PICK-UPS

PRIZE WINNING DESIGNS
1000 Watt Broadcast Station
(See pages 29-50)

AUGUST 1940

Western Electric introduces F. M. Synchronized
NAB Salutes the West — San Francisco, Aug. 4-7, 1940

PICK-UPS

AUGUST, 1940

BEING A PERIODICAL DEVOTED TO DEVELOPMENT IN SOUND TRANSMISSION. PUBLISHED BY THE

Western Electric

COMPANY

195 Broadway : New York, N. Y.

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This is Pick-Ups' biggest issue due mostly to 20 full page reproductions of architectural renderings submitted in the competition conducted by the Beaux-Arts Institute of Design and Western Electric for the design of a 1000 watt broadcast transmitter station.

This competition, conceived by Pick-Ups with the hope that new interest would be aroused in the design of transmitter stations, proved to be one of the most successful ever held by the Beaux-Arts. The final count showed 92 designs submitted by 116 students from 19 American colleges. Renderings ranged all the way from pen and ink drawings to the most elaborate scale models.

It is unfortunate that Pick-Ups cannot reproduce every one of these renderings, but it is felt that a detailed study of those reproduced on pages 29 to 50 will unearth many new ideas in station design.

Those attending the convention of the National Association of Broadcasters will have an opportunity of seeing many of these designs which will be displayed by the Association.

* * *

The American public has a peculiar fondness for alphabetical combinations. It also loves its radio. Thus, the symbol FM has become familiar to almost everyone. The public, because of FM's tremendous build-up, is expecting great things of it and FM will have to go some to live up to this ballyhoo.

Our old Friend Bill Doherty, known to all Pick-Ups' readers for his many fine technical articles, has the lead story in this issue in which he describes Western Electric's first frequency modulated transmitter. Western Electric's contribution to FM, synchronized frequency modulation, is discussed at length by Mr. Doherty.

* * *

J. E. Tarr, another friend of Pick-Ups' readers, describes how Western Electric's standard amplifiers, rectifiers and other circuit components may be arranged in any number of custom built combinations to meet the particular speech input requirements of broadcasters. This equipment is both of high quality and high fidelity and is of particular interest to stations going on the air with FM transmitters.

* * *

The West has contributed much that is fine in radio. Today many of our most interesting and valuable programs originate there. What then could be more fitting than to have this year's convention of the National Association of Broadcasters in San Francisco? The West, always known for its hospitality, will do everything to entertain its eastern friends. With the added attraction of a World's Fair, this convention should be one of the most enjoyable as well as the most successful ever held.

* * *

Just how much of a boon to mankind the men of radio are has been forcefully and personally brought home to us. We are dictating this in a hospital room where we have been laid low for the last two weeks. Yet, through the magic of a little box at our arm's length, we have kept abreast of all that is happening in this fast moving old world of ours.

THIS ISSUE

SYNCHRONIZED FM

Western Electric Introduces Unique System Featuring Outstanding Carrier Stability

By W. H. DOHERTY
Commercial Products Development, Bell Telephone Laboratories

Important new developments in communication, as in other sciences, are often retarded in their commercial application by the lack of apparatus and techniques that are suitable for actual use in the field, where exacting standards of performance have to be met over long periods of time with complete reliability. Wide band frequency modulation presents its share of these practical problems, but through the coordination of a number of new and distinct laboratory developments, the approaching expansion in FM broadcasting finds equipment ready for use that meets the most rigorous requirements. These new developments are embodied in Synchronized Frequency Modulation, which makes its appearance for the first time in the 1000 watt Western Electric 503A-1 Radio Transmitting Equipment.

Probably foremost among the practical problems is that of frequency stability — a term which in FM must of course have a new meaning, since it can refer only to the average frequency. In amplitude modulation systems the crystal oscillator has provided all that could be desired in the way of frequency stability; but in a mode of transmission employing deliberate variation of frequency over a wide range, the direct use of the crystal as the source of the oscillations would necessarily give rise to a conflict between the factors which stabilize the frequency and those which are to produce the desired variation. Yet the mean frequency in FM transmission is subject to the same strict regulation prevailing for the carrier frequency in amplitude modulation, requiring that in some manner the virtues of the crystal oscillator be made use of.

Now the mean frequency in a frequency modulated signal may be defined as the *total number of cycles* occurring in a second, whatever their distribution in time over this interval may be; so that a logical and direct procedure in maintaining the mean frequency at the assigned carrier value, would be to count continuously the number of cycles per second, comparing this with the number generated by a precise fixed-frequency standard, and adjusting the source of the oscillations to keep the two always exactly the same. This is in effect what is accomplished in Synchronized Frequency Modulation. The procedure has a close parallel in electric power system practice, where cycle counting by means of synchronous motor clocks permits accurate control of the average frequency.

It is not necessary, however, to count millions of cycles each second, for the frequency may be reduced to any desired degree through the new technique of *frequency division*, whereby a low frequency is obtained which is an exact submultiple derived directly from the original frequency and having its variations reduced in proportion. The frequency divider, a tool of considerable promise in the communication field, consists basically of a modulator (M. Fig. 1) and a vacuum tube amplifier. The frequency f_2 appearing in the output of the modulator is the difference between the frequency fed back from the output, which is f_2 itself, and the frequency f_1 applied to the device; that is, $f_2 = f_1 - f_2$. This requires that

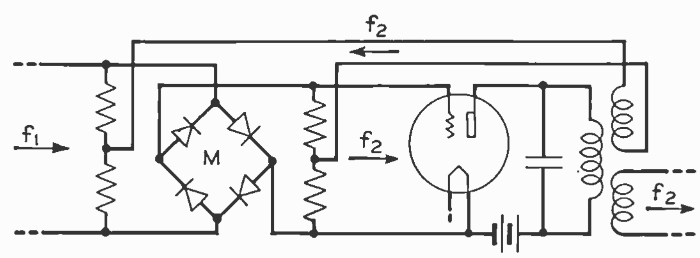


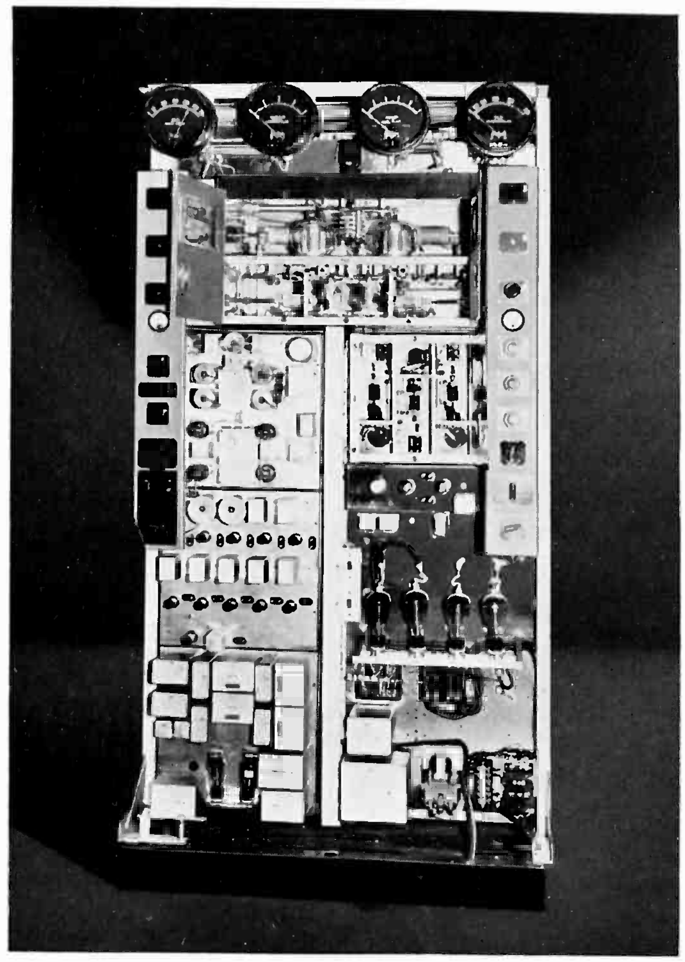
Fig. 1—Schematic of a 2-to-1 frequency divider.

$f_2 = f_1/2$, so that we have an exact halving of the frequency; and the output wave, although produced by a regenerative action, is under complete control of the input by virtue of the modulation process through which it originates.

Using a modulator of the copper oxide type, which recent refinements have rendered suitable for use at frequencies of several megacycles, the frequency divider becomes a very compact and simple device. By cascading a series of such dividers, we obtain for synchronizing purposes a frequency as low as desired, in exact submultiple relationship to the carrier frequency. In Synchronized Frequency Modulation the dividing process ends up with a frequency of about 5000 cycles, or 1/8000 of the carrier frequency.

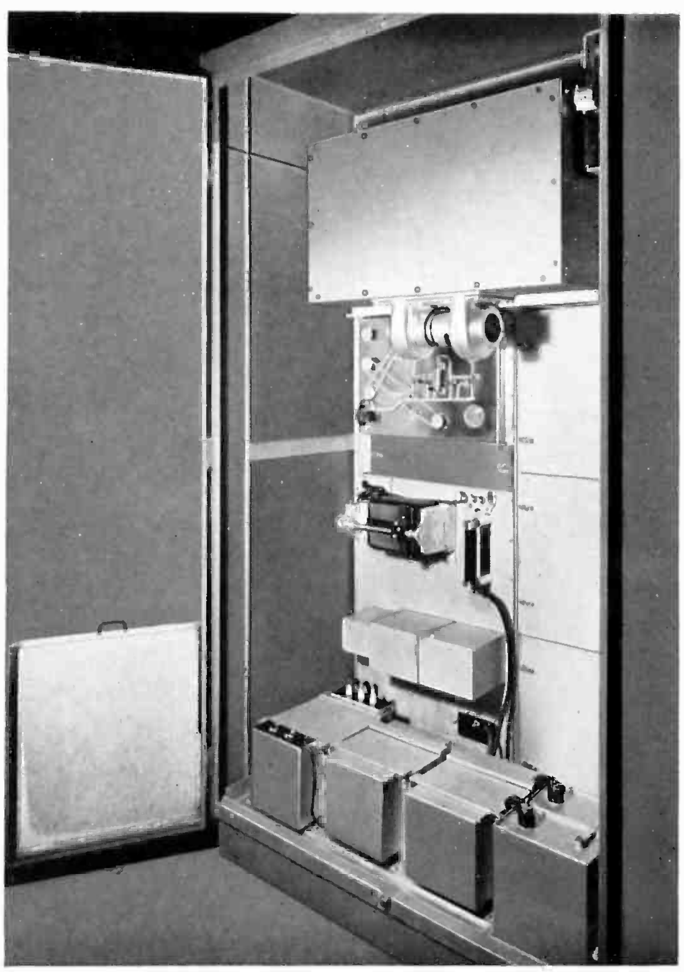
Referring now to the block diagram of the system, Fig. 2, the role of the frequency divider

Western Electric I KW Synchronized FM Transmitter

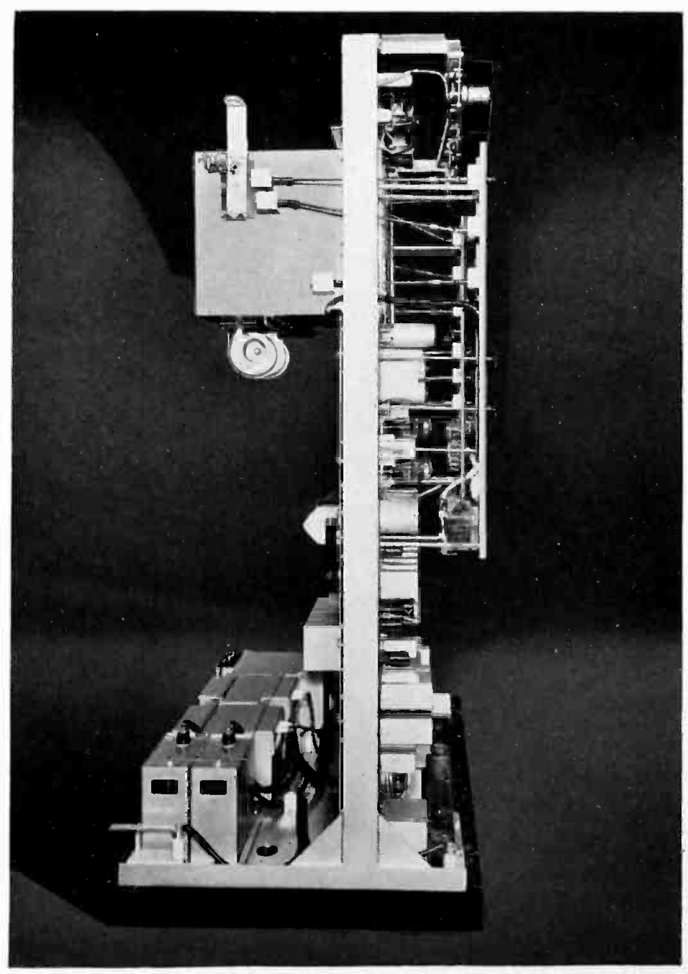


Front of transmitter with cabinet removed

Rear view of unit with full length door open



Side view of transmitter with cabinet removed



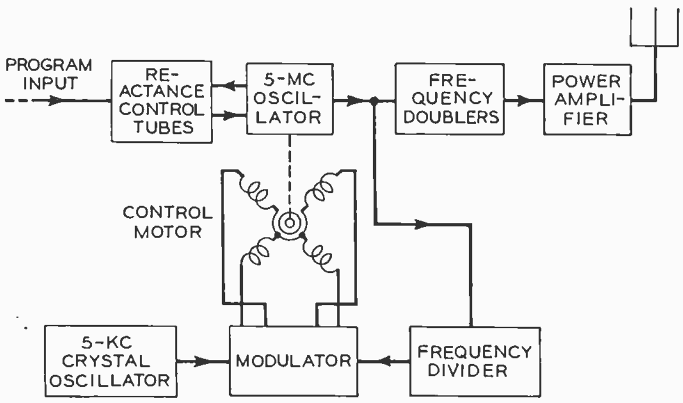


Fig. 2—Block diagram of the frequency modulation transmitter.

becomes apparent. The divider is energized from the output of a frequency modulated oscillator operating at about five megacycles, and its function as a part of the synchronizing system is to insure the constancy of the mean frequency of this oscillator, and hence of the final output frequency (42 to 50 megacycles) to be obtained by doublers following the oscillator.

There has been in use for some years a method of synchronizing two frequencies wherein the frequencies are combined in a modulator to produce a rotating magnetic field whose speed and direction of rotation correspond to the amount and sense of the frequency difference. As a small armature, geared to the tuning condenser of one oscillating source, brings the frequency back toward synchronism, the speed of rotation of the field decreases and the armature slows down, coming to rest when exact synchronism is attained.

At first thought, one would not expect such a device to be applicable in an ultra-high frequency system because the departures in frequency are so great as to be beyond the capacity of a mechanical system to follow; but when the frequency is reduced by our dividing process to the order of 5000 cycles, or 1/8000th of the output frequency, we find that variations of hundreds of kilocycles in the output frequency are represented by variations of only tens of cycles, so that with a low-frequency crystal oscillator as the comparison standard we obtain a rotating magnetic field readily followed by the armature. So effective and immediate is the control that if the output frequency through some cause were to depart suddenly by as much as *four hundred kilocycles* from its assigned value, it would be returned to exact synchronism in two to three seconds; while gradual changes in frequency of as much as several megacycles will also be corrected because the change is followed continuously.

It is well known in frequency modulation theory that the phase deviations are directly proportional to the frequency swing and inversely proportional to the audio rate at which the swing is produced. The frequency swings employed in wide band frequency modulation are so great as to entail phase deviations of thousands of degrees; that is, the frequency modulated wave is alternately advanced and retarded by many complete cycles with respect to an unmodulated comparison wave. When a high order of frequency division is introduced, however, the frequency swing becomes small while the audio rate is unchanged, so that the phase departures due to modulation are then only a few degrees.

The magnetic field in the control device therefore oscillates only slightly at audio frequencies about its mean position, and the oscillation is not followed by the motor because of its inertia; the slightest change in *mean* frequency, however, produces a continuous rotation of the field and is corrected at once. The frequency divider, then, serves two important purposes: to reduce the whole phenomenon to a time scale suited to electromechanical operations, and to obscure the effects of modulation so that only changes in the mean frequency, or total number of cycles per second, can influence the frequency control mechanism.

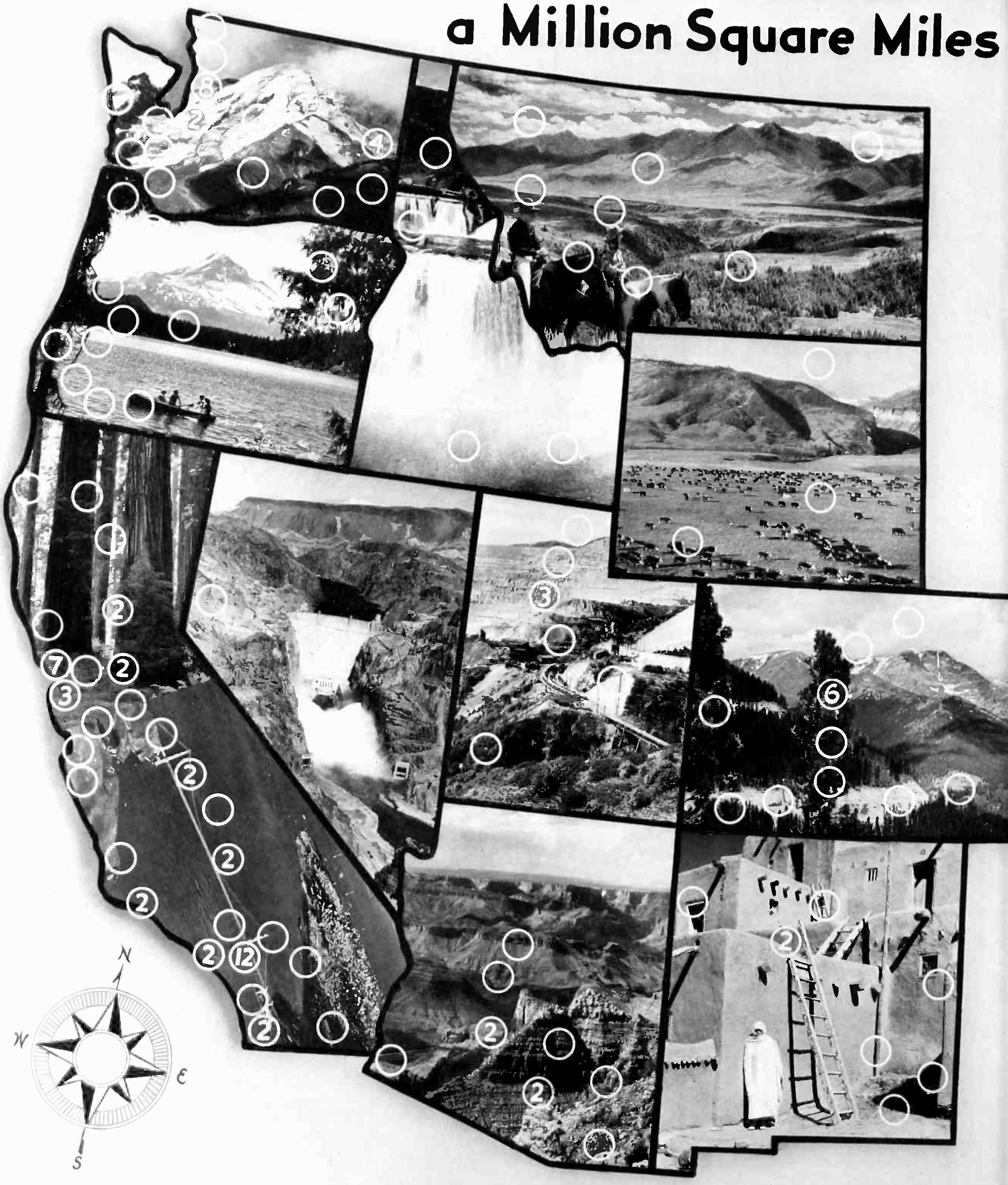
Not long ago 50 kilocycles was regarded as an extremely low frequency for quartz crystals. The appearance of a 5-kilocycle crystal oscillator in the block diagram of Fig. 2 is a reminder that advances in the frequency range of radio equipment are not being confined to the high-frequency end of the spectrum. This is a low temperature co-efficient crystal oscillator giving the same per cent stability as obtained in the best broadcast crystals. The stability is well under one part in a million per degree centigrade, making temperature control entirely unnecessary.

The system of frequency control described above is so unique in a number of important characteristics as to bring to light immediately certain limitations of other methods that might not otherwise be obvious. For one thing, the stability is identically that of a single crystal oscillator, unaffected by any beating process with other oscillators, or by changes in gain or frequency characteristics of associated circuits. There are no temperature-controlled networks for converting frequency changes into amplitude changes, opening the door to errors due to gain fluctuations; everything in the control system is kept in terms of frequency. In the second place, the actual control exercised on the oscillator to maintain its mean frequency is mechanical, involving a variable condenser; and being mechanical, when the oscillator is brought to the correct frequency it is *left* there, without the necessity of any sustaining voltage such as must be supplied when slope-circuit control is used, and therefore without the danger of a sudden wide departure in the frequency should the control voltage fail.

Mechanical control, moreover, completely relieves the frequency modulating elements of any connection with the stabilization of the mean frequency, so that these elements may always be operated at the optimum point for linear modulation and the frequency swing obtainable is not limited by the necessity for correcting frequency drifts in the oscillator. Finally, the entire synchronizing system, including the

(*Continued on page 28*)

These 157 Broadcast Stations Serve a Million Square Miles



ARIZONA · · 10	IDAHO · · · · · 7	NEW MEXICO · 8	WASHINGTON · 25
CALIFORNIA · 53	MONTANA · 8	OREGON · · 19	WYOMING · · 3
COLORADO · · 15	NEVADA · · · 1	UTAH · · · · 8	★

◯ *Number and Location of stations*

THE FABULOUS WEST

Pick-Ups Presents a Broadcasting View of it

By M. M. BEARD

San Francisco being the rendezvous for NAB associates this summer, PICK-UPS prepared for the big gathering by ferreting out some facts and figures concerning broadcasting in the West and the extent and type of territory it serves there. The 11 states comprising the Mountain and Pacific groups were roped off as the area to be surveyed. Here broadcasting has erected 157 stations dotted throughout a vast stretch of country famous for its mountain peaks, forests, dams, canyons, caverns, primeval wilderness, crystal lakes and rushing rivers.

Populated by 12,500,000 people the West covers 1,187,140 square miles of territory — 39 per cent of the country's total area. It is so huge that only by comparisons can one actually gain a true perspective of the size. For instance, these 11 states cover 196,915 more square miles than the combined areas of the British Isles, France, Holland, Belgium, Norway, Sweden, Denmark, Germany and Italy.

California, listing 6,000,000 inhabitants, or nearly half of the entire population of the West, naturally leads the two groups of states in number of radio stations, with a total of 53. Washington has 25; Oregon 19; Colorado 15; Arizona 10; Montana, New Mexico and Utah have 8 each; Idaho 7; Wyoming 3; and Nevada 1. Of the big fellows — the 50,000 watters — three are located in California, one in Colorado and one in Utah. According to "Broadcasting's" 1940 Year Book, 41 stations installed in the West are equipped with Western Electric transmitters — more than any other standard make. All in all, 550,600 watts of power are shooting out over the ether supplying the West with its broadcasting fare.

What a job of sculpturing and painting Nature turned out when she fashioned this section of the country. If the natives go wild over their spectacular landscape, thousands of tourists from all parts of the United States, who travel westward each year, echo these sentiments with unstinted praise. You can't beat it for scenic beauty seems to be the popular verdict.

No wonder the West goes in for superlatives when it can trot out such masterpieces as the Grand Canyon, Glacier National Park, Yellowstone, Carlsbad Caverns, Gypsum Cave, Crater Lake, Shoshone Falls, Great Salt Lake, Mt. Rainier, and Grand Coulee, Boulder, Roosevelt and Bonneville dams.

Crisscrossing, like shiny white ribbons, through these wonder spots are 50,088 miles of highway traveled each year by some millions of tourists. The United States Travel Bureau gives as a conservative figure 2,000,000 traveling west annually from east of the Mississippi.

Fabulous wealth is buried here, for the land fairly oozes gold, silver, copper, lead, zinc, petroleum, asbestos, manganese, tungsten. Even helium, platinum and the rare and priceless radium are packed away in its treasure chests.

Grains, vegetables and fruits grow in abundance, for large tracts of arid land have been transformed into fruitful acres by the great dam projects and irrigating systems. On plains and mountain sides huge herds of cattle and sheep graze — meat packing is a leading industry and the wool clip ranks high. Salmon packing likewise boosts the West's revenue considerably, since fisheries, centering at the mouth of the mighty Columbia, are among the largest in the world. Here, too, is located the largest lumber market in the country — Washington and Oregon leading all states with their prolific output.

Last, but not least, the West has Hollywood, the largest film production center in the world. From an entertainment angle, Hollywood holds a dominant place in American broadcasting. The program which has topped all others in popularity for more than two years running originates at the movie capital — its star, that winning, wheedling, bad boy Charlie. This fantastic land of make-believe might be termed the melting pot for movie and microphone stars, with broadcasting drawing on the screen for many of its headliners and vice versa.

Compared to other sections of the country, the West ranks far above the average in buying power. Today, the Pacific Coast leads in retail sales as the nation's No. 1 per capita market. In 1938 retail sales in California, Nevada and Wyoming hit the high mark of $400 per capita, the only other state to reach this sales level being New York. The 11 states averaged $333 per capita — $55 per capita greater than the average for the entire country. Total retail sales for these states amounted to $4,634,430,000 — 13 per cent of the country's total retail sales figure.

Getting down to station net sales which come closer to broadcasters hearts — or should one say

(*Continued on page 25*)

WFTL

Fort Lauderdale, Florida

By FRANCIS G. CARROL,
Chief Engineer

Eight months ago, on December 3, 1939, WFTL, Fort Lauderdale, Florida, went on the air. One month before that, the spot on which the station's beautiful building now stands was an empty plot of ground. In that one month WFTL grew from a set of blueprints to a radio station complete in every detail with the finest in broadcasting equipment installed in a modern, beautiful building.

The construction of a station that is new in every respect permits the builder to follow an ideal plan much more closely than would be possible if he were merely remodeling an existing structure or installing a station in a building already standing. This was exemplified at WFTL in the laying of the ground system under the building, which is located a distance of only 15 per cent of the tower height from the nearest tower leg. First the foundation footings for the building were poured. Building construction was then suspended while that portion of the ground system which would be under the finished building was laid. The ends of the radials across the footings were anchored to the footing forms and six feet of wire were buried at each anchor point.

On the footing for the tower, 22 feet square and 2 feet thick, rest the four supporting piers which rise about seven feet to a point six inches above the average ground level. Around the tower base, as an anchor for the tower end of the radials, there is a four-

Topping the panel of photographs is WFTL's new home located 25 miles from Miami. Next in line is the reception room—the doors opening into sound lock studio A which is shown below. Left: Control room housing Western Electric 310B transmitter.

inch strip of copper, grounded to each tower leg and to the eight-foot copper-clad steel ground rods, two of which were driven under each leg before the concrete was poured. To this strip are welded 120 quarter-wave radials, each of which has an eight-foot ground rod at its far end. Interspersed with these are another 120 radials ending at a distance of 15 per cent of the tower height from the tower base. Circling the tower at this point there is another copper strip to which are soldered all of the long radials as well as ends of the short ones. Altogether about 24,000 feet of No. 10 copper wire are in this ground system, buried six inches in the ground.

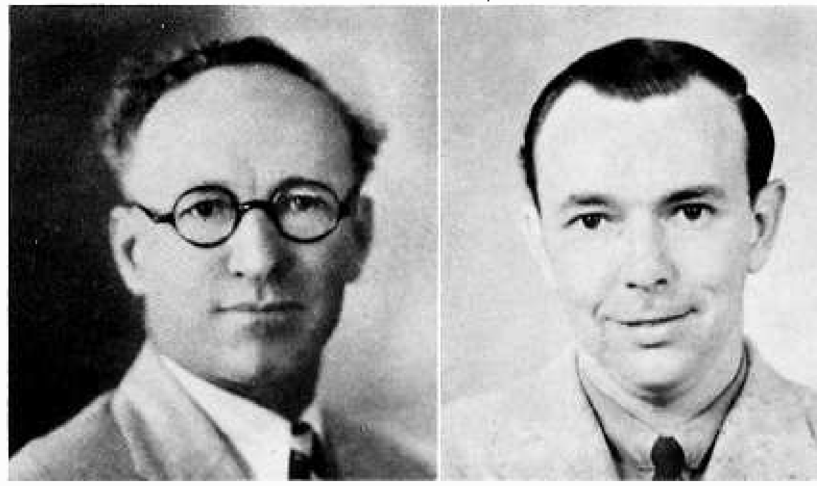
In the building, which was designed to provide a setting for all of the facilities necessary for the operation of a broadcasting station, are transmitter-control room, studios, reception room and offices. No expense was spared to provide the maximum of operating convenience, efficiency, comfort and beauty.

In the control room, the operator's desk directly faces the Western Electric 310B transmitter which, with two racks of speech input and auxiliary equipment, appears to be mounted in the wall. Actually, this wall is made up of the equipment, two removable plywood panels and two doors. This method of mounting not only provides the maximum of accessibility to the rear of the equipment, but also provides space for a workshop in the rear as well as a neat, pleasing appearance in the front.

The rack to the left of the transmitter mounts the 110A program amplifier and two 94D monitoring amplifiers. One of the 94D's is for "air program" amplification for six 750A loudspeakers in the control room, reception room, audition room and offices. The other drives the same loudspeakers for auditions.

The air program monitor amplifier is driven from the audio output of the 310B transmitting equipment which is padded for proper level into the 94D. The audition amplifier is driven from a 117A amplifier with three channel mixing for auditions. Two-position keys installed at the input of all three input circuits to the audition amplifier permit six inputs to be handled on audition.

Robert M. Tigert, general manager, directs the activities of WFTL from this attractive office with glass brick wall.



Tom M. Bryan, owner and operator of the station, is one of the oldest settlers of Fort Lauderdale. Francis G. Carrol, chief engineer, spent several years at WJNO, West Palm Beach.

The cabinet at the right of the transmitter houses the frequency monitor, deviation meter and modulation monitor.

