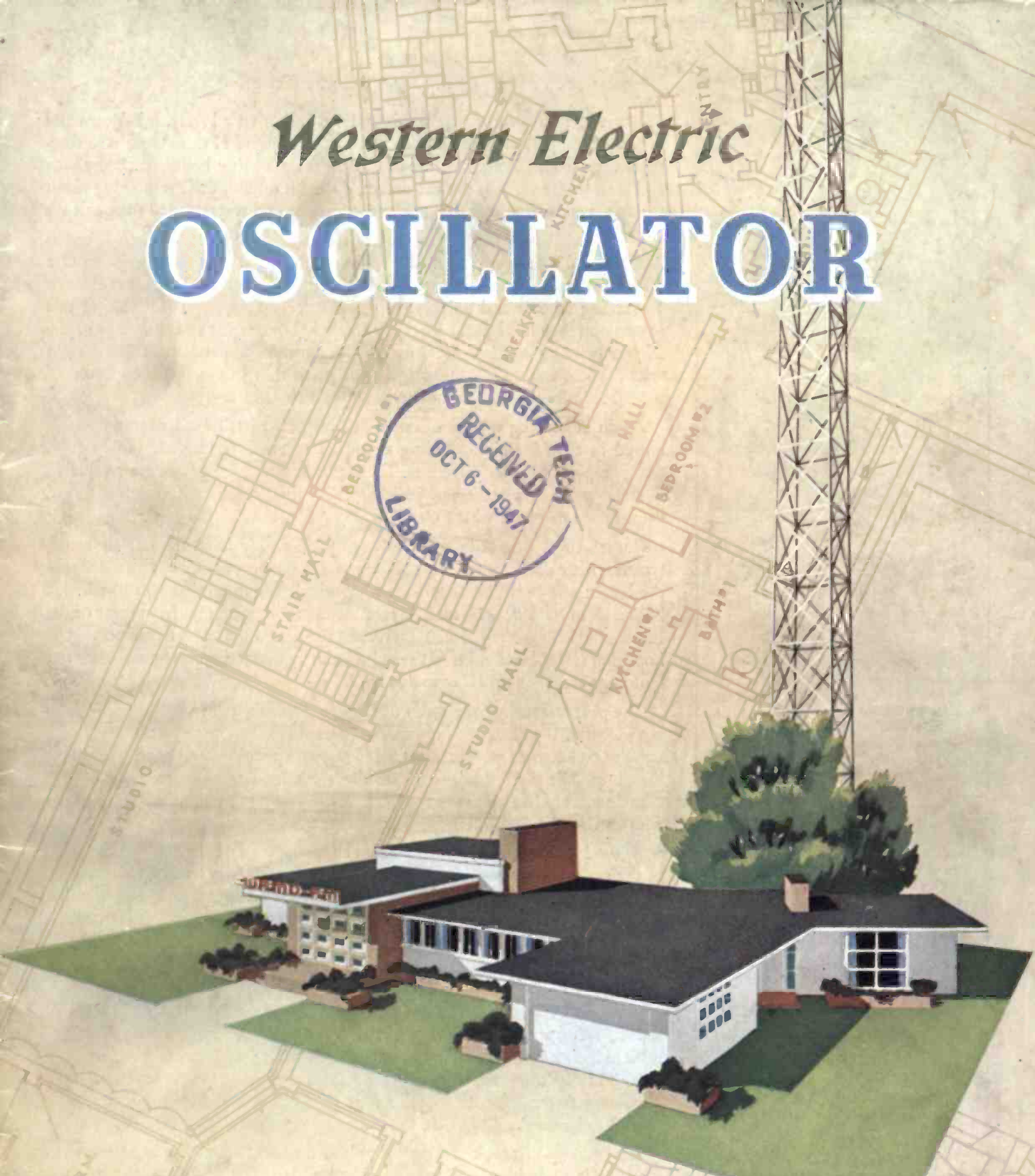
Western Electric

OSCILLATOR



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The Architecture of Broadcast Transmitter Buildings

Number 9 • September 1947

Western Electric
OSCILLATOR

SEPTEMBER 1947

DEVOTED TO DEVELOPMENTS IN COMMUNICATIONS AND ELECTRONICS

Published quarterly from November, 1935 to May, 1942 under the name *Pick-Ups* by the

Western Electric Company

195 Broadway · New York, N. Y.

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THE COVER

Utility, eye appeal and careful planning for equipment and facilities are evident in many of the broadcast transmitter buildings springing up today all over the country. One having more than its share of all these assets is the building now under construction for WFMD-FM, Frederick, Md., shown in the perspective rendering and floor plan on the front cover. Combining FM transmitting equipment, studio and complete living quarters, the single-floor layout puts every square foot of floor space to work. This attractive building was designed by Robert C. Deigert of Deigert & Yerkes, architects; equipment layout and technical planning was done by James W. Robertson, Chief Engineer of WFMD and WFMD-FM.

THIS ISSUE

A Dream Come True

For a round dozen of years we have been harboring a lovely, full-blown and rosy dream. That dream was to present in the pages of this magazine a complete treatise on the architecture of broadcast transmitter buildings. Every now and then we have taken out the dream, dusted it off and done something about making it come true, but things like depressions and wars seemed to stymie us.

Once we almost made it come true. That was back in 1940 when Western Electric held a competition in cooperation with Beaux Arts for the design of a 5 kilowatt transmitter building. One hundred and two architectural students in 19 leading schools and universities competed. The August 1940 issue of this magazine (then known as *Pick-Ups*) carried photographs and drawings of the 26 prize-winning and honorable mention designs. A comparison of those designs with modern transmitter buildings offers proof that this competition had considerable influence on transmitter building architecture.

Again in keeping with our dream, this magazine has from its inception presented in each issue outstanding examples of radio transmitter buildings in photographs and descriptive text. These presentations have been most valuable to stations in the planning of buildings. Yet the dream itself remained just a dream until this issue of the *Oscillator*.

But it's come true at last. Just turn to page 8. We think it's just about the sweetest little dream we ever saw emerge from the hazy land of "someday" into the bright and beautiful "here-it-is-right-now." We hope that you like it. It's been a lot of hard work. It took a lot of wonderful cooperation from some of the best brains in Radio and Architecture. But the dream did come true, and we just hope that it will be of value to the radio industry that today sees new transmitter buildings cropping up all over this land.

The proper housing of a radio transmitter is a subject of vital importance to the industry. We discovered quite early in our investigations that there is a close correlation between good stations, good station operations and good transmitter buildings. We discovered, too, that those outstanding managers and owners who do most to live up to the responsibility inherent in a station grant, are those who also build well when they come to make a home for their transmitter.

A good building brings dividends in so many ways. It is an added incentive to the operating personnel who work and live in it. It is an expression of the belief in the present and future of the industry, and it says to the public that Radio Broadcasting is solid and of value to the community and the nation.

NAB Convention

Right now the twenty-fifth annual convention of the National Association of Broadcasters is in full swing at Atlantic City . . . and how fortunate the industry is to have a strong organization to back it and to keep it marching ahead as a unit. This industry which has grown so fast since the war, and is due to grow even faster, has tremendous things ahead of it, and a strong organization is vital to its continued health.

It is so easy to sit back and marvel at how far the industry has come in so few years. It is something else to plan ahead with vision and foresight to chart Broadcasting's course. Sure, we have come a long way, but we have a longer way to go. It is particularly gratifying to see the engineering side of radio come in for revitalized attention by the NAB under the guidance of Royal V. Howard. Technological advance is going at such a terrific speed these days, bringing with it such marvelous new opportunities for service to the nation, that emphasis on engineering cannot be too strong.

W.W.

Determining Degree of Modulation in FM Broadcasting

A simple test equipment application

By H. R. Whaley

Broadcast Engineering Force
Western Electric

THE low inherent noise level of FM transmission permits a wide range of modulation levels, resulting in a wide range of sound intensities from the loudspeakers of listeners' receivers. Modulation in excess of 100 percent, however, must be avoided because FM receivers cannot be expected to pass waves which are considerably overmodulated without the introduction of serious harmonic distortion.

A similar relationship between modulation level and distortion exists in the case of AM also, but in AM the distortion resulting from overmodulation occurs principally in the transmitter itself, not in the receiver. In both FM and AM, a Modulation Monitor is employed to provide a continuous indication of percentage modulation, so that 100 percent modulation will not be exceeded.

Chief engineers of AM stations have long recognized the desirability of periodically checking the performance of their transmitters and associated equipment, noting particularly the distortion introduced by the transmitter at different levels of modulation and for various modulating frequencies. While percentage modulation is indicated directly by the station's Modulation Monitor, usually a determination of the modulation level independent of this monitor is desired. One advantage in using an independent means of determining the depth of modulation is that the accuracy of the Modulation Monitor itself may be investigated. In AM practice the modulated wave is viewed on an oscilloscope. One hundred percent modulation occurs when the negative peaks of modulation just "kiss," provided the test point is properly chosen (see "Notes on Modulation of AM Transmitters," W. H. Doherty, *Western Electric Oscillator*, October, 1946). Lower percentages of modulation are then established by inserting a loss in the audio path.

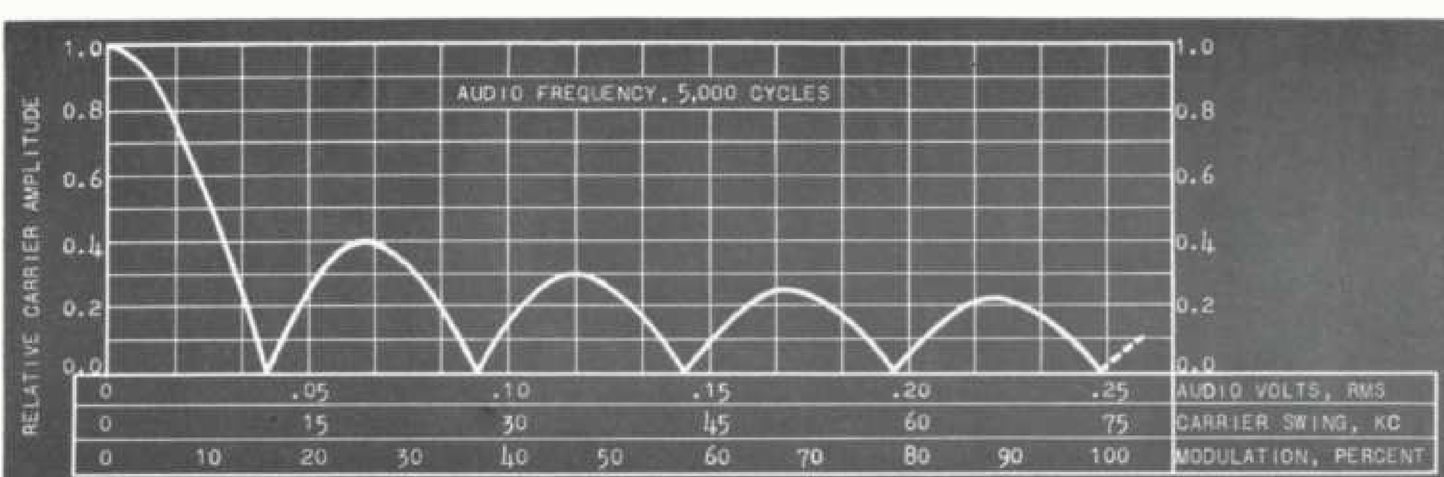
Behavior of Carrier and Side Frequencies

Because the modulated wave in FM is not at all like that in AM, the same technique for determining percentage modulation cannot be employed in both cases. The need for different techniques is seen from a comparison of the energy distribution in the FM wave with that of the AM wave.

In AM, the modulation of a carrier by a single audio frequency signal, which gives the familiar envelope pattern when viewed on an oscilloscope, actually results in three frequencies: the carrier, the upper side frequency, and the lower side frequency. The amount of power transmitted varies with the amplitude of the audio frequency signal, being 50 percent greater than the power of the carrier alone when 100 percent modulation is achieved. The amplitude of the carrier is not changed by the modulation process. The additional power radiated during modulation is entirely in the side frequencies. This may be proved by the application of selective filters which make it possible to separate the various frequencies from each other, whereupon their amplitudes may be accurately measured.

In FM, conditions are materially different. The total power radiated is constant for all modulation percentages. When no modulating audio signal is applied, this power is, of course, all carrier power. When an audio frequency signal is applied to the FM modulator, the carrier amplitude decreases. Side frequencies appear, and their amplitudes are such as to maintain the total radiated power constant. However, when a carrier is frequency modulated by a single audio frequency signal, a single pair of side frequencies does not result from the process. Rather a large number of pairs is produced, with the frequency interval between successive side frequencies being equal to the audio frequency involved. As the amplitude of the single-frequency audio modulating signal is increased steadily, the amplitudes of the carrier and side frequencies vary in an apparently inexplicable manner. Actually, these amplitude variations follow mathematical relationships known as Bessel functions, the carrier varying in amplitude and relative polarity in conformity with the

Figure 1—Relationship between the carrier amplitude and audio input level, frequency swing and percentage modulation for an audio frequency of 5,000 cycles. The audio voltage values indicated are only illustrative and are to be determined for a specific transmitter by the methods given in the text.



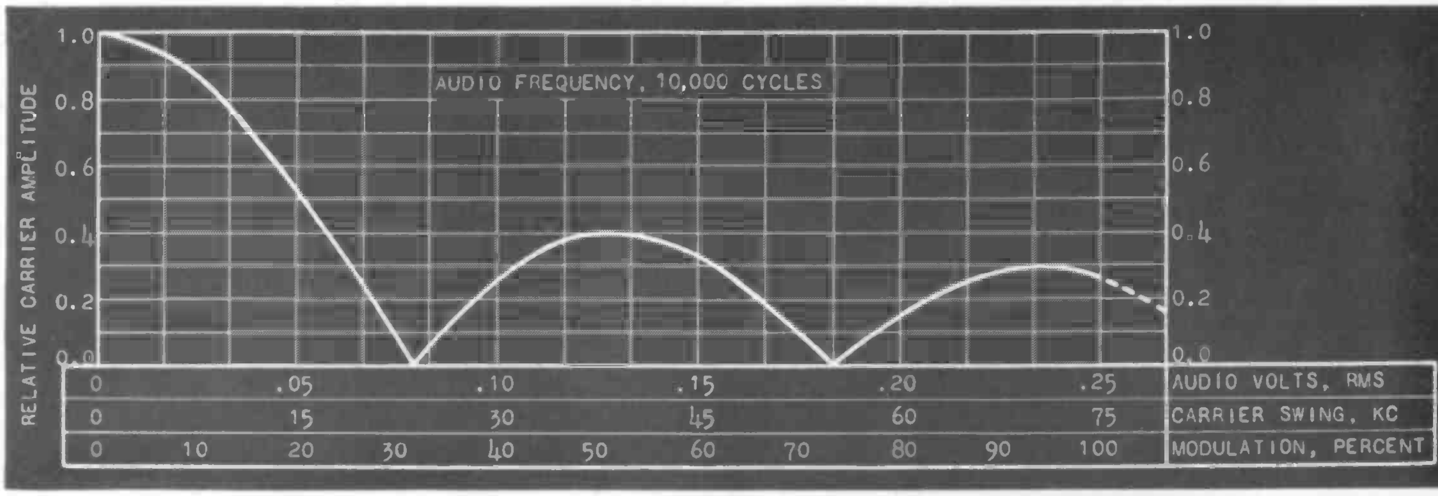


Figure 2—Relationship between the carrier amplitude and audio input level, frequency swing and percentage modulation for an audio frequency of 10,000 cycles. As in Figure 1, the audio voltage values indicated are only illustrative and are determined for a specific transmitter by the method given below.

Bessel function of zero order.

Another way of viewing the FM modulation process is to consider that this carrier frequency is varied above and below its mean value by an amount which is proportional to the amplitude of the audio modulating signal; i.e., doubling the audio input voltage doubles the frequency swing. One hundred percent modulation is defined as a frequency swing of plus and minus 75 kc. Accordingly, when the audio input required to produce 100 percent modulation has been determined, any lower degree of modulation may be obtained, as in the AM case, by reducing the audio voltage proportionately to the desired reduction in the degree of modulation.

Figure 1 shows the relationship between audio input, frequency swing, and percent modulation and the carrier amplitude for an audio frequency of 5,000 cycles. In the figure, an audio input of 0.25 volts, rms, is shown as producing 100 percent modulation. No importance should be attached to the use of this value; in fact the method discussed in this article has as its objective the establishment of the audio input required to produce any desired degree of modulation with a given transmitter.

Figure 2 is similar to Figure 1 except that an audio frequency of 10,000 cycles is used. It will be noted that the audio input required to produce a given frequency swing is the same for both audio frequencies, but the frequency swing corresponding to the various carrier zeros is different in the two cases. A close scrutiny of the curves, however, will lead one to the conclusion that there is a definite relationship at each of the carrier zeros between frequency swing and audio frequency. The swings in the first three zeros of Figure 1 are 12,000, 27,500 and 43,500 cycles, respectively. If these swings are divided by the audio frequency involved, namely, 5,000 cycles, the quotients are 2.4, 5.5, and 8.7, approximately. If the same ratio, $\frac{\text{frequency swing}}{\text{audio frequency}}$ is determined for the first three zeros of Figure 2, the results again are 2.4, 5.5, and 8.7. This is not a coincidence.

There is a precise relationship between frequency swing and audio frequency at each of the carrier zeros. Values of these ratios sufficiently accurate for practical use in determining percent modulation in FM broadcasting are given in Table I. These are the key numbers of this method. Actual measurement of the variation in carrier amplitude, as an increasing audio voltage is applied to a transmitter, is extremely difficult and involves the use of a complex array of equipment. But disappearance of the carrier is easy to detect and requires only the equipment normally on hand at an FM transmitter. Since frequency swing and audio frequency are related at the first six carrier zeros by the key numbers of Table I, it is necessary merely to select the proper audio frequency in order to make the carrier disappear at any desired swing, i.e., any desired degree of modulation.

TABLE I

CARRIER ZERO	KEY NUMBER
1	2.405
2	5.52
3	8.65
4	11.79
5	14.93
6	18.07

Let us consider a specific application of the carrier zero method. Assume that an FM transmitter has just been installed to operate on a carrier frequency of 100.1 mc. The Modulation Monitor is being adjusted, so we wish to determine accurately the audio voltage required to produce 100 percent modulation in order to check the Monitor's accuracy. We have available an audio signal generator, a heterodyne frequency meter with a fundamental range of 10 mc to 20 mc, an a-c vacuum tube voltmeter, and a pad of about 30 db.

We note that the 6th harmonic of 16.7 mc is 100.1 mc, the 7th harmonic of 14.3 mc is 100.1 mc, the 8th of 12.5 mc, etc. (slide rule figures—not precise). Accordingly, we may adjust the heterodyne frequency meter to any of these frequencies and hear a beat note between the transmitter carrier and the selected harmonic of the heterodyne frequency meter. Whenever we adjust the audio input voltage to the value which causes the carrier to disappear, the beat note disappears. Disappearance of the beat note means to us a carrier zero.

Figure 1 shows that, for an audio frequency of 5,000 cycles, the 5th zero is very close to 75 kc swing, 100 percent modulation. From the relationship $\frac{\text{frequency swing}}{\text{audio frequency}} = $ key number, which may be written $\frac{\text{frequency swing}}{\text{key number}} = $ audio frequency or frequency swing $=$ audio frequency $\times$ key number, we may solve for the exact audio frequency which will give 75 kc frequency swing at the 5th zero, or we may determine accurately the frequency swing for 5,000 cycles at the 5th zero, as follows:

$$\frac{\text{frequency swing}}{\text{key number}} = \frac{75{,}000}{14.93} = 5{,}020 \text{ cycles}$$

and frequency swing $=$ audio frequency $\times$ key number $= 5{,}000 \times 14.93 = 74.7$ kc $= 99.6$ percent modulation. It is apparent that 5,000 cycles is "precise" for our purpose; the error of 0.4 in percent modulation is negligible.

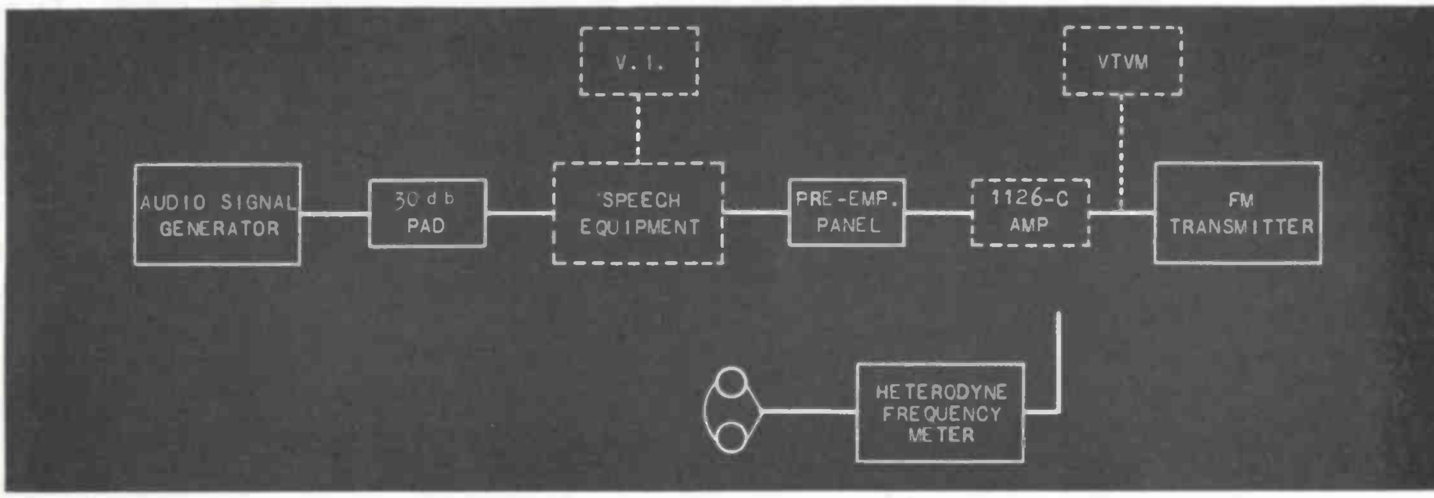


Figure 3 — A typical set-up using a heterodyne frequency meter. Alternatively, an r-f signal generator and a receiver may be used instead of the heterodyne frequency meter. A vacuum tube voltmeter, shown at transmitter input terminals, should, of course, be in audio rack so that transmitter doors may be closed.

It is preferable to use an odd harmonic of the heterodyne frequency meter to beat with the transmitter carrier. This will be evident from the following considerations: When the transmitter output frequency is 100.1 mc, the output of the next-to-last doubler is 50.05 mc. When the swing is 75 kc at the carrier frequency, it is 37.5 kc at the output of the next-to-last doubler. The quotient of 37,500 by 5,000 is 7.5, which is not a key number. Accordingly, though the carrier be at its 5th zero because of application of the proper amount of 5,000 cycle audio, the "carrier" at the output of the next-to-last doubler is not zero. If the 6th harmonic of 16.67 mc is beating with 100.1 mc, the 3rd harmonic of this frequency will beat with 50.05 mc. If any appreciable amount of the 50.05 mc frequency is picked up by the heterodyne frequency meter, the carrier zero may be obscured by the other beat note. For this reason it is advisable to use an odd harmonic of the heterodyne frequency meter.

Another consideration is that of noise output of the audio signal generator. Frequently in this modulation determination, audio is applied at some convenient point in the system other than the "Transmitter In" jacks on the audio rack. Perhaps one or more amplifiers are between the point of audio application and the transmitter input, so that the output required from the audio signal generator is very low. With very low output the signal-to-noise ratio of many audio signal generators is low, producing a growl in the phones that obscures the carrier zero. A pad of 30 db or so at the output of the audio signal generator will purify the beat note heard in the phones and make the carrier zero easier to spot precisely. A beat note of 700 or 800 cycles is best, since it can be followed right down to zero even though other higher frequency notes are heard also.

Figure 3 illustrates a typical set-up using a heterodyne frequency meter. Alternatively an r-f signal generator and a receiver may be used instead of the heterodyne frequency meter. A vacuum tube voltmeter is shown at the transmitter input terminals. This should, of course, be in the audio rack so that the transmitter doors may be closed. It is possible to perform this measurement without the inclusion of the VTVM in the set-up, but it will prove advantageous to have a record of the audio voltages required at this point to produce various degrees of modulation, as well as VI readings taken at the speech input equipment.

The application of the method of this article facilitates the determination of the required audio level to produce any desired degree of modulation. This audio level is that required for steady-tone modulation. To be sure, the peaks, as indicated by a standard VI, should be held to a level 6 to 10 db below this steady-tone value, the margin depending on the program material involved. If a VI preceding the pre-emphasis panel is chosen to indicate the reference level, rather than a VTVM across the transmitter input, the pre-emphasis panel must then be replaced by a fixed pad equal in loss to the low frequency insertion loss of the pre-emphasis panel. (With the pre-emphasis panel as supplied for use with Western Electric FM transmitters this involves merely interchanging plugs P1 and P2 during the test.)

It may be an advantage to beat the heterodyne frequency meter with a low power stage in the transmitter, such as the output of the Oscillator-Modulator panel of the Western Electric 503B-2 Transmitter. At this point the frequency is $\frac{1}{8}$ of the carrier frequency, and the swing, for 100 percent modulation, is $\frac{1}{8}$ of the carrier frequency swing of 75 kc, that is, 9,375 cycles. If a 3,900 cycle audio signal is impressed on the transmitter input, the frequency swing at the output of the Oscillator-Modulator panel will be 9,375 cycles at the 1st zero, and the transmitter carrier will be swinging plus and minus 75 kc.

That FM chief engineers will probably find it desirable to familiarize themselves with this method and provide themselves with the equipment required may be pointed up thus:

An FM transmitter has been in operation for a number of months. One day, it is noted that audio levels, as shown by the VI, which formerly produced an indication of 95-100 percent modulation on the Modulation Monitor are now indicating only 50-60 percent. Should the operator increase the audio level on the assumption that the trouble is in the transmitter modulator circuit? He should not, of course. For if the Monitor is at fault, an increase in audio level to make the monitor indication normal will seriously overmodulate the transmitter. Severe distortion will result in listeners' receivers; and the resulting reaction of the "front office" will be much more violent than would be the case if the degree of modulation were somewhat below normal for a few hours. Action should be deferred, barring a serious worsening of the situation, until the program day is ended, and then use made of the method of this article to find the trouble.

It is hoped that this article will be useful to engineers engaged in FM broadcasting. Neither the method itself nor any part of the underlying modulation theory is original. Those who wish to probe deeper into the fundamental relationships of frequency modulation are referred to the excellent text by August Hund, *Frequency Modulation*, published by McGraw-Hill, which also contains an extensive bibliography to original sources.

Visitors at the Royal Hawaiian Hotel now have music from a Western Electric program distribution system to add to the pleasures of vacationing at Waikiki.

There's Music on the Beach at Waikiki

The Royal Hawaiian in Honolulu – one of the world's famous hotels – installs a sound system for background music

THE Royal Hawaiian Hotel on famed Waikiki Beach at Honolulu is an outstanding example of how low level background music can contribute to a hostelry's popularity.

"This music is really relaxing. It has just the right touch," is one of the comments of visitors to the main dining room, "surf bar," lounge and outdoor dancing areas where the new sound installation is operating. After several months of use there is no doubt that the program system is popular with patrons and profitable to the hotel.

When the Royal Hawaiian completed its tour of duty as a "rest home" for our Pacific fighting men, the management decided on an extensive program of redecoration and refurnishing to make the famous resort hotel even more luxurious and attractive than it was before the war. Under the direction of Warren B. Pinney, Managing Director of Hotels for the Matson Line, owner of the Royal Hawaiian, architect Gardiner Dailey of the Matson Line and architect George J. Wimberly of Honolulu, the entertainment areas were rearranged to make even fuller use of the natural beauties of the setting. The terraced dining room seating 900 people, main lounge, "surf bar" and dancing area all were oriented toward the beach and "opened up" with broad expanses of glass or the removal of the walls entirely, so that guests can enjoy to the full the sun, the ocean and the surfboard-riding Hawaiians engaged in their favorite sport.

Designed for Relaxation

The aim of the planners was to have a top quality sound system in the important public areas of the hotel which would provide pleasing, relaxing music for listeners throughout these areas without rising above conversational level at any point. Through the John J. Harding Company, Western Electric's sound dealer in Honolulu, and the San Francisco office of the Graybar Electric Company, a Western Electric system was installed which completely fulfilled the hopes of the hotel planners.

Western Electric 728B loudspeakers are distributed generously through the areas to be served, with each individual speaker operating at a low power level. The result is that each room seems to the listener to be filled with music, providing a continuously pleasing background for eating, drinking and conversation. Technical details of the complete system, which includes

Western Electric microphones and amplifiers as well as loudspeakers, are given in the technical description at the end of this article.

Four Sources of Program Material

The system has four sources of program material, any three of which can be used simultaneously to feed one or more of the six groups of loudspeakers. These sources are:

(1) Direct pickup of dance music and entertainers from the bandstand in the outdoor dancing area;

(2) Radio tuner for reception of broadcast programs;

(3) Automatic record players, of which two are installed, for reproduction of commercial recordings;

(4) Local wired music service (Muzak).

The four program sources provide flexibility in the choice of material, and a jack and patch cord arrangement allows the operator to send a program to any of the areas served by the loudspeakers. Thus music appropriate for dining, dancing or listening is always on tap and ready for distribution.

In the dining room, twenty 728B speakers are installed in built-in sound-treated boxes and the sound is projected through circular grilles.

In the main lounge there are sixteen 728B speakers installed in the walls along each side of this relaxation area. These speakers are mounted behind square grilled openings which are flush with the wall on one side and project slightly on the other.

In the bar, the eight 728B speakers are placed to provide "room-filling" music with complete listener comfort. Three additional 728B speakers, to make up the total of 47 used in the system, are installed in the bandstand to distribute the music to the adjoining outdoor area. Thus dancers — and even bathers and strollers on the beach — can enjoy the same music as persons in the hotel.

Some Technical Aspects of System

The new sound system has among its major elements: three cardioid microphones, six main amplifiers, six autotransformers for matching main amplifiers to loudspeakers, two preamplifiers and 47 twelve-inch loudspeakers. The amplifiers, radio tuner, and one record player are mounted in a double rack in a soundproofed, air-conditioned control room which has viewing windows overlooking the operating area. The record player is in a compartment just above the jack panel in the left-hand rack. The second record player is in the front office of the hotel, permitting remote operation of the system from that point.

The dual volume indicator panels, one on the amplifier rack and one between the viewing windows, are arranged so that they can be switched across any one of the four program channels on the input jack strip. The monitor speaker in the top of the rack can be switched into any of the six loudspeaker channels on the output jack strip.

The circuiting is such that the four microphones and one 116A Amplifier form one program channel; the radio tuner constitutes another, the two record players —only one of which can be used at a time —are the third program channel and the wired music line is the fourth. These four lines are brought into the input jack strip, and each can be patched to any one or more of the six amplifiers. On the output jack strip, the lines to the six groups of speakers are brought in so that any one of them can be connected to any one of the amplifiers.

