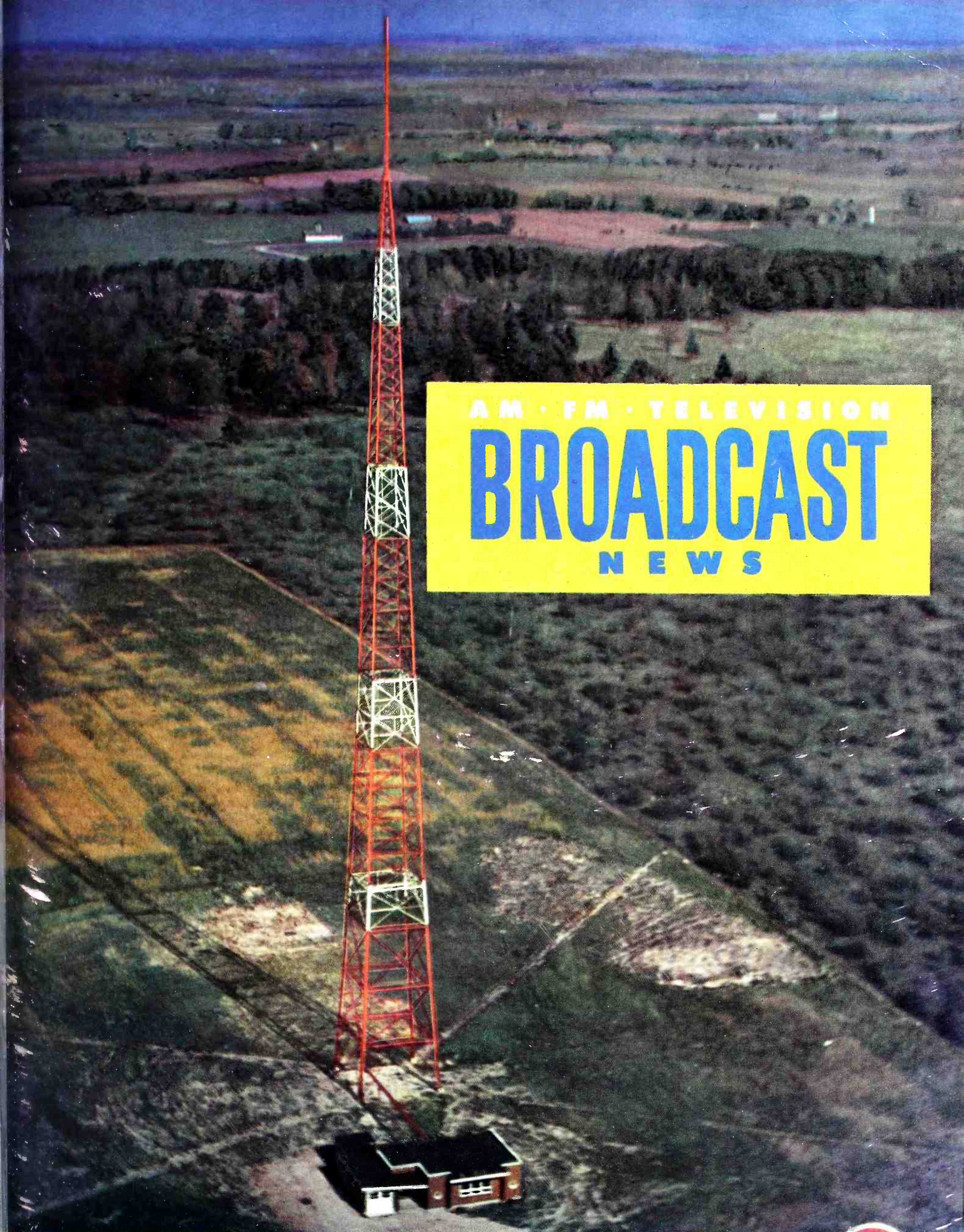
AM · FM · TELEVISION

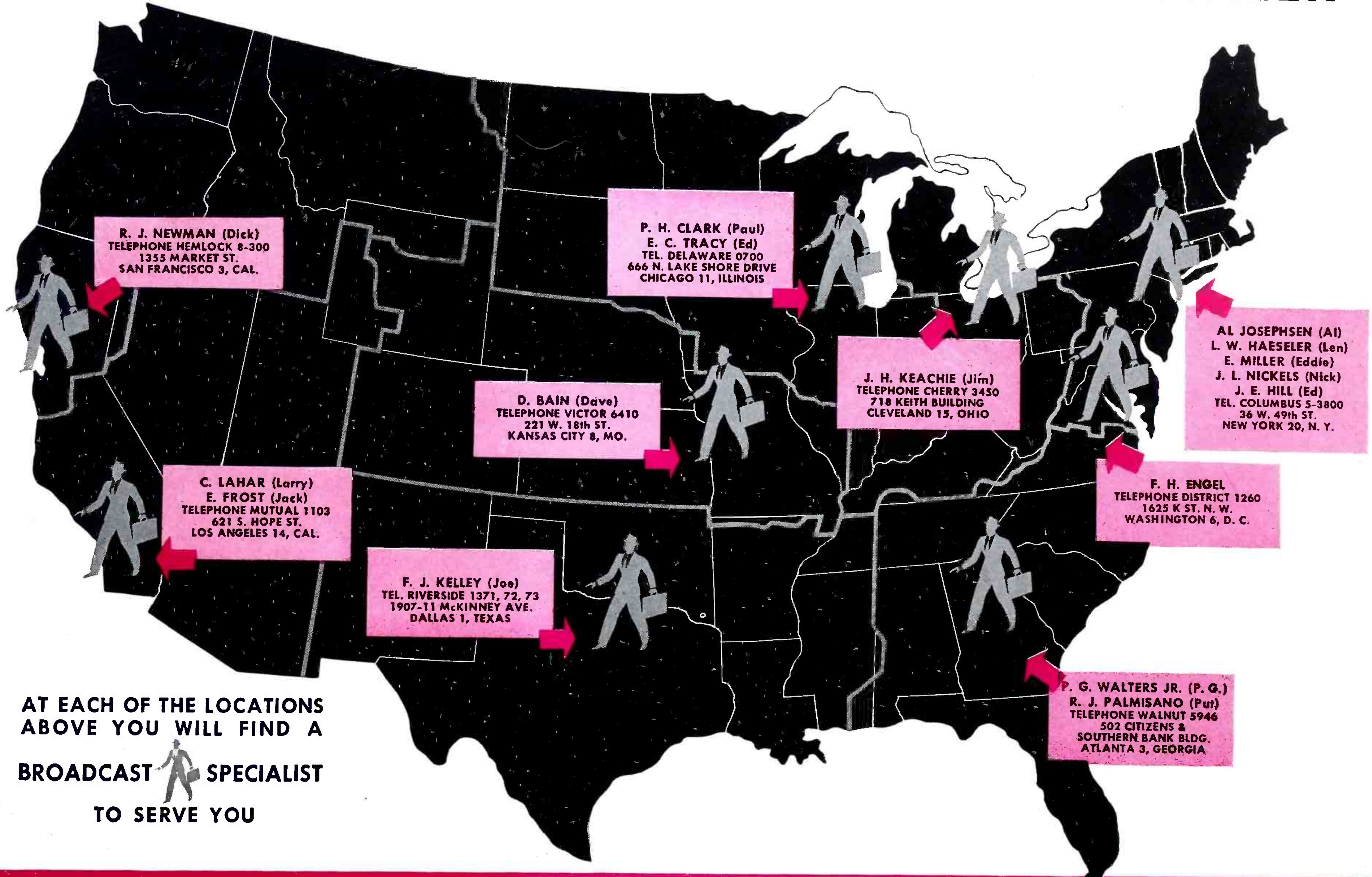
BROADCAST NEWS



WJPG's FM INSTALLATION... SEE PAGE 8

RCA

FOR QUICK ACTION ON EQUIPMENT PROBLEMS CONTACT YOUR NEAREST RCA FIELD ENGINEER



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Broadcast News

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Published by the

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ENGINEERING PRODUCTS DEPARTMENT . . . CAMDEN, NEW JERSEY

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W. O. HADLOCK, M. L. GASKILL, Associate Editors

Contents

OUR COVER for this issue is reproduced from a Kodachrome transparency forwarded to us by Elmo W. Reed, Chief Engineer of WJPG, Green Bay, Wisconsin. Visible in this picture are the brick building housing WJPG-FM's 3 KW transmitter, the 325-foot tower, and the 4-section Pylon Antenna atop the tower. Mr. Reed sent a photographer up in a plane twice, and took more than a dozen pictures all told, before he obtained just the right one for this interesting cover. He also sent us the story and photographs of WJPG-FM which appear in this issue (Pg. 8). Our thanks, Mr. Reed, and congratulations on a very good-looking installation.

WSBA-FM story, a sequel to that in our December issue—describes conversion of WSBA-FM for 10 KW operation. WSBA-FM is one of the cleanest and best-engineered installations we've seen—and it's the first installation of our BTF-10B Transmitter, of which we are also quite proud. In order to find out how it really feels to convert from 3 to 10 in the field, Bill Tucker and Frank Talmage of our transmitter section helped Woody Eberhart of WSBA make the changeover. Their description of the new setup will be found in the story starting on Pg. 12.

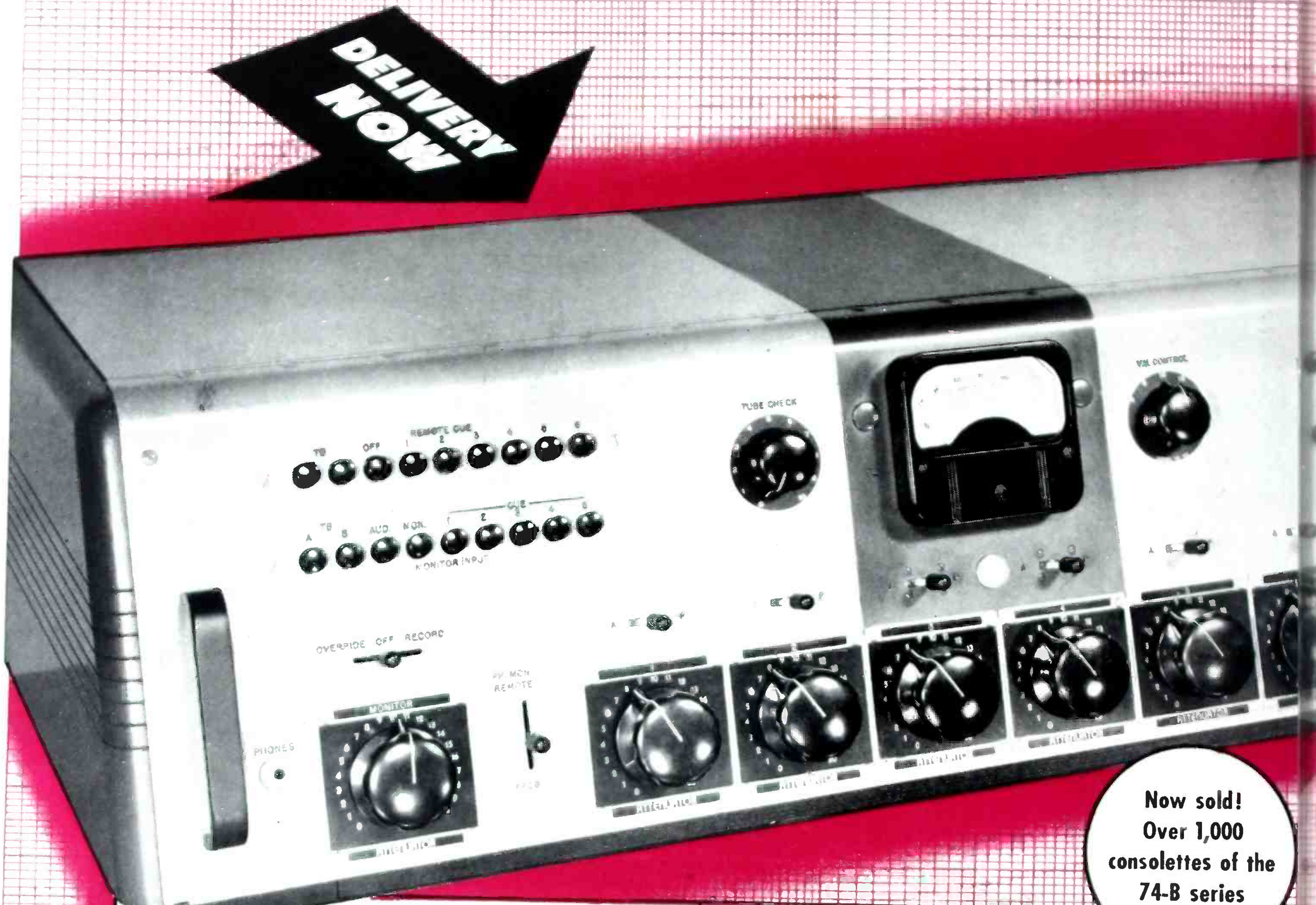
OUTSTANDING STATION ENGINEERING is evident throughout this issue. For instance, the WGAR-KMPC article is one of the best engineering stories we've had, about a couple of the finest installations we know of, by one of the best engineering groups in the industry. Everything about the operation of the Richards stations—WGAR-WJR-KMPC—impresses us—the promotion, the planning, and most of all, the progress (three fifty kilowatters today, where ten years ago they had one). The progress, incidentally, was greatly contributed to by their brilliant engineering staff. And the best part of it is that this has been recognized. Morrie Pierce, a Vice President of WGAR and KMPC, takes an active part in management policy-making. Frank Leydorf, Chief Engineer of WJR, has been made a Vice President of WJR since the story on Pg. 52 went to press. Lloyd Sigmund, Chief Engineer of KMPC, and Sid Fox, Installation Supervisor, have also received a large share of the credit. Recognition such as this has, until recently, been rare. However, within the last few years quite a number of the larger stations have given official recognition—and appropriate pecuniary reward to their engineering supervisors. About time, say we! With television moving on stage, many stations will be spending large sums on equipment and plant. A good engineer can avoid mistakes which will save his salary many times over. We believe in more recognition (verbal and folding) for the engineer—and we're going to plug for it at every opportunity. We've always tried to give the engineer the glory in BROADCAST NEWS articles—and from now on that goes double.

KCMO'S new fifty kilowatter is another installation we're real proud of. While probably not the fanciest layout in the country, it certainly is one of the best from an engineering and performance viewpoint. Karl Troeglen, KCMO's Technical Director, started this job—and substantially completed it—during the days of acute shortages. In order to get it done in a reasonable time he had to plan carefully. Even so it required ingenuity to complete it on time. That Karl was able to do it is a tribute to his resourcefulness and to his 20 years of experience in this field. Much of this experience was gained as technical director of the Capper stations during the ten year period before the war. During the war Karl supervised Navy Radar installations. Immediately after V-J Day he took over the planning of the new KCMO. To see how good a job he did one need only study the KCMO floor plan (Pg. 20).

250 BETWEEN 2 stirred up a lot of interest. Answers to the number of nearly a hundred came in by mail, wire, TWX, and even long-distance phone.

Three of the answer-writers correctly guessed that the reference was to our new Broadcast Equipment Catalog—250 pages of detailed information between two covers. (Corny, isn't it—but aren't we all). Because we couldn't figure for sure who was first we are giving all three a personal radio. The winners are: J. E. Hitt, Chief Engineer, KBTM, Jonesboro, Ark.; John Dubuque, Chief Engineer, KXA, Seattle, Wash.; Roy A. Olerud, Chief Engineer, WGYN-FM, New York, N. Y. The rest of you so-lucky-people will receive—you guessed it—a beautiful brand new copy of same catalog.

Only $1,375 Buys the 76-B4



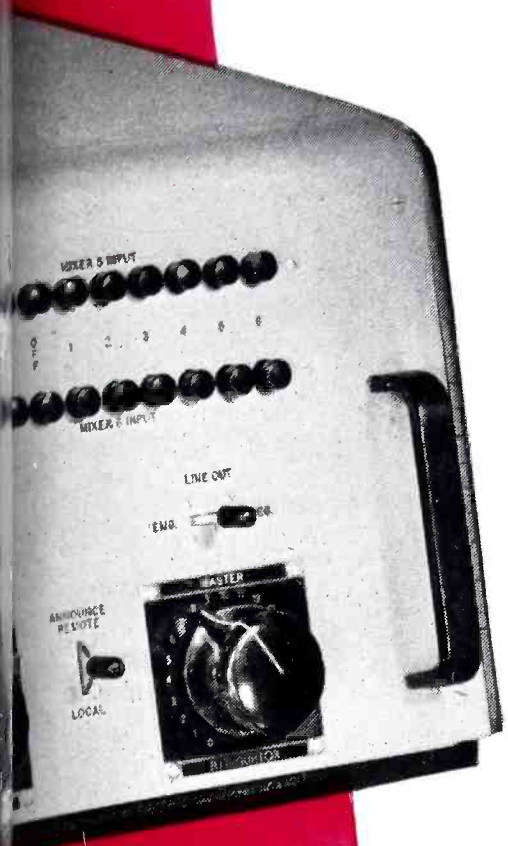
Now sold! Over 1,000 consolettes of the 74-B series

The Features

- Four pre-amplifiers.
- Over-ride facilities for all remote lines. Permits engineer or announcer on remote broadcast to "call-in" by over-ride on control room speaker.
- Six-channel mixer.
- Direct talk-back system to any studio and any remote line. Studio speakers and remote lines are interlocked to prevent feedback.
- Cue feed to remote lines.
- Five spare monitor inputs for monitoring externally produced programs, such as networks, other studios, outgoing channels, etc.
- Large VU meter connected to rotary selector switch permits accurate program monitoring. Plate current checking system for all tubes and program channel.
- No lost time due to possible failures of amplifiers or power supplies. Emergency operation may be obtained quickly by means of switches.
- Headphone monitoring across output line, monitor and external source, such as network.
- Recorder feed.
- Low-noise, low-microphonic type-1620 tubes.
- Built-in isolation coils for remote lines and turntable booster amplifiers.

Broadcasting's favorite Consolette

for AM, FM and TV



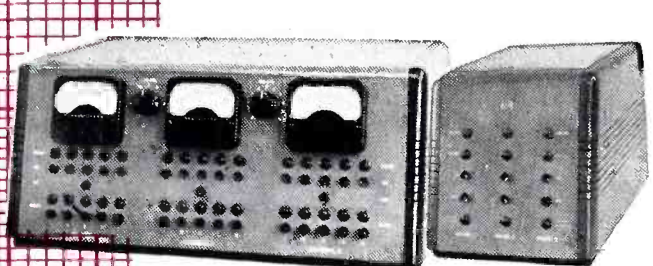
NOTHING like the 76-B4 Consolette to keep studio programs and rehearsals in motion. Because there's nothing like it for flexibility and easy operation. It provides program quality that meets FM requirements. It has full facilities for simultaneous auditioning and broadcasting . . . for practically any combination of studios, turntables, or remote lines. It performs all the amplifying, monitoring, and control functions of most large and small stations—AM, FM, and TV sound.

Here's where you use it

- For two-studio operation, using two microphones in each—one announce booth microphone, and one control-room microphone.
- For two transcription turntables using external booster amplifiers.
- For single-studio operation . . . using four microphones, one announce booth microphone, and one control-room microphone.
- For remote lines—up to six! With independent control of each.

For complete technical information on the 76-B4, the consolette that's backed by more than 20 years of broadcast engineering experience *in the field*—call your RCA Broadcast Sales Engineer. Or write Dept. 23-D.

NOW . . . Switching Systems for RCA Consolettes



Master Control Sub-Control

Type BCS-1A—Handles the output of as many as five control consolettes. Feeds three outgoing lines. Enables you to monitor studio, network, recording room, remote inputs. Switches these inputs into transmitter or network lines.

Type BCS-2A—For the smaller station requiring only two RCA consolettes. Handles up to four studios and two announce booths. Routes your program to two outgoing lines (AM, FM, or either transmitter and a network lines).

Sub-Control

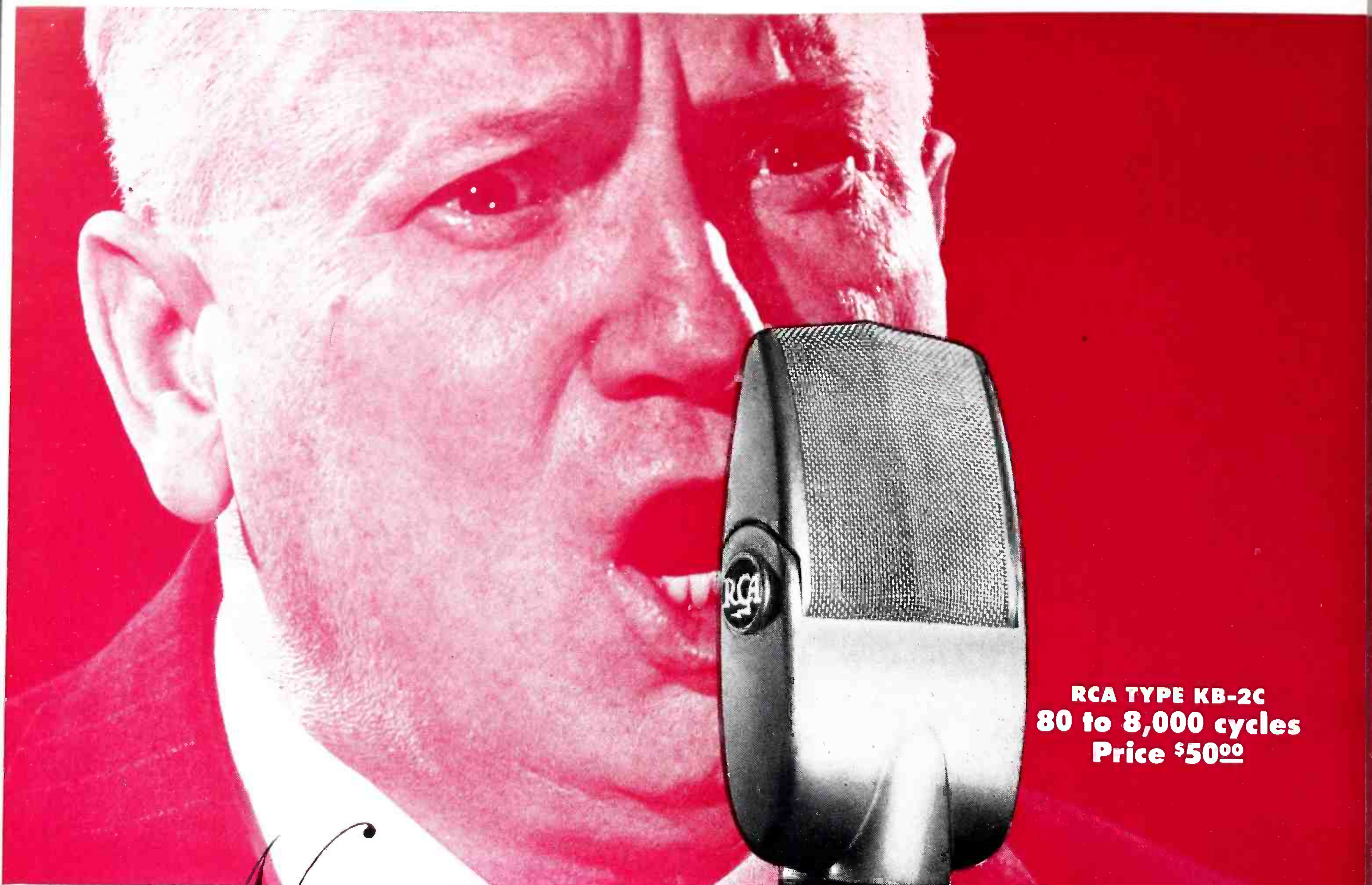
RCA

BROADCAST EQUIPMENT

RADIO CORPORATION of AMERICA

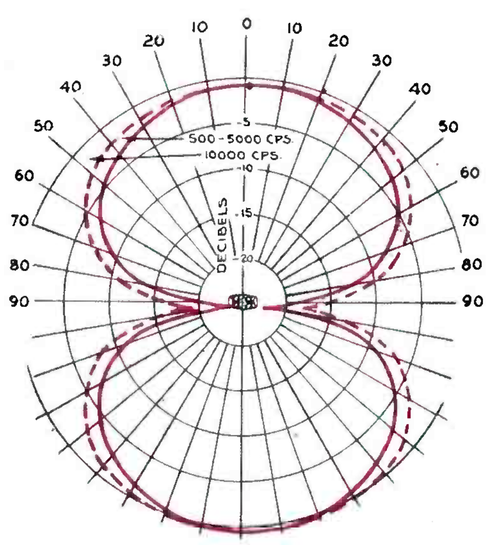
ENGINEERING PRODUCTS DEPARTMENT, CAMDEN, N.J.

In Canada: RCA VICTOR Company Limited, Montreal

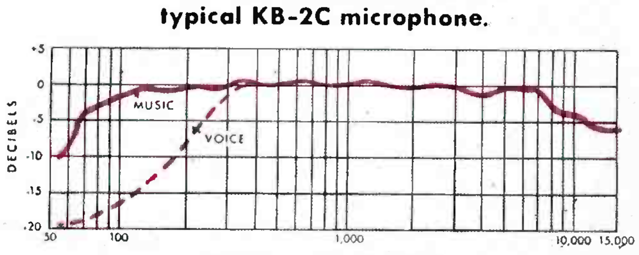


The KB-2C shown here is actual size.

New VELOCITY MICROPHONE *Bantam Size!*



Directional characteristics of a typical KB-2C microphone.



Open Circuit Frequency Response of a typical KB-2C microphone.

BECAUSE this man is talking into the new miniature KB-2C, his audiences hear him . . . and see him! Hear him—because the KB-2C has "big mike" quality. See him—because the KB-2C is one of the *smallest* high-quality microphones yet designed. It's ideal for conventions and night clubs. And it's ideal for general station and other indoor uses.

Using highly efficient magnetic material . . . and a magnet structure *that's a part of the microphone case itself*, here's a microphone that's as "light as a feather"—and so small it fits into your pocket. Its directional characteristics provide a symmetrical figure eight . . . with surprisingly uniform frequency response between 80 and 8,000 cps. Hum level, −108 dbm. Effective output level, −56 dbm. Three output impedances provided; 30, 150, and 250 ohms, in accordance with RMA standards.

Plenty of operating conveniences, too. You can tilt the KB-2C backward and forward on its swivel through an angle of about 30 degrees. You can select your bass response by means of a screwdriver-type switch located under the swivel pivot. You can disconnect the cable right at the microphone. For desk positions, use RCA's type KS-2A low-height stand. For other services, use any standard floor stand or collapsible stand.

• • •

More about the 12-ounce KB-2C from your RCA Broadcast Sales Engineer. Or write Dept.

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

In Canada: RCA VICTOR Company Limited, Montreal

Immediate Delivery

PRICE $630.00

TYPE 70-D
RCA HIGH-FIDELITY
TRANSCRIPTION TURNTABLE

Standard of the Studios—NEW EDITION

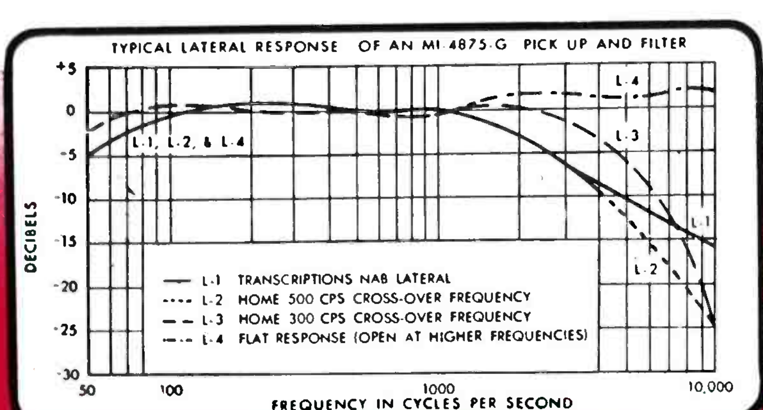
Over 3000 units of this professional series are now in use

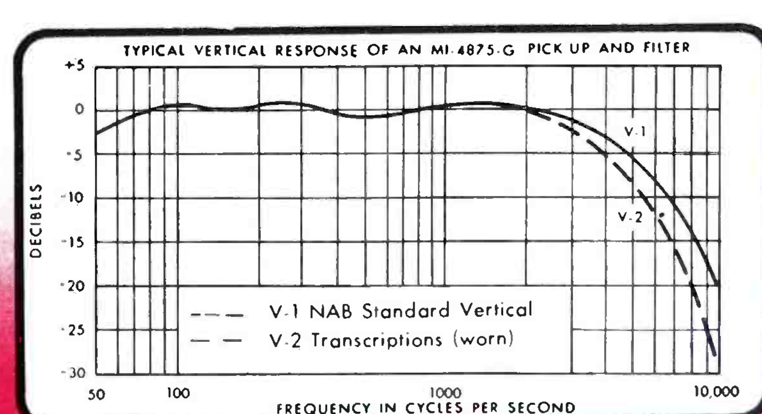
● Type 70-D is designed specifically to meet your needs for higher and higher reproduction quality in studio transcriptions.

In this unit—latest of the "70 series"—you will find all the exclusive features of the previous models . . . and important new ones. There's the universal lightweight pick-up with the diamond-point stylus . . . unexcelled for high-fidelity characteristics on either vertical or lateral recordings. And the mechanical filters and spring clutch assembly that *completely* isolate the driving motor from the platter and fly-wheel assembly.

There's the heavy-duty, constant-speed synchronous motor with all the driving power you need for recording *and reproducing* at 33⅓ or 78 rpm. And there's the handsome new hinged-door *metal* cabinet with its durable formica top . . . with the inside space to house booster amplifiers and record cueing amplifiers . . . and with accommodations on the formica top for adding an RCA 72-D or 72-DX Recording Attachment when you decide to go into recording.

For the finest response from your recording . . . for dependable timing to the very last second . . . for even running and smooth starts and stops, this studio turntable has it! Available in two cabinet-top heights . . . 28 inches and 30 inches. Equipped with convenience-plug outlets for a-c and audio circuits. Ask your RCA Broadcast Sales Engineer for complete data, or write Dept. *115-L.*





MIDGET FIELD INTENSITY METER *for the* AM Broadcast Band

by R. E. GRIMM*
Engineer, Clarke Instrument Corporation

There has long been a need on the part of stations and consultants for a small, truly portable, and, above all, accurate instrument for measuring field intensities. The new WX-2A field intensity meter was designed to meet this need. It provides, for the first time, an instrument which is accurate, truly portable, entirely self contained, simple in operation, direct reading, and priced at a figure which is well below that of other instruments for the same purpose.

The total weight of the meter, complete and ready to use, is 12.6 lbs. It is no longer necessary to organize a safari to carry equipment for making field intensity measurements. The instrument is so light that it can be easily held in one hand and properly oriented while making a measurement. It is also arranged for mounting on a light-weight tripod.

FIG. 1. (above) *The WX-2A Field Intensity Meter is an extremely convenient, entirely self-contained instrument providing direct readings with high accuracy at frequencies in the AM broadcast band.*

FIG. 2. (left) *The complete instrument is 12" x 8½" x 5½" in size, weighs 12½ pounds with batteries. Loop is mounted in the lid so that no cables of any kind are required.*

The first requisite for any measuring instrument is that it be accurate. The WX-2A is direct reading in microvolts per meter, without the necessity of charts, factors, curves, or computations of any kind whatsoever. To achieve this it is necessary to eliminate the many innaccuracies in other field intensity measuring equipment, which are concealed into one all-inclusive correction figure termed "loop antenna factor."

In the WX-2A a statically shielded, unbalanced loop is used which is integral with the cover of the instrument. This loop has only a few turns, and, consequently, the natural resonant frequency, due to distributed capacity, is very much higher than the highest frequency in the operating range. The high side of this loop is loaded with a high "Q" coil to make up the

FIG. 3. (right) *For convenience in making measurements the WX-2A may be mounted on a lightweight tripod. A midget in size only, this new field intensity meter has all of the controls and operating conveniences provided in larger models of older design.*

total inductance necessary for the operating range. Injection of the calibrating voltage into the loop circuit is by means of a small toroidal-wound inductance. The "Q" of the loop circuit is approximately 100 at one megacycle. This high "Q", plus the use of a stage of radio frequency amplification, results in a very high order of image rejection. This feature is necessary since the large increase in the number of stations in some localities has made the use of field intensity meters having insufficient front-end selectivity impractical. By careful design, other spurious responses, such as IF harmonics, have been greatly reduced. The use of crystal diodes for metering purposes eliminates the meter errors due to varying cathode voltages on thermionic rectifiers. The crystals are used in special circuits which swamp out variations due to temperature, etc. The meter will indicate accurately with filament voltages as low as one volt and plate voltages as low as 45 volts.

Ordinary flashlight cells, obtainable everywhere, are used for the filament. A 67-volt battery of the size in common use in small camera-type radios is used for plate supply. The total plate drain of the receiver is 8 ma. The filament drain is 300 ma. Separate batteries are used for the calibrating oscillator. All batteries are carried in a compartment accessible through a door in the rear of the instrument. Provision is made for checking battery voltages with the same meter as used for field intensity indication.

Since the tubes are quick-heating filamentary types and the instrument stabilizes in a few seconds, it is not necessary to keep the set turned on between readings. Under normal conditions prevailing on a survey, the batteries will last for at least 500 measurements.

The direct reading feature of the instrument is one of its outstanding points. The output indication is taken from a shaped pole piece instrument having a long scale which is approximately logarithmic. This provides the same reading accuracy regardless of the deflection over a 10 to 1 range. The scale accuracy of the indicating instrument is held to 3% at any point on the scale, using mid-scale as reference.

Two attenuators are used in the instrument, one operating at signal frequency after the loop and the other at the intermediate frequency. These two attenuators are ganged together and operate as one unit. The indexed positions are marked in terms of "Full Scale Range, Microvolts per Meter." The measuring range of the WX-2A is from 10 volts per meter to 10 microvolts per meter at any frequency from 540 kc to 1600 kc. After the calibrating procedure is carried out, the answer is instantly displayed in the usable term of "Microvolts per meter." It is not necessary to log a meter reading, an attenuator reading, and then multiply these by a factor to get the answer. The answer is read directly from the meter scale. The wide range of the instrument, from 10 volts per meter to 10 microvolts per meter, makes possible close-in measurements on high-powered directional arrays, on the one hand, and interference studies where very low signals are encountered, at the other extreme. The instrument will calibrate readily in the presence of extremely strong fields, and it is seldom necessary to go through the detuning procedure common in the past under such circumstances.

The receiver dial and the calibrating oscillator dial are calibrated directly in frequency. The dials are driven by reduction drives which are free from annoying hacklash. The control knobs are large and can be conveniently operated in cold weather when heavy gloves are in order.

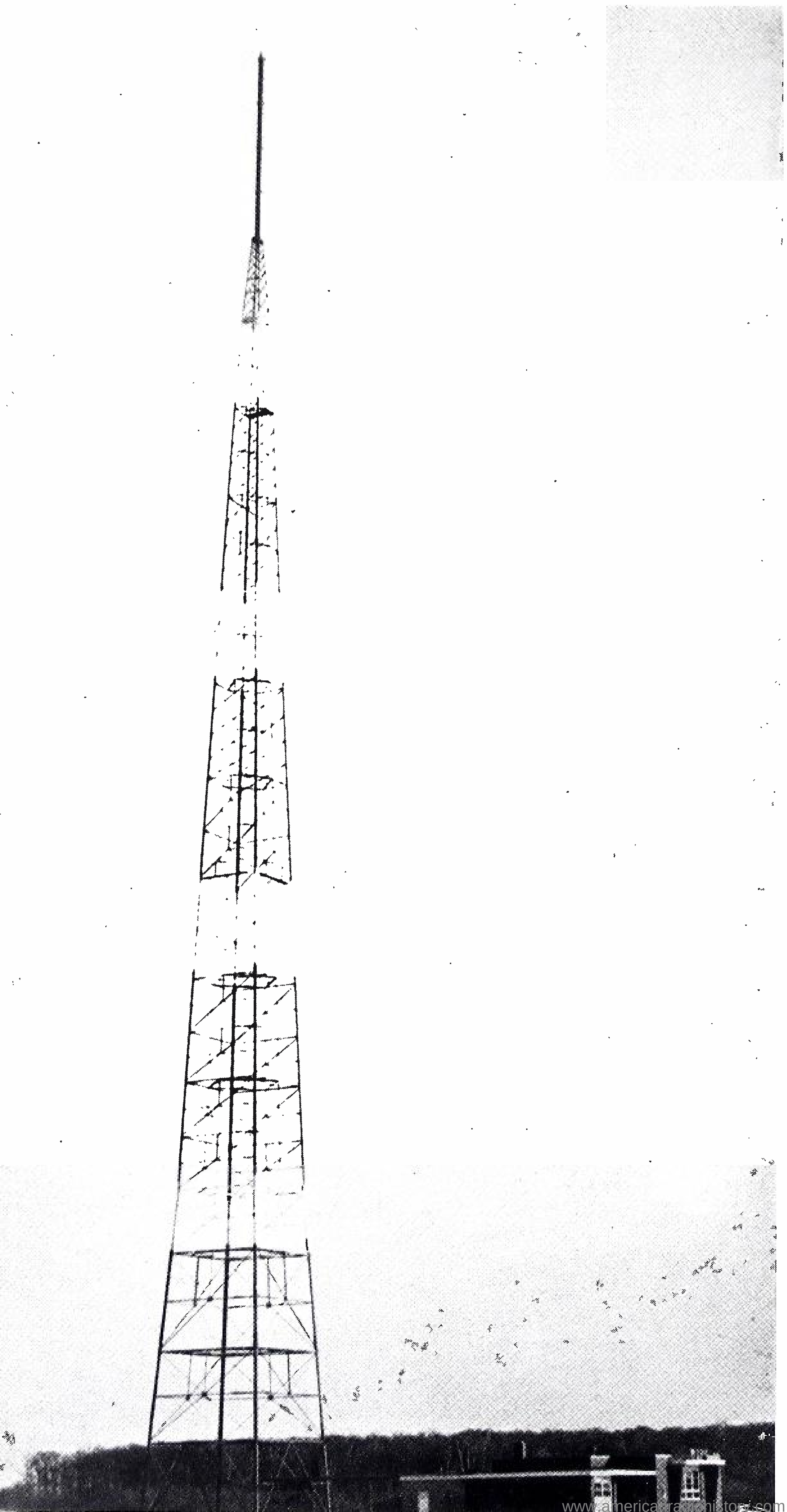
Despite its small size, nothing has been sacrificed in the way of quality or workmanship. In fact, it takes better workmanship and design to compress all the usual components of a field intensity meter, plus some extras, into the compact package of the WX-2A, which measures only 12 x 8½ x 5½ inches. Components of the highest quality are used. The design is such that all components are accessible, and inspection of the interior reveals the thought and effort expended on development. Despite its many desirable features, the WX-2A is priced at a figure well below that of any previously available field strength measuring equipment. Consultants and stations will find that it adequately fills a long-felt need. The almost universal comment of those who have seen the instrument is, "Why hasn't somebody done it before?" No longer need the field engineer be a beast of burden.

*** The WX-1A VHF Field Intensity Meter and the WX-2A Standard Band Field Intensity Meter were both designed and are being manufactured by the Clarke Instrument Corporation of Silver Spring, Maryland. Effective March 1, 1948, RCA became a national distributor of these instruments.**

WJPG-FM

First FM Service in North East Wisconsin Area

by ELMO W. REED
Chief Engineer
Radio Station WJPG and WJPG-FM



Since August 13, 1947, WJPG-FM (a radio service of the Green Bay Press Gazette) has been providing northeastern Wisconsin listeners with their sole source of FM broadcast programs. When WJPG's 3 kilowatt FM station went on the air (channel 266, frequency 101.1 mc) in August, we culminated two years of planning and construction from the time that an application was filed with the commission. The one-kilowatt AM transmitter, RCA Type BTA-1L (AM station photos are not available as this is written) was installed during the late fall. The AM transmitter and building are located in the same general area as that of the FM building and tower, except at a lower elevation.

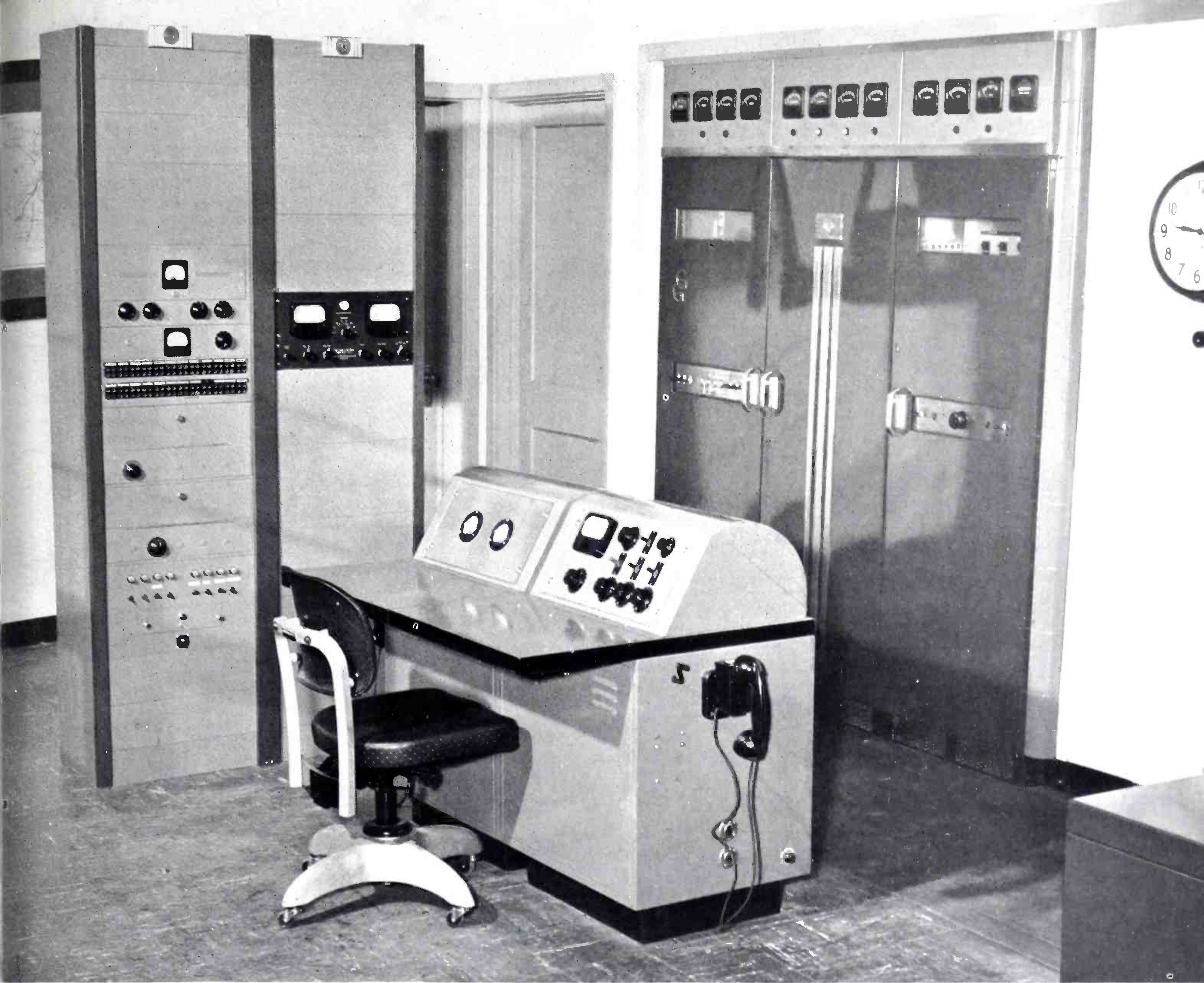
NEW STUDIO BUILDING AND EQUIPMENT UNDERWAY

In a sense, WJPG-FM, which has been programming eight hours daily, is in a temporary period of operation. The small studio we now use, located at 428 Cherry Street behind the Press-Gazette building, will be a far cry from the studios under construction. The completely new building and studios equipped with polycylindrical diffusers will contain four main studios, two control rooms and a talent-observation lounge. These facilities will fulfill both AM and FM requirements. Six racks of custom-built speech input equipment and two specially-built studio control consoles are being furnished by RCA. We believe it will be one of the finest small-city station studios in the country. Meanwhile, WJPG-FM will continue to produce local studio shows from the temporary quarters and pipe programs via telephone lines to the FM transmitter, 10 miles distant.

