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Aug. 1952

FM-TV THE JOURNAL OF

RADIO COMMUNICATION

★★Published by★★
Milton B. Sleeper

Temporary Antenna for First Post-Freeze TV Station

ALSO FEATURED IN THIS ISSUE:

New Communication Equipment

Method of Rating Recorded Music

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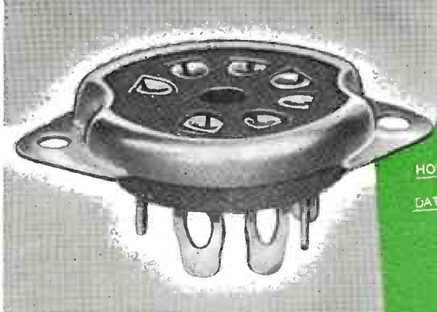

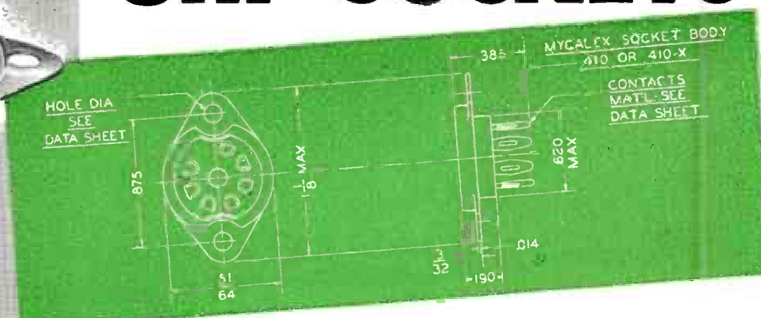

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- LOW INTER-ELECTRODE CAPACITANCE
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MYCALEX engineers designed these sockets to provide a complete, yet economical, solution to UHF tube mounting problems. Exhaustive tests have proven their mechanical excellence and high electrical efficiency. The use of "MYCALEX 410" (injection molded glass-bonded mica) with its great dimensional stability permits a minimum amount of dielectric to be used in the body structure. This plus other unique design features results in extremely low inter-electrode capacitance. In addition to its other advantages—high arc resistance, high dielectric strength, non-porosity, etc., "MYCALEX 410" has very low dielectric loss at all frequencies including UHF and thereby offers great advantage over phenolic materials. "MYCALEX 410" operates continuously in temperatures up to 650°F with practically no change in electrical properties or mechanical structure. Soldering operations will not cause body distortion.

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TROUBLE-FREE CONTACT TERMINALS!

Contact terminals on these sockets are so designed that the effective inductance from soldered connection to the tube base is no greater than if the connection was made directly to the tube pin. Special design results in high contact area pressure that effectively reduces contact resistance. Contact terminals are secured in the body in a manner that permits 90° bending of the tab without weakening.

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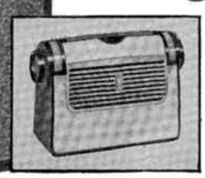
Model J-504Y



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AC, DC AND
EXTRA-LONG LIFE
BATTERY PORTABLE

Talk 'em Up  and You'll Sell 'em!

NEW End Tuning
Quick and easy to tune from any side. Oversize tuning knobs fit naturally to grip. Big, clear revolving dial.

NEW Rich "Big Set" Tone
Powerful Superheterodyne Circuit, Zenith built speaker and Wavemagnet* antenna give amazingly true tone.

NEW Carrying Handle
Fits the hand comfortably. "Snuggles down" against cabinet when not in use. Smart-looking, easy-to-carry.

NEW Durability
Rugged plastic frame and knobs with sturdy Black "Stag" covered body; or Brown, with Tan "Madagaska" cover.

NEW Long-Life Battery
New self-contained Z909 long-life battery with patented battery-saver switch for remarkably long service.

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Trim, streamlined case is compact, lightweight. Combines function with fashion for unusual smartness.

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Now, when summer picnics, vacations, and outings put a portable radio in bigger-than-ever demand—the profit-getting potential of the new Zenith Universal is virtually unlimited. Talk it up—and chalk up plus business!

R2188

ZENITH "LONG DISTANCE" RADIO and TELEVISION — THE ROYALTY OF RADIO AND TELEVISION

ZENITH RADIO CORPORATION, Chicago 39, Illinois

FM-TV RADIO COMMUNICATION

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

VOL. 12 AUGUST, 1952 NO. 8

INDUSTRY NEWS

BROADCASTING

AUDIO

COMMUNICATION

SPECIAL DEPARTMENTS

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CPA AUDIT

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

AUDIO receiver production in June according to RTMA statistics was about 200,000 units below the same month last year, and about 75% of the AM sets were portable, auto, or clock models. FM receivers, exclusive of the tuners sold for hi-fi installations, continue to run about 15% of the AM home models. Average monthly AM production is 200,000 below 1951.

That does not indicate, however, that TV is killing the market for audio receivers, for more home-model audio sets are still outselling TV sets. On the other hand, comparisons mean little in terms of the prospects for fall and winter sales because, by that time, TV sets will be moving to cities where the first new stations authorized will be going on the air early in 1953.

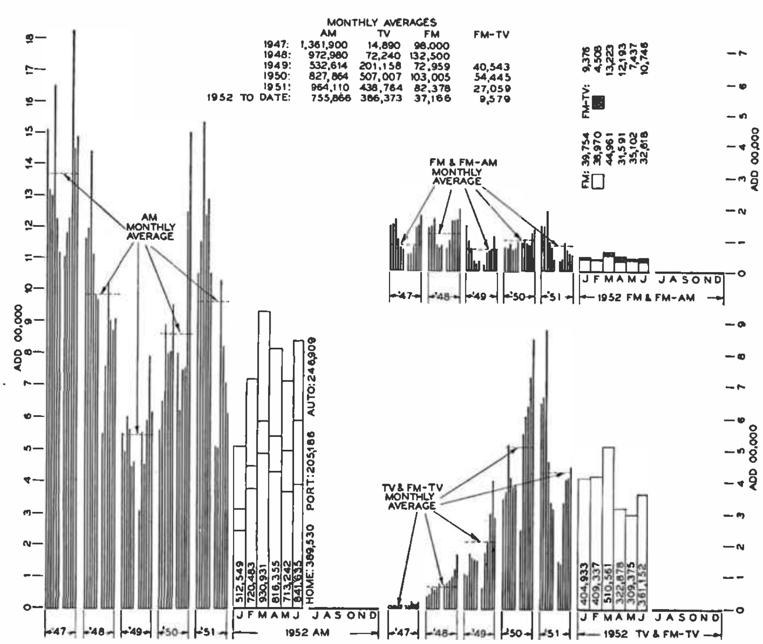
These new markets are badly needed, for TV sets in the first 6 months of this year dropped more than 2 million below the number produced in the same period of '51. Or to put it differently, the average monthly production is down 170,000 sets.

During the first 5 months of this year, states receiving shipments of more than 20,000 TV sets were:

N. Y.	220,697	N. C.	38,184
Calif.	177,105	Ia.	36,670
Penn.	161,912	Va.	32,670
Ohio	145,667	Md.	30,668
Ill.	101,710	Fla.	28,755
Mass.	77,560	Wisc.	28,470
Mich.	76,699	Okla.	28,263
Texas	73,466	Tenn.	25,604
N. J.	71,859	Ky.	25,393
Ind.	71,520	Minn.	25,181
Mo.	47,806	W. Va.	23,041
Conn.	42,835	Ala.	22,438
Ga.	38,777		

Total shipments to dealers in the 5-month period amounted to 1,799,977 sets, according to RTMA, but that was 100,000 less than the number produced during those 5 months, indicating that warehouse stocks have not been reduced this year, but are increasing.

In the hi-fi field, fall signs point to increased activity on the part of manufacturers. This summer, a considerable number of parts dealers, disappointed in their profits from TV, are cleaning out all their TV sets and are using the display space for hi-fi equipment. At the New York Music Merchants convention, dealers in that group expressed serious interest for the first time in taking on lines of tuners, amplifiers, turntables, speakers, and the associated equipment for high-quality reproduction from FM, records, and tape.



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

THIS MONTH'S COVER

When the TV freeze was clamped down, Denver did not have a television station. But within 20 days after July 1, when the FCC started to process new applications, KFEL-TV was on the air from Lookout Mountain with the temporary transmitting antenna shown in this month's cover. To make this possible, a complete 500-watt installation, including a 3-section turnstile, was flown out from Camden. The temporary antenna was used during erection of the turnstile. Eventually, ERP will be upped to 56 kw. from a 6-bay antenna. In the picture are Tom Morrisey, chief engineer of KFEL-TV, and RCA engineer E. T. Griffith.

SPOT NEWS NOTES

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

Note for 1956 Conventions:

It would conserve the vocal chords of our political speakers if some one would tell them they don't need to shout. It must be a terrific strain on them to roar away at the top of their lungs and, at least on radio and TV, it's very tiring to listeners.

First Territorial TV Grant:

Construction permit has been granted El Mundo Broadcasting Corporation at San Juan, Puerto Rico. Operation will be on channel 2+, with effective radiated power of 100 kw. visual and 50 kw. aural.

L-P Record Catalog:

In an action for copyright infringement, W. Schwann, publisher of the monthly *Long Playing Record Catalog*, obtained an injunction against Sam Goody, cut-price record dealer in New York City, requiring the latter to discontinue the sale of his publication which he has distributed under the same name.

New Offices:

The radio communications division of Bendix Aviation Corporation has moved its sales, advertising, and spare parts department from Towson to 2120 N. Charles Street, Baltimore 18, Md.

TV Channel Changes:

Because it has been found that certain UHF channel assignments do not meet the minimum mileage separation requirements, the following changes have been made by the FCC in the table of assignments (see the complete table in RADIO COMMUNICATION May, 1952):

Baltimore, Md.	from 30	to 60
Wilmington, Del.	53	83
Elberton, Ga.	16	24
Ft. Wayne, Ind.	21	69
Lexington, Ky.	33	64
Fall River, Mass.	40	68
North Adams, Mass.	15	74
Lima, Ohio	41	73
Youngstown, Ohio	33	21
Warren, Ohio	21	67
Allentown, Pa.	45	67
Harrisburg, Pa.	33	55
Reading, Pa.	55	33
Newberry, S. C.	37	70

Copies of the May, 1952 issue of RADIO COMMUNICATION, containing the complete, original table of assignments released April 14, are still available. The table is printed on two sheets, suitable for mounting.

Communication Equipment:

Supplementing its military radio production, Platt Manufacturing Company, 489 Broome Street, New York 13, has entered the mobile communication field. Murray Platt is president of this company, and J. B. Ferguson, formerly of Link Radio, is chief engineer. First equipment to be delivered are 30-watt units for 25 to 50 and 152 to 174 mc. This will be followed by 450-mc. equipment.

Reason for Special Programs:

Research by Colgate-Palmolive-Peet reveals that the *average* daytime radio listener is a woman of 30 to 34 years, married 11 years to a factory worker earning $3,683 to $5,542 per year. Her principal interest is in her son and daughter, aged 5 and 8. She reads the local newspaper, buys one book a year, subscribes to one magazine. A high school graduate, she does not discuss world affairs with her husband, but she feeds him well though not lavishly, and is concerned with his health and the progress of his work. She buys four dresses and one permanent

(Continued on page 7)

SPOT NEWS NOTES

(Continued from page 6)

wave a year, wears very little make-up, is not very sophisticated, objects to swearing and excessive emphasis on sex. Certainly there are many types of programs of interest to large non-average listener groups.

FM Promotion:

Growing interest in hi-fi reproduction has done more in the past 12 months to boost FM listening, and the demand for improving FM programs, than anything that has been done by broadcasters or manufacturers during the past 10 years. TV is helping FM, too, because people are learning that FM can give them as good or better audio quality as they hear on television programs.

Industrial TV for Banks:

A London bank is using TV to provide tellers with reproductions of specimen signatures, transmitted from the record files. The teller simply gives the name by phone to the file clerk, who then puts the signature card in front of a TV camera. The signature appears on a 3 by 5-in. screen in the teller's cage, at a place where it cannot be seen by the customer. The whole proceeding can be completed so quickly that the customer does not know that the signature is being verified on the check he has presented.

Output Tube for Mobile Use:

RCA has released a new output tube for mobile transmitters, identified as type 6146. At 60 mc., the output is rated at 69 watts, or 36 watts at 175 mc.

New Address:

Headquarters office of Magnecord, Inc. has been moved to 225 W. Ohio Street, Chicago 10. Phone number is now Whitehall 4-1889.

Educational TV:

FCC Chairman Walker has joined the speechmaking team that is working so assiduously to promote educational TV. No one would question Mr. Walker's sincerity, but there is reason to wonder about the group which is interesting men of his calibre in this cause. There's no doubt but what educational television has all the potential values claimed for it, but even Commissioner Hennock, behind her starry-eyed enthusiasm, must have the facts of life concerning the cost of installing and operating even a fraction of the educational stations for which channels have been reserved. With every city beset with financial problems of teachers' salaries and the need for more

(Continued on page 8)

SPOT NEWS NOTES

(Continued from page 7)

teachers and schools, where will the money come from for TV? Obviously, the only source is the Federal Government. But who is so anxious to put into the hands of the national political administration such a means of persuasion as educational television? And to teach exactly what? Until those questions are answered, and it seems unlikely that they will be, educational TV must be regarded not only as a dubious but a dangerous project.

Field Service:

Ampex has opened a Chicago office at 111 E. Ontario Street, with Russell J. Tinkham in charge. Various types of Ampex tape machines are displayed at this address, and replacement parts are carried in stock.

Reliable 1,000-mile Radio:

Experiments in progress since January, 1951 by the National Bureau of Standards, M.I.T., and Gates Radio indicate that 1,000-mile communication at VHF is possible with exceptional reliability. Directional antennas are employed at both ends, aimed at a point in a non-sporadic E layer equidistant from the stations. Located at a height of 620 miles above the earth, this E-layer is relatively stable. Reflection is accomplished by scattering through turbulence. During periods when high-frequency signals fade severely from sudden ionospheric disturbances, the received signal at VHF becomes stronger and background noise is reduced!

S. H. Van Wambeck:

Former director of research at Knapp-Monarch and professor of electrical engineering at Washington University has joined the Hammarlund Manufacturing Company as chief engineer.

Stainless Steel Parts:

All types of stainless steel wood and machine screws, nuts, washers, nails, pipe fittings, hinges, and hardware are listed in a new catalog from the Star Stainless Steel Screw Company, 195 Union Ave., Patterson 2, N. J.

Where Our Money Goes:

It's a frightening thing to learn from Federal statistics that federal, state, and local government expenditures amount to 78% (that seventy-eight per cent is not a typographical error) of the total wages and salaries paid to people engaged in non-government pursuits. While certain government functions are necessary to all of us, and others are neces-

(Concluded on page 9)

SPOT NEWS NOTES

(Continued from page 8)

sary to specific groups, many services the administration has presumed to perform for us are so expensive that they are not worth what they cost us. So we are faced with the alternatives of 1) continuing to pay from our pockets for those extravagant services, and the wages of those who perform them, or 2) eliminating the services and letting a considerable number of government employees earn their living by joining the ranks of productive workers.

Audio-Type Connectors:

A 32-page catalog of connectors and receptacles for microphones and audio circuits has been issued by Cannon Electric Company, 3209 Humboldt Street, Los Angeles 31. There are 61 types illustrated with dimension drawings.

Wired TV Service:

Independent telephone companies are going into the business of picking up TV programs and distributing them by wire lines strung on their own poles. It's a natural service for them to perform, since they have the experience, personnel, and facilities, and they can add the TV charges to telephone bills.

IRE-RTMA Fall Meeting:

Annual engineering session will be held October 20 to 22 at Hotel Syracuse, Syracuse, N. Y., under the chairmanship of Virgil Graham. Papers will be devoted to UHF television, quality control, color TV, electronic devices, and general television subjects.

Railroad Radio:

A contract for two-way portable, mobile, and fixed equipment, amounting to $140,000, has been placed with Bendix Radio by the N. Y., Chicago, & St. Louis Railroad.

MEETINGS and EVENTS

SEPTEMBER 19-20,
IRE COMMUNICATION CONFERENCE
Roosevelt Hotel, Cedar Rapids, Iowa
SEPTEMBER 22-25,
NEDA CONVENTION & CONFERENCE
Atlantic City, New Jersey
SEPTEMBER 29-OCTOBER 1,
NATIONAL ELECTRONIC CONFERENCE
Hotel Sherman, Chicago
SEPTEMBER 29-OCTOBER 2, IMSA CONVENTION
Hotel Statler, Boston, Mass.
OCTOBER 13-17, AIEE FALL MEETING
New Orleans, Louisiana
OCTOBER 20-22,
RTMA FALL ENGINEERING MEETING
Hotel Syracuse, Syracuse, N. Y.
OCTOBER 29-NOVEMBER 1, AUDIO FAIR
Hotel New Yorker, N. Y. C.
NOVEMBER 17-18,
AIEE INSTRUMENT CONFERENCE
Benjamin Franklin Hotel, Philadelphia
JANUARY 14-16,
IRE-AIEE MEETING ON HF MEASUREMENTS
Washington, D. C.
FEBRUARY 5-7,
IRE SOUTHWESTERN CONFERENCE & SHOW
Plaza Hotel, San Antonio, Texas

PATTERN FOR TV PROFIT

PART 3 CONCLUDED — DESCRIPTIONS OF ACTUAL STUDIO LIGHTING INSTALLATIONS — FIXTURE MOUNTING METHODS — LIGHTING CONTROL SYSTEMS

By ROY F. ALLISON, *in collaboration with* A. B. CHAMBERLAIN, RODNEY D. CHIPP, RAYMOND F. GUY, THOMAS E. HOWARD, *and* FRANK L. MARX*

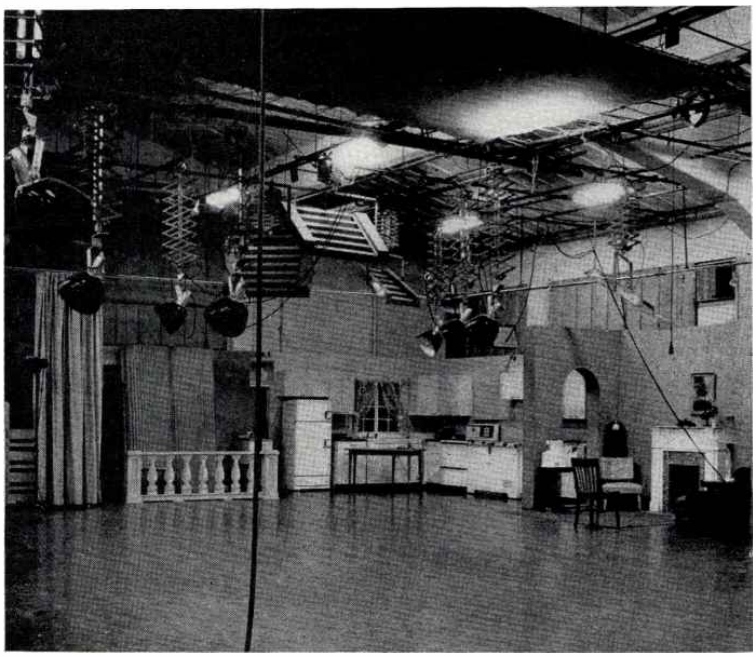


FIG. 25. THIS KSL-TV STUDIO EMPLOYS PANTOGRAPH-MOUNTED LIGHTING FIXTURES EXCLUSIVELY

Placement of Lights:

There are no hard and fast rules with regard to lighting-fixture support and placement. Each installation must be made according to the individual circumstances. However, since by far the greatest proportion of the fixtures are most conveniently located overhead, some means for suspending them from the ceiling is required for all installations. In smaller studios, a permanent grid of iron piping is usually erected near the ceiling. Diameter of the pipes is usually 1½ ins., and they are spaced from 4 to 6 ft. apart. Where the ceiling height is less than 15 to 20 ft., the grid is commonly installed from 1½ to 2 ft. below the ceiling, or far enough to clear ductwork, conduit, and other objects fastened to the ceiling also. Raceways are then fastened to or near the pipes for electrical cables, with outlets spaced at convenient distances. The trend in newer installations is to provide pigtail connector cables as outlets, with female stage-type pin plugs attached.

The lighting fixtures can then be attached directly with clamps to the grid, to hanging extension rods of fixed or variable lengths which are clamped to the grid, or to pantograph arms by which the individual fixtures can be raised almost to grid height or lowered nearly to the floor. Such pantograph units can be clamped semi-permanently to the grid or can be mounted on a track attached to the grid. The track may be energized in some cases to provide remote horizontal positioning of the units, or it can be set up for manual operation. Tracks can be obtained also which are energized to supply power to the lighting fixtures associated with them, although such equipment is quite expensive. The fixtures themselves should be pivot-mounted so that they can be rotated and tilted freely.

Fig. 25 is a view of a studio at KSL-TV, Salt Lake City. Here, all the fixtures are mounted on pantograph units,

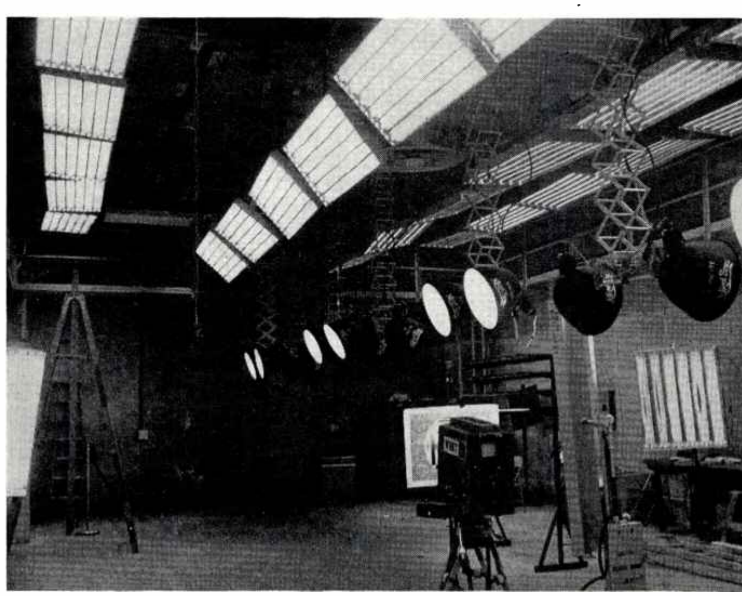


FIG. 26. WNBT LIGHTING ARRANGEMENT IS VERSATILE AND QUITE EFFECTIVE FOR SMALL STUDIO

*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.

even the fluorescent pans. At WNBT's studio at 106th Street, New York City, on the other hand, two rows of fluorescents are mounted permanently on each side of the studio. A row of incandescent scoops is in the center, Fig. 26, and they are mounted on pantograph units to provide the required flexibility. A particularly good view of the grid and an outlet raceway in this studio is given in Fig. 27. Details of the pantograph units and the clamps can be seen also.

