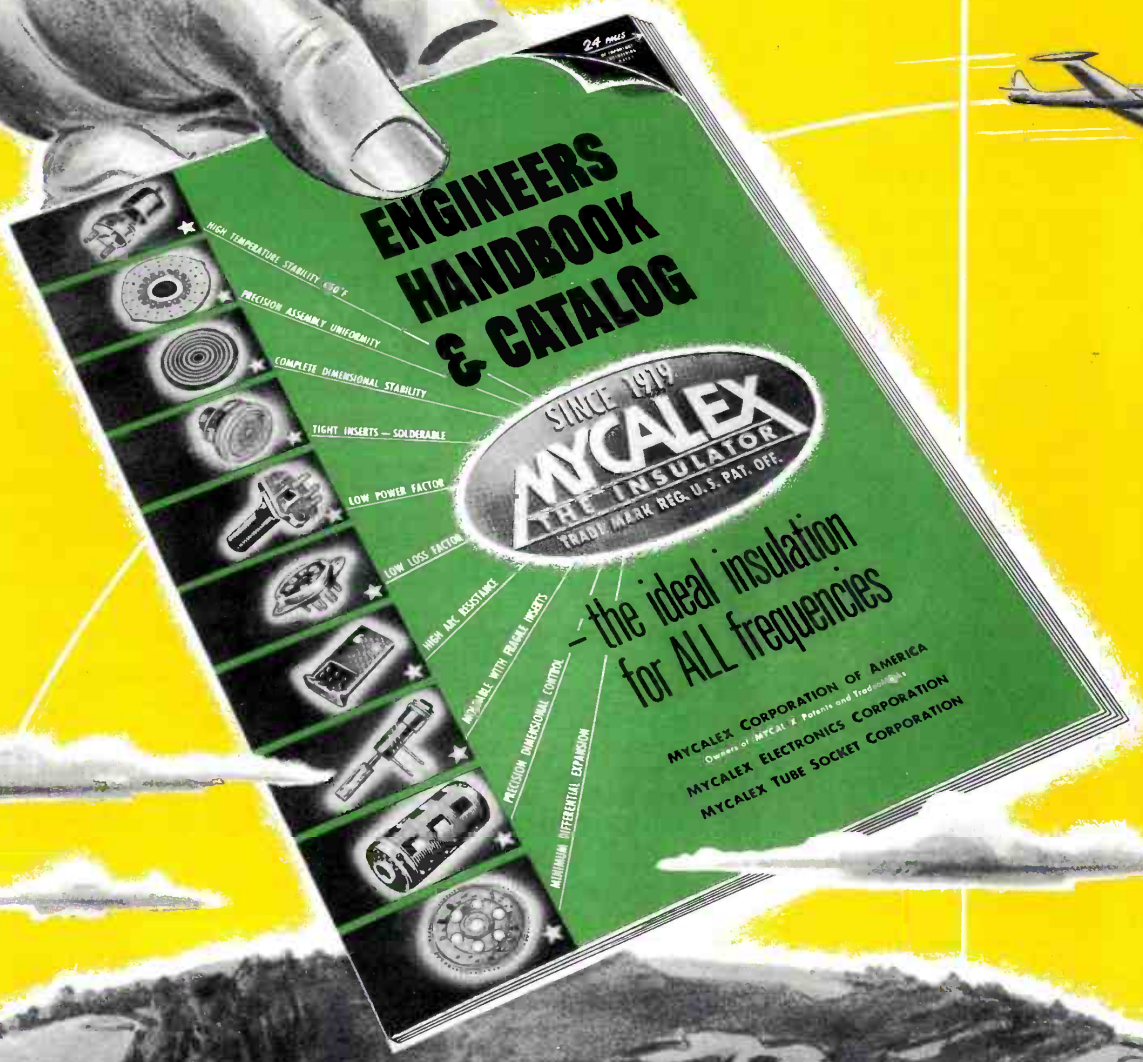

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ENGINEERS HANDBOOK AND CATALOG

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CHARACTERISTICS OF MYCALEX	A detailed analysis of all the important characteristics of Mycalex glass-bonded mica insulation including every pertinent electrical and mechanical feature. Also included are tables of comparison with all other competitive materials.
INJECTION-MOLDED GRADES	Contains complete data and specifications plus a wealth of explanatory information covering Mycalex 410, the injection-moldable grade of glass-bonded mica insulation. Replete with graphs, tables of properties, and ample illustrations.
COMPRESSION-MOLDED GRADES	Everything the designer needs to know in applying Mycalex 400, the compression-molded glass-bonded mica insulation, to problems involving fabricated dielectric parts. This chapter graphically illustrates the versatility of this dielectric.
DESIGN OF MOLDED INSULATORS	A veritable "gold mine" of valuable information — covering the capabilities and adaptability of MYCALEX 410 and 410X — in designing and producing molded insulators and other dielectric components. Complete data is included.
MACHINING AND FABRICATING METHODS	Comprehensive recommendations for machining and fabricating Mycalex 400, the compression-molded glass-bonded mica insulation. Details all machining, cutting, drilling, threading, tapping, slotting, grinding, finishing.
DESIGN OF MACHINED INSULATORS	Another section of the catalog which is equally valuable to the engineer and shop man. Text and diagrammatic views cover all phases of design pertaining to fabricated insulators. Recommendations are included for the solution of ordinary problems.
SWITCHES AND COMMUTATOR PLATES	Mycalex products of this type demonstrate the precision accuracy, and functional perfection attainable only through the use of Mycalex glass-bonded mica insulation. Various commutators and switch plates are described in detail.
MYCALEX TUBE SOCKETS	Mycalex manufactures a wide variety of low-loss tube sockets extensively used in commercial and governmental applications. These sockets are fully described with diagrammatic drawings showing dimensions and other details.

—and complete information on the MYCALEX ADVISORY SERVICE

Mycalex technicians, experienced in the field of high frequency insulation, are available to manufacturers and design engineers for collaboration in the solution of insulation problems. The Mycalex staff will gladly assist in the planning stage of new products or equipment, as well as in the modernization of existing production to meet stricter specifications. The Mycalex Advisory Service is available without obligation—inquiries should be addressed to the general offices, in Clifton, New Jersey for prompt attention.

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FM-TV RADIO COMMUNICATION
TELE-VISION ENGINEERING

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

VOL. 12 DECEMBER, 1952 NO. 12

INDUSTRY NEWS

TELEVISION

COMMUNICATION

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Publication Office: The Publishing House, Great Barrington, Mass. Tel. Great Barrington 1300.
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PRODUCTION data on TV and audio receivers for October. released by RTMA, show an increase in weekly output as compared to September, even though the total was down, because September figures were for five weeks.

Most interesting fact disclosed by the Production Barometer is that TV sets are currently running at more than twice the volume of home-type audio receivers. On the other hand, average monthly TV production this year is only 706 units above the 1951 average.

The total of 21,524 FM sets is not an accurate indication of activity, since it represents only complete models in cabinets. Eleven companies are now advertising FM and FM-AM chassis for high-fidelity installations. These are: Altec Lansing, Bogen, Browning, Collins Audio, Espey, Fisher, Hallicrafters, Pilot, Radio Craftsmen, Sargent-Rayment, and Stromberg-Carlson. Early in 1953, it is expected that REL will be in production on a new model 646-C tuner. There are several companies making excellent brand-name FM tuners, so that the total output by this group is running far ahead of the RTMA figure. A well-informed guess would put the combined output of complete FM sets and tuners something above 50,000. Expectations are that fast-spreading interest in high-fidelity and the stepped-up promotion in consumer magazines will more than double the present sales volume in 1953.

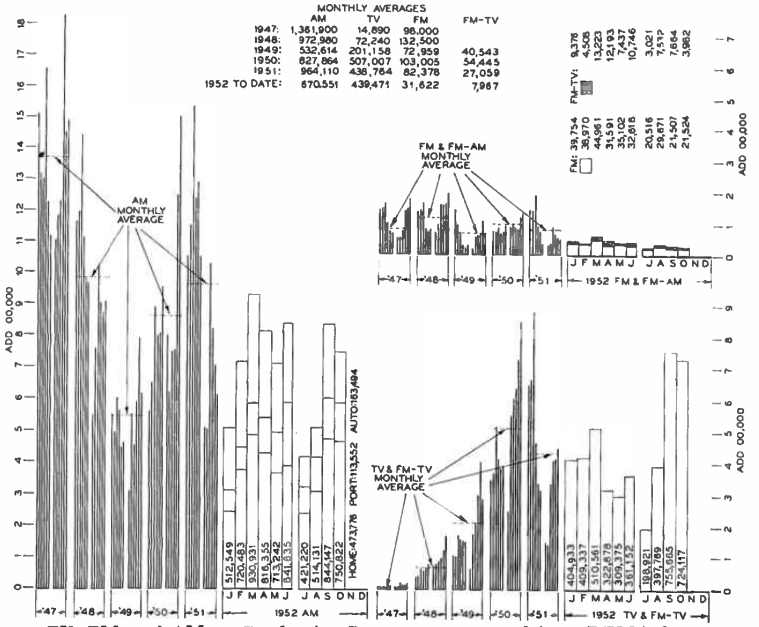
RTMA started to report cathode-ray tube sales on an industry-wide basis last September. The figures are indicated as estimates, presumably because some manufacturers are not RTMA members.

October sales to equipment manufacturers amounted to 862,431 units or $19,761,300, compared to September sales of 640,793 units or $14,362,000. Total sales in October were 1,045,300 units or $23,240,200, compared to 788,100 units or $17,232,400 in September.

Receiver-type tubes sold in the first 10 months of '52 were 287,569,000 units, compared with 314,932,800 in the same period of 1951.

October sales were 41,880,300 or $28,379,300, compared to 34,196,300 or $24,432,700 in September. October sales were divided as follows: 29,132,000 for new equipment; 8,791,400 for renewals; 3,105,000 for Government agencies, and 851,800 for export.

Starting in 1953, this Production Barometer will be carried in the new TV & RADIO ENGINEERING Magazine, the first issue of which will be published February 15, and every other month.



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

Sew up the holes in the net-with FM

There are over 4 million FM sets in use nationally, according to the most recent estimates.

FM is a necessity in a wide list of static and "white spot" areas that stretch from Florida to Minnesota, from upstate New York to San Francisco. If you want to catch *all* your prospects, include FM in your coverage.

FM fills "holes" in 352 communities*

In 28 communities, FM is the *only* local radio buy.

In 67 communities, FM is the only local radio buy after sunset.

In 257 communities, FM is used to supplement AM, because AM is directionalized after sunset.

Special to Broadcasters

Your local Zenith dealer will gladly help promote your station and programs in his newspaper ads and displays. Get in touch with him today.

ZENITH RADIO and TELEVISION

THE ROYALTY OF RADIO AND TELEVISION

If you want the complete list, simply write to: ZENITH RADIO CORPORATION, Chicago 39, Illinois

THIS MONTH'S COVER

I takes a lot of money, know-how, and equipment to produce and transmit a television signal. Especially equipment. Master-control equipment, for instance, is a good deal more extensive in a TV station than in an audio broadcast station of comparable size, as is discussed in this month's installment of *Pattern for TV Profit*. The cover photograph shows *part* of the TV master-control installation at the New York headquarters of the American Broadcasting Company.

SPOT NEWS NOTES

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

Effective in January 1953:

In case you haven't read the previous announcements: Starting next month RADIO COMMUNICATION will be expanded into two separate, bimonthly magazines. COMMUNICATION ENGINEERING will cover all the communication (non-broadcast) services, and military and civilian developments in mobile, microwave relay, point-to-point, and air-ground equipment and systems. Articles will be directed to both manufacturers and users.

TV & RADIO ENGINEERING will be devoted to developments in the broadcast services, with articles for the information of manufacturers of receivers, transmitters, and associated equipment, and for broadcasters. Thus, for the first time, there will be separate publications concerned with these two principal segments of the radio industry. Each subscriber has been asked by letter to advise us if he wants his subscription completed with COMMUNICATION ENGINEERING or TV & RADIO ENGINEERING. In cases where no reply has been received, the former magazine will be sent.

Western Electronic Show:

Will be held August 19 to 21 at the San Francisco Municipal Auditorium. This has become a major industry event. In 1952, attendance exceeded 15,000, with 199 exhibitors. Chairman is Joseph H. Landells, Westinghouse Electric Corporation, San Francisco.

William W. Dean:

Appointed director of engineering for Langevin Manufacturing Corporation. Mr. Dean was with GE for the past 11 years, most recently as audio facilities project engineer in the broadcast engineering section.

Communication Equipment:

A letter from Robert Graham of Communications Company, Inc., Coral Gables, Fla., contains the information that sales agencies are available in some territories for Comco mobile radio equipment. Preference will be given to companies handling installation and maintenance in the industrial, petroleum, taxi, and police services.

Railroad Radio:

Figures released by the Communication Section of the Association of American Railroads show that the number of transmitters licensed to the railroad radio service has increased from less than 1,000 in 1947 to nearly 10,000 in 1952, while the number of licensees has grown from 30 to 107. Nearly one-third of the transmitters were licensed in 1952.

Station Log on Tape:

Four-channel tape equipment to record incoming and outgoing dispatches has been developed for communication systems by Magnecord, Inc., 225 W. Ohio Street, Chicago 10. Designed to CAA specifications for use at airports, it is equally suited to all other services as a complete station log. Speed is 1⅞ ins., with response flat to ±3 db from 300 to 2,700 cycles.

Misdirected Effort:

Wisconsin's Senator McCarthy wants to start an investigation of the FCC, alleging but not specifying grievous official defections. Seems as if a lot more useful information could be turned up if Senator McCarthy would undertake to find out how the FCC has been able to maintain so much higher ethical standards than most of the other Govern-

(Continued on page 7)

SPOT NEWS NOTES

(Continued from page 6)

ment departments. Also, it would be interesting to know why the FCC cannot get enough money to continue essential services when other departments are hard put to get rid of unspent funds at the end of each fiscal year.

Norman Caplan:

Appointed chief engineer of the military communication and navigation engineering department at Bendix Radio, Towson, Md. He was previously chief engineer of the test equipment design department.

1,057-Ft. Tower:

WBEN-TV Buffalo is now using its new sky-scratcher. Atop the TV antenna is an FM pylon to provide greatly increased coverage for WBEN-FM.

New Facilities:

Construction is being completed on a 2-story, $2 million building of 150,000 square feet to be occupied by Allied Radio Corporation at Western Avenue and Washington Boulevard, Chicago. Provisions are made to increase Allied's present stock of 19,000 items to 25,000, and the present peak of 4,000 orders handled daily to 7,500. There will be a spacious store area on the first floor, with offices occupying the second floor. Customer parking space a block long will be provided in front of the building.

Educational Television:

While FCC Chairman Walker and Commissioner Hennock are assuring educators that they can operate educational TV stations without embarrassment to school budgets, NARTB's Richard Doherty, former head of Economics Department at Boston University, has been making a realistic analysis of TV operating records: "Actual operating cost of such an [inexpensive] educational outlet will certainly be double that of a small commercial station, and this assumes a small educational operation can get free services from faculty members and others . . . doing a limited, simple, and not very professional job. (it) will cost at least $1,000 a day to operate."

Subminiature RF Amplifier:

RCA has brought out a subminiature heater-cathode tube, type 5718, for use as an RF power amplifier or oscillator. Identified as a Premium design, it has a useful power output of nearly 1 watt at 500 mc., and can be used with full input up to 1,000 mc. Filament takes 6.3 volts at .15 ampere, with 100 or 150 volts on the plate at 8.5 or 13 milliamperes.

(Continued on page 8)

SPOT NEWS NOTES

(Continued from page 7)

Protests over FCC Form 400:

Although few manufacturers or operators of communication systems took part in the hearing which preceded official adoption of FCC application 400, strong opposition to its use, scheduled to start January 5, is now developing. Reason is that vital statistics will no longer be available. FCC's purpose in adopting Form 400 was to reduce clerical work by having applicants do the work filling out the application and license blanks. From where we sit, it looks as if the FCC will wind up doing more work than ever, because such a large number of application-license forms will be made out incorrectly. For that reason, we believe that Form 400 will defeat its intended purpose.

Dr. Robert Adler:

Appointed associate director of research for Zenith Radio Corporation, Dr. Adler, who received his Ph.D. degree from the University of Vienna in 1937, joined the Zenith research staff in 1941.

Stereosonic FM Broadasting:

No official announcement has been released, but visitors to the IRE Show in New York next March will hear binaural radio programs transmitted from a single FM station—probably WQXR-FM. The Stereosonic system. developed by Murray Crosby and William Halstead, will be employed. Meanwhile, at least one manufacturer is planning to market the unit which takes the second audio channel from any FM home receiver. Plan is to have them in New York stores before the Stereosonic programs start.

New Plants:

Measurements Corporation has purchased a plant of 15,000 square feet located on a 72-acre plot in Randolph Township, N. J., 12 miles from their Boonton headquarters.

Hammarlund Manufacturing Company has leased 12,000 square feet adjacent to their main plant at 541 W. 34th Street, New York.

Leece-Neville Company, Cleveland, Ohio, has added 18,000 square feet.

Dorne & Margolin has moved to a new building especially designed for high-frequency antenna research and production, at Westbury, N. Y.

Sargent-Rayment Company, whose plant was recently destroyed by fire, is now in full operation at 1401 Middle Harbor Road, Oakland 20, Calif. Telephone number is Glencourt 1-7045.

(Concluded on page 9)

Professional Directory

SPOT NEWS NOTES

(Continued from page 8)

Data on Resistance Instruments:

An unusually well organized presentation of engineering data is contained in a new catalog just released by Tech Laboratories, Inc., 4 Edsall Boulevard, Palisades Park, N. Y. It covers a complete line of pads, potentiometers. and attenuators including the linear scale type, rotary switches, wheatstone and limit bridges, gain sets, and other special instruments. Copies are available on request.

UHF Mobile Radio:

Next month, COMMUNICATION ENGINEERING will present a particularly interesting report on mobile radio transmission on 150. 450, 900, and 3,700 mc., by W. Rae Young, Jr., of Bell Telephone Laboratories. In view of the pressure to utilize the higher frequencies, the data and conclusions deserve careful study by communication engineers.

FM Broadcast Receivers:

At least three new, top-quality FM tuners will be introduced early in 1953, supported by substantial advertising campaigns. Two of the companies are newcomers in the field.

IRE Officers for 1953:

Dr. James W. McRea will succeed Dr. Donald Sinclair as president of the Institute of Radio Engineers. Vice president will be S. R. Kantebet, general manager of the Government of India Overseas Communications. Stuart L. Bailey and B. E. Shackleford were elected directors for the 1953-55 term.

MEETINGS and EVENTS

JANUARY 14-16,
IRE-AIEE MEETING ON HF MEASUREMENTS
Washington, D. C.

FEBRUARY 5-7,
IRE SOUTHWESTERN CONFERENCE & SHOW
Plaza Hotel, San Antonio, Texas

FEBRUARY 5-7,
WEST COAST AUDIO FAIR
Alexandria Hotel, Los Angeles

MARCH 23-26,
IRE NATIONAL CONVENTION & SHOW
Grand Central Palace, New York City

APRIL 11,
NEW ENGLAND RADIO ENGINEERING MEETING
Univ. of Connecticut, Storrs, Conn.