FM TRANSMITTER EQUIPMENT AND BUILDING

Situated on Scray's Hill, about 10 miles southeast of Green Bay, is our brick-constructed transmitter building, which is shown in Figure 1. It houses the flush-mounted 3 KW FM transmitter, the control console, and monitoring and audio equipment (see Figures 2 and 3). The two RCA speech input racks contain the limit amplifier jack panel, monitor

FIG. 1. (left) *This view shows WJPG-FM's 325-foot tower with its four-section RCA Pylon mounted on top. The location on Scray's Hill provides the Pylon Antenna with a height of nearly 500 feet above average terrain. WJPG's brick transmitter building is shown in the foreground.*



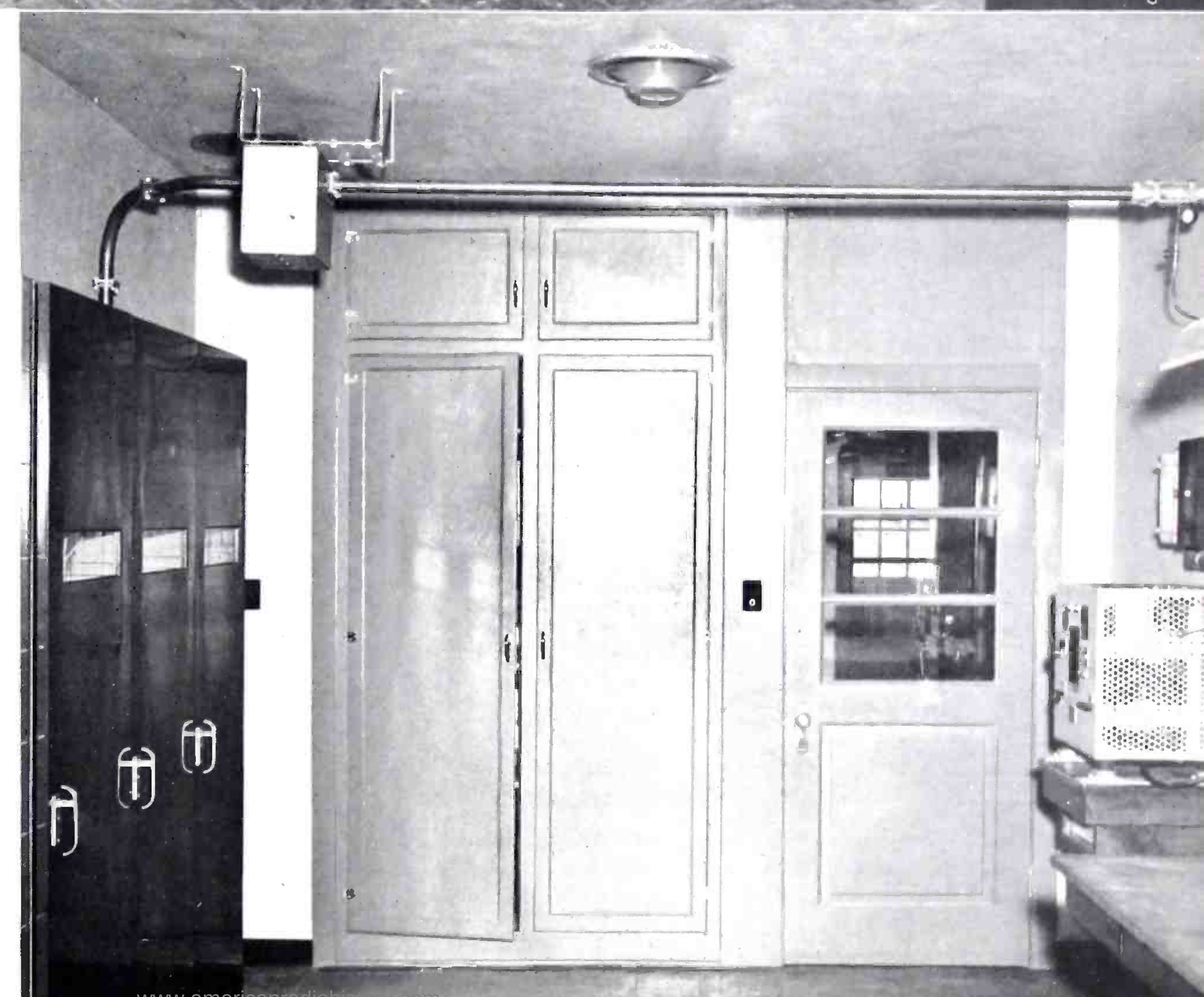


FIG. 2. (above) *A partial view of the transmitter room. Visible are—the 3 KW RCA FM transmitter (flush-mounted to provide a neat arrangement in which all controls are easily accessible)—the speech input equipment rack and control console. On the left panel of the console are the tower light burnout indicators, and on the right panel, the vu meter with its attenuator switch, monitor selector switch, monitor volume control, master gain control and three input circuits consisting of line, mike and turntable.*

FIG. 3. (right) *Plenty of walk-around and working space was provided behind the 3 KW FM transmitter. All three cabinets of the FM transmitter have full-width front and rear doors for easy access to tubes and components. Also visible in this view are the harmonic filter, tower beacon flasher, photo-electric control box for the tower lights, and the transmission line dehydrator unit.*

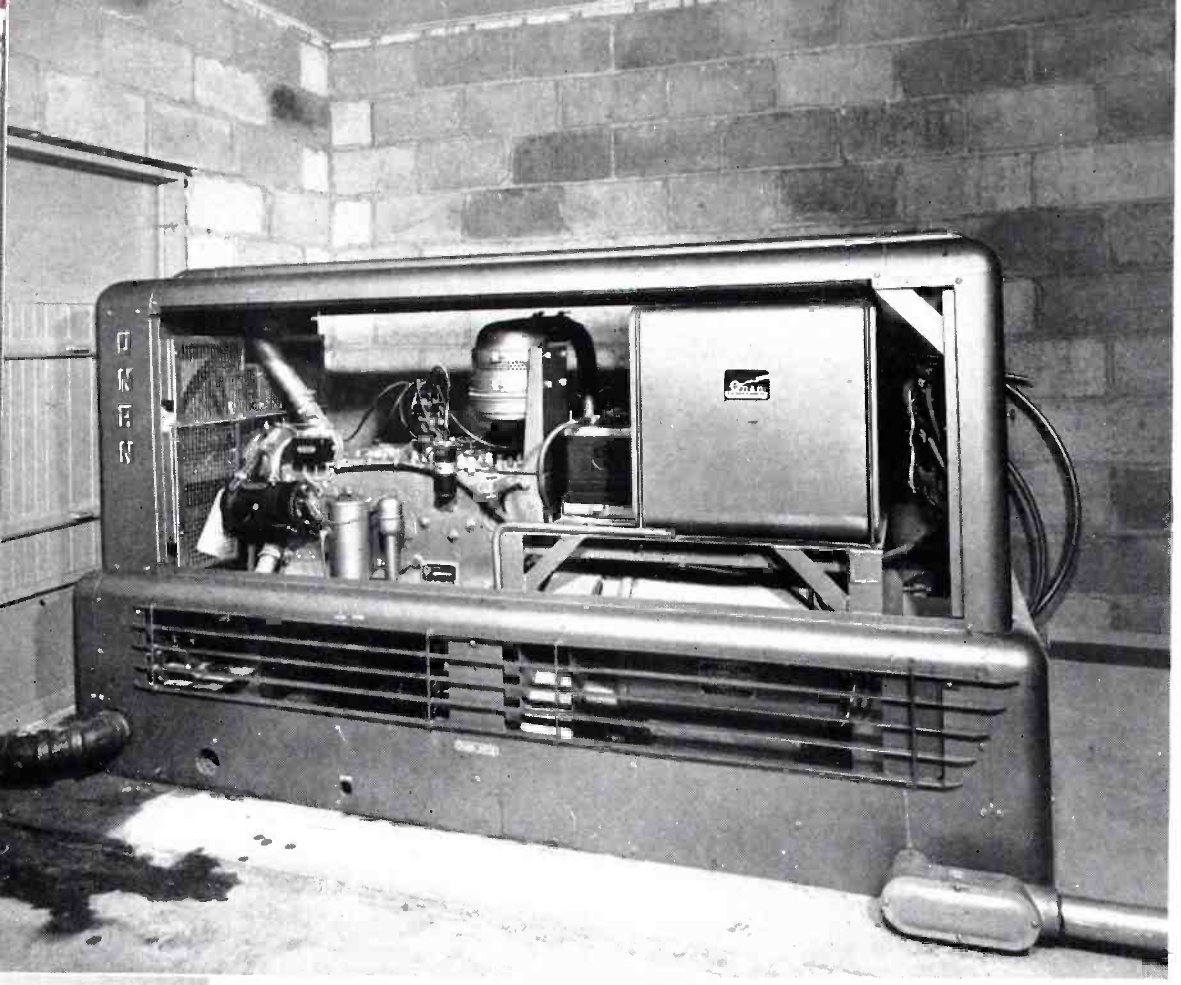


FIG. 4. (above) *The standby power plant located in the WJPG-FM transmitter house consists of a six-cylinder gasoline driven Onan motor which develops 35,000 watts. It is equipped with undervoltage relays which automatically start the generator and switch the load from the power line to the generator in the event of transmission line failure.*

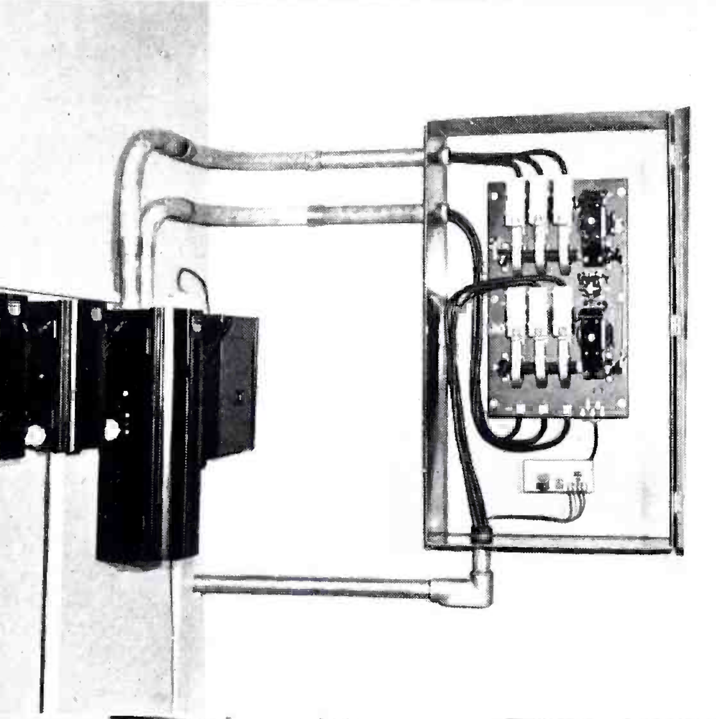
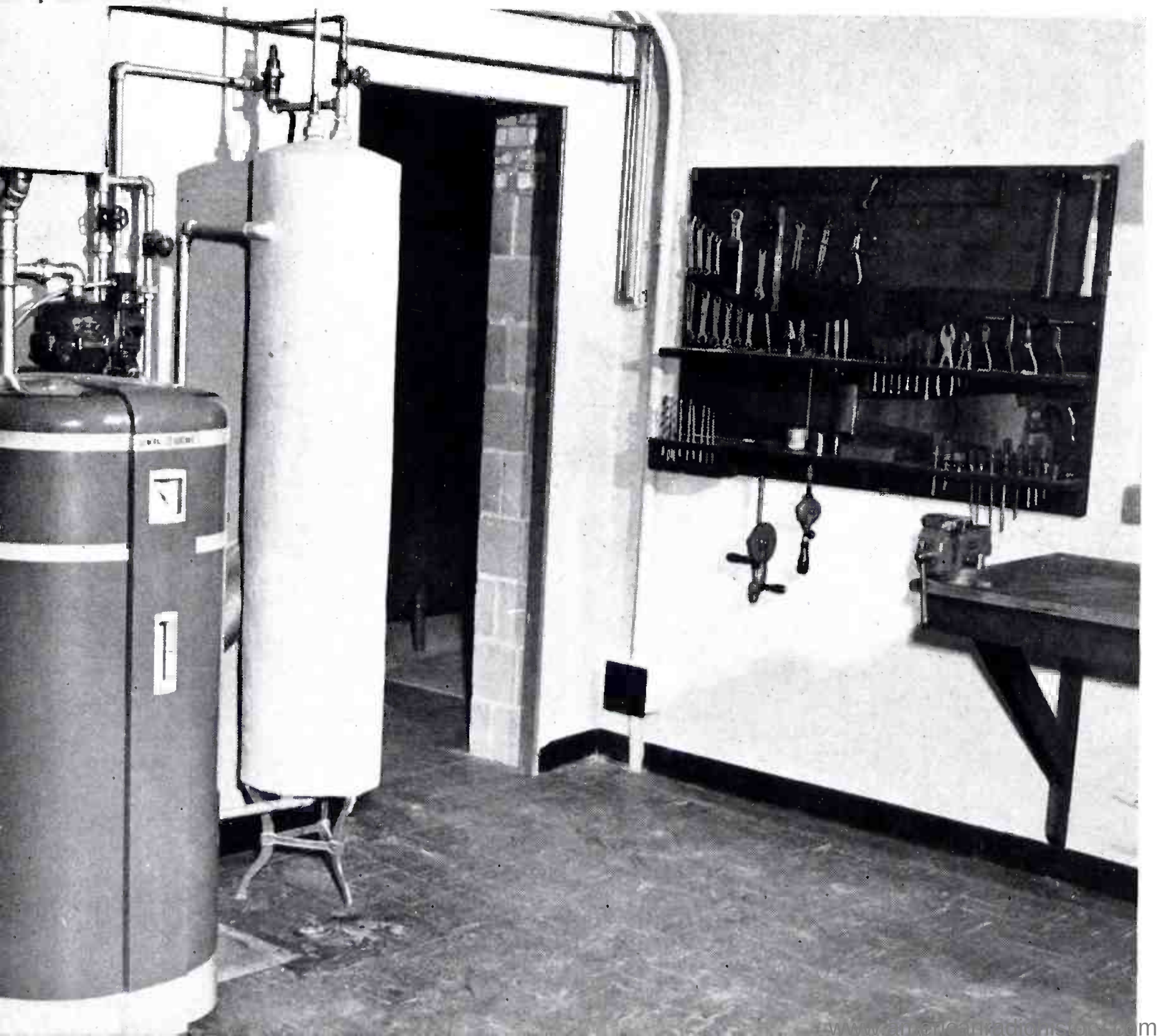


FIG. 5. (left) *The various power switches in the WJPG-FM building are located as shown here. From left to right are the telephone termination cabinets and the power changeover switch for the Onan standby power plant.*



amplifier, a-c switches and the frequency and modulation monitors. The control console, which is a composite affair made by bolting two RCA public address consoles together, is located so that the operator has easy access to all controls required for normal transmitter operation. In addition to the transmitter and its associated equipment—a combined utility room and workshop, and a 35,000-watt standby power plant are located in the same building (see Figures 4, 5 and 6).

RCA broadcast equipment was specified almost entirely and the high quality of reception, to which listeners in this area attest, is a compliment to that equipment. WJPG-FM's transmitter is a 3 kilowatt, RCA Type BTF-3B. The transmitter output is fed through a coaxial transmission line to the four-section RCA Pylon, which is mounted atop the 325-foot Blaw-Knox tower (see Figure 1).

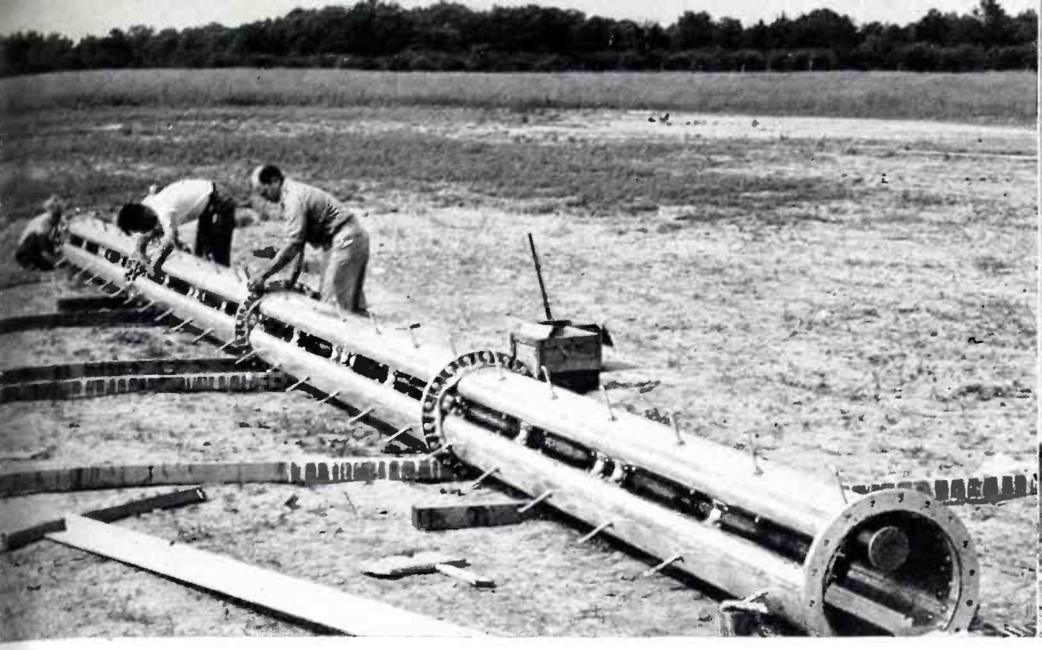
THE PYLON ANTENNA

The 54-foot RCA Pylon Antenna, due to its design, steps up the 3 KW power output to an effective radiated power (transmission line loss subtracted) of 14.4 kilowatts, which has proved to be more than adequate to cover the prosperous Green Bay area. WJPG-FM is provided with a minimum coverage of 60 miles in radius with a signal strength of 50 microvolts.

The antenna tower is located just to the right and immediately behind the transmitter building on Scray's Hill. The "Hill" has an interesting geological background. It is a part of what local people know as "the ledge"—which is a young limestone formation underlying this part of the United States. Its most famous outcropping is at Niagara Falls. The height of Scray's Hill, plus the 325-foot tower, give the RCA Pylon Antenna a total height of about 500 feet above average terrain.

The entire installation of antenna and tower proceeded smoothly. The four-section Pylon antenna was *raised and mounted to the tower top as one completely-assembled unit.* As may be seen in Figure 7, all four Pylon sections (each section is 13½ feet long and 19½ inches in diameter) were bolted together at the flanges, antenna beacon attached, and transmission line harness inserted—while "on the ground". The only connection required in the air was in coupling to the transmission line from the transmitter. Throughout the entire Pylon installation, the construction crew used only standard equipment, such as the motor-driven winch, necessary cables, tag lines and gin pole. A series of views (Figures 7 to 10) is included here to illustrate the antenna installation, as it progressed.

FIG. 6. (left) *The combined utility room and workshop in the WJPG-FM transmitter building includes a GE oil burner and hot water tank, and tool racks, as shown. The room was designed to give ample space around the work bench.*



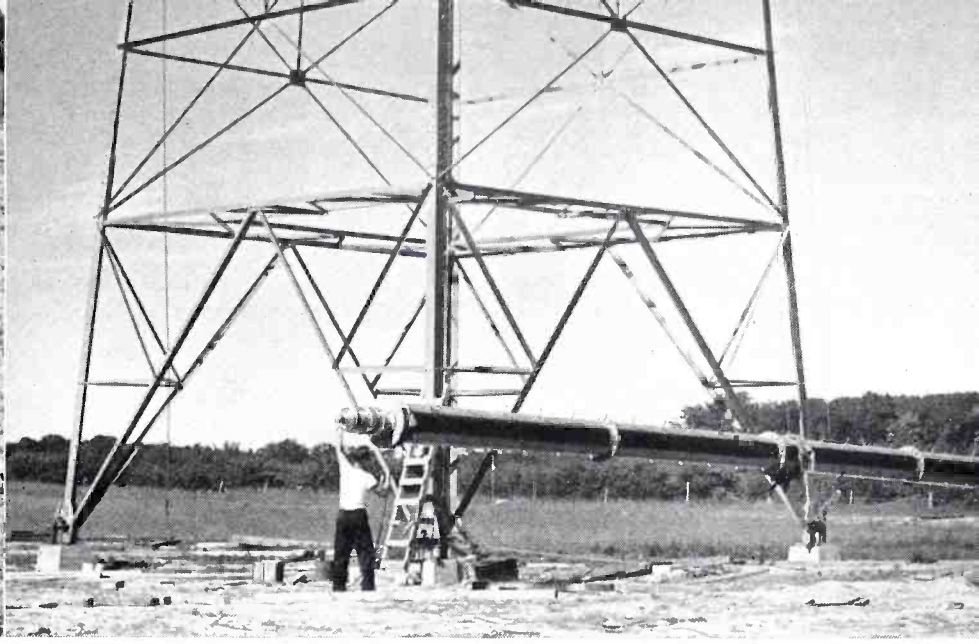
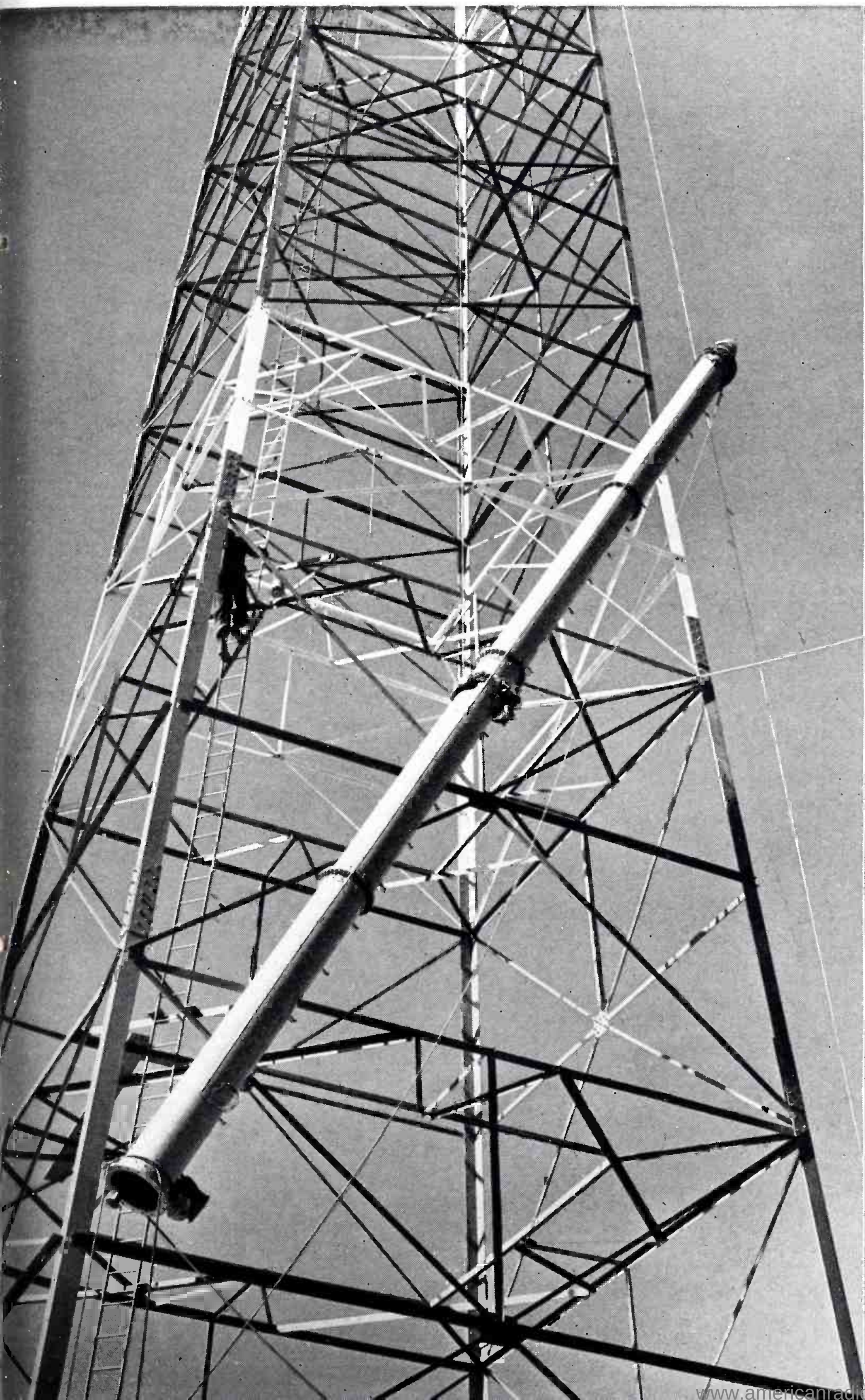


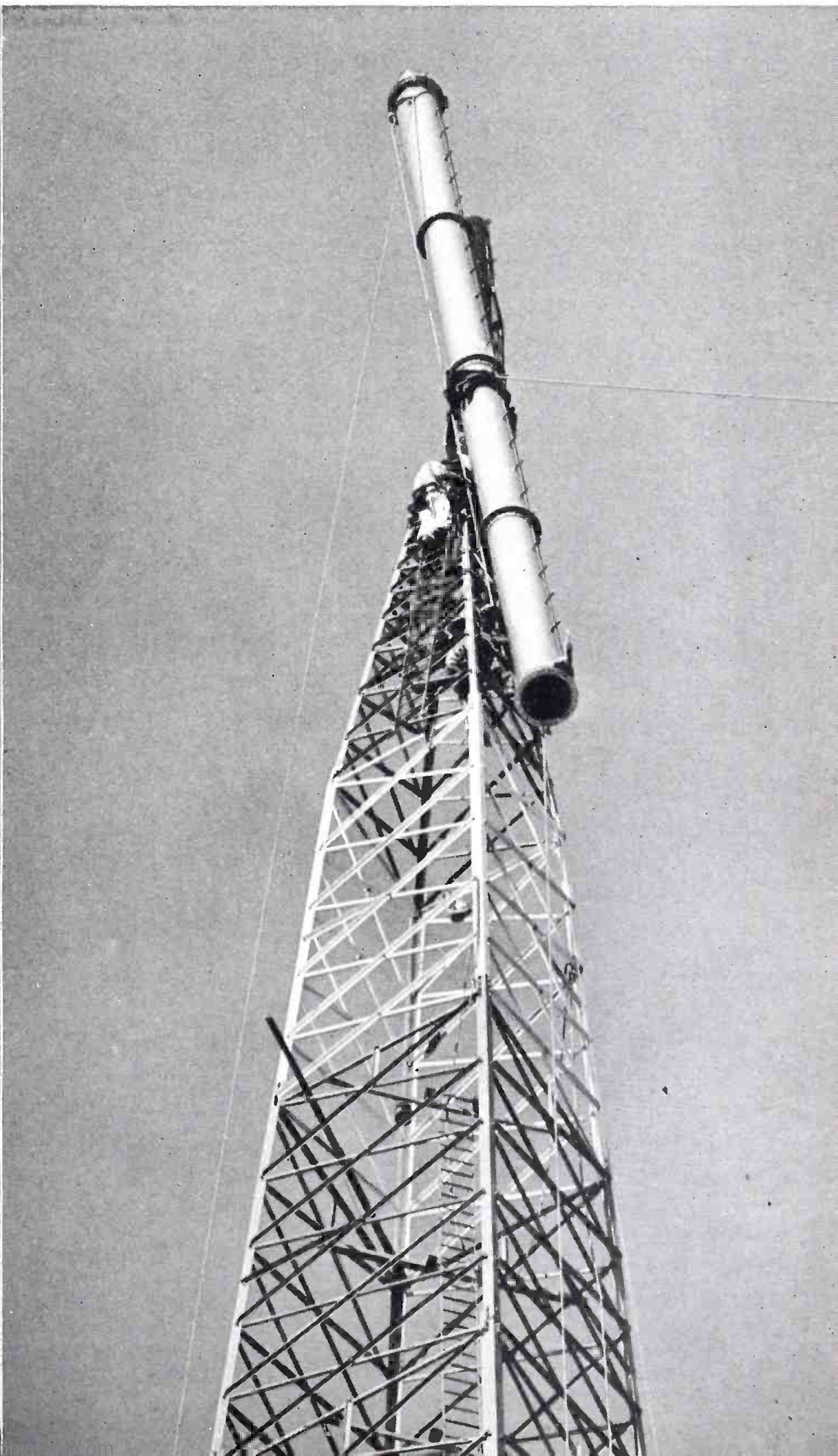
FIG. 7. (above) *All Pylon assembly work was done on the ground. The four sections were bolted together at the flanges, and transmission line harness was inserted prior to erection.*

FIG. 8. (above) *Completely assembled (with polyethelene sheets covering the full length slots and with beacon attached) the Pylon is ready to start its way up the tower.*

FIG. 9 (below) *This view shows how the four-section Pylon is carefully guided up the tower with the aid of ginpole, motor-driven winch and necessary tag lines.*

FIG. 10. (below) *With the Pylon nearly raised to full tower height, riggers are getting ready to mount the antenna atop the 325-foot structure.*





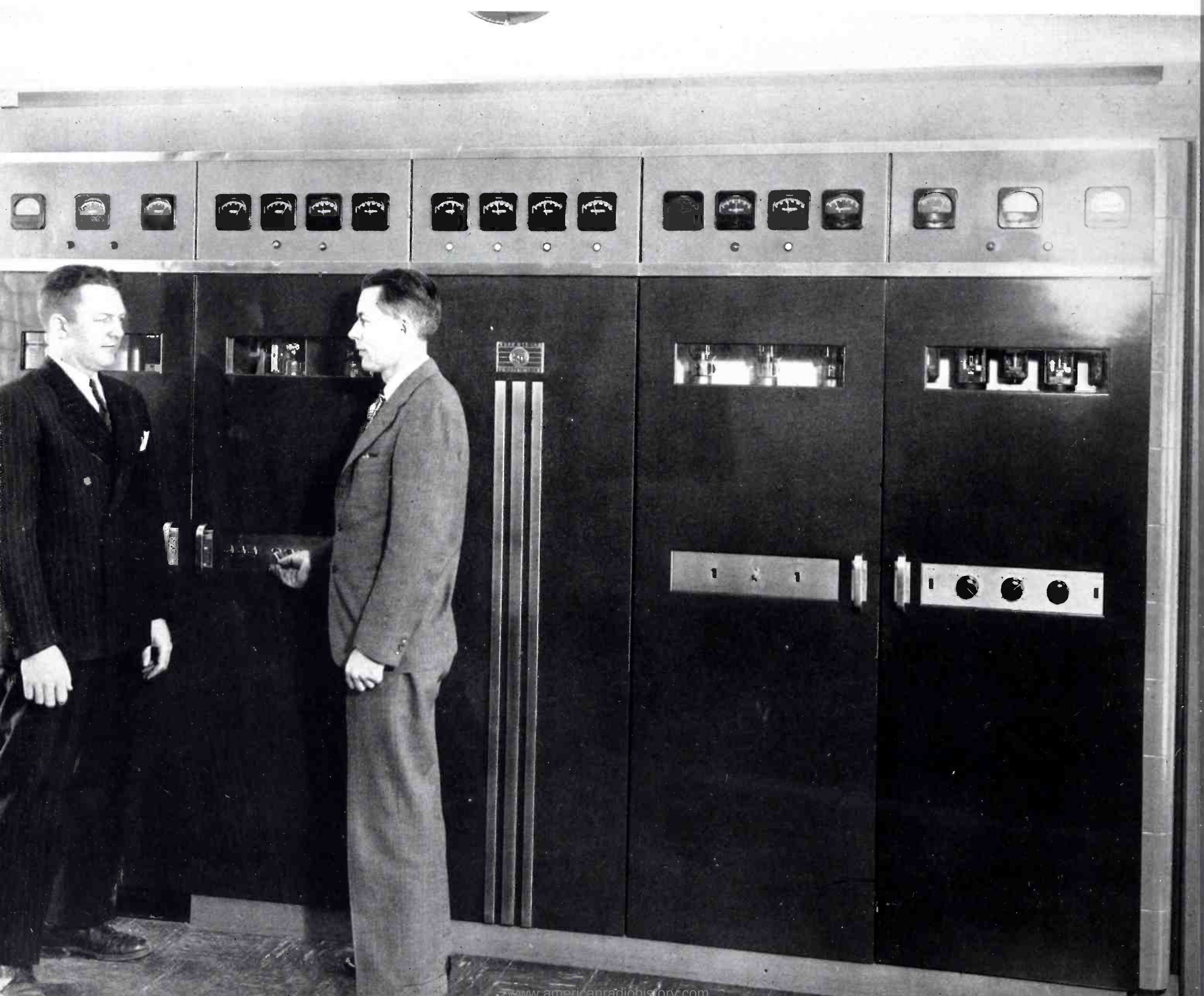
WSBA-FM GOES TO 10KW

by W. E. TUCKER and F. E. TALMAGE
Transmitter Engineering Section
Engineering Products Department

During late January WSBA-FM, which is located at York, Pa., converted their 3 KW FM Transmitter, Type BTF-3B to 10 kilowatts. Prior to the power conversion, WSBA-FM had been broadcasting on a regular schedule with their 3 KW Transmitter (for more detailed information see BROADCAST NEWS No. 47, December 1947).

Because WSBA-FM is located near to both the Camden and Lancaster RCA plants, it afforded an excellent opportunity for RCA engineers to observe the conversion and, at the same time, note performance of the transmitter under typical operating conditions. Through the cooperation of W. G. Eberhart, Director of Engineering at WSBA-FM, much valuable information was obtained concerning the quickest and most practical methods of installing RCA add-on amplifier designs. This information should prove of particular interest to FM Broadcasters planning to make similar power increases. A step by step description of the procedure followed, with complete details, including installation drawings, will be made available to broadcasters upon request.

FIG. 1. (below) *W. G. Eberhart, Director of Engineering at Radio Station WSBA-FM and W. E. Tucker, RCA, are shown (left to right) in front of the WSBA-FM transmitter, after conversion to 10 KW. The transmitter is flush-mounted in the wall and lends a streamlined appearance to the overall FM setup.*



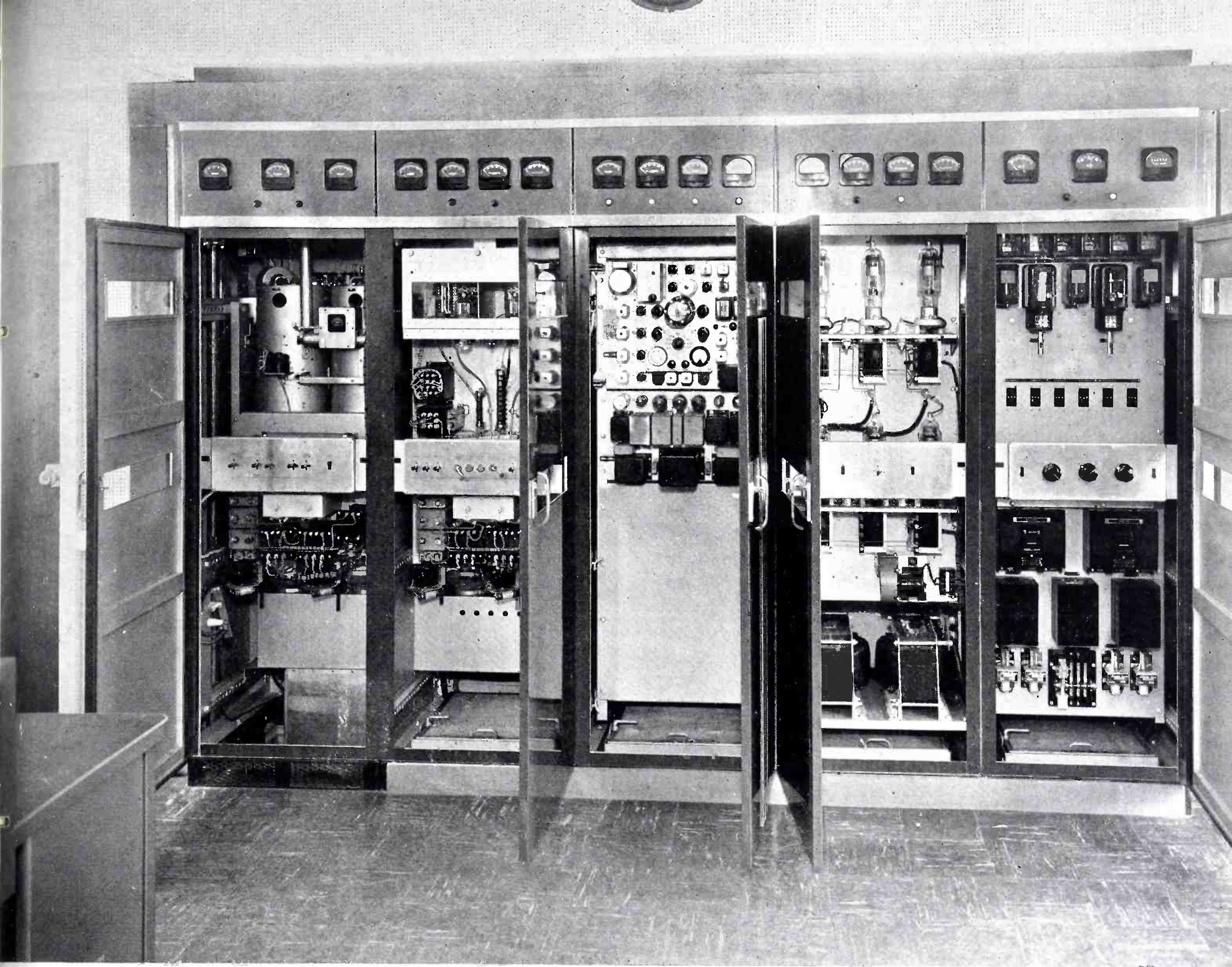


FIG. 2. (above) *Front view of the 10 KW FM Transmitter in which access doors are opened to show (cabinets from left to right): Final 10 KW amplifier, Low Power R-F (250 watt, 1 and 3 KW), Direct FM Exciter, H-V Rectifier and Power and Control sections. All controls and switches, necessary for normal operation, are conveniently located at hand level.*

THE WSBA-FM TRANSMITTER

Mechanically, the 10 KW Transmitter, as now installed at WSBA-FM, consists of five (25″ x 25″) standard fabricated steel cabinets which are bolted to a common base frame. Front and rear full-width doors and side panels complete the cabinet-type enclosures. (See full front views of Figures 1 and 2.)

Electrically, the r-f circuits of the BTF-10B (10 KW Transmitter) are the same as those of the BTF-3B (original WSBA-FM, 3 KW Transmitter) plus the addition of the high stability grounded-grid amplifier to furnish the increased power.

The 10 kilowatt final amplifier, which was added to WSBA-FM's 3 KW Transmitter, uses two RCA 7C24 air-cooled tubes operating in parallel. (See the two concentric-line tank circuits at right shown in Figure 3.) Both are similar electrically and mechanically to the 1, and 3 kw driver stages. Each plate tank is concentric with the anode of its 7C24 tube and each forms an integral part of the grounded-grid circuit. This design provides a low inductance path from grid to ground, effectively isolates plate circuits from cathode circuits—and eliminates the need for neutralization.

The two tubes in the 10 KW amplifier have a common input circuit with motor-driven tuning and coupling adjustments. All plate circuits are tuned by adjusting the position of capacitor-type shorting bars and output coupling is effected by small loops between the inner and outer conductors of the plate lines. In all stages—input, plate and loading—circuits are motor-tuned from front-panel switches.

The output of the 10 KW final amplifier, variable throughout the entire range of 3,000 to 10,000 watts, is fed to the antenna system through a coaxial transmission line. (See floor plan of Figure 6A.) Two pick-up loops are used in this assembly; one connects to a thermo-couple and meter and aids in adjusting the output, and the other provides r-f voltage for test and measurement use. A fixed-tuned harmonic attenuator (mounted in basement as shown in Figure 5) designed to reduce all harmonics is located in the output circuit.

The high-voltage rectifier, installed by WSBA-FM in place of the previous 3 kw unit, is located in the second cabinet from the right, as shown in the open door view of Figure 2. In this rectifier a new type tube, the RCA 673, is used to provide high-voltage direct current for all amplifiers except those of the FM exciter. Since the RCA Type 673 rectifier tube is operated well below its maximum ratings, a considerably longer tube life is expected. Only six RCA Type 673 tubes are used in the entire high-voltage rectifier. Associated components such as filament transformers, filter reactor and capacitors, are located in the same compartment.

The new power and control section, installed by WSBA-FM for 10 kw operation, is shown in the extreme right-hand cabinet (see Figures 1 and 2). It contains the control circuit relays, overload relays, and timers required to provide correct sequential starting and full protection for all transmitter circuits. Both manual and automatic overload protection are provided. When in the automatic position, a 3 shot recycling sequence is provided by the control or "brain center" which automatically returns the transmitter to the air two times in case of repeated overloads. If such an overload condition still persists, the transmitter is automatically shut down. As an added precaution, the transmitter line monitor is connected into this circuit so that any arc on the transmission line will also cause the transmitter to shut down momentarily to allow the arc to clear. A special hold-in circuit permits the transmitter to return instantly to the air in case of a momenary power line failure, thus avoiding the 1 minute delay required for the plate time delay relay to close.

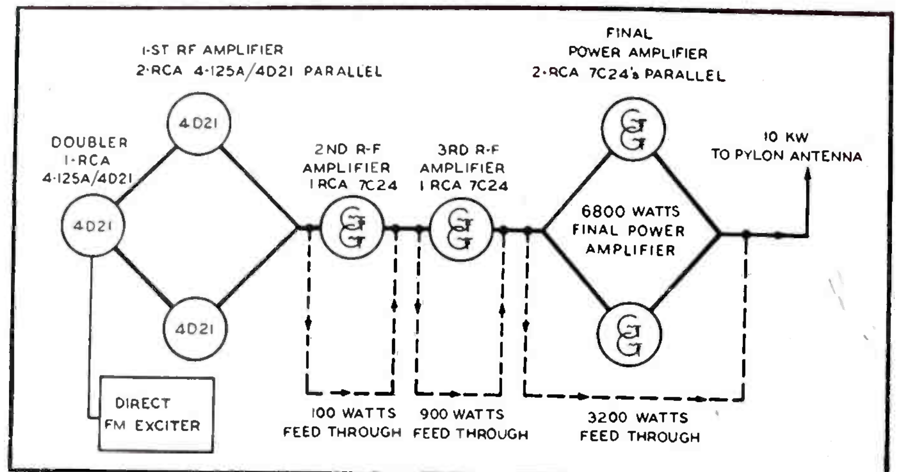
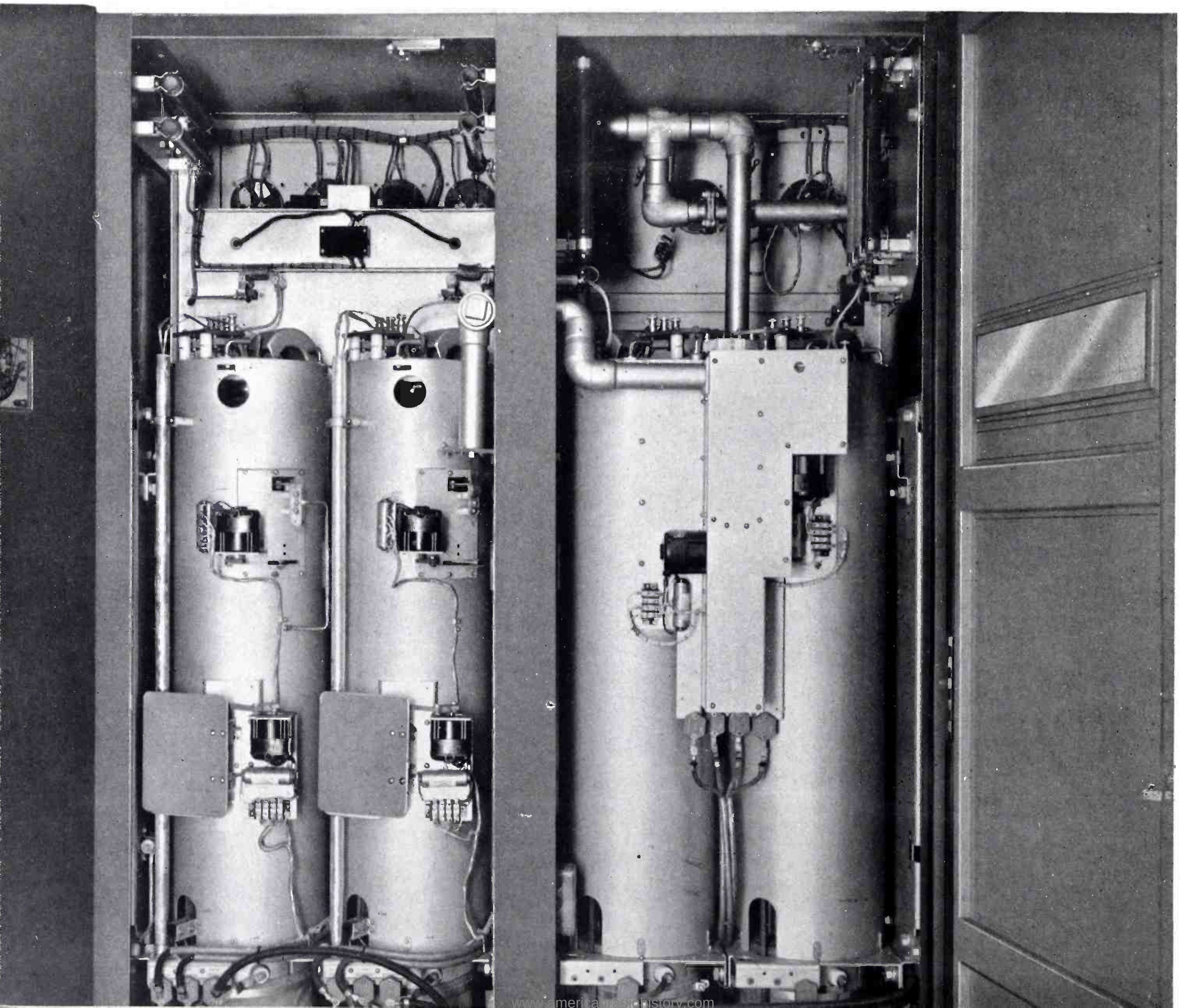


FIG. 4. (above) *Because RCA Grounded-Grid circuits put tube input and output voltages in series . . . and in phase, power output is additive. The grounded-grid drivers contribute nearly 3200 watts to the total power output. This allows the use of smaller, less expensive tubes in the final P. A.*

FIG. 3. (below) *All power stages (1, 3 and 10 KW) shown are simplified single-ended amplifiers operated class "C", and use a minimum number of variable elements. All are grounded-grid circuits and all use RCA Type 7C24 tubes. Only two spares are needed for the entire transmitter.*



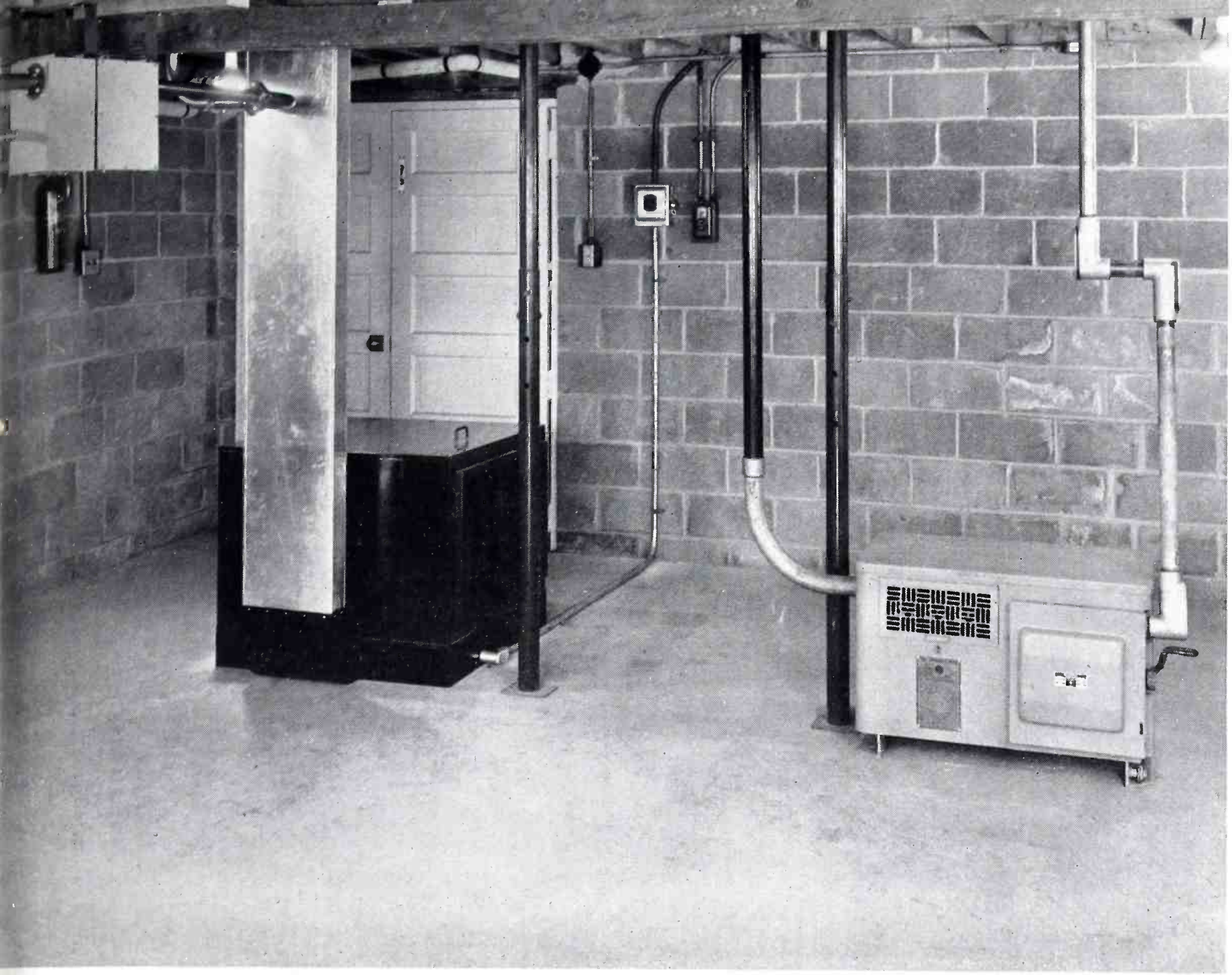
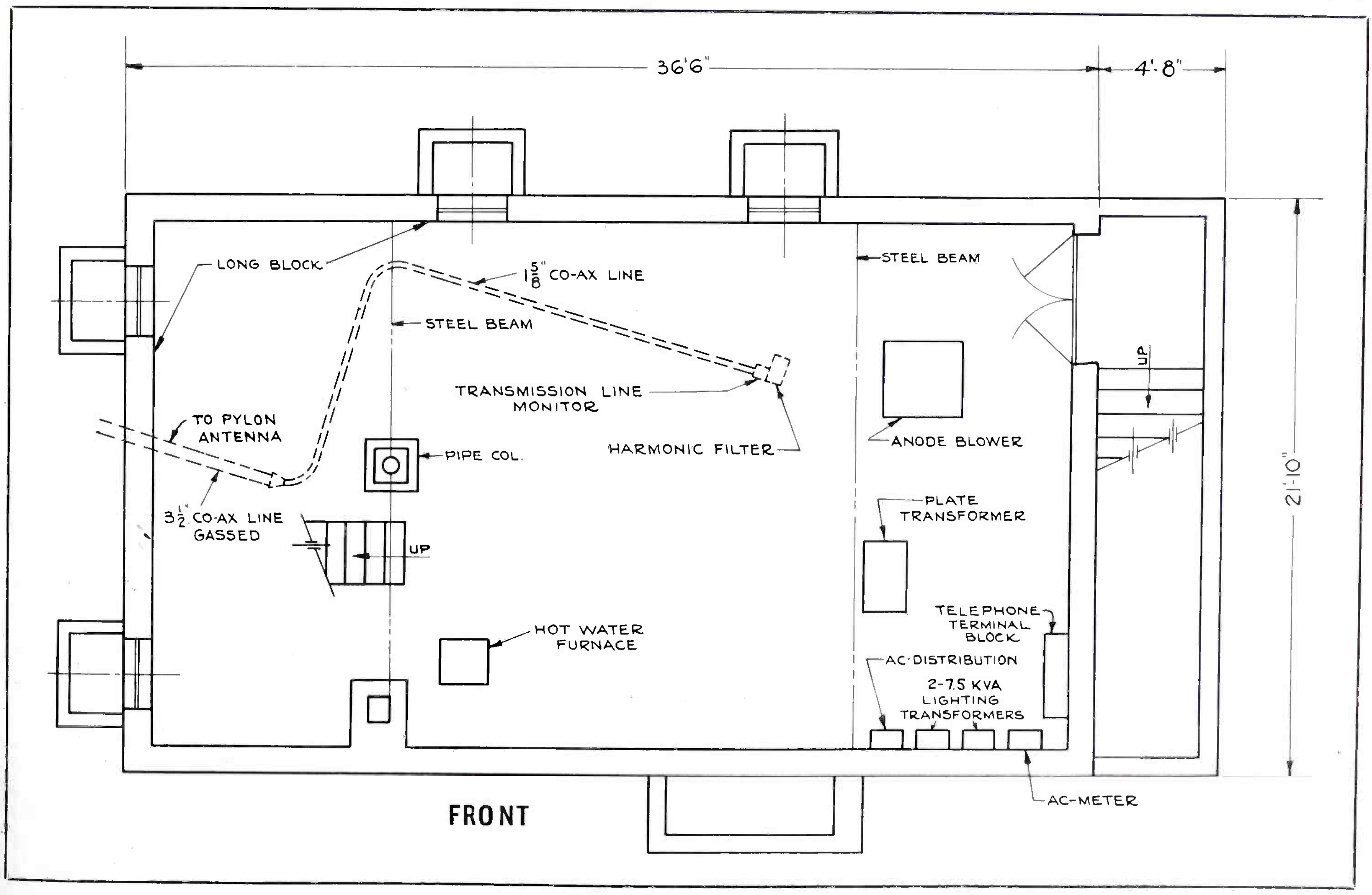


FIG. 5. (at left) *A view, of the basement directly under the BTF-10B transmitter, showing the blower, plate transformer, harmonic filter, and transmission line monitor. Note that a special duct is used to carry the air from the blower through the transmitter base to the power amplifiers.*

FIG. 6a. (below) *Basement Floor Plan of WSBA-FM, showing placement of blower, plate transformer, harmonic filter, transmission line monitor, etc.*



The exciter and its power supply, and the low power stages up through the 3 KW stage, are identical with WSBA's BTF-3B, 3 KW Transmitter, thus no modification of these units was required.

WSBA-FM BUILDING PLAN

The WSBA-FM transmitter building layout (see Figures 6A and 6B) was found to be very practical, efficient and neat in appearance. Complete provisions were made in original station planning for the addition of the 10 kilowatt power amplifier and power supply. Thus, the increase in power from 3 to 10 KW proceeded smoothly and without loss of airtime.

A novel feature in station planning at WSBA-FM is the method used for mounting the transmitter base on parallel floor beams so that most of the underside area of the transmitter is open and accessible. This greatly facilitated making the electrical conduit connections and provided an excellent source of cool air from the basement for the transmitter filter intakes. The blower for the 7C24 anodes and plate transformers is located in the basement, as shown in the photograph of Figure 5. Cooling air from the blower is supplied by a special duct (see Figure 5) directly to an air chamber in the bottom of the transmitter for the power amplifier stages.

An air exhaust fan (not visible in illustrations shown) is located behind the transmitter. This fan is normally used to expel warm air outdoors. However, during the cold months at WSBA-FM, the fan is turned off and the basement door left open, thus the natural circulation of the warm air aids in maintaining comfortable quarters and in reducing heating bills. A tune-operate switch, provided on the high-voltage plate transformer, permits low-voltage operation for tune-up and test. Since the plate transformer is located in the basement, Mr. Eberhart plans to install a contactor allowing operation of the tune-operate function from a remote switch located on the control console.

The 10 KW FM Transmitter is flush-mounted in a wall of the transmitter room (see Figure 1), which is provided with overhead lighting. Building doors on either side of the transmitter provide entrance to the rear of the transmitter and lend a balanced appearing setup. Blank panels previously covered the space into which the 10 KW FM amplifier and power supply cabinets were installed.