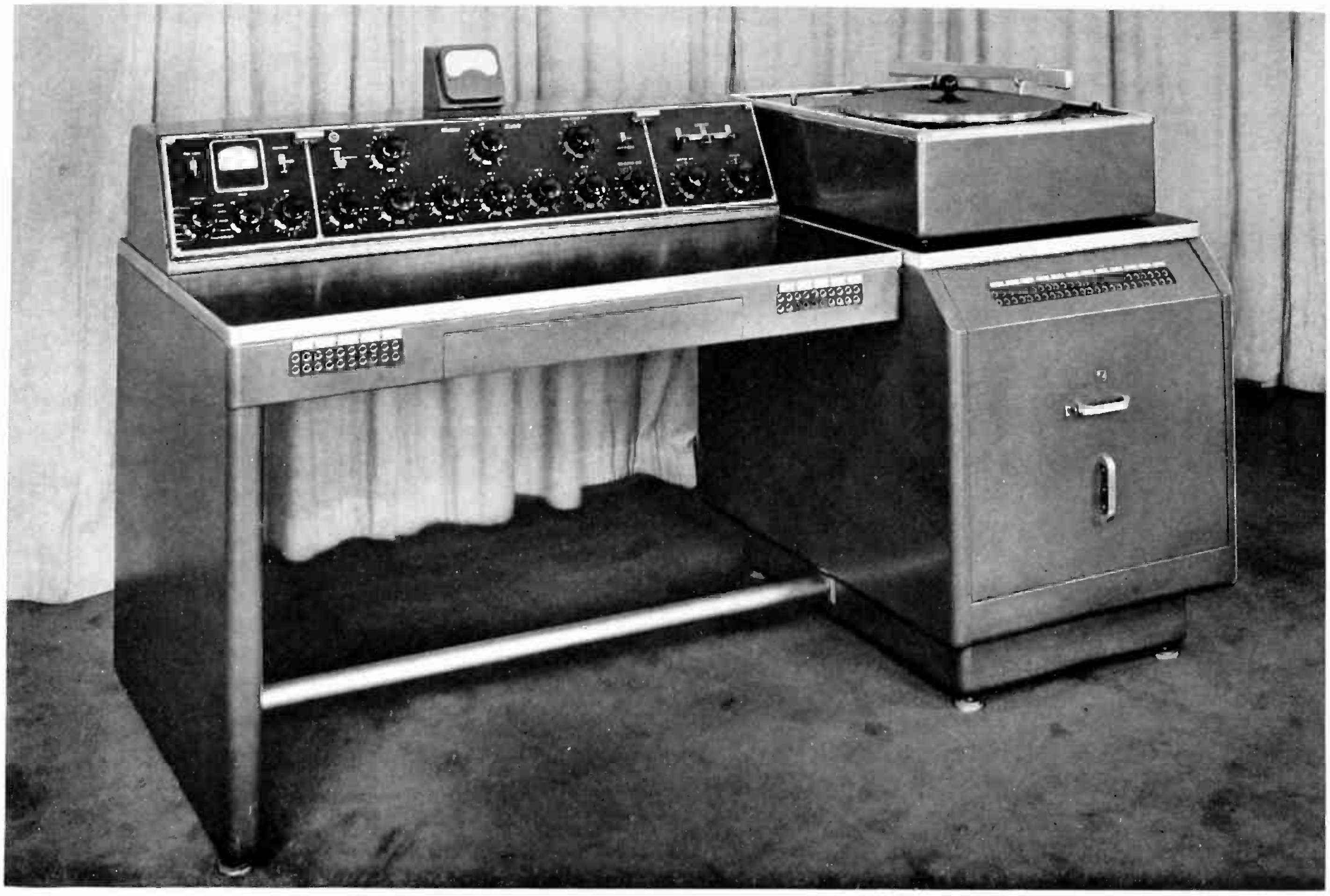
Mounted on the control desk are a 23B speech input console, two small desk type cabinets and two 300A turntable assemblies, complete with 9A reproducers. A small 78 r.p.m. turntable for sound effects records is also on the desk directly behind one of the 300A reproducer panels. The pick-up on the 78 turntable has an output high enough to be run permanently into one of the line inputs. The 300A turntables mount flush with the desk top, one on either side of the operator. They are turned so that the operator does not have to reach across either pick-up to cue transcriptions. Since this position places the motor switches of the 300A's out of easy reach, separate mercury contact switches are installed on the sides of the desk on either side of the operator.

The 23B console is wired with mixers 1 and 2 controlling microphones in the two studios. Auxiliary microphone channels installed in each studio and in the audition room and terminated at the jack panel, provide for extra microphones in the studios and allow the audition room to be used as an auxiliary studio. Mixers 3 and 4 are connected to the 300A turntables. The other sides of 3 and 4 are open for any other input.

In the cabinet on the left of the 23B the jack-strip mounts 96 jacks which handle all remote lines as well as all microphone and transcription circuits. All but the remote lines are wired through back-to-back, closed-circuit jacks so that, with a straight studio set-up, there are no patch cords on the panel. However, any signal source may be patched to any input on the 23B or the 117A audition amplifier for a special set-up.

Under the jack-strip is mounted a 279 A

(*Continued on page 17*)



WOR Installs Custom-Built High-Quality Speech Input System Designed for FM

By J. E. TARR
Commercial Products Development, Bell Telephone Laboratories

The use of wide-band frequency modulation in ultra-high frequency broadcasting promises a new order of system performance through substantial improvements in frequency range, signal-to-noise ratio and freedom from distortion in the "radio link" between the speech input terminals of the transmitter and the detector output in the receiver. Commercialization of these potential improvements will make possible realization of the full range performance capabilities of other system elements.

The first Western Electric synchronized frequency modulation broadcasting transmitter installation at Station WOR, which is expected to play an important part in demonstrating the capabilities of the new modulation system, was therefore felt to warrant the provision of speech input equipment giving performance superior to that of any heretofore used commercially. This equipment was shown as part of the synchronized frequency modulation demonstration equipment at Bell Telephone Laboratories in June, and while it was inspected there by many readers of "Pick-Ups" it is felt that a more complete discussion of its design and construction will be of general interest to the field.

This equipment was custom-built. The choice of facilities provided, the arrangement of controls and several of the new circuit features are largely the work of E. J. Content of Station WOR who co-operated with the Laboratories in its design and testing. The flexibility inherent in the basic design not only fulfills practically any set of requirements which may be met in present-day broadcasting practice but also any which seem likely to arise through the application of frequency modulation.

Apart from the special features required to meet specific requirements at WOR the fundamental design of this equipment was aimed at the following broad objectives:

1. Wide Frequency Range — from 30 to well beyond 15,000 cycles
2. Adequate Net Gain — ample margin over normal requirements to promote ease and flexibility of operation
3. Improved Signal-to-Noise Ratio — a

close approach to theoretical limits throughout the normal range of control adjustments, and better than 60 db at normal gain

4. Adequate Overload Margins — ability to deliver normal program level over a wide range of control adjustments and with uniformly low harmonic distortion
5. Simplicity of Control—maximum compatible with full operating flexibility of a complex system
6. Maximum Reliability — ability to deliver program even during partial equipment failure
7. Advanced Mechanical Design — compactness without sacrifice of accessibility for servicing; clean-cut, modern appearance and flexibility to permit assembly of equipment in various ways to meet various operating requirements
8. Use of Standard Components — the desk assembly is composed of standard apparatus available from the Western Electric Company
9. New Basic Structure—harmonizing with modern steel studio furniture design, with the probability that structural units of this type will be standardized

The basic system design is conventional, although certain departures were made in order to meet the specific requirements of Station WOR. An eight-channel parallel mixer is used to accommodate six studio microphones, electrical transcription and incoming program line respectively. The microphone and transcription circuits are equipped with two-stage pre-mixing amplifiers (120A Amplifiers) while the line position has a variable equalizer, repeating coil and pad and a key for selecting either of two lines. A single key controls all microphone positions as a group and controls the studio speaker relay as well.

The mixer is followed by regular and emergency main amplifier channels in duplicate; each of these channels includes a two-stage low-level amplifier (120A) and two-stage high-level amplifier (121A with two-stage connection) with a master gain control between them, and the "Regular-Emergency" keys, yoked together so as to operate as one key, permit shifting instantly from one main channel to the other in case an emergency should develop during a program. The low-level amplifier and master gain control of the emergency channel are also used in the talk-back circuit described below, being made available automatically for this use when the "Regular-Emergency" key is in the "Regular" position.

The output from either main channel feeds a resistance bridge network which divides the output power in predetermined proportions among the volume indicator, a monitoring output and the program bus, the latter output being under control of the three-position output key whose auxiliary functions are described below. The function of the bridge design in

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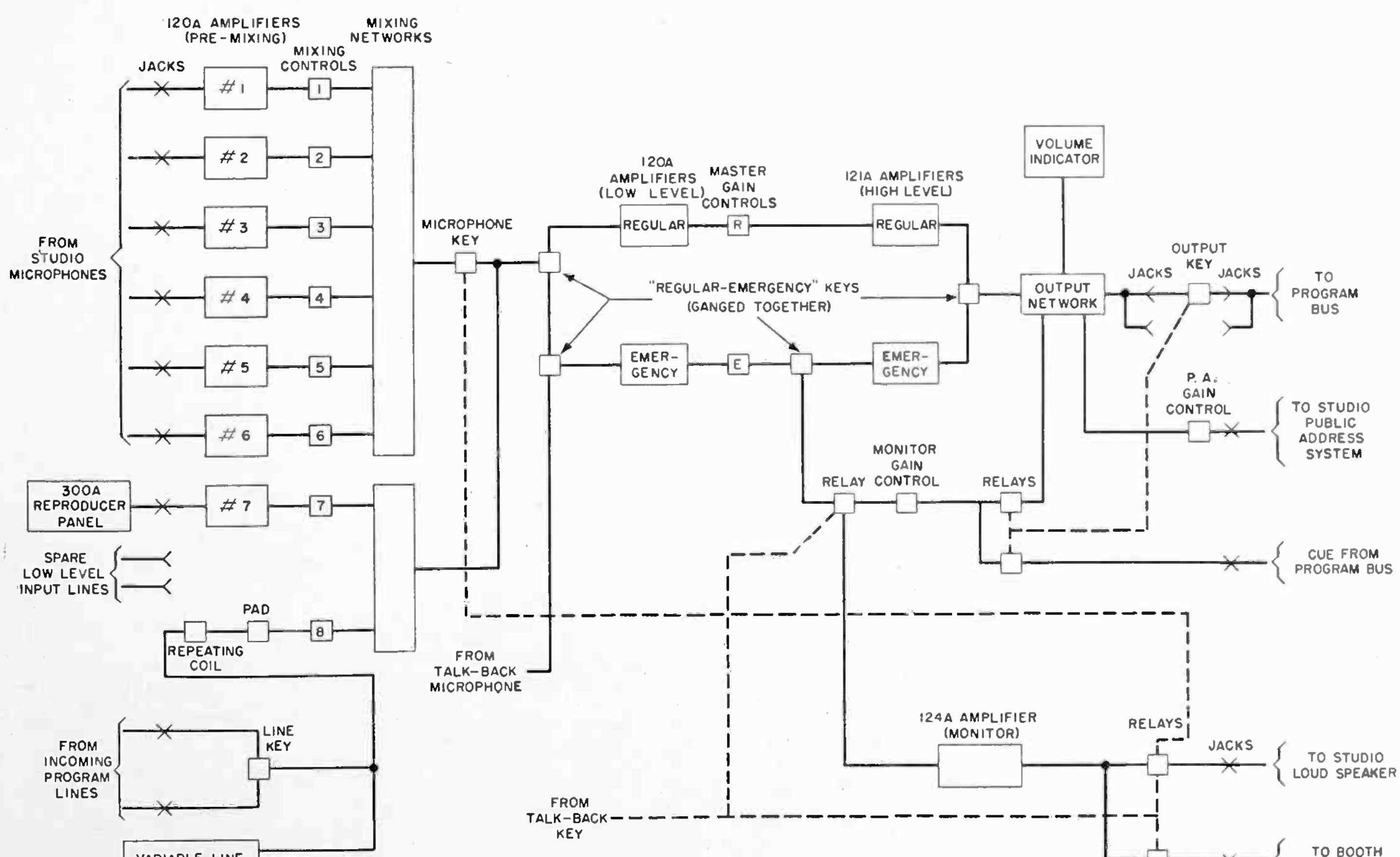


Block schematic of custom-built desk speech input equipment

Cedric V. Davey

Roy M. Flynn

Nathan Wilcox

KRLD—50 KW

Dallas, Texas

By ROY M. FLYNN, Chief Engineer

Our transmitter has been in operation about 10 months and we have had quite an experience here in Dallas. Besides having an entirely new type of transmitter, with directional antenna, all of which were new to us, we had the misfortune to lose the top section of one of our antennas. During this experience it was necessary for us to become well acquainted with the high efficiency amplifier by being compelled to retune this unit under conditions which were far from the best.

Up to the time of our antenna trouble, we naturally had made checks on the tuning of this unit and were well pleased with the ease of handling and the stability of the amplifier. We did not fully appreciate the flexibility of the Doherty Circuit until we were forced to make an emergency change from the directed antenna to a single tower in the shortest possible time. When our tower fell the branching circuit was changed and the transmitter ready to go in approximately three hours' time. This time could have been cut in half had there not been the usual confusion coupled with trouble of this nature.

At the present time it is necessary for us to run 10 KW from local sunset until midnight. This change is made simply by lowering the plate voltage and driving until the proper antenna current is reached. Possibly this is not the best way to do the job but it is the simplest and as our distortion is well within the limits it allows us to make this change without any break whatsoever.

I believe that anyone can see from the above that we are well pleased with the unit. We would not hesitate to recommend the Doherty Amplifier to anyone.

As to the life our tubes, it is still too early to form any opinion as to their normal life due to the fact that the original tubes are still operating satisfactorily.

KTUL—5 KW

Tulsa, Okla.

By NATHAN WILCOX, Chief Engineer

The operating procedure of the Doherty Circuit is disgustingly simple. You turn the transmitter on in the morning and log the meter readings every half hour. These might well be rubber stamped because they are always the same unless you purposely change them. At the end of the broadcast day you shut the transmitter down and go to bed with a peaceful mind because you know that tomorrow is going to be the same as today. In fact, after 16 months' operation, we are still waiting for something to happen.

Maintenance night — Ah! Now we'll find out something because this is done after one o'clock when you can do things with the carrier — modulation — things that are not permissible during the broadcast day. Well, I'm afraid that you are due for a great disappointment because maintenance night on a Doherty transmitter consists of going over the transmitter with a vacuum cleaner — blower and dust rag. When this is finished you can check the distortion and noise. We do this because we think that perhaps it will indicate when a tube is getting old. But after 9,500 hours' operation with a filament voltage still considerably below normal we are beginning to have our doubts. The same results are obtained — week after week — month after month.

Noise is minus 64 db below 100 per cent modulation and distortion 1.2 per cent at 400 cycles. Occasionally we make an overall frequency run — reading the results on the db scale of our modulation monitor. Our oscillator has a range from 20 to 16,000 cycles. The transmitter is within one db over that range. Possibly this is one of those so called straight curves we hear so much about.

I have had to demonstrate this a few times and if anyone is doubtful I'll be glad to accommodate him if he desires to stay up after one o'clock. Most any night will be perfectly satisfactory — and you won't have to notify me in advance because this is one

They Elect the Doherty Circuit For Better Broadcasting

transmitter that stays put — and doesn't need to be prettied up either mechanically or electrically before a demonstration.

When the transmitter was first installed we checked the oscilloscope patterns about a dozen times a day. After a few weeks' operation this became somewhat of a chore, especially since we always obtained the same patterns. If you want to change the patterns — go ahead and change them. It will still operate with them all cockeyed. In fact you can change nearly everything on the front panel without disturbing the operation to any great extent. Of course, it will make a difference in the distortion and noise measurements. But the difference is hardly noticeable on the air. If the patterns are a little off we don't worry much about it any more. Our chief worry is in getting the audio quality to the input of the transmitter — good enough quality so that the transmitter can really demonstrate what it can do.

Last year we lost approximately six minutes actual air time. Part of this was due to power failure. I do not feel that my operating staff is any better or worse than that of the average commercial broadcast station. If this is true, then certainly the equipment should get a large share of the credit for trouble free operation. Of course the transmitter is quite a lot cheaper to operate, not only in power costs but also in tube replacement expenditures. But every good engineer already knows this fact — so it is not news anymore.

There is one important feature about this transmitter that 15 years' operating experience has taught me to respect. That is the fact that it has a Western Electric nameplate on the front. That nameplate is more than just a symbol or trade mark. To me it means that there is an organization behind it — an organization of trained men who have thought things out — designed them — played with them — built and rebuilt them. When I get a piece of equipment with that nameplate I know that it will perform as stated — not just today or tomorrow under ideal conditions but day in and day out under ordinary service conditions.

I know that the men comprising this organization do not forget a piece of equipment once it has been put in production. They keep working with it and if they do make new discoveries or changes that will give better, more efficient operation, I know that these men — the organization behind that nameplate — will see that I am informed of those changes and modifications instead of sending me an announcement of a new model that will render my present equipment obsolete or wholly out of date.

The romance of operating a Doherty transmitter ceases the day you complete the installation and put it on a regular operating schedule. But does it — I wonder? True the honeymoon days are over. But there is still romance — romance in knowing you have something that will remain consistent day by day — week by week — month by month. Romance in the ultimate realization that you have something that is economical — beautiful — something that looks good and sounds better.

If I had it to do over again I would make the same choice I made two years ago when I decided that our new transmitter would be a Western Electric Doherty.

KQW — 5 KW

San Jose, Cal.

By CEDRIC V. DAVEY, Chief Engineer

Installation of our new transmitter at KQW went ahead with enthusiasm and discussions centered mainly on the Doherty Circuit. Questions were raised — many of them. How did it work? Was it hard to tune? Would it be critical in adjustment? Would it maintain that adjustment or require constant attention? What about tube life?

Installation completed, equipment and connections checked and re-checked — tuning began. Finally the high point of the job — the first test was at hand. Fire it up, check the tuning, check the oscillograph pattern on the Doherty. Check the plate current on the peak tube, the carrier tube. Re-check everything. Modulate with tone — 10, 20, 50, 80, 100 per cent. Crack! Kill the power. What happened? A cracked insulator — voltage too high. The condition corrected, further adjustments made, tone applied, pattern checked, feedback adjusted, plate currents and antenna currents re-checked and all was well.

Now can it take it? Let's see. Hit it hard. It can. Anything show any signs of breaking down? No, not a thing. Let's have music — perfect. Shut it down — start it up — check those relays — try it again. Man, it works and how! Start program tests? Why not? It's stable, signal clear, quality excellent, hum way down. Manual and mechanical operation precise.

Thus on October 24, 1939, KQW came on the air with a new signal to serve its listeners with the most modern facilities that radio engineering provides.

Time and experience have proved this

(*Continued on page 25*)

New Hampshire Police Covers State with 1 KW Transmitter

First police installation of new type single unit transmitter provides broadcast quality and coverage.

By R. V. FINGERHUT

A few months ago a red flag or a lantern, hanging from gasoline station or roadside restaurant in New Hampshire, was a signal to the state trooper who patrolled that road that police headquarters in Concord was trying to get him on the telephone. Today, there is a radio receiver under the dashboard of that trooper's car and he receives his instructions clearly and distinctly, direct from headquarters, without moving from his seat.

This important change dates back to December 14, 1939, when the New Hampshire State Police Radio System took over the task of providing instant communication between headquarters in Concord and 43 patrol cars which, day and night, constantly rove about the highways of the state.

A map of New Hampshire shows the state in the form of a right-angle triangle about twice as high as it is wide. In the southern portion where the land is relatively flat are located most of the towns and cities and the greater part of the population. To the north the terrain becomes more mountainous until the point is reached where the White Mountains, with some of the highest peaks on the Eastern seaboard, lie across the state from east to west. This mountain range cuts off the northern tip of New Hampshire, a sparsely settled area consisting of about one eighth of the state's total of 9,031 square miles.

To cover this huge area, the state police uses one 1,000 watt transmitter, a Western Electric 443A-1, the first of this new single unit type to be employed for police radio. From the capital city of Concord this one transmitter, operating on 1682 kilocycles with the call letters WRPT, sends a clear signal to practically every portion of the state. This means that the signal covers an area approximately 8,000 square miles in extent.

Before the advent of police radio in New Hampshire, when headquarters wanted to send a message to a trooper in a patrol car it was necessary to telephone to a number of points on that trooper's route. At these points, usually gas stations or diners, arrangements existed with the attendants who, when such a call came in, hung out a red flag during the day or a lantern at night. When the trooper happened by such a point and saw the signal it was necessary for him to leave his car and telephone to headquarters in Concord for his instructions. Much valuable time was lost by this method of communication, ranging from 15 minutes on short patrol routes to over an hour on long ones.

Today, with police radio on the job, as soon as a report of trouble is received at headquarters the dispatcher flips a switch and puts the message on the air. Immediately a patrol car is on its way to the scene. In addition to actual emergencies, troopers all over the state are kept up to the minute on stolen car reports, wanted and missing persons, accidents and crime of every kind.

The information which is thus sent out comes into headquarters by three different mediums, teletype, telephone and personal visits. In the dispatching room are two teletype machines, one of which is hooked into a three-point circuit of Concord, Manchester and Nashua. The other machine is the New Hampshire terminus of a seven state network joining together the state police headquarters of New York, New Jersey, Delaware, Pennsylvania, Massachusetts, Connecticut and New Hampshire. Through these tele-

Above: Colonel George A. Colbath, Superintendent of New Hampshire State Police.

Chief Radio Communication Engineer Basil Cutting adjusts the level into the Western Electric 443A-1 transmitter.

Center: The voice of Dispatcher Daniel Ahearn is well known to every one of New Hampshire's mobile troopers.

Right: Transmitter building on the outskirts of Concord, showing transmission line and portion of antenna tower.

type machines comes a never ending story of stolen cars, hit-and-run accidents, wanted persons and other cases, any of which can be put on the air in an instant's time.

In addition to the patrol cars the police radio system makes this information available to many communities throughout the state. In at least 13 towns and cities, receivers in police stations or sheriff's offices, constantly tuned to WRPT, keep the local law enforcement authorities up to date on police news.

The best way to appreciate the improvement that has been brought about by the new police radio system is to get into one of the black cars with the "State Police" license plates and spend a few hours patrolling the beautiful New Hampshire countryside. The trim, green-clad troopers who drive these cars up and down the highways are best able to tell how radio has made their task easier, has enabled them to do a more efficient job of policing the state.

Listen to the stories your trooper-driver will tell about cases solved with the aid of police radio. To him they will probably be commonplace, uninteresting cases such as stolen cars recovered in a few hours because the troopers on the roads knew they were missing almost as soon as their owner did — or hit-and-run drivers caught within a few miles of their crime. But before the days of radio, your informant will tell you, these cars might have been hundreds of miles away, well hidden or completely disguised, before a report was in the hands of the troopers.

Or he might tell you of the difficulties formerly encountered in covering automobile accidents, an important phase of state police work in this summer resort state whose motoring population doubles or trebles when vacation season rolls around. Instead of arriving at the scene of an acident in a matter of minutes, as is usually now the case, often a trooper would be increasing the miles between himself and the accident while headquarters was trying to get him on the telephone with the old signalling system. This meant that many times when the trooper did reach the scene of an accident, victims and witnesses alike had disappeared.

The radio equipment which has made this improvement possible is surprising in its compactness. The equipment at police headquarters in Concord consists of an 89A amplifier, 116A amplifier and 633A salt-shaker microphone. Controls on the 89A amplifier permit the dispatcher to turn the carrier on and off, send out a tone signal and talk to the cars. At the transmitting station the single unit 1,000 watt transmitter takes up only 40 x 44 inches of floor space while the auxiliary control equipment easily fits on one small table.

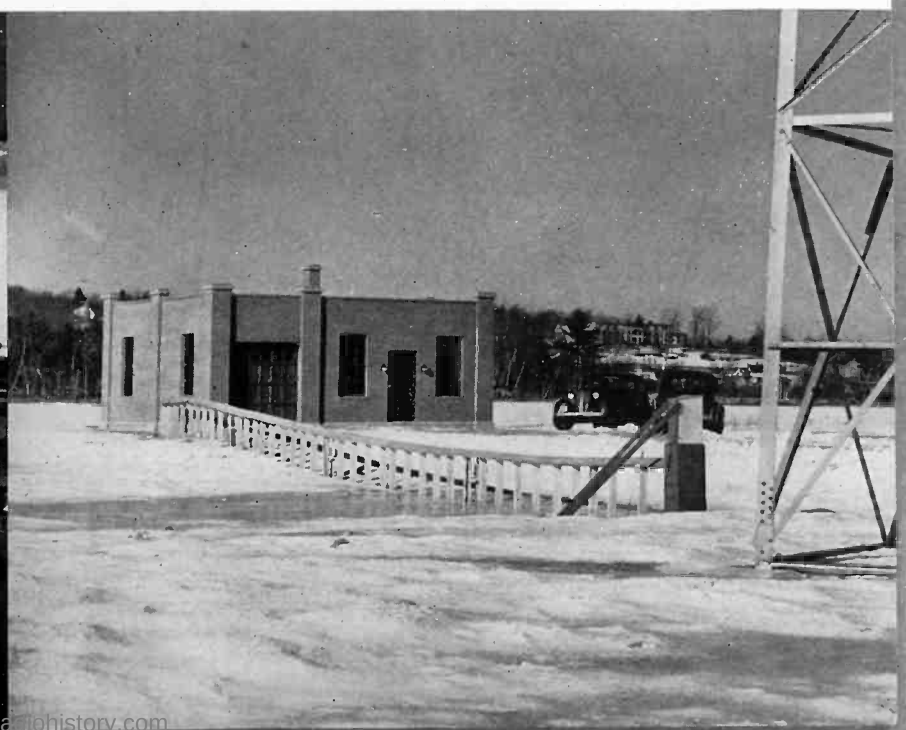
The transmitter building is located just outside the city on a clear, level tract of land which 30 years ago was the site of the annual state fair. It is a one story brick structure containing, besides the transmitter room, a combination garage and service room, a lavatory and a spare room which, if necessary, could be furnished to provide living quarters for the transmitter operator. In the basement is an oil burning heating plant and a compact 10 kilowatt emergency power unit.

In the transmitter room the neat and compact 443A-1 transmitter is the center of attraction. Directly in front of it stands the control desk on which is mounted an 89A amplifier, 116A amplifier, loudspeaker and modulation indicator. A 633A microphone provides for communication with the patrol cars from this point.

Outside of the building the half wave, shunt fed antenna rises 325 feet into the air. This 12-ton Blaw-Knox unit rests on a 30-ton concrete base, unusually large because of the softness of the moist soil. The ground system consists of 320 radials 325 feet in length and the same number of 50 foot radials interspersed. A one-inch coaxial transmission line connects the tower with the transmitter through a D-99418 antenna coupling unit.

Every precaution has been taken to prevent the failure of normal facilities from taking the transmitter off the air. The emergency power plant will take care of any power failures. The speech input line from headquarters as well as the telephone line

(*Continued on page 22*)



New Low-Powered Transmitter for Broadcast, Police and Emergency Services

A new low-powered radio transmitter, designed by Bell Telephone Laboratories for broadcast, police and emergency communication services, is the most recent addition to Western Electric's line of modern broadcasting apparatus. Operating in the range of from 550 to 2,750 kilocycles at a power output of either 100 or 250 watts, or both, the new equipment has been designated as the 450A-1 (100 watt), or the 451A-1 (250 watt) radio telephone transmitting equipment.

Incorporating a number of electrical and mechanical refinements, the new transmitter features unusual economy of operation and maintenance. Low power consumption, low tube cost, surprisingly little time and effort for maintenance, and freedom from breakdowns are important advantages of the new unit.

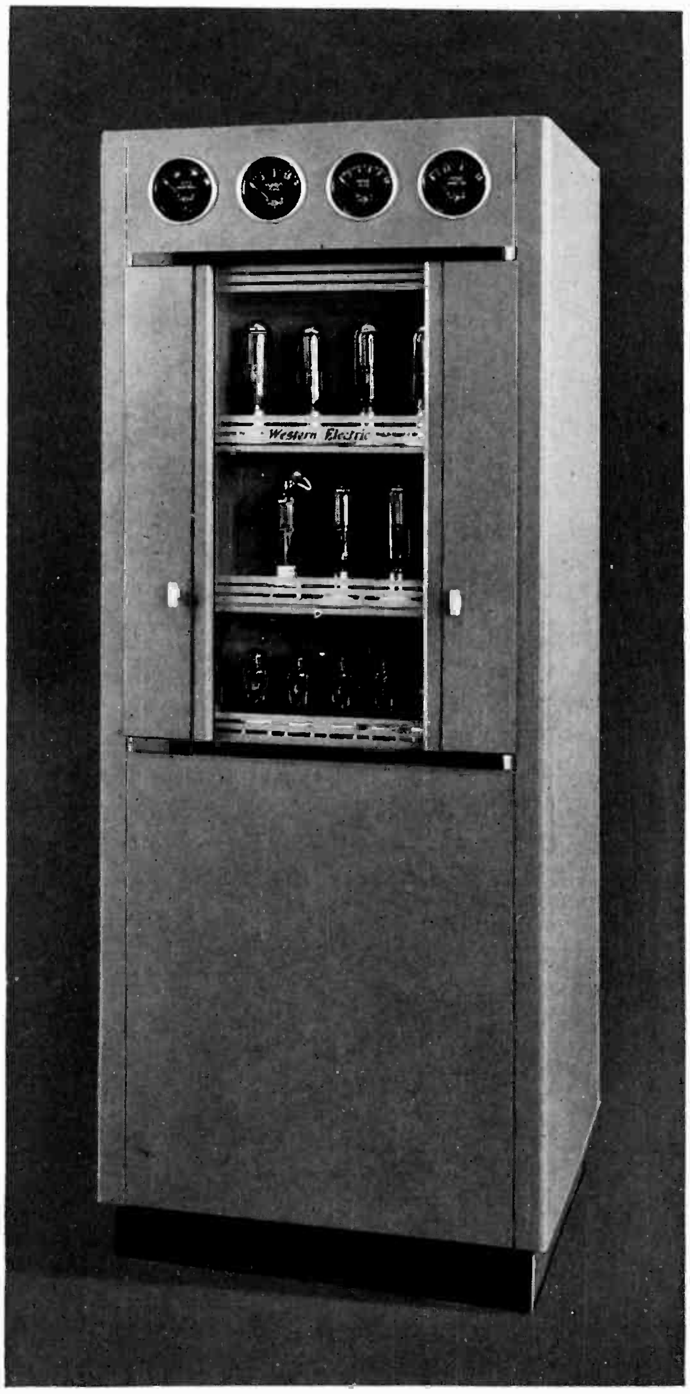
Many improvements are also to be found in the circuit, particularly the newly designed grid modulated power amplifier which requires only a minimum of circuit adjustments.

The nominal output ratings of the new transmitter are 100 and 250 watts. For 100 watt service only, four final stage tubes are used. For any station operating 250 watts day time and 100 watts night, power change equipment is furnished.

The carrier frequency is maintained well within 10 cycles of the assigned frequency by means of the low temperature coefficient quartz plate mounted within the temperature controlled chamber of the 702A oscillator. This oscillator, used in all recent Western Electric transmitters, is followed by three tuned radio-frequency amplifiers, the last of which is grid bias modulated. The tubes of the last stage are arranged in push-pull, and the output circuit may be coupled directly to an antenna or to a transmission line.

The ability to take high program levels is an outstanding feature in this equipment. The modulated amplifier is designed to carry over-modulation peaks without a sharp increase in distortion and without damage to circuit components or tubes. This is a direct result of Bell Laboratories' continuing development and research in modulation systems and associated over-all stabilized feedback circuits.

The transmitter has a frequency response that is flat within $\pm$ 1.5 db from 30 to 10,000 cycles per second. Typical measurements of r.m.s. audio frequency harmonic distortion show less than five per cent in the frequency range of 30 to 7,500 c.p.s. and less than three per cent in the frequency range below 5,000 c.p.s. — all measurements at 100 per cent modulation.



New Western Electric 100-250 watt transmitter

The r.m.s. noise level of this equipment is 60 db or better unweighted and 70 db weighted below signal level at 100 per cent single frequency modulation.

No radio frequency harmonic greater than 0.03 per cent (voltage) of the fundamental is radiated. This corresponds to better than 70 db below the output at the fundamental frequency.

The new unit operates from a 200-240 volt, single phase, 60 cycle power supply, (50-cycle equipment can also be supplied, if desired.) A self contained voltage regulator provides for operation from any primary voltage over the range of 200 to 240 volts. The power consumption of the 100 watt 450A-1 transmitter is 1,250 watts, while that of the 250 watt 451A-1 is 1,750 watts. The power factor is approximately 90 per cent.

The mechanical construction of the new transmitter follows the most modern practice where simplicity of control and accessibility of parts have been developed to a high degree. All electrical components are assembled on a central structure of vertically mounted steel plates. Practically all wiring is on the flat surfaces where each wire is easily accessible and each component is available for servicing without interference from any other part. These features have been brought over directly from the 443A-1 (1 KW) amplitude modulated and the 503A-1 (1 KW) frequency modulated radio transmitters.

All tuning and operating controls and a test meter with its associated transfer switch are mounted on narrow vertical side panels. In most cases the controls are directly coupled to the associated apparatus. Wherever electrical requirements demand an extended drive, a rack and gear system is used. This gives a positive and smooth operating control with no backlash. Since all controls are mounted on the main central structure and are installed and mechanically adjusted at the factory, considerable time is saved in the field installations.

The mechanical design of the transmitter greatly facilitates installation and subsequent inspection and maintenance. Assembled on the central structure, all of the apparatus when received is fully exposed. After completing the usual installation work, including connections to power line, antenna, speech input and other units, the cabinet is fastened in place. This is done by simply hanging the front and back doors and screwing the two side panels to the main structure.

While the principal function of the cabinet is to give the equipment an attractive appearance, care has been taken to see that it affords the operating personnel convenient access to the apparatus components. The full length door in the front gives complete access to the components on the front side of the main structure, while the large door in the back opens for access to the apparatus located on the rear side of the panels and to the heavy power supply transformer, coil and blower mounted on the frame base. The large front door is electrically interlocked with the control circuit so that power is removed as it opens. The two small side doors, behind which are the controls and meters, can be opened at any time without affecting operation of the transmitter.

The new equipment is extremely compact. It measures only 30 inches wide, 28 inches deep and 76 inches high, and weighs approximately 1,000 pounds. The cabinet, styled by the well known designer Henry Dreyfus, is finished in an attractive gray with trim of satin chrome.