APRIL 18,
CINCINNATI SECTION IRE CONFERENCE
Cincinnati, Ohio

APRIL 28 - MAY 1,
NARTB BCST. ENGINEERING CONFERENCE
Philharmonic Auditorium, Los Angeles

MAY 11-13,
IRE AIRBORNE ELECTRONICS CONFERENCE
Dayton, Ohio

MAY 18-21,
1953 ELECTRONICS PARTS SHOW
Conrad Hilton Hotel, Chicago

AUGUST 19 - 21,
WESTERN ELECTRONIC SHOW
San Francisco Auditorium, San Francisco

SEPTEMBER 1-3,
INT'L SIGHT AND SOUND EXPOSITION
Palmer House, Chicago

Professional Directory

NEW...
CUSTOM DESIGNED FOR AIRCRAFT

Typical Operation

Radio Frequency Power Amplifier or Oscillator

Class-C telegraphy or FM telephony, 200-400 mc.

D-C Plate Voltage	1000 volts
D-C Screen Voltage	250 volts
D-C Grid Voltage	—110 volts
D-C Plate Current	160 ma
D-C Screen Current	6 ma
D-C Grid Current	8 ma
Driver Output Power	8 watts
Power Input	160 watts
Useful Power Output	100 watts

Eimac announces the development of the 4X150D radial-beam power tetrode designed for equipment simplification in commercial and military aircraft and vehicular operation. Through a specially constructed heater that has a rating of 26.5 volts at 0.57 amperes, Eimac presents aviation with a tube ideal for 24-28 volt electrical systems. Except for the heater the 4X150D is identical to the universally accepted 4X150A and can be used with the 4X150A air-system socket. The 4X150D is a natural for aircraft and mobile equipment because it combines high power output with small size and a ruggedness that gives it great immunity to damage by thermal or physical shock. Employed as an amplifier, oscillator or frequency multiplier into UHF regions, the 4X150D has a rated plate dissipation of 150 watts.

For further information or for consultation about your power tube needs write our application engineering department.

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

Eimac TUBES

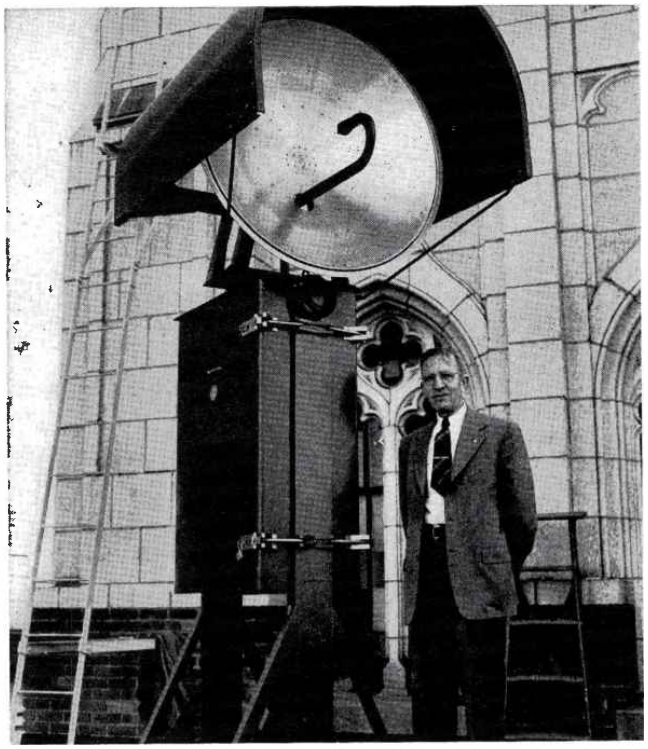


FIG. 1. HUBERT SHARP, M.S.B.T. RADIO ENGINEER, AT DENVER END OF MICROWAVE CIRCUIT

Microwave TV Relay

ST LINK CARRIES NETWORK OR LOCAL PROGRAMS TO KBTV ON MOUNTAIN-TOP–*By* HAROLD A. JONES*

THROUGH the use of short-haul microwave relays, communities that are not on the coaxial cable routes, or are distant from terminals of the cross-country TV relay system will be able, nevertheless, to have the benefits of TV network programs. Suitable microwave equipment, designed for high-quality transmission of television signals over distances up to 200 miles, is now commercially available and is economically practical for spur circuits as well as studio-to-transmitter links.

One of the new Motorola TV relay installations, operated by KBTV, is shown in the accompanying illustrations. It provides an interconnecting circuit between the Telephone Company's network radio relay terminal in Denver, and the KBTV transmitter on Lookout Mountain, 14 miles distant and some 3,000 ft. above the mile-high City.

Fig. 1 shows the equipment housing and the parabola at the City end of the circuit, with the installation on the mountain-top, Fig. 2, set up adjacent to the TV transmitter. Service was inaugurated by Mountain States Telephone & Telegraph Company in time to carry the presidential election to Denver.

*Manager, Technical Information Center, Communications & Electronics Division, Motorola, Inc., 4545 Augusta Blvd., Chicago 51, Ill.

Design of the Equipment:

The system termination for this relay installation was so designed that cable patches on the studio distribution board select either a network program or one which is produced at the local studios, thus affording complete flexibility.

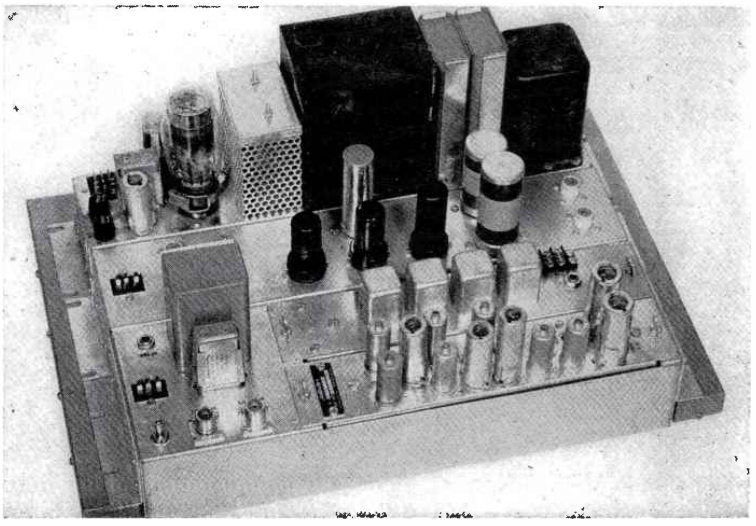
A unique feature of the microwave equipment is the use of a single RF channel for broadcast-quality video signals and a high-fidelity audio program channel, plus a two-way voice channel for orders and cuing. This simplifies adjustment and maintenance greatly, and facilitates program switching, since all elements are coordinated automatically.

This equipment is basically similar to Motorola installations now in use for cross-country relays in the communication services, now totaling 5,000 miles. It is intended for continuous duty 24 hours a day, and adequate electrical and mechanical tolerances are provided to deliver performance which mets the specifications of high-quality TV programs.

As Figs. 1 and 3 show, a package-type design is employed. That is, all the equipment, with the exception of the rack-mounted amplifying units, is installed in a weatherproof housing which carries the antenna and parabola. In the front view, the RF plumbing and control panel are at the left, with the power supply in the lower right hand section, and the subcarrier circuits above. The rear view shows the video amplifier and the IF chassis.

When a relay is used between a studio and a mountain-top transmitter, the microwave antennas can be mounted as in Figs. 1 and 2. But in cases where the ends of the circuit are at about the same altitude, or if the circuit must operate over a considerable distance, additional antenna height may be required. To obtain added height, the paraboloid can be mounted horizontally to beam the signals upward to a 45° passive reflector at the top of a tower, so that the signals are reradiated in a horizontal direction. In either case, all the radio equipment is installed at ground level where it is readily accessible for service.

FIG. 4. SUBCARRIER RECEIVER AND FILTER, MOUNTED EXTERNALLY WITH VIDEO OUTPUT AMPLIFIER



Common carrier frequencies of 6,415 and 6,340 mc. are used in the system One is for the multiplexed video, audio, and service channels in one direction and the other for service or cue channel transmission in the return direction. Performance at these high frequencies has proved exceptionally reliable. Actual operating experience on the 6,575 to 6,875-mc. industrial frequency band has proved completely satisfactory in Motorola industrial point-to-point communications networks now in service throughout the country. The equipment for television service is also available for operation in the 6,875 to 7,125-mc. STL range.

The packaged design of the equipment is shown in the front and rear views, Fig. 3. It is identical to standard Motorola multi-channel equipment except for minor modifications. First, the standard subcarrier transmitter-receiver system for voice communication has been replaced by a high-fidelity system for maximum quality of the audio signal. Second, the modulating and demodulating equipment has been designed for direct connection of the video signal to the RF section without the use of subcarrier equipment. The video signal, the program signal on a subcarrier channel, and a two-way service channel (order wire) on a separate subcarrier channel are all frequency-multiplexed on one RF carrier.

Performance Characteristics:

The video input signal is fed into a 75-ohm unbalanced circuit at a nominal level of 1 volt peak-to-peak (300 mv. peak-to-peak minimum.) At the receiving terminal, up to 1.5 volts peak-to-peak are fed into a 75-ohm unbalanced load of either polarity, or a 110-ohm balanced load. Overall system video response is essentially flat within less than −0.2 db at 60 cycles, and less than −2.5 db at 4.5 mc. The system is completely free from sync pulse compression. The video output amplifier at the receiving terminal, if used alone, has a frequency response characteristic of less than −1 db at 10 cycles and less than −3 db at 7 mc.

FIG. 2. INSTALLATION AT THE KBTV TRANSMITTER

Designed to work with standard line impedances of 600 ohms, the program circuit operates with a minimum input of −10 dbm and a maximum output of +5 dbm, with nominal values of 0 dbm. Audio frequency response is better than +0, −3 db from 50 cycles to 14.5 kc. Distortion is less than 1% at mid-range, and less than 1.5% at the ends of the range. The signal-to-noise ratio, with flat weighting, is better than 50 db.

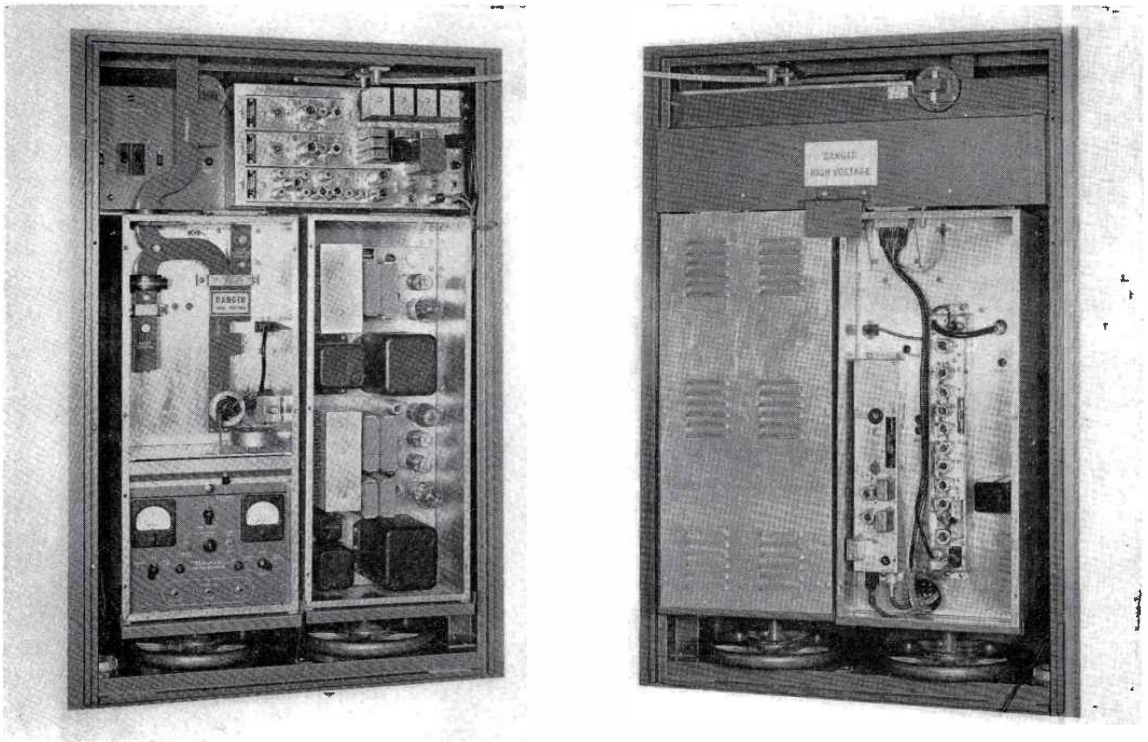
For the order wire, a two-way push-to-talk service channel with push-button ringing is built into the equipment. Designed for the audio range of 300 to 2,700 cycles, the 600-ohm circuit is built for nominal input and output levels of 0 dbm. It is capable, however, of satisfactory operation with a −10 dbm input and a +20 dbm output. Each relay station, as well as each terminal station, can be equipped with regular central battery telephone instruments connected into this service channel. A self-contained talking battery is provided.

The foregoing are nominal performance specifications for a two-hop system. The short haul relay will provide broadcast quality transmission through two or three repeated stations with only nominal compromise of signal-to-noise and distortion characteristics.

Operating in the 6,800-mc. range, antenna gains in the order of 35 db or 3,200 times are realized with compact 40-in. parabolas. A type 5976 Klystron is employed as the receiver local oscillator and 0.1 watt transmitter tube.

The low first cost and maintenance make this type of installation practical as a means of extending the area of coverage.

FIG. 3. FRONT VIEW, LEFT, AND REAR OF THE MICROWAVE RELAY FOR TV BROADCAST SERVICE. COVERS OF WEATHERPROOF HOUSING ARE REMOVED



PATTERN FOR TV PROFIT

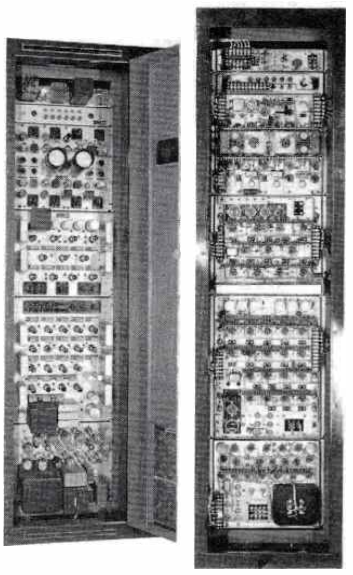
PART 5 — DESCRIPTION OF THE TELEVISION WAVEFORM AND THE PURPOSE OF EACH PART—SYNCHRONIZATION—STUDIO EQUIPMENT & ITS FUNCTIONS

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

IN all modern television systems, picture information is contained in a series of lines which are intended to be reproduced consecutively (not concurrently) at some very small vertical displacement with respect to each preceding line. The lines are formed at the receiver by a pencil-like beam of electrons which excites a fluorescent coating on the back of a picture-tube face. Light is produced only in the screen area immediately surrounding the point at which the beam strikes, and the amount of light produced is proportional to the intensity of the beam. If the beam is caused to move horizontally across the face of the screen, and the intensity of the beam is varied in accordance with the shades of gray in areas of the picture being transmitted, then a line of picture information is formed on the picture-tube face.

As the beam moves across the screen horizontally from left to right, it is also moved down steadily by a very slight amount. When it reaches the right-hand side of the screen it is blanked out, and is returned suddenly to the left side and begins moving across the screen again, forming another line of the picture. However, because of the slight downward motion received during the time it takes to scan the first line and fly back to the left side of the screen, the second line begins at a point just below the starting position of the first line. This process is repeated, with each line formed directly under the preceding one, until the whole face of the screen has been scanned. The light and dark areas are slightly different in each succeeding line for a normal picture, corresponding to the shades in the same relative line across the picture being transmitted.

In the American system, a complete picture consists of 525 lines which recur at the rate of 15,750 lines per second. During the first downward traversal of the screen, the evenly-numbered lines are scanned to form one *field* of 262½ lines. During the next field, the odd-numbered lines, those which lie between the lines scanned in the first field, are



FIGS. 1 AND 2. STUDIO-TYPE SYNC GENERATOR

reproduced. Thus, two fields are needed to produce a complete picture, called a *frame*. By simple division it is found that 30 pictures or frames are produced every second. The screen is illuminated at twice this rate, because of the two-field-per-frame scanning system.

Such a system is called *interlaced scanning*. The reason for its adoption is that it reduces the sensation of flicker without a corresponding increase in frame rate or a reduction in picture definition. Horizontal definition is limited in a TV system by the horizontal sweep speed and the frequency bandwidth of the system. Since the bandwidth is limited by considerations of spectrum economy, the horizontal picture sweep rate is the determining factor for horizontal picture resolution. The *number* of lines per frame affects the vertical resolution; the field rate affects the degree of flicker. By employing interlaced scanning, therefore, the frame rate can be reduced from 60 to 30 cycles, providing an increase in picture resolution without an increase in flicker or bandwidth.

The Sync Generator:

The sweep circuits at the receiver and at the picture generator must sweep the beam horizontally at 15,750 times per second and vertically at 60 times per second. These sweeps must be timed very accurately and, moreover, the receiver sweeps must be synchronized with those of the equipment which generates the picture. Finally, the beam must be cut off as it flies back from the end of one line to the beginning of another, and from the bottom of one field to the beginning of another, in order to prevent retrace lines from appearing in the picture.

These essential functions — synchronization and retrace blanking — are initiated at the television station by a complex piece of equipment known as a sync generator. Front and rear views of a studio sync generator are shown in Figs. 1 and 2. This equipment has been aptly called the heart of a television system, because it provides drive and blanking pulses for all the various picture pickup sources, as well as the sync and blanking pulses in the transmitted signal for operation of the receiver circuits.

Fig. 3 is the lower half of the transmitted video envelope in the vicinity of two succeeding vertical sync pulses. In the diagrams, the tops of the waveforms

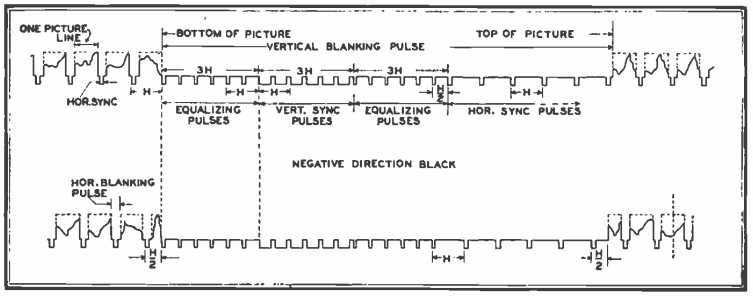


FIG. 3. LOWER ENVELOPE OF TRANSMITTED TV SIGNAL FOR TWO SUCCEEDING VERTICAL SYNC PULSES

*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.

represent white signal level, with black downward. Three or four lines are shown at the left and right ends of the waveforms. Although the time intervals are not exactly in scale, the larger intervals are taken up with picture information. It can be seen that the level of the waveform in these intervals changes according to the shadings in the picture at the level of each particular line. Between these intervals are the line blanking pulses, which are slightly below the black picture level in order to cut off the beam during horizontal retrace periods. Just below these are the horizontal sync pulses, which are responsible for the actual triggering of the sweep circuit.

