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FM-TV THE JOURNAL OF

RADIO COMMUNICATION

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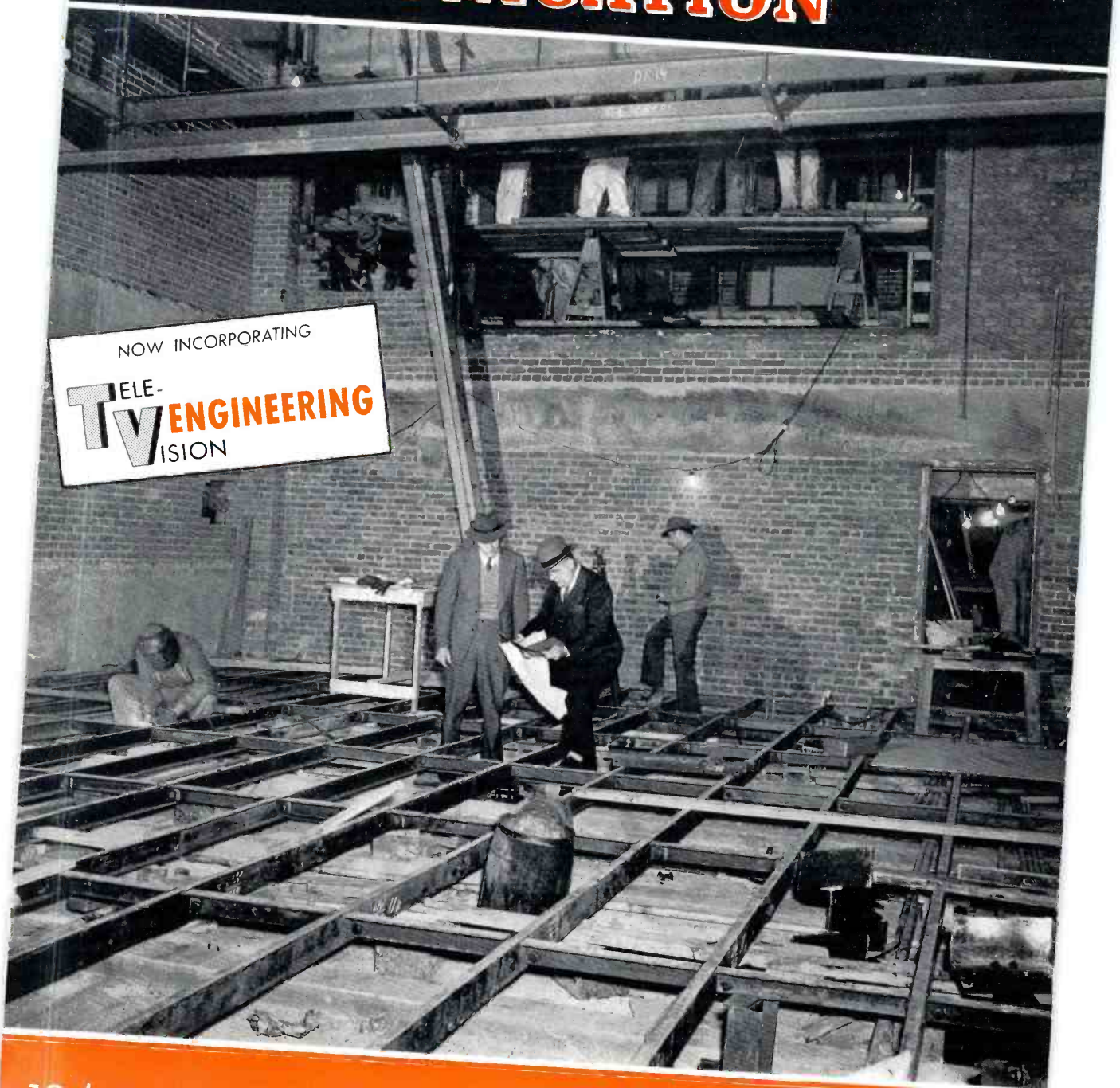

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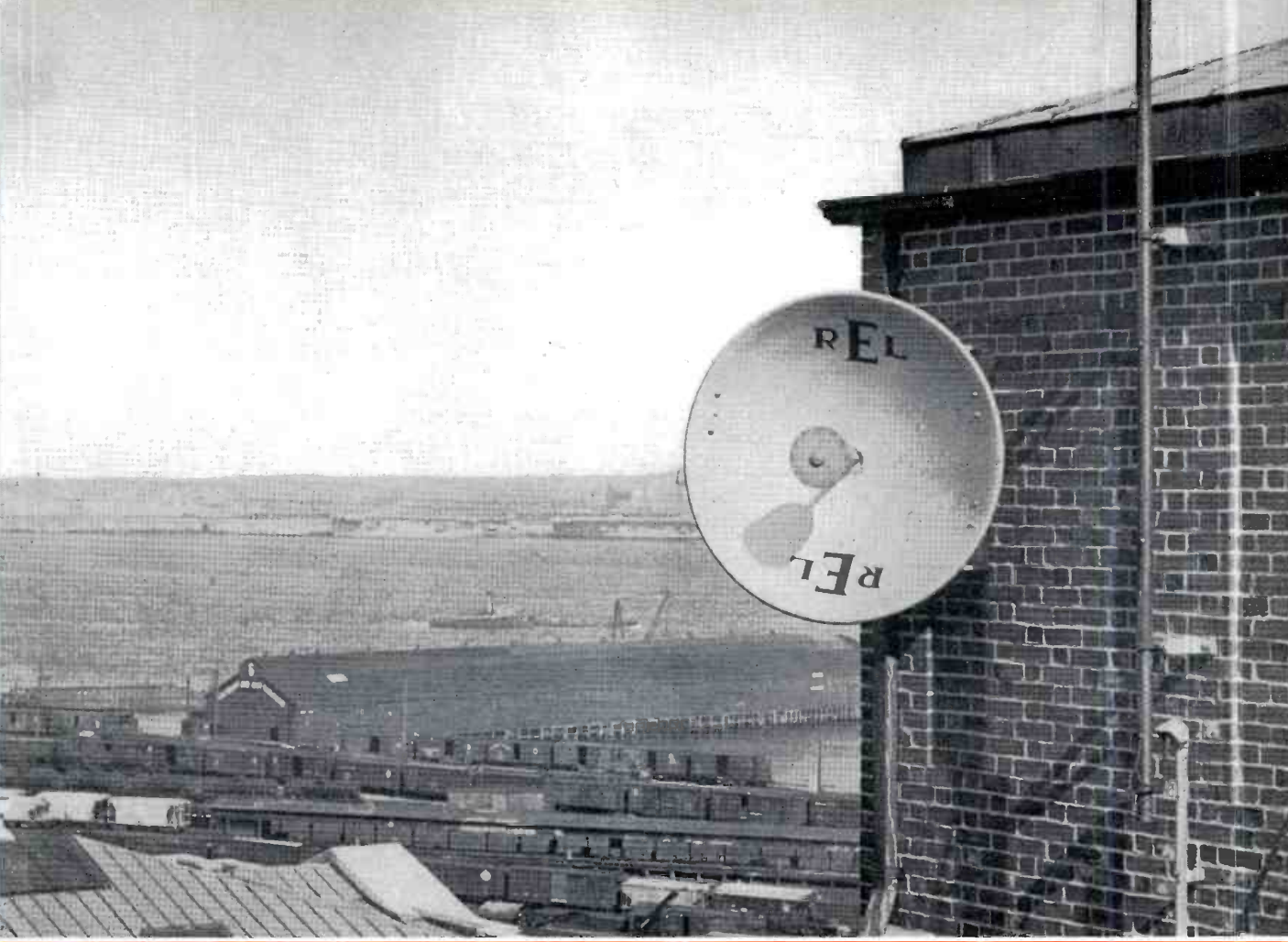


THE STANDARD OF PERFORMANCE

ENGINEERED FOR CONTINUOUS DUTY: REL MULTIPLEX POINT-TO-POINT AND LONG-DISTANCE RELAY SYSTEMS OPERATING ON 50 TO 1,000 MC.

MULTIPLEX COMMUNICATION

SPECIAL-PURPOSE TRANSMITTERS

THE SERRASOID MODULATOR

CUSTOM-BUILT CONTROL CONSOLES

REL multiplex installations are now in use by both domestic and foreign services. As links in telephone land lines, for example, their performance is equal or superior to standard telephone channelizing equipment.

Typical of REL special-purpose, continuous-duty types are the eight 350-watt, 150-mc. transmitters and the 950-mc. link used by the Fire Department to guard the five boroughs of New York City. (See illustration.)

The REL Serrasoid modulator meets the most exacting performance specifications of the communication services, even under the most severe topographical and climatic conditions encountered anywhere in the world.

Among the special control consoles designed and built by REL are those for the 6 operating positions of the N. Y. Fire Department, handling traffic from 650 vehicles and 9 fire boats of the 5-borough system.

Radio Engineering Laboratories, Inc.

36-40 37th Street, Long Island City 1, N. Y. Tel.: Stillwell 6-2100 Teletype: N.Y. 2816

PIONEERS IN THE CORRECT USE OF REL ARMSTRONG FREQUENCY MODULATION

NOW U.H.F. IS HERE these achievements . . .

PIONEERED by ZENITH will PAY BIG DIVIDENDS:

1. ZENITH WAS FIRST to use a Turret Tuner with provision for interchangeable U.H.F. tuner strips.

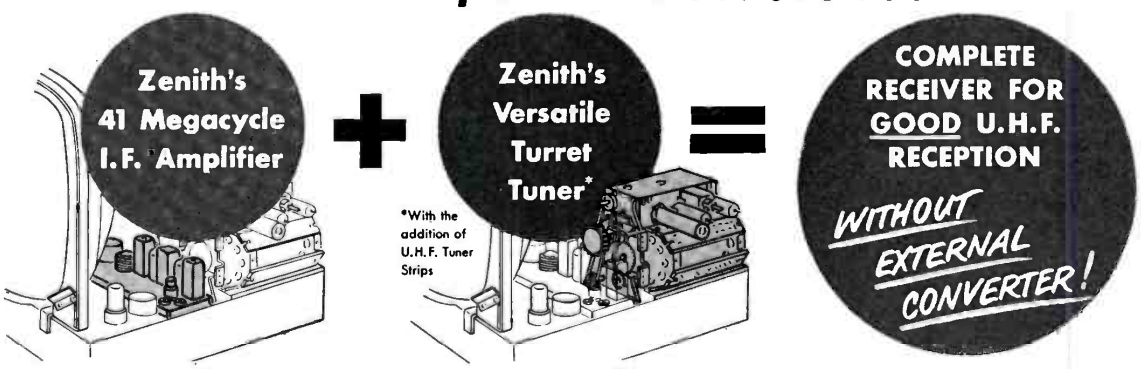
2. ZENITH WAS FIRST (ALONG WITH ANOTHER MANUFACTURER) **to use a 41 Megacycle I.F. Amplifier.**

and . . .

3. ZENITH WAS FIRST . . . and remains ONE OF THE FEW . . . to COMBINE THESE TWO GREAT FEATURES!

T-235

This is important because . . .



THE 21 MC I.F. AMPLIFIER VS THE 41 MC I.F. AMPLIFIER. It is agreed among TV engineers that the higher the frequency of the amplifier, the greater is the TV set's ability to reject certain interfering signals. The 41 MC I.F. Amplifier assures greater immunity from interference on V.H.F.—and does an even better job of eliminating interference from other stations on U.H.F. Most important of all, the 41 MC I.F. Amplifier is considered essential for *really* satisfactory U.H.F. reception in all locations.

For many TV set-owners, the day U.H.F. stations go into operation will mean the opening of a whole new world of enjoyment.

Unfortunately for others it will mean the beginning of considerable extra expense and lost time before their present sets can be converted for U.H.F. reception. And, it is not unlikely, that some set owners will *never* be able to convert their sets except at a *prohibitive cost!*

Years ago, Zenith engineers prepared every Zenith Owner for the day when U.H.F. would become a reality by developing and being the first television manufacturer to use a Turret Tuner with provision for U.H.F. tuner strips.

Today, All Zenith TV Owners are assured easy and inexpensive conversion to U.H.F. because of Zenith's engineering skill and foresight . . . and Zenith Dealers know that this advanced planning will pay *Big Dividends for them* in goodwill now that U.H.F. is here.

"BECAUSE IT'S YEARS AHEAD . . . YOU'RE DOLLARS AHEAD"

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 JUNE, 1952 NO. 6

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

WHILE the ratio of TV to audio broadcast receiver production was a little more than 1 to 1.9 in March, the proportion fell to 1 to 2.6 in April. The TV figure was the lowest since August 1951, but radio sets reached the highest rate of production for the year, even taking into account the fact that March was a 5-week month.

It is hard to say whether TV sets are running at a very high level, or if home radio sets are down substantially. Whichever way one looks at the figures, TV production this year has kept well above home radio sets, excluding the clock models.

Most spectacular increase is in clock radios, up to 176,000 in April, which accounted for 1/3 of the total home radio models. While these are novelty items, they are good business as long as they sell.

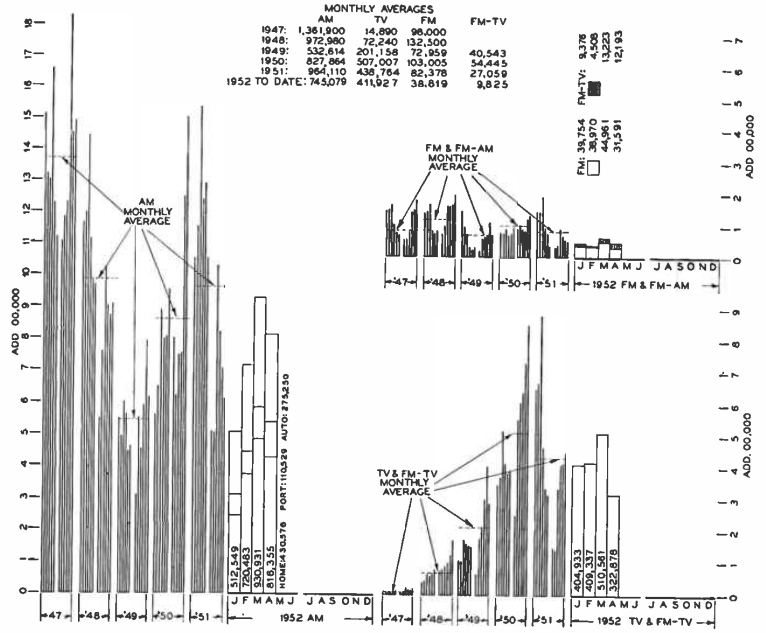
Currently, there is a general feeling of dissatisfaction over the TV set situation. Production is below capacity, price adjustments and price cutting are causing losses all down the line, dealers complain that they spend their profit repairing new sets to put them in salable condition, and the business of installation and repair has been thrown into confusion by newspaper advertisements of books that virtually brand the servicemen as thieves, and promise to show the uninitiated how to fix their own receivers.

However, there is nothing wrong with TV sales that can't be corrected by the opening of a few new markets, and that will come about as soon as the FCC starts granting construction permits.

Meanwhile some manufacturers are eyeing the market for expensive tuners, amplifiers, and speakers as a means of upping their dollar volume, and making use of idle production capacity. We can feel this trend, because almost every mail brings requests from sales and advertising executives who want information about the high-fidelity market. Some things we can tell them. Other questions must go unanswered until RTMA starts to compile statistics.

Cathode-ray tube sales to set manufacturers were on a par with April '51, but totalled only 270,781 units at $6,074,540 as compared to 370,206 units at $8,582,538 the previous month.

Sales of receiving tubes were reported as 26,247,258 units at $19,801,541 during April. Of these, 15,334,092 were for new equipment, 6,095,641 for replacement, 1,560,406, for export, and 3,257,119 for Government agencies.

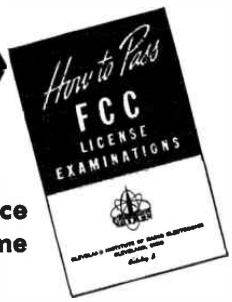


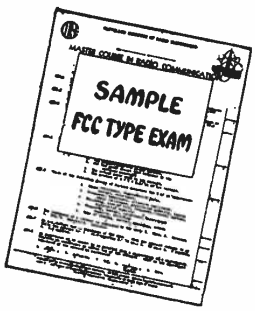
TV, FM, and AM set Production Barometer, prepared from RTMA figures.

NEED A LICENSED RADIO OPERATOR YOU CAN COUNT ON?

HERE'S WHAT TO DO . . .

1. Send for this FREE Material





It tells how easily a man of your choice can be trained at home in his spare time to get his FCC license.

TELLS HOW . . .
TO GO ABOUT SELECTING A MAN
- **NOW WITH YOU**
- **WHO WILL STAY WITH YOU**
- **WHO WANTS TO GET AHEAD**

2. ENROLL HIM in this Guaranteed FCC License Training UNDER ONE OF THESE THREE PLANS

1. **You Pay All, $89.50 Cash**
2. **He Pays All** (Terms Available)
3. **You & He Split Cost**

Send for Information on These Plans

Look How FEW HOURS OF STUDY MAY BE REQUIRED TO GET FCC LICENSE WITH OUR COACHING AT HOME IN SPARE TIME

Name and Address	License	Lessons
Lee Worthy, 2210½ Wilshire St., Bakersfield, Calif.	2nd Phone	16
Clifford E. Vogt, Box 1016, Dania, Fla.	1st Phone	30
Francis X. Foerch, 38 Beucler Pl., Bergenfield, N. J.	1st Phone	30
S/Sgt. Ben H. Davis, 317 North Roosevelt, Lebanon, Ill.	1st Phone	20
Albert Schoell, 110 West 11th St., Escondido, Calif.	2nd Phone	23

Cost is Minor Compared to the Security

WE GUARANTEE

TO TRAIN AND COACH HIM AT HOME IN SPARE TIME UNTIL HE GETS

HIS FCC LICENSE

If he has had any practical experience — Amateur, Army, Navy, radio repair or experimenting.

Cleveland Institute of Radio Electronics
Special Attention: Desk 21
4900 Euclid Avenue
Cleveland 3, Ohio

I want to know how a man of my choice can get his FCC ticket in a minimum of time. Send FREE booklet, "How to Pass FCC License Examinations" (does not cover exams for Amateur License), as well as a sample FCC-type exam, and information as to payment plans available.

☐ Be sure to check here if you are an employer.

NAME .....

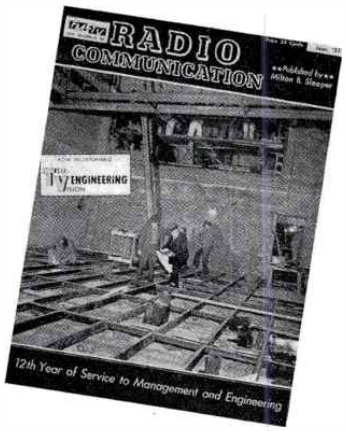
ADDRESS .....

CITY .....ZONE .....STATE .....

Paste on 2-cent postcard or send air mail.

THIS MONTH'S COVER

New TV station design and construction will be simplified for those entering the field now because of the experience accumulated by the pioneers who went on the air in the '40's. They had to learn the hard way. The cover photograph shows special studio construction, by which the inner walls, ceiling, and floor are suspended from the outer shell, which was employed by WPIX in the *hope* that it would provide sufficient vibration isolation from newspaper presses in the same building. Fortunately, it did.



SPOT NEWS NOTES

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

The Speech From Abilene:

At least in our part of the Country, a cloudburst let loose just before Mr. Dwight Eisenhower went on the air at Abilene. Static was so heavy that it interfered slightly with FM reception from our REL 646-B, and it washed out AM reception completely.

WATV to Move:

The FCC has authorized WATV to move its channel 13 transmitter to the Empire State Building.

Walter C. Evans, 1898-1952:

Following a brief illness, Walter Evans, Westinghouse vice president in charge of the X-ray and electronics division, passed away at Johns Hopkins Hospital in Baltimore. At 16 he was a radio operator on the Great Lakes. He started his career in broadcasting at KYW Chicago in 1921, becoming general manager in 1926. Subsequently he was elected a director of Westinghouse Radio Stations, assuming the presidency in 1947. In 1942 he was elected vice president of the parent company, responsible for manufacture of radio and radar equipment. Among his associates he was known as a brilliant, loyal, and exacting executive.

OK for Transit Radio:

With a 7 to 1 decision from the U. S. Supreme Court, Transit Radio, Inc. is set to go ahead with the expansion that was well under way when it was attacked by undisclosed interests identified only as the National Citizens Committee Against Forced Listening. Transit Radio offices are in the Union Trust Building, Cincinnati. Prior to the Court action, REL had developed a highly successful transit receiver, and presumably this double-superheterodyne model will be put back into production again to take care of demand for the expansion of transit radio service.

Dynamic Range on TV:

Several of our readers have commented recently on the limited dynamic range of TV audio channels. We checked this on the Firestone program, and found it to be true, although we haven't an explanation. This show is carried on FM as well as TV, so that we could switch back and forth. On TV, the audio level was almost flat, but FM provided a very wide dynamic range. In fact, the difference on comparison was quite striking.

Theatre Television:

Date of January 12, 1953, has been set by the FCC for a hearing on frequencies, rules, and regulations. Those who have not already filed appearances may do so before November 14, 1952.

Appointments:

George Scott, formerly assistant sales manager at FT & R, and Charles Bell, formerly TV director at WBTV Charlotte, now represent Du Mont's transmitter sales division in New York State and New England, and in the eastern and southeastern territories, respectively. William Cothrone has joined Du Mont as a sales engineer. He will make his headquarters at the plant in Clifton, N. J.

High-Quality Amplifier:

Data released on the new Sargent-Rayment amplifier rates the harmonic distortion on 15 watts at not more than

(Continued on page 7)

SPOT NEWS NOTES

(Continued from page 6)

.5% at any frequencey from 30 to 15,000 cycles, with intermodulation distortion of 2.5% at 40 and 7,000 cycles, and frequency response flat within .2 db from 20 to 20,000 cycles. This amplifier has 26 db of inverse feedback.

The Remarkable PRC-6:

Of the radio equipment we have seen over a long time, Raytheon's design of the PRC-6 has the greatest number of new ideas, techniques, and methods. This FM successor to the wartime Handie-Talkie is being produced in a separate plant presided over by George E. M. Bertram, whose radio manufacturing experience dates back to the days of Acme Apparatus Company. If Signal Corps clearance can be obtained, we plan to publish a feature article on the PRC-6 in the immediate future.

New Job for Broadcasters:

Jack Gould in *The New York Times:* "Radio's crying and desperate need is to stop moaning about the past and rise to the challenge which now lies ahead. For in these weeks and months while TV is not yet functioning on a truly national basis lies the chance to do the job which inevitably must be done; that is, to build a new audience for what to all intents and purposes during the evening hours must become a new and different medium.

"The first opportunity, which some local [New York] stations are showing signs of grasping with intelligence and foresight, is in the field of good music. Music is one of the delights which can be enjoyed really more by radio than television, and constitutes an almost endless source of programming.

"However, radio will not build a new audience for its wares if it merely expands on its present practice of allowing inane chatter by disc jockeys, or compressing scores of commercials in between and after numbers. The new radio must follow a more relaxed pace and a more soothing tempo. Confusion, babbling voices, and overly energetic salesmanship exist in profusion in television. Radio's assignment is to be different."

Two important notes might be added to that very sound comment: 1) To average listeners, *good music* does not necessarily indicate formal compositions. Rather, good music calls for the impression of live talent, whether it comes originally from a symphony orchestra, a violin solo, or a piano recital, or from a barbershop quartet, a hillbilly band, or a steel guitar. 2) To deliver that kind of program quality, and to reach and build

(Continued on page 8)

SPOT NEWS NOTES

(Continued from page 7)

a larger nighttime audience, the audio broadcasters will be forced to rely on FM transmision.

John H. Ganzenhuber:

Resigned as vice president of Standard Electronics to head the government contracts department of Hoffman Laboratories, Inc., Los Angeles.

Coil Forms:

By injection molding, Mycalex Corporation of America is producing low-cost, high-precision RF coil forms of glass-bonded mica, with wall thickness down to .015 in. Forms can be supplied with bonded metal inserts.

Audio Demonstrations:

General complaint heard after the Chicago Audio Show: Why does practically everyone who puts on an audio demonstration crank up the volume to the point where it's simply deafening? No one listens at that level in his own home, nor is it possible to judge tone quality under such conditions. Suggested remedy: At audio shows in the future, the demonstration rooms should be policed with a sound-level meter, and each exhibitor fined for exceeding a reasonable level.

Appointments:

R. W. Griffiths, formerly manager of electronics sales at Graybar's New York headquarters, has been appointed manager of broadcast and communication equipment sales. The post he vacated has been filled by G. I. Jones, who was manager of electronics sales in the Philadelphia area.

Transistor Transformers:

A line of transformers for transistor applications has been brought out by Crest Laboratories, Inc., Whitehall Building, Far Rockaway, N. Y. They are available in hermetically sealed cases 7/8 in. in diameter by 5/8 in. high, and in cases 3/4 by 3/4 by 1 1/8 ins. high.

James F. Cosgrove:

Appointed sales manager for Product Development Company, Inc., Arlington, N. J. Mr. Cosgrove will have charge of their complete line of microwave antennas, lighting and dehydrating equipment, and transmission line.

Identification:

NARTB has set up a committee, with Michael Hanna of WHCU, Ithaca, N. Y., as chairman, to seek an amendment to FCC Rules requiring identification of

(Concluded on page 9)

Professional Directory

SPOT NEWS NOTES

(Continued from page 8)

recorded, transcribed, and filmed programs. That Rule seems to be a carry-over of prewar thinking, for which there is little justification today. If a program is good, the audience doesn't care how it originates. If it isn't, that information doesn't make the program more acceptable.

Homer M. Hill, Jr.:

Formerly in charge of engineering for Ansley Radio Corporation, and more recently with the Applied Science Corporation of Princeton, has been appointed general manager of Arthur Ansley Mfg. Company, Doylestown, Pa.

AM Quality on FM:

Last month, we commented on FM-AM stations which monitor only their AM transmission. Awards of wilted petunias should also go to FM-AM stations where the operator cranks up the bass boost and cuts off the treble in accordance with AM practice, and feeds the distorted output to both transmitters. Some of the worst offenders call such FM transmission high-fidelity broadcasting because they use records and transcriptions of formal music.

Grid Dip Meter:

A new model, offered by Barker & Williamson, Inc., Upper Darby, Pa., covers 1.75 to 260 mc. with 5 plug-in. coils. The very small case carries a 0-500 microampere meter, and contains a built-in power supply to operate from 110 volts AC. Price is $48.

Edmond G. Shower:

Former Bell Laboratories engineer has been appointed head of National Union's new transistor division which has been set up to produce germanium and silicon diodes and transistors.

Unnecessary Traffic:

It's surprising to hear how much unnecessary traffic is carried on mobile radio channels. For example, until Police Commissioner Timothy O'Connor recently issued an order to stop the practice, wives of policemen in Chicago could call desk sergeants and give them personal messages to be relayed to their husbands over the department's radio system.

MEETINGS and EVENTS

AUGUST 12-15, APCO CONFERENCE
Hotel Whitcomb, San Francisco, Calif.
AUGUST 15-16,
IRE EMPORIUM SECTION SEMINAR
Emporium, Penna.
AUGUST 27-29,
WESTERN ELECTRONIC SHOW & CONVENTION
Municipal Auditorium, Long Beach, Calif.
OCTOBER 20-22, IRE-RTMA FALL MEETING
Syracuse, New York

Professional Directory

UHF at VHF prices

Representing a culmination of extensive research and development by Du Mont, this new UHF transmitter now makes possible UHF transmission at the price of VHF. In addition, the simplicity of circuitry employed in this new transmitter provides top dependability and performance, along with lowest maintenance costs.

Through the use of the Du Mont 5 KW UHF Transmitter, it is possible for the UHF broadcaster to go on the air with an ERP of 100 KW or greater. All the inherent limitations of UHF transmission as to cost, maintenance and operation have been eliminated in this newest product of Du Mont engineering skill.

for future growth

The exciter and driver units incorporated in the Du Mont 5 KW UHF Transmitter provide for future expansion to higher powers. The driver provides many times greater power than required by the 5 KW Klystron. For future expansion it is necessary only to change the power amplifiers, utilizing the original exciter and driver with no modifications.

TUNING CAVITIES

Revolutionary design permits the use of Klystron cavities entirely divorced from the power tube. These cavities are part of the transmitter and do not need replacing with tube changing. Easily and quickly tuned by means of simple built-in test equipment.