WFTL, Ft. Lauderdale, Fla.

(Continued from page 9)

equalizer panel. This is patched to multipled jacks for remote broadcasts.

The cabinet to the right of the 23B console houses the 117A audition amplifier and mixer and the 754A volume indicator panel. The volume indicator, used for auditions and also for line equalizing, can be patched to any circuit from the jack panel.

639 type microphones are used in the studios for program pick-ups. On the announcers' desks, both in the studios and in the control room, are 633 type microphones.

For all remote broadcasts 22 type portable speech input equipments are employed.

There are two studios at WFTL, one on either side of the control room. Studio "A" is approximately 25 by 35 feet in size, while Studio "B" is about 25 feet square, both with ten-foot ceilings. Walls and ceilings of both studios as well as the control room are finished in vari-colored acoustic material. The studios have proved more than adequate for every type of broadcast, including a 50-piece band and a chorus of 105 children.

Tom M. Bryan, owner and operator of WFTL, is one of the oldest settlers of Fort Lauderdale and is in every sense a pioneer, having built the first ice plant and the first electric generating plant and distribution system in the city. WFTL marks his first entry in the broadcasting field.

Clipped from the May, 1940, issue of Pick-Ups and mounted on a wall of the control room at the WOR-Mutual Playhouse, this illustration of the six directivity patterns of the 639B cardioid microphone serves a double purpose, according to Playhouse Manager Harry Miller. It serves as a stopper for the enthusiastic production men with definite but mistaken ideas as to how the new microphone should be used. And for those who don't know anything about it but insist on learning, this layout provides a simple explanation.

One of the new 21-passenger Douglas DC-3's leaving Santa Monica, California, to join the Mississippi Valley Fleet.

On hand to check installation of Western Electric Radio equipment is Clarke Jones, Communications Superintendent.

Chicago and Southern Equips Mississippi Valley Fleet with Western Electric Radio

A fleet of 1940 Douglas airliners, connecting the Great Lakes with the Gulf Coast, was launched by Chicago and Southern Air Lines, May 1st. Equipped with the most modern devices for safe and comfortable air travel, these luxury transports are winging up and down the Mississippi Valley in the short span of six hours. The Company terms this Valley Fleet of theirs the "missing link" on the air travel map of the United States since it offers new Douglas service to St. Louis, Memphis and Jackson with important east and west plane connections at these points.

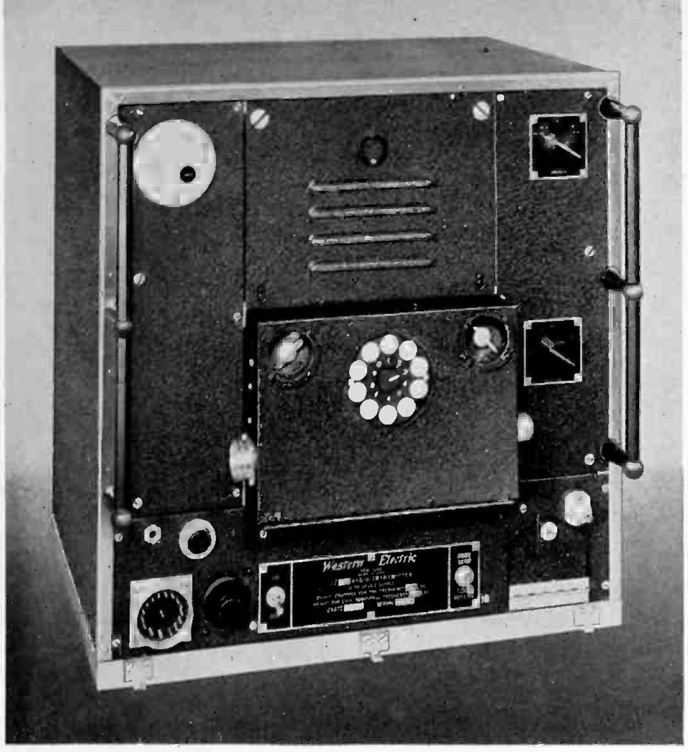
On each of the 21-passenger Douglas DC-3's the following Western Electric radio equipment is installed: for two-way voice communication with ground stations the 13C transmitter and 12D receiver; for airway beacon facilities the 14B and 27A beacon receivers. These radio units together with 631A microphones, 1019A headsets, assure Chicago and Southern pilots of reliable radio facilities at all times.

From a shoestring beginning, as the Pacific Seaboard Air Lines back in 1933, Chicago and Southern in seven years has become one of the major transport companies of the country's domestic network of airways. During this period of rapid growth the Company has established an outstanding record in operating one of the most efficient communication systems in the air-transport business. Back in 1936 when the line purchased 10-passenger Lockheeds, Bruce Braun, operations manager, selected Western Electric radio equipment for all planes and the chain of ground stations located at Chicago, St. Louis, Memphis, Jackson and New Orleans. The ground station equipment includes 14B transmitters rated at 400 watts and ES-192 crystal controlled receivers operating on one of two frequencies—one day and one night.

During the past four years Chicago and Southern's communication department has handled more than 500,000 radio messages and plane contacts. With the new Douglas service it is estimated that the number of messages and contacts will be doubled during the coming year.

The year 1940 has been a momentous one for the entire aviation industry. Air transport companies throughout the country were shooting at a record and hopeful airmen waited with fingers crossed for March 26 to arrive. The day came and with it the jubilant announcement that no fatal accident had occurred on any air line in the United States for one year. Not even a serious mishap marred this perfect safety record — the first in aviation's fast moving history. Furthermore, airmen hit this safety bulls-eye during a year which included a particularly severe winter. The air transport companies estimate that they flew 814,906,250 passenger miles; 87,325,145 plane miles and that their ships carried 2,028,817 passengers.

In speaking of this outstanding achievement, Clarke Jones, Chicago and Southern's superintendent of communications, paid tribute to the performance of Western Electric radio equipment when he said, "The perfect safety record of domestic airways of this country was largely due to the efficiency of the air carriers' communication systems."



The 27A transmitter (above) is equipped with as many as 10 pre-tuned crystal controlled operating frequencies. The 29A receiver (right) is a highly selective, crystal controlled unit.

Multi-Channel Aviation Radio Equipment

To provide for the increased communication requirements of modern long-range airliners, a multi-channel aviation radio telephone system has been developed by the Western Electric Company. This equipment has more than twice the power of previous systems and, with provision for telephone, telegraph and facsimile operation, is designed for future as well as present aviation communication needs.

The transmitter, known as the 27A, is equipped with as many as 10 pre-tuned crystal controlled operating frequencies. The tuning units are mounted on a rotating turret which is driven by the multi-purpose dynamotor mounted in the transmitter. This dynamotor also drives the ventilating fan and supplies the audio plate and bias voltages. The transmitter can be tuned to any type of plane antenna and is capable of delivering in excess of 125 watts of carrier power at any frequency between 2,000 and 10,000 kilocycles and somewhat lower power at frequencies up to 15,000 kc. Low frequencies may also be added to provide operation in the 300 kc-500 kc band.

The companion unit, the 29A receiver, accommodates up to ten pre-tuned fixed channels, all in one band or scattered throughout the entire frequency range of the receiver — from 2,000 to 15,000 kilocycles. When transmitter and receiver are used together, a mechanical coupling, geared to the turret of the transmitter, switches both units simultaneously.

The 29A is a high quality receiver, with a signal-to-noise ratio of 6 db up to 10 megacycles and 5 db from 10 to 15 mc. It has a sensitivity of 1 microvolt for 50 milliwatts output at 30 per cent modulation and its frequency response is flat within ± 2 db from 250 to 3,000 cycles. The small amount of power required to operate the receiver— 4.2 amperes at 12 volts or 2.2 amperes at 24 volts — is supplied by a power unit mounted directly in the receiver itself.

The equipment is extremely simple to operate. The number of controls in both transmitter and receiver has been reduced to the minimum — a feature that is of importance to busy pilots and radio operators. Both remote and local control are available, with the same operating features for either condition. With remote operation, transmitter and receiver are simultaneously controlled from a small switching panel mounted on the plane's instrument board. This control is accomplished electrically, requiring no mechanical cabling or rotating shafts between the remote panel and the equipment. One switch on the control unit gives the pilot a choice of any one of the 10 receiving and 10 transmitting frequencies. A second switch converts the equipment for telephone, CW or MCW telegraph, or facsimile operation. An "on-off" switch, and a toggle switch for "send" and "receive" when employing telegraph, complete the controls.

When either transmitter or receiver is to be used alone a separate electrically operated remote control panel may be supplied for each unit or, if desired, local control can be employed.

Careful attention has been given to all design details affecting maintenance. All connections are made through plugs mounted on the front panels, and test meter jacks, also on the front, give ready access to those portions of the circuit requiring measurement. When the equipment is installed remotely, all of the maintenance work, including the final transmitter tune-up, can be performed without entering the cockpit of the plane.

New Speech Input at WOR

(*Continued from page 11*)

the output network is to provide mutual isolation among the three outputs so that the attenuation and source impedance for each are independent of the terminations on the others; this feature serves further to localize any trouble which might develop and to insure true volume indication and monitor response even when the output is fed to a reactive load such as an equalized program line.

Jacks are provided in all input circuits to permit interchange of pre-mixing amplifiers in emergencies, and at all important junctions in the high level circuits to facilitate maintenance and testing; however, the system is designed to provide all normal operating functions without patching and thus to minimize operating errors and maintenance difficulties associated with extensive use of patching cords.

With the exception of the main power switch and transcription controls, all operating controls are located on the hinged control panel. In accordance with WOR's practice the optimum grouping of important operating controls was given careful attention.

Moreover, whereas the same basic operating functions could have been provided at about the same cost with fewer amplifiers but with more complicated control circuits, this would have resulted in a system inherently less flexible and more subject to operating errors; the system design was therefore based on liberal use of amplifiers wherever operating control could thereby be simplified.

Primary operating controls are grouped in the center section of the control panel where they occupy a lateral space of about 25 inches. The six microphone mixers and the regular master gain control are placed in that order along the bottom where their frequent use justifies the location most convenient to the operator. Above them are the transcription and line input mixers and the emergency master gain control, a little less convenient perhaps but still directly before the operator. The common microphone control key is at the upper right corner and the main output key, made conspicuous by its red handle, at the upper left surmounted by a lone indicating lamp which lights when the channel is put "on the air" by the master control room operator.

The extreme end sections of the panel are used for controls of secondary importance. At the left are the milliammeter and switches for reading plate currents in all pre-mxing, low-level and high-level amplifiers, together with the incoming line selector key, the single control dial of the equalizer which is calibrated directly in db loss at 1000 cycles, and the equalizer range key providing a choice of two equalizer frequencies. The "Regular-Emergency" key group is near the top of the right end section, directly above the monitor and public address gain controls referred to below.

The monitor tap on the main channel output network feeds two independent gain controls through a dividing pad. One of these controls is for feeding a studio public address system whose volume is thus controllable independently by the booth operator. The second control is connected to the local monitor system.

A high-gain monitor amplifier (124A) is included to drive the booth and studio speakers. A system of relays associated with this amplifier provides for cue monitoring of a preceding program, local monitoring of a program being originated through the equipment with studio speaker cut off during microphone operation, and local monitoring with talk-back during rehearsals. These functions are controlled primarily by the output key which operates as follows:

In normal program operation the output key is in the "Program" position, where its auxiliary contacts operate the relays to monitor the program being originated; this is heard through the booth speaker and, except when the microphone key is closed, in the studio speaker also. The talk-back system is disabled during program origination to guard against accidental talk-back operation interrupting the program on the air.

When the studio is standing by preparatory to beginning a program the output key is left in the "standby" position, which terminates the system output and operates relays to monitor the program which is nearing completion; this "cue" is heard over both studio and control booth speakers even though the microphone key is closed, so that the operator, to start the new program, need only throw the output key to "Program" in order to connect the system out to the program bus, give indication to master control, switch the monitor to the local program, cut the studio speaker and operate the studio warning light.

During rehearsals the output key in the "Rehearsal" position normally terminates the system output, although this key can be bridged by a patching cord if the rehearsal is being recorded from the program bus; the output key in this position also prepares the talk-back relay circuit for operation by either foot-switch. The talk-back relays, when operated, (1) connect the monitor amplifier input to the output of the emergency low-level amplifier, whose input is already connected to the booth microphone, the main channel switch being in the "Regular" position; (2) cut the booth speaker and (3) connect the studio speaker.

The relay circuits provided for these functions are so designed that the complex circuit operations are performed automatically in the sequence required for noiseless operation.

No talk-back key is included in the equipment proper, but the control circuit is brought to terminals for use with two externally mounted treadle-type foot-switches for use by the operator and production man.

Auxiliary relay contacts are also arranged to give indication in master control when the channel is "on the air" and the microphones connected to operate studio warning lights.

A single channel turntable is included primarily for sound effects and spot advertising transcriptions. This is a standard 300A Reproducer Panel, rubber mounted in a special shallow enclosure to sit at convenient operating height on the wing at the right of the desk structure.

This panel is, of course, equipped with the standard universal (9A) reproducer for both lateral and vertical recordings, two-speed motor for both 33⅓ and 78 r.p.m., and universal equalizer circuit providing a total of seven response curves.

Power and output connections are made at the rear of the enclosure through plugs and receptacles so that the turntable unit may be removed readily.

Two standard 18A Rectifiers are included to supply filament and plate power to the premixing and main channel amplifiers. Each rectifier carries one main channel and half of the pre-amplifiers, so that even complete failure of one rectifier would leave the system capable of normal operation with three microphones.

The monitor amplifier includes its own power supply equipment.

No low-voltage rectifier is included, since a 12 volt bus is used at WOR to operate relays and signal lamps throughout the plant. An individual local rectifier could, however, have been included.

Failure of the relay power supply during a program would not interfere seriously with operation since the studio speaker is "off," the booth speaker "on" and the monitor circuit connected for normal operation when all relays are at rest. The use of dual-contact (U-type) relays exclusively provides additional assurance of reliable relay performance.

The pre-amplifiers are mounted behind and below the control panel, and their tubes are readily accessible for replacement by opening the hinged panel. The latter operation also permits ready access to all control panel equipment and wiring for testing and servicing.

Internal and external wiring of the pre-amplifiers is accessible by removal of a light steel cover under the pre-amplifier compartment.

All other major components are mounted in the equipment drawer and wired through flexible cables to permit opening the drawer for ready inspection. The rectifiers and monitor amplifier are at the sides of the drawer, their wiring protected by removable bakelite cover plates. The four main channel amplifiers are carried by a hinged gate at the top of the drawer; raising this gate reveals their wiring and facilitates removal of rectifier and monitor amplifier tubes.

The desk structure itself is fabricated of sheet steel in three sections: the table proper, the thin leg at the left and the equipment drawer.

These units are made with concealed knock-outs so that they may be bolted together in various ways. For example, the equipment drawer could as well be placed at the left and the leg at the right, instead of as shown; two legs and the table section would make a more compact assembly for use where rack space is already available for the more bulky units; or two equipment drawers could be used if a more elaborate circuit calls for more amplifier mounting space, or if mounting space for two turntables is required in which case one drawer could be equipped to serve as a record file.

Moreover, since the basic structure is in the standard style of a leading manufacturer of steel office furniture, desks or tables of matching design for use by announcers or production men should be readily available.

The response frequency measurements from microphone input terminals to the system output show a response that is substantially flat to a point well beyond the range of audibility, thus minimizing resonance or transient effects which might result from a sharply falling response within the audible range.

This uniformity of frequency response may well appear remarkable in view of the fact that it represents the performance of three amplifiers totalling six stages in tandem and that stock amplifiers were used without special selection or equalization.

The variation of signal-to-noise ratio with varying gain adjustment as shown in Figure 1 also indicates a new order of system performance. The significant points here are (1) the close approach to theoretically ideal noise ratio at high gain settings, (2) the corresponding improvement in noise ratio as the gain is reduced by either the mixer or master controls to a value well within the most rigorous performance standards, and (3) the wide margin of available net gain, about 26 db, above that required to give reference output with the accepted normal microphone level of — 60 vu.

At normal gain unweighted noise levels obtained from the complete system are between 68 and 74 db below the single frequency tone level required for normal volume indicator reading. Since the

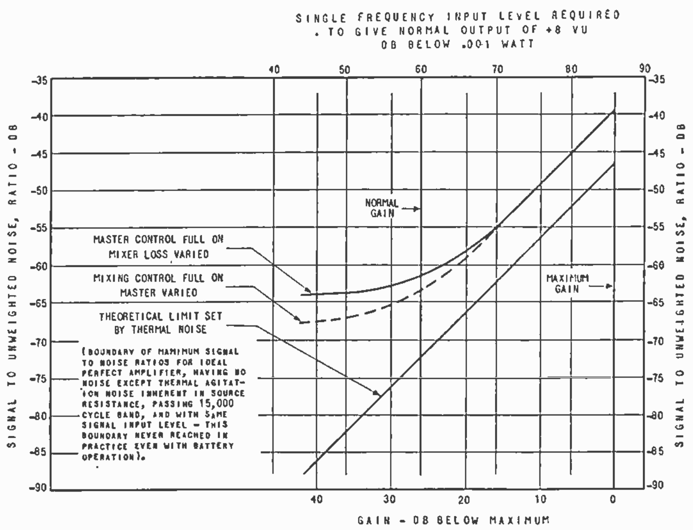


Fig. 1

Signal-to-noise ratio with varying gain adjustment

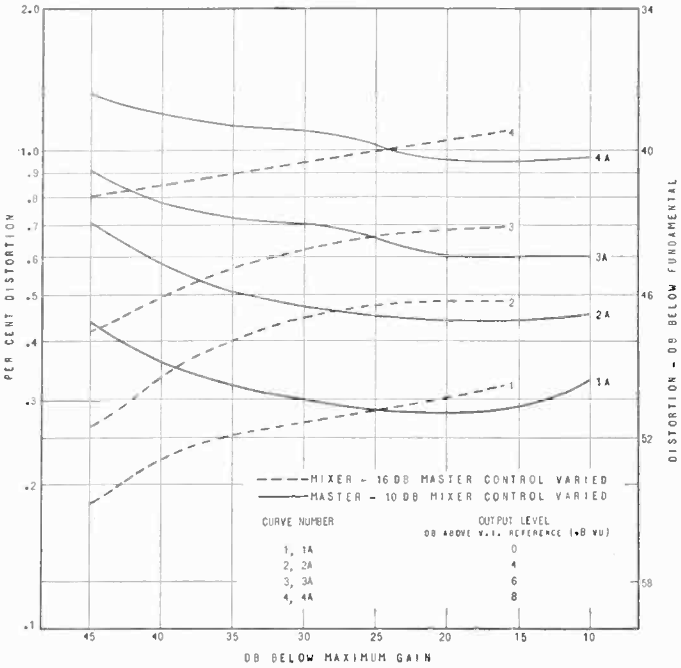


Fig. 2

Typical distortion characteristics for a 400 cycle signal

peak signal output on program material representing instantaneous complete modulation of an associated radio transmitter may run from 6 to 10 db above volume indicator readings, unweighted carrier noise attributable to the speech input equipment should run from 68 to 74 db below the complete modulation signal level under these conditions, affording a "dynamic range" commensurate with the most rigorous system performance standards.

Typical distortion characteristics for a 400 cycle signal are shown in Figure 2; this is in the frequency range where highest power levels occur in speech and music.

Measurements at other frequencies between 50 and 7500 cycles are much the same. For peak signal levels reaching 8 db above nominal output level the total r.s.s. harmonic voltage is in the order of 1% of the fundamental, and does not exceed 1½% even for abnormal gain control attenuations. For the great majority of peaks which will not exceed the rated single frequency output level, the distortion attributable to this equipment would appear to be negligible even in a frequency modulation system where most exacting requirements may prevail.

The excellent performance capabilities of this system and particularly the wide range of control adjustments which can be used without serious impairment of quality and signal-to-noise ratio are attributable largely to the careful design of the basic circuit, including optimum distribution of gains and losses, but primarily to the superior capabilities of the new standard amplifiers which were developed with a view to meeting the most rigorous system operating requirements of commercial broadcasting practice.

It is felt that many of the advanced features exemplified in this custom-built equipment will soon find application in everyday equipment designs.

New Hampshire Police Radio

(*Continued from page 15*)

are both run underground from the nearby highway. An amateur radio station at headquarters and another in the spare room at the transmitter building provide additional communication between these two points in cases of emergency such as the hurricane which in 1938 destroyed practically all wire communication in this section of New England. Both of these ham rigs were built by the station's operators, two of whom are licensed amateurs.

Everyone concerned with the operation of the new system is well pleased with the efficient manner in which it functions. Basil Cutting, chief communications engineer of the New Hampshire State Police, was a member of the committee which selected the equipment for the system. Cutting, now responsible in his official capacity for the performance of the equipment, is still positive the committee could not have made a better choice.

Although it is too soon to make comparisons of a "before and after" nature, the authorities are delighted with the results obtained with the use of radio. "One thing we can be sure of," asserted Colonel G. A. Colbath, superintendent of the State Police, "is that all delays in reaching the troopers have been eliminated. As soon as a complaint is received at headquarters a call is put on the air and, immediately, a trooper is on his way to the scene of trouble. This means that the time between report of trouble to headquarters and the arrival of a trooper at the scene has been cut at least in half, and possibly more."

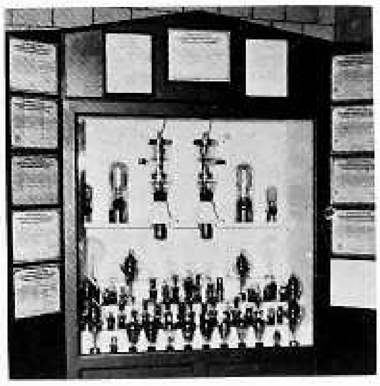
Walter W. McCoy, chief engineer of station WJAS, Pittsburgh, Pennsylvania, holds a 279A vacuum tube which was removed from the station's transmitter after 16,297 hours of operation. Although still functioning it was removed at the end of this period because the station feared it might fail and cause lost time on the air.

THEY DO IT THIS WAY

How do you do it? Pick-Ups invites engineers throughout the country to send in items for this page.

Tube Cabinet

The accompanying photograph shows a combination tube cabinet and license frame designed by the writer and built in the shop at our transmitting plant. It accommodates a complement of Western Electric tubes for our 335E-1 transmitter as well as tubes for the speech input equipment and various monitoring devices and a set of tower lamps. The bottom section holds additional tubes and lamps.



The engineer can tell at a glance that a complete set of spare tubes is on hand and he can select a tube quickly in an emergency without opening boxes and wasting time. Also when the FCC inspector arrives he can see that our tube quota complies with regulations. In addition it makes an attractive display of great interest to visitors.

HARRY H. TILLEY, Chief Engineer,
WEAN, Providence, R. I.

Panel Cleaner

Perhaps some of your readers will be interested in a good cleaner for "Western Electric Gray" panels. After trying for nearly five years to find a cleaner that really does the job, we stumbled across "Soil-Off," a product of the Soil-Off Manufacturing Company of Glendale, California. This cleaner removes all finger marks and scum and leaves a dull mat finish. We tried everything from soap and water to lemon oil, including automobile cleaners, and have found nothing, to our way of thinking, that compares with the "Soil-Off" preparation.

We trust that some of the "gang" will be interested.

E. R. ANDERSON, Transmitter Supervisor,
WOW, Omaha, Nebraska.

Servicing Faders

A simple and effective way of cleaning faders of the Daven type has been used at WOR for the past five years. This method was developed under the guidance of our maintenance supervisor, S. L. Davis.

The cleaning solution consists of two ounces of carbon tetrachloride and one half of one level teaspoonful of white uncarbolated petrolatum. Shake this well and let stand overnight. The solution is then ready for application. Remove covers of all faders to be cleaned and, with a small stiff brush similar to a baby's tooth brush, brush all faders with the solution, using about one immersion for each fader. Let the faders dry for two or three minutes, during which time wash your hands, making sure that they are thoroughly clean and dry. Then, slowly and with medium pressure, wipe over the contacts of each fader, using a clean finger for each fader.

As a matter of test, the writer likes to have a 1,000 cycle tone going through each fader during this operation. When noise gets down to a very slight click, as the arm goes from contact to contact, you are sure that there will be no noise on an air program.

HARRY B. MILLER
Engineering Dept., WOR, New York, N. Y.

Cleaning Recording Jewel

Did you know that a recording jewel can be cleaned of aluminum by first pushing it into some soft lead and then punching it into a piece of soft wood such as pine? It's a good idea, and very effective, to do that for all jewels that have gathered any foreign materials at all. However, unless there is metal in the accumulation, use only the soft wood treatment.

Every studio, at one time or another, is visited by an artist who requires very "special" attention. One, at WICC, demanded a microphone be placed just over the keyboard of a piano, at the proper height for singing. A suspended mike would not do as it would have to be adjustable not only for height but every which way, depending on the artist's moods — and boy how those moods could vary. The bill was filled to a nicety by a length of flexible gooseneck from a table or desk lamp, chromium plated.

GARO W. RAY, Chief Engineer
WICC, Bridgeport, Conn.

Selector Switch

One of the simpler gadgets at KGNC is a double-pole, double-throw selector switch connected across the incoming program line. The fact that positive and negative peaks on speech are unequal was noticed for two years before the fact became well known. With this selector switch the line can be reversed at will to maintain the correct polarity and permit heavier modulation. Contrary to expectation there is no pop or click when the switch is thrown since it "breaks" before it "makes."

H. W. BELLES, Transmitter Engineer,
KGNC, Amarillo, Texas.

KBIX

Muskogee, Okla.

The men behind the transmitter—Raymond Brophy, Engineer; Chief Engineer Lester Harlow and Earl Graves, engineer.

Located in the heart of the Indian country with the beautiful Ozark Mountains and Cookson Hills nearby and surrounded by farmland and industrial centers, KBIX, Muskogee, Oklahoma, has made a name for itself as the community service station. Today it serves over 37,000 families.

KBIX first went on the air May 1, 1936, using a frequency of 1500 kilocycles and a transmitter with 100 watts power. Before many months had passed it had won a staunch following.

Station officials contend that a radio station is not judged by the extent of its service area or power but by how it uses that power in serving the area. Recognizing this, KBIX has continued to stress local features of particular interest to its ever-growing radio audience. In addition, many outstanding national and state programs are brought to its listeners through the facilities of the Mutual Broadcasting System and the Oklahoma Network.

The Western Electric transmitting and studio equipment is combined into one efficient operating unit and is located on the ninth floor of the Barnes Building in the center of the business district of downtown Muskogee. On the roof of the building is the 179 foot Blaw-Knox self-supporting vertical radiator, topped by a 1000 watt beacon.

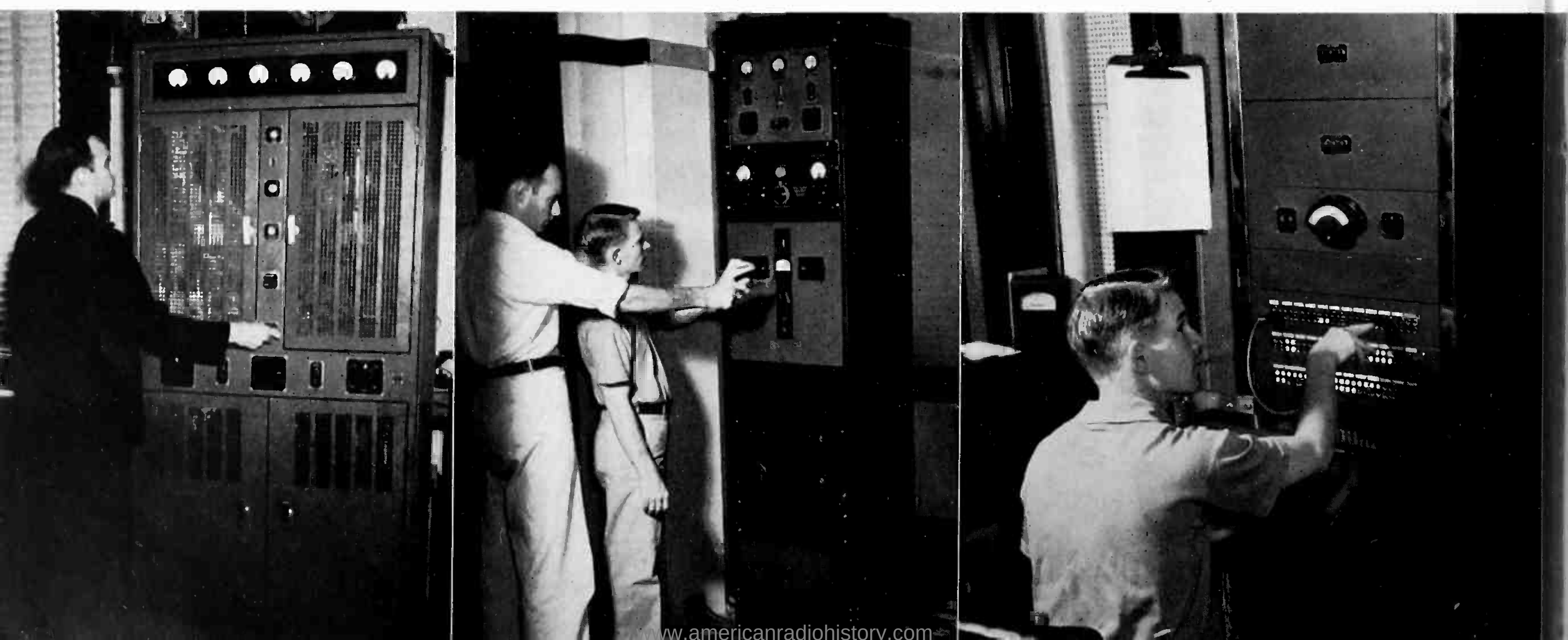
KBIX has two main studios. The manager's office is arranged so that it, too, can be used as a studio. In addition, a small studio is located in the newsrooms of the Muskogee Daily Phoenix and the Times-Democrat from which newscasts of local and national happenings are presented at frequent intervals.

An increasing schedule of local programs, added equipment and a demand for greater operating convenience made necessary a number of changes from the original set-up with the result that the control room was moved and enlarged and the equipment rearranged with only minor interruption of schedules.

The master control room equipment consists of a 701A speech input bay with a 267A control console and turntables equipped for vertical and lateral transcriptions. This equipment has been expanded by the addition of two 80B amplifiers and a 222A jack panel to accommodate the new equipment and an increased number of remote lines.

To the rear of the master control room is the transmitter room which contains a 310B transmitter, 110A amplifier, 1A frequency monitor, audition amplifier, monitor speaker amplifier, an interconnection panel and network termination facilities.

The lighting system is handled from the control room so that the engineer on duty may attract the attention of the occupants of either of the studios by blinking the lights. In addition, warning lights are



Chief Engineer Harlow checks the Western Electric transmitter. The Chief explains the controls on the panel of 110A amplifier to Engineer Brophy. Right: Brophy, at the speech input equipment, patches for a remote broadcast.

placed over the doors to the studios, the lights being operated by the microphone keys simultaneously with the microphones.

Remote pick-up lines extend to the Municipal auditorium, Masonic Temple, the leading hotel, theatres and athletic field. When a recreation project was formally opened to the public in a remote part of the Cookson Hills, a KBIX crew was on hand to carry the description of activities and speeches which were fed to a statewide network.

The man largely responsible for the progress and excellent rating of the station is Tams Bixby, Jr., vice-president and general manager. Mr. Bixby has been a life long resident of Muskogee and is thoroughly conversant with the needs of the community. He is actively connected with a number of civic enterprises.

The engineering staff consists of Lester Harlow, chief engineer; Earl Graves and Raymond Brophy, control operators. Other members of the organization are: Frank Rough, commercial manager; Mark Weaver, program director; Ed Edmonson and John Black, announcers and Naomi Warner, secretary.

They Elect Doherty Circuit

(*Continued from page 13*)

transmitter dependable. Stability excellent. Adjustment? Definitely not critical and certainly tuning the final by oscillograph proved easy and accurate. Maintenance from the standpoint of periodical readjustment and general servicing required, extremely low. Retuning — a rare necessity — usually only as a check on operation after cleaning. Frequency drift — negligible, within one cycle of assignment. Protection — the Doherty Circuit definitely proved itself for us when a heavy wind storm caused a momentary short circuit at the tower end of a transmission line. Result — no damage, trouble cleared and the business of broadcasting resumed immediately.