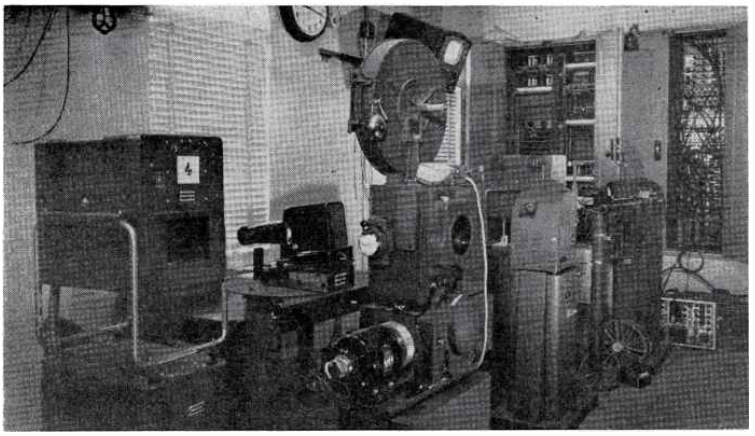


FIG. 4. FILM AND SLIDE EQUIPMENT, INCLUDING 35-MM. PROJECTOR AND ICONOSCOPE FILM CAMERAS

Between these series of regular pulses is a long blanking pulse, upon which are superimposed vertical equalizing pulses and the vertical sync pulse. It will be noted that the horizontal sync pulses in the lower waveform are placed in time midway between those in the upper diagram, as they should be for 2-to-1 interlacing. The purpose of the equalizing pulses is to make the vertical sweep generator disregard the difference in time intervals between the last horizontal sync pulse and the vertical sync pulse for succeeding fields. Therefore, the vertical sweep is initiated at the right time regardless of the field relationships. Also, the equalizing pulses occur at exactly twice the line sync pulse rate. Every other equalizing pulse, then, serves to trigger the horizontal sweep circuit to keep it in exact synchronization, so that it is ready to operate correctly on the first new horizontal sync pulse after the vertical pulse. Slots are cut in the actual vertical sync pulse at twice the horizontal sweep frequency for the same purpose. Although the entire vertical sync waveform consumes time equivalent to only about 9 lines, the vertical blanking pulse lasts for about 14 lines. This is simply a safety measure, permitting receiver manufacturers more leeway in the design of vertical deflection systems.

Sync and blanking pulses are not in the original picture waveform as it is delivered from the source equipment, but are added later. The sync generator does supply similar pulses (sometimes called drive) to these sources, however, to trigger their sweep circuits in synchronism with receivers. It also supplies pulses to cut off the scanning beams during retrace periods, that are similar to the blanking pulses described except that they are of somewhat shorter duration. This is known as *camera blanking*, even though it is used for signal sources other than cameras.

Synthetic addition of blanking from the sync generator can be accomplished before or after switching to the signal sources. When blanking is added, it is done so as to maintain a fixed relationship between black level in the picture waveform and the blanking level. The process is called DC insertion; that is, it provides a fixed reference point occurring regularly in the signal that is at a definite relation to black level. As transmitted, black level is supposed to be 95% of the blanking level. When blanking is added to the signal originally, it may be more than 5% higher from zero carrier than black level for compression in amplifier stages. However, whatever the relative levels, the important point is that they are fixed. This permits the use of AC amplifying circuits following the addition of blanking, because the signal can always thereafter be restored to the correct DC level by the use of clamping circuits which operate on the blanking pulses.

Generally, sync is added to the signal only after all switching is completed, in order to avoid disturbance in the received picture because of sync time variations between sources. The amplitude of the sync pulses as transmitted is specified as 25% of the total height of the waveform; as with blanking, this may be greater when first added in order to compensate for amplifier compression.

The sync generator shown in Figs. 1 and 2 is of the studio type. Field, or portable, sync generators are widely used also. They are much more compact and may be less expensive than the studio generators, and are quite satisfactory. However, they may not be as accurate or as easy to service and maintain.

Picture Sources:

There are three basic means for originating video pictures commonly used in television stations: Camera pickup tubes, monoscopes, and flying-spot scanners. Probably most important is the television camera.

Two types of cameras have been in wide use during post-war years. Developed originally in 1923, and still used for TV film pickup, is the iconoscope pickup tube. A film camera employing one of these tubes can be seen at the far left in Fig. 4. The iconoscope was used for live as well as film pickup before the image orthicon tube was developed. Iconoscopes (ikes), while capable of producing pictures of excellent quality, are much less sensitive than orthicons. Therefore, they require far higher light levels for proper operation, and more careful adjustments. When the image orthicon tube was developed, therefore, it was put to use in live-pickup cameras because it gave good pictures at reasonable light levels, even though it was considerably more expensive to use. Ikes were relegated to use with film and slide projection equipment, where the required light levels were readily attainable.

FIG. 5. IMAGE ORTHICON LIVE-PICKUP CAMERA

A live-pickup camera, Fig. 5, contains sweep circuits driven by the sync generator, an electrical view-finder for picture composition and focusing, a video preamplifier to obtain a good signal-to-noise ratio, and a system of lenses mounted on a rotating turret. Controls

for the tube sweep circuits and some for operating voltages are also furnished on the camera itself.

Power, drive, and camera blanking are supplied to the camera by means of a long cable from the control room. The picture video is returned to the control room via the same cable. A cue circuit is usually included also.

Camera lenses are an important part of the investment in studio equipment. They run the gamut from wide-range 2-in. lenses to 20-in. lenses for extremely narrow-angle pickups. Up to 4 of these lenses can be mounted on the rotating turret. Two types of zooming lenses (which must be mounted singly) can be obtained.

Each camera requires a power supply unit and a camera control unit, which includes a picture and wave-form monitor. The camera control may be located in the studio control room or the master control room in a small station. Some recent large installations provide for a central camera control room, where the camera controls for all studios are located. This requires extra monitors in the individual studio control rooms, but in a large operation this disadvantage may be offset by other efficiencies attained. Iconoscope cameras as well as orthicons require these control units. Picture shading and general quality is maintained by the control operator.

The camera, camera control unit, and power supply make up a *camera chain*.[1] Complete live-pickup chains, as well as other program units, are available as either studio or field equipments. The main difference between the two is that the field units are designed as suitcase-mounted devices that are easily portable. Performance and price-wise, there is little or no difference; studio equipment may be more handsome in appearance and easier to work with *in the studio*. However, field equipment can be used either on remote pickups or in the studio. Except for a large station planning extensive operation, it would appear wise to install field equipment for the most part, which is versatile enough to meet any program requirement. It might be a good idea to install a studio sync generator for normal studio use, with the field sync generator as a standby.

[1]DuMont chains include camera auxiliaries.

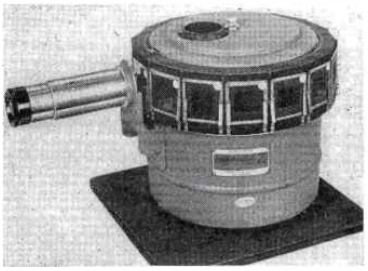


FIG. 6. REMOTELY-ACTUATED SLIDE PROJECTOR

An ike film chain does not include a viewfinder or a lens system, since it is usually fixed in position and the film projectors include lens systems. For most installations, 16-mm. motion-picture film projectors will be employed exclusively. Although 35-mm. equipment does, undeniably, offer better quality, the problems of handling the 35-mm, film inhibits their use in any but the largest, most competitively-situated stations. The minimum film projection equipment would be two 16-mm. projectors and a slide projector multiplexed by means of mirrors into one film camera. A much safer and more convenient arrangement for the small station consists of two film cameras, each fed by one film and one slide projector. Fig. 4 shows another variation: two 16-mm. film projectors and a slide projector operate into one camera in the background, and the camera in the foreground handles slide and 35-mm. equipment.

Slide projectors are very important items, for they are used quite often for simple spot commercials. They range from the simplest manually-operated devices to automatic strip-film and turret projectors, as shown in Fig. 6, which are operated remotely from the camera controls. Even more versatile still projectors are available, as described later.

FIG. 7. A SPECIAL-EFFECTS SLIDE PROJECTOR

Film equipment is often set up in or adacent to the master-control room, with the cameras operated at the master-control position. Where film is required as an integral part of a studio or remote program, it can be supplied on cue and integrated by the master control operators. In large installations, a film room is often set up containing all projection equipment. Film portions of studio programs can then be integrated by the studio control personnel.

As has been pointed out in this series many times, film equipment is not something that can be slighted with impunity. A significant part of a station's programming may be handled by film, and a major part of its income will come from film commercials. In the past, TV film quality has not been generally good; this has been mostly the result of poor film, partly poor equipment, and, to some extent, incorrect operation of film equipment. Recently, TV film techniques and processing have improved so that 16-mm. film made specifically for TV can now be very good. Several new 16-mm. TV projectors have been made available which are excellent. Under development at the moment are flying-spot scanners for film pickup which should have substantial advantages over standard camera systems. In a competitive market, film quality on TV becomes increasingly important, and the best possible equipment should be obtained.

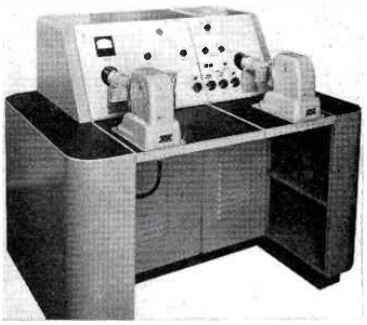


FIG. 8. VERSATILE FLYING-SPOT EFFECTS UNIT

Considerable operating experience has been accumulated on the use of standard orthicon cameras for film pickup. In this method, the film image is projected on a translucent screen inside a shadow-box, and a studio camera is focused on the screen. This method of film operation has distinct advantages in that no iconoscope cameras need be installed and maintained, any of the regular studio or field cameras being suitable, and camera adjustments need not be so critical.

Operating cost of the orthicon camera is higher than that of an iconoscope camera. However, projection lamps of considerably less brilliance can be employed, and when the costs of projection lamps and pickup tubes are combined, the difference in operating costs for the two systems seems to be negligible. Proponents of the orthicon film-pickup system are convinced that pickup quality is entirely satisfactory; dissenters are of the opinion that it is not so good as a properly-operated iconoscope chain. It

is certain, however, that the orthicon film system has real operational advantages.

The second type of locally-originated video source is the monoscope. This is a convenient means for obtaining a fixed image of known quality for test and adjustment work, or for test-pattern transmission. A fixed image is impressed on the face of a monoscope tube. Sweep circuits in the monoscope generator are driven by the studio sync generator. Standard blanking signals are added in an associated video amplifier, so that the output of the monoscope generator is a completely-synthesized video signal except for sync pulses.

Finally, the video source may be a flying-spot scanner. This is basically one of the simplest methods of producing video, although it is presently limited to subject matter of small size, such as fixed slides. The subject is scanned with a fine beam of light, obtained from a raster on the face of a kinescope screen. Light reflected from (or passed through, in many cases) the object falls on a photo-electric cell or electric eye which generates the video waveform. In other words, the subject is scanned by a fast-moving (flying) spot of light. Flying-spot scanners which handle slides only are used for test-pattern generation as well as other high-quality slide projection. In TV stations where film cameras normally handle slides, a flying-spot scanner would free them for use in rehearsals, previewing, or maintenance, and would eliminate the need for monoscope generators.

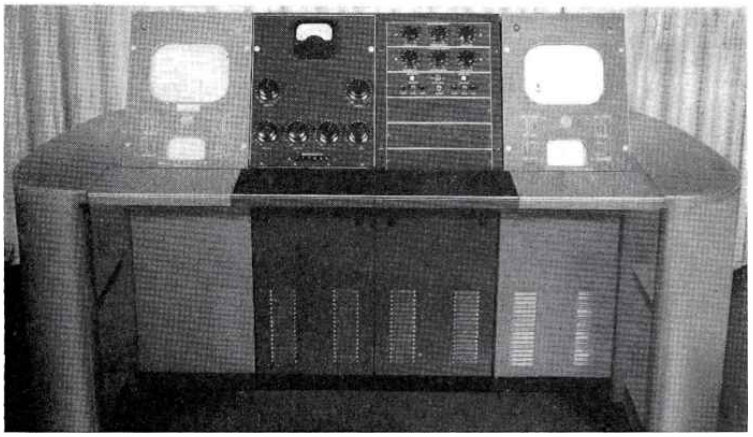


FIG. 9. BASIC MASTER-CONTROL AND MONITORING EQUIPMENT WHICH CAN BE EXPANDED AS DESIRED

Special Effects:

A great variety of equipment comes under this general heading, including background projection for studio pickup, special lighting effects, and electrical transmission and combination.

The simplest electrical effect is probably the fade, whereby one signal is faded out and/or another faded in. This can be accomplished simply at the camera switching position or master control desk. However, other effects usually require more elaborate equipment.

Electrical montage and effects amplifiers can be used with flying-spot scanners or film cameras to provide wipes, superimpositions, and distinct insertions of 2 or more separate single sources in an almost unlimited variety of effects. Slide projectors, such as the one shown in Fig. 7, can combine images of transparent and opaque slides and even small solid articles in laps and dissolves, and are versatile enough to be called special-effects equipment. Fig. 8 shows one type of flying-spot scanner and effects amplifier combined into a single console unit. With such equipment, any parts of one or more pictures can be inserted into another picture at will. Pointers can be superimposed to direct attention to any part of a picture. Such systems aid immeasurably in broadening the programming possibilities of a station. If it is not possible to provide such facilities in the beginning, almost any station should plan for one as soon as possible.

Control, Switching, Distribution:

A basic requirement for even the smallest TV station is a master switching and control station for selecting and adjusting the audio and video signals to be fed to the transmitter. This may be combined with studio and/or film control in the smallest stations, as explained previously. It may be combined with the transmitter control where the transmitter is located at the station, or where film facilities are provided at a remote transmitter. Finally, it may be the central feed selection and control point for signals from two or more studios, a film room, remote pickup, and network lines.

Fig. 9 shows a basic master control and monitoring console for simple installations. It contains switching and control circuits for 8 video and 8 audio inputs to a single output line. Video switching is accomplished through relays operated by pushbuttons. Video and audio switching can be simultaneous or separate. Controls in the right-hand dark section are for remote operation of film and slide projectors, and for control of incoming remote or network signals and of the outgoing signal to the transmitter. Monitoring facilities can be added as desired, as shown by the lighter sections of the console.

A more complex video switcher can be seen in Fig. 10. Although this is designed as a field unit, it is versatile enough for use in a studio. A monitor switching bus is represented by the top row of pushbuttons. This switches any of 5 local or 2 remote inputs to a monitor output, independent of the line switching section at the bottom. Fades and dissolves are provided between any two inputs by the center rows of push-buttons. This unit may be part of the master control or, in more elaborate installations, of the studio control equipment.

Separate switching and control facilities for audio signals are ordinarily provided also. Turntables, microphones, film projectors, and audio special effects inputs are just as important to successful local programming as the corresponding video signals. As has been explained, the job of the audio engineer is more difficult in a television station than in a standard radio broadcast setup, since he must operate under restrictions as to mike placement that would turn the hair of less patient and resourceful men gray overnight. The TV audio engineer must follow the directions of the directors as well as instruct the microphone boom operator(s), ride gain, and operate turntables. Audio control equipment has been described previously.

Intercom systems may range from simple single-channel single-studio setups to quite involved multi-circuit systems. In most cases, these systems are custom-

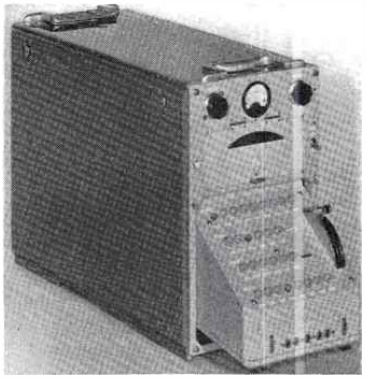


FIG. 10. A VERSATILE VIDEO SWITCHING UNIT

FIG. 12, BELOW: SUCH A STUDIO CAMERA CRANE PROVIDES FOR SMOOTH MOTION OF THE CAMERA IN ANY DESIRED MOVEMENT AND ANY DIRECTION

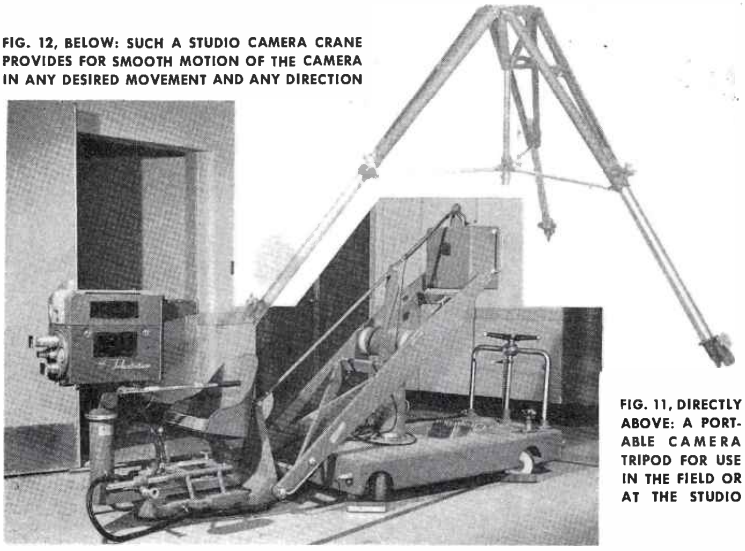


FIG. 11, DIRECTLY ABOVE: A PORTABLE CAMERA TRIPOD FOR USE IN THE FIELD OR AT THE STUDIO

designed to handle the problems involved in a specific setup. Cue circuits are required for technical directions to microphone and camera operators on studio floors, between program director and stage hands and floor manager, and sometimes between personnel in the studio proper. Very often the technical and program circuits are separate. There has been a trend recently toward the use of miniature low-power radio cue circuits for one-way communication from the program director to his people on the floor. By using pocket receivers, they are unencumbered by trailing wires.

In the larger stations, intercom systems between studio, film room, and master control are usually necessary also, because so many departments are directly involved in the production of a television show. The need for close coordination requires an extensive, closely-knit intercommunication system.

Other essential components of studio systems for television are sync-generator lock-in devices and stabilizing amplifiers. The sync locking units are used for synchronizing the local sync generator with that used at whatever remote or network program source is to be switched into the program channel, so that when the actual switching is accomplished there will be no interruption of transmitted sync. The lock-in is accomplished before switching, thus preventing any disturbance to pictures on receivers. Stabilizing amplifiers perform, in effect, a clean-up job on a TV signal. Special clamping circuits remove hum components from an incoming signal, clip off noisy sync pulses and replace them with new sync pulses, and remove switching transients. Stabilizing amplifiers are used on all incoming remote lines and after all video switchers. They are also used on outgoing lines to transmitters, since they include controls for adjusting sync amplitude to compensate for transmitter compression.

Distribution amplifiers are another essential item of studio equipment. They are simply unity-gain amplifiers having one or more high-impedance inputs and 5 or more low-impedance outputs. Their uses are manifold, including sync and picture distribution, sync mixing, amplification (by parallelling inputs and outputs), bridging, and isolation.

Finally, monitors are usually required in fairly large quantity around a station. There are two types: those which have precision sweep circuits and waveform display facilities, and which are used at control positions; and *utility* monitors, which are used for observation and information only. Utility monitors would be used for client's viewing, for the audio engineer and lighting control personnel, and for general supervisory personnel, among other applications. Each monitor receiver requires an output channel of a distribution amplifier.

Miscellaneous Equipment:

An expensive and important part of the budget for a station beginning with local studio programming will be that allocated for camera and microphone booms, dollys, and cranes. Microphone booms are of two general types. Light booms can be used on shows staged in small areas, where relatively short cross arms can be used. Heavier booms with higher, longer arms are used for theater-type stages where audience participation on a large scale is contemplated.