At WHAS-TV, in Louisville, Kentucky, the studio ceiling is covered completely by fluorescent lights, as shown in Fig. 28. Pantographs on traveling tracks support the incandescent scoops and spots, so that they can be readily positioned anywhere in the studio.

If the ceiling of a studio is very high, it may be practical to construct the grid far enough down so that cat-walks can be placed above the grid. This facilitates the location and adjustment of lights and scenery which is often suspended from a grid or battens also.

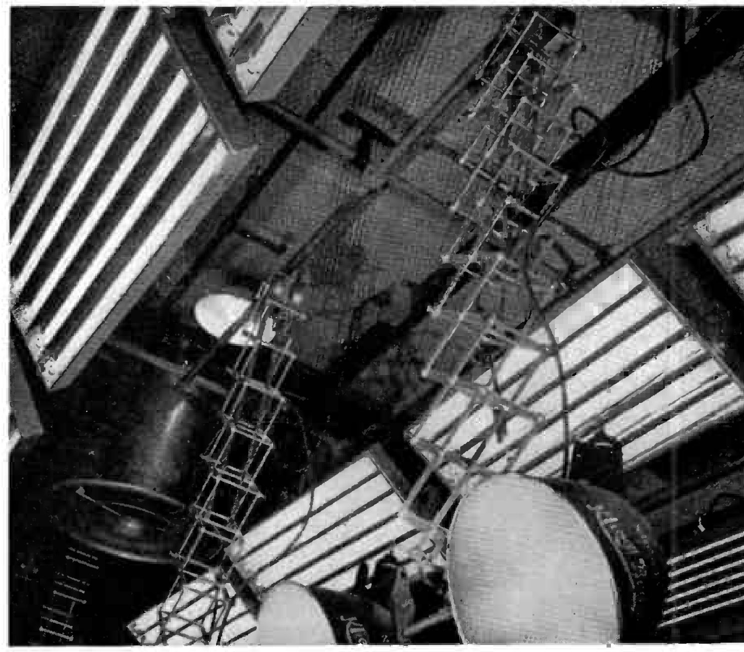


FIG. 27. NOTE PIPE GRID FOR FIXTURE SUPPORT, AND POWER RACEWAY WITH OUTLET RECEPTACLES

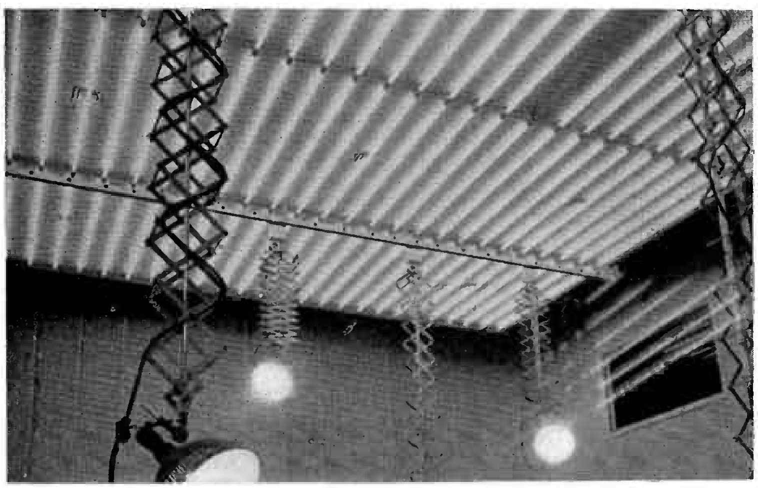


FIG. 28, ABOVE: LIGHTING ARRANGEMENT EMPLOYED BY WHAS-TV. FIG. 29, BELOW: COUNTERWEIGHTED BATTENS SUPPORT FIXTURES IN WNBT STUDIO 8H

It has been found that, except for an occasional permanent set such as a kitchen or a news room, an inflexible lighting system is not practical. It pays to provide a versatile and easily-adjustable lighting installation in any production-type studio. Many newly-constructed studios, especially those of medium and large size, are provided with counterweighted battens, easily adjustable in height, to which lighting fixtures and scenery are attached. Battens are sections of pipe suspended individually, and are not interlocked in grid fashion. Therefore, they must all be parallel. They are usually made parallel to the shortest wall of the studio, although they do not ordinarily reach from wall to wall. Some installations employ battens as long as 20 ft., but they are most often shorter to provide increased flexibility. In general production areas, battens are placed about 4 ft. apart. Where they are employed over staging areas and are used to fly sets, however, they may be placed as closely at 1 ft. apart. General practice is to install two or more distinct rows of battens.

Fig. 29 is a view of WNBT studio 8H, in which the counterweighted-batten system is employed. This studio is 78 by 130 ft. in area. At one end, an area 78 by 30 ft. was set up as a stage, although an actual stage was not constructed. Battens were grouped considerably more closely over this section than in the remaining area. In the stage area, a total of 103 20-ampere pigtail outlets were provided in strips attached to the battens. In the remaining production area, 100 ft.

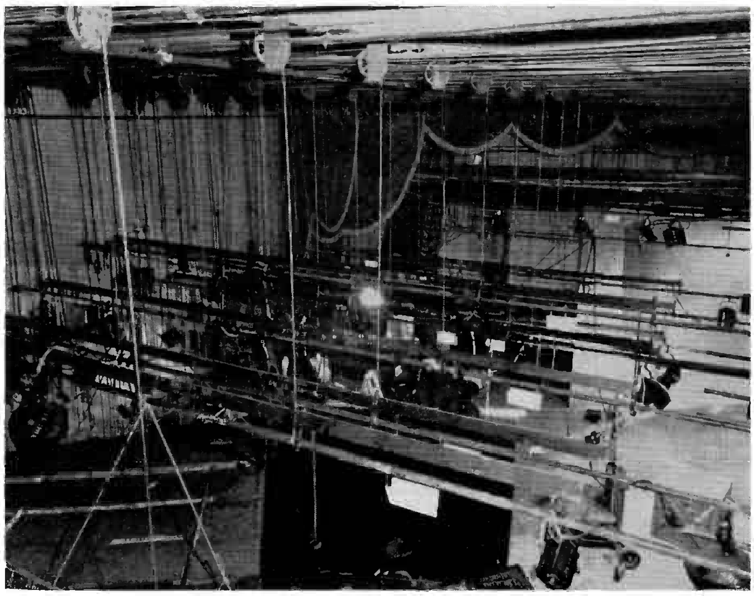


FIG. 30. ADJUSTABLE BATTENS, FIG. 29, PARTIALLY LOWERED, CAN BE DROPPED ALMOST TO FLOOR

long, 266 similar outlets were installed. Twenty-four 30-ampere outlets and four 50-ampere outlets were provided on the walls of the studio near the floor, to accommodate lighting units mounted on mobile floor stands.

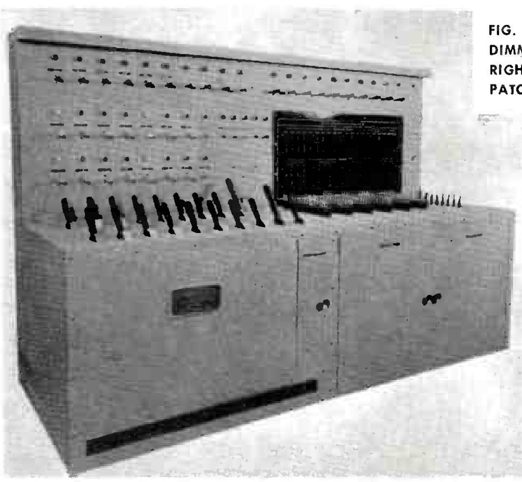
The battens can be raised to a height of 22 ft. from the floor, as shown in Fig. 29, or lowered to 5 ft. from the floor. They are shown partially lowered in Fig. 30. The pulleys and ropes for adjusting their heights can be seen at the top of the picture, and the counterweights are visible on the wall at the left in Fig. 29.

Lighting Control:

The need for flexibility extends to the electrical control of lighting units as well as physical control. It should be possible to turn on and off and to dim groups of lights in combination, as well as each individual unit.

The simplest lighting control system would, of course, consist of a central switchboard with a breaker-type switch for every outlet circuit. In the smallest type of installation, this may be employed.

For most operations, however, some sort of dimming control will be desired. In order to reduce the number of dimmers required, it is the usual practice to provide some means whereby any individual outlet circuit can be connected to a dimmer and controlled individually or in conjunction with other outlets connected to that same dimmer. Usually, autotransformer type dimmers are employed, of about 4,000 watts capacity, so that 3 or 4 outlet circuits can be controlled by each dimmer at the same time. Most dimmer installations are provided with one or more master dimmers, so that groups of dimmer circuits can be controlled proportionally.



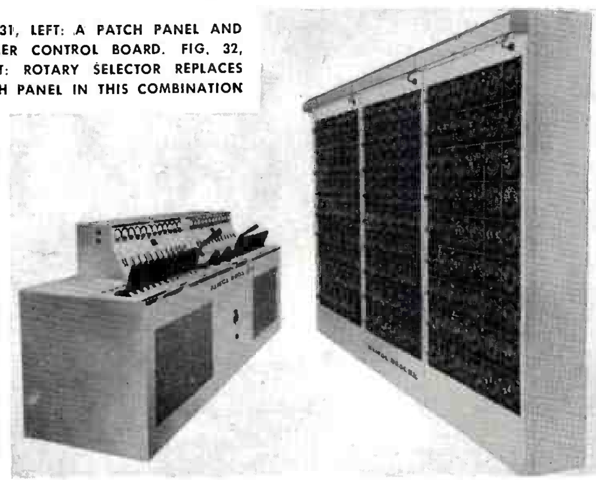
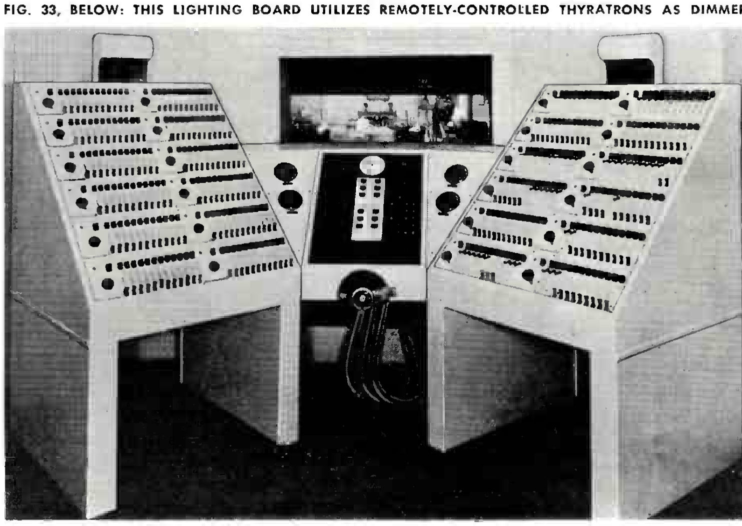


FIG. 31, LEFT: A PATCH PANEL AND DIMMER CONTROL BOARD. FIG. 32, RIGHT: ROTARY SELECTOR REPLACES PATCH PANEL IN THIS COMBINATION

FIG. 33, BELOW: THIS LIGHTING BOARD UTILIZES REMOTELY-CONTROLLED THYRATRONS AS DIMMERS



There are two types of switchboards commonly employed to make these circuit selections. One is the patch-panel type, in which each outlet circuit is brought to a pigtail cable terminated by a male connector plug. This plug can be patched to any of the female connector panels which are energized by individual dimmers or breaker switches. A board of this type, manufactured by

(Concluded on page 17)

New UHF-TV Antenna

PART 2 — TFU-24B HORIZONTAL AND VERTICAL RADIATION CHARACTERISTICS — *By* O. O. FIET*

Lower-gain antennas of construction similar to the TFU-24B can be obtained on special order; however, low-gain antennas do not appear to provide the most economical combination for maximum signal strength and coverage area in most applications. The advantage of high gain with beam tilt for a given transmitter power is clearly evident in the field strength radials shown in Fig. 7, which compares an isotropic radiator with a directivity gain of .61 with this antenna, having a directivity gain of 27.3. Identical conditions are assumed for each.

Perhaps, if 500 to 1,000-kw. UHF transmitters become available in the future, some stations may use them in combination with low-gain antennas. On the other hand, propagation measurements made at Princeton, New Jersey on UHF signals transmitted from Bridgeport indicate that interfering signals beyond the useful service area of a UHF station can be reduced greatly by tilting the vertical pattern of a high-gain antenna down a suitable amount.[11] A high-gain tilted beam antenna can give greater ERP within its service area than at the horizon.

Recordings of field strength of Bridgeport UHF Station KC2XAK made on top of the RCA Building in New York City during 40 to 50 miles an hour winds at Bridgeport, Connecticut indicated received field strength variations of approximately ±10%.[3,4] The tower used in the Bridgeport installation is self-supporting, and does not, therefore, provide an antenna base stability nearly as great as that of most guyed towers supporting a similar antenna load.

This experience is particularly significant because the width of the main beam and the locations of first nulls are almost identical for the Bridgeport antenna and the new antennas. Greater field-strength variations were observed at some close-in locations at Bridgeport during high winds. However, satisfactory reception was obtained at all locations since the signal variations were well within the control range of the receiver AGC systems. Experience indicates that AGC is required on all UHF-TV receivers in order to obtain satisfactory reception. Consequently, signal variations caused by mechanical oscillations of a properly installed high-gain transmitting antenna will not cause unsatisfactory reception during high winds which occur occasionally. Exceptionally severe storms, of course, may cause unfavorable reception in some locations.

The effect of high winds on lead-in and receiving antenna stability will have a more disastrous effect on the quality of reception than any possible transmitting antenna variation for a well designed transmitting antenna and support installation. The bending stresses in the TFU-24B antenna at the highest wind velocities are quite conservative (about 9,000 psi) in comparison with permissible structural stresses (about 20,000 psi.) This minimizes bending and deflection of the antenna structure during high winds.

Horizontal Pattern:

The horizontal pattern in the principal plane of the TFU-24B antenna can be calculated from assumed boundary conditions on the outside surface of a perfectly conducting slotted cylinder.[12, 13, 14] The horizontal pattern is, theoretically, a perfect circle within ±.232% for zero elevation angle. Fig. 8, showing typical measured radiation patterns, indicates excellent agreement between measured and calculated results.

If each layer of the TFU-24B antenna had six slots rather than three, the horizontal patterns shown in Fig. 8 for other values of elevation angle would approach a perfect circle as closely as the measured pattern for 0°.

Directional horizontal patterns can be obtained for special applications by using components of this antenna. Fig. 9 illustrates a horizontal pattern obtained with a single set of colinear slots in a TFU-24BM antenna cylinder. Directional UHF antennas must ordinarily be custom-designed for particular applications.

Vertical Pattern:

The measured vertical pattern of the TFU-24B antenna closely resembles the calculated pattern obtained by the product of an array factor for a colinear broadside array and a suitable element pattern.[14]

The antenna can be considered approximately as an array of infinitesimally spaced circular current loop antennas whose diameter is the same as that of the actual antenna. The total aperture is equal also to that of the antenna. Each loop has a uniform in-phase circumferential current.

Such an idealized array of uniform current loop antennas would radiate only a horizontally polarized component of electric field.[14] Actual measurements on a TFU-27BH antenna show the cross or vertically-polarized component of electric field to be very small. The power thus radiated is about .3% of the total power radiated and, therefore, causes a .3% reduction in measured gain. It is quite possible that the measured vertically-polarized component is greater than that actually radiated, because of non-ideal conditions in the measuring site which are responsible for conversion of some of the horizontal component of polarization.

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[11]"Some Experiments with 850-Megacycle Television Transmission in the Bridgeport, Connecticut Area," G. H. Brown.

[12]"Electromagnetic Theory," by J. A. Stratton, McGraw-Hill Book Co., New York 18, N. Y., 1941.

[13]"Measurement of Aircraft Antenna Patterns Using Models," George Sinclair, E. C. Jordan, and Eric W. Vaughan, *Proc. IRE.*, Dec., 1947. Vol. 35 No. 12.

[14]"Antennas," by J. D. Kraus, McGraw-Hill Book Co., New York 18, N. Y.

[15]"Elektrische Schwingungen und drahtlose Telegraphie," F. Braun, *Jahrbuch, der drahtlosen Telegraphie und Telephonie*, Vol. 4, No. 1, 1910. page 17.

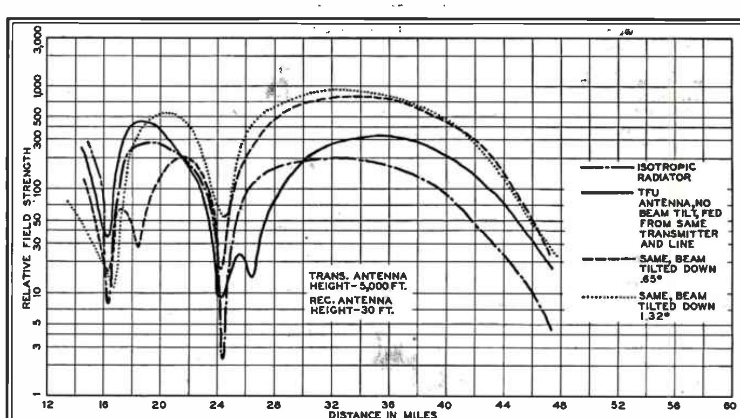


FIG. 7. FIELDS OF AN ISOTROPIC RADIATOR AND A TFU-27BH WITH VARIOUS AMOUNTS OF BEAM TILT

This polarization conversion can be caused by irregular terrain, trees, weeds and brush, fences, wires, or similar objects.[14, 15]

In any case, the cross component of field for the TFU-24B antenna is negligible for broadcast applications. However, it should not be concluded that all omni-directional antennas intended to radiate only one field component have negligible radiation in the undesired plane of polarization. Antennas whose radiating elements yield elliptic polarization may depend on interfering fields in adjacent elements to cancel undesired polarization in the principal plane. Such cancellation in the principal plane can still leave large amounts of cross-polarized energy at other elevation angles. A measurement made on an antenna construction using the polarization interference principle indicated the gain was reduced approximately 25% by the undesired component of electric field.

Some omni-directional VHF television broadcasting antennas radiating predominantly horizontal polarization have been shown theoretically and experimentally to have a gain reduction of 5 to 15% because of vertically-polarized radiation. The practical effect of 15% reduction of ERP on the coverage is negligible, and such an error should be acceptable; but as the state of the art develops, and more accurate measuring techniques are used, an attitude approaching perfectionism has appeared. For this reason, and because some recently-developed antennas have undesired cross-polarized radiation which is not negligible, it is desirable in pattern and gain measurements to account completely for both components of the electric field.

Measurement Techniques:

Power gain and patterns are obtained with a setup whereby the antenna whose pattern is to be measured is set on a rotating spindle with its center of radiation over the axis of the spindle, as shown in Figs. 1 and 3. The plane of the antenna in which it is desired to measure the pattern is set parallel to the ground.

The antenna whose pattern is to be measured[16] is used as a receiving antenna which drives a recording voltmeter. The recorder chart is driven by a gear and servo system connected to the antenna spindle. A transmitting antenna which provides the signal of the desired frequency is located at a point sufficiently distant to obtain nearly the lowest possible relative field strength in the nulls of the vertical pattern. In the case of the setup shown in Fig. 3, the transmitting antenna is about 2,400 feet from the turntable. This results in a waveform phase error of less than 15.7 electrical degrees at the extremities of the antenna aperture. Both components of the electric field are measured for each antenna position.

Although this new antenna is omni-directional, and it might be assumed that the total radiated power could be evaluated by the single integral of one vertical pattern,[9] assuming rotational symmetry of the vertical pattern, such an approach can produce errors for patterns in certain meridians as great as 10% in power gain because of the slight variation from rotational symmetry shown in Fig. 8. The power gain should be computed from a sufficient number of vertical patterns for both components of polarization in order to provide the desired accuracy. The magnitude of the vertical pattern field should be normalized to agree with the corresponding relative field intensity in the principal plane horizontal pattern, Fig. 8, for the corresponding meridian angle. In the case of the TFU-24B antennas, the vertical patterns in the plane of any line of slots are all the same and the vertical patterns in a plane half way between slots are the same. The variation of the field between vertical patterns is approximately sinusoidal, as shown in Fig. 8. Consequently, the average of the two vertical patterns mentioned above can be used in a single integral to evaluate the gain of the antenna.

The integration is readily performed on a rectangular coordinate plot using a planimeter.[9] In the case of the TFU-27BH antenna, the gain calculated from measured patterns was about 1.3% below theoretical. About .3% is accounted for by the cross-polarized field component, and 1% is due to filling of the nulls in the vertical pattern.

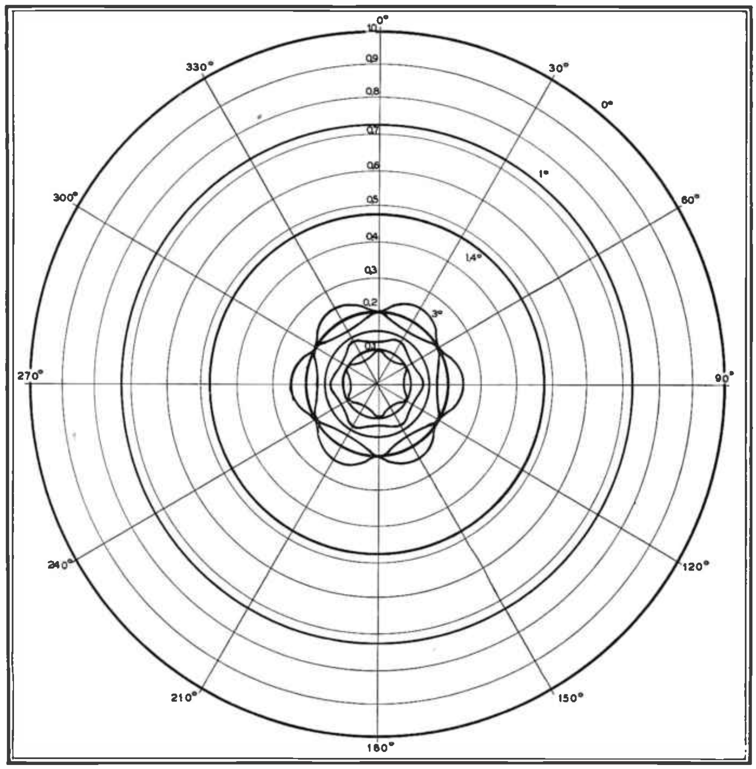


FIG. 8. HORIZONTAL RADIATION PATTERNS OF A TFU-24B ANTENNA AT VARIOUS VERTICAL ANGLES

This null-filling can be caused by slight departures from the uniform, in-phase current distribution assumed for the theoretical pattern calculations. In a practical antenna employing iterated feed for the radiating system, small dimensional errors and variations in impedance for different layers because of different mutual impedances can produce null-filling. This helps to assure adequate field strength at all locations within the service area. It is probable, however, that even without null fill-in a high-gain antenna would produce greater field strength in its low-signal areas than a low-gain antenna with the same power input, because ground reflections and scattering help to distribute the signal from a highly directive source. With a low-gain antenna which radiates signals of comparable magnitude at all angles of elevation, low-signal areas are produced by interfering reflections. Fig. 7 shows a field-strength radial comparing

[16] "Pattern Testing the RCA TFU-27BH Antenna," E. H. Shively, *Broadcast News*.

the TFU-24B antenna with a low-gain antenna having the same power input and height. A null fill-in of 2% of the maximum field was assumed for the high-gain antenna. The actual null is approximately 10% of the maximum field for the antenna null at the greatest distance from the transmitting antenna. Consequently, the field strength in this null can be expected to be about 5 times greater than shown in Fig. 7. This is clearly much better than is obtained with a low-gain antenna using the same transmitter, tower, and location. In general, an antenna with a gain of 20 to 30 will produce field strength 4 to 7 times greater than an antenna with a gain of 1 or 2, with the same power input, over most of the service area.