The six loudspeaker groups, each of which is fed by a single 118A Amplifier, are as follows:

- Two groups of ten each in the dining room
- Two groups of eight each in the lounge
- One group of eight in the "surf bar"
- One group of three on the outdoor bandstand

It can be seen that in the enclosed areas, where uniform, low-level distribution is desired, no single speaker handles more than an eighth of the output of a single 118A amplifier, whereas the bandstand speakers which project sound onto the beach operate at a relatively higher level— only three on a single amplifier. This illustrates the flexibility of design possible in a sound distribution system of this type, and incidentally, shows the exact kind of matching problem which the Western Electric 18A Autotransformers solve simply and conveniently.

Tailored to Every Need

Further flexibility of control is provided by three remote volume controls, which are used by personnel in the areas served, to adjust the volume of individual groups of speakers. The complete system is tailored to the needs of the hotel in every respect and has thoroughly won its place as a "service" which the guests enjoy and appreciate.

To the luxurious accommodations, soft tropical air, coral sand and emerald water to be found at the Royal Hawaiian has been added another drawing card—reproduced music that is a delight to hear.

One program source for the loudspeaker system is the dance music and other entertainment originating in this outdoor dancing area adjoining the dining room.

The main dining room has music from the twenty Western Electric loudspeakers installed there, as well as this famous vista of Diamond Head across the bay.

THE ARCHITECTURE OF BROADCAST TRANSMITTER BUILDINGS

PLANNING

DESIGN

CONSTRUCTION

TECHNICAL REQUIREMENTS

You are facing a serious problem — the construction of a home for your new broadcast transmitter, a transmitter building that will be an efficient part of the technical operation of your broadcasting business.

This guide has been prepared to help you and your builder over this hurdle, by assembling in compact form as much information as possible on the basic principles that underlie the design of practical, efficient transmitter buildings.

It is presented for use by the broadcasting industry, but especially for the newcomer, whatever the make, type, or power rating of his transmitter, who must put a house around it before he can close ranks with the rest on the air.

S. P. Taylor

Manager, Distributor Sales
Radio Division
Western Electric Company

A COOPERATIVE ENTERPRISE FOR BROADCASTING

DOMINATING the multitude of questions which constantly come to us has been the one regarding transmitter building design. This has been particularly so during the rapid expansion of the Radio Broadcasting Industry over the past two years. Consistent with our established policy of cooperating with the Industry and in the hope of contributing an answer to this question, the *Oscillator* launched a series of surveys and studies on transmitter building design and construction. The results, offered in the pages which follow, represent the combined knowledge and experience of many authorities.

In this project we find demonstrated once more the spirit of cooperation which we believe to be one of the most important factors in bringing the Radio Broadcasting Industry to its present level of achievement and technical excellence. Indeed, its pooling of knowledge, skills and experiences from within and from without is one of the most striking elements of the Industry's development. In my capacity as Manager, Distributor Sales of Western Electric's Radio Division and as Chairman of the Transmitter Division of the Radio Manufacturers Association I have witnessed this spirit in operation many times.

In preparing this guide, we had the advantage in full measure of this same spirit of cooperation. In this instance I saw how freely and willingly hundreds of busy chief engineers and hard-working station managers from stations all over the land answered questionnaires, sent in blueprints, designs and valuable suggestions and how some of the country's foremost network engineering executives and leading architects in the radio field gave of their time and experience to insure the project's success.

So this guide, compiled from all of these sources, is presented for the benefit of all broadcasters. Use it as you wish. We hope it will in this way be fully justified by its value to you and to the whole Industry.

THEY MADE THIS GUIDE POSSIBLE
Recognized throughout the industry as engineering and architectural authorities, these seven men, acting as consultants, gave unstintingly of their time, knowledge and experience in the planning and preparation of this guide.

ADOLPH BERNARD CHAMBERLAIN, Chief Engineer, Columbia Broadcasting System. A pioneer in network engineering and in the design, installation, operation and maintenance of many phases of broadcast equipment, he was responsible for the planning and construction of the engineering facilities of such an outstanding array of stations as KNX, Hollywood, Calif.; WTOP, Washington, D. C.; WCBS, New York, N. Y. and WEEI, Boston, Mass.

ADOLPH BERNARD CHAMBERLAIN

ROYAL V. HOWARD

ROYAL V. HOWARD, Director of Engineering, National Association of Broadcasters; for 14 years vice president in charge of engineering for The Associated Broadcasters, Inc., and subsidiary companies of San Francisco, holds a number of patents on radio equipment. He is a Senior Member of the IRE and a member of the AIEE. He is Technical Advisor to the United States Delegation at the International Telecommunications (Radio) Conference.

JAMES L. MIDDLEBROOKS, Facilities Engineer for the American Broadcasting Company, a former Director of Engineering of the NAB, has to his credit the engineering design and erection of many well known stations, including KSFO, San Francisco; WJJD, Chicago; WKRC, Cincinnati; WSAI, Cincinnati and KOIN, Portland, Ore. Formerly a member of Columbia Broadcasting System's Engineering Department, he also served as Technical Director of the Broadcast Division of Field Enterprises, Inc.

JAMES L. MIDDLEBROOKS

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DAVID NORTON YERKES, architect, member of Deigert & Yerkes, Communications Architects, BFA, Yale University, member of the American Institute of Architects and an Associate of the Acoustical Society of America. Among the stations now being designed by the firm of Deigert & Yerkes are WFMD-FM, Frederick, Md.; WDNC, Durham, N. C.; WINX, Washington, D. C.; WASH, Washington, D. C.; WRUN, Utica, N. Y. and WRUN-FM, Rome, N. Y.; WMCP-FM, Baltimore; KVUN, Los Angeles; KUBR, St. Louis, Mo. and WVUN, Chattanooga, Tenn.

J. R. POPPELE, Vice President and Chief Engineer of WOR, heads a staff of 80 technical experts. A pioneer in broadcasting, he early instituted and supervised at WOR a fine engineering laboratory. He was an early experimenter in FM and Television. He is President of the Television Broadcasters Association, Senior Member of the IRE, a director of the Veteran Wireless Operators Association. He belongs to the Radio Club of America, the Acoustical Society and the Society of Motion Picture Engineers.

J. R. POPPELE

JOHN W. RAGSDALE, Associate Editor, *Architectural Record*, a graduate of Princeton University, 1937. He was News Editor of the Record from 1939 to 1941. As Associate Editor, he has been engaged for the Record in the preparation of a monthly series of Building Types Studies, involving analysis and description of latest trends in the planning, design and construction of such architectural types as apartments, churches, factories, hotels, hospitals, libraries and stores.

ROBERT CAMPBELL DEIGERT

DAVID NORTON YERKES

JOHN W. RAGSDALE

SECTION I

Building the Home for Your Broadcast Transmitter

By R. S. Lanier

Whatever kind of building you put up to house your broadcast transmitter, you are going to live with it constantly, day in and day out, for a long time to come. If it fails, even in small ways, to give the transmitter the proper conditions for trouble-free, efficient operation, or if it throws needless obstacles in the way of maintenance and servicing, the cost to you in time, money, and peace of mind will continue to grow as long as you use the building.

The information in the following pages has been brought together to help you in planning a building that will not cause such needless expense, a building that in every respect will be a "home" for your transmitter. The material has been arranged in outline form, with the following main sections:

On page 25, you will find a table of "do's" and "don'ts" to give you a quick reminder of various points covered in the article. The table on page 16 constitutes a breakdown of the building units or rooms that go into a transmitter building, so that initial layout can be based on the choice of the units that will be needed in your building.

A. PRELIMINARY PLANNING

1. First, secure expert help in planning and construction

Each management will face a different problem in choosing technical guidance. The available sources upon which you may draw are:

The manufacturer of the transmitter, for full installation details, technical requirements of the transmitter, and assistance in installing and testing;

Your chief engineer and his staff, for adaptation of the technical facilities to your own needs and plans;

The architect, for planning the building itself in accordance with your needs and resources, for coordinating the technical requirements with the various building and contracting services, and for supervising actual construction;

The radio consulting engineer, for advisory services which include preparation of the FCC reports and applications, technical advice on all the special problems of installation and "proof of performance," or even taking over the complete job of planning your transmitter installation and supervising the whole job until you are in operation;

The building contractor and various subcontractors, who are responsible for the actual erection of your building.

2. These specialists must work together from the beginning

Nothing is more important than for your chief engineer, and your architect or builder, to sit down with a transmitter specialist or with your radio consultant, and, with a *complete* set of installation drawings for the transmitter, to plan all the technical features of the installation.

Architects Deigert and Yerkes emphasize the need for this kind of cooperation: "The design of a transmitter building is a complex problem, involving the close coordination of structural, mechanical, and electrical elements. The designer of the transmitter building is engaged in arranging the various rooms and equipment to produce a good, workable building. In order to do this he must have a thorough understanding of the functions and the interrelationship of the equipment as well as of the elements of the building. The engineer is interested in the technical requirements and auxiliary services for the transmitter. The two *must* work together closely to fit the plumbing, heating, structural, and electrical features into a unified whole with the transmitter services, or they will not produce a plant that really works."

3. Expert planning will save you money

Good, workable buildings that provide your transmitter with all of the services it needs are *not* necessarily expensive, but they are necessarily well planned from the beginning. With additional money you can buy additional services and conveniences, but a basically excellent building need cost no more, and indeed often costs less, than a badly designed, poorly constructed, expensive-to-operate building.

Good planning saves money in several positive ways: by preventing mistakes that are costly to rectify; by making efficient use of building materials in a sensible, well-engineered building structure; by arranging the building so that it is easy to maintain and operate. "In the past many transmitter buildings suffered from lack of advance planning," says J. R. Poppele. "The industry is now well aware of the importance of careful layout and design."

B. CHOOSING A SITE

1. Basic formula for site selection is signal strength and coverage versus cost of land, construction and operation

Adequate coverage is the first necessity for the success of any broadcast station. With two or more sites to chose from, you can balance improved coverage against the factors listed below.

2. Factors in site selection

Zoning Restrictions: Visit your municipal or county government early in your negotiations to find what building restrictions, if any, apply to the site.

Roadways: Will you need additional roadways? How much will they cost?

Water: Is fresh water available? Must you sink a well to unknown depths in search of water, with possibly very high costs?

Sewage: What provision must be made for sewage disposal?

Power: Will primary power be easy or difficult to bring in? What about an alternate source of primary power?

Program Circuits: What is necessary to bring in program circuits?

Drainage: Unless your building is specifically adapted to a marshy site, does the land drain properly with the heaviest precipitation to be expected?

Soil and Foundation Conditions: Are there any unusual conditions that will make construction difficult and costly? Will soil give the ground screen reasonable efficiency?

Transmission Line: Are there any problems in the proposed transmission line run, such as steep grades or soft ground?

Towers: Is there a convenient location for the erection of your antenna towers? Check the Civil Aeronautics Authority for any restrictions on antenna height at the site you are considering.

Accessibility: Will the site have unusual construction and operation costs because of inaccessibility?

3. How much land does a broadcast station need?

FM stations will fit on a small tract of land because they do not require acreage for an antenna ground system. Little more than the building plot, with parking area and appropriate landscaping, will accommodate the majority of FM stations, provided the antenna tower can be erected on or near the building. However, bear in mind the desirability of exercising control over property in the immediate vicinity of the tower in order to avoid the possibility of future erection of a tall structure which might adversely affect the propagation of your FM signal.

AM stations must have land for the antenna grounding area: 1 to 5 acres for non-directional antennas, forty or fifty acres for directional arrays involving two or more towers. If you are putting up an AM station consider seriously getting a tract large enough for an array even though your single radiator may require only a part of the total. As A. B. Chamberlain puts it: "The only way for many AM stations to increase service area in the future will be through the use of directional arrays. There may come a day when you desperately need those extra acres for a directional antenna system."

4. Marshy or over-water sites give increased radiation efficiency for AM stations, but generally make the building more expensive

The improved propagation characteristics of an AM installation on marshy ground or over water are attractive, but you should have competent estimates of the cost of construction in hand before you can be sure that such a site will "pay off." Building on marshy ground often involves very expensive underpinning. Building over water will also require special construction methods.

The ideal site from this point of view is one on which the transmitter building can be put up on a waterfront plot by conventional methods, with a short transmission run to the tower system in an adjoining sheltered body of water. The photograph below of Station KRE, Berkeley, California, shows an unusually fine site of this kind.

5. The mid-city building as a transmitter site

The excellent coverage and operating convenience of FM installations in tall city buildings must be weighed against the following:

Are there any zoning restrictions or building or-

Aerial view of 250 watt AM Station KRE, Berkeley, California, with combined transmitter-studio building, shows a site with many advantages. Transmitter is on edge of community, with easy access by main highway. Sheltered body of water provides excellent grounding conditions.

dinances against installation of the transmitter in the building, or the antenna on top of it?

Will the building support the antenna? Will the transmitter overload the floor at the chosen location? A preliminary study by competent engineers on these points is good insurance against unforeseen expense. Structural alterations on modern skyscrapers can be very expensive.

Can you get the transmission line to the roof without interference with other tenants? A top-floor installation makes this easy but is not always available.

Is the power cabling to the transmitter location large enough? Will there be large variations in the power consumed by other tenants, causing irregular supply voltage? A separate power run to the top floor of a tall building is an expensive item.

What about building services such as heat and elevators during your after-midnight operation?

6. Transmitters on mountain tops

As everyone knows, FM and television are "going to the mountains" for antenna height. Obviously a mountain top is in general a very inaccessible site. Its usual advantage, besides coverage, is *low land cost*. Here are the items that offset this:

Water, roadways, power, program lines are often difficult and expensive to bring in.

The building will cost more, because of the distance both labor and materials must travel.

Severe weather conditions may require special weatherproofing. A study should be made of the maximum wind velocities and rainfall at the proposed site, to be sure that the building will be watertight, especially around doors and windows.

Cost of operation will be higher because of the inaccessibility. Complete living facilities for personnel will be necessary, particularly in areas where "snowing in" can be expected.

The ideal high-frequency site would be a mountain top in or near a city, with consequent short roadways, water, power and signal runs. Station KPFM, which is shown on pages 50 and 51, has an excellent site in this respect with its mountain overlooking the city of Portland, Oregon.

C. LAYOUT OF THE BUILDING

1. Is it better to combine or separate studios and transmitter?

This architectural guide does not discuss studio installations as such. The combination of transmitter and studios will effect certain economies in the cost of building and operation. However, if studios near the business center are desired, separation is often necessary with larger AM transmitters, which must usually go to the country for land of reasonable cost. Mountain-top FM and television transmitters must also usually be separated from the studios.

The different situations are as follows:

Combined studio and transmitter installations are advisable for FM and television stations in tall city buildings, or AM stations in smaller cities where the cost of land for the radiation system is not prohibitive. Many new stations, particularly of low and medium power, have found that a combined installation in a suburban district is practical and economical.

Separate locations for studio and transmitter are usually necessary with mountain-top sites for FM and television, and AM stations finding "breathing room" for their antenna systems by going into the country.

2. Should a transmitter building be a "show-place" — or just an enclosure for transmitter and operators?

If you have looked over the field to see what kind of building to put up, you are probably in a muddle about these two opposing conceptions.

If your building will be in a remote location, seldom seen by any persons except the operating force, it is obvious that no extra money should be spent merely to give it public appeal. Careful planning and sound architecture, however, *do* pay off heavily, even in remote locations. The difficulties of the site make it even more important and prudent to think carefully in advance, to coordinate the planning of persons involved in the building, and to put up a permanently satisfactory building that will be easy to maintain, with all the facilities necessary for efficiency of the operating force.

Functional Units of a Broadcast Transmitter Building

Essential	Transmitter Room Control Room or Area Washroom Storage Space Work Shop
Desirable	Office Shower Room Kitchen or Kitchenette Emergency Studio Garage
Optional, Depending on Requirements	Living Quarters Employees' Lounge Heater Room Transformer and Power Distribution Room Viewing Lobby or Visitors' Lounge

On the other hand, if your transmitter building is seen regularly by a large number of people in your community, the building becomes a permanent advertisement for your station, establishing in the minds of your listeners the character of your organization. The minimum response to this situation should be a building with a clean, well-balanced exterior appearance, well-kept approaches, architecture neither pretentious nor dowdy. This kind of clean, smart looking building need not cost substantially more than a cluttered, ugly, ramshackle type of building—again it is expert planning that counts.

Each management must make a decision, based on its resources and the probable benefits in goodwill to be obtained, as to just how far it wants to go beyond this minimum toward a more elaborate use of the transmitter building in the public relations scheme of the station. Many arrangements are possible, ranging from the use of a glass wall on the control area, a fairly inexpensive and often most effective way of "showing the works" to the public, up to fountained gardens, beautifully furnished visitors' lounges, raised viewing lobbies that circle the whole transmitter area. A number of practical schemes for the accommodation of visitors are shown in the plans in Sections II and IV.

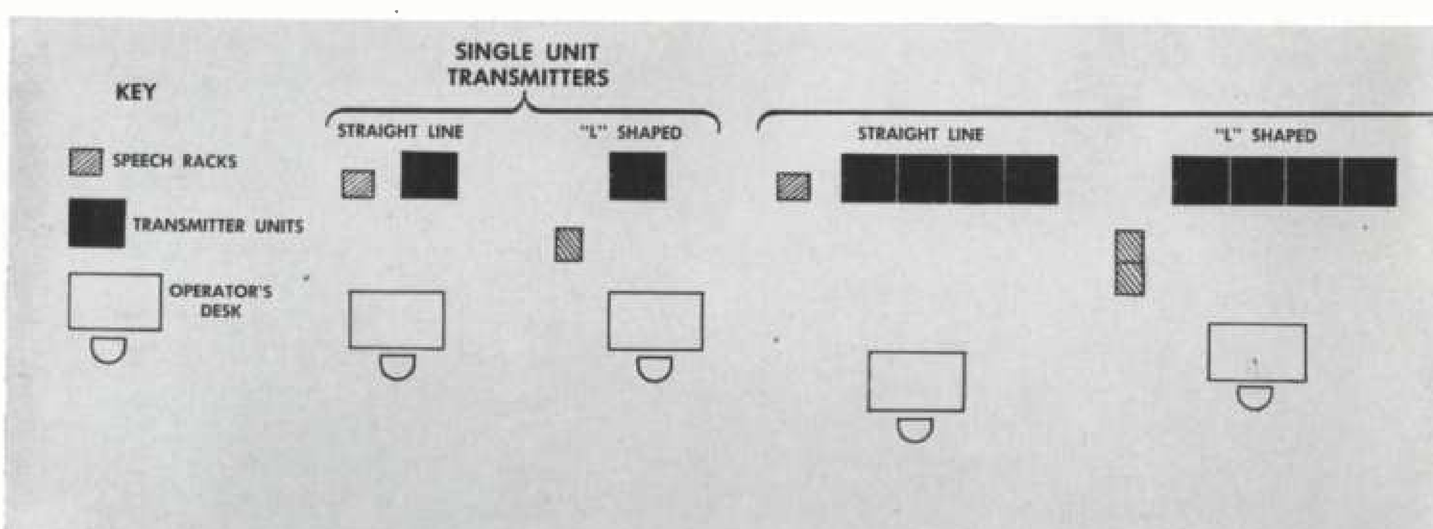
3. Units of the building

Architecturally speaking, a transmitter building can be divided into the unit functions and features shown in the table at the left.

Your planning of interior layout can be based on the selection of the building units or rooms to take care of your particular needs and problems.

The transmitter room and control room are the heart of any transmitter building, and they should be designed first, to accommodate your transmitter and to provide for installation of the services necessary for operation and maintenance. Choice of the other building units or rooms required for your installation can then be made. These additional rooms should be added around the transmitter and control rooms to provide proper and efficient operating flow to the various parts of the building. The transmitter room and control room are discussed in detail be-

BASIC PLANS FOR



low, after which the other building units are taken up in the order shown in the table at the left.

Transmitter Room: The floor space must be sufficient for the transmitter itself, and in addition must provide room completely around it for easy servicing. This means that in back of the transmitter, there must be room to open any swinging doors, *plus* additional room to allow the operator, with portable test equipment or small power tools, to pass the opened doors. The front of the transmitter will face into the control room or area. Detailed characteristics of the control room are discussed beginning on page 20.

The larger transmitters which include auxiliary high voltage or cooling apparatus in separate units will ordinarily have recommended transmitter room layout plans supplied by the manufacturer. Layout of a transmitter room with a number of auxiliary units is based on: (1) short interunit connections; (2) separation of equipment that must be attended in operation, from dangerous high voltage equipment; (3) provision of proper insulation and separation for high voltage wiring runs.

The enclosure of high voltage equipment in separate rooms with "interlock" switches on all entry doors which cut off the power automatically when the door is opened should be planned in accordance with FCC and Underwriters' regulations. These should be studied to make sure that any planned layout of high voltage equipment is in order.

The ceiling height in the transmitter room must include a margin of several feet over the standing height of the transmitter itself. A minimum over-all ceiling height of 10 feet for AM and 12 feet for FM transmitters is advisable. This is to allow for:

(1) Access space for servicing meters and other equipment near the top of the transmitter.

(2) Room for discharge of heat from the tops of small and medium size transmitters.

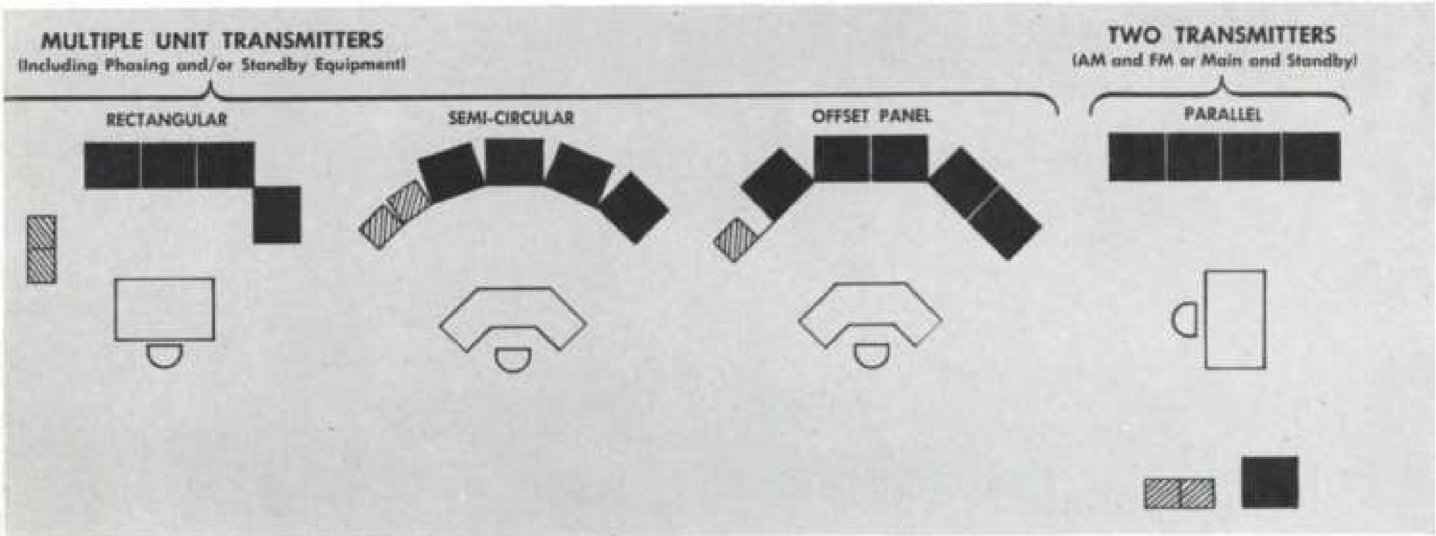
(3) For FM transmitters, room for transmission line and harmonic shunt line stubs installed on or near the top of the transmitter. If harmonic shunts are contemplated, careful consideration should be given to the maximum length of stub that would be required, and vertical space allowed accordingly.

After scaling the room and preliminary placing of the main transmitter units on paper, study the plan from the point of view of the operator. Can he reach control points quickly and easily? Is there room for all normal maintenance, testing and service? Obvious, but sometimes overlooked: Are the doors to the transmitter room large enough for the largest unit of apparatus to be installed? (For placement of the transmitter units with respect to the control desk, see the following section on "control room.")

In the layout of the transmitter room, as in every feature of a transmitter building, *the anticipation of probable expansion* is one of the surest forms of long-range economy. All of the experts agree that every person going into the broadcast business should take a hard look ahead at his future and lay definite plans in the transmitter building for the

(*Continued on page 20*)

ARRANGEMENT OF EQUIPMENT



TYPES OF BROADCAST

GENERAL ARCHITECTURAL TYPES

WLBC, Muncie, Indiana

CONTEMPORARY: Exterior form in this case evolves naturally from efficient spatial organization of the inside. Showing expert use of modern materials and methods, this building is in harmony with its site and is altogether distinctive in expressing its function.

WRVA, Richmond, Va.

TRADITIONAL: Special conditions may indicate a recourse to tradition. However, symmetries achieved on the exterior may be independent of internal needs. Distinctive expression of the building's purpose here comes principally from the proximity of the antenna.

TYPES ACCORDING TO LOCATION

KDYL, Salt Lake City, Utah

RURAL: Such locations impose fewer limitations to the development of expressive exterior forms. Freedom, however, must not be pushed to the point of defying all environmental restraint, and there should be no attempt to dwarf the out-of-doors with monumentality.

KJBS-FM, San Francisco, Calif.

CITY: The chief prerequisite here is removal above surroundings disturbing to transmission. Thus, ready-made locations make interior planning largely an adjustment to existing spaces and exterior expression limited to the antenna and perhaps some identificatory lighting.

SIMPLE UTILITY TYPES

WHAV, Haverhill, Mass.

CEMENT OR CINDER BLOCK: This example of cement block coated with stucco shows strictly utilitarian use made of economic building materials. In some cases, the locations and surroundings do not really warrant an elaborate concentration on external appearances.

KOAD, Omaha, Nebr.

WOOD FRAME: Many small new stations springing up make few early gestures at special housing. Here a former milkhouse has been taken over and converted, with a few swift adaptations inside to take care of equipment and provide rudimentary comforts for personnel.

TRANSMITTER BUILDINGS

KOB, Albuquerque, N. M.

REGIONAL: This example of a regional type in the Southwest is in harmony with its surroundings, though not to the point of excluding the possibility of other forms being equally successful. This particular type happens to be quite in keeping with interior efficiency and economy and shows how to use style to advantage.

By John W. Ragsdale

Associate Editor, Architectural Record

The exteriors of transmitter buildings should be judged architecturally by the same standards used for other types of buildings. Does the exterior form proceed logically from the planning of interior space and suitably express the building's purpose? Is it harmonious with respect to site and environment? Since a transmitter building's purpose is so essentially of the present, exterior forms in the modern or contemporary manner would seem to be generally appropriate. "Modern," however, does not mean those clichés and rootless stylisms necessitating the term "modernistic." Moreover, there are many cases where exterior expressions in regional, traditional or other manners are amply justified.

WMIT, Winston-Salem, N. C.

MOUNTAIN TOP: This ideal location for an FM transmitter building does constrain the architect in his choice and handling of materials to provide appropriate shelter. Traditional and regional factors are seldom important, but expressiveness of form must be subordinate to considerations of weather and exposure.

WCBS, New York, N. Y.

ISLAND: A site like this provides as nearly perfect ground conditions as are possible for a permanent transmitter building. The architecture, though functional in appearance to the point of severity, is generally suitable to the purpose and environment. A more elaborate style would probably appear specious.

WWDC, Washington, D. C.

QUONSET: Slightly more creative is this adaptation of a familiar structure of general utility to the specific purposes of radio transmission. Although the Quonset form has architectural validity in many functional applications, it is doubtful that it provides the best basis for efficient permanent solutions.

WKYW, Louisville, Ky.

SPECIAL PROBLEM: This solution, in the tradition of the original flood, insures protection against the worst rampages of the Ohio River. Combined height of the concrete piers and former Army pontoon barges put prefabricated transmitter building well above average high-water mark. Barges are moored fore and aft.

(*Continued from page 17*)
changes he hopes to make. As stated by Royal V. Howard, "Every small or medium power transmitter building should allow for expansion to higher power, if the owners have any hope for normal expansion and growth of their business." In the transmitter room, this means sufficient space for a larger transmitter, and any secondary units required. Such additional floor space costs very little per square foot. A wall of glass brick, unit partitions, or other easily removable construction is one of the simplest and most popular methods of facilitating future expansion in the transmitter room.

After layout of the room, the next major planning job for the transmitter room is that of supplying dirt-free air to the transmitter and auxiliaries and keeping ambient temperature at the proper levels.

Dirt Removal. As pointed out by A. B. Chamberlain, "It is more economical as well as more satisfactory, for maintenance and continuity of service, to supply dirt-free air to the transmitter than to have operating personnel constantly engaged in removing dust and dirt which may eventually cause equipment failures. Filtered air will be found, over the long run, one of the best investments the designer of a transmitter building can make."

An analysis of the normal dirt content of the air at the transmitter location will give an indication of the problem you face in cleaning up the air for your transmitter room. Simple filters on the air intake of the transmitter cabinet will often be sufficient, particularly if a slight positive air pressure is maintained inside the cabinet. On the other hand, it may be desirable to filter the air for the whole room or building. If the transmitter is not in a separate room, precaution may be necessary against entry of dirt when outer building doors are opened.

With the larger air-cooled transmitters, which pull cooling air from outside the building, close control of dirt becomes of paramount importance. An electrostatic precipitator at the air intake will give assurance of clean air for cooling the transmitter. Various types of filters can also be used on the intake with somewhat lower effectiveness, but still giving satisfactory service.

Ambient Temperature. The disposal of waste heat in a broadcast transmitter, to keep the temperatures at safe operating levels, is of course one of the principal design factors for which the manufacturer has made provision. The planner of the building must consider, in addition, the comfort of operating personnel. Thus the general considerations that affect the planning of the transmitter room are as follows:

(1) In a building cooled by mechanical refrigeration, waste heat should not be added to the load on the cooling equipment, but discharged outside. The waste heat will almost certainly overload the cooling equipment.

(2) The same will be true if the cooling air for the transmitter is taken from a building area cooled mechanically.

(3) Thus treatment of transmitter heat separately from that in the building itself is highly desirable, especially in warm climates and whenever mechanical refrigeration is used to cool the building.

(4) By enclosing the area in back of the transmitter front panel as a separate room, dirt, ventilation and heat disposal can all be handled on the most efficient basis, with the operator's comfort assured.

Control Room: The space in front of the transmitter, or the separate room into which the transmitter faces, must be used as the control room. The central feature of the control room is the control desk, so placed that the operator on duty can monitor the transmitter efficiently during operation.

The layout of the transmitter and the racks of

Beautifully finished control room at WHEC, Rochester, N. Y., has the "L" arrangement of units, with ample space left around control desk.

audio and test equipment around the control desk so that they are easily seen, with ample space for movement of personnel, *is one of the most important planning jobs in any transmitter building*. The sketches at the bottom of pages 16 and 17 have been prepared to show the various basic plans which accommodate themselves well to these requirements, as adapted to single unit transmitters, multiple unit transmitters, and two transmitters. The following principles should guide the layout of the control room or area:

(1) The operator must be able to see the indications of the most essential meters (although not necessarily to read the meters accurately) without leaving the control desk.