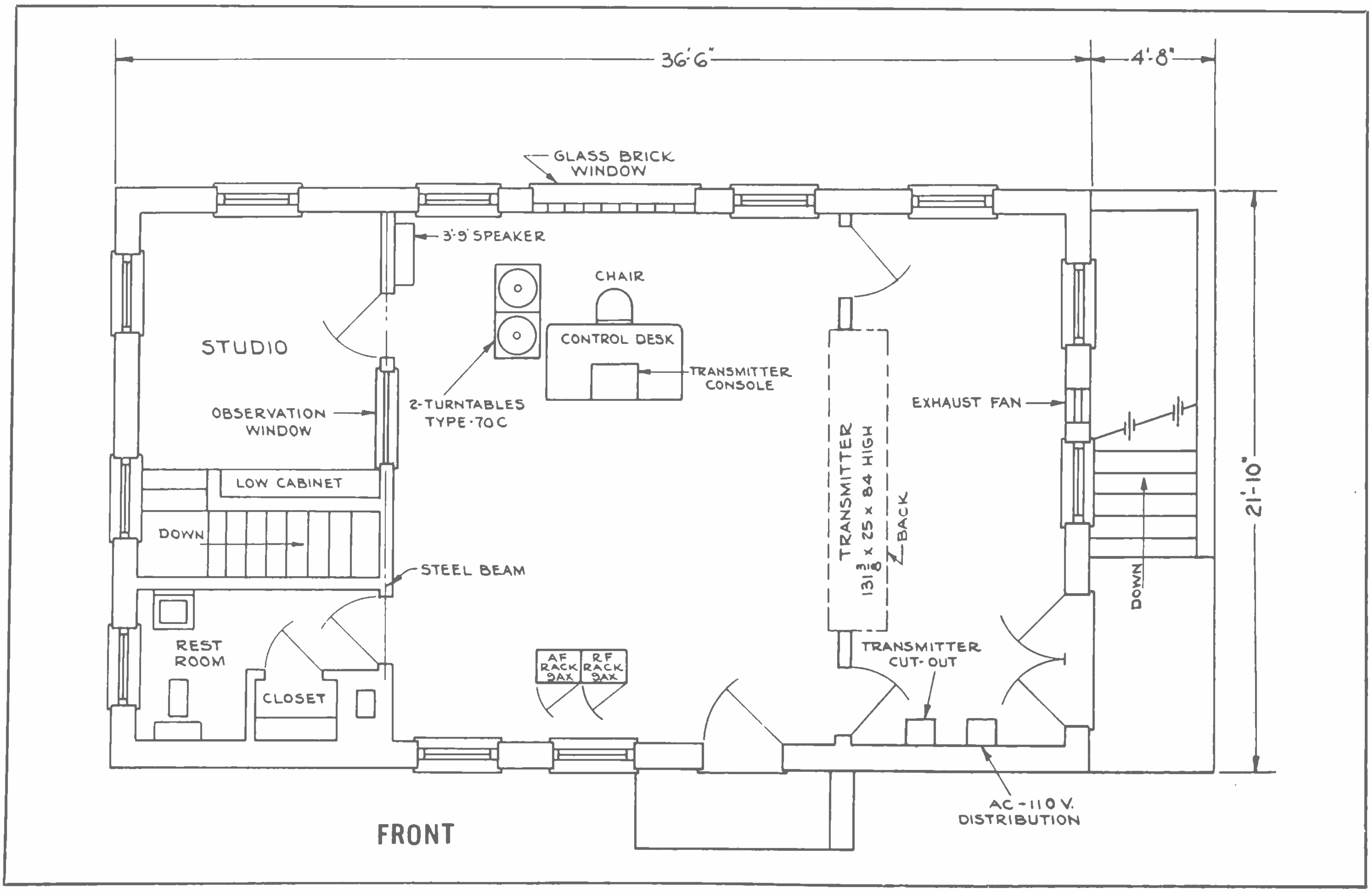
CONVERSION TO 10 KW

Since WSBA-FM had been on the air for some time with their RCA 3 kw transmitter, one of the most important points to be determined was the best method of converting to 10 KW without the loss of air time. At the time of the installation, WSBA-FM was operating on an eight-hour schedule from 3 p.m. to 11 p.m. It was decided to divide the installation into a two-night schedule. The conversion was started at 11 p.m. under Mr. Eberhart's supervision. As much of the installation as possible had been completed in advance without interrupting the 3 KW, BTF-3B Transmitter.

The first night, the power and control units were installed and sufficient interconnections were made to allow temporary operation of the 3 KW amplifier—with the 10 KW power and control equipment. The transmitter was ready for operation by 4 a.m.

The power amplifier unit was installed the second night and the carrier was back on by 10 a.m. Much time was consumed

FIG. 6b. (below) *First floor plan of WSBA-FM showing position of 10 KW FM Transmitter, control console and associated equipment.*

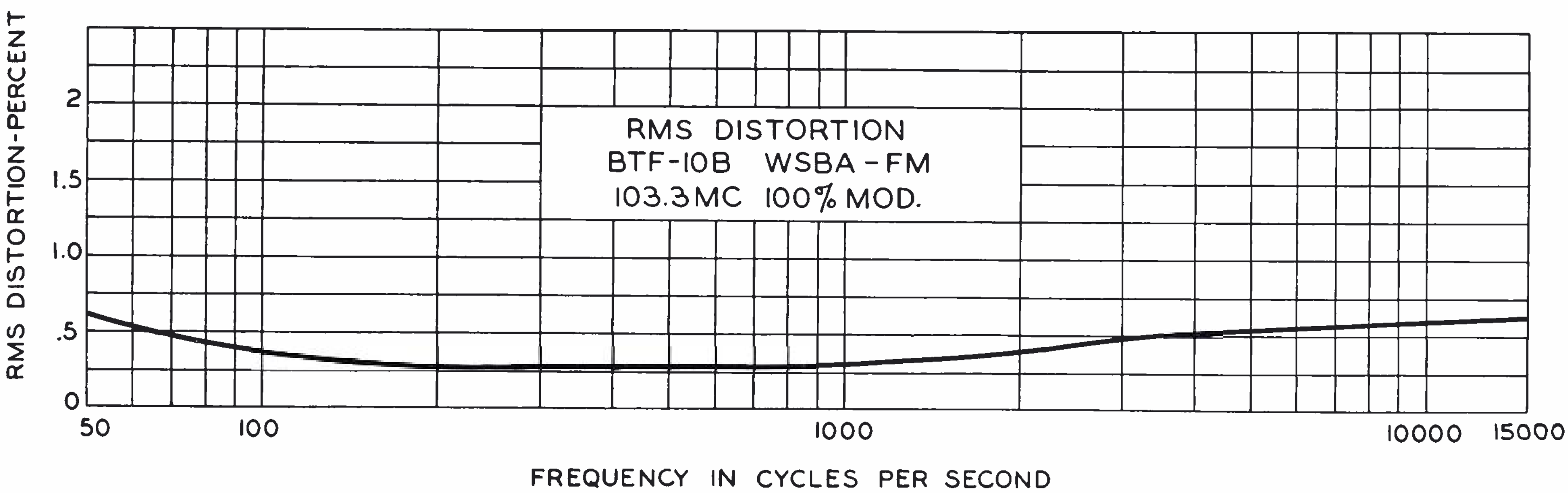


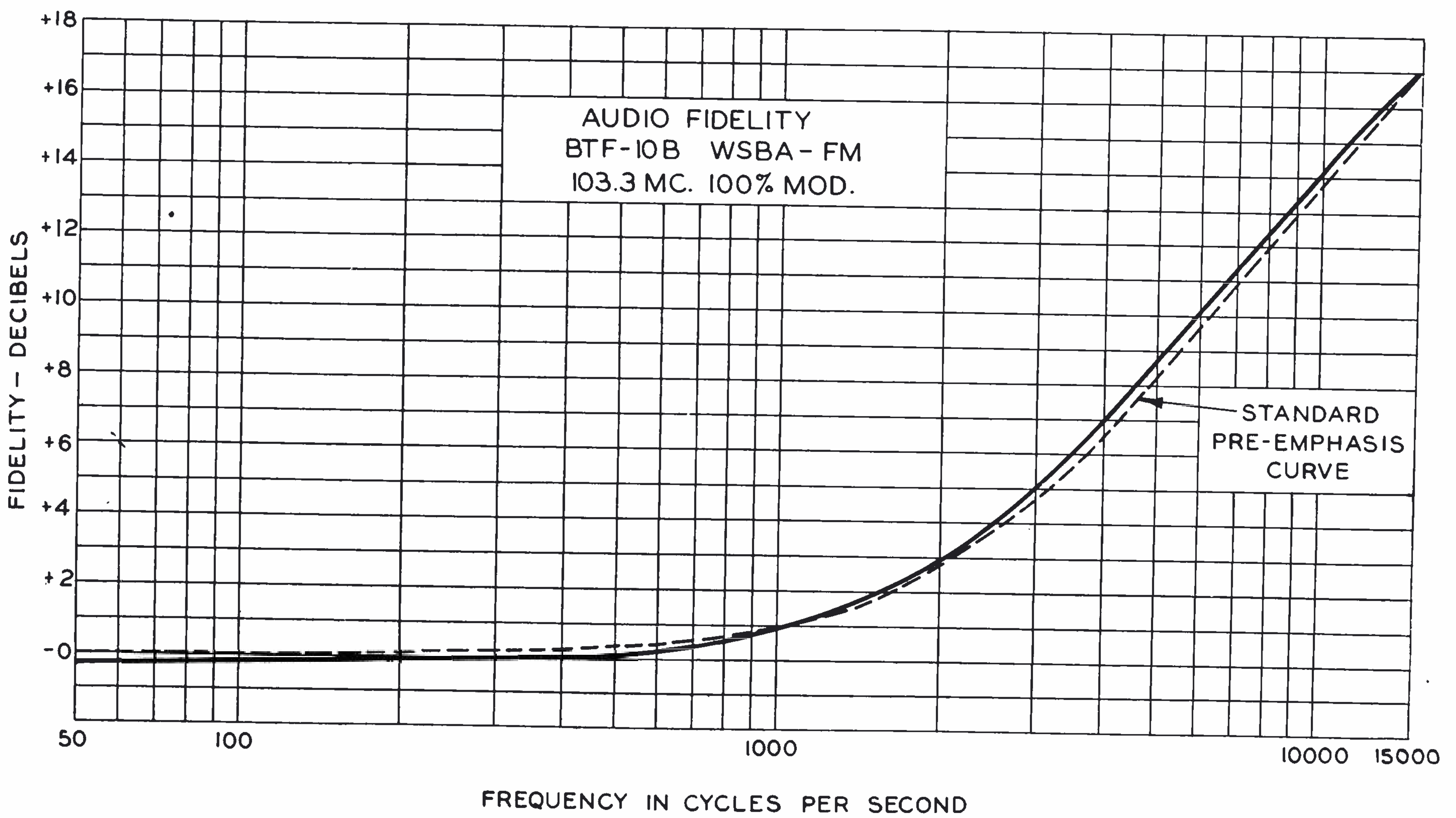
the second night in cutting and adding flanges to the transmission line. (This can be done in advance to reduce installation time still further.) With the experience gained from this first installation, it should be easily possible to make essential conversions in two eight-hour shutdown periods. For practically all stations, this means that conversion can be effected without loss of scheduled air time.

PERFORMANCE MEASUREMENTS

By the time this article appears, WSBA-FM will have been operating their 10 KW Transmitter for several months. Initial field strength measurements indicate that satisfactory signals are being received over an approximate area, 60 miles in radius. (WSBA-FM is using a 2-section RCA FM Pylon antenna with an effective radiated power of 20 KW.)

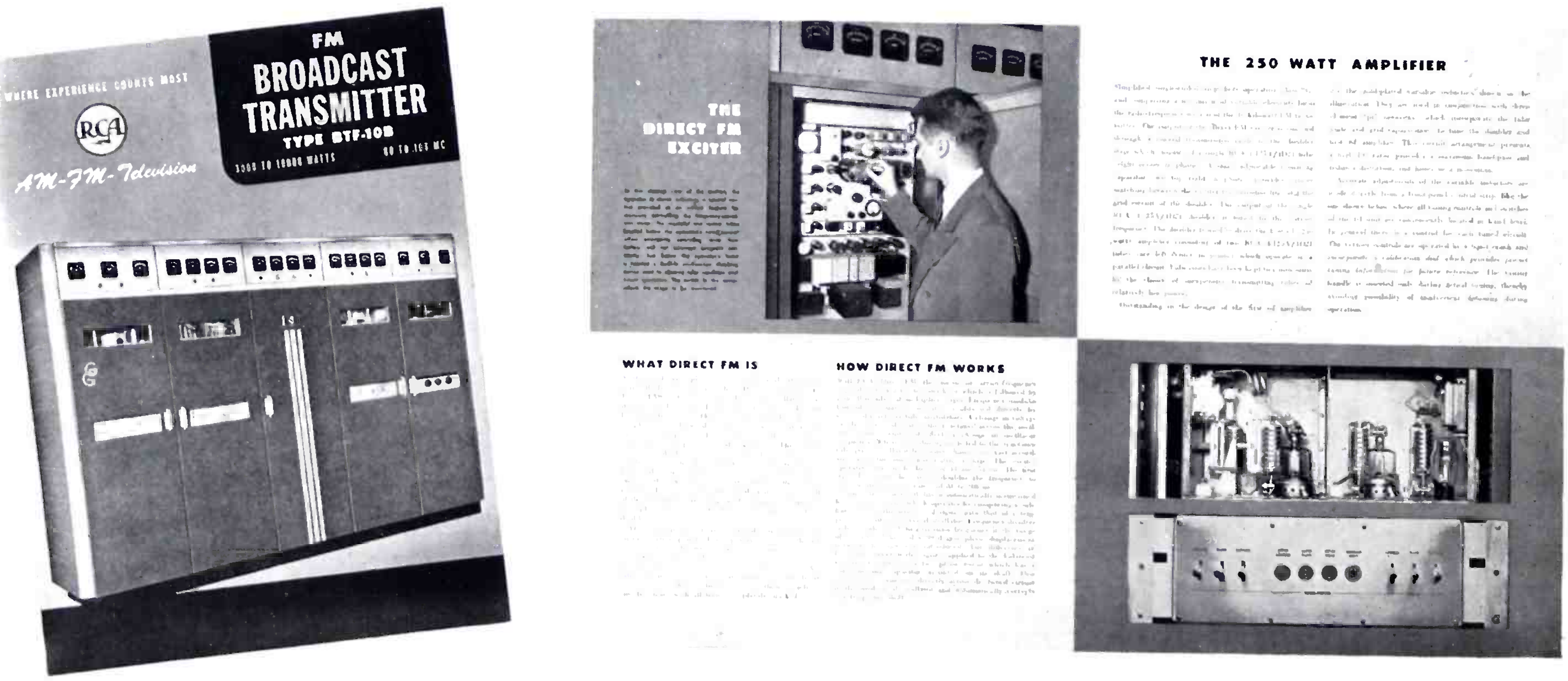
Distortion, fidelity and noise measurements were made with the 10 KW Transmitter fully loaded. In all cases, the performance was, as expected, well within RMA limits (see performance curves below). Hum and noise measured —71 db and distortion was less than .65 at 50 and 15,000 cycles—and dropped to 0.3% at 400 cycles. Fidelity was within ±0.5 db (reference to 1000 cps) of the FCC standard pre-emphasis curve.





WWJ-TV's remote cameras (RCA Type TK-30A's) were on hand when Santa Claus staged his twenty-first annual Thanksgiving Day Parade in Detroit. The parade is presented each year by the J. L. Hudson Company, one of Detroit's leading department stores. This year, in addition to the crowds that lined Woodward Avenue to watch the twenty-four floats and nine bands as they passed by, thousands more watched the parade on the several thousand television receivers now in operation in Detroit. The telecast of the parade was sponsored by the J. L. Hudson Company. Picture at the right shows one of the floats passing Hudson's.

NEW 16 PAGE 10 KW FM BOOKLET - - ASK FOR YOUR COPY



A colorful 16-page brochure, providing detailed information on the RCA 10 kw FM Broadcast Transmitter, is now available to broadcasters upon request from the Broadcast Equipment Section, Engineering Products Department. Profusely illustrated and giving complete operating data and simplified line drawings, the new brochure provides full particulars on such subjects as direct and indirect FM, grounded-grid power amplifier stages, power supply and control circuits, and general overall performance specifications.

The brochure entitled "FM Broadcast Transmitter, Type BTF-10B", can be obtained from any of the RCA district sales offices or by writing to Department 516, RCA, Engineering Products Department, Camden, New Jersey.

BUCK LEWIS APPOINTED FIELD SALES MANAGER OF BROADCAST SECTION

Appointment of C. M. ("Buck") Lewis as National Field Sales Manager of the Broadcast Section has been announced by A. R. Hopkins, Manager of the Broadcast and Industrial Section of the RCA Engineering Products Department. Buck has been active in broadcasting—as operator, design engineer, and sales engineer—for nearly twenty years. Prior to his new assignment he was Field Sales Manager for the Chicago Region.

Buck started in radio as an amateur in 1920 (call 9CCS) and was engineer of KFKU and WREN from 1929 to 1934. He attended Baker University and the University of Kansas, joined RCA's transmitter engineering group in 1934, and transferred to Broadcast Audio Sales in 1937. From 1938 until the outbreak of the war he was in charge of audio equipment sales, and in this capacity contributed greatly to the planning of many of the country's outstanding broadcast studio installations. During the war, as Commercial Manager for Radar Equipment, he handled the sales of millions of dollars of radar gear to the Army and Navy. From 1945 until early 1947 he was manager of the Broadcast Transmitter Section.

In his new position Mr. Lewis will plan and supervise the activities of RCA's broadcast and television sales engineers located in eight regional offices throughout the country.

C. M. LEWIS
Field Sales Manager, Broadcast Section

DAN MEADOWS APPOINTED MERCHANDISE MANAGER FOR AUDIO EQUIPMENT

F. D. MEADOWS
Merchandise Manager, Audio Equipment

Appointment of F. D. ("Dan") Meadows as Merchandise Manager for Audio Equipment was announced May 1st by A. R. Hopkins, Manager of the Broadcast Industrial Section of the RCA Engineering Products Department. Previous to his new assignment Mr. Meadows had been a staff assistant in the Broadcast Section.

Mr. Meadows was graduated from Phillips University with an A.B. degree—and later pursued graduate work in Electronics at the University of Oklahoma. He joined RCA in 1941 when he accepted a position as an engineer in the amplifier development laboratories. Among his achievements was the development of a high-quality 50-watt amplifier for recording purposes. During the war, Dan was in charge of the Sonar (Underwater Sound) Engineering Section in RCA's Indianapolis plant. For his work during this period he received the WPB Award of Merit. At the conclusion of the war, he was appointed Administrative Assistant in the Engineering Products Department and was charged with the responsibility of coordinating activities of various product lines, including Broadcast Audio, Broadcast Transmitter, and Television.

In his new position Mr. Meadows will be responsible for planning and directing the merchandising activities for RCA's extensive line of audio equipment for AM, FM and TV broadcast stations.

RIGHT — WKY's Mobile Studio, which was described in detail in the last issue of BROADCAST NEWS. This is an extra illustration for which we did not have room last time.

KCMO - KANSAS CITY'S 50 KW

New Plant Features Functional Building Design and Well-Thought-Out Arrangement of Equipment and Facilities

Considering the comparatively short time Radio Station KCMO, Kansas City, Missouri, has been operating, its growth and expansion have been extraordinary.

Incorporated in June 1936, and at that time broadcasting with only 100 watts, it has today become one of this area's leading stations from every standpoint. On Tuesday, September 9, 1947, KCMO became the most powerful broadcasting station in Kansas City. Operating with 50,000 watts day and 10,000 watts night on a new frequency of 810 kilocycles, it brings the finest in service and entertainment to this prospering widespread Mid-America area.

For KCMO to have reached this goal in a matter of ten years is an accomplishment of which it is very proud. The constant effort and work involved in building a radio station up to 50,000 watts represents countless days and nights of hard work; not only from the management standpoint, but from the harmonious cooperation of each of the station's various departments. It is this very combination which, in KCMO's case, has proved invaluable in setting up operation so that the changeover to increased power was smoothly handled.

From June 1936, with 100 watts at 1370 kilocycles, to 1000 watts at 1450 kilocycles day and night operation—in less than three years—was the first step. Then after only fifteen months, a grant was received to operate with 5000 watts day and 1000 watts night on the same frequency. The next step took longer. In January 1945 KCMO started operating full time at 5000 watts day and night, and in the meantime a new frequency of 1480 kilocycles had been assigned. Only one year later—January 1946 to be exact—grant was made for KCMO to operate on a new frequency of 810 kilocycles with 50,000 watts day and 10,000 watts night.

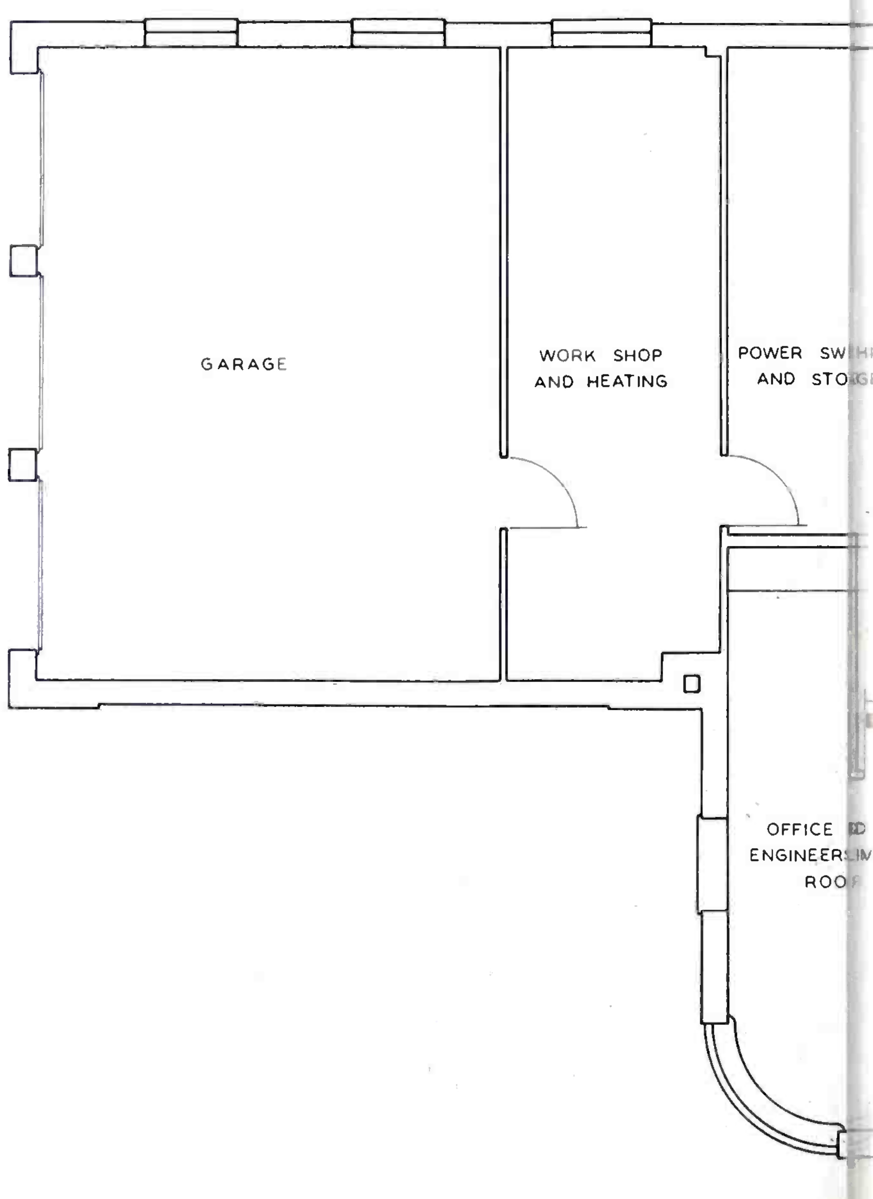
KCMO owes no small amount of its present success to its General Manager, E. K. Hartenbower. "Joe"—as he is known to his host of friends in the trade—came to Kansas City from Chicago. In the Windy City he was affiliated with NBC, and later with The American Broadcasting Company as Sales Manager for the Central Division. In this position he was instrumental in the sale of the "Breakfast Club" to Swift and Company; and also responsible for the creation of the Children's Program Cycle—spearheaded by such favorites as Jack Armstrong, and The Lone Ranger. Other shows on which he worked include: Life of Riley, Adventures of Nero Wolfe, Edgar A. Guest, and John Freedom. Since coming to Kansas City, all of Joe's efforts have been devoted to the guidance of KCMO's operation with 50,000 watts—as well as the development of KCFM—KCMO's new FM station. Rather than take the credit for KCMO's progress however, he maintains that the greater share should go to the entire KCMO organization.

STATION DESCRIPTION

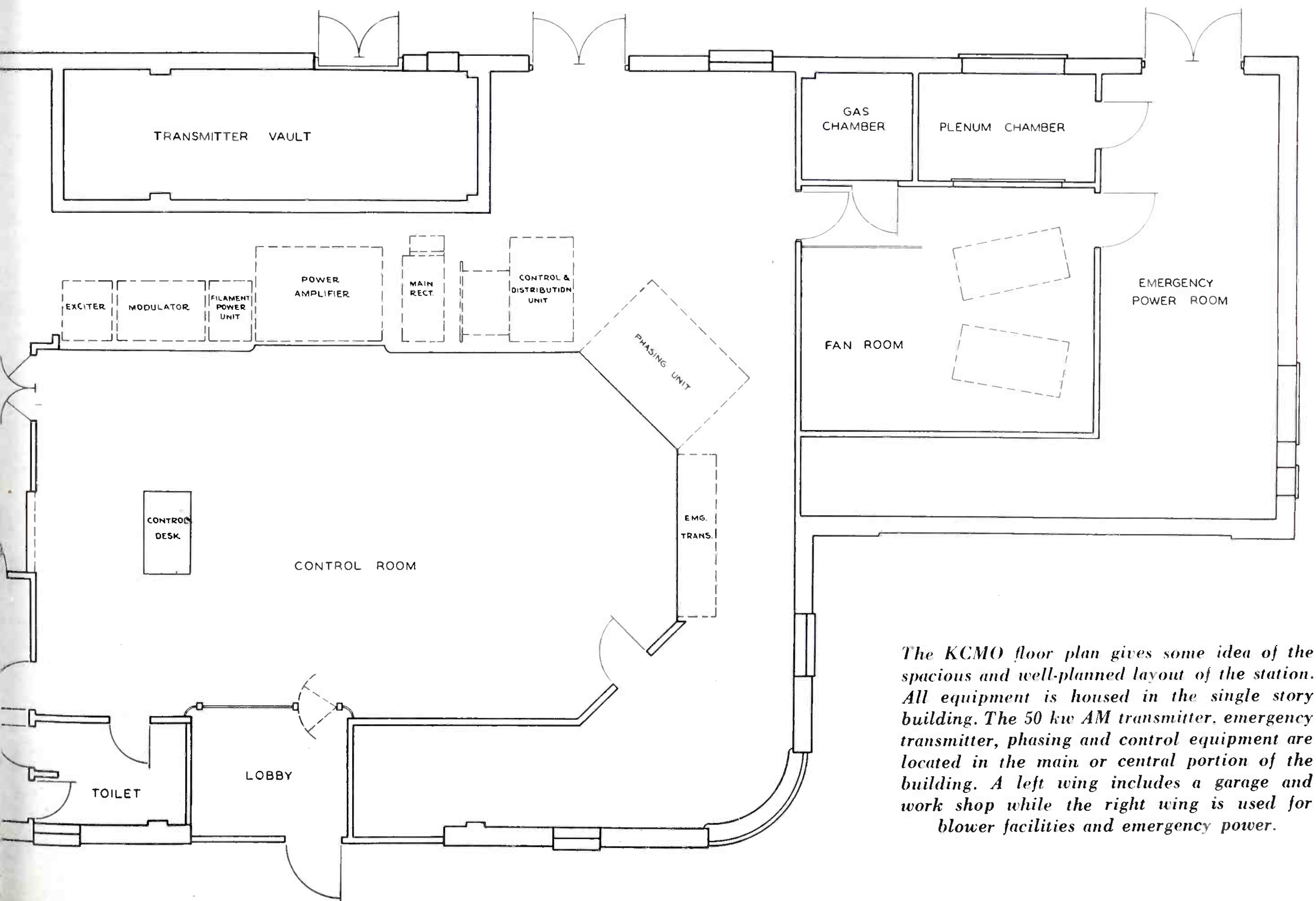
KCMO's new and modern transmitter plant was planned, and its construction supervised, by Karl Troeglen, KCMO's Technical Director. The station was started, and largely completed, during the worst of the shortage crisis. However, good planning and perseverance carried it through despite a number of unexpected difficulties. The business-like appearance and the extremely practical layout are the outstanding features of this plant. Karl is such a modest fellow that we had difficulty worming much of the story out of him. However, we did manage to get the pictures shown on these pages and a short description of some of the station features.

The station is located about fourteen miles north of Kansas City on a 160 acre farm, the five element array and transmitter building requiring 80 acres of this site. Due to the very irregular terrain in this area, it was necessary to do quite an extensive grading job. To make way for the towers and building, over 180,000 cubic yards of dirt were moved. There is quite a change in the area today, as compared to that time fourteen months ago. It is the hope and plan of the management to surround its radio facilities at this location with a model farm, including the latest improvements; and to establish a radio show place for the people of Greater Kansas City and its adjacent communities.

In view of the building difficulties which existed at the time this station was built, every effort was made to insure that the installation be as simple as possible. The equipment is housed in a single story building without basement. Interior walls of the 20 by 40 foot control room are made of glazed tile which can be removed to take care of future expansion.



Shown here is KCMO's attractive and modern transmitter building (of brick construction) in which their 50,000 watt transmitter and control equipment are located. Plans are underway to surround the new 50 kw building, which is located just outside Kansas City, with a model farm. A 160-acre tract of land is available for this purpose.



The KCMO floor plan gives some idea of the spacious and well-planned layout of the station. All equipment is housed in the single story building. The 50 kw AM transmitter, emergency transmitter, phasing and control equipment are located in the main or central portion of the building. A left wing includes a garage and work shop while the right wing is used for blower facilities and emergency power.

The RCA Type BTA-50-F Transmitter is arranged in a straight line along the side of the operating room which faces the door (see floor plan). The control console is at the left so that the operator looks down the length of the room. Conveniently located in the wall behind him are the audio and monitoring equipment racks. In the wall at the far end of the room are the phasing cabinets and the low-power emergency transmitter. Arrangement of the transformer vault, cooling equipment and other auxilliary equipment is shown on the floor plan (preceding page).

The transmitter is installed so that the blowers are located in a room to the right of the transmitter. The floor in this room is four feet below the main control room floor. This makes it possible to run the blowers right into the air duct without any bends to restrict air flow. Since all our coaxial lines to the towers are buried, this room also makes entry of the lines into the building quite simple. Ducts are provided over the transmitter to allow circulation of transmitter exhaust air through the building for heating in winter. All wiring to the present equipment is run under the floor in conduit. However, trenches are provided in the floor for wiring in any new equipment.

In addition to the standard lightning protection provided with the 50-F transmitter, KCMO also installed RCA monitors at each of the towers. Since the sampling loops are bonded to the towers, it was necessary to use isolation chokes, located inside the tuning house, to feed the ⅜-inch sampling line around the base insulators. The lightning protection monitor coils are coupled to this isolation inductor. Horn gaps are provided at the top of each antenna tuning house.

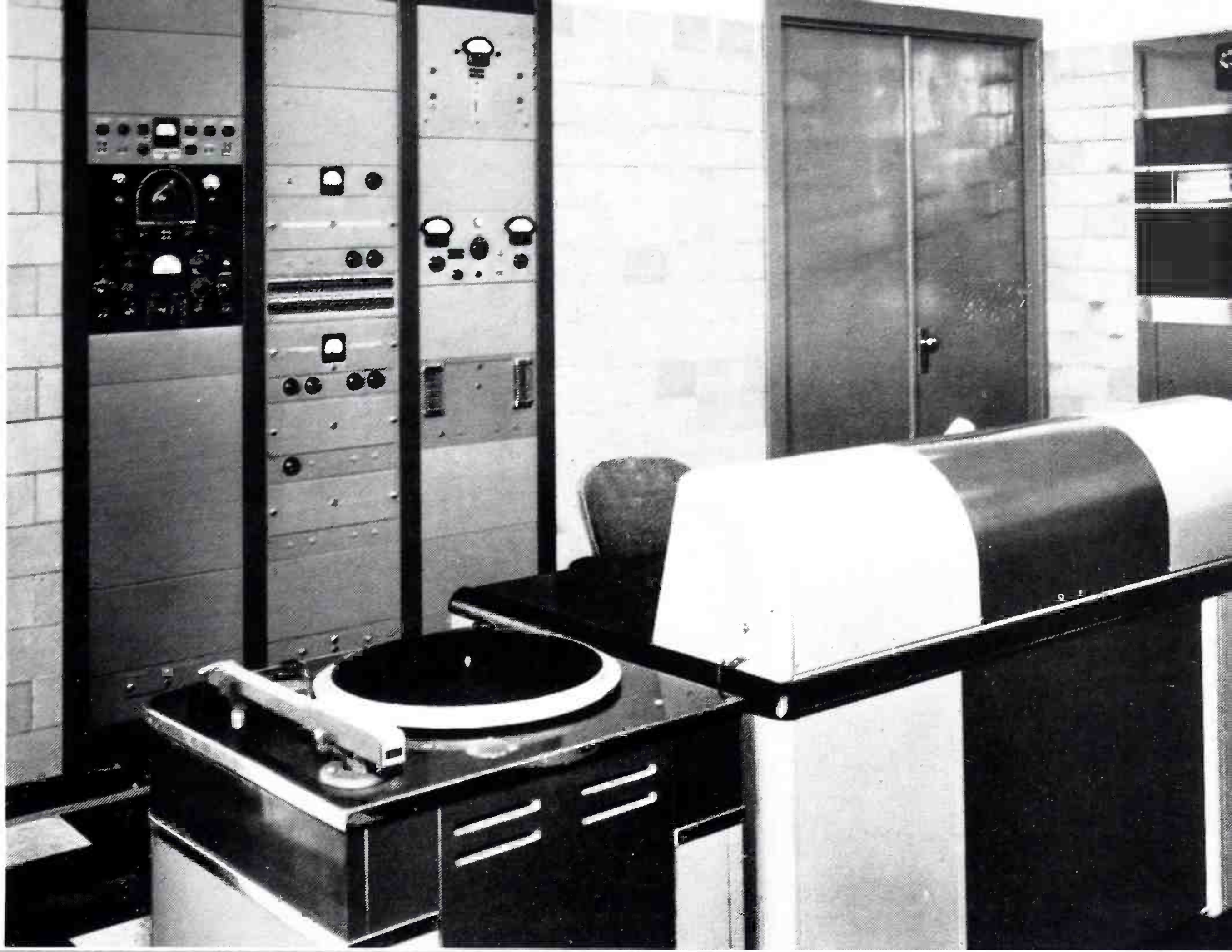
Since the center tower only is used for 50 KW N.D. operation, it was found desirable to use two antenna terminating units at this tower, one for 50 KW operation and a lower powered unit when this tower is used as part of the array.

Clearing the transmitter site, erecting the building and installing the transmitter required about twelve months. Additional time was needed to complete equipment tests, including adjustment of the directional array. However, the day eventually arrived when KCMO was officially on with its "fifty grand." Today, KCMO is serving a wider area—more people—more homes; and providing them with a higher quality service than ever before. Joe and Karl may be justly proud of their new installation and the job it is doing throughout the Greater Kansas City area.

(AT LEFT) *Left to right: Karl Troeglen, Technical Director of KCMO, who supervised and carried out the installation in every detail; and General Manager E. K. Hartenbower, whose efforts have been devoted to guiding KCMO's new operation, as well as KCFM, the FM station.*

(AT RIGHT) *KCMO's 50 kw AM transmitter, Type RCA BTA-50F is installed as shown here. RCA custom-built phasing equipment is located in the section at the right (mounted at a slight angle). An emergency transmitter (not visible) is also located at the right.*

(AT RIGHT) *This corner view of the transmitter room illustrates how equipment is located to facilitate operation. An RCA 70-D Turntable and transmitter supervisory console are shown in the foreground. To the right a section of the transmitter is visible and at the rear are shown three RCA audio, test and monitoring equipment racks.*

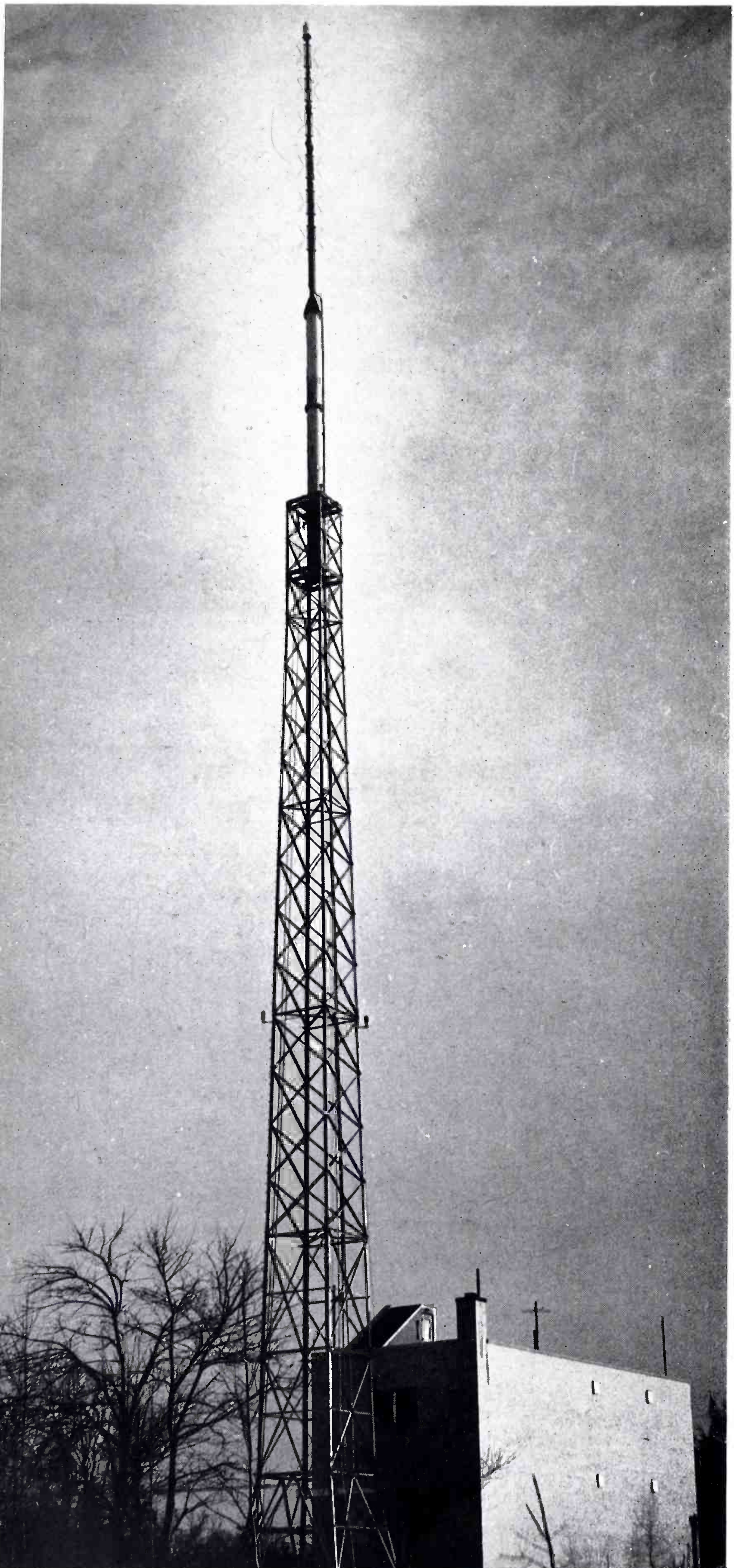


UP THEY GO . . . AT WATV, NEWARK

Bremer Broadcasting Erects Combination FM and TV Antenna

by

W. O. Hadlock and M. L. Gaskill



Situated on the ridges of West Orange, at an elevation of 620 feet above sea level, are the combined TV and FM facilities of the Bremer Broadcasting Co. (see BROADCAST NEWS No. 47). The installation of WATV's RCA TT-5A, 5 kilowatt television transmitter was completed in early 1948. The FM transmitter (WAAT-FM) has been on the air for several months operating with an interim antenna. With the new RCA FM and TV antenna combination (see Figure 1) recently installed, WATV and WAAT-FM will provide full coverage (of a nearly circular, horizontal pattern) for both FM and TV. The two-section RCA heavy-duty Pylon (with a power gain of 3) will furnish three times the effective radiated power of the interim antenna previously used. The output of the 5 kw, RCA TV transmitter feeds the six-section RCA Super Turnstile antenna which is mounted atop the two-section Pylon. The six-section Super Turnstile provides an approximate power gain of eight and is used to radiate both the TV sound and picture signals simultaneously.

THE PYLON AND SUPPORTING TOWER

In early December, 1947, WAAT-FM installed its new RCA, two-section heavy duty Pylon on a 130 foot Lehigh Tower which is located directly behind the station's transmitter building. The Lehigh Tower is a self-supporting type made of structural steel, and each of the four tower legs are capable of supporting about 79,000 lbs. The total load, with both FM and TV antennas installed (and including wind and ice stresses), is estimated to be approximately 50,000 lbs. The four main tower supports are anchored at the base in inclined cement abutments.

Each Pylon antenna section (which weighs about 2000 lbs) is 13½ feet high and 20 inches in diameter with a narrow slot running from top to bottom. After installation of the transmission line, the slot is covered with a "no-loss" polyethelene strip to exclude the weather. Electrically, each cylindrical section is approximately a wavelength long and a half-wavelength in circumference. Since the ends of the Pylon operate at ground potential, it is not necessary to insulate either the antenna base or its supporting tower (grounding also provides maximum lightning protection for antenna and transmitter).

INSTALLING THE HEAVY-DUTY PYLON

The first step in the antenna installation was to provide a suitable mounting plate, or base, atop the tower, to act as a mounting support for the combined FM and TV radiators. This consists of a cross-membered framework, of structural steel, which was constructed at a point about 12 feet from the tower top. A 1000 lb. dummy metal

FIG. 1. (Opposite Page) *Full view of WATV combination FM and TV antenna installed at West Orange, N. J.*

FIG. 2. (Right) *Sketch of the combination antenna showing the mechanical arrangement of tower, 2-section Pylon, and 6-section television superturnstile.*

cylinder (not part of the antenna radiating system), of nearly the same height and of the same diameter as that of one Pylon section, was raised over the tower top and then lowered onto the mounting base (located about 11 feet below the tower top, as shown in Figure 2). Thus seated, the top flange of the dummy section was exactly even and in line with the top surfaces of the tower. Provided with mounting flanges at both ends, like the Pylon sections, the dummy was then bolted and anchored to the supporting tower. Standard equipment, used throughout the installation, consisted of—a motor-driven winch, necessary cables, tag lines for keeping the dummy clear of the tower, and the gin pole (approximately 15 feet high and 4 inches in diameter) used for support at the tower top.

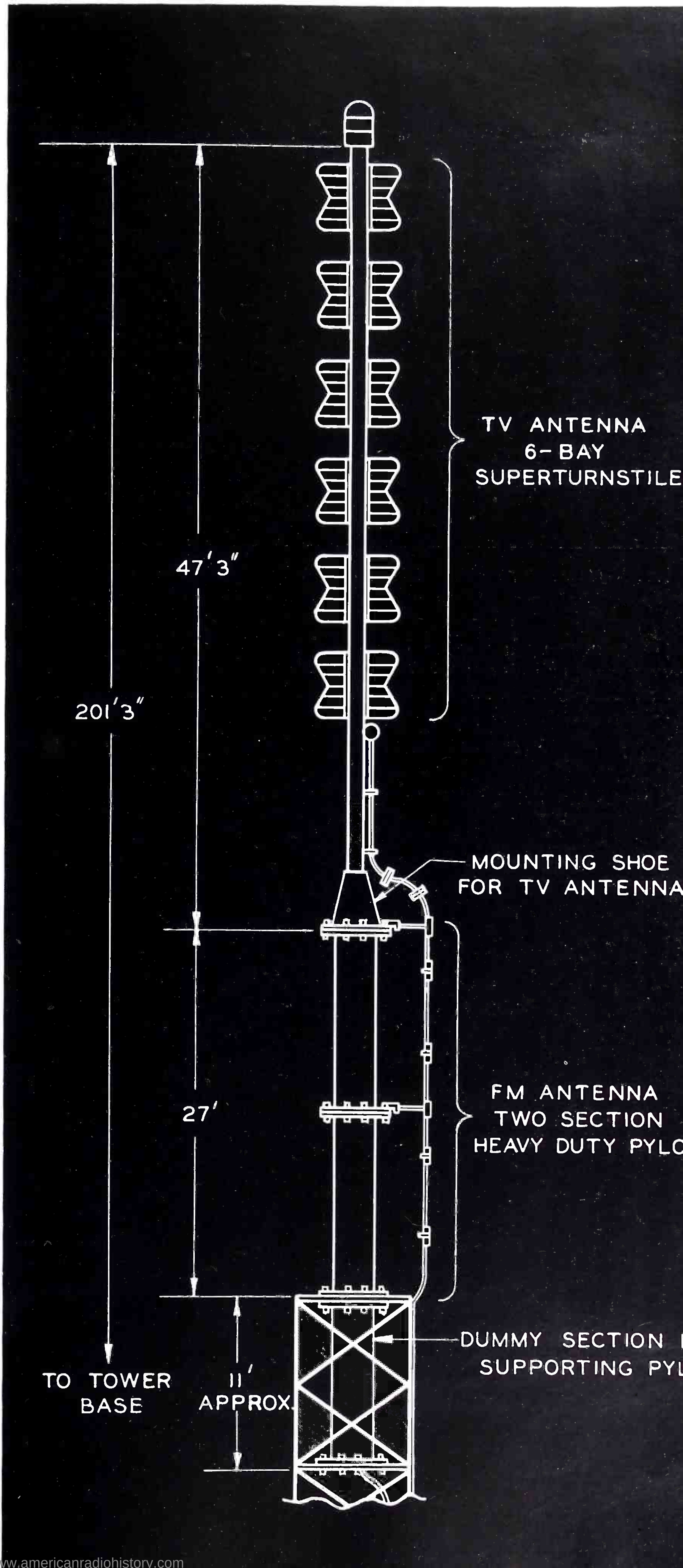
With the dummy mounted in position, the sections of the heavy-duty RCA Pylon were installed one at a time (standard Pylons of lighter design, for FM only, are usually bolted together on the ground and erected as a unit). In mounting the first section, the gin pole was supported at the outside corner of the tower. The first section (see Figure 3) was raised from the ground to the top of the dummy section within a few minutes.

When the second section was installed, (see Figures 4 and 5) the gin pole was strapped to the first Pylon section and to the dummy inside the tower. In this way, it was seemingly easier to "swing in" the second section for mounting. The operating crew consisted of three men "on the ground"—the boss rigger who directed the erection, the winch operator, and one man on the tag line. Three riggers were employed on the tower to "swing in" the sections, line up the bolt holes (with the aid of pinch bars), and to secure the thru-bolts for mounting. The gin pole was strongly held with two guys and the Pylon sections were guided with the help of the tag line. Thick rubber gaskets were cemented between all sections for water-tightness.

INSTALLING THE SUPER TURNSTILE

Erection of the Super Turnstile on top the two section Pylon antenna was accomplished in half a day with very little difficulty. An additional six inches of snow had fallen since the time of erection of the Pylon, but the tower itself was free of ice and snow. However, a brisk wind and below-freezing temperatures made working atop the tower somewhat difficult.

The first step in erection of the Super Turnstile was to replace the gin pole used for erection of the Pylon. A longer pole was required to hoist the Super Turnstile to a height where its base could be swung into position on the top of the Pylon.



The gin pole used (see Figure 6) was 53 feet long, weighed 980 lbs. and was capable of supporting 5 tons. Lashed to the corner of the tower, it extended about 25 feet above the top of the Pylon. This provided adequate clearance between the bottom of the Super Turnstile and the top of the Pylon, with the hoisting cable attached just above the gravitational center of the Super Turnstile. (The Super Turnstile is 47 feet long.) After the gin pole was securely fastened and strongly guyed, a mounting shoe was raised and bolted to the top Pylon section. This shoe is actually a steel socket into which the pole of the Super Turnstile is inserted. The shoe is the only support for the Super Turnstile, the Pylon and Super Turnstile combination being a self-supporting structure requiring no guy lines. Heavy setscrews around the shoe hold the Super Turnstile in position. Figures 7 and 8, show the Super Turnstile just before and after installation atop the two-section Pylon.

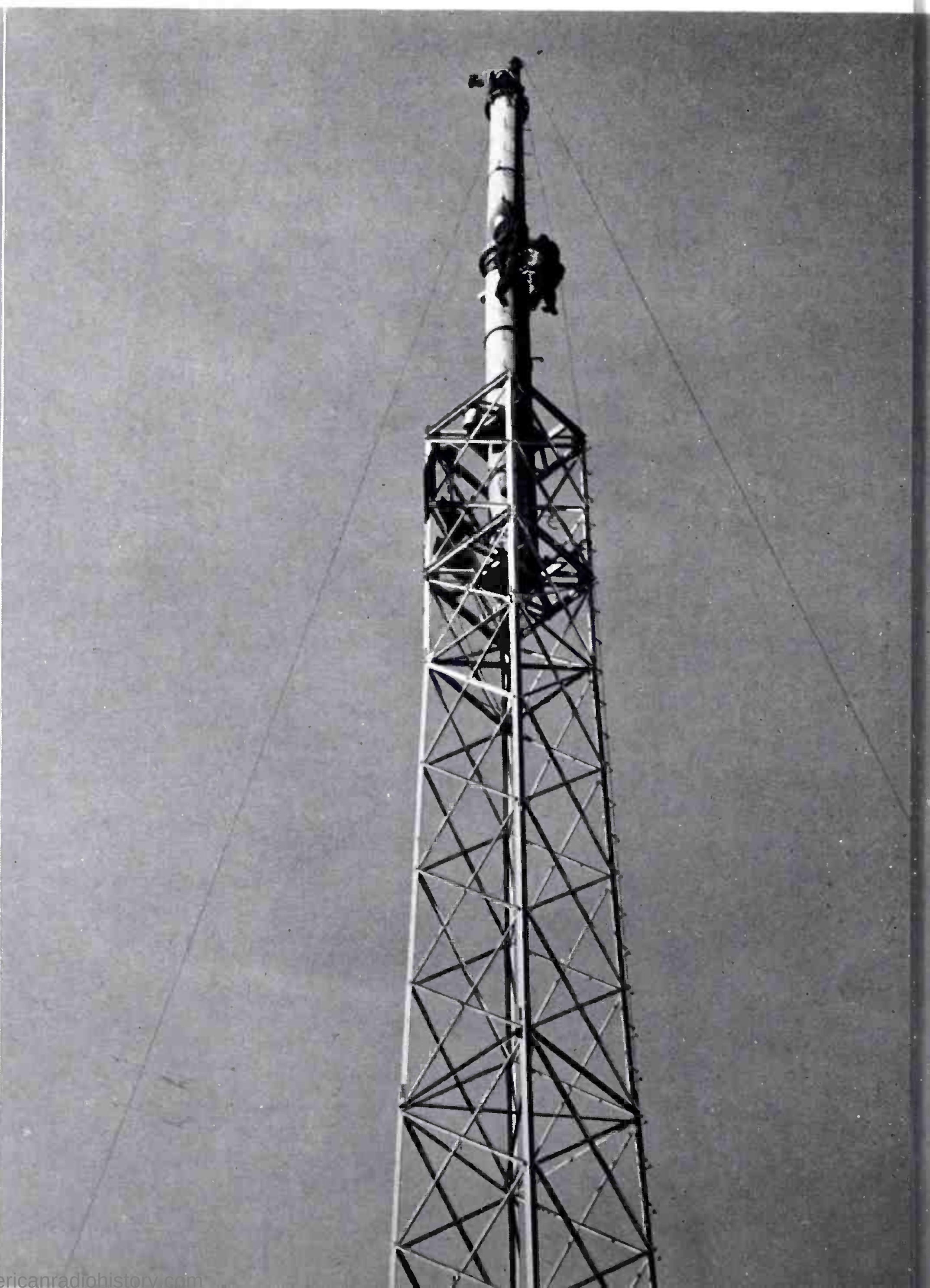
TRANSMISSION LINES

Feed lines for the Pylon and Super Turnstile Antennas were installed after erection of both an-

FIG. 3. (Above) *With cables attached for hoisting, the first Heavy-Duty Pylon section is ready to start its way up the tower.*

FIG. 4. (Below) *In this view, the second Pylon section is being carefully guided up the tower. Winch cables and the tag line are visible.*

FIG. 5. (Below) *With the second Pylon section in position, riggers are securing thru-bolts to complete the FM Pylon installation.*



tennas was completed. For the Pylon, the transmission line harness was installed into position inside the Pylon. Only two connections were required "in the air"—one to the Pylon mid-point, and one to the main feeder line at the base of the Pylon.