Camera bases range from a simple metal tripod, Fig. 11, intended for field applications but usable in the studio also, to the elaborate television crane shown in Fig. 12. Camera maneuvering devices for studio use are heavy, smoothly-functioning precision devices to insure quiet and even motion of the camera. In addition to the bases shown, two others are quite extensively used in studios. The camera pedestal is a heavy but freely-moving single-column mount equipped with 3 sets of rubber-tired wheels. It is moved by the camera operator. The panoram dolly is a flat-bed device on which is mounted a rotating short camera crane. The dolly, on which the cameraman rides, is moved about by an operator in response to directions.

Editor's Note: Part 6, the concluding section of "Pattern for TV Profit," will appear in the February, 1953 issue of TV & RADIO ENGINEERING.

FCC Television Grants

RADIO COMMUNICATION Magazine 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 October 20 to November 14, 1952.

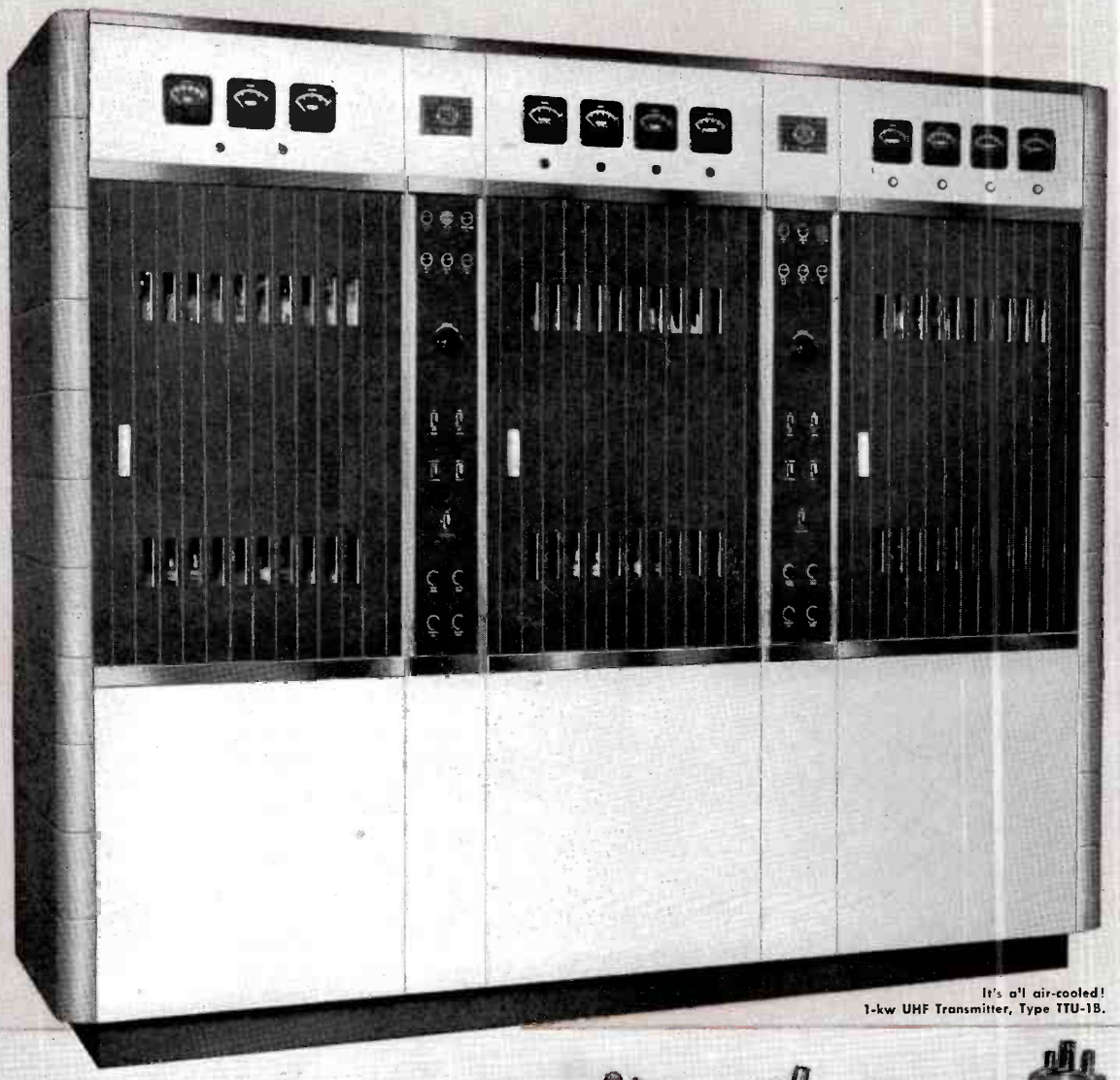
Information given for CP grants consists of the city, channel number, visual and aural ERP's, estimated costs of construction, and principal owner or owners. If grantee controls audio broadcast station, call letters are given in parentheses.

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

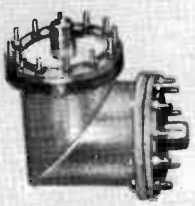
	CH.	KW.	COST
Gadsden, Ala. Jacob A. Newborn, Jr.	21	22-11	$140,000
Tucson, Ariz. Arizona Bcstg. Co. (KVOA)	4	11-5.5	$249,000
Tucson, Ariz. Old Pueblo Bcstg. Co. (KOPO)	13	316-160	$370,000
Fort Smith, Ark. Southwestern Publishing Co. (KFSA)	5	265-145	$289,000
Little Rock, Ark. Gt. Plains TV Properties, Inc.	23	17.5-10	$247,500
San Bernardino, Calif. KITO, Inc. (KITO)	18	87-49	$180,000
Santa Barbara, Calif. Santa Barbara Bcstg. & TV Corp.	3	50-25	$289,000
Pueblo, Colo. Pueblo Radio Co. (KDZA)	3	10.5-5.3	$167,000
Pueblo, Colo. The Star Bcstg. Co.	5	12-6	$150,000
Waterbury, Conn. WATR, Inc. (WATR)	53	245-125	$283,500
Pensacola, Fla. Southland Television, Inc.	15	20-10	$177,500
Muncie, Ind. Tri-City Radio Corp. (WLBC)	49	16-8.1	$197,000
Sioux City, Iowa Gt. Plains TV Properties, Inc.	36	18.5-10.5	$218,500
Frederick, Md. Monocacy Bcstg. Co. (WFMD)	62	105-54	$196,000
Battle Creek, Mich Booth Radio & TV Stations, Inc.	64	24.5-14	$167,500
Duluth, Minn. Gt. Plains TV Properties, Inc.	38	17-9.6	$240,000
Atlantic City, N. J. Neptune Bcstg. Corp. (WFPG)	46	18-9	$152,500
Elmira, N. Y. Elmira Television	24	58-29	$241,500
Asheville, N. C. Radio Station WISE, Inc. (WISE)	62	23-13	$122,500
Warren, Ohio Warren Tribune Radio Station, Inc. (WHHH)	67	80-43	$484,500
Bethlehem, Pa. Associated Broadcasters, Inc.	51	2.25-2.25	$204,500
Williamsport, Pa. WRAK, Inc. (WRAK)	36	21-10.5	$137,500
Charleston, S. C. WCSC, Inc. (WCSC)	5	100-50	$290,000
Honolulu, T. H. Radio Honolulu, Ltd.	11	125-74	$364,000
El Paso, Texas KEPO, Inc. (KEPO)	13	120-60	$435,500
Waco,Texas Central Texas TV Co.	34	5-3	$225,500
Wichita Falls, Texas White Television Co.	22	18.5-9.3	$275,000
Lynchburg, Va. Lynchburg Bcstg. Corp. (WLVA)	13	28-14	$162,000
Lynchburg, Va. Old Dominion Bcstg. Corp. (WWOD)	16	100-57	$167,000
Green Bay, Wisc. Norbertine Fathers (WBAY)	2	100-50	$463,500

Complete "Package"



It's all air-cooled!
1-kw UHF Transmitter, Type TTU-1B.

UHF Spring Hanger



UHF 6⅛" Mitre Elbow

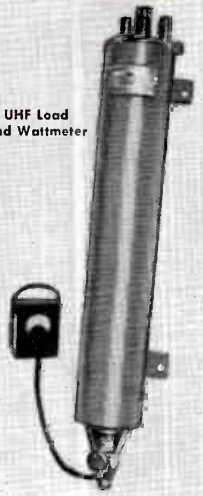
UHF 6⅛" Transmission Line

UHF 3⅛" Mitre Elbow

UHF Connector/ Inner Conductor and Insulator

UHF 3⅛" Gas Stop

UHF 3⅛" Transmission Line



UHF Load and Wattmeter

for UHF

Transmitter Plants

WITH THE UHF EQUIPMENT and accessories illustrated here, you can build a 1-kw UHF plant capable of delivering up to 20 kw, ERP. RCA has the transmitter. RCA has the antenna. RCA has the indispensable accessories needed to complete the installation—transmission line, mitred elbows, line transformers, spring hangers, dummy loads, wattmeters, frequency and modulation monitors, filterplexers, etc. In short, everything—from ONE responsible manufacturer!

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Like this 1-kw package, RCA has UHF combinations to meet power requirements—up to 1000 kw! Your RCA Broadcast Sales Representative can tell you what you'll need for the power you use—show you a practical plan for a minimum outlay. Call him today.

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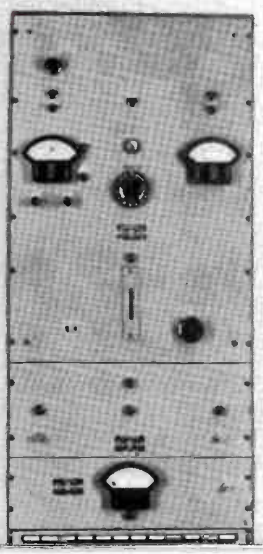

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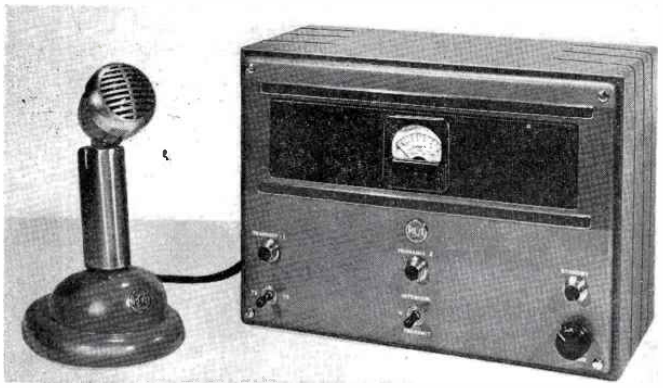
UHF Vestigial Sideband Filter and Notch Diplexer (Filterplexer)

RCA's high-gain UHF Pylon. The most economical way known to produce high ERP.



CONTROL FOR ONE OR TWO REMOTE TRANSMITTERS ALSO SERVES AS AN INTERCOM UNIT

Communication News

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

THE three-day conference of the IRE Vehicular Radio Group at Washington on December 3 to 5, under the chairmanship of Frederick Budelman, was highly successful. About 200 attended the technical sessions and the mobile radio demonstrations. The papers were exceptionally interesting and well presented. They will be reviewed in the forthcoming issue of COMMUNICATION ENGINEERING.

Most of the papers were concerned with split-channel operation, over which there is still considerable difference of opinion, although there is general agreement that the present channels can be reduced in width.

Remote Operating Control:

RCA has introduced a new unit for controlling one or two remote transmitters. Separation may be any distance from a few feet to 10 miles. The control, illustrated here, contains a speech amplifier, power supply, loudspeaker, speaker amplifier, and circuits which permit all remote control functions to be operated over a single pair of telephone wires. On the front panel are the meter for monitoring the line level, a volume control, transmitter selector, and a switch to shift from radio to intercom. Provisions are made for using either a dynamic or carbon microphone.

The very compact cabinet is 13½ ins. wide, 9½ ins. high, and 6 ins. deep, with total weight of 19 lbs. Current consumption is 68 watts from 110 to 117 volts, 50 to 60 cycles.

Faster Dispatching:

A very simple device, operated by a foot switch, is being used by dispatchers who handle both incoming telephone calls and radio communication. Manufactured by American Radiotelephone Company, 3505 4th Street North, St. Petersburg,

DISPATCHER'S LINE-AND-RADIO FOOT SWITCH

Fla., this control switches a headset-microphone from land-line telephone to radio, and holds the telephone connection open. There are two advantages: the dispatcher's hands are free at all times, and since the incoming call is held while the radio message is transmitted, the dispatcher can report the completion or disposition of the message at once. This is important in the police, fire, taxi, and message traffic services. Also, the control can be used with two separate radio services, as in the case of microwave relays operated in conjunction with mobile systems. When there are two or more dispatchers handling incoming calls for one mobile system, as in a taxicab office, a lockout circuit prevents one dispatcher from making a radio call if another dispatcher is already on the air.

Sweeping Condenser:

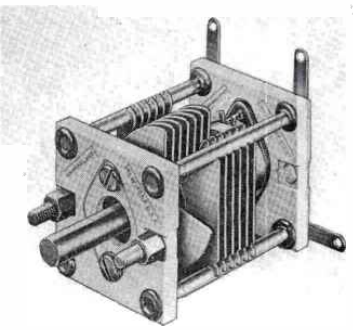
Although there are many applications for motor-driven capacitors to provide continuously varying frequency, the bearings and contacts of conventional variable capacitors are not designed for such use. Now, Hammarlund Manufacturing Company is producing a butterfly design with ball bearings and an end-thrust take-up so the capacitor can be driven continuously at speeds up to 3200 rpm. Contacts are not a consideration, since the butterfly type does not require them. These devices are available with effective series capacity values of 5.4 to 17 mmfd. Rotors and stators are of soldered brass, nickel and cadmium plated. Silicone-treated steatite end plates measure 1⅜ by 1⅜ ins.

Citizens Band for Business Use:

The general impression seems to prevail that the citizens radio band is for private use only. Actually, it is available to any commercial enterprise that wants to operate in that band. FCC Rules provide for class A operation on 460 to 462 mc., and 468 to 470 mc., with the input to the final amplifier limited to 50 watts. Class B operation, on 462 to 468 mc., is limited to 10 watts input to the final amplifier. It is further provided that equipment operated in those bands must be type-approved by the FCC.

Now that satisfactory communication has been amply demonstrated over distances up to 15 miles and more on the citizens band, it is expected that those frequencies will be used for mobile and point-to-point services by many companies not eligible to use 152 to 174 mc., or 450 to 460 mc.

Motorola recently received the first class A-type approval No. CR-405 on its mobile equipment model T44A, and No. CR-407 for its model L44A base station equipment. Of course, these are not the under-$30 vest-pocket units originally envisaged for the citizens band. Instead, the 21-tube receiver and the 9-tube transmitter are of standard commercial design, priced accordingly. Experience has shown that there just isn't a cheap answer to the design of equipment giving commercial-grade performance.



MOTOR-DRIVEN CAPACITOR FOR SWEEP CIRCUITS

Information on New FCC Form 400

EXPLAINING WHY THE NEW FCC APPLICATION FORMS HAVE BEEN ADOPTED, HOW TO AVOID MISTAKES IN THEIR PREPARATION—*By* JEREMIAH COURTNEY*

JUSTICE Cardoza once observed, in over-throwing an established rule of law, that "certainty is illusion, and repose is not the destiny of mankind."

In somewhat similar spirit, the FCC has cast aside its old reliable 401 application form, the foundation upon which the present structure of the Safety and Special Radio Services has been built. The Commission held a wake for Form 401 on the evening of December 3, the first day of the IRE vehicular communications meeting in Washington.

The Five Percent License:

Mr. Charles R. Weeks, head of the FCC Authorization Analysis Division, opened the seminar conducted by Merle Floegel with a fitting eulogy for the old 401 Form explaining that, with the new 400 Form, applicants must complete 100% of the application and 95% of the authorization as well.

Form 400 has a work sheet for the convenience of the applicant but, simple as it is, it is by no means proof against all mistakes. The work sheet is attached to six copies. The former is retained by the applicant as his copy of the application, and the remaining sheets are forwarded to the FCC. After the application has been processed, the upper half of the first sheet is completed in the spaces marked "This space for Commission use only," and is returned to the applicant as his authorization. The remaining carbon copies of the top half go to the field office in which the station is located, and to other departments of the FCC's Washington office dealing with frequency assignments.

Goodbye, Mobile Records:

Some captious critics have claimed that the new form represents an abdication of the FCC's licensing function in the mobile radio service field. That criticism may or may not be justified, but certain it is that the Commission has given up its record-keeping role.

First, applicants using Form 400 no longer specify the manufacturer or the type of the equipment they will use. The Commission will issue a "List of Equipments Acceptable for Licensing"[1] designated for use in the Public Safety, Industrial, and Land Transportation Radio Services in which the new Form will be used. If the equipment is on that list, it isn't necessary to name it.

The advantage of this procedure is that a licensee may substitute equipment of a different manufacture, type, or model number without filing a modification application as long as the equipment to be used appears on the Commission's current List. Thus, an important source of industry statistics will be eliminated. That in itself is a serious disservice.

Equipment which does does not appear on the Commission's List may be authorized only if a detailed description is included with the application, and the Commission approves its use.

Second, the application provides only for specifying the *maximum* permissible power input permitted for stations operating in the particular *radio service*, not the power of the particular *equipment* the applicant proposes to use. This makes it impossible to coordinate effectively an applicant's proposed frequency use in any particular area.

In the past, an applicant could ascertain the power of the various stations authorized in a given area. If several high-power stations were on a particular frequency, the use of that frequency would, of course, be avoided. Now, neither the Commission nor any other person will know the power and, therefore, the range of the stations operating in any particular area. Effective frequency coordination is thus ended.

Third, the authorization under the new form will be issued as a combined construction permit and license. This is true whether or not the applicant applies for mobile and base transmitters, stations operating at fixed locations, or both. Due to the Commission's practice of issuing authorizations for mobile units based on the applicant's anticipated requirements, it has never been possible to tell from the Commission's records how many mobile units were operated on a particular frequency. In the past, however, there was a sure indication as to whether or not a base station was in operation by reference to the type of authorization outstanding, *i.e.*, a construction permit for a base station, or a license for a completed base station in use. Under the new Form 400, there will be no way of telling how many base stations are in actual operation.

Fourth, neither the Commission nor any one else will ever henceforth be able to tell how much equipment is owned and operated, and how much is leased from others for operation. The new form simply asks whether the applicant will have exclusive control over all the equipment and control points covered by the application. The superseded Form 401 required the applicant to submit a copy of the lease agreement if his application did not show on its face that he owned the equipment for which he was requesting authorization. It is important to the Commission and industry to know the terms upon which the manufacturers are leasing that equipment. This regulatory function has now been dropped.

Finally, the new form does not require applicants to show the facts (birth place, naturalization order, etc.) from which their citizenship can be determined, since it contains only the question: "Is applicant a citizen of the United States?"

FCC's Inadequate Budget:

It is regrettable indeed that Congress should so reduce the funds available to the Commission that it must abandon its record-keeping functions in the mobile and point-to-point services. And it is difficult to understand how effective regulation can be obtained without industry statistics on highly relevant particulars, the cut seems odd in view of the national importance of these services.

Individual Applications:

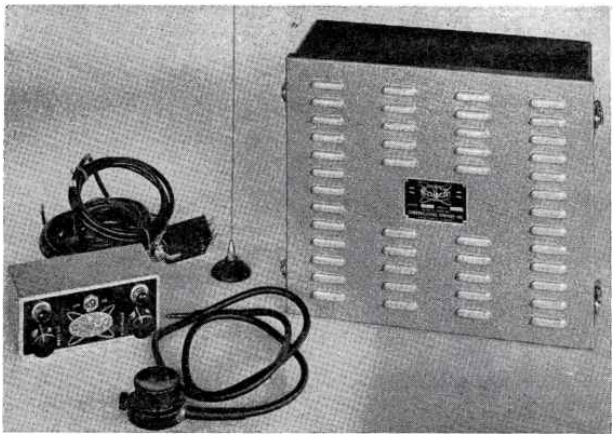
Mr. Weeks announced at the IRE seminar that the Commission will not accept applications on the old 401 Forms after the end of January. Effective February 1, applications submitted on the old forms will be returned to the applicants. The 400 Form should be used on and after January 5 wherever possible.