Equipment failures? Minor in nature and did not involve time off the air. For example: An arc-over on the jacks provided for oscillograph tuning made necessary the replacement of two jacks. Further trouble from this source prevented by increasing the number of turns on the associated RF chokes. An arc-over on the RF pick-up coil provided for the modulation monitor. Cure? Change position of pick-up coil and add more turns.

Tube maintenance costs? 4,000 hours of operation and tests show that it is still quite practical to run filaments of the final 343A's considerably under rated voltage and yet obtain the necessary emission for 100 per cent modulation. When will they have to be replaced? Maybe in another year or so we'll know.

Economy of operation with respect to the power bill? Results to date have fulfilled all expectations and have more than justified the claims for the efficiency of the Doherty Amplifier.

Shunt-fed directional antenna give any trouble? Despite a wide difference of engineering opinion as to its probable efficiency, a two element directional was installed at Alirso, California, ten miles north of San José, and proof of performance data supplied to the FCC shows operating efficiency comparable to that which was estimated for an insulated antenna of the same design.

And so . . . are we still sold on Western Electric? We are.

The Fabulous West

(*Continued from page 7*)

their pocketbooks — the West rang up $11,363,153 on radio cash registers in 1937. The industry as a whole pocketed $81,649,718 in net sales. Although these 11 states have less than one-tenth of the nation's population, they rolled up almost 14 per cent of the country's total station net sales.

The West has eight regional networks feeding their own groups of stations and, through the facilities of the big chains, relaying programs to many other sections of the country. These are: The Arizona Network; Arizona Broadcasting System; California Radio System; McClatchy Broadcasting System; Northern California Broadcasting System; Pacific Broadcasting Company; Z-Bar Network; and the Don Lee Broadcasting System, Mutual's outlet for the Pacific Coast. This last named network with its 31 stations is the largest regional network in the United States.

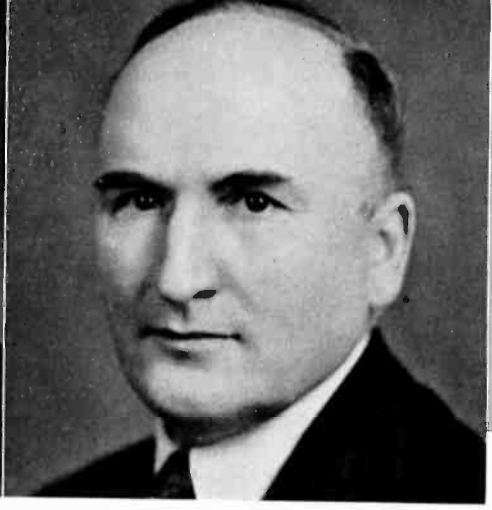
According to a recent survey these 11 states have added another "largest" to the long list of superlatives — 95 per cent of the families on the Pacific Coast own radio sets, the largest percentage of radio equipped homes in the country. This latest claim to fame must bring a sparkle to western broadcasters' eyes and a grin of satisfaction to their lips. The United States as a whole lists 82 per cent of families as radio set owners, while the western states together average 91 per cent. Of these radio fan families 2,053,000 are urban — 1,173,500 rural. Add them — and you have 3,226,500 families tuning in on radio programs. Using the 91 per cent figure as a basis, it is estimated that out of 12,500,000 people living in the West nearly 11,000,000 can be classed as radio listeners.

Naturally, families do not buy radio sets to decorate the living room. They buy because they want to listen to radio programs and they won't listen long if broadcasting does not cater to their tastes. Thus, it is a pretty safe bet to wager that western broadcasters, in chalking up such a large listener figure, are doing a bang-up job in satisfying the public's radio appetite.

NOTE: Statistics incorporated in this article were obtained from the following sources: Broadcasting 1940 Year Book, Radio Directory 1940, World Almanac 1940, Printers' Ink Monthly, September 1939.

Eugene G. Pack,
Tech. Director

Earl J. Glade, Executive Vice-president



Ivor Sharp, Assistant to the President

Willice E. Groves,
Chief Engineer

KSL's Old Voice Takes on New Timbre

By WILLICE E. GROVES, Chief Engineer

Keeping stride with progress, KSL, Salt Lake City, has recently completed a $150,000 program of modernization of its technical facilities. New from microphone through antenna, this progressive station has again boosted its peak of broadcasting excellence.

For seven years, a Western Electric 7A 50 KW transmitter has been doing a first class job of delivering KSL's programs to the homes of Western America, and, through its broad secondary coverage, to far flung reaches of the world.

However, the far sighted management of KSL quickly appreciated the advantages of the Doherty Circuit. After careful investigation, they recommended to the station's board of directors that the old 7A be replaced with new Western Electric 407A-4 equipment. At the same time, in order to bring all technical facilities up to the standards of this new transmitter, installation of a 455 foot vertical radiator and new speech input equipment throughout the station was recommended. The "green light" was flashed on June 9, 1939 and the 407A-4 transmitter placed on the air February 14 of this year. The new radiator was switched in on May 2.

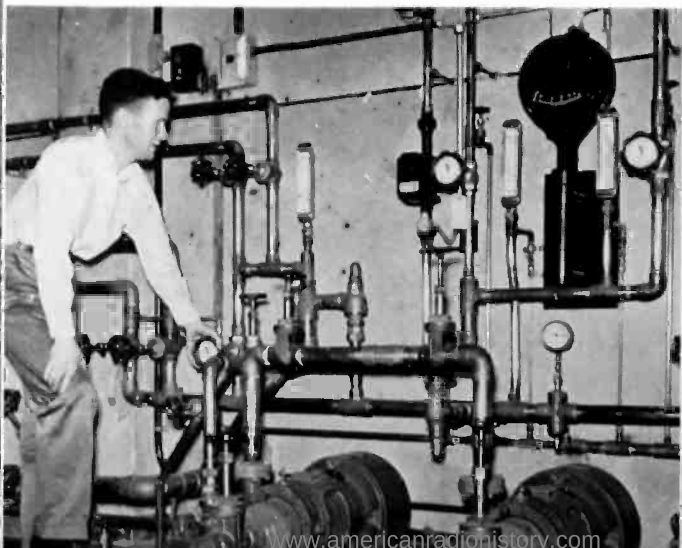
Inasmuch as Pick-Ups has covered other installations of the new Western Electric Doherty transmitter, only the unique features of the KSL installation will be described in the following paragraphs.

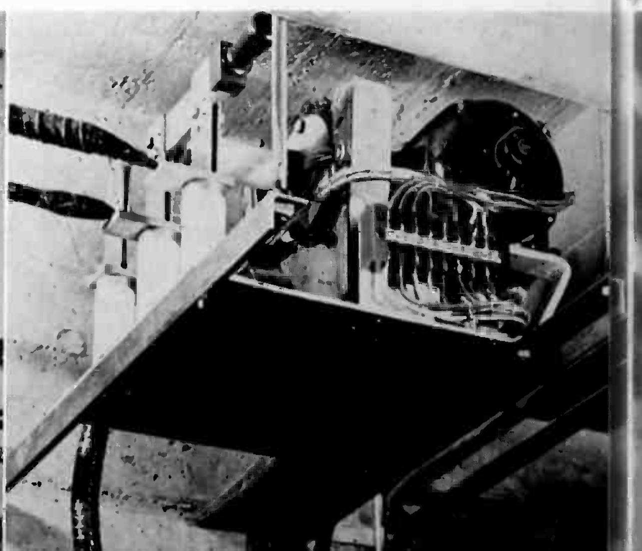
Thanks to the ample proportions of the transmitter building, as arranged to accommodate the 7A equipment, it was not necessary to construct a new building, or even to move major parts of the 7A in order to find adequate space for the new transmitter. Of course, the relatively small overall size of the new equipment had something to do with this accomplishment. Since the most desirable position for the new transmitter was directly over the original stair-well a new entrance stairway to the building was constructed. The net result was a distinct improvement in the appearance of the building and a very neat installation of the transmitter with a minimum of building modifications.

Supporting the front of the transmitter units, a hollow metal duct was installed instead of the usual oak base. This duct accommodates all of the wiring of the power and control circuits to the transmitter units. The bottom front style-strip serves as the cover for the duct. Removal of only six screws is necessary to obtain complete accessibility to the power and control wires when desired. Needless to say, this greatly simplified the original wiring of the units, and will materially assist if any future modifications are found desirable.

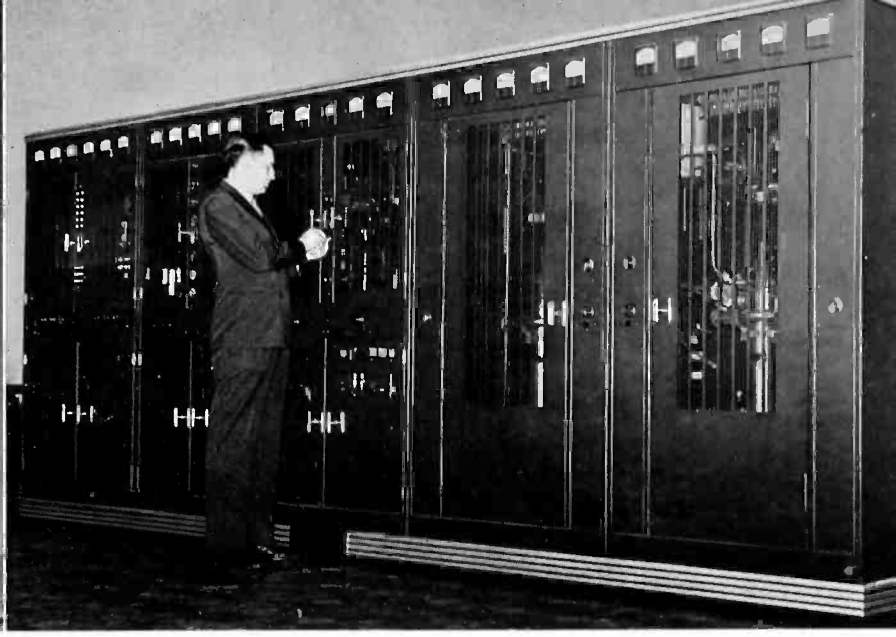
All high voltage wiring of the transmitter was accomplished by means of high voltage cable

Jay Wright, transmission engineer, shows novel method devised for laying transmission line above ground with accessibility to all parts. Cutler Miller, operator, adjusts the water at the "water switchboard." The motor operated high-voltage change-over switch used in cutting back to the 5 KW.





KSL transmitter building's new face and new 455 foot antenna. Circular structure at front encloses the new entrance stairway.



Willice E. Groves at the new Western Electric 50 KW which incorporates the Doherty Circuit. Groves supervised installation.

in conduit except for a very few open busses between the 50 KW rectifier and filter units behind the transmitter. Use of this cable permitted a neat installation without requiring the plate transformer vault to be directly under the rectifier unit.

The water cooling system was installed in an unusually compact arrangement. All water controls are located together in the form of a "water switchboard". From this central point, all adjustments to the water system may be made, as may log readings of all pressure gauges and thermometers.

The porcelain tubing for insulating the 50 KW amplifier sockets from the grounded portion of the water system was also installed in non-standard fashion. Instead of doubling the porcelain tubing back and forth to provide the necessary length, it was installed in a straight line along one wall of the building. A very simple and practical installation was thereby accomplished with a minimum of parts and joints. Should it be necessary to swab the interior of the insulating tubing at some time in the future, which is not beyond the realm of possibility, the straight-line assembly will simplify the task considerably.

The 407A-4 transmitter is equipped for cut-back to 5 KW by pressing a single push-button when it is necessary to work on the 50 KW amplifier or rectifier during normal operating hours. All circuit changes necessary for switching from 50 KW to 5 KW operation are accomplished electrically in three seconds.

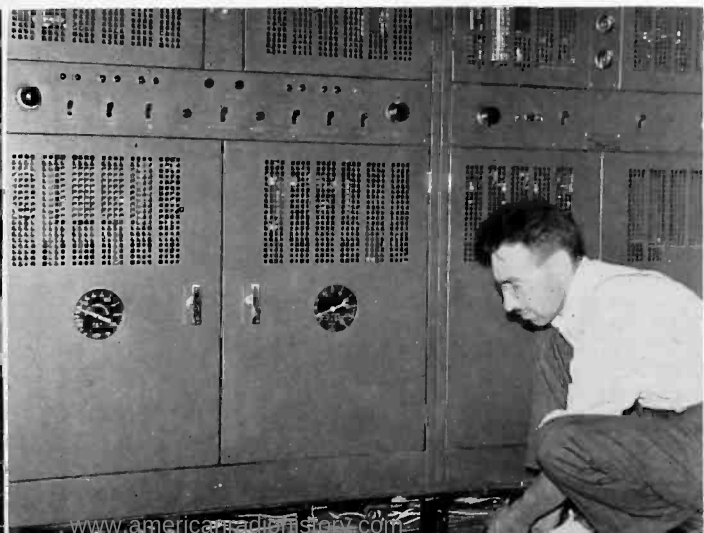
The new 455 foot vertical radiator is shunt-excited by means of a standard 62.5 ohm, 2⅝ inch concentric transmission line. The installation of this line is believed to be unique. As complete accessibility of all parts of the line was desired, burying of the line in the earth was not considered. From the standpoint of protection against several possibilities of damage, it was not desirable to support the line above the ground on T standards. A method of installing the line which combined adequate accessibility with adequate protection was devised.

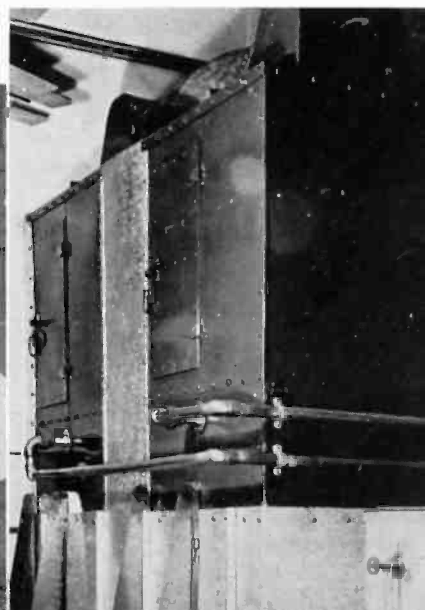
The bottom halves of split concrete irrigation pipe were laid between 2 by 4 inch redwood rails fastened together with redwood ties laid on the ground, like a railroad track. The pipe halves were then filled with sand, and the transmission line was installed on the sand. Order circuits and power wires were laid in the sand alongside the main line and the top halves of the pipe were replaced. The exposed surface of the concrete pipe was then sprayed with aluminum paint.

Sufficient heat insulation is provided by the concrete pipe and the aluminum paint so that no special differential expansion joints are required in the transmission line. Differential expansion is provided for by means of standard flexible connectors in the

(*Continued on page 28*)

Straight line assembly of porcelain tubing in the water cooling system (bracing at end is temporary). Rollow Kimball, operator, shows how style-strip cover is removed from wiring duct under front of transmitter. The photograph at the right shows the compact and efficient water cooling system.





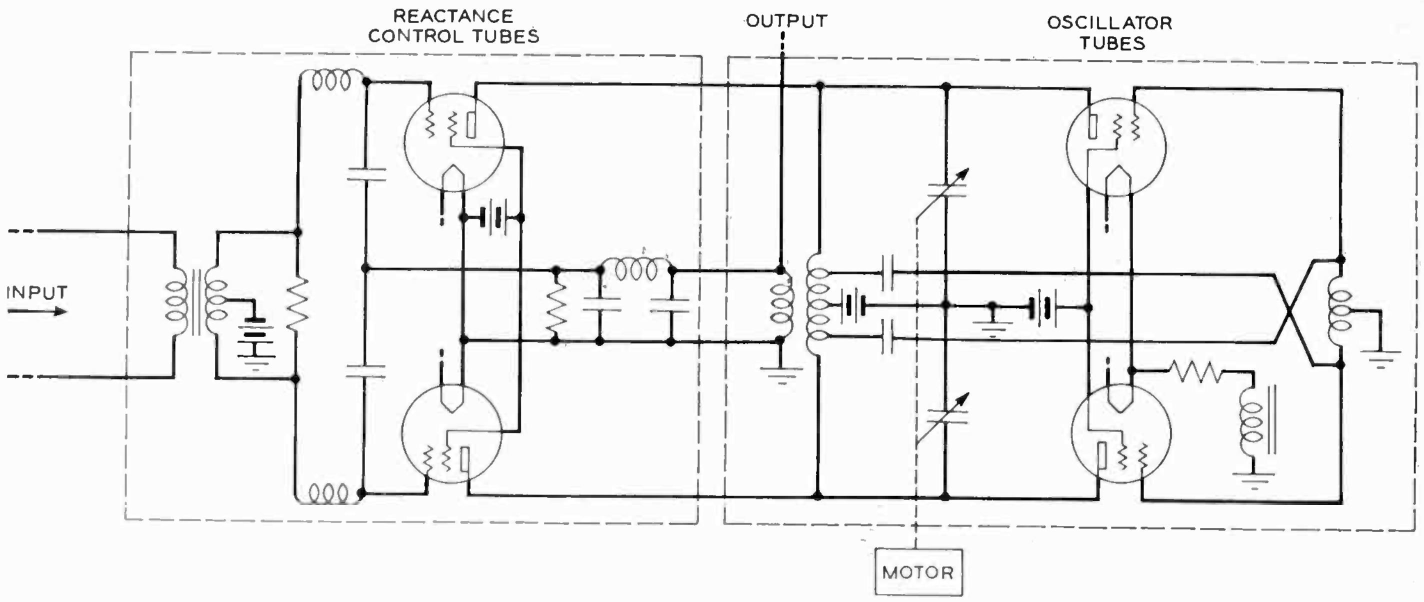


Fig. 3—Schematic of the frequency modulation circuit.

Synchronized FM

(*Continued from page 5*)

crystal oscillator, is completely external to the program-carrying part of the transmitter and no failure or mis-adjustment within it can have any influence on either the quality or the continuity of the transmission.

Frequency modulation holds such promise as a vehicle for high-quality noise-free broadcast service that no pains have been spared in producing a transmitting circuit design of extremely low distortion and background noise level. By modulating at a carrier frequency of five or six megacycles, where the phase deviations are large, the difficulty encountered at low initial frequencies from phase modulation due to power supply hum and microphonics is removed. In Synchronized Frequency Modulation, moreover, the complete separation of the two functions of modulation and frequency stabilization permits the use of push-pull reactance control tubes for modulating the oscillator, so that ripples in bias or plate voltage supplies do not modulate the frequency. The balanced circuit (Fig. 3) employed for these tubes and for the oscillator, together with other refinements in design, permit a frequency excursion of hundreds of kilocycles on either side with very low distortion.

Following the modulated oscillator in the 503A-1 equipment are four pentode stages, three of them being doublers, and all extremely simple in design. At the final output frequency two triode stages increase the power to 1000 watts for transmission to the antenna. These triode stages use the 356A and 357A, stemless and baseless ultra-high frequency tubes in the molded hard glass type envelope. The 357A is rated at 350 watts plate dissipation, with full voltage rating up to 100 megacycles. Two of these in the 40-50 megacycle range deliver 1000 watts for FM with great ease.

The 1-kilowatt broadcast transmitter in which the 357A tube made its debut a year ago introduced a new mechanical construction and an exceptionally attractive modern cabinet design. These features have been received so favorably for broadcasting and high quality police service that the same lines have been followed in this first commercial Western Electric frequency modulation transmitter. All apparatus is mounted independently of the cabinet; every part is immediately accessible for inspection or maintenance; all controls are protected by narrow side doors flanking the main door. The apparatus has been designed to give long and trouble-free life.

The new techniques and apparatus refinements that are made use of in Synchronized Frequency Modulation have been contributed by various departments of the Bell Laboratories. The co-ordination of these contributions into a practical and reliable system of frequency modulation generation and control is the work of J. F. Morrison. His associates at the Whippany Laboratory, in designing the 503A-1, have applied to their first FM product the results of long experience in the regular broadcast band.

KSL Installs New 50 KW

(*Continued from page 27*)

junction boxes at the ends of the line. The line is divided in the center and anchored at the two ends to take care of expansion of the outer conductor.

Although the transmitter has been in operation over four months, lost time due to transmitter outages is still a matter of seconds, most of which cannot be charged against the transmitter. For the "shake-down" period, this is an excellent performance record. Power saving through use of the Doherty Circuit is averaging close to $600 per month. It is also expected that tube savings will be appreciable. Quality of transmission is practically perfect. It certainly looks as if station KSL is due for another long period of economical, trouble-free A-1 broadcasting.

Modern Designs Feature Beaux-Arts, Western Electric Competition

Top Honors for Best Transmitter Building Design Go to Louis Shulman, N.Y.U.; 102 Students Compete, 19 Leading Schools and Universities Represented.

Pursuing the theory that radio broadcasting stations should be seen as well as heard, the Beaux-Arts Institute of Design, on June 19th, brought to a successful conclusion its first competition for the design of an ideal building in which to house a radio transmitter and its auxiliary equipment.

The competition, which aroused such widespread interest among architectural students throughout the country, was announced January 8th of this year and closed June 1st. The final count showed 91 entries from 102 individuals representing 19 leading schools and universities. In working out the problem, enthusiastic competitors used a wide variety of mediums such as three-dimensional models, photographs, scale drawings, elaborately bound books and even a phonograph record which described the design.

The competition was sponsored by the Western Electric Company. Its aim, according to F. R. Lack, manager of the Specialty Products Division of Western Electric, was to achieve a perfect wedding of radio broadcasting equipment and the building which houses it.

First prize of $250.00 went to Louis Shulman whose other trophies include the Henry Hornbostel prize of Architecture. The second prize which carried a cash award of $100.00 was won by Roger W. Flood. Percy C. Ifill took third place winning $50.00. All of the prize designs as well as 24 renderings receiving honorable mention will be made available to the broadcasting industry.

Selections were made by a five-man jury, including four prominent architects and one practicing radio engineer. The architects were: Ralph Walker, of Voorhees, Walker, Foley and Smith; Ely Jacques Kahn; Alfred Fellheimer of Fellheimer and Wagner; J. Andre Fouilhoux, of Harrison and Fouilhoux; J. R. Poppele, chief engineer of station WOR, an outstanding representative of the radio industry.

Speaking for the jury, as its technical representative, Mr. Poppele said, "The work of judging the 91 drawings and models submitted in the competition proved one of the most stimulating and interesting assignments I have ever had."

According to Mr. Poppele the contestants attacked the problem from many different approaches and the results are most dramatic. "While it is true," he said, "that no one solution represents an ideal station judged from the utilitarian standards of broadcasting, it is apparent to anyone that many unique and practical ideas may have been evolved by the contestants which might well be incorporated in the design of a station. For an overall appraisal of the competition, the results show much of worth to the industry."

Other members of the jury expressed similar satisfaction with the prize winners. J. Andre Fouilhoux, for example, said "The first prize has many qualities, simplicity and straightforwardness which are always essential in any good architectural design. It should be inexpensive to build which will certainly appeal to clients. At the same time it will command the attention of the public in a dignified way."

Ralph Walker declared the solutions showed a great deal of ingenuity and interest in the realm of a new science, and Mr. Kahn felt that the more obvious objections were "overbalanced by virtues which were certainly towards the side of interesting effect produced by simple means." Mr. Fellheimer concurred and added, "The desired dramatic ensemble sought for by the program is obviously best obtained by a close grouping of the relatively small building structure with the tower, well illustrated in the first prize design, which although lacking in some details of plan is specially praiseworthy in this regard."

In a summarizing statement to the Institute, Otto Teegen, director of the Department of Architecture for Beaux-Arts, said, "The conclusion reached by the B.A.I.D. is that it was eminently worthwhile to have given the problem. One reason is shown by the number of competitors, schools and individuals entered. We are of the opinion that the freedom of program made the problem more interesting and that another on a similar line might be held again next year, with the hope that, if there are newer and better methods of presentation, they may appear. It is hoped that the endeavors of the students may have some influence on better work in radio design, and that contact with this type of problem helped the student on his way to clearer thinking."

The winning designs and other entries were placed on public display at the Rockefeller Home Center, where they were shown for two weeks. The designs will also be displayed in San Francisco during the annual convention of NAB which convenes August 4th.

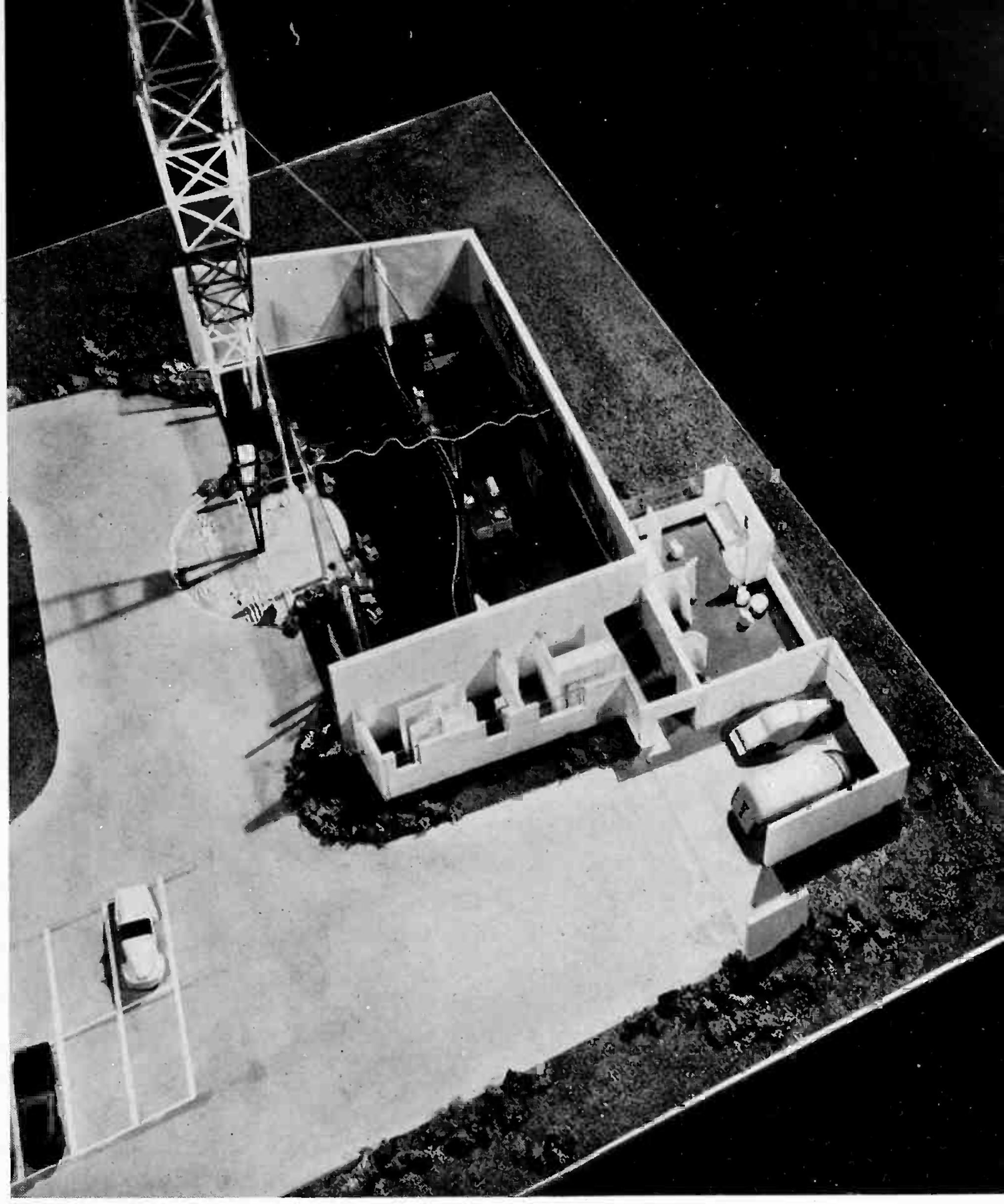
Winners of Beaux-Arts-Western Electric Architectural Competition Receive Awards

Louis Shulman explains his design to Otto Teegen, director of Department of Architecture for Beaux-Arts Institute of Design (center). J. R. Seltz, Shulman's collaborator at left.

J. R. Poppele, chief engineer at WOR, addressing contestants, says many practical ideas have been evolved. P. L. Thomson, director of Public Relations for Western Electric, at right.

Members of the blue ribbon jury (below) judge the work. They are, left to right: Alfred Fellheimer, J. R. Poppele, J. Andre Fouilhoux, Ralph Walker and Ely Jacques Kahn.

Interested spectators inspect the many beautifully worked out plans submitted by students. Below: Display sign at Rockefeller Home Center where designs were later exhibited.

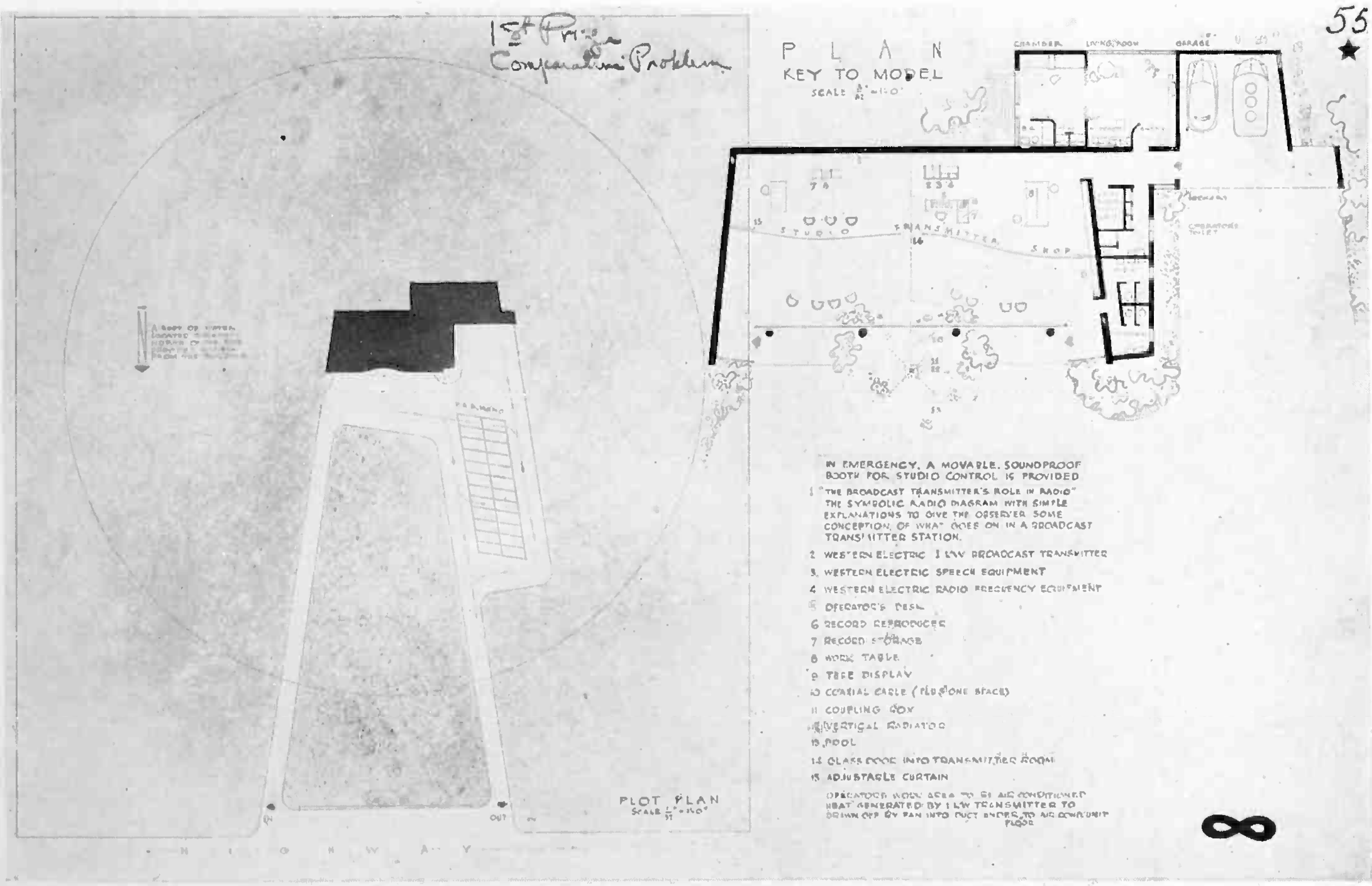


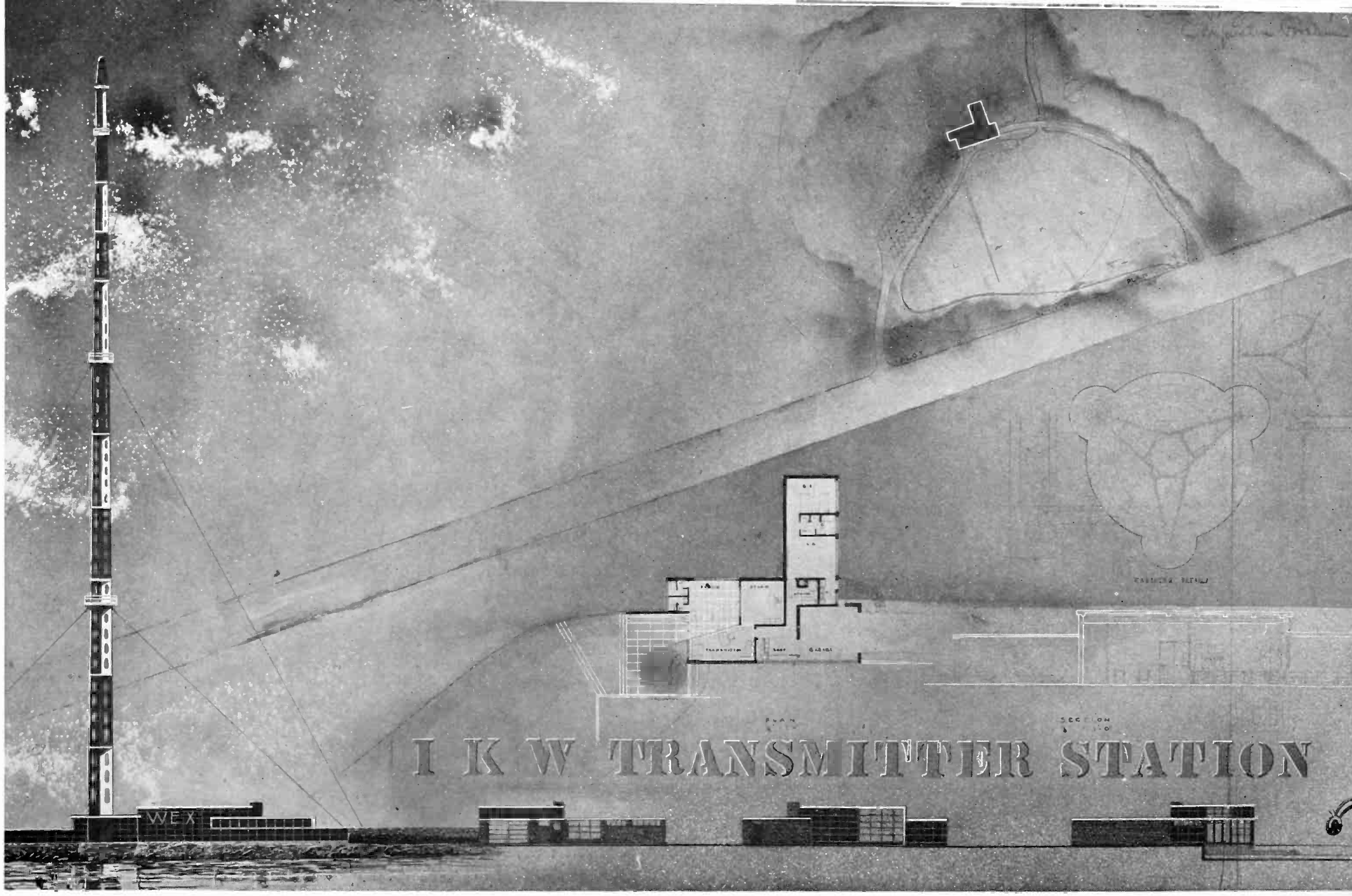
Louis Shulman has a past record of prize winning dating back to 1927 when he was awarded the Wanamaker medal for drawing. A few years later he received the Henry Hornbostel prize in architecture at Carnegie Tech and in 1930 he added the Parker medal to his trophies.