For the Super Turnstile, all branch feed lines emanating from junction boxes mounted on the mast to each of the six bays of radiators were installed before erection. The only ones to be installed after erection were the two 1⅞-inch copper lines from the transmitter room to the junction boxes at the base of the TV antenna.

READY FOR BOTH — FM AND TV

The heavy-duty RCA Pylon and 6-section Super Turnstile thus installed permit a single tower to serve for both FM and TV. This should interest the many broadcasters who are now planning for FM—with the ultimate addition of television later. Ordinarily television would mean another antenna and generally another tower. But not so with the heavy-duty Pylon which is, as far as we know, the only FM antenna capable of supporting a TV antenna.

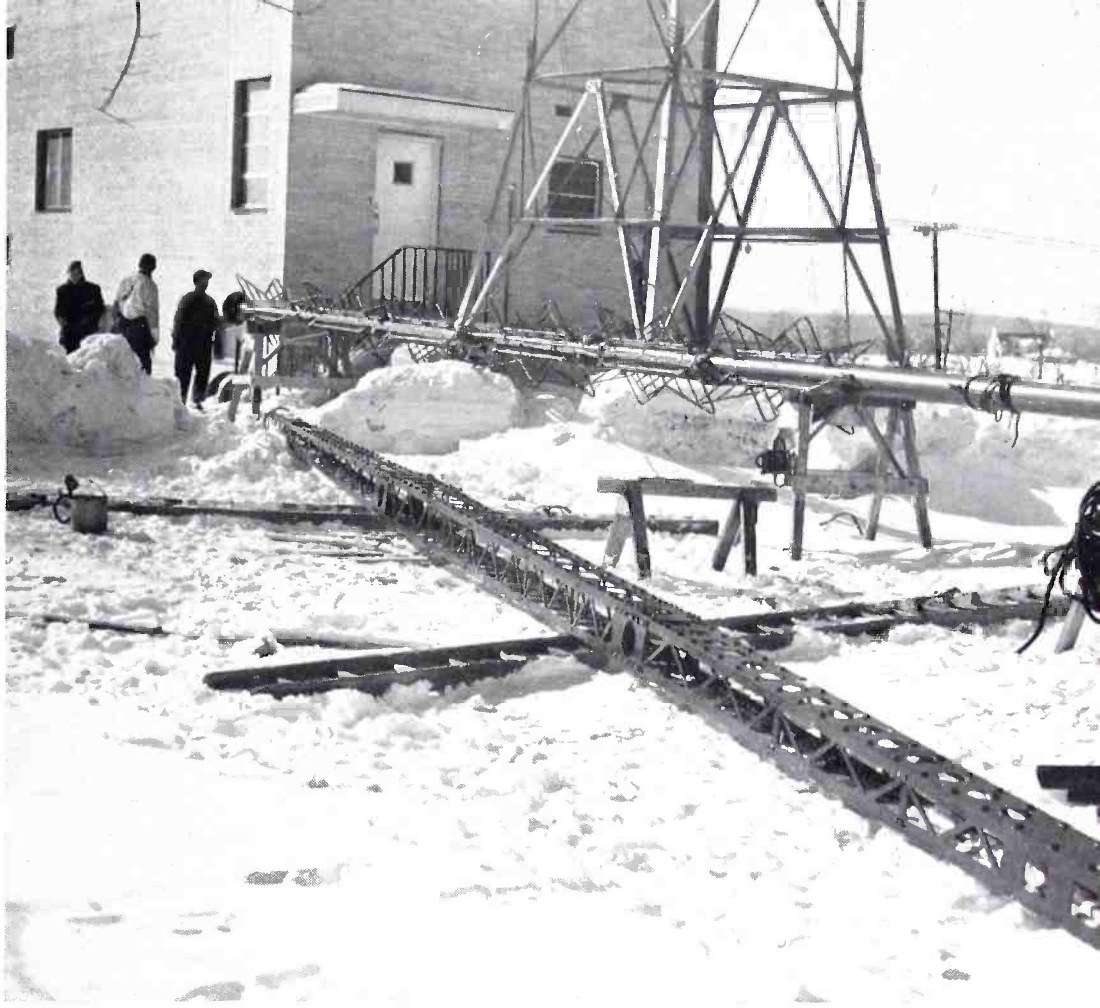
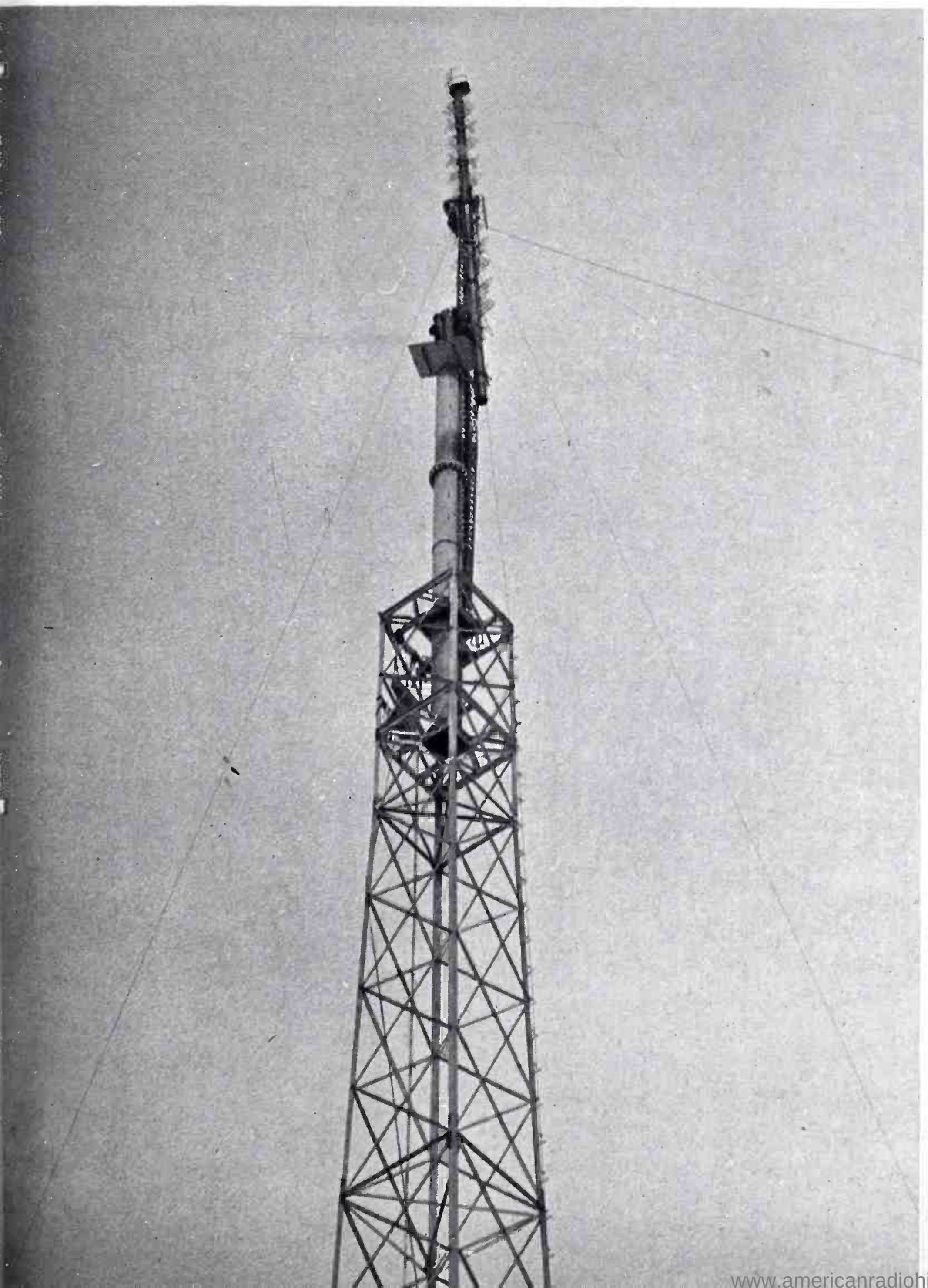
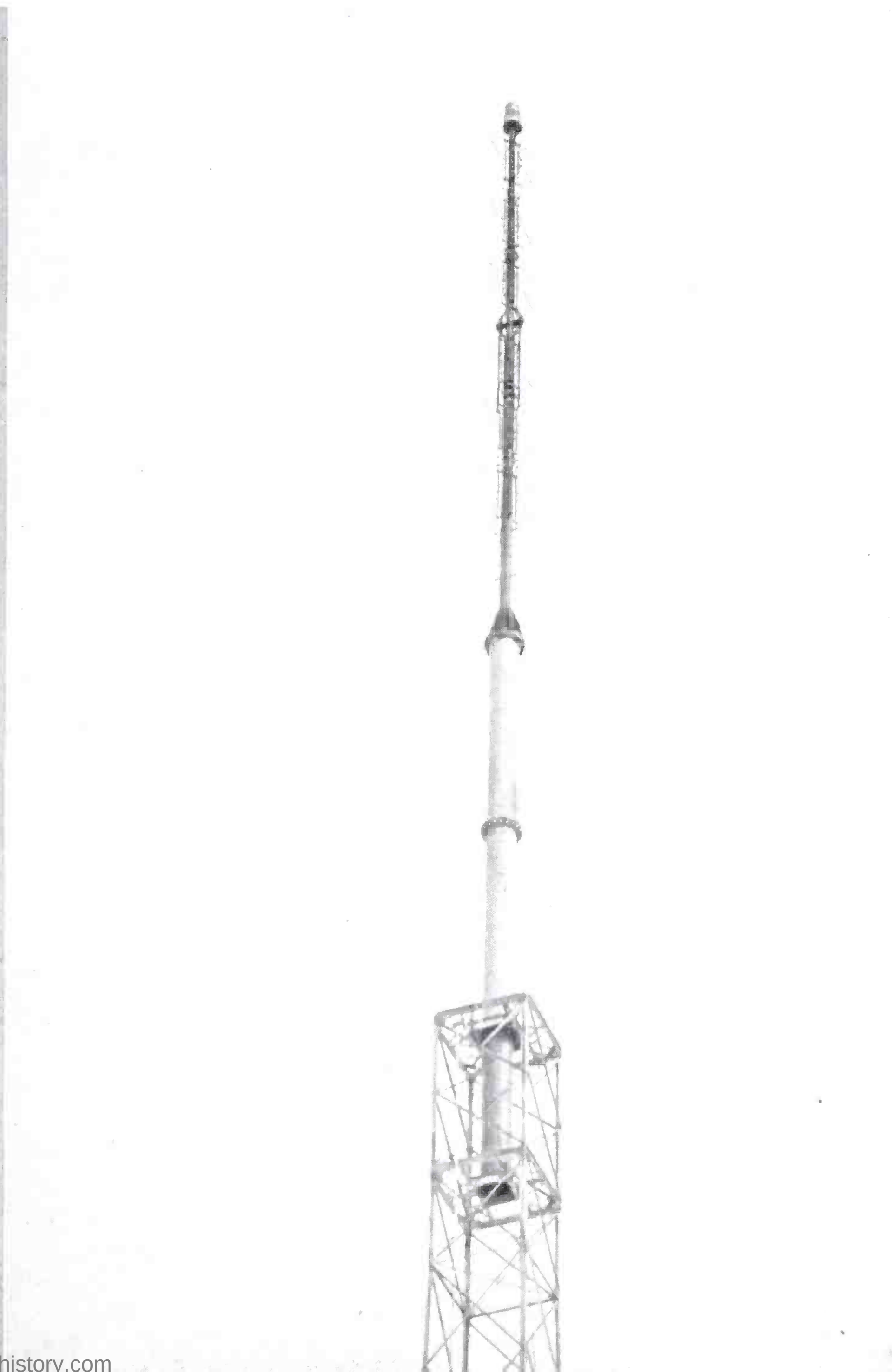


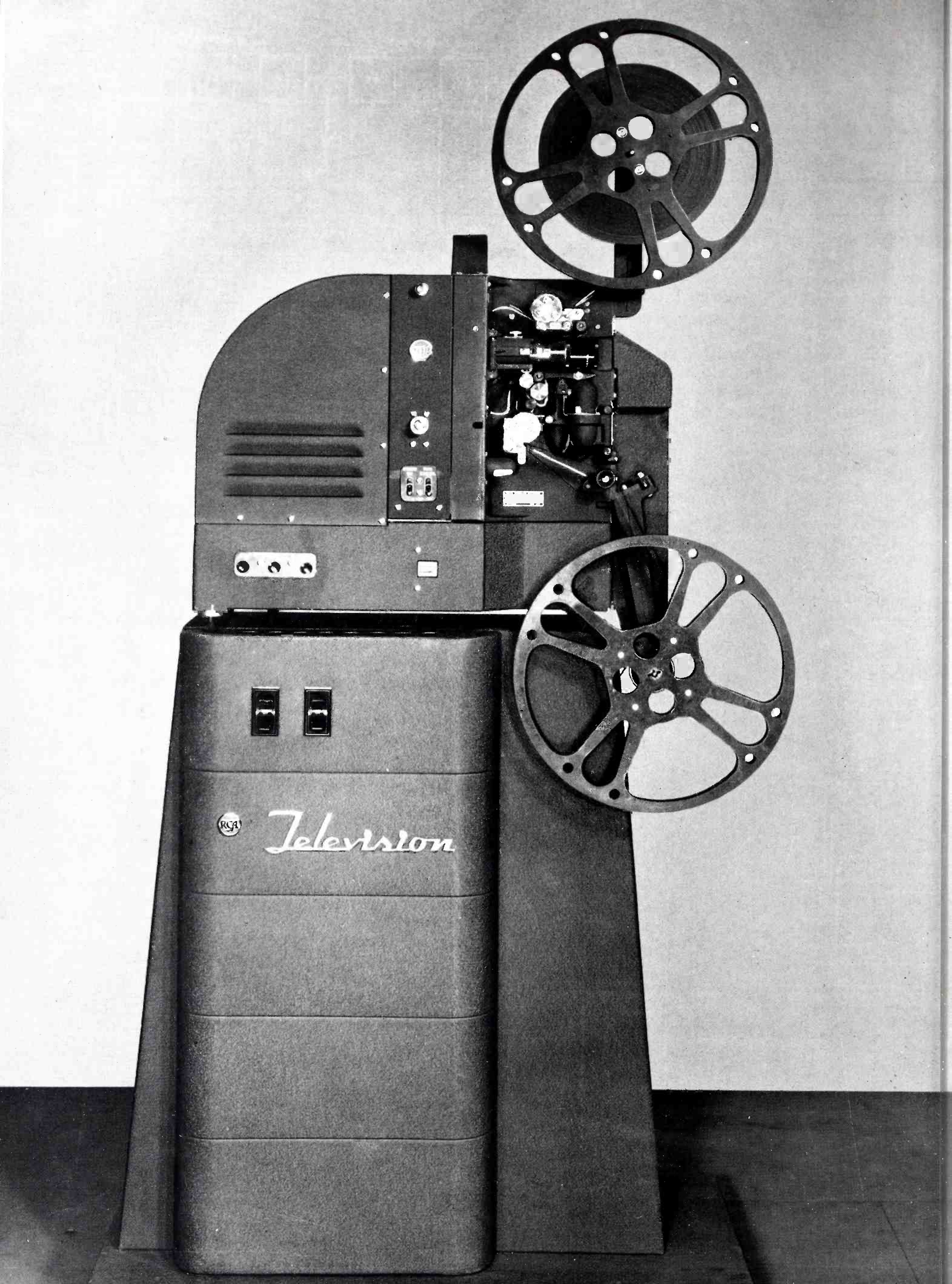
FIG. 6. (Above) *A longer gin pole (see foreground) was used i raising the RCA 6-section TV superturnstile which is shown here.*

FIG 7. (Below) *In this view, the 6-section superturnstile is shown, almost to the tower top, and just before mounting atop the 2-section RCA Pylon which will be used for FM.*

FIG. 8. (Below) *After erection of the FM and TV combination wa completed, feed lines were installed. WATV is now ready for both FM and TV with a single tower.*






RCA
Television

the TP-16A 16mm TELEVISION PROJECTOR

by R. V. LITTLE, Jr.
Television Terminal Equipment Section
Engineering Products Department

Newest unit in RCA's rapidly expanding line of postwar television equipment is the Type TP-16A Projector. This projector, in conjunction with a TK-2A Television Film Camera, provides a convenient means of utilizing standard 16mm sound motion pictures as regular television program material. Such programs may be alternated with live programs and network shows to add variety to the station's program schedule.

DESCRIPTION

The TP-16A Projector is entirely self-contained and is entirely enclosed. The projector housing is provided with an attractive umber-gray crackle finish matching that of other RCA television equipments. The projector proper is mounted on a heavy-cast base frame. This frame, in turn, is mounted by means of leveling screws on a lightweight pedestal of matching design and finish. This pedestal greatly improves the appearance and provides a convenient place for mounting the controls and field supply for the special three-phase motor, which is a feature of the TP-16A.

The mechanism of the Type TP-16A Television Projector is an adaptation of that used in RCA's outstandingly successful PG-201 Deluxe 16mm Sound Projector. The film-feed arrangement, optical system, and sound pickup unit of the TP-16A are identical with those of the PG-201. The cast-aluminum frame and the front part of the projector housing are also the same. Use of these precision-made components, whose adequacy is attested by thousands of PG-201's in use, not only insures troublefree operation, but also makes it possible to provide a deluxe-type projector at a price much lower than if these machines were specially-developed and manufactured from scratch in the relatively small quantities required for television use.

* The TP-16A Television Projector was developed by W. R. Isom of the General Advanced Development Group, which is headed by Dr. E. W. Kellogg. The product design was by F. G. Talley of the 16mm Sound Section This group is under the supervision of Sidney Read, Jr.

OPTICAL SYSTEM

The optical system and film-feed arrangement are illustrated diagrammatically in Figure 3. The optical projection system consists of a 1000-watt air-blast-cooled incandescent lamp, a silver-coated pyrex glass reflector, a large two-element aspheric condenser lens, and a 3-inch, F.2 "coated" projection lens. This system provides plenty of illumination on the mosaic of the camera iconoscope and is, of course, much simpler than systems using switched or pulsed light sources.

FILM-FEED ARRANGEMENT

The film-feed arrangement of the TP-1. . A is identical with that of the standard projector with the exception that the pull-down

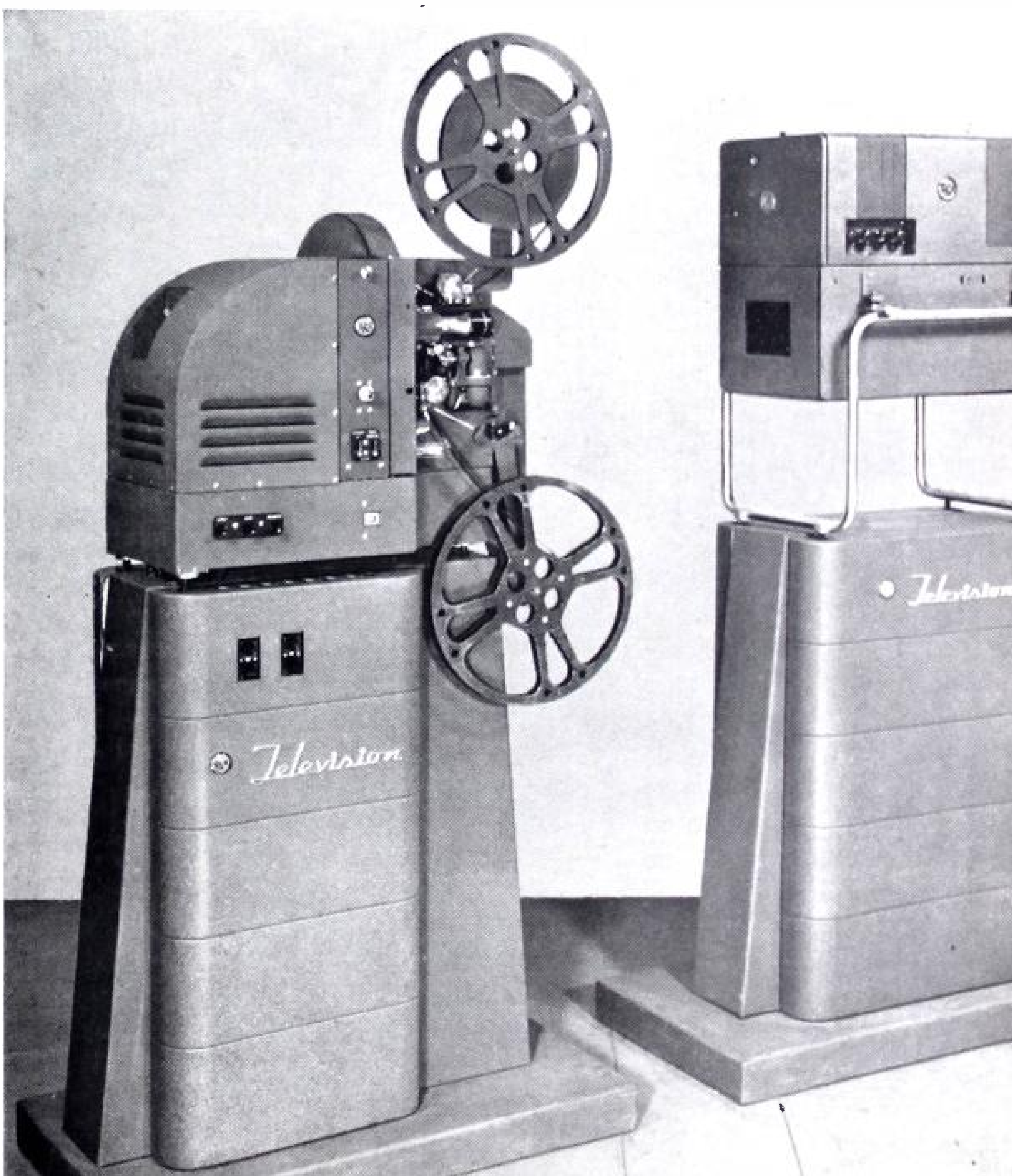


FIG. 1. (Left) *The new Type TP-16A Projector especially designed for televising of standard 16mm sound motion picture films.*

FIG. 2. (Right) *The TP16A Projector is designed for use with the TK-2A Film Camera, as shown in this illustration.*

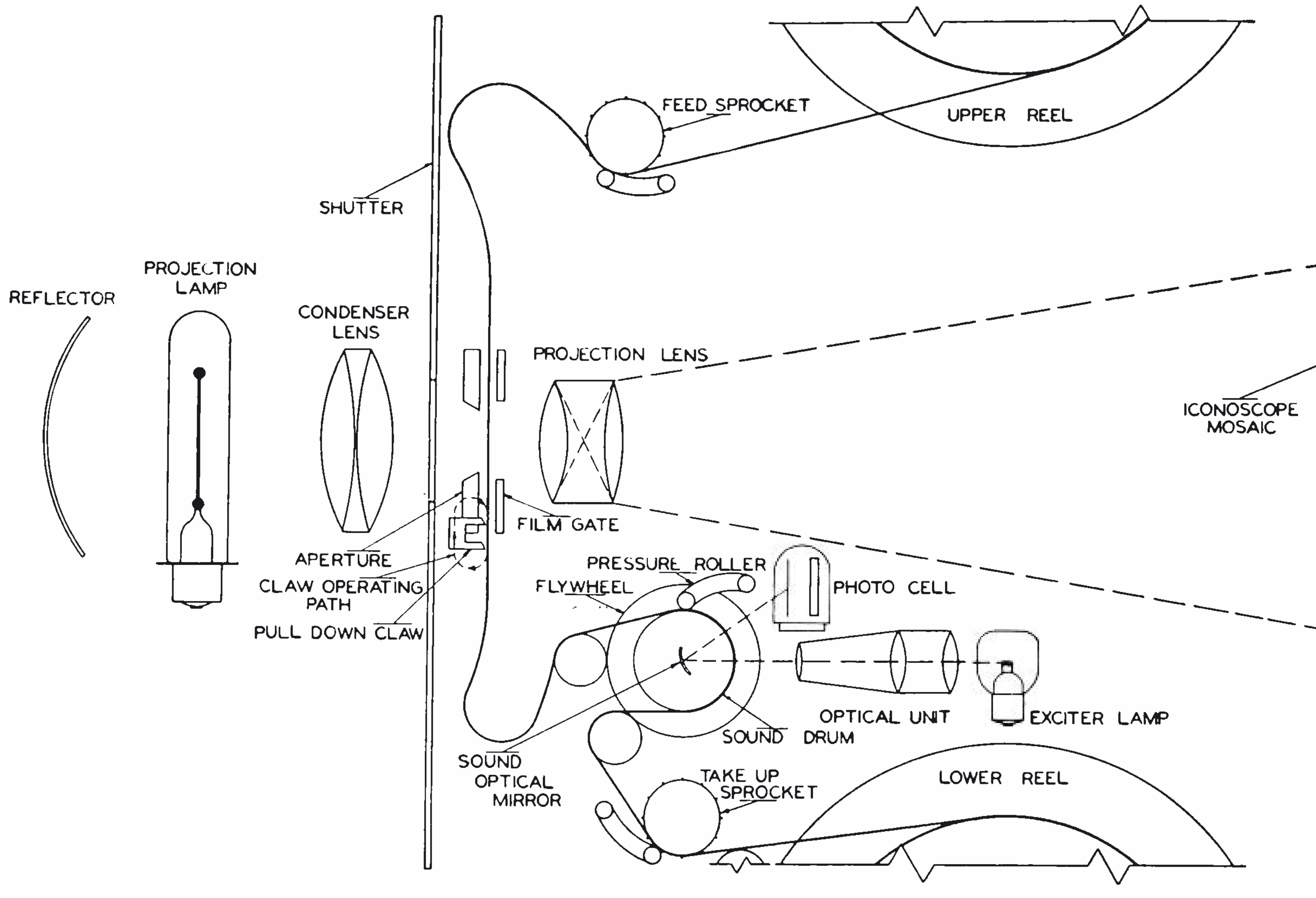


FIG. 3. *Diagram of the optical and film feed systems of the TP-16A Projector.*

claw works at a different speed. Film is fed from the upper reel (Figure 3) under a large sixteen-tooth feed sprocket and through the precision-made film gate. Light, controlled by the rotating shutter (see below), is projected through the film at this point. The film is pulled down through the gate, a single frame at a time, by the pull-down claw just below the gate.

"2-3-2-3" . . . SCANNING SEQUENCE

Television standards (and proper synchronization) require transmission of 60 fields (30 frames, interlaced) per second. Since motion picture film is made for projection at 24 frames, some means must be provided for conversion from the one rate to the other. In the TP-16A this is done by "scanning" the first frame twice; the second frame three times; the third, twice; the fourth, three times; and so on. The average rate, then, is 2½ scannings per frame—which, multipled by the 24 frames per second, provides 60 scanned fields per second. This ingenious system was developed by Stuart Seeley of RCA Laboratories (U. S. Patent No. 2,303,960).

FAST "PULL-DOWN"

In order to employ the 2-3-2-3 scanning sequence successfully the "pull-down" time—that is, the time required to pull a new frame into place—must be shorter than that employed in standard projectors. The "pull-down" interval in a standard projector, such as the PG-201, is about one-sixth the total "frame cycle" (line A in Figure 4). If this interval were used for television projection, alternate pull-downs would slightly overlap the scanning cycle and would cause annoying "travel ghosts." To avoid this the spur gears ordinarily used in the PG-201 have been replaced in the TP-16A with a set of elliptical gears. The effect of the latter is to cause the claw mechanism to travel about fifty percent faster in the downward direction. As a result the pull-down time is reduced to about one-eighth the "frame cycle," and therefore allows sufficient time to complete the television scanning cycle before the pull-down to successive frames.

LIGHT AND SCANNING CYCLE

In order to obtain a complete television signal the mosaic of the film camera pickup tube must be scanned almost continuously. The only significant break is the interval in which the beam returns from the bottom of the picture to the top. During this interval—1/750th of a second, every 1/60th of a second—the picture is blanked out. If the "pull-down" could be accomplished during this time, no further modifications of the standard projector would be necessary. Unfortunately, this is not mechanically possible. Therefore, a further stratagem is employed. This is the use of short light flashes so timed that the film picture is projected on the pickup tube mosaic for only 1/1200th of a second, every 1/60th of a second. These flashes occur during the vertical retrace time (line C in Figure 4). This arrangement is possible because the mosaic of the pickup tube "stores" the picture during the interval between flashes of illumination. Lines B, C, and D, which are correctly spaced with relation to each other, indicate the overall sequence in one arrangement which in practice has proved to be the most satisfactory.

SHUTTER PROVIDES LIGHT FLASHES

In the TP-16A Projector the 60 light flashes required every second are provided by a rotary shutter which consists of an 18-inch metal disk with a slot cut in its periphery (Figure 5). This disk is driven at a speed of exactly 3600 rpm by a special 3-phase synchronous motor. The shutter is located where the cross section of the beam to be interrupted and is small compared to the size of the shutter opening, thereby providing a quick opening and closing, and a relatively long full-opening time.

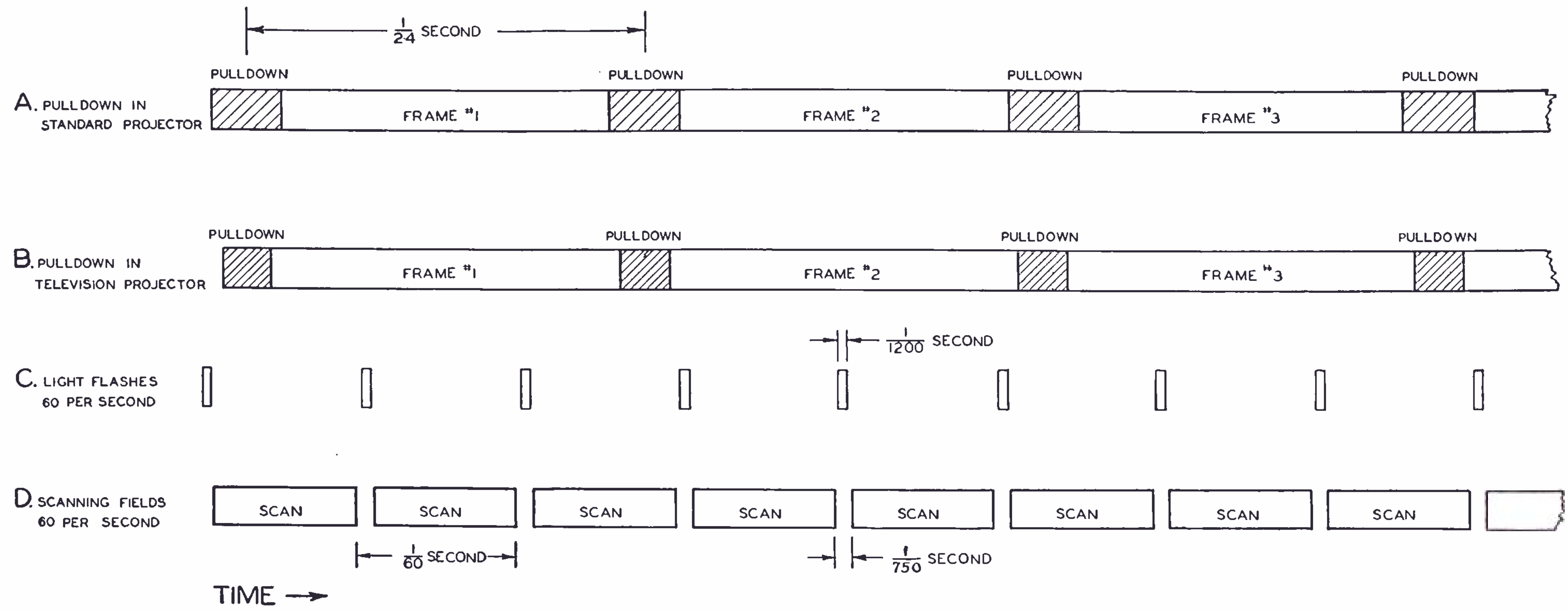


FIG. 4. *This diagram illustrates the time relationship of the framing, light and scanning sequences employed in the RCA type TP-16A 16mm Television Film Projector. Line A shows the "pull-down" interval in a standard 16mm film projector (Type PG-201). The "pull-down" interval is about one-sixth of the total frame cycle. Line B illustrates the effect of speeding up the "pull-down" in the TP-16A Projector. The "pull-down" interval is now only one-eighth the total frame cycle. Line C indicates the duration and repetition rate of the short intervals during which light is allowed to fall on the film. Note that Frame 1 is twice, Frame 2, three times, and so on. Line D shows the scanning intervals. Note that scanning is accomplished during the unlighted interval following each period of illumination.*

SYNCHRONIZATION

A fundamental requirement of a television projector is that it must synchronize with the television system. In the TP-16A this is assured by virtue of the fact that both the television synchronizing generator (which drives the beam in the camera pickup tube) and the motor (which drives the projector shutter) have a common source of power. To insure that the shutter will be in step at all times, a large-size motor of special design, utilizing a separately excited d-c field, is used. The d-c field, being polarized, makes the motor always "lock" in proper relationship with the synchronizing generator. The power supply for the motor field is included as part of the auxiliary equipment mounted in the pedestal.

SOUND PICKUP SYSTEM

After the film leaves the film gate (Figure 3) it makes a short, free loop, then passes over the sound "drum." At this point, light from the "exciter" lamp (concentrated into a fine beam by a lens system) passes through the film sound track and falls on a photoelectric cell. Area or density variations in the film sound track cause the transmitted light to be varied in accordance with the recorded sound. The output voltage of the photocell varies in the same manner. This signal, after amplification, is used to modulate the sound part of the television transmitter.

A number of unusual features are incorporated in this sound unit. One is the use of radio-frequency voltage (28 kc) on the exciter lamp filament. This prevents hum and noise being introduced by the lamp itself. Another feature is the fact that the exciter lamp mounting and sound carriage are die-cast in one piece, thereby insuring permanent, accurate alignment. Still another is the use of the famous RCA-developed rotary stabilizer on the sound drive (can be seen in Figure 5). This maintains smoothly uniform film speed for sound takeoff—a guarantee of sound reproduction at originally recorded pitch.

SOUND PREAMPLIFIER

In order to feed the output audio line at a fairly high level our audio preamplifier is built into the base of the projector. This amplifier, which is of conventional design, employs an RCA-1620 as a photocell amplifier, an RCA-6J7 as a voltage amplifier, and an RCA-6V6FT/G as an output tube. A tapped output transformer provides output impedances of 250 or 500 ohms. Output level is +4VU at 1000 cycles with less than 1% total rms harmonic distortion.

The audio amplifier is assembled on a small chassis, which can be easily removed from the base housing. Also mounted on this panel is the 28 kc oscillator, which supplies voltage for the

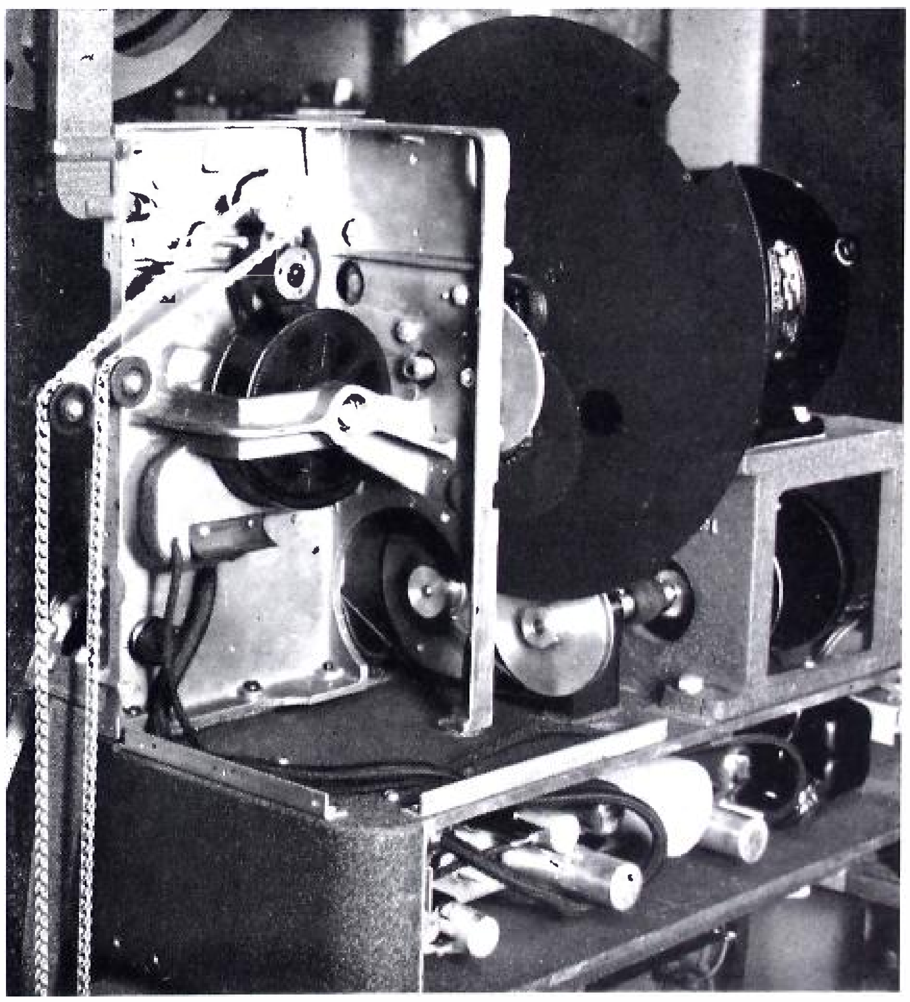


FIG. 5. *This photograph, with projector cover removed, shows details of shutter and drive. The small motor beneath the main drive motor operates a blower which ventilates the lamp house. The RCA-developed rotary stabilizer used on the sound take-off drum is in the foreground.*

FIG. 7. *The amplifier, a self-contained unit, is shock-mounted in a recess in the base casting. Cover of the amplifier compartment, held in place by thumbscrews, is easily removed for servicing.*

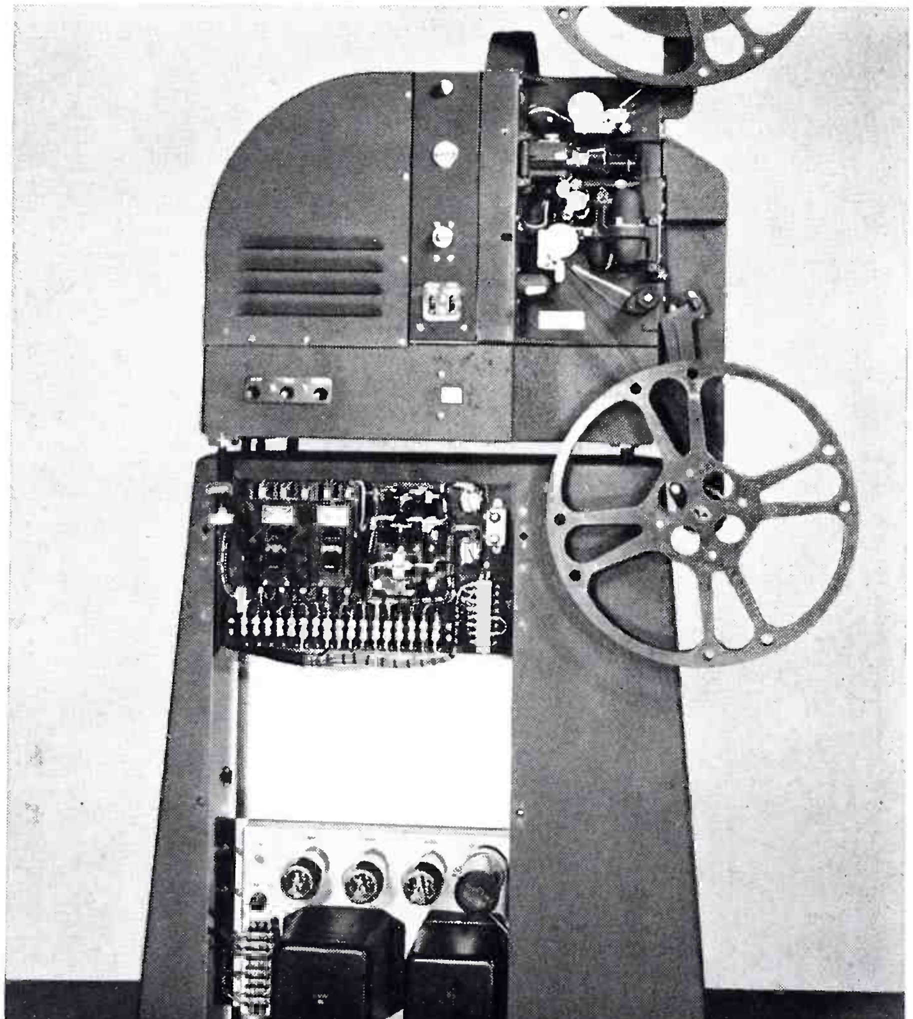


FIG. 6. *Pedestal covers are easily removed for servicing. Removing the right side cover, as shown here, provides access to the relay panel and field power supply.*

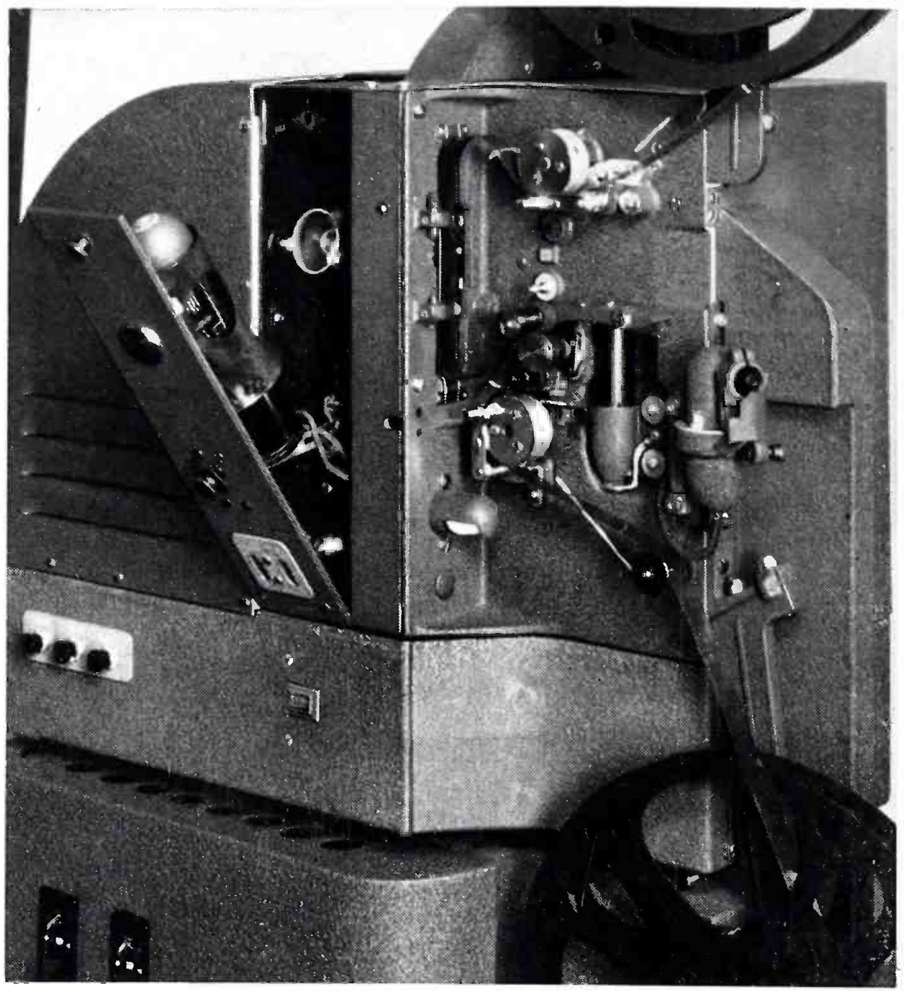


FIG. 8. *Another feature which contributes to maintenance operation is the fact that reflctor, condenser lens and projector lamp are instantly accessible for inspection and cleaning.*

filament of the exciter lamp, and a power supply using a 5Y3-GT/E, which supplies plate voltage for the amplifier and oscillator.

SOUND EQUALIZER PANEL

A sound equalizer panel is available as an accessory for the projector sound channel and is identified as MI-26313. The unit is constructed to be mounted convenient to the audio control position so that the film sound may be easily adjusted for proper response. The compensation in frequency response is necessary because of the wide variation in recording and printing of 16mm films. A single control is used in a tilt circuit with a straight through center position, with three high-boost and three low-boost positions of 2.5 db. steps each.

PROVISION FOR REMOTE CONTROL

Controls mounted on the projector include "Standby," "Emergency Run," "Start," "Stop," and "Remote." When the standby control is operated, low voltage is applied to the projector lamp, the blower motor operates and the preamplifier is turned on, as this is the normal "warmup" position. When the remote switch is operated, "Start" and "Stop" controls at a remote location may be used to control operation. These circuits operate through relays and a master contactor mounted on the pedestal (see Figure 6). Also mounted on the pedestal are 115-volt, single-phase, and 220-volt, three-phase circuit breakers for primary circuit protection.

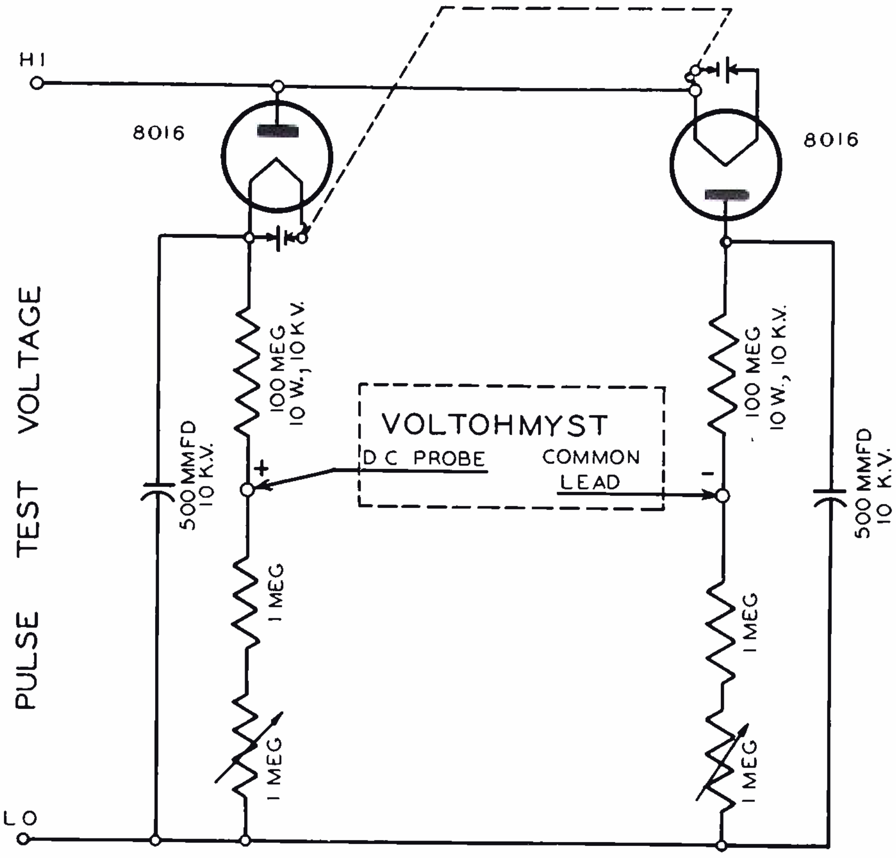
MAINTENANCE FEATURES

Easy and quick maintenance is one of the features of the TP-16A Projector. The field power supply, control circuits and all external connectors in the pedestal are easily reached by removing the pedestal side covers (Figure 6). The preamplifier and exciter filament supply unit are available when the cover plate, held by two thumbscrews, is removed (Figure 7). The projector lamp is reached through a hinged door (Figure 8).

A 10-KILOVOLT TEST PROBE FOR TELEVISION

Easily constructed adapter for type 195A VoltOhmyst measures high voltage in television circuits

by J. M. BRUMBAUGH
Television Terminal Equipment Section
Engineering Products Department



Schematic diagram of Adapter showing hookup with Model 195-A VoltOhmyst.

Engineers and technicians who have serviced television transmitting or receiving equipment will welcome this little twist on how to build a probe for measuring pulsed and d-c high voltages. Designed as an adapter for the RCA 195-A VoltOhmyst, the probe extends the voltage range of the VoltOhmyst to 10,000 volts so that it can be used to measure peak-to-peak deflection and anode voltages in cathode-ray tube and camera circuits.

Featuring high input resistance (100 megohms) and low input capacity (10 mmf) the adapter produces negligible loading on the television circuits. Measurements, therefore, are highly accurate; even recurring pulses of very short duration can be measured with accuracy.