THE EIMAC KLYSTRON

Simple Klystron, less cavities provides LONG LIFE — LOW COST power amplifier. Three basic sizes cover the entire UHF band.

TELEVISION TRANSMITTER DIVISION

ALLEN B. DU MONT LABORATORIES, INC., CLIFTON, N. J.

FCC PRIORITY LISTS FAVOR UHF

BREAKDOWN OF 85 CITIES WHICH WILL GET FIRST CONSIDERATION SHOWS THAT 128 VHF AND 243 UHF CHANNELS ARE AVAILABLE FOR ASSIGNMENT

THE FCC's preliminary priority lists for processing new TV applications were released on May 22. Interested parties are invited to bring any apparent errors to the attention of the Commission. From time to time, the list of cities will be republished to show those from which applications have been received, and to indicate progress of the processing lines.

Thirty stations now on the air are listed in Group A-1. They will be shifted to new channels, in accordance with the new allocation plan. They are first in processing priorities.

Applications for new stations in Group A-2 and in the B Groups will be processed concurrently. Priorities in each Group will be assigned to applications in the order of the population of the cities where stations are proposed.

Group A-2 Applications:

Cities in Group A-2 are those 40 miles or more from any existing station. There are 1,004 in this Group. Denver, with a population of 415,786, leads the list, with Goldfield, Nevada, population 336, at the foot. Altogether there are:

27	cities,	100,000 or more	pop.
51	cities,	50,000 to 100,000	
126	cities,	25,000 to 50,000	
156	cities,	15,000 to 25,000	
166	cities,	10,000 to 15,000	
478	cities,	less than 10,000	

The first 27 cities are listed in this order:

Denver	Austin
Portland, Ore.	Chattanooga
Tampa—	El Paso
St. Petersburg	Mobile
Springfield—	Evansville
Holyoke	Shreveport
Youngstown	Baton Rouge
Wichita	Scranton
Flint	Knoxville
Spokane	Savannah
Beaumont—	South Bend
Port Arthur	Peoria
Duluth—	Corpus Christi
Superior	Montgomery
Sacramento	Little Rock
Fort Wayne	

Group B-1 Applications:

Cities in Group B-1 are those less than 40 miles from one or more VHF stations, to which only UHF channels have been assigned. In this Group, cities are listed according to population, with those which now have service from 1 VHF station coming first, followed by those which now have VHF service from 2, 3, 4, 5, 6, and 7 stations. Thus, only UHF stations will be authorized in:

76 cities now served by 1 VHF station
32 cities now served by 2 VHF stations
18 cities now served by 3 VHF stations
6 cities now served by 4 VHF stations
2 cities now served by 5 VHF stations
1 city now served by 6 VHF stations
5 cities now served by 7 VHF stations

There are 140 cities in this Group, of which the first 20 are:

Bridgeport, Conn.	York, Pa.
Canton, Ohio	Kenosha, Wisc.
Fall River, Mass.	Jackson, Mich.
Reading, Pa.	New Castle, Pa.
New Bedford, Mass.	Battle Creek, Mich.
Allentown, Pa.	Anderson, Ind.
Waterbury, Conn.	Meriden, Conn.
Harrisburg, Pa.	High Point, S. C.
New Britain, Conn.	Portsmouth, Ohio
Racine, Wisc.	Ft. Lauderdale, Fla.

Group B-2 Applications:

Cities in Group B-2 are those in which one or more stations are now operating; all VHF channels, except educational, have been authorized; and only UHF channels are available for new stations. The cities are listed in the same manner as in Group B-1.

These break down as follows:

14 cities with 1 VHF station
5 cities with 2 VHF stations
7 cities with 3 VHF stations
2 cities with 4 VHF stations
1 city with 6 VHF stations
1 city with 7 VHF stations

There are 30 cities in this Group, of which the first 10 are:

Albany—	Wilmington, Del.
Schenectady-Troy	Lansing, Mich.
Grand Rapids, Mich.	Binghamton, N. Y.
New Haven, Conn.	Greensboro, N. C.
Utica-Rome, N. Y.	Lancaster, Pa.
Erie, Pa.	

Group B-3 Applications:

Cities in Group B-3 have no VHF stations now on the air, but have VHF assignments and are located less than 40 miles from not more than one operating VHF station. There are only 8 of these cities, and they are listed in this order:

Des Moines, Ia.	Winston-Salem. N. C.
Hartford, Conn.	Altoona, Pa.
Tacoma, Wash.	Petersburg, Va.
San Jose, Calif.	Mesa, Ariz.

Group B-4 Applications:

Cities in Group B-4 are those with only one VHF station now on the air, and are located 40 miles or more from any other station. There are 24 of these cities, listed as to priority in the order of population. All but two, Albuquerque and Huntington, have over 100,000 population, while the top 6 have over 500,000. The top 10 are:

St. Louis	New Orleans
Pittsburgh	Seattle
Buffalo—	Kansas City, Mo.
Niagara Falls	Indianapolis
Milwaukee	Memphis
Houston	

Group B-5 Applications:

Cities in Group B-5 are those less than 40 miles from two or more VHF stations now on the air. There are only 10 such cities, listed as follows:

Ogden, Utah	Boston, Mass.
Provo, Utah	San Antonio, Tex.
Ft. Worth, Tex.	Omaha, Nebr.
Providence, R. I.	Salt Lake, City
Minneapolis—	San Francisco
St. Paul	

UHF Stations First:

This system of priorities puts UHF in the lead on new construction in the large cities that will get the first new stations. The first 27 cities in Group A-2, all of 100,000 population or more, have been allocated 52 VHF and 57 UHF channels. Only UHF channels are available in the 140 cities comprising Group B-1. Of these, the 13 cities with over 50,000 population have been allocated 23 UHF channels. Only UHF stations can be added in the 30 Group B-2 cities. All but 2 are of more than 50,000 population. Thus, in this big-city group, where the greatest activity can be anticipated, there are channels available for 71 UHF stations, but none for VHF. There are 11 VHF and 14 UHF channels to be assigned in the 8 Group B-3 cities. Groups B-4 and B-5 are made up of large cities, also. Of the 102 new stations to be authorized in Group B-4, 49 will be VHF and 53 will be UHF, while in Group B-5, of the 41 to be authorized, 16 will be VHF and 25 will be UHF.

Adding up the channels enumerated here, it appears that in the areas where greatest activity is expected, there are 128 VHF and 243 UHF channels available for assignment to new TV stations.

PATTERN FOR TV PROFIT

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

PART 3—FACTORS WHICH MUST BE CONSIDERED, AND CURRENT PRACTICE FOR DESIGN AND CONSTRUCTION OF TELEVISION LIVE-TALENT STUDIOS

TELEVISION studio design and construction depends to a considerable extent on knowledge of techniques utilized in the allied fields of radio broadcasting, motion-picture making, and the theatre, but is different enough from any of these that the subject merits more than passing consideration in this series. This is especially true in view of the high expense involved in building and equipping TV studios.

Because of the many aspects of studio design which must be evaluated in terms of the end purpose — efficient production of high-quality live television programs — it is planned to present a general discussion of the problems and requirements, after which the more important categories will be covered in greater detail. While such separate treatment is possible to some extent, the factors are so interrelated that there may be repetitive references. However, it seems that the perspective of design concept as a whole would suffer deterioration if the individual elements were isolated to a greater extent than has been done in this discussion.

General Requirements:

A television studio is, in one sense, a workshop.[1] It is built for the express purpose of producing a saleable commodity — pictures and sound that can be distributed to the television viewer in his home. Therefore, the same weight should be given to functional considerations as to the construction of any other commercial working area. Teamwork between the owner and his agents, the architect, and the builder is necessary for the satisfactory completion of the project. A great many details must be considered and settled by all the parties concerned, acting as a group, such as the layout of available space and the selection of building materials.

In all decisions, the team's primary consideration should be that of optimum efficiency. However, the future operating plans for the studio should be considered along with initial construction costs in making such decisions. The amount the owner can afford to invest in the studio, the type of programs for which it is intended to use the studio, and the frequency of use, all have a bearing on the optimum layout, construction methods, and materials.

Each studio construction job has its own peculiar problems, some caused by conditions in existing buildings, some by the proposed uses of the particular studio, and others by economical considerations. One important factor is the proposed location. The construction of a studio in the tower of a high building presents a set of problems entirely different than those for a basement location. Another is the availability of various types of materials in different areas. Because of such differences, it cannot be said in an absolute way that any specific materials are best for the construction of floors, walls, or ceilings. For example, in some localities cinder blocks make the best and most economical wall and partition structures, while in other areas cinder blocks may cost too much or other factors may preclude their use. Also, building codes vary, and may determine the type of materials used. Finally, a factor that may not be obvious to everyone is that of general construction practice in the area. Labor costs invariably increase if workmen are forced to handle unfamiliar materials.

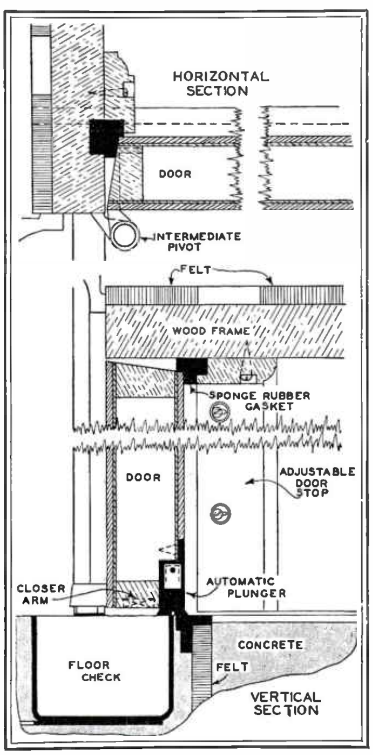


FIG. 1. DETAILS OF A SOUND-ISOLATING DOOR

Some requirements of radio and television studio construction are similar.

For instance, exterior and foreign sounds must be kept out, and sounds originating within the studio must be controlled rigidly. However, acoustic treatment is different in degree.

Suitable space must be made available for operating personnel and talent. Because of the necessity of providing room for stage-type lighting, flats, props, and sometimes cycloramas and drops, in addition to camera working space, a TV studio must be larger not only in floor area but in height. Door openings should be large enough to accommodate large props and pieces of scenery flats. They should be of the soundproof type, with rubber gaskets for heads and jambs, and felt plungers at the bottom. Hardware should be extra heavy. Kick and push plates should be installed on service entrance doors.

Sound locks should be utilized at all studio entrances, except where very large stages are involved. These consist of two individual sound-treated doors separated by a short, acoustically-treated passage. One of these doors is shown in Fig. 1. The door itself is of solid wood 2½ ins. thick, and in the closed position fits snugly against a sponge-rubber gasket all around its perimeter. Hinges are of the pivot-type, to provide better closure. An automatic closing mechanism is utilized at the bottom of the door. Also, a plunger operates on closure of the door to project a piece of felt from the door down into a recessed opening.

[1]This section was prepared in part by Charles F. Dalton, of John Lowry, Inc., Builders, 52 Vanderbilt Avenue, New York 17, N. Y.

Doors of this type provide the high degree of sound isolation necessary. It will be noted also that the door framing impinges on felt padding at all points.

Every opening in the walls enclosing a studio, whether it be a door, a window, a duct opening, a conduit, or an outlet box, should have special treatment to prevent sound transmission. This treatment will vary according to the type of construction, the space available, and equipment location.

Windows should be double-glazed, with different glass thicknesses, and the panes should not be parallel. The glass on the studio side of the window should be pitched, and not closer than 5 ins. to the other pane at the closest point. Felt or rubber lining should be used for the set-in window frame. If glass partitions are required, they should be constructed in the same manner.

Television lighting requirements increase substantially the air-conditioning loads for studios, and introduce new and intricate problems in the design of air-conditioning equipment. Large volumes of cool air must be delivered in such a way that drafts and noise are not created, nor the movement and use of scenery hampered. Ductwork terminations in the studio should be located so that cool air is not wasted on space occupied by equipment, but not used normally by personnel; this practice can provide substantial savings in air-conditioning equipment and operating expenses.

Where a duct passes through a studio wall, it should be enclosed before entering the studio in order to prevent sound transmission from outside. Installing the duct above a hung ceiling is very effective. The duct should be lined with acoustic material or provided with sound traps. Sometimes both are necessary. Neither supply nor return ducts should be run through another studio if it is possible to avoid doing so. They should be routed through service space all the way to the fan room. Flexible connections, usually in the form of canvas collars, should be employed, and the air-conditioning units should be installed on vibration-isolating foundations of the best type.

Electrical conduits present the same sort of problem, to a lesser degree. They should be run outside the studio also. Good practice indicates the use of flexible connections wherever conduit enters the studio, and for joints to panel boxes, outlet boxes, and switches. It is recommended also that such items be surface-mounted, for it would be necessary in most cases to cut out part of the sound-isolating material in order to flush-mount them on a wall. In many installations, the switches or boxes protrude slightly beyond the acoustic treatment.

When two studios adjoin, a double partition wall between them should be employed. Where openings between them are required for windows, doors, or duct-work, each partition should be treated as the enclosing wall of a studio.

All masonry work, whether on an enclosing wall or a partition wall, should be examined very carefully, and all holes or voids filled before acoustic treatment is applied. This matter is more important than it may seem, for the location of sound leaks after acoustic material has been fastened down is a long and expensive process.

A popular type of partition wall where sound isolation is required consists of two walls of 4-in. cinder blocks, with an air space between. The use of double walls provides greater isolation for a total given materials weight than a single, thicker wall. Of course, acoustic material is applied to the walls also. A partition between studio and control room can be single in most cases. Outside bearing walls are usually fairly thick in any case and, except in very noisy locations, can be of single construction. Where one studio is located above another, double construction should be employed for the ceiling of the lower studio in order to provide adequate sound isolation.

One way to avoid the expense of sound isolation between studios (in addition to other advantages) is to place the control rooms for both studios between them, as was done at DuMont's station WTTG in Washington, D. C. Part of the floor plan is shown in Fig. 2. It can be seen that the studio control area is roughly a square, with about half the available space devoted to controls for each studio. The audio control operators have individual booths, so that their monitor speakers do not distract the directors. These booths are elevated slightly so that the audio operators can see over the heads of the directors into the studios. The master control room and film-projection rooms are above the studio control areas. In addition to master control functions, all camera control and switching operations are handled here also.

The floor of a television studio should be as close to perfectly flat as it is possible to make it, no matter what the construction. This is because cameras must often be moved while pictures from them are being transmitted. These are called dolly shots. The slightest bump or waver in the floor is noticeable as a sudden shift in the picture frame, which is very disturbing indeed.

One form of construction for the studio floor, which has proved to be quite satisfactory, consists of a network of steel beams over the standard building floor, usually a concrete slab. Conduit is laid and the space between the beams is filled with cinders or some other light-weight fill material. Then, about

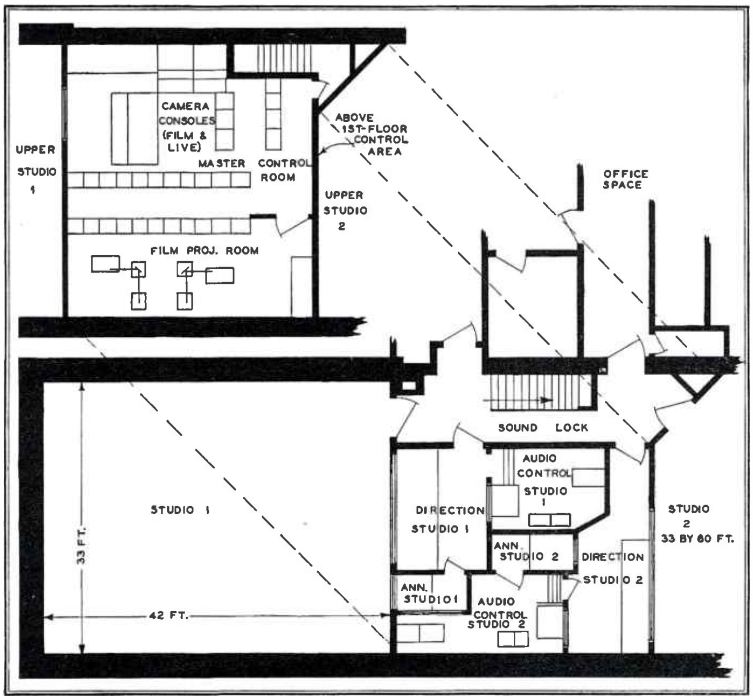


FIG. 2. LAYOUT SHOWING HOW WTTG CONTROL ROOMS AND FILM ROOM ARE LOCATED BETWEEN TWO STUDIOS, INCREASING EFFICIENCY AND ELIMINATING NECESSITY FOR DOUBLE WALL CONSTRUCTION

1½ ins. of cement is poured and leveled off. Fig. 3 shows one of the WTTG studio floors in process of construction.

The perfect TV studio floor would be like a sheet of glass, although this precision cannot ordinarily be obtained without special construction. It helps to specify screeds as close together as practical. and to exercise special supervision on this part of the work. The usual type of expansion joints cannot be utilized; however, blind joints should be provided.

If the studio is to be built in an existing structure with wooden floors, care should be taken to ascertain that the floor concerned is capable of supporting the expected weight load, that it is in good condition, and that it has no free movement or squeaks. If it meets these requirements, it can probably be used safely as a base. If it does not, however, the finished surface may warp or crack, and it will usually save money and headaches in the long run if the wooden floor is repaired or replaced at the beginning. One generally satisfactory treatment for an existing wooden floor consists of a layer of felt over which ¾-in. plywood sheets are laid, and screwed down to the original floor. A standard finish covering is then applied to the plywood.

The final floor covering may be linoleum, asphalt or rubber tile, or rubber sheeting. Other surfaces such as magnesium oxychloride or even plain cement have been used, although they are harder and, for many purposes, less satisfactory than the coverings listed above. In some cases, stations have used cement floors at first and later covered them with tile or sheet material.

Tile floors are more easily damaged than sheet-covered floors, since heavy equipment or sets dragged along a tiled floor causes picking at the corners and joints of the individual tile sections. Sheet rubber is probably the most satisfactory flooring material, but is also the most expensive.

Building vibration is not ordinarily troublesome, although it may turn up in unexpected places. Certainly, if there is any reason to suspect trouble from vibration, it will pay to check any proposed location before plans for studio construction are carried very far. Subways, for instance, are known to be troublesome in the New York City area. Very heavy machinery in the same building as a proposed studio can produce severe vibration in some cases. If there are railroad tracks in the vicinity, train rumble may be transmitted to the building, depending on the type of ground and the building foundation. Where vibration is encountered, special construction must be employed to isolate the studio. WGN in Chicago is located in the same building with heavy printing presses, and it was found necessary to float the entire studios on cushions of air in order to provide the degree of isolation required. Studios for WPIX are also in the same building with printing machinery. Fig. 4 is a cross-section of the inner studio wall, ceiling, and floor construction, which shows that each is suspended within the outer rigid shell. Framework for the floor rests on isolater units consisting of many layers of felt, as is shown in Figs. 5 and 6. In some cases, it will be found economically impractical to undertake such elaborate special construction.

It is necessary occasionally to construct the floor so that it affords considerable sound isolation from a room below. In such a case, some sort of double construction must be utilized. Fig. 7 shows a popular type of sound-isolating floor, as used for NBC's Radio City studios. Steel I-beams were used as joists, resting on felt pads and isolator strips. After filling with cinders, concrete was poured and leveled, and linoleum or rubber sheet applied.

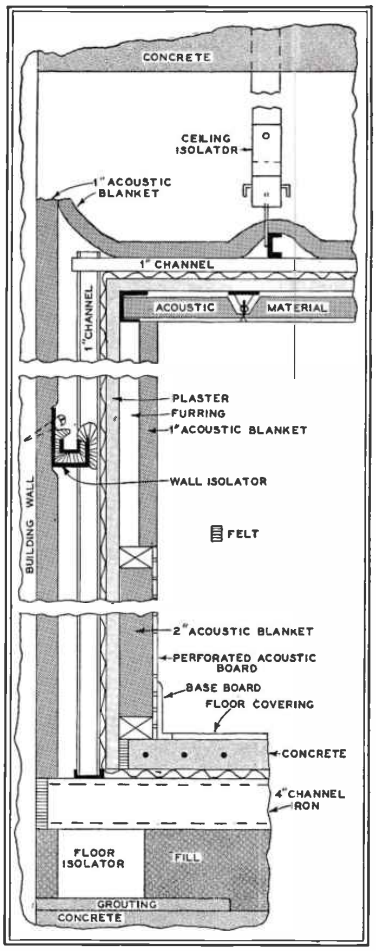


FIG. 4. WPIX STUDIO WALL, CEILING, AND FLOOR CROSS-SECTION SHOWS THAT ALL ELEMENTS OF THE STUDIO ARE ISOLATED FROM OUTER SHELL

Where sound isolation is desired from a relatively quiet room overhead, a suspended ceiling is usually adequate. Typical construction for this type of ceiling is shown in Fig. 8. It will be noted that this type of ceiling construction has another advantage in that air-conditioning ducts can be concealed easily, and duct noise is reduced considerably.

The ceiling, of whatever type employed, must be high enough so that lighting equipment can be installed with ample clearance for microphone booms and camera cranes, as well as large sets and flats. Where provision is made to fly sets and props (elevating them, moving them on traveling hoists along the ceiling, and dropping them where desired), the ceiling height requirement is increased considerably.[2]

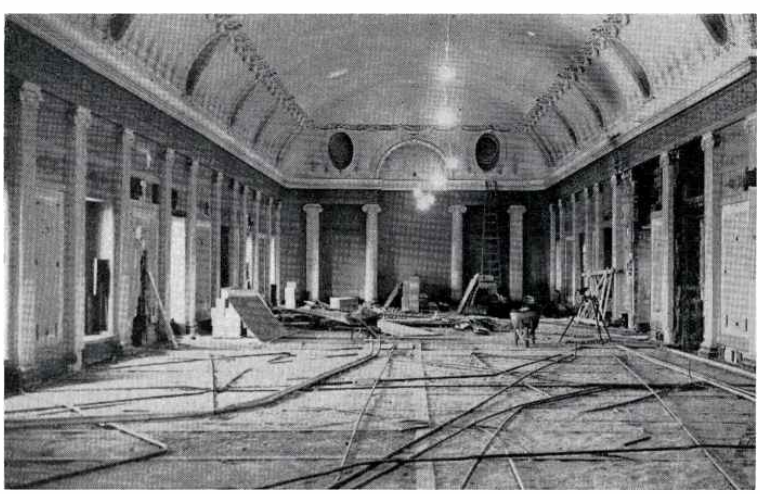


FIG. 3. WTTG STUDIO IN PROCESS OF CONVERSON. NOTE STEEL BEAMS AND FILL FOR THE FLOOR

[2]See "Pattern for TV Profit," Part 2, RADIO COMMUNICATION, April, 1952, page 16.

Studio lighting control equipment may consist of a simple switch panel, a patch panel and manual dimmer system, or an electronically-operated system. Electronic dimmer boards are coming into wide use because of their great versatility and because the control panels are small enough that they can be located conveniently. Also, they are now only slightly more expensive than conventional systems.

Lighting control is an operating function that is often minimized in im-

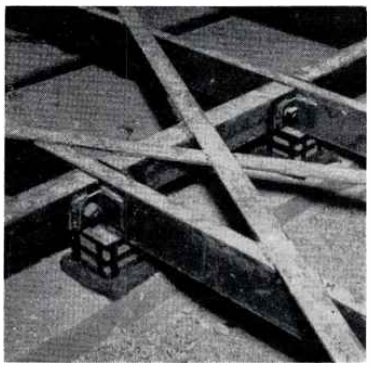


FIG. 6. A DETAILED VIEW OF ISOLATOR UNITS

portance. Possibly the best location for the control equipment would be a separate booth with a picture monitor and a view of the studio. Ordinarily, however, it is located on the studio floor because there is no other place for it. In a theatre installation, the control switchboard is often placed in the wings at stage level. Where it is located close to the production area, within microphone range, it is important that silent-operating switches be employed.

Air Conditioning:

Air-conditioning equipment[3] for studios and control rooms is bulky and expensive, but is almost always necessary. The tendency in recent years is to install master systems which can be controlled in such a way as to provide maximum cooling where it is needed most.

Most heat is generated by the lighting equipment in a studio. In order to estimate the heat load for air-conditioning purposes, some figure in the range of 25 to 35 watts per square foot of studio floor area is usually employed. This may be changed for color television, since it is probable that more light will be required for good color pickup. Also, if the studio is in a temperate, *dry* climate (such as a mountainous area) the figure given can be reduced somewhat. The load in a control room is based on the amount of equipment to be installed.

A figure used very often is that of 1 ton of air-conditioning capacity per 100 sq. ft. of floor area. Where an audience is to be accommodated, 1 ton for each 15 to 20 persons in the audience is added to the figures.

Chilled-water air-conditioning systems are most often used for TV plants even where they are not required by local ordnances. In many localities, it should be noted, direct-expansion systems are prohibited under regulations concerning places of audience assembly.

Use of the chilled-water type of system permits the installation of actual refrigeration units at any convenient place, with the fans and air-handling systems at other points. The chilled water can then be directed to whatever group of air units desired, in any relative amounts desired. Thus, it is one of the most flexible and easily-controlled systems. Fig. 9 shows the refrigeration units being installed at WCAU's new radio and television production center in Philadelphia. Two 200-ton compressors, either of which can carry all the load on an emergency basis, feed 11 separate air-handling systems which service various parts of the building. Note that rubber piping is employed, in order to minimize vibration transmission.

The figures given previously for determining capacity requirements should be employed only for preliminary estimates, of course. Final capacity requirements should be based on the actual heat dissipation to be handled, in addition to the size of the audience. However, it is not necessary to provide air-conditioning to handle the maximum heat loads in all areas simultaneously. Even when only one studio is employed, it is unlikely that all the lights would be turned on at one time. Most shows utilize one stage area for the whole production, or move from one relatively small staging area to another in sequence. Thus, a factor of 75 to 90%, depending on studio size, is applied to the maximum heat load from lighting for a single studio. Where more than one studio is cooled by the same diversity system, the factor may be reduced to 50 to 70%.

The capacity required can be held to a minimum by careful placement of the mouths of the studio inlet and exhaust ducts. One method consists of side wall inlet duct installation, with adjustable grilles. These are set as low as possible, considering the interference to their operation that might be caused by other equipment, so that the heat given off by the lights collects in a warm air pocket near the ceiling which is not disturbed by the supply-air flow. The warm air is drawn off through exhausts at the ceiling level, and is cooled and mixed with about 20% fresh air before being returned to the studio. Care must be taken that no flats or large props are placed in front of the inlet duct grilles. This is sometimes a difficult and annoying problem.

In another type of system, air is both supplied and exhausted through duct mouths on the side walls. Still another system utilizes Anemostats or equivalent units, either fixed or movable, which hang from the ceiling and force the conditioned air downward. Exhausts are located on the side walls.

Duct systems for cooling control rooms are similar. However, an air exhaust system is ordinarily used to supplement the air-conditioning unit. Air drawn through the equipment racks is usually exhausted out of doors, with no return through the system. Wherever heated air can be exhausted directly out

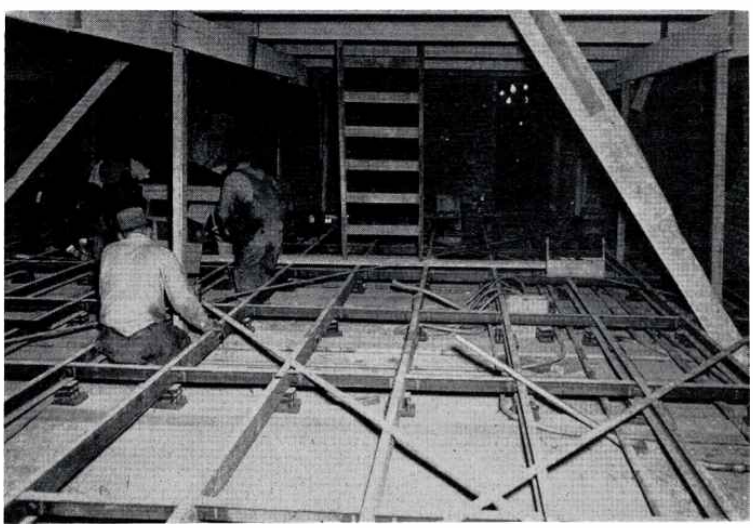


FIG. 5. FLOOR CROSS-BRACES FOR WPIX STUDIO ARE SUPPORTED ON SPECIAL JOHNS-MANVILLE ISOLATORS. THIS WAS REQUIRED FOR ADEQUATE REDUCTION OF VIBRATION CAUSED BY NEWS PRESSES

[3]This section was prepared in part by Don V. Petrone, of Typhoon Air Conditioning Company, Inc., 794-6 Union Street, Brooklyn 15, N. Y.

of doors, a saving can be made on air-conditioning expense.