It should be emphasized that field strengths for locations less than 1,500 feet from high-gain UHF transmitting antennas cannot be predicted by using the usual far or Fraunhofer zone radiation patterns.[14] In general, it is found that the near-zone field pattern does not have the deep nulls obtained in the usual far-zone patterns, and that the field in all directions from the antenna is more nearly equal. It is quite possible to obtain field strengths of 9 to 100 volts per meter below a UHF transmitting antenna at close-in locations, with transmitters available today. Signal strengths

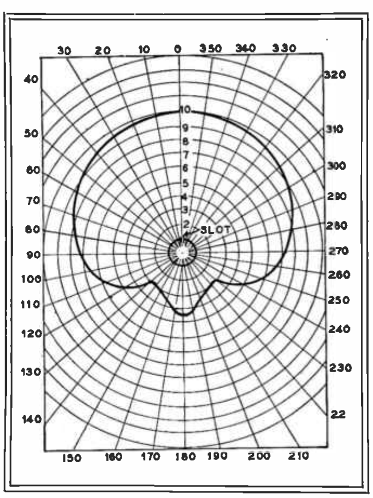


FIG. 9. PATTERN OF DIRECTIONAL UHF ANTENNA

of this magnitude will overload UHF-TV receivers, causing impaired reception, spurious responses, and possible damage. High-gain UHF antennas are of value in reducing the close-in field strength to a value which provides satisfactory close-in reception, thus permitting the most advantageous urban location of the antenna to cover the principal city. Lower-gain antennas may necessitate a rural installation in order to prevent close-in receiver overload. Consequently, there will be a reduction of desirable signal strength in the most densely-populated area of the principal city to be served.

Electrical Vertical Pattern Tilt:

By shifting the feed point from the center of the array, the phases of the top half and the bottom half of the array are shifted relative to each other, causing the vertical pattern to tilt up or down as desired. This is accomplished mechanically by loosening the clamp on the hub of the lower shorting bar which holds the harness in position, and shifting the harness longitudinally as required. Such an adjustment can be accomplished easily in the field, to assure optimum coverage,[8] or it can be preset to a calculated position by reference to the instruction book.

In the case of the TFU-24B antenna, the spacing between the radiation centers of the upper and lower halves of the array is 12 to 14 wavelengths. Consequently, the mutual impedance between the two halves of the array is small in comparison with the self-impedance of each half. The driving point impedance, therefore, is equal to the self-impedance and is practically independent of the relative phase of the current in the upper and lower halves of the antenna. Since the input impedance of each half stays constant for any phase adjustment, the current and power distribution on each half is independent of the adjustment.

Fig. 10 shows a measured vertical pattern for the TFU-27BH antenna with .92° pattern tilt.

Antenna Harness Support:

The harness can be removed from the antenna by loosening the same clamp which was loosened for the beam tilt adjustment. Low loss ceramic pin centering insulators support the transmission line harness in the center of the antenna cylinder. A Teflon cap on the end of the ceramic pin prevents abrasion of the transmission line during removal or installation, and when the antenna is swaying in the wind. This same type of support insulator was used in the Bridgeport antenna. The Teflon end cap has a hard waxy feel with a very low coefficient of friction which permits easy adjustment, removal, or installation of the transmission line within the antenna, without disturbing the centering insulator adjustment.

Icing Considerations:

Voltage standing wave ratio measurements were made on the antenna at Bridgeport during a severe ice storm, and the change in voltage standing wave ratio was found to be small. The antenna system and transmitter were capa-

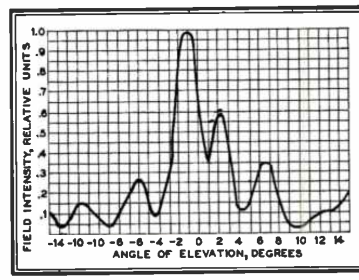


FIG. 10. VERTICAL PATTERN WITH BEAM TILTED

ble of operating with the antenna in an iced condition without difficulty, and the transmitted picture was of normal quality. Because of the further improved performace characteristics, it is believed that the TFU-24B antenna may not require de-icing. However, if further tests indicate that it is desirable in locations where icing is very frequent and severe, de-icing equipment will be available as an accessory. The antenna setup at Camden, New Jersey, shown in Fig. 1, includes a sprinkler at the top for icing tests. These tests will be made as weather permits.

Acknowledgment:

The TFU-24B antenna is a result of contributions of many engineers in the Broadcast Antenna Engineering Section of RCA. Particular credit is due Charles Polk, who did much of the electrical development; E. H. Shively, who was responsible for the field pattern work; and A. Mathern, who carried out the mechanical design.

"MICROPHONES" — A NEW HANDBOOK

A THOROUGH but concise treatment of microphones for use at broadcast stations has just been released for general consumption. Prepared by BBC's Engineering Training Department, it was written specifically to serve as both an instructional and a reference work.

Requirements for studio microphones are discussed in detail in the opening chapter, which is followed by chapters concerned with the behavior of sound waves. The design and characteristics of ribbon, moving-coil, crystal, and condenser microphones are covered in subsequent chapters. Finally, an extensive appendix includes sections on mathematical proofs and the derivation of design analogies.

This book should be in the library of every broadcast engineer, and of those concerned with design and development work on microphones. Available from Radio Communication, Inc., Great Barrington, Mass., at $3.25 each.

PATTERN FOR TV PROFIT

(Continued from page 13)

Century, is shown in Fig. 31. Dimmer handles are at the left on the shelf section, and the outlet plugs are at the right. The plugs are attached to spring-loaded cables, so that it is not likely that they will become entangled. The patch panels are directly above the plugs on the vertical section of the board, and switches occupy the rest of that section.

An alternative method of circuit connection is by means of multi-position selector switches. Fig. 32 shows one of this type, a Kliegl Rotolector board. The output of each control on the board at the right feeds a studio outlet (or, in a theater-type installation, possibly a group of outlets). Corresponding contacts on all the rotary selector switches are connected together and are fed by one of the dimmers on the board at the left. Each outlet can be connected individually or with others to any dimmer. Thus, there are as many positions on each selector switch as there are dimmers provided in the installation. Selector switches are available in 12, 24, 36, and 48-position units. Each unit has its own circuit breaker and a disconnect switch which can be used as an individual control switch.

Some installations employ push-button selector switches rather than those of the rotary type.

All-electronic dimmers have been developed which reduce markedly the space required at the control operator's position and, at the same time, increase the versatility of control. These systems consist of low-power primary control boards and remote banks of thyratron tubes which actually control the light intensity. Control is effected by varying the bias on the thyratron tubes, whose plate currents are used for the lighting power. They may be used with patch-panels, rotary selectors, or push-button selectors. Lighting combinations can be pre-set and the changeovers accomplished automatically or with a single manual control. Especially for the more complex installations, these systems cost little more than an extensive conventional switchboard system. Figs. 33 and 34 are views of control consoles for electronic Kliegboards and Century-Izenour boards, respectively.

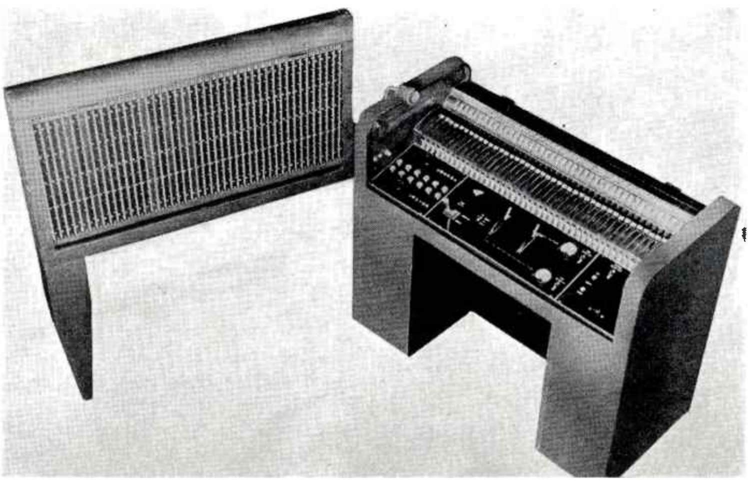


FIG. 34. THIS ELECTRONIC CONTROL BOARD CAN BE OPERATED BY ONE MAN FOR ORDINARY STUDIO SHOWS. LIGHTING COMBINATIONS CAN BE PRE-SET, AND CHANGEOVERS MADE WITH SINGLE CONTROL

Lighting Costs:

The equipment described here cannot be purchased inexpensively. Studio lighting equipment must be of top quality, not only to satisfy safety codes but because dependable, versatile equipment is less expensive in the long run.

Each installation must be planned individually according to specific requirements. Therefore, exact cost figures cannot be provided. The following figures are given only as a guide for preliminary estimates, and represent average cases. In many instances, of course, it will be possible to install temporary lighting systems at much lower costs; in others, requirements will be such that these cost figures will be exceeded. *Installation costs are not included, nor is the expense for a grid or batten supporting system.* Figures in the MINIMUM column are for studios used primarily for interviews, demonstrations, panel discussions, and limited dramatic or novelty shows. The use of patch-type switchboards is assumed. The figures in the NORMAL column represent lighting costs for completely-equipped general-purpose studios, and provide for selector-type switchboards.

TYPICAL STUDIO LIGHTING EQUIPMENT COSTS

DIMENSIONS, FEET	MINIMUM	NORMAL
20 x 30	$ 4,900	$ 8,700
40 x 50	9,700	16,300
45 x 60	15,400	24,500
Auditorium, Theatre		$15,000 up

This is the concluding section of Part 3, on television studio design and lighting, of "Pattern for TV Profit." Part 4, concerned with transmitters, antennas, and towers, will begin in the September issue of RADIO COMMUNICATION.

FCC Television Grants

RADIO COMMUNICATION Magazine, in line with its policy of providing complete information on matters of interest to the industry, is presenting each month data on television station CP's, channel changes, and power increases granted by the FCC. Actions listed below are for the period from July 11 to July 25, 1952.

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

CONSTRUCTION PERMITS GRANTED

		CH.	KW.	COST
COLO.	**Denver** Eugene P. O'Fallon, Inc. (KFEL)	2	56-28	$364,500
	Denver Colorado Television Corp. (KVOD)	9	240-120	$394,000
	Denver Empire Coil Co.	26	105-52	$347,000
CONN.	**Bridgeport** Sthn. Conn & Long Island TV Co. (WICC)	43	81-46	$223,900
	New Britain New Britain Bcstg. Co. (WKNB)	30	180-90	$323,800
KANS.	**Manhattan** Kansas State College	*8	52-26	$362,600
MASS.	**Holyoke** Hampden-Hampshire Corp. (WHYN)	55	65-35	$180,000
	New Bedford E. Anthony & Sons (WNBH)	28	200-100	$396,000
	Springfield Springfield TV Bcstg. Corp.	61	115-58	$265,000
MICH.	**Flint** Trans-American TV Corp.	28	17.5-8.7	$189,400
N. Y.	**Albany** Univ. of State of New York	*17	205-110	$251,000
	Buffalo Univ. of State of New York	*23	205-105	$251,500
	Rochester Univ. of State of New York	*21	205-105	$251,500
OHIO	**Youngstown** WBKN Broadcasting Corp.	27	200-100	$353,000
ORE.	**Portland** Empire Coil Co.	27	91-46	$347,000
PENN.	**York** Helen Coal Co.	49	96-54	$176,500
	York Susquehanna Bcstg. Co. (WSBA)	43	170-86	$305,500
TEX.	**Austin** Capital City TV Co.	18	216-108	$405,500
	Austin Texas Bcstg Co. (KTBC)	7	110-55	$341,000
WASH.	**Spokane** KHQ, Inc.	6	100-50	$331,900
	Spokane KXLY and Bing Crosby	4	100-55	$377,000
P. RICO	**San Juan** El Mundo Bcstg. Corp. (WKAQ)	2	100-50	$463,355

AUTHORIZED CHANNEL CHANGES AND POWER INCREASES

			CH.	KW.
ALA.	Brmgham.	WBRC-TV	4 to 6	14 to 100
GA.	Atlanta	WLTV(TV)	8 to 11	24 to 316
KTY.	Louisville	WAVE-TV	5 to 3	7 to 100
MICH.	Gd. Rapids	WOOD-TV	7 to 8	20 to 316
N. Y.	Rochester	WHAM-TV	6 to 5	17 to 100
OHIO	Cincinnati	WCPO-TV	7 to 9	24 to 316
	Cincinnati	WKRC-TV	11 to 12	25 to 316
	Dayton	WHIO-TV	13 to 7	24 to 200
PENN.	Johnstown	WJAC-TV	13 to 6	6.5 to 70
	Pittsburgh	WDTV(TV)	3 to 2	17 to 100
R. I.	Providence	WJAR-TV	11 to 10	30 to 316
W. VA.	Huntington	WSAZ-TV	5 to 3	17 to 84
WIS.	Milwaukee	WTMJ-TV	3 to 4	1 to 100

AT THE CAPITOL STUDIOS, ALL ORIGINAL RECORDINGS ARE MADE ON AMPEX TAPE EQUIPMENT

Rating Recorded Music

HOW CAPITOL QUALIFIES NEW RECORDINGS FOR THEIR FDS SERIES — *By* MILTON B. SLEEPER

THE term *high-fidelity* has come into general use in relation to wide-range reproduction, but no quantitative or definitive standards have been established that answer the questions: 1) How high is high-fidelity? or 2) how wide is wide-range?

The fact is that no way has been found to set up parameters of audio quality in terms of performance measurements that would not be rejected when they were in conflict with the staunchly individualistic opinions of expert listeners. Inevitably they would say: "I can't accept those measurements because they do not agree with what I hear!"

So far, we lack means to measure the intellectual interpretation of impressions received from such a non-standard device as the human ear is known to be. It seems, then, that we must make the most of expert opinions of audio performance, relegating laboratory instruments to the secondary role of establishing somewhat uniform listening conditions.

Ratings for Records:

The introduction of a special series of Capitol FDS records (Full Dimensional Sound) implies the establishment of performance standards under which specific recordings would qualify for the FDS label. A recent visit to Capitol's studio in Hollywood presented an opportunity to find out just what the FDS label signifies, and to report on what, as far as we know, is the first attempt to work out standard quality ratings of phonograph records.

What Capitol has done is to correlate listening conditions, established by actual measurements, with aural performance factors established by definitions on which panels of expert listeners can agree. Then, to make sure that the scoring by the judges is not weighted by enthusiasm for the composition under consideration, without due regard for technical faults in making the original tape or cutting the record, each panel is made up of two engineers and two repertoire men. This is to preclude the possibility that overly enthusiastic members of the sales department might break down the standards represented by the FDS label. Also, review personnel alternate to avoid any personal bias.

Actually, as Capitol executives Lloyd Dunn and Robert Myers explained, a record having the FDS identification must do more than gain the approval of the judges as to audio quality. It must qualify as to musical merit, too, and afford a faithful reproduction of the original music, free of modification at the hands of the recording engineer.

To avoid confusion which might arise from listening to loudspeakers of different characteristics, the 20 speakers installed at the Capitol studios are of identical design. Sound level measurements at the specified listening levels determine the acoustic response. Corrections are made if necessary to provide uniform listening conditions. Tone controls are not employed. Sometimes, to check on

THE FOUR JUDGES EVALUATE NEW RECORDINGS ON EIGHT FACTORS OF REPRODUCTION QUALITY reproduction as it might sound in average homes, factory-built consoles are used. Before records are played, however, each set is checked at 100, 1,000, and 5,000 cycles, and the tone controls are set for uniform response as indicated by a meter across the output.

Method of Rating Records:

When a panel of judges meets for a scoring session on one or more new records, they first spend half an hour playing other records of a similar character. The purpose is to prepare for critical listening. One of the accompanying illustrations shows such a session in progress. From left to right are Robert Myers, West Coast classical department representation; Edward Uecke, chief engineer; Roy Dunann, acting director of recording; and William Miller, artist's repertoire representative.

Each panel member has a chart on which he enters ratings for the following characteristics:

1. Background noise
2. Electrical distortion
3. Acoustic distortion
4. Frequency range
5. Separation
6. Dynamic range
7. Musical balance
8. Performance

The basis of the point rating is:
100—Excellent, no criticism
90—Good
75—Fair
60—Acceptable

To qualify for FDS rating, an average of 90 points is required, and the rating of any factor must not be less than 80 points. Of course, a selection that does not qualify for the FDS label may still be released as a Capitol record, but in that case a different minimum average is used and the rating on any factor must not be less than 60.

The final score on overall performance and the ratings of individual factors are obtained by averaging the point values set down by the reviewers participating.

Definitions of Rating Factors:

To assure common understanding and agreement as to the factors on which recordings are to be rated, and of the method of scoring, Capitol has adopted these definitions and instructions:

1. Background Noise—A continuous noise which may consist of system and/or tape noise in the middle or high-frequency range, or it may be low-frequency rumble or hum, observed just before start of modulation, or during low-level or silent passages in recording. Evaluate degree to which noise is present.

2. Electrical Distortion—Distorted sound attributable to electrical causes such as clipping of modulation peaks and/or slow recovery, leaving "holes" in modulation, or "buzz" on certain types of modulation, usually on peaks.

3. Acoustic Distortion — Distorted sound originating in studio pickup, caused by undesirable intermodulation effects heard as unnatural tones of instruments or sections; or confused sounds having unnatural resonances from the reverberation characteristic of the studio. Evaluate degree to which acoustic distortion is present.

4. Frequency Range—Evaluate the recording as to whether it contains the maximum and minimum frequencies capable of reproduction by the wide-range playback system (40 to 10,000 cycles), or the degree by which the recorded range is restricted.

5. Separation—The degree of clarity, transparency, and definition to which the blending of instruments and/or vocalists permits individual instruments, inner voices, or choirs to be distinguished and identified, or are unnaturally masked by the overall sound.

6. Dynamic Range—This is the maximum and minimum recorded level. Evaluate the degree to which the volume range simulates the range demanded by the scoring, within the maximum limit that can be recorded safely, and the minimum which will be audible above the groove noises.

7. Musical Balance—The degree of perfection in recording a true orchestral balance and the perspective of sound which will create an illusion of reality in reproduction, as differentiated from an artificial balance often achieved by equalization of the deficient part of the frequency spectrum which usually destroys the *true* timbre, and quality of instrumental and vocal sounds.

8. Performance — The quality of playing, interpretation of the score, and feeling.

9. Remarks—There should be included an explanation of the rating and or suggestions and recommendations by which the quality might be improved with re-recording corrections.

EQUIPMENT USED FOR PLAYING TEST RECORDS

Rated Records:

It might be supposed that the FDS series would carry a higher price than other classical releases from Capitol. That is not the case, however. The identification is intended only for the guidance of record collectors and the hi-fi clan. By setting extremely high standards for the FDS label, an element of competition is undoubtedly introduced within the company organization by giving recognition to outstandingly fine recordings.

The question has been raised as to whether this system might be adopted as industry-wide practice. That seems unlikely, and probably undesirable from the point of view of both the manufacturers and customers. Reasonably uniform standards can be maintained within one organization, but it would not be possible to maintain a significant degree of uniformity between companies.

NEW RECTIFIERS OF TITANIUM DIOXIDE

A NEW type of rectifier, developed recently at the National Bureau of Standards, is composed of a layer of semi-conducting titanium dioxide, a sheet of titanium metal, and a counterelectrode of some other conducting material. Both the initial development and subsequent experiments are the work of R. G. Breckenridge and W. R. Hosler of the NBS Solid State Physics Laboratory.

The new rectifiers are prepared by forming a layer of titanium dioxide on a sheet of titanium metal and then applying a counterelectrode to the oxide surface. Two processes have been devised to form the oxide layer. The first process involves heating the titanium first in oxygen and then in hydrogen. The other consists of heating the titanium metal in steam at elevated temperatures.

While the titanium-dioxide rectifiers are still in an early stage of development, some of their properties have aroused considerable interest. The units can withstand a reverse potential of about 20 volts per plate. In addition, good performance is maintained up to 150°C.


Centralized Control... with

"tailored" switching and monitoring

TC-4A Control Console combines Audio-Video Switching with Transmitter Control—makes it possible to centralize all operations at one position

Now you can do all (or any desired part) of your audio-video switching *right in your transmitter room . . .*

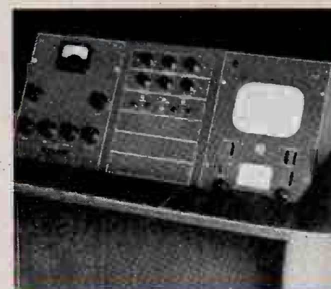
And you do not have to take a fixed group of units to do it. You can have whatever group of audio and video facilities you need to fit your particular requirements. Moreover, you can add further audio and video facilities as needed.

You get this economy and flexibility by building your equipment layout around the new TC-4A Control Console. The TC-4A is a two-section unit containing basic switching facilities for handling up to 8 audio and 8 video signals (remote or local). It can fade to black and "program-switch" network, remote, film, and local studio signals. Up to twelve signals can be monitored including transmitter operation.

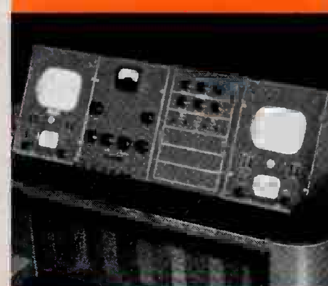
To this two-section unit you can add as many console sections (for "on-air" monitor, preview monitor, individual camera monitors) as you need to take care of your individual requirements. In this way you can build up a "centralized" control position from which one man can (if necessary) perform all operations.

Moreover, you do all of this with standard RCA units exactly like those used by the largest stations and the networks. Thus, if you decide later to expand to a multiple studio layout you can very easily rearrange these same units for that type of setup.

Remember . . . in TV it's good business to buy the best to begin with.