HOW IT WORKS

The adapter consists of two half-wave 8016 rectifiers with separate voltage dividing load circuits. One 8016 rectifies the positive side of the voltage under test, and the other 8016 rectifies the negative side. The VoltOhmyst, connected between the two loads, measures a d-c voltage difference which is calibrated in terms of the peak-to-peak value of the applied voltage. The voltage dividing load circuits are calibrated so that the VoltOhmyst receives d-c voltage equal to 1/100 of the peak-to-peak voltage applied to the adapter. Therefore, the voltage reading given by the VoltOhmyst x 100 equals the peak-to-peak value of the applied voltage.

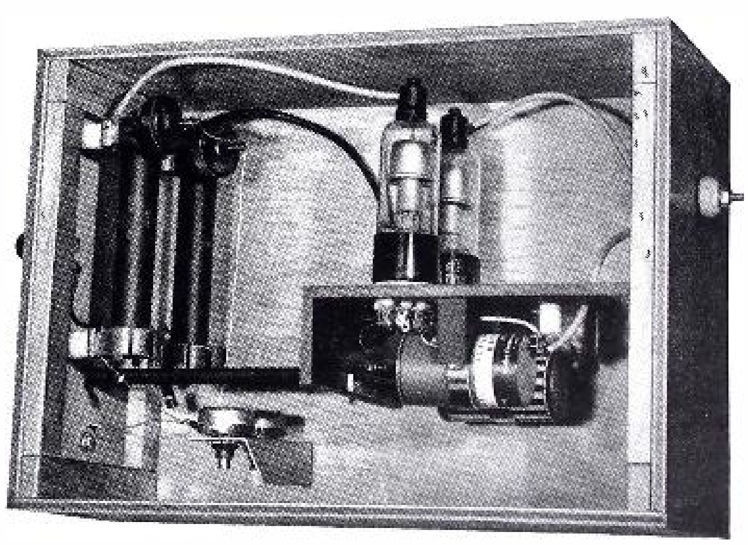
It is easy to calibrate the adapter. A known d-c voltage is applied between the HI and LO input terminals, and the potentiometer in the load circuit of the conducting rectifier is adjusted until the VoltOhmyst reads the correct voltage. The polarity of the applied voltage is then reversed and the other potentiometer is adjusted.

CONSTRUCTION

One method of construction is shown in the photographs. Here the adapter is housed in a wooden box 8¾″ high x 5½″ wide x 12½″ deep. Two flashlight batteries provide filament power for the 8016 tubes. A specially-constructed pushbutton switch applies filament power only when held in place, thus extending battery life. Moreover, this type switch reduces stray capacity which, of course, is the most important consideration in determining the parts used and their arrangement. The HI input is fed directly to the two 8016's from a terminal at the rear end of the box. The LO terminal is on the front end with the d-c output terminals to which the VoltOhmyst is connected. The two 1-megohm pots are screwdriver-adjusted through holes in the side. The two 100-megohm resistors are 10-watt, 10-kilovolt sizes.

The adapter can be used for measuring audio voltages, but its accuracy falls off at frequencies below 2000 cycles due to the small time constant in the rectifier load impedances.

View of Adapter housed in laboratory-built cabinet.



Open view of Adapter showing placement and mounting of components.

HOW TO USE THE TELEVISION STABILIZING AMPLIFIER

by JOHN H. ROE

Television Terminal Equipment Section
Engineering Products Department

INTRODUCTION

Most of the units which make up the video system of a television station are counterparts of the audio units in a standard broadcast station. Thus, the camera itself corresponds to the microphone, the camera amplifier to the microphone pre-amplifier, and so on. Generally speaking, these television units are arranged in much the same manner as the units of the audio system. There are, however, several television units, such as the synchronizing generator, which have no audio counterparts. In addition, there are a number of television units which, although corresponding in a general way to well-known audio units, have a different or more extensive function to perform than the analagous audio unit. The stabilizing amplifier is one of the latter.

Considered solely from its place in the system, the stabilizing amplifier may be considered as corresponding to the ordinary line amplifier in broadcast audio systems. For instance, a stabilizing amplifier is generally used at the transmitter location between the incoming line and the input of the transmitter proper. It is used at the studio location between the camera mixer and the master control position. If incoming signals from a network line or relay receiver are weak, another such amplifier may be inserted previous to the mixing position. These, of course, are all points at which a line amplifier would be used in a standard audio system.

If the function to be performed by the stabilizing amplifier was directly analagous to that of the line amplifier, it would be sufficient to use a straightforward video amplifier (such as the TA-1A Distribution Amplifier). However, under some conditions the incoming signal from a line, relay receiver, or camera may have excessive low frequency disturbances or hum. Or the synchronizing signal may have been saturated during the transmission from one point of the system to another. The stabilizing amplifier is designed to improve such signals. It includes: (a) clamping circuits which operate to remove the low frequency disturbances and hum; (b) circuits for separating and amplifying the synchronizing signals; and, (c) provision for adding

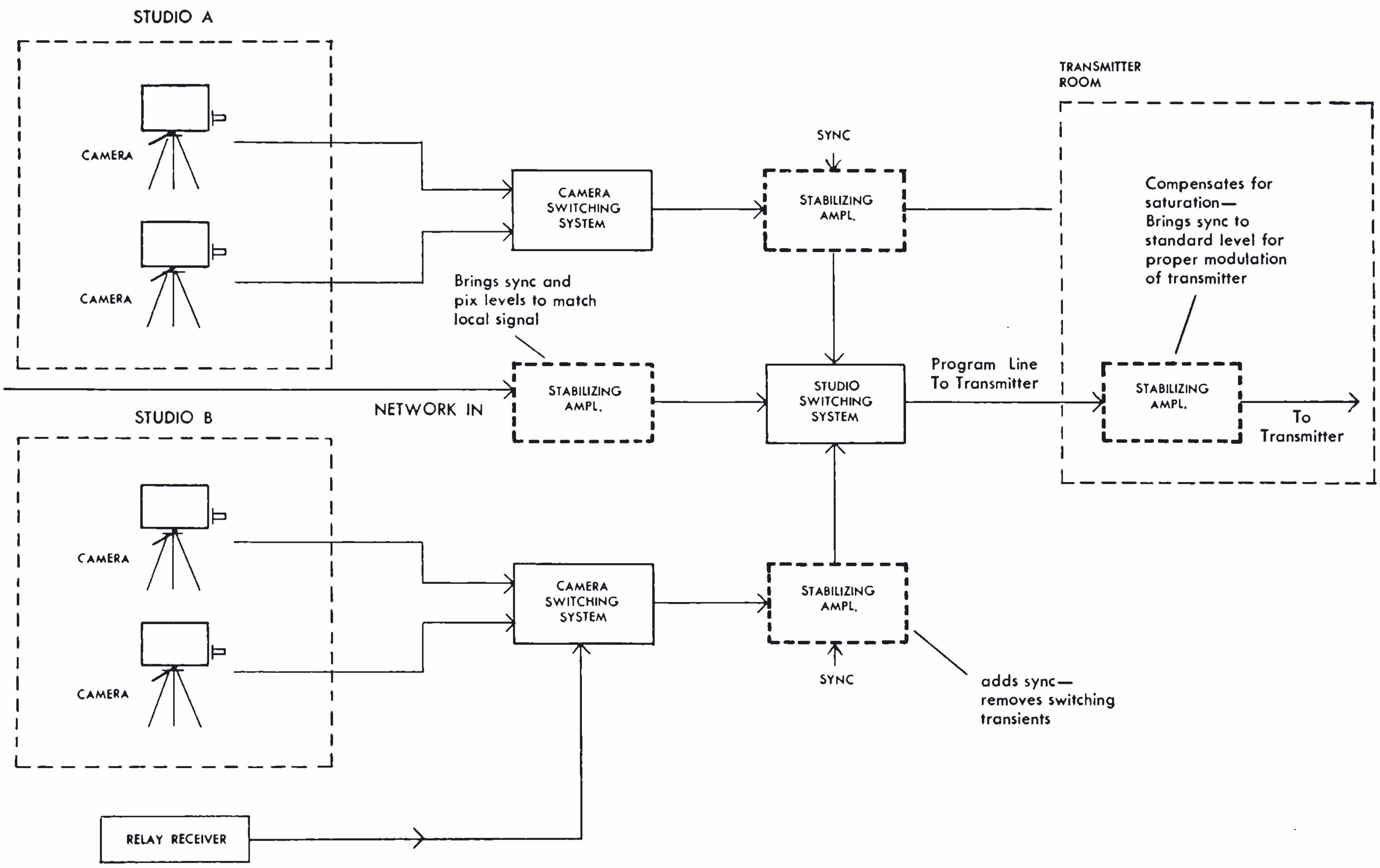


FIG. 1. *Block Diagram (above) shows a few typical applications of the Stabilizing Amplifier in the television studio and in the transmitter room.*

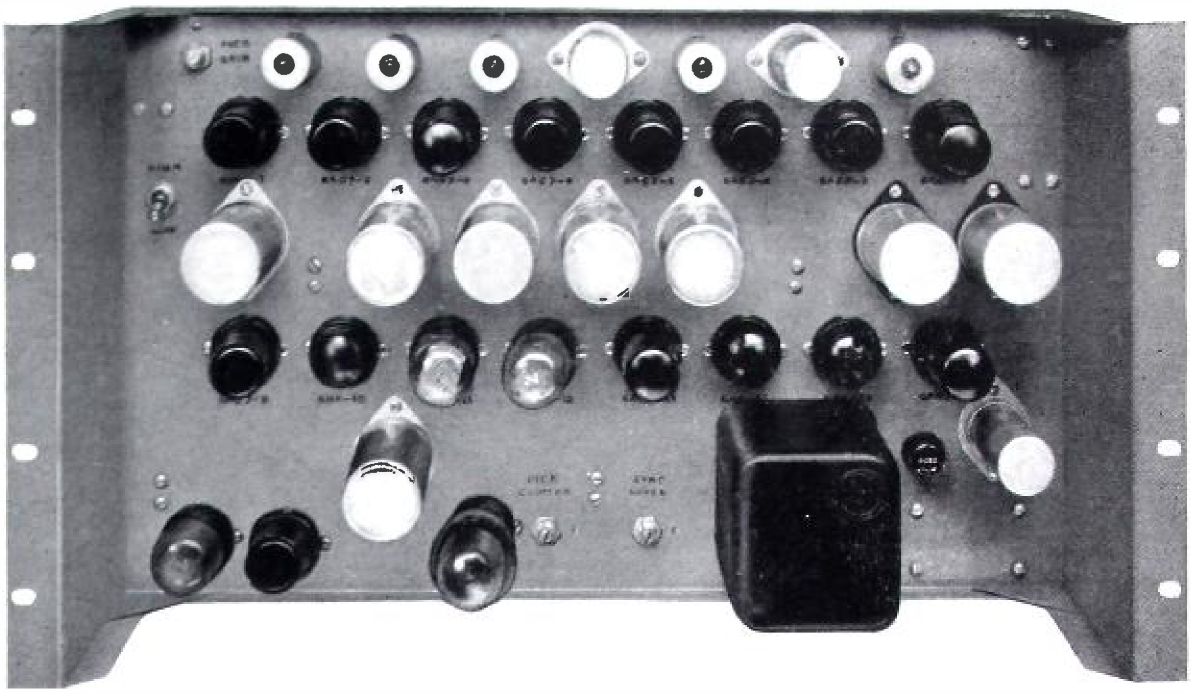


FIG. 2. *The Stabilizing Amplifier is not a "cure-all" for any and all types of defective video signals, but it has some interesting and important applications in the TV station as the author describes in this article. Both the TA-5A and TA-5B models are rack-mounting units. Shown at right is the TA-5B.*

synchronizing signals when the input signal (as, for instance, from the camera) does not contain sync. All these functions, of course, are in addition to the simpler one of raising the signal level to the input level required for the following unit of the system.

Because the stabilizing amplifier does, under certain conditions, provide an almost miraculous improvement in the signal quality, it has (somewhat prematurely) been hailed as a "cure-all." Broadcasters encountering it for the first time break into an amazed "why-haven't-I-heard-about-this-before" expression. This is a reaction which worries the design engineers because it may lead to considerable difficulty. There are some signal deficiencies which the stabilizing amplifier will not cure. Moreover, even within its given province it must be operated with strict attention to limiting conditions. In order to define more clearly the limitations of this amplifier and the conditions under which it must be operated the following detailed description of the way it is used and the way it operates has been prepared.

WHAT IT WILL DO

The faults which the Stabilizing Amplifier will correct, or at least minimize, are two in number as follows:

1. It will minimize or completely eliminate spurious low frequency signal components which have been added to the picture signal in any part of the system ahead of the stabilizing amplifier. Power supply surges, switching surges, hum picked up from low frequency power systems, microphonics, and discrepancies introduced by poor low frequency response of amplifiers are examples of spurious signals which can be corrected.

   There are, however, definite limits in type and magnitude to the discrepancies which can be corrected. A spurious signal component which causes a negligible amplitude change within the period of one scanning line $\left(\frac{1}{15750}\text{ second}\right)$ will be completely eliminated. However, if the amplitude change in this period is not negligible, then the stabilizing amplifier will serve only to minimize the difficulty. Furthermore, if the amplitude of the spurious signal is at any place so large as to cause amplitude modulation (non-linear amplification) of the picture signal, then only the spurious signal itself, but not the modulation, will be removed by the stabilizing amplifier.

2. It will "stretch" or amplify the sync pulses in the incoming picture signal without affecting the other parts of the signal. This feature may be used to restore the sync pulse amplitude to normal in cases where the incoming signal is deficient in this respect, or it may be used to pre-emphasize the sync pulses to compensate for the saturation which normally occurs in the P.A. stage of a television transmitter.

   Here again there are definite limitations in the character of the signals which can be accommodated. The entire functioning of the amplifier is dependent on the presence of sync pulses in the incoming signal. If their amplitude at the input is below a reasonable minimum, i.e. if the sync-to-picture ratio is too low, improper operation will result. Also, if the sync-to-picture ratio is too large, improper operation may result unless some readjustments of the controls are made. A tabulation of reasonable operating ranges will be found on a succeeding page.

   A further requirement is that the wave shape of the sync and blanking pulses should not be seriously degraded. All pulse widths must be held within the standard tolerances specified in the RMA drawings, the "back porch" must be reasonably free of spurious pips and changes in level, and there should be no serious difference in pulse amplitude during the vertical sync pulse period.

The limitations mentioned in the paragraphs above may seem to add up to a formidable total, but consideration of them indicates that they do not include anything which should not be required by the rules of good operating practice. In other words, the stabilizing amplifier should not be expected to act as a cure-all for every trouble resulting from careless or faulty operation of other parts of the system.

CIRCUIT DESCRIPTION

The circuits of the stabilizing amplifier are shown in block diagram form in Figure 3. They may be considered in several groups. The first group includes the tubes V-1, V-2, and V-3 which serve as conventional linear amplifiers to raise the in-

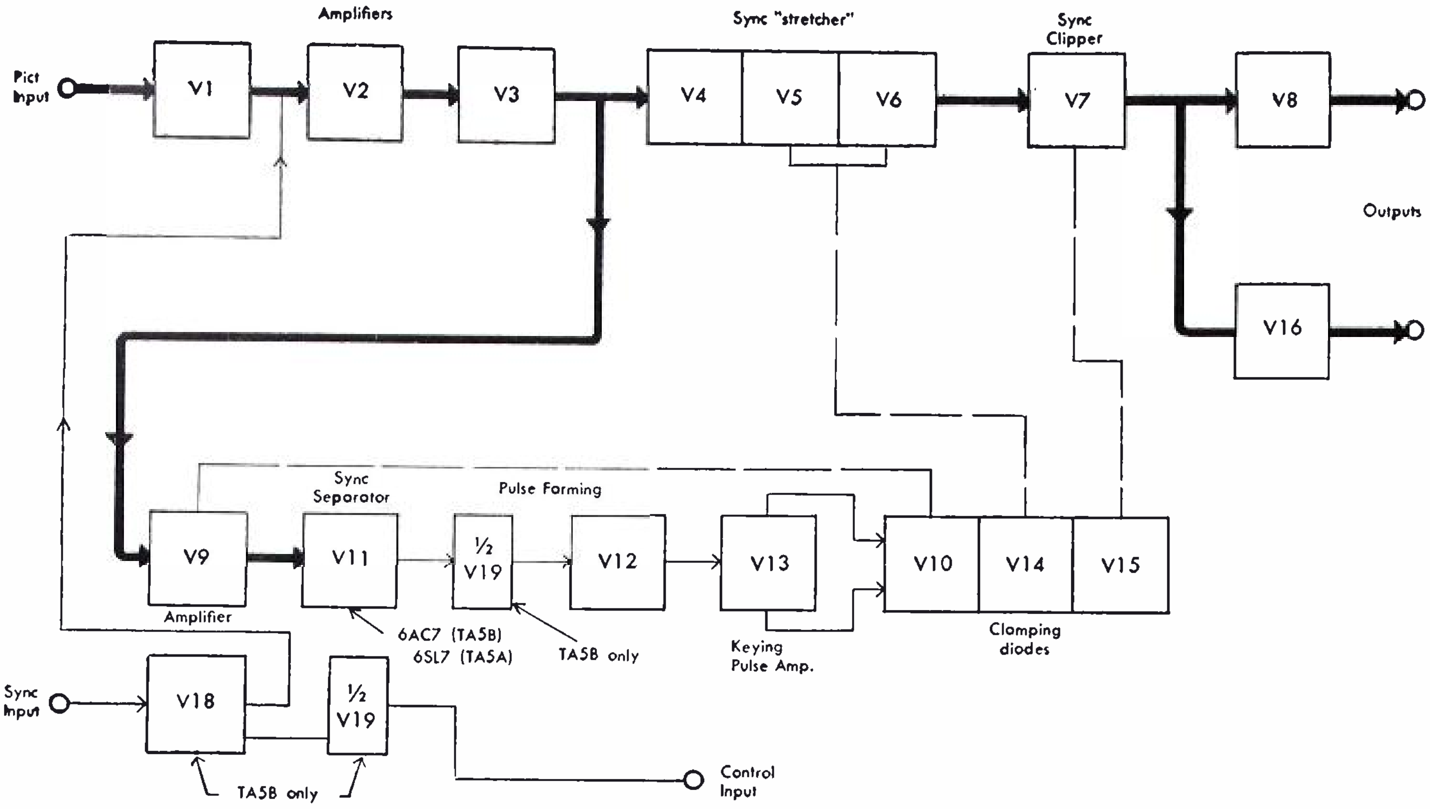


FIG. 3. *Circuits of the Stabilizing Amplifier are shown here in block diagram form. Video circuits are indicated by the heavy lines; pulse-forming and clamping circuits are shown by the broken lines.*

coming picture signal to a usable level for the circuits which follow. At the input is a 75 ohm network which acts as a termination for the coaxial feed line, and also serves to accommodate a wide range of input signal levels. The network includes a fixed attenuator with a two-position selector switch. In the LOW position, low level signals, down to a minimum of 0.25 volt, peak-to-peak, are applied directly to the PICT. GAIN control which provides continuous adjustment of the signal level on the grid of V-1. In the HIGH position, the signal is reduced by a factor of about 8.5 before being applied to the PICT. GAIN control. This latter position should be used whenever the incoming signal exceeds about 1.2 volts, peak-to-peak, because distortion of the frequency response characteristic in the PICT. GAIN control results when it is turned near its minimum limit.

The next stage, including three tubes (V-4, V-5, V-6) in parallel, performs the sync "stretching" operation. These three tubes do not all operate in the same manner. V-4 is a linear amplifier which by itself does not "stretch" the sync, but simply amplifies the entire signal including the sync. V-5 and V-6, on the other hand, are controlled in such a way that they amplify only the sync portion of the signal. The resultant signal at the grid of V-7 is therefore modified in that the amplitude of the sync pulses is normally somewhat greater than the amplitude of the picture portion of the signal. It may be said, in other words, that this stage as a whole is a non-linear amplifier which functions as shown in Figure 4. Here, BF is the characteristic curve of tube V-4, and AD is a portion of the characteristic produced by the operation of V-4, V-5, and V-6 together.

The final special function in forming the picture signal is performed in V-7. The signal with the "stretched" sync is applied, with sync negative, to the grid of this stage. The tube is controlled (by manual adjustment) in such a way as to clip off the sync pulses at some point which leaves just the desired amount of sync at the output of the amplifier. When the desired clipping level has been set by the manual control, the circuit maintains clipping at that same level regardless of the variations in the picture portion of the signal. Thus the sync pulses in the output remain constant in amplitude at all times. Tubes V-8 and V-16 are identical output stages for feeding 75-ohm coaxial lines.

Control of the sync "stretching" tubes (V-5, V-6) and the sync clipping tube (V-7) is accomplished by means of clamp circuits. These circuits operate on the grids of the tubes which they control, and restore the grids to arbitrary reference potentials during a short interval of each horizontal blanking pulse. The clamping action is entirely independent of the signal passing through the controlled tubes. In this particular amplifier the clamping action takes place during the "back porch" interval and hence restores the "back porch" or black level to the fixed reference potential.

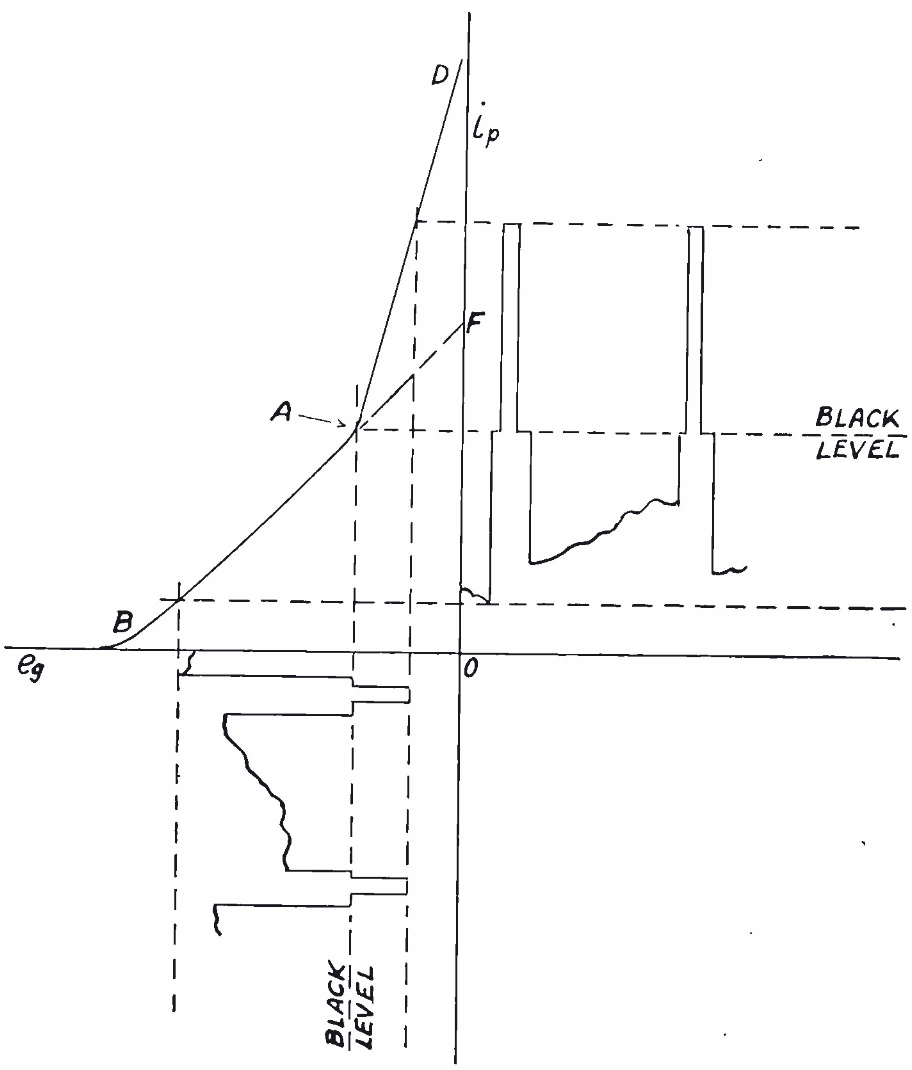


FIG. 4. *Characteristic curve showing operation of the sync stretching stages of the amplifier. Tubes V5 and V6 amplify only the sync portion of the video signal as indicated by portion AD of the curve.*

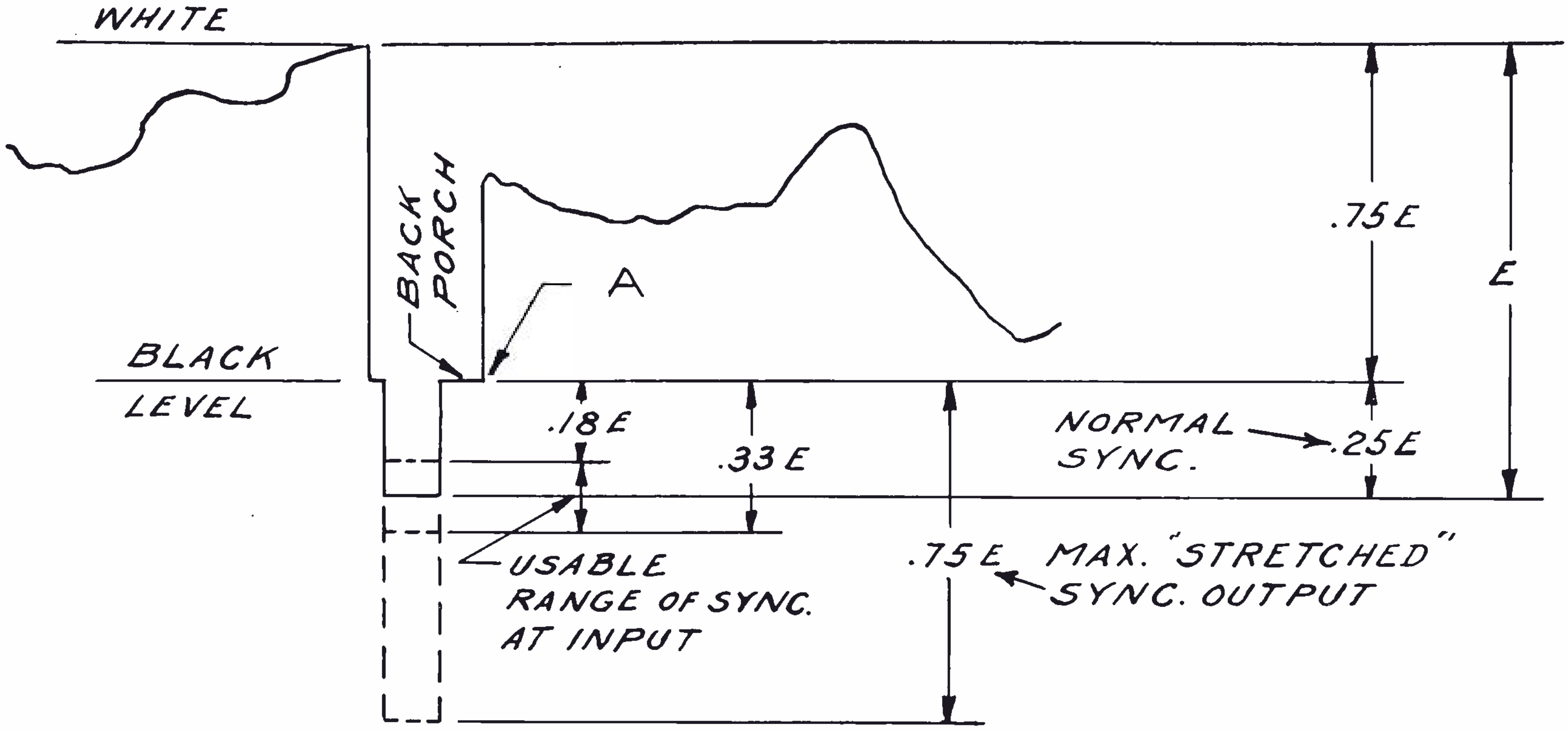


FIG. 5. *The drawing above shows the possible sync-to-picture voltage ratios in the stabilizing amplifier. Also shown is the "back porch" interval of the blanking pulse, during which the clamping action takes place.*

The "back porch" part of the blanking pulse is shown in Figure 5. This action has the effect of removing any relatively low frequency spurious signal which may have been added to the composite picture signal. (Detailed discussion of the clamp circuit may be found in a paper entitled "New Television Field Pickup Equipment Employing the Image Orthicon," by John H. Roe in "Proc. of IRE" for December, 1947). It also has the effect of holding the black level in the signal at fixed points on the e_g-i_p curves of the controlled tubes thus maintaining clipping action at fixed levels with respect to black level. It is this accurate control which holds black level at point A (Figure 4) and makes possible the action of V-5 and V-6 in amplifying only the sync pulses, and the fixed clipping in V-7 which yields the constant sync output as described previously.

Faithful performance of a clamp circuit depends on having keying pulses (to drive the clamp) which are constant in amplitude at all times, and timed correctly with respect to the signal in the controlled amplifier. In the stabilizing amplifier the keying signal is derived from the sync portion of the incoming composite picture signal. Tube V-9 is an amplifier for feeding the circuits used in deriving the keying pulses. In its plate circuit is an arrangement for partial integration of the signal to minimize high frequency noise components. V-11 is a sync separator which acts in a manner similar to the sync separator in a television receiver. V-12 (and part of V-19 in the Type TA-5B) is used for differentiating and other shaping functions in connection with formation of the keying pulses. V-13 is a phase inverter amplifier for providing push-pull keying signals to the balanced clamp circuits which include tubes V-10, V-14, and V-15. V-10 clamps the grid of V-9 to remove hum and low frequency surges from the signal going to the separator and thus assure clean separation of the sync in the succeeding circuits. V-14 and V-15 clamp the grids of V-5, V-6 and of V-7 respectively.

In the TA-5B version of this amplifier, provision is made for adding sync to incoming picture signals which do not have sync already. This feature of the amplifier is required when it is used in connection with camera switching equipment such as the TS-10A where the inputs to the system consist of signals from camera chains. In this case the quality of the sync pulses entering the keying pulse amplifier is good because the source is local. Hence the circuits for minimizing noise are not necessary, but are not disconnected because they do no harm. The sync signal is amplified in V-18 and added to the picture signal in the plate of V-1. Operation of the rest of the TA-5B is the same as the TA-5A.

When the TA-5B is used with the TS-10A or other switching equipment, it must be capable of accommodating two types of input signals. The first type is that which is supplied from local camera circuits and which normally requires the addition of sync pulses in the TA-5B as described in the preceding paragraph. The second type is a signal coming from a remote source where the sync pulses have already been added from a sync generator at the source. In this latter case, the sync mixing circuits in the TA-5B, which add sync from the local sync generator. must be made inoperative because there is no assurance that the local and remote sync generators are in phase with each other, and therefore the two signals must not be mixed. Hence, provision is made for electronic switching of the local sync mixing stage (V-18) by applying a positive biasing potential to its cathode. This bias potential is applied from an external source such as the TS-10A switching system in which the bias is provided automatically whenever a remote signal is selected.

Because the switching of V-18 cuts off its plate current, a surge is introduced in the main amplifier in the plate circuit of V-1. This surge is larger than can be handled by the clamp circuits operating on the sync stretching and clipper stages which follow. Therefore one section of V-19 (marked Switching Transient Suppressor) is arranged to draw the same current as V-18 and in the same circuit, but when this section of V-19 is made operative, then simultaneously V-18 is made inoperative, and vice versa, so that the surge in the plate circuit of V-1 is balanced out. Exact balancing of the two currents may be obtained by adjusting R-101 in the cathode circuit of V-19.

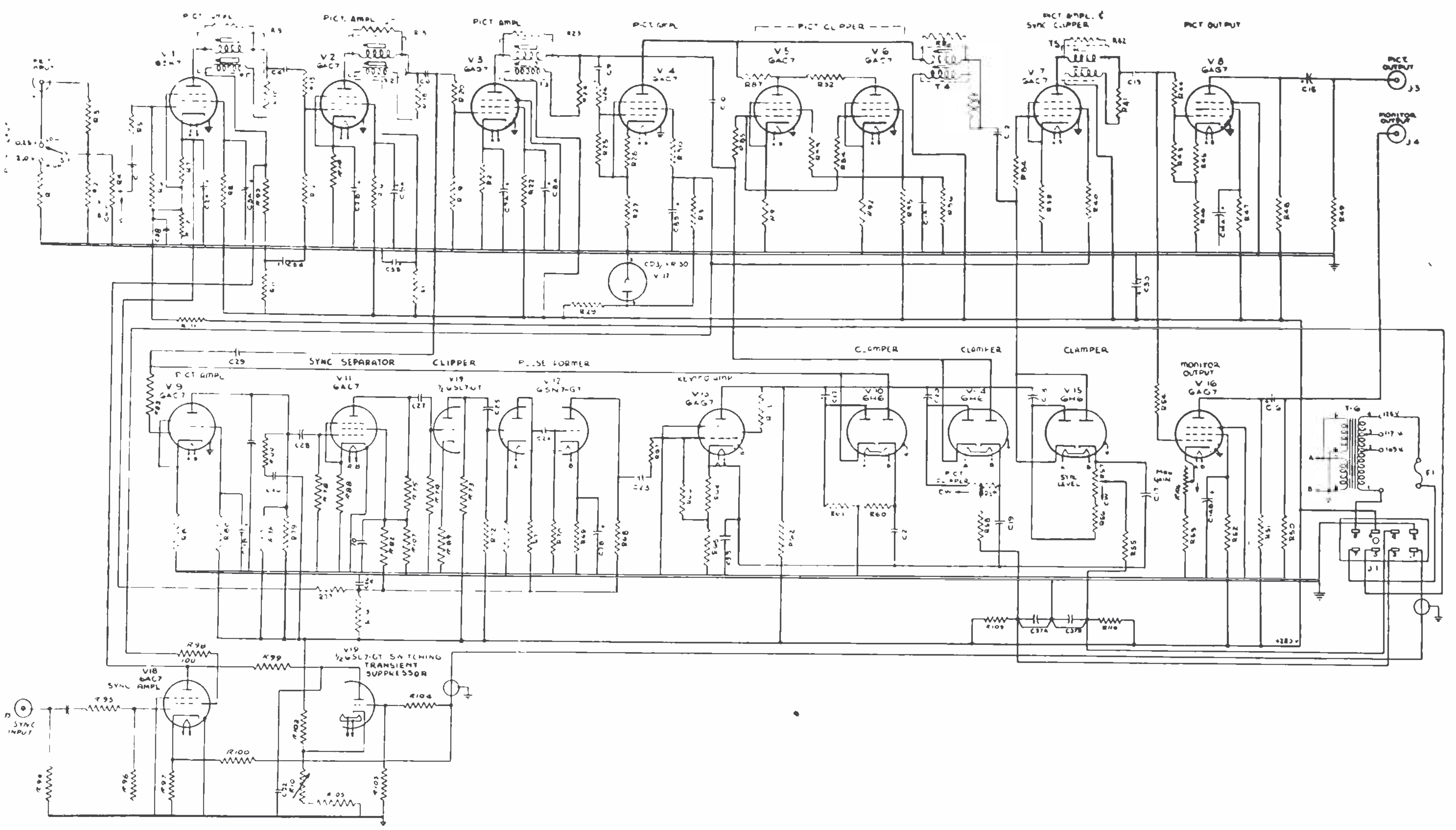


FIG. 6. *Schematic diagram of the Type TA-5B Stabilizing Amplifier.*

INITIAL ADJUSTMENTS

Initial adjustments of the stabilizing amplifier require a composite picture signal, including sync, at the input terminal J-2. (In the TA-5B, an alternative method is to apply picture signal without sync at J-2, and sync only, at 4 volt level, to J-5.) The only pieces of test equipment required are a wide-band oscilloscope with a voltage calibrator, such as the RCA Type 715-B or Type WO-79A, and a high resistance voltmeter, such as the RCA Voltohmyst.

To understand clearly the operation of the amplifier, the waveform diagram of Figure 5 should be studied. In this diagram, E is taken as the unit of measurement of signal level. The *normal* ratio of sync to picture is indicated by the figures of 25% and 75% of the unit, E. On all studio transmission lines, it is expected that E will be 2 volts, and hence the picture amplitude will be 1.5 volts and the sync amplitude 0.5 volt.

The amplitude of the picture and blanking portion of the composite signal may be assumed to remain constant. However, the amplitude of the sync may change because of saturation or overemphasis in some part of the system. The values of 18% and 33% sync represent the usable limits of a range through which the sync may vary at the input of the Stabilizing Amplifier. With proper initial adjustments, the amplifier will operate satisfactorily with any value of sync in this range without readjustment. If larger values of sync are encountered, a readjustment of the PICTURE CLIPPER control will correct the situation. It is better practice, however, when possible, to request a reduction of the sync at the source. Values of sync less than 18% do not cause unstable operation of the amplifier unless the amplitude is less than approximately 10%; but it is usually impossible to stretch the sync up to the normal maximum of 75% unless the amplitude is at least 18% at the input.

It is apparent from the preceding discussion that proper operation of the Stabilizing Amplifier is predicated on the maintenance of correct signal levels. It is impossible to avoid this situation because of the special functions it performs. The greatest possible flexibility has been provided in the way of tolerances, but stable operation outside of these tolerances cannot be expected.

It is necessary to measure only one signal level to assure proper operation, provided that it is known that the sync amplitude at the input falls in the allowable range between 18% and 33%. This one signal level, *which may be considered a yardstick for normal operation, is the output signal level. This output should be 1.5 volts, peak-to-peak, of picture and blanking across a 75 ohm load.* If this level is maintained, other levels within the amplifier will be correct for normal operation. The actual value of the signal level at the input may vary over a wide range (from 0.25 volt to approximately 3.0 volts). The GAIN control and two-position attenuator switch provide means for adjusting the output to the correct value throughout this range of input signals.

With this basic rule in mind, the ensuing steps may be followed in making initial adjustments:

1. Connect a composite signal (sync between 18% and 33%) to the terminal J-2 (black negative). (In a TA-5B model, an alternative step is to connect a signal without sync to J-2, and a sync signal only, 4 volts, peak-to-peak negative, to J-5.)

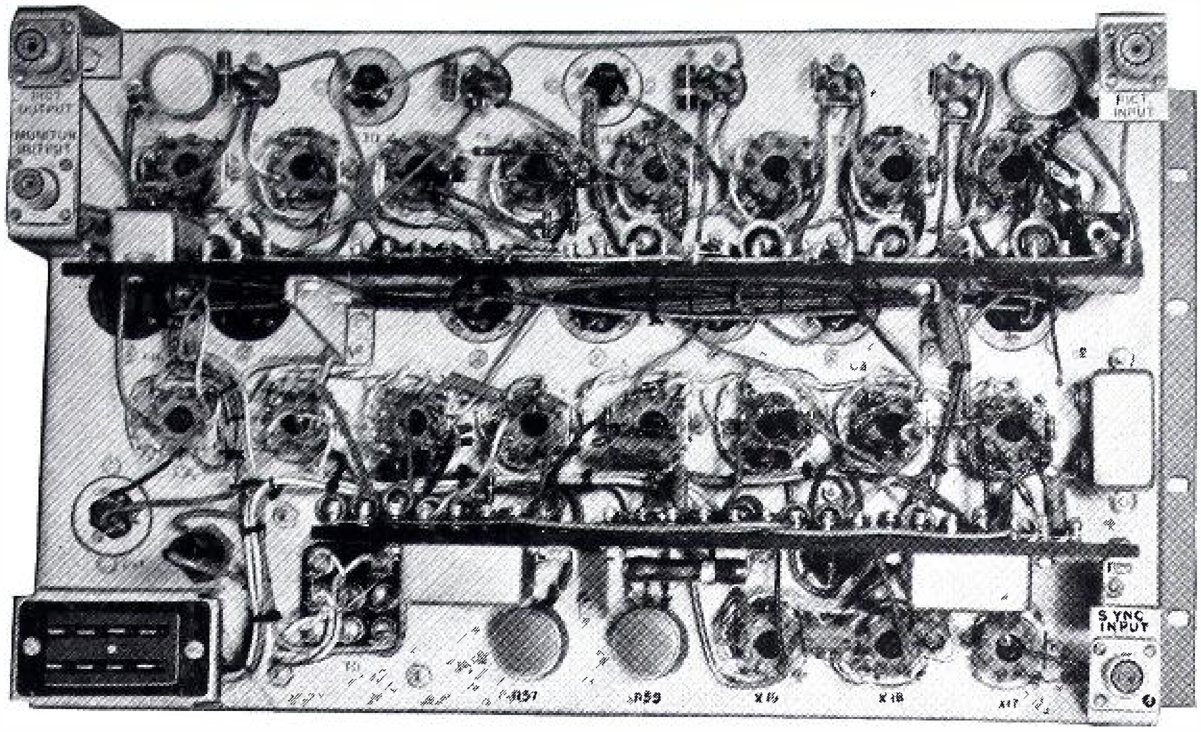
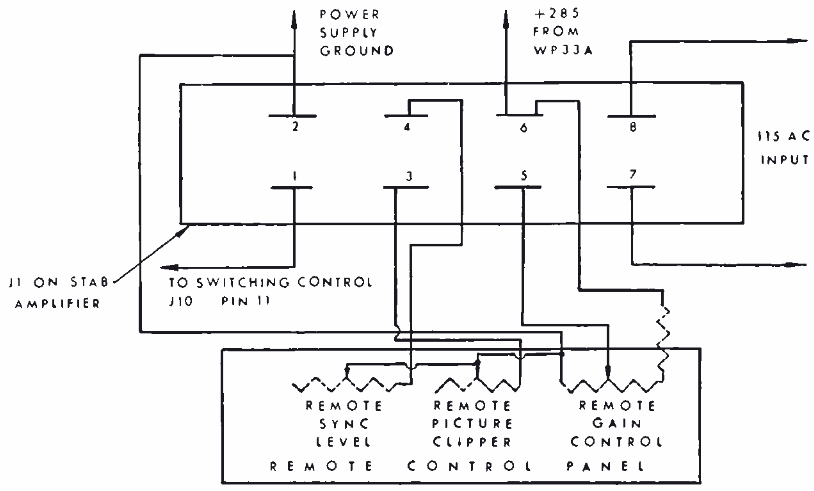


FIG. 7. *Rear view of the TA-5B Stabilizing Amplifier. Video connections are made through the coaxial receptacles at the corners of the chassis.*

FIG. 8. *Diagram (right) shows the connections of the 8-pin plug on the lower left corner of the chassis. A-c, d-c and remote control connections are made through this plug. Remote control operation of the TA-5B is described on a later page of this article.*



2. Terminate both outputs, J-3 and J-4 in 75 ohm loads.
3. Turn the PICTURE CLIPPER control counter-clockwise as far as possible.
4. Turn the SYNC LEVEL control to its maximum position.
5. Turn on power and adjust +B voltage to 280 volts.
6. Connect a calibrated oscilloscope to one of the output terminals.
7. Throw Switch S-1 to the LOW position.
8. Adjust the GAIN control to provide 1.5 volts, peak-to-peak of picture and blanking at the output as shown on the oscilloscope. If it is necessary to turn the GAIN control to a point within the first quarter of its range at the low end, then throw S1 to the HIGH position and readjust the GAIN control to give the proper output.
9. Turn the PICTURE CLIPPER control clockwise until the oscilloscope begins to indicate stretching of the signal in the black region, i.e. at the negative peak of the blanking pulses (see A in Figure 4). Then back off this adjustment until the sync pulses just begin to decrease in amplitude from the maximum. This assures that V-5 and V-6 operate only on the sync pulses and not on picture blacks.
10. Adjust the SYNC LEVEL control to provide whatever sync amplitude is required at the output. The maximum obtainable should be approximately 75% or 1.5 volts, as indicated in Figure 4.

OPERATING ADJUSTMENTS

Some readjustments of controls may be necessary to accommodate unusual operating conditions. Discussion of some possible situations follows:

Changes in Signal Level

It is obvious that the input signal level may change, especially when the source of the signal changes, as at a shift from one program to another. Thus, it may be necessary to readjust the GAIN control from time to time in order to keep the output constant.

Excessive Sync at Input

If the input sync amplitude exceeds approximately 33%, the grids of V-5 and V-6 may be driven into a region where they draw current. The operation of the clamp circuit is impaired by grid current, and therefore faulty operation of the amplifier will result. Turning the PICTURE CLIPPER control counter-clockwise until unevenness in the signal disappears is a legitimate way of correcting this situation. The adjustment should be restored to normal (as in 9 above) as soon as normal sync amplitude is available because, if it is not restored, the "stretching" range is curtailed for normal values of input sync.

Deficient Sync at Input

If the input sync amplitude is less than 18%, it may not be possible to obtain the full 75% of "stretched" sync at the output. Of course, if this full 75% is not required, then there is no need to be concerned. If it is required, it may be possible to compromise ideal conditions by turning the PICTURE CLIPPER control clockwise slightly and thus increase the sync output and at the same time stretch the picture blacks slightly. The latter effect is not desirable, but may be tolerated under otherwise adverse conditions. Of course, normal adjustments should be restored as soon as signal conditions permit. If input sync falls below 10% or the threshold of stable operation, the only recourse is to request more sync from the source.

OPERATION OF STABILIZING AMPLIFIER

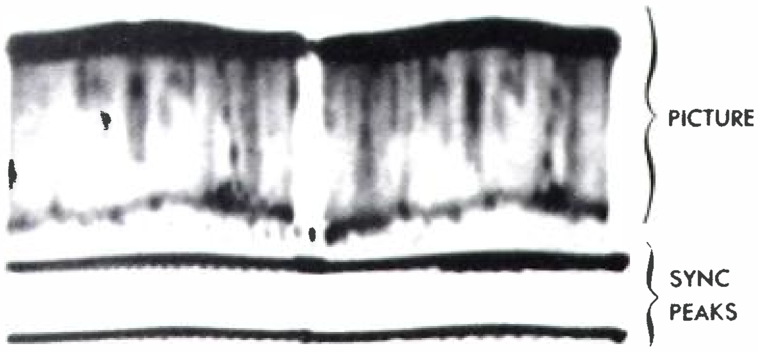


FIG. 9. *An oscillogram of a typical noise-free signal generated by a Monoscope camera. The sweep frequency is 30 cycles, therefore, the gap in the center is a vertical blanking interval.*

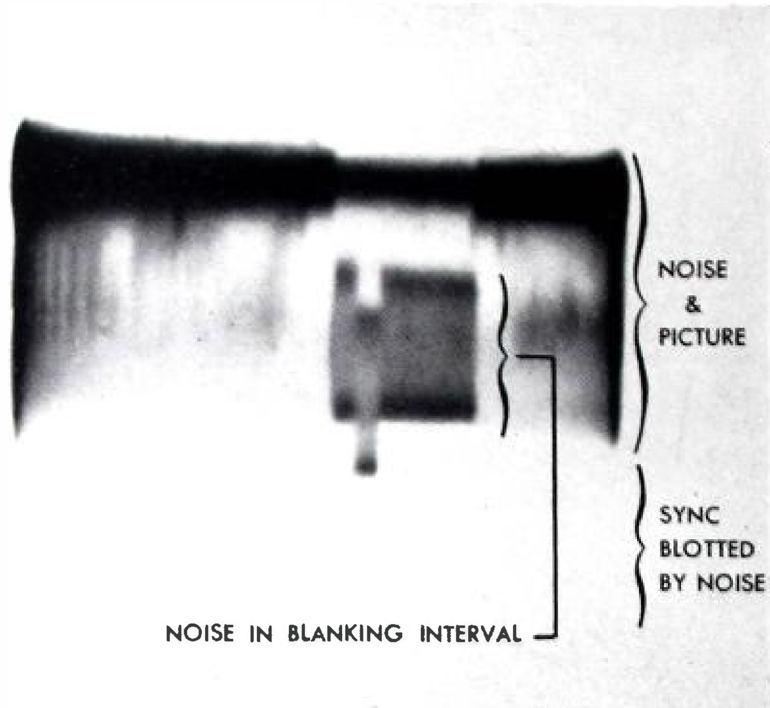


FIG. 10. *An oscillogram of the Monoscope signal adulterated with a high-frequency hiss signal. A 60-cycle sine wave sweep frequency was used in this case to magnify the vertical blanking interval and thus show to better advantage the effect of adding the hiss signal. As can be seen, the hiss has almost obliterated the horizontal sync pulses.*

Good operating practice should provide normal sync at the input, neither excessive nor deficient. This is a goal, among others, to be sought at all times. No operating crew should consciously produce defects in the picture signal which require correction by another crew in some other part of the system.

Degradation of Waveform

The Stabilizing Amplifier will not function properly if the "back porch" of the blanking pulse is seriously degraded in form. How much degradation can be tolerated is determined by the results. Slope or curvature of the "back porch" results in apparent change of black level, and hence of clamping level. When such degradation occurs, it will result in a change in the "stretching" (by V-5 and V-6) of the blacks in the signal, and also in a change in sync amplitude at the output. The only recourse under such conditions is to readjust both the PICTURE CLIPPER and SYNC LEVEL controls until normal results are obtained. If the degradation is so serious as to cause unstable operation of the amplifier, there is no obvious solution to the problem except to correct the trouble at its source.

TABULATION OF NORMAL OPERATING VOLTAGES

Type Signal	*Minimum Volts*	*% E*	*Maximum Volts*	*% E*
Composite Picture Input (J-2)	0.25		3.0	
Sync Amplitude-Composite Input		18		33
Separate Sync Input (J-5)	3.5		5.0	
Picture and Blanking Output	1.5*	75		
Sync Amplitude-Composite Output	0	0	1.5	75

* Variations of approx. ±10% from this value are not detrimental in most cases.

SPECIAL OPERATING CONDITIONS

In some applications it may seem desirable to use the Stabilizing Amplifier to control the signal level fed to a succeeding part of the system such as a transmitter. If this is the case, the GAIN control in the Amplifier *should not* be used to control the output level of the composite signal. There are two reasons for this. First, the GAIN control will affect only the picture and blanking portion of the signal over an appreciable range, and will leave the sync amplitude the same. It does not function as an output level control for the composite signal. Second, changing the GAIN control from its normal position upsets the normal operating levels within the amplifier and may result in unstable operation.

When it is desired to adjust the level of the composite output signal, a simple modification of the amplifier may be made. This modification consists of shunting the output circuit (J-3) with a resistor. If a fixed change in level is desired, a fixed resistor may be used. If the level requires frequent adjustment, a 500 ohm carbon potentiometer may be connected as a rheostat across the output circuit. Either type of shunt must be connected at the terminal J-3, not at the far end of the output transmission line. The far end of this line must be terminated in 75 ohms to avoid reflections.

If this modification is made, the signal voltage across the output circuit is reduced in proportion to the total load resistance, and this fact must be taken into account in making initial adjustments of the controls. An alternative method of making initial adjustments is to measure the signal voltage across the monitor output (J-4) which may be loaded with 75 ohms instead of the lower value used on the main output. Then the tabulation given above may be used.