In using Form 400, it must be remembered that as many forms must be filled out and submitted as the number of authorizations required for the system involved, since the Form serves as a combined application and authorization. In the past an oil drilling company, for example, could submit a single 401 application for 40 temporary base stations. The Commission then prepared 40 separate authorizations, each with different call letters. Now the applicant must type

(Concluded on page 26)

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

[1]Editor's Note: COMMUNICATION ENGINEERING will publish the FCC's List of Equipments Acceptable for Licensing as soon as it becomes available. Revisions to the List will also be published as they are released.



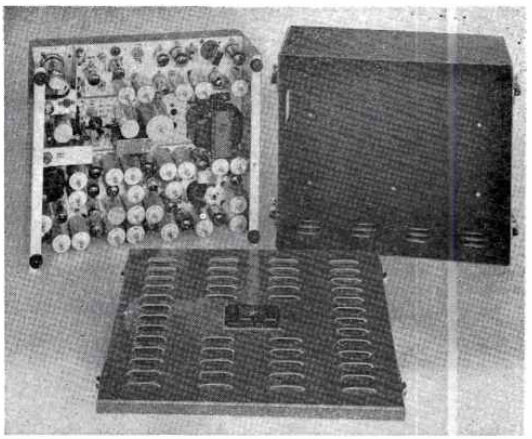


FIG. 1. ALL EQUIPMENT, EXCEPT SPEAKER, NEEDED FOR ADDITION OF 2-WAY FM FACILITIES IN AIRCRAFT. FIG. 2. MAIN CHASSIS AND DUST-COVER

FM For Aircraft

HOW 2-WAY FM EQUIPMENT IS BEING USED IN EXECUTIVE AND PATROL AIRCRAFT—*By* R. GRAHAM*

MANY petroleum, power, and pipeline companies, as well as other utilities and industrial concerns, are making extensive use of 2-way VHF-FM radio communication facilities. Utilities which do not have 2-way communication systems are at a disadvantage with respect to their competitors who are, in many cases, 100% radio-equipped. Two principal frequency bands are most often used for these applications: namely, 25 to 50 and 152 to 174 mc. The latter band is considered better for short-range operation, providing 10 to 15-mile communication ranges between base stations and land mobiles. The lower frequencies are better suited for communication over greater distances, up to 50 miles. Distances mentioned are over flat or rolling terrain.

In most cases, license applicants in these industries have a choice of specific frequencies in either band, according to requirements. For operation within a city, the higher band is usually considered better; for rural or country operation, the low-band frequencies are more suitable. Petroleum, pipeline, and power-line companies generally require 25 to 50-mc. frequencies, which provide the greater ranges needed for their operations.

These companies often utilize aircraft for patrolling pipelines and long power lines. Small planes such as cubs are usually employed; more recently, helicopters are being tested. Other companies use their executive aircraft for patrolling and inspection as well as transportation. When equipped with VHF-FM equipment, its passengers can maintain constant telephone communication with headquarters while in flight.

For the executive aircraft operator or pilot not familiar with FM equipment but who uses standard VHF-AM aircraft radio equipment for air-to-airways and air-to-tower communication, the following may be of interest: VHF-FM, like VHF-AM in the 108 to 132 mc. aeronautical band, has a range approximately equal to line-of-sight distance; however, FM communication equipment is not nearly so susceptible to interference from aircraft ignition, generator noise, or man-made static. FM equipment installed in a small aircraft having no shielding or bonding whatsoever will furnish excellent communication over distances up to 100 miles. AM aircraft equipment, on the other hand, requires considerable bonding and shielding in order to minimize ignition and generator noise. Another advantage of FM over AM is the weight factor. An FM transmitter designed for aircraft service will have a much better watts-per-pound ratio. This is because the transformers and other components required for the AM modulator are eliminated in the FM transmitter. Further, the AM modulator draws considerable power from the power supply. For an equivalent power supply, approximately three times as much transmitter power output can be delivered to the antenna by the FM transmitter.

The following facts should, therefore, be evident:

1) FM communication equipment can be of great value when installed in company aircraft on patrol and inspection trips as a means of reporting and receiving instructions from a headquarters base-station, or in facilitating exchange of information with and coordinating movements of land mobile units.

2) Two-way FM equipment designed specifically for aircraft applications will be light in weight, moderate in power requirements, and inexpensive to install.

Communications Company has developed the Flightcom line of FM transmitter-receivers specifically for aircraft applications. Given the general designation of model 400, the equipment, shown in the photographs on these pages, has an output of 10 to 12 watts at 25 to 50 mc. and 5 to 7.5 watts at 152 to 174 mc. As can be seen in Figs. 1 and 2, the transmitter, receiver, and power supply are contained within a single case which is only 13 by 11 by 5½ ins. overall, and which weighs only about 20 lbs.

General Description:

Fig. 1 shows a complete 160-mc aircraft package, with the exception of a speaker. The total weight of the complete equipment is just over 22 lbs. Because no tuning is required, the unit can be installed anywhere in the airplane, at any distance from the cockpit. The small control head, containing the power switch and squelch and volume controls, is installed in the cockpit and connected to the chassis by a lightweight cable. The microphone, with a press-to-talk switch, is plugged into the control head, and the antenna cable is connected to the main chassis.

Fig. 2 shows the main chassis removed from the case. It can be seen that the unit is actually an assembly of three individual chassis bolted together. This assembly is shown in greater detail in Figs. 3 and 4, which show top and bottom views of the chassis, respectively. The transmitter subchassis is at the top of the picture in each view, with the power-supply at the center and the receiver at the bottom.

*Communications Company, Inc., 300 Greco Avenue, Coral Gables, Fla.

Power Supply:

The same power-supply chassis can be employed in equipment for either frequency band. Three models are available, however, depending on the voltage and type of primary power. Supplies can be obtained for either 12 or 24 volts DC, commonly used in aircraft electrical systems, or for 115-volts AC when the equipment is to be used at a base-station.

Battery-operated supplies are of the vibrator-selenium rectifier type, and are of unusually high efficiency. Stand-by drain on 12 volts input is 4½ amperes; when transmitting, total drain is 10 amperes. On 24 volts input, standby and transmit currents are 2½ and 5 amperes respectively.

Fig. 5 shows the power and relay circuits. This system diagram explains in part the low battery drain figures. Two values of B voltage are furnished by the power supply. A low B+ voltage is applied continuously to the receiver plates. In the transmit position of the press-to-talk switch, this is removed and applied to the early transmitter stages along with a higher B+ voltage for the final stages. Filament current is supplied continuously to all tubes in the unit in order to assure instant operation and to keep frequency drift to the absolute minimum.

Transmitter Section:

The transmitter is conventional in design to the extent that it can be used with any standard FM communications receiver. Two stages of speech amplification are used in conjunction with an automatic deviation limiter, which is provided with a deviation control. This can be set to limit modulation to either ±15 kc. for standard operation, or to ±7.5 kc. for narrow-band operation on 25 to 50 mc.

The output of the limiter phase-modulates a crystal oscillator which has a small compensated trimmer capacitor for precise center-frequency adjustments. This is followed by a series of multipliers, the exact number depending on the frequency band involved. Tuned circuits following the second multiplier are all individually shielded. A network-type antenna coupler is used at the output of the single-ended power amplifier. By these precautions, spurious radiation is kept at least 60 db down.

Metering for the grid circuits of the multiplier stages and the output stage is accomplished by means of a switch and an extension meter. Frequency stability in the low band is .01%, and in the high band, .005%. Temperature control of the crystal can be provided.

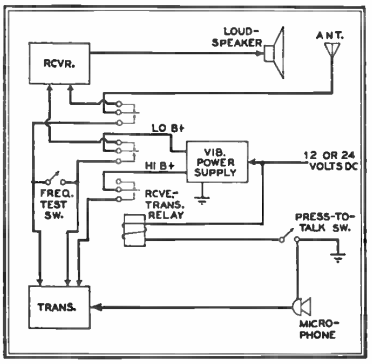


FIG. 5. FUNCTIONS OF THE SWITCHING RELAY

The Receiver:

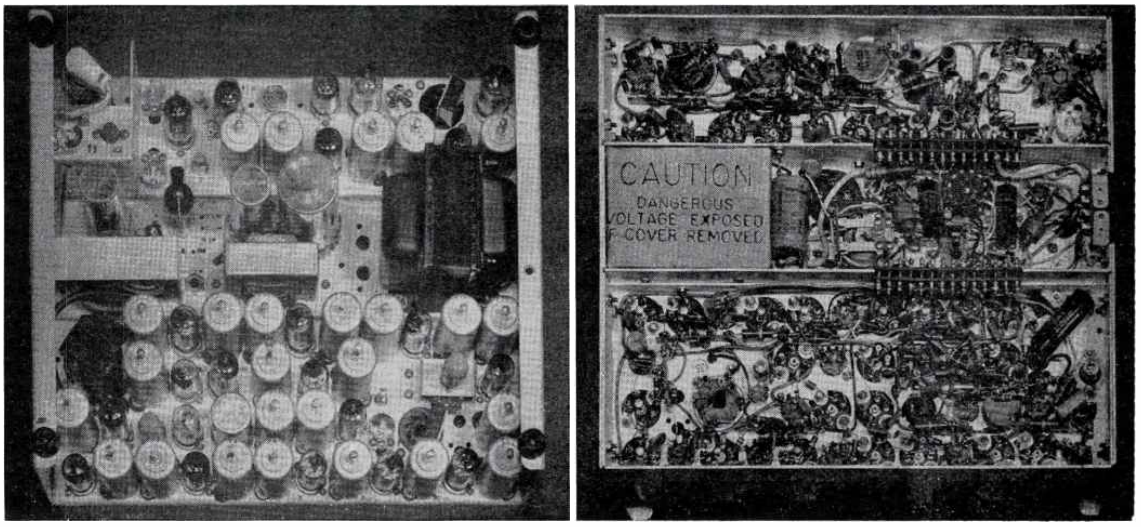
Receivers for both bands are crystal-controlled, double-superheterodyne units utilizing 25 high-Q tuned circuits in RF and IF sections. Bandwidth is not less than 20 kc. at 6 db down, and not more than 70 kc. at 100 db down. Frequency stability is .005% or better, with crystal temperature control optional. Sensitivity is .5 microvolt for 20 db quieting.

Squelch operation is initiated at .2 microvolts input. One watt audio power is available for loudspeaker operation at 4 ohms. Alternatively, 500-ohm headphones can be used.

Antennas:

The antenna required on the aircraft for 160-mc. operation consists of a quarter-wave vertical whip, similar to the usual VHF-AM aircraft antenna except that it is slightly shorter. A suitable antenna for the 25 to 50-mc. band usually presents a problem, since a quarter-wavelength at these frequencies is 4½ to 9 ft. A whip type, on the high end of the band, is practical for some types of aircraft. However, for the lower end of the band, a whip is impractical. It may be necessary to use a loading coil with a 4 to 5-ft. whip, or a T or L type antenna cut for a quarter wavelength. The latter usually requires a wing-tip-to-tail installation. Attention is called to the fact that the vertical section is the only part of the antenna providing useful radiation. In both frequency bands, vertical antenna polarization is always used. For best results, therefore, it is necessary to use a vertical antenna to match the ground and mobile stations. For the high band, the 18-inch whip can be mounted on top of the plane or under the belly. In any case, the antenna should be mounted far enough aft to avoid prop modulation.

The VHF-FM equipment does not, of course, provide communication with CAA airways or the tower stations. AM aircraft equipment must be used for normal aeronautical communication. However, with both AM and FM, the pilot can stand by simultaneously on airway and company frequencies.



FIGS. 3 AND 4. TOP AND BOTTOM OF COMBINED TRANSMITTER, RECEIVER, AND VIBRATOR POWER-SUPPLY CHASSIS. NOTE SINGLE-LEVEL PARTS MOUNTING

Microwave Protective Relaying

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

Staged fault-tests were made with this[7] equipment, which included both tripping and blocking operations for the two types of relaying. Internal faults were inserted separately on each of two parallel lines protected by one of the relaying systems. This provided both tripping and blocking operations for each set of relays. A third fault inserted on the line section beyond the relays was external to both protected lines.

Because this installation was experimental in nature, no emergency power supply was provided. During one of the staged faults, the AC voltage at one microwave terminal dropped enough to interrupt momentarily the blocking signal. As a result, the relay at the opposite terminal tripped on an external fault. This emphasizes one of the prime requisites of a microwave relaying installation: a completely reliable power source. In the event of failure of the normal supply, some emergency source must be connected immediately to the equipment in order to prevent even a momentary interruption. The subject of power sources is discussed further elsewhere in this paper. With the exception noted above, the relay operation was correct on the staged tests.

Remote tripping is another relaying service that is adapted readily to a microwave channel. Two audio tones can be used, both of which must be transmitted simultaneously for tripping the remote breaker.

A varation which has found some application consists of transmitting one tone continuously as a blocking signal, sometimes called a guard tone, then stopping this tone and transmitting the second tone for tripping. With either of these schemes, the tones can be tested one at a time without removing the equipment from service.

Operating a remote-tripping audio-tone service over a microwave channel, as described, has several advantages over a power-line carrier system. First, the entire equipment is dissociated from the power line. The channel is unaffected, therefore, by changes in system conditions. Second, the arcing caused by operation of disconnect switches presents no interference problem at the microwave frequencies. Also, the microwave equipment is unaffected by transient disturbances on the station battery which may affect carrier operation unless suitable precautions are taken, such as additional filtering.

Applications:

One example of the application possibilities[8] for microwave relaying is illustrated in Fig. 6. In this, the microwave installation may have been set up previously as a central dispatching point to stations A, B, and C. These microwave channels might also be used for telemetering, load control, and supervisory control. If the installation were made primarily for relaying, the location of the microwave repeat station might be necessary because a line-of-sight path between the stations was not available. As shown, the two parallel lines between stations A and B are relayed through the repeat point, using separate audio tones in each direction on each line. The two lines between stations B and C are relayed similarly but they have included transformer banks which must be relayed by remote tripping, since there are no high-voltage breakers at station C. Consequently, at station C, two tone transmitters are used for relaying of the two lines to station B, and four more tone transmitters are used for two remote-trip channels, using two tones on each channel for a total of six tone transmitters. Only two tone receivers are needed at station C for relaying on the lines to station B.

At station B, four tone transmitters and tone receivers are required for line relaying, and four additional tone receivers are needed to receive the remote tripping signals from station C for transformer faults.

Microwave-Only Schemes:

There is an important difference between microwave and power-line carrier systems as applied to protective relaying. In a microwave system, the channel is completely dissociated from the power line. For that reason, it is possible to send a tripping signal over the channel during an internal fault. Such operation has never been considered dependable with power line carrier, because the fault itself may short the carrier signal to ground and prevent its reaching the remote terminal. This, obviously, cannot happen with a microwave channel.

One possible method of operation for microwave transferred-trip relaying is shown in Fig. 7. At each station, a

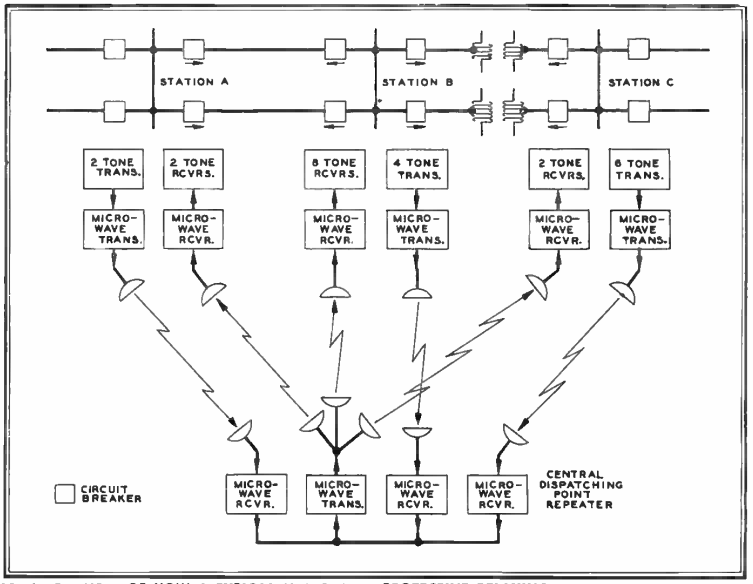


FIG. 6. EXAMPLE OF HOW A TYPICAL MICROWAVE PROTECTIVE RELAYING SYSTEM MIGHT BE SET UP

*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.

[7]Refers to 960-mc. microwave equipment for distance and phase-comparison relaying. This installation for the Pennsylvania Electric Company was described fully in Part 1 of this article, which appeared in RADIO COMMUNICATION for October, 1952.

[8]"Economics of Relaying by Microwave," by R. C. Cheek, *Electric Light and Power*, May, 1951, pages, 82 to 84.

single-zone impedance element for each phase, in conjunction with a directional element, is set to reach more than halfway toward but not beyond the opposite station bus. In addition to completing the trip circuit of the local breaker, the directional and impedance relays start the transmission of a tone to the opposite line terminal where the tone receiver relay contact bridges the directional and impedance element contacts to complete the trip circuit. For a fault in the zone where the impedance settings overlap, simultaneous high-speed operation of both breakers occurs, independent of the microwave channel. For a fault in either end zone, the near relay operates to complete the trip circuit and initiate a tone signal. Reception of that tone at the other terminal completes its trip circuit. This provides high-speed sequential operation, the only delay being the operating time of the tone receiver. Assuming one cycle operating time for the protective relay and one cycle for the tone equipment, the total operating time for this relaying scheme is two cycles.

Another type of microwave transferred tripping is shown schematically in Fig. 8. Directional-impedance or directional-overcurrent relays can be used in this system. The main requirement is that the relays reach thorough the protected line section and a reasonable distance beyond, so that they operate positively for a fault anywhere in the section. As in the system described previously, operation of the relays begins the transmission of a tone to the opposite terminal. The trip circuit is completed only when the tone is received over the channel, and the local directional and impedance or overcurrent relays operate also. As can be seen in Fig. 8, for a fault in the line section GH, relay contacts D and Z or I close at both stations to energize the tone transmitter. Transmission of the tone from each terminal to the opposite terminal closes the tone-receiver contacts to complete the trip circuits at both stations. The operating time of this relaying system is approximately two cycles also.

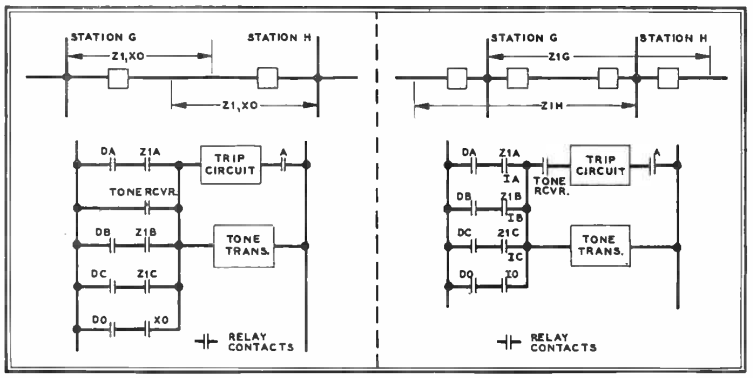
For an external fault just to the right of station H, Fig. 8, the directional and impedance contacts at station G close to initiate the tone transmission to station H. At station H, however, the directional contacts remain open, since power is flowing out of the line at that terminal. Under this condition, there is no tone transmission from station H. Consequently, the trip circuits at both stations G and H remain open for this external fault. It is essential that the tone receiver relay contact should open before the directional element contact closes during a power reversal, as discussed previously. If it does not, proper coordination can be obtained by the addition of an auxiliary relay in the trip circuit that adds only a few tenths of a cycle to the overall tripping time.