One of the main problems encountered in air-conditioning installations is that of keeping the noise level low enough so that studio microphones do not pick up fan noise or vibration, air rush, or noise from other studios or rooms conducted through the ductwork. Steps which are usually taken to accomplish this are as follows:

1) Limiting air velocity to 1,000 ft. per minute in ductwork within the studio, and to 500 ft. per minute at inlet and exhaust grilles. Exhaust velocities of 300 ft. per minute maximum are recommended in many instances.

2) Running ducts above suspended ceilings, as in Fig. 8.

3) Using an internal lining of acoustic material in all ducts. This may be Fiber Glass, Cabot's Quilt, or some similar acoustic blanket material. It may be necessary in some cases to subdivide the ducts into two or more parts, each lined with absorbing material, as illustrated in Fig. 8. This lining reduces noise and vibration from the fans and from air rush.

4) Sound traps or baffles may be required in some cases, in addition to the acoustic lining.

5) Designing the air-handling equipment and the compressor units for minimum vibration and noise. This is accomplished by mounting the blowers and the compressors on sound-isolating bases, and by employing flexible couplings.

6) Where one main duct serves two or more studios, the connections to the main duct should be at least 15 ft. outside each studio.

Air filters should be employed extensively. In urban areas, air is sometimes filtered as it enters the building and again as it enters the studio or equipment rack. Even then, it has been found that grease and soot can accumulate on equipment. This may, in time, cause trouble.

The cost of air-conditioning systems may run from $500 to $1,000 per ton capacity, with the usual figure between $700 and $800 per ton. A typical studio 40 by 60 ft., without audience seating provision, may require 20 to 25 tons. If this studio is the only one served by an air-conditioning system, the total cost installed may be about $25,000 to $30,000. If it is one of two or more studios, this cost will be reduced considerably.

Local water conditions and regulations may permit the use of cool well water for air-conditioning purposes. If this is possible, the refrigeration units can be reduced in capacity or eliminated altogether, with significant savings.

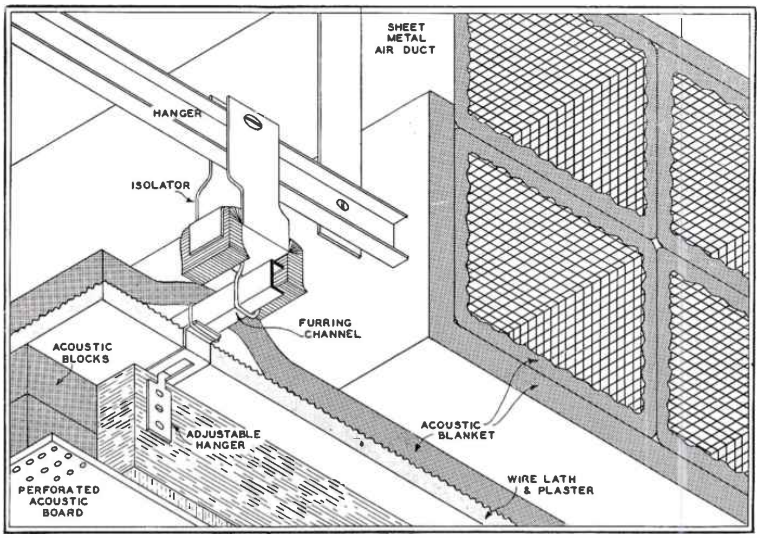


FIG. 8. HOW A SUSPENDED CEILING CAN BE CONSTRUCTED FOR REDUCTION OF NOISE FROM ABOVE

Acoustic Treatment:

Probably the most strict and unvarying requirement in television studio construction is for acoustical deadness,[4] or very short reverberation time. This is brought about by a number of cumulative factors which make TV sound pickup different from that of ordinary audio broadcasting.

There are, ordinarily, more people in motion in a TV production who are not connected with the scene being televised, and they all contribute (albeit inadvertently) to the extraneous noise level. Air-conditioning equipment is not always as quiet as it should be. Prop men and stage hands may be moving objects in preparation for the following scene. Camera cables dragging or whispered instructions may be picked up by a microphone. In order to keep the microphones out of camera range, they are usually 3 or 4 ft. from the performers, and for this reason the gain must be turned up higher. Thus, it can be seen that as high a ratio of direct-to-reflected sound as can be obtained requires a non-reverberent room, and one in which noises are minimized by absorption.

Props and flats used as sets are, in most cases, very live. They may provide, in themselves, sufficient liveness for most TV productions. Where more liveness is desired, it can be obtained with an echo chamber in the microphone channel.

Rock wool or Glass Wool blanket, or

Figs. 1, 7, and 8 reproduced by permission of *Broadcast News*.

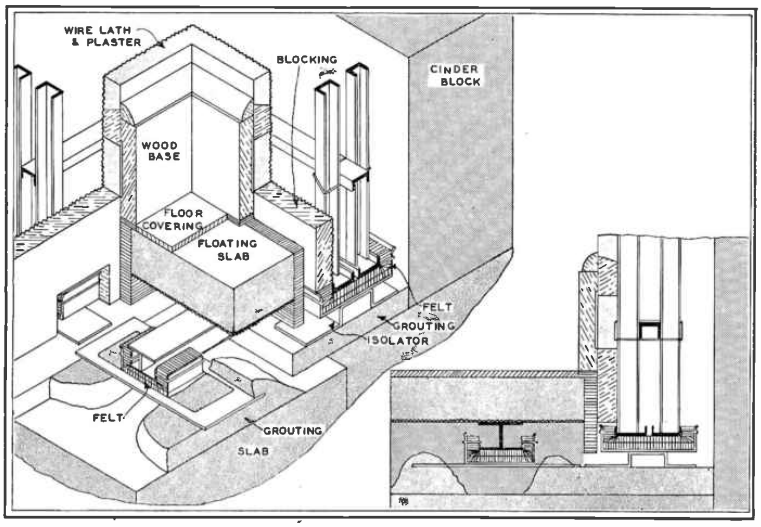


FIG. 7. ONE WAY TO PROVIDE GOOD SOUND ISOLATION BETWEEN STUDIOS OR FROM NOISE BELOW

[4]This section was prepared in part by M. J. Kodaras, of Johns-Manville Sales Corporation, Building Products Division, 270 Madison Avenue, New York 16, N. Y.

equivalent products marketed under various names, are used extensively for acoustic treatment. This is fastened directly to studding and is protected by wire mesh in a studio. Ordinarily, the ceiling is completely covered and the wall area is covered from 50% to 100%. Fig. 10 is a view of a studio at WCAU in process of construction. The ceiling

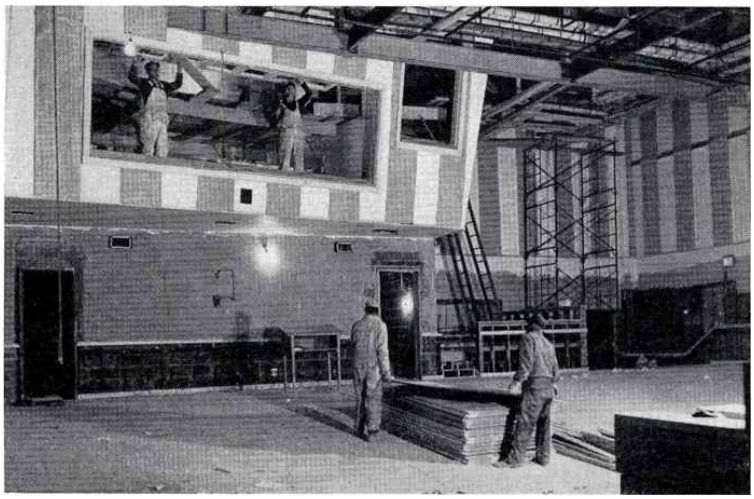


FIG. 10. WCAU STUDIO IN THE CONSTRUCTION STAGE, SHOWING NOVEL USE OF ACOUSTIC BLANKET

is completely covered with rock-wool blanket. The walls are covered partially by strips 2 ft. wide and separated by 2 ft. Blanketed strips on one wall are directly opposite bare strips on the other wall.

The blanket strips are self-supporting, and wire mesh can be eliminated if desired except in the audience areas and on the lower portions of walls. It serves no purpose other than protection. They may also be covered by perforated acoustic board, which has little effect on the absorptive qualities and improves the appearance.

Control rooms, client's booths, and sound locks are usually treated in the same manner as for radio broadcasting. Ordinarily, this consists of 2-in. rock-wool or Fiber Glass blanket covered by perforated asbestos board. It is applied to the ceiling and two adjoining walls except for sound locks where, of course, it is applied to all surfaces except the floor and doors. Fig. 11 shows the neat appearance of this treatment when applied to a control room.

One disadvantage of perforated acoustic board is that the absorptive qualities are likely to suffer severe deterioration when the board is painted. After 2 or 3 coats of paint, it is doubtful that any appreciable absorption is retained, other than that of ordinary board.

Cost of acoustic treatment varies according to the extent of treatment, studio size, and labor costs. However, a fairly generous estimate for a studio 40 by 60 by 20 ft. would be around $4,000, assuming partial wall treatment.

Electrical Requirements:

Because the electrical supply system of a TV studio is so interrelated with that of the complete station, this section, prepared by Bernard Eichwald,[5] is expanded to consider the power system of an entire television plant.

Each of the following categories consists of items for which power requirements should be considered separately: 1) General light and power circuits, 2) Air-conditioning, 3) Elevators, 4) Pumps and general house machinery, 5) Studio lighting, 6) Rehearsal rooms, 7) Dressing rooms, 8) Studio outlets, 9) Studio control rooms, 10) Projection room, 11) Dressing room call and other intercom facilities, 12) Master control room, 13) Rack rooms, 14) Telephone and other terminal facilities, 15) Maintenance shop, 16) Electric clock circuits, 17) On-air rehearsal light circuits, 18) Paint shop, 19) Carpentry shop, 20) Prop storage room, and 21) film recording equipment. If all these facilities are not provided initially, it is a good idea to plan the power layout so that they can be accommodated when expansion is contemplated. It is usually found that additional service needs arise in any TV plant that were not anticipated originally. Inadequate provision for such contingencies in the beginning can be very costly later on.

Input power service should be 3-phase, 4-wire AC at 120/208 volts, in order to operate at lowest cost and maximum efficiency. This is required in most cases although, where a remote transmitter is employed at a small station, it is feasible to operate on 120 volts only. At the transmitter of such a station, 120/208 should be provided. For economy of installation and best voltage regulation, the transformer vault should be located close to the load-center.

Main distribution panels are required with sufficient capacity to permit future expansion, and feeder distribution sufficient to assure maximum dependability

[5]B. Eichwald & Company, Inc., 237 East 39th Street, New York 16, N. Y. Mr. Eichwald's company was the contractor for the erection of the new TV tower on the Empire State Building, and handles the design, construction, maintenance, and operation of all electronic facilities at the United Nations, as well as TV and radio installation and construction for most of the major networks.

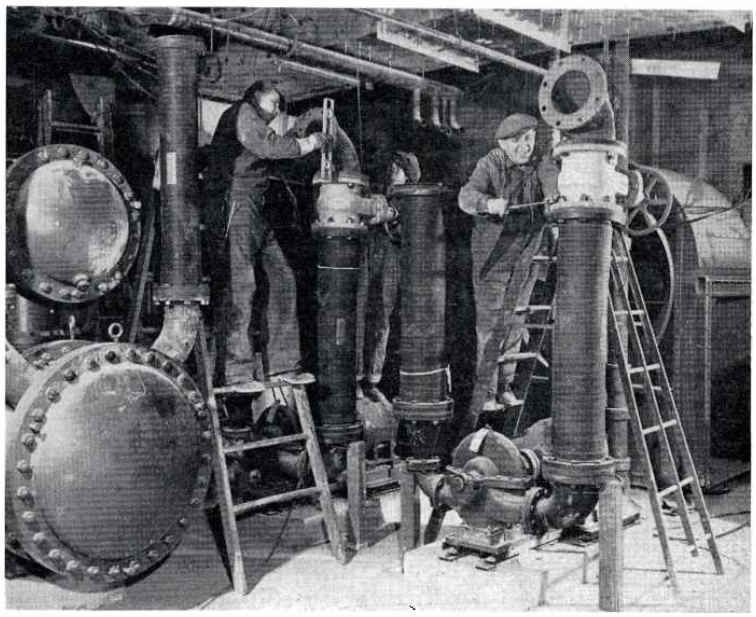


FIG. 9. AIR-CONDITIONING UNITS BEING INSTALLED AT WCAU. NOTE USE OF FLEXIBLE COUPLINGS

of operation. Separate feeders should be provided for general power and light circuits, air-conditioning and house machinery, studio lighting. audio and video power, and emergency power.

Provision for emergency primary power can be be accomplished by obtaining two distinct source connections from the electric utility company. Emergency engine-driven generators may be provided for the transmitter. All emergency service should be contemplated on the basis of minimum to maximum power requirements during normal load failure, to provide overall special circuitry in the basic design.

The general lighting fixtures for offices and public areas should be chosen in accordance with the architectural arrangement and color scheme. Choices are available between flush and suspension-type lights; incandescent and fluorescent types; and direct, semi-indirect, and indirect lighting. Special provisions are usually desirable for entrance, area, and lobby lighting, and for decorative effects. On air-Rehearsal signs, step lights. and exit lights are usually necessary for studios. Special lighting for control rooms is required to eliminate glare. It is a good idea to furnish flexible or reel-type lighting fixtures at equipment racks to facilitate maintenance.

For studio lighting, there should be a completely flexible cabling system to meet the requirements of all types of shows. Incandescent alone or incandescent and fluorescent lights can be employed. Fluorescent lights have the advantage that they do not produce as much heat for a given light output as do incandescent, but they do not give as desirable a quality of light as do incandescent types. Means should be provided for silent switching and dimming. Wireways should be planned in relation to fixture layout and control board location to facilitate optimum load center distribution and installation economy.

Electric clock circuits will depend on the criticalness of the timing requirements. In some localities, the frequency stability of the AC line voltage will be sufficient for the station's requirements. In others, however, it may be necessary to employ the time services of Western Union, IBM, American Time Company, or a similar organization.

Distribution panels should be positioned to provide the best load center location insofar as possible. Circuit-breakers may be employed entirely, or may be used on some circuits and fuses on others, depending on the relative importance of the circuits concerned. For instance, office lighting circuits may be fused. Adequate provision for spare circuits and alterations to load circuits should be made.

FIG. 11. PERFORATED ACOUSTIC BOARD, APPLIED OVER ACOUSTIC BLANKET ON CEILING AND WALLS OF CONTROL ROOM, AFFORDS ADEQUATE SOUND TREATMENT AND IS PLEASING TO THE EYE AS WELL

Conduit circuits needed for audio equipment include those for power supplies, amplifiers, audio consoles, turntables, intercom, cue, and audience reaction audio circuits, sound effects equipment, studio microphones, loudspeakers, and sound reverberation facilities. Those for video equipment include power supplies, amplifiers, cameras, video consoles, master, studio, and audience monitors. sync generators, film control equipment, special effects equipment, and film and slide equipment. These need not necessarily be installed in individual conduits. Many can be grouped and run in ducts or raceways, thus facilitating maintenance work as well as cutting installation costs. However, care should be exercised that mutually-interfering circuits are not run together. Low-level audio circuits, for instance, should not be close to those for AC power.

Intercom circuits required are ordinarily extensive, and must be designed on an individual basis. Special circuits must be provided for the audio and video maintenance shop. Outlets at various strategic places for soldering irons and test equipment will pay dividends in faster, more efficient on-the-spot repairs.

Considerable economies can be effected by specifying standard stock parts for items of general construction such as pipe, wire, and outlet boxes. Standard panelboards, pullboxes, and similar equipment should be selected with regard to available space, ease of installation and maintenance, and applicability to expansion. These precautions do not generally increase the initial cost and are likely to save considerable time and money at some later date.

All material should meet the standards of Underwriters Laboratories, Inc., where these standards have been established. Care must be taken to ascertain that the installation complies with local codes as well as with the standards of the National Electric Code, and with the regulations of the local electric company furnishing the power.

All metallic conduit, supports, cabinets, and equipment should be grounded carefully to a common point. Usually, connections are made to a copper strip which is then fastened to the building ground. This may be on the street side of the water meter.

Separate plans should be made for power and light circuits and for audio and video interconnections. This information should not be put on the building plans, but on separate tracings devoid of details not essential to the electrical work. There should be included schematics of special systems (such as telephone facilities), and any items to be installed in part. The procedure for future work should then be indicated clearly. A logically-planned and coordinated system of circuit numbering for power and light circuits, with particular consideration to the many audio and video cables, will prove to be of great assistance in avoiding confusion.

Space for present power panels, switchgear, and racks should be assigned with as liberal clearances as are practical, because this practice simplifies maintenance, replacement, and expansion.

Part 3 will be concluded next month

TV FILM PROJECTOR

NEW EASTMAN 16-MM TELEVISION FILM PROJECTOR COMBINES FINE PERFORMANCE AND RELIABILITY

FIG 1. THE NEW EASTMAN KODAK MODEL 250 PROJECTOR IS BUILT IN AN EXTREMELY RUGGED FASHION

FILMED program material finds an important place in the schedule of virtually all television stations. Most TV advertisers rely on short commercial films as the most convenient and inexpensive method of presenting their messages. Kinescope film recordings are to television what transcriptions are to audio broadcasting. News broadcasts, among others, utilize both motion-picture film and still film slides extensively.

Although 35-mm. film and equipment is generally satisfactory, it is very much more expensive than 16-mm. and, for this reason, the industry has employed 16-mm. almost exclusively. However, a serious problem in regard to picture quality has plagued TV users of 16-mm. equipment in the past. The Eastman model 250 television projector, shown on this page, is designed to overcome many of the factors which contribute to poor program quality from films. Fig. 1 shows the complete projector assembly, and Fig. 2 is a view of the upper section, showing the controls and the film-handling mechanism.

Mechanical Design:

In order to provide maximum reliability, the basic mechanism of the model 25 projector was employed. The model 25 is a heavy-duty auditorium motion-picture projector developed for use by the armed forces, and meets rigid JAN specifications. Its use was made possible by reason of its easy adaptability to the short pulldown requirement of television projectors.

In these projector mechanisms, the intermittent is isolated completely from the sprocket drive. This isolation is accomplished by the use of 2 synchronous motors, one driving each section of the mechanism. Such a design was employed originally to avoid coupling of shocks from the intermittent to the main mechanism and the sound system. As used in the television projector, it achieves this end and, at the same time, permits the spring coupling between the intermittent and its driving motor to be varied in order to obtain the desired angular pulldown.

A large shutter, driven by a separate 3,000-rpm 3-phase synchronous motor, controls the exposure within the retrace period. The shutter is located in such a manner as to cut the optical beam at a position that provides maximum light-output efficiency, while maintaining a 5% application time. A phasing circuit is utilized to obtain perfect synchronization in all sections of the mechanism.

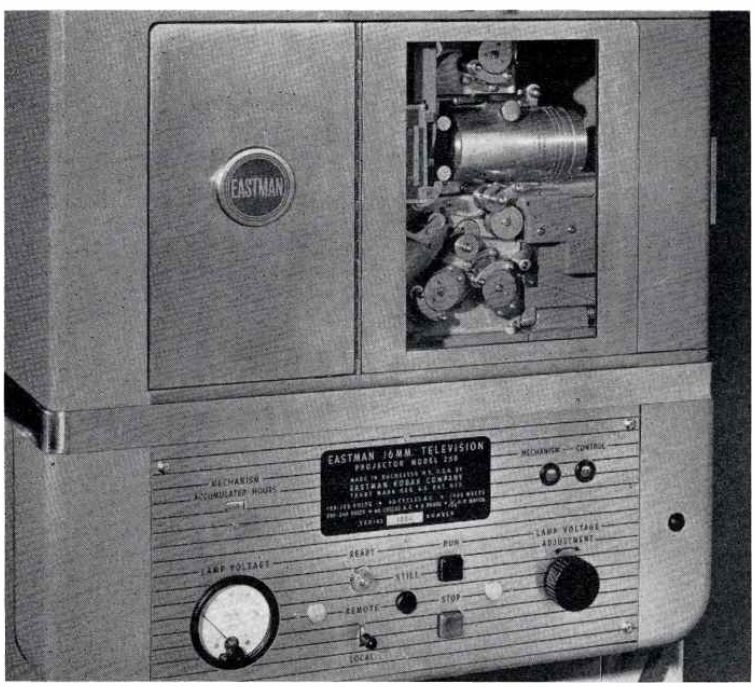


FIG. 2. DETAILS OF THE CONTROL PANEL, AND A PARTIAL VIEW OF THE PROJECTOR MECHANISM

Sound & Optical Systems:

The projector is fitted with an f/1.5 lens, corrected for aberrations at the recommended working distance, at which the magnification is 12 times. A 1,000-watt lamp, provided with a standby, furnishes ample light for an iconoscope camera. The system can be adapted for use with an image orthicon camera also.

In order to prevent image veiling, the infrared radiation of the lamp is filtered out. This, with the separately-driven shutter, permits continuous projection of a single film frame without damage to any part of the system.

The sound system incorporates a 2-stage preamplifier with equalization for slit and coupling losses. Flutter is claimed to be less than .2% rms; intermodulation .3% at + 4 dbm and 1% at + 14 dbm, the maximum output level; and signal-to-noise ratio, 57 db at + 4 dbm. Overall distortion with film input is said to be less than 5%.

The lamp voltage, as can be seen in Fig. 2, is metered and is adjustable con-

(Concluded on page 43)

BBC PULSED-GLIDE DISPLAYS

PART 1—OSCILLOGRAPH DISPLAYS SHOW PROMISE OF ASSISTING INTERPRETATION OF ACOUSTIC PHENOMENA — *By* T. SOMERVILLE AND C. L. S. GILFORD*

Since its perfection in 1935, the high-speed sound-level recorder has been used universally for most acoustic measurements, and has been satisfactory in many applications. The instrument has, however, certain limitations and disadvantages, and it has now been superseded for most of the BBC's work by direct-reading logarithmic displays on a cathode-ray oscillograph. This article deals with the application of new methods, developed in the BBC Research Department, to reverberation-time measurement and to the study of structural vibrations. It describes a new technique in which the behaviour of the studio over the desired frequency range is registered photographically.

THE invention of the high-speed sound-level recorder, and its development as a laboratory instrument by Neumann in 1935, rendered previous techniques for architectural acoustic measurements out-of-date. Before then, the study of transient effects in auditoria was hampered by the necessity for laborious determination of separate points on the time-level curve, or photographic recording of decay curves with the Duddall oscillograph. Examining decay curves on a logarithmic scale for reverberation times as short as a fraction of a second was not then practical, although it is now commonplace, nor could the fine structure of reverberation curves be observed.

The high-speed recorder is still used for most routine measurements. However, it has certain limitations, some of which cannot be overcome. In the first place, the maximum writing speed of recorders of this kind is limited. The Neumann Pegelschreiber, which utilizes magnetically-operated friction clutches, has a maximum writing speed of 300 db per second for a 50-db scale width. The Bruel and Kjaer recorder[1] recently introduced has a performance figure of 1,000 db per second, obtained by the use of direct electromagnetic forces on the recording pen, in place of an electromechanical servo system. Unfortunately, this system introduces considerable extra weight in the form of permanent magnets. Moreover, in any servo system in which displacement is proportional to control, hunting can be avoided only by good design and careful maintenance. There are disadvantages also in the fact that the apparatus produces records which require subsequent analysis. In many applications, the analysis of records increases greatly the total time of measurement. The permanency of the written record, though occasionally an advantage, is seldom necessary for routine measurements.

The system to be described, in which cathode-ray tube displays are employed, was developed to overcome the disadvantages and limitations of electromechanical recording instruments.

Possible Techniques:

The first attempt of the BBC to devise a means for obtaining a direct reading of reverberation time was made by C. G. Mayo of the Research Department in 1946.[2] The objective of his reverberation meter was to integrate the sound level vs. time during the whole period of the decay, and to compare this integral with the initial steady-state level. This device did not fulfil expectations since the steady-state level depended upon *both* the direct and reverberant sounds, whereas, for a correct measurement, the reverberant sound only should be taken into account. Therefore, the meter was inaccurate unless the microphones were remote from the sound source. An improved system, in which the integral over a short period of time after the cessation of the source was compared with the integral over the remainder of the decay, was experimented with subsequently. The apparatus was rather complicated and heavy, however, and was sensitive to supply voltage fluctuations. Also, it had in common with relay methods employed in the early 1930's the limitation that only the decay as a whole, not in fine structure, could be examined conveniently.

There are two alternative possibilities for obtaining CRT displays useful for

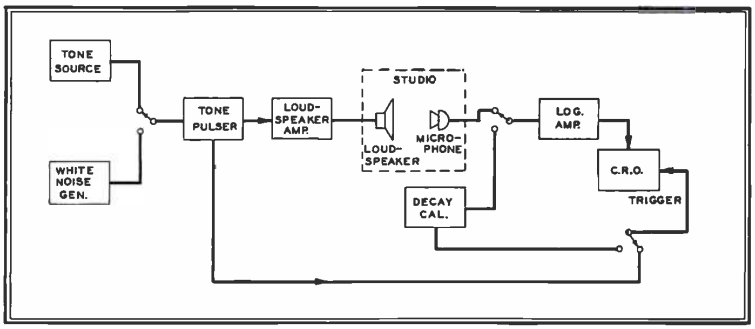


FIG. 2. BLOCK DIAGRAM SHOWING HOW THE EQUIPMENT IS SET UP FOR OBTAINING THE DISPLAYS

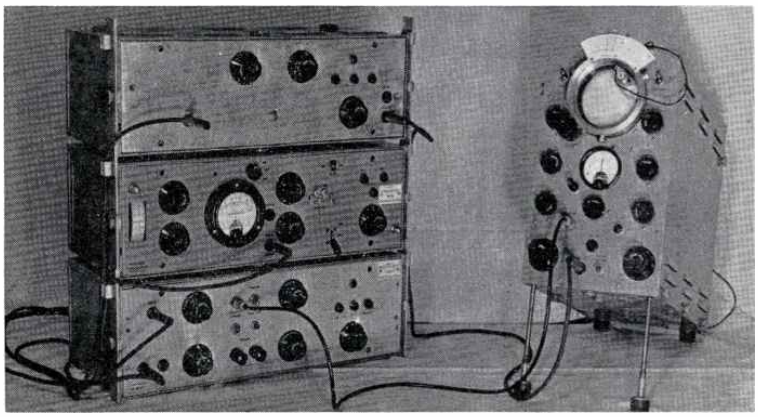


FIG. 1. EQUIPMENT USED WITH SPEAKER, MICROPHONE, AND CAMERA FOR THE PULSED-GLIDE TESTS

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

[1] P. V. Bruel and U. Ingard, "A New High-Speed Level Recorder," *JASA* 21, (1949) page 91.

[2] C. G. Mayo, R. H. Tanner, and W. Wharton, British Patent 652,384.

the purpose. An increasing-gain amplifier described by Tak[3] provides for the display of an exponential decay as a horizontal line by the suitable adjustment of a time-constant. The time-constant setting is a measure of the reverberation time. Since the display must he adjusted to correspond with a fixed reference direction, measurement by this means is a matter of trial and error.

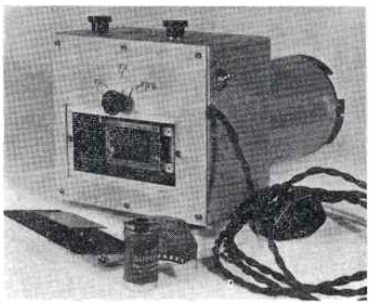


FIG. 4. THE MODIFIED OSCILLOGRAPH CAMERA

The second possibility is the development of a logarithmic amplifier providing a rectified output, so that a trace identical in form with that produced by the high-speed level recorder could be obtained on the CRT. By this means, a fixed trace can be compared for purposes of reverberation measurement with an adjustable reference slope, and the use of a persistent oscillograph screen permits setting the reference line in one operation. This method showed obvious promise, since no trial and error would be necessary, and for that reason it was followed up.