SHOWN BY SCOPE PICTURES

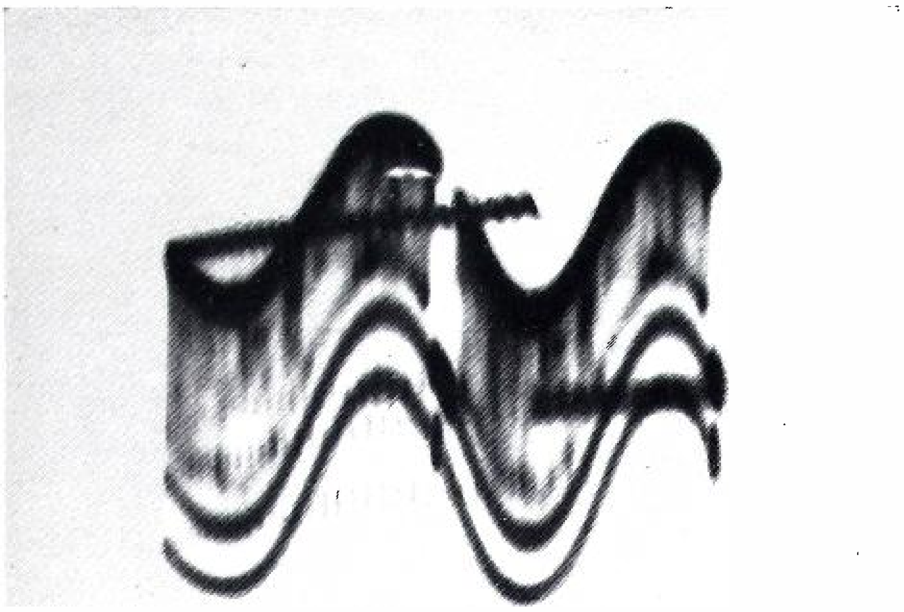


FIG. 11. *An oscillogram of the Monoscope signal after addition of 60-cycle hum. A 30-cycle sweep frequency was used in producing this oscillogram.*

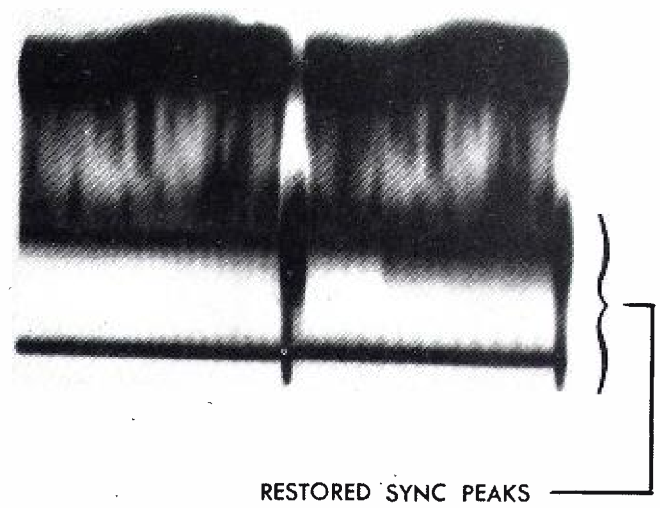


FIG. 12. *An oscillogram of the signal obtained from the TA-5B after feeding the composite signals of Figures 9, 10, and 11 into the Stabilizing Amplifier. Note the increase in both sync-picture ratio and signal-to-noise ratio in the sync. Also the hum has been completely eliminated. A 30-cycle sweep frequency was used here.*

REMOTE OPERATION

Inasmuch as the Stabilizing Amplifier is not usually mounted near to a picture monitor, it is often desirable to be able to adjust the operation of the amplifier from another location where the effect of the adjustments can be observed on a picture monitor and oscilloscope. In the TA-5B, circuits are provided for connecting remote controls to supplement the local controls for GAIN, PICTURE CLIPPER, and SYNC LEVEL. The remote controls are three 10,000 ohm carbon potentiometers connected as shown in Figure 6.

In any case where the remote controls are installed, initial adjustments of the TA-5B should be made with all of these remote controls turned to zero (counter clockwise). The procedure given in the paragraph on Initial Adjustments may then be followed. This assures that the amplifier itself is functioning properly. Then adjustment of the operating ranges of the remote controls may be accomplished as follows:

1. Turn the remote GAIN control to its mid-position.
2. Readjust the local GAIN control to provide the normal 1.5 volts of picture and blanking on a 75 ohm output.
3. Turn the remote SYNC LEVEL control to its maximum position.
4. Turn the remote PICTURE CLIPPER control to its mid-position.
5. Readjust the local PICTURE CLIPPER to a point where the sync pulses just begin to decrease in amplitude from the maximum.
6. Readjust the local SYNC LEVEL control to provide the maximum amount of sync, i.e. 1.5 volts across the 75 ohms.
7. Readjust the remote SYNC LEVEL control to provide the required amount of sync at the output.

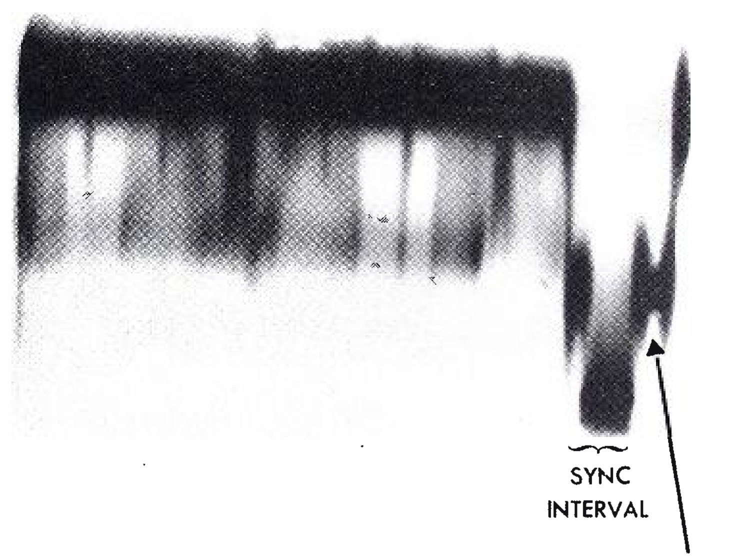


FIG. 13. *An oscillogram of the output signal shown in Figure 12 except that a saw-tooth sweep frequency of 15750 cycles was used. The horizontal blanking interval appears at the right. The notch in this interval is caused by the clamp circuit effecting a low-impedance path between grid and ground in the amplifier and thus suppressing the hiss signal.*

All three remote controls, when so adjusted, provide a reasonable range of control in both directions from the nominal values required. The remote GAIN control has limited range compared to the local control, but the range is sufficient to compensate normal fluctuations in signal level. In switching programs, it may be necessary to readjust the local GAIN control if the change in level is large.

WLOS

makes its debut in the wonderful land of the sky

by

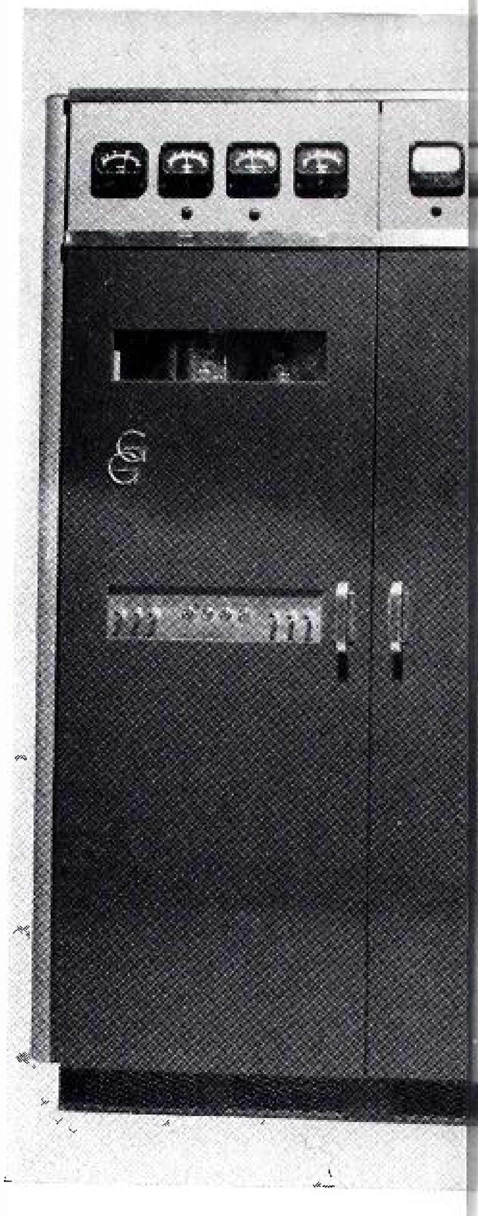
PALMER A. GREER

Director of Engineering

Radio Station WLOS and WLOS-FM

FIG. 1. (Right) *The WLOS 3 KW FM transmitter, RCA Type BTF-3B is flush mounted in the wall of the transmitter room, thus providing a convenient, neat-appearing arrangement.*

FIG. 2 (Extreme right) *The WLOS 5 KW AM transmitter, RCA Type BTA-5F, and the control console. At the right are three racks of test, monitoring and speech equipment. RCA phasing equipment (not visible in this view) is housed in a left wing extension cabinet.*



(Above) *Mr. Charles B. Britt, Vice President and General Manager, Skyway Broadcasting Corporation, WLOS and WLOS-FM.*

(Above) *Mr. Palmer A. Greer, Director of Engineering WLOS and WLOS-FM.*

The Skyway Broadcasting Corporation made application to the Federal Communications Commission in January 1946, for a radio station to be located in Asheville, N. C. On December 30, 1946, the application was granted for WLOS to operate on a frequency of 1380 kc with a power of 5,000 watts during the day and a power of 1,000 watts night, directional. In the meantime, application was made for an FM station and the construction permit was granted for WLOS-FM to operate on a frequency of 104.3 mc with a radiated power of 8,800 watts.

Our studio space, which was leased from the Battery Park Hotel, is located in the southeast corner of the hotel on the street level and consists of approximately 3,000 square feet of floor space. Plans were completed for the remodeling of this space and turned over to the contractor on February 15, 1947. Alterations (completed May 1, 1947) provided for 3 studios, 3 control rooms, reception room, 5 private offices and 1 general office, newsroom, record storage and shop.

The transmitter site was leased and plans were made for the building. A complete survey of the transmitter site and contours was completed April 1, 1947, and the plans were turned over to the contractor on April 2, 1947. Construction was started April 7, 1947, and the building completed June 1, 1947. It should be noted that a survey including contours was necessary, since the terrain surrounding Asheville is very mountainous and the problem of securing a site, which is reasonably flat, is almost an impossibility. In our case it was necessary to move approximately 7,250 cubic yards of soil in order to level the site sufficiently for the antenna and ground system. The building was completed after the equipment was in place. The transmitter building is of concrete block construction with stucco. This building has an operating room, shop, utility room, and toilet facilities. A sketch of the floor plan is shown in Figure 3.

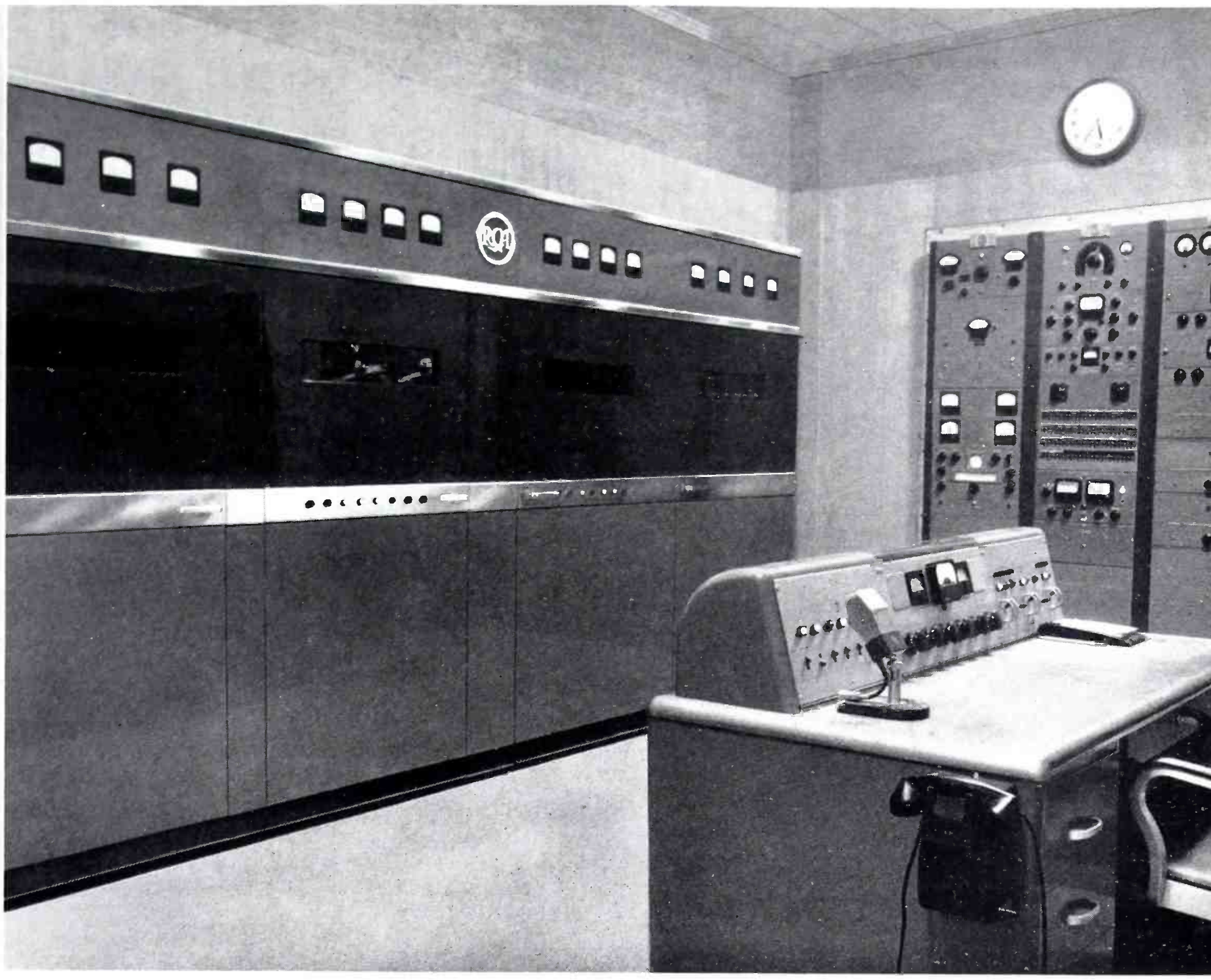
AM AND FM TRANSMITTERS

The WLOS AM transmitter is an RCA BTA-5F and the WLOS FM transmitter is an RCA BTF-3B (see Figures 1 and 2 above). The master control desk for the transmitters faces the AM transmitter and phasing equipment. To the left is the FM transmitter, to the right are located 3 racks of test, monitoring and speech equipment.

The operator has complete access to all units and can see all equipment from the control desk, none is hidden. All equipment is set in the wall and there are at least 6 feet of FREE WORKING SPACE provided behind each unit. The installation was not planned with an eye to beauty only, but rather the prime consideration of all our planning was to make the installation WORKABLE and SERVICEABLE.

Proceeding with the idea that adequate test and monitoring equipment is a MUST, we secured the following: RCA WM-43A Modulation Monitor, RCA WF-48A Frequency Monitor, RCA WM-30A Phase Monitor, RCA 69-C Noise and Distortion Meter, RCA 68-B Audio Oscillator, RCA 89-C Attenuator Panel, Gr. 916-A RF Bridge, RF Oscillator, Detector for Bridge, Field Intensity Meter, and a Vacuum Tube Voltmeter.

The installation of transmitters was started immediately after receipt of the equipment on May 13, 1947. Power facilities furnished by the local power company were completed June 13,

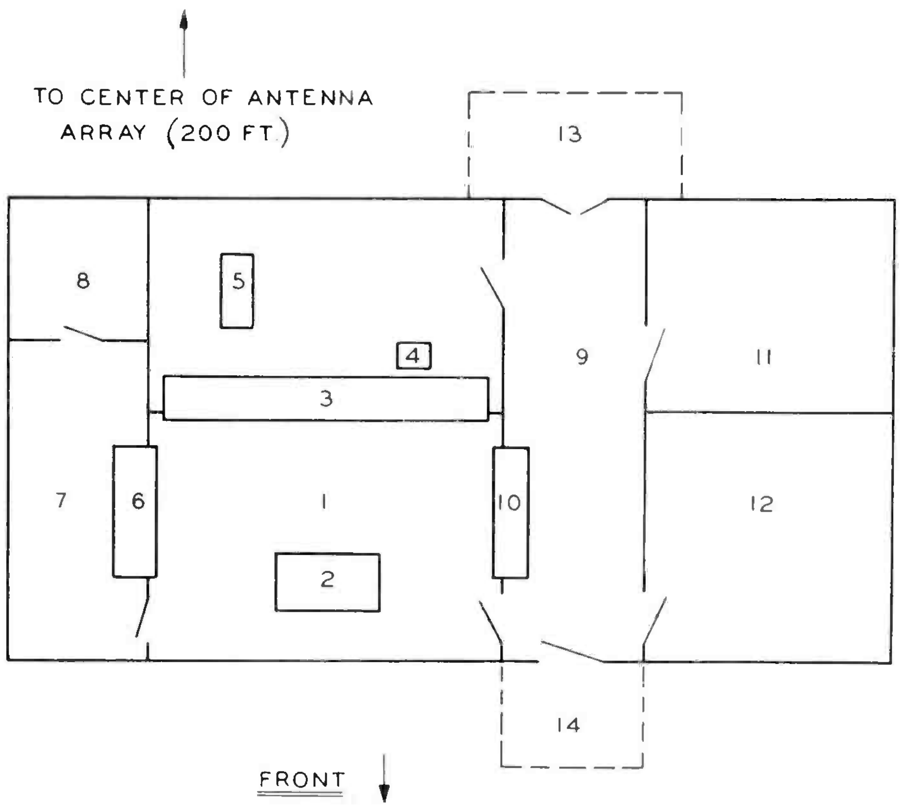


and power was applied for the first time June 14. Tune-up and testing into a dummy antenna was completed within 5 days, and the first test broadcast was made June 21, 1947 for the initial frequency test. (Results: plus 4 cycles! Monitor reading: plus 2!) Tune-up of the directional antenna was started immediately. There is very little that can be said about installation and tune-up of the BTF-3B FM transmitter. We just put it in the space provided, bolted it together, connected the wiring harness, turned it on, tuned it and there it was. There it is today—just as simple as that.

Audio line response tests indicate that the program circuit for the AM transmitter is flat within 0.3 (three-tenths) of one db from 50 to 10,000 cycles; while the program circuit for the FM transmitter is flat within 0.2 (two-tenths) of one db from 50 to 17,000 cycles. The noise level of both circuits is 65 db below program level (8 vu).

ANTENNA AND GROUND SYSTEM

The antenna system utilizes four Truscon, self-supporting towers, each 182 feet in height. The towers, which were received on May 14, were erected by the Frederick Tower and Erection Co. within a period of about 10 working days. The ground system consists of 45-foot square ground screens underneath each tower. There are 147 radials, 240 feet in length, of bare #10 copper wire for each tower and at the overlap point the radials are joined by a four-inch copper strap. As may be seen in the sketch of Figure 5, a four-inch copper strap is also used to connect each of the 4 towers running the full length of the array, and to connect between each tower and the transmitter building. All joints in the ground system were brazed instead of soldered. The tower nearest town (#1) is used for the daytime



1 - OPERATING ROOM
2 - CONTROL DESK
3 - BTA-5F TRANSMITTER
4 - MODULATION TRANSFORMER
5 - POWER TRANSMITTER
6 - BTF-3B TRANSMITTER
7 - HALLWAY
8 - WASH ROOM
9 - HALLWAY
10 - SPEECH EQUIPMENT
11 - UTILITY ROOM
12 - SHOP
13 - LOADING RAMP
14 - PORCH

FIG 3. *Floor Plan diagram of WLOS and WLOS-FM. The control console for the AM and FM transmitters is located so that the operator has full vision of and access to all equipment required for normal operation.*

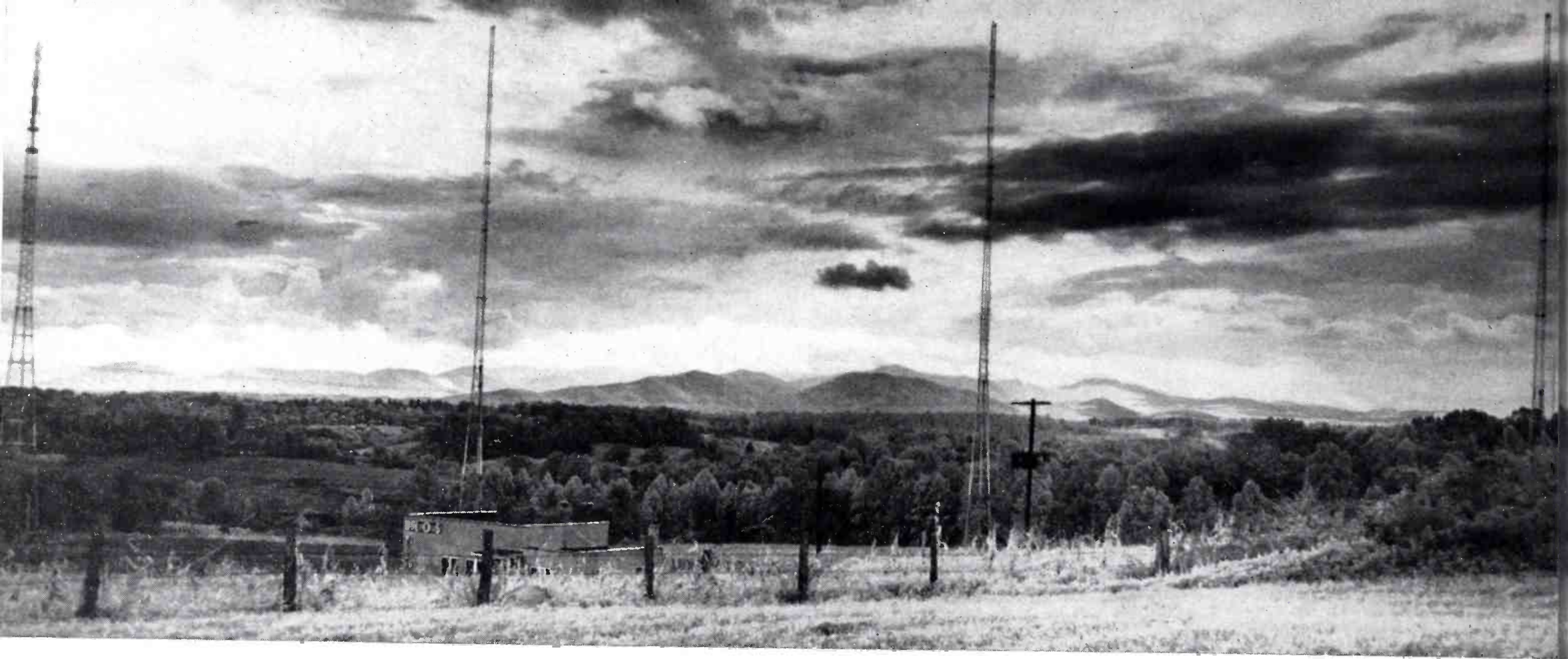


FIG. 4. *WLOS Antenna Array with Mount Pisgah and Smokies in the background. (FM antenna is at extreme left.)*

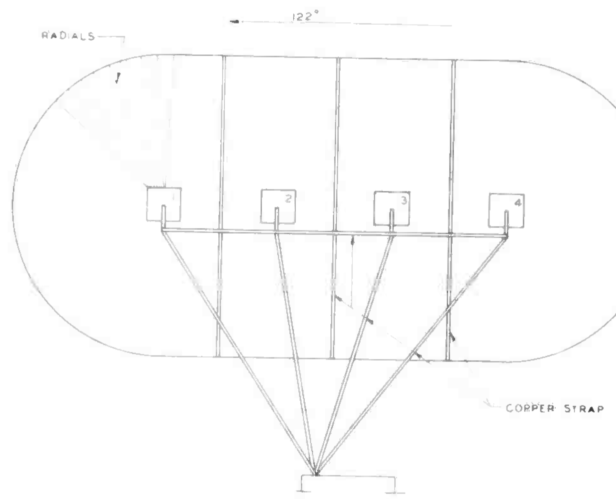
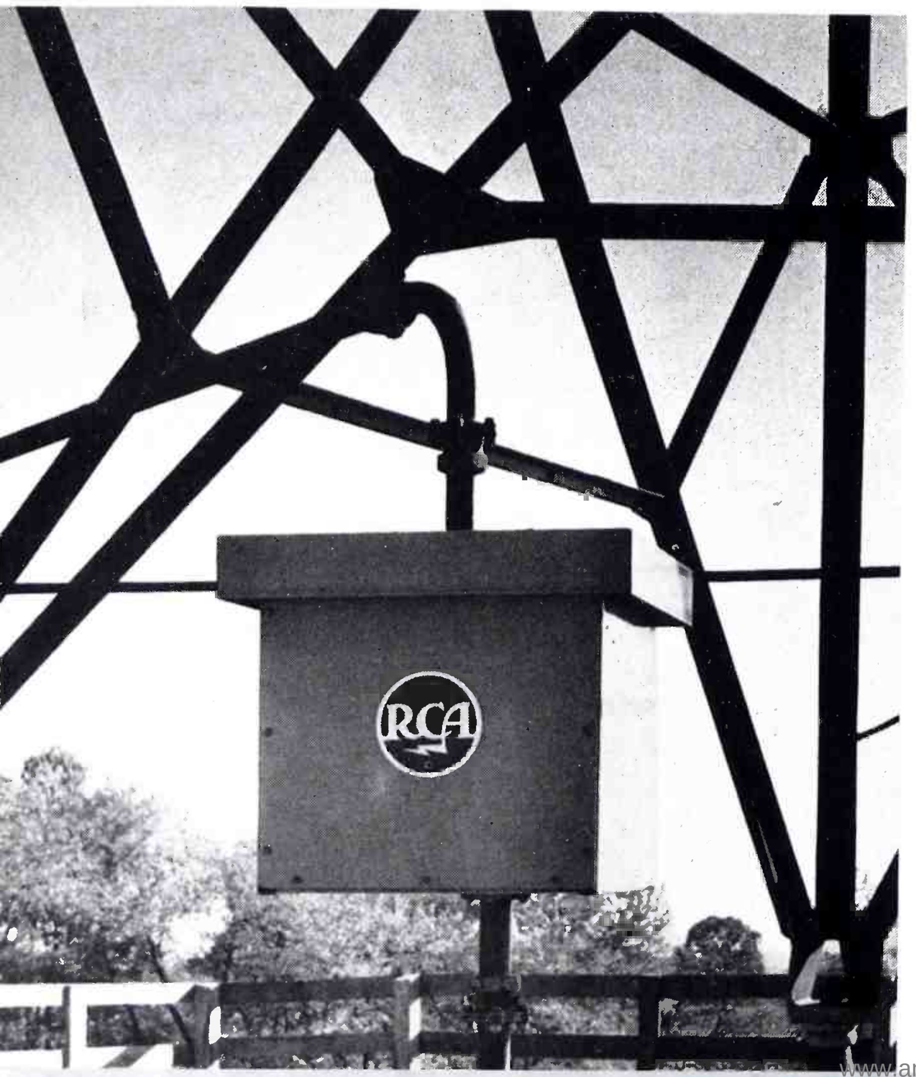


FIG. 5. (Above) *Sketch showing approximate layout of antenna and ground system of WLOS and WLOS-FM.*

FIG. 6. (Below) *The RCA BAF-4A FM/AM isolation unit, connected across the base of the #1 tower which supports the RCA super turnstile FM antenna.*



and also supports the FM antenna (an RCA BF--3B Superturnstile, 3 bay). Isolation is provided by the RCA BAF-4A AM/FM Isolation Unit shown in Figure 6. Duplicate transmission lines are provided for each tower and we used Communication Products Co. Seal-o-Flange, ⅞" 51-ohm line for AM and 1⅝" 51-ohm line for FM.

CONTROL ROOMS AND STUDIOS

As mentioned before, each of the three studios has its own control room. It was felt that only by doing this could we provide proper service, since single control installations are severely handicapped so far as proper operation and service are concerned. Each of our studios has 4 microphone outlets, and two utility outlets. Each control room has an RCA 76-B2 Consolette, mounted in a specially-designed desk with an inclined mounting (see Figure 9), which makes operation and service easy and provides a maximum of vision into the studio. All studio microphones are RCA 44-BX, senior velocity. Control Room #1 (shown in Figure 8) is equipped with two RCA 70-C1 Turntables, while Control Room #2 (not shown here) is equipped with two recorders and playback machines.

Control Room #3 (illustrated in Figure 7) is equipped with two RCA 70-C1 Turntables and, in addition there are three RCA 9-AX Racks which house 20 rows of jacks, 2 RCA MI-4162A Line Equalizers, 2 RCA BA-4C Monitor Amplifiers, 2 RCA BA-3B Utility Program Amplifiers, 3 RCA BA-1A Booster Amplifiers, 1 RCA BX-1B Power Supply, 1 RCA MI-4917A Sound-effects Filter, 1 RCA MI-11251 VU Meter, 5 AM Tuners, 2 FM Tuners and a Relay Switching System. This relay system is composed of 18 relays which are operated from the "line" key on the consolette. This key in the right position connects the consolette with the transmitter line by means of a relay and, at the same time, interlocks the studio so that no other studio can feed the transmitter until the original operator releases. With the "line" key in the left position this operation is duplicated, except, in this case, it feeds the FM line and interlocks itself. Therefore, automatic switching is made possible for the AM or FM line. Network appears on the 5th position of all consolettes at all times. Position #6 is used for remotes and utility. The con-

FIG. 7. (Right) *Control Room #3, showing the RCA 76-B2 Consolette. turntables and the three cabinet racks which contain audio equipment, FM and AM tuners and a relay switching system.*

FIG. 8. (Right, center) *A partial view of Control Room #1 which is also equipped with two RCA turntables and a 76-B2 Consolette.*

FIG. 9. (Right, below) *Diagram of the WLOS desks designed, with inclined consolette mountings, to provide an unobstructed view into the studios.*

solettes were modified so that positions #3 and #4 accommodate both turntables and microphones. With either of the keys in the left position the turntables are connected. With the keys in the right position the studio microphones are connected. This increases the usefulness of the consolettes immeasurably.

Power supplies for the consolettes are mounted on the wall in the rear of the racks. Wiring between power supplies, racks and consolettes is run in an iron duct, 6″ x 6″, with removable top cover. This duct is connected to the microphone outlet boxes by means of short lengths of conduit.

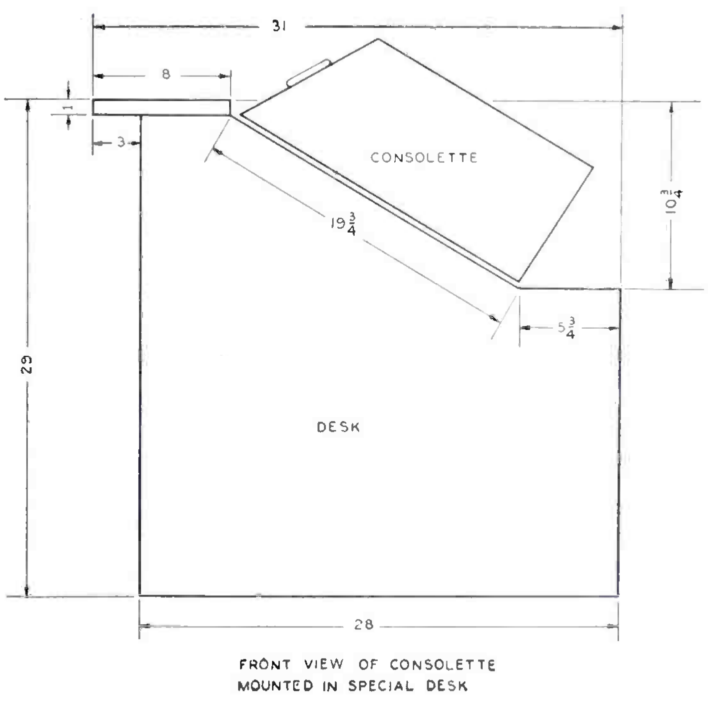
MONITORING SYSTEM AND REMOTE EQUIPMENT

Each of the offices is provided with a monitor amplifier and speaker. In a wall box, convenient to the desk of the individual who occupies the office, is mounted a selector switch, volume control and power switch. The selector switch provides monitoring facilities of 13 lines; 3 studios, 1 network, AM line, FM line, 5 AM tuners and 2 FM tuners. This provides complete monitoring of all our radio activities in the area—a must in a highly-competitive market.

In addition to the foregoing, remote broadcasts are handled with the following equipment: 3 sets of OP-6 and OP-7, 4 microphones (88A), 2 junior velocity microphones and 1 battery box RCA MI-11214 for use with the OP-6 and 7.

SUMMARY

The Engineering Department of WLOS and WLOS-FM is manned by 11 persons, which we feel is the minimum with which we can operate effectively. WLOS and WLOS-FM, which started to grow February 15, 1947, came of age and began regular operation at 11:00 A.M., August 11, 1947, just 5 months and 27 days after the first plans were turned over to the contractor. Numerous delays were encountered during construction which we feel lengthened the time required by at least a month, but we are, nevertheless, proud of the fact that we accomplished a big job in a relatively short time. And, by the way, if you haven't already guessed, it's "RCA All the Way" for WLOS and **WLOS-FM.**



FRONT VIEW OF CONSOLETTE
MOUNTED IN SPECIAL DESK

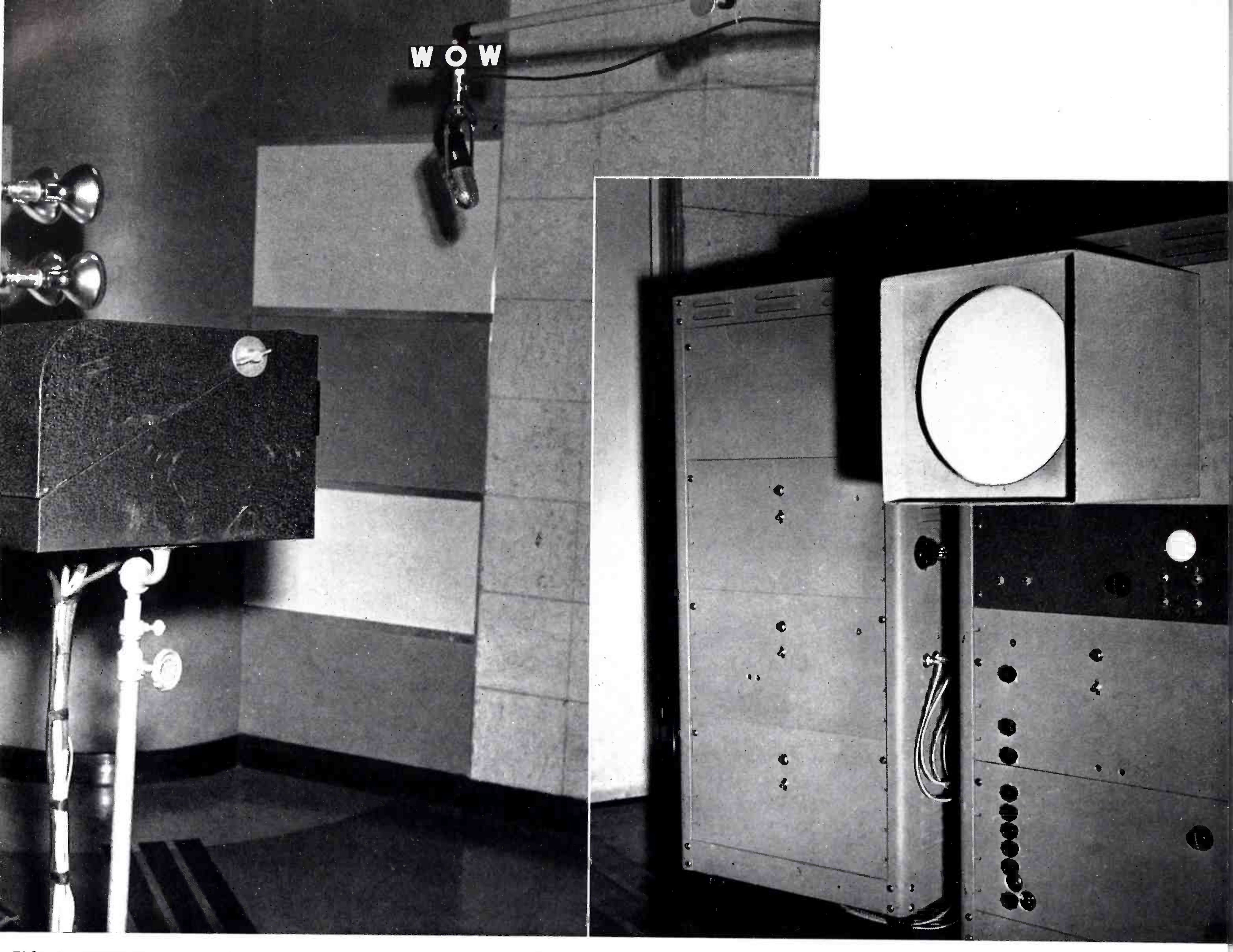


FIG. 1. *WOW began its television program several years ago with equipment built by the staff. At left above is shown the iconoscope camera and, at right, the camera control and monitor units built by the WOW engineering staff.*

TRAINING A TELEVISION STAFF

by JOE HEROLD
Technical Supervisor, Radio Station WOW
Omaha, Nebraska

On December 26, 1947, Radio Station WOW, Inc., filed an application with the FCC for a commercial television station construction permit. This date also marked the end of a year of intensive program experimentation in preparation for actual television broadcast programming. The date also closed a two-year period of technical training and research in television.

In reviewing our experiences of the past two years, we realize that our efforts will result in superior production, operation and programming when our proposed television station goes on the air. It is our belief that actual experience, such as we have had, is vital to the proper operation of a television station. With the thought in mind that some of our experiences will benefit other prospective television broadcasters, we will outline the program as it was developed at WOW.

Advanced technical training in television began with the construction of a complete iconoscope camera chain by the engineering department. This unit was used in connection with weekly instruction periods for the engineers. Test equipment was purchased or constructed during this period, to align and demonstrate functions of the various circuits in the camera chain. The course of study was under the direction of W. J. Kotera, Chief Engineer of Radio Station WOW. Members of the engineering department showed great enthusiasm for the project and progressed so rapidly that it was considered advisable to purchase standard commercial television equipment to train the engineering department under actual pickup conditions, and to begin a period of program training and research.

To facilitate this program a contract was entered into with the Radio Corporation of America, for two TK-30 cameras and associated equipment. The cameras were delivered during December, 1946, and have been in use since that time.

A television program and production department was established. Russ Baker, well known radio announcer and producer,

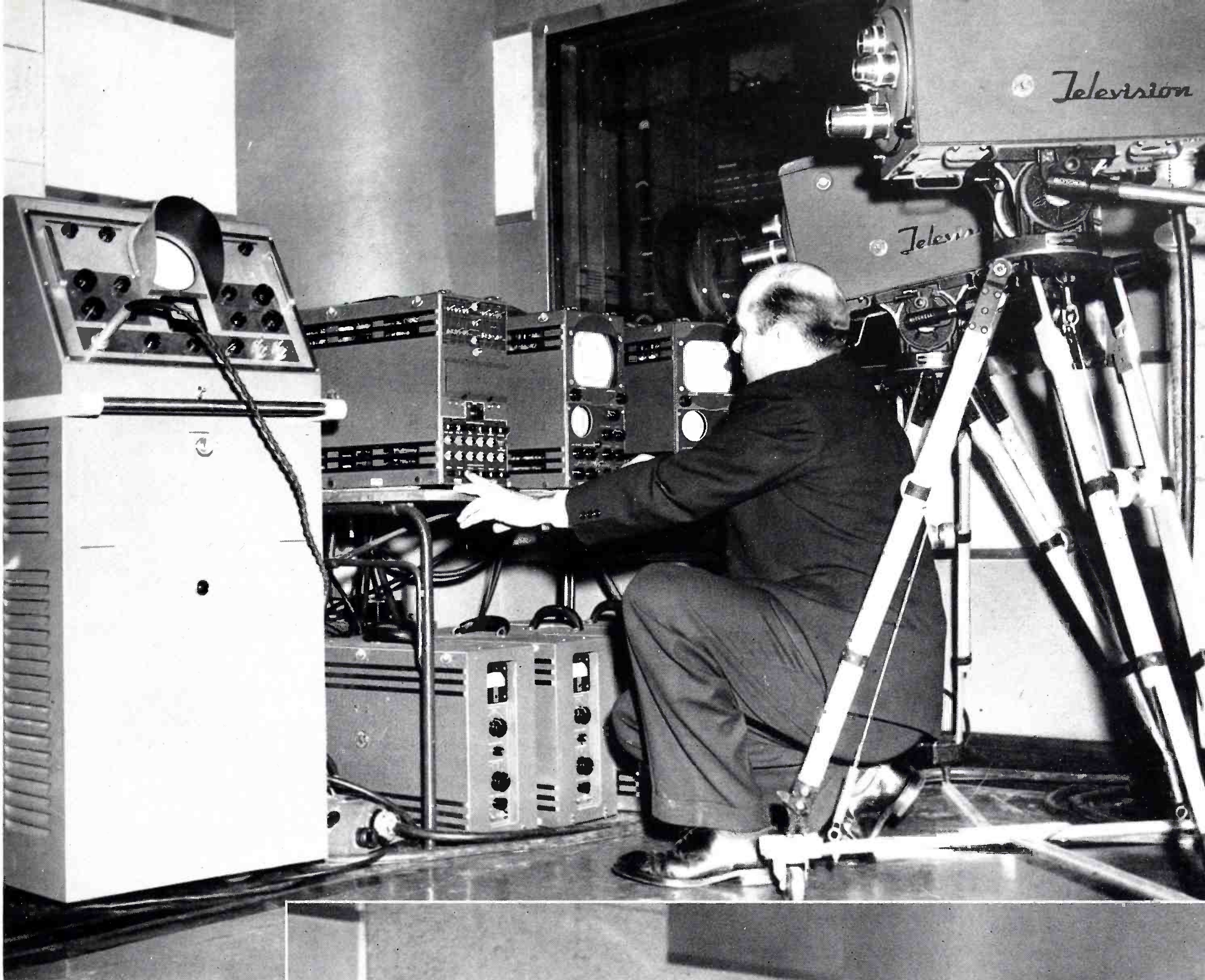


FIG. 2. (above) *In December 1946, WOW purchased the two RCA Image-Orthicon Camera Chains shown above in the WOW studio. Unit at left is an RCA 715-B Oscilloscope which is especially designed for television testing.*

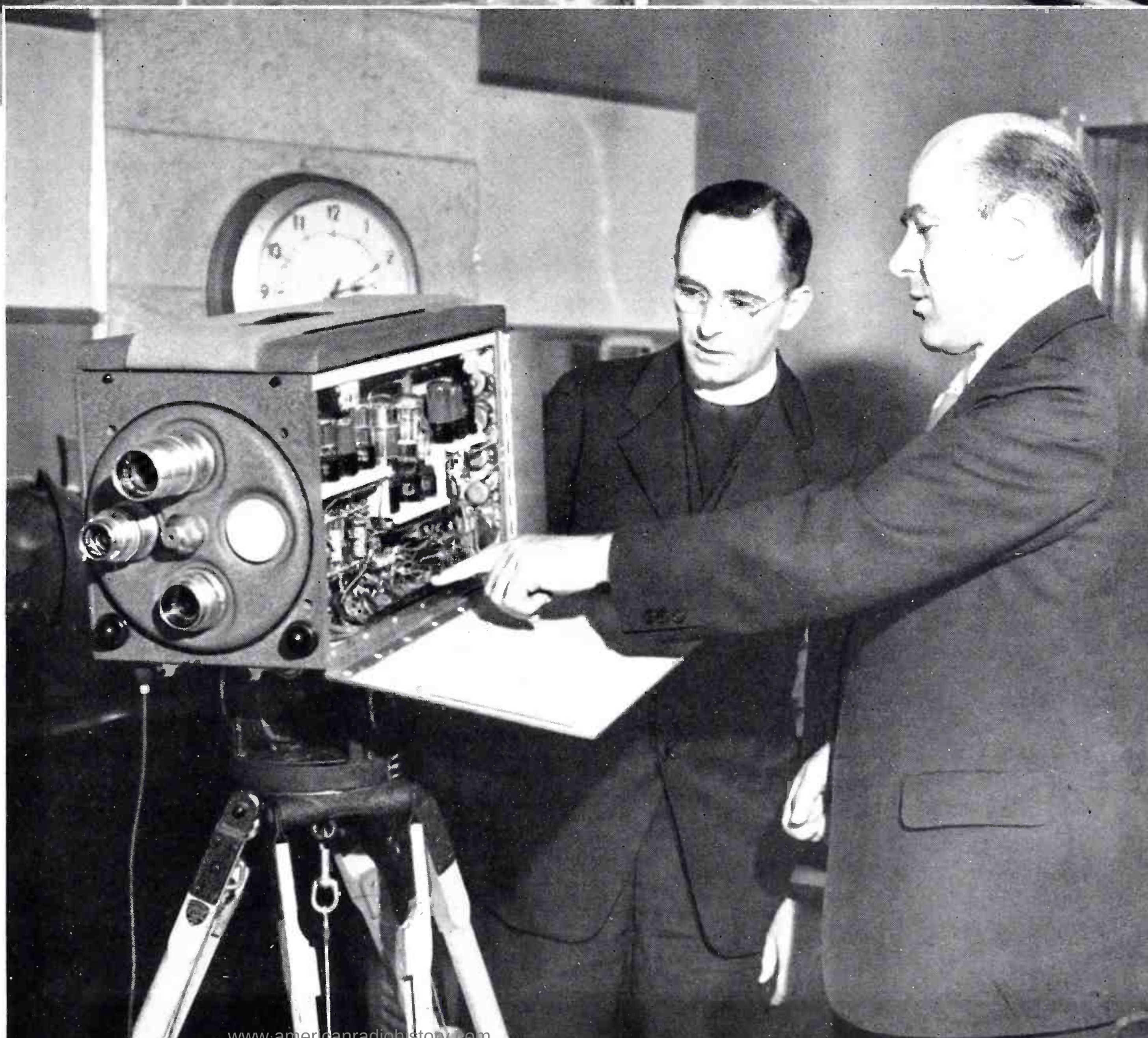


FIG. 3. (right) *An important part of WOW's television program is a contract with Creighton University of Omaha for cooperation and collaboration on television training. In this picture Jos. Herald, Technical Supervisor, is explaining RCA TK-30A to Father R. S. Williams, S.J., Coordinator of Television for Creighton University.*

heads this department. The selection was particularly fortunate, since Mr. Baker's theatrical background, together with his radio experience proved the ideal combination for television direction, production and programming.

A contract was entered into with Creighton University, of Omaha, for the purpose of collaboration and cooperation in experiments in television and training of the proposed television station staff. Under terms of the contract, the university provided space in the Creighton Auditorium, and cooperated in experimental televising of all athletic activities, drama, experiments in education by television, and other activities of the university. This association with Creighton has proved to be very advantageous, since it has provided space for storage of our television equipment, an auditorium for audience research, and has given us free access to a great amount of program material. Students and faculty have been most helpful as a source of talent and program ideas.

Through the arrangement with Creighton, the WOW staff has televised basketball, football, track events, baseball, wrestling, boxing, drama, and the numerous other activities of a large university. A number of experiments have been conducted and demonstrated in cooperation with the Creighton faculty and students, in connection with surgery, bacterology, teaching of drawing, languages, etc. A notable experiment and demonstration was the televising of an operation for removal of a stomach cancer. This was demonstrated to an audience of over two hundred doctors and nurses. Projection of images of live bacteria through the television system has also been successful.

In addition, the WOW staff has televised at points removed from the university, hockey, parades, the Ak-Sar-Ben Coronation, the annual 4-H Livestock Show, horse races, University of Nebraska football, track meets, etc.

The entire cast of a television dramatic production, "The Game of Chess," traveled to St. Louis, where the play was presented over KSD-TV as a salute on the opening of their new television station.

Thousands of people have witnessed the closed circuit demonstrations conducted by the WOW staff. Questionnaires are distributed to the guests, on which they are requested to indicate their program preferences, impressions of the demonstrations, hours best suited for various types of television programming, preferences of size and brightness of receiving screens, and other pertinent data.

The equipment and televising of various events were exhibited at the Omaha Electrical Exposition, on November 3-8, 1947, where an estimated 60,000 people indicated great interest in the demonstrations.

Since our staff was not under the terrific pressure of programming for immediate broadcast, we have been able to take time to develop ideas and production techniques to our satisfaction, and then to check our results through the questionnaires distributed at the closed circuit demonstrations. During our year of experimentation we have investigated every possible source of program material within a 50 mile radius of Omaha. We have made arrangements to pick up these events by means of high-frequency-beamed relay transmitters. We have carefully logged the results of our experiments for future reference. We have experimented with various camera locations at local events, to determine best possible pickup. Our engineering department has developed new lighting methods, camera lens, tilting machines, mike booms and production aids of all kinds as the occasion demanded.