Power Supplies:

Microwave transmitters and receivers require higher tube plate voltages for satisfactory operation than is available from a station battery. For this reason, rectifier power supplies are used to furnish the required DC voltage, on the order of 300 to 500 volts, and the low voltage for tube heater circuits. Such power supplies are usually energized from the 120-volt, 60-cycle circuits available in the power station.

When a microwave channel is to be used for protective relaying, it is essential that there be no interruption of power which could permit incorrect operation of the relays. Such a requirement precludes the use of the local AC source unless some provision is made to assure continuity of service even during fault conditions when such a source may be interrupted. One possible solution to this problem is three-unit motor-generator sets for use at power stations. Such a unit consists of an AC motor, a DC motor, and an AC generator, all on the same drive shaft. The assembly is driven normally by the AC motor, and the microwave equipment is energized by the AC generator. Since the total power required for a microwave assembly is generally less than 1,000 watts, the motor and generator losses are negligible from an economic standpoint. In the event of failure of the normal AC supply, a high-speed under-voltage relay switches the drive from the AC motor to the DC motor which is connected to the station battery. The inertia of the rotating assembly is sufficient to maintain the voltage through the switching time, thus permitting continuous operation of the microwave and relay equipment. When the voltage returns to normal, the AC motor resumes the load to minimize the drain on the station battery.

The emergency power supply system just described is satisfactory for most relaying installations in which the microwave equipment is located at the line terminals, and station batteries are available to drive the DC motor. However, in relaying a line that is too long for a single microwave hop, or where there is intervening high terrain, a repeater station may be necessary at a remote point where the only source of power is the local AC line. No general solution can be given for this problem. There are several possibilities, however. A large capacitor bank across the plate voltage supply could carry the load through momentary dips in voltage. For longer interruptions, a heavy-duty vibrator supply energized from a low-voltage storage battery could provide the plate voltage, while the tube heaters could be energized directly from the battery. For extended power outages, where continuity of service is important, a diesel or gasoline engine-driven generator could then be used to supply AC power to the entire microwave repeater station.



FIGS. 7 AND 8. TWO POSSIBLE TYPES OF TRANSFERRED TRIPPING SYSTEMS EMPLOYING MICROWAVES

Conclusions:

The following summary can be made of the points covered in this paper:

1) Microwave channels can be used to advantage to supplement power-line carrier systems for transmission-line relaying.

2) The practicability and reliability of microwave channels for relaying has been ascertained by laboratory and field tests.

3) Microwave systems provide many new channels in locations where the power-line carrier spectrum has been fully utilized.

4) Because of its separation from and independence of the power line, a microwave system can be utilized for new relaying schemes not feasible with power-line carrier.

5) Microwaves present a new field for future development of relaying techniques.

FCC FORM 400

(Continued from page 21)

the 40 individual applications, thereby doing most of the clerical work formerly done at the FCC office.

For the same reason, an applicant who desires to operate mobile units in conjunction with more than one base station must submit a separate application for mobile units. In the taxicab field, for example, now as in the past, one authorization and a single set of call letters will be issued for a base and the mobile units, but that does not apply in such services as Special Industrial, where separate authorizations and different call letters are issued for the base and mobile units of the system.

Applications for making certain minor changes in an existing Form 400 authorization must hereafter be submitted on Form 400-A. The changes to be accomplished by this form are as follows: change of control point; addition or deletion of a presently-authorized control point; reduction of antenna height; or extension of the date for completion of construction.

A 400-A Form can only be used to modify a Form 400 authorization. If the user has an outstanding authorization not issued on Form 400, then the first modification of the system must be applied for on a 400 Form. Until the first 400 Form is filed, the equipment used must conform to the outstanding license.

New FCC Applications

This list includes applications for mobile, point-to-point, control, and relay communication facilities filed with the FCC from October 20 to November 21, 1952.

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

AERONAUTICAL & FIXED

	Mobile Units	Mobile W.	Mobile Mc.	Fixed Sta.	Fixed W.	Fixed Mc.	
Airinc 1523 L St NW Washington 5 D C							
	1	5	127.90				C
	1	50	128.70	1	9.9	128.70	T
	2	50	128.70				T
Alton Ill				1	9.9	122.10	T
Huntington W Va				1	9.9	127.30	T
Los Angeles Calif				1	50	131.10	WW
Stillwater Okla				1	9.9	128.30	X
Arctic Radio Telephone Co Box 1601 Anchorage Alaska							
Eastchester Alaska				1	10	5.622	X
						5.652	
McGrath Alaska				1	100	2.922	NN
						2.748	
						4.650	
						5 122	
						5.622	
						5.652	
				1	250	2.648	X
						2.923	
						5.122	
						5.310	
						5.622	
						5 652	

FLYING SCHOOL

Texas Aviation Industries Hondo Tex				1	100	.303	X

FLIGHT TEST

RCA Frequency Bureau 60 Broad St New York 4 N Y							
	1	8	123.10				NN

AERO MOBILE UTILITY

E Baton Rouge Parish Airport Comm Box 3468 Baton Rouge La							
	p1	1	121.70				R
			121.90				

AIRDROME ADVISORY

Aviation Services Inc Maryville Airport Maryville Mo							
				1	3.5	122.80	X
Mid-State Aviation Box 492 Norwich N Y	1			1	4	122.80	NN
City of Hastings Mun Airport Hastings Neb							
				1	...	122.80	NN
R F Devener Hanover Pa				1	4	122.80	NN
Luther Flying Serv Co Rte 2 Johnstown Pa	1			1	4	122.80	NN
B C Wright 722 1st Ave W Williston N D	1			1	4	122.80	NN
Comm of Mass Logan Airport East Boston Mass							
Framingham Mass				1	4	122.80	NN
E R Mertesdorf Vernon Center Minn				1	4	122.80	NN
Delbert W Koerner Kankakee Ill				1	4	122.80	NN
L Millar Wittig Box 623 Hibbing Minn				1	4	122.80	NN
R I State Div of Aeronautics Green Airport Hillsgrove R I							
Smithfield R I				1	4	122.80	NN
New Shoreham R I				1	4	122.80	NN
Westerly R I				1	4	122.80	NN

CIVIL AIR PATROL

CAP Ind Wing Grp 522 Sqdn 522-1 2349 Central Ave S Bend Ind							
	20	20	2.374	2	75	2.374	X
			4.507	5	...	148.14	X
			4.585				
CAP Va. Wing Richlands Airport Richlands Va							
Tazewell Va				2	25	4.325	X
						4.585	
West Point Va				1	4	same	
Manassas Va				1	50	same	
New Market Va				1	50	same	
CAP N Y Wing 49 Ellsworth Rd Larchmont				1	25	2.374	X
						4.507	
						4.585	
						148.14	
CAP N Y Wing New Rochelle Sqdn Stratton Rd New Rochelle N Y				1	120	2.374	X
						4.507	
						4.585	
						148.14	
CAP Rhode Island Wing County Courthouse Providence R I							
Cranston R I				1	50	4.507	X
						4.585	
CAP Group 22 Box 1779 Cuddiby Field Corpus Christi Tex							
..	75	4.507		2	150	4.507	C
		4.585				4.585	
				q1	150	2.374	C
CAP Calif Wing Delta Sqdn 44 Bldg 204 Presidio of S F							
Antioch Calif				1	12	148.14	T
CAP La Wing Lake Charles Sqdn Box 167 Lake Charles La				1	75	4.585	X
						4.507	
CAP Tenn Wing Johnson City Sqdn 229 E Main Johnson City							
	1	8	148.14	1	8	148.14	T
	7	175	5.500	1	175	4.325	M
						4.585	
						5.500	
CAP Tenn Wing Greeneville Sqdn Box 354 Greeneville Tenn							
Tusculum Tenn				1	75	4.325	G
						4.585	
CAP Hastings Sqdn 635-2 RFD 1 Hastings Mich							
	2	15	4.507	1	63	2.374	X
			5.585				
	6	10	148.14	1	10	148.14	X
	p2	.75	5.500	1	63	4.585	X
CAP Battle Creek Sqdn 635-1 7709 6th Ave Battle Creek Mich							
				1	10	148.14	X
CAP Grp 9 Mich Wing 1520 Portage Kalamazoc Mich							
	1	10	148.14	1	100	4.507	X
						4.585	
	p1	.75	5.500	q1	100	2.374	X
CAP Ind Wing Sqdn 5212-2 29 Euclid Dr Evansville Ind							
				1	150	4.507	G
						4.585	

POLICE

Deschutes County Sheriff Bend Oregon							
	10	60	155.25	1	600	155.25	M
	10	120	155.25				M
Saline County Sheriff Benton Ark				1	120	37.10	M
State Hiway Patrol 523 State Off Bldg Atlanta Ga							
	p20	3	45.50				M
Manchester Ga				1	500	42.02	G
State Police Patrol Sacramento Calif							
Newhall Calif				1	150	42.34	G
Cuyamaca Peak Calif				1	150	42.34	G
				r1	120	74.14	G
San Diego Calif				q1	120	74.10	G
Liebre Mtn Calif				1	150	42.34	G
				r1	1	960.00	G
Newhall Calif				q1	1	960.00	G
Marysville Calif				1	150	42.34	G
				q1	120	74.10	G
South Mtn Calif				1	150	42.34	G
				r1	1	960.00	G
Ventura Calif				q1	1	960.00	G
State Police Patrol 10th & Van Buren Topeka Kans							
Fort Scott Kans				1	120	44.98	G
Pittsburg Kans				1	120	44.98	G
Garden City Kans				q1	120	74.58	G
				r1	120	73.30	G
El Dorado Kans				1	120	44.98	G
P. D. Hobart Okla	3	60	156.59				M
	3	120	156.59				M
Kiowa C. S. Box 780 Hobart Okla							
	8	120	156.59	1	120	156.59	M
	4	60	156.59				M
Montmorency C. S. Atlanta Mich							
	1	60	42.74				M
			42.58				
Washington C. S. Court House Chipley Fla							
	2	60	45.06				M
Perkins Twp c/o L L LaPrad Rte 1 Sandusky Ohio							
	5	75	39.58				M
			39.66				
Mohave C. S. 4th & Spring Kingman Ariz							
	10	60	39.18	q1	60	757.80	M
	p6	3	39.18				M
Hayden Peak Ariz				1	120	39.18	M
				r1	120	39.18	M
P.D. City Hall Millen Ga							
	10	10	156.33	1	10	156.33	M
P.D. 1280 River St Niagara Wis							
	2	120	39.58	1	30	39.58	M
			39.66				
P.D. Middlebury Conn ..		60	45.50	1	60	45.50	L
Yolo C.S. Woodland Calif				1	120	154.71	M
P.D. 410 Walnut St Rockford Ill							
	p2	.2	2455	Speedmeter			
P.D. Dickinson N D	2	120	42.38				M
			42.26				
P.D. 2714 Van Brunt Blvd Kansas City Mo							
	p4	.2	2455	Speedmeter			
P.D. City Hall Oroville Calif							
	5	60	156.21	1	120	156.21	M
Coleman C. S. Courthouse Coleman Texas							
	6	120	37.18	1	150	37.18	L
P. D. Ranger Tex	5	140	37.18	1	140	37.18	M
Comm of Mass Hiway Patrol 1010 Commonwealth Av Boston							
Milton Mass				r1	50	455.95	L
				r1	25	455.65	M
Pittsfield Mass				q1	50	454.35	L
				q1	25	454.05	M
P. D. 45 Van Horn St Savannah Beach Ga				1	12	155.13	M
P. D. Box 28 Maumee Ohio							
	p1	.2	2455	Speedmeter			
State Hiway Patrol 1117 E Broad St Columbus 5 Ohio							
Xenia Ohio				1	120	39.10	M
P. D. Grand Forks N D	5	75	39.90	1	150	39.90	R
	2	75	39.90				M
Multnomah C. S. Courthouse SW 4th & Main Sts Portland Ore							
Bawfaw Mtn Wash				1	60	159.03	M
Johnson C. S. Courthouse Cleburne Texas							
	p2	2	42.90				M
	5	150	42.90				M
Cross C. S. Wynn Ark	10	120	37.10	1	120	37.10	M
P. D. Old Town Me	15	25	155.43	1	120	155.43	G
Orange C. S. 12502 Placentia Ave Orange Calif							
				2	110	954.00	R
San Clemente Calif				1	same		
Seal Beach Calif					same		
La Habra Calif					same		
Laguna Beach Calif				r2	110	957.00	R
Fullerton Calif				r2	110	957.00	R
P. D. Mun Bldg Greenwich Ohio							
	3	30	39.58				M
	3	60	39.66				M
Grand Forks C. S. Court House Grand Forks N D							
	4	120	42.26				G
			42.38				
P. D. Palm & 6th St Hialeah Fla							
	25	30	154.77	1	120	154.77	T
	5	30	154.77				X
P. D. New Brighton Minn							
	5	30	158.97				M
			159.09				
Harlan C. S. Alma Neb	2	60	42.30				M
P. D. Booneville Miss	5	60	155.73	1	120	155.73	M
P. D. Commerce Tex	3	30	37.26				G
P. D. Manalapan Fla 1012 Comeau Bldg W Palm Beach Fla							
	2	60	155.43				M
P. D. Carmel Ind	6	24	154.89	1	24	155.13	G
			155.13			156.37	
P. D. Parkville Mo	2	40	155.73				M
P. D. Manistique Mich	2	120	42.58				M
			42.74				

State Hway Patrol Box 1791 Baton Rouge La
1 600 44.70 G
P. D. & F. D. 113 W Quesenberry Sallesaw Okla
5 50 .. 1 150 .. M
Dorchester C. S. Summerville S C
10 60 45.46 1 60 45.46 M
State Police Patrol Raleigh N C
Wadesboro N C q1 120 73.22 L
Nr Salisbury N C q1 120 73.22 L
Nr Eldorado N C r1 150 72.02 L
Comfort N C r1 120 73.22 L
Alaska Highway Patrol Box 2073 Juneau Alaska
Seward Alaska 1 180 5.135 1 180 2.442 K
7.480
McCulloch C. S. Brady Tex
8 120 30-50 1 100 30-50 WC
Comm of P R Box 4355 San Juan P R
p1 .2 2455 Speedmeter
P. D. City Hall Harrisonville Mo
2 60 155.73 M
p2 3 155.73 M
Monroe C. S. Madisonville Tex
10 114 37.26 1 114 37.26 R
P. D. Thomlinson Av & W Atlantic Laurel Springs N J
p10 2 155.37 1 30 155.37 RA
15 30 155.37 R
Benton C. S. Box 628 Prosser Wash
Kennewick Wash 1 124 39.82 G
State Police Patrol State Capitol Sacramento Calif
Berkeley Calif 1 60 155.67 G
Concordia Parish Sheriff Vidalia La
10 75 39.50 2 150 39.50 M
10 150 39.50
P. D. Mt Carmel Pa p4 1 155.13 1 120 155.13 M
6 30 155.13 M
P. D. 500 Main St Wellsville Ohio
p1 .2 2455 Speedmeter

FIRE

F. D. 27th & Nevin Ave Richmond Calif 6 85 33.70 L
Vol F. D. No. 1 Fleetwood Pa
p6 3 33.94 A
12 60 33.94 R
F. D. Columbia Conn p4 1 33.90 M
6 30 33.90 M
City F. D. 600 E Overland St El Paso Tex
68 30 154.13 1 120 154.13 GM
Seldon Fire Dist Fire House Seldon L I N Y
p2 3 46.34 M
46.46
5 40 same M
F. D. Pearl River N Y p7 3 46.18 M
5 120 46.18 M
F.D. So Windsor Conn
10 62 33.94 1 124 33.94 G
F. D. City Hall Rosenburg Tex
5 120 46.06 1 120 46.06 M
5 60 46.06 M
5 30 46 06 M
p3 3 46.06 M
F. D. Raymond Me 5 60 154.31 1 60 154.31 G
Valley Falls Fire Co Valley Falls N Y
p5 2 39.18 M
Cent Point Rural Fire Protection Dist Central Point Ore
10 30 154.13 1 10 154.13 M
Village of Patchogue Village Hall Patchogue LI N Y
p10 3 46.46 1 40 46.46 M
Colma Fire Dist Rainier St Colma Calif
3 60 39.50 M
F. D. 120 W Walnut St Santa Ana Calif 1 140 46.06 M
Lucas C Bd of Comm County Courthouse Toledo Ohio
Maumee Ohio 25 60 33.74 1 124 33.74 G
Clark C Firemans Assn Box 355 Donnellsville Ohio
Springfield Ohio 35 25 154.07 1 150 154.37 R
154.37
Springfield F. D. Central Engine House Springfield Ohio
15 25 154.07 1 28 154.04 R
154.37
Swartz Creek Fire Dept Miller & Morris Rds Swartz Creek Mich 4 25 154.19 1 150 154.19 M
Flint Twp F. D. 1496 So Dye Rd Flint Mich
5 25 154.19 1 150 154.19 M
F. D. Fullerton Calif 123 W Wilshire St Fullerton Calif
25 120 46.06 1 120 46.06 M
F. D. Lennon Mich 4 25 154.19 1 150 154.19 M
Davison F. D. Davison Mich
5 150 154.19 1 150 154.19 M
Genesee Twp F. D. Flint Mich
3 25 154.19 1 150 154.19 M
City F. D. 61 Pratt St Meriden Conn
10 62 46.38 1 124 46.38 G
F. D. 3747 Monroe St Wayne Mich 1 10 154.37 M
Beecher Met Dist F. D. N Saginaw & Coldwater Rd Flint Mich
4 25 154.19 1 150 154.19 M
F. D. Gaines Mich 4 25 154.19 1 150 154.19 M

FORESTRY

State Dept of Forestry Buffalo Block Kalispell Mont
q1 75 172.22 M
Nr Kalispell Mont 1 120 31.26 M
r1 75 159.27 M
State Game & Fish Comm Little Rock Ark
St Charles Ark 1 150 46.74 R
46.82
State Forestry Dept 607 Monroe St Montgomery Ala
Nr Reform Ala 1 30 159.54
Nr Pleasant Ridge Ala same
Nr Buhl Ala same
Nr Brownsville Ala same
State Dept of Forestry Box 1200 Tallahassee Fla
Longwood Fla 1 30 159.27 M
159.33
Perry Fla 1 same
State Game & Fish Dept New Smyrna Beach Fla
Perry Fla 1 120 46.82 C
Keystone Heights Fla 1 25 46.82 C
State Dept of Forestry State Capitol Atlanta Ga
1 30 159.39 M
Nr Hampton Ga same
Berrien Ga same
Ocilla Ga same
Ashburn Ga same
Alapah Ga same
Nr Enigma Ga same
State Dept of Forestry Walton Bldg Austin Tex
t1 150 31.22 D
r1 40 159.27 M
q1 40 161.79 M
Rocksprings Tex 1 120 31.22 G