Shulman was born in Greenwich Village, New York City, in 1910. After graduating from George Washington High he entered the Carnegie Institute of Technology and later continued his education at Columbia. Since 1936 he has been enrolled at the New York University School of Architecture and Allied Arts. He gained practical experience in his chosen field in the offices of the late Will Rice Amon and James E. Casale. At present he is a designer with J. M. Daugherty.

In preparing his design for the 1000 watt transmitter building Shulman acknowledges the assistance of J. R. Seltz, a graduate of Ecole de Beaux Arts in Paris.

FIRST PRIZE — Louis Shulman, *New York University*





SECOND PRIZE — Roger W. Flood, *New York University*

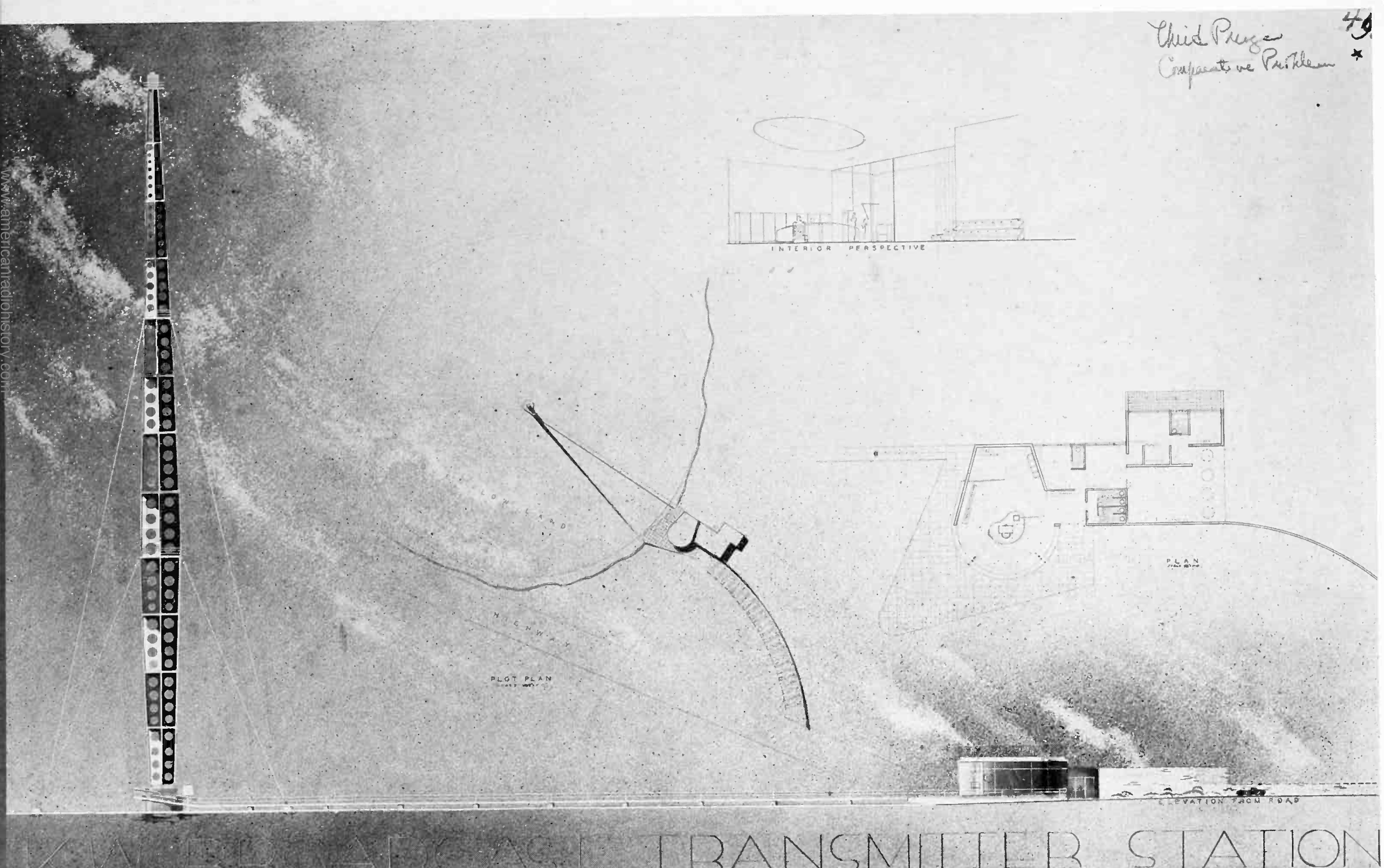
Roger W. Flood was born at Roanoke, Virginia, in 1905. He attended elementary schools there and in Baltimore. Before entering the School of Architecture at New York University Flood had gained an excellent foundation in art work at the Rhode Island School of Design in Providence.

Expenses for his education were earned through working at many odd jobs including that of railroad laborer, mason's helper, house painter and serving as steward on various steamships. At present he is associated with the New York Housing Authority. Much of his leisure time is spent painting in oils.

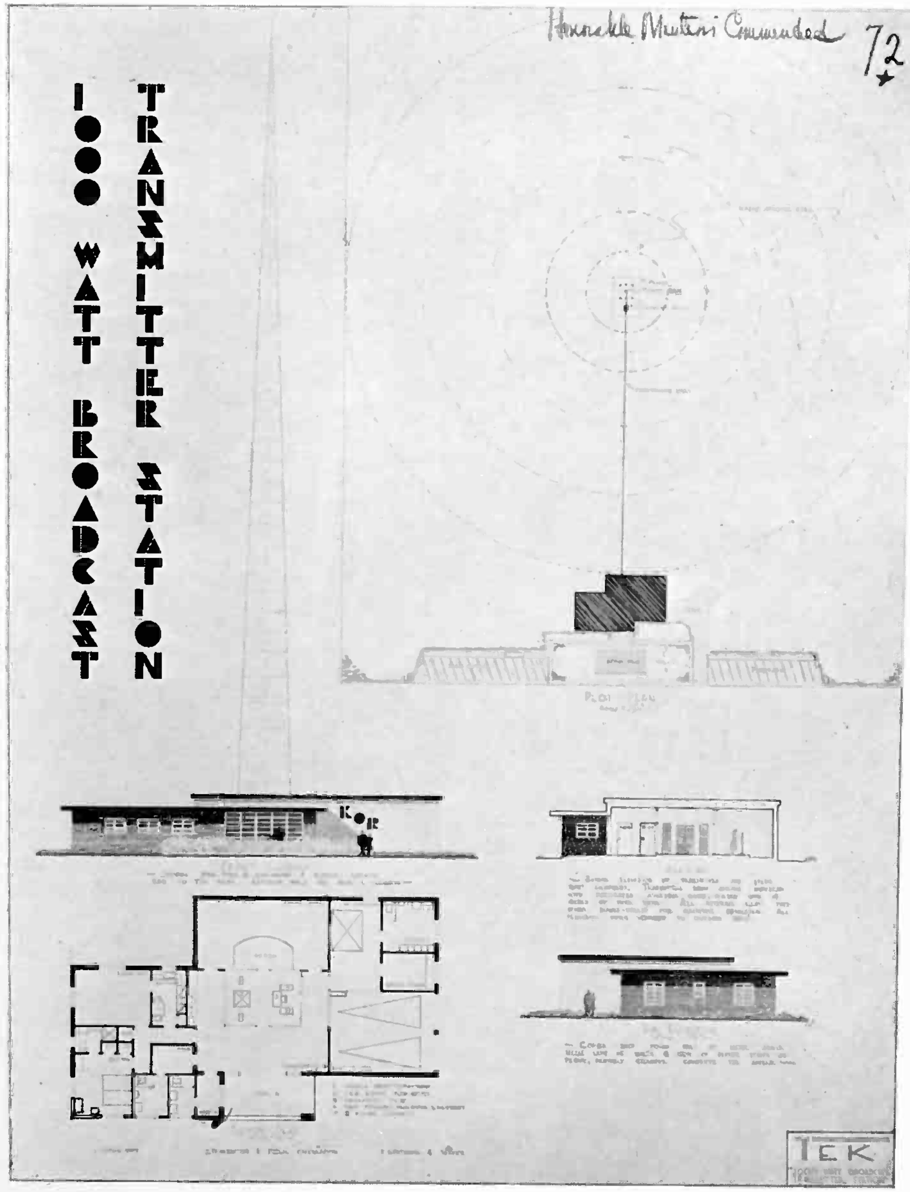
THIRD PRIZE — Percy C. Ifill, *New York University*

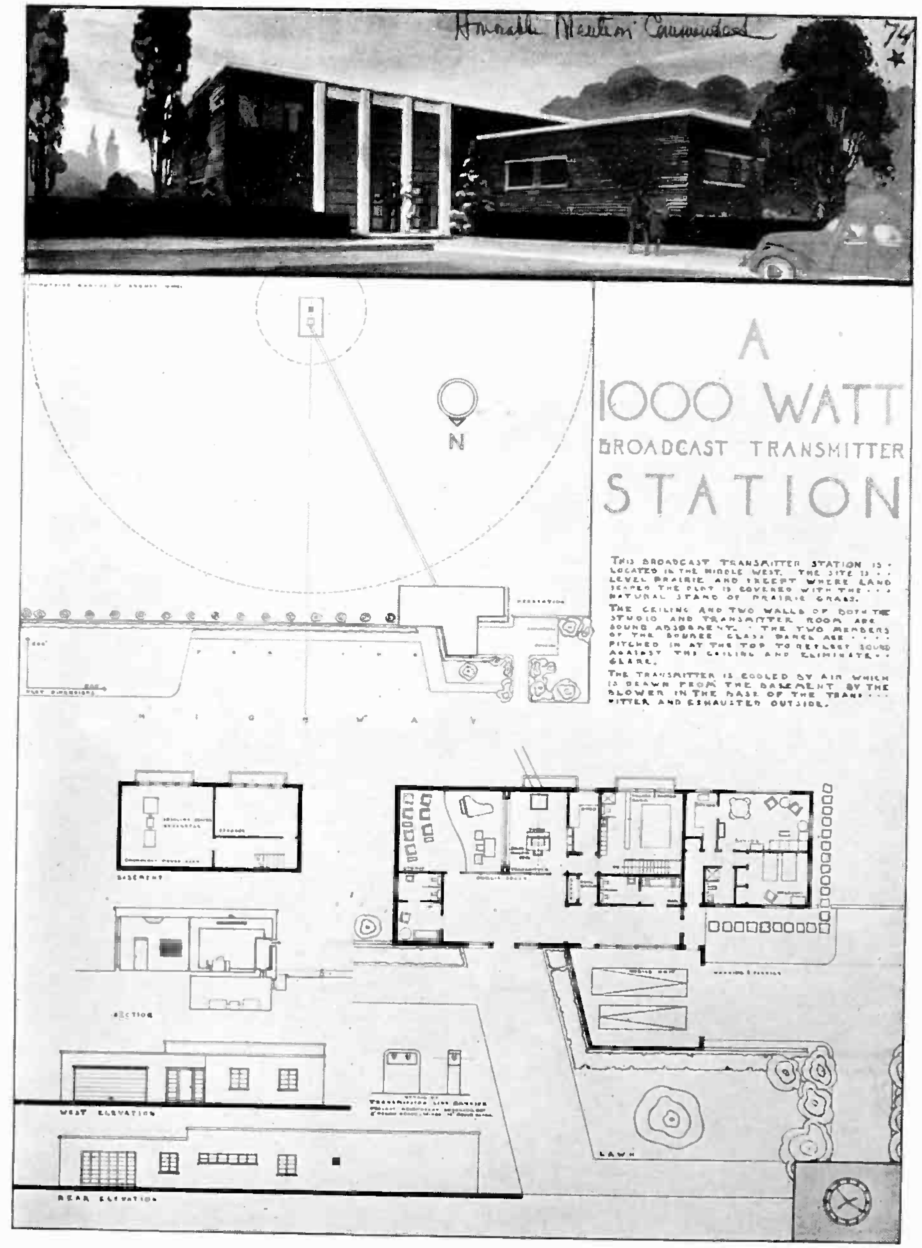
Percy C. Ifill, who is 27 years old, graduated from DeWitt Clinton High, New York City, in 1930. Since 1935 he has been attending evening classes at the School of Architecture, New York University, where he received the Hayden Scholarship and the Alpha Phi Alpha Regional Scholarship.

To earn his way through the University he worked as draughtsman on the Mayor's Committee on City Planning for four years. At present he is a draughtsman with the Department of Hospitals in New York City. He devotes his spare time to photography and the study of contemporary literature.



HONORABLE MENTION COMMENDED—Burket E. Graf, *University of Nebraska*

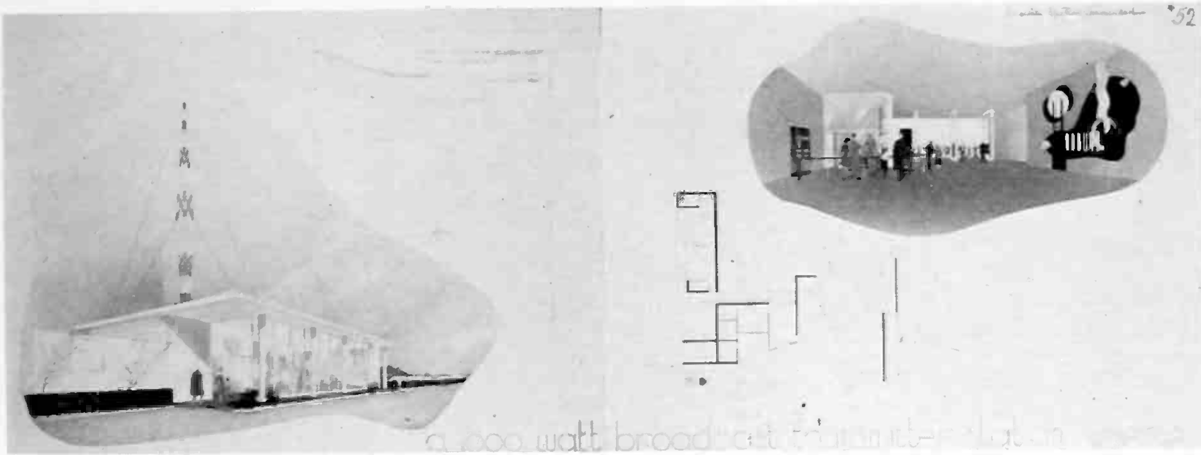




HONORABLE MENTION COMMENDED

Darrel D. Rippeteau, *University of Nebraska*

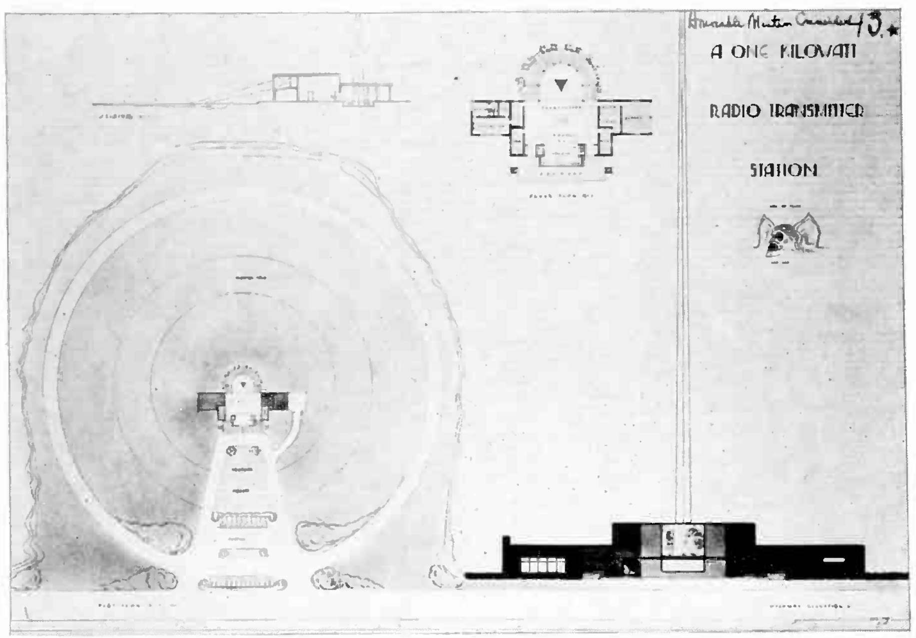
HONORABLE MENTION COMMENDED—J. E. Stewart, *Pennsylvania State College*

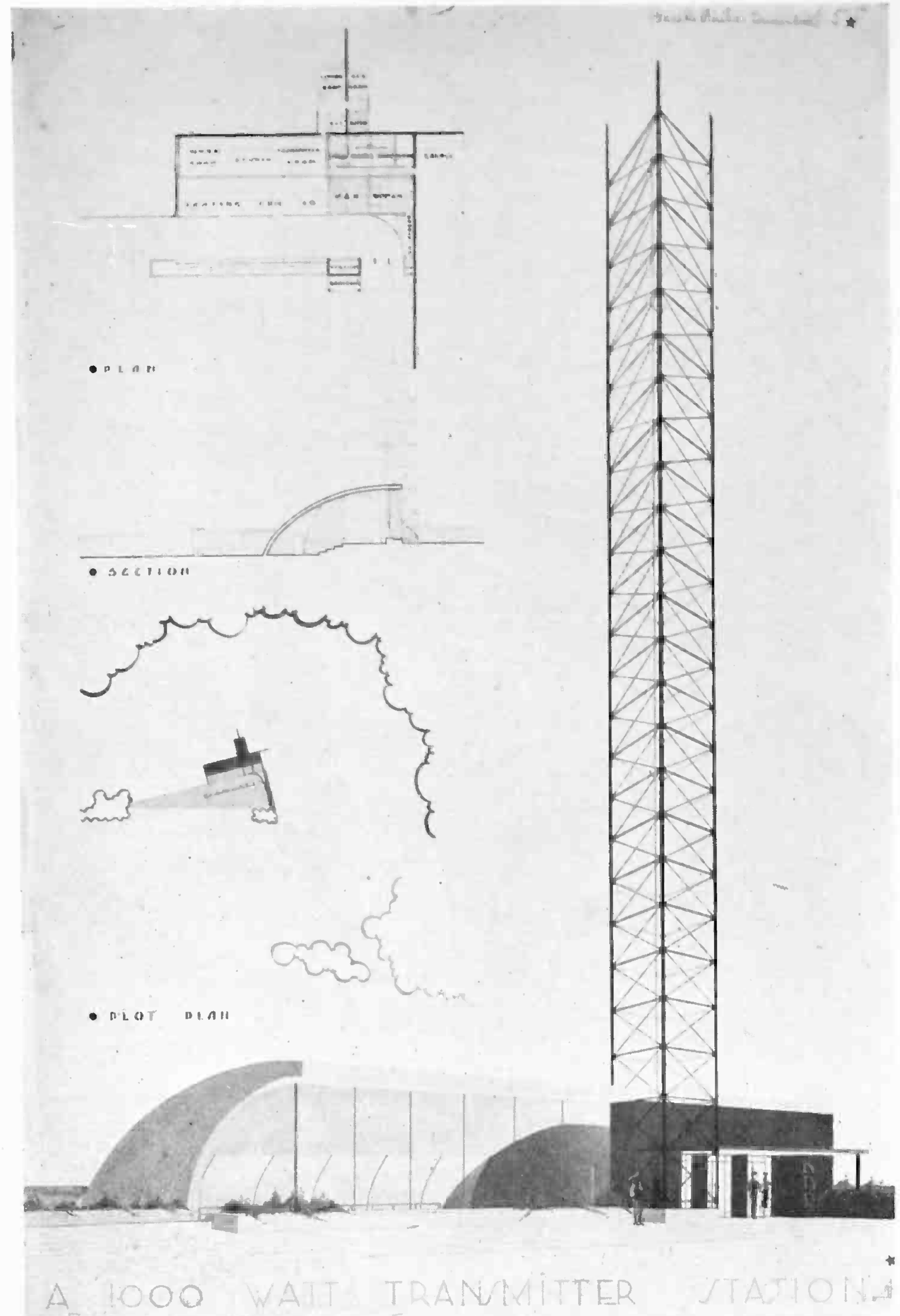


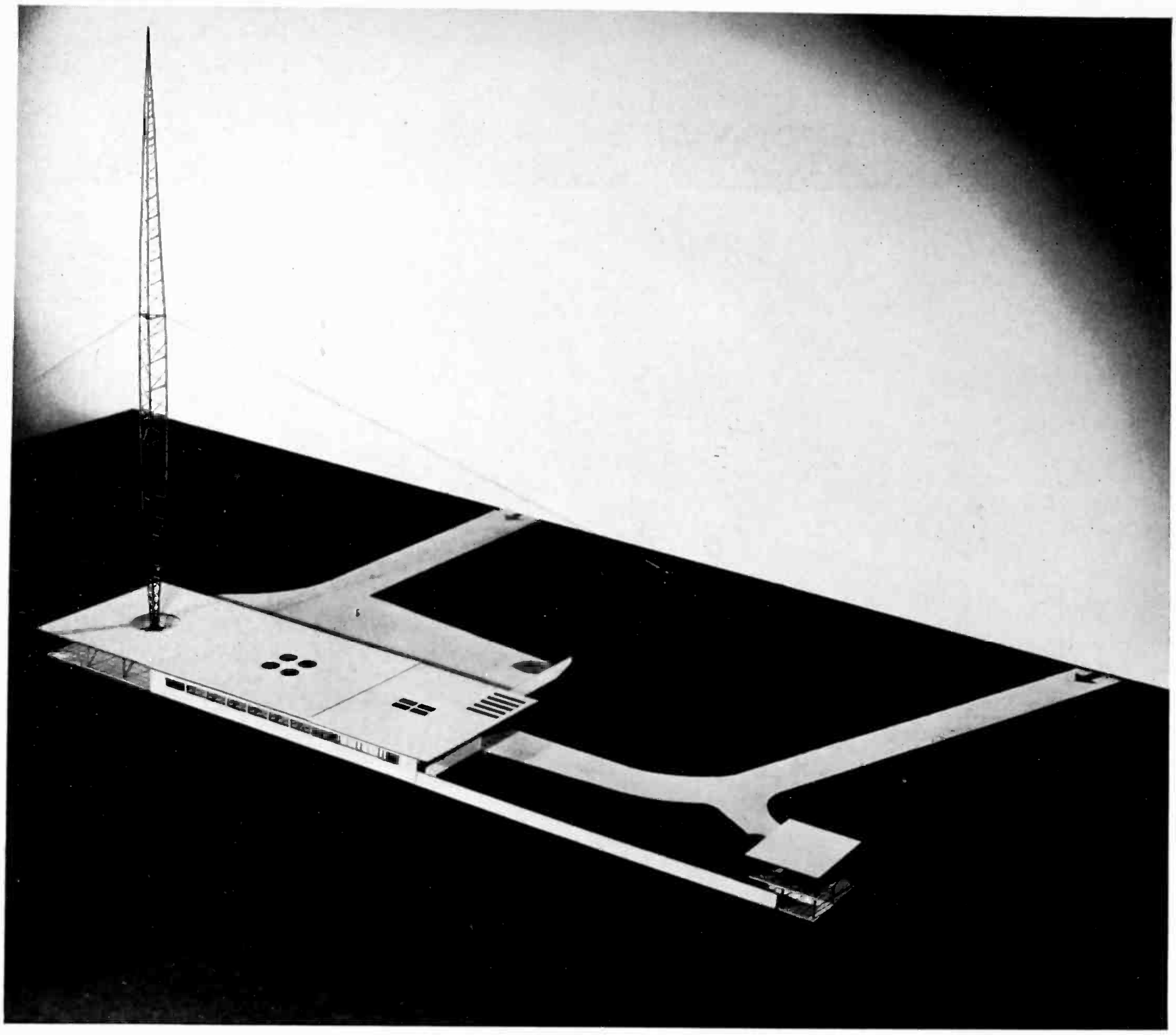
E. Rabinowitz, *New York University*

HONORABLE MENTION COMMENDED

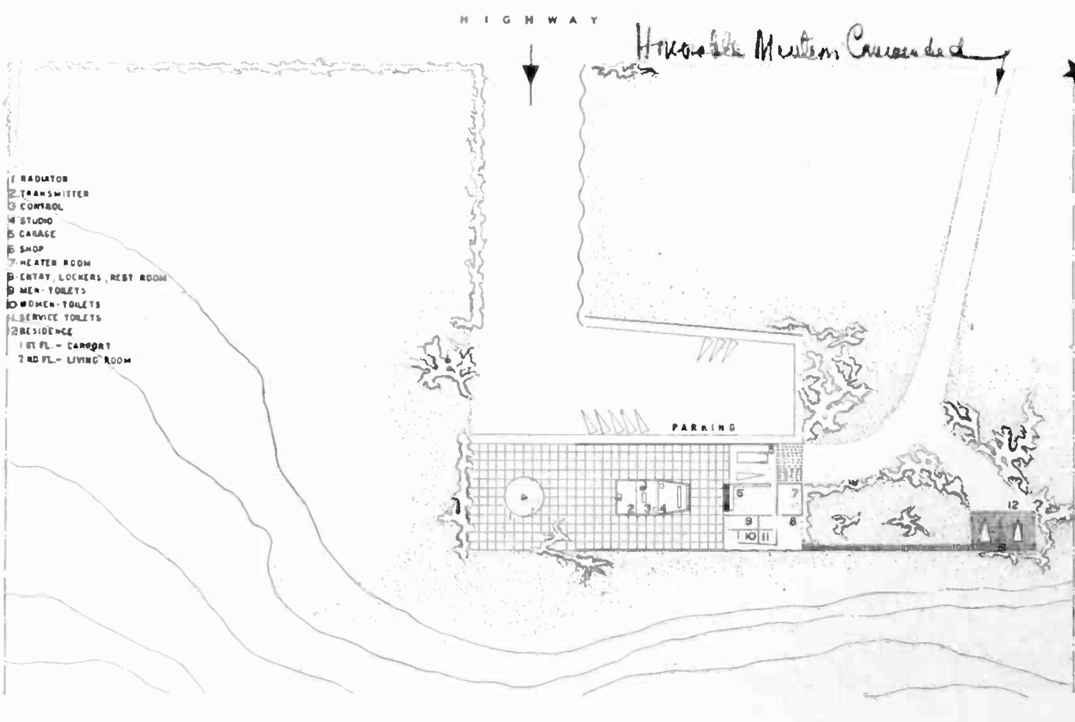
John H. Anderson, *Carnegie Institute of Technology*

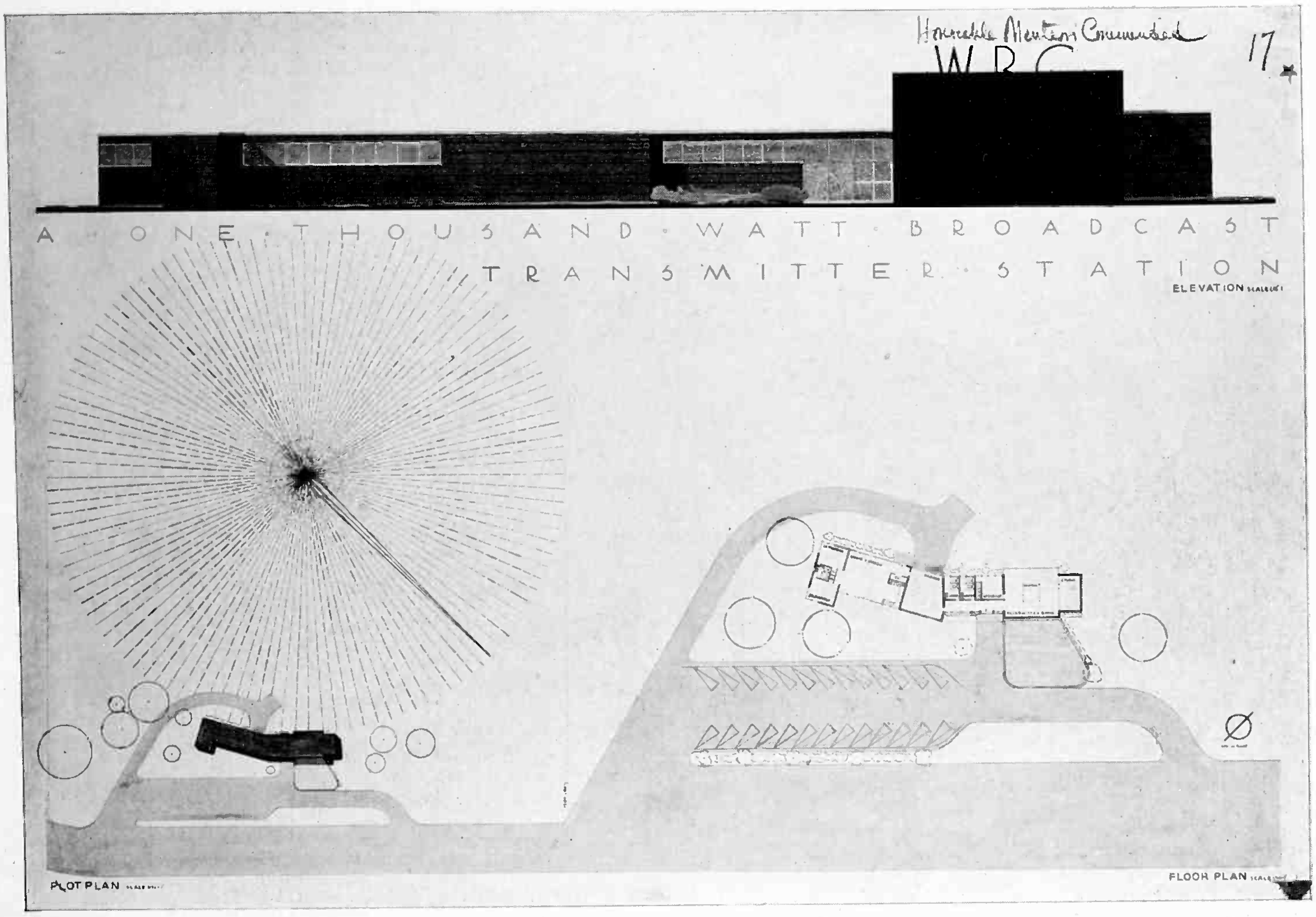






HONORABLE MENTION COMMENDED—Roy S. Johnson, F. Ginsbern, F. J. LaBianca, *New York University*