(2) The *minimum* distance between desk and transmitter should allow for easy passage of the operator between the two with the transmitter doors open—approximately five or six feet.

(3) As units are added to the transmitter, the control desk must be moved back from the transmitter front, to give the operator a proper view of all the units. Thus the average distance between control desk and transmitter in medium power installations is eight to ten feet.

(4) As more units are added to the transmitter, a rectangular, semi-circular, or other "folded" arrangement (see sketches at bottom of pages 16 and 17) becomes desirable to bring all of the units within proper viewing distance of the operator. Such arrangements also make for easy maintenance and use space efficiently.

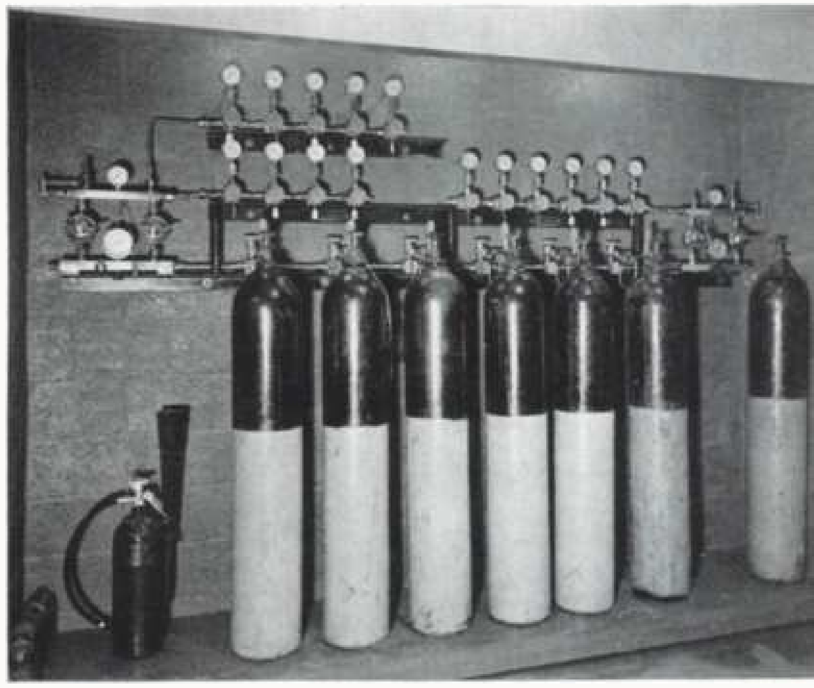
(5) Not only the transmitter itself, but auxiliaries such as phasing equipment, modulation, frequency, and phase monitors, noise and distortion meters, line and limiting amplifiers, should be visible and readily accessible to the operator.

(6) The auxiliary units listed above must be arranged so that the operator can get in back of them, with ample space for servicing or maintenance.

After layout of the transmitter, control desk, and other units and scaling of the control room, plans should be made for maintaining temperature, ventilation, and lighting in the room, all adjusted to the requirements of continuous occupation by an operator. Proper lighting of the front of the transmitter will add measurably to the appearance of the equipment and the efficiency of operation.

Acoustic treatment of the control room walls and ceiling has become general practice, to lower the noise level with consequent improved program monitoring efficiency and additional comfort for the operator.

A feature of the control room often overlooked is the provision of convenient space for a typewriter. Standing a typewriter on the control desk puts it in the way of other operations and makes it inconvenient to use.



Gas for pressurizing transmission line is conveniently installed in basement or at back wall where transmission line leaves building.

When the preliminary layout of major units of equipment in the transmitter room and control room is on paper, attention should be turned to planning for proper and economical installation of the following "services" to the transmitter and associated equipment:

- Incoming primary power
- Incoming program lines
- Interunit connections
- Outgoing transmission line
- Lighting circuits
- Cooling water piping (if water cooled)
- Air ducts for cooling (larger air cooled transmitters)
- Gas equipment for pressurizing transmission line

It is in the placement and arrangement of these items that many buildings go wrong, with consequent expensive alterations, or inefficiency caused by difficult maintenance and operation. Your technical specialist, and your architect or building contractor must work closely together in making thorough advance plans for installation of all these services to the transmitter. For such planning, "accurate and complete installation drawings of the transmitter and auxiliaries are priceless to the designer," says J. L. Middlebrooks. "They are the best insurance against costly hindsight architecture."

Each building and each transmitter will present an individual problem, but the following general considerations should be noted:

Terminal boards and overload control points, such as power distribution panels, fuse boxes, circuit breaker panels, should be placed so that they are readily accessible to the operator on duty.

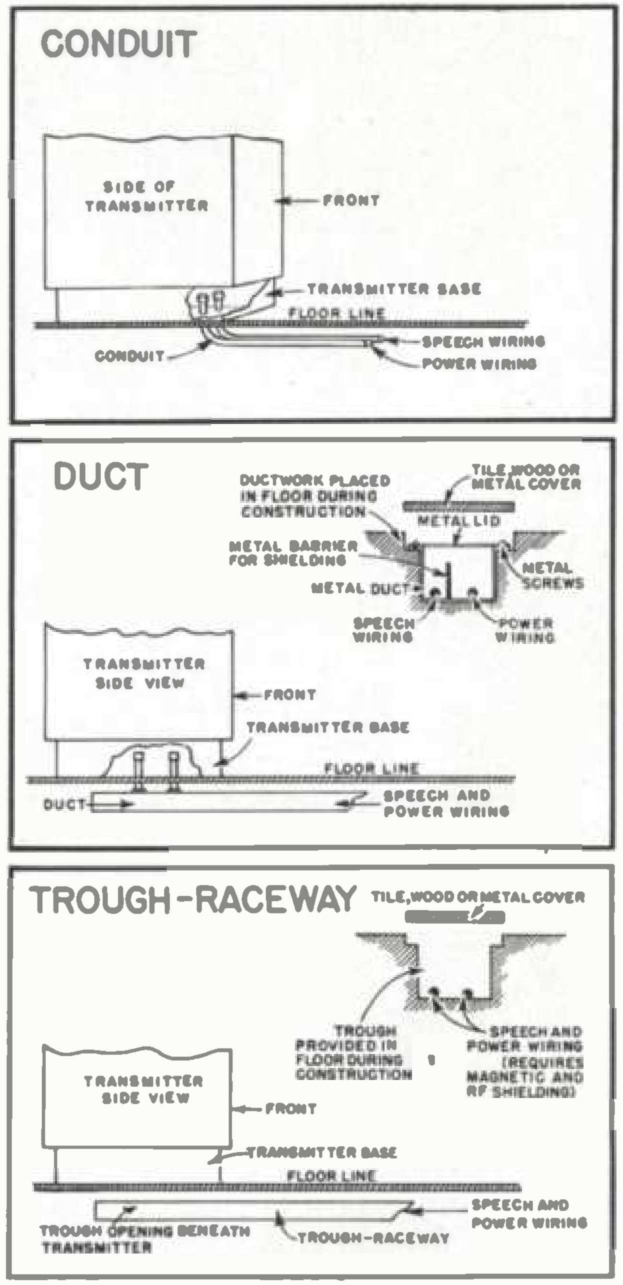
Incoming program and power lines should be brought in to separate, centrally located terminal boards. If these lines run near your AM antenna, you should consider burying them, to reduce interference problems.

Interunit connections should be planned with particular care. A drawing showing every electrical and transmitter circuit in the building should be prepared, to provide assurance that plans have been made for all necessary circuits.

The builder has a choice of a number of methods for installing interunit power and audio circuits:

(1) Conduit: Commercially available conduit can be (a) buried in poured cement floor, after which relocation of wiring is difficult and costly; (b) run under the floor if there is a crawl space or basement, in which case changes require cutting holes in the floor and disconnecting the conduit; (c) run under false floor. A double floor permits the conduit to be laid between the two floors.

(2) Ductwork: Many forms of metal ductwork are commercially available and this is a very popular device for installing interunit wiring. Duct in general has a rectangular cross section and removable top. Many types are supplied with an integral shielding barrier which can be used to separate speech circuits from power circuits, making other shielding unnecessary. The sketches at the right show typical methods of installing ductwork. The



Practical methods for installing interunit wiring are shown in above sketches. All of them are adaptable to a variety of floor constructions.

removable top makes for easy maintenance or alteration in the wiring at any point along the duct. It can be: (a) laid in poured concrete floors, (b) installed under false floors; (c) hung from the floor if there is a crawl space or basement.

(3) Troughs or Raceways: Troughs or raceways formed in poured cement floors provide another method for installing interunit wiring. The wire can simply be laid in the trough. Some kind of top cover must be added, and if speech and power cir-

cuits, or high and low level circuits, are run in the same trough, shielding is required.

Convenience outlets near each of the major units of the transmitter for operation of test equipment, small power tools, trouble lamps and soldering irons should not be overlooked. Some manufacturers supply such outlets in the transmitter cabinet.

After design of the transmitter room and control room, the other building units can be added to the plan. These are discussed below.

Washroom: The FCC requires that a washroom be installed close enough to the operator on duty so that he will not find it necessary to be away from the control point more than a few minutes at any time. No stipulation as to the exact distance from the control desk is made nor is it required that the washroom open directly into the control room. However, if the operator has to go to the end of a long corridor, or to another floor a considerable distance from the transmitter, it is considered a case of bad practice in this respect.

Storage Space: No transmitter building can operate efficiently without storage space. Spare tubes, test equipment, replacement parts are essential and should not be piled in the corner of the room because nothing better has been provided.

In estimating the amount of storage space needed, it pays to go well over on the generous side. The "Survey Study of Broadcast Transmitter Buildings" which is presented beginning on page 42 gives definite information on the value of storage space, as determined by the experience of broadcast stations in all parts of the country. Among the six hundred stations answering the questionnaire, the most frequent lack mentioned in describing the transmitter building was "insufficient storage space." This makes it plain that storage space is commonly underestimated in stations of all ratings.

In larger stations specialized storage schemes may offer benefits. With a high power transmitter, for instance, the tube storage can be arranged on a functional basis, with racks constructed to hold an exact duplicate set of the tubes in the transmitter, arranged in corresponding order.

One type of storage sometimes overlooked is *storage for reports and other papers*. Ordinary file cabinets will be satisfactory. Built-in cabinets, conveniently located, make an attractive solution.

Further improvements in efficiency and convenience can be achieved with the following specialized types of storage:

(1) Racks or drawers for safe storage and easy removal of the numerous blueprints needed in a broadcast station

(2) Closet and lockers for clothes and personal belongings of operating personnel;

(3) Bookshelves or racks for engineering refer-

Workshop at WTOP has ample bench space with covered storage below the bench. Note natural and artificial lighting over working area.

Another well-planned shop, this one at WHEC, Rochester, has plenty of open and closed storage, drill press, vise, and test equipment.

ence books and periodicals and equipment catalogues. A "library corner" in the office or other convenient space is a great help to neatness and order, and puts the reference tools in a known location where they can always be found quickly by the operating force.

Work Shop: A shop consisting of a regularly equipped bench with adjacent storage space for tools and small parts should be included in every broadcast transmitter building.

The tools most commonly needed are the small tools ordinarily used in repairing or rewiring electronic equipment, plus a drill press and heavy vise. In the larger stations a small metal lathe may be useful, but the completely equipped machine shop has been found to be unnecessary by the great majority of broadcast stations. Covered storage space to keep dust off of expensive test equipment, should be included in the shop. *With FM transmitters, and AM transmitters of 1 kw and lower power,* shop, storage space and transmitter room, or shop and heater room, may be conveniently combined. *With AM transmitters above 1 kw* it is usually dangerous to have personnel working at a bench directly in back of the transmitter. No one should work in the near vicinity of a high-power radio transmitter unless his full attention is on the transmitter. In addition, the safety regulations may require that the area in back of the transmitter be within an "interlocked" enclosure.

Office: Usefulness of an office even in smaller stations arises from the record-keeping activities that are imposed by law on every broadcast station. Storage of records and a place to prepare the required reports are just two of the functions that make an office desirable. It is possible to combine the office with other functions, such as the visitors' lobby or the operators' lounge (see plans, Sec. II).

There is another kind of value arising from the inclusion of an office for the chief engineer or transmitter supervisor. The technical heads of a broadcast station have a professional standing which should be an integral part of their thinking about their jobs, and should be recognized by the management and the general public. Proper office facilities are important in maintaining this valuable frame of mind for both the technical men and for those in contact with them.

Shower Room: After more storage space, the shower room was one of the features most often mentioned as desirable by the persons answering the Survey questionnaire.

Kitchenette: This is another convenience which has universally proved itself in the minds of operators, owners and builders of transmitter buildings, as revealed in the Survey. Naturally in a building with living quarters, a complete kitchen must be included. However, in the buildings without living quarters or regular kitchens, the single unit kitchenette with stove, sink, storage and refrigerator all in one compact, relatively inexpensive piece gives the operators a place to "boil up a bite" while on duty. This has proved particularly valuable for operators on all-night watches.

Emergency Studio: Every broadcast transmitter which is separated from its studios faces the possibility of being cut off from the program source. Prolonged time off the air can be avoided if provision is made in the transmitter building for emergency program production. Various arrangements at the transmitter building will allow the station to get on the air on a more or less minimum basis:

(1) *Turntable and speech input facilities added to transmitter control desk.* This is the simplest arrangement and will generally be satisfactory for recorded music programming. The use of a microphone at the control desk may be unsatisfactory without acoustic treatment of the control room. The noise level produced by air cooling equipment of some transmitters may make a glass isolation screen in front of the transmitter desirable.

(2) *Turntables and speech equipment at transmitter control desk, with a separate acoustically treated room for microphone pickup.* With a microphone pickup room adjacent to the control room, a properly placed viewing window will make it possible for the transmitter operator to operate the turntables, and to control the live pickup, without leaving his position.

(3) *Complete emergency studio.* Naturally there is no limit, except the resources and needs of the station management, to the completeness of the studio equipment installed in the transmitter building. For the average medium-power station, which has no unusual programming methods or operating problems, an emergency studio along the lines of those in the plans on pages 36 and 39 has been found satisfactory.

As shown in the plans referred to, the turntables, speech control equipment, and live pickup are all in the studio together. The studio adjoins the transmitter control room with a viewing window between the two. This arrangement works well with the simple type of program production to be expected for emergency use in a station of this type. In a regular studio, of course, the much more complicated program control necessary would not permit the audio control man to sit with his back to the microphone positions, and within the studio space.

Garage: The need for a garage at the great majority of transmitter buildings is obvious. Additional parking space is a further convenience for visitors and personnel.

Living Quarters: The provision of living quarters for at least a part of the operating personnel will pay off in many locations which are so inaccessible as to make regular daily coming and going of the operating force difficult and time-wasting. The widespread use of living quarters as a part of the transmitter building, either from necessity or to increase the efficiency and attractiveness of the building for the operating force, is clearly indicated in the Survey results on pages 44 and 45.

Employees' Lounge: The employees' lounge is another building unit which adds greatly to the convenience of the building for the operating force. It can be combined with the office, as shown in the plans on pages 31 and 36.

Heater Room: The trend to single-floor layouts brings the separate heater room to the fore as a feature of the main floor plan in nearly every building in climates where heating is required. In the smaller stations, the heater room can be combined with shop and storage (see plan, page 31).

Transformer and Power Distribution Room: The larger transmitters using separate high voltage equipment introduce the necessity of constructing separate rooms or enclosures which embody the safety and isolation characteristics required by FCC and Underwriters' regulations, and good engineering practice, as already explained on page 17. Interlock systems and other safety measures for such rooms will ordinarily be specified for each transmitter by the manufacturer. The planner of the layout must take care that interlocked high voltage areas do not interrupt the normal operating flow of the building, nor interfere with the maintenance of equipment which must for any reason be attended while the transmitter is in operation.

There are many solutions to the problem of isolating dangerous high voltage equipment from parts of the transmitter which must be attended. The completely enclosed and interlocked transmitter room is shown in the plan on page 39. The use

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When Planning and Constructing a Broadcast Transmitter Building . . .

DO

- ☐ Check local zoning restrictions.
- ☐ Consult C.A.A. on tower height.
- ☐ Secure complete installation information from transmitter manufacturer.
- ☐ Allow room for expansion, if this is contemplated.
- ☐ Check building plans with fire insurance consultant to get lowest rates.
- ☐ Check rainfall, snowfall, wind conditions, temperature range, etc. at site.
- ☐ Have doors wide enough for moving in equipment.
- ☐ Plan location of all interunit wiring before construction begins.
- ☐ Provide enough work shop and storage space.
- ☐ Provide sleeping facilities, if only for emergency use.
- ☐ Arrange to keep temperature in operating areas at comfortable level for personnel.
- ☐ Provide dirt-free air for transmitter and operating areas.
- ☐ Isolate transmitter heat from building cooling system.
- ☐ Provide kitchenette facilities, particularly if food is not available nearby.
- ☐ Place convenience outlets near all equipment.
- ☐ Provide rack space for all the audio and test equipment you will need.
- ☐ Ground any large conducting parts of building frame.
- ☐ Make your building an attractive, efficient home for your transmitter—and a building in which employees will enjoy working.

DON'T

- ☐ Select a site until you have checked costs of roadways, building services and utilities.
- ☐ Plan other rooms until you have laid out transmitter room and control room.
- ☐ Place wash room at too great a distance from control desk.
- ☐ Buy land for AM site without considering need for directional array in the future.
- ☐ Use building power circuit which is subject to heavy, irregular loading by other tenants.
- ☐ Put high-voltage units or wiring where they will endanger personnel.
- ☐ Place "interlocked" areas so they block normal access to other rooms or equipment.
- ☐ Put audio and power lines in same raceway without shielding.
- ☐ Allow small metal parts in building to become hot from induced r-f energy.
- ☐ Put up a transmitter building in your community which misrepresents you and the character of your business.

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of a chain link fence is shown in the plan on page 53. Others will be noted in the various plans in Sections II and IV.

Viewing Lobby and Visitors' Lounge: The general problem of deciding what provisions should be made for the public has already been discussed on pages 15 and 16. The viewing lobby is a popular form of public relations effort, for the reason, often pointed out, that transmitting equipment has beauty and drama for the general public. A transmitter with the circle or "U" of units facing the operator, the high-power amplifier tubes visible through the front panels, and the rows of meters and controls, is impressive to any onlooker. The viewing lobby can be combined with an attractive lounge.

Naturally if you are going to show your building to the public the operating area should be neat and straightforward in arrangement. The appearance of precision and efficiency which a well-arranged, well-kept transmitter area gives the onlooker can be a valuable goodwill agent for any station.

D. TECHNICAL ACCESSORIES TO THE BUILDING

There are a great number of technical features that can be added to a transmitter building, the choice of which will be determined in most cases by individual needs, as interpreted by the technical specialists working on the building. A few of the most generally valuable features of this type are discussed here.

Emergency Power: The chance of losing air time due to primary power failure can be minimized in two ways:

(1) Installation of standby diesel or gasoline-engine driven generating equipment large enough to operate the transmitter and auxiliaries. Such generating equipment should usually be placed in a separate building, for lower insurance rates.

(2) Provision of alternate power run, or connection to entirely separate commercial source, if such is available.

Emergency power has strongly proved its value in the experience of many broadcast stations.

Communication System: Communication between different parts of the building becomes important in the larger buildings. Telephones for outside calls and building intercom should be placed on the control desk. In particular, a telephone line from the control room to the base of the antenna towers, in directional arrays, will greatly facilitate adjustment of the antenna system.

Recording Room: In combination studio-transmitter buildings, where disc recording is to be done regularly, a stable floor in the recording room is essential. Various construction methods are available for giving the floor a very low period of vibration and insulating it from disturbances in the rest of the building.

Shielded Test Room: In the higher frequency stations—FM and television—a shielded test room may be found valuable, to eliminate errors in adjusting monitoring and test equipment. The conventional grounded "chicken wire" booth is usually satisfactory.

Your control room can "work" for you with the public, as shown by this beautifully arranged and decorated room at Station WWJ, Detroit.

E. BUILDING SERVICES—CONSTRUCTION METHODS

1. Heating the building — Waste transmitter heat

Transmitter buildings in colder climates can be heated by any of the conventional methods, but hot air and radiant systems have proved the most popular types. Insulation pays off in transmitter buildings in the same way as in other types of buildings.

The subject most discussed in this connection is naturally the use of waste transmitter heat to heat the building. The system has received widespread application, as can be seen in the Survey tabulations on page 44. Many successful installations of this type have been made which have proved to be economical and practical. However, before you plan to use it, your architect and heating engineer should give careful consideration to the following:

(a) In colder climates, waste heat should not be relied on as the *sole* means of heating the building. Most broadcast transmitters are turned off a part of the time, *whereas in cold weather a building must be heated continuously.*

(b) In most cases in colder climates, the waste heat should be used to *supplement* the regular heating system rather than the other way around, since the regular heating system must have full capacity for those periods when the transmitter is turned off.

(c) In summer, the waste heat must naturally be discharged outside the building. This means that a system of control must be installed which can be used to discharge the waste heat outside in the summer, and utilize it in the building in the winter. When correlated with an air conditioning system for summer cooling (see below) this can become an elaborate and expensive system.

(d) A careful study of the cost of the required control systems sometimes shows that it is cheaper to exhaust the waste heat outside the building, winter and summer, and rely on a conventional heating system for the building.

2. Cooling the building

Whether or not a system is installed for cooling the building by mechanical refrigeration will be determined by the climate and by the resources of the management. *Wherever hot summer temperatures are encountered, a complete conditioning system for cooling the building and filtering the air will promote efficiency of personnel and will pay big dividends in increasing the reliability of the equipment.* The minimum should be a system for exhausting the air of the whole building in summer, with provision for entry of filtered air to replace that moved out.

As pointed out on page 20, transmitter waste heat should not be loaded on the building mechanical refrigeration system if it is possible to avoid it. With the larger transmitters, provision *must* be made to isolate the transmitter heat from the building cooling system in the summer.

3. Construction methods and building materials

The construction methods for a broadcast transmitter building are in most respects the same as those for other types of buildings of similar size. Choice of materials will depend on cost and availability, on building ordinances, and on the desires and resources of the station management.

Reinforced concrete and brick are the two most popular forms of construction for the larger buildings. Fieldstone, alone or in combination with concrete or wood, is economical in many areas, and can produce a substantial, attractive building that has a strong harmony with its surroundings.

Many of the smaller buildings are very satisfactorily built mainly of wood. The original design for a 250 watt AM station on pages 30 and 31 shows what an attractive and efficient building wood construction will produce when combined with brick inner walls. Wood in combination with concrete is another attractive possibility.

Your listeners want to see your transmitter building. KRSC invited them in for a good look around on opening night, as shown below.

On pages 18 and 19 several simple "utility" types of construction are shown. The "utility" building has been of particular value during the war and early post-war years. It permitted many stations to get on the air which would otherwise have lost their chance to get into the business. Building block, converted wood structures, and various types of prefabrication have all played their part during this period when building was difficult.

Fireproof construction is valuable not only as a safety measure, but in lowering insurance rates. To make sure of getting the best possible construction from the Fire Underwriters' point of view, have your building plans examined and recommendations made by a fire insurance consultant.

It is required by the Underwriters' and FCC regulations that the metal frame of a transmitter and all associated equipment, as well as the frame of the transmitter building itself, be thoroughly grounded as a protection to operating personnel. In some cases this is combined with the r-f ground for the transmitter. No large conducting bodies in a transmitter building should be left ungrounded. If metal lath is used on the walls, this should be bonded together at a number of points and connected to the grounding system, to form a practical shield against r-f energy.

A hazard often overlooked is the induction of r-f energy in small metal parts of the building frame with consequent dangerous temperature levels, particularly when the antenna is close to the building. This applies especially to AM stations of higher powers, *but it remains as a possibility even with lower power AM stations and FM stations of all powers*. Wooden buildings with composition roof are more often subject to this kind of danger. Heating of the nails in the roof or floors of the building may require some form of shielding or grounding system to eliminate a definite fire hazard.

4. Landscaping

The landscaping of a transmitter site will naturally follow the ideas and desires of the station management. Do not forget that the landscaping plays a major role in the idea that the public forms of your station, as already pointed out on page 16. It can be a very positive element in the public relations program of the station. The Survey tabulation on page 44 shows average expenditures for landscaping by stations throughout the country.

F. THE STYLE OF YOUR TRANSMITTER BUILDING

Finally, you must be satisfied that the whole style of your building truly fits in with what you want your station to be. Permanently satisfactory architectural style is based on two principles: (a) It follows naturally from the interior shape and function of the building; (b) it has some pleasing order or harmony in the exterior, which fits in with the site and with the materials used.

Because a radio transmitter is a very modern phenomenon, it seems appropriate that the transmitter building should usually follow a style belonging within that broad range roughly known as "contemporary". However, as shown on pages 18 and 19, many styles are possible, and the important thing is that the building follow your own needs, desires, and expectations of the future.

It is here that a less tangible element enters into the planning of your transmitter building, an element strongly personal but nevertheless inseparably connected, over the long run, with the success or failure of your business. This is the sense of permanence, of pride, of personal identification with the standing of your business in the community, which should be expressed in many ways, and certainly in a substantial and beautiful transmitter building. It is easy to pick out, in broadcasting as in other businesses, the organizations that achieve long-range success. Every aspect of their equipment expresses this same sense of permanence and pride.

You have read this guide because you know that getting on the air with a broadcast station is a large undertaking, involving a considerable investment of money and effort. You understand that you cannot afford to let your transmitting equipment operate in a building that is badly planned and carelessly built. Your hopes for the future should be built around a really fine transmitter building. Can you afford anything less?

SECTION II

Transmitter Buildings With a Future

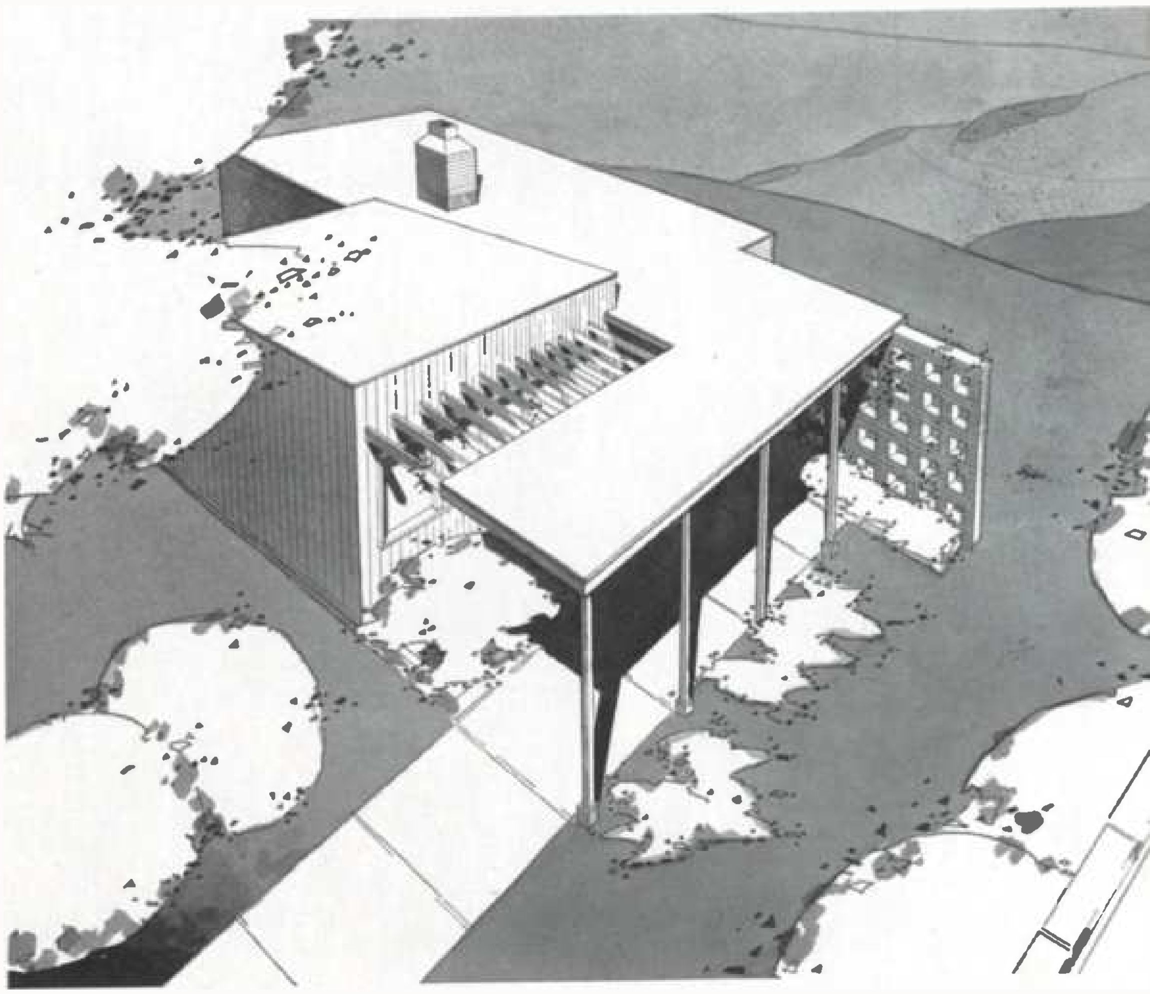
SIX ORIGINAL PLANS DESIGNED BY

DEIGERT AND YERKES, ARCHITECTS, WASHINGTON, D. C.