HIGHWAY MAINTENANCE

County Bd of Road Comm Adrian Mich
12 60 33.10 1 150 33.10 M
Comm of Mass 100 Nashua St Boston Mass
Monterey Mass 1 560 46.90 G
Chicago Bur of Street Traffic Rm 710 City Hall Chicago Ill
1 120 47.10 G
Washtenau County Dept of Highways 415 W Washington St
Ann Arbor Mich 25 60 37.94 1 600 37.94 M
Los Angeles C Road Dept 108 W 2nd St Rm 1014 Los Angeles
1 .1 6705.0 M
1 .1 6585.0 M
City & County of San Francisco Rm 210 45 Hyde St San Francisco Calif 30 30 37.90 1 250 37.90 M
State Hiway Dept Shoshone Idaho 1 120 156.99 G
157.41
County Bd of Road Comm 953 Keating Ave Muskegon Mich
25 30 46.94 1 250 46.94 M
Whitehall Mich 5 same 1 same
Ravenna Mich 5 same 1 same
Twin Lake Mich 5 same 1 same
Huntington Hiway Dept 641 N Y Ave Huntington N Y
20 60 159.63 1 120 159.63 R
State Hiway Dept State Capitol Sacramento Calif
Nr San Bernardino Calif 1 150 47.02 R
47.10
State Hiway Dept Carson City Nevada 1 150 47.30 —
47.38
q1 150 157.41 —
Reno Nev 1 150 47.30 —
47.38
q1 150 157.41 —
Peterson's Station Nev 1 150 47.30 —
47.38
Eastgate Nev 1 150 same —
Nr Virginia City Nev
150 150 47.30 1 150 47.30 —
47.38 r1 150 157.29 —

SPECIAL EMERGENCY

Dr Thomas Hurley SD 1 120 47.66 1 120 47.66 M
C P Huff Rte 3 Sussex N J
1 12 47.66 1 12 47.66 M
Professional Ambulance Serv 2700 S Monroe St Muncie Ind
6 30 33.10 1 60 33.10 G
Simpson Funeral Home 307 S Main St Borger Texas
5 125 47.50 1 125 47.50 G
Dr Lester Mick Oriskeny Falls N Y
1 30 47.50 1 60 47.60 R
Drs R A Igow Jr & W B Hotalin 1104 N Gault Ave Ft Payne Ala
2 25 160.47 1 150 160.47 M
Gale Mortuary Anderson Colif
2 120 154.65 L
Mayor & City Council 202 Guilford Ave Baltimore Md
10 120 161.25 9 120 161.25 M
161.79 161.79
Animal Clinic Wisner Neb
2 30 161.85 1 60 161.85 M
Neal Amb & Funeral Home West Side of Sq Louisville Ill
Hord Ill 1 60 47.66 G
M L Claftin & G K Land Box 663 Barron Wis
2 30 47.66 1 60 47.66 M
David A Walker 16 Park St Morrisville Vt
2 60 47.42 1 120 47.42 M
Dr L J Barger Box 872 Merced Calif
1 60 47.58 1 120 47.58 M
C C Templeman Jr Williams Iowa
1 30 47.62 1 60 47.62 M
McCoy Vet Hosp 117 N 14 St Garland Tex
1 120 47.54 M
A & A Amb Serv 908 Jefferson St Waco Tex
7 30 161.91 1 120 161.91 M
Derryberry Animal Clinic Box 27 McKinney Tex
3 70 47.62 1 70 47.62 G
City of Seattle County & City Bldg Mayors Off Seattle Wash
35 30 159.63 2 120 159.63 G
15 75 159.63 G
30 ... 159.63 G
W S Bull Star Route Watertown N Y
Burrs Mills N Y 1 30 47.62 1 60 47.62 M
R C Newman Jr 3 Harding St Island Falls Me
4 60 47.50 1 120 47.50 M
Dr W H Merrick 608 S Beech St Toppenish Wash
2 30 47.54 1 30 47.54 M
Neal Hasselbach St Edward Neb
1 120 47.66 1 120 47.66 M
Dr E Deane Freitas Lexington Ave N Dartmouth Mass
1 30 47.50 1 120 47.50 M
Ganado Mission Ganado Ariz
6 80 47.50 1 140 47.50 M
A L Lee Ganado Ariz
Black Mtn Ariz 1 30 47.50 M
Salina Ariz 6 80 47.50 1 140 47.50 M
p3 3 47.50 M
Dr D H Knaus Rifle Colo
1 60 47.62 1 120 47.62 M
Dr H E Dapson 402 W Housatonic St Pittsfield Mass
1 20 47.48 1 20 47.48 M
Dr F L Rogers 371 Jamison St Cadiz Ohio
2 60 47.46 1 60 47.46 M
H S Lames Dysart Iowa 1 12 47.62 1 60 47.62 M
Dr M Van Der Maaten Orange City Iowa
2 ... 47.62 1 ... 47.62 M
W E Spence Cooper's Corner Dover Del
2 120 47.50 1 120 47.50 G
W C Oglesby DVM Clinton N C
1 30 47.46 1 30 47.46 M
Washington C Vet Hosp Sandersville Ga
1 30 47.58 1 30 47.58 M
W B Van Aken DVM Clay St Kirklin Ind
2 30 161.49 1 30 161.49 G
O E Bunnell Box 132 Worland Wyo
2 150 47.58 1 150 47.58 G
Moore's Vet Hosp Cedar Lane Metter Ga
1 30 47.62 1 30 47.62 M
City & County of S F Room 210 45 Hyde St San Fran Calif
p30 .5 115.00 M

STATE GUARD

Tex State Guard Box 613 Refugio Tex t1 50 2.726 X
1 45 2.726 X

POWER UTILITY

Lone Star Gas Co 301 S Harwood Dallas Tex
1 60 48.54 M
Kans-Neb Nat Gas Co 300 North St Joseph St Hastings Neb
Colby Kans r1 30 72.66 M
Haigher Neb r1 60 37.50 M
r1 30 75.66 M
Union Elec Pr Co 315 N 12 Blvd St Louis 1 Mo
Nr Ft Madison Ia 1 60 48.38 R
Nr Keokuk Ia 1 60 48.38 R
Minn Pr & Lt Co 30 W Superior St Duluth Minn
1 130 48.18 G
Nr Hibbing Minn 1 500 48.18 G
q1 50 72.30 G
q1 50 73.70 G
Nr Aurora Minn 1 130 48.18 G
Coleraine Minn 1 130 48.18 G
Eveleth Minn 1 130 48.18 G
Nr Winton Minn 1 130 48.18 G
City of Wilson Utilities Wilson N C
15 60 — 1 120 — M
Salt River Proj Agricultural & Pr Dist 145 W Van Buren
Phoenix Ariz
Rittenhouse Ariz u1 12 72.10 R
Scottsdale Ariz u1 same
Cons Gas Utilities Corp Box 1439 Oklahoma City Okla
Erick Okla 1 60 153.47 M
Sayre Okla same
Hidalgo C Wtr Control & Improvement Dist 15 Box 599
Edinburg Texas 1 30 47.78 M
City Utilities 419 SW Market St Portland Ore
25 60 153.71 1 120 153.71 M
Bull Run Dam Ore 1 120 153.71 M
Okla G & E Co 321 N Harvey Oklahoma City Okla
El Reno Okla 1 60 37.82 L
Pub Utilities Dept 237 W Commonwealth St Fullerton Calif
50 30 47.78 1 60 47.78 M
City Util Dept Box 178 Gastonia N C
15 25 153.41 1 25 153.41 G
Ohio Fuel Gas Co 99 N Front St Columbus 15 Ohio
Parma Ohio 1 30 153.65 L
Platte Valley Pub Pr & Irrig Dist 911 Lake Av Gothenburg
Nebraska p5 .5 48.42 1 60 48.42 M
10 12 48.42 M
Worcester Gas Lt Co 727 Mass Ave Cambridge 39 Mass
Boston Mass 1 150 48.02 L
Wayne White Counties Elec Coop 609 Sycamore St Carmi Ill
1 60 158.25 M
McLeansboro Ill 1 60 158.25 M
So Colorado Pr Co 115 W 2nd St Pueblo Colo
Colorado Springs Colo 1 150 47.86 G
Mun Elec Lt Plant City Hall Hagerstown Md
10 25 153.53 120 153.53 G
Ariz Pub Serv Box 2591 501 S 3rd Ave Phoenix Ariz
Florence Ariz 1 30 153.41 R
City of Seattle (Dept of Lighting) 1015 3rd Ave Seattle Wash
20 20 456.65 1 20 456.65 M
SE Ill EC Inc 25 S Commercial Harrisburg Ill
Nr Herod Ill 1 150 37.78 M
N J Nat Gas Co 58 1st Ave Atlantic Highlands N J
Toms River N J 30 106 153.53 1 115 153.53 G
La Mesa Lemon Grove Spg Valley Irrig Dist 4769 Spring St
La Mesa Calif 12 120 153.59 1 120 153.59 M
Fla Pr & Lt Co 25 SE 2nd Ave Miami Fla
Miami Beach Fla 1 150 37.86 G
Columbus Water Wks 1500 13th Ave Columbus Ga
20 60 153.53 1 60 153.53 M
City Div of Water City Hall 920 Broad St Newark N J
40 106 153.47 1 115 153.47 G
Gibson C EMC Trenton Tenn
Alamo Tenn 1 120 47.90 G
Roosevelt Irrig Dist Buckeye Ariz
Nr Perryville Ariz 1 30 158.25 R
Bozrah Lt & Pr Co Gilman Conn
1 30 48.54 1 120 48.54 M
Calif Wtr & Tel Co 2116 Huntington Dr San Marino Calif
10 10 37.86 1 60 37.86 M
Pacific G & E 245 Market St San Francisco Calif
Livermore Calif 1 120 158.13 L
City Utilities Peabody Mass
6 30 48.00 1 120 48.00 M
Elizabethtown Wtr Co Cons 22 W Jersey St Elizabeth N J
25 60 47.90 1 120 47.90 G
Public Utilities Att: G K Armes St Petersburg Fla
20 25 158.25 1 115 158.25 G
16 75 158.25 qr1 500 153.41 G
Hillsboro C Fla 1 115 158.25 G
Appalachian Elec Pr Co 40 Franklin Rd Roanoke 9 Va
Whitesville W Va 1 150 37.70 L
Bald Knob W Va 1 75 37.70 L
N Y State Elec & Gas Corp 62 Henry St Binghamton N Y
Lockport N Y 1 150 37.78 G
Socorro Elec Corp Inc 210 Manganares Socorro New Mex
1 500 48.10 L
1 120 72.34 L
Top of Socorro Mtn 1 120 72.54 L
City Utilities 119 N Glendale Ave Glendale 6 Calif
1 250 47.98 M
30 30 47.98 1 60 47.98 M
City Utilities 200 3rd St Clarksdale Miss
10 15 158.25 1 60 158.25 R
K-C Elec Assn Inc Riall St Cheyenne Wells Colo
Hugo Colo 1 120 153.47 1 120 153.47 M
N Y State Elec & Gas Corp 62 Henry St Binghamton N Y
New Berlin N Y 1 120 37.78 M

(Continued on page 28)

NEW APPLICATIONS

(Continued from page 27)

PIPELINE PETROLEUM

J P Reeves 2603 1st Nat'l Bank Bldg Oklahoma City Okla
5 60 153.29 1 250 153.29 M
t1 60 153.29 M
Atlantic Pipeline Co 260 S Broad St Philadelphia Pa
Castroville Tex 1 120 49.12 M
Nr Fashing Tex 1 120 49.12 M
Nr Refugio Tex 1 120 49.12 M
p6 1 49.12 M
10 120 49.12 M
Interstate Petroleum Comm 1319 Shell Bldg Houston Tex
Sterling Colo 15 120 48.66 1 120 48.66 M
t2 120 48.66 M
Pub Serv Co of N C 170 W Franklin St Gastonia N C
Raleigh N C 1 30 48.98 M
Durham N C 1 250 48.98 M
Loudon Pipeline Co Box 57 Pana Ill
6 60 48.86 1 60 48.86 M
Nr Hissong Ill 6 60 48.86 1 60 48.86 M
Interstate Nat Gas Co Box 1482 Monroe La
10 150 48.58 R
Gardner Bros Drilling Co 1708 Republic Bank Bldg Dallas Tex
10 70 48.70 1 70 48.70 G
t5 70 48.70 G
Sinclair Pipeline Co Independence Kans
Raymond Kans 1 250 153.17 M
Nr McPherson Kans 1 60 153.17 M
Nr Rosalia Kans 1 250 153.17 M
Eureka Kans 1 60 153.17 M
Eldorado Kans uq1 40 456.05 M
Nr Rosalia Kans r1 40 457.55 M
Offshore Raydist 3503 Fern St New Orleans 18 La
6 20 2.292 Q
El Paso Nat Gas Co 1010 Bassett Tower El Paso Tex
Midkiff Tex 1 10 1895.0 R
Monahans Tex 1 same
No Trees Tex 3 same
Best Tex 2 same
Crane Tex 2 same
Goldsmith Tex 1 10 1955.0 R
Odessa Tex 1 same
Ozone Tex 1 same
Penwell Tex 3 same
Texon Tex 3 same
Crane Tex 2 same
Jal New Mex 1 same
Phillips Petroleum Co Eng Dept Bartlesville Okla
Gobernador New Mex 1 60 33.38 M
Lovington New Mex 1 60 33.38 M
ur1 40 457.95 M
Hobbs New Mex uq1 40 456.45 M
Jal New Mex 1 60 33.38 M
Nr Midland Tex 1 250 33.38 M
N Y State Nat Gas 140 Stanwix St Pittsburgh 22 Pa
Springdale Pa 1 500 48.70 G
Atlantic Seaboard Corp Box 215 Falls Church Va
Bel Air Md 1 150 33.38 G
Kerr-McGee Oil Industries Kerr-McGee Bldg Okla City Okla
t6 120 30.66 M
Interstate Oil Pipeline Co Box 1107 Shreveport La
Bridger Mont r1 150 153.29 M
Gen Petroleum Corp Box 1652 Casper Wyo
Tip Top Wyo 1 120 49.02 M
Laffland Bros Co Box 1649 Tulsa Okla
50 70 48.76 t23 70 48.76 G
Vernal Utah uq1 50 75.78 G
Whiterocks Utah ur1 50 73.02 G
United Fuel Gas Co 1033 Quarrier St Charleston W Va
t3 150 33.38 G
Tenn Gas Transmission Co Box 2511 Coudersport Pa
1 500 33.26 M
Rogers Geophysical Co 3616 W Alabama Houston 6 Tex
20 25 25.02 M
25.06
25.10
25.14
25.18
Interstate Petroleum Comm Inc 1319 Shell Bldg Houston Tex
Morgan City La 1 120 48.70 G
Houma La 1 120 48.70 G
Union Oil Co of Calif 617 W 7th St Los Angeles 17 Calif
Orcutt Hill Calif 30 30 153.43 1 250 153.43 M
Santa Fe Springs Calif 1 250 48.90 M
t15 30 153.43 M

FOREST PRODUCTS

Thompson Falls Lumber Co Thompson Falls Mont
Nr St Regis Mont 6 100 49.58 1 120 49.58 C
r1 30 74.10 C
Nr Thompson Falls Mont q1 30 72.30 C
Magnolia Motor & Logging Co Inc Box 185 Ashland Ore
Camp Humboldt Calif 1 60 49.34 M
Nr Witchpec Calif 10 60 49.34 1 60 49.34 M
Diamond Match Co Box 1483 Spokane Wash
Elk River Idaho 50 124 49.42 1 120 49.42 G
Iskra Bros Logging Co 431 Finch Bldg Aberdeen Wash
Nr Amanda Park Wash 1 120 49.66 M
Glenco Forest Prod Box 1142 Sacramento Calif
Elk Creek Calif 1 60 49.34 M
Nr Willows (Elk Creek) Calif
15 60 49.34 1 60 49.34 M
Deer Park Pine Industries Deer Park Wash
25 124 49.34 1 560 49.34 G
Gt Northern Paper Co Millinocket Me
Greenville Jct Me 1 120 49.26 M
St John Depot Me same
Pittston Me same
Twp 16 Range 11 Me 1 30 49.26 M
St Francis Plantation Me 1 120 49.26 M
M & M Wood Working Co 2301 N Columbia Blvd Portland Ore
t1 150 49.58 G

SPECIAL INDUSTRIAL

Thornton Constr Co 1028 Ethel Ave Hancock Mich

	10	30	43.02	1	60	43.02	M
				t1	60	43.02	M
E I DuPont de Nemours & Co Wilmington 98 Del							
Gibbstown N J	5	30	152.93	1	30	152.93	M
Bethlehem Steel Co Bethlehem Pa							
	35	30	154.49	1	120	154.49	M
	p10	3	154.49				M
Fuller Lime Co Butler Mo							
	10	30	30.62	1	120	30.62	M
Black Rock Mining Corp 137 Clarke St Bishop Calif							
Inyo County Calif				1	120	43.02	G
Matich Bros Box 390 Colton Calif							
	5	60	43.06	1	60	43.06	M
	5	30	43.06				M
Lazy Eight Flying Serv Box 88 Chandler Ariz							
	15	12	43.06	1	60	43.06	M
S Birch & Sons Constr Co Box 1926 Great Falls Mont							
	25	75	43.02	t3	120	43.02	M
	p5	3	43.02				M
Pumice Products Co Rte 1 Boise Idaho							
				1	120	43.18	M
Nampa Idaho	6	80	43.18	1	120	43.18	M
G J Igel & Co Inc 484 Eaton St Columbus Ohio							
	25	30	154.49	1	60	154.49	M
Ray Costa Barbaraworth Hotel El Centro Calif							
	5	30	43.18	1	60	43.18	M
Memphis Compress Co Memphis Texas							
	6	125	49.90	1	125	49.90	G
				t2	125	49.90	G
Nello L Teer Co Box 1131 Durham N C				t9	120	43.02	M
George Dowser So Plainfield N J							
	4	60	43.14	1	120	43.14	M
Tri-State Materials Corp Pomeroy Ohio							
	10	60	30.62	1	60	30.62	M
	10	30	30.62				M
	10	12	30.62				M
	5	.75	30.62				M
	5	.50	30.62				M
Levitt & Sons Inc Adm Bldg Levittown Pa							
	75	20	43.14	1	120	43.14	M
H C Grendahl No 1218 Waterworks Spokane Wash							
	6	30	43.10	1	30	43.10	C
Sowers Contracting 1203 Beverly Rd Independence Mo							
	6	60	43.18	1	60	43.18	M
Cadillac Asphalt Paving Co 12490 Evergreen Detroit Mich							
Nr Wayne Mich				1	12	43.18	M
Phelps Ranch Co Meeteetse Wyo							
	10	150	49.98	1	120	49.98	G
	p6	2	49.98				A
Cons Vultee Aircraft Corp Box 1950 San Diego 12 Calif							
	6	10	154.49	t3	10	154.49	M
	p11	.25	154.49				M
Bixler Lumber Co 1350 Jackson St Columbus Ind							
	6	80	30.58	1	120	30.58	G
Construction Aggregates Corp 33 N LaSalle St Chicago Ill							
				t1	30	43.18	M
				t1	120	43.18	M
				t1	20	43.18	M
Gulf Vegetable & Fruit Co Box 325 Weslaco Tex							
	p1	150	30.58				M
F M Reising 1102 N Closner Edinburg Tex							
Mission Tex				1	30	49.78	M
Havana Tex				1	30	49.78	M
Clark's Seed Farms Richford N Y				1	30	49.90	M
Butler Constr Co Grand Forks N D				t1	120	154.49	M
Westmoreland Manganese Corp Batesville Ark							
	..	60	49.94	1	60	49.94	M
Nr Cushman Ark				1	60	49.94	M
W W Washburn 800 W 2nd St Desmet S D							
	2	150	27.31	1	150	27.31	H
E & F Ivaldi E Bay Excavating Co 1700 1st Av San Leandro Calif	3	120	43.02	1	120	43.02	M
Ralph Gilkey Box 426 Corcoran Calif							
	20	10	152.87	1	60	152.87	M
W D Gale Inc 7145 Tireman Av Detroit Mich							
	15	60	43.17	1	60	43.17	R
Latex Constr Co of Ga Box 56 Northside Br Atlanta Ga							
	10	60	30.62	t1	60	30.62	M
Parks Williams Fruit Co Box 511 Leesburg Fla							
Nr Leesburg Fla	15	40	27.39	1	80	27.39	X
S Birch & Sons Constr Co Box 1901 Post Rd Anchorage Alaska							
	12	40	30.62	1	120	30.62	M
Price & Fewell Elec Co 1124 W Short 17th St North Little Rock Ark	2	10	154.49	1	10	154.49	F
Anaconda Copper Mining Co Box 1000 Yerington Nev							
				1	150	49.86	G
Harbert Constr Corp Box 1369 Birmingham Ala							
	10	120	49.94				M
B C Cook & Sons Box 36 Haines City Fla							
	12	60	49.90	1	500	49.90	M
Double U Co Post Tex	6	125	43.10	1	125	43.10	G
Quigg Bros Constr Co 1500 Riverside Ave Hoquiam Wash							
	5	60	43.10	1	120	43.10	M
	5	30	43.10				M
Strange Co 13 Third Ave Rome Ga							
	10	12	30.58	1	12	30.58	M
Wagoner Constr Co Box 1127 Salisbury N C							
	10	60	43.14	1	120	43.14	M
Heldenfels Bros McBride Lane Corpus Christi Tex							
	5	30	27.31	t1	30	27.31	M
	p10	3	27.31				M
O'Banion Ranch Box 171 Dos Palos Calif							
	12	120	49.98	1	150	49.98	G
Rohm & Haas Co Washington Square Philadelphia 5 Pa							
Pasadena Tex	5	30	49.98	1	30	49.98	M
	p10	3	49.98				M
Republic Aviation Corp Farmingdale L I N Y							
	10	30	152.87	1	30	152.87	M
	p6	3	152.87				M
Bethlehem Steel Co 3075 Richmond Terr Staten Island N Y							
	10	80	154.49	1	120	154.49	M
	3	30	154.49				M
	p2	3	154.49				M
Smith Canning & Freezing Co Pendleton Ore							
				vq3	30	152.93	C
Point Sal Growers & Packers Box 906 Guadalupe Calif							
	8	30	30.62	1	60	30.62	M
R A Verrier 65 Commercial St Portland Me							