Logarithmic Display:

The apparatus for producing the required logarithmic display has been described in detail in papers by Mayo and Beadle.[4, 5] Fig. 1 shows the experimental apparatus used for reverberation measurement, and Fig. 2 is a block diagram of the experimental equipment chain. The source of sound is a loudspeaker radiating pulses of warbled tone. The pulses are usually comparable in length with the reverberation time, but wide variations in length are permissible without affecting results. Other sound sources have been investigated carefully, such as white noise and pistol shots, since they are favoured for reasons of simplicity by other workers in the field. They give results identical with the warble-tone results if, and only if, they are used in conjunction with bandpass filters 1/3 octave wide or less. The warble tone source gives equal results with either octave or 1/3 octave filters, and has been found to provide better correlation with subjective assessments than other methods using octave filters.

Microphone signals are passed to the logarithmic amplifier where, after linear preamplification, they are passed through octave filters connected between the preamplifier and logarithmic stages. The DC output of the logarithmic stages is applied to the vertical plates of an oscilloscope through its direct-coupled amplifier. The horizontal deflection plates are fed a time-base of variable speed, triggered by the finish of the tone pulse.

A goniometer, shown in Fig. 3, is attached by bayonet fasteners to the front of the oscilloscope. Parallel reference lines are engraved on the graticule, which is aligned with the trace by turning the projecting vernier knob. The reverberation time can then be read directly from the scale appropriate to the calibration. Three or four successive pulses are usually sufficient for an individual reverberation-time determination.

Reverberation times below 0.1 sec. have been measured with this apparatus. The writing speed can be varied over very wide limits. It is possible to measure reverberation times in small scale models, provided due regard is paid to the lower frequency limit.

Calibration:

The overall calibration and performance of the system can be checked by means of a decay calibrator, as described by Mayo and Beadle (loc. cit.). This instrument provides an accurately exponential decay at a level suitable for application to the logarithmic amplifier input. If the apparatus is working correctly, the oscilloscope trace will be a straight line whose slope can be changed independently by altering the decrement of the original decay or the time base speed. The decrement, which is adjustable for discrete values corresponding to reverberation times of .2, .4, 1, and 2 seconds, is set to the value judged most suitable for the room, and the goniometer is adjusted to read the same figure on one of the scales. Then, the time base is set to bring the slope of the line parallel to the graticule lines, thus completing the calibration.

An alternative method of calibration, which is less convenient but capable of better accuracy, makes use of the fact that the tone pulser is designed to provide accurate pulse lengths from .1 second to 2 seconds. It can be seen that rectangle ABCD, in Fig. 3, is marked centrally on the goniometer graticule. In order to calibrate the device, the logarithmic amplifier output and the oscilloscope time base speed are adjusted independently so that 1) the insertion of a 50-db attenuation moves the trace produced by a steady tone from AB to DC, and 2) the length of, say, the 1-second pulse is equal to AB. The reverberation time can then be read directly from the second scale of the goniometer. Other pulse lengths are used in calibrating to the other scales.

Pulsed-Glide Displays:

When investigating room acoustics, it is necessary to know not only the variations in slope along a time-decay curve, but also the variations in slope as a function of frequency. All methods of measurements so far have been restricted to the measurement of reverberation time at a few selected frequencies or bands. It should be obvious, however, that a complete panorama showing the characteristics at all frequencies simultaneously is most desirable. This has been accomplished in loudspeaker tests, by Shorter,[6] but the methods applicable to loudspeakers are useless in room-acoustic work, where the decay times extend to seconds.

While this paper was being written, F. J. Leeuwen[7] published an interesting method of obtaining continuous reverberation-frequency diagrams by the use of a level-recorder. In this method, however, the reverberation time at each frequency is represented by the length of a vertical line, and the shape of the decay curve is not shown.

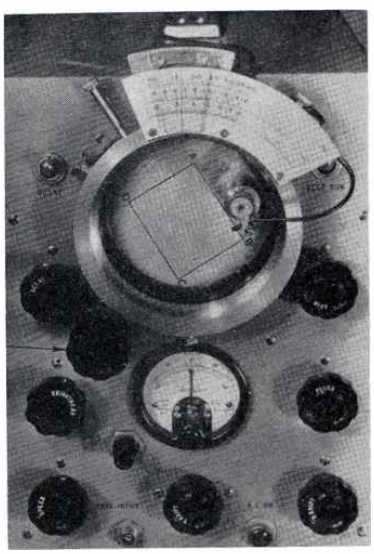


FIG. 3. SCOPE WITH THE GONIOMETER ATTACHED

(Continued on page 43)

[3] W. Tak, *Philips Technical Review* 8, (1948) pages 82 to 88.

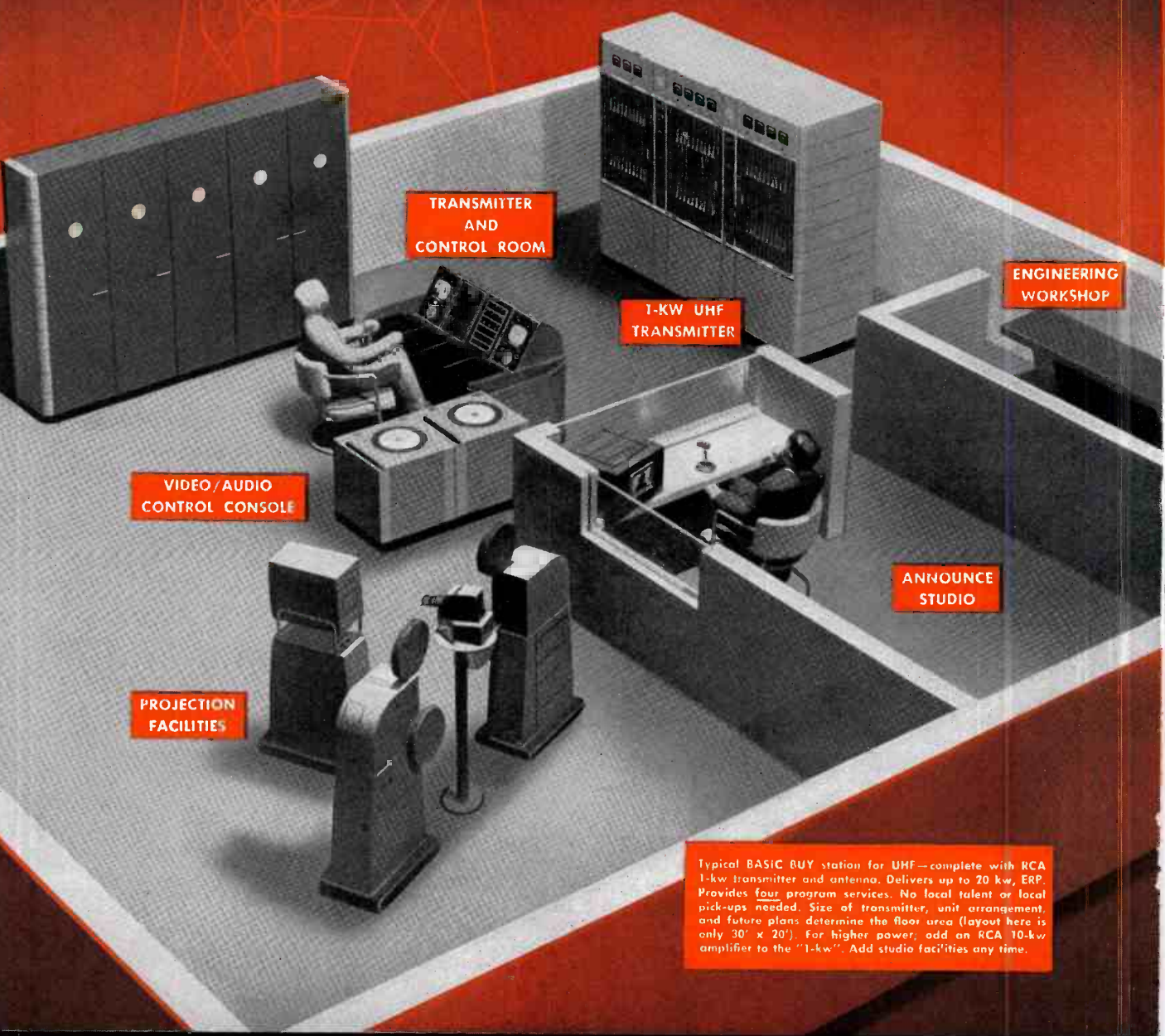
[4] C. G. Mayo, D. G. Beadle, and W. Wharton, "Equipment for Acoustic Pulse Measurement," *Electronic Engineering*, Nov. 1951.

[5] C. G. Mayo and D. G. Beadle, "Equipment for Acoustic Measurement," *Electronic Engineering*, Dec. 1951.

[6] D. E. L. Shorter, "Loudspeaker Transient Response," *BBC Quarterly*, Vol. 1, No. 3, October, 1946.

[7] F. J. Leeuwen, "Een Automatisch werkend Naglameettoestel," *Tijdschrift van het Nederlands Radiogenootschap* XVI, Jan. 1, 1951, pages 13 to 36.

RCA's TV "Basic"



Typical BASIC BUY station for UHF—complete with RCA 1-kw transmitter and antenna. Delivers up to 20 kw, ERP. Provides four program services. No local talent or local pick-ups needed. Size of transmitter, unit arrangement, and future plans determine the floor area (layout here is only 30' x 20'). For higher power, add an RCA 10-kw amplifier to the "1-kw". Add studio facilities any time.

"Buy" does the most

-with the least TV equipment

-VHF or UHF!

4 PROGRAM SERVICES
—no local studios needed!

- **Network programs**
- **Local films (16mm)**
- **"Stills" from local slide projector**
- **Test pattern from monoscope (including individualized station pattern in custom-built tube)**

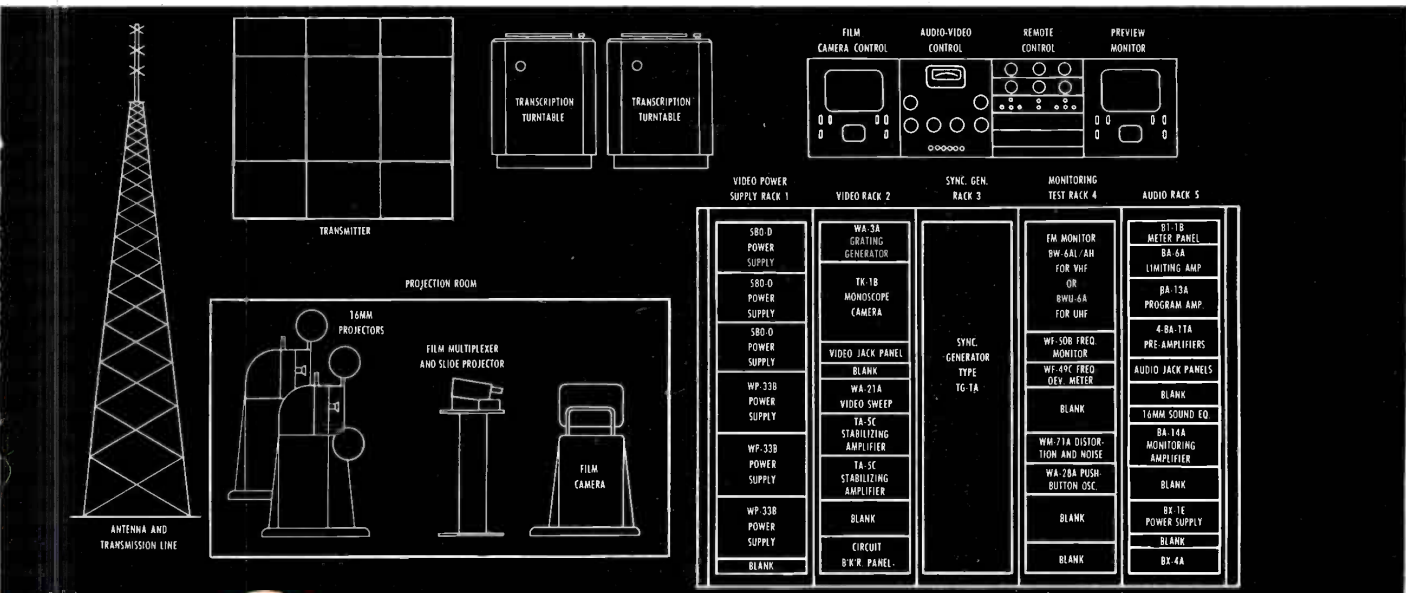
THIS PICTURE ILLUSTRATES what we think is the minimum equipment a TV station should have to start with—*and earn an income.* The arrangement can handle any TV show received from the network and provides station identification and locally inserted commercials as required. In addition, it offers an independent source of revenue—by including film and slide facilities for handling local film shows and spots, or network shows on kine recordings.

The BASIC BUY includes: A transmitter and an antenna (necessary for any TV station); monitoring equipment (required by FCC); film and slide equipment (for local programs—and extra income); monoscope camera for reproducing a test pattern of known quality (important for good station operation and as an aid to receiver adjustment); and a control console that saves operator time and effort (it enables one technical man to run the station during nearly all "on-air" periods).

RCA's BASIC BUY can be used in combination with any RCA TV transmitter and antenna, of any power—VHF or UHF. Matched design and appearance make it easy to add facilities any time (you need never discard one unit of a basic package). And note this: *RCA BASIC UNITS ARE IDENTICAL TO THE RCA UNITS USED IN THE BIGGEST TV STATIONS!*

RCA's BASIC BUY is already being adopted by many TV station planners. Let your RCA Sales Representative work out a flexible package like this for you—show you how to do the most with the least equipment!

This is what the BASIC BUY includes!



RADIO CORPORATION of AMERICA
ENGINEERING PRODUCTS DEPARTMENT **CAMDEN, N.J.**

High Fidelity at Low Cost with a

NEW SPEAKER SYSTEM

INEXPENSIVE 5-INCH SPEAKERS IN THIS SMALL ENCLOSURE PROVIDE WIDE-RANGE REPRODUCTION

THOSE who attended the meeting of the Radio Club of America in New York City on May 22 witnessed and heard a most remarkable demonstration of a high-fidelity speaker system developed by Dr. Jordan J. Baruch and Henry C. Lang of the M. I. T. Acoustics Laboratory. Dr. Baruch, in his very interesting talk, described the system as "the embodiment of a principle, just as the Model T Ford epitomized a principle in its time." He was referring to the concept that true high-fidelity performance can be achieved at extremely low cost.

The Baruch-Lang system employs four 5-in. cone loudspeakers in the enclosure shown in Fig. 1 to cover the full audio range without crossover networks. In a space hardly larger than a shoebox, the assembly radiates .1 acoustic watt (a deafening level in an ordinary living room) at 3% distortion. Response is flat within ± 3 db from 40 to 12,000 cycles, and the high-frequency angular dispersion is about 75°. Good response is maintained out to 15,000 cycles when the speakers are flush-mounted on the front of the enclosure.

The demonstration simulated the results that could be obtained in the home with an FM receiver driving this speaker system. High-quality tape recordings were employed as a source of program material. The output of the studio-type tape machine was fed to a miniature FM transmitter, whose signal was picked up by a Zenith Major receiver. The only change in the set was a modification to the output transformer. When the audio output was applied to the speaker system, it produced ample volume for the auditorium, which was considerably larger than any living room. Efficiency of the speaker system is about 5%, so that 2 watts input produces the full rated output.

During the course of the demonstration, the output of the tape machine was fed directly to a standard audio amplifier of expensive design, and then to the speaker system. The difference in quality was so slight as to be barely distinguishable. Both were astonishingly good.

Dr. Baruch described the enclosure as a modified acoustic phase inverter.

Rather than a conventional port, however, an array of small holes is employed to tune the box, as is shown in Fig. 1. Fifteen holes 15/32 in. in diameter provide the requisite port area for the ½-cubic foot volume of the box. Because the holes are distributed over a large area, the radiation impedance of the array is equivalent to that of a 21-in. cone. With the enclosure mounted in a corner consisting of any two planes at right angles, this effective piston area is quadrupled.

A single speaker of large cone size would have provided low-frequency performance equivalent to that of 4 small speakers. However, the small speakers have better high-frequency response and dispersion than a large single-cone speaker, and the four are considerably less expensive than a large coaxial speaker. The speakers employed are standard low-cost replacement units, modified to meet the requirements of the system. Dr. Baruch did not explain the modifications in detail, but said speakers of the modified design can be manufactured at lower cost than the original model.

Optimum dimensions of the cabinet and of the holes, as well as the configurations of the holes and the speaker array, are determined by the characteristics of the particular speakers used. Thus, each system of this type must be designed as a whole. Any given speaker requires a cabinet of specific proportions and dimensions in order to provide optimum results. For that reason, it is not recommended that the cabinet described here be used with any speakers other than those designed for it. No exact date was given for the availability of the modified speakers, but it was stated that they will be produced commercially in the near future.

Although the enclosure dimensions are fairly critical, Dr. Baruch felt that no special manufacturing procedures would be necessary to maintain the 10% tolerance range he specified. The enclosure can also be fabricated of plastic at low cost and with excellent results. He estimated that the complete speaker system and enclosure could be sold at a consumer price of about $20.

An important advantage of this design is that the enclosure can be placed almost anywhere in the room, since a 3-angle corner is not required. It can be mounted anywhere on the floor or ceiling against a wall, or in the corner between two walls at any height. The only restriction is that there be at least

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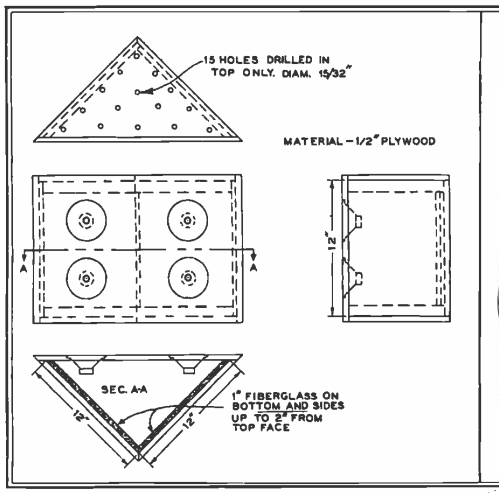


FIG. 1. CONSTRUCTION OF THE BARUCH-LANG SPEAKER ENCLOSURE.

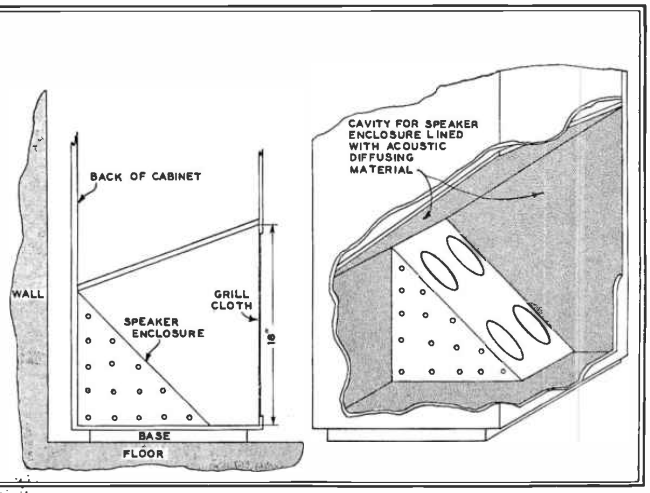


FIG. 2. HOW THE SYSTEM CAN BE INSTALLED IN A RADIO-PHONOGRAPH CABINET

CHICAGO: BIG NEWS WAS HI-FI

ASSURED PROFIT SPURS MANUFACTURERS, ATTRACTS DEALERS, AS PUBLIC INTEREST GROWS IN CUSTOM EQUIPMENT FOR RECORDS, TAPE, FM RECEPTION

SOMETHING new was added to the Parts Show at Chicago this year, and it sent the manufacturers, reps, and parts jobbers back home with more new ideas about stepping up sales and profits than they have picked up at this annual event for many a year. This refers, of course to equipment for high-fidelity reproduction from records, tape, and FM broadcasting.

Checking back on the displays, meetings, and discussions, this was the most important Parts Show since the war, thanks to high-fidelity, for otherwise it would have been a dull and unimportant affair. It should be noted, however, that the most spectacular display in the Show was that of Amphenol products, on the 5th floor, and they were not related directly to audio equipment!

Revolution:

Orthologically, it may be incorrect to apply the term *high-fidelity* to the new equipment offered for improved audio reproduction. But the words have been used so widely that they have stuck, and it's too late to make a change now.

The high-fidelity idea represents a simple yet revolutionary departure from the old concept of putting a radio receiver, record-player, and loudspeaker in a single cabinet. Cabinets, whether of console or table model size, have always put a limitation on the size, cost, and performance of the units mounted in them. Eye-appeal, not ear-appeal, became the manufacturers' primary consideration.

Thus, from year to year, the quality of reproduction deteriorated until the performance of current AM table models is about on a par with the mechanical phonograph cira 1910.

Meanwhile, FM broadcasting, LP records and magnetic tape came along in that order, opening up new possibilities for musical entertainment at home and making people realize, by comparison, how awful AM table model radios had become.

Of course, *high-fidelity* is a relative term only. But the reproduction from a moderately-priced installation comprising an FM tuner, record-player, amplifier, and a good loudspeaker in a proper cabinet, is so far superior to a conventional AM table set that, relatively, the performance seems high-fidelity indeed!

Furthermore, the idea of buying separate units of equipment eliminates the cabinet problem. Now, the appearance of a high-fidelity custom installation, if indeed the equipment is in evidence at all, is entirely a matter of the individual owner's taste and ingenuity.

And there is the advantage of flexibility in the selection of the units as to size, design, performance, and price, as well as the possibility of replacing or adding separate items of equipment from time to time.

So the public is discovering, at long last, that what counts is the musical quality produced by the loudspeaker. And as more and more people hear fine music from FM, records, and tape, the volume of sales of high-fidelity equipment climbs accordingly.

The Price Problem:

Inevitably, the matter of prices and discounts came up at the Chicago Parts Show. The questions were asked: 1) How can dealers and servicemen buy high-fidelity equipment from parts jobbers when the parts jobbers are giving net prices to consumers, and 2) what right has a parts jobber to sell consumers anyway?

The parts jobbers replied bluntly to the effect that: 1) dealers and servicemen don't sell hi-fi equipment, so it's not necessary to protect them on discounts, and 2) since they don't want to sell this type of merchandise to consumers there is no reason why the parts jobbers shouldn't. As for the legitimate, established custom installation companies, they buy in sufficient quantities to order direct from manufacturers, at jobber prices. Besides, the mail order houses sell at net price to everyone, so that list prices have become purely ficticious, and the sooner they are dropped entirely, the better for everyone. It's a good thing this matter came up, because it cleared the atmosphere for all concerned.

A related subject that came up for discussion was the entry of camera stores in the hi-fi field. The parts jobbers don't like the idea. There has been talk of boycotting manufacturers who sell them, but of course that is not the answer.

It was probably Revere's tape recorder that started them off. Revere, one of the leading manufacturers of 16-mm. cameras, sells directly to dealers. Thus, they had ready-made distribution for their tape recorder which, incidentally, is outstandingly good in its price class. Now it looks as if many of the camera stores are going to expand into carrying complete hi-fi lines.

What worries the radio trade is that the camera stores most likely to move into the hi-fi field are those who use the "professional discount" as consumer-trade bait. But they do not give their customers the technical service that is available at stores which maintain retail prices.

Since hi-fi is not a cash-and-carry-and-don't-ask-questions business, it is probable that if people can't get the help and information they want, they'll go where they can.

Next New Idea:

Actually, the type of store most likely to succeed on a larger scale than those now operating will be the kind that handles both records and equipment. So far, the audio specialists have been afraid of records, and the record stores have been completely indifferent to the idea of selling equipment. But the combination is bound to come, because each would help the other.

Traveling Demonstration:

At Chicago, Electro-Voice unlimbered a new and powerful piece of hi-fi promotion in the form of a huge trailer, elaborately fitted out with audio equipment, and big enough to hold a considerable audience. Idea behind this venture is that the only way to sell high-fidelity reproduction is to give people a chance to hear how much entertainment it provides. So they are going to send this audio - demonstration - room - on-wheels around the Country, along with a crew of men who know music and equipment.

Before the end of the Parts Show, Electro-Voice had enough requests from stores specializing in high-fidelity to keep the trailer on the road for months to come. Plan is to have a dealer run advance promotion in his local newspaper. Then the trailer will be parked in front of the store so that demonstrations and sales can be tied together. Or, where an auditorium is available, the trailer can be parked outside, and wires run in to loudspeakers on the stage. This idea has endless possibilities, and should prove the most effective means of hi-fi promotion so far devised.

West Coast Companies:

It looks as if the West Coast companies

(Continued on page 35)

MOBILE RADIO

NEWS AND FORECASTS

A very interesting plan of municipal radio operation is represented in the Kansas City system. It may serve as a pattern in other cities when they prepare to replace existing facilities. It was laid out by Roy De Shaffon, Supervisor of Communication, who is one of the pioneers in police radio. He had the opportunity to engineer the system in the light of some 21 years' experience, and to modernize the old system in every detail. A complete account of this unique setup, which serves the Police and Fire Departments, Board of Public Works, Health Department, Liquor Control, and Welfare Department, will be published next month.

Radio at High Speed:

Incidentally, Roy De Shaffon's system is generally credited with the fastest action ever achieved by the use of radio communication. Not so long ago, a lone bandit held up the bank at Blue Springs, Mo. The police got a description of him from a bank employee, set up road blocks, and began checking all points where he might have made a getaway. Finally, at the Kansas City Municipal Airport, they found that a man fitting the description of the bandit had bought a ticket for St. Louis. However, the plane had left some time earlier.

Roy got a message to St. Louis by the interzone CW radio telegraph just two minutes before the plane landed. The St. Louis operator called the patrol car nearest the Lambert Airport, and the police reached the plane just as the passengers were walking down the ramp. They identified the bandit, found the money and a gun in his bag, and arrested him. One minute later, and he might have escaped!

Turnpike Communication:

Bonds have been offered to construct a throughway across Ohio, as an extension of the Pennsylvania Turnpike. A similar project is underway in New York State, and Massachusetts is making plans for such a highway. About $92½ million will be spent for radio communication facilities. And this is only the beginning.

The systems will call for top engineering talent, and the finest equipment. They will probably follow the general pattern of the Pennsylvania Turnpike system, using multiplex microwave relays in combination with VHF communication with the mobile units.

Low-Power Industrial Radio:

An examination of license applications shows that, while the light-weight, hand-carried units were originally brought out for the low-power industrial service, the majority of these sets are being bought as adjuncts to the various public safety systems. Explanation is that 10-watt mobile units are more practical and much less expensive to maintain, except where the transmitter-receiver is to be actually hand-carried.

However, the low-power units have proved to be of utmost value for fire-fighting, flood patrols, and in disasters where cars cannot go. Game wardens are using them extensively. Police departments and public utilities are buying them in substantial quantities. The use of dry cells is generally preferred, rather than storage batteries.

Split-Channel Operation:

The frequency-coordinating committee of the petroleum industry is actively investigating the possibilities of split-channel operation on 30 to 50 mc. Since channels in that band are now 40 kc. wide, this would mean operating on 20 kc. While no final report is available, the tests which have been conducted indicate that this can be done successfully.

H-33 Handset:

Those who have used them like the Signal Corps H-33 handset much better than the heavier, standard type. It fits the hand comfortably, and delivers excellent speech quality. When it is available in quantity for commercial use, it may well become the preferred design for mobile use. Some kind of a special hang-up box will be required because of the light weight and shape of the H-33.

Registry of Public Safety System:

Annual revision of our Registry of Public Safety Systems is being completed, and copies will be ready for mailing early in July. Listings include all municipal, county, state, zone, and interzone police systems, and fire, forestry, special emergency, and highway maintenance systems. Complete addresses, call letters, frequencies, number of mobile units, and make of equipment are shown. Practically all have new call letters.

The work of revising our series of Registries has grown to the point where we are reminded that, if the FCC seems to move a little slowly, or makes a mistake once in a while, it shouldn't be criticized too severely! Additions, deletions, and changes in the Registries are made directly from copies of station licenses in the FCC files, and the volume of these records has expanded to an almost unbelievable extent during the past two years. Nevertheless, when we run into complication in taking off data for the Registry listings, we find that most of the confusion is due to inaccuracies in supplying information to the Commission, rather than to errors made by the staff in the file room.

Reorganization:

Link Radio Corporation has filed a voluntary petition in bankruptcy, and is now undertaking a reorganization to protect its creditors and to assure continued service and replacement parts for Link equipment.

IRE Vehicular Group:

New officers for the IRE Professional Group on Vehicular Radio are: chairman, Frederick Budelman, Budelman Radio Corporation, Stamford, Conn., succeeding Austin Bailey; vice chairman, Waldo Shipman, Virginia Gas Transmission Corporation, Falls Church, Va.; treasurer, George M. Brown, N. Y. Central Railroad, 466 Lexington Avenue, N. Y. C. The national conference held by this Group in Chicago last year was so successful that plans are being formulated now for a 1952 session. It may be in Washington, but the location has not been settled yet.