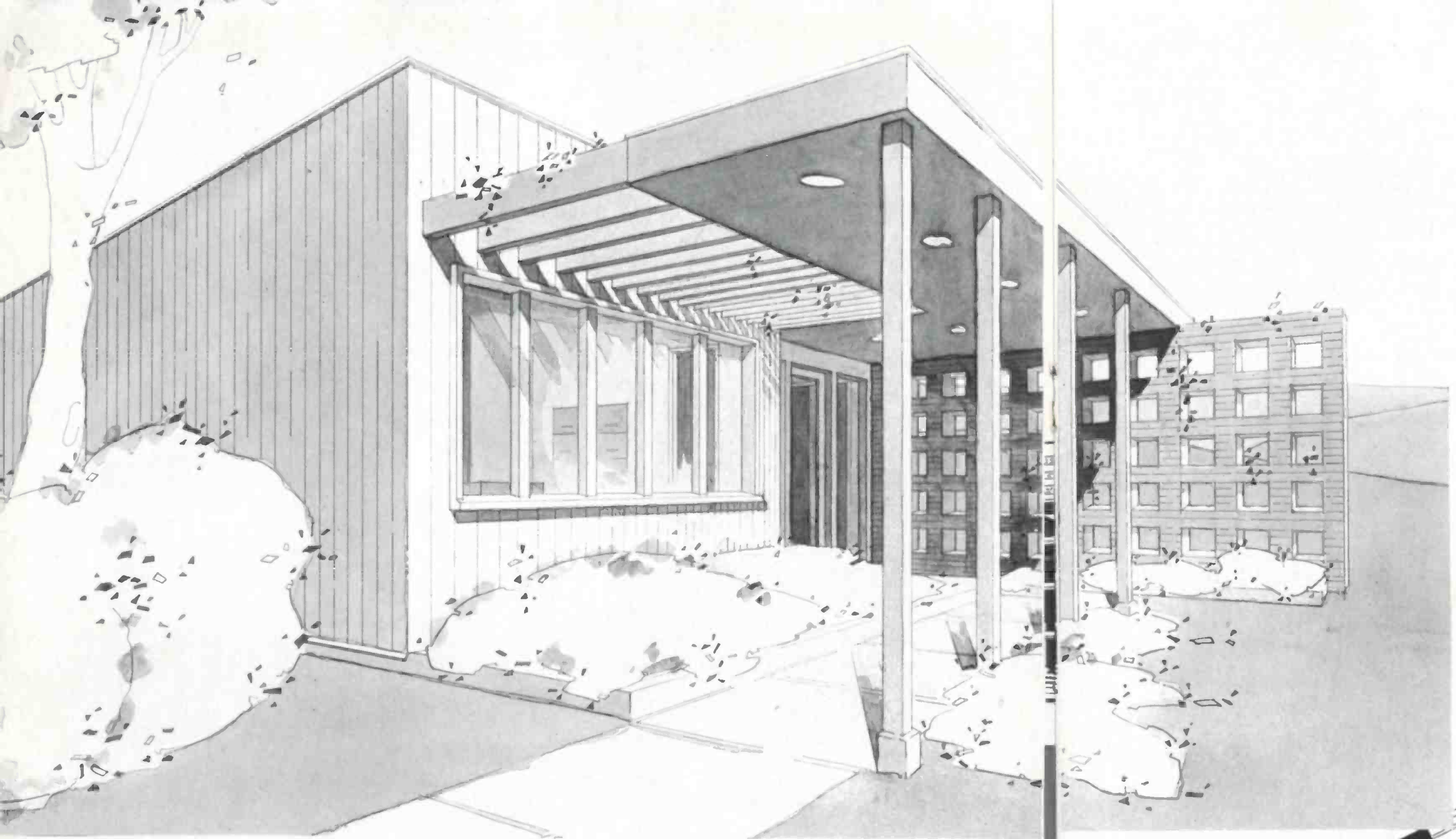
AND PRESENTED TO THE BROADCASTING INDUSTRY BY

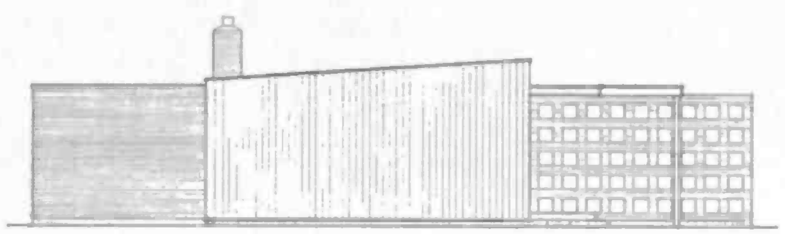
Western Electric

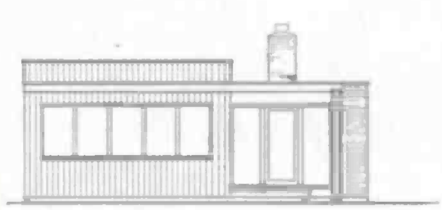
250 WATT AM



This modern building of wood and brick is shown with floor plans, elevations, construction details on next two pages. Perspective drawing at right shows roof plan and handling of entrance.







PRELIMINARY ELEVATION STUDIES

SUGGESTED FACILITIES FOR EQUIPMENT WIRING

250 WATT AM

FEATURES

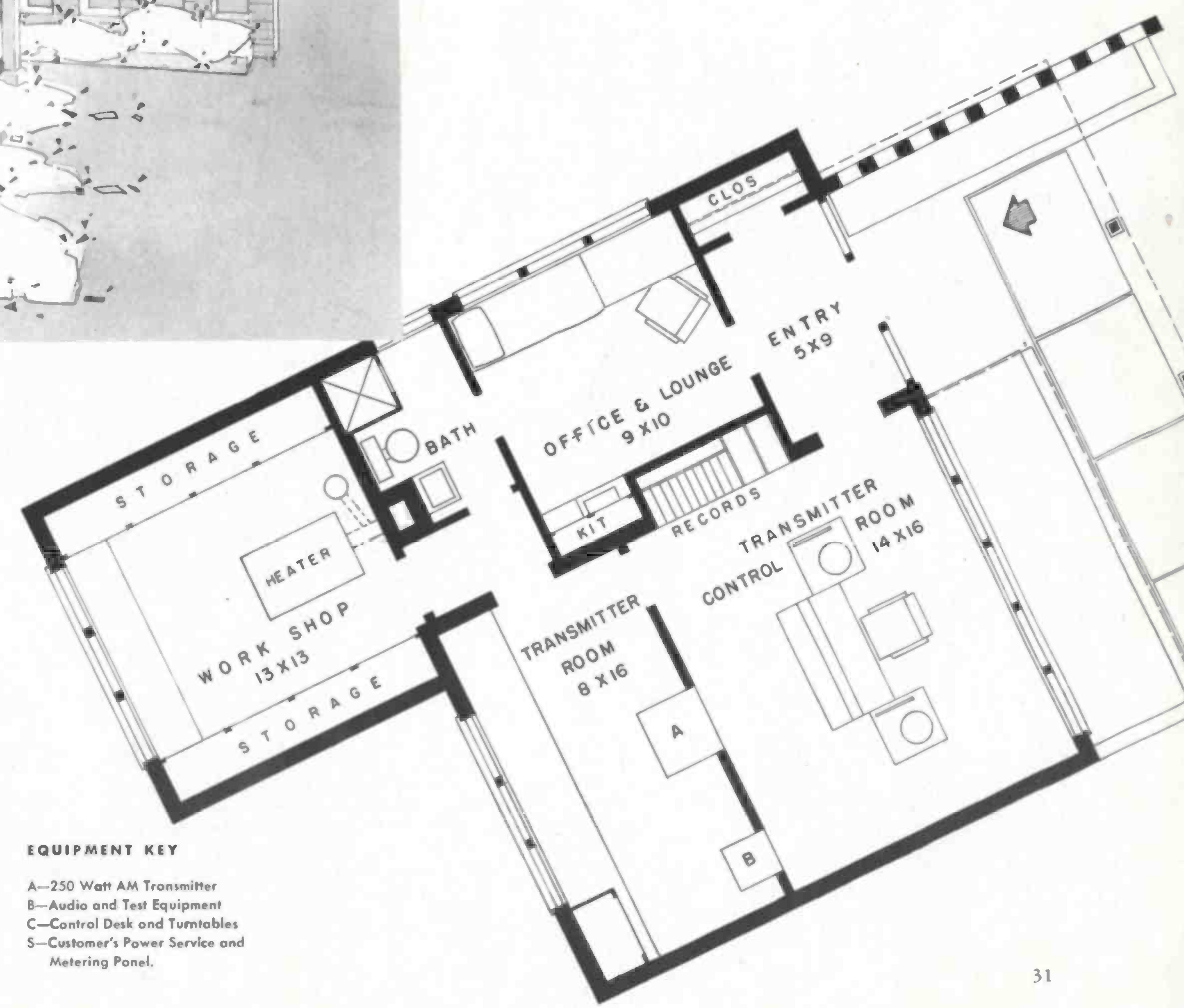
This plan provides for efficient operation of a small transmitter in compact space. Filing cabinets and transcription storage built into control room wall. Unit kitchen and desk in lounge, which also has bed for overnight emergencies.

CONSTRUCTION OUTLINE

FLOOR—Concrete slab. Crawl space under transmitter and control rooms. WALLS—Exterior, partly stud, partly 8" brick, with exterior finish vertical redwood siding. Interior acoustically treated in Control Room, other spaces plaster or plywood. All exterior masonry walls are furred. ROOF—Frame construction; built-up tar and gravel over wood deck. WINDOWS—Wood casements and fixed glass. HEATING—Radiant heating in floor slab.

TRANSMITTER

Western Electric 451A-1, 250 Watt AM. For dimensions and other data see page 62.



EQUIPMENT KEY

A—250 Watt AM Transmitter
B—Audio and Test Equipment
C—Control Desk and Turntables
S—Customer's Power Service and Metering Panel.

250 W FM

LOCATION

This plan utilizes space in existing office or hotel building. Room sizes will vary from building to building. Dimensions listed are average for structures of this type.

FEATURES

Storage space and work shop are adjacent to transmitter room, but separated from it. Additional built-in storage for papers, etc., is provided in lounge. Unit kitchenette in lounge is optional—will be particularly valuable if all-night programming is contemplated.

CONSTRUCTION OUTLINE

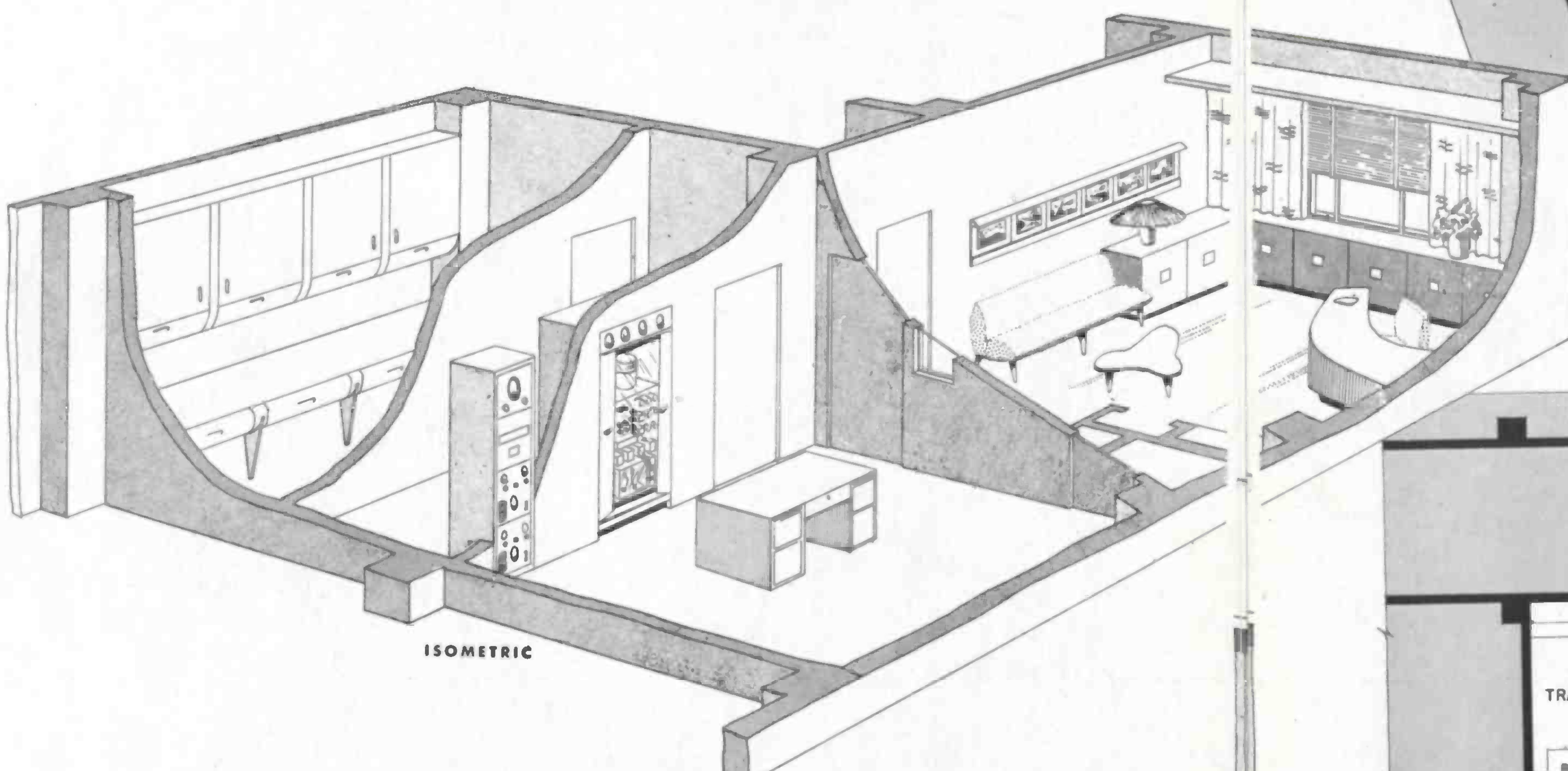
FLOOR—Usually concrete. Finished with linoleum or rubber. WALLS—Interior partitions are usually concrete block or tile, plastered. Control room walls and ceiling are acoustically treated. TRIM—Flush steel trim. HEATING AND AIR CONDITIONING—As furnished by building.

TRANSMITTER

Western Electric 501C-2, 250 watt FM. For dimensions and other data, see page 63.

ALTERNATE FLOOR PLAN

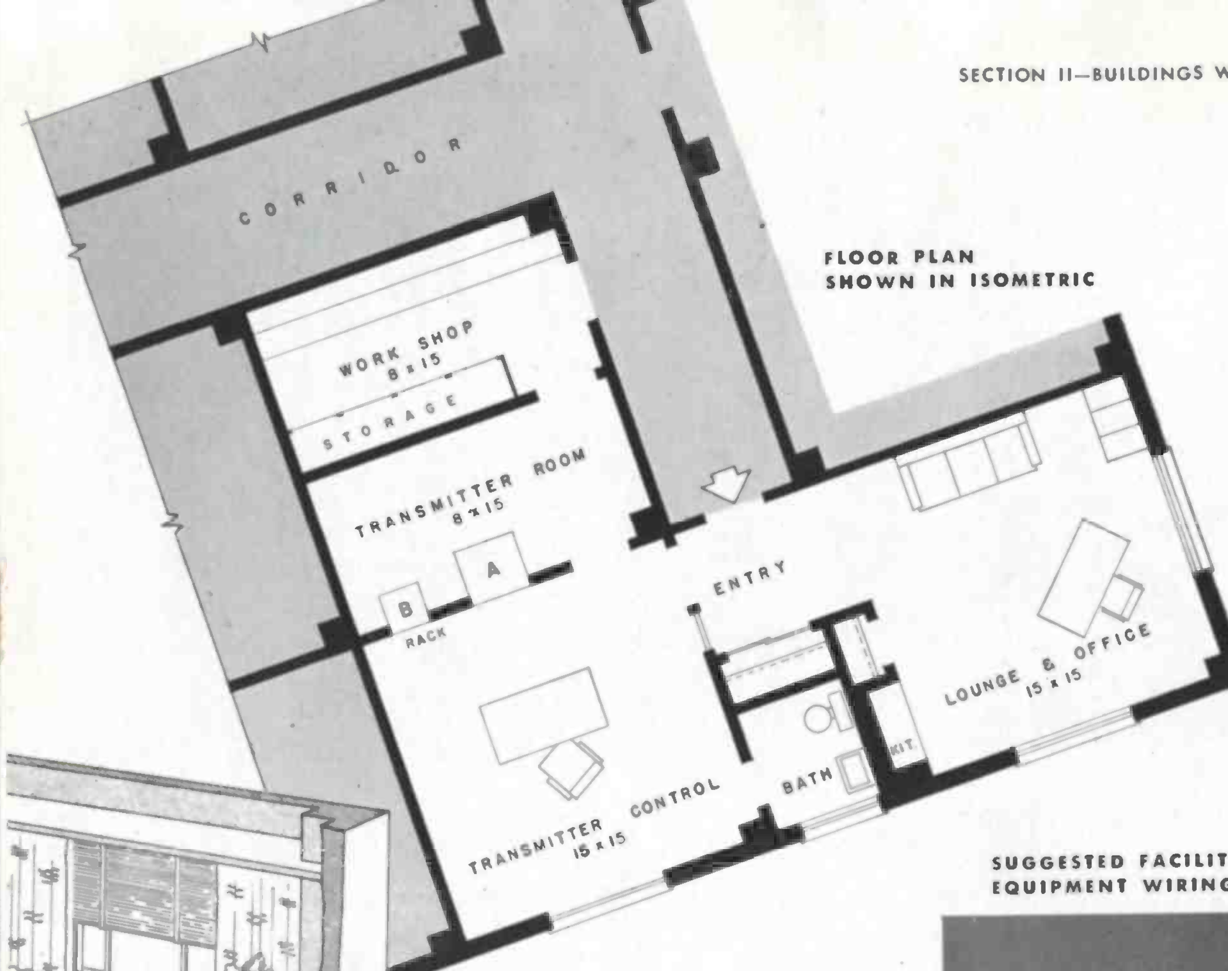
Provides studio for live broadcasts, in addition to facilities included in other plan. Also provides spacious entry and viewing lobby, with viewing windows into control room and studio. Control room controls both transmitter room and studio.



ISOMETRIC

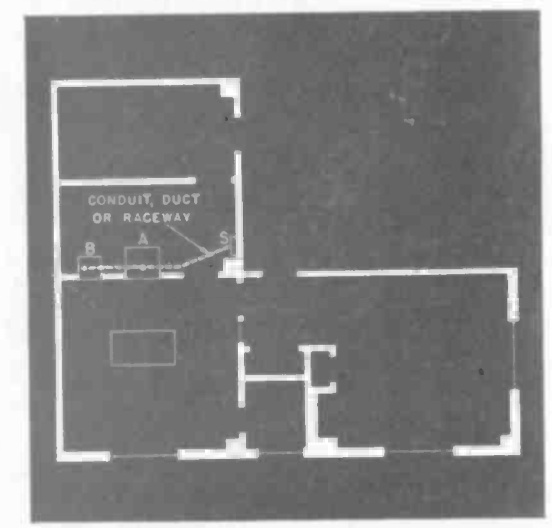
The arrangement shown above includes transmission facilities only, located on an upper floor of the building. Studios and transcription turntables can be located in adjacent rooms or on a lower floor of the building.

The alternate floor plan at right fills approximately the same building space, but is rearranged to include minimum studio requirements for a 250 watt FM station. Transmitter room and shop have been combined and the control room has been made smaller to provide studio space. Small room opening off the office may be used as wash room.



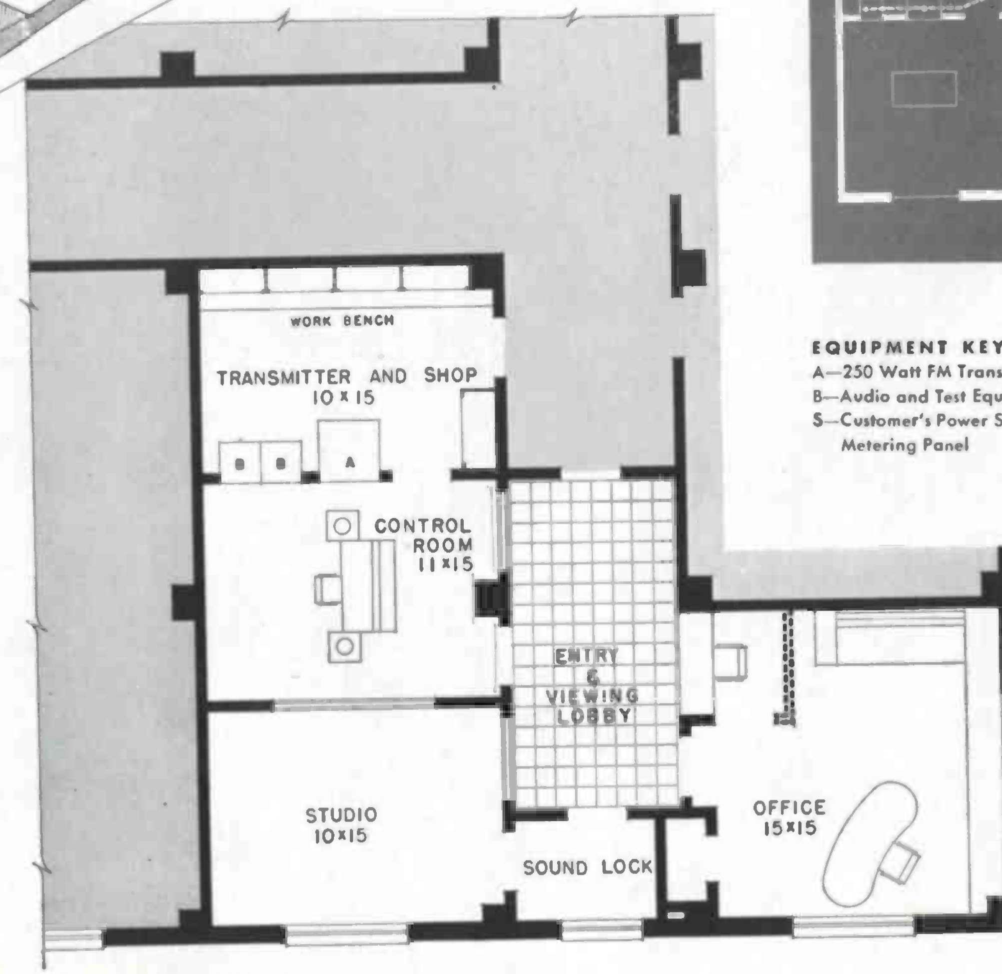
FLOOR PLAN SHOWN IN ISOMETRIC

SUGGESTED FACILITIES FOR EQUIPMENT WIRING



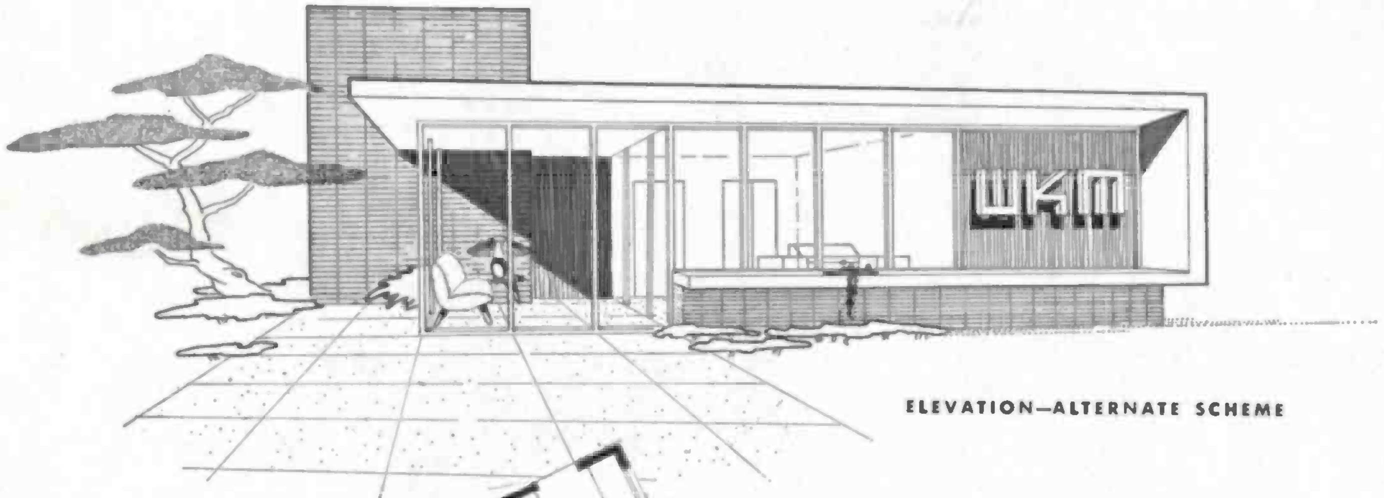
EQUIPMENT KEY

A—250 Watt FM Transmitter
B—Audio and Test Equipment
S—Customer's Power Service and Metering Panel

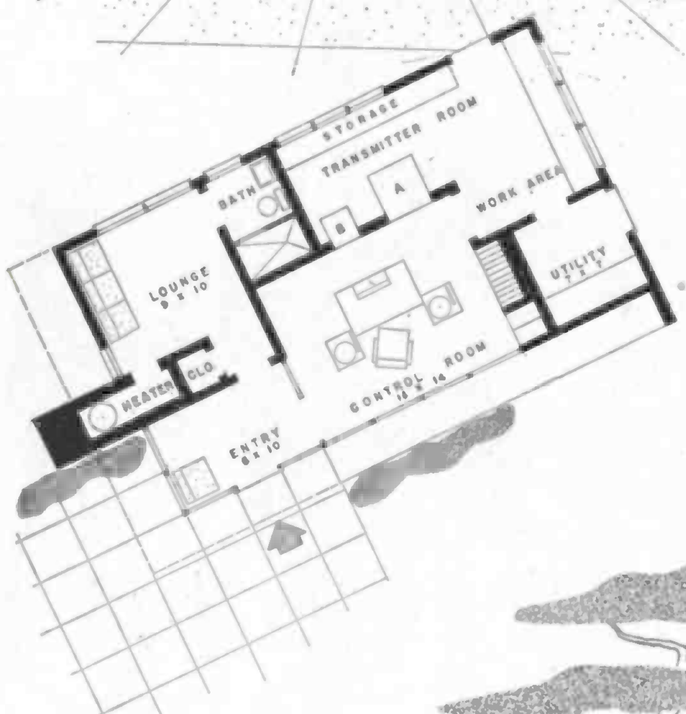


ALTERNATE FLOOR PLAN

1 KW AM



ELEVATION—ALTERNATE SCHEME

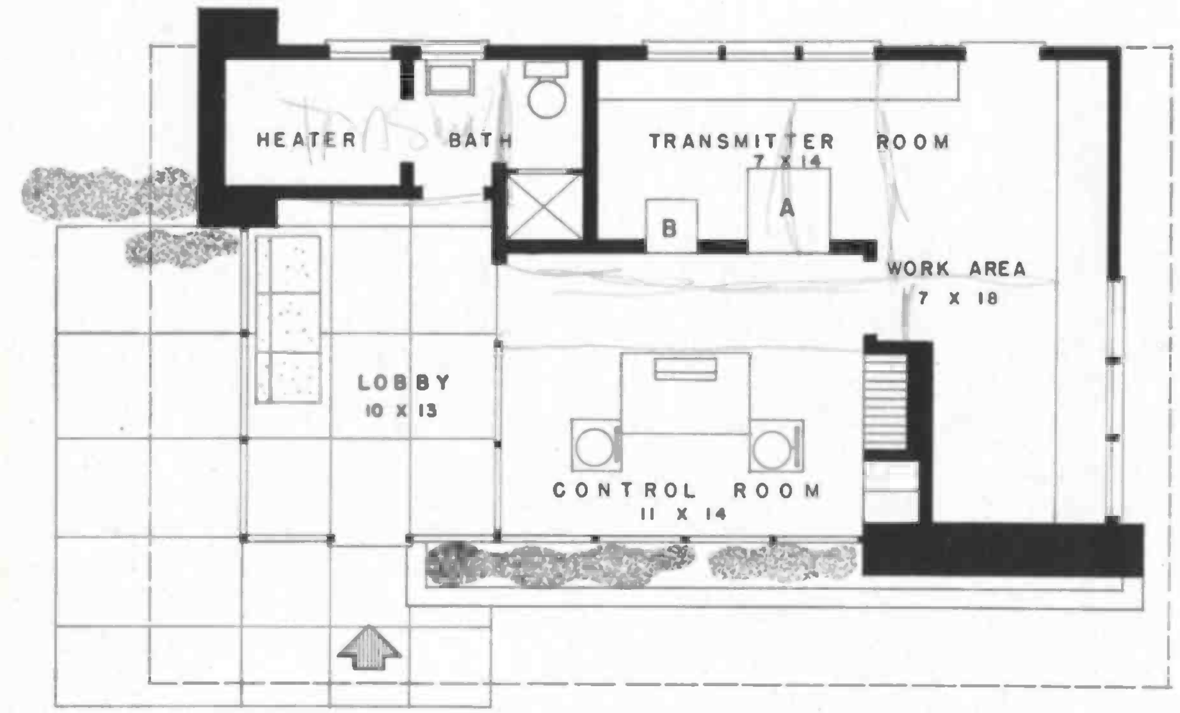


FLOOR PLAN
ALTERNATE SCHEME

ALTERNATE SCHEME

Provides most of the features shown in the floor plan at the right and the perspective drawing below, but adds a small lounge which can be used as sleeping quarters when necessary.

Construction and materials are the same, except for the following: WALLS—Exterior walls are partly stud, partly 8" brick. Outer surfaces of exterior stud walls are waterproof plywood, the joints covered with wood battens. Exterior masonry walls are furred.



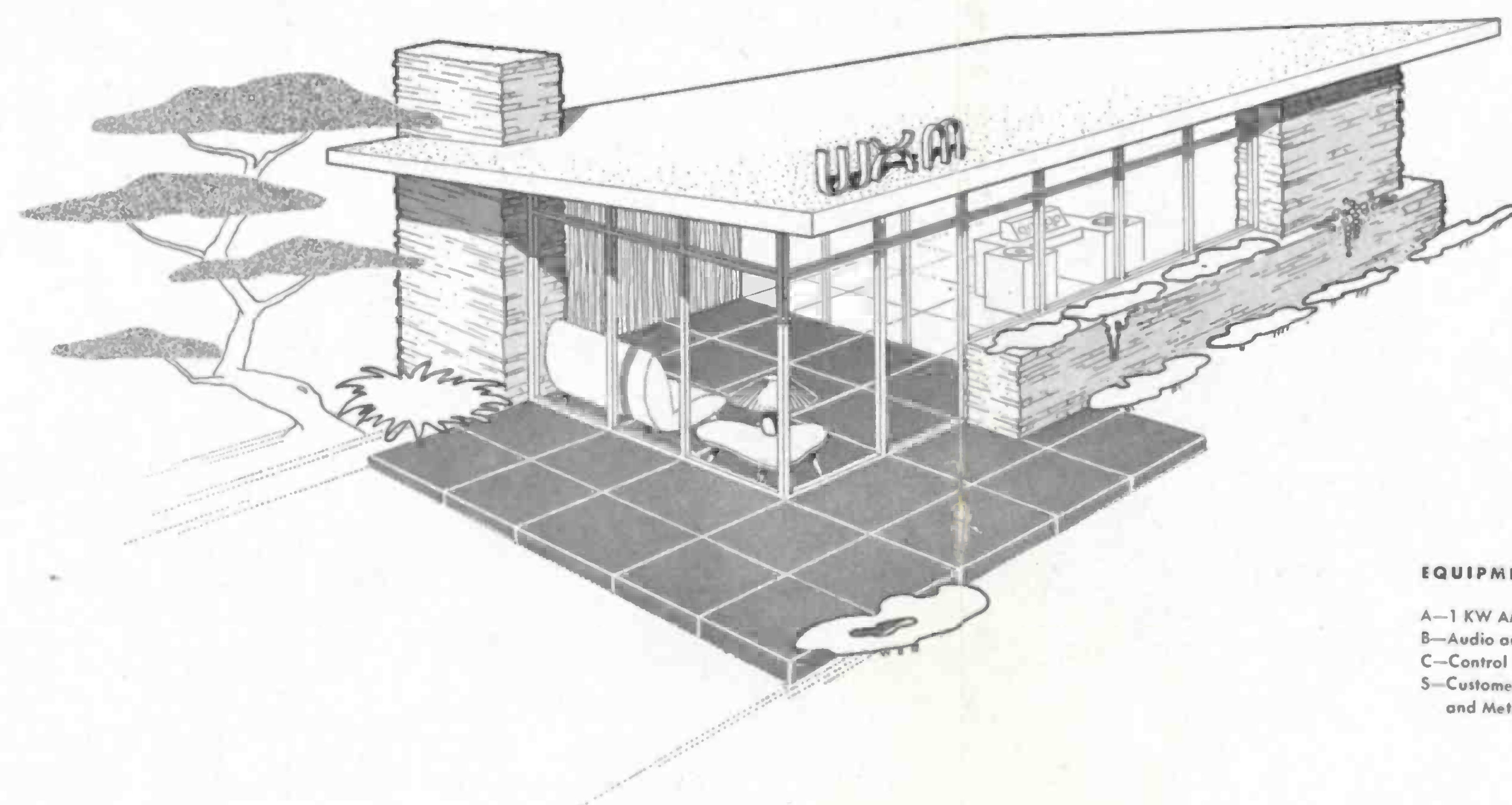
EQUIPMENT KEY: A—1 KW AM Transmitter B—Audio and Test Equipment

FEATURES

Compact plan provides minimal recommended facilities. Transmitter room and work shop are combined. Filing cabinets and transcription storage are built into wall of control room. Glass walls between lobby and control room permit viewing by visitors. Large windows provide uninterrupted view of transmitter and control room from outside the building.