FIG. 4. (above and right) *WOW's equipment as set up for telecasting Creighton U. basketball games. On the cameras are Louis DeBoer and Dick Peck. Below, at the control position, are Russ Baker, production manager; Bill Kotera, Al Maller and Larry Sibilia, engineers; and Tom Dailey, announcer.*

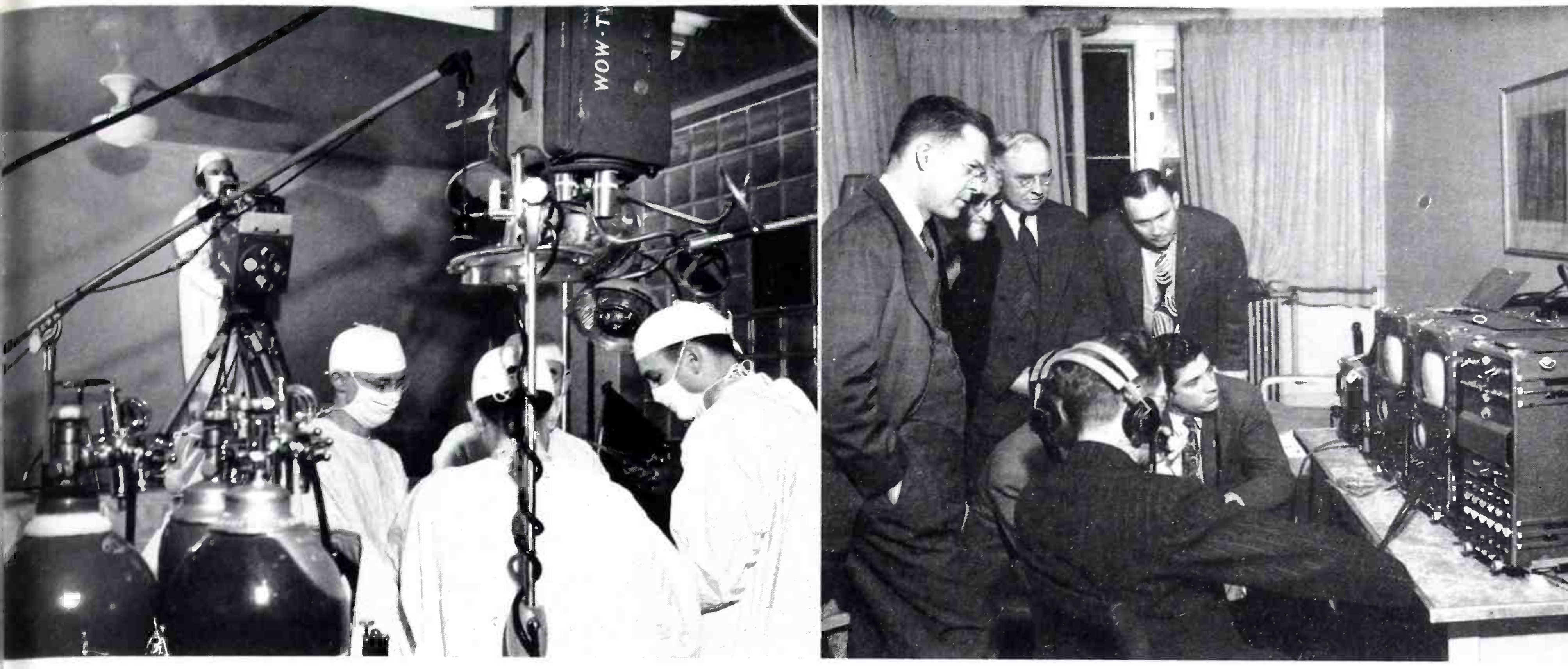


FIG. 5. *One of WOW's most notable demonstrations was the televising of an operation. View at left above shows WOW's cameras set up in the operating room. At right surgeons watch the program of the operation on WOW's camera monitors.*

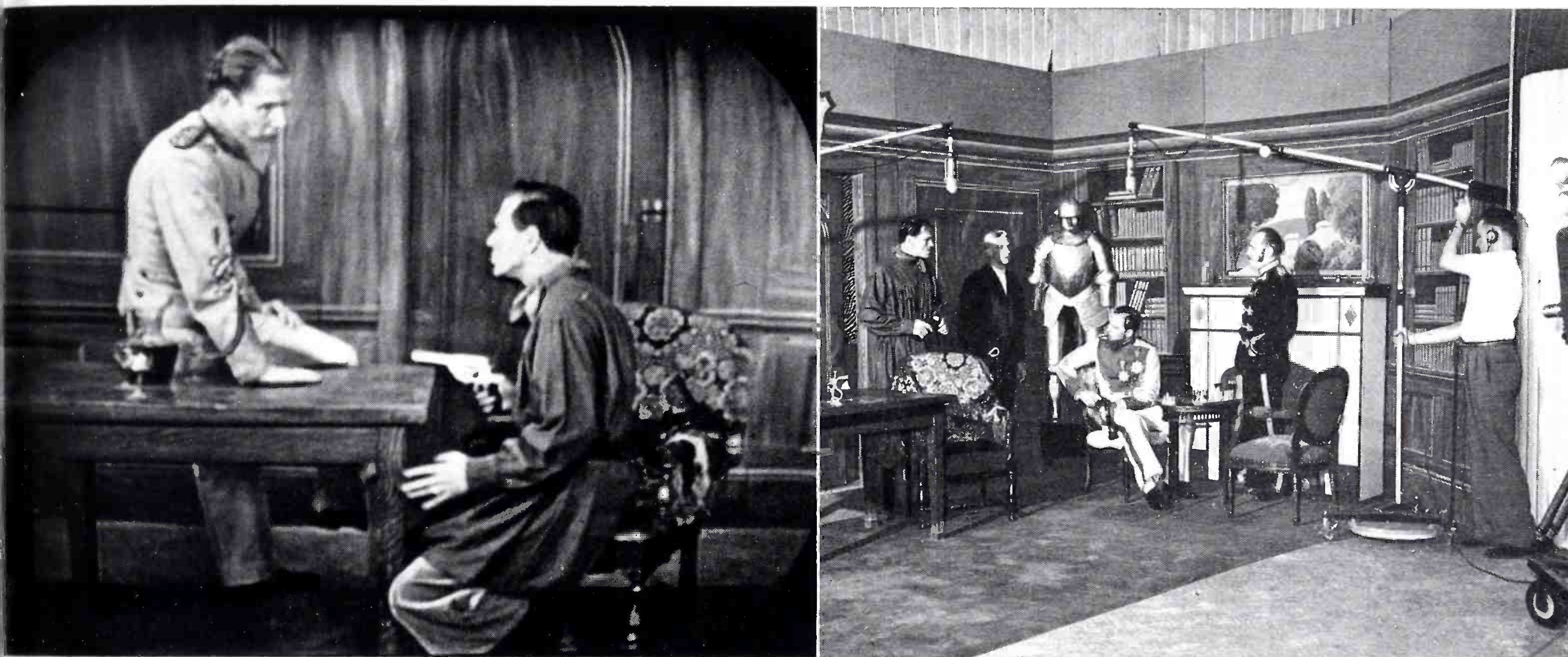


FIG. 6. *WOW experimental programs have included a number of dramatic productions. One of these, "The Game of Chess," was taken to St. Louis where it was presented over KSD-TV. Picture at left is a photo direct from the monitor screen.*

With the filing of application for commercial television station construction permit, activities in connection with television training were accelerated. 16mm film cameras have been purchased, with which we will compile a backlog of film events for future use. This will include special events, historical events, and all sorts of special films for background effects, etc.

All of this will assure a staff well qualified, through actual experience in all phases of television broadcasting, to provide an experienced, competent program service to the people of this area.

Radio Station WOW is now in the final phase of its staff training program, directed to advertising agency representatives, department store personnel and representatives of other interests, and including instruction in the capabilities and limitations of the television system and the proper techniques for production of television commercials and programs.

A series of weekly lectures and demonstrations on television techniques is underway for a group of over 150. The demonstrations include script writing for television, staging, special effects, costuming, production, direction and lighting. After the series of general meetings, the staff of WOW will cooperate with individuals in developing ideas for television programs and commercials, and will assist in the demonstration of the results, by closed circuit television, to interested clients or prospective sponsors.

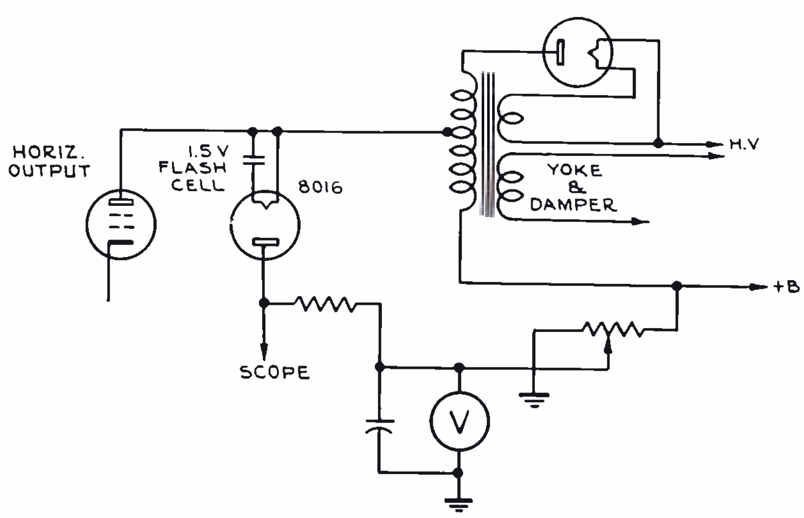
The training program will be concluded by June 1, 1948. WOW's staff will then begin installation of television equipment under the construction permit granted by the FCC on February 2, 1948. It is expected that WOW will begin regular television programming by October 1, 1948.

Note On Means of Measurement of Output Plate A. C. Voltage of a Television Deflection Circuit During Scanning Interval

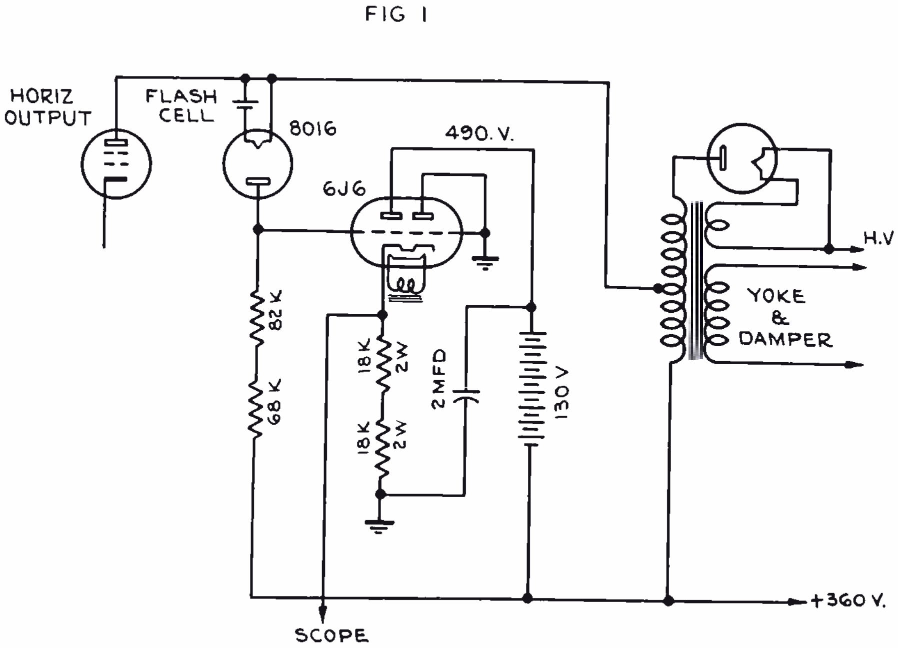
by J. M. BRUMBAUGH
Television Terminal Equipment Section
Engineering Products Department

In the design or adjustment of horizontal output and high voltage transformers and circuits for television, it is often desired to look at, and make measurements on the scanning portion of the subject voltage waveform. Determination of dissipation in the output tube, or of proper loading of this tube, requires such measurements. These are difficult because of the large transient pulses (both positive and negative) which occur during fly-back. If these do not arc over the 'scope input terminals, they cause overloading and blocking in the 'scope long before the gain can be increased sufficiently to make measurements on the part of the waveform which is of interest. Moreover, there is always difficulty in obtaining a reliable d-c reference point on the waveforms.

A capacity-corrected voltage divider across the transformer primary, though difficult to compensate properly, solves the voltage breakdown problem; but the relatively large and unwanted transients and the d-c reference problem still remain, and the loading of the divider is likely to change the operating conditions.



POSITIVE PULSE CLIPPER
FIG I



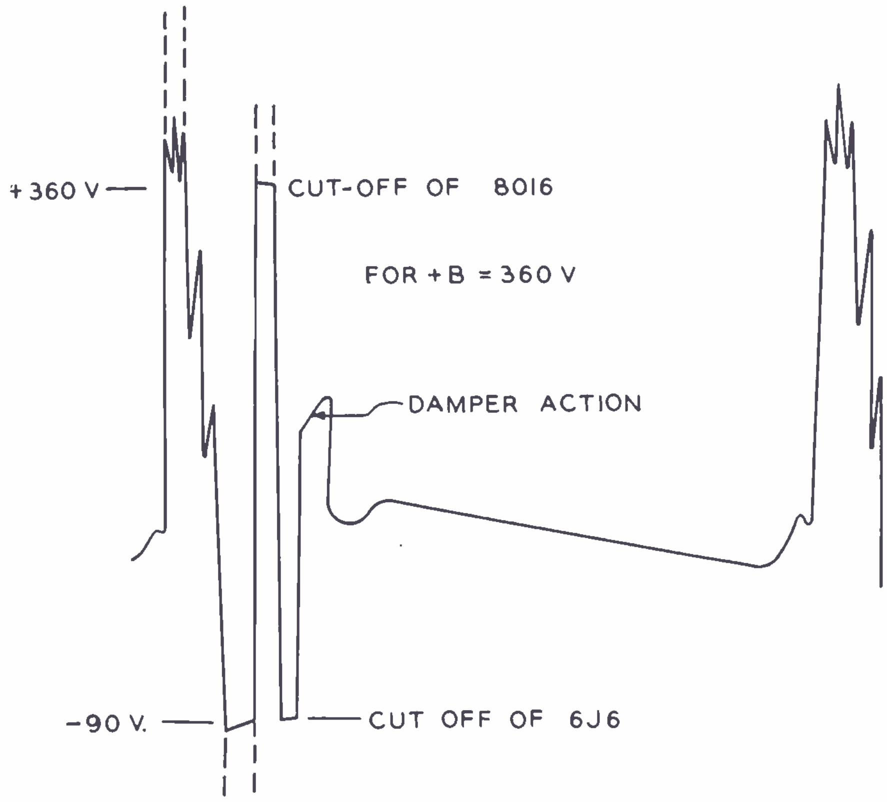
FINAL TEST CIRCUIT
FIG. 2

About a year ago the writer used the circuit of Figure 1 to remove the high-voltage positive pulse by means of an 8016 diode, believing that the negative swing (usually about 20% of the positive pulse) would be cut off by the input stage of the 'scope and cause no trouble. However, on some 'scopes at least, swing beyond cut-off on the input stage causes some undesirable blocking in later stages. Another difficulty arose in making the discharge time-constant of the diode circuit (including 'scope capacity) fast enough to follow the return on the negative transient. Some fairly good data were obtained, however, by using the diode cut-off point as the d-c reference.

The need was apparent for cut-off type transient clippers on both polarities with fast action and return times on both clippers. A more definite d-c reference level was also desirable. Some work was done on a circuit of the type of Figure 2, but this was never completed until recently. As in Figure 1, the 8016 removes the positive peaks which are greater than the output B supply voltage. The low input capacity of the 6J6 cathode follower provides the required fast time constants, and, if the attenuating input cable of the Type 715 'scope is used to observe the output on the cathode, it does not overload the cathode circuit. The 6J6 cuts off at about —20 volts on the grid (bringing the cathode to 0. volts), thus practically eliminating negative swings from the cathode output. The diode section of the 6J6 prevents the cathode from being driven appreciably below zero potential by capacity feed-through or other effects from the large negative swings below —20 volts on the grid. It was feared that these surges (about —1000 volts in the circuit used) might harm the 6J6, but several tubes tried did not break down.

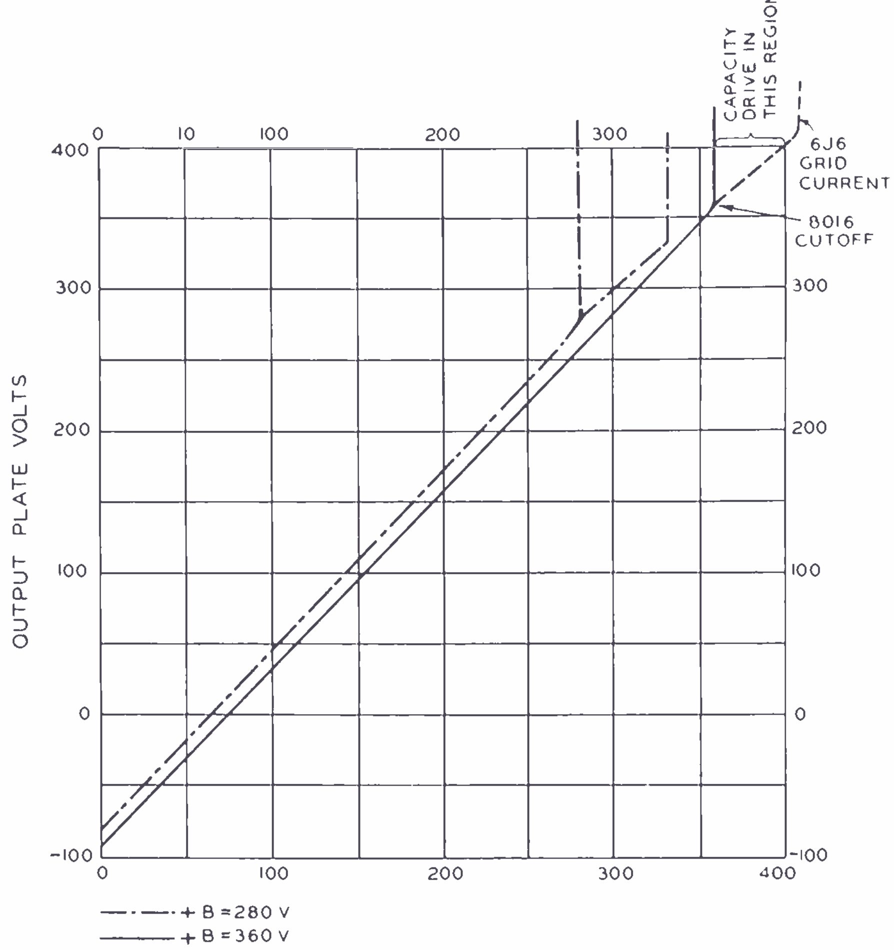
As shown in the typical waveform of Figure 3, this limiting action at the 6J6 cathode provides a definite *reference voltage* on the output waveform (with a slight negative over-shoot, as shown, permitted by imperfect limiting). From this reference one can measure the plate voltage at various points on the waveform during the scanning interval, using the normal 'scope calibration procedure. As shown, this reference of —90 volts, for 360 volt supply, takes into account the loss in the 6J6 (grid at —20 and cathode at 0) and the drop of 70 volts in the 8016, and corresponds to zero volts on the 6J6 cathode and —20 volts on its grid.

The additional B supply for the 6J6 must be of sufficient voltage to prevent hitting zero bias before the 8016 cuts off on a positive swing of the driver plate. To determine its value, draw the 6J6 load line (cathode resistance) on its plate family of curves, starting from the driver supply voltage and zero current. From the zero-plate-voltage point on this load line, draw



TYPICAL WAVE FORM
FOR 360 V. SUPPLY

FIG. 3



VOLTS ABOVE CUT-OFF REFERENCE
ON SCOPE WAVE

FIG. 4 CALIBRATION CURVES

a horizontal line to the zero bias curve. This latter line represents the required additional 6J6 supply voltage, to which a 20% safety factor should be added. The actual load line, of course, starts from the combined B voltage, and the original choice of cathode resistance must be such as not to overload the 6J6 under this operating condition.

For the large positive pulses above cut-off of the 8016, there is appreciable capacity feed-thru of any high frequency transients which may be superposed on such pulses, and such transients will thus be shown attenuated on the 'scope during the positive pulses.

Where fairly accurate voltage data are required, as pointed out above, the loss in the 6J6 and the drop in the 8016 must be taken into account. For the circuit of Figure 2, the calibration curves of Figure 4 are computed from tube data, for several values of plate supply voltage.

(Right) — *NBC's Image Orthicon Cameras at the Radio City skating rink.*

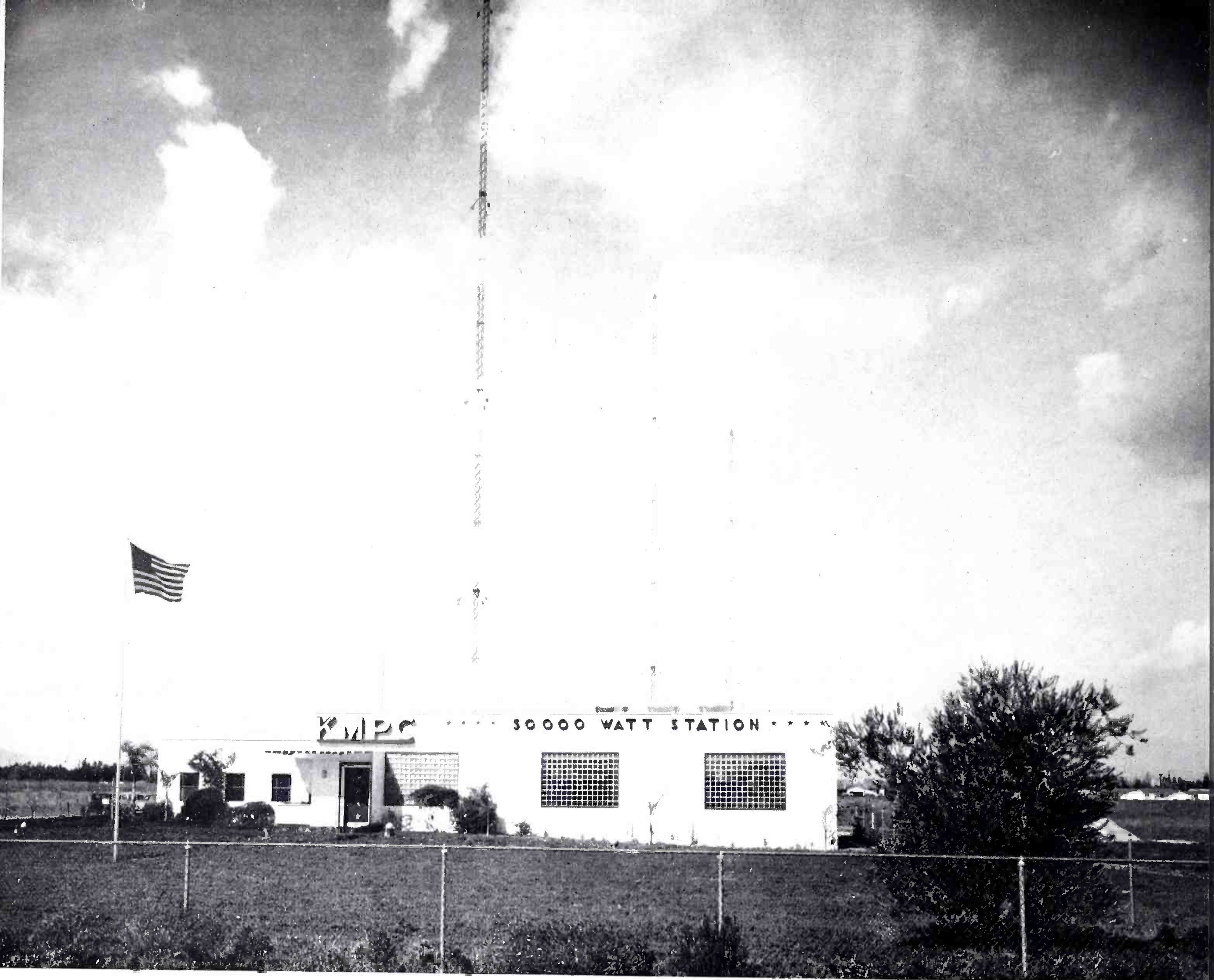


FIG. 1. *KMPC's beautiful transmitter building is located in the San Fernando Valley, 10 miles north of Hollywood. It houses the new RCA 50 KW transmitter, as well as the older RCA 10 KW transmitter now used as a standby.*

WGAR

CLEVELAND

KMPC

LOS ANGELES

INTERESTING DETAILS OF THE 50-F TRANSMITTER INSTALLATIONS AT THESE TWO RICHARDS' STATIONS, BOTH OF WHICH ARE NOW OPERATING WITH 50,000 WATTS

Two notable construction projects have been completed in the past year by the WGAR-WJR-KMPC Organization; the installation of a new RCA 50 KW transmitter at KMPC and the construction of a complete new 50 KW plant at WGAR, which included a building, an RCA 50 KW transmitter, and a 5-tower Directional Array.

Both WGAR and KMPC (as well as WJR, Detroit) are owned and operated by companies of which Mr. G. A. Richards is

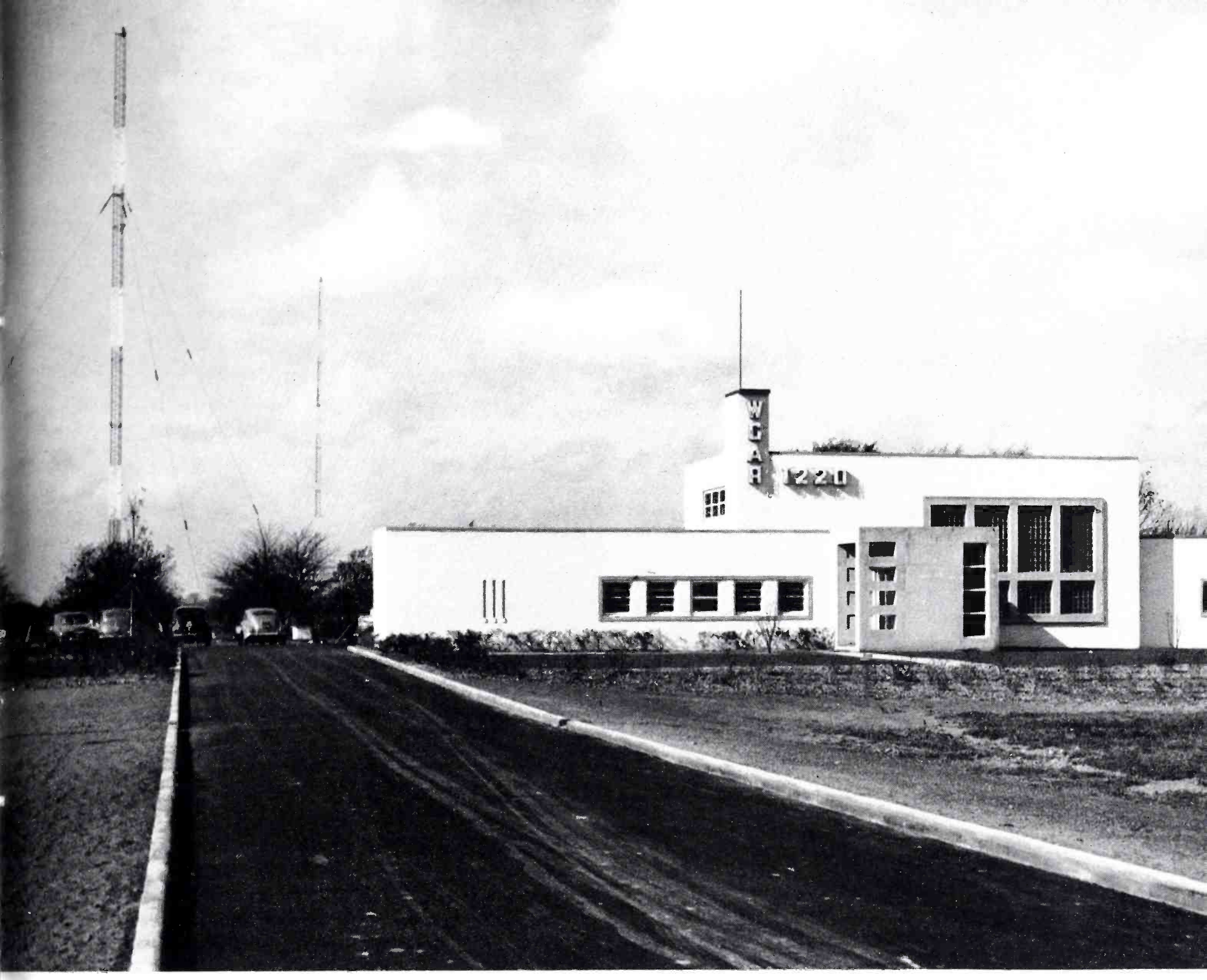


FIG. 2. *WGAR's new and modern plant is located thirteen miles south of Cleveland. Installed here is WGAR's new RCA 50 KW transmitter, the RCA 5 KW transmitter (for standby) and an RCA 3 KW FM transmitter.*

president and principal stockholder. Both stations started as 500-watters, grew through several power-step-ups, and went to 50,000 watts in 1947. And both are longtime users of RCA equipment. In fact, this is KMPC's fourth RCA transmitter, previous installations having been a 1 KW in 1932, a 5 KW in 1940, and a 10 KW in 1942. It is WGAR's second, their previous transmitter being an RCA 5-D installed in 1938. In both cases they have retained their lower-powered transmitters for standby use.

The WGAR and KMPC transmitter plants are as modern and up-to-date as any in the country. The 50-F Transmitter (BROADCAST NEWS No. 45, Pg. 8) is the finest and most efficient high-power transmitting equipment ever developed. At WGAR and KMPC the installation of this equipment was planned and carried out by a group of engineers whose experience includes not only the building of the several Richards stations, but also the installation of a number of high-power stations for the OWI during the war. This happy combination of deluxe equipment and deluxe engineering has resulted in installations which may well be the model for others to follow. With this in mind we have presented on the following pages a detailed description of these two stations with special emphasis on the constructional features which we believe will be of interest to all station engineers, particularly those planning new installations in the near future. However, before we proceed with these descriptions we would like to give credit to the men who planned these outstanding installations.

Mr. G. A. Richards, as noted above, is President and principal stockholder of Stations WGAR, WJR, and KMPC. Mr. John F. Patt is Vice President and General Manager of WGAR. Mr. Robert O. Reynolds is Vice President and General Manager of KMPC. Mr. Robert Morris Pierce, Vice President in Charge of Engineering of each of the above stations, was responsible for the overall supervision of both construction projects.

The WGAR building construction and equipment installation was supervised by Mr. Robert A. Fox, of the WGAR-WJR-KMPC General Engineering Department. Mr. William G. Hutton, of the same department, was generally responsible for the design of the array and phasing equipment, and he, together with Mr.

FIG. 3. *The WGAR transmitter room is rectangular in shape. The RCA Type BTA-50F 50 KW transmitter forms one of the long sides of the room while the other long side is of glass brick. The operating console is in the center of the room facing the 50 KW transmitter. Clock and ventilating louvres are located in the drop wall above the transmitter.*

Donald R. McCollister, WGAR Transmitter Supervisor, were generally responsible for the adjustment of the array and the preparation of the proof-of-performance.

The construction and installation of the new 50 KW KMPC plant was supervised by Mr. Lloyd Sigmon, Chief Engineer. Mr. Pierce was responsible for the design of the directional array and Mr. G. F. Leydorf, Chief Engineer of WJR, Detroit, assisted with the adjustment of the directional array.

WGAR BUILDING

The site selected for the WGAR Directional Antenna and transmitting plant is thirteen air-line miles from Cleveland's Public Square, and comprises fifty-two acres of land at an elevation of twelve hundred feet, being about six hundred feet above the average city elevation. The site is ideal for FM and Television since it is approximately halfway between Cleveland and Akron and free of obstructions. From this location WGAR-FM and WGAR-TV can serve both cities with an excellent FM and TV service as well as AM.

The WGAR building is of functional design constructed of painted brick and limestone (Figure 2). The main operating room (Figure 3) is rectangular in shape and two stories high. The 50 KW AM transmitter (RCA BTA-50F) forms one of the long sides of the room and the other long side is of glass brick. The 5 KW AM transmitter (RCA 5D) is an auxiliary and forms one of the short sides of the room (Figure 5) while the 10 KW FM transmitter (RCA BTF-10B) plus the speech equipment and monitoring equipment forms the fourth side (Figure 4). Entrance to the building is through a lobby paneled in white-leaded oak. A large paved parking area sixty by eighty feet is provided in the rear for visitors. The driveway is sufficiently wide for two cars to pass.

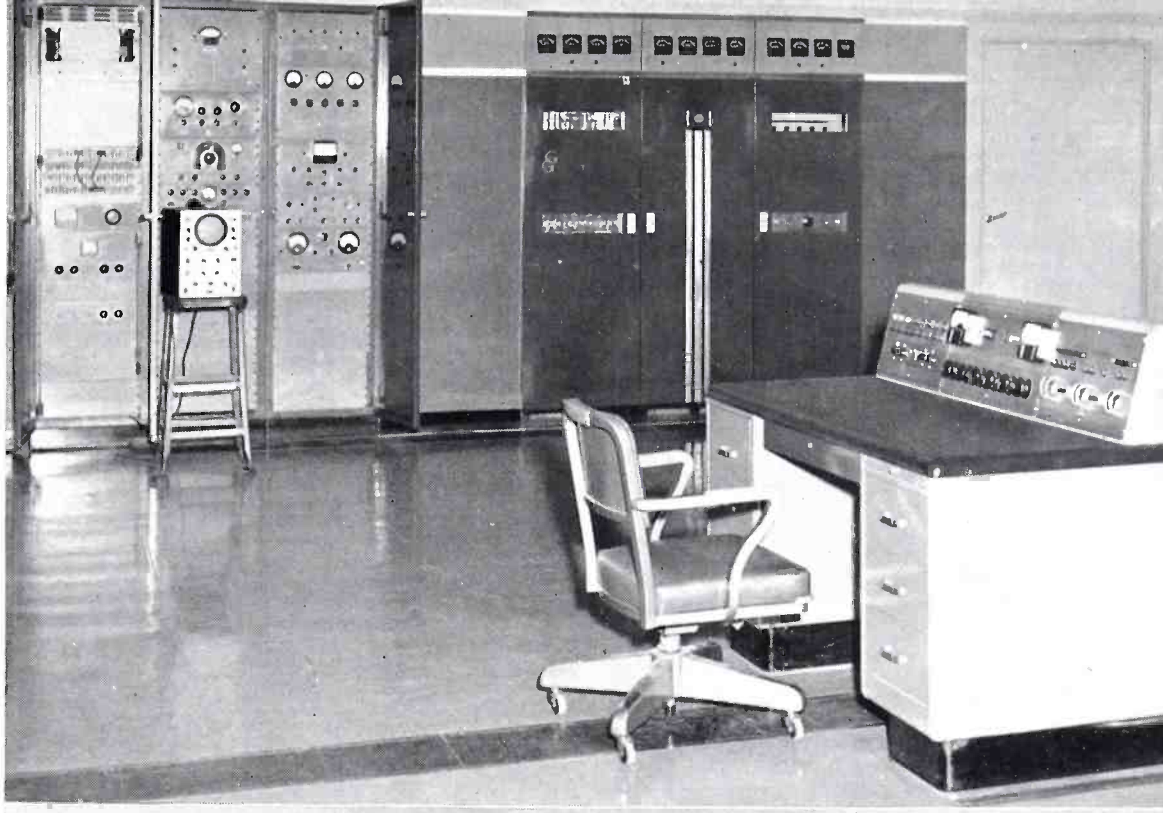


FIG. 4. (right) *Set in the wall to the operator's left are three cabinet type racks (in which are mounted the audio and monitoring equipment) and an RCA Type BTF-3B 3 KW FM transmitter. The latter will be increased to 10 KW in the near future. Note blank panels on each side.*

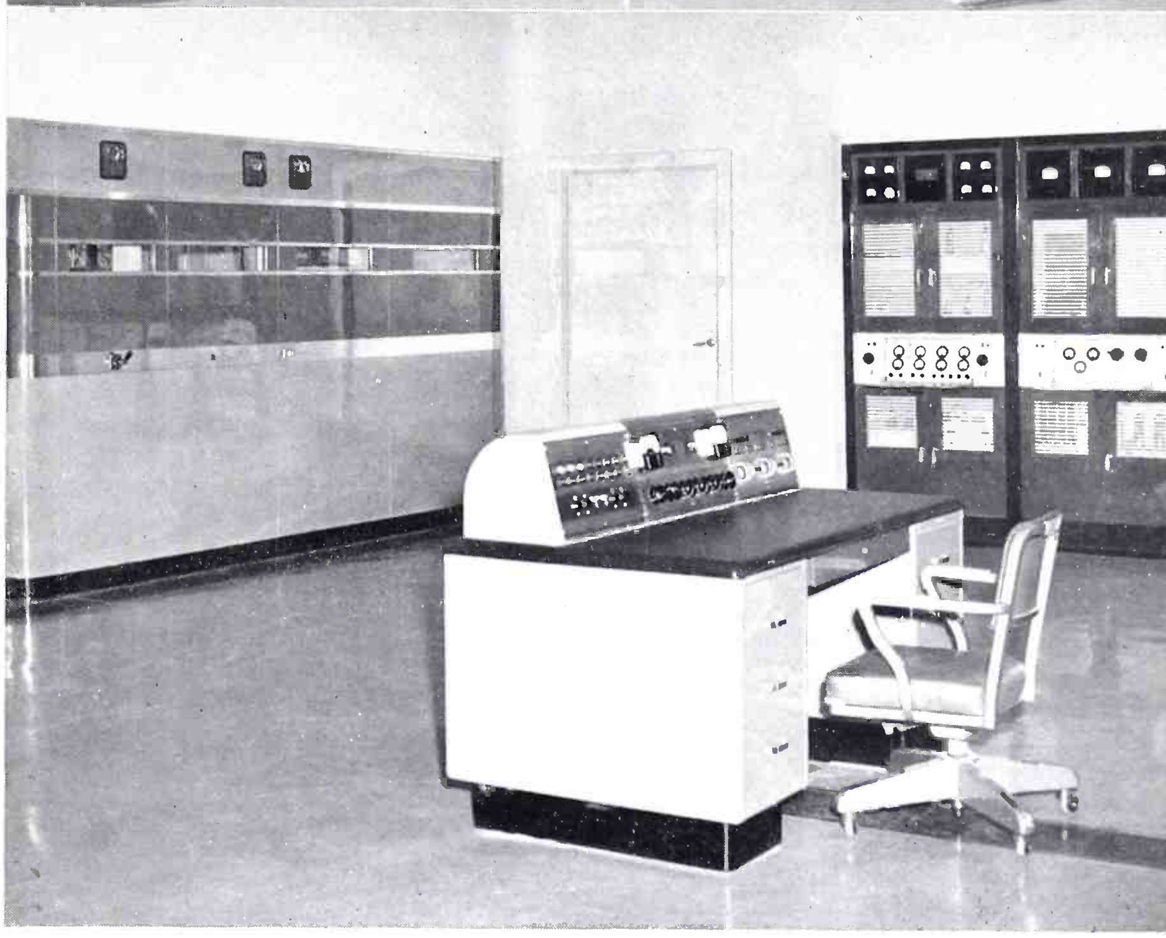


FIG. 5. (above) *In the wall to the right of the operator's console is WGAR's old transmitter, an RCA 5-D which, in an emergency, can be operated from the station's 30 KVA deisel-generator.*

The structural details will be of interest. Like nearly all building projects in 1946, shortages in materials and labor threatened, at times, to bring the entire project to a halt. The original plans called for poured concrete foundations. Lumber for forms was not available so the foundations were laid up out of concrete blocks and as each course was laid the air spaces were poured full of concrete. This gave a substantial foundation, in some respects superior to a poured wall—especially in appearance. The foundation was, of course, water-proofed on the outside. The area under the main operating room, the 5D transmitter, and offices is unexcavated. Figures 6 and 7 show the concrete floor being poured with conduits and wire trough in place.

The area housing the 50 KW RCA 50F transmitter was completed first. A commitment had been made with RCA to accept delivery of the transmitter on a specified date, but due to delays caused by material shortages, labor shortages, and a city wide carpenters' strike, the building was several weeks behind schedule. The roof slab over the 50F area and the floor were completed on an overtime basis and delivery of the 50F accepted. The installation of the transmitter began before the roof was completed. Tarpaulins were used to protect the equipment from rain and dirt while the installation went forward. The balance of the building was built around the 50F transmitter and all plastering, painting and finishing was done after the electrical installation was completed. This was all accomplished without any damage to the transmitter or the highly-polished front enclosure (Figures 8 and 9).

Figure 11 shows the enclosure at the rear of the 50F transmitter. Some building codes require oil-filled transformers be housed in masonry enclosures of special specifications. Since this installation is in a rural area this was not required. There is some advantage in being able to observe the operation of this equipment. In this installation, an oil curb is provided and a wire mesh completes the enclosure. An oil drain is provided.

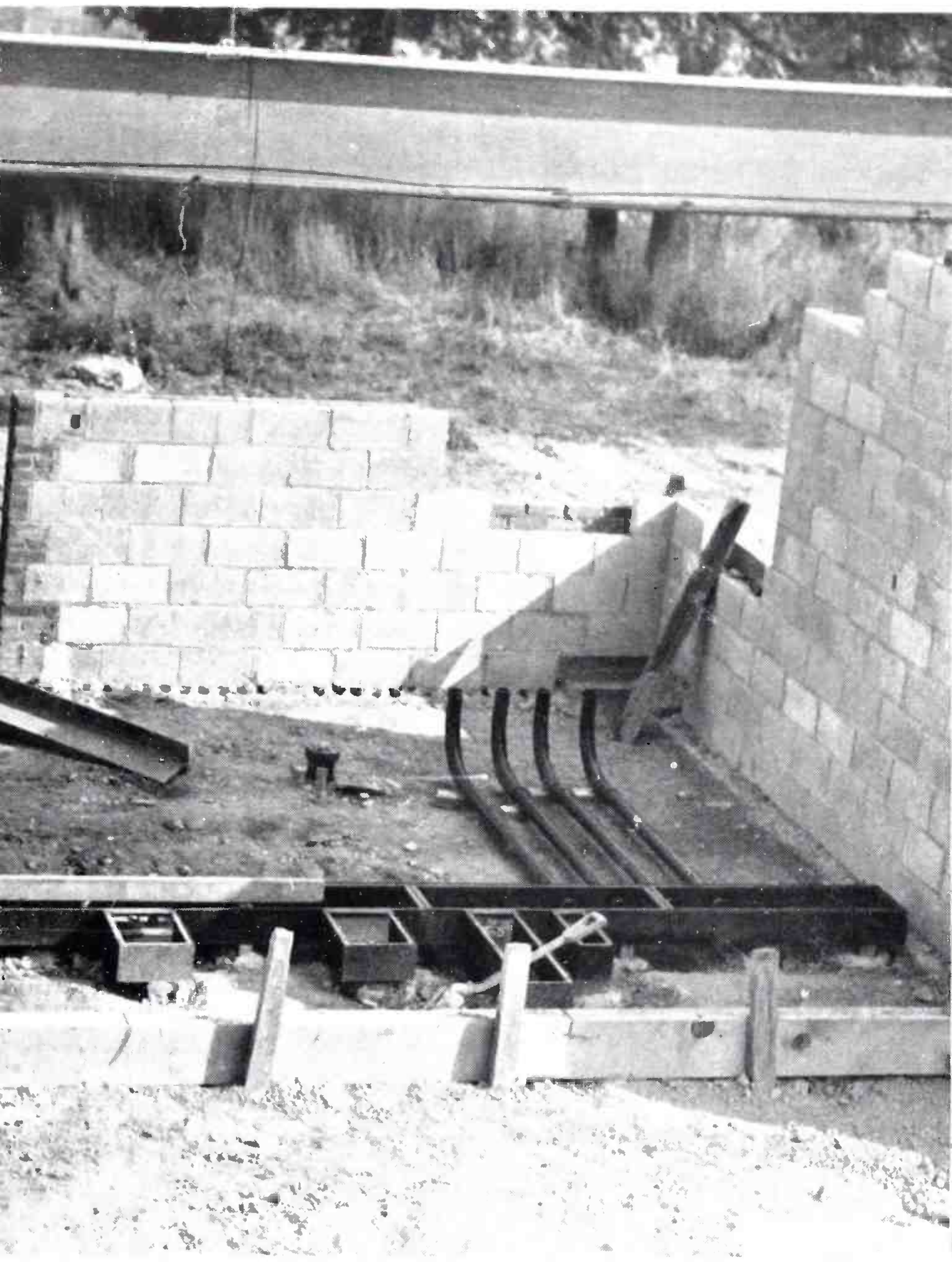


FIG. 6. *Foundation walls for the WGAR building consist of concrete block, with air spaces of each course filled with concrete. Above ground walls are concrete block faced with brick painted white. This illustration shows the space for the 5-D transmitter, with the wiring trenches and conduit in place preparatory to pouring the concrete floor.*

FIG. 7. *This illustration shows the same area (as in Fig. 6) during the actual operation of pouring the floor. A part of the enclosure which forms the wall of the transmitter room may be seen at the right. Access to the area in back of the 5-D is provided by a door at the left of the transmitter (see Fig. 5).*

FIG. 8. *This shows the 50 KW transmitter area after pouring of the floor. Set in the floor at the front of this area is the input air duct. The large round openings in the top of this duct are the air inlets to the several stages of the transmitter.*

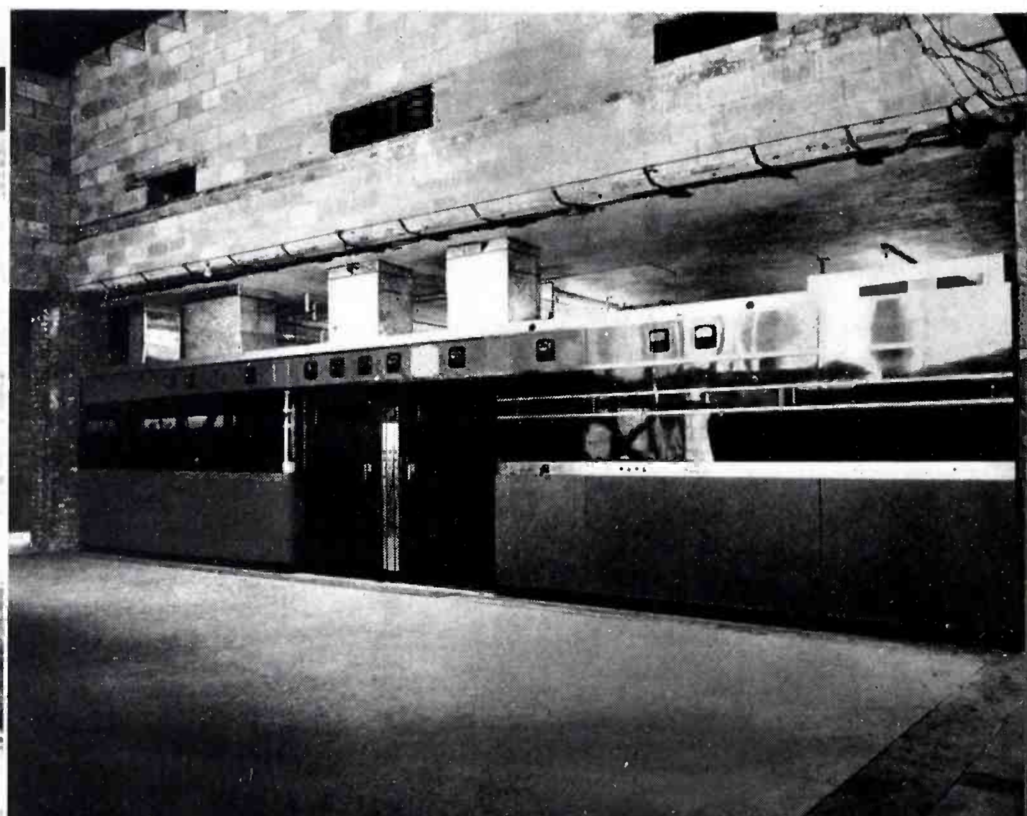


FIG. 9. *This illustration shows the 50-F transmitter in place before the drop wall and wall finish were completed (see text). The outlet air ducts from the modulator, power amplifier, and r-f driver stages can be seen leading up from the transmitter proper into the room ceiling.*

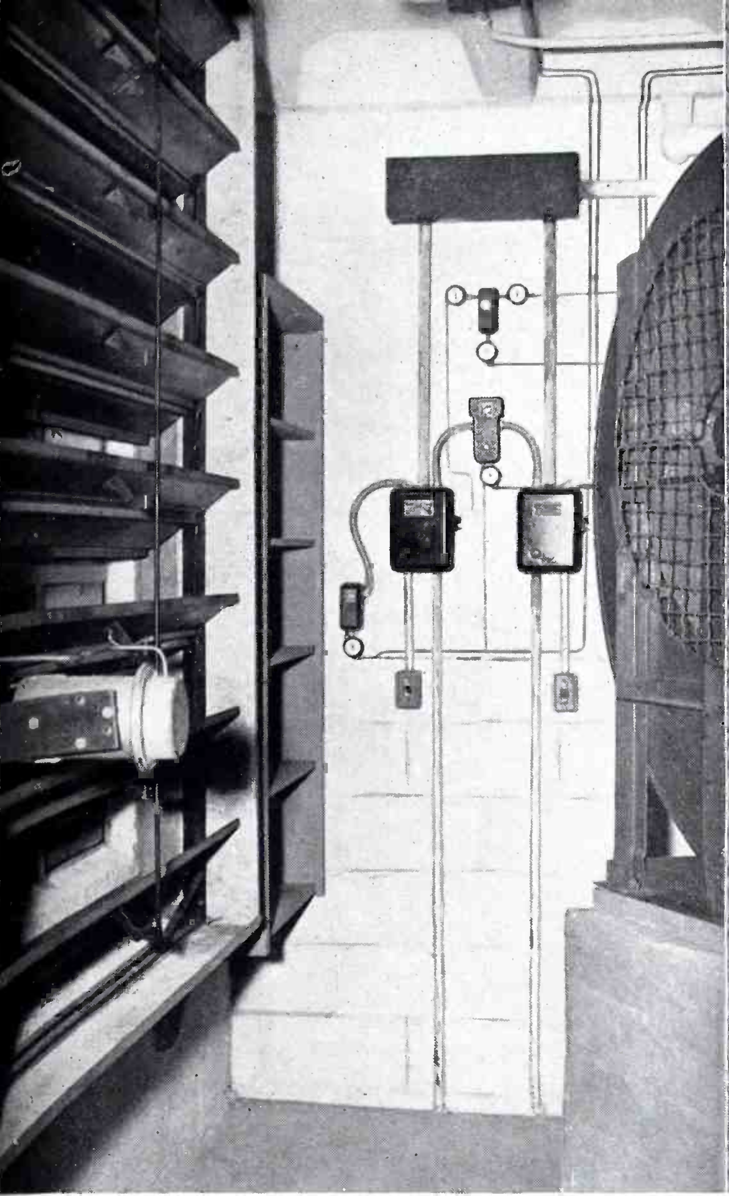


FIG. 10. *A corner of the blower room. One of the blowers may be seen at the right. At the left are the thermostatically-controlled inlet dampers. Blower controls are on the back wall.*

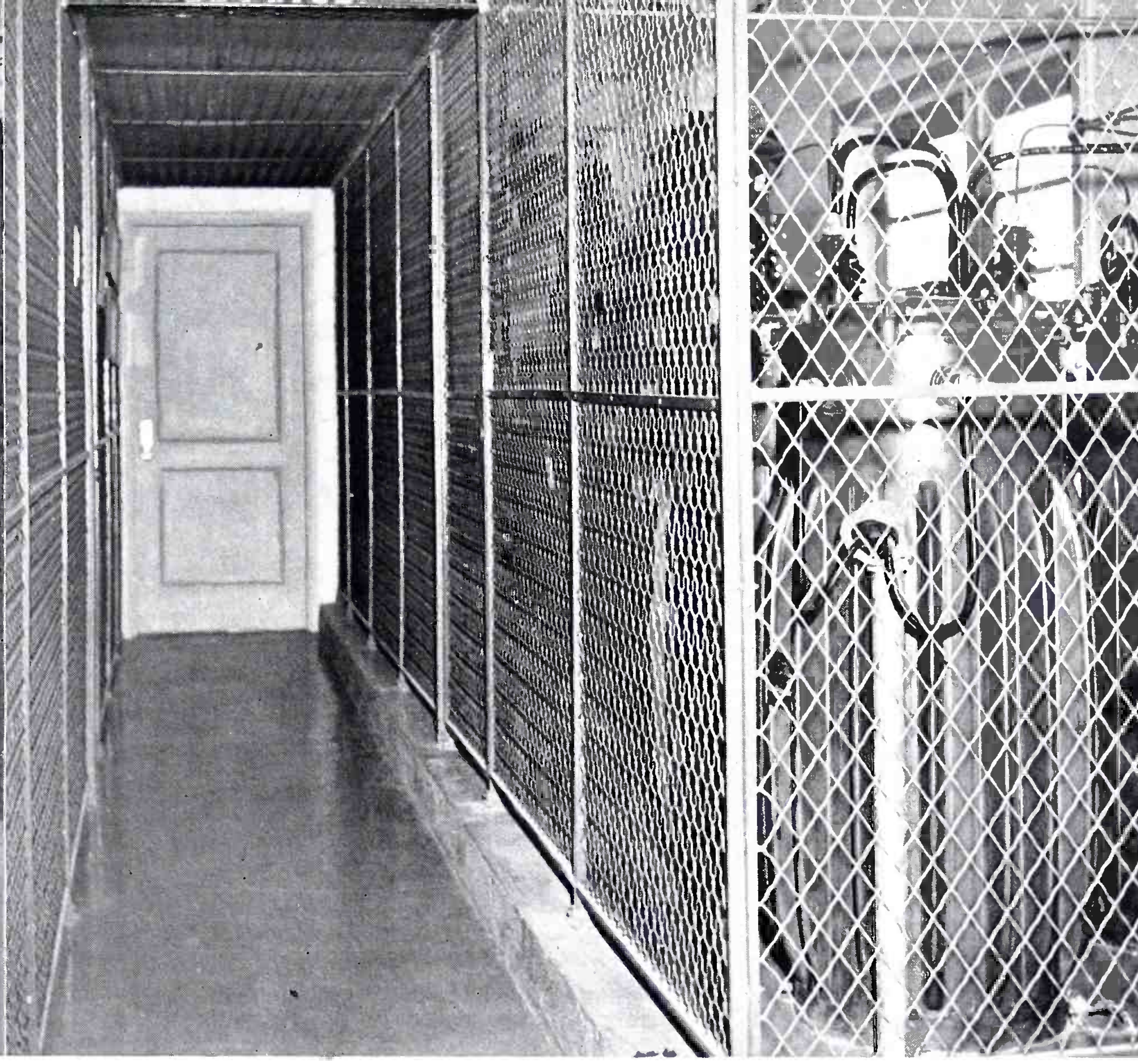


FIG. 11. *Visitors can be taken through this protected aisle-way behind the 50 KW transmitter. At the left of the aisle is the transmitter proper. At the right, the transformer enclosure (note oil curb).*

It is safe to take visitors through the rear of the transmitter since the wire mesh is carried overhead for protection from overhead bus work. The operating personnel can observe oil level, leaks, temperatures and the general overall performance while on the air. A CO_2 fire fighting equipment is installed just outside the fire door for immediate use should an oil fire occur.