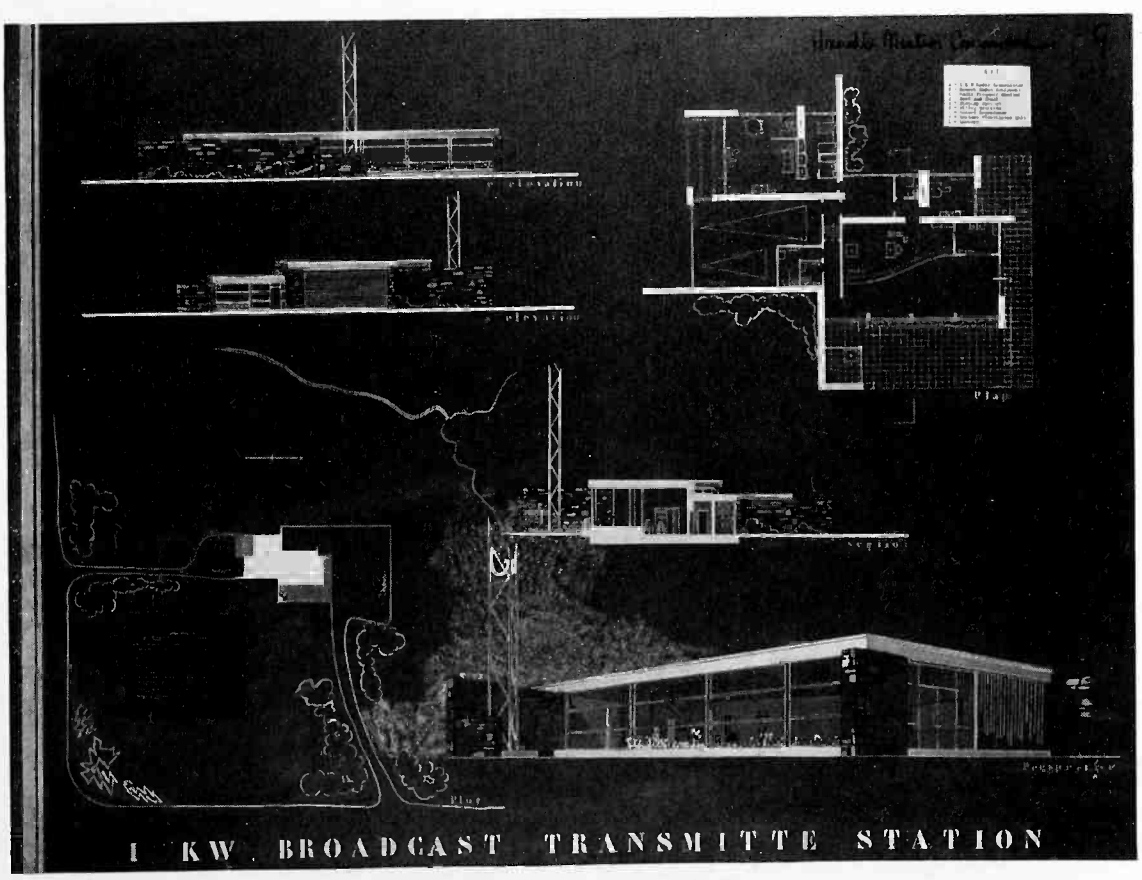


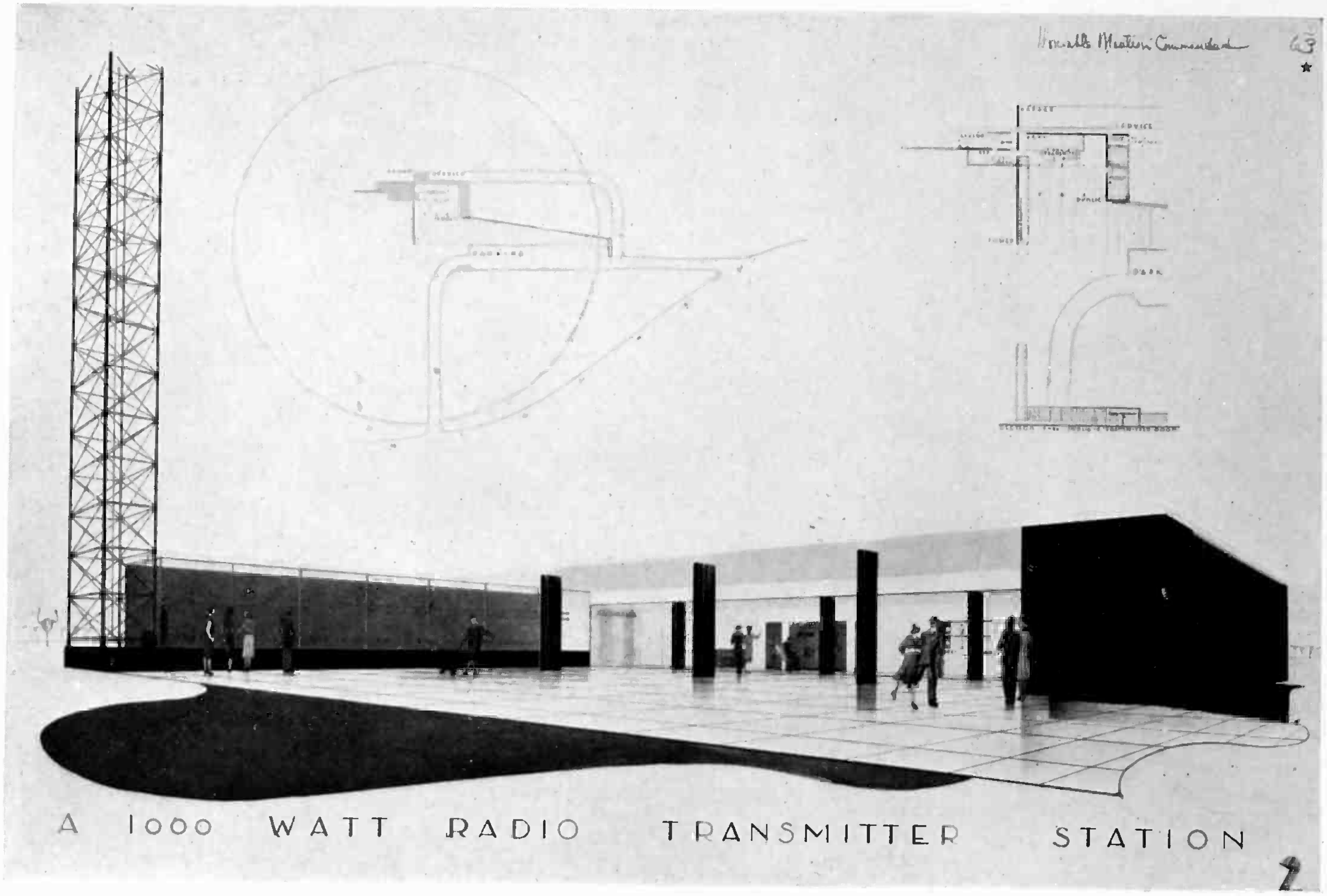


N. J. Frey, *Carnegie Institute of Technology*

HONORABLE MENTION COMMENDED

Herbert Glassman, *Boston Architectural Club*

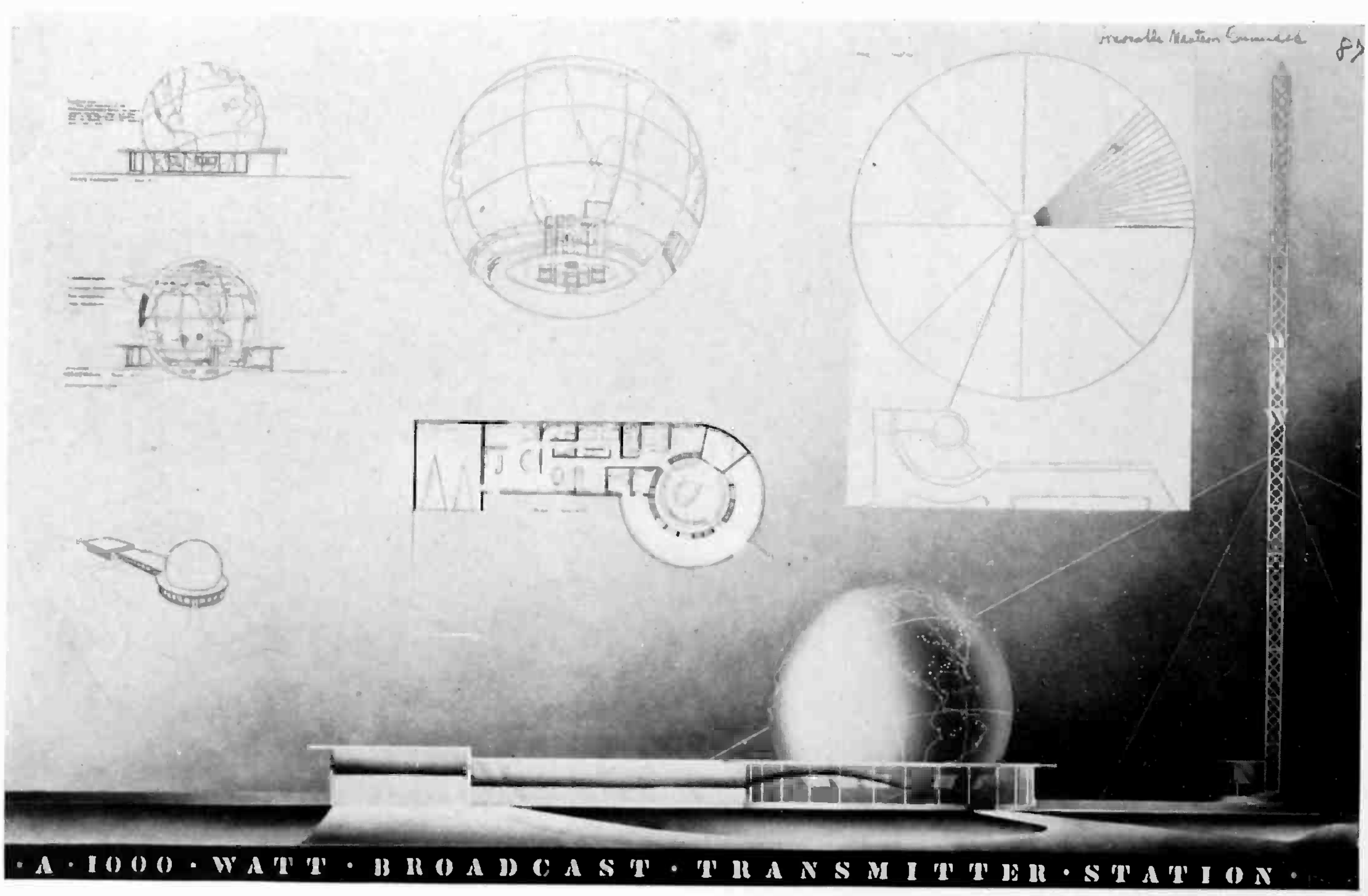


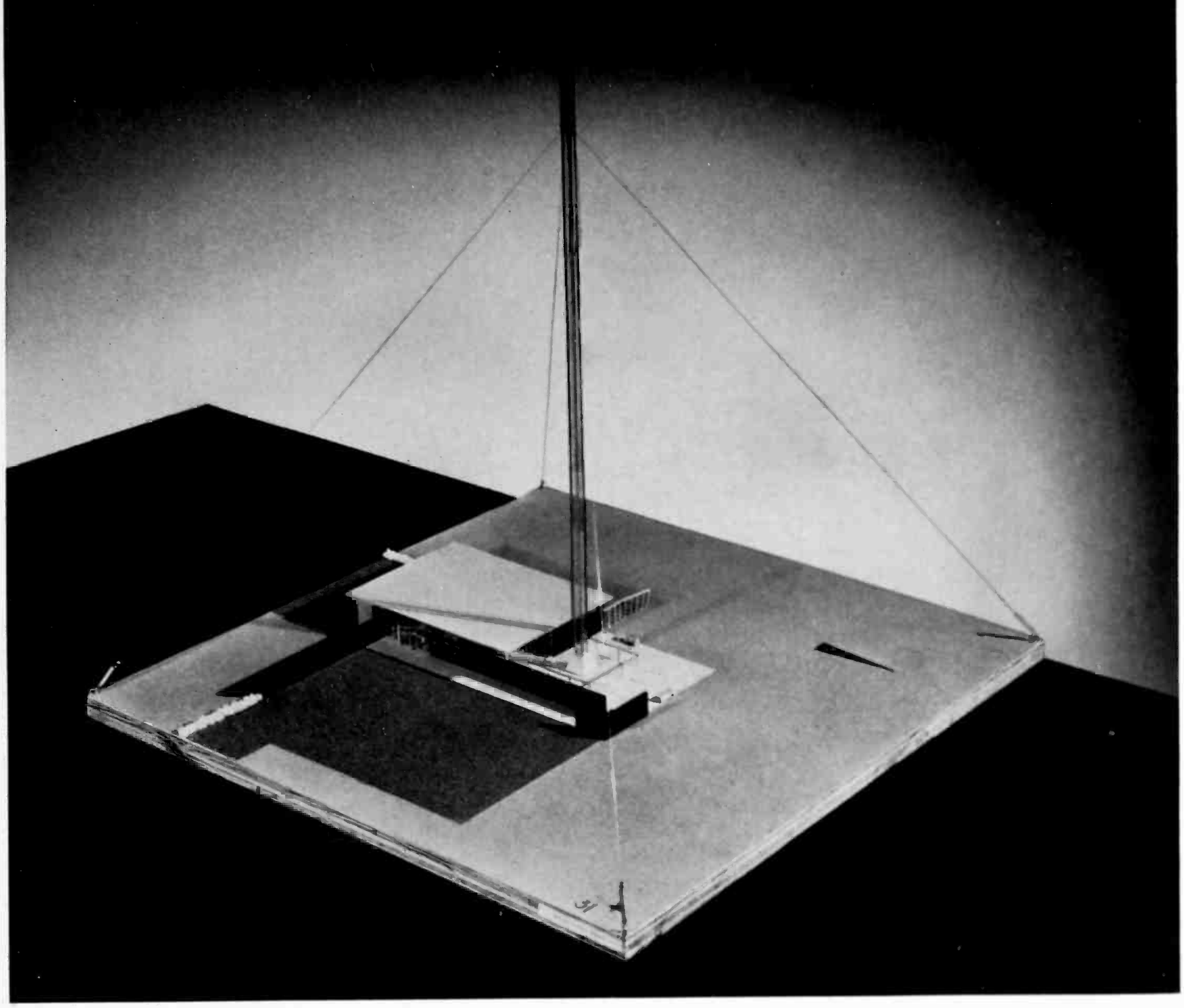


John Suydam, *Pennsylvania State College*

HONORABLE MENTION COMMENDED

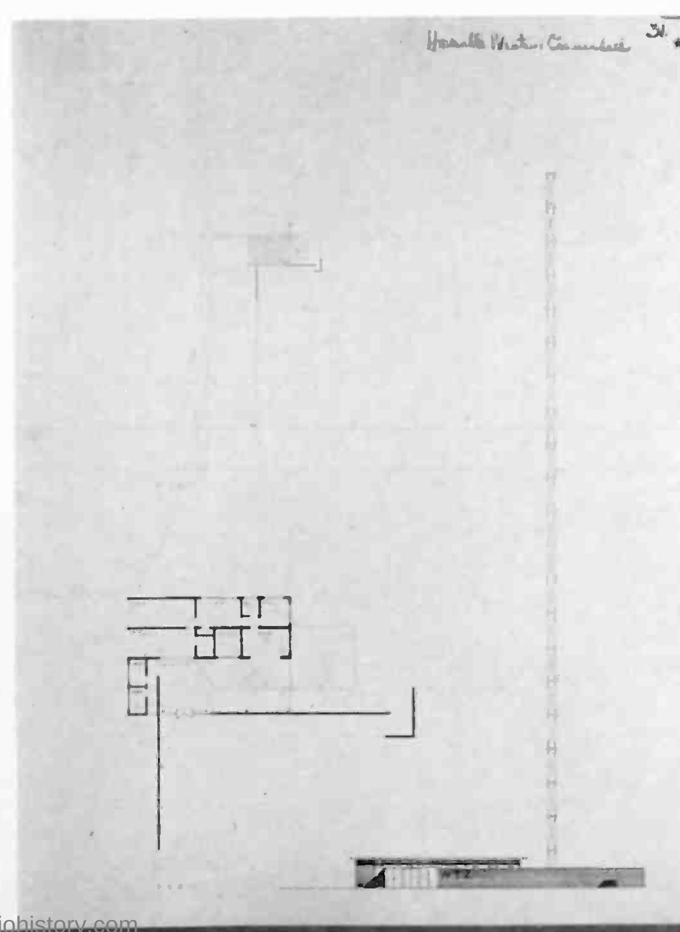
Gail Palmer, *University of Oklahoma*

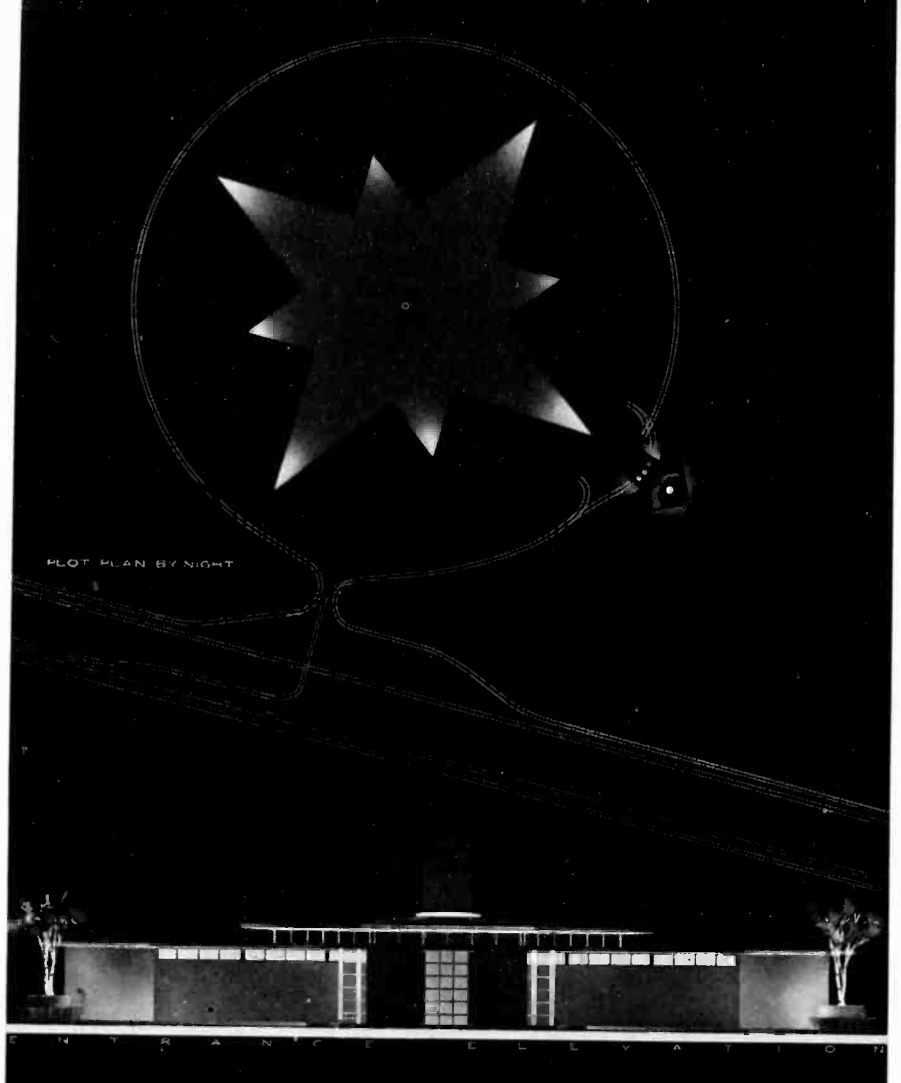




HONORABLE MENTION COMMENDED—

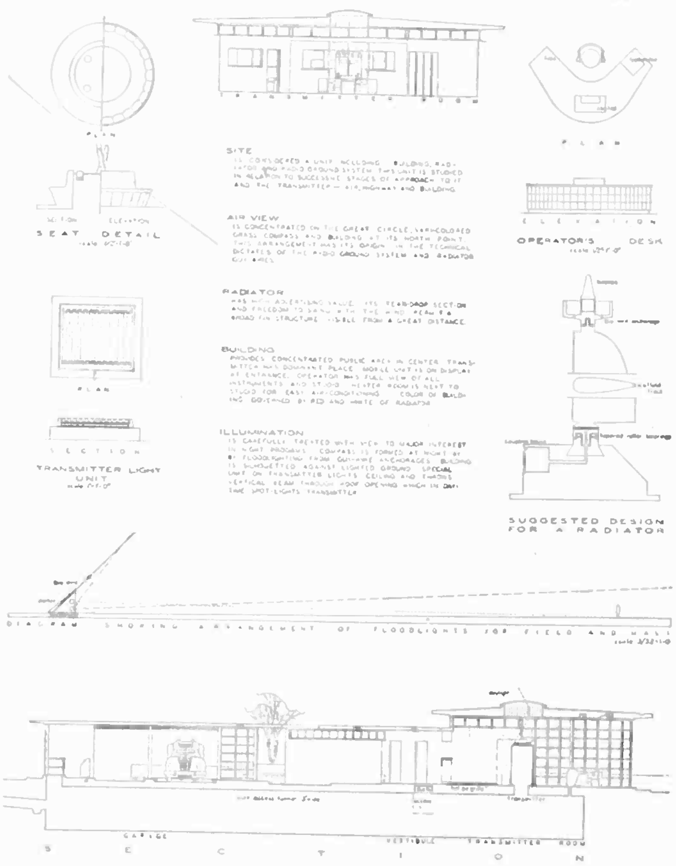
Carleton Richmond, Edward L. Barnes, *Harvard University*



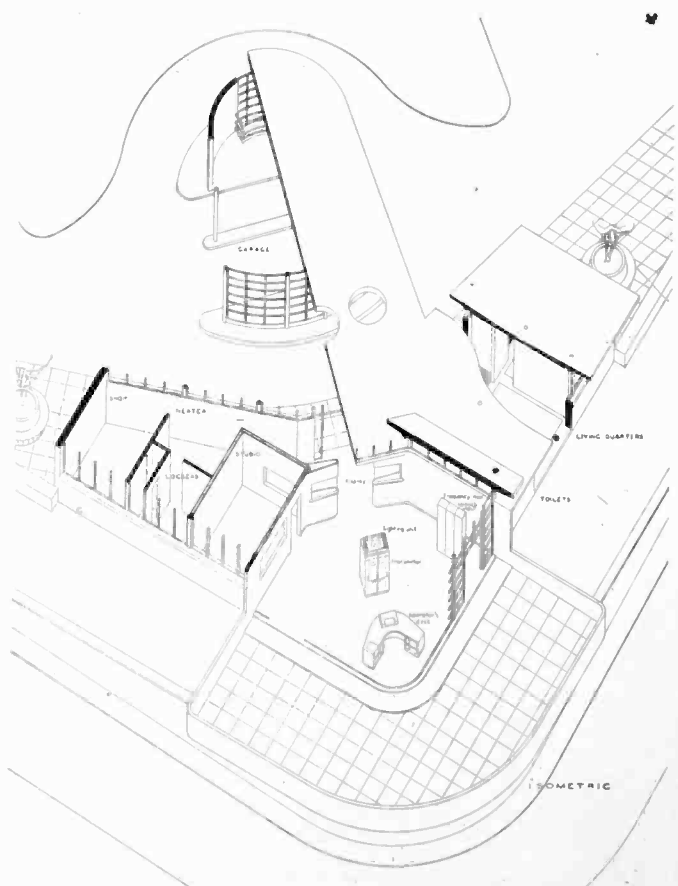


A TRANSMITTER STATION

HONORABLE MENTION COMMENDED—William C. Renwick, *Princeton University*



A TRANSMITTER STATION



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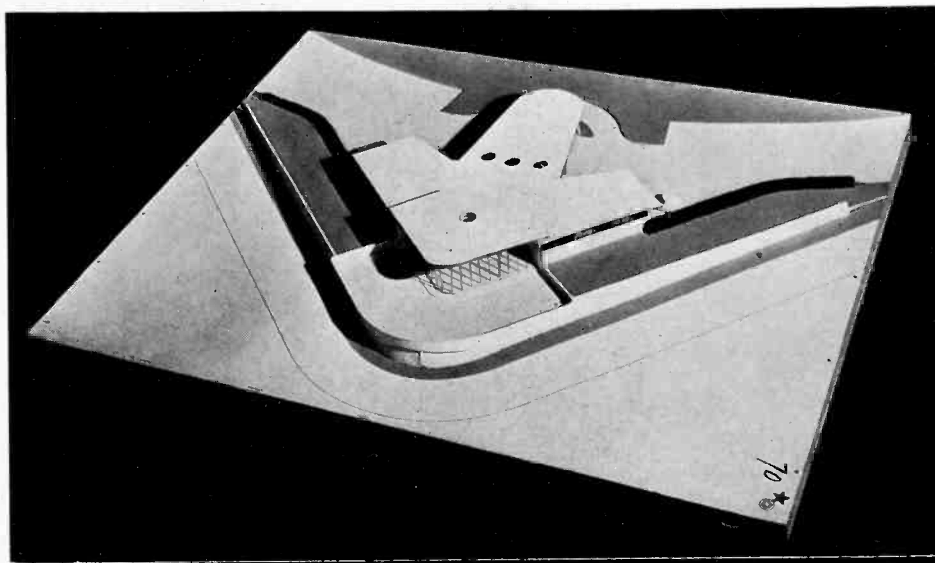

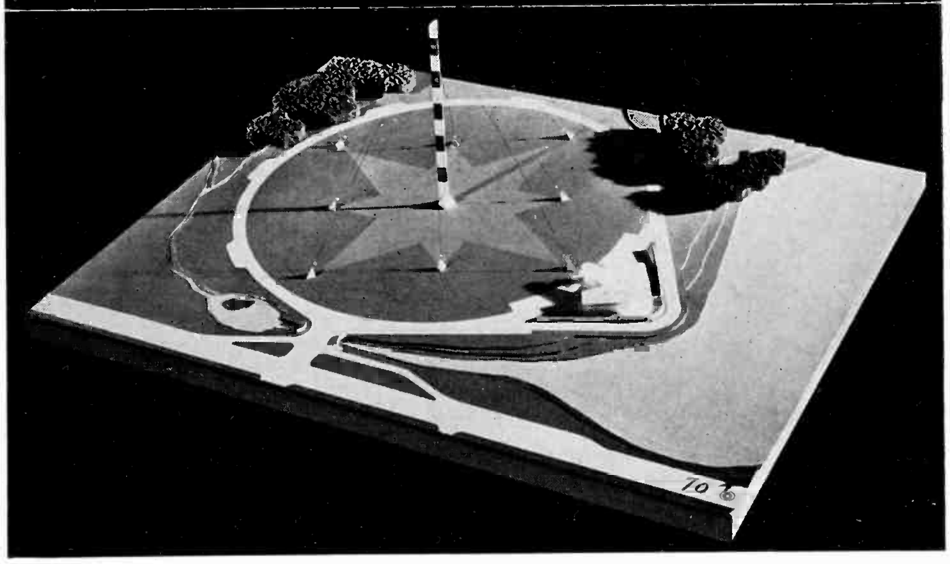

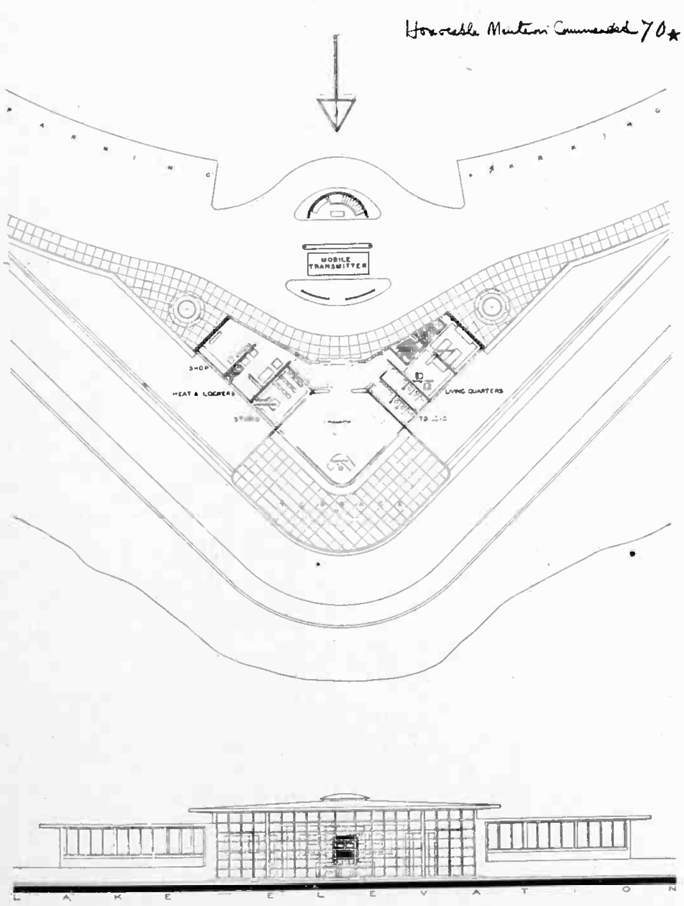

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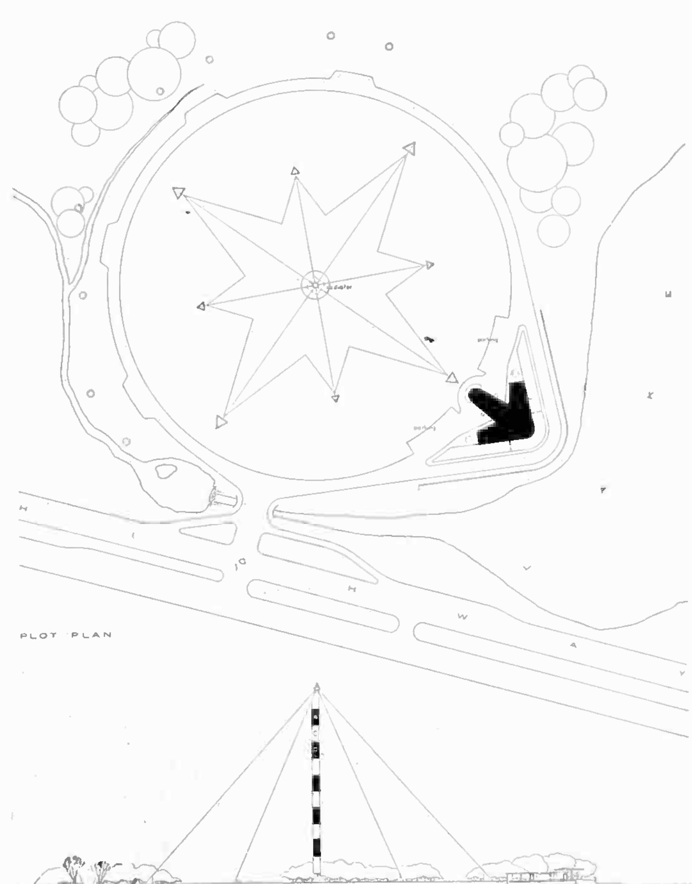