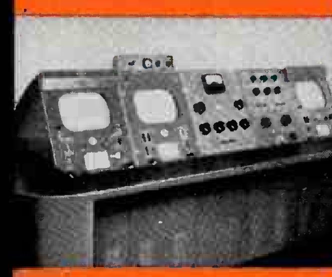
The basic TC-4A (left-hand and center sections) with a master monitor (right-hand section) as normally used at the transmitter (i.e., no video origination at this location).



The same setup with a film camera control unit added (at the left) for programming of slides and films from the transmitter—or for small stations without "live" studios.

TC-4A Control Console (3rd and 4th units from left) combined with three monitor sections to provide complete station operating control from a position in the transmitter room. In this arrangement the first unit of the console (starting from the left) is the "live" camera control and monitor, the second is a film camera control, the third unit contains audio faders and audio and video switching, the fourth unit contains monitor switching and remotely located equipment controls, the fifth unit is the line master monitor. Audio and video amplifiers, power supplies, etc., are mounted on the racks at left (shown shaded). The transmitter in the background is the Type TT-2A 2 kw, VHF TV Transmitter. However, the same arrangement of controls and audio-video facilities can, of course, be used with any RCA TV transmitter, UHF or VHF, 500 watts to 50,000 watts (providing ERP's of 1 kw to 1000 kw).

TC-4A with master monitor unit, preview monitor unit, and two camera control units (one live and one film or two film). If desired, sections can be arranged U-shape or L-shape to fit available space.



Similar setup with two camera control units (one live and one film, or two film), such as used in the RCA "Basic Buy" for TV.

RADIO CORPORATION of AMERICA

ENGINEERING PRODUCTS DEPARTMENT **CAMDEN, N.J.**

BBC Pulsed-Glide Acoustic Displays

PART 3 — RELATIONSHIP BETWEEN SUBJECTIVE JUDGMENTS AND INTERPRETATIONS OF THESE DISPLAYS — *By* T. SOMERVILLE AND C. L. S. GILFORD*

Subjective Correlation:

Pulsed glide tests have been made in a number of studios in the London area, with the object of establishing correspondence between the appearance of the displays and the subjective qualities of the studios. Several examples of the intrinsic features described above were found, and are illustrated in Figs. 13A to 13D.

Studio 3F at Egton House, Fig. 13A, has a colouration in speech and a ring on pulsing in the region of 175 cycles. The cause of the colouration is not known, and the indication on the pattern is not very marked. Bush House Playback Room, Fig. 13B, has a colouration due to floor vibration which appears as a sudden spread in the display, whatever the microphone position. Grafton Theatre narrator's studio has a colouration in the region of 170 cycles, caused by radiators in the room. Fig. 13C shows this region clearly. The experimental speech studio in Nightingale Square, Fig. 13D, has a serious colouration at 115 cycles.

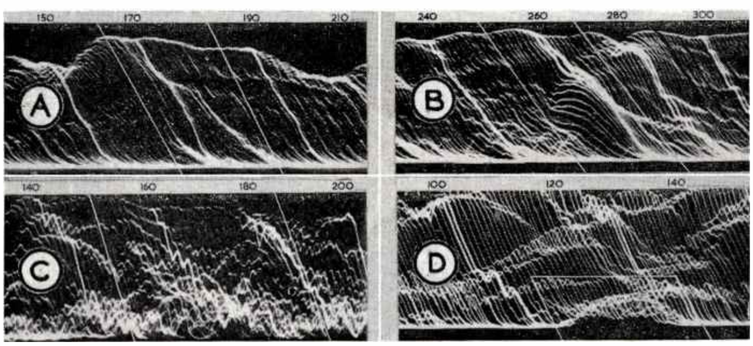


FIG. 13. FOUR EXAMPLES OF INTRINSIC FEATURES FOUND IN DISPLAYS FROM BROADCAST STUDIOS

These examples are fairly typical of the findings in recent surveys. Pattern structures such as those shown are always associated with audible colourations, though the converse is not so invariably true.

High-Frequency Formations:

The rapidly-varying nature of the patterns at high frequencies and in large auditoria makes it impossible to examine the trends over small frequency bands. There are no clear horizontal structures. Consequently, as an initial step we can only attempt to apply criteria based on the appearance or other property of the record as a whole. Generally speaking, any tendency to form repeating patterns indicates a discrete eigentone, and all modern wave acoustics begin with the assumption that this is an undesirable condition. The absence of such a tendency is indicated by the maximum degree of randomness in the pattern. An attempt to represent the degree of randomness in a semi-quantitative form was made in the following way:

Short samples were selected from available glide records varying from the highly-ordered type, such as in Fig. 5A, to the random type represented in Fig. 5B. From these samples, ten were selected which, by visual judgment, provided an arbitrarily-chosen series of gradations from one extreme to the other. These were numbered from 1 to 10 and assembled together as a sample card. Ten glide patterns, taken in studios whose subjective order of merit had already been decided, were then each divided into ten equal frequency bands. Each of the bands was assigned an index of randomness by comparison with the sample card and these indices were plotted for each studio as a function of the midband frequency. The graphs thus obtained were compared with the subjective judgments.

The assignment of a subjective rank is a task full of pitfalls, for reasons which will be discussed subsequently. For this purpose, however, the assessment was the best possible for general quality, excluding isolated peculiarities such as colourations. The graphs of randomness against frequency showed the expected increase of randomness with frequency and auditorium size. They show also a rough correlation between randomness and subjective merit, but it was not sufficiently precise for practical purposes.

A comparison was made between the different studios at corresponding frequencies chosen to give the same value of the non-dimensional constant μ, as given by Bolt and Roop.[11] The value of μ is the product of the frequency concerned and the cube root of the room volume, divided by the velocity of sound. TABLE 1, comparing subjective assessments with randomness indices at corresponding frequencies, shows the degree of correlation obtained.

TABLE 1

Studio	Rel. Volume	Frequency, Cycles	Randomness Index	Order of Subj. Merit
A	1,140	80	6	6
B	3,400	60	10	1
C	2,210	70	9	4
D	327	125	6.5	3
E	83	210	6	7
F	3,400	60	8	2
G	47	225	3	5

It is clear from a comparison of the last two columns that, although the better studios have generally higher randomness indices, there is not complete agreement between the orders in the two columns. The degree of agreement can be represented mathematically as a correlation coefficient[12] calculated from the two sets of figures. The correlation coefficient is zero if there is no agreement, and 1 for complete agreement with a positive sign if the highest figures correspond, and 1 with a negative sign if the highest figure in one column corresponds with the lowest in the other. A coefficient greater than 0.5 is generally taken to indicate a significant agreement. In the table above, the correlation between the last two columns is .65, a figure high enough to confirm that visual randomness tends to be associated with good subjective qualities in a studio.

Brightness Variation:

The output of the logarithmic amplifier can be applied to the grid of the oscilloscope rather than the vertical deflection plates, thus varying the brightness of the trace in proportion to the logarithm of the sound level. The vertical deflection plates are disconnected, and the camera rotated through a suitable angle between 45° and 90°, so that the horizontal sweep runs *across* the film.

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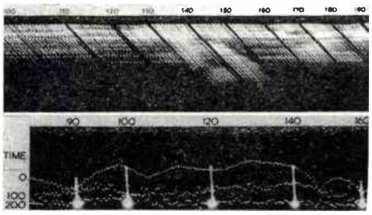
*Engineers, British Broadcasting Corporation, Nightingale Square, London S.W. 12, England. This article appeared in the *BBC Quarterly* also.

[11]R. H. Bolt and R. W. Roop, "Frequency Response Fluctuations in Rooms," *JASA* 22 (March 1950), pages 280 to 289.

[12]Yule and Kendall, INTRODUCTION TO THE THEORY OF STATISTICS, Third Ed., (Griffin, London) page 209.

The photographic record then consists of a series of parallel lines, as shown in Fig. 14, each line diminishing in brightness along its length as the sound level falls. This form of display is simpler than that described above, intensity being represented as brightness on a plane whose axes are frequency and time, in the manner of the visible speech patterns of Potter and Steinberg.[13] Very careful control of photographic exposure and processing is necessary if reliable results are to be obtained, and it was decided accordingly that the vertical deflection displays should receive first attention. The possibilities of the brightness-variation method have, consequently, not yet been explored.



FIGS. 14, ABOVE, AND 15, BELOW: ALTERNATIVE METHODS FOR DISPLAYING PULSED-GLIDE DATA

Delayed Response Displays:

Still another form of display can be produced by interrupting the normal pulsed glide to illuminate the screen only at the beginning of the decay and at certain selected times after the decay curve has begun. In Fig. 15, the upper row of dots indicates the beginning of each decay, and the other rows of dots occur at 100 and 200 milliseconds from the beginning. The vertical lines are frequency markers. Colourations are indicated in the 90 and 150-cycle regions by the irregular dot arrangements. This type of display is not yet fully developed, but it appears to show promise.

Structural Resonances:

Serious colouration can be caused by structural resonances. Their presence is usually indicated in the pulsed glide displays as described previously. The usual cause is a building structure which exhibits a marked resonance at one frequency by virtue of having uniform properties, or equally-spaced attachments over a large area. It can usually be prevented by damping or the introduction of irregularity in the design.

A number of methods can be employed to detect such resonances. It is possible to use a vibration pick-up in contact with the structure to measure the frequency of resonance, using a loudspeaker in the room as the sound source. There are many such pick-ups on the market, but none has proved to be entirely successful in the acoustic field. Phonograph pick-ups have been modified also, but without success. A moving-coil microphone with a thin conical paper contacting point has been developed and has proved to be practical. Fig. 16 shows this device mounted on a lead-screw, which is used to adjust its position relative to the surface under investigation.

With this contact microphone, it is possible to explore the frequency response of a panel and to measure the decay time in exactly the same manner as the reverberation time of the room. When the reverberation time of the panel greatly exceeds that of the room at the same frequency, serious colouration can be expected.

The acoustic coupling between the room itself and its component surfaces may cause serious difficulty in making structural-resonance measurements. In such cases, alternative methods of drive have been used. For example, the surface can be excited by means of a similar contact microphone used as a vibrator. For other purposes, the surface can be struck with a mallet, and filters used to separate the output of the contact microphone into bands. A microphone-operated trigger pulse can be employed to start the oscilloscope sweep.

Another method which does not require special equipment and gives good results is that of listening to the sounds picked up by a microphone while various parts of the structure are tapped with a drum stick, or a mallet with a soft covering. Resonances can be heard very easily, and compared with a tone source to determine the pitch. Even more satisfactory results can be obtained by using a selective amplifier which, when tuned to a frequency or frequencies of resonance, permits an exact determination of the resonance components.

Subjective Judgments:

One of the main difficulties confronting the worker in architectural acoustics is the difficulty of describing the subjective attributes of an auditorium in sufficiently exact terms to render possible any sort of rank correlation with physical measurements. Very careful listening tests must, therefore, be carried out in parallel with all physical measurements. Generally, in matters of preference, special tests involving the public must be made.

Fortunately, however, there are several subjective criteria which can be described accurately enough to mean precisely the same thing to all interested people. Examples of these are *liveness* or *deadness*, *single-frequency colourations*, *boom* and *toppiness*. On the other hand, some attributes of a concert hall are described in terms which do not seem to have a universal meaning, which may indeed be different aspects of the same thing, or even mutually exclusive. *Definition* and *blend*, *hardness* and *singing tone* are examples.

The first of these two classes of attributes can be measured to a certain extent by reverberation methods and the pulsed glide tests. They can be assessed subjectively with substantial agreement between observers. The best general test criteria are speech and music. Speech is a transient phenomenon which covers a wide spectrum, and has the advantage that everyone knows how it should sound. If the speaker is known to the listeners, the test becomes very critical indeed. Music, on the other hand, covers a wide frequency range, and extremely high sound intensities are produced. The acoustic conditions in a studio can be assessed fairly easily by experienced listeners, but for those who are not expert the faults can be emphasized in a simple way. A recording is made in the studio, and is then replayed in the studio and recorded. The process is repeated until the defect becomes obvious by being multiplied at each repetition.

Colouration in speech from a studio can be examined with the help of a selective amplifier. The output of the microphone is fed to a normal amplifier as well as to the selective amplifier, and the outputs mixed in such proportions that the accentuation produced by the selective amplifier is scarcely noticeable. The tuning dial is then swept over the whole frequency spectrum. Any colourations are heard strongly when they coincide with the selective amplifier frequency. The frequencies thus measured can be compared with the patterns on the pulsed glide displays.

The other class of attributes is more difficult to investigate, partly because the descriptions given by one individual may not mean very much to another, and partly because the boundary between matters of fact and matters of preference is being approached. The difficulty is most obvious when judging music studios and concert halls. Opinions of the Royal Festival Hall provide a striking example. Most people agree in saying that the hall is less reverberant than it should be for the most pleasing

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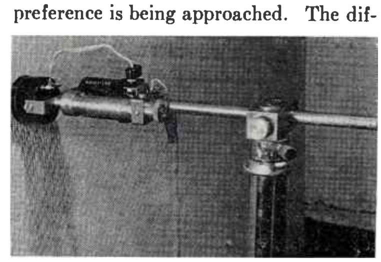
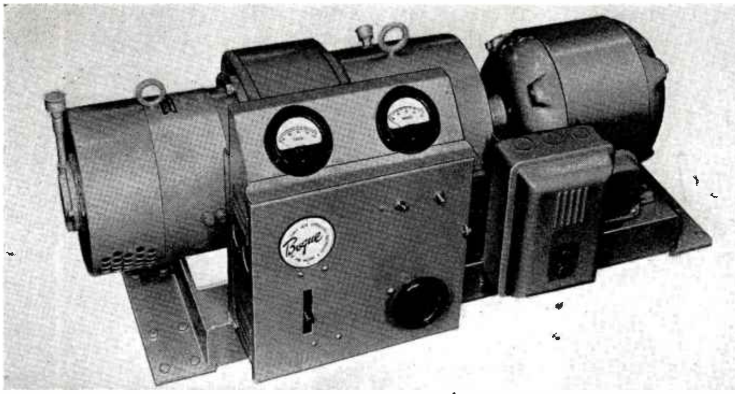


FIG. 16. A MOVING-COIL MICROPHONE MODIFIED FOR MEASUREMENT OF STRUCTURAL RESONANCES

[13] R. K. Potter, J. C. Steinberg, et al., VISIBLE SPEECH, Van Nostrand, 1949.



WHEN THE OUTSIDE POWER SOURCE FAILS, THIS BOGUE UNIT PICKS UP THE LOAD INSTANTLY

Communication News

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

IN contrast to the slump which descends on the home radio set business each summer, the communication equipment business seems to thrive on warm weather. This can be seen from the large number of applications for new facilities, as reported in this issue.

Work on revising our Registry of Transportation Systems is already under way at the FCC file rooms, and the word is that, during the past year, the number of taxi systems has increased more than in any previous year. In fact, when this Registry comes out in November, it may be necessary to increase the price, due to the number of pages which must be added. Seemed as if most of the taxi companies should have had radio long ago, but apparently that was not the case.

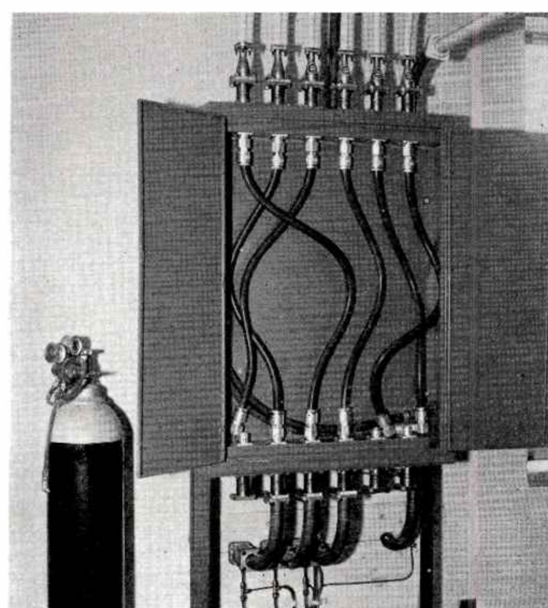
Incidently, if you figure that, considering wear and tear and technical obsolescence, the life of communication equipment is 10 years, the volume of *replacement* sales is now increasing by 500 fixed transmitters and receivers, and 3,500 mobile units each year. In 1952 about 20,000 mobile units will be bought as replacements, in addition to some 2,000 fixed transmitters and receivers. Tube replacements run close to 1 million annually. Microphones, which some police officers still use to crack nuts, must be almost up to 100,000, while vibrator replacements will probably exceed ¼ million. These figures do not include the common carrier and air-ground services.

New Telephone Set:

Back in the mobile communication field again, Bendix Radio is bringing out some interesting items of equipment. One of these, illustrated here, is a desk-type control unit which has some very smart design features. The base, of conventional appearance, has a loudspeaker where the telephone dial is located on ordinary instruments. A knob at the left controls the receiver squelch, and another on the right regulates volume. A channel-selector switch can be provided also. When the handset is picked up, the loud speaker is muted. This instrument should prove extremely popular with headquarters dispatchers.

Subminiature Tube Assembly:

A subassembly design brought out for computers by Avion Instrument Corporation, Paramus, N. J., has some interesting possibilities for communication equipment. The standard units, illustrated here, carry 8 to 12 subminiature tubes in a magazine of high thermal con-



LEFT: NEW 60-WATT RCA DESK-MOUNTING EQUIPMENT FOR ADJACENT-CHANNEL OPERATION. RIGHT: JUNCTION BOX FOR SHIFTING TRANSMITTERS ductivity, mounted on a block of thermosetting compound in which the circuit components are sealed. Input and output circuits are wired to a standard tube base which plugs into a socket.

In case of tube failure, the entire assembly is replaced. Then, at the repair shop, the defective tube or, preferably, all the tubes are replaced. It is interesting to recall that Aeronautical Radio planned some years ago to develop aircraft equipment comprised of plug-in assemblies, in order to simplify service work. However the high-reliability tube project was launched instead. The idea of plug-in tube and circuit units is entirely sound, nevertheless, and is probably the most practical way to handle the service of communication equipment, particularly where systems are remote from shop facilities.

In Case of Power Failure:

Specifications for some of the new communication systems limit the permissible interruption of service, in case of primary power failure, to a matter of milliseconds. Since it may take a minute or more to start an engine-driven generator, an additional power source is required.

To meet this need, Bogue Railway Equipment, Paterson 3, N. J., has brought out the continuous-generating set illustrated here. It consists of an AC motor, AC generator, and a DC motor all coupled together, and mounted on one base. It is used in conjunction with an automatic control unit and a set of standby storage batteries.

Normally, the unit is driven by the AC motor from the power mains, and the DC motor serves as a generator to charge the batteries. If the outside power fails, or is interrupted briefly, the batteries supply current for the DC motor, and the AC generator furnishes current to the radio installation. Then, when the engine-driven generator starts, it charges the battery to run the DC motor, or else takes over the load of the radio equipment. The motor-generator sets are available in ratings of 1 to 50 kw.

CITY TRANSPORTATION, DALLAS, USES A CONTINUOUSLY-MOVING BELT TO CONVEY CALL SLIPS FROM THE OPERATORS TO THE DISPATCHERS. THIS IS A COMMUNICATIONS ENGINEERING INSTALLATION

FIELD SERVICE NOTES

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

In response to many requests, we shall provide a new department, under the title of Field Service Notes, where such experiences can be exchanged. If you have met and solved a problem, of installation, operation, or maintenance, or if you are seeking help with a difficulty you haven't been able to lick, write a letter about it, include pencil diagrams if necessary, and send it to Field Service Notes, RADIO COMMUNICATION, The Publishing House, Great Barrington, Mass.

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

Antenna Connections:

One of the accompanying illustrations shows the method employed at the Kansas City communication headquarters to connect three pairs of 250-watt transmitters to the three antennas. This photograph is published in response to several inquiries as to the method employed at this station, described last month by Roy DeShaffon.

Coaxial lines run from each transmitter to the junction box, entering at the top. The lines to the three antennas run out from the bottom. Any of the flexible solid-dielectric lines can be connected to the antennas. Thus, if something should happen to one antenna, the operator can decide which of the three services — police, fire, and city departments — should be kept on the air. This is more flexible than the usual arrangement of relays which can connect one antenna only to one of two transmitters.

Radio Paging:

Very keen interest is developing in the business of radio paging, discussed in this

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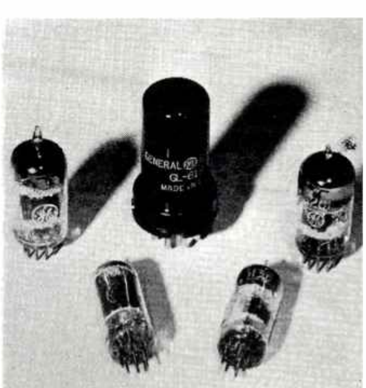
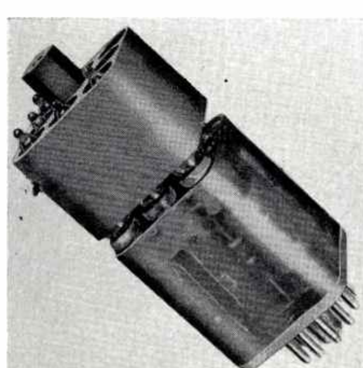




LEFT: ADDED HIGH-RELIABILITY GE TUBES ARE, LEFT TO RIGHT, GL-6072 (12AY7), GL-6136 (6AU6), GL-6137 (6SK7), GL-6135 (6C4W), AND GL-6201 (12AT7). CENTER: AVION INSTRUMENT COMPANY'S SUBMINIATURE TUBE AND CIRCUIT ASSEMBLY. RIGHT: BENDIX CONTROL UNIT FOR RADIO SYSTEM DISPATCHERS

Equipment For Telemetering Systems

PART 2 — DESCRIPTIONS OF TELEMETERING EQUIPMENT MANUFACTURED BY BENDIX, ESTERLINE-ANGUS, GE, LEEDS-NORTHRUP AND LENKURT ELECTRIC

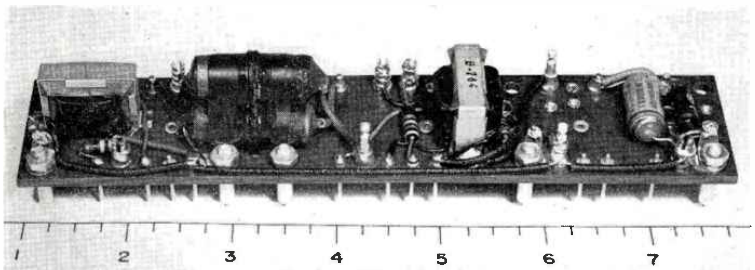


FIG. 8. BENDIX SUBCARRIER OSCILLATOR OF THE RESISTANCE-BRIDGE TYPE. NOTE MINIATURE SIZE

Bendix Aviation Corp., Pacific Division, *166 W. Olive Avenue, Burbank, Cal.* Bendix-Pacific makes all equipment for FM/FM telemetering systems, including pickups, subcarrier oscillators, commutators, transmitters, receivers, filters, subcarrier discriminators, electronic decommutators, and power supplies.