Figure 10 shows a view of the blower controls. Dampers control the amount of outside fresh air that is taken in through the filters. Through a system of compressed air motors and thermostats, outside air and recirculated air are mixed to maintain a temperature of 80° F. entering the air duct for cooling the tubes in the RCA 50F transmitter. In cold weather very little outside air is taken in since radiation from the air ducts cools the air sufficiently to recirculate almost all of it. Any excess of hot air can be discharged into the operating room to supplement the heat from the boiler.

The blower controls also interlock the dampers on the two blowers. When one is shut down the damper is automatically closed to prevent re-entrance of the air through the idle blower. Compressed air motors are used throughout for heating, cooling and ventilation control.

The amount of heat available from the 50 KW transmitter is sufficient to heat the building at outdoor temperatures above 40° F. The total a-c power required for a 50 KW unmodulated carrier is about 100 KW which includes blower motors, filaments. bias and all plate power. This provides only 50 KW of heat dissipation. For outdoor temperatures below 40°, boiler heat is also required. Modulation raises the dissipation slightly; the total a-c power for 100% modulation is about 140 KW. It is believed that the new WGAR 50 KW transmitter operates with the lowest total input power of any 50 KW transmitter in existence. This high efficiency is the result of the use of the new RCA Type 5671 Thoriated Filament tubes in the modulator and final amplifier stages. This transmitter has operated since the inaugural program with these new type tubes. They were originally installed as RCA developmental type A-2270. These tubes had approximately 5000 hours service as of March 1, 1948 and, as a result of the success obtained with their use at WGAR, they have just recently been made commercially available.

Two power mains enter the building underground from two separated routes. Automatic transfer from the Regular to Emergency is provided in a special switch room located next to the transformer vault. When a fault has occurred on the Regular feeder and transfer to the Emergency has taken place, the load will stay on Emergency until the operator switches back to the Regular. This prevents a power failure and restoration taking place within a five or ten minute period causing two interruptions on the same program. The switch back can be accomplished during a station break so only one program failure occurs.

A 30 KVA Diesel plant is available in case both power lines fail. This plant cannot, of coures, provide power for the 50 KW transmitter, but does permit the operation of the 5 KW standby for long periods of time if necessary. All other power loads are automatically dumped when the Diesel Plant is in operation. Only the 5 KW standby, the tower lights and essential building lights are retained.

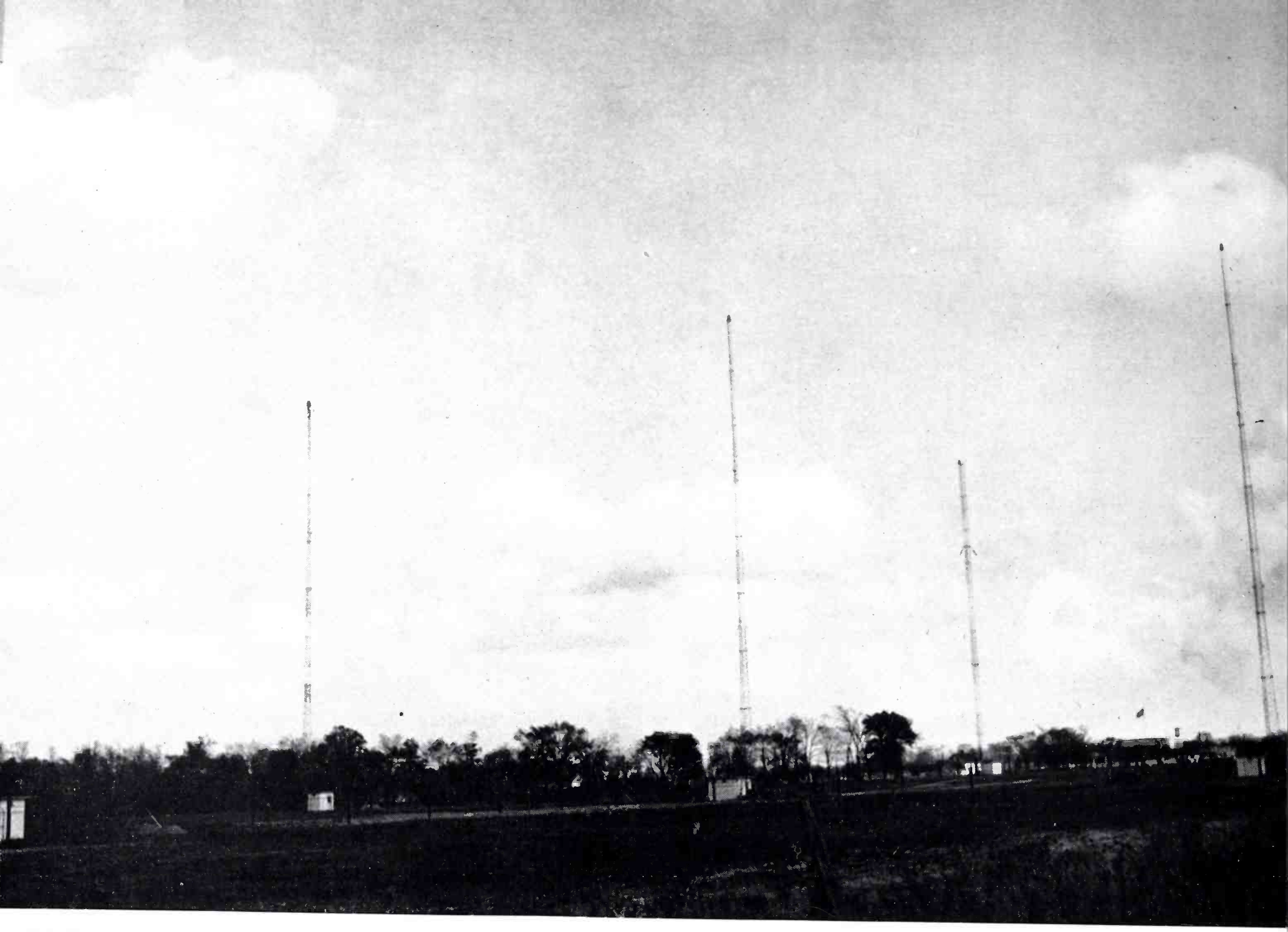


FIG. 12. *WGAR's 5-tower directional array is shown in this illustration. The four outer towers are arranged in a rhombic with the fifth tower at the approximate center, (see Fig. 14). The phasing and power dividing networks are located in the center tuning house which is the physical, as well as the electrical, center of the array.*

WGAR ANTENNA ARRAY

The five-tower directional array at WGAR is rhombic in shape with the fifth tower approximately in the center. A plot diagram (Figure 14) shows the physical layout. Figure 12 shows all five towers and their tuning houses as well as the main building.

The Phasing and Power Dividing networks are located at the physical center of the array and adjacent to the center tower. This reduces the main building space requirements and saves about 4,400 feet of transmission line construction. All phase and current metering is referred to the center tower which radiates approximately half the total power.

Sampling loops are coupled to the leg of each tower for the monitoring of the amplitude and phase of the r-f current. The schematic of this arrangement is shown in Figure 13. Great care was taken to insure that all of the sampling loops were of equal physical length when they were originally installed. Since the East and West antennas are the most widely spaced, it was necessary to form a sufficient length of sampling line into a coil at the North, South and Center tuning houses so that their lengths were equal to the East and West sampling lines. Prior to the tune-up of the array these lines were again checked and where necessary trimmed, so that the electrical length of each line was exactly alike as measured on the phase monitor. R-f relays in the center tuning house, controlled by pairs in the telephone cable, switch the r-f circuits and RG8U coax lines. A schematic of the five tower Phasing and Power Dividing Networks is shown in Figure 15. The remote control wiring for control of antenna switching and monitoring is not shown.

By means of a monitor panel in the main building any antenna can be switched into the phase monitor for comparison of phase and current ratio to the center tower. Since samples of r-f are carried back to the building all currents are read on r-f Thermocouple type meters instead of rectifier type d-c metering. This has a definite advantage since line voltage sometimes changes the readings on the Rectifier Type system.

Transmission lines for the 50 KW r-f power are all of the 6-wire type. Figure 16 shows the transmission line leaving the building. A slack span of twenty-five feet is used between the building and an H fixture. This removes all stress from the building wall and lead-through bowl. The H fixture takes the dead-end strain of the 6-wire line as well as the messenger cable used to support the 60-cycle power lines for tower lights, the telephone cables for inter-communication between tuning houses and main

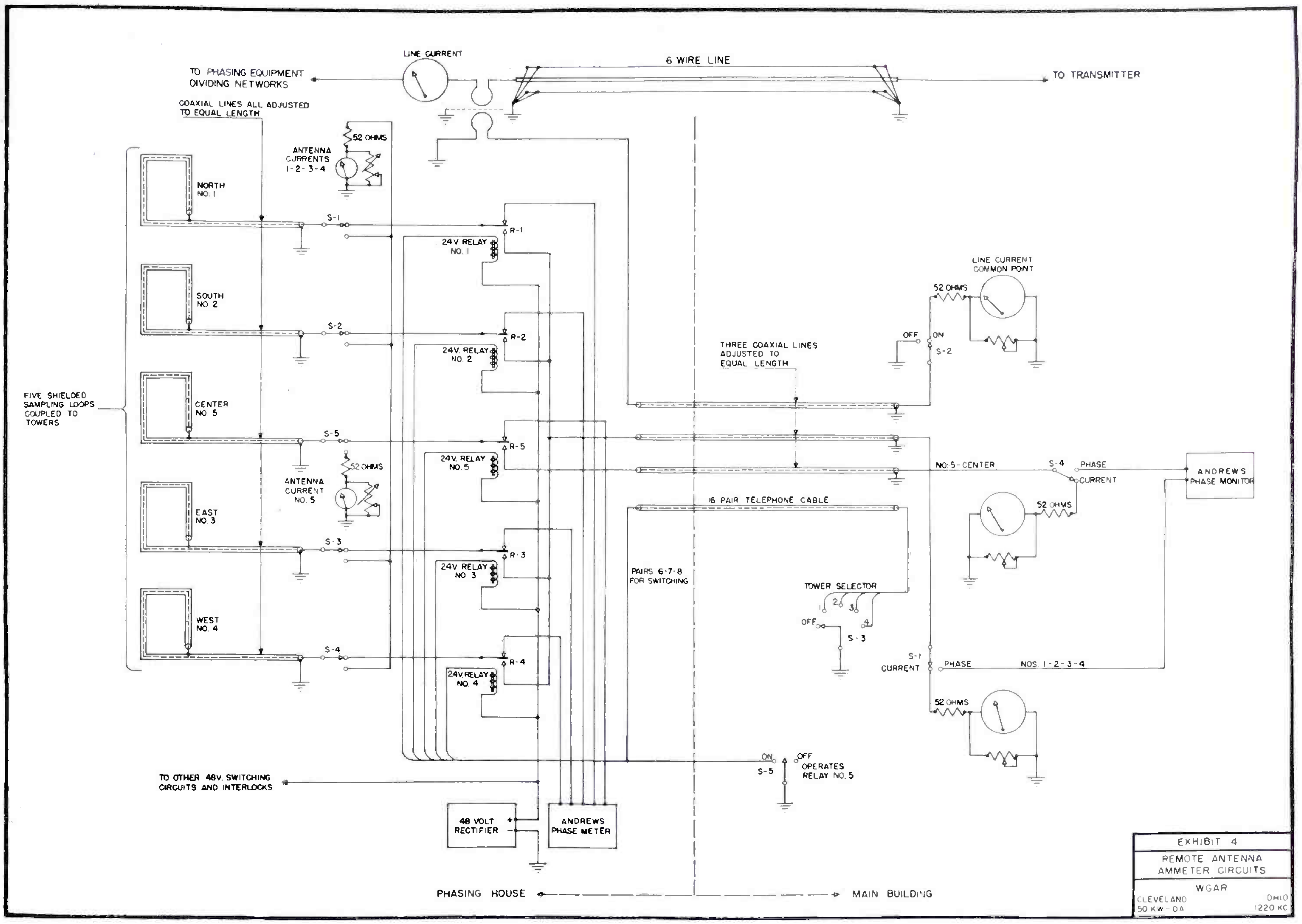
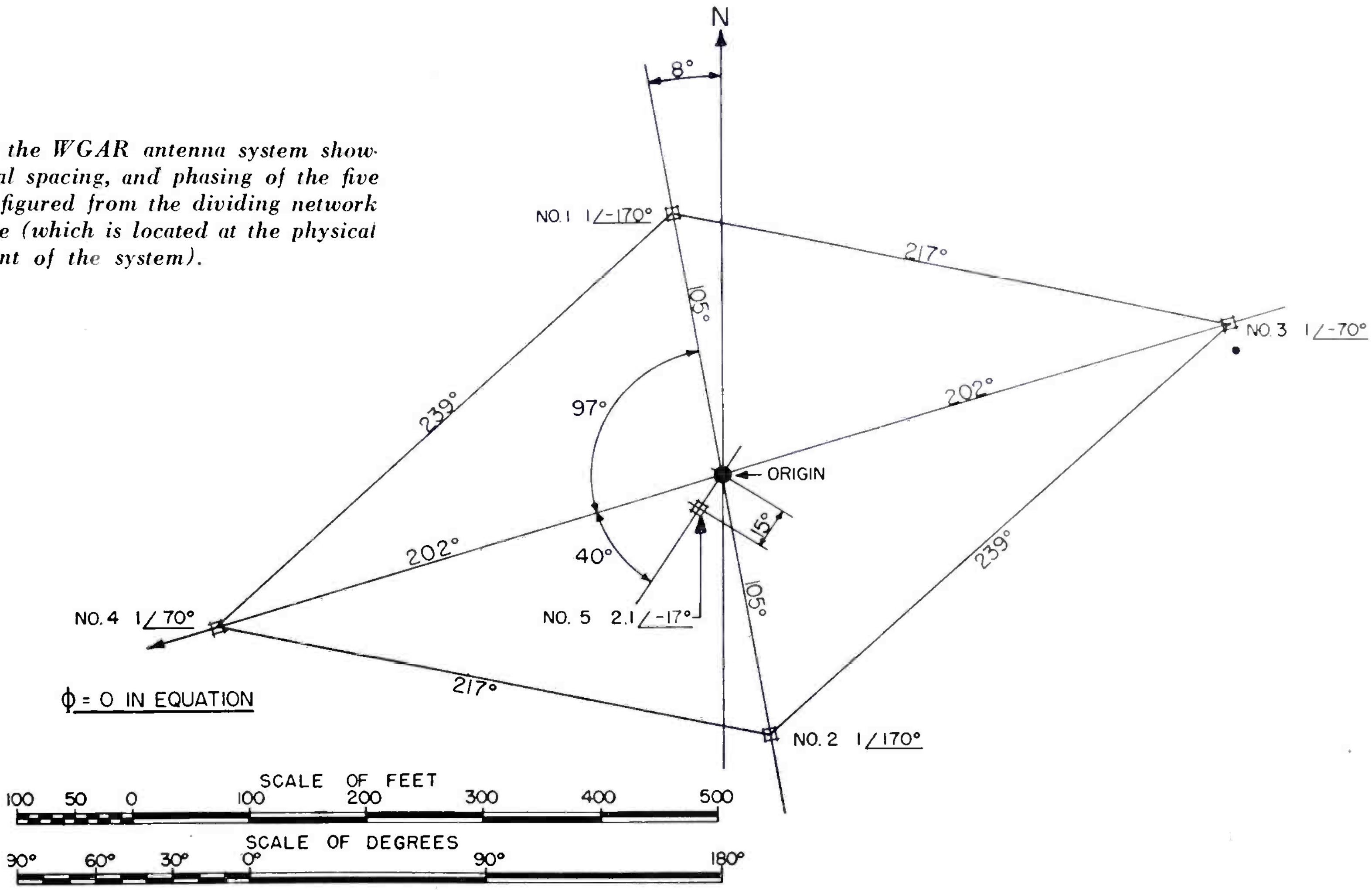


FIG. 13. *Sampling loops coupled to each of the five towers feed coax lines which terminate in the center tuning house. Three coax lines from the center house to the transmitter room, together with a suitable switching arrangement, provide a means whereby the current and phase in any tower may be monitored at the transmitter. The diagram above shows the circuits involved.*

FIG. 14. (right) *Plot of the WGAR antenna system showing physical and electrical spacing, and phasing of the five towers. Phase angles are figured from the dividing network in the center tuning house (which is located at the physical centerpoint of the system).*



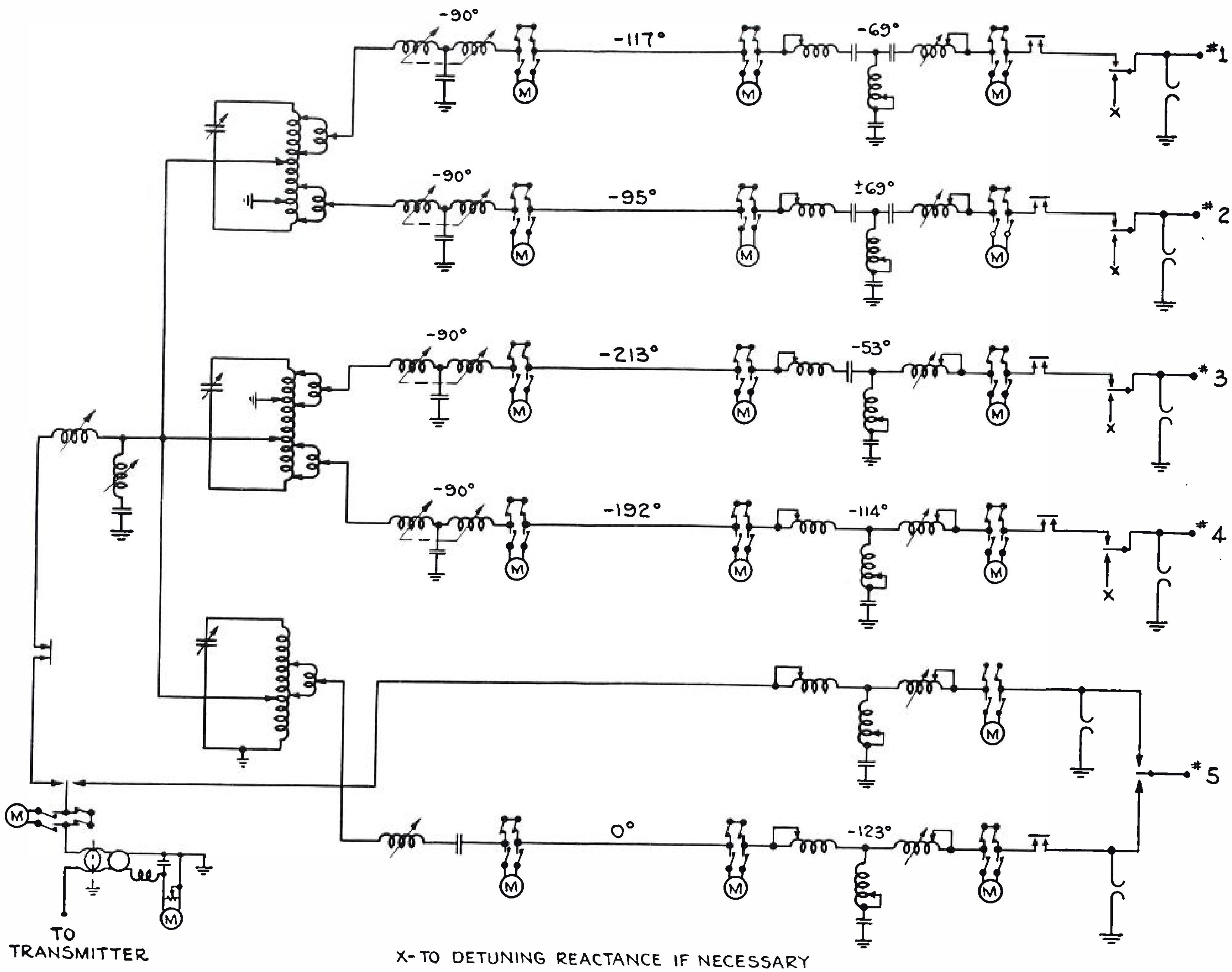


FIG. 15. *Schematic diagram of the five-tower Phasing and Power Dividing networks which are located in the center tuning house of the new WGAR installation. For daytime non-directional operation, the center (No. 5) tower only is used. Switching of power circuits, as well as monitor circuits, is accomplished from the main transmitter building by means of remote control circuits which, for simplicity, are not shown here.*

building, and control circuit switching. Coax cable (RG8U) is also supported on this messenger cable for r-f sampling to the phase monitor in the phasing house and in the main building and remote antenna current metering. All facilities except the 6-wire line enter the building underground from the H fixture. It is 1100 feet from the main building to the center tuning house.

Several photos show the methods of construction employed to handle the 6-wire line at dead-ends and distribution points. Figure 17 is an overall view of the transmission lines before towers were erected. Approximately 2800 feet of line is employed. RCA 6-wire brackets are used througout except where lines are dead-ended. Where two sections of line are dead-ended, but where the pole line continues on in both directions, a dead-end fixture using cross-arms is employed (Figure 18).

Five lines feed through the center tuning house. Figure 20 shows the feed lines to the East-West and North-South towers, leaving the center tuning house where the power dividing and phasing has been accomplished. Since the East-West line must cross-over the North-South line, suitable cross-over is accomplished by using taller poles on the East-West than on the North-South. This makes it difficult to break away the East-West line at right angles to enter the building because of the height above the lead-through bowls. A wood support structure permits the line to be carried up about four feet before connecting across to the pole line. The North-South line is level with the lead-through bowls and can be connected across directly. None of the transmission lines dead-end on the building structure. Instead, all dead-end strains occur at special dead-end poles which are also shown in Figure 20. The center tower requires only a lead-through without a 6-wire line connection. The view in Figure 19 shows the difference in height of the East-West and North-South lines, the center tower connection and the H fixture dead-end for the main line from the 50 KW transmitter. No difficulty has been experienced with coupling or radiation from the 6-wire lines, although it is required to maintain very low fields over a wide angle.

The usual 120 radials are of course included in the ground system. The ground wires were plowed in using a special tooth attached to the blade of a bulldozer. The coils of wire were located at the circumference of each set of ground radials. The wire was fastened to the lower end of the tooth. The bulldozer operator lowers the blade and continues straight for the tower.

FIG. 16. (right) *All WGAR transmission lines are open 6-wire type. This view shows the termination of the main feed line at the transmitter building. A slack span of 25 feet is provided between the building and the H-fixture which takes the dead-end strain, thereby removing all stress from the building lead-through.*

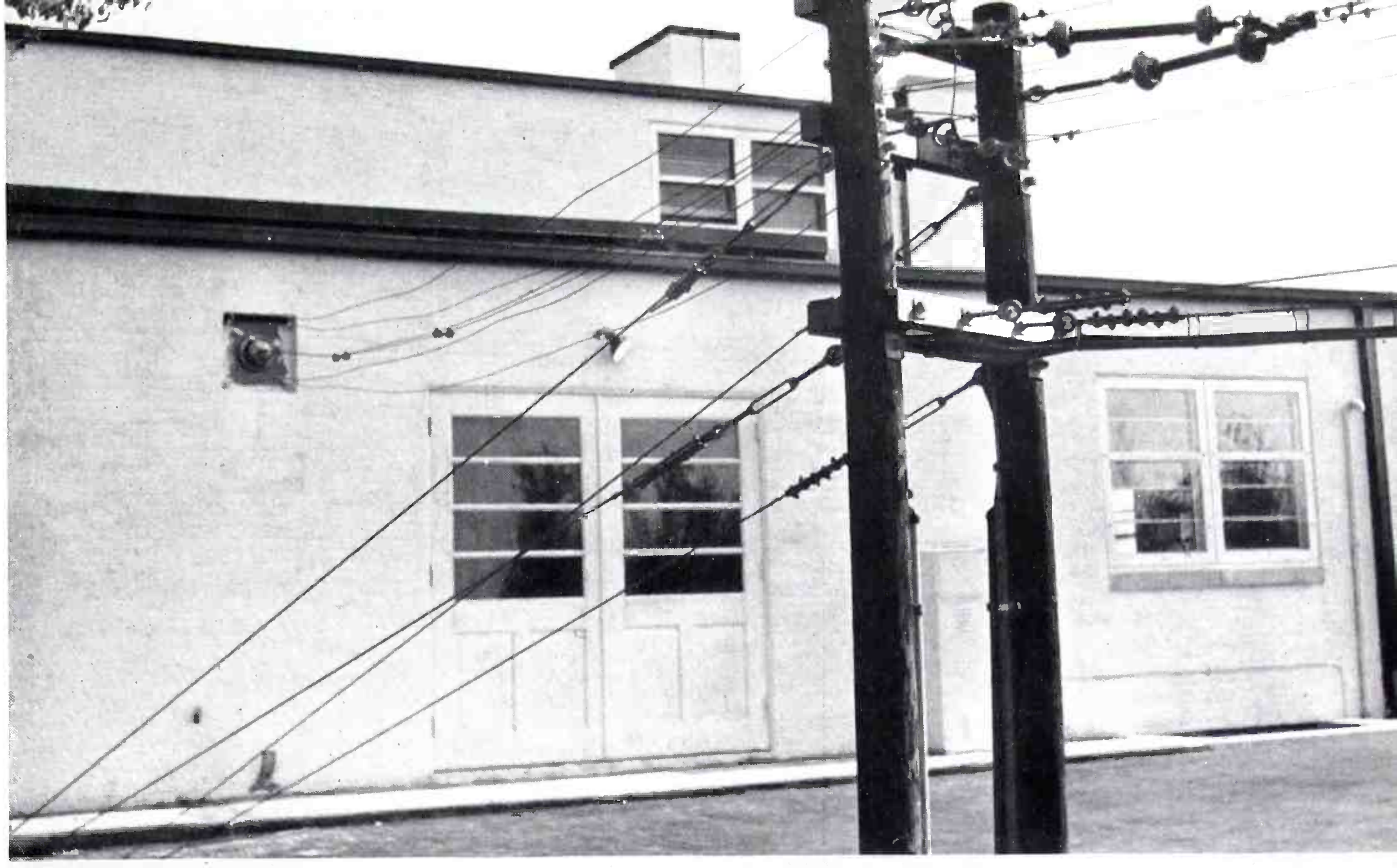
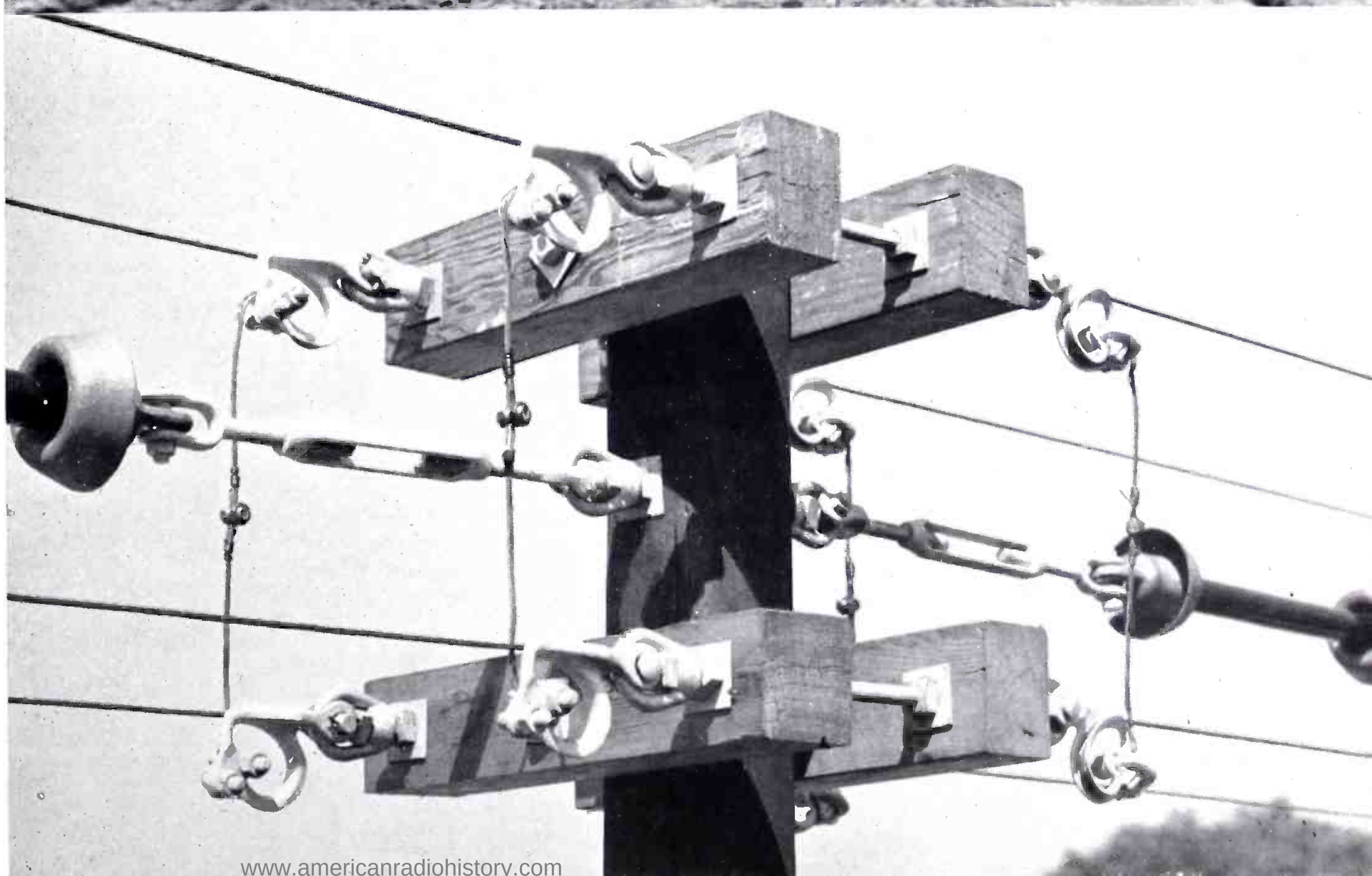


FIG. 17. (right) *Standard RCA 6-wire brackets were used to support the WGAR transmission lines at all points except the terminations. This view shows a part of the line installation before the towers were erected. Total length of lines employed is approximately 2800 feet.*

FIG. 18. (right) *This interesting picture shows to advantage the details of the dead-end fixture which is used at a point (near the center tuning house) where two lines are dead-ended, but the line of poles continues in a straight line.*



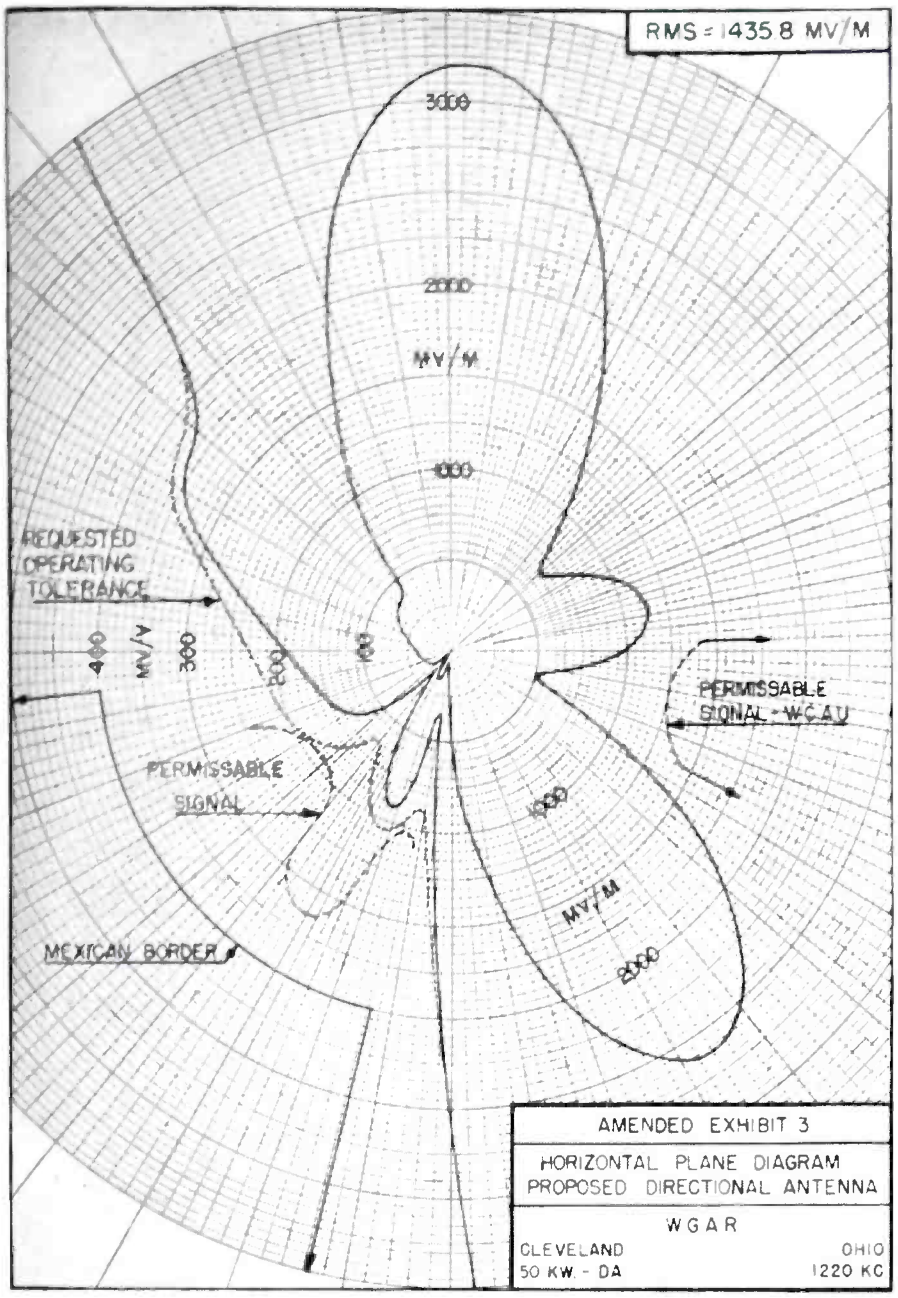


FIG. 21. *Computed horizontal polar diagram of the unattenuated field at one mile for the five-tower WGAR array.*

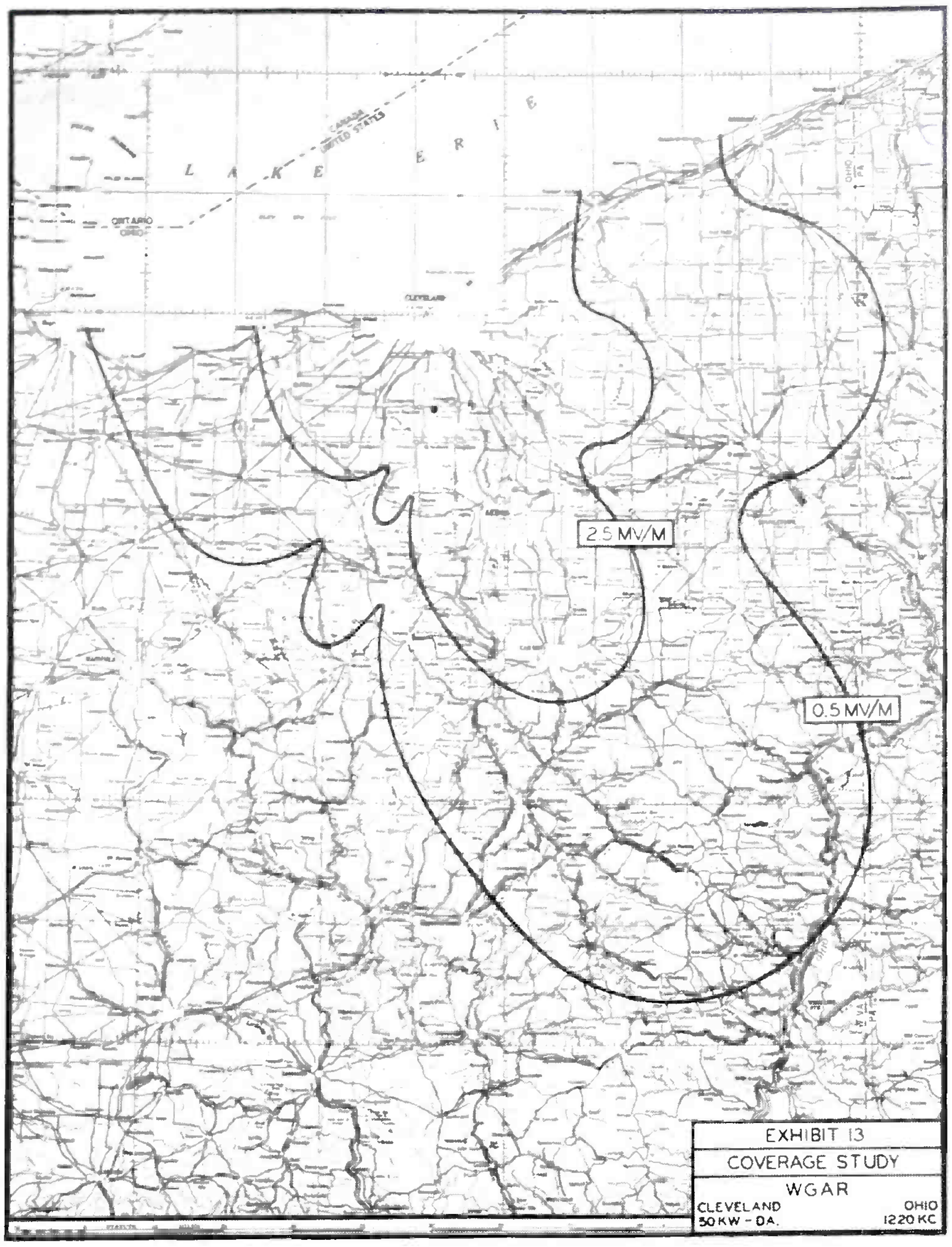


FIG. 22. *Computed coverage of new WGAR 50 KW transmitter and directional system described in accompanying article.*

The tooth cuts a slot in the ground and pulls in the wire. As the slot (about two inches wide) collapses, the wire is buried. Back-filling is not required as the first heavy rain takes care of the back-fill. Since the bulldozer can go up close to the tower it is possible for the entire length to be pulled in in one operation with very little hand labor. If additional slack is desired at the tower end it is easily pulled by hand if done at once, before the slot caves in. After the wire has been pulled to the tower base the bulldozer backs up for the next run. Meanwhile the wire is cut off—the end bent and shoved into the ground. Thirty miles of wire were placed in the ground on 600 separate radials in eleven days by this method; two days were in muddy weather.

In addition to the 120 radials per tower, each had an expanded copper ground screen 50 feet square. This area is fenced in for protection and covered with two inches of slag screenings and weed-killing chemical.

Figure 21 shows the computed horizontal polar diagram of the unattenuated field at one mile. Figure 22 shows the computed coverage. The protection requirements for the use of 1220 kc with a power of 50 KW with the location at Cleveland, Ohio. fixed the design of the array. Because protection has to be afforded over a wide angle to the southwest, and because the highly-populated areas of Akron and Canton lie to the Southeast, it seemed desirable to radiate a high field in the direction of this populous area. The effective power which is radiated in the direction of Akron and Canton equals approximately 160 KW. For this reason WGAR has a higher field intensity in the cities of Akron and Canton than any other out-of-city station. Figure 21 shows that the effective power toward the city of Cleveland to the north is approximately 250 KW. The field in downtown Cleveland is approximately 75 mv/m.

FIG. 19. (opposite page, top) *Base of the center tower which is fed directly by a lead-through from the center tuning house.*

FIG. 20. (opposite page, bottom) *East-West and North-South lines leaving center tuning. East-West line is made higher to simplify cross-over. The messenger cable carries the power for the tower lights, building lights, RC8U r-f sampling lines telephone cable for communication and remote control switching.*

KMPC PLANNING

In 1937, Mr. G. A. Richards purchased station KMPC, Los Angeles, then located at Beverly Hills, which is a suburb immediately adjacent. At that time KMPC operated with a power of 500 watts daytime only on 710 KC. Then began a series of negotiations to obtain nighttime operation. The former RCA 5-C transmitter, building and tower of KECA were purchased and in January, 1940 KMPC began operations as a full-time assignment on 710 KC with a power of 5000 watts daytime and 1000 watts nighttime. Immediately thereafter an application was filed to increase power to 10,000 watts day and night employing a directional antenna protecting stations WOR and KIRO. This application was granted in 1941 and in August 1942, KMPC commenced operation with 10 KW full time. The 10 KW transmitting plant was located in a new building which had been constructed in San Fernando Valley immediately north of Holly-

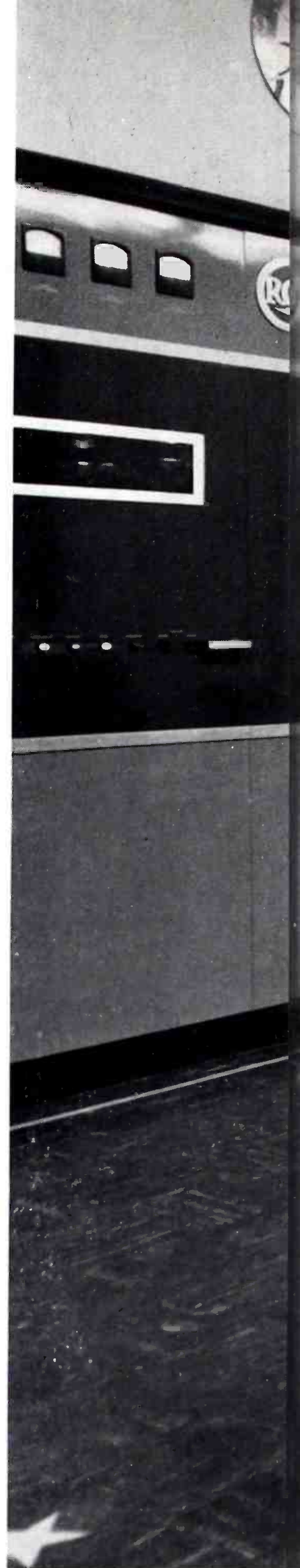


FIG. 23 *This photograph gives just an idea of KMPC's beautifully-finished transmitter plant which is located in equally beautiful San Fernando Valley. The 3-tower directional array may be seen in the background.*

wood, one of the original RCA 10 KW Type 10E transmitters having been installed. (See BROADCAST NEWS, January 1944.)

Immediately after the expiration of the "Freeze" order in October, 1945 KMPC, filed an application for construction permit to increase power to 50 KW day and night employing a directional antenna during nighttime hours on 710 KC. On August 2, 1946 the Federal Communications Commission granted the above construction permit and construction was commenced immediately. A wing was added to the existing transmitter building and an RCA Type BTA-50F transmitter installed.

Except for the adjustment of the directional antenna, the complete 50 KW construction was accomplished within seven months. The actual installation time of the RCA 50-F transmitter was thirty-five days from the time the first piece of the transmitting equipment was set in place.

KMPC BUILDING

In the design of KMPC's transmitting facilities, simplicity, accessibility, and straightforwardness were the keynotes. You will note in Figure 24 that the only equipment in front of the transmitter panels are the control consoles and operating chairs. Monitor speakers are mounted in the ceiling directly over each console. Speech equipment, phasing and power dividing networks, and other monitoring units are mounted as part of the unified transmitter front. See Figure 24. In order to provide

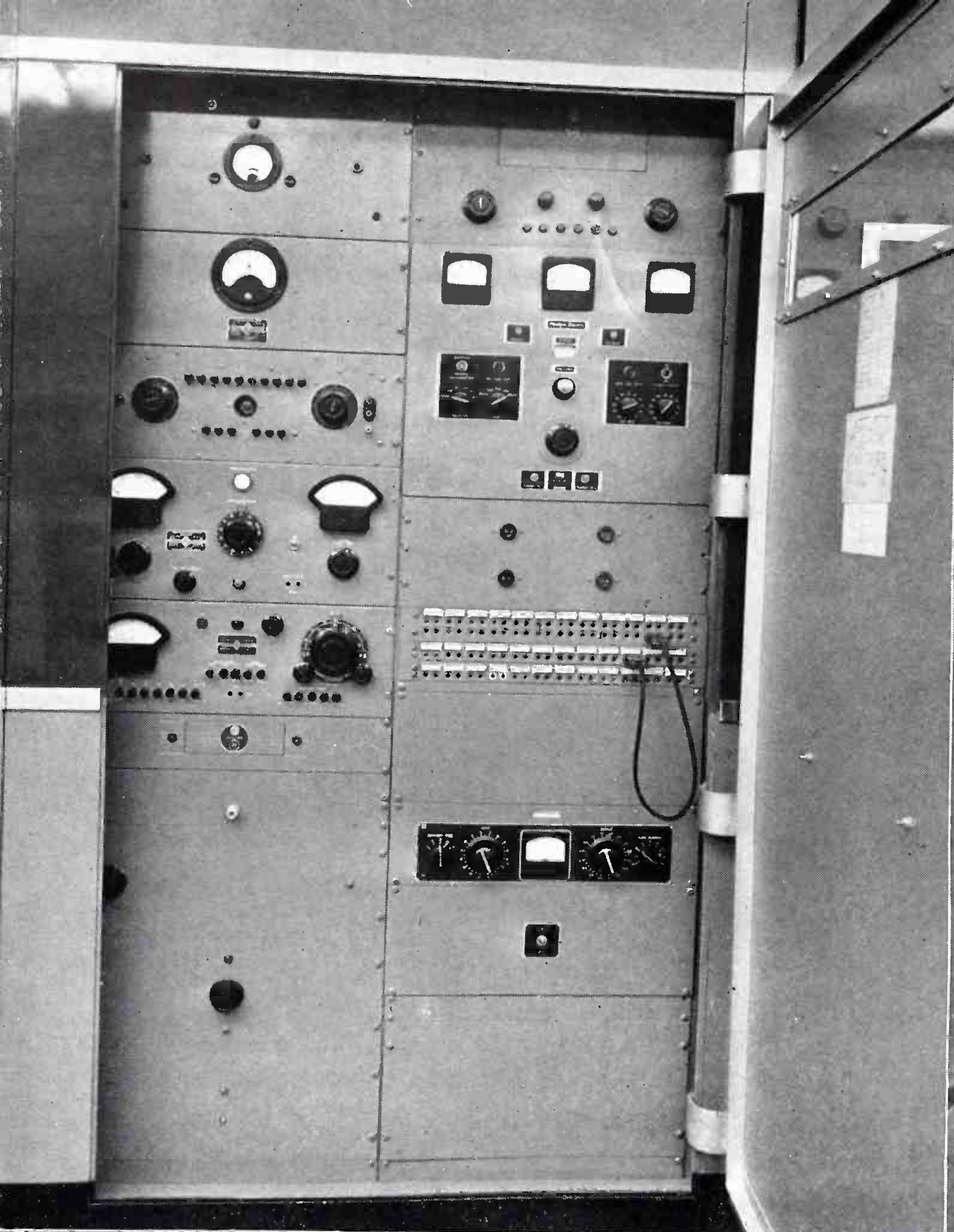
FIG. 24. *The interior of the "Station of the Stars" is no less beautiful, at least to the eyes of an engineer. Nearly 80 feet of unbroken transmitter front—and all of it the newest and finest. In the left foreground is the RCA 10-E (10 KW standby) transmitter while at the further end is the new RCA 50-F 50 KW transmitter.*