CONSTRUCTION OUTLINE

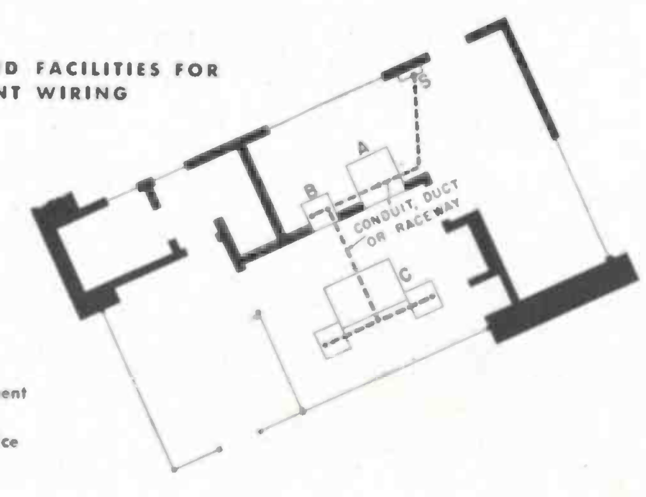
FLOOR—Concrete slab, finished with asphalt tile or rubber. WALLS—Exterior walls are partly stone, partly stud covered with redwood siding. Interior walls and ceiling of control room are acoustically treated; other interior wall surfaces are plastered or covered with plywood, except that stone walls are left exposed. ROOF—Frame construction; built-up tar and gravel roofing over wood deck. WINDOWS—Wood casement and fixed glass. In colder climates Thermopane will minimize heat loss through large glass areas. HEATING—Radiant heat in floor slab. AIR CONDITIONING—Cooling system for control room and lobby.



TRANSMITTER

Western Electric 443A-1, 1KW AM. For dimensions and other data, see page 62.

SUGGESTED FACILITIES FOR EQUIPMENT WIRING



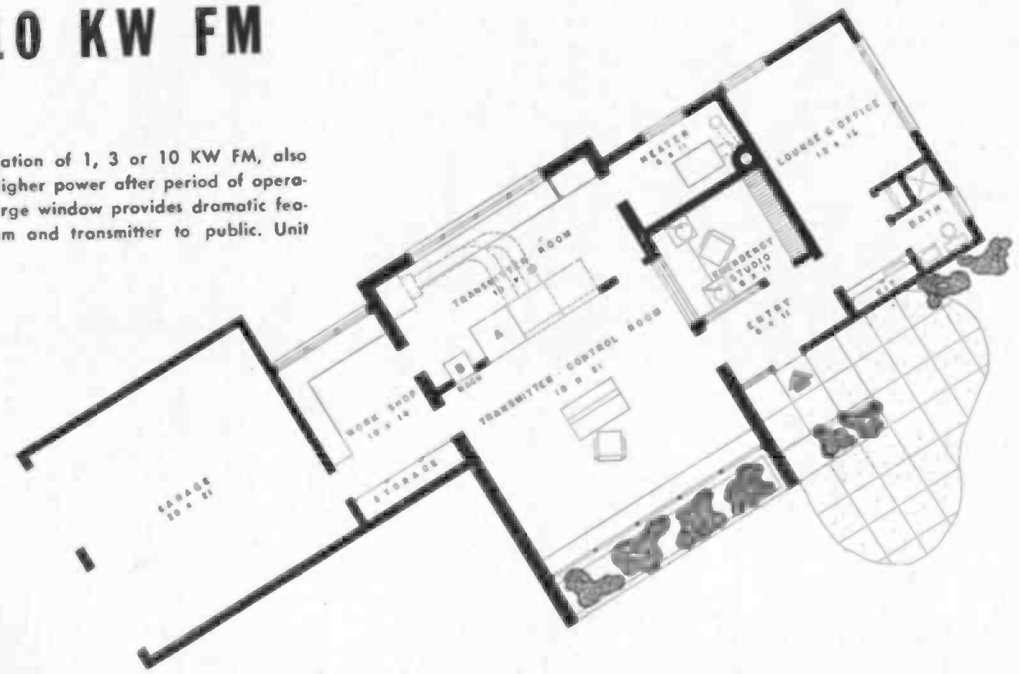
EQUIPMENT KEY

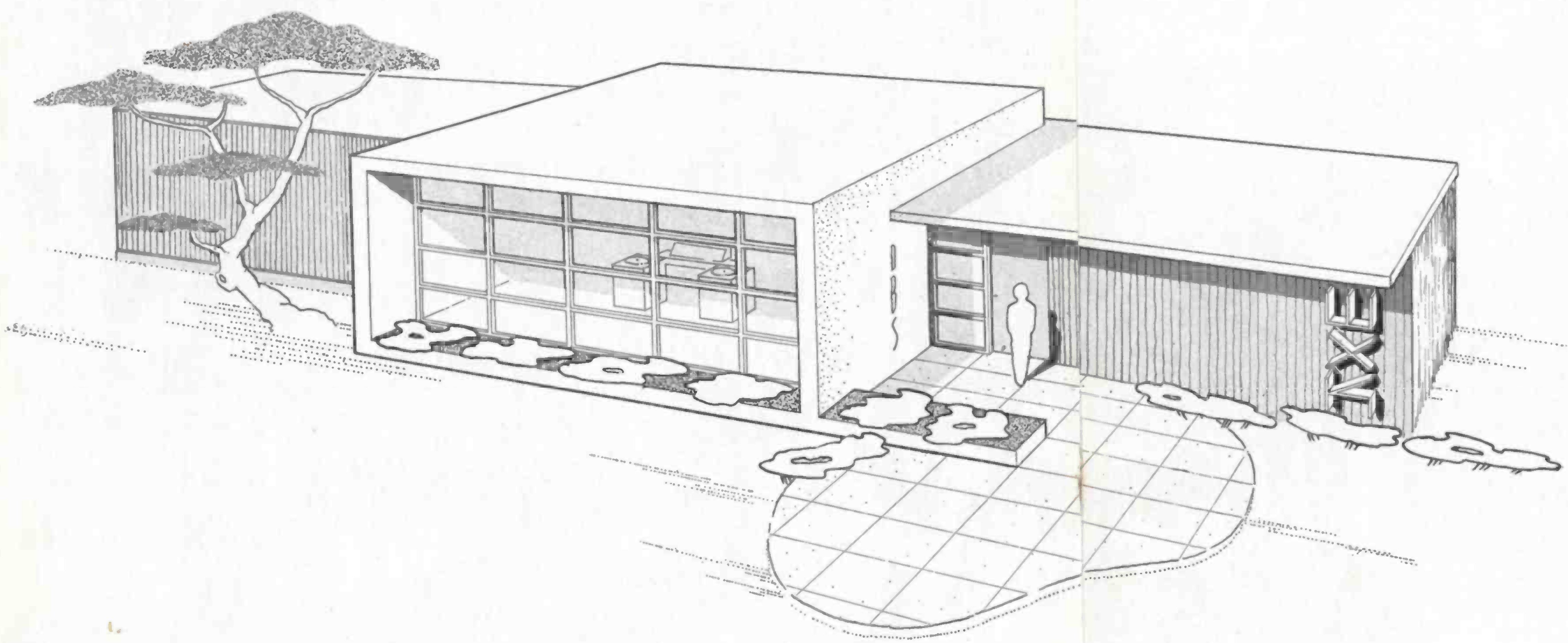
A—1 KW AM Transmitter
B—Audio and Test Equipment
C—Control Desk
S—Customer's Power Service and Metering Panel

1, 3 OR 10 KW FM

FEATURES

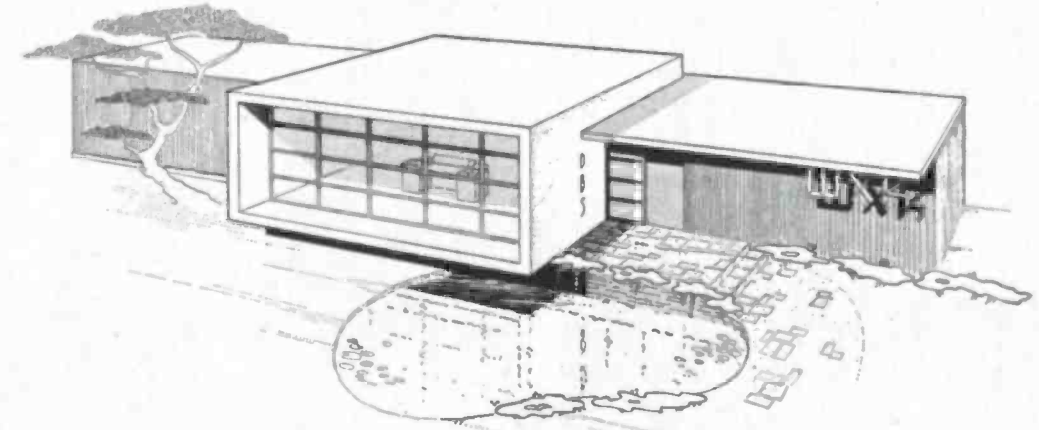
Building for permanent installation of 1, 3 or 10 KW FM, also allows for easy expansion to higher power after period of operation with 1 KW transmitter. Large window provides dramatic feature and displays control room and transmitter to public. Unit kitchen is included in lounge.

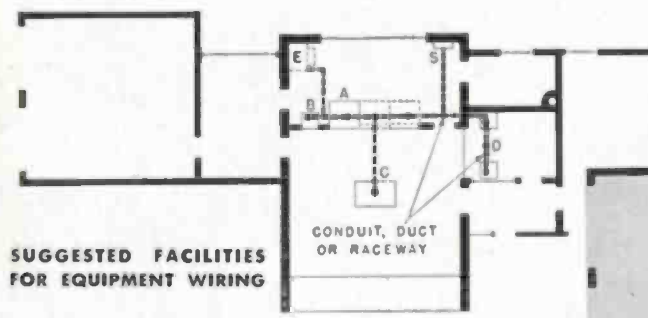




EQUIPMENT KEY

A—1 KW FM Transmitter (Units added to 1 KW to make 3 KW or 10 KW are shown with dotted line)
B—Audio and Test Equipment
C—Operator's Desk
D—Speech Input Console and Turntables
E—Electrostatic Precipitator. (10 KW only)
S—Customer's Power Service and Metering Panel

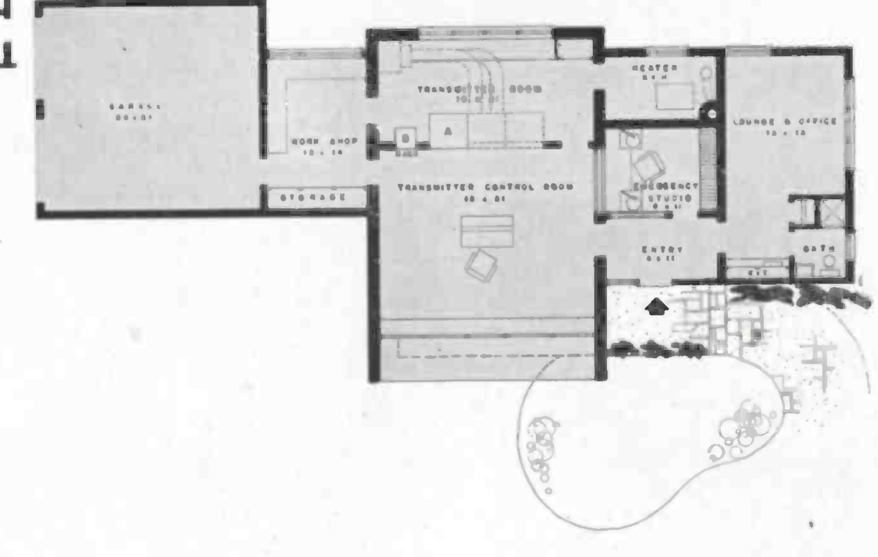




SUGGESTED FACILITIES FOR EQUIPMENT WIRING

ALTERNATE SCHEME

Perspective above and floor plan below show alternate arrangement with central part cantilevered over decorative pool at building entry.



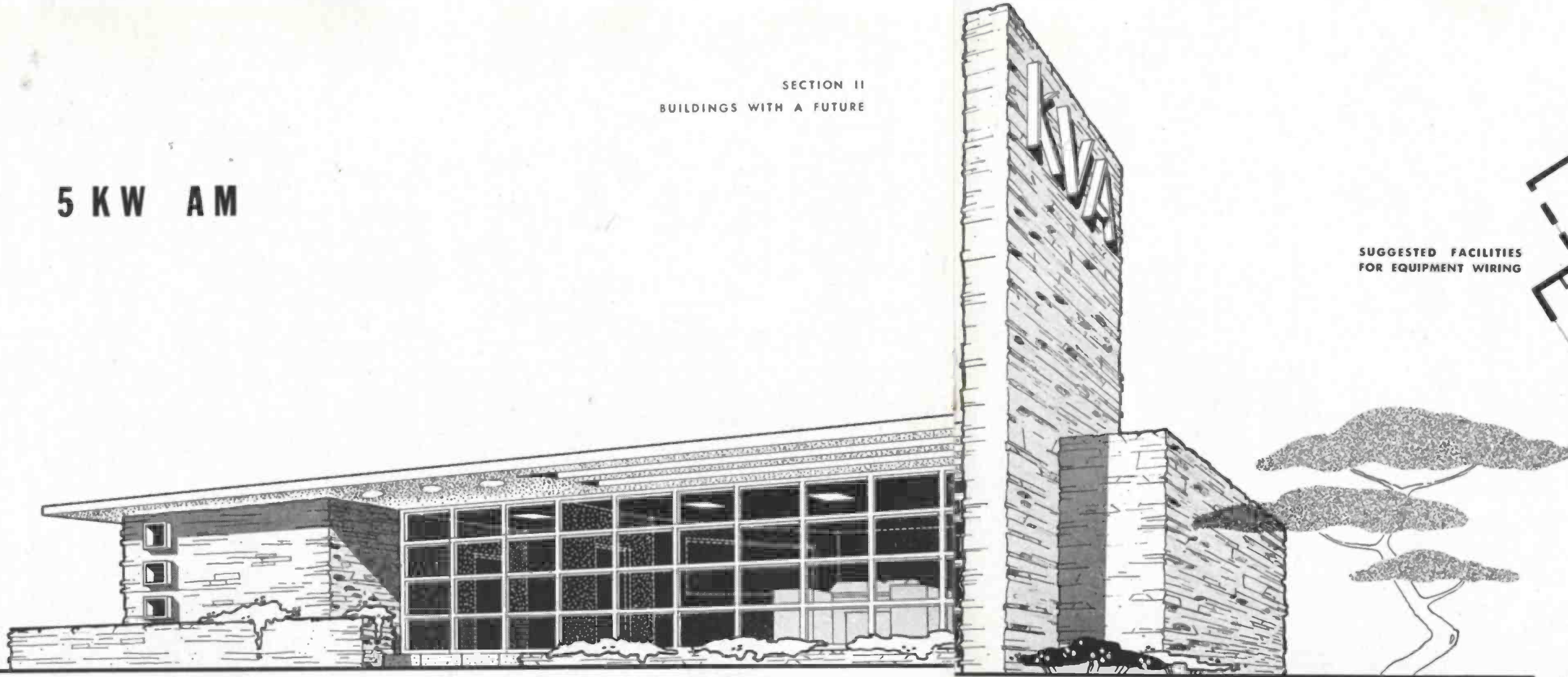
CONSTRUCTION OUTLINE

FLOOR—Concrete slab, with asphalt tile, linoleum or rubber. WALLS—Exterior, central part of reinforced concrete or concrete block faced with stucco. Exterior of wings, frame covered with vertical redwood siding. Interior partitions are stud. Control room and studio acoustically treated. Other walls plastered or finished in plywood. ROOF—Central part concrete, wings of frame construction. Roofing built-up tar and gravel. WINDOWS—Fixed sash in control room. Wood casements elsewhere. HEATING—Radiant heating in floor. AIR CONDITIONING—Cooling system for control room and studio.

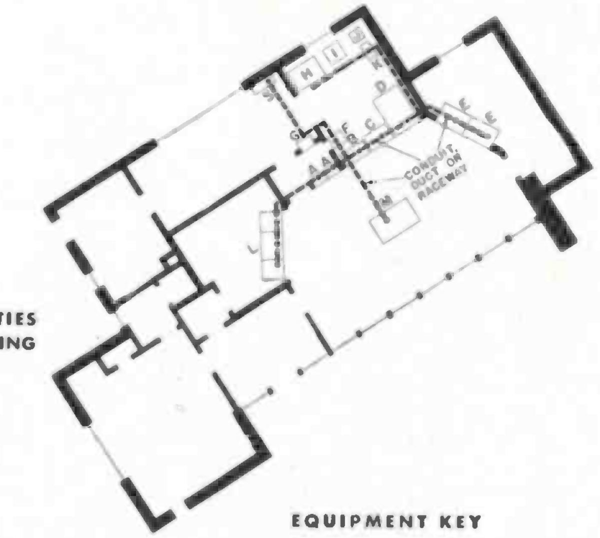
TRANSMITTER

Western Electric 503B-2, 1 KW; 504B-2, 3 KW; or 506B-2, 10 KW FM. For dimensions and other data, see pages 63 and 65.

5 KW AM



SUGGESTED FACILITIES FOR EQUIPMENT WIRING



EQUIPMENT KEY

A—Audio and Test Equipment
B—Control Unit
C—Oscillator Amplifier
D—Power Amplifier
E—Antenna Control Equipment
F—Automatic Voltage Regulator
G—Power Distribution Cabinet
H—Rectifier
I—High Voltage Transformer
J—Retardation Coil
K—Filter Condenser
L—Speech Input Console and Turntables
M—Control Desk
S—Customer's Power Service and Metering Panel

FEATURES

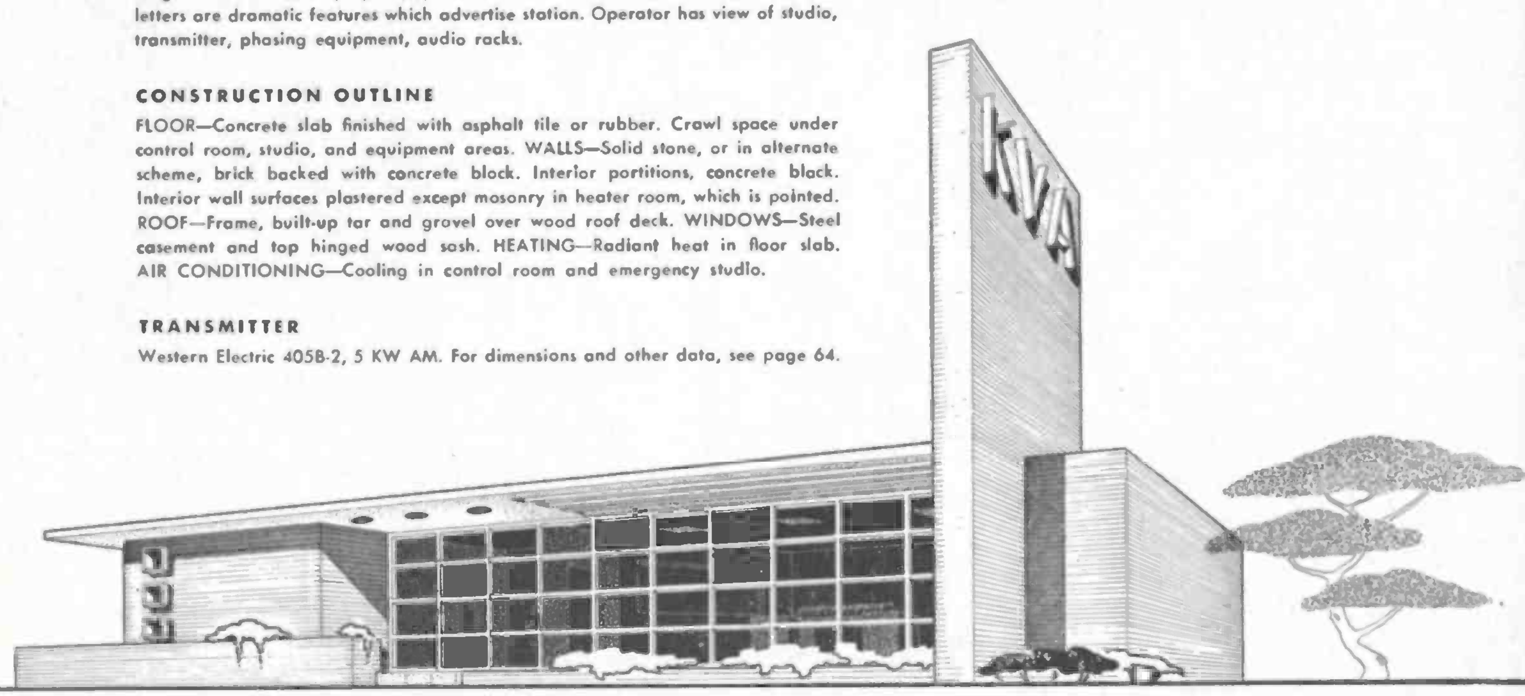
Large window area displays equipment in control room to public. Pylon and call letters are dramatic features which advertise station. Operator has view of studio, transmitter, phasing equipment, audio racks.

CONSTRUCTION OUTLINE

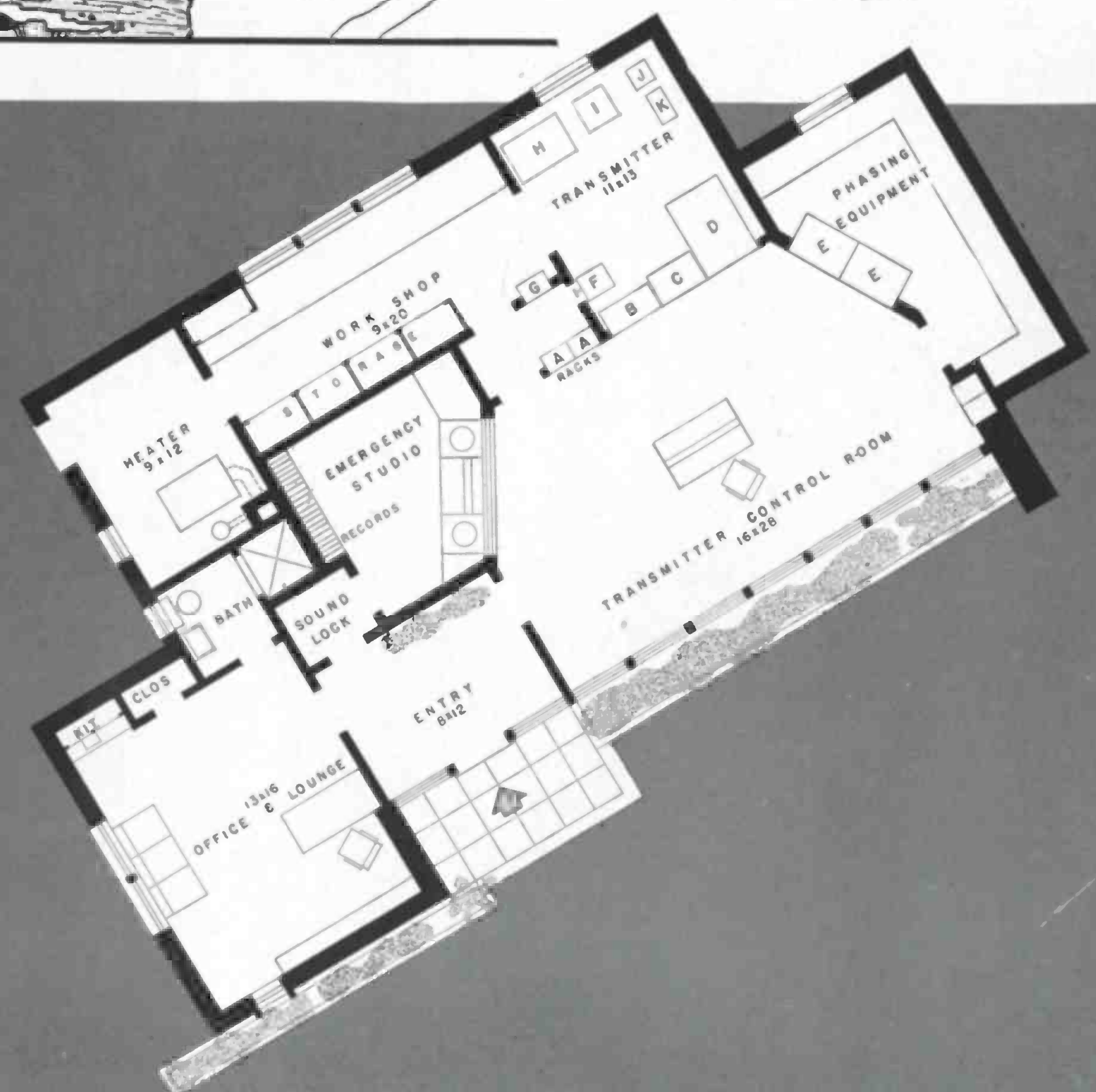
FLOOR—Concrete slab finished with asphalt tile or rubber. Crawl space under control room, studio, and equipment areas. WALLS—Solid stone, or in alternate scheme, brick backed with concrete block. Interior partitions, concrete block. Interior wall surfaces plastered except masonry in heater room, which is pointed. ROOF—Frame, built-up tar and gravel over wood roof deck. WINDOWS—Steel casement and top hinged wood sash. HEATING—Radiant heat in floor slab. AIR CONDITIONING—Cooling in control room and emergency studio.

TRANSMITTER

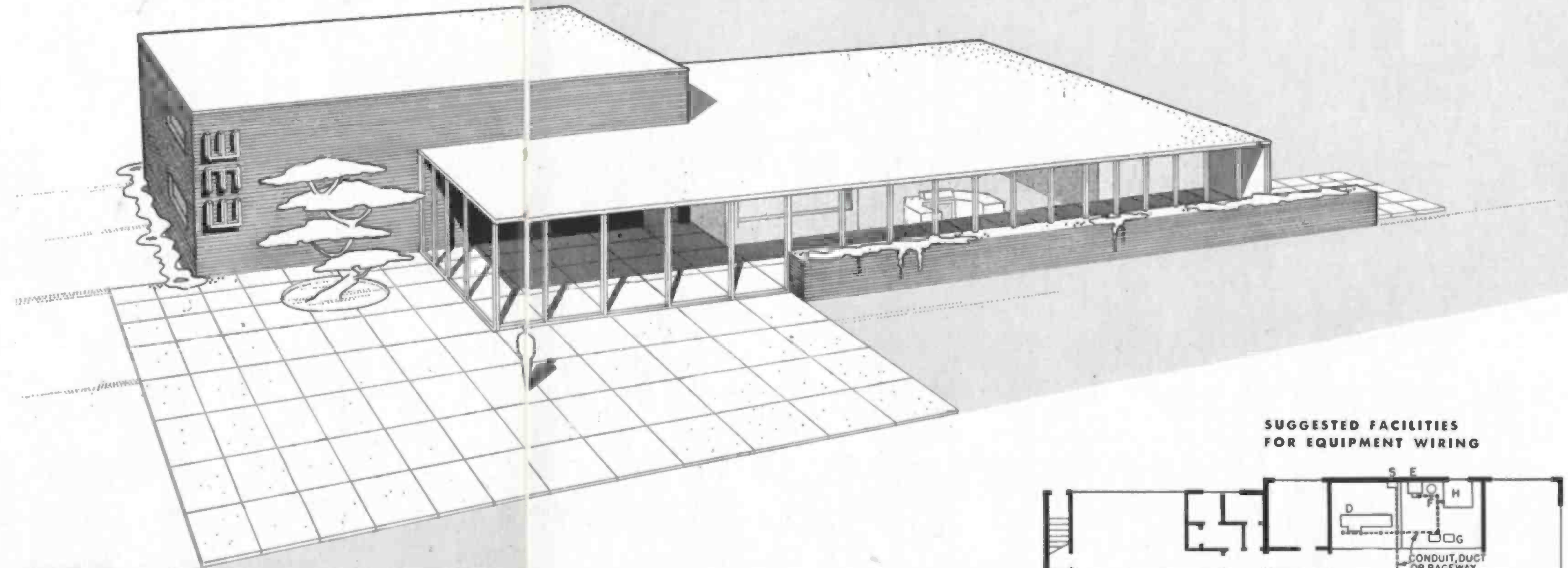
Western Electric 405B-2, 5 KW AM. For dimensions and other data, see page 64.



ALTERNATE CONSTRUCTION—This alternate method uses brick backed up with concrete block for outer walls.



50 KW FM



FEATURES

Continuous flow of glass area in lobby and gallery invites inspection of transmitter facilities and equipment by visitors. Employees' lounge on first floor and engineer's living quarters on second floor of main building overlook a private garden area.

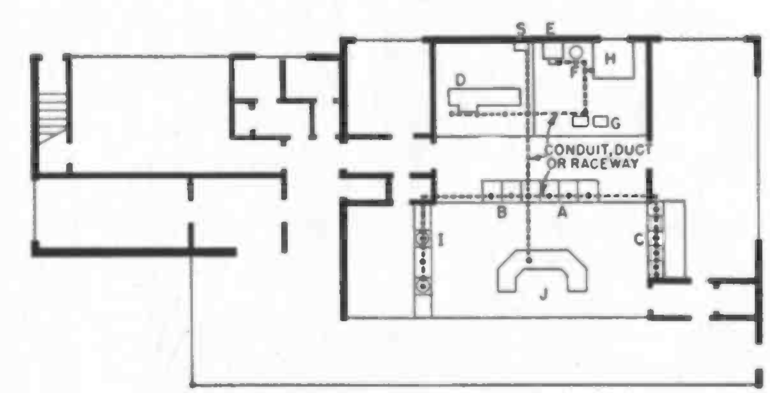
CONSTRUCTION OUTLINE

FLOORS—Concrete slab, finished with asphalt tile, linoleum, or rubber. Polished concrete grid forming exterior terrace continuous into lobby and gallery. WALLS—Exterior walls of tan-finished brick veneer backed up with cinder block. Interior partitions are of stud construction. Walls of control room and emergency studio are acoustically treated. Other walls plastered or finished with plywood. ROOFS—Standard built-up tar and gravel. WINDOWS—Fixed sash in control room, operable steel casements elsewhere. HEATING—Radiant heating in floor slabs. AIR CONDITIONING—Cooling system for control room and emergency studio.