Up to 14 continuous-measurement channels can be accommodated on a single RF channel in the 215 to 230-mc. band. Frequency response of the subcarrier channels can be as high as 5,000 cycles. Inputs to one or more of the subcarrier channels can be commutated to provide up to 30 individual channels per subcarrier channel. Commutators are available with switching rates of 1, 2, or 6 rps. for 2 to 20 samples per revolution, 5 or 10 rps. for 18 samples per revolution, and 2½ or 5 rps. for 30 samples per revolution. They can be shorting or non-shorting types, depending on requirements. Also, a long segment can be provided in the commutator ring for sample identification or for synchronization with decommutating circuits at the receiving station. These units can be furnished for operation at 6, 12, or 24 volts.

Commutation can be accomplished at other points in the transmitting system, such as at the output of groups of subcarrier oscillators or at the transmitter.

Pickups of all types are available for measurement of virtually any quantity. They are used with four types of subcarrier oscillators, depending on the output of each particular pickup. The oscillators are of the inductance, voltage, resistance-bridge, or reactance type.

The standard RF transmitter is a midget 4-tube FM unit with an output of 2 watts, sufficient for operation at 15 to 25 miles. An auxiliary amplifier is available which provides an output of 15 watts. This is adequate for operation from 40 to 70 miles.

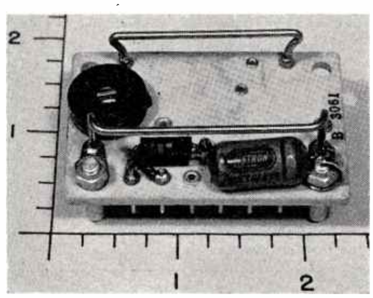


FIG. 9. AN INDUCTANCE SUBCARRIER OSCILLATOR

Subminiature plug-in construction is employed throughout. Figs. 8 and 9 show complete subcarrier oscillators of the resistance bridge and inductance types, while Fig. 10 is a view of oscillator units mounted on a standard rack panel.

A typical 6-channel system, with pickups and power supply, ordinarily occupies less than 150 cubic ins. and weighs less than 12½ lbs. Figs. 11 and 12 are views of a complete telemetering system with pickups and cable. The assembly is extremely rugged, and can be used under the most rigorous operating conditions.

Receiving station equipment can be portable, as in Fig. 13, or fixed. All equipment required for reception and demodulation is available, and the outputs are suitable for driving galvanometer or CRT oscillographs, or pen or magnetic recorders. Outputs are −10 to +10 milliamperes into 330 ohms for each channel at full modulation. Overall system accuracy, excluding recorders, is better than 2%.

Esterline-Angus Company, Inc., *Indianapolis 6, Indiana.* This company manufactures a DC current telemetering system, intended for use over a 3-wire line transmission medium. By an ingenious translating system in the transmitter, the system is made insensitive to power line voltage variations, tube characteristics, and connecting line resistance.

Fig. 14 shows the operating principal of the system. The plate current of the control tube in the transmitter (consisting actually of 2 type 45's) is the line current. The grid of the control tube is connected directly to the single contact C on the shaft of the translating milliameter, which is in series with the line. This contact swings between a pair of contacts H and L which are carried by the primary pointer, one of these contacts being arranged to increase the grid bias and the other to decrease it. When no contact is made by C to H or L, the existing bias on the control tube is held virtually constant by a very large oil-filled capacitor connected to the grid.

Suppose the measured quantity decreases. This causes rotation of the

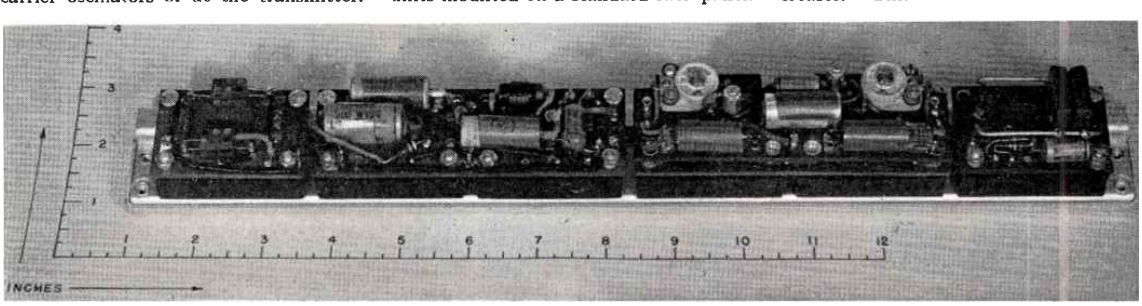


FIG. 10. A 19-IN. RACK PANEL LESS THAN 2 INS. WIDE CARRIES FOUR OF THESE PLUG-IN COMPONENTS. SMALL SIZE AND RUGGEDNESS ARE FEATURED

primary pointer, bringing contact H against contact C and causing the grid capacitor to begin charging in a negative direction at the grid. Plate current of the control tube decreases, decreasing the line current and causing the deflection of the translating milliameter to decrease until contacts C and H separate. The grid capacitor maintains the potential on the grid at that instant constant, and there is no further action until the primary pointer moves again. When the measured quantity increases, contacts C and L are engaged and the grid capacitor is connected to a positive source. Thus, the control tube current, which is the line current, is caused to follow the primary pointer.

Receivers are simply milliammeters connected to indicators, recorders, contact alarms, control devices, or a combination of these elements. These systems are operable over practically any distance, depending on the sizes and characteristics of the transmission lines employed. With suitable primary elements, almost any measurable quantity can be telemetered. Overall accuracy from primary quantity to recorder is guaranteed to be within 2%. When zero-center operation is employed, line current ranges from +15 to −15 milliamperes. If required for totalizing purposes, the transmitter can be adjusted for any full-scale current between 1 and 30 milliamperes.

General Electric Company, *Schenectady, New York*. Three distinct types of telemetering system are manufactured, as follows:

1) The *frequency telemeter* employs a primary detector which produces a sinusoidal voltage whose frequency is proportional to the magnitude of the measured quantity. This frequency is applied to a carrier-current or microwave transmitter. At the receiving end, the output of the receiver is applied to an electrical frequency meter which feeds an indicator, recorder, or control device.

The primary detector is a watthour meter of standard construction. A light-modulating disk is attached to the shaft of the meter. The edge of the disk intercepts a light beam impinging on a photocell, and is shaped so that the output of the photocell is of sinusoidal shape. As the input to the detector increases, the watthour meter shaft rotates faster and the output frequency increases to a maximum of 27 cycles. A constant input to the device is provided, sufficient to cause a 6-cycle output, so that a positive zero indication is obtained. Thus, a sub-zero reading in the end device indicates a fault at the transmitting end.

Since the output of the frequency telemeter ranges from 6 to 27 cycles, and normal voice channels in carrier-current or microwave equipment extend from 300 to 3,000 cycles, the output cannot be used to amplitude-modulate the carrier directly. Therefore, frequency-shift keying or amplitude-modulation of a fixed audio tone that in turn modulates the carrier frequency must be employed. This permits the application of a great number of telemetering channels to a single voice channel.

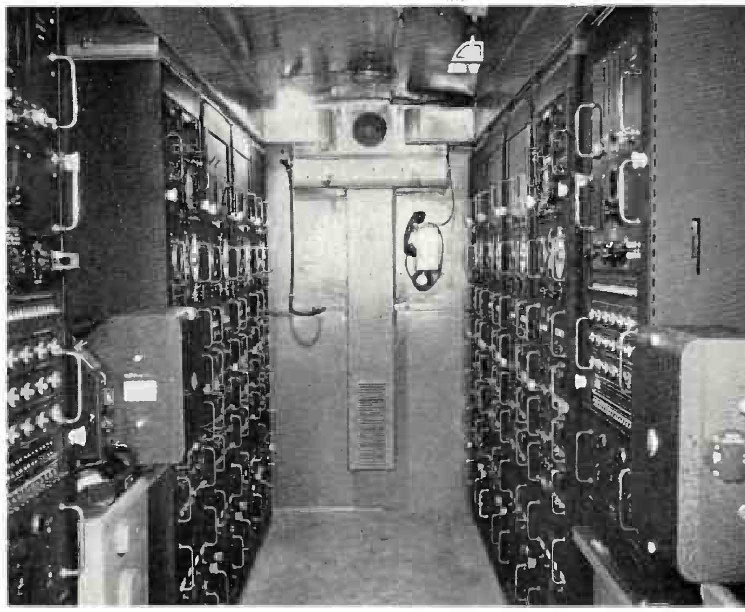
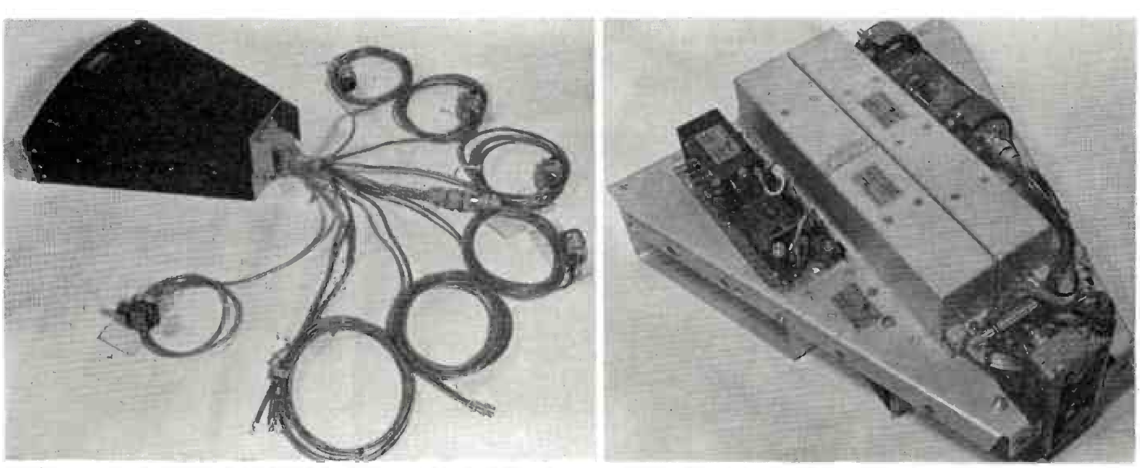


FIG. 13. TELEMETERING RECEIVING STATION EQUIPMENT CAN BE FIXED OR INSTALLED IN A TRUCK

The receiver, Fig. 15, is transformer-coupled to the radio or carrier-current demodulator output. The resultant signal is fed through a low-pass filter, which passes only the 6 to 27-cycle component, to a limiting amplifier, and thence to a saturating transformer whose output is square-wave pulses of substantially constant width regardless of frequency. After rectification, the pulsating-DC signal is fed to the indicator. Since the



FIGS. 11 AND 12. A COMPLETE TELEMETER TRANSMITTING SYSTEM, INCLUDING CABLE AND PICK-UPS. OUTER CASE IS REMOVED IN VIEW AT THE RIGHT

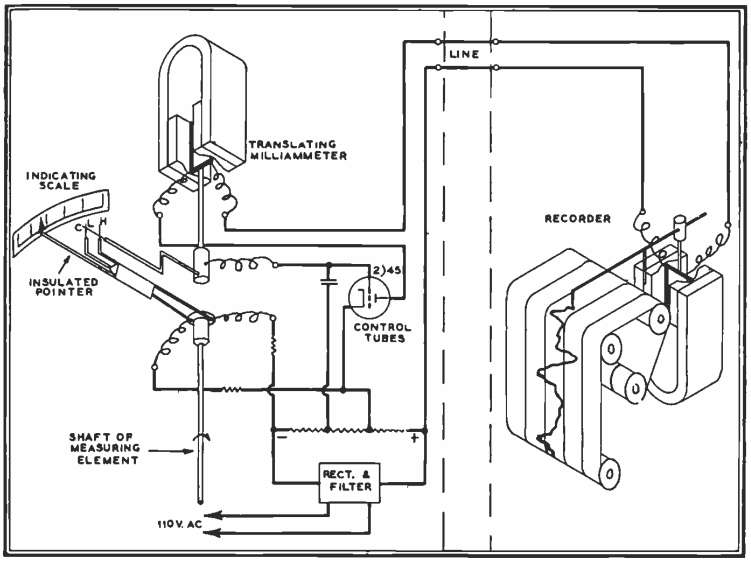


FIG. 14. TRANSMITTER OF THE ESTERLINE-ANGUS TELEMETER, INTENDED FOR WIRE-LINE OPERATION

pulses are of constant width regardless of frequency, the average DC value is directly proportional to the input frequency.

The frequency telemeter is suitable without modification for measuring position or any AC electrical quantity. DC quantities can be telemetered also upon the addition of a torque-balance converter, which is a simple device for converting DC to single-phase AC watts. Accuracy is within 1%, and the accuracy of the frequency telemeter system also is within 1%, excluding the end device.

2) The *torque-balance telemeter* is used for any type of measurement in which the measured quantity can produce torque. For measurement of AC or DC electrical quantities, the torque is produced by a meter element; for indication of pressure or position, the torque is produced mechanically by a bourdon-tube pressure gauge or a selsyn motor. The output of this telemeter is DC, which makes it useful primarily for wire-line transmission. An advantage of this system, as for all DC systems, is that various quantities can be totalized conveniently at virtually any point in the chain.

In the transmitter, the torque balance is established between the primary detector and a restraining element through which the line current flows and which is connected to the same shaft. Light is reflected from a mirror attached to the shaft also, and falls upon two photocells whose outputs are connected in opposition. At zero torque input, the same amount of light from the mirror impinges on each photocell, and their outputs cancel, resulting in zero line current.

When the measured quantity is not zero, it produces torque and turns the shaft. This causes the output of one photocell to decrease while the output of the other increases. A DC current is produced in the line, which is proportional to the amount of rotation. This current flows also through the restraining element, which is similar to a DC meter movement. As more torque is produced, the shaft is turned farther, producing more output from the photocells. This, in turn, increases the current through the restraining movement, producing more torque in opposition, so that a balance is always obtained. Input torque in the opposite direction causes a resultant output from the photocells of the opposite sense, producing line current of opposite polarity.

The receiver is simply a DC milliammeter connected to whatever end device is required. A zero-center instrument can be employed to read values of both polarities. Accuracy within 1% is obtained for electrical quantities, and within 2% for mechanical quantities, excluding the end device. Operation over wire lines up to 100 miles in length is possible.

3) The *photoelectric telemeter*, consisting of a modified photoelectric recorder and a DC milliammeter, is employed for telemetering over wire lines those quantities which cannot conveniently be made to produce torque, such as very small electrical quantities, power factor, or phase angle. It is suitable also for potentiometric measurements.

In this system, the primary detector is the measuring element of the photoelectric recorder. It is similar in operation to the torque-balance system, except that a more complex mirror and shaft arrangement is employed so that the torque produced by the primary detector is nil.

Leeds & Northrup Company, *4901 Stenton Avenue, Philadelphia 44, Pennsylvania.* This company manufactures, in addition to equipment for wire-line operation, the Speedomax impulse-type telemetering system. Although developed primarily for power generating systems, to provide remote indications of conditions at interchanges and tie points, various other kinds of primary detectors can be employed to make the system applicable to all kinds of telemetering service.

Basically, the impulse-duration system is suitable for use with either power-line carrier or microwave equipments, or wire lines. In this type of system, impulses are generated at a fixed frequency by the transmitter. The duration of each impulse is varied so as to be proportional to the quantity being measured. The impulses then key the carrier or microwave equipment.

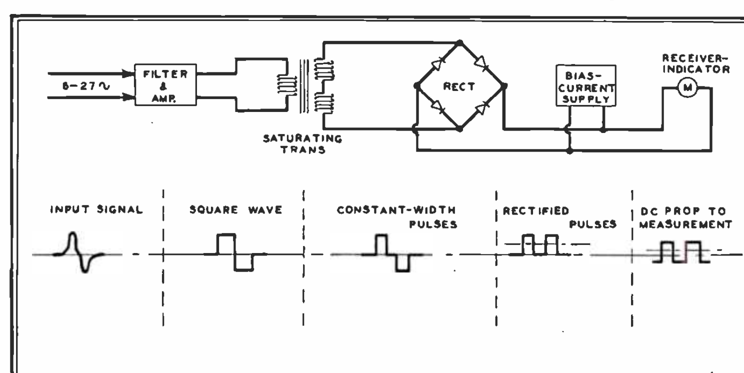


FIG. 15. A BLOCK SCHEMATIC OF RECEIVER FOR GENERAL ELECTRIC'S FREQUENCY TELEMETER SYSTEM

Fig. 16 is a functional schematic diagram of a Speedomax transmitter, in this case set up for operation with a thermal converter as a primary detector. The output of a thermal converter is a DC voltage, whose magnitude is directly proportional to the amount of measured power flow and whose sense is determined by the direction of power flow. This DC voltage is measured and recorded continuously by a potentiometer-type recorder, identified at the left in Fig. 16 as the load measuring circuit.

The recorder contains also an impulse transmitting mechanism, which produces impulses proportional in duration to the recorder reading. The transmitter motor rotates two disks continuously at 25 rpm. Each disk has a notch on its perimeter which operates a contact once per revolution. The contact operated by one disk is fixed in position. This contact, labeled S in the diagram, starts each impulse by completing the circuit for relay K1. Contacts K1A, a holding contact, and K1B, the impulse-generating contact, then remain closed.

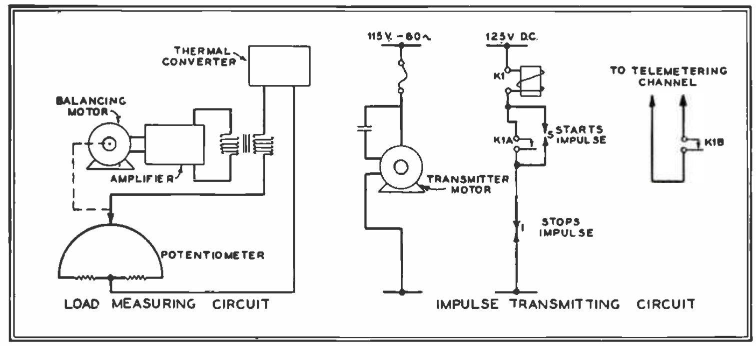


FIG. 16. THIS DIAGRAM SHOWS BASIC DETAILS OF LEEDS-NORTHRUP IMPULSE-DURATION TRANSMITTER

The contact operated by the second disk is normally closed. This contact, labeled I, moves in relation to the first contact according to the reading of the recorder. When it is opened momentarily by the second disk, it breaks the circuit for the relay field. Contacts K1A and K1B then open, the impulse is ended, and the cycle begins again when the first disk operates contact S.

It can be seen that the versatility of this system is derived in part from the fact that the impulses themselves can be of any form — DC, or AC of any frequency. Contact K1B can be employed to close a DC circuit for wire-line operation, for instance, or to key an audio tone generator for carrier-current operation or microwave multiplexing applications.

At the receiving end, the impulse is made to operate a relay whose contacts close the circuit for relays A and B, Fig. 17. Relay B is so designed as to lag slightly behind relay A in operation, when energized or deenergized. Upon operation of the relays, contact A1 moves up to short out capacitor C through contact B1, which does not open immediately. This removes all charge on C. When B1 opens, C is connected in series with resistor R across the battery, and C is charged slowly at an exponential rate. The voltage across C builds up until the end of the received impulse opens the circuit for relays A and B, at which time contact A1 drops down, opening the charging circuit. Thus, the final value of the voltage across C is proportional to the length of the received impulse.

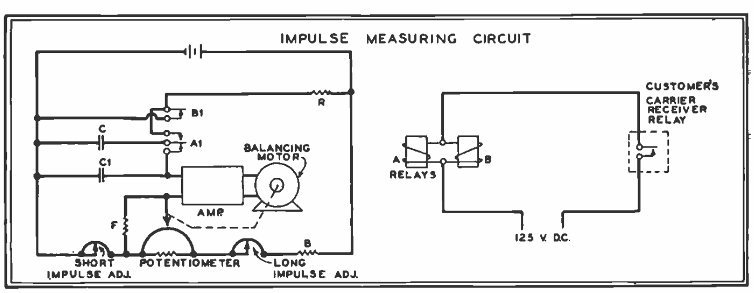


FIG. 17. PRINCIPLE OF OPERATION FOR THE RECEIVER IN IMPULSE-DURATION TELEMETER SYSTEM

Capacitor C1 is of much smaller value than C. Therefore, when contact A1 connects them in parallel, C1 assumes the charge on C without any significant change in the parallel voltage. The amplifier compares this new voltage value with that at the potentiometer tap. If there is a change from the previous condition, the balancing motor is energized and moves the potentiometer slide and the indicator pointer accordingly, to match or balance the new charge on C and C1. If there is no change (if the impulse was of the same length as the previous one, and capacitor C had charged to the same voltage as previously), then there is no unbalance and there is no change in indication.

The maximum delay of the system's response to changes is 2.4 seconds, since this is the total cycle period. However, the delay may be very nearly zero if a change occurs near the end of the impulse cycle. Therefore, the average response time is considerably less than 2 seconds. This time delay renders the system unable to follow extremely rapid changes. However, this is not important in the great majority of applications, and may be an advantage in many cases.

Lenkurt Electric Company, Inc., *1105 County Road, San Carlos, California.* This company manufactures audio tone-generators and keyers which are actuated by DC impulses; tone receivers; and remote control and indicating devices for controlling the amount and direction of rotation of a motor, and obtaining an indication of the position of that motor. The equipment can be used with wire-line, power-line carrier, or microwave transmission mediums.

Two types of transmitters are available, designated types 440A and 441A. Each signal transmitter panel contains two independent tone transmitter circuits, in standard frequency pairs. Each channel is rated normally for maximum operating speeds of 14 pps. For normal voice channels occupying a band from 300 to 2,800 or 3,000 cycles, 18 signaling channels can be accommodated. Each channel can be used for telemetering, telegraph, or signaling purposes. Twenty-four such channels (at 14 pps.) can be accommodated in a wide-band voice channel, extending to 3,500 cycles. Wide-band equipment, providing maximum operating speeds of 28 pps., is available also. These units provide 8 channels (2 per unit) in the range from 780 to 2,460 cycles.

Intended particularly for direct application on carrier-derived voice channels, 20 channels between 4 and 8 kc. are allocated. Also, 32 additional channels from 8 to 33.6 kc. can be provided for by this equipment. All are operable at 14 pps.

Each 2-channel unit is assembled on a 19-in. rack panel 3½ ins. wide. Type 440A equipments provide an output from each channel which is either zero or at some fixed level, in accordance with the input. Type 441A units, on the other hand, provide for each channel zero output or an output which is at one of two levels, in accordance to the input. Ordinarily, one output level is 10 db below the other. This increases greatly the control capabilities of the system, as will be explained.