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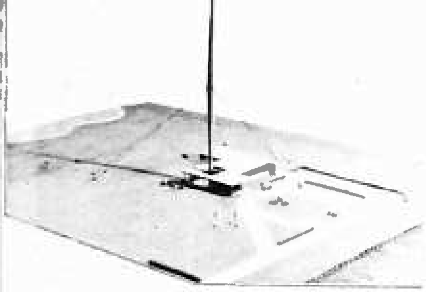
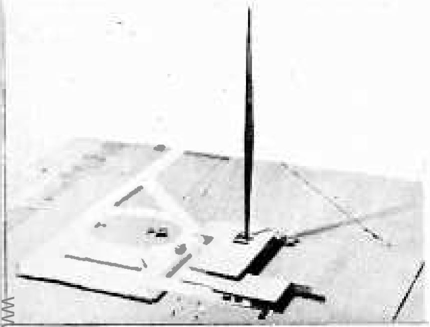
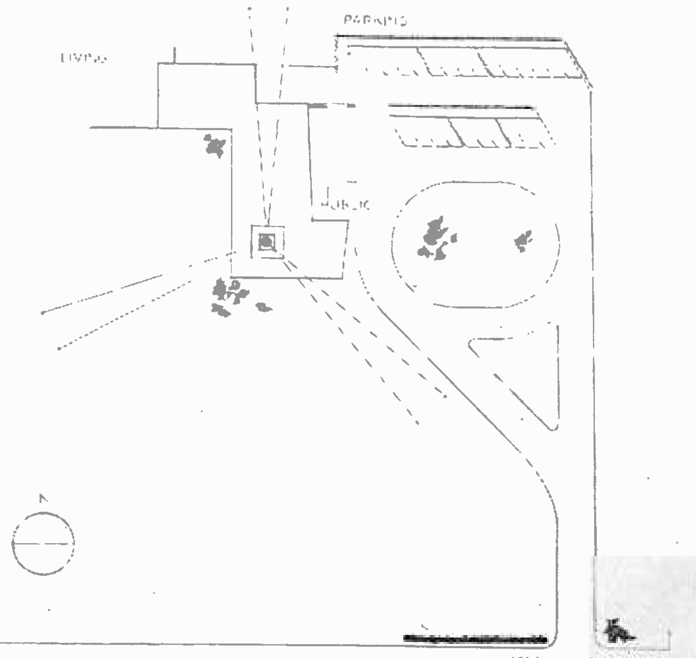
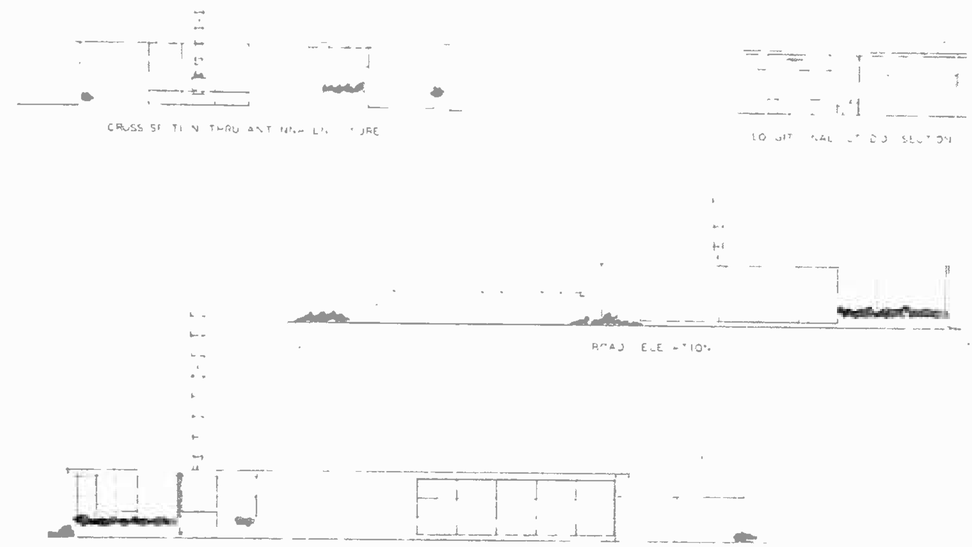


VIEW FROM SOUTHEAST

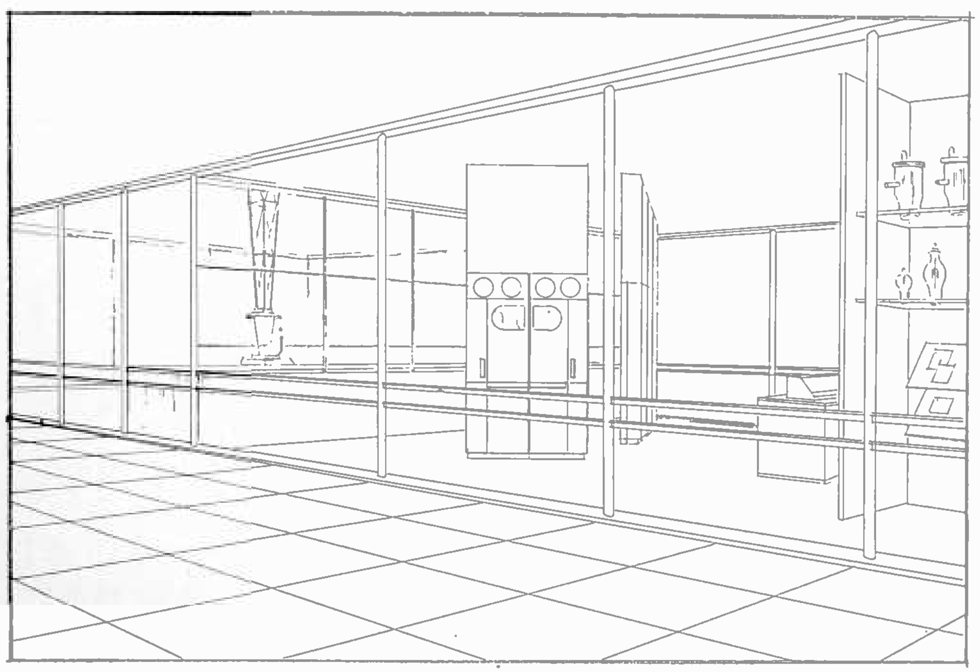


VIEW FROM NORTHWEST

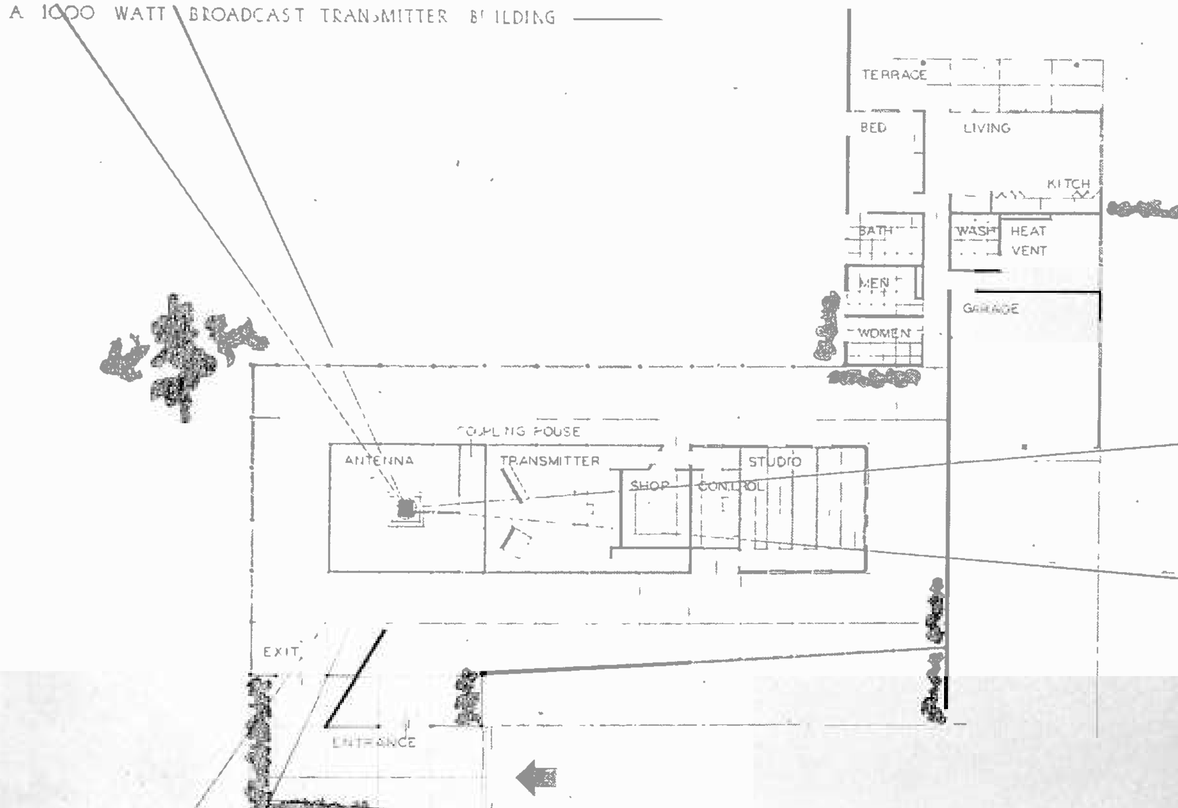




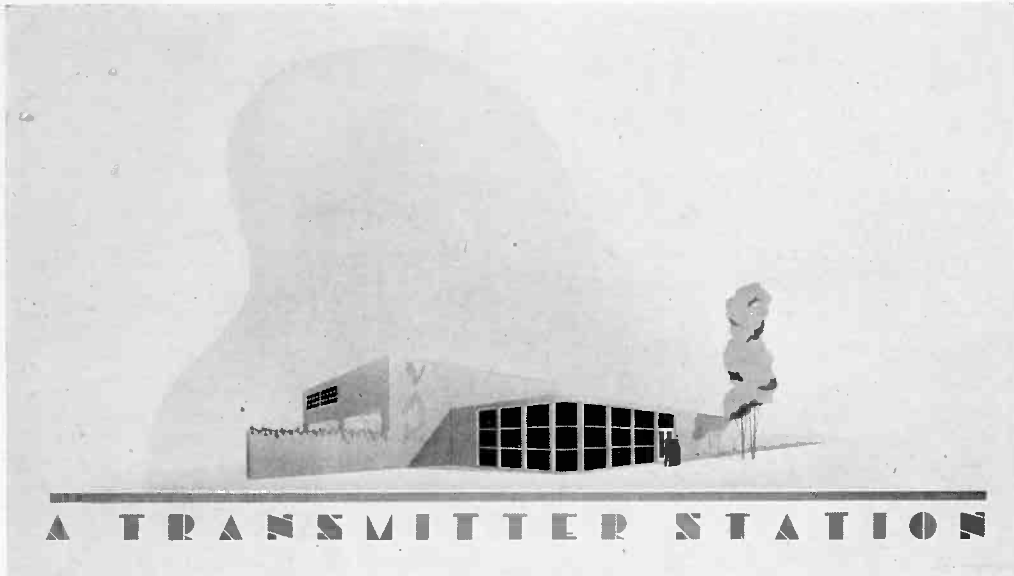
HONORABLE MENTION COMMENDED—Peter Ogden, *Yale Unive. ity*

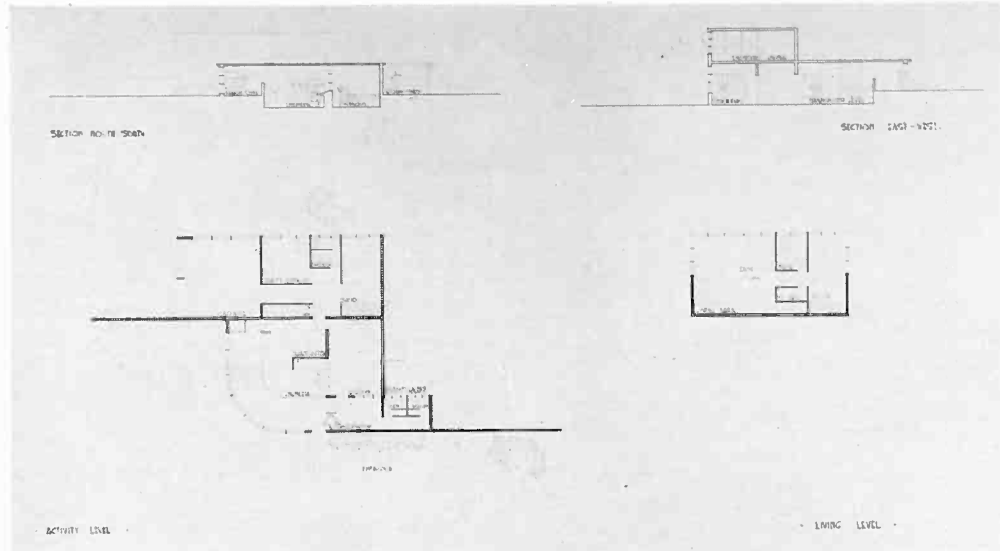


A 1000 WATT BROADCAST TRANSMITTER B' ILDING

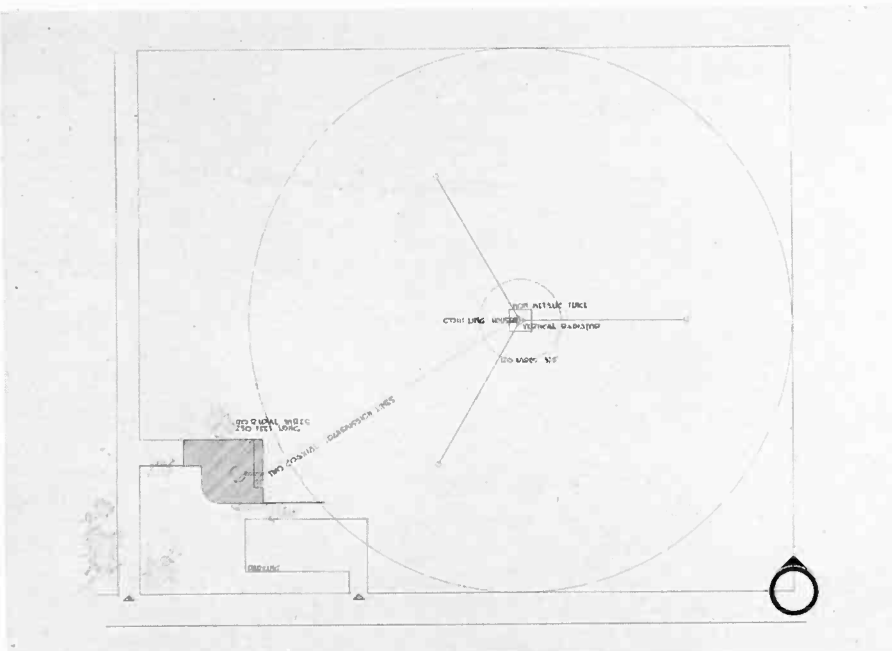


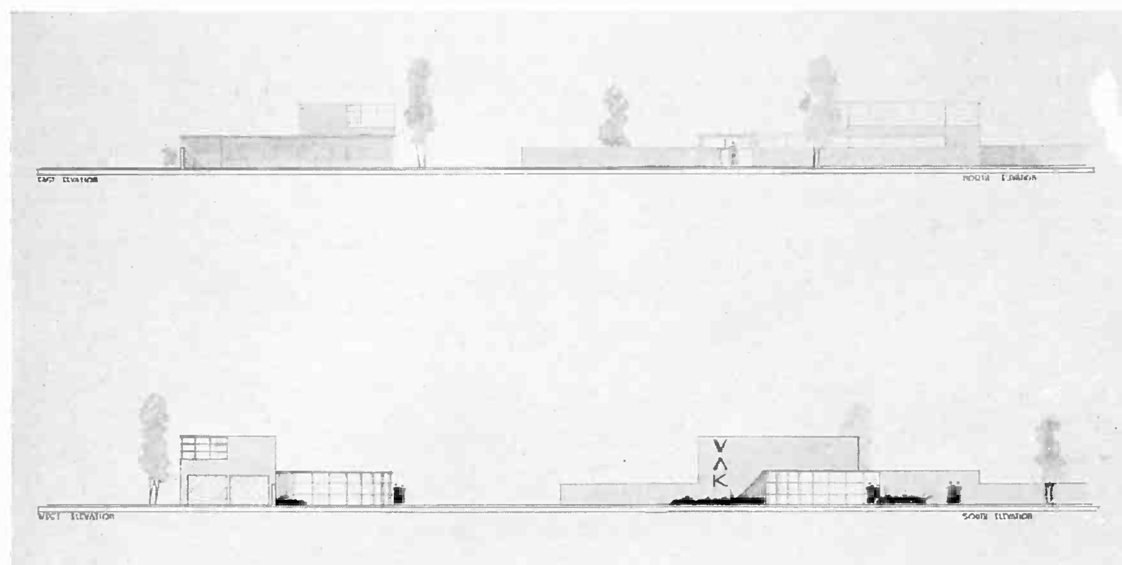
FLOOR PLAN

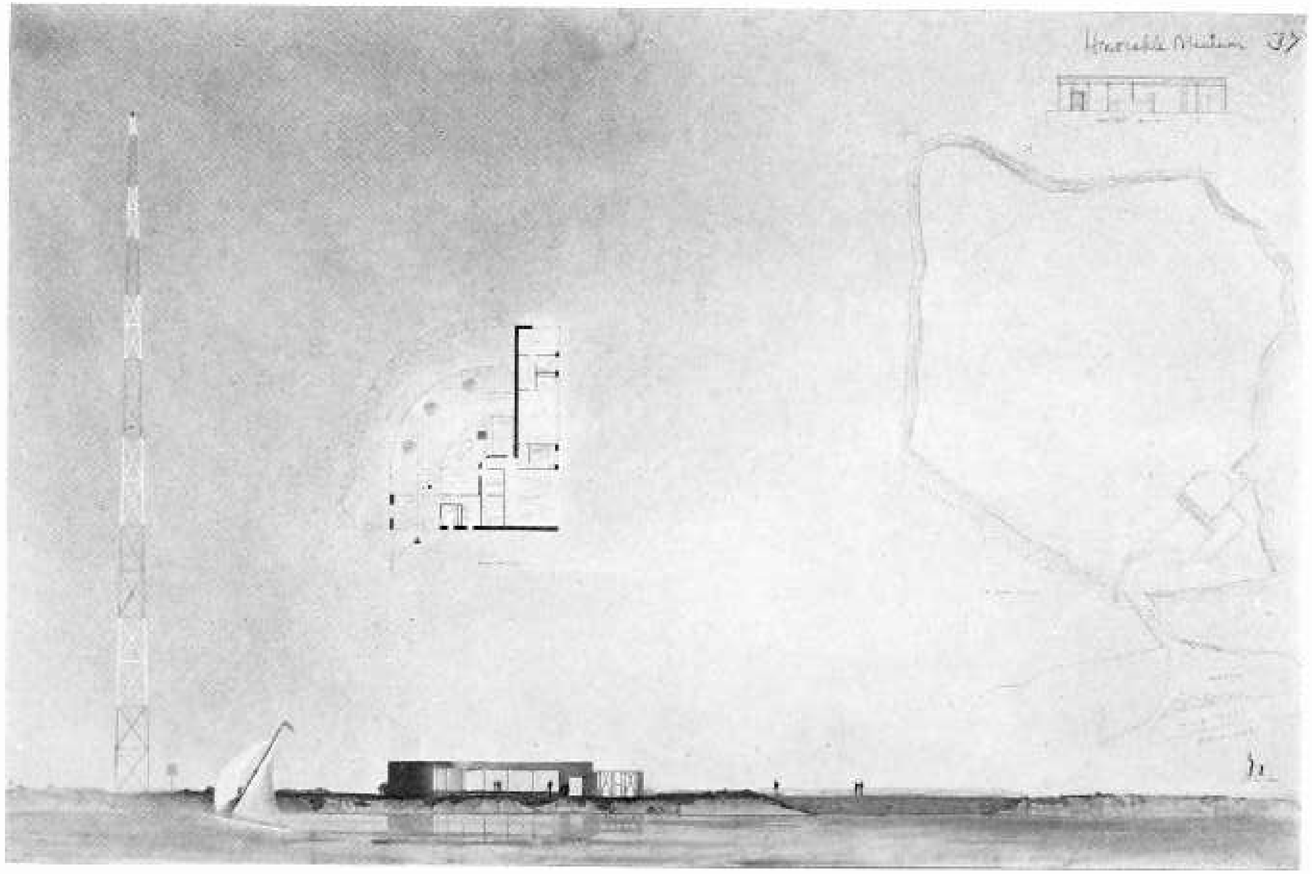




HONORABLE MENTION—Yuji Kawamoto, Romeo Martini, *Catholic University of America*



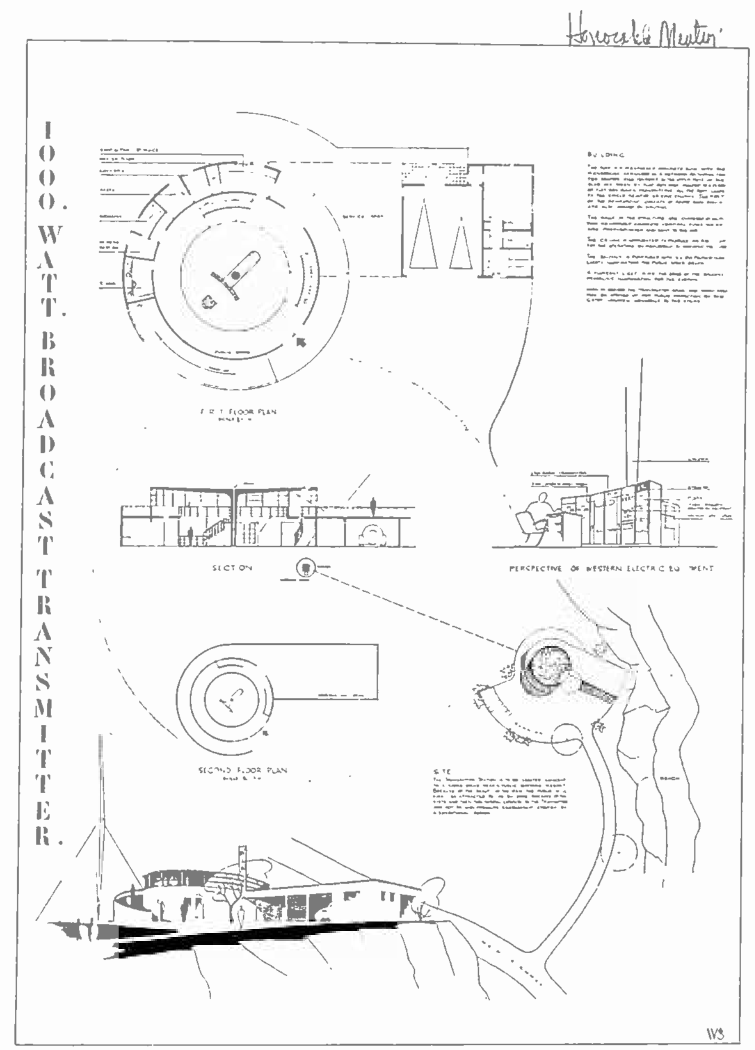




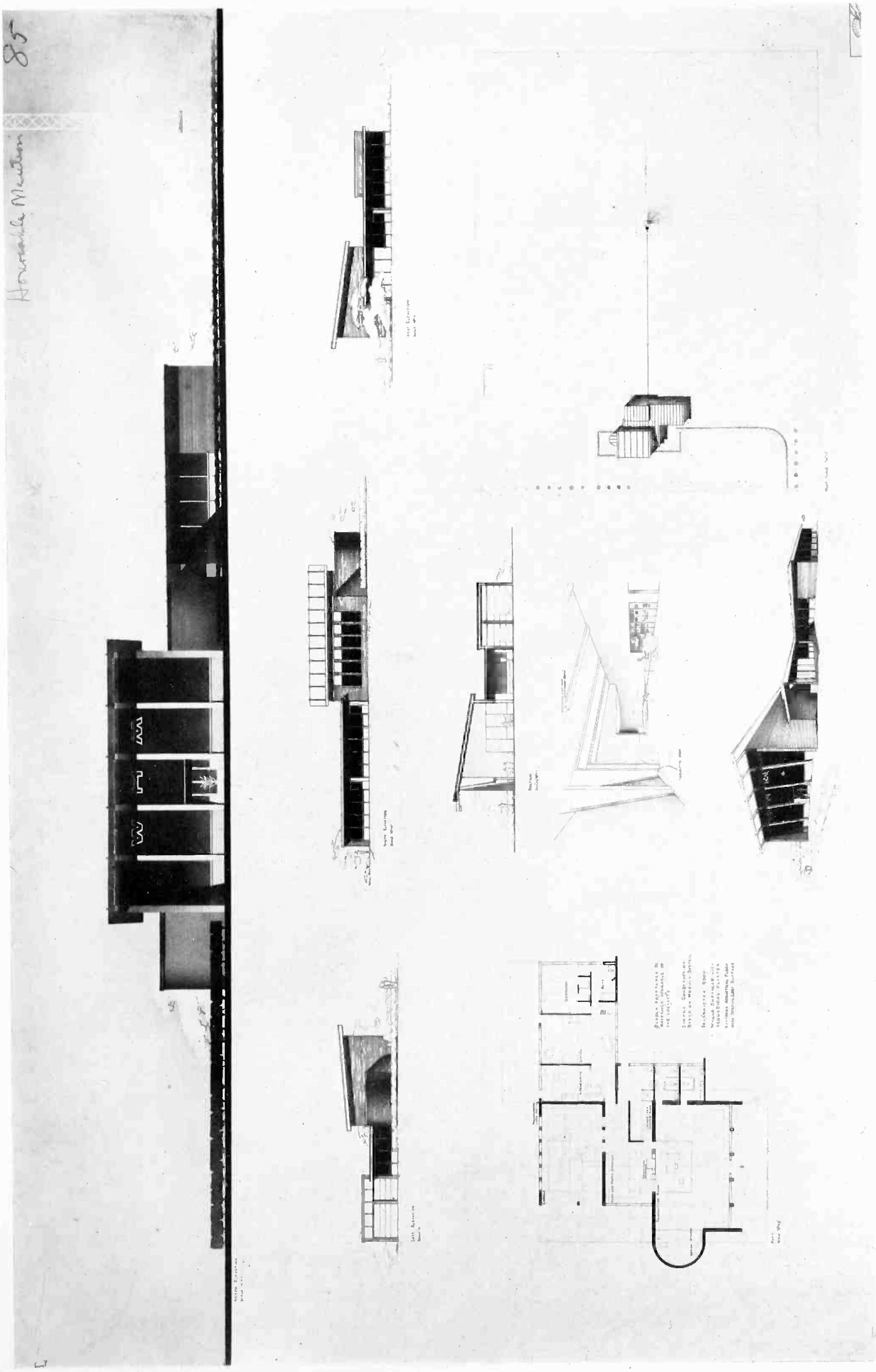
HONORABLE MENTION—R. Craven, *New York University*