Business Notes:

A west coast parts and service department has been opened by Motorola at 811 South B Street, San Mateo, Calif. John Jipp, former sales manager for Motorola in the Southwestern area, will be in charge. He will be succeeded there by Ed Falls, who has been zone manager in Southern California.

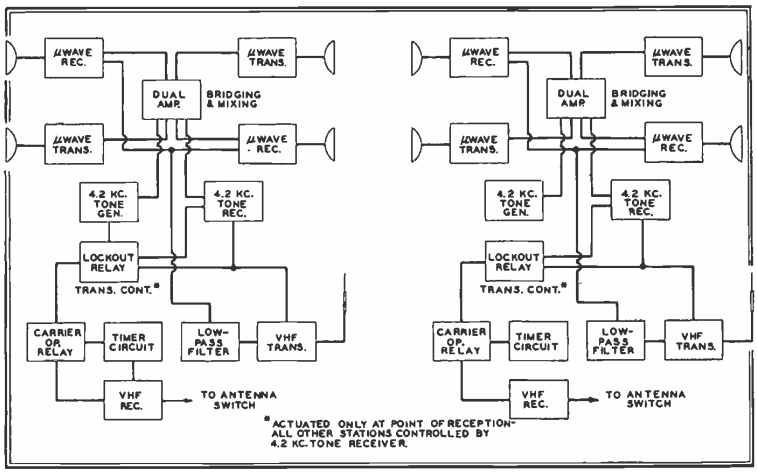
Radio Paging:

The initial success of radio paging indicates that this service will be expanded on a wide scale. Operating as a common carrier on 43.58 mc., this is a one-way system, with a main station transmitting to subscribers who carry tiny pocket receivers. The first setup of this sort is that of Telanserphone, Inc., 224 E. 38th Street, New York. Transmitter input of 500 watts is authorized by the FCC.

(Continued on page 43)

VHF-UHF TURNPIKE RADIO SYSTEM

PART 2: PHASING INTERFERENCE — FUNCTIONS OF RELAY CONTROLS — HOW THE SYSTEM IS MAINTAINED — *By* DOUGLAS N. LAPP AND ARDEN B. HOPPLE



TWO VHF-UHF INSTALLATIONS, WITH STATION A AT THE LEFT, AND STATION B AT THE RIGHT

Mid-Point Reception:

IN any mobile radio system where identical signals are transmitted from two or more fixed stations on the same channel, the mobile units pass through areas where the signals are of equal strength. Reception in these phasing areas, unless special measures are taken, is often reduced to unintelligible hash. For example, with reception on 150 mc., a car antenna moving at 70 mph. travels approximately 40 wavelengths per second.

This is not only a factor in car reception, but it can introduce unusual effects in reception at a relay receiver during transmission from a car traveling at high speed.

We encountered this problem on the original Pennsylvania Turnpike radio system, although the interference was negligible because we were operating down at 30 mc. At 159 mc., we found it to be much worse. Various solutions were attempted, but experience indicated that additional circuitry created new uncertainties of operation that offset any advantage they afforded.

Finally, we decided against the use of any method that would introduce new possibilities of electrical or human failure, and worked out an arrangement that gives intelligible reception at practically any point along the Turnpike where signals of equal strength are received from two fixed stations. Engineers who come to observe the operation of the Turnpike radio system have been surprised at the relative freedom from phasing interference, which is indeed exceptional.

Briefly, the method employed is this: The problem was solved by a practical approach and investigation, rather than tackling it from the theoretical angle. Field tests indicated that two factors contributed 90% of the hash. They were:

1. Differences in the frequencies of adjacent VHF transmitters (east and west). This could result in a combination of low-frequency beats that essentially destroyed the voice reception.

2. Wide differences in deviation (3 to 4 kc.) of adjacent VHF transmitters carrying the same message.

Both these major contributors of hash were minimized by improving the control of the oscillator and phase modulator stages. It should be noted that the original VHF transmitters used temperature ovens on the crystal units while these tests were in process, but this was not sufficient for effective control of the dual problem.

Routine maintenance keeps these two important circuits under control, and has successfully overcome what appeared at first to be a serious operational difficulty.

Relay Operation:

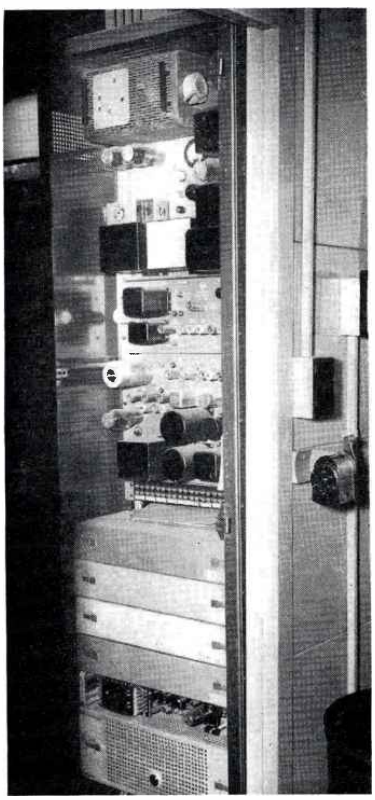
In the process of relaying signals along the Turnpike for re-transmission to the cars and fixed stations, the system must perform certain essential operational functions. The means for achieving them can be made clear by explaining just what takes place when transmission is initiated at a car or fixed station. The accompanying block diagram represents the circuit elements at any of the relay installations:

1. When a mobile transmitter or fixed station goes on the air, its 155.67-mc. carrier is received by VHF receiver at the relay station A.

2. Reception of the VHF carrier actuates a carrier-operated relay which turns on a 4,200-cycle tone generator, and closes a relay to turn on the VHF transmitter at station A, to re-transmit on 159.21 mc. the voice signals from the mobile transmitter.

3. At the same time, the 4,200-cycle tone modulates microwave transmitter A, and the tone is transmitted east and west. Operation of the entire UHF chain is almost instantaneous, and normal press-to-talk operation is achieved.

4. Reception of the 4,200-cycle tone at station B operates a tone receiver which



RCA MULTIPLEX UHF TRANSMITTER-RECEIVER

THE CONESTOGA RELAY STATION, WITH THE ASSOCIATED VHF ANTENNA IN THE FOREGROUND

closes a relay to turn on the associated VHF transmitter. The voice signals, with the tone filtered out, are then transmitted to cars and fixed stations on VHF in the area served by station B.

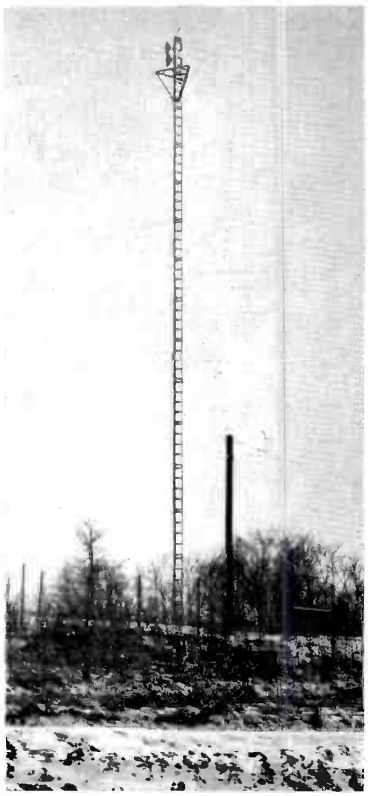
5. The tone receiver relay at station B locks out its VHF carrier-operated relay to eliminate the possibility that another signal picked up on its VHF receiver would gain control of the system. (At station A, no signals are being received on the microwave voice channel from east or west. Therefore, local operation is controlled by the VHF receiver relay.)

6. The VHF carrier-operated relay at each relay station is so designed that the stronger the received signal, the faster the relay operates. Thus, a signal received simultaneously by two relay stations takes control at the point where the signal is stronger. If the operator at some other VHF transmitter snaps on at the end of a transmission, the relay may stay closed, even though the signal is weak. As a result, reception of his transmission may be noisy. The receiving operator will then say: "Ten-nine." (Repeat your transmission.) When the message is repeated, the louder signal will take over. (Operating instructions call for a 3-second interval between messages.)

7. At each relay station, there is a timing circuit which limits VHF voice transmission to 1 minute. This action is initiated when the VHF carrier-operated relay is closed at the station where the signal originates. The purpose is two-fold. The system cannot be tied up in case 1) the carrier from a VHF transmitter is kept on the air accidentally, or 2) by any malfunction of equipment, as in the case of an oscillating receiver, because the timing circuit locks out the local VHF receiver until the source of interference is removed. Meanwhile, the rest of the system continues to function normally.

8. If the microwave receiver at any relay station becomes inoperative, due to the loss of the transmitted signal or any other failure, a relay-operated squelch quiets the receiver, so that noise is not passed along the relay chain.

Thus, it will be seen that circuits at the relay stations perform the functions necessary to meeting the second and third basic requirements of accepting VHF signals at only one point, and locking the relay system against interference between two VHF transmitters, as specified in Part 1 of this article, published last month.



A DIFFERENT TYPE OF TOWER WAS INSTALLED FOR THE MICROWAVE ANTENNAS AT GATEWAY

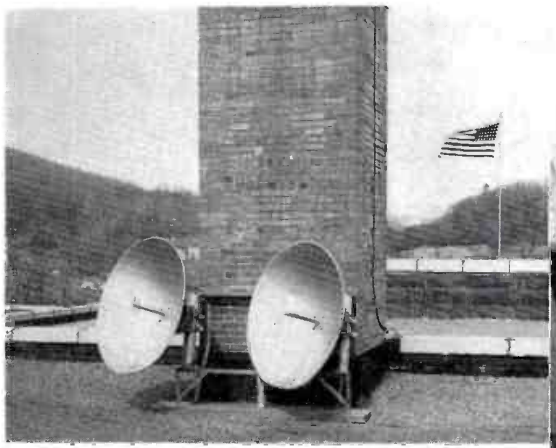
System Notes:

The modulation band of the microwave transmitters is ± 150 kc. (The program channel response is ± 1 db from 300 cycles to 30 kc.) This carries transmissions from the various sources as follows:

1. Voice signals from the fixed and moble stations are on 300 to 3,000 cycles.

2. Control signals for the VHF transmitters are on 4,200 cycles.

3. Teletype signals are on 7,200 cycles, with a 150-cycle bandpass using ampli-



LEFT: OPPOSITE POLARIZATION IS USED FOR THE UHF ANTENNAS AT THE EVERETT MAINTENANCE BUILDING. RIGHT: THE DUAL OPERATING POSITION AT EVERETT, THE MID-POINT OF THE RELAY SYSTEM

ABOVE: THE STATE POLICE HEADQUARTERS BUILDING AT BEDFORD. LEFT: THE OPERATOR'S POSITION AT THE BEDFORD BARRACKS. AN RCA VHF TRANSMITTER-RECEIVER UNIT IS INSTALLED ON THE DESK

tude modulation. The teletype operates with no signal as "mark," and signal for "space." Standard teletype subcarrier tone generators and receivers are employed, with special Raymond Rosen power supply and relay panels, operating model 15 teletypewriters.

4. The administrative voice channel operates on a 15.8-kc. subcarrier.

The relay system is divided at Tussey Mountain, where all signals from VHF and microwave stations, both east and west, are transmitted to the operating position at the Everett Maintenance Building. Signals from the east are received and demodulated at Tussey, and reinserted on the north leg to Everett on an 11.5-kc. subcarrier. Signals from the west are demodulated at Tussey and are reinserted at voice frequencies on the same leg to the Everett station.

The photograph of the operating position at Everett shows two loudspeakers. A neon glow-lamp on each speaker shows whether signals are coming in from the east or west.

Eastbound transmissions from Everett to VHF fixed and mobile receivers and microwave stations go to Tussey on an 11.5-kc. subcarrier. At Tussey they are demodulated and reinserted at voice frequency on the eastbound relay. Westbound transmissions from Everett go to Tussey at voice frequencies. Then they are received and reinserted at voice frequencies on the westbound relay.

Signals to operate the VHF transmitters in the eastern section of the relay are transmitted on 4,600 cycles from Everett to Tussey, from which the 4,200-cycle control signal is sent east. Signals going west are transmitted on 4,200 cycles from Everett to Tussey, and are carried west on that same frequency. This arrangement permits the operator at Everett to select the direction of messages which he originates.

The microwave link going into Harrisburg, however, is a spur, and operates in the same way as the other stations.

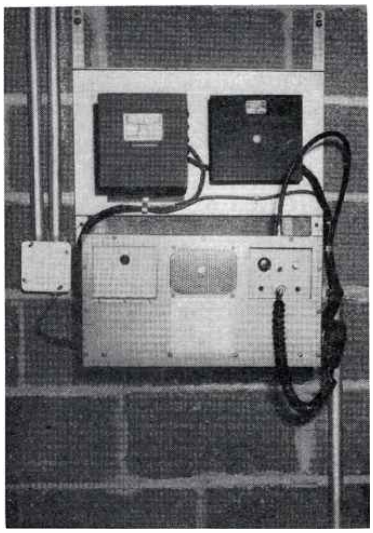
One of the accompanying photographs shows the microwave transmitter, receiver, and channelizing equipment at Valley Forge. Similar units are installed at the relay stations. Additional views are not available because the equipment was not photographed prior to installation.

The RCA transmitter and exciter panels are at the top, with the receiver and test jacks below. Next down is the Lenkurt channelizing equipment, and the power supply. Each transmitter has an Eimac 4X150 for the output. Altogether, 30 of these tubes are used in the relay system, operating continously. It is interesting to note that, at this time of writing, they have been in use for 8 months without a single failure. In fact, the outage time due to failures in the equipment at any point in the system has been less than .00009% in the last 10 months.

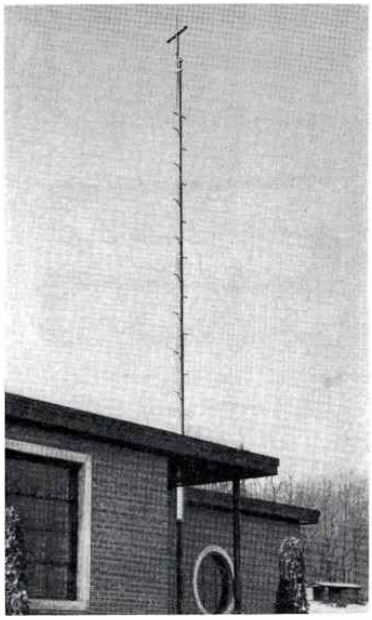
Because of the heavy volume of traffic over the Turnpike system, tape recorders have been installed to eliminate the necessity of keeping detailed log books. Operator log books are kept, however, as required by the FCC. Rack-mounted Presto CM1 tape recorders, operated at 1 ips., are used for this purpose. The tape records provide an accurate report of operations for reference purposes. The tapes will be kept for 1 year, and then reused.

The cost of the complete installation and the five-year maintenance contract come to something over $1 million. Meanwhile, changes are being made and facilities added as new construction or operating requirements make them necessary. The traffic over the Pennsylvania Turnpike continues to increase in volume, and the demands on the radio system are growing accordingly. That

(Concluded on page 34)



AT NEW CUMBERLAND, THE VHF UNIT AND CONTROLS ARE MOUNTED IN THIS SIMPLE MANNER



PIPE MAST CARRIES AN ANDREW VHF ANTENNA AT NEW CUMBERLAND MAINTENANCE BUILDING

NEW YORK'S FIRE RADIO SYSTEM

PART 3 — DESCRIPTION OF THE MICROWAVE LINK FOR STATEN ISLAND AND THE 350-WATT BASE TRANSMITTERS — By LIEUT. SAMUEL HARMATUK

AS explained previously, a radio link, operating on 957 mc., is used between the Staten Island headquarters and the Richmond VHF transmitter. This is supplemented by a wire line, but the performance of the radio link has been so satisfactory that it has been kept in service continually since it was installed. The transmitters are standard REL units, but acceptance tests were made in accordance with Fire Department specifications. Fig. 9 shows the transmitter and Fig. 10 illustrates the receiver installation.

The specifications called for a nominal output of 5 watts on continuous duty, and 8 watts maximum; FM signal-to-noise ratio of 70 db; AM signal-to-noise ratio of 50 db; distortion, measured through the associated receiver, of less than ½% rms. sum for single tones over the range of 100 to 20,000 cycles at an input level of 4 dbm; and fidelity flat within 1 db from 100 to 20,000 cycles.

Other transmitter characteristics specified were: spurious emission, including harmonics, −75 db; second harmonic, −75 db; power drain for full output, 350 watts; standby drain, 275 watts; modulation, ±100 kc.; carrier frequency stability, ±.002% over an ambient temperature range of −30° to +60° C.; audio input, +10 dbm for ±100 kc. full deviation, or +4 dbm for 250 to 3,000 cycles. The requirement of phase-shift modulation with no tuned circuits was met by the REL Serrasoid modulator.

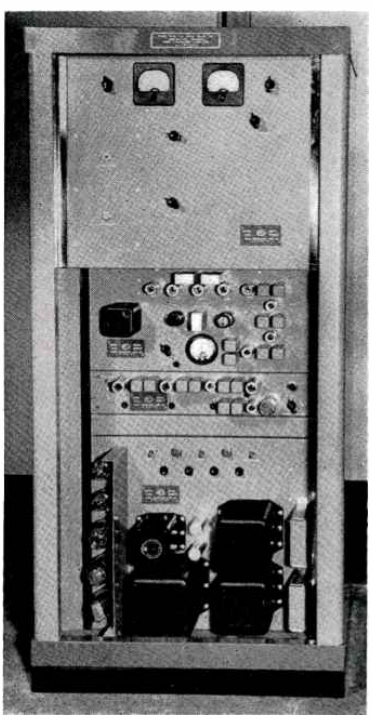


FIG. 9. THE REL MICROWAVE LINK TRANSMITTER

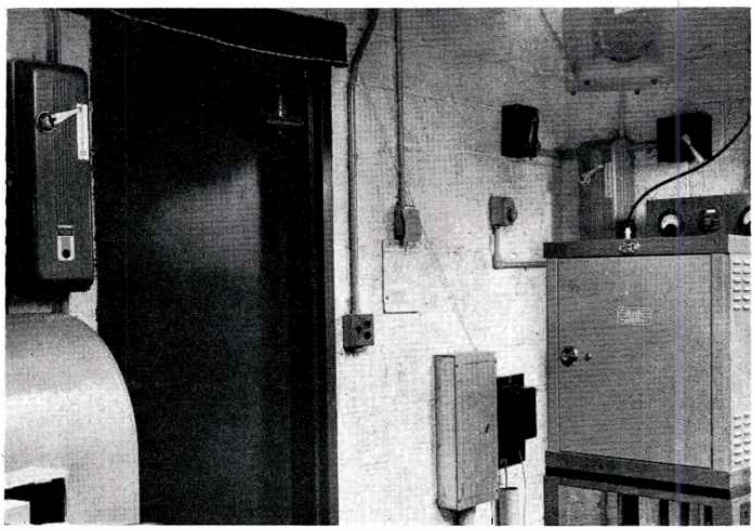


FIG. 10. THE MICROWAVE RECEIVER, DUPLICATE VHF TRANSMITTERS, AND EMERGENCY ENGINE-DRIVEN GENERATORS ARE LOCATED IN A SMALL, TEMPERATURE-CONTROLLED BUILDING OF CONCRETE BLOCKS

All resistors, condensers, and hook-up wire and cables were required to meet JAN specifications, and hermetic sealing was called for on all transformers, with a maximum operating temperature of 85° C. Jones barrier strips were called for on all wire and cable interconnections to and from the final, driver, modulator, and multiplier stages, so that the connections could be removed without the use of a soldering iron.

The operation of all power tubes was set at 50% of their maximum ratings. A guarantee of 1,000 hours was called for on all tubes, under which the useful life would be deemed to have been reached when the the output dropped by an amount of 25%. It was further specified that all receiver-type tubes should be of the ruggedized designs.

Performance requirements for the link receiver were set forth in even greater detail. They called for a crystal-controlled, double-IF superheterodyne set, with a stability of ±.002% from −20° to +60° C., and gain to the limiters such that the noise from the first circuit will cause limiting.

Limiting and demodulation: Two cascade pentode limiters with a speed of response materially shorter than the shortest pulse that can be passed by the receiver, and a balanced discriminator.

Bandwidth: Attenuation not more than ± 2 db over the range of ± 100 kc.; at 5 times this band width, at least −40 db; at 7 times, at least −60 db.

Spurious Response: Except for selectivity indicated above, all spurious responses down not less than 60 db when the applied interference is less than .1 volt at the input terminals.

Output Noise Ratio: Apart from random noise governed by received signal strength, other noise not greater than 65 db below the 100% modulation level per voice-frequency channel.

Distortion: The contribution to system distortion not to exceed .5% rms. sum for single tones at a level corresponding to crest for the voice-frequency channel in which the tone lies; the summation to be made in a band including the second harmonic of the highest modulating frequency.

Voltage Stabilization: Screen voltage of limiters to be stabilized to maintain constant discriminator output. In addition, audio amplifier degeneration may be used to provide an overall stability of ± .2 db in the audio output for line voltage changes of ± 10% of the rated value of 117 volts, 50 to 60 cycles.

Microwave Antenna:

The parabolic antennas for the link transmitter and receiver are 42 ins. in diameter, providing 15 db gain over a half-wave dipole. These are REL types, designed and mounted to withstand a minimum wind load of 85 mph. when coated with 1 inch of ice.

350-Watt Base Transmitters:

Figs. 11 to 14 show the construction of the 350-watt base transmitters. These were designed and built to meet the particular requirements of the New York Fire Department. One specific requirement of these transmitters and of the microwave link equipment was that they should be capable of continuous operation. The point is stressed because experience has shown that, in times of a major disaster during peace or war, fire departments are called upon to perform so many and varied services that continuous operation of the radio communication system should be anticipated. This accounts for the unusual arrangement of the individual panels on which assemblies are mounted, since quick repairs or replacements, particularly of tubes, make accessibility a necessity. In this design, every part can be reached conveniently from the front or rear.

Fig. 11 shows the transmitter cabinet as it appears normally. The small access door opens on a set of key switches which provide the same controls as at the console for shifting frequencies or antennas. Thus, the transmitter can be operated from this position for test purposes. The knob at the left is for a Variac, to regulate the power input.

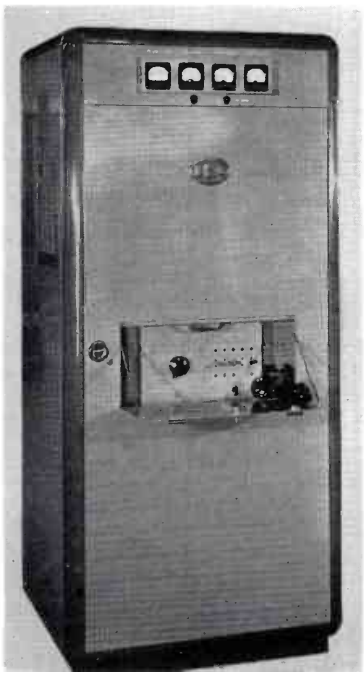


FIG. 11. FRONT VIEW OF 350-WATT REL BASE TRANSMITTER, SHOWING CONTROLS FOR TESTING

FIG. 12. QUICK ACCESS IS PROVIDED TO THE POWER SUPPLY CIRCUITS BELOW, AND TO THE SECTIONS CONTAINING THE PUSH-PULL OUTPUT TUBES AND THE INTERMEDIATE AMPLIFIER

In Fig. 12, left, the main door has been opened and the power control section has been tipped forward. The right hand view discloses the power output section, using two 4X-500A Eimac tubes push-pull. The two small sections at the extreme right contain a tripler stage and a straight amplifier stage which feeds the power output. Amperex type 9903 tubes are used in those circuits.

A left side view in Fig. 13 shows the air intake, with the filter removed, which cools the power output tubes.

Panels for the four remaining circuit assemblies can be seen in Fig. 14, both in their normal position, at the left, and tipped forward for inspection at the right. At the top left is the complete Serrasoid modulator. Adjacent to it is the Motorola Vibrasponder section. These controls, described in a subsequent section, are operated by audio frequencies generated at the control console and transmitted over the wire line or, at Staten Island, over the radio link also. In this manner, the operating frequency can be shifted, and either transmitter or either antenna can be selected, in accordance with the requirements of each station as indicated in the block diagram of the entire system, Fig. 5, Part 2.

The time-out relay and its circuits are carried on the narrow panel at the left center. By means of this control, if the carrier is on, but there is no modulation for a period of 3 minutes, the transmitter is switched off. In that way, a failure in any part of the circuits between the console and the transmitter cannot

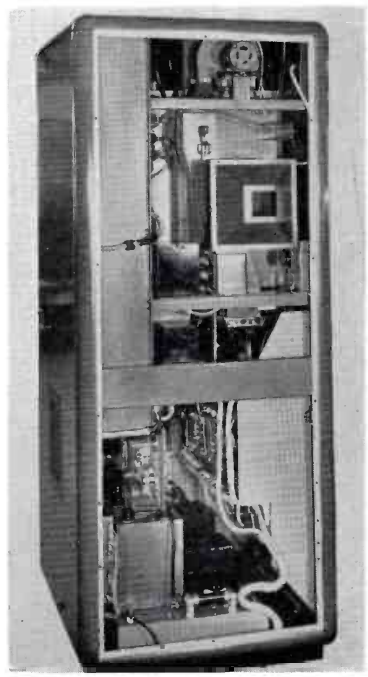


FIG. 13. INTAKE FOR FILTERED AIR TO COOL THE AMPLIFIER TUBES IS ON THE LEFT SIDE

tie up the RF channel. Operation of this control turns on a signal at the console.

The right center section is a Motorola receiver. The two large cases at the bottom are condensers.

Base Transmitter Specs:

Very tight specifications were laid down for the base transmitters. They called for an FM signal-to-noise ratio of 65 db; AM signal-to-noise ratio, 50 db; spurious emission, including all harmonics, –100 db; second harmonic emission, –106 db; and distortion, less than 1% from 100 to 3,000 cycles, measured with deemphasis.

At 350 watts output to the antenna, the specifications called for approximately 1,400 watts input, with a standby drain of approximately 300 watts, and Final amplifier efficiency at least 70%. Standby filament voltage on the RF amplifier tubes was required to be 15% below the operating potential, in order to extend the tube life. A frequency stability of ±.0005% was specified with direct crystal control, and no tuned circuits in the modulator. Finally, a modulation band of ± 15 kc. was called for, with instantaneous deviation limiting. In addition, conventional mechanical and electrical features were set forth in detail, but the features already enumerated cover the basic performance requirements.

Operational Controls:

Fig. 5 shows that controls for shifting frequency, antennas, and transmitters are necessary at the different control consoles. While they are not used at present at each installation, provisions were made for the following remote control functions:

1. Primary power switching.
2. Selection of either of two antennas.
3. Selection of either of two operating frequencies.
4. Switching carrier on and off.
5. Intercommunication on and off. Motorola Vibrasender and Vibrasponder units were chosen for this purpose. These are tuned audio-frequency circuits, capable of operation over the same telephone pair or the radio link used for modulation and reception. The carrier on-off function is positive, does not depend upon sequence-type relays, and operates at a speed of less than 300 milliseconds.

EDITOR'S NOTE: The concluding part of Lieut. Harmatuk's description of this system will appear in a forthcoming issue.

IMSA CONVENTION

The 57th annual convention of the IMSA will be held at the Hotel Statler, Boston, September 29 to October 2, 1952.