TRANSMITTER

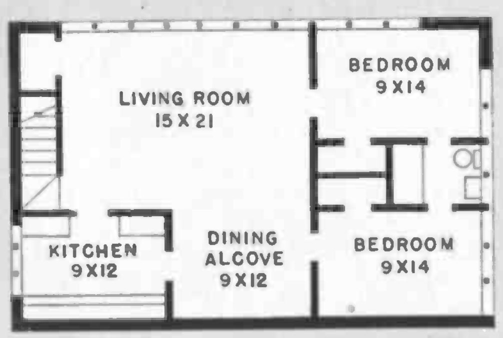
Western Electric 507B-2, 50 KW FM.

SUGGESTED FACILITIES FOR EQUIPMENT WIRING

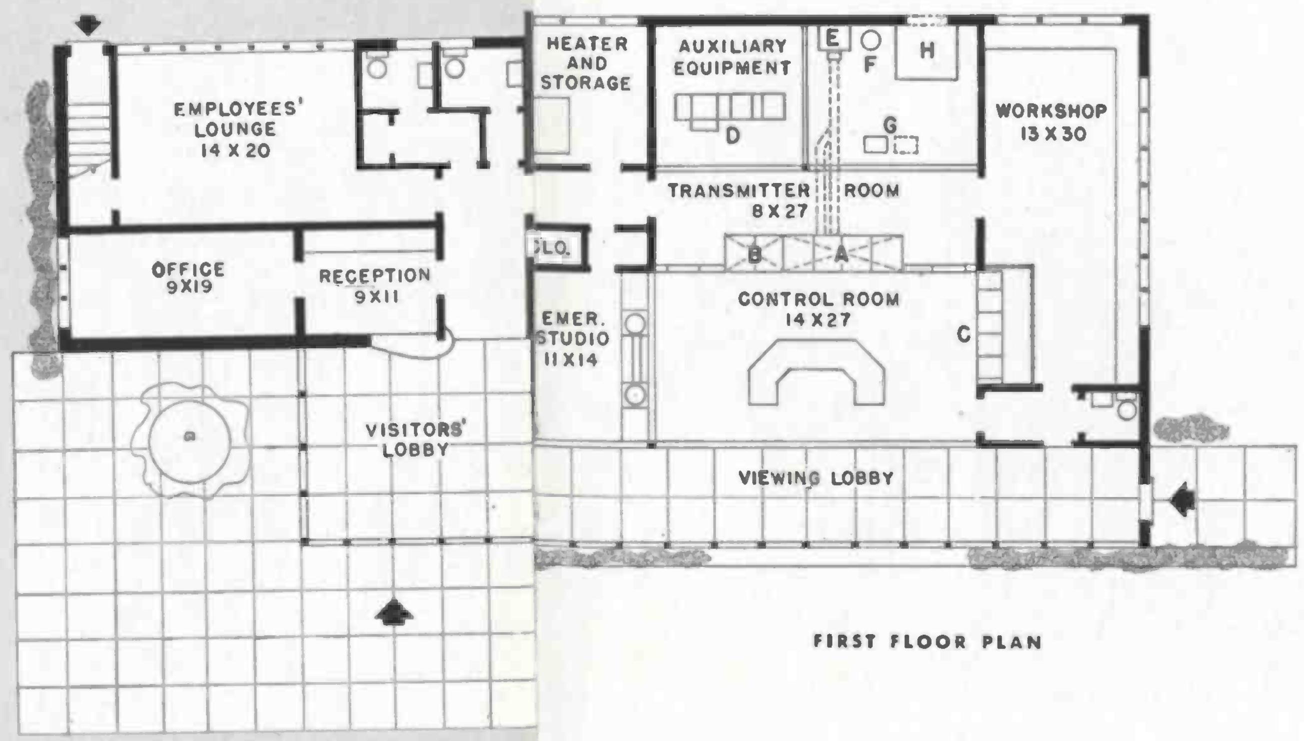


EQUIPMENT KEY

A—50 KW FM Transmitter
B—Standby FM Transmitter
C—Audio and Test Equipment
D—Rectifier
E—Electrostatic Precipitator
F—Water Tank
G—Water Pumps, Main and Standby
H—Blower
I—Audio Console and Turntables
J—Control Desk
S—Customer's Power Service and Metering Panel



SECOND FLOOR PLAN



FIRST FLOOR PLAN

SECTION III

A Survey Study of Six Hundred Ten Broadcast Transmitter Buildings

This is a report on the American broadcast transmitter building—and on the hard-won wisdom of the men who own, manage and operate it. Six hundred such men throughout the industry laid the foundation for this report by answering a detailed questionnaire sent out to discover the characteristics of transmitter buildings for every power rating—how big they are, what they cost, what technical functions and operating conveniences they embody.

The statistical picture of the American transmitter building which these six hundred questionnaires contain has been painstakingly developed by tabulation, recapitulation and analysis, and is presented in the table on pages 44 and 45 of this guide. From the figures shown, it is possible for the first time to generalize about the character of the transmitter building which has developed after two-and-a-half decades of broadcasting in America.

It is evident, for instance, that:

The American transmitter building is most often a single story structure of brick or concrete, in a style which its owners regard as "modern;"

It was built almost entirely between 1935 and the present, with certain classes—in particular the FM stations—built heavily in 1946 and 1947;

The use of combined studio-transmitter installations is concentrated strongly in the 250 watt stations, of which about half are of this type;

Waste transmitter heat is used to heat building areas in a substantial majority of the buildings covered in the Survey.

These facts and many others are shown in complete detail in the table on pages 44 and 45, which indicates not only the size, cost and type of construction for buildings of each class, but also the building units and rooms, subsidiary to the actual operating areas, which are included in the transmitter buildings covered.

The six hundred station owners, managers, and operators who participated in the Survey have done more than give the dimensions, cost and construction of the buildings they use. They were invited to tell what they *did* and *did not* like about their buildings after the experience of living with them, and they plainly jumped at the chance.

"Inadequate storage space" is the complaint made most often. "I would say that there should be at least twice as much space for storage," is the report from a 250 watter, with 100 square feet of storage space. "We find the amount of storage space we have not nearly sufficient: we think at least 250 to 300 square feet should be provided," comes from a 5 kw AM installation. One particular type of storage mentioned several times was that for a record and transcription library, in a location making recorded program material easy and efficient to use.

Other building facilities of uppermost interest to managers and chief engineers are, in approximately the order named: workshop, shower room, garage, kitchenette, employees' lounge, and living quarters. If the building lacks any of these facilities that lack is apt to be noted; if it has them, satisfaction is generally expressed with the convenience and efficiency of such features.

"We really should have the following features to make our building satisfactory from an operator's standpoint: attached garage, shower room, kitchen and sleeping quarters, extra storage space"—this from a 1 kw AM station.

A 250 watt station with two complete apartments, one at each side of the transmitter and control room, comments: "This duplex arrangement with transmitter between has certainly been a good bet in the last few years."

Among the more graphic warnings noted is one from an FM station on a mountain top: "If we had known about the terrific wind and rainstorms on this mountain, we would have given greater consideration to weatherproofing. The rain drives across the mountain horizontally and went right through the walls, until our special weartherproofing was completed." Another warning based on bitter experience comes in these words from a 250 watt station: "Also fence entire area to prevent trespassing and disturbance of ground system, namely, unlawful removal of same."

A number of the technical features and building services that stand out as winning more or less general acceptance are: air conditioning for the building; high-capacity exhaust fans to move hot air out of the transmitter room; electrostatic precipitators for cleaning the air; emergency power sources; emergency studios.

"Would incorporate in a new building" writes a 5 kw AM from Florida, "a solar water heating system, automatic emergency power supply on a separate concrete base to eliminate vibration, and residence for chief engineer."

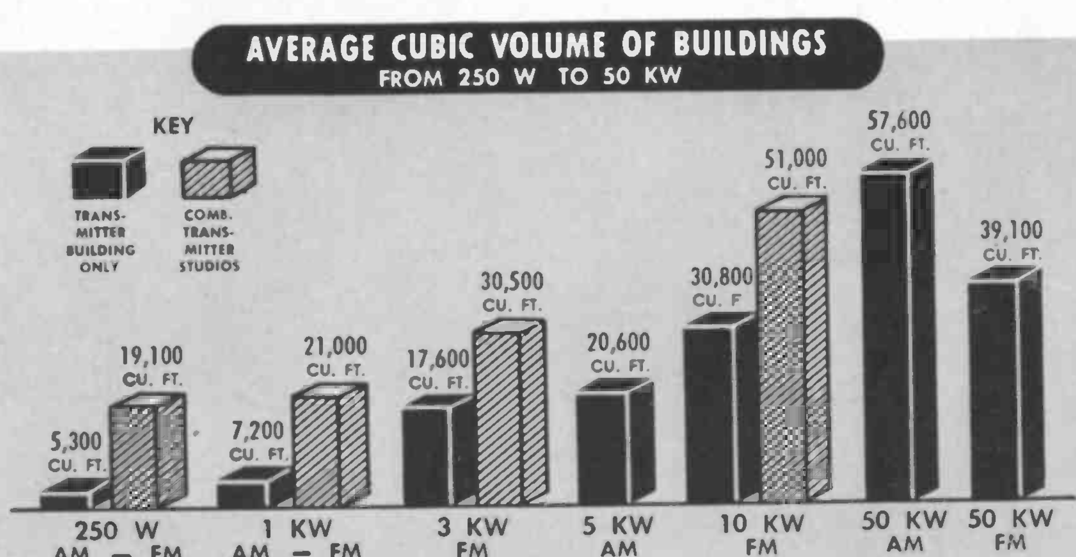
A number of stations comment on the importance of having duct or raceways in the floor to facilitate interunit wiring, a matter discussed in detail on page 22 of this guide.

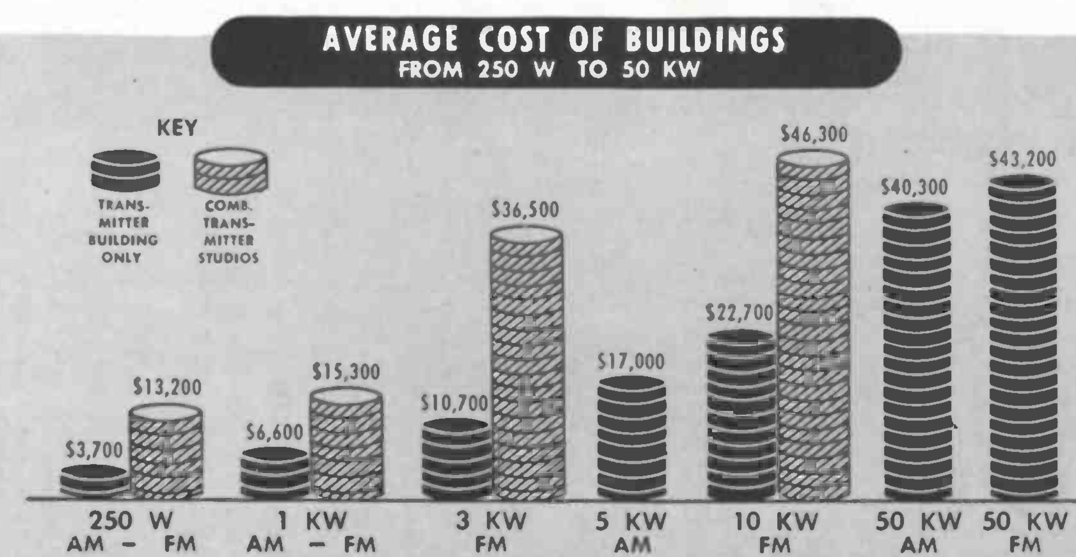
"The most valuable idea incorporated in the construction of our building is the wiring through the floor, which makes it easy to repair wiring, and the addition or rearrangement of equipment is easily done," comes from a 1 kw AM.

Other technical and architectural features, mentioned as definitely proving themselves in use, include: a water screen on the roof to provide insulation; an enclosed entry to keep dirt from getting in the transmitter room when persons enter the building; glazed tile to make a removable control room wall for easy expansion; bonding and grounding of metal lath to make an r-f screen around the building.

The extent to which transmitters are today housed in temporary structures is borne out by the number of times that a description of "our future permanent building" is offered. The wartime construction difficulties forcing so many stations into emergency quarters, and the continuing expansion of the industry, make it certain that transmitter buildings are going to be erected in enormous volume in the next few years.

Regarding the cost figures shown in the charts below and on the table, it should be remembered that the average cost for buildings and the cost per cubic foot cover the whole period of construction, beginning approximately in 1930, and continuing to the present. With the well known rise in prices of the war and post-war years, this average is naturally lower than prices prevailing at the present time.





Results of the Survey of American Broadcast Transmitter Buildings

ITEMS OF SURVEY	250 WATT AM—FM	1 KW AM—FM	3 KW FM	5 KW AM	10 KW FM	50 KW AM	50 KW FM
1. Location of Transmitter							
(a) In its own building	88%	89%	53%	96%	90%	100%	92%
(b) In office or other building	12%	11%	47%	4%	10%	—	8%
(a) In city	20%	18%	47%	4%	21%	—	7%
(b) Edge of city	68%	48%	20%	35%	51%	6%	50%
(c) Country	12%	34%	33%	61%	28%	94%	43%
(a) Percent having separate transmitter building	49%	86%	74%	96%	79%	100%	100%
(b) Percent having combination studio-transmitter building	51%	14%	26%	4%	21%	—	—
Average distance between transmitter and studios	.9 mile	3.4 miles	5.3 miles	7.7 miles	5.8 miles	13.4 miles	14.5 miles
2. Year Building was Constructed							
(a) 1947	16%	41%	12%	7%	37%	3%	42%
(b) 1946	32%	24%	16%	6%	22%	10%	—
(c) 1940-45	21%	16%	32%	44%	22%	47%	33%
(d) 1935-39	23%	7%	24%*	36%	16%*	23%	17%*
(e) 1930-34	3%	5%	—	4%	3%*	17%	—
(f) Before 1930	5%	7%	16%*	3%	—	—	8%*
3. Type of Architecture							
(a) Contemporary	52%	51%	72%	65%	77%	59%	50%
(b) Traditional	5%	7%	—	15%	15%	13%	8%
(c) Other	43%	42%	28%	20%	8%	28%	42%
4. Type of Construction							
(a) Brick	23%	19%	50%	36%	32%	69%	80%
(b) Wood	40%	21%	4%	6%	7%	6%	—
(c) Concrete	25%	31%	35%	22%	29%	16%	20%
(d) Cinder Block, Prefabricated or other	12%	29%	11%	36%	32%	9%	—
5. Basement, percent of buildings having	26%	26%	53%	51%	35%	56%	43%
6. Total Number of Floors (excluding basement)							
(a) One	86%	92%	75%	85%	73%	60%	46%
(b) Two or more	14%	8%	25%	15%	27%	40%	54%
7. Use waste transmitter heat to heat building areas, percent	47%	50%	67%	71%	70%	65%	83%
8. Landscaping grounds, average cost	$670	$935	$2200	$1400	$1400	$2350	$1700
9. Land for building and towers, average area — acres	6	15.3	24.5	45	24	47.5	45.3
10. Visitors to transmitter building, average number per week	95	88	96	15	30	11	18
11. Auto Parking Area							
(a) Percent having	71%	65%	80%	80%	84%	89%	64%
(b) Average size	5000 sq.ft.	2280 sq.ft.	2500 sq.ft.	3400 sq.ft.	2600 sq.ft.	2880 sq.ft.	1170 sq.ft.
12. Station Call Sign displayed prominently on building, percent	65%	54%	69%	86%	74%	77%	58%
(a) Unilluminated	31%	39%	45%	40%	27%	21%	57%
(b) Incandescent illuminated	23%	24%	15%	20%	18%	29%	29%
(c) Neon illuminated	46%	37%	40%	40%	55%	50%	14%

*Represents FM transmitters installed in buildings originally constructed for AM stations or for other purposes.

	250 WATT AM—FM		1 KW AM—FM		3 KW FM		5 KW AM	10 KW FM		50 KW AM	50 KW FM
	Transmitter Building Only	Comb. Transmitter-Studio Bldg.	Transmitter Building Only	Comb. Transmitter-Studio Bldg.	Transmitter Building Only	Comb. Transmitter-Studio Bldg.	Transmitter Building Only	Transmitter Building Only	Comb. Transmitter-Studio Bldg.	Transmitter Building Only	Transmitter Building Only
13. Average Cubic Volume of Buildings	5300 cu.ft.	19,100 cu.ft.	7200 cu.ft.	21,000 cu.ft.	17,600 cu.ft.	30,500 cu.ft.	20,600 cu.ft.	30,800 cu.ft.	51,000 cu.ft.	57,600 cu.ft.	39,100 cu.ft.
14. Building Facilities											
Office space (a) percent having	26%	86%	25%	78%	35%	63%	44%	39%	100%	78%	71%
(b) average size	260 sq.ft.	540 sq.ft.	227 sq.ft.	1002 sq.ft.	697 sq.ft.	460 sq.ft.	205 sq.ft.	130 sq.ft.	1274 sq.ft.	168 sq.ft.	461 sq.ft.
Studio space (a) percent having	25%	100%	14%	100%	18%	100%	23%	26%	100%	16%	21%
(b) average size	317 sq.ft.	508 sq.ft.	255 sq.ft.	914 sq.ft.	136 sq.ft.	1667 sq.ft.	227 sq.ft.	135 sq.ft.	1000 sq.ft.	135 sq.ft.	555 sq.ft.
Storage space (a) percent having	71%	71%	53%	74%	78%	100%	78%	70%	100%	88%	86%
(b) average size	195 sq.ft.	246 sq.ft.	147 sq.ft.	358 sq.ft.	259 sq.ft.	270 sq.ft.	519 sq.ft.	300 sq.ft.	376 sq.ft.	606 sq.ft.	966 sq.ft.
Workshop (a) percent having	78%	72%	81%	79%	75%	75%	88%	91%	100%	94%	93%
(b) average size	124 sq. ft.	142 sq.ft.	125 sq.ft.	163 sq.ft.	190 sq.ft.	263 sq.ft.	191 sq.ft.	236 sq.ft.	202 sq.ft.	278 sq.ft.	320 sq.ft.
Garage (a) percent having	18%	9%	21%	7%	43%	13%	59%	39%	40%	81%	64%
(b) average size	258 sq.ft.	551 sq.ft.	240 sq.ft.	400 sq.ft.	397 sq.ft.	200 sq.ft.	319 sq.ft.	496 sq.ft.	350 sq.ft.	559 sq.ft.	452 sq.ft.
Sleeping quarters (a) percent having	26%	21%	26%	9%	52%	25%	54%	39%	—	47%	64%
(b) average size	122 sq.ft.	178 sq.ft.	200 sq.ft.	125 sq.ft.	304 sq.ft.	58 sq.ft.	162 sq.ft.	260 sq.ft.	—	403 sq.ft.	194 sq.ft.
Kitchen (a) percent having	11%	15%	26%	22%	52%	33%	54%	52%	20%	81%	57%
(b) average size	79 sq.ft.	128 sq.ft.	65 sq.ft.	101 sq.ft.	116 sq.ft.	58 sq.ft.	102 sq.ft.	73 sq.ft.	240 sq.ft.	146 sq.ft.	74 sq.ft.
Shower Room (a) percent having	33%	23%	30%	13%	48%	38%	64%	78%	—	84%	93%
(b) average size	32 sq.ft.	40 sq.ft.	39 sq.ft.	62 sq.ft.	48 sq.ft.	26 sq.ft.	39 sq.ft.	51 sq.ft.	—	62 sq.ft.	88 sq.ft.
Employees' Lounge (a) percent having	12%	31%	7%	30%	13%	25%	10%	2%	60%	16%	21%
(b) average size	49 sq.ft.	108 sq.ft.	95 sq.ft.	160 sq.ft.	190 sq.ft.	—	109 sq.ft.	208 sq.ft.	332 sq.ft.	380 sq.ft.	121 sq.ft.
Visitors' Lounge (a) percent having	13%	49%	9%	74%	22%	25%	10%	22%	100%	31%	—
(b) average size	153 sq.ft.	257 sq.ft.	99 sq.ft.	360 sq.ft.	188 sq.ft.	—	114 sq.ft.	152 sq.ft.	238 sq.ft.	240 sq.ft.	—
15. Cost of Buildings (excluding land and equipment)	(The figures below cover whole-period of construction going back to 1930 and are thus lower than prices prevailing at the present time.)										
(a) Average cost	$3700	$13,200	$6600	$15,300	$10,700	$36,500	$17,000	$22,700	$46,300	$40,300	$43,200
(b) Average cost per cubic foot	.70	.69	.91	.73	.61	1.12	.82	.74	.91	.70	1.10

SECTION IV

Six Outstanding Buildings of Today

Offices and studios open off the entrance lobby.

250W AM & 3KW FM

KGBS HARLINGEN, TEXAS

COMBINATION TRANSMITTER-STUDIO BUILDING

OWNER—Harbenito Broadcasting Co. GEN'L MGR.—Troy McDaniel. CHIEF ENG.—W. O. Porter. ARCHITECT—Newell Waters. CONTRACTOR—Hugh Ramsey. BUILT—1941. BASEMENT—No. NO. FLOORS—1.

FEATURES

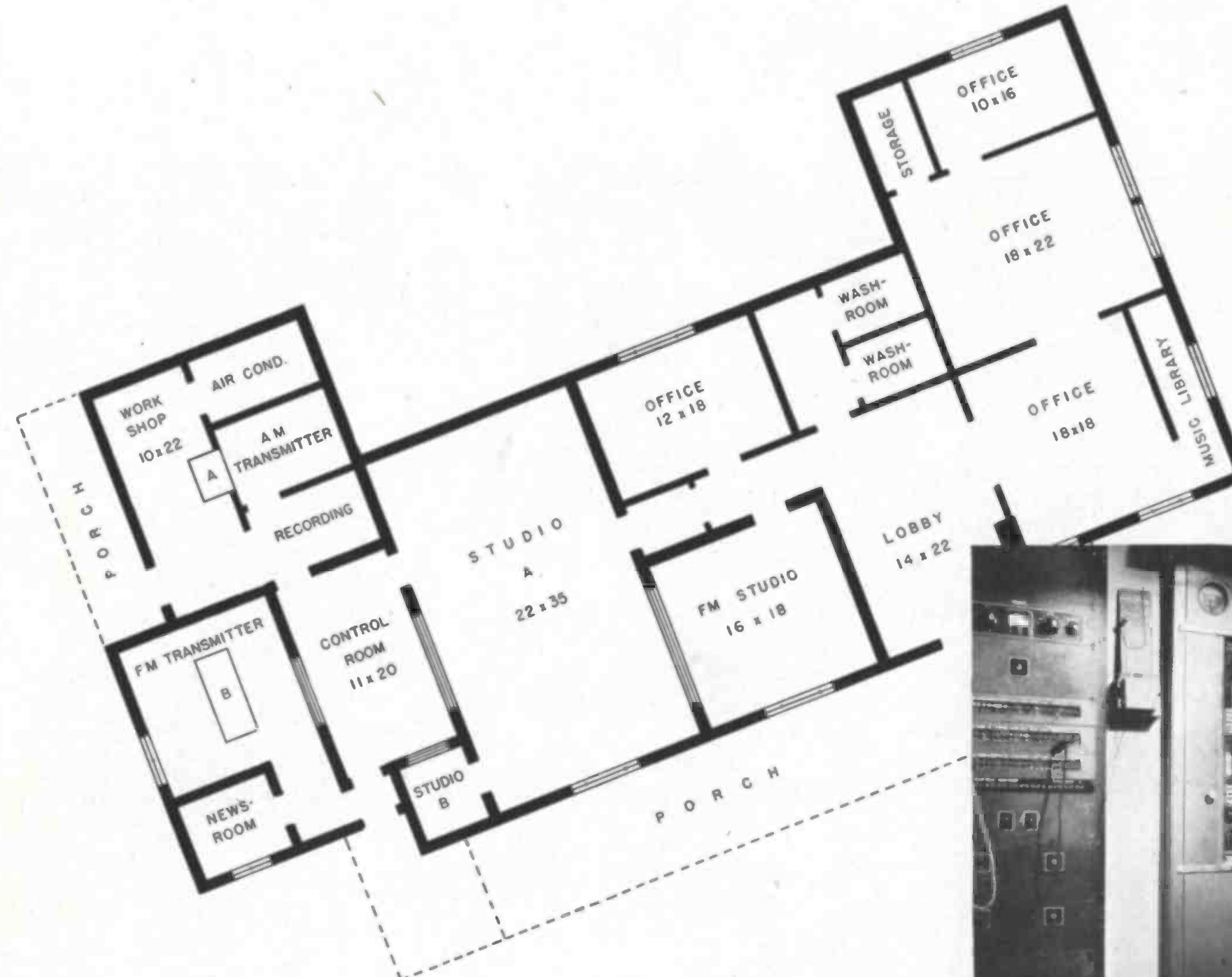
Single control room has view of three studios. Separate rooms for AM and FM transmitters. Transmitting equipment, service areas and work shop concentrated in one wing.

CONSTRUCTION OUTLINE

FOUNDATION—Reinforced concrete. STRUCTURAL MATERIAL—Brick and tile. ROOF—Composition. INSULATION—Rockwool. WINDOWS—Steel sash. HEATING AND AIR CONDITIONING—York.

EQUIPMENT OUTLINE

TRANSMITTERS—250 watt AM and 3 KW FM. ANTENNA—425'. EMERGENCY POWER—None. WIRING RUN—Steel conduit.



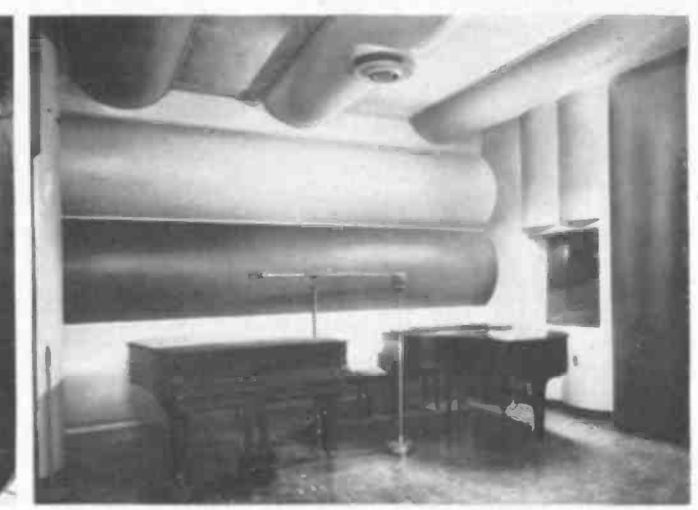
EQUIPMENT KEY

A—250 Watt AM Transmitter

B—3 KW FM Transmitter

250 watt AM transmitter set in wall.

Programs are reproduced in the station manager's office.



Polycylindrical wall treatment is used in large studio.

General office and reception lobby are combined in this ample room. Note visitors' studio viewing window at left.

1 KW AM & 1 KW FM, KSJO

SAN JOSE, CALIFORNIA

COMBINATION TRANSMITTER-STUDIO BUILDING

OWNER—Santa Clara Broadcasting Co., Inc. GEN'L MGR.—Donald H. Telford. ENG. DIRECTOR—John G. Bouriedel. CHIEF ENG.—Larry King. ARCHITECTS—Austin, Field, Fry and Criz. CONTRACTOR—Earl W. Heple. BUILT—1946. BASEMENT—No. NO. FLOORS—1.

FEATURES

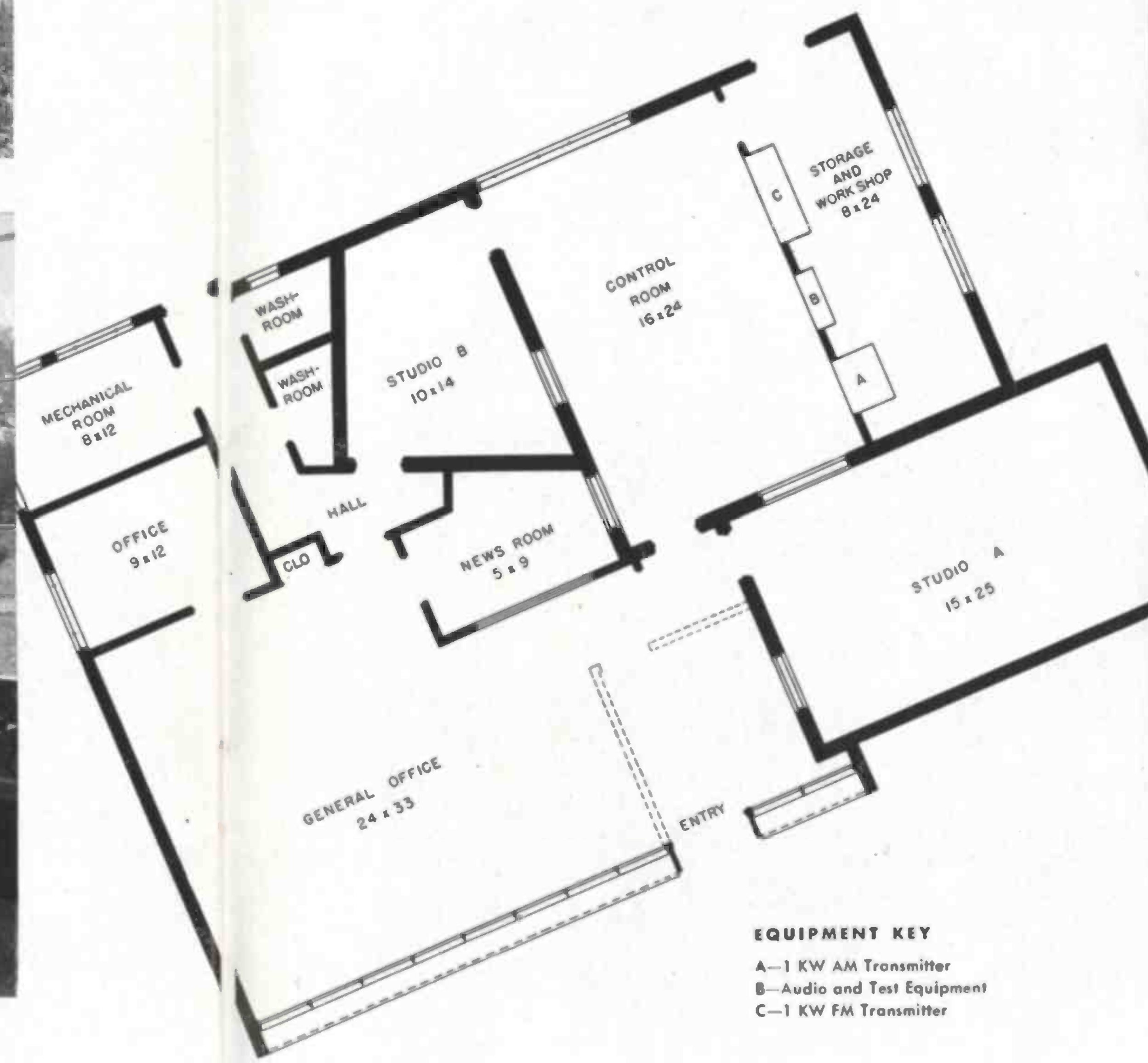
Single control room serves two transmitters, two studios, news room, and reception lobby. Work shop and storage combined with transmitter room. Large general office has full glass wall for exterior light. Auxiliary studio viewing from reception lobby.