Receivers are available for each transmitter frequency and operating speed. Type 444A receivers are two-channel tone-selective units designed for operation with 440A transmitters. A common input transformer is employed for

(Continued on page 34)

4.5 Kw. in 2 Sq. Ft.

A NEW COMMUNICATIONS TRANSMITTER FEATURES SPACE-SAVING DESIGN METHODS — *By* J. R. HECK*

CAREFUL design, a willingness to try the unconventional, and the judicious utilization of new as well as familiar materials and components are required to provide better transmitter performance in less space. Since the earliest days of radio, low-frequency transmitters have required an inconveniently great amount of room. Most of this space has been occupied by final tank coils and capacitors, which were bulky even in low-power units. Also, intermediate coils and associated shields added to the overall size of the transmitter. In contrast, the unique design of the Westinghouse type MW low and medium-frequency transmitter, which provides full power output of 4.5 kw. at any frequency between 250 and 540 kc., has resulted in such space conservation that the complete transmitter can be housed in a cabinet only 1 ft. wide.

*Communication Equipment Engineering Department, Westinghouse Electric Corp., Baltimore, Maryland.

General Description:

The MW is crystal-controlled, and is set up ordinarily for two-frequency operation. All stages of the transmitter are untuned, so that no circuit switching or retuning is necessary when the frequency is shifted. Instant frequency changeover is accomplished simply by switching crystals.

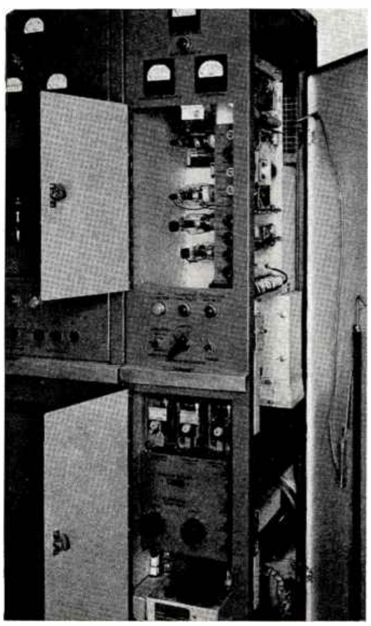


FIG. 2. TRANSMITTER WITH ACCESS DOORS OPEN

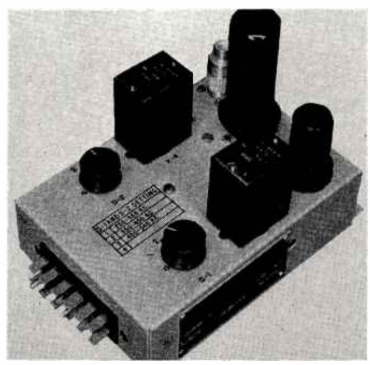


FIG. 4. TWO-FREQUENCY CRYSTAL CONTROL UNIT

The circuit arrangement of the transmitter is shown in Fig. 1. All switching is done by relays, so that remote control of the transmitter is accomplished easily. The signal from the crystal oscillator is fed through a harmonic filter, and then amplified by 2 push-pull 807 stages. Eight 807's in a push-pull cathode-follower circuit drive the output stage, which utilizes two 5736's operated Class B. The final stage feeds through a low-pass filter to a 50-ohm line. With this arrangement, the matching transformer and loading coil can be located near the antenna.

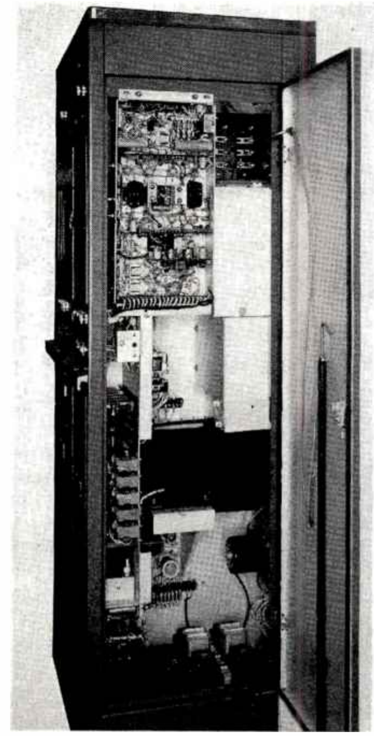


FIG. 3. SIDE DOOR REVEALS PARTS AND WIRING

The low/medium-frequency and high-frequency MW units are powered by a common high-voltage rectifier. This power supply, whose cabinet can be seen in Fig. 2, requires 3-phase 50 or 60-cycle AC, at 210/230 volts. It furnishes control and bias voltages, low DC voltages, and either 3,500 or 4,000 volts DC. The unit can supply 20 kw. at high voltage for simultaneous operation of a number of low or high-frequency transmitters.

The low/medium frequency transmitter rack cabinet is shown in Fig. 2.

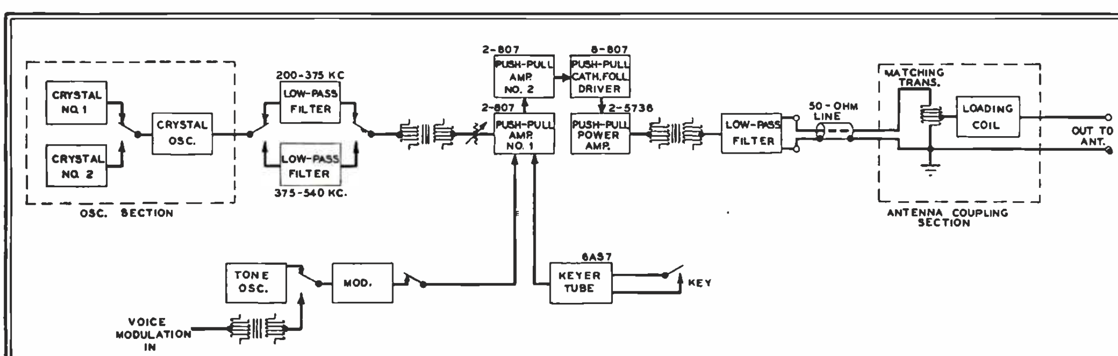


FIG. 1. DIAGRAM SHOWING BASIC CIRCUITS OF THE WESTINGHOUSE MW LOW AND MEDIUM-FREQUENCY TRANSMITTER FOR VOICE, CW, OR MCW OPERATION

FIG. 5. INTERMEDIATE AMPLIFIER COMPONENTS AND CONTROLS ARE ALL ON A SEPARATE CHASSIS

The cabinet is 76 ins. high, 24 ins. deep, and 12 ins. wide. It is constructed of ⅛-in. aluminum sheet. A door at the top provides access to the intermediate amplifier tubes. On the front of the intermediate amplifier chassis are located controls for RF gain, modulation switching, tone frequency, and meter switching. A second door at the bottom opens to reveal the overload relays, line switches, filament controls, and the crystal oscillator unit.

When the transmitter is mounted in a line of similar components, it can be rolled forward on guide rails, so that the side door can be opened. The side door provides access to the blower motors, the final power amplifier, the bias rectifier tubes, and all circuit wiring. Fig. 3 is a view of the side of the transmitter cabinet with the door open.

Heavy-duty, low-impedance bias supplies for the power amplifier tubes are located in the base of the cabinet. At the lower right is a cabinet cooling fan. This fan draws air through a filter at the rear of the cabinet, which is exhausted through the top of the cabinet. Just above the fan is a blower which cools the power amplifier tubes. This blower draws air through a filter from the rear, and forces it into a plenum chamber containing the power amplifier tubes. These can be reached by removal of the cover plate just to the right of the intermediate amplifier chassis. The air heated by the PA tubes is exhausted directly out the back of the cabinet.

The wiring side of the intermediate amplifier chassis is directly inside the door, as can be seen, facilitating tests and maintenance. The power amplifier output circuit, as well as the tubes, is enclosed in the plenum chamber.

Oscillator Section:

The oscillator Fig. 4, is built on a small plug-in chassis, which has space for two temperature-controlled quartz crystals. A relay switches the desired crystal into an untuned Pierce oscillator circuit, and an isolating amplifier feeds the output to a coaxial line. This unit can be mounted with other frequency-control equipment in a separate rack cabinet, if desired, or it can be installed in the transmitter cabinet through the lower front access door.

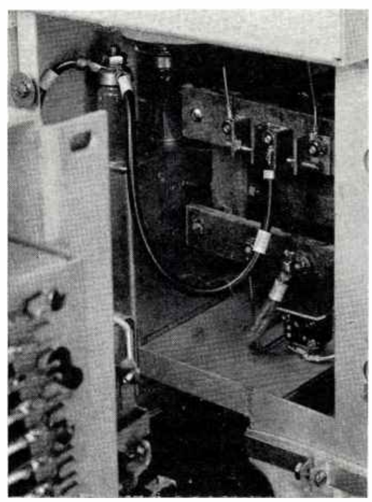


FIG. 6. LOWER PART OF THE PLENUM CHAMBER

Intermediate Amplifier:

Most of the amplifier section of the transmitter is assembled and wired on an independent chassis, shown in Fig. 5. This chassis is installed in the upper part of the cabinet, with all the wiring accessible from the side-access door of the transmitter. The controls are accessible from the front of the transmitter, and all tubes can be removed or replaced without moving the chassis.

Signals from the crystal oscillator are fed through a low-pass filter to the amplifier section. Because of the low power level at this point, the filter required is very small. However, it serves to remove all carrier harmonic frequencies. The remaining stages of the transmitter produce very little distortion. Thus, a large filter unit is not required at the output.

The first voltage amplifier stage employs a pair of WL-807 tubes operating Class A. The transmitter is bias-keyed at this stage by means of a 6AS7 vacuum-tube keyer. When voice modulation or MCW is required, the same stage is modulated by a voice signal or a vacuum-tube audio oscillator. Modulation can be accomplished at this low power level because all succeeding stages are linear, being capacitively coupled. The second stage utilizes push-pull WL-807's also.

The driver stage consists of eight push-pull parallel WL-807 tubes. This tube type is quite inexpensive and operates at low voltage. The elimination of high voltages from the driver stage makes the use of a small tube advantageous. It is also practical, since the driver output coupled directly to the power amplifier grids furnishes adequate drive for full output.

Power Amplifier:

The output stage is a Class B push-pull amplifier, utilizing two WL-5736 vacuum triodes. These are air-cooled, of only 3½ ins. diameter, and have a plate dissipation rating of 2.5 kw. The same tubes are employed in the MW high-frequency transmitter, providing 3 kw. output from 2 to 24 mc.

The plates of the power-amplifier tubes are connected to a newly-developed output transformer mounted directly beneath the tubes in the plenum chamber, as shown in Fig. 6. This transformer matches the Class B output to a 50-ohm line. Although the overall distortion is

(Concluded on page 34)

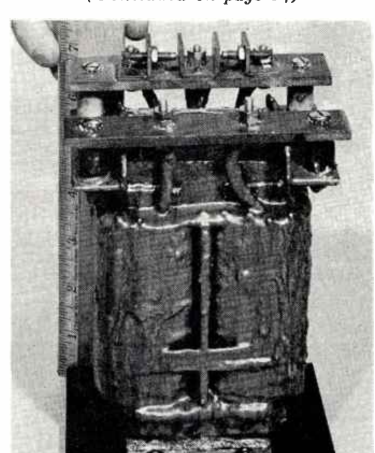
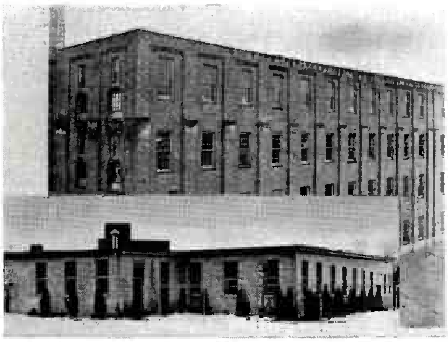
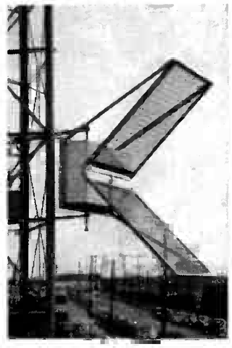
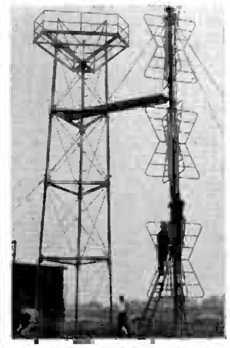


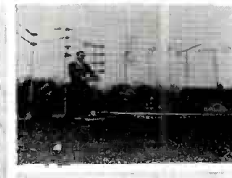
FIG. 7. HYPERSIL CLASS B POWER TRANSFORMER

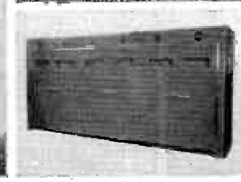
NEW EQUIPMENT AND COMPONENTS











TOP ROW

FAR LEFT: Two new buildings in Norwood, Mass., have been acquired by Workshop Associates Division of the Gabriel Company. Totaling over 70,000 sq. ft., these buildings will be used for production formerly handled at the Needham plant, which will then be employed for design and research work exclusively.

CENTER LEFT: Cavity-fed corner reflectors provide about 12 db gain and front-to-back ratio of 20 db on 360 to 420, 890 to 960, and 1,850 to 1,990 mc. Product Development Company, Inc., Kearny, N. J.

CENTER RIGHT: This 3-bay TV antenna has been shipped to KPIX-TV for use atop Mt. Sutro in San Francisco. New antenna with GE 35-kw. amplifier, on order, will provide eventually an ERP of 100 kw. for the station. General Electric, Electronics Park, Syracuse, N. Y.

FAR RIGHT, TOP: Experimental group of VEE-D-X UHF receiving antennas developed by La Pointe Plascomold Corporation, Rockville, Conn.

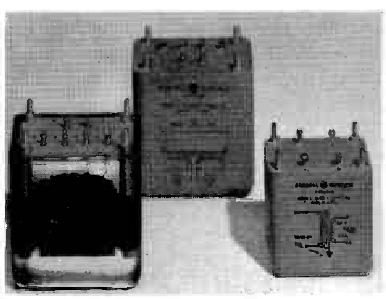
FAR RIGHT, BOTTOM: GE's 5-kw. air-cooled TV transmitter for VHF channels 7-13 is now in production. Also available at present time are 5-kw. low-band VHF transmitters, high-power amplifiers for VHF, and UHF 100-watt transmitters. General Electric, Electronics Park, Syracuse, N. Y.

CENTER ROW

FAR LEFT: Model 670 five-inch oscilloscope provides 10-millivolt sensitivity from DC to 500 kc., with usable response beyond 2 mc. Designed specifically for TV-FM-AM alignment work. Hickok Electrical Instrument Company, Cleveland 8, Ohio.

CENTER LEFT: Hermetically-sealed transformers intended for military applications meet MIL-T-27 Grade 1 requirements, are 20% smaller than former components of same type. General Electric, Schenectady, N. Y.

CENTER RIGHT: Microwave wiring is produced by etching or stamping and embossing directly from diagrams. Shown are two magic T junctions, conventional waveguide at top and new ground-plane wiring at bottom. Federal Telecommunication Laboratories, Inc., Nutley, N. J.



FAR RIGHT: Image orthicon TV camera is virtually all new in design and performance, but can be interchanged with older models in same system. RCA, Engineering Products Department, Camden, N. J.

BOTTOM ROW

FAR LEFT, TOP: Subminiature wire-wound resistors are hermetically sealed, can be furnished with or without mounting brackets, with wire or terminal-type leads. Extreme stability and accuracy are featured. Daven Company, 191 Central Avenue, Newark, N. J.

FAR LEFT, BOTTOM: Ruggedness and immunity to humidity are claimed for these wire-wound resistors with new type of coating which provides good heat dissipation and will not flake. Hamilton-Hall Manufacturing Company, Milwaukee 2, Wisconsin.

NEAR LEFT, TOP: Ferrule-type feed-through capacitors for UHF provide filtering for leads passing through chassis. Values up to 100 mmf. are available. Sprague Electric Company, North Adams, Mass.

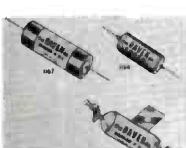
NEAR LEFT, BOTTOM: Decimal counting units are direct-reading, plug-in electronic counters capable of operating at up to 1 million counts per second. Units are completely interchangeable. Berkeley Scientific Corporation, Richmond, California.

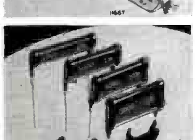
CENTER: Ferrite-core horizontal output auto-transformer is claimed to have high efficiency, low retrace time, and excellent regulation. Ram Electronics Sales Company, Irvington-on-Hudson, N. Y.

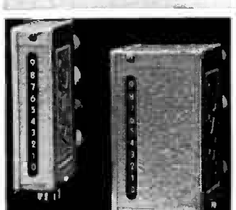
NEAR RIGHT, TOP: Designed for conversion of low-level DC signals to proportional AC signals, model F5A magnetic modulator has been made available for general industrial use. Lear, Inc., LearCal Division, Los Angeles, Calif.

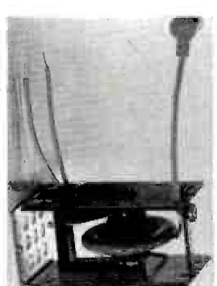
NEAR RIGHT, BOTTOM: Subminiature selenium diodes are suitable for use from −60° to +100°C., are available in wide range of voltage and current ratings. International Rectifier Corporation, El Segundo, California.

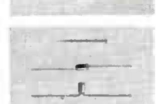
FAR RIGHT: Portable TV picture monitor presents monochrome or color pictures in black-and-white at flick of switch. 7-in. kinescope provides better than 450-line resolution. Polarad Electronics Corporation, Brooklyn 11, N. Y.

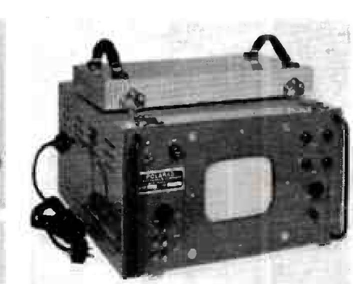


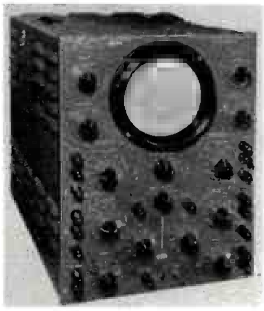


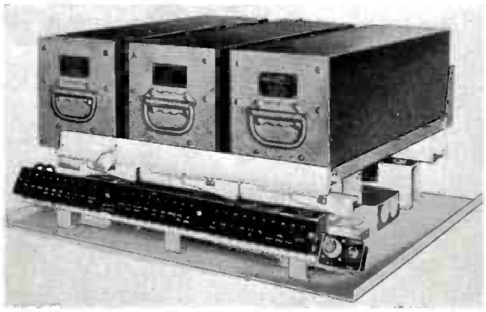


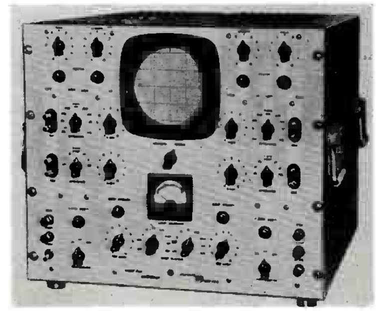












TOP ROW

LEFT: Model 322 dual-beam oscilloscope consists electrically of two complete 304-H scopes in a single cabinet with presentation on the same screen. Sweeps from 2 to 30,000 cycles, and frequency response from DC to 300 kc. are provided. DuMont Laboratories, Inc., 1500 Main Avenue, Clifton, N. J.

CENTER: Railmaster mobile radio equipment for railroad use operates in the 152 to 174-mc. band, consists of shockmounted plug-in transmitter, receiver, and power supply. Transmitter powers from 2½ to 35 watts are available. Bendix Radio Division, Bendix Aviation Corporation, Baltimore 4, Maryland.

RIGHT: Dual-beam oscilloscope is versatile instrument containing two 'scope channels in one case, each controlling one beam. Sweeps from 2 cycles to 50 kc. are generated internally. Electronic Tube Corporation, Philadelphia 18, Penn.

CENTER ROW

FAR LEFT: Polytetrafluorethylene electrical insulating film can be fused into coherent mass after application. Applied as flexible tape film, the material shapes itself to conform to shape of object, to which it adheres until fused. Can be fused in 20 mins. at 650°F. or in 15 secs. at 1,000°F. Dielectric strength is 1,000 volts per mil. Minnesota Mining and Manufacturing Company, St. Paul 6, Minn.

NEAR LEFT, TOP: New terminal blocks of feed-through type are available with solder or screw terminals on one side, banana plug receptacles on other. Rated at 300 volts between terminals and to ground, at 20 amperes per terminal, they can be obtained in strips of from 1 to 16 terminals. Curtis Development and Manufacturing Company, Milwaukee 16, Wisconsin.

NEAR LEFT, BOTTOM: Printed-circuit techniques applied to rotary switches for pulse work and telemetering permit irregular timing intervals to be obtained at high speeds. Shorting or non-shorting switches have life expectancies of over 1 million revolutions. Daven Company, Newark, N. J.

NEAR RIGHT: Unit crystal oscillator provides signal outputs as harmonics of 10 kc., 100 kc., and 1 mc., with short-time stability of one part per million. Usable output frequencies extend to 1,000 mc. Low-cost unit intended for applications where greater accuracy is not required. General Radio Company, Cambridge 31, Mass.

FAR RIGHT: Model 381 capacity bridge has been modified to make it more compact and easier to use. Now, the capacitor is clipped into place, a button is pressed for the desired range, the bridge arm is adjusted for maximum deflection, and the value is read directly. Simpson Electric Company, 5200 W. Kenzie Avenue, Chicago, Ill.

BOTTOM ROW

FAR LEFT: This precision AC line voltage regulator for computors and servo systems holds line voltage constant to within .01% over an input voltage range of ±10%, with a transient attack time of .01 sec. Power-handling capacity, 100 volt-amperes. Avion Instrument Corporation, Paramus, N. J.

NEAR LEFT, TOP: Mobile radio test unit type 10249 is a local-control adaptor for use in making operational checks and adjustments on Link 2-way FM radios. Unit is plugged into transmitter-receiver chassis, permitting direct connection of test microphone and loudspeaker at that point. Link Radio Corporation, 125 W. 17th Street, New York 11, N. Y.

NEAR LEFT, BOTTOM: Type R resistors are intended for use in microwave power measurement and impedance-matching applications, in pick-up loops, pads, and attenuators, with both coaxial cable and waveguide. Consists of highly stable noble-metal film on glass base. Telewave Laboratories, Inc., 100 Metropolitan Avenue, Brooklyn, N. Y.