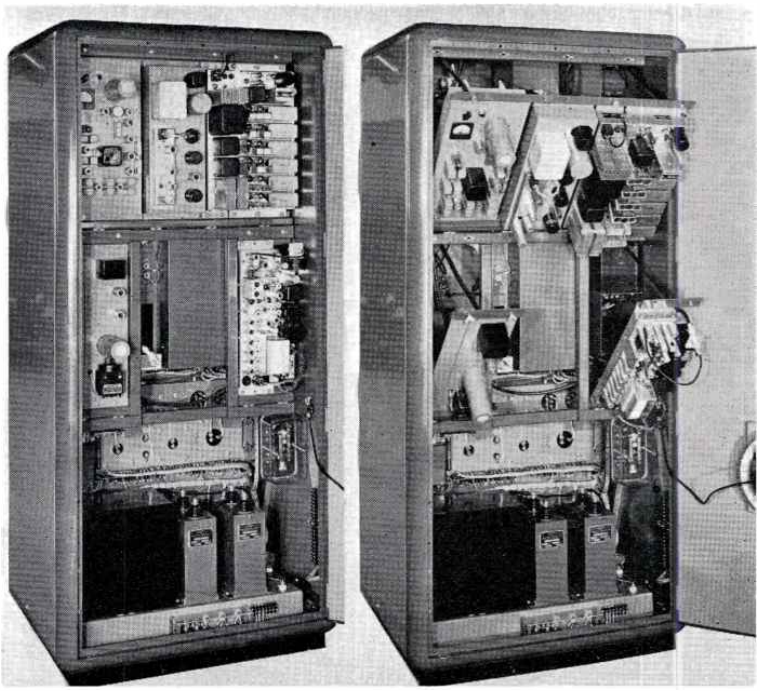


FIG. 14. THESE REAR VIEWS SHOW THE METHOD OF MOUNTING THE MODULATOR, REMOTE CONTROLS, TIME-OUT RELAY, AND VHF RECEIVER. EACH UNIT CAN BE REPLACED WITHOUT A SOLDERING IRON

TURNPIKE SYSTEM

(Continued from page 31)

situation was anticipated, so that future requirements can be met without rendering the present equipment obsolete.

Maintenance Service:

The Turnpike Commission is responsible for the engineering and operational supervision of the radio system, but does not handle maintenance or system engineering. This is done under contract by Raymond Rosen Engineering Products, Inc. This fixes the annual cost to the Commission for maintenance and replacement parts, and puts the responsibility for keeping the system at peak efficiency in the hands of the company that supplied and installed the original equipment.

The supervisor, who makes his headquarters at Bedford, has four maintenance men who live along the Turnpike. Working 4 days on and 2 days off, they are available at any time to meet emergency situations. They take care of the car and fixed-station equipment. Also, they check the performance of each relay station on a fixed schedule. In this way, they can anticipate failures by checking the performance of the circuits in the relays. This keeps tube replacement down to a minimum, an important factor in maintenance, since it is necessary to watch new tubes closely after they are first put in service, as they may fail.

Each serviceman is equipped with the following instruments for field work:

RCA type WV65A battery-operated vacuum-tube voltmeter.

Simpson model 260 volt-ohm-milliammeter.

Bird RF wattmeter.

Browning MD-25A deviation meter.

Measurements type 80 signal generator.

Ballantine model 300 AC vacuum tube voltmeter.

This last instrument is used on microwave circuits where it must operate at potentials as low as .037 and .029 volts at 1,000 cycles across 600 ohms.

The use of a Gertsch type FM1 frequency meter is shared by the four maintenance men.

As noted above, they do not use tube-checkers, since they determine the condition of individual tubes by meter readings in the various circuits.

Conclusion:

This, in brief, is the story of the radio system which serves the Pennsylvania Turnpike Commission, and the operators of more than 10 million vehicles who, this year, will pay some $20 million for the pleasure and convenience of using this highway. This system will probably serve as a model for the many other superhighways now in the planning stages or under construction.

BIG NEWS WAS HI-FI

(Continued from page 27)

are taking the lead in the manufacture of audio equipment. One reason, no doubt, is the great activity around Los Angeles related to the motion picture business. For example, Newcomb Audio Products showed the most complete line of amplifiers and preamplifiers, with eight models in steps covering the whole price range. Sargent-Rayment is pushing ahead with an FM-AM tuner and a matched amplifier and preamp. Two or three more amplifier lines will be announced by West Coast companies this fall. Add up the list of manufacturers already building tape equipment, amplifiers, and loudspeakers, with transformer production from Peerless and Triad, and the total shows a greater concentration than in any other part of the Country.

Set Manufacturers Eye Hi-Fi:

One interesting newcomer was Stromberg-Carlson, with a matched line of tuners, amplifiers, record-changers, speakers, and cabinets. Other set manufacturers will follow suit this fall. They are being forced into it because of their declining dollar volume in AM cabinet models. While it means added competition in the hi-fi market, all will benefit by the increased promotional effort. Stromberg's distribution will probably be largely through music dealers. We haven't official confirmation, but we understand that this line will be sold direct, rather than through the jobbers handling their TV receiver line.

FM Tuners:

The variety of FM tuners is still limited. This is the most difficult item of hi-fi equipment to design and manufacture, and there is a general reluctance to attempt it. There's no market for a cheap tuner of low sensitivity, and the design of a high-sensitivity receiver with adequate limiting is a major development project.

Noticeably absent is an equivalent of the famous REL 646-B, which is not being manufactured now. There is a possibility that Harvey Radio Laboratories will put their 193-R double superheterodyne FM receiver into production again, however. If they do bring it out in its original form, the price will probably be somewhere near $400. A strictly commercial design, it is exactly suited to the tastes of free-spending audio enthusiasts.

Binaural Reproduction:

The most spectacular feature of the Parts Show was the demonstration of binaural reproduction, staged in the tower of the Hilton Hotel (Stevens to the old-timers) by Magnecord, Jensen and Radio Craftsmen. Opinion of the binaural effect was divided between fair and excellent, but all agreed that it has fascinating possibilities.[1]

It appears that further investigation of microphone and speaker placement is required to get the complete illusion of sound dimensions. Also, it seemed to this observer that the volume level from each speaker during the demonstration was so high as to mask the binaural effect.

Note on AM Broadcasting:

Here's an item of interest to those who insist that FM isn't needed in metropolitan areas because there isn't any interference to eliminate on AM:

Magnecord, Jensen, and Radio Craftsmen went to much pains and expense to provide binaural broadcasting for their demonstration at the Parts Show. The plan was to use a local 50,000-watt AM station to carry one audio channel, and its FM affiliate for the other.

However, to the consternation of all concerned, at the last minute, when the equipment was hooked up and checked out for the first demonstration, the FM signal was perfectly clear and clean, but the AM signal came in with such a heavy background of noise that it was impossible to use it. Several hundred invitations had been sent out in advance, so the demonstration could not be called off at the last minute.

The only way out was to call on the Telephone Company for a line to carry the audio channel that was to be picked up on AM. This was done, and the demonstration of binaural reproduction was put on with an FM station and a telephone line!

AM and FM Coverage:

Public interest in better audio reproduction is doing more to build FM audiences than anything the broadcasters have done themselves by way of promotion. Also, people are discovering that TV audio quality is much superior to AM. This is something new that AM broadcasters haven't recognized yet.

Walter Stanton, president of Pickering & Company, held forth at length on this subject in a discussion during the Parts Show. He said: "We have the productive capacity to make a larger quantity of home appliances than we can use in this Country. What we lack is the element of quality. Today, quality is in short supply."

We were reminded of that remark, as it applies to AM broadcasting and the production of AM sets, by a letter from Charles Crutchfield, executive vice president of WBT, Charlotte, complaining about the comparison drawn between interference-free nighttime coverage of FM station WMIT and the Carolina AM stations as presented in this Magazine last August.[2]

It was pointed out that "WBT's nighttime pattern is not circular, since the station (with 50,000 watts) must go directional to limit interference with KFAB in Lincoln, Neb. Listeners in the important city of Gastonia, 18 miles from the transmitter, do not get WBT for that reason." Mr. Crutchfield took exception to that statement, yet he pointed out that a second transmitter is operated at Shelby, in order to cover Gastonia.

WBT's interference-free nighttime range was rated at 20 miles, which is a generous figure. Mr. Crutchfield wrote: "As you and I know, your 'square miles covered' standard is not the accepted standard in radio. What the advertiser wants to know is 'how many listen.' As a matter of fact, WBT's nighttime skywave covers many hundreds of thousands of square miles from Maine to Florida."

There is no denying that WBT, or any other 50,000-watt AM transmitter, has very great skywave coverage. But such coverage, as a means of providing enjoyable entertainment, is as uncertain as the skywave itself. Mr. Crutchfield pointed out that BMB figures show that 96% of the families in Wadesboro, 46 miles away, "listen regularly to WBT," and 92% in Statesville, at 72 miles. That may be so in the daytime, but there is reason to doubt that any AM station delivers signals of any entertainment value at 50 or 75 miles at night. As to the percentage of families "listening regularly" to a given AM station, some of the BMB reports on which these figures are based list as many as 30 and 40 stations. So it's difficult to go along with Mr. Crutchfield's conclusion that: "Obviously our signal in these areas is excellent if these thousands of families habitually and regularly tune in WBT."[3]

With the growing demand for high-fidelity reproduction, AM is confronted with serious competition from FM, records, and tape. To those who recognize the increasing extent of this competition, there's something a little old-fashioned about the attitude that: The quality of our signal is not important, as long as you listen to our station! Today we have a substantial surplus of poor recep-

(Concluded on page 45)

[1] This was discussed in detail in "Sound Movement and Dimensions" by Milton B. Sleeper, RADIO COMMUNICATION, November 1951.

[2] "FM Station WMIT is Back Again" by Milton B. Sleeper, RADIO COMMUNICATION, August 1951.

[3] WBT also operates WBT-FM, which has an interference-free nighttime radius of about 100 miles. However, a check of advertising and promotion on WBT failed to disclose any reference to WBT-FM.

New FCC Applications

This list includes applications for mobile, point-to-point, control, and relay communication facilities filed with the FCC from April 28, 1952 to May 23, 1952.

AERONAUTICAL & FIXED

Aeronautical Radio Inc 1523 L St NW Washington DC
Inyokern Calif 1b 9.9w 127.1 T
Thief River Falls Minn 1b 50w 130.9 WW
Bemidji Minn 1b 50w 130.9 WW
Miami Okla 1b 9.9w 129.1 T
Norfolk Neb 1b 50w 130.5 WW
Mitchell SD 1b 50w 130.5 WW

AERO MOBILE UTILITY

Western Air Lines Box 10005 Airport Station Los Angeles 45 Cal 2m 10w 121.7; 2m 10w 121.9 T
National Airlines 3240 NW 27 Ave Miami Fla
1m .5w 121.9 C
City of Flint Bristol at Tarrey Rd Rte 7 Flint Mich 3m 6w 121.9 SS
Chicago & Southern Airlines Mun Airport Memphis Tenn 1m 5w 121.9 C
Lane Aviation Corp Columbus Ohio 1m 6w 121.9 SS
Monroe County Sheriff Rochester Airport Rochester 11 NY 8m 1w 121.9, 122.5 T

AIRDROME ADVISORY

Talford-Good Aviation Inc Delmar Calif
1b 4w 122.8 NN
Hancock Field Univ of SC College of Aeronautics Santa Maria Calif 1b 4w 122.8 NN
Russell A Miller North Benton Ohio 1b 6w 122.8 X
Thomas D Winters W Trenton NJ 1b 6w 122.8 R
Texas Co 135 E 42nd St New York 17 NY
Houma La 1b 9.9w 122.8 X
Weiss Airport Kirkwood Mo 1b 4w 122.8 NN
Tenn Valley Flight Serv Decatur Ala 1b 4w 122.8 NN
Fred E Ennis Salisbury Md 1b 4w 122.8 NN
City of Benton Harbor Mich 1b 4w 122.8 NN
Lake County Airport Waukegan Ill 1b 4w 122.8 NN
R D Shea Buyshoga County Airport Cleveland Ohio
1b 3w 122.8 NN
Salem Air Service Salem Ill 1b 4w 122.8 NN
Boston Met Airport Inc Norwood Mass
1b 10w 122.8 T
Gilbert M Chapell Batavia NY 1b 4w 122.8 NN

CIVIL AIR PATROL

CAP NY Wing Oswego Sqdn Oswego NY
1m 125w 2.374, 4.507, 4.585 Q
CAP NY Wing Amsterdam Sacandaga Sqdn
11 Pine St Amsterdam NY 1m 48w 2.374 X
CAP Minneapolis Minn 1b 10w; 1m 10w 148.14 T
Blytheville Sqdn Ark Wing CAP Blytheville Ark
3b 75w 4.507, 4.585; 21m 1w, 75w 5.500, 4.507 X
Burlington Sqdn Colo Wing CAP Burlington Colo.
1b 90w 4.507, 4.585 X
Kern County Sqdn 113 Deputy Calif Wing CAP
9300 Crescent Dr Los Angeles Calif
Bakersfield Calif 1b 50w 148.14 U; 2b 50w 148.14; 1b 15w 148.18; 1b 15w, 50w 148.18; 4.507, 4.585 T
CAP Aux USAF Stinson Field San Antonio Tex
1b 97.5w, 117w 4.585 X
CAP Calif Wing 9th Grp Beaumont Calif
1b 15w 148.14 X
CAP Deputy Calif Wing Flight 59 Grp 9
9300 Crescent Los Angeles Calif
Pomona Calif 2b 15w 148.14 T
CAP Hdqtrs NY Wing Watertown Sqdn Dexter NY
1b 25w 4.507, 4.585 X; 1m 10w 4.507, 4.585 X
CAP Hdqtrs Kans Wing 434 Maple Wichita 12 Kans
1b 75w 2.374, 4.585, 4.507 G; 1b 15w 148.14 T
15m 12w 4.585, 4.507; 10m 15w 148.14 X
CAP Olney Sqdn Olney Tex 1b 75w 4.507, 4.585 X
6m 40w 4.507, 4.585 X
CAP Nevada Wing Walker Lake Flight Box 893
Babbitt Nev 1b 75w 4.507, 4.585, 5.500, 148.14 Q
1m 1w 4.507, 4.585, 5.500, 148.14 T
10m 25w 4.507, 4.585, 5.500, 148.14 X
Hdqtrs Kans Wing CAP 434 Maple Wichita 12 Kans
Colby Kans 2b 100w 4.585, 4.507; 2b 15w 148.14 XT; 15m 15w 4.585, 4.507; 10m 15w 148.14 X
Middlesboro Sqdn CAP Middlesboro Ky 2b 100w 4.325, 4.585; 6m 50w 4.585 X
Poughkeepsie Sqdn Westchester Grp 1 N Y Wing CAP Poughkeepsie N Y 1b 130w 2.374, 4.507, 4.585 —
Anderson Air Activities Milwaukee Wis
1b 4w 122.8 NN

FLIGHT TEST

Bell Aircraft Corp Helicopter Div Buffalo N Y
20m 3w 123.3 X

POLICE

City of Ladue Mo 9345 Clayton Rd
.2w 2455 Speedmeter
Clark County Sheriff Marshall Ill
1b 120w; 8m 30w, 60w 39.5 M
Leake County Sheriff Carthage Miss
2m 120w 42.02, 42.18 L
Miss State Dept of Public Safety 2550 N State Jackson Miss
Doloroso Miss 1b 75w 73.30 L
Ida County Sheriff Ida Grove Ia
1b 120w; 5m 60w 37.1 M
Village of Randolph Wis 1m 75w 39.34, 39.42 R
Village of Owensville Ohio 2m 75w 39.58, 39.66 M
Pearl River County Sheriff Poplarville Miss
1b 150w; 3m 120w; 1m 3w 45.1 L
Scotland County Sheriff Laurenburg NC
1b 60w; 4m 1w; 10m 20w 46.02 M
Mich State Police Patrol Harrison Rd E Lansing Mich
3tb 120w 42.58 M
Village of Hempstead NY 3b 60w 155.13 L
Jasper County Sheriff Newton Ia 1b 120w 37.1; 6m 60w 37.1 M
City of Anna Ill 1m 150w 39.5 M
Mayor & Council Inc Box 229 Middletown Del
1m 48w 39.5, 39.78 L
D O LeMoine 3496 S Arlington St Akron 12 Ohio
4m 20w; 6m 60w; 4m 3w 39.58, 39.66 M
City of Clinton Tenn 1b 60w; 3m 30w 37.26 M
City of Elizabethtown Ky 1b 120w 155.25, 155.37; 6m 30w 155.25 M
City of Middletown Conn 225 Main St 1b 110w; 30m 80w, 110w 155.37 G; 1b 110w; 1m 110w 155.37 L
Tarrant County Sheriff Rte 10 Box 174A Ft Worth Tex
1m 75w
City of Monticello Ind 1b 120w 155.13, 155.37; 3m 80w; 3m 30w 154.89, 155.13 M
Calif State Police Patrol Sacramento Calif
1b 75w 155.67 M
Pottawatomie County Sheriff Westmoreland Kans
1b 120w; 10m 120w 39.58 R
Burlington City Police Dept Box 169 Burlington NC
1m .2w 2455 Speedmeter

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	

Gov of PR Insular Police Box 3826 San Juan PR
2b 30w 154.89, 155.13 M
Isla de Cabra PR 1b 30w 154.89, 155.13 M
Vega Baja PR 1b 30w 154.89, 155.13 M
Roberts County Sheriff Miami Tex
1b 120w; 6m 120w 37.18 M
Essex County Sheriff Newark NJ 2m 30w 45.18 M
Town of Rochester Mass 2m 75w 39.22 G
Shenandoah County Sheriff Woodstock Va
1b 120w; 15m 60w 39.5 M
City of Caney Kans 3m 60w 39.58 R
Village of Donnelsville O 2m 100w 39.58, 39.66 M
Franklin County Sheriff Meadville Miss
1m 120w 42.02, 42.18 L
Cumberland County Sheriff Toledo Ohio
1b 120w; 3m 120w 39.5 M
Harrison County Sheriff Corydon Ind 1b 120w 155.13, 155.37; 3m 80w; 3m 40w 154.89, 155.13 M
City of Greeley Colo 1b 90w 454.15 L
Village of Lithopolis Ohio 4m 75w 39.58, 39.66 M
City of Moncks Corner SC 1b 20w; 5m 20w 155.67 M
Pondera County Sheriff Box 98 Conrad Mont
1sq 15w 155.79 G
Nr Conrad 1sr 50w 158.79 G
Humboldt County Sheriff Winnemucca Nev
1b 500w 1.634 H; 6m 50w 39.38 M
Davies County Sheriff 2nd & Frederica Sts Owensboro Ky 2m 120w; 2m 60w 155.73 G
Town of Dudley Mass 1b 120w; 3m 30w 155.43 M
Calif State Highway Patrol Sacramento Calif
Nr Santa Rosa Calif 1b 150w 42.34 G
City of Orrville Ohio 1b 30w 39.58 M
City of Ft Meade Fla 1b 24w 155.85 M
City of Los Angeles Police Dept
1b; 5m 12.5w 159.75 T
Town of Westborough Mass
1b 60w; 10m 60w 45.98 L
Middlesex County Sheriff Cambridge Mass
Concord Mass 1b 25w; 10m 25w, 10m 2w 155.79 L
Wilson County Sheriff Fredonia Kans
Neodesha Kans 1b 150w 39.58 G
Los Angeles County Sheriff Rm 238 Hall of Justice Los Angeles 12 Calif 4us 15w 6625, 6685, 6705, 6745 M
San Dimas Calif 1us 15w 6825 M
New Hall Calif 1us 15w
City of Humboldt Kans 1m 80w 39.58 G
City of Royal Oak Mich 221 E 3rd St
1p .2w 2455 Speedmeter
State Police Patrol Box 1420 Trenton NJ
Plainsboro Twp NJ 1b 150w 44.94 —
City of Reedley Calif 1b 60w 155.07 M
City of Eunice N Mex 1b 120w; 5m 120w 39.9 M
Lanier County Sheriff Lakeland Ga 3m 150w 42.02 G
Portage County Sheriff 213 W Main Ravenna Ohio
20 10w 2455 Speedmeters
Presidio County Sheriff Marfa Tex 3m 150w 42.9 G
Brazoria County Sheriff Angelton Tex 1p 12w 37.26 M
Georgia State Police Patrol Box 1456 Atlanta Ga
Hardwick Ga 1b 120w 154.25 R
City of Santa Barbara Calif 1b 30w 159.21 M
Archer County Sheriff Archer City Tex
1b 120w; 4m 120w 37.18 M
Teton County Sheriff Choteau Mont.
1b 20w 155.07; 1b 20w 159.15 M
Flathead County Sheriff Kalispell Mont
1b 150w 39.82 M
City of Springdale Ark
1b 120w; 5m 120w; 5m 30w 37.1 M

FIRE

Vigilant Engine, Hook & Ladder Co Great Neck NY
1b 500w; 5m 60w 46.1 R
Laura Fire Dept Laura Ohio
1b 27.7; 5m 27.7w 59.5, 46.1 R
Van Buren Twp Fire Dept 112 West Dorothy Lane Dayton Ohio 1b 27.7w; 21m 24.8w 154.19 R
Arconum Fire Co Arconum Ohio
1b 27.7w; 6m 24.8w 154.19 R
Greenville Fire Dept Greenville RI
1b 120w; 10m 60w, 2w 154.19 M
Brentwood Fire Dist Brentwood NJ
1b 120w 46.46; 8m 3w, 80w 46.34, 46.46 M
City of Buffalo NY 322 Ellicott St
1b 30w; 1b 60w 154.19, 153.89 M
Wilson Vol Fire Co Phoenix Ariz
1b 25w; 5m 25w 154.31 G
Islip Fire Dist Islip LI NY
1b 120w 46.46; 2p 3w, 9m 80w 46.46, 46.34 M
Valley of the Moon Fire Dist Boyes Hot Spgs Calif
1b 120w; 5m 21w 154.31 M
Sullivan Co Fire Dept Monticello NY
1b 150w 46.10; —m 115w 46.10, 46.22 —
City of Baltimore Fire Dept Baltimore Md
2b 500w 154.31; 186m 60w 154.07 MF
Prince George's County Commissioners 5012 Rhode Island Ave Hyattsville Md 1m 75w 33.86 L
W Milton Fire Co West Milton Ohio
1b 27.4w; 15m 27.7w 154.19 R
Bolivar Fire Dept Bolivar NY
1b 120w; 6m 60w 46.1 R
Carlisle Fire Co Milford Del
1b 120w; 11m 5-60w, 6-3w 33.87 M
Town of N Gloucester Me 20m 2w, 80w 154.31 GA
Contra Costa County Box 39 Martinez Calif
Moraga Calif 1b 80w 46.10, 46.38 L
Winters Fire Dist Winters Calif 1b 120w 154.19 L
Fire Dept Hdqtrs Lakewood Ohio
1b 120w; 8m 120w 154.25 G
Marley Vol Fire Co Inc Marley Park Md
1b 120w; 3m 60w 46.5 G
Greenwich Fire Dept Greenwich Conn
1b 120w; 35m 60w 46.5 G
Fire Dist #1 S Dartmouth Mass
1b 120w; 5m 75w 46.18 G
City of Royal Oak Mich Fire Hdqtrs
1b 30w; 15m 10w; 1m ¼w 155.43 M
Town of Munster Ind Fire Dept Hammond Ind
1b 10w; 6m 10w 154.13 M
Huntingdon Valley Fire Co #1 Huntingdon Valley Pa
1b 80w; 7m 60w 154.13 P
Norwell Fire Dept Norwell Mass 3m 75w 33.9 L
Ferndale Volunteer Fire Co Inc Glen Burnie Md
Ferndale Md 1b 114w 46.5; 5m 114w 46.5, 57.8 R
Roslyn Fire Co #1 Bradford Rd & Heston St
Roslyn Pa 6m 60w 154.13 P
Ridge Fire Dist Ridge LI NY
2m 40w; 2m 30w 46.34, 46.46 M
Hightstown Engine Co #1 Hightstown NJ
1b 119w; 8m 59.5w 154.13 M
Baltimore County Fire Dept Towson Md
1b 500w 46.46; 155m 33.42, 46.46 M
Montgomery County Fire Dist Court House Rockville Md
Washington Grove Md 1b 500w 33.78 M

FORESTRY

Georgia State Forestry Comm State Capitol Atlanta Ga
Augusta Ga 1b 30w 159.39 M
Quitman Ga 1b 30w 159.39 M
Mettasville Ga 1b 30w 159.39 M
New York State Conservation Dept Albany NY
26m —w 31.86, 31.98 X
Miss State Forestry Comm Box 649 Jackson Miss
Spring Hill Miss 1b 75w 31.22, 31.30 R
Camden Miss 1b 75w 31.22, 31.30, 31.42; 2b 75w 31.22 31.30; 2tb 80w 31.22, 31.30 L

(Continued on page 38)

NEW APPLICATIONS

(Continued from page 36)

Barton Miss 1b 40w 31.3 M
Chatou Miss 1b 40w 31.3 M
Calif State Dept of Forestry Sacramento Calif
2mr 120w 172.22, 172.37 R
1tb 120w 159.27, 159.33, 159.39, 159.45 M
Independence Cal 1b 30w 159.27, 159.33, 159.45 R
Nr Auburn Calif 1b 120w 172.22 P
State of Ala Dept of Conservation 607 Monroe St Montgomery Ala
Jacksonville Ala 1b 120w 159.45 G
State of Ga Dept of Forestry Box 811 Waycross Ga
Ellabelle Ga 1b 30w 159.39 M
Forest Glen Ga 1b 30w 159.39 M
Montana State Game & Fish Dept Helena Mont
35m 80w; 10m 3w 39.82 M; 25m 75w 39.82 R
New Hampshire State Dept of Forestry Concord NH
Farmington NH 1b 40w; 15m 25w 31.9 X
Idaho State Forestry Dept Capitol Bldg Boise Idaho
Nr Elk River Idaho 1b 15w 159.45 C
Nr Headquarters Idaho 1b 15w 172.22 C
Nr Elk Point Idaho 1b 15w 172.22 C

HIGHWAY MAINTENANCE

Comm of Mass Dept of Public Works 100 Nashua St Boston Mass
Princeton Mass 1r 15w 959 G
Worcester Mass 1b 124w 46.9; 1q 15w 953.5 G
Traffic & Planning Div Del State Highway Dept
Dover Del .2w 2455 Speedmeter.
St Joseph County Hway Dept South Bend Ind
2b 70w; 12m 40w 37.98 G
Board of Huron County Rd Comm Bad Axe Mich
1b 120w; 15m 60w 46.86 M
S C State Dept of Highways Box 1498 Columbia SC
Nr Orangeburg SC 1b 5C0w 47.22 G

SPECIAL EMERGENCY

Wm C Edwards Cambria Wis
1b 120w; 1m 80w 47.66 M
Steele's Animal Hospital Toccoa Ga
1b 12w; 1m 12w 47.66 M
Dr Herschel J Chudomelka Ozark Mo
1b 30w; 3m 30w 47.62 M
Dr R J Sykes Mt Airy NC 1b 60w; 1m 20w 157.47 M
Dr E J Straley Bellefonte Pa
1b 120w; 1m 120w 47.54 M
Mtn Rescue & Safety Council 5213 11th NE Seattle Wash 1p 2w 3.190 X
Dr C M Loy Columbia Ky 1b 120w; —m 120w 37.94 G
D O MacKintosh Gallatin Mo 1b 41w: 3m 41w 47.5 M
Dr J C Hughes Lebannon Mo 1b 60w· 3m 60w 47.46 M
Wm H Vanderbilt DVM Durham NC
1b 120w; 1m 60w 47.5 M
James B Wilson Jr Milltown Wis 1b 60w 47.5 M
Dr R A Bruce Ottawa Kans 1b 124w; 4m 124w 47.5 G
Dr R Cullen Dodds Caledonia Minn
1b 120w; 2m 60w 47.54 M
E D Frederiksen Stewartville Minn
1b 60w; 2m 60w 47.58 M
Dr K E Griebe Hutchinson Minn
1b 120w; 2m 60w 47.58 M
L H Taylor Oxford Pa 1b 120w; 1m 60w 47.54 G
Raudabaugh & Hay Vet Serv Piper City Ill
1b 60w; 3m 30w 47.62 M
A L Lee Ganado Ariz 1b 30w 37.94 B
Yates Funeral Home Ft Pierce Fla
1b 120w; 6m 30w 47.66 M
C W Field Columbus Grove Ohio
1b 20w; 3m 20w 47.62 M
Boyd's Vet Hospital Waynesboro Va
1b 120w; 2m 60w 47.54 M
H A Friede Act Elec Eng Dist of Columbia Disaster Comm Dept of Civil Defense Washington DC
1b 250w 47.46 R
John Janss DVM Belle Plaine Ia
1b 60w; 2m 30w 47.46 M
Wallace Ambulance Serv Whittier Calif
1b 30w; 8m 10w 47.46 M
W J Kilpatrick & D H Perkins DVM Mediapolis Iowa
1b 30w; 3m 30w 47.54 M
Dr A W Pennings Minneota Minn
1b 120w; 2m 60w 47.54 M
Harry P Lortz Coleridge Neb
1b 60w; 2m 30w 157.45 M
Dr R W Rieke Fairmont Minn
1b 60w; 1m 60w 157.47 M