CONSTRUCTION OUTLINE

FOUNDATION — Concrete. STRUCTURAL MATERIAL — Concrete block. ROOF—Composition. INSULATION—Rockwool. WINDOWS—Steel sash. HEATING AND AIR CONDITIONING—Gas-fired hot and cold unit.

EQUIPMENT OUTLINE

TRANSMITTERS—1 KW AM and 1 KW FM. PHASING EQUIPMENT—Yes. TRANSMITTER ROOM COOLING AND AIR FILTERING—Sebastopol. ANTENNAS—Vertical uniform cross section, 3 sets of guys. EMERGENCY POWER—None. WIRING RUN—Trench.

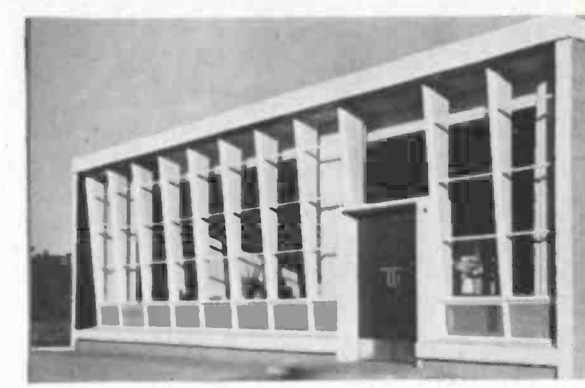


EQUIPMENT KEY

A—1 KW AM Transmitter
B—Audio and Test Equipment
C—1 KW FM Transmitter

Transmitters, all audio controls in this room.

Decorative call letters are neon-illuminated.



Glass front has overhang to control sunlight.

1 KW FM, KPFM PORTLAND, OREGON

COMBINATION STUDIO-TRANSMITTER BUILDING

Right—Large office has a 6 x 10 foot "thermopane" window and wall of glass blocks.

Above—Studio control area of transmitter and control room. Operator seated at the built-in desk in background has a view of both studios.

Top—1 KW Frequency Modulation Transmitter.

OWNER—Broadcasters Oregon, Ltd. GEN'L MGR.—S. M. Goard. CHIEF ENG.—Walter M. Nelson. ARCHITECT—Donald Byers. CONTRACTOR—G. Edgar Swan. BUILT—1946. BASEMENT—Yes. NUMBER FLOORS—1.

FEATURES

Simple, functional building designed for maximum utilization of space. Employees' lounge in basement. Large picture windows and use of glass block assure maximum natural light. Ample space in transmitter and control room allows for expansion to 10 KW power.

CONSTRUCTION OUTLINE

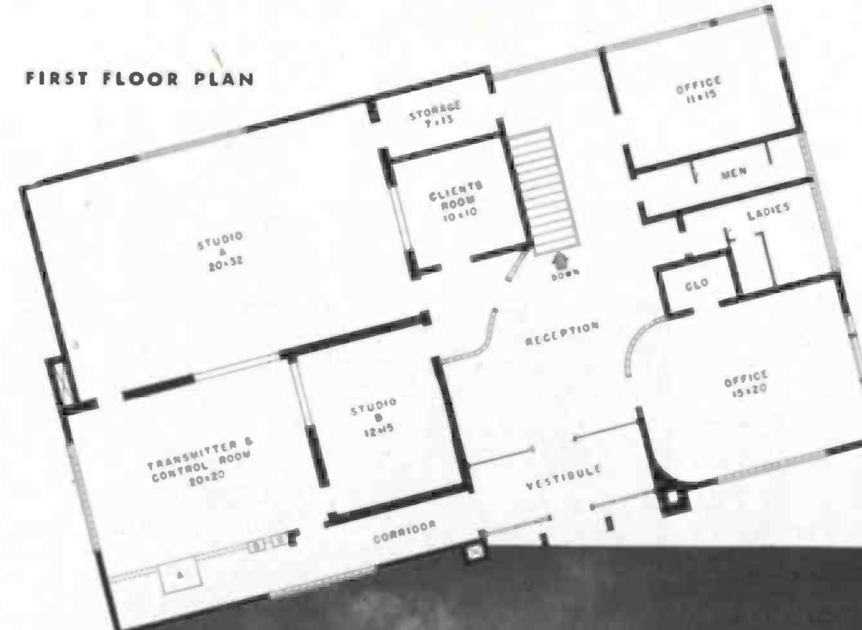
FOUNDATION—Reinforced concrete. STRUCTURAL MATERIAL—Concrete. ROOF—Built-up, class B composition. INSULATION—2" fiberglas. WINDOWS — Thermopane. HEATING — Hot air, oil burner.

EQUIPMENT OUTLINE

TRANSMITTER—1 KW FM. ANTENNA—Slotted cylinder (temporary). TRANSMISSION LINE—1⅝". EMERGENCY POWER—None. WIRING RUN—Trough and conduit.

Entrance and reception room. Sound lock leading to studios is at right.

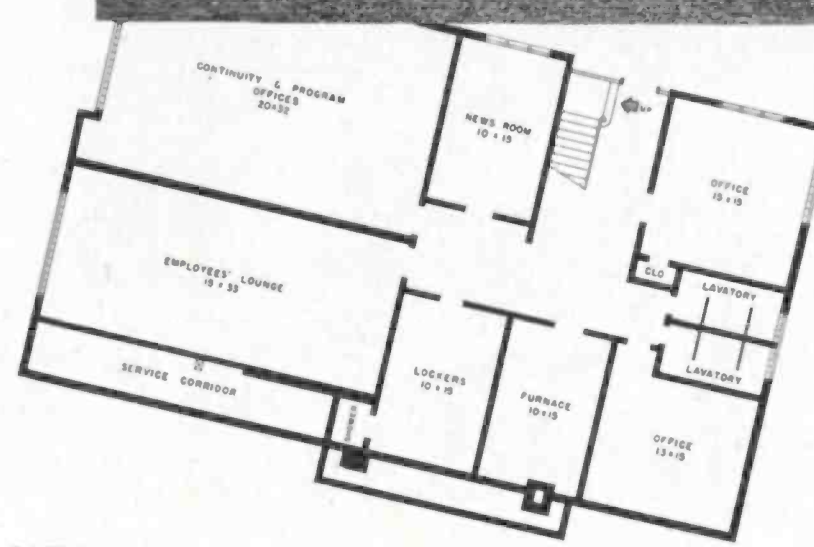
FIRST FLOOR PLAN



EQUIPMENT KEY

A — 1 KW FM Transmitter
B — Audio and Test Equipment
C — Audio and Test Equipment

Building is located on mountaintop just outside the city limits, two miles from business district.

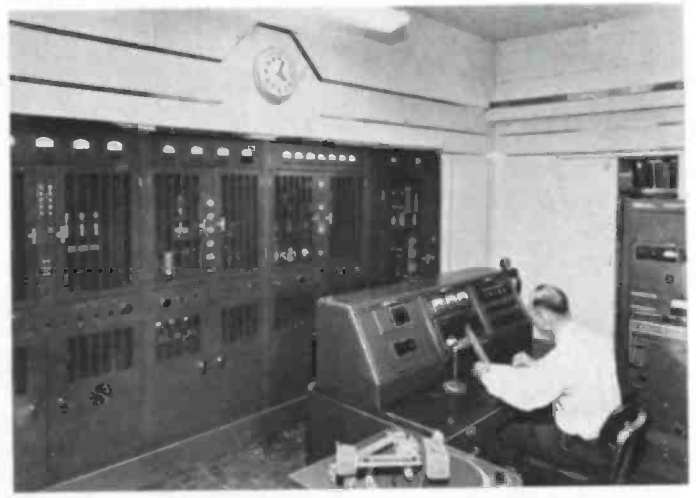


BASEMENT PLAN

5 KW AM, KTAR

PHOENIX, ARIZONA

A chain link fence in transmitter room keeps personnel away from high voltage equipment.



Control room, showing 5 KW AM transmitter, antenna control unit, control desk, and audio equipment at right.

OWNER—KTAR Bcstg. Co. GEN'L MGR.—Richard O. Lewis. CHIEF ENGR.—Arthur C. Anderson. ARCHITECTS—Gilmore & Ekman. CONTRACTOR—Hugh Meadows. BUILT—1941. BASEMENT—Excavated area for conduits and transmission lines. NO. FLOORS—1.

FEATURES

Viewing lobby, separated by glass partition from control room. Basement under equipment, with all main conduits and transmission lines in open. Entire building completely bonded, with parallel 2" copper strips each 2 feet under roofing, bonded to 6" copper strips at each corner. All conduits bonded with 2" copper strips and all grounds connected to 6" copper strips extending to main antenna ground screen.

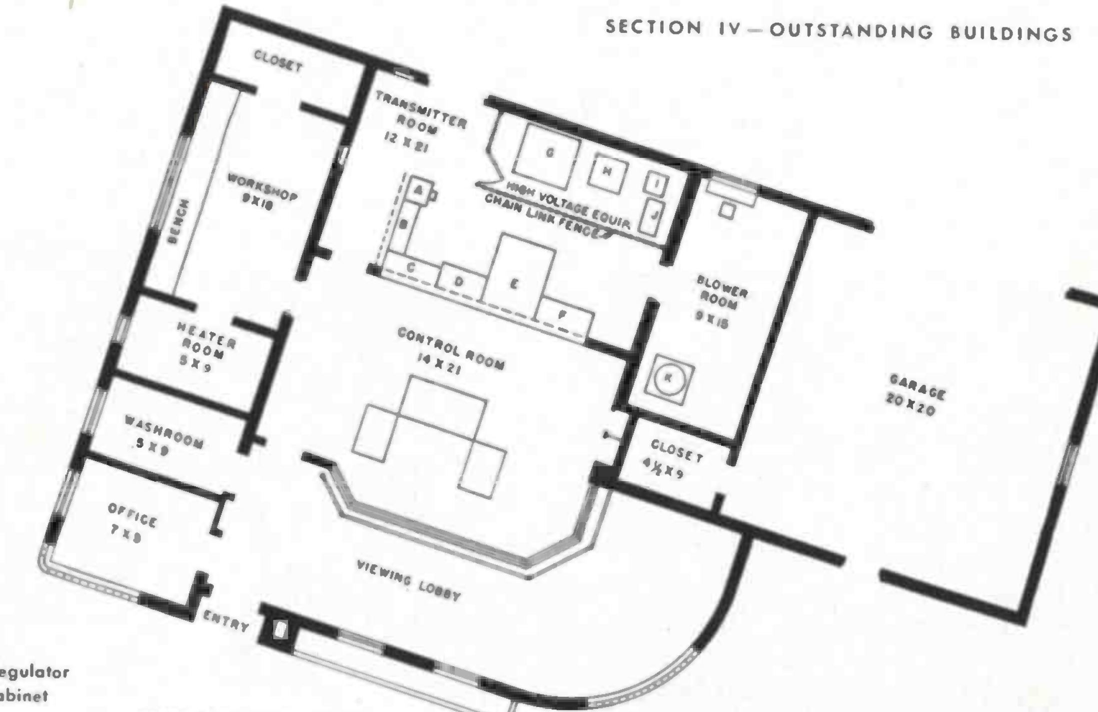
CONSTRUCTION OUTLINE

FOUNDATION — Reinforced concrete. STRUCTURAL MATERIAL — Brick. ROOF — Asbestos built-up. INSULATION — Rockwool and acoustical celotex. WINDOWS—Fenestra steel frame. HEATING—Central system with ducts, butane gas. AIR CONDITIONING—Self-contained, 2-3 ton mechanical refrigeration system.

EQUIPMENT OUTLINE

TRANSMITTER—5 KW AM. ANTENNA CONTROL EQUPT.—Yes. ANTENNAS—2 self-supporting. TRANSMISSION LINE—⅞". EMERGENCY POWER—Butane gas engine-driven generator, 37½ KVA, 22 V, 3 phase, automatic. WIRING RUN—Basement under equipment with all main conduits and transmission lines in open.

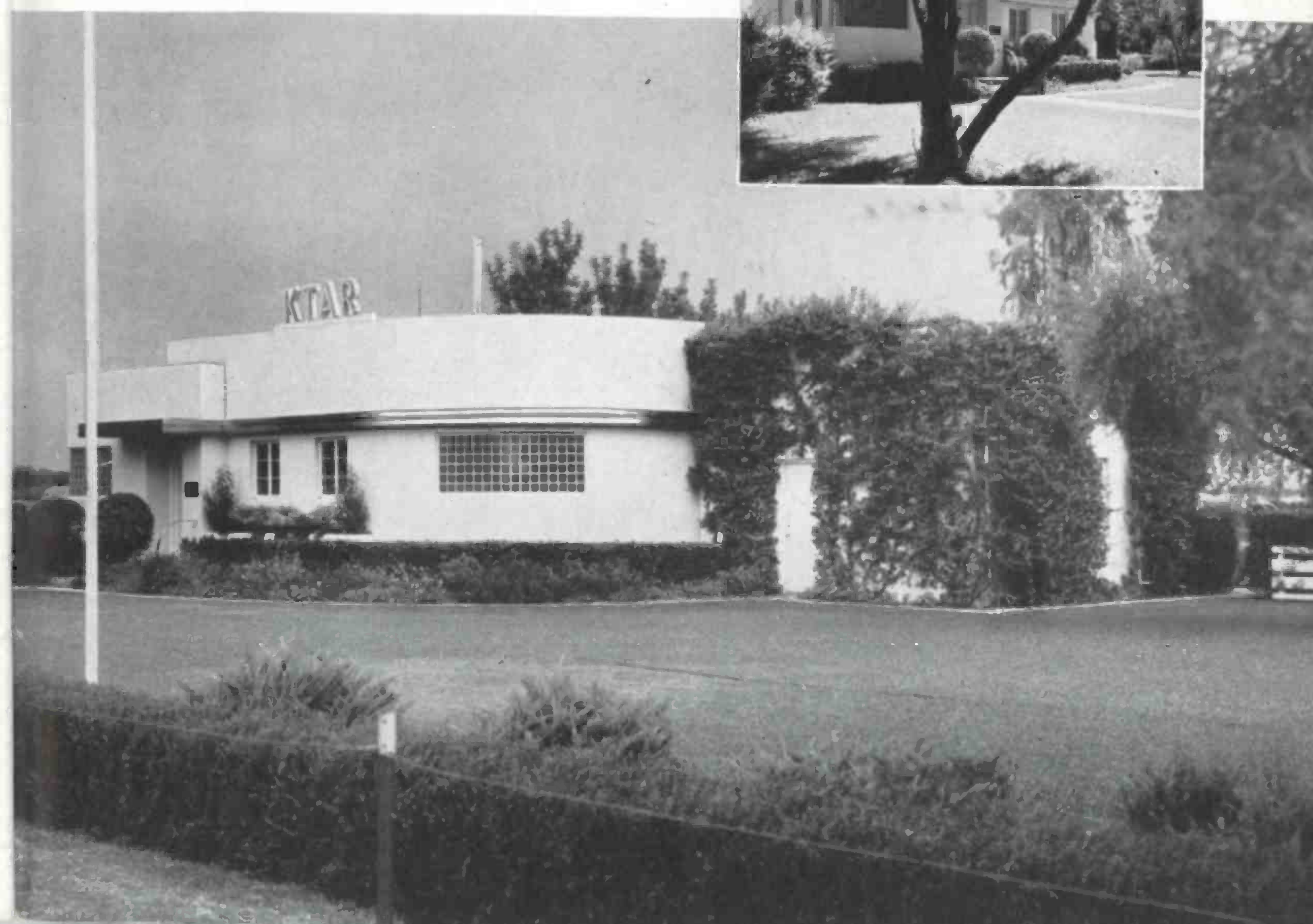
Public viewing lobby is separated from the transmitter control room by glass panels.



FIRST FLOOR PLAN

EQUIPMENT KEY

A—Automatic Voltage Regulator
B—Power Distribution Cabinet
C—Control Unit
D—Oscillator Amplifier
E—Power Amplifier
F—Antenna Control Equipment
G—Rectifier
H—High Voltage Transformer
I—Retardation Coil
J—Filter Condenser
K—Water Storage Tank



5 KW AM
WIOD

MIAMI, FLORIDA

OWNER — Isle of Dreams Broadcasting Corp. GEN'L MGR. — James M. LeGate. CHIEF ENG. — M. C. Scott, Jr. ARCHITECT — Robert L. Weed. CONTRACTOR — J. Y. Gooch Co. BUILT — 1940. BASEMENT — No. NO. FLOORS — 2.

FEATURES

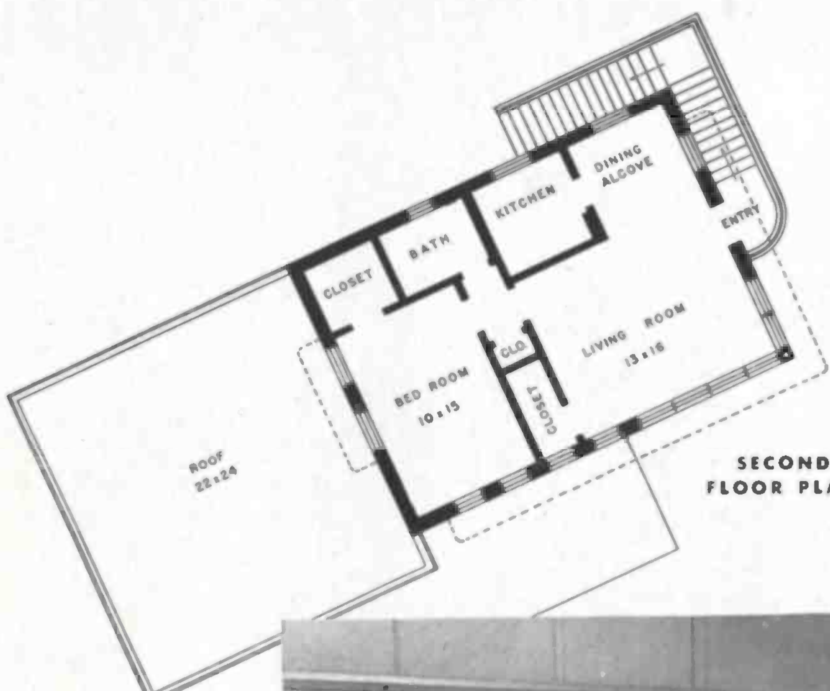
Island Location in Biscayne Bay. Complete living quarters on second floor. Operators' lounge with kitchenette, adjacent to operating room. Large, well-lighted work shop. Room for gasoline engine-driven emergency generator connected to, but not a part of, main building. Compact operating and transmitter rooms.

CONSTRUCTION OUTLINE

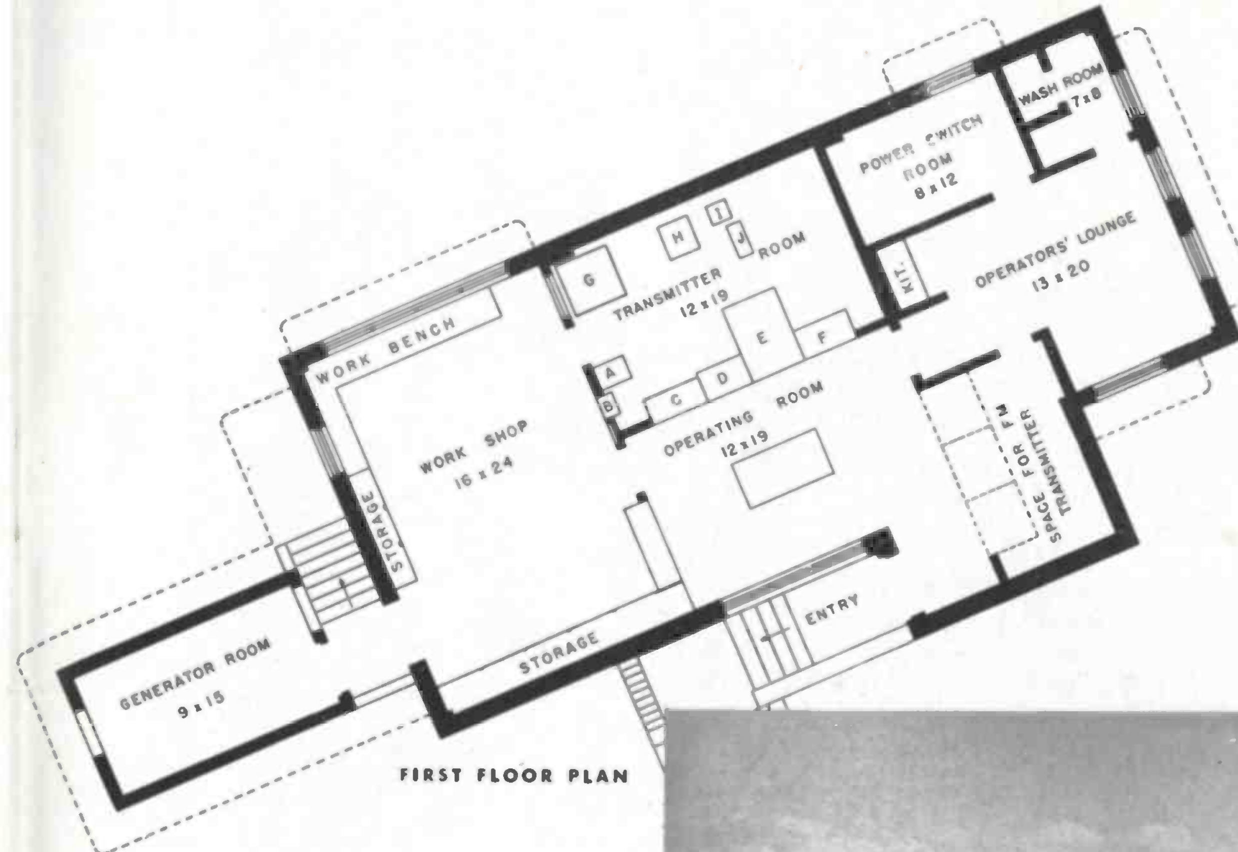
FOUNDATION—Concrete piling. STRUCTURAL MATERIAL—Poured concrete and concrete block. ROOF—Concrete slab. INSULATION—None. WINDOWS—Non-opening, in wood frame. HEATING—Small portable heaters only. AIR CONDITIONING—Forced air ventilation by centrifugal blowers.

EQUIPMENT OUTLINE

TRANSMITTER—5 KW AM; 10 KW FM to be installed. TRANSMITTER ROOM COOLING—Centrifugal blowers. AIR FILTERING—Spun glass filters. ANTENNAS — 2-300' self-supporting. TRANSMISSION LINE—⅞". EMERGENCY POWER—63 KVA, 230 V, 3 phase, 3 wire, driven by 105 HP gasoline engine with fully automatic start and switch. WIRING RUN—Tubular conduit with square floor duct.



SECOND FLOOR PLAN



FIRST FLOOR PLAN

EQUIPMENT KEY

A—Automatic Voltage Regulator
B—Power Distribution Cabinet
C—Control Unit
D—Oscillator Amplifier
E—Power Amplifier
F—Antenna Control Equipment
G—Rectifier
H—High Voltage Transformer
I—Retardation Coil
J—Filter Condenser

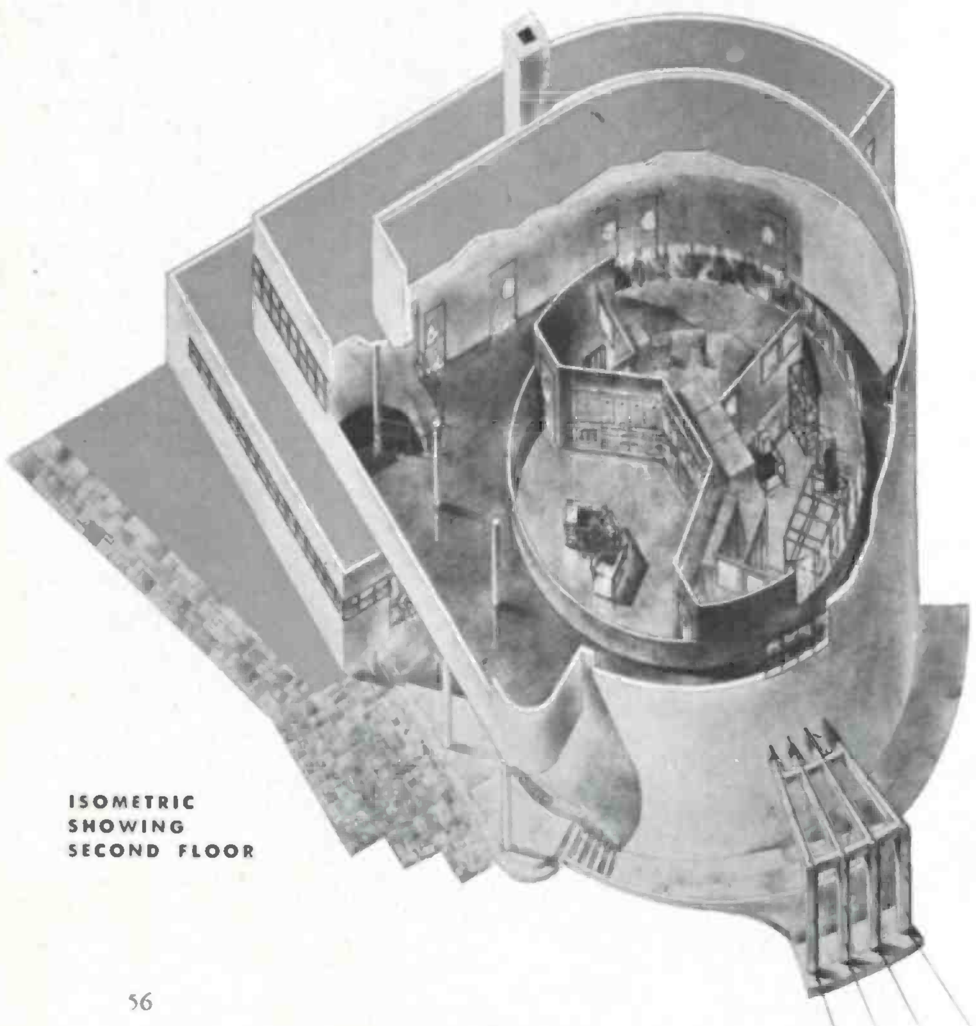
Excellent ground conductivity and easy access to mainland by causeway are assets of WIOD's island location.

Below, left—Spacious work shop, adjacent to transmitter. Below—Transmitter room. Ceiling furred down to a point above the equipment, to form a recess for lighting cove.

Living room of complete apartment on second floor.

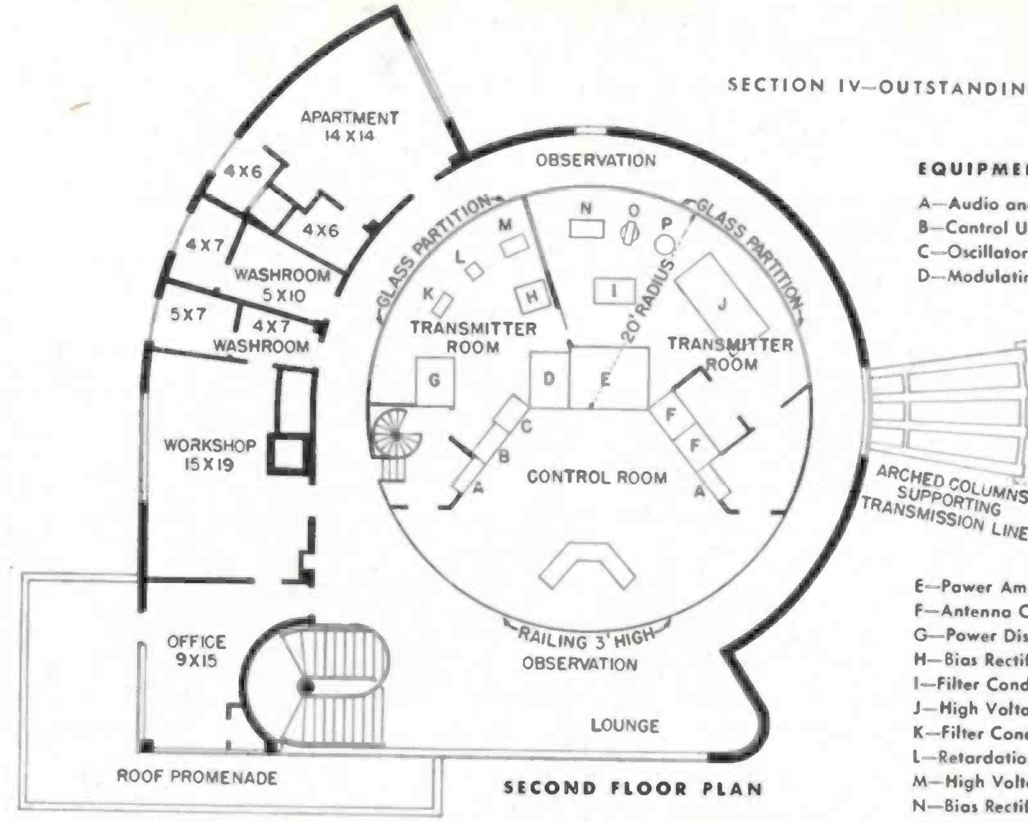
50 KW AM WTOP

WASHINGTON, D. C.



ISOMETRIC SHOWING SECOND FLOOR

Electric kitchenette in apartment.



SECOND FLOOR PLAN

EQUIPMENT KEY

A—Audio and Test Equipment
B—Control Unit
C—Oscillator Amplifier
D—Modulating Amplifier
E—Power Amplifier
F—Antenna Control Equipment
G—Power Distribution Cabinet
H—Bias Rectifier (5KW)
I—Filter Condenser (50 KW)
J—High Voltage Rectifier
K—Filter Condenser (5 KW)
L—Retardation Coil (5 KW)
M—High Voltage Transformer
N—Bias Rectifier (50 KW)
O—Retardation Coil (50 KW)
P—Thyrite Protector

OWNER—Columbia Broadcasting System, Inc. GEN'L MGR.— Carl J. Burkland. CHIEF ENG.—Clyde M. Hunt. ARCHITECT—E. Burton Corning. CONTRACTOR—George C. Martin. BUILT—1940. BASEMENT—No. NO. FLOORS—2. FIRST FLOOR—Garage, transformer vaults and service areas. SECOND FLOOR—See floor plan.

FEATURES

Circular observation promenade surrounding transmitter and control rooms allows visitors to view all units of transmitting equipment while station is on the air. Arched columns serve as attractive supports for transmission lines leaving building.