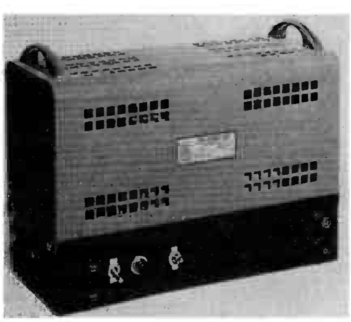
CENTER, TOP: Subminiature tube sockets mount in chassis without screws or rivets. Available with cadmium-plated brass or silver-plated beryllium copper terminals. Body is Mycalex 410 glass-bonded mica, with minimum insulation resistance of 50,000 megohms. Mycalex Tube Socket Corporation, 30 Rockefeller Plaza, New York 20, N. Y.

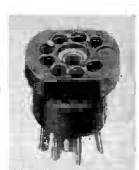
CENTER, BOTTOM: Combination of a resistor and a fuse, this Fusistor is available in a wide range of ratings. Milwaukee Resistor Company, Milwaukee 4, Wisconsin.

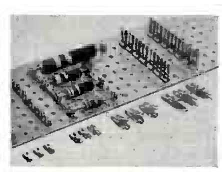
NEAR RIGHT, TOP: Miniature terminals are of a new design which provides for holding a component lead in place for soldering without the necessity for twisting or wrapping the lead with pliers. Terminals are for use with pre-punched, multi-hole terminal cards. Alden Products Company, Brockton, Mass.

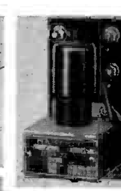
RIGHT, BOTTOM: Special line of Stabelex D capacitors are claimed to be equal in most respects to laboratory standards. They will hold charge for 200 days or longer. Q is 10,000, power factor .00025, insulation resistance 900,000 megohm-mfds. Standard capacity tolerance is ±10%, available down to ±1% on special orders. Hermetically sealed. Industrial Condenser Corporation, 3243 N. California Avenue, Chicago 18, Ill.

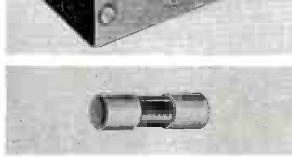
FAR RIGHT, TOP: Relays and switches employing triple-distilled mercury for making and breaking contacts are claimed to have virtually unlimited life and very little deterioration in performance over extended periods. Durakool, Inc., Elkhart, Indiana.

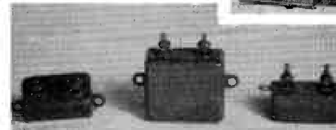












TELEMETERING UNITS

(Continued from page 29)

both channels, followed by bandpass filters which select the desired incoming channel frequencies and feed them to the proper channels. In each channel, the signal is amplified, rectified, and is employed to cause operation of a relay, closing its contact for the duration of the signal. Thus, the system is ideally suited to impulse-duration telemeters, and the 28-pps. equipment is applicable for frequency-type telemeters.

Type 446A receivers are intended for use with 441A transmitters. These units are responsive to input level as well as duration. One input level causes operation of one relay, and the other input level causes operation of another relay. Thus, twice as much information can be carried on one channel.

One application of the 441A-446A system is for remote positioning of control shafts, and continuous indication of the positions of the controlled devices. Control units are available, for use at both transmitting and receiving stations, for remote control and position indication of reversible motors, geared down to 1 rpm, which can be connected to any mechanism it is desired to control.

(To be concluded)

4.5-KW. TRANSMITTER

(Continued from page 31)

very low, an additional low-pass filter is connected between this transformer and the output terminals to reduce harmonic output even further.

Fig. 7 shows the output transformer, which is only 7 ins. high, in detail. It is not unlike many iron-core transformers except for its size and the frequency band involved. The core material is Hipersil, a material developed only recently.

Conclusion:

The use of linear amplifiers, Class B output, and a new type of output transformer has facilitated the design of a 2.5 to 4.5-kw. transmitter smaller than the usual low-frequency transmitter.

Since all stages of the transmitter are broad-band, the phase shift between input and output is controlled by stable elements. There is no variation in phase such as occurs with Class C stages. It is possible, therefore, to operate MW low/medium-frequency transmitters in parallel to obtain increased output power. The transmitter described here is capable of an output of 4.5 kw. to a line at any frequency between 250 and 540 kc. Two of the transmitters, connected in parallel and fed from a common oscillator, provide 9 kw. over the same range.

COMMUNICATION NEWS

(Continued from page 25)

Department in June. Telanserphone, Inc., 224 E. 38th Street, New York, first went on the air with this service in October, 1950, and now, with the initial kinks ironed out, is handling calls to subscribers in a highly successful manner. In a discussion with Telanserphone president, Sherman Amsden, he informed us that his company designed the original automatic number-paging machine, to which he gave the name Mechanicall. The machine was built under contract by Reeves Sound, using a design on which Telanserphone has applied for patents.

Since the market for the Mechanicall is necessarily limited, and the cost per unit quite high in consequence, it is expected that these machines will be made available to operators in other cities on a rental basis.

The AM receivers were also designed by Telanserphone, and built by several manufacturers under contract. They, of course, are relatively inexpensive. That fact, coupled with the very low labor cost of operating the Mechanicall makes it possible to offer radio paging service to subscribers at a very modest rate, as compared to that of two-way communication.

Economics of Radio Relays:

One of the public utilities, having made a thorough cost study of microwave relays and wire lines, decided to employ the former for a very interesting reason. It was found that facilities for communication with mobile units could be added to the microwave system, since the relay towers would be located at high elevations, at an additional cost of only 5%.

Adding mobile radio to wire lines, however, made that cost prohibitively expensive, since that combination would still require towers, buildings, road construction, and maintenance.

New FCC Applications

This list includes applications for mobile, point-to-point, control, and relay communication facilities filed with the FCC from June 23 to July 18, 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 and type of facilities are shown, with the operating power, frequencies, and 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

FLIGHT TEST

North American Aviation 4300 E 5th Ave
  Columbus Ohio 1m —w 133.92, 150.12, 235.4, 314.6, 381.6 Q

AERO MOBILE UTILITY

Bell Aircraft Corp Box 1 Buffalo NY
  Nr Niagara Falls 1b 5w 121.9 U; 1m 4w 121.9 C
Hiller Airport Barre Mass 1b 3.5w 122.8 X
Rickcliffe M Decker Rahway NJ 1b 7w 122.8 R
J R Winter Pressed Steel Co Napoleon Ohio
  1b 4w 122.8 NN
Stillwater Mun Airport Stillwater Okla
  1b —w 122.8 X

AERONAUTICAL & FIXED

Aeronautical Radio Inc 1523 L St NW Washington DC
  1m 10w 127.1 T

AIRDROME ADVISORY

York Continental Airways York Pa 1b 4w 122.8 NN
Joe Eaton Box 637 La Mesa Calif 1b —w 122.8 NN
Hubert A Powell Danville Ill 1b 4w 122.8 NN

CIVIL AIR PATROL

CAP Ore Wing Lakeview Ore
  10m 15w 148.14, 4.585 X
CAP La Wing New Orleans La
  1b 20w; 49m 20w 148.14 T
CAP Minneapolis Sqdn Minneapolis Minn
  1b 10w 148.14, 5.500 X; 5m 1w 5.500 T
CAP Mich Wing Adrian Airport Adrian Mich
  2b 75w, 15w 2.374, 4.507, 4.585, 148.14; 3m 15w 148.14 X
CAP Anacosta Sqdn Nat'l Capital Wing
  Washington DC
  1b 10w 4.325, 4.585 R; 5m 10w 4.325, 4.585 URKX; 3 sq 10w 2.374, 148.14 GT
CAP Volusea Sqdn Cent Fla Grp VI Fla Wing
  New Smyrna Beach Fla
  1b 75w 2.374, 4.325, 4.585 G
CAP Oak Ridge Sqdn Tenn Wing
  1b 45w 2.374, 4.325, 4.585, 5.500 A; 1b .75w; 3m .75w 5.500 M
CAP Ore Wing Hermiston Flight Hermiston Ore
  1b 75w 2.374, 4.507, 4.585; 50w 148.14; 1w 5.500 X
CAP Ind Wing 527 Grp Flight 2 Indianapolis Ind
  1b 75w 4.507, 4.585 AA; 1b .75w; 5m .75w 2.374, 4.507, 4.585, 5.500 M; 1b 39w; 5m 39w 148.14 T
CAP Nassau Sqdn 4 LI Grp 2 NY Wing
  LI University Brookville NY
  Manhasset NY 3b 75w 2.374, 4.507, 4.585; 50w 148.14; 4m 60w 4.507, 4.585; 18w 148.14 X
CAP Texas Wing Dallas Tex 1b 1w 5.500 X
Harlan Sqdn 725-3 CAP Harlan Iowa
  1b 50w 148.14 T; 1b 1w; 3m 1w 5.500 M

POLICE

State of Okla Box 1826 Oklahoma City Okla
  Nr Wewoka Okla 1r 120w 159.21 R
Brook Park Village Ohio 1b 75w 39.02 G
City of Washington Pa 1b 120w; 10m 60w 155.25 M
Town of Stoney Creek Va 3m 124w 42.7 G
Village of Bennington Vt
  1b 120w; 3m 60w, 3m 30w, 3p 3w 155.19 M
Sheriff of Ashland County Ashland Wis
  1b 30w 75.82 M
Muellen Wis 1b 60w 39.58; 1b 30w —; 4m 30w 39.58 39.66 M
Barnstable County Sheriff Barnstable Mass
  Brewster Mass 1b 25w 158.85 G
City of Live Oak Calif 1b 25w 155.13 L
Dodge County Sheriff Mantorville Minn
  Kasson Minn 1b 500w; 6m 60w, 1m 3w 155.07, 155.37 M
City of Sioux City Iowa 116 6th St 1m .2w 2455 Speedmeter
Boro of Middletown Pa
  1b 24.8w; 6m 24.8w, 155.49 G
Hampton County Hampton S C
  1b 120w; 10m 120w 45.14 M

City of Sandusky Mich 3m —w 39.1 M
City of Martinsville Va 5m .2w 2455 Speedmeter
Beaver County Sheriff Beaver City Okla
1b 120w; 10m 120w, 2m 60w, 2m 30w 39.58 M
Calif State Patrol Sacramento Calif
Placerville Calif 1b 150w 42.34 G
Stockton Calif 1b 150w 42.34 —
Pinedale Calif 1b 150w 42.34 —
San Bernardino Calif 1b 150w 42.34 G
Sacramento Calif 1b 150w 42.34 —
Grass Valley Calif 1q 120w 74.1 G
Nr Santa Rosa Calif 1b 150w 42.34 G
Grass Valley Calif 1b 150w 42.34; 1q 120w 72.26 G
Placerville Calif 1q 120w 74.5 G
Town of Simpsonville SC 1m 120w 37.1 M
Warren County Sheriff Front Royal Va
1b 120w; 15m 60w 39.5 M
City of Ogden Utah 1b 125w; 40m 30w 155.13 M
City of Honolulu Merchant & Bethel Sts
Honolulu TH 20m 5.85w 155.01 M
Town of Brookline Mass 339 Washington St
1m .2w 2455 Speedmeter.
Town of Wilmington Mass
1b 120w; 10m 30w 155.13 M
City of Fresno Calif City Hall 1 Speedmeter
City of Eveleth Minn
1b 30w; 3m 30w, 2p 1w 155.13 M
City of Bucknell Ind
1b 20w 155.13, 155.37 R; 2m 10w 155.13 BM
Village of Oak Harbor Ohio 5m 75w 39.58, 39.66 G
Grant County Sheriff Silver City N Mex
1us 60w 79.94 M
Grant County N Mex 1ur 60w 72.34 M
City of Ludlow Ky 5m 40w 154.77 M
City of Hillsdale Mich
1b 50w 155.37, 155.49; 10m 12w 155.49 G
City of McGregor Tex 215 W 3rd St
3m 50w 39.4 M
Douglas County Sheriff 17 & Farnam sts Omaha Neb
1tb 150w 37.1 G
City of Reedsburg Wis
1b 30w 39.58; 3m 80w 39.58, 39.70 M

FIRE

Town of Lenox Mass 1b 50w 154.31 G
Roslyn Rescue Hook & Ladder Roslyn NY
1b 120w 46.1; 5m 60w 46.22 L
Town of Maynard Mass 3m 75w 46.50 G
Fire Dept Hilton NY 1b 30w; 8m 30w 154.31 M
Town of Scituate RI
1b 120w; 3m 60w, 2m 2w 154.19 M
Fire Dept Dallastown Pa 1b 120w; 6m 60w 33.9 M
Eggleston Twp Fire Dept Muskegon Mich
1b 120w; 5m 60w, 2m 1w 154.19 M
Norton Fire Dept Muskegon Mich
2b 120w; 5m 20w, 2m .5w, 10m 20w 154.19 M
Bayport Fire Dist Bayport NY
1b 40w 46.46; 5m 40w, 2p 2w 46.34, 46.46 M
Alamogordo N Mex 1b 27.7w; 10m 24.8w 154.31 R
Fire Dept Wellsboro Pa
1b 120w; 5m 60w, 4p 1w 155.43 M
Merrick Fire Dept Merrick NY 5m 62w 46.1 G
Framingham Mass 1b 120w; 11m 120w 33.98 LG

FORESTRY

State of Tex Walton Bldg Austin Tex
Edinburg Tex 1b 150w 31.22 R
State of Florida Tallahassee Fla
Leesburg Fla 1b 120w 46.82 C
Keystone Heights Fla 1b 25w 46.82 C
Ark Resources & Dev Comm Little Rock Ark
Prescott Ark 1b 150w 31.58, 31.70, 31.82, 31.94 L
State of Calif State Capitol Sacramento Calif
1mr 120w 172.225 L
Nr Sacramento Calif 1b 150w 159.27, 159.33, 159.39, 159.45 —
Pinedale Calif as above
Stockton Calif as above
State of Idaho State House Boise Idaho
McCall Idaho 1b 115w 20m 25w, 20p 1w 159.45 GA

HIGHWAY MAINTENANCE

County of Sweetwater Green River Wyo
1b 140w 37.9 M
Rock Springs Wyo 1b 140w; 10m 80w 37.9 M
District of Columbia Washington DC
1b 150w 46.90, 46.98 R
State of Calif State Capitol Sacramento Calif
Stockton Calif 1b 150w 47.02, 47.10 —
Pinedale Calif 1b 150w 47.02, 47.10 —
Nr Sacramento Calif 1b 150w 47.02, 47.10 —
Nr Morgan Hill Calif 1b 150w 47.1, 47.02 R
State of W Va Box 410 Buchannon W Va
Nr Moundsville W Va 1b 250w 37.9, 37.98 G

SPECIAL EMERGENCY

Dr Arthur F Morrison Lewiston Pa
1b 120w; 2m 60w 47.46 M
Fred O Haberman Centerburg Ohio
1b 120w; 2m 60w 47.46 M
State of La Baton Rouge La
1b 600w; 6m 90w, 6p 3w 47.46 GM
Dr John Pope Benton Ill 1b 124w; 2m 124w 47.46 G
Dr John Anderson Zumbrota Minn
1b 60w; 2m 60w 47.54 M
Dr C H Schlanderoff Red Wing Minn
1b 60w; 2m 60w 47.58 M
Paris Veterinary Clinic Paris Tex
1b 120w; 1m 120w, 2m 80w 47.54 M
Frank J Logler MD Newport RI
1b 120w; 1m 30w 47.5 M
VA Thieleke Sheboygan Wis
1b 120w; 1m 80w 47.66 M
Norbert A Dahlke Waupaca Wis
1b 120w; 1m 80w 47.58 M
Everett G Falconer MD Seward Ill
1b 120w; 1m —w 159.51 R
Victor F Van Wagonen MD Fultonville NY
1b 120w; 1m 80w 47.62 M
Earl J Albers MD Murphysboro Ill
1b 120w; 2m 120w 47.5 M
Howard L Baker MD Hagerstown Md
1b 120w; 1m 60w 47.66 M
A A Moore DVM Hamilton Tex
1b 120w; 3m 120w 47.46 M
Donald R Lynch DVM Frederick Md
1b 30w; 1m 30w 47.54 M
J E Spore Princeton Ind 1b 60w; 2m 30w 47.58 M
George W Lantis Jr Quincy Ill
1b 60w; 1m 60w 47.46 M
G J Henry Funeral Home So Portland Me 1b —w — T
Snyder Ambulance & Oxygen Serv Bakersfield Calif
1b 60w 47.66 M
Dr Dale Crawford Baldwin City Kans
1b 124w; 2m 124w 47.62 G
Puerto Rico Transportation Auth San Juan PR
Box 3508 3b 150w; 2m 75w 47.50 G

STATE GUARD

Texas State Guard Box 613 Refugio Tex
1tb 120w; 1tb 80w 2.726; 1tb 50w 2.726 X

POWER UTILITY

Cent West Utility Co Kansas City Mo
Herington Kans 1b 120w; 10m 60w 47.78 M
Gas Service Co 824 Grand Kansas City Mo
1b 120w; 50m 30w, 10p 3w 48.46 M
Florida Power & Light Co 25 SE 2nd St Miami Fla
1p 150w 37.86 G
Gulf States Utilities 362 Liberty Beaumont Tex
Navasota Tex 1b 150w 48.5; 2b 80w 450-460mc M
M & A Elec Pr Coop 114 N Bdway Poplar Bluff Mo
Morehouse Mo 1b 120w 48.18 M
Idalia Mo 1b 120w 48.18 M
Delta Mo 1b 120w 48.18 M
Montana-Dakota Utilities Co 831 2nd Av S
Minneapolis Minn
Dickinson ND 1b 250w 48.26 G
Hot Springs County Wyo 1b 124w 48.26 G
Gloucester Elec Co Gloucester Mass
1b 50w; 10m 30w 48.14 G
Cent Tex Elec Coop Box 553 Fredericksburg Tex
1b 500w 37.82 M
Llano Tex 1b 140w; 20m 120w 37.82 M
La Power & Light Co 142 Delaronde New Orleans
Bernice La 1b 150w 37.5 M
Lane County Elec Coop Eugene Ore
1b 500w; 15m 60w, 6m 2w 47.94 M
Bryan Light & Water Works Bryan Ohio
1b 20w; 10m 20w 153.41 G
Pub Serv Co of Ind 1000 E Main Plainfield Ind
Greensburg Ind 1b 150w 48.46 G
Delphi Ind 1b 150w 48.46 G
Custer Public Power Dist Sargent Neb
1b 70w 48.50 G
Mississippi Gas Co Box 1191 Meridian Miss
Nr Amory Miss 1b 120w 48.06 M
Lincoln County Pr Dist 1 Pioche Nevada
Boulder City Nev 1b 500w 48.34 G
Castleton Nev 1b 500w 48.34 G
Alamo Nev 1mr 500w, 20m 124w 48.34 G
Pacific Gas & Elec Co 245 Market San Francisco 6
Wasco Calif 1b 120w 153.71 L
Texas Power & Light Co 1506 Jackson Dallas Tex
Milan County Tex 1b 150w 37.50 G
Sandow Tex 1b 150w 37.50 G
Sioux Valley Empire Elec Assoc Coleman SD
Hartford SD 1b 120w 37.74 M
No Ind Pub Serv Co 5265 Hohman Av Hammond Ind
Nr Peru Ind 1b 250w 37.78 M
Caddo Elec Coop Gotebo Okla 1b 120w 153.71 L
Ark Pr & Lt Co Pine Bluff Ark
McCrory Ark 1b 60w 37.54 M
Heber Springs Ark 1b 60w 37.54 M
Kans Pr & Lt Co 808 Kans Ave Topeka Kans
Ford County Kans 1b 500w 37.62 G
Cleveland Elec System Cleveland Tenn
1b 119w; 10m 24.8w 153.59 R
Kentucky Util Co Carrollton Ky 1b 150w 48.30 G
Tri-County REC Mansfield Pa
1b 60w 72.22; 1b 60w 75.82 M
Milwaukee Gas Lt Co 626 E Wisconsin Ave
Milwaukee
West Bend Wis 1b 60w 153.47 M
City of Hamilton Ohio
1b 120w; 21m 30w; 5p 1w 153.71 M
Illinois Power Co Vandalia Ill 1b 60w 153.65 M
Gillespie Ill 1b 60w 153.65 M
Public Service Co of Colo 900 15th St Denver Colo
Nr Grand Junction Colo 1b 250w 37.74 G
Western Slope Gas Co 900 15th St Denver Colo
Nr Rangeley Colo 1b 60w; 3m 50w 37.74 G
Interstate Power Co Prairie du Chien Wis
1b 60w 37.5 R
Lancaster Wis 1b 60w 37.5 R
Montana-Dakota Utilities Co 831 2nd Av S
Minneapolis Minn
Nr Glen Ullin ND 1 b 50w 48.26; 1sr 80w 75.66 G
Bismarck ND 1sq 80w 72.58 G
Pacific Gas & Elec 245 Market St San Francisco
Monterey Calif 1b 120w 153.71 L
Fulton Calif 1b 120w 158.25 L
Novato Calif 1b 120w 153.71 L
Appalachian Elec Power Co 40 Franklin Roanoke Va
Lynchburg Va 1b 2.5w 959.5 G
Nr Lynchburg Va 1b 2.5w 954.5 G
North Bd of Control Owyhee Project Box 491
Nyssa Ore 1b 50w 158.13 G
Homedale Idaho 1b 50w 158.13 G
Owyhee Ore 1b 12w; 12m 12w 159.13 G
Grand River Dam Auth Vinita Okla
Pryor Okla 1b 50w 37.54 M
Pend Oreille Elec Coop Inc Newport Wash
Newport Wash 1q 100w 74.58 G
Saddle Mtn Wash 1b 124w; 15m 124w 37.66 G; 5p ¾w 37.66 A; 1r 100w 75.94 G
Puget Sound Pr & Lt Co King County Wash
1b 150w 153.41 L