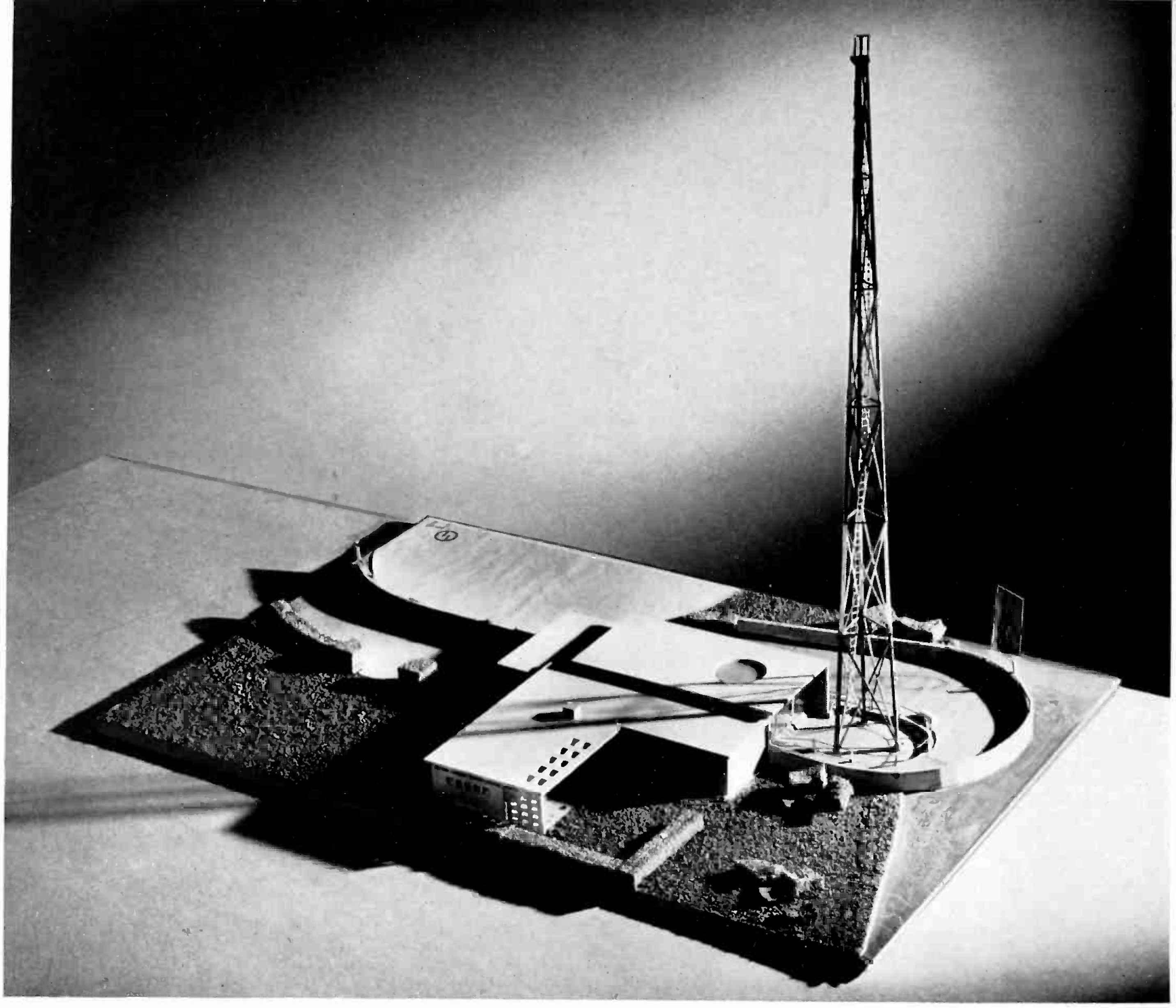
HONORABLE MENTION—

Walter W. Wilkman, *Boston Architectural Club*



HONORABLE MENTION—Frank Binckley, *University of Oklahoma*





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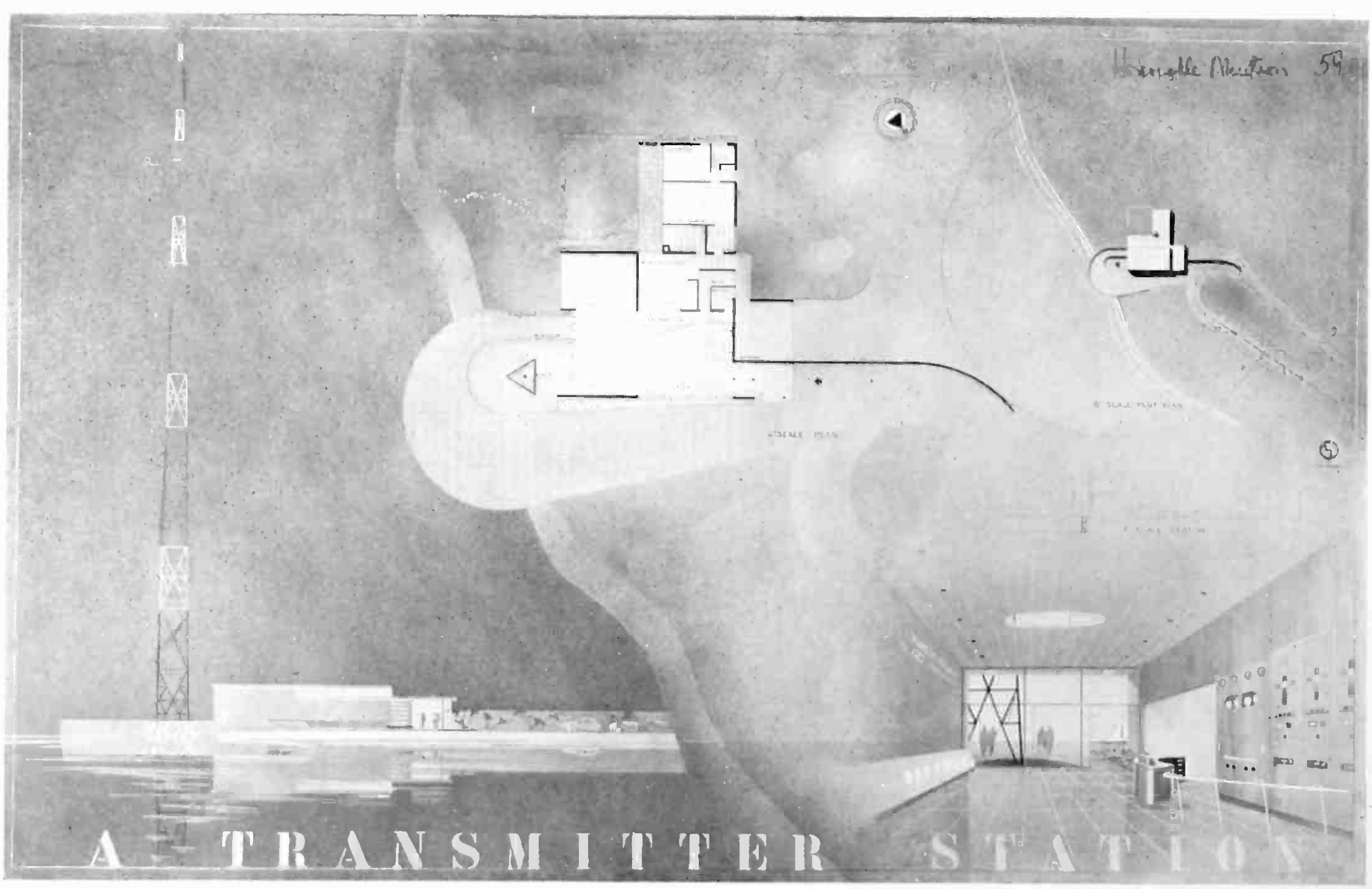
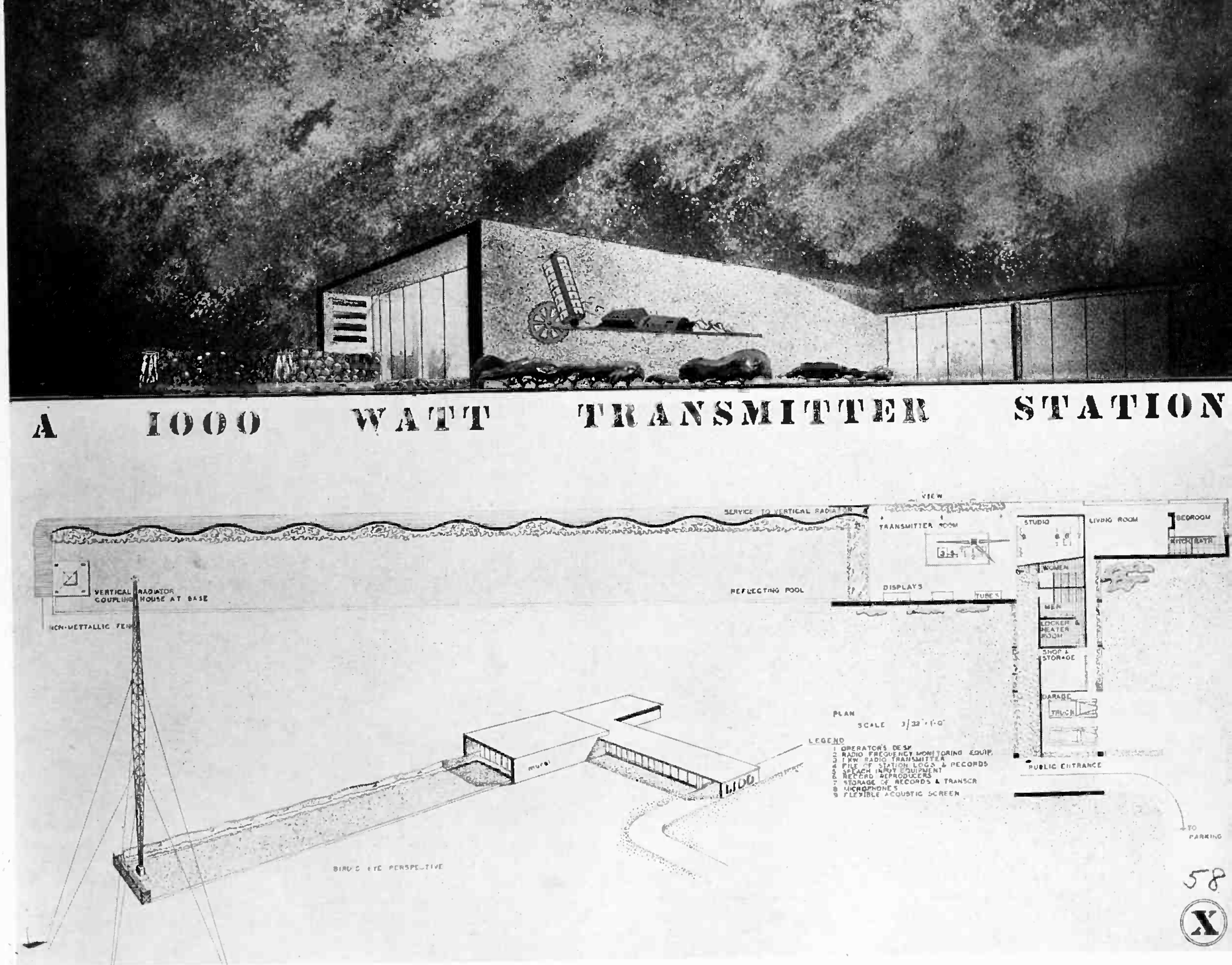
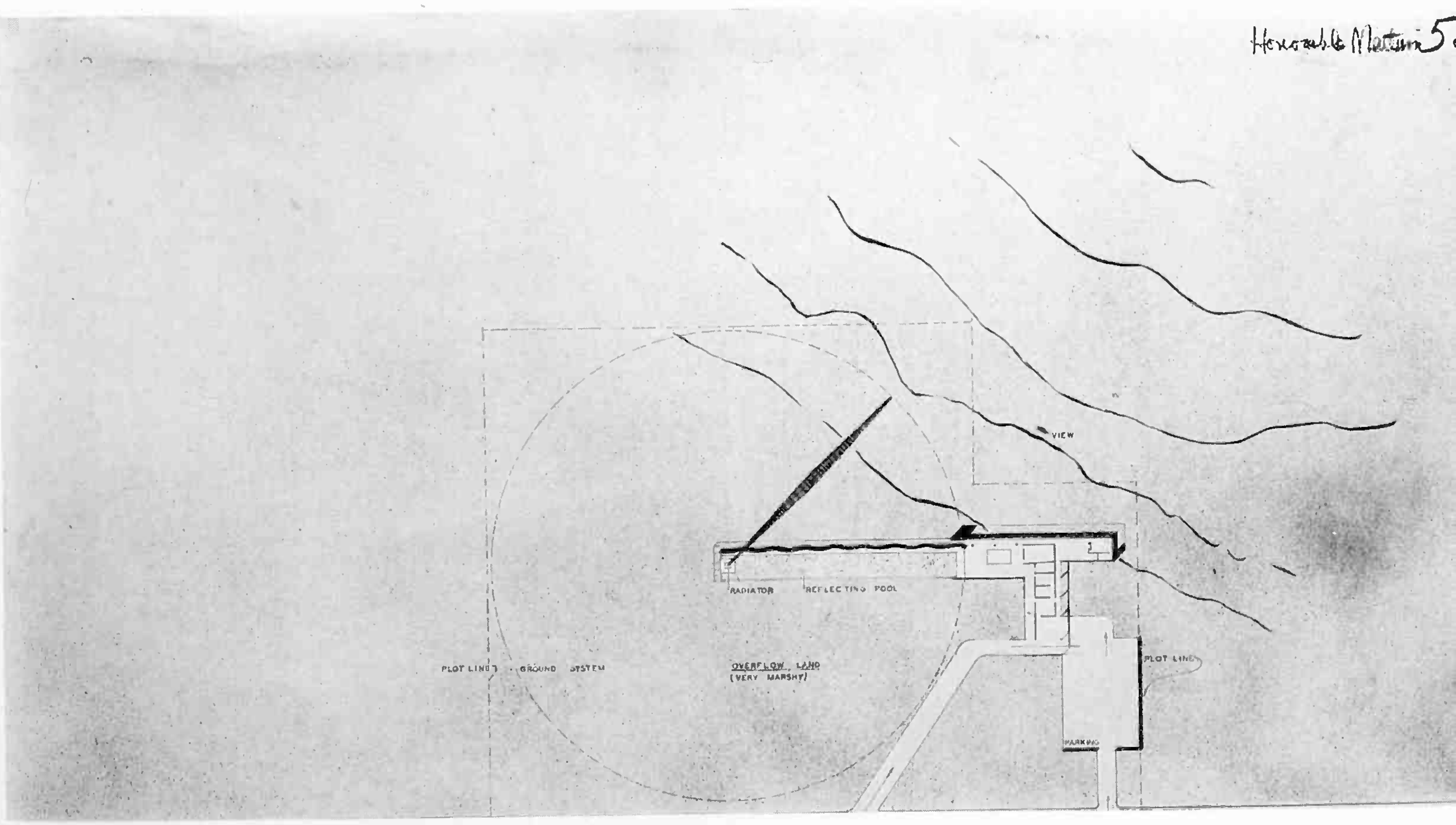
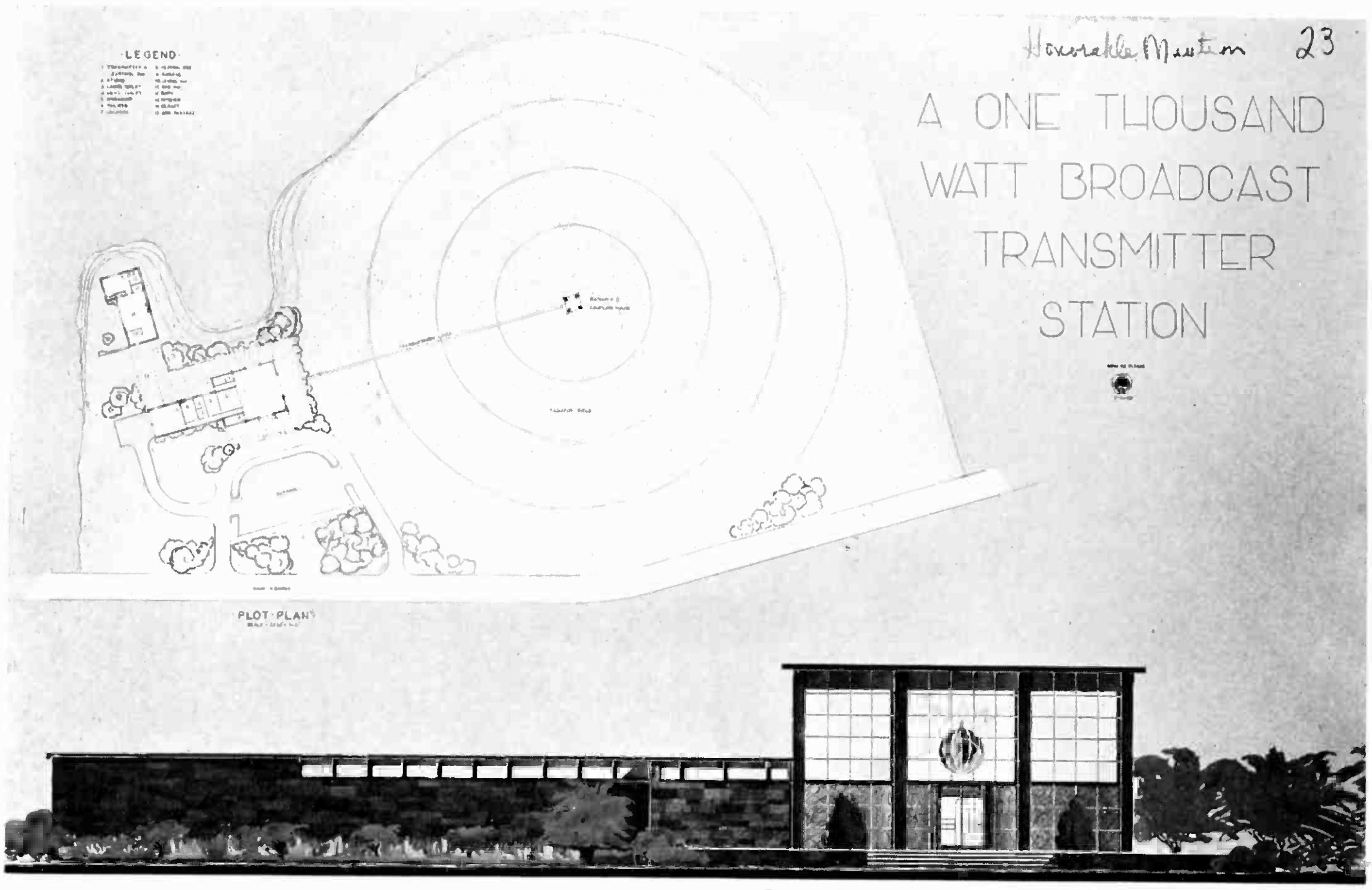




HONORABLE MENTION—D. Wiesinger, *New York University*

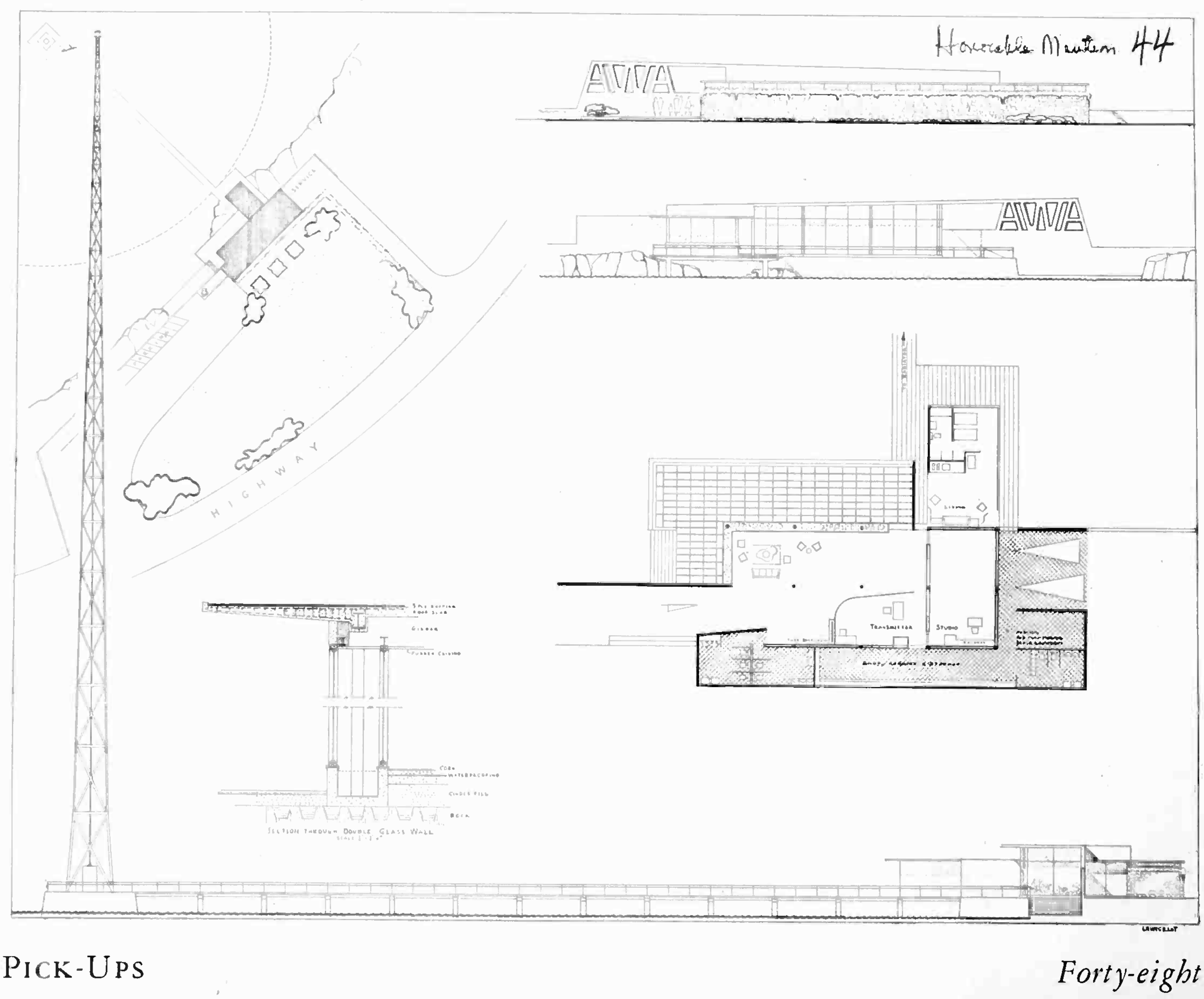


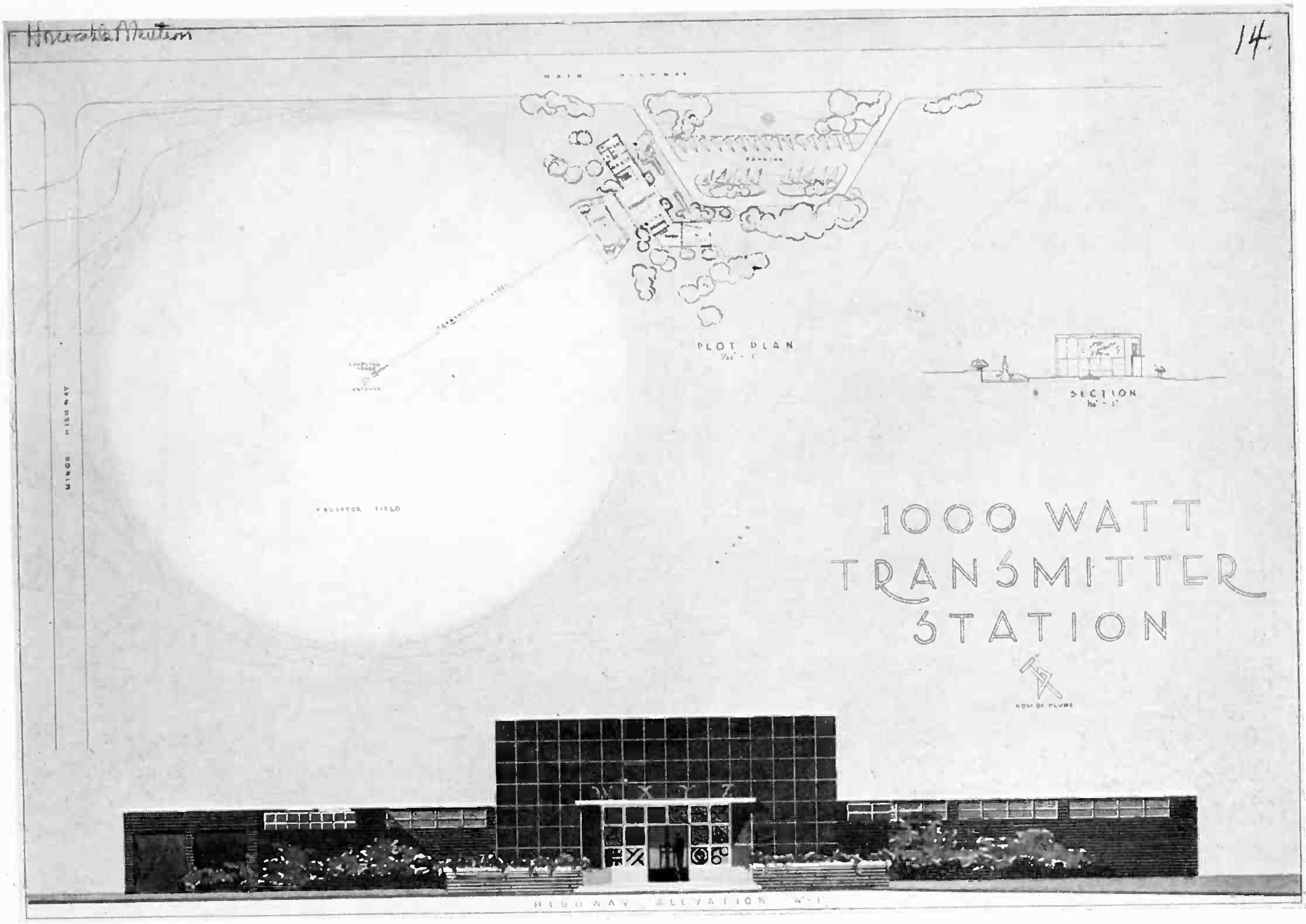


R. L. Metcalf, *Carnegie Institute of Technology*

S. Hughes, *New York University*

HONORABLE MENTION

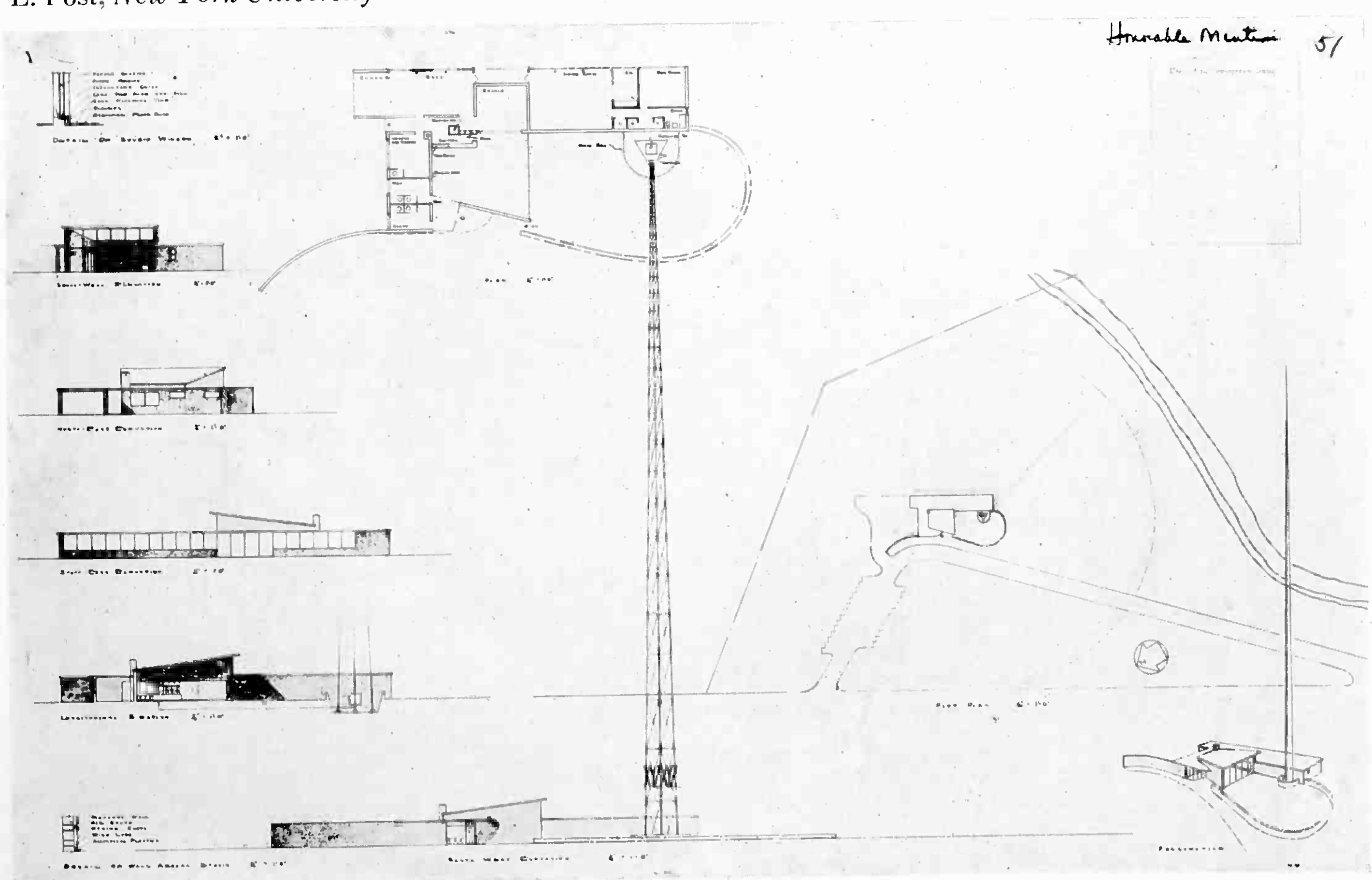


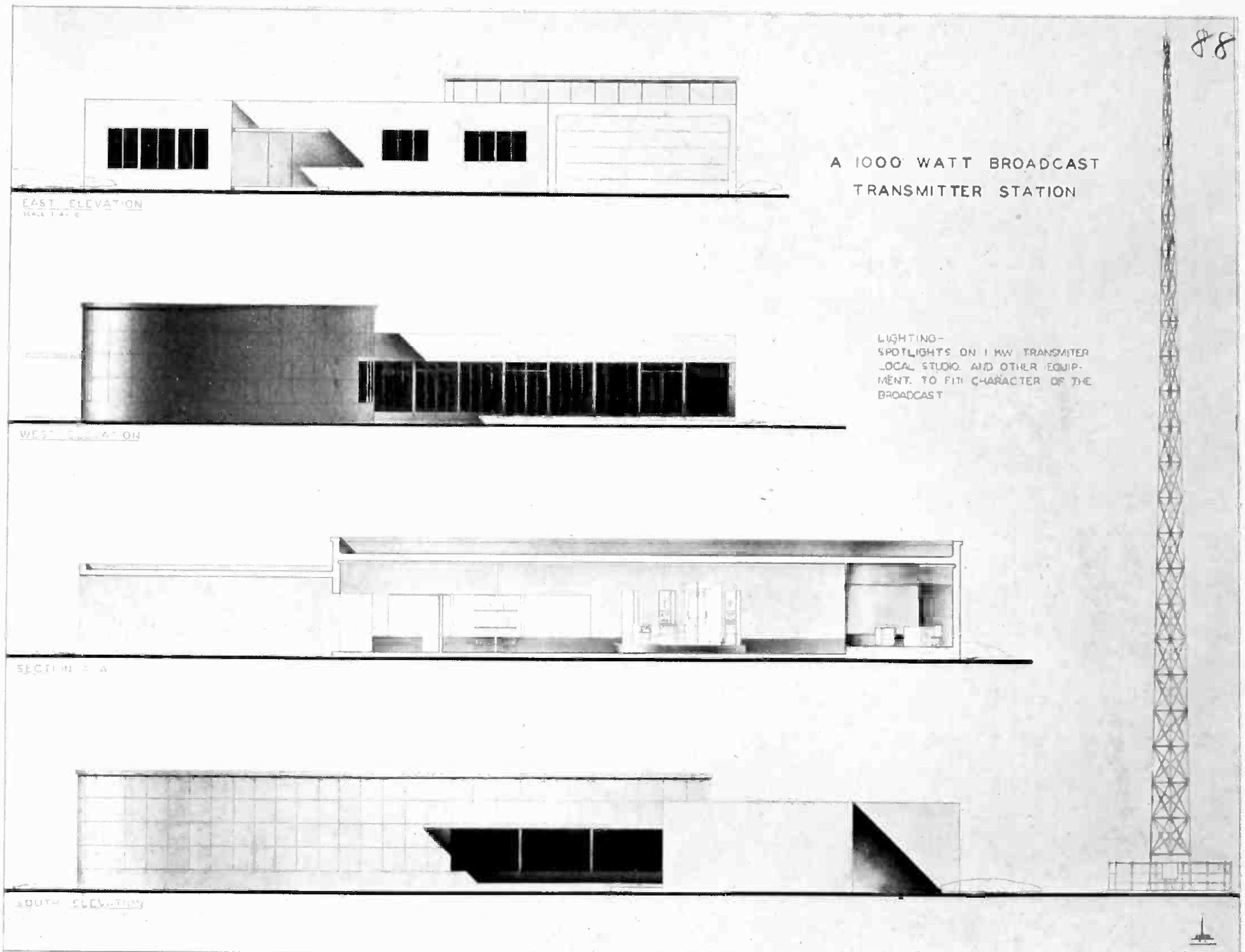


G. Arnold, *Carnegie Institute of Technology*

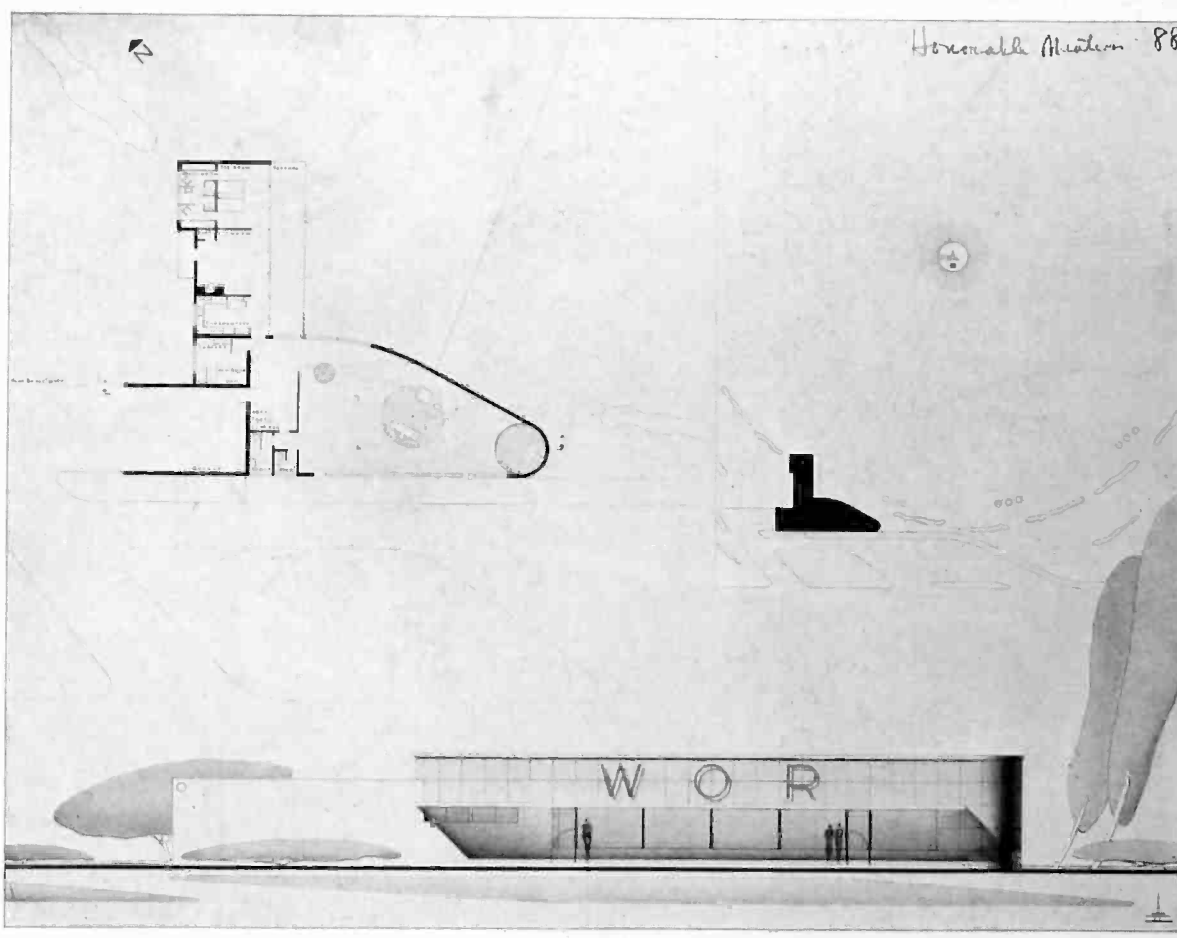
HONORABLE MENTION

E. Post, *New York University*





HONORABLE MENTION—C. Julian Vahlberg, *University of Oklahoma*

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