STATE GUARD

Mich State Troops Box 210 Lansing Mich
5b 100w 2.726 X
Detroit Mich 5b 100w 2.726 X
Grand Rapids Mich 5b 100w 2.726 X
Flint Mich 5b 100w 2.276 X
Escanaba Mich 5b 100w 2.276 X
Texas State Guard Box 613 Refugio Tex
1tb 350w 2.726 X; 1tb 250w X; 2tb 40w 2.726 H; 1tb 32w; 1tb 40w; 1tb 330w 2.726 X

POWER UTILITY

Yampa Valley Elec Assoc Steamboat Springs Colo
Craig Colo 1b 140w 48.42 M
McGregor Colo 1b 40w 48.42 M
Virginia Elec & Pr Co 7th & Franklin Richmond Va
Waynesboro Va 1b 120w 49.14 M
Brazos River Trans Elec Coop 2404 LaSalle Waco Tex
Nr Ennis Tex 1b 150w 47.86 M
Downing Tex 1b 150w 47.86 M
Idaho Power Co 1220 Idaho St Boise Idaho
Parma Idaho 1b —w 153.59 M
Rich Mtn Elec Coop Mena Ark
Dierks Ark 1b 60w 153.71 M
City of Seattle 1015 Third Ave Seattle 4 Wash
Concrete Wash 1us 250w 169.575 M
Gorge Dam Wash 1us 10w 169.575 M
Arizona Pub Serv Co Box 2591 Phoenix Ariz
1usq 10w 1855 R
Nr Phoenix Ariz 1usr 10w 1895 R
Nr Jerome Ariz 1usr 10w 956.74, 1855 R
Prescott Ariz 1usq 10w 958.25 R
Nr Flagstaff Ariz 1usr 10w 958.25, 1805; 1usq 10w 956.75 R
Winslow Ariz 1usq 10w 956.75 R
Pacific Gas & Elec Co 245 Market San Francisco Calif
Burney Calif 50w 158.25 R
Placerville Calif 1b 120w 153.71 L
Appalachian Elec Pwr Co 40 Franklin Rd Roanoke Va
Kenova W Va 1b 75w 37.7 L
Union County Elec Coop Elk Point SD
1b 115w; 5m 105w 158.25 G
Nantahala Pr & Lt Co Franklin NC
Nr Nantahala NC 1b 150w 37.7 G; 10m 150w 37.7 M; 50m 150w 37.7 G
Nr Glenville NC 1b 150w 37.7 G
Franklin NC 1b 150w 37.7 G
Town of Middleton Mass 1b 170w; 4m 30w 48.46 M
Bangor Hydro-Elec Co Bangor Me 1b 60w 37.54 G
South Jersey Gas Co Millville NJ 1b 60w 153.65 M
New England Pwr Co 35 Harvard St Worcester Mass
1tb 120w 37.86 M
City of Cuyahoga Falls Ohio
1b 120w; 25m 20w; 10m 60w; 15m 3w 153.47 M
Mich Gas & Elec Co Box 415 Three Rivers Mich
Nr Jones Mich 1b 250w 37.62; 35m 30w 48.06; 1b 8w 457.95 M
Three Rivers Mich 1b 8w 456.05 M
Cent Illinois Light Co Peoria Heights Ill
1b 50w; 100p 1w 153.47 G; 10m 35w 153.47 A
City of Palo Alto Calif 1b 15w; 20m 15w 457.75 L
Dept of Public Utilities Richmond Va
1b 120w; 30m 60w 158.13 R
Texas Elec Service Co Box 970 Ft Worth Tex
Nr Sweetwater Tex 1b 124w 72-76mc G
Kans-Nebr Natural Gas Co 300 North St Joseph Hastings Nebr
Scott City Kans 1b 30w 75.66 M
Deerfield Kans 1b 30w 72.66 M
Cent Illinois Light Co 316 S Jefferson Peoria Ill.
Springfield Ill 1b 50w 153.47 G
Town of Milton Mass 1b 120w; 8m 30w 48.1 —
Philadelphia Suburban Water Co 762 Lancaster Ave
Bryn Mawr Pa 1b 250w; 25m 50w 48.1 G
Springfield Pa 1b 50w 48.1 G
Jenkintown Pa 1b 50w 48.1 G
Media Pa 1b 50w 48.1 G
Janney Pa 1b 50w 48.1 G
Phoenixville Pa 1b 50w 48.1 G
Ohio Power Co 606 2nd St SE Canton Ohio
Ironton Ohio 1b 75w 37.7 G
Portsmouth Ohio 1b 75w 37.7 G
Chesapeake Ohio 1b 75w 37.7 G
N Kenova Ohio 1b 75w 37.7 G
Pomeroy Ohio 1b 75w 37.7 G
Ala Elec Co-op Inc Andalusia Ala
Troy Ala 1b 150w 48.5 M
Kans-Nebr Nat Gas Co 300 N St Joseph Hastings Nebr
Sutherland Neb 1b 60w; 37.5; 1r 30w 72.66 M
Big Springs Neb 1b 60w 37.5 M
Cozad Neb 1r 30w 72.66 M

PIPELINE PETROLEUM

Standard Oil Co of Calif 225 Bush St San Francisco
4tb 30w 158.37 M
Midwestern Drillers Wright Bldg Tulsa Okla
10m 60w 30.74 M
Rowan Drilling Co Inc Fair Bldg Ft Worth Tex
New Orleans La 1b 148w; 10m 148w 2.292 X
Magnolia Petroleum Co Box 900 Dallas Tex
Dickinson ND 1b 100w 1.614, 1.628, 1.652, 1.676 1.700, 2.292; 1tb 100w 1.614, 1.628, 1.652, 1.676, 1.700, 2.292 K
Lorac Service Corp Box 1590 Tulsa 1 Okla
12m 100w 1.614, 1.628, 1.652, 1.676, 1.700, 2.292 A
Placid Oil Co Tex Eastern Bldg Dallas Tex
Nr Olla La 1b 70w 49.14 G
Nr Marksville La 1b 70w 49.14 G
Hunt Oil Co Mercantile Bank Bldg Dallas Tex
Shongaloo La 1b 70w 49.14 G
Nr Jonesville La 1b 70w 49.14 G
Donnell Drilling Co 112 O'Michael Bldg Odessa Tex
1b 300w; 10tb 70w; 15m 70w 49.1 G
Gen Petroleum Corp Box 1652 Casper Wyo
Lakeridge Wyo 1b 120w 49.02 M
John W Mecom 2906 Gulf Bldg Houston Tex
1tb 150w; 1tb 40w 30.74 L
Southern Nat Gas Co Box 2563 Birmingham 2 Ala
Nr Birmingham Ala 1b 17w 45.79 M
Onward Miss 1b 60w 49.06 M
Birmingham Ala 1b 17w 45.64 M
Petty Geophysical Eng Co Box 2061 San Antonio Tex
6p 65w 1.614, 1.628, 1.652, 1.676, 1.700 X
Ark-La Gas Co Box 1734 Shreveport La
Waskom Tex 1b 120w 30.82 M
C G Glasscock Box 498 Corpus Christi Tex
1m 200w 25.26 K
United Gas Pipeline Co Box 1407 Shreveport La
Jackson Miss 1b 10w 1925, 1965 R
Crystal Springs Miss 1b 10w 1925, 1965 R
Brookhaven Miss 1b 10w 1925, 1965 R
Jayess Miss 1b 10w 1925, 1965 R
Osyka Miss 1b 10w 1925, 1965 R
Montpelier La 1b 10w 1925, 1965 R
Texas Eastern Transmission Corp Box 1612 Shreveport La
Aberdeen Miss 1b 60w 48.94 M
Tomkinsville Ky 1b 60w 48.94 M
Columbia Tenn 1b 60w 48.94 M

(Continued on page 40)

NEW APPLICATIONS

(Continued from page 38)

Tuscumbia Ala 1b 60w 48.94 M
Chauncey Ohio 1b 60w 48.94 M
Stanford Ky 1b 60w 48.94 M
Owingsville Ky 1b 60w 48.94 M
New Lexington Ohio 1b 60w 48.94 M
Pasotex Pipeline Co Box 1022 El Paso Tex
2m 3w 49.98 M
Ashland Oil & Refining Co 1409 Winchester Ave
Ashland Ky
1 mi So of Covington Ky 1b 60w 49.06 M
Phillips Petroleum Co Engrg Dept Bartlesville Okla
6tb 60w 48.9 M
Nr Rockport Tex 1b 12w 48.9 M
Oil Production Maintenance Inc Houston Tex
1b 500w 153.11; 7tb 120w 153.11; 20m 120w 153.11 M

FOREST PRODUCTS

Weyerhaeuser Timber Co Box 420 Centralia Wash
Camp McDonald Wash 1b 150w 49.38 G
Nr Silver Lake Ore 1b 150w 49.38 G
Bly Ore 1b 90w 49.38 G
Great Northern Paper Co Millinocket Me
1b 120w 49.54 M
Crown Zellerbach Corp 1400 Pub Serv Bldg
Portland Ore
Seaside Ore 1b 150w 153.23 G
Vernonia Ore 1b 150w 153.23 G
Greene Bros Lumber Co Elizabethtown NC
1b 120w; 15m 60w; 5m 20w; 5m 1w 49.5 M
Coast Redwood Co Box 216 Arcata Calif
Nr Klamath Calif 1b 50w; 12m 50w 153.05 G
Consumers Coop Assn 318 E 10th St Kansas City Mo
Swisshome Ore 1b 150w 49.62 G
Lane County Ore 1b 150w; 20m 150w 49.62 G
Willamette Nat'l Lumber Co 326 Pacific Bldg
Portland Ore
Cascadia Ore 1b 120w 49.3 G; 1b 90w 49.3 X
Pine Tree Timber Co Box 464 Ridgeland SC
Possom Corner Plantation 1b 30w; 10m 30w 49.5 M
Twin Feather Mills Inc Kamiah Idaho
Clearwater Idaho 1b 150w 49.22 G
Crosby Chemicals Inc De Ridder La
1b 500w; 12m 150w 49.34 R
Fuller Logging Co Jackson Calif
1b 100w; 6m 118w 49.58 L

SPECIAL INDUSTRIAL

Capitol Constr Co Inc Box 7336 Santurce PR
Jayuga PR 1mr 120w 154.57 L
Carolina PR 1b 2½w 154.57 T; 1b 10w 152.93 L
San Juan PR 1b 10w; 12m 10w 152.93 L
Vernon Thomas Inc Box 369 Huron Calif
1b 120w; 70m 120w 49.78 G
D W Winkelman Co Inc 205 Harrison Syracuse NY
East of Mississippi 1b 60w; 20m 30w 43.06 M
Robt G Cole Avon Twp NY 1b 60w; 20m 25w 43.06 M
Union Carbide & Carbon Corp 30 E 42nd St
New York NY
(Div Electro Metallurgical Co)
Marietta Ohio 1b 120w; 14m 30w 152.99 —
J C Watson Co Parma Idaho 1b 40w; 15m 40w 43.1 M
Brazato Paving Co Belmont Calif
1b 120w; 4m 57.8w 49.86 R
B J Service 6505 Paramount Blvd Long Beach Calif
Rankin Tex 1b 70w; 2tb 70w 49.7 G
Nebraska Farm Prods Inc Cozad Nebr
1b 60w; 10m 12w 49.9 M
Brawley Calif 1b 60w; 10m 12w 49.9 M
Mullett Coal & Clay Mines Mt Eaton Ohio
Holmesville Ohio 1b 27.7w; 11m 24.8 154.57 R
Nr Mt Eaton 1b 27.7; 11m 24.8 154.57 R
Kershaw Mining Co Box 630 Birmingham Ala
1b 15w; 5p 1w 43.18 M
Horseshoe Basin Mining & Development Co
5209 Clarkston St Tacoma Wash
1b 120w; 10m 60w 154.49 M
A P Atkins Box 470 Guymon Okla
1b 60w; 2m 60w; 2m 10w; 2m 1w 30-50mc band M
Nr Guymon Okla 1b 60w 30-50mc band M
Benton & Co Inc Box 1346 St Petersburg Fla
10m 30w; 5m 3w; 2p 2w 152.87 M
Jones Construction Co Grant Neb
1b 60w; 10m 60w; 5m ½w 30.58 M
H T Martinez Hebbronville Tex
1b 120w; 5m 120w; 6m 80w; 5m 30w 49.54 M
Nr E Hebbronville Tex 1b 30w 49.54 M
Nelson Mullen & Webster Inc 355 Gateway Bldg
Minneapolis Minn
1tb 120w; 4m 60w; 4m 30w 152.87 M
Otto B Ashbach & Sons 2975 Hamline Ave N
St Paul Minn 3tb 120w; 4m 3w; 18m 60w 152.87 M
Carl Puline Inc Erie Pa 1b 60w; 10m 30w 49.9 R
E I DuPont de Nemours Box 117 Augusta Ga
25p 25w 154.49 M
O R Cote Co Inc Springfield Mass
1b 120w; 10m 30w 49.94 M
Detroit Asphalt Paving Co 5700 E Nevada St Detroit
Green Oaks Mich 1b 60w 49.9 M
Service Lumber Co Box 248 Liberty Tex
Nr Liberty Tex 1b 95w; 20m 120w 43.1 M
Rotary Engineering & Mfg Co Inc 701 S Peco St
Midland Tex 1b 500w 43.06; 1b 120w 74.5 M
H E Sargent Inc Stillwater Me
1tb 120w; 20m 120w 43.06 R
Howard C Draper 119 Rose St Mankato Minn
1tb 120w 43.06 M
Bethlehem Pacific Coast Steel Corp San Francisco
1b 120w 43.1; 25m 57.8w 43.1 R
Southern Materials Co Box 246 Chester Va
Farrar's Island Va 1b 124w; 10m 62w 43.1 G
Harry J Forepaugh Bedford Ohio
1b 60w; 5m 30w 43.14 G
Rockcrete Inc 9400 Pelham Rd Dearborn Mich
Taylor Twp Mich 1b 60w; 15m 30w 152.93 R
Pismo Oceano Vegetable Exchange Box 239
Oceano Calif 1b 60w; 5m 30w 49.9 M
Amer Potash & Chem Corp 3030 W 6th St Los Ang
Trona Calif 1b 60w; 10m 20w; 6m .25w 152.87 M
H-E-B Constr Co Box 1658 Hobbs New Mex
Nr Brownfield Tex 1b 70w 49.86 G
A S Wilkstrom Inc Box 217 Skaneateles N Y
1p 60w 49.98 M
Lake Mining Co Biwabik Minn
1b 30w; 10m 30w; 6p 1w 154.49 M
Wayne T Wright Roll Ariz
1b 30w; 4m 30w; 14m 3w 154.57 M
Gem Canning Co Emmett Idaho
1b 40w; 5m 40w 152.87 M
Agriform Co Inc 710 Main El Centro Calif
Wasco Calif 1b 60w 49.94 M
Bradley Mining Co Box 829 Boise Idaho
Ima Mine Patterson Idaho 1b 45w 4.637 K
Burkett Bros Coal Co Uhrichsville Ohio
1b 27.7w; 10m 24.8w 152.93 R
A C Pierce Queen Creek Ariz
1b 125w; 15m 115w 152.87 G
Lucky Gold Hill Co Box 485 Yuba City Calif
1b 120w 40-50 M
Nr La Porte Calif 10m —w 40-50 M
Libby McNeill & Libby US Yards Chicago 9 Ill
Nr Rochester Minn 1b 120w; 15m 60w; 4m 120w 43.18 M
Hugh J Hughes Heating Co Birmingham Ala
1b 60w; 5m 15w 49.9 M
Halliburton Oil Well Cementing Co Duncan Okla
Falfurrias Tex 1b 300w 49.74 G
Hebbronville Tex 1b 70w 49.74 G
Freer Tex 1b 70w 49.74 G
Kenedy Tex 1b 70w 49.74 G
Beeville Tex 1b 70w 49.74 G
Pleasanton Tex 1b 70w 49.74 G
Refugio Tex 1b 70w 49.74 G
Victoria Tex 1b 300w 49.74 G
Robstown Tex 1b 70w 49.74 G
Alice Tex 1b 70w 49.74 G
Farmington New Mex 1b 300w 49.74 G; 1uq 50w; 75.62 1ur 50w 72.1 G
Mission Tex 1b 300w 49.74 G
Gen Mots Res Corp 3044 W Grand Blvd Detroit Mich
Flint Mich 1b 10w; 20m 10w 152.93 M
German-Hoff Potato Co Cozad Nebr
1b 60w; 10m 12w 43.02 M
Marble Cliff Quarries Columbus O 1b 10w 154.49 G
F M Reising Edinburg Tex
1b 120w; 30m 120w 49.78 M
Yuba City Mills Yuba City Calif
1b 30w; 8m 30w 152.93 M
Electric Construction Co 1650 Center St
Tacoma Wash 10m 30w 154.49 M

Brown & Root Inc Box 3 Houston Tex 1b 60w 2.292 R
Patti McDonald Constr Co Anchorage Alaska
1b 120w; 8m 40w 43.18 M
Brooks & Turner Well Servicing Box 493
Coahoma Tex
1b 90w 74.54; 1b 90w 72.5 L
United States Steel 525 Wm Penn Pl Pittsburgh Pa
Falls Twp Pa 6b 75w; 60m 75w 49.94 G
Central Paving Co Box 42 Dallas Ore
Salem Ore 1b 30w 154.49 F
Delhi Gravel Co Holt Mich 1b 10w; 5m 10w 49.98 M
George Covert Tracy Calif 1b 120w; 10m 60w 43.1 M
Brown Paving Co Lexington NC
Margarettsville NC 1b 60w; 10m 60w 30-50 L
Di Carlo Bros Inc Newton Mass
1b 60w; 20m 30w 43.18 R
Leon Tillman Constr Co Lufkin Tex
1b 30w; 8m 30w 43.06 M
Hubbard Constr Co Fairvilla, Orlando Fla
1b 120w; 15m 60w 43.1 M
Westphall & Davis Albuquerque N Mex
1b 60w; 1m 30w; 10p 1w 43.1 L
John L Rice Gooding Idaho
1b 120w; 10m 60w 43.06 M
Romer Agricultural Serv Holly Colo 1b 120w 43.14 M
Powers County Colo 2b 60w; 15m 60w 43.14 M
Hudson Co Beach ND 2b 120w; 10m 120w 43.1 M
City Water Tank Golden Valley County ND 1b
120w; 5m 120w 43.1 M
W Hodgman & Sons Fairmont Minn
1tb 120w; 7m 60w; 2m 120w; 2m 3w 43.02 M
Jimmy E Golematis Metaline Falls Wash
1b 30w; 10m 30w 154.49 M
L W Wells Constr Co Saginaw Mich
1b 60w; 11m 60w 43.18 M
L A Davidson Constr Co 213 E St Joseph
Lansing Mich 1b 60w; 11m 30w 43.14 M
Dear Bros 916 Walnut Kansas City Mo
1b 120w; 40m 30w, 60w, 120w 43.14 M
Mecasphalt Corp Box 637 Lakeland Fla
3tb 120w; 35m 60w, 3w 43.02 M
W E Anderson Sons Co Columbus Ohio
1b 119.0w; 200m 59.5w 152.87 R
Gen Tire & Rubber Co Akron Ohio
1b 60w; 1b 15w; 25m 30w 152.99 M

LOW POWER INDUSTRIAL

Herb Fitzgerald 635 E 185th St Cleveland Ohio
15p 3w 154.57 M
Commercial Electronics Inc 108 E 14th St
Chicago Hghts Ill 5p 3w 154.57 M
Wantagh Rangers Inc Wantagh NY 1m 3w 27.51 SS
South Penn Oil Co 54 Boylston Bradford Pa
6p .75w 42.98 M
W Va Pulp & Paper Co Covington Va 6p 3w 154.57 M
Bethlehem Pacific Coast Steel Corp 3391 Randolph St
Los Angeles Calif 11p 1w 154.57 M
Michigan Bell Telephone 1365 Cass Ave Detroit Mich
25p .50w 42.98 M
Kamp Difrent Rte 1 Aitken Minn
9 mi NE Garrison on Hway 18 1b 3w 2p 3w
42.98 M
A Duane Corey 64 W Schiller Chicago Ill
5p 3w 154.57; 10p —w 154.57 M
Reed & Prince Mfg Co Worcester Mass
1b 3w —15p 3w — M
Rolf Wight Roley 104 McArthur Pana Ill
5p 3w 154.57 M
Syracuse Regatta Assoc Hotel Syracuse Syracuse NY
10p 1.5 154.57 G
Cedar Grove Cemetery Assoc H Harding Blvd
Flushing NY 8p 3w 35.02 M
Standard Steel Works Inc 16th & Howell Sts
North Kansas City Mo 11p 3w 154.57 RA
Milton A Bowers Jr 340 Clara Ave Morton Ill
2p 1.3w; 4m 25w 154.57 M
Jacob Bros Inc 1240 Seaview Ave Bridgeport Conn
5p 3w; 5p 1w 154.57 M

COASTAL & MARINE RELAY

E E Saunders & Co Pensacola Fla
1s 100w 2.182, 2.214 X

ALASKAN COASTAL

Coastwise Line c/o Northern Electric 314 Bell St
Seattle Wash
Seaward Alaska 1s 100w 10 channels from 1.708
to 5.167 BB
Valdez Alaska 1s 100w 10 channels from 1.708
to 5.167 BB

ALASKAN FIXED PUBLIC

Tibbetts-Nelson Airmotive Naknek Alaska
1b 35-50w 1.622, 2.430, 2.566, 3.190 H

COASTAL & FIXED

Port Wrangell Packing Co Chignik Alaska
1s 30w 5 channels from 2.512 to 2.670 X
Halferty Canneries Inc c/o Northern Electric
314 Bell Seattle Wash
Kodiak Alaska 1s —w 9 channels from 2.382 to
5.167 NN
Arland H Breëze Wrangell Alaska
Farm Island Alaska 1b 100w 2.406, 2.538, 3.190 G

MARITIME FIXED

John W Mecom 2906 Gulf Bldg Houston Tex
La & Tex Gulf Coastal Area 1s 75w 2.134, 2.206 R
Magnolia Petroleum Co Box 900 Dallas Tex
1tb 30w 2.134, 2.206 X

RAILROAD

Southern Railway Co Box 1808 Washington 13 DC
Nr Harrodsburg Ky 1b 8w 160.95 M
Chicago Burlington & Quincy RR Co 547 W Jackson
Chicago 6 Ill

Denver Colo 1b 60w; 1p 60w 159.99 W
Ft Worth Tex 1b 60w 1p 60w 159.99 W
The Denver & Rio Grande Western RR Co
1531 Stout St Denver Colo
Grand Junction Colo 1b 120w 160.83 T
The Atchison Topeka & Santa Fe Rway
80 E Jackson Blvd Chicago 4 Ill
Amarillo Tex 3b 120w 161.07, 161.73, 160.29; 1b
120w 161.37 T
El Segundo Calif 1b 120w 161.37 T
Los Angeles Calif 1b 120w 161.37 T
Atlanta & St Andrews Bay RR Co 127 N Foster St
Dothan Ala
Panama City Fla 1b 30w; 15m 30w; 10m 3w
160.77 M
Terminal Railway Ala State Docks Mobile Ala
1b 120w; 25m 30w; 5m 10w — M

TRANSIT UTILITY

Champaign-Urbana City Lines Inc Champaign Ill
1b 140w; 5m 80w 44.54 M

INTER-CITY BUS

National Bus Communications Inc 141 W Jackson
Blvd Chicago 4 Ill
Beckley W Va 1b 120w 43.82; 1srq 72.02 55w M
Top of E River Mt W Va 1b 120w 43.82; 1srq 55w
72.02 M
Nr Oceana W Va 1b 120w 43.82; 1sr 55w 74.22 M
Nr Logan 1sr 55w; 1q 30w 72.02 M; 1b 120w
43.82 M
Mullens W Va 1q 30w 72.02 M
War W Va 1q 30w 72.02 M
Welsh W Va 1q 30w 72.02 M
Williamson W Va 1q 30w 72.02 M

TAXICABS

DeLuxe Taxi Service Banning Calif 1b 25w 152.27 X
E Detroit Cab E Detroit Mich
1b 12w 152.39; 1m 12w 157.65 G
Al's Taxi Augusta Me
1b 60w 152.33; 7m 15w 157.59 R
Morty's Taxi Inc Gardner Mass
1b 25w 152.39; 5m 25w 157.65 G
Doris Cab Bradenton Fla
1b 120w 152.45; 15m 30w 157.71 M
Bridge Taxi Glen Cove NY
1b 120w 152.27; 6m 30w 157.53 M
City Cab Co Decatur Ga
1b 30w 152.45; 4m 30w 157.71 M

(Continued on page 42)

NEW APPLICATIONS

(Continued from page 41)

Greenwood Taxi Greenwood Ind
1b 30w 152.39; 40m 10w 157.65 M
Midway Cab Co Franklin Tenn
1b 120w 152.33 K; 8m 30w 157.59 L
City Cab Co Highlands NC 1b 25w; 5m 25w 152.33 G
T A & C Taxi Inc Dover NH
1b 50w; 7m 30w 152-162 K
Airline Cab Co of Havelock Inc Box 902 New Bern NC
Havelock NC 1b 120w 152.39; 20m 20w 157.65 M
Tuxedo Cab Co Coos Bay Ore
1b 120w 153.29; 10m 120w 157.65 L
Bordeaux Cab Nashville Tenn
1b 120w 152.45; 8m 30w 157.71 M
Square Deal Taxi Bay City Texas
1b 20w 152.33; 10m 20w 157.59 M
White Top Cab Rockaway NJ
1b 24.8w 152.33; 6m 24.8w 157.59 G
Chester-Newell Taxi 601 Carolina Ave Chester W Va
1b 50w 152.39; 3m 30w 157.65 M
De Luxe Cab Co Mansfield Ohio
1b 30w 157.71; 8m 60w 152.45 M
City Cab Baraboo Wis
1b 60w 152.45; 7m 10w 157.71 M
Schock Taxi Serv Elizabethtown Pa
1b 20w; 4m 20w — M
Redford Veterans Cab Co Detroit Mich
1b 60w 152.45; 15m 10w 157.71 M
City Cab Tooele Utah
1b 40w 152.45; 7m 40w 157.71 M
Katherine's Taxi Tell City Ind
1b 15w 152.45; 6m 15w 157.71 M
Murphy's Taxi Co Brunswick Ga
1b 30w 152.33; 7m 30w 157.79 M
Bayou Cab Co Galena Park Tex
1b 15w 152.39; 10m 15w 157.65 M
Ace Taxi Bowling Green Ohio
1b 20w 152.39; 8m 20w 157.65 M
Leon C Painter Ardmore Okla
1b 30w 152.45; 12m 30w 152.71 L
Deerpark Taxi Service Deerpark NY
1b 50w 152.27 R; 5m 30w 157.53 L
Yellow Cab Lufkin Texas
1b 120w 152.27; 12m 120w 157.53 M
Smith's Taxi Portland Me
1b 30w 152.45; 5m 7w 157.71 M
Yellow Cab Co of St Joseph St Joseph Mo
1b 140w 152.33; 35m 41w 157.59 M
Commercial Cab Co Greenville SC
1b 60w 152.33; 15m 15w 157.59 M
Yellow Cab Co Corsicana Tex
1b 120w 152.38; 15m 20w 157.65 M
Littlejohn Taxi Service Memphis Tenn
1b 120w 152.39; 30m 10w 157.65 M
Whittens Taxi Service Uxbridge Mass
1b 30w; 4m 30w 152.39 M
Georgetown Yellow Cab Co Georgetown Ky
1b 120w 152.23; 20m 30w 157.53 M
Deluxe Radio Cab Hillsdale Mich
1b 10w 157.65; 5m 10w 152.38 M
Cozy Taxi Co Kinston NC
1b 120w 157.53; 20m 20w 152.27 M
Central Taxi Valley Stream NY
1b 30w 152.45; 5m 30w 157.71 M
Independent Cab Co Naugatuck Conn
1b 30w 152.33; 10m 30w 157.59 —
Palatine Cab Co Palatine Ill
1b 30w 152.45; 10m 30w 157.71 G
Hennesseys Public Cab Long Branch NJ
1b 30w 152.33; 10m 10w 157.59 L
City Cab Co Sauk Centre Minn
1b 30w 152.27 T; 5m 30w 157.53 B
United Livery Chicago Ill
1b 120w 152.27; 40m 60w 157.53 L
Ada's Old Transfer Taxi Service North Bergen NJ
1b 60w 152.33; 4m 30w 157.59 L
Checker Cab Co Downey Calif
1b 150w 152.45; 5m 24.8w, 40w 157.71 R

AUTO EMERGENCY

Automobile Club of Pittsburgh Pittsburgh Pa
1b 60w; 10m 30w 35.7 G
Charlie's Auto Body Hempstead NY
1b 120w 35.79; 5m 60w 35.7 L
Hapco Inc 10 W Canal St Sumter SC
Manning SC 1b 30w; 3m 15w — M
Sumter SC 1b 30w; 3m 15w — M
Town Auto Co Inc Allentown Pa
1b 120w; 6m 60w 35.7 G
Red Isaacs Garage Hamilton Ohio
1b 60w; 8m 30w 35.7 M
Truitt & Richards Motor Co Morganfield Ky
1b 114w; 14m 114w 35.7 R

HIGHWAY TRUCKS

F A, J E & G E Brewton Co Winnfield La
1b 120w; 10m 120w 35.82 M
Joe Bradley Co 305 S Pecos St Midland Tex
Hadacol Tex 1b 25w 35.86 M
Shays Service Inc N Main St Dansville NY
Buffalo NY 1b 120w; 22m 120w 35.82 M
Pixley & Co E Bethany NY
1b 120w; 20m 30w 35.9 M
Wright Trucking Co Stockton Calif
1b 120w; 15m 60w 35.74 M
Arcata Truck & Equipment Arcata Calif.
Nr Arcata Calif 1b 100w; 2b 60w 35.74 K; 8m 60w 35.74 G
Pickett Bros Truck Line 226 N 6th Ave Walters Okla
1b 60w —; 8m 60w — M
Cyril Okla 1b 60w — M
Comanchee Okla 1b 60w — M
H E Swezey & Son Motor Trans Inc New London Conn

1b 120w; 5m 60w 35.9 R
Keenan Welding Supply Co Albany Ga
1b 60w 35.82 M
H E Swezey & Son Motor Trans Inc Eastport LI NY
Eastport NY 1b 500w; 50m 60w 35.9 R
Orient Point NY 1b 120w; 5m 60w 35.9 R
Valley Stream NY 1b 120w; 5m 60w 35.9 R
New York NY 1b 120w; 5m 60w 35.9 R
Magic Gas Co Center Tex 1b 85w; 5m 60w 35.94 K
West Machinery Co Inc Kinston NC
1b 120w 25.5 L; 10m 120w 25.5 R

FILM PROJECTOR

(Continued from page 21)

veniently. Cumulative operating hours are indicated. A switch on the control panel transfers control to a remote location when desired. Push-buttons are provided for starting and stopping the mechanism, as well as for still projection.