(Continued on page 30)

NEW APPLICATIONS

(Continued from page 29)

			1	160	49.90		G
Harpswell Me	20	150	49.90	1	150	49.90	G
J B Grierson Co Meyers Mont							
Hysham Mont	6	124	49.98	1	124	49.98	G
D Cutrupe & Sons Inc 2156 N Hoyt Ave Fort Lee N J							
	10	120	30.58	1	120	30.58	G
4th Street Rock Crusher Box 469 1945 W 4th St San Bernardino Calif	20	30	43.18	1	60	43.18	M
Oil City Welding Works 1298 Railroad Ave Beaumont Tex				t1	120	43.02	M
Valle Sommers Constr Co Box 1725 Anchorage Alaska							
	12	40	43.06	1	120	43.06	M
Gulf Coast Oil Field Houston Highway Victoria Tex							
	20	120	49.70	1	120	49.70	M
Monmouth Concrete Co 79 Central Ave Red Bank N J							
Deal N J	10	60	43.14	1	120	43.14	G
Walnut Creek Canning Co Box 577 Walnut Creek Calif							
	10	120	.....	1	120	.....	G
H L Baughman Inc 1240 Jefferson Rd Rochester 18 N Y							
	12	25	27.39	1	120	27.39	G
	6	60	27.39	t1	60	27.39	G
Sack Bros Inc 601 11th St Jamestown N Y							
	10	60	43.14	1	60	43.14	M
Reber & Allan Co Box 491 Cotton Calif							
Bloomington Calif	12	60	43.10	1	120	43.10	M
J B McHale 5237 Redfield St Dallas Tex							
	7	30	43.10	1	120	43.10	M
	2	80	43.10				M
	2	120	43.10				M
Builders Lumber & Supply Co Malvern Ark							
	8	125	43.10	1	125	43.10	G
The Four Companies Box 248 Tracy Calif							
	5	96	43.10	1	96	43.10	L
Tune Constr Co 1251 Leverett St Fayetteville Ark							
	10	30	50.00	1	60	50.00	M
Al Nero & Co Laurel Del							
	6	120	30.58	1	120	30.58	M
Boyett Farming Co Box 386 Corcoran Calif							
	25	12	27.47	2	12	27.47	M
R G Watkins & Son Mill Yard Amesbury Mass							
	15	60	30.62	1	60	30.62	R
Erwin Shrler Box 368 Delano Calif				1	12	43.18	M
Pittsburg & Midway Coal Mining Co Pittsburg Kans							
	10	75	154.49	2	150	154.49	G
Radio Installation & Maint Serv Co 803 S Church St							
Rocky Mt N C	2	60	30.62	1	120	30.62	M
Fontana Steel Co Box 72 Fontana Calif							
	10	60	43.02	1	60	43.02	M
	5	30	43.02	t1	60	43.02	M
So Bay Growers So Bay Fla							
	12	70	49.90	1	70	49.90	G
Halliburton Oil Well Cementing Co Duncan Okla							
Nr Glendive Mont				1	300	49.74	G
Tioga N D				1	300	49.74	G
Graham Constr Co Box 268 Cleveland N C							
Nr Cleveland				1	150	49.86	M
Nr Ridgecrest N C				1	150	49.86	M
Nr Winston-Salem N C				1	150	49.86	M

LOW POWER INDUSTRIAL

Harris Radio Corp 115 N 10th St Manitowoc Wis							
	p3	3	154.57				A
Pan American Airways Inc N Y Int'l Airport Jamaica N Y							
	p70	3	42.98				M
Television Associates Michigan City Ind							
	p2	3	154.57				R
	p1	3	154.57				A
Jack Ammann 829 N St Marys St San Antonio Tex							
	p4	3	154.57				M
L M Minsky 109 3rd Ave Pittsburgh 22 Pa							
	p3	3	154.57				A
Borg Warner Corp (Spring Div) 718 S 25th St Beliwood Ill							
	p16	3	154.57				M
Mobile Electronic Specialties 25465 Hereford Dr Royal Oak Mich	p6	1	154.57				A
Hallett Constr Co 2628 Main St Crosby Minn							
	p10	3	42.98				M
Owens-Illinois Glass Co Box 1035 Toledo Ohio							
	p5	3	154.57				M
	p25	1	154.57				M
Main Elec Supply Corp 148 Anderson St Portland 3 Me							
	p2	3	154.57				A
Goodyear Aircraft 1210 Massillon Rd Akron Ohio							
	p6	3	154.57				M
Eastern Air Lines Miami Int'l Airport Branch PO Box 787 Miami Fla	p3	3	154.57				M
Industrial Electronics Inc 127 Light St Baltimore 2 Md							
	p3	3	154.57				A
Dayton Wired Music Serv Inc 231 Hulman Bldg Dayton 2 Ohio							
	p2	3	154.57				A
D P Wilde South Hamilton Mass							
	p3	3	154.57				A
Smitty's Radio Serv 269 Humboldt St Chico Calif							
	p3	3	154.57				A
Pacific Fruit Express 116 New Montgomery San Francisco Calif	p5	3	154.57				M
Samsons Enterprises Inc 222 E Erie St Milwaukee Wis							
	p2	1	154.57				A

COASTAL & MARINE RELAY

Warren Fish Co Pensacola Fla				1	150	2.214	Q
Milam Bros Marine Serv Rte 1 Box 97 Hot Springs Ark							
				1	10	2.206	R
						2.638	
						2.670	
						2.738	
P W Nielsen Pauloff Harbor Alaska							
	p1	...	2.632				K
			2.512				
			2.986				
			2.190				
Maryland Drydock Co Box 6306 South Sta Baltimore Md							
	p4	3	156.40				M
P W Martin Inc 139 S 3rd St Philadelphia Pa							
				1	108	156.50	R
Clover Pass Resort RFD North Tongass Ketchikan Alaska							
				1	65	2.382	NN
						2.466	
						2.382	
Superior Oil Co 400 Oil & Gas Bldg Houston 2 Tex							
				t1	125	2.134	C
						2.206	

ALASKAN FIXED PUBLIC

Harry Shawback c/o Northern Elec Co 314 Bell St Seattle Wash							
Naknek Alaska				1	20	2.430	NN
						2.512	

RAILROADS

Southern Pacific 65 Market St San Francisco 5 Calif							
Watsonville Jct Calif				1	60	160.23	M
						161.67	
Gt Northern Rway Co 175 E 4th St St Paul 1 Minn							
	100	120	160.65				T
Brookston Minn				1	120	160.65	T
Canisteo Minn				1	120	160.65	T
Kelly Lake Minn				1	120	160.65	T
Swan River Minn				1	120	160.65	T
Saunders Wis				2	120	160.65	T
Atlantic Coast Line RR Wilmington N C							
Fayetteville N C				1	40	160.29	T
Chicago Gt Western Rway 309 W Jackson Blvd Chicago 6 Ill							
Minneapolis Minn				1	60	159.57	X
Council Bluffs Iowa				1	60	160.17	X
NE Okla Rway Miami Okla							
Nr Miami Okla				qu1	30	72.22	M
Columbus Kans				ur1	30	75.82	M
Union Pacific RR Co 1416 Dodge St Omaha Neb							
Marysville Kans				1	60	160.05	M
Portland Ore				same			
Tacoma Wash				same			
E Riverton Wash				same			
Emmett Kans				same			
Lawrence Kans				same			
Frankfort Kans				same			
Kansas City Kans				same			
Council Bluffs Iowa				1	10	161.07	M
Gulf Mobile & Ohio RR 104 St Francis St Mobile Ala							
Jackson Tenn				1	60	161.73	M
Madison C Tenn				1	60	161.73	M

TAXICABS

Luxor Cabs 1361 Bush St San Francisco				1	60	152.27	M
Smith Cab Co 505 Legion Way E Point Ga							
	10	10	157.53	1	10	152.27	M
Belair Road Cab Co 4 W Overlea Ave Baltimore Md							
	10	10	157.59	1	30	152.33	T

Black & White Cab 219 Depot Lagrande Ore
12 100 152.27 1 50 157.53 K
Bermuda Motor Car Renting Co 137 W 56 St New York N Y
25 15 157.71 1 60 152.45 R
Santa Maria Cab Co 207 N Broadway Santa Maria Calif
20 15 157.53 1 60 152.27 M
United Cab Co 222 Newell St San Antonio Tex
50 20 452.55 1 40 452.05 M
Mutual Cab Service Co Glen Ellyn Ill
10 30 152.39 1 30 157.65 M
Union Cab Co 626 S Adams St Camden Ark
15 12 157.59 1 30 152.33 M
Central Cab Co 5 Depot Square Barre Vt
6 30 157.71 1 60 152.45 M
Georges Taxi 34 McDavet Pl Dover N J
5 120 157.65 1 120 152.39 F
Maple City Cab Monmouth Ill
5 10 157.53 1 30 152.27 M
5 12 157.53 M
Yellow & Turner Cab Co 1808 O'Neil Cheyenne Wyo
10 15 157.65 1 60 152.39 G
Checker Cabs 4 S Washington Ave Pulaski Va
15 30 157.65 1 120 152.39 M
Flash Cab 101 Center St S Bloomington Ill
20 10 157.65 1 30 152.39 M
Hub's Taxi 116 Hotel St Brewton Ala
15 10 157.71 1 10 152.45 M
Wayside Cab Co 120 W Market St Reidsville N C
20 50 157.59 1 120 152.33 B
Earl's Taxi Service 1 Center St Glassboro N J
6 15 ..... 1 45 ..... R
St Anns Cab Co 10128 St Charles Rd St Anns 14 Mo
10 30 157.65 1 120 152.65 M
City Checker Cab Co 609 W Broad St Elyria Ohio
15 20 157.59 1 120 152.33 M
Laurel Cab Co 170 Laurel Hill Ave Providence R I
10 30 157.71 1 120 152.45 M
Ace Taxi Co 12 Courtland St Lowell Mass
10 12 157.71 1 60 152.45 M
Yellow Diamond Cab Co 23 Bennett St Williston S C
10 10 157.53 1 30 152.27 M
Patrick Henry Cab Co 7704 Virginia Ave Newport News Va
Warwick Va 5 30 157.59 1 60 152.33 M
5 60 157.59 1 120 152.33 M
Genessee Cab Co 32 Elm St Rochester N Y
26 30 157.71 1 60 152.45 M
Yellow Cab Co 20 S 6th Ave Phoenix Ariz
60 20 152.27 1 120 152.27 M
Ephrata Taxi Lincoln Pa B 20 157.71 1 120 152.45 M
City Cab Co 118 Michigan Ave Albion Mich
5 30 157.65 1 60 152.39 M
Clyde's Taxi 216 Bellville Ave Brewton Okla
10 10 157.53 1 10 152.27 M
Ambler Cab Reading RR Station Ambler Pa
6 20 157.71 1 120 152.45 M
Heights Cab Serv Lincoln Heights Cincinnati Ohio
10 10 157.53 1 10 152.27 M
Yellow Flash Cabs 104 S Market St Reidsville N C
20 50 157.65 1 120 152.33 B
James Conger 1639 W Onodaga St Syracuse N Y
1 10 157.59 M
Pepin's Taxi Cumberland Ave Saco Me
1 15 157.59 1 10 152.33 M
Forest Park Cab Co Forest Park Ga
5 10 157.59 1 10 152.33 M
Broadway Garage 21 Bdway Rockport Mass
5 30 157.59 1 30 152.33 M
Center Taxi 394 Main St Fitchburg Mass
6 12 157.65 1 60 152.39 M
OK Cab Co 303 Sellers Ave Orangeburg S C
10 25 157.71 1 25 152.45 G
Oak Park Nash Cab 250 E 9 Mi Rd Ferndale Mich
6 12 157.71 1 50 152.45 G
Robins Cab Co 105 Watson Blvd Warner Robins Ga
6 15 158.49 1 30 152.03 K
R K Roulton 317 Baker Ave Syracuse 5 N Y
1 15 157.59 M
City Cab Co 728 3rd St Reedsburg Wis
5 30 157.53 1 30 152.27 M
Fort Bliss Taxi Inc Fort Bliss El Paso Tex
50 30 157.65 1 60 152.39 M
Day & Nite Cab Co 5724 E Florence Bell Gardens Calif
5 30 157.59 1 40 152.33 G
White & Black Taxi 423 N Hickory Du Quoin Ill
8 30 157.65 1 120 152.39 M
Whitefish & Hungry Horse Taxi 15 Central Ave Whitefish Mont
10 25 157.53 1 25 152.27 M
Cook's Taxi 114 N Main Tipton Ind
5 30 157.71 1 30 152.45 M
mperial Taxi 2112 Pine St La Grande Ore
6 30 157.53 1 100 152.27 M
Watch City Red Cab Serv 663 Main St Waltham Mass
10 12 157.53 1 60 152.27 M
Big Dad Taxi 426 Boulevard Lake Charles La
20 20 157.65 1 120 152.39 M
Avon Cab Co 927 Lincoln Ave Cincinnati 6 Ohio
10 30 157.53 1 120 152.27 G
Quaker Cab Co 406 Mifflin St Philadelphia Pa
6 60 157.53 G
Madison Taxi Co Main St Madison W Va
6 10 157.53 1 60 152.27 G
Jones Taxi Serv 32 S Main Belair Md
10 10 157.59 1 30 152.53 T
Ideal Taxi 202 Texas Ave Palestine Tex
10 10 157.71 1 30 152.45 M
Macomb Cab Co 8015 E 9 Mi Rd Van Dyke Mich
10 10 157.59 1 60 152.33 M
Arlington Combined Cab Serv 3122 Columbia Pike Arlington Va
25 20 157.71 1 120 152.45 M
Chicago Courtesy Rentals Inc 1056 W 69th St Chicago Ill
20 18 452.35 1 25 452.35 M
May McDonald 1009 Lodi St Syracuse N Y
1 10 157.59 M
Leo Curran 316 Granger St Syracuse N Y
1 10 157.59 M
Sam Conti 602 E Division St Syracuse N Y
1 10 157.59 M
Obie's Taxi 994 Main St Walpole Mass
5 30 157.71 1 30 152.45 M

AUTO EMERGENCY

Fryer's Wrecker Serv 580 Ballough Rd Daytona Beach Fla
12 124 35.70 1 124 35.70 G
Automobile Club of St Paul 85 E Kellogg Blvd St Paul Minn
25 20 453.85 1 40 453.85 M
U S Radiator Co Inc 408 Willoughby St Brooklyn N Y
1 150 35.70 L
A & Z Auto Electric Serv 1380 Southfield Lincoln Park Mich
5 12 35.70 1 12 35.70 M
Keith's Garage 114 Jackson Terrace Charlotte N C
6 10 35.70 1 12 35.70 M
Johnny's Auto & Truck Towing 1122 Sweitzer Ave Akron Ohio
15 50 453.95 1 50 453.95 M
Tippetts Towing Co 908 Ave E St Louis Ill
6 30 35.70 1 60 35.70 M
Glover's Service Station 200 Bdway St Pekin Ill
2 12 35.70 1 30 35.70 M

HIGHWAY TRUCKS

Adams & Cooper Fuel Co 173 Sumter Ave Charleston S C
10 15 — 1 15 — M
Strohman Hdwre & Implement Co 309 N Main Sigourney Iowa
2 85 35.86 1 85 35.86 G
Hampton Roads Tractor & Equip Co 3812 Killam Norfolk Va
11 120 35.78 1 500 35.78 M
Spaulding C Coop Dairy 1115 Wright St Griffin Ga
15 50 35.74 1 50 35.74 MG
F W Bickford East Main Rd Leroy N Y
6 60 35.86 1 120 35.86 M
Yurown Gas Co Box 52 McKinney Tex
10 124 35.86 1 120 35.86 G
Superior Fuel Co 919 Wells St Fort Wayne Ind
20 60 35.94 1 60 35.94 G
Loveland G & E Co Loveland Ohio
14 120 35.86 1 120 35.86 M
Hamilton Ohio 1 120 35.86 M

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N Y Tech Inst 207 E 8th St Cincinnati Ohio
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158.49 158.49

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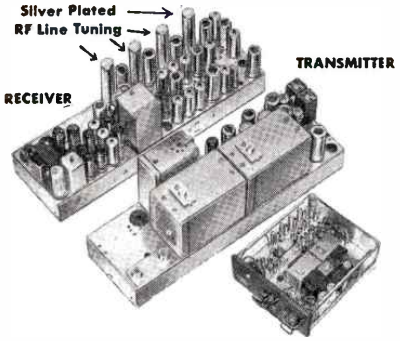

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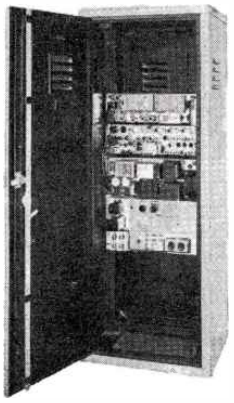

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