CONSTRUCTION OUTLINE

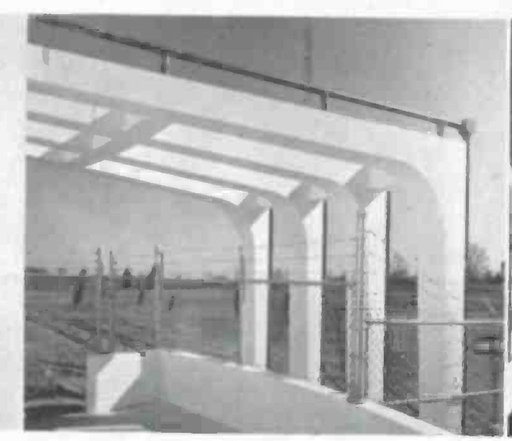
FOUNDATION—Reinforced concrete. STRUCTURAL MATERIAL—Reinforced concrete. ROOF—Built-up. INSULATION—Gypsum tile. WINDOWS—Steel casement. HEATING—Hot water system. AIR CONDITIONING—Refrigeration system for operating personnel area; humidity-controlled filtered air for entire building.

EQUIPMENT OUTLINE

TRANSMITTER—50 KW AM. ANTENNA CONTROL EQUPT.—Yes. ANTENNAS—3-340', triangular uniform cross section. TRANSMISSION LINES—2⅝". EMERGENCY POWER—94 KVA, gas engine-driven. WIRING RUN—Metal duct.

Control room and front of transmitter as seen from observation promenade.

Rear of transmitter from observation area.



Arched columns support transmission lines.

Lounge and control room observation

5KW WOW, Omaha, Nebr.

10 KW FM WNBF-FM, Binghamton, N. Y.

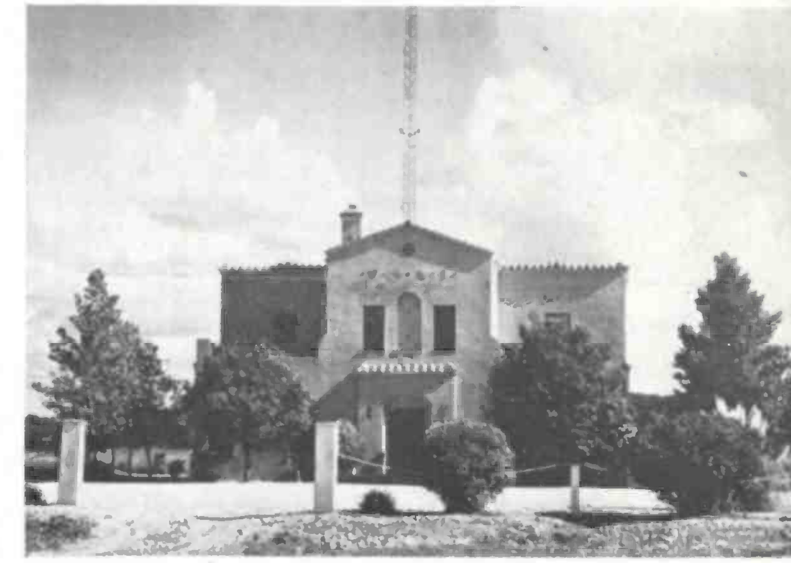
50 KW KFAB, Omaha, Nebr.

50 KW KIRO, Seattle, Wash.

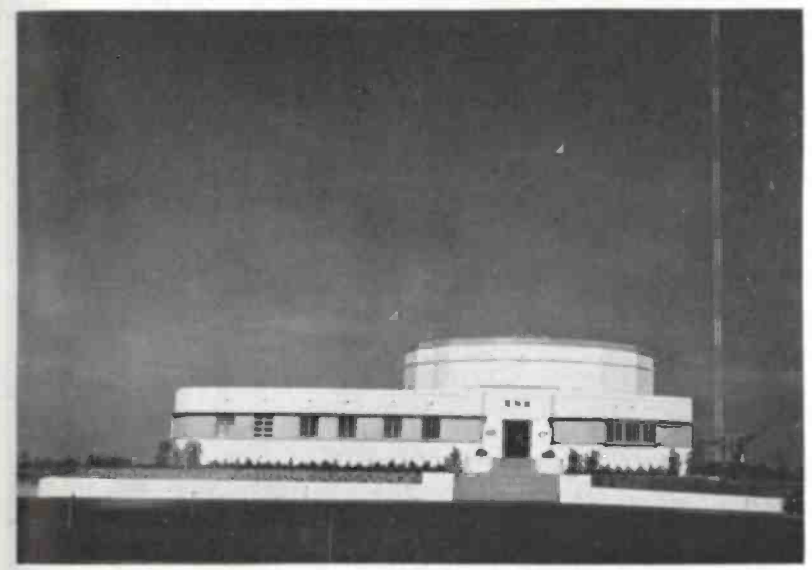
50 KW KSL, Salt Lake City, Utah

50 KW FM WKY-FM, Oklahoma City, Okla.

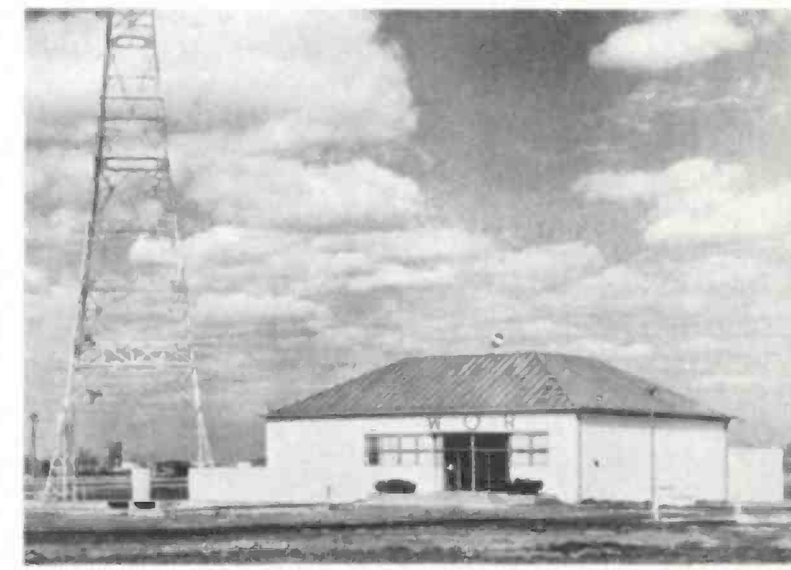
50 KW WHAS, Louisville, Ky.



50 KW WOAI, San Antonio, Tex.



50 KW KNX, Los Angeles, Calif.



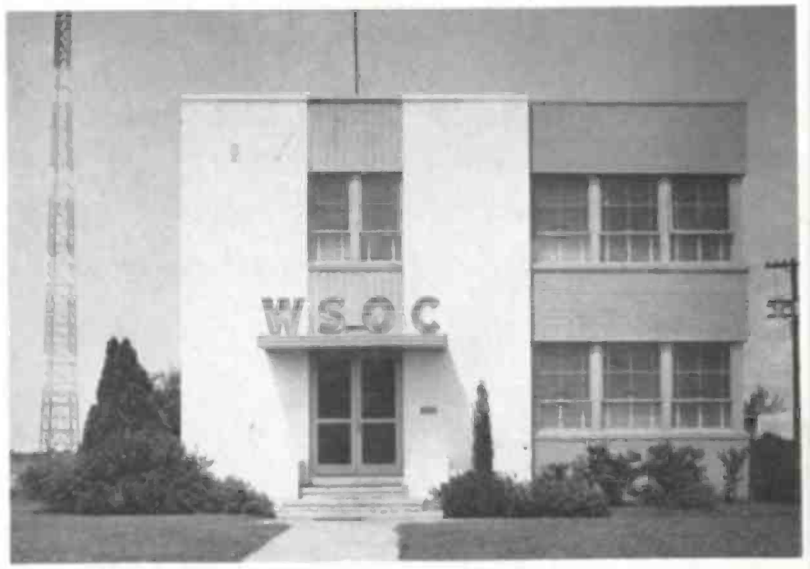
50 KW WOR, New York, N. Y.

50 KW WBZ, Boston, Mass.

50 KW KSTP, St. Paul, Minn.

Section V—The Face of the American Transmitter Building

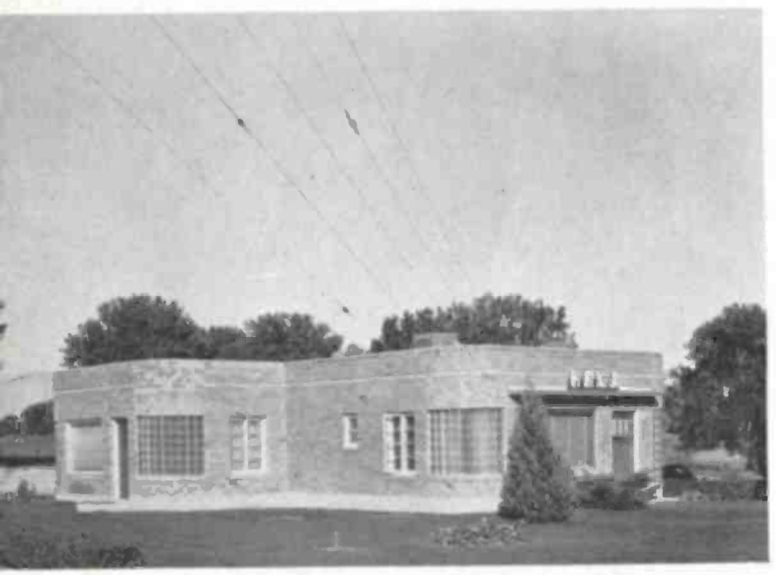
250 W WKBR, Manchester, N. H.



250 W WSOC, Charlotte, N. C.

250 W KTUC, Tucson, Ariz.

250 W KRE, Berkeley, Calif.

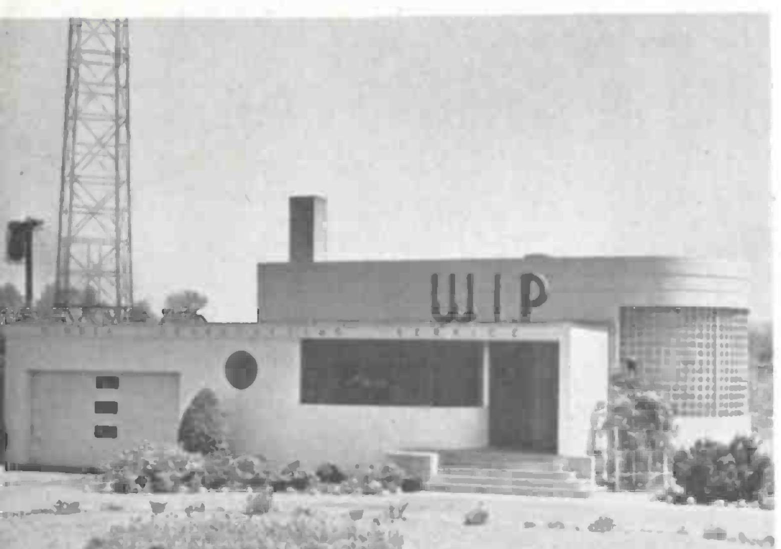


1 KW KFXJ, Grand Junction, Colo.

1 KW KRSC, Seattle, Wash.

1 KW KOY, Phoenix, Ariz.

5 KW WSPD, Toledo, Ohio



5 KW WIP, Philadelphia, Pa.

5 KW KHJ, Los Angeles, Calif.

5 KW WHEC, Rochester, N. Y.

5 KW WRNL, Richmond, Va.

WESTERN ELECTRIC AM AND FM TRANSMITTERS

...Specified in Original Building Plans in Section II, Pages 29-41

250 W AM

CODE NUMBER—451A-1 Radio Transmitting Equipment.

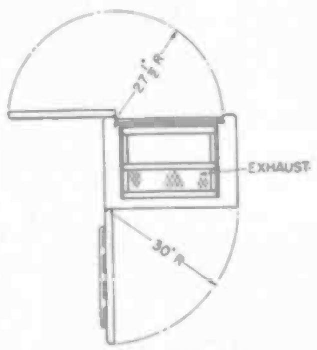
FREQUENCY RANGE—540 to 2750 kilocycles. Any specified frequency in this range.

POWER OUTPUT—250 watts.

PRIMARY POWER SUPPLY—200 to 240 volts, 60 cycles, single phase. (Can also be furnished for 50 cycles.)

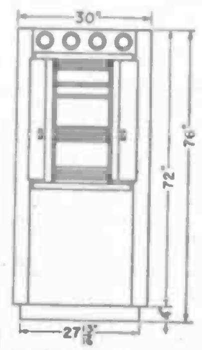
WEIGHT—Approximately 1000 pounds.

SEE PAGES 29-31 FOR ORIGINAL PLANS OF BUILDING TO HOUSE THIS TRANSMITTER.



TOP VIEW


SIDE VIEW


FRONT VIEW

250 W FM

CODE NUMBER—501C-2 Radio Transmitting Equipment.

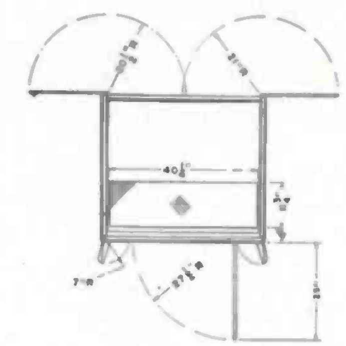
FREQUENCY RANGE—88 to 108 megacycles. Any specified frequency in this range.

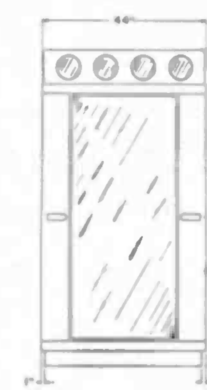
POWER OUTPUT—250 watts.

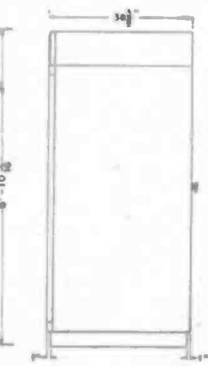
PRIMARY POWER SUPPLY—187 to 250 volts, 60 cycles, single phase. (Can also be furnished for 50 cycles.)

WEIGHT—Approximately 1000 pounds.

SEE PAGES 32-33 FOR ORIGINAL PLANS OF OFFICE BUILDING LAYOUT FOR THIS TRANSMITTER.


TOP VIEW


FRONT VIEW


SIDE VIEW

1 KW AM

CODE NUMBER—443A-1 Radio Transmitting Equipment.

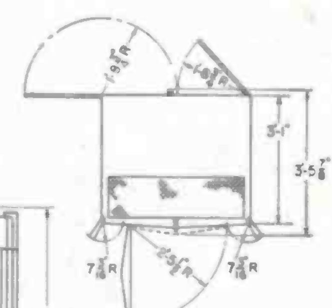
FREQUENCY RANGE—540 to 2500 kilocycles. Any specified frequency in this range.

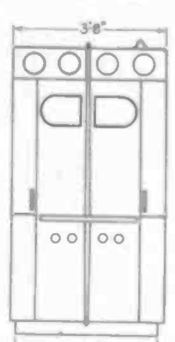
POWER OUTPUT—1000 watts. (500 watts—442A-1.)

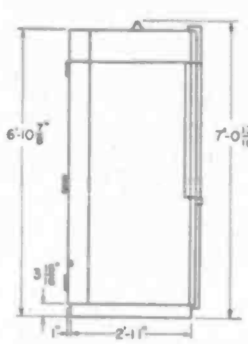
PRIMARY POWER SUPPLY—187 to 250 volts, 60 cycles, single phase. (Can also be furnished for 50 cycles.)

WEIGHT—Approximately 2000 pounds.

SEE PAGES 34-35 FOR ORIGINAL PLANS OF BUILDING TO HOUSE THIS TRANSMITTER.


TOP VIEW


FRONT VIEW


SIDE VIEW

1 KW FM

CODE NUMBER—503B-2 Radio Transmitting Equipment.

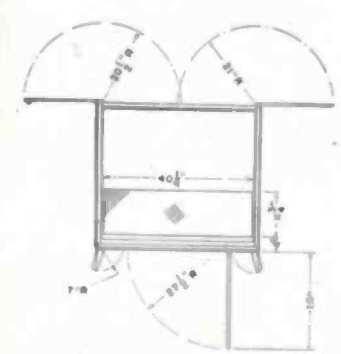
FREQUENCY RANGE—88 to 108 megacycles. Any specified frequency in this range.

POWER OUTPUT—1000 watts.

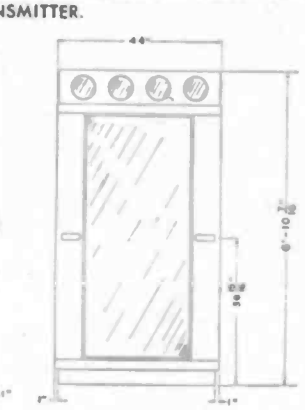
PRIMARY POWER SUPPLY—208 to 230 volts, 60 cycles, single phase. (Can also be furnished for 50 cycles.)

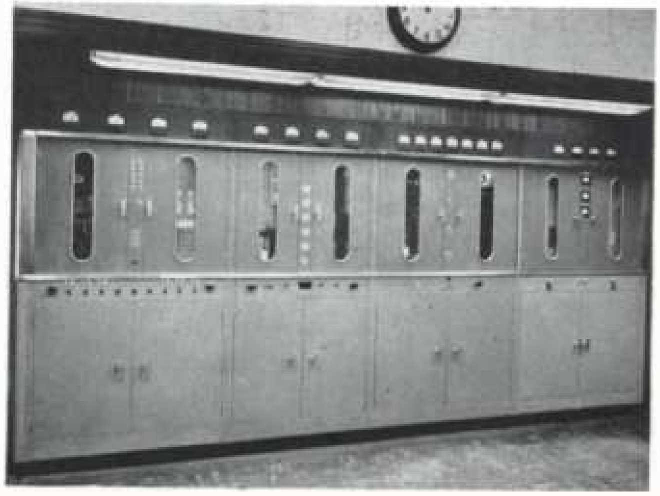
WEIGHT—Approximately 1500 pounds.

SEE PAGES 36-37 FOR ORIGINAL PLANS OF BUILDING TO HOUSE THIS TRANSMITTER.


TOP VIEW


SIDE VIEW


FRONT VIEW



5 KW AM

CODE NUMBER—405B-2 Radio Transmitting Equipment.

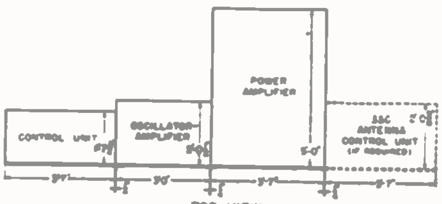
FREQUENCY RANGE—550 to 1600 kilocycles. Any specified frequency in this range.

POWER OUTPUT—5000 watts. Power reduction by push button control to 2500 or 1000 watts, as adjusted.

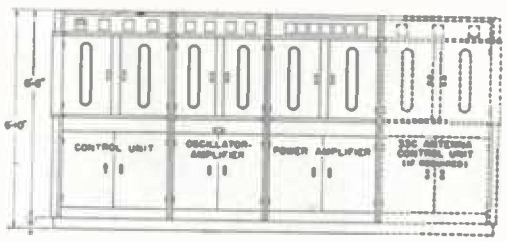
PRIMARY POWER SUPPLY—210 to 250 volts, 60 cycles, 3 phase. (Can also be furnished for 50 cycles.)

WEIGHT—Approximately 8900 pounds, including all accessories.

SEE PAGES 38-39 FOR ORIGINAL PLANS OF BUILDING TO HOUSE THIS TRANSMITTER.



TOP VIEW



FRONT VIEW

50 KW AM

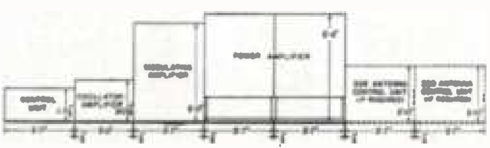
CODE NUMBER—407A-1 Radio Transmitting Equipment.

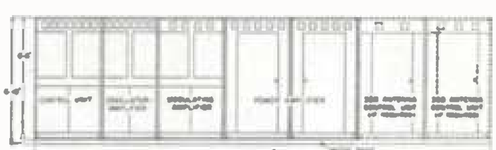
FREQUENCY RANGE—540 to 1600 kilocycles. Any specified frequency in this range.

POWER OUTPUT—50 kilowatts.

PRIMARY POWER SUPPLY—460 volts, 60 cycles, 3 phase. (Can also be furnished for 50 cycles.)

WEIGHT—Approximately 27,000 pounds, including all accessories.


TOP VIEW


FRONT VIEW

3 KW FM

CODE NUMBER—504B-2 Radio Transmitting Equipment.

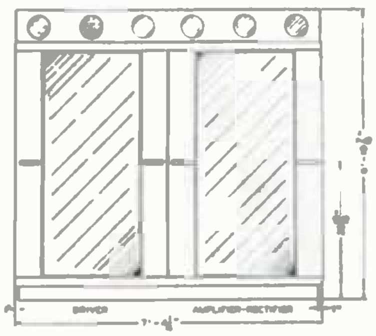
FREQUENCY RANGE—88 to 108 megacycles. Any specified frequency in this range.

POWER OUTPUT—3000 watts.

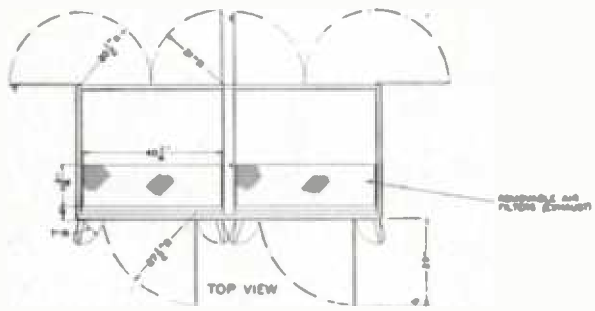
PRIMARY POWER SUPPLY—208 to 230 volts, 60 cycles, 3 phase. (Can also be furnished for 50 cycles.)

WEIGHT—Approximately 3700 pounds.

SEE PAGES 36-37 FOR ORIGINAL PLANS OF BUILDING TO HOUSE THIS TRANSMITTER.



FRONT VIEW



10 KW FM

CODE NUMBER—506B-2 Radio Transmitting Equipment.

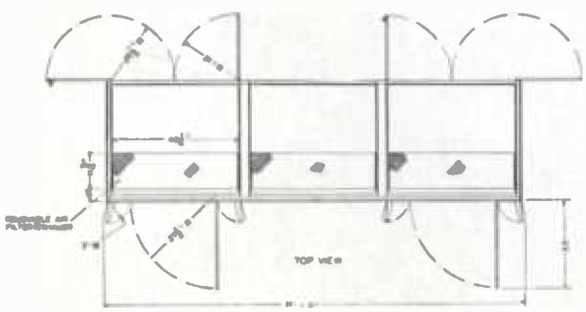
FREQUENCY RANGE—88 to 108 megacycles. Any specified frequency in this range.

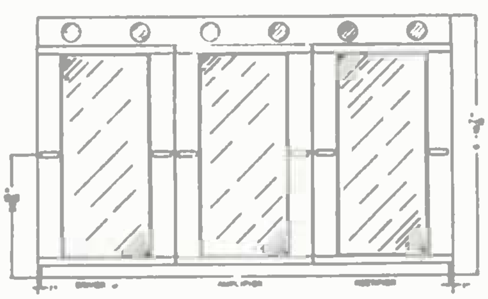
POWER OUTPUT—10,000 watts.

PRIMARY POWER SUPPLY—208 to 230 volts, 60 cycles, 3 phase. (Can also be furnished for 50 cycles.)

WEIGHT—Approximately 5700 pounds.

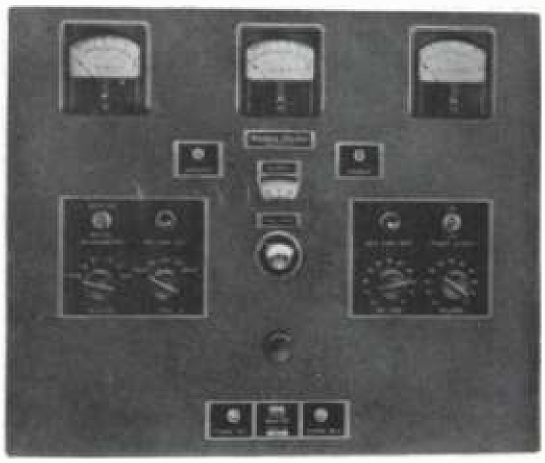
SEE PAGES 36-37 FOR ORIGINAL PLANS OF BUILDING TO HOUSE THIS TRANSMITTER.





AUXILIARY

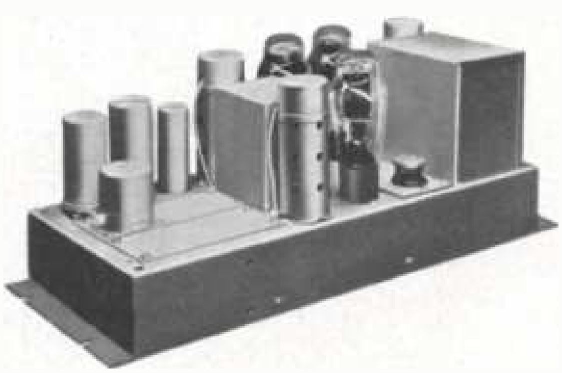
5A FREQUENCY MONITOR FOR FM



2A PHASE MONITOR

TRANSMITTER CONTROL DESKS
FOR 5 AND 50 KW AM TRANSMITTERS

124E MONITOR AMPLIFIER



EQUIPMENT

5A FREQUENCY MONITOR FOR FM — Gives continuous indication of transmitter center frequency error; shows level of transmitter modulation up to 140%; has a light that flashes when a selected level of modulation is exceeded.

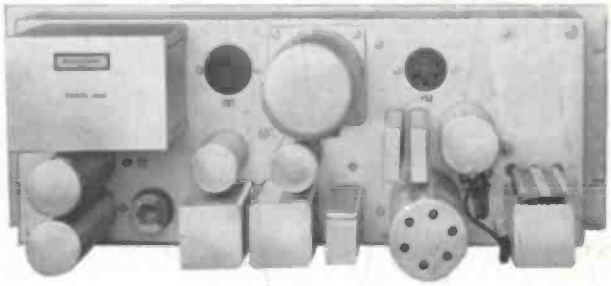
2A PHASE MONITOR — Measures phase and amplitude relations of the currents in the antenna elements of a directional array so that these relations can be correlated with the field pattern.

TRANSMITTER CONTROL DESKS — For 5 KW and 50 KW AM Transmitters. Contain volume indicator panel, monitoring amplifier, meter panel, line and announce control panel and power switch panels for controlling transmitter circuits.

124E MONITOR AMPLIFIER — For monitoring AM and FM programs in transmitter buildings and studios. Designed for relay rack mounting. Has a gain control and power switch mounted on the face mat.

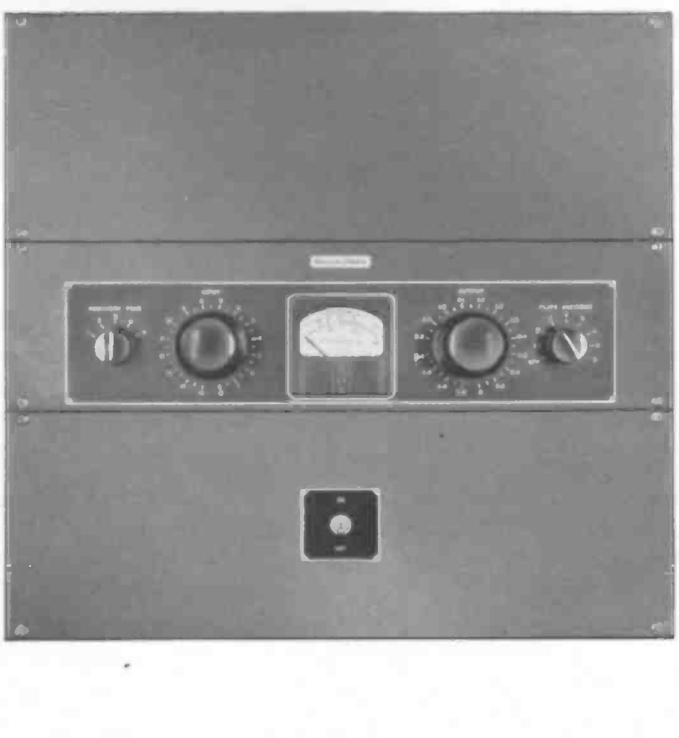
106A LINE AMPLIFIER — For raising the level of programs coming into a transmitter building from the program lines.

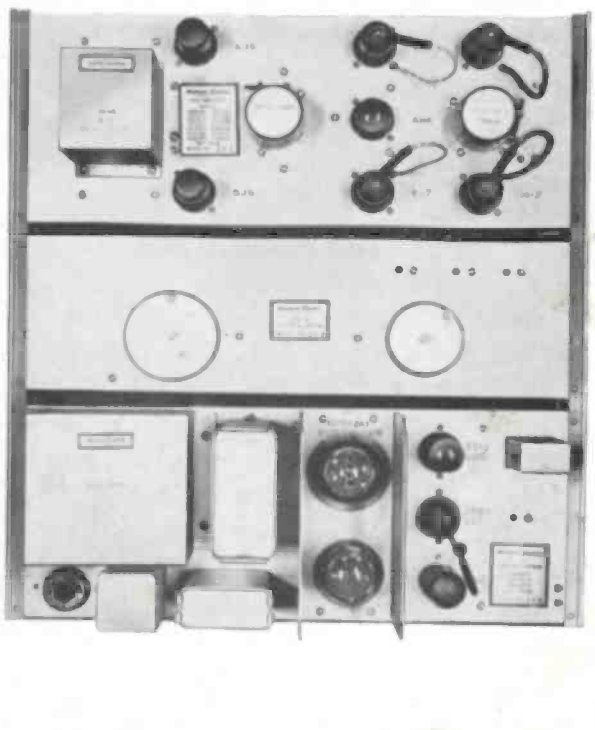
1126C PROGRAM OPERATED LEVEL GOVERNING AMPLIFIER — Reduces excessive peaks and protects against over-modulation in AM transmission. Prevents over-swing in FM, which may cause distortion in the receiver and the guard band to be overridden.



106A LINE AMPLIFIER

1126C PROGRAM OPERATED LEVEL GOVERNING AMPLIFIER





AM FM

Complete line consists of 250 Watt, 1 KW, 5 KW (shown) and 50 KW transmitters—Antenna Coupling-Phasing Equipment and Accessories.

Complete line consists of 250 Watt, 1 KW, 3 KW, 10 KW (shown) and 50 KW transmitters—Clover-Leaf Antenna and Accessories.

YOUR BEST BUY IN AM! All Western Electric AM transmitters offer stabilized feedback, maximum accessibility through central chassis design, attractive appearance and unusually low power consumption. These features, plus the Doherty *High Efficiency* Amplifier Circuit used in the higher powered units, have given hundreds of broadcasters years of dependable, economical operation.

YOUR BEST BUY IN FM! Only Western Electric transmitters give you the striking appearance and full visibility of TRANSVIEW design, plus the protection of the Frequency Watchman to keep your station on frequency, the Arc-Back Indicator to utilize full life of rectifier tubes, the new RF Wattmeter that gives constant direct reading of output power—and a new high in performance characteristics.

Western Electric

—QUALITY COUNTS—

Distributed by Graybar — OFFICES IN 95 PRINCIPAL CITIES