A separate torque motor is furnished for the take-up reel drive. Extremely quiet operation is obtained, with many of the vital moving parts running in continuous oil baths.

BBC DISPLAYS

(Continued from page 23)

It was considered at first that amplitude, time, and frequency might be shown by presenting successive logarithmic decays on a CRT at progressively increasing frequencies, and applying incremental shifts to the X and Y axes as each pulse was radiated into the room, so that a composite picture could be obtained photographically. Some experiments were conducted also with a skiatron[8] to display the composite picture, but practical difficulties led eventually to the adoption of a simpler system. Successive traces on the face of the CRT are photographed on a film which is moved at a rate of 1 mm. per second by a synchronous motor in an experimental camera, Fig. 4. Reference frequencies are marked by depressing a push-button which brightens the trace for the duration of a single pulse.

(To be continued next month)

MOBILE RADIO NEWS

(Continued from page 28)

This power is sufficient to operate the pocket receivers under practically all conditions at a radius of 10 miles or more. Adequate signals can often be picked up from the Telanserphone station at 40 to 50 miles.

When a call comes in for a subscriber, the operator inserts a slug in an automatic voice-transmitting machine. The subscribers' call numbers are repeated over and over. As soon as a subscriber calls Telanserphone and gets his message, his slug is removed from the machine. It's all very simple, completely automatic, highly effective, and quite inexpensive for the subscribers. The transmitting machine and the pocket receivers

(Concluded on page 44)

MOBILE RADIO NEWS

(Continued from page 43)

are manufactured by Budelman Radio Corporation, Stamford, Conn. Details of the equipment will be published soon in this Magazine.

Miscellaneous common carriers may find radio paging much more profitable than two-way communication, not only because operating expense and the investment per subscriber is far less, but because the low rates will attract a much larger number of customers.

Name Wanted:

"You ought to have a more accurately descriptive title for this department than Mobile Radio News, because it carries items concerning point-to-point and microwave relay systems." That comment came from Gardiner Greene, president of Workshop Associates. We believe he is right, too, but we can't think of a title that will cover all those subjects. Do you have a suggestion?

6 Volts for Bench Tests:

Most service shops use 6-volt storage batteries for making bench tests on mobile radio equipment. Electro Products Laboratories, 4501 North Ravenswood Avenue, Chicago, makes a very fine filtered power supply that delivers 6 volts DC from 115 volts AC, but the output is only 20 amperes. When we asked why they didn't make a unit delivering enough current to operate mobile radio equipment, they replied: "Just put two of the 20-ampere units in parallel. For short periods of transmitter tests, the pair will deliver 70 amperes." Sounds like a simple way to eliminate the nuisance of a storage battery in the service shop.

SPEAKER SYSTEM

(Continued from page 26)

18 ins. clearance in front of the array of holes.

It was stated that the speaker system can be incorporated easily into standard console radio or radio-phonograph cabinets. The enclosure can be positioned in the base of the cabinet so as to be close to the floor and to the wall against which the cabinet is placed. Fig. 2 shows one possible arrangement for the loud-speaker section of such a cabinet.

Other designs employing larger speakers have been worked out tentatively. Preliminary tests on an enclosure of 1.3 cubic feet, for a single 12-in. speaker, indicate excellent response down to 30 cycles.

It is certain that this type of speaker-enclosure combination will find immediate and enthusiastic acceptance.

BIG NEWS WAS HI-FI

(Continued from page 35)

tion, but there is a decided shortage of programs which come in with enjoyable quality.

Chicago Audio Show:

There was an Audio Show at Chicago directly following the Parts Show. No exact figure of attendance was available since admission was free, and many people didn't register. Nor was it possible to make an estimate because the 57 exhibits were so widely scattered along the corridors of three floors in the Hilton Hotel.

Nevertheless, the attendance confirmed the expectation that Chicago can support a big annual audio show. Specifically lacking at the initial event was well-organized promotion to reach the public, and the element of showmanship necessary to give an impressive atmosphere to such an event. Consensus of opinion was that shows in Chicago should be run by a Chicago management.

NEW BOOKS

ANTENNAS: THEORY AND PRACTICE, by Sergei A. Schelkunoff and Harald T. Friis. John Wiley & Sons. 639 pages, $10.

Written primarily for students and practicing radio engineers, this book presents the theory required for antenna design and experimentation, and the application of this theory to design of antennas of various frequency ranges. Does a good job of bridging the gap between antenna mathematics and practical design work.

ADVANCED ANTENNA THEORY, by Sergei A. Schelkunoff, John Wiley & Sons. 216 pages, $6.50.

This is a rigorous treatment of new methods of attack on the theory and design of broadband antennas. An excellent review of the recent work of Hallen, Stratton and Chu, and of the author, stressing spherical functions as an aid to physical interpretation.

RADIO LICENSE EXAMINATIONS, How to Pass, third edition, by Charles E. Drew. John Wiley & Sons. 367 pages, $4.50.

This book is a compilation of questions and answers on all subjects covered in an FCC examination for a radio operator's license, with the exception of material on elements 7 and 8. These are concerned with endorsements for aircraft radiotelegraph and ship radar operation. Contains also a complete appendix.

PROCEEDINGS OF THE NATIONAL ELECTRONICS CONFERENCE, volume 7 (1951), $5. Published by National Electronics

(Concluded on page 46)

NEW BOOKS

(Continued from page 45)

Conference, Inc., 852 East 83 Street, Chicago 19. Copies of volumes 2 through 6, containing the proceedings for 1946 through 1950, are available also at $5 each.

Volume 7 contains the 79 papers, complete or in digest form, given at the 1951 conference. Papers are given on electronic research, audio systems, components, computers, high-frequency measurements, information theory, magnetic amplifiers, medical and industrial electronics, microwaves, propagation, servo theory, signal detection, television, and vacuum tubes.

AMPLIFIERS, The Why and How of Good Amplification, by G. A. Briggs and H. H. Garner. Wharfdale Wireless Works, Bradford, Yorkshire, England. 215 pages, 15/6.

Although written in Mr. Briggs' usual engaging style, this is not quite up to the standards set by his previous books. This is due in most part to a lack of specific information; there is a discomforting vagueness about the application of the information contained.

RADIO ANTENNA ENGINEERING, by Edmund A. Laport. McGraw-Hill. 563 pages, $9.

Here is a book of practical design information, intended to save time and reduce costs in antenna design and construction. All common types of antennas in use today are considered. Short-cuts and economy pointers are provided for the benefit of antenna engineers, with considerations affecting operational requirements and system engineering.

ELECTRICAL MEASUREMENTS, by Forrest K. Harris, John Wiley and Sons. 784 pages, $8.

A very thorough treatise on all aspects of DC and low-frequency measurements, from basic principles to applications. Alternative methods of measurement are presented for each conceivable application, with advantages and disadvantages. Written for the benefit of practicing engineers and laboratory workers as well as students and research workers, it is successful along both lines but more so for the latter group.

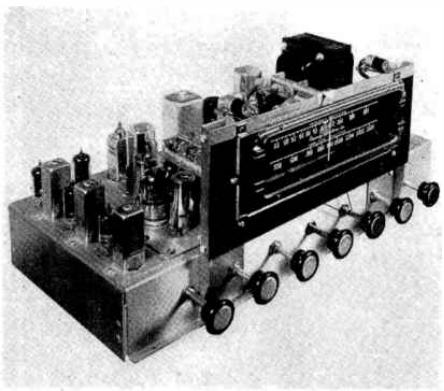
RADIOTELEPHONE LICENSE MANUAL, by Woodrow Smith. Editors and Engineers. 197 pages, $3.75.

Since only the first 4 elements of FCC license examination are covered, this book is intended only for prospective radiotelephone operators. It is not intended as a textbook; however, the questions and answers serve to limit the field of study to pertinent subjects, and to emphasize those subjects most likely to be misunderstood. An appendix of useful information is included.

INDEX OF ADVERTISERS

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

BROWNING FM AND FM-AM TUNERS ARE



RJ-20B FM-AM TUNER

The number of custom radio-phonograph installations is increasing at a truly phenomenal rate. In recent years, this activity has spread from a few metropolitan areas to the point where it is national in scope. This is best illustrated by the accompanying list of distributors, now handling BROWNING FM and FM-AM tuners.

Professional custom set builders have come to standardize on BROWNING tuners because:

First of all, they deliver maximum performance on *both* FM and AM. Behind the current models is a continuing program of engineering refinement and improvement that was started in 1940. The latest feature to be added is the Selective AFC control, now available on all three.

In addition, these tuners are designed specifically to meet the requirements of custom set builders. Consider, for example, the convenient terminals for connecting associated equipment, and the single switch to cut in FM, AM, or TV reception, or a record player.

Finally, there is a choice of three distinct BROWNING models, to meet various space limitations, different types of installations, and the preferences of individual customers. However, all models have the same basic radio circuits, and all give the same outstanding performance.

Model RV-10B is a straight FM tuner, with a drift-compensated Armstrong circuit employing a 2-stage noise limiter to give 20 db quieting on signals of 10 microvolts.

Model RJ-12C is a very compact, high-performance FM-AM tuner, with a separate power supply unit. Separate RF and IF circuits are used on FM and AM, with triple-tuned IF transformers. On FM, the drift-compensated Armstrong circuit provides 20 db quieting on 10 microvolt signals.

Model RJ-20B is a single-chassis tuner similar to the RJ-12C, but with variable IF bandwidth on AM, and a built-in preamplifier with controls to give up to 20 db bass and treble boost.

One of these three models will meet the requirements of any installation, no matter how simple it is to be, or how complicated. See, hear, and order them from your nearest distributor. For detailed data sheets, write BROWNING LABORATORIES, Inc., 700 Main Street, Winchester, Mass.

In Canada, address Measurements Engineering, Ltd., Arnprior, Ont.

WHERE TO BUY BROWNING HIGH-SENSITIVITY FM and FM-AM TUNERS

Partial list of distributors who will be pleased to supply you with BROWNING tuners best suited to your particular requirements

Alaska

Anchorage
Alaska Radio Supply
P. O. Box 84

Alabama

Birmingham
Ack Radio Supply Co.
223 N. 22nd St.
Clary Co., Inc.
2024 Fourth Ave., N.

Arizona

Tucson
Elliott Electronics
418 N. Fourth Ave.
Branch: Phoenix

Arkansas

Fort Smith
Wise Radio Supply
1001 Towson Ave.

Little Rock
Southern Radio Supply
1419 Main St.
Branch: Dallas, Tex.

Texarkana
Lavender Radio Sup.
522 E. 4th St.

California

Burbank
Valley Elect. Sup. Co.
1302 N. Magnolia Blvd.

Eureka
Comm. Radio & Electr.
317 W. 7th St.

Fresno
Arbuckle Radio
2330 Kern
De Jarnatt Wholesale
223 Fulton St.
Branch: Stockton

Long Beach
Dean Co., Fred S.
969 American Ave.
Scott Radio Supply Co.
266 Alamitos Ave.

Los Angeles
Henry Radio
11240 W. Olympic Bvd.
Kierulff & Co.
820 W. Olympic Bvd.
Branches: Fresno, San Diego
Radio Products Sales
1501 S. Hill St.
Radio Specialties Co.
1956 S. Figueroa St.
Univ. Radio Supply
1729 S. Los Angeles St.

Oakland
Brill Co., W. D.
198 10th St.
Electric Supply Co.
149 12th St.
Wenger Co., E. C.
1450 Harrison St.
Branches: Sacramento, Fresno, San Francisco

Pasadena
Dow Radio, Inc.
1759 E. Colorado St.
Branch: Chicago

Sacramento
Kemp Co., E. M.
1115 "R" St.
Branch: Reno, Nev.
Radio Telev. Prod. Co.
1519 19th St.
Sacramento Elec. Sup.
1219 S St.

San Bernardino
Bagley Co., George H.
1216 "D" St.
Branch: San Bernadino

San Diego
Coast Electric Co.
744 G St.
629 8th Ave.

San Francisco
Assoc. Radio Dist.
1251 Folsom St.
Brown Co., C. C.
61 9th St.
Branch: Sacramento
Cox Distributing Co.
2598 Lombard St.
Graybar Elec. Co.
1750 Alameda St.
Kaemper and Barrett
1850 Mission St.
Branch: Berkeley
Leo J. Meyberg Co.
70 Tenth St.
Branches: Fresno, Los Angeles
Pacific Wholesale
116 Ninth St.

G. M. Popkey Co.
458 Brannan St.
Branches: Duluth, Minn., Marinette, Wis.
S. F. Radio & Supply
1282 Market St.
San Francisco Radio
1280-84 Market St.
Zack Radio Supply Co.
1426 Market St.

San Jose
Frank Quement, Inc.
161 W. San Fernando St.

Santa Barbara
Channel Radio Supply
434 State St.

Stockton
Dunlap Whsle. Rad. Co.
27 N. Grant St.

Colorado

Denver
Sound Service
446 Broadway

Pueblo
L. B. Walker Co.
218 W. 8th St.
Branch: Denver

Connecticut

Hartford
Hatry of Hartford
203 Ann St.
Branches: Bridgeport, Stamford, Waterbury
Moses Radio Elec. Co.
54 Flower St.

New Britain
United Radio Supply
53 E. Main St.

New Haven
Brown Co., Thomas H.
15-25 Whiting St.

Waterbury
Bond Radio Supply Co.
439 W. Main St.

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Kenyon Radio Sup. Co.
2020 14th St., N. W.
Sun Radio & Service
938 F St., N. W.

Florida

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Walder Radio & Appl.
1809 N. E. 2nd Ave.

Pensacola
Grice Radio & Elect.
358-360 E. Wright St.

St. Petersburg
Cooper Radio Co.
648 Second Ave., S.

Sarasota
Morley Radio Electric
944 Main St.

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Kinkade Radio Supply
402-04 W. Fortune St.
Thurow Distributors
134-36 S. Tampa St.

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Craddock's Radio Sup.
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Illinois

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833 W. Jackson Bvd.
Newark Electric Co.
223 W. Madison St.
Walker-Jimieson, Inc.
311 S. Western Bvd.

Mt. Carmel
Wabash Radio Distrib.
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Rockford
Mid-West Associated
506 Walnut St.

Indiana

Angola
Lakeland Radio Sup.
525 S. West St.

Fort Wayne
Pembleton Labs.
236 E. Columbia St.

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Archer & Evinger
1348 Wabash Ave.

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Gifford & Brown, Inc.
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Branches: Cedar Rapids, Waterloo, Ft. Dodge

Kansas

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Amateur Radio Equip.
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Kentucky

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Radio Equipment Co.
480 Skain St.
Louisville
Burks & Company
911 W. Broadway
Universal Radio Sup.
533 S. 7th St.
Owensboro
Central Electronics
600 N. Third St.

Louisiana

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Columbia Radio & Sup.
3940 3rd St.
Shuler Supply Co.
415 Dryades St.
Southern Radio Sup.
1900 Tulane Ave.
Walther Bros. Co.
714-20 Howard Ave.

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Baltimore
Henry O. Berman Co.
12 E. Lombard St.
Wholesale Radio Parts
311 W. Baltimore St.
Hagerstown
Zimmerman Whlslrs.
114 E. Washington St.

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Demambro Radio Sup.
1111 Commonwealth
Branches: Lawrence, Providence, R. I.
Hatry & Young
42-44 Cornhill
Branches: Lawrence, Springfield, New London, Conn.
Herman Co., Inc.
885 Boylston St.
Mayer Co., A. W.
895 Boylston St.
Radio Shack Corp.
167 Washington St.
Radio Wire Television
110 Federal St.
Brockton
Ware Radio Supply Co.
913 Centre St.
Cambridge
Electrical Sup. Corp.
1739 Mass. Ave.
New Bedford
Beckman Co.
11-35 Commercial St.
Pittsfield
Pittsfield Radio Co.
41 West St.
Springfield
Cushing, T. Frank
349 Worthington St.
Springfield Radio Co.
405 Dwight St.
Branch: Holyoke
Springfield Sound Co.
147 Dwight st.
Worcester
Demambro Radio Sup.
729 Main St.
Radio Maintenance
19-25 Central St.

Michigan

Ann Arbor
Purchase Radio & Cam.
605 Church St.
Wedemeyer Elect. Sup.
213-17 N. Fourth Ave.
Branch: Lansing
Battle Creek
Electronic Sup. Corp.
185 W. Michigan Ave.
Branch: Kalamazoo
Detroit
Duffy & Co., Inc.
2040 Grand River Ave.
K. L. A. Laboratories
7422 Woodward Ave.
Radio Specialties Co.
456 Charlotte St.

Minnesota

Minneapolis
Bonn Co., Lew
1211 LaSalle Ave.
Branches: Duluth, St. Paul
Northwest R. & E. Sup.
52 S. 12th St.
Branch: St. Paul
Stark's, Inc.
71 S. 12th St
Branches: Duluth, La Crosse, Wis.

Mississippi

Jackson
Cabell Electric Co.
422 S. Farish St.

Missouri

Butler
Henry Radio Shop
211 N. Main St.
Branch: West Los Angeles, Cal.
Cape Girardeau
Suedekum & Sons
620 Good Hope Ave.
Joplin
Brotherson Co.
515 N. Byers Ave.
Kansas City
Burstein-Applebee Co.
1012-14 McGee St.
St. Louis
Ashe Radio Co.
1123-25 Pine St.
Van Sickle Radio Co.
1113 Pine St.
Springfield
Reed Radio Supply
833 Boonville Ave.

Montana

Billings
Electronic Supply Co.
214 11th St., W.
Missoula
Northwest Distributors
50 S. Higgins

Nebraska

Lincoln
Hicks Radio Co.
1420-22 O St.
Omaha
Radio Equipment Co.
2822 Farnam St.

Nevada

Reno
Saviers Elec. Prod.
640 Sierra St.
Branch: Las Vegas

New Hampshire

Concord
Evans Radio
10 Hills Ave.
Dover
American Radio Corp.
510 Central Ave.
Manchester
Radio Service Lab.
670 Chestnut St.
Branches: Portland, Bangor, Maine

New Jersey

Jersey City
Nidisco-Jersey City
713 Newark Ave.
Newark
Continental Sales Co.
195 Central Ave.
Electronic Marketers
415 Halsey St.
Lippman & Co.
246 Central Ave.
Radio Wire Television
24 Central Ave.
Phillipsburg
Williams, Carl B.
154 S. Main St.
Trenton
Allen & Hurley
25 S. Warren St.

New York

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Ft. Orange Radio Dist.
904 Broadway
Taylor Co.
465 Central Ave.
Amsterdam
Adirondack Radio Sup.
32 Guy Park Ave.
Brooklyn
Benray Distrib. Co.
485 Coney Island Ave.
Peerless Electronics
76 Willoughby St.
Buffalo
Dymac, Inc.
2329-31 Main St.
Genesee Radio & Parts
205 E. Genesee St.
Radio Equipment Corp.
147-51 Genesee St.
Hempstead, L. I.
Davis Electronics
204 Main St.
Standard Parts Corp.
277 N. Franklin St.
Ithaca
Stallman of Ithaca
127-31 S. Tioga St.
Jamaica, L. I.
Norman Radio Distrib.
94-29 Merrick Rd.
Peerless Radio Distrib.
92-32 Merrick Rd.
Branch: New York
Mt. Vernon
Davis Radio Distrib.
66-70 E. Third St.
New York
Arrow Electronics
82 Cortlandt St.
Dalis, Inc., H. L.
175 Varick St.
Federated Purchaser
66-68 Day St.
Branch: L. Angeles, Cal.
Easton, Allentown, Pa.
Fischer Distrib. Co.
118 Duane St.
Harrison Radio Corp.
12 West Broadway
Branch: Jamaica, L. I.
Harvey Radio Co., Inc.
103 W. 43rd St.
Leonard Radio, Inc.
69 Cortlandt St.
Milo Radio & Elect.
200 Greenwich St.
Newark Electric Co.
242 W. 55th St.
Radio Wire Telev.
100 6th Ave.
Stan-Burn R. & E. Co.
1697 Broadway
Branch: Brooklyn
Sun Radio & Elect.
122-24 Duane St.
Terminal Radio Corp.
85 Cortlandt St.
Rochester
Hunter Electronics
233 East Ave.
Rochester Radio Sup.
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Branch: Syracuse
Schenectady
Schwartz & Son
710-12 Broadway
Syracuse
Broome Distrib. Co.
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Branch: Binghamton
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Trojan Radio Co., Inc.
420 River St.
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Charlotte
Shaw Distributing Co.
205 W. 1st St.
Raleigh
Car. Radio Equipment
105 E. Martin St.
Winston-Salem
Dalton-Hege Rad. Sup.
342 Brookstown Ave.

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Akron
Olson Radio Warehse.
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Sun Radio Co.
110 E. Market St.
Canton
Burroughs Radio Co.
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Cleveland
Northern Ohio Labs.
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Olson Radio Warehouse
2020 Euclid Ave.
Pioneer Radio Supply
2115 Prospect Ave.
Progress Radio Supply
415 Huron Rd.
Winteradio, Inc.
1468 W. 25th St.
Columbus
Hughes-Peters, Inc.
111-17 E. Long St.
Branches: Dayton, Cincinnati
Thompson Radio Sup.
182 E. Long St.
Dayton
Srepco, Inc.
135 E. 2nd St.
Branch: Springfield
Elyria
El-A-Co.
121 Lodi St.
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26 N. 11th St.
Warren Radio Co.
1320 Madison Ave.
Branches: Lima, Akron, Peoria, Ill.
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Youngstown
Ross Radio Co.
325 W. Federal St.
Zanesville
Thompson Radio Sup.
135 S. Sixth St.

Oklahoma

Oklahoma City
Electronic Supply
212 N. W. 10th St.
Tulsa
Radio, Inc.
1000 S. Main St.

Oregon

Medford
Verl G. Walker Co.
205 W. Jackson
Portland
Central Distributors
1131 S. W. Washington
Northwest Radio Sup.
717 S. W. Ankeny St.
Portland Radio Supply
1300 W. Burnside St.
United Radio Supply
22 N. W. Ninth Ave.
Branch: Eugene

Pennsylvania

Bethlehem
Buss Radio Electric
59-63 E. Broad St.
Erie
Duncombe Co.
1011 W. 8th St.
Warren Radio Co.
12th & State Sts.
Philadelphia
A. C. Radio Supply Co.
1539 W. Passyunk Ave.
Branch: Chester
Almo Radio Co.
509 Arch St.
Consolidated Radio Co.
612 Arch St.
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Neuber, Herbert K.
1207 Race St.
Radio Electric Serv.
701 Arch St.
Branches: Philadelphia, Allentown, Easton, Pa., Camden, N. J., Wilmington, Del.
Pittsburgh
Cameradio Co.
963 Liberty Ave.
Branch: Wheeling, W. V.
Tydings Co.
632 Grant St.
Reading
Barbey Co., Inc.
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Branch: Lancaster
Scranton
Pursell, Fred P.
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San Antonio
Straus-Frank Co.
301-07 S. Flores St.
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Waco
Hargis Company, Inc.
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Wichita Falls
Mooney Radio Supply
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Utah

Salt Lake City
Standard Supply Co.
531 S. State St.

Virginia

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Radio Supply Co.
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Branch: Richmond
Roanoke
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Washington

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Waitkus Supply
110 Grand Ave.
Everett
Pringle Rad. & Elect.
2516 Colby Ave.
Seattle
General Radio Co.
100 Wall St.
Harper-Meggee, Inc.
960 Republican St.
Branches: Spokane, Portland, Ore.
Radio Products Sales
1214 First Ave.
Radio TV & Appliance
510 Westlake Ave., N.
Seattle Radio Supply
2117 Second Ave.
Branches: Spokane, Portland, Ore.
Western Electr. Supply
2609 First Ave.
Zobrist Co., Inc.
2121 Westlake Ave.
Branch: 1214 First Ave.
Spokane
E. M. Johnson Co.
West 615 First Ave.
Northwest Electronics
N. 102 Monroe St.
Tacoma
C. & G. Radio Supply
2502 Jefferson Ave.

West Virginia

Charleston
Charleston Elec. Sup.
914 Kanawha Bvd.
Chemcity Radio & Elec.
103 Clendenin St.
Hicks Radio Service
10 Virginia St., E.
Branch: Charleston.
Huntington
King & Irwin, Inc.
314-16 11th St.
Parkersburg
Randle & Hornbrook
536-38 7th St.

Wisconsin

Green Bay
Northern Radio & TV
708 S. Broadway
Madison
Satterfield Radio Sup.
326 W. Gorham St.
Milwaukee
Electro-Pliance Distr.
2458 W. Lisbon St.

For Complete Technical Data on These FM and FM-AM Tuners, Address:

BROWNING LABORATORIES, Inc.

700 Main Street, Winchester, Massachusetts

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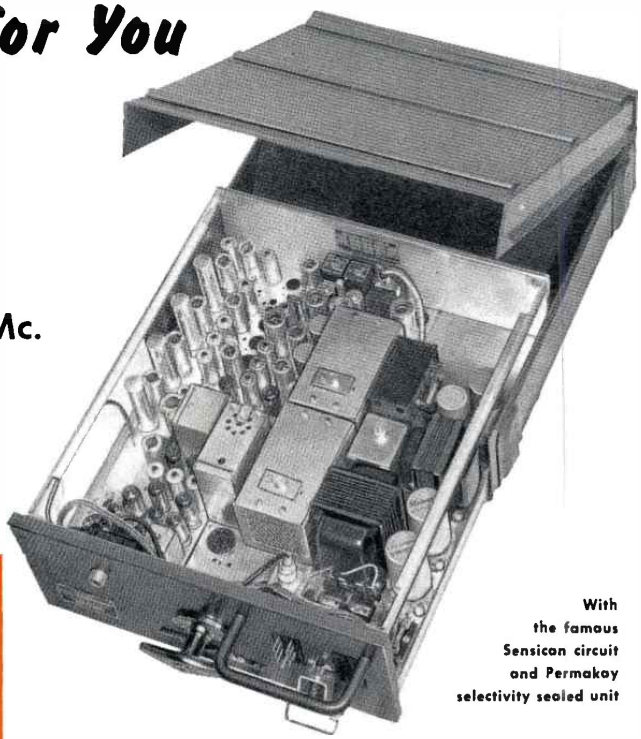
NEW

450-470 Mc.

2-Way Radio Communication Equipment for New Public Safety, Land Transportation, Industrial, and Citizen Bands



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