PIPELINE PETROLEUM

G E Kadane & Sons Hamilton Bldg Wichita Falls Tex
6tb 70w 33.26 G
Oil Production Maintenance 1450 Esperson Bldg
Houston Tex 1q 16w 456.35 M
Nr Fairbanks Tex 1r 16w 457.85 M
Mich Gas Storage Co 212 Mich Av W Jackson Mich
Saginaw Mich 1tb 12w 33.3 M
Marion Mich 1tb 12w 33.3 M
Sinclair Research Labs Box 3157 Whittier Station
Tulsa Okla 10m 20w 1.614, 1.628, 1.652, 1.676, 1.700 X
Atlantic Refining Co Harbor Island Tex
1b 30w 49.14 M
The Texas Co 135 E 42 St New York 17 NY
Iberia Parish La 1b 120w 48.94 M
American Liberty Pipeline Co Mt Pleasant Tex
Lane Tex 1b 70w 33.34 G
Sulphur Bluff Tex 1b 70w 33.34 G
Tex Gas Trans Corp Box 577 Owensboro Ky
Nr Wilmot Ark 1b 60w 48.9 M
Salt Lake Pipeline Co Salt Lake City Utah
Nr Willard Utah 1usr 70w 75.74 M; 1usr 300w 74.34; 1usr 300w 74.42 X
Interstate Petroleum Comm Inc 1319 Shell Bldg
Houston Tex
Nr Healdton Okla 1b 120w; 10m 60w 158.43 M
Tex Eastern Trans Co Box 1612 Shreveport La
No Little Rock Ark 1b 120w 48.94 M
Many La 1b 120w 48.94 M
Humble Oil & Refining Co Box 2180 Houston Tex
Nr Seminole Tex 1b 150w 46.86 G
Tex Co Producing Dept 135 E 42nd St New York NY
3m 150w 48.94 G
Midland Geophysical Co 233 Capitol Bldg
Midland Tex 4m 10w 30.82 M; 4m 12w 1.652 X
Mack Greenwood Washington Ind
1b —w 49.14SS; 1m —
Sunray Oil Corp 1st Nat Bank Bldg Tulsa 3 Okla
Aransas Pass Tex 1b 50w 48.58 G
Apex Development Co 2509 Spence St Houston Tex
3m 50w 1.614, 1.628, 1.652, 1.676, 1.700 K
John W Mecom 2906 Gulf Bldg Houston Tex
1tb 120w 30.74 M
Pub Serv Co of NC Inc Gastonia NC
1b 500w; 50m 60w 48.98 M
Ralph Lowe Box 832 Midland Tex
1b 300w; 5tb 70w 48.74 G; 30m 70w 48.74 G
Humble Pipeline Co Drawer 2220 Houston Tex
Alice Tex 1b 50w 48.86 G
Corpus Christi Tex 1b 50w 48.86 G
Nr Refugio Tex 1b 50w 48.86 G
Husky Oil Co Box 380 Cody Wyo 1q 75w 75.42; 25m 20w, 5m 3w 48.74 M
Nr Cody Wyo 1b 120w 48.74; 1r 75w 72.7 M
Nr Pitchfork Wyo 1b 120w 48.74 M
Nr Little Sand Draw Wyo 1b 120w 48.74 M
Malco Refineries Box 660 Roswell N Mex
Nr Blanco N Mex 1b 300w 48.98 G
Nr Counselors N Mex 1b 70w 48.98 G
Hospah N Mex 1b 70w 48.98 G
Prewitt N Mex 1b 70w; 15m 70w 48.98 G

FOREST PRODUCTS

Nat'l Logging Co Box 607 Beaver Wash
Tyee Wash 1b 120w; 20m 60w 49.58 M
Wm Endicott Logging Co Prineville Ore
1b 50w; 15m 50w 49.3 X
Pine Products Corp Prineville Ore
9m 50w 49.3 X
Murphy Lumber Co 836 Pacific Bldg Portland Ore
1tb 124w 49.54 G
Iskra Bros Logging 431 Finch Bldg Aberdeen Wash
Lake Quinault Wash 1b 120w; 50m 60w 153.11 M
Central Fire Control Assoc Carthage Miss
Philadelphia Miss 1b 200w 29.73 K
Gardiner Lumber Co Gardiner Ore 1b 60w 153.29 M
Foresthill Logging Co Box 312 Auburn Calif
1b 120w; 11m 120w 49.34 G
Foresthill Calif 1b 120w 49.34 G
Cascade Lumber Co No 7 & H Sts Yakima Wash
1b 124w 49.5; 1r 110w 73.14 G
Gleed Wash 1q 110w 72.3 G
Naches Wash 1q 110w 72.3; 100m 124w 49.5 G
Broughton Lumber Co Cook Wash
Nr Willard Wash 1b 10w; 12m 10w 153.11 C
Weyerhauser Timber Co Box 420 Centralia Wash
Forest Lookout Wash 1b 15w 49.38 X

SPECIAL INDUSTRIAL

Ullard Bros Austin Minn 1b 50w; 10m 50w 49.9 G
Meekins Inc Hollywood Fla
1b 120w; 11m 30w 152.93 M
Airpex Prods Co Cambridge Md 1b 250w 152.99 T
Middle River Baltimore Md 1b 250w; 1m 30w 152.99 T
A Dude & Sons Coop Assn Oviedo Fla
Belle Glade Fla 1b 150w 43.18 R
Bill Rusconi Farms San Joaquin Calif
1b 124w; 12m 120w 43.14 G
Tecon Construction 1201 Main Dallas Tex
5tb 120w; 10m 120w, 10m 40w, 5p 3w 43.1 M
T F Scholes Inc 632 Washington St Reading Pa
1tb 60w; 4m 20w, 1w 152.99 M
Beaufort Fisheries Inc Beaufort NC
1b 500w; 10m 150w, 10m 100w 43.14 K
S J Groves & Sons Co 19 Rector St New York 6 NY

(Continued on page 36)

NEW APPLICATIONS

(Continued from page 35)

1tb 60w 152.99 M
Lambeth Construction Co Greensboro NC
1b 120w; 20m 62w 43.18 G
Petroleum Serv Co Alamo Bank Bldg San Antonio
Corpus Christi Tex 7tb 70w 49.62; 25m 1w 154.57 G
Claude Botkin Co Box 302 Arvin Calif
Nr Arvin Calif 1b 60w; 4m 30w 30.58 M
Nr Tehachapi Calif 1b 60w; 4m 30w 30.58 M
Pfister Hybrid Corn Co El Paso Ill
1b 60w; 20m 12w 152.93 M
M H Ratliff Brownsfield Tex
1b 120w; 10m 120w 43.06 M
Boland Planting Co Estill Miss
1b 15w; 12m 12w 154.49 K
Deck Excavating Co Lebanon Pa
1b 120w; 6m 60w, 2m 20w, 2p ½w 154.49 M
Beryllium Corp Box 1462 Reading Pa
Temple Pa 1b 60w; 6m 20w 152.87 M
Longhorn Supply Co Box 4149 Houston Tex
1q 16w 456.25 M
Nr Fairbanks Tex 1b 500w; 20m 95w 43.18; 1r 16w 457.75 M
Massey Pipeline Constr Co Box 2099 Corpus Christi Texas 1tb 124w 27.35 G
Gordon H Ball Tulare Calif
1b 60w; 10m 30w 27.35 M
Congleton Bros Beattyville Ky
1b 27.7w; 6m 24.8w 154.49 R
Carlson Hybrid Corn Co Audubon Iowa
1b 124w; 5m 62w 27.35 G
Crucible Steel Works of America Midland Pa
1b 120w; 25m 20w 154.49 M
American Viscose Corp Front Royal Va
1b 30w; 1m 30w 154.49 M
Carl E Copeland Co Sumter SC
1b 30w; 1tb 15w; 4m 15w 154.49 M
Alvey Constr Co Morganfield Ky
1b 114w; 10m 114w 43.14 R
An-Nan Constr Co Del Paso Hgts Calif
1b 60w; 5m 60w 43.1 L
Bethlehem Sparrows Point Shipyard Co
Sparrows Point Md 1b 119w; 35m 30w 154.57 R
Kaiser Aluminum & Chem Corp 1924 Bdway Oakland Calif
Fallon Nev 1b 114w 43.02 R
None Nev 1b 147w; 5m 132w 43.02 R
Donald Lee Walker Edinburg Tex
1b 120w; 10m 120w 49.58 M
Miller Alfalfa Co Defiance Ohio
1b 120w; 10m 60w 43.06 M
Bacon Produce Co 198 Locust S Twin Falls Idaho
Hazelton Idaho 1b 60w 49.9 M
Geo B Thomas Inc Berryville Va
1b 120w; 15m 120w 49.86 M
Farmers Aerial Sprayers 3303 Itasca Lubbock Texas
1tb 120w; 2m 80w; 3p 2w 43.06 M
Ging Jeng Mock Dos Palos Calif
1b 124w; 10m 124w 43.02 G
Bill & Ed Koda S Dos Palos Calif
1b 124w; 10m 124w; 49.54 G
D W Winkelman Co 205 Harrison St Syracuse NY
Solvay NY 1b 60w 43.06 G
J F Gatchel Hood River Ore
1b 15w; 6m 10w 152.99 C
Douglas Aircraft Co 3000 Ocean Pk Blvd Santa Monica, Calif
Los Angeles Calif 1b 3w; 1m 3w 154 M
Austin Radiopage Austin Tex 1b 120w 43.58 M
Duffy Reed Constr Co Twin Falls Idaho
1b 30w; 10m 30w 43.1 M
McClinton Bros Co Box 749 Fayetteville Ark
Nr Johnson Ark 1b 60w; 5m 30w 30-50mc band M
Dowell Inc Box 536 Tulsa Okla
Nr Rover La 1b 300w 43.18 G
Brown & Root Inc Box 1072 Nashville Tenn
1tsr 35w 72.9; 1tsq 35w 73.9 G
C H Gragg Constr Co 323 Britton Av Oklahoma City
1tb 120w; 25m 62w 43.06 G
Rinker Materials Corp West Palm Beach Fla
1b 120w; 35m 30w 154.49 M
D W Winkelman Co Syracuse NY 1b 60w 43.06 G
Murray's Sales & Serv Raleigh NC
1b 20w — X; 3m 60w, 30w — M
Clement F Sculley Constr Co St Paul Minn
1b 140w, 1b 30w; 5m 80w, 5m 30w 152.93 M
Fairmont Canning Co Fairmont Minn
1b 120w; 10m 60w 152.93 M
Winnebago Minn 1b 120w; 10m 60w 152.93 M
Warner Bros Constr Co 2826 Eaton St Denver Colo
Nr Denver Colo 1b 120w; 1tb 120w; 6m 80w; 3p 2w 43.02 M

LOW POWER INDUSTRIAL

Texas Instruments Inc 6000 Lemmon Av Dallas Tex
2p 1w 154.57 D
Chicago Cemetery Assoc 11900 S Kedzie Av Chicago
4p 3w 154.57 M
Henry R Staats 2636 SE Ankeny Portland Ore
6p 2w 42.98 M
RCA Communications Inc 60 Broad St New York NY
2p 2.9w 154.57 R
Olypia Fields Country Club Olypia Fields Ill
3p 1w 154.57 A
Jack D Lee Rte 2 Continental Village Peekskill NY
1p 2w 33.14 A
Harry W Butcher Bluff Isl Lodge Clayton NY
3p 3w 154.57 M
Radio Receptor Inc 84 N 9 St Brooklyn 11 NY
2p 3w 33.14 X
Tide Water Assoc Oil Co 79 New Montgomery St San Francisco 20 Calif
Ventura Calif 3p 3w 154.57 R
Brown Blauvelt & McFarland Inc 44 Cooper St
Woodbury NJ 10p 2w 154.57 M
Sylvania Elec Prod 80-30 Kew Gardens Rd
Kew Gardens NY 2p 1w 154.57 A
Electronic Supply Co 94 Hamblin Av Battle Creek Mich 2p 3w 154.57 A
W P Fuller & Co 301 Mission San Francisco Calif
15p 3w 154.57 M
Julien Elfenbein 1770 Bdway New York NY
2p 2w 154.57 A
Sonotone Corp Box 200 Elmsford NY 2p 1w 154.75 A
E I Dupont De Nemours & Co 2120 Elston Av
Chicago Ill 6p 3w 154.57 M
Samsons Enterprises 222 E Erie Milwaukee Wis
2p 1w 154.57 A
Chesapeake & Potomac Tel Co of Baltimore
320 St Paul Place Baltimore 10m .25w 154.57 M
Rex T Brown 362 W Bowery Akron 7 Ohio
15p 3w 154.57 M
Bond Radio Supply Box 271 Waterbury Conn
3p 3w 154.57 A

RADIO LOCATION

Offshore Daydist Inc 3503 Fern St New Orleans La
Nr Point a la Hache La 3b 100w 1.75125; 3b 100w 1.77564 X
Nr Galveston Tex 3b 100w 1.753; 3b 100w 1.77814 X
Nr Sabine Pass Tex 3b 100w 1.77880; 3b 100w 1.77835; 3b 100w 1.78681 X
Nr Freeport Tex 3b 100w 1.77851; 3b 100w 1.77936 X; 3b 100w 1.78335; 3b 100w 1.78380 X
Nr Matagorda Tex 3b 100w 1.75875; 3b 100w 1.78314 X
Nr Seadrift Tex 3b 100w 1.7835; 3b 100w 1.78436 X
Nr Venice La 3b 100w 1.77585; 3b 100w 1.77630 X
Nr Aulac La 3b 100w 1.77601; 3b 100w 1.77686 X
Nr Esther La 3b 100w 1.78625; 3b 100w 1.78580 X
Nr Creole La 3b 100w 1.78559; 3b 100w 1.76125 X
Sabine Pass Tex 3b 100w 1.78596

ALASKAN COASTAL

Resurrection Bay Co Seward Alaska
1b 25w 2.422, 2.512, 2.538 X

COASTAL & FIXED

James M. Dolan Valdez Alaska
1b 65w 7 channels from 2.450 to 3.092 NN
Nakat Packing Corp c/o Northern Elec 314 Bell St
Seattle 1 Wash 1p 30w 11 channels from 2.382 to 3.190 NN
Sitka Canning Co Box 1121 Juneau Alaska
Sitka Alaska 1b 50w 2.512, 2.450, 2.632, 3.190 Q
Western Fisheries Co c/o Northern Elec 314 Bell St
Seattle Wash 1tb 100w 10 channels 2.382 to 5.167 NN

MARITIME RADIO LOCATION

Puget Sound Pilots 814 Insurance Bldg Seattle Wash
Port Angeles Wash 1b 35w 9320-9500 X

MARITIME FIXED

John W Mecom 2906 Gulf Bldg Houston 2 Tex
1m 100w 2.134, 2.206 X

COASTAL & MARINE RELAY

Donohugh Towboat Service Box 841 San Pedro Calif
2m 10w 156.6 T

RAILROAD

Atlantic Coast Line RR Wilmington NC
Rocky Mt NC 1b 30w 160.29 T
Savannah Ga 1b 30w 160.29 T
Charleston SC 1b 30w 160.29 T
Chicago So Shore & So Bend RR Michigan City Ind
1b 60w 161.37 M
N Y Dock Railway Brooklyn NY
1b 30w; 14m 30w 161.19 R
Union Pacific RR Co 1416 Dodge St Omaha Neb
Hinkle Ore 1b 60w 160.29 M
Ogden Union Rway & Depot Co Ogden Utah
1b 30w 160.23; 12m 2w 159.87, 160.11, 160.59, 160.71, 160.95, 161.19 M
Missouri Pacific RR Co 310 N 13th St St Louis Mo
Pueblo Colo 1b 60w 160.41, 160.47 M
Nepesta Colo 1b 60w 160.41, 160.47 M
Haswell Colo 1b 60w 160.41, 160.47 M
Brownell Kans 1b 60w 160.41, 160.47 M
Sheriden Lake Colo 1b 60w 160.41, 160.47 M
Marquette Kans 1b 60w 160.41, 160.47 M
Healey Kans 1b 60w 160.41, 160.47 M
Utica Kans 1b 60w 160.41, 160.47 M
Ordway Colo 1b 60w 160.41, 160.47 M
Atchison Topeka & Santa Fe RR Co 80 E Jackson St Chicago 4 Ill
Mojave County Ariz 1b 3w 160.65 T
Southern Pacific Co 65 Market San Francisco Calif
Sacramento County Calif 1b 60w 161.55, 161.61, 161.79 M
Texas & Pacific RR Co Texas & Pacific Bldg Dallas
Baird Tex 1b 40w 160.41 T

TRANSIT UTILITY

Columbus Transit Co Columbus Ohio
1b 60w; 15m 30w, 15m 12w 6m .5w 44.38 M

TAXICABS

Texaco Cabs Scottsburg Ind
1b 60w 152.39; 5m 12w 157.65 M
R A Thomas Taxi Hampton Ia
1b 60w 152.33; 3m 12w 157.53 M
Pendleton Radio Pendleton Ore
1b 120w 152.33; 10m 25w 157.59 M

John J Lyle Reynoldsville Pa
1b 120w 152.27; 5m 25w 157.53 B
South Bergen Taxi Lyndhurst NJ 1b 120w 152.27 M
Star Taxi Aransas Pass Tex
1b 30w 152.39; 10m 30w 157.65 M
Yellow Cab Co Modesto Calif
1b 115w 152.33; 12m 25w 157.59 G
Center Cab Co Irvington NJ
1b 30w 152.27; 16m 30w 157.53 M
Santor's Taxi Raritan NJ
1b 120w 152.39; 4m 30w 157.65 M
So Charleston Taxi So Charleston W Va
1b 60w 152.39; 15m 10w 157.65 M
Greyhound Cab Co Lawrence Kans
1b 115w 152.27; 2m 7w 157.53 M; 10m 25w 157.53 G
Ace Taxi West Palm Beach Fla
1b 24w 152.33; 6m 24w 157.59 M
Union Cab Co Quincy Ill
1b 60w 152.33; 10m 12w 157.59 M
Herb's Taxi Gardner Mass
1b 40w 152.45; 3m 40w 157.71 B
Yellow Cab Riverside Ill
1b 50w 152.33 G; 20m 10w 157.59 GM
Westland Taxi Co N Chelmsford Mass
1b 120w 152.45; 6m 30w 157.71 M
Imperial Taxi La Grande Ore
1b 30w 152.27; 6m 20w 157.73 M
Chicago Courtesy Rentals Inc Chicago Ill
1b 50w 152.45 G
City Cab Dunkirk NY
1b 15w 152.39; 6m 15w 157.65 R
Eugene Sears Greencastle Ind
1b 60w 152.45; 5m 30w 157.71 M
North Side Taxi Lufkin Tex
1b 120w 152.33; 6m 40w 157.59 M
Highland Cab Co Kingsport Tenn
1b 120w 152.33; 10m 30w 157.59 M
Shorty's Cab Harrisonburg Va
1b 120w 152.39; 10m 120w 157.65 G
Ft Lewis Taxi Assoc Ft Lewis Wash
1b 120w 152.27; 30m 40w 157.53 M
Friendly Cab Co San Francisco Calif
1b 15w 152.45; 10m 25w 157.71 G
Chanute Radio Cab Co Rantoul Ill
1b 60w 152.27; 6m 30w 157.53 M
Diamond Cab Co Burley Idaho
1b 30w 152.33; 5m 30w 157.59.M
Chicago Courtesy Rentals 1056 W 69th St Chicago
20m 50w 157.71 G
Vets Cab Co Ripon Wis
1b 30w 152.27; 3m 30w 157.53 M
Edgeworth Auto Service Cranston RI
1b 35w 152.33 K; 15m 40w 157.59 KM
Valley Cab Service Valley Falls RI
1b 120w 152.45; 5m 30w 157.71 M
Rogers & Rogers Hartselle Ala
1b 30w 152.45; 5m 30w 157.71 M
Richard's Taxi Old Town Me
1b 120w 152.45; 3m 30w 157.71 M
Harold Applegate Hood River Ore
1b 51w 152.27; 4m 15w 157.53 X
Campus Cab Co Bloomington Ind
1b 15w 152.45; 15m 15w 157.71 M
Gilliam Cabs Kingsport Tenn
1b 120w 152.45; 20m 30w 157.71 M
City Cab Edinburg Tex
1b 30w 152.33; 5m 30w 157.59 M
Joseph A Davy Springfield Mass
1b 120w 152.39; —m 30w 157.65 —
United Cabs Honolulu TH
1b 50w 152.33 C; 50m 30w 157.59 X
Bridgeport Car Livery Serv Co Chicago Ill
1b 50w 152.39; 10m 50w 157.65 G
Willmar Cab Co Willmar Minn
1b 30w 152.27; 5m 30w 157.53 M
Petoskey Cab Serv Petoskey Mich
1b 10w 152.39; 5m 10w 157.65
Red Top Cabs Sarasota Fla
1b 60w 152.39; 15m 30w 157.65 M
Superior Cab Co Charles City Iowa
1b 60w 152.45; 5m 12w 157.71 M
Edgemoor Cab Co Edgemoor Del
1b 60w 152.39; 25m 60w 157.65 M

AUTO EMERGENCY

Southern Investigators Inc Montgomery Ala
1b 60w 35.7 M
Auto Wrecker Serv Nashville Tenn
1b 75w 35.7 B
Automobile Emergency Radio Serv Washington DC
1b 40w; 20m 40w 453.85 M
Concourse Repair Inc Bronx NY
2b 200w; 15m 100w 35.7 M
Balsley Garage Bremen Ind
1b 120w; 5m 62w 35.7 G; 3m 62w 35.7 L

HIGHWAY TRUCKS

Anderson Butane Serv Monroe La
1b 150w; 10m 150w 35.82 R
Muster Motor Sales Valparaiso Ind
1b 60w; 2m 60w 5m 30w 35.7 M
Coretti-Gross Inc Pelham Manor NY
1b 500w; 30m 120w 35.74 G
John Beakart & Sons Co Pittsburgh Pa
1b 500w; 31m 60w 35.94 M
Edward Scribner Schoharie NY
1b 60w; 5m 60w 35.74 L
Freeman Gas & Elec Co Spartanburg SC
1b 124w; 15m 62w 35.86 G
Magic Gas Co Columbia La
1b 150w; 10m 150w 35.82 R
Salmon Butane Gas Appliance Co Summerville Ga
1b 60w; 10m 60w 35.78 M
United Truck Lines Inc Seattle Wash
1b 60w; 100m 30w 35.82 G
Dyer Trucks Corcoran Calif
1b 60w; 10m 30w 35.82 M

ACOUSTIC DISPLAYS

(Continued from page 23)

sensation, but there are wide disagreements on the question of definition. Many people are convinced that definition and clarity are outstandingly good, but there is an important minority which is equally convinced that it is poor. Again, hardness of tone or singing tone may not be independent qualities, but may be intimately connected with the reverberation time or the shape of the characteristic.

It is these controversial attributes which a study of the high-frequency regions of the pulsed glide might be expected to clarify, since the first class is already sufficiently revealed by reverberation measurements and the low-frequency displays. An exact interpretation can, therefore, hardly be expected until the subjective qualities can be more exactly described and placed in some order of merit.

The order of subjective assessment which is shown in Table 1 was based on an overall judgment of quality, taking into account all the less definable attributes. The fact that there is any appearance of correlation is therefore encouraging, but the possibility must not be ruled out that the correlation exists only because both sides of the comparison are correlated separately with a third property, possibly measureable.

Conclusions:

The equipment described in this article facilitates making the recognized acoustic tests more quickly and conveniently than by former methods. It also makes possible certain measurements where much higher writing speeds are needed than were available before, such as on models, and provides a new type of test in the pulsed glide display. The interpretation of these displays is still at an elementary stage, but present progress is encouraging. The formations at low frequencies are most easy to decipher, but the interpretation of the high-frequency patterns is likely to be difficult because of their randomness and the lack of agreement on the subjective assessment of the acoustic qualities with which they may be correlated.

Although there are still difficulties to be surmounted in the detailed interpretation of the displays, the pulsed glide technique has already proved of great use as a diagnostic aid in the hands of a skilled acoustician. It is possible to use this method of recording the behaviour of a studio or concert hall as an adjunct to careful listening, and by this means to trace defects and prescribe remedies for them. Experience gained in this way has proved of great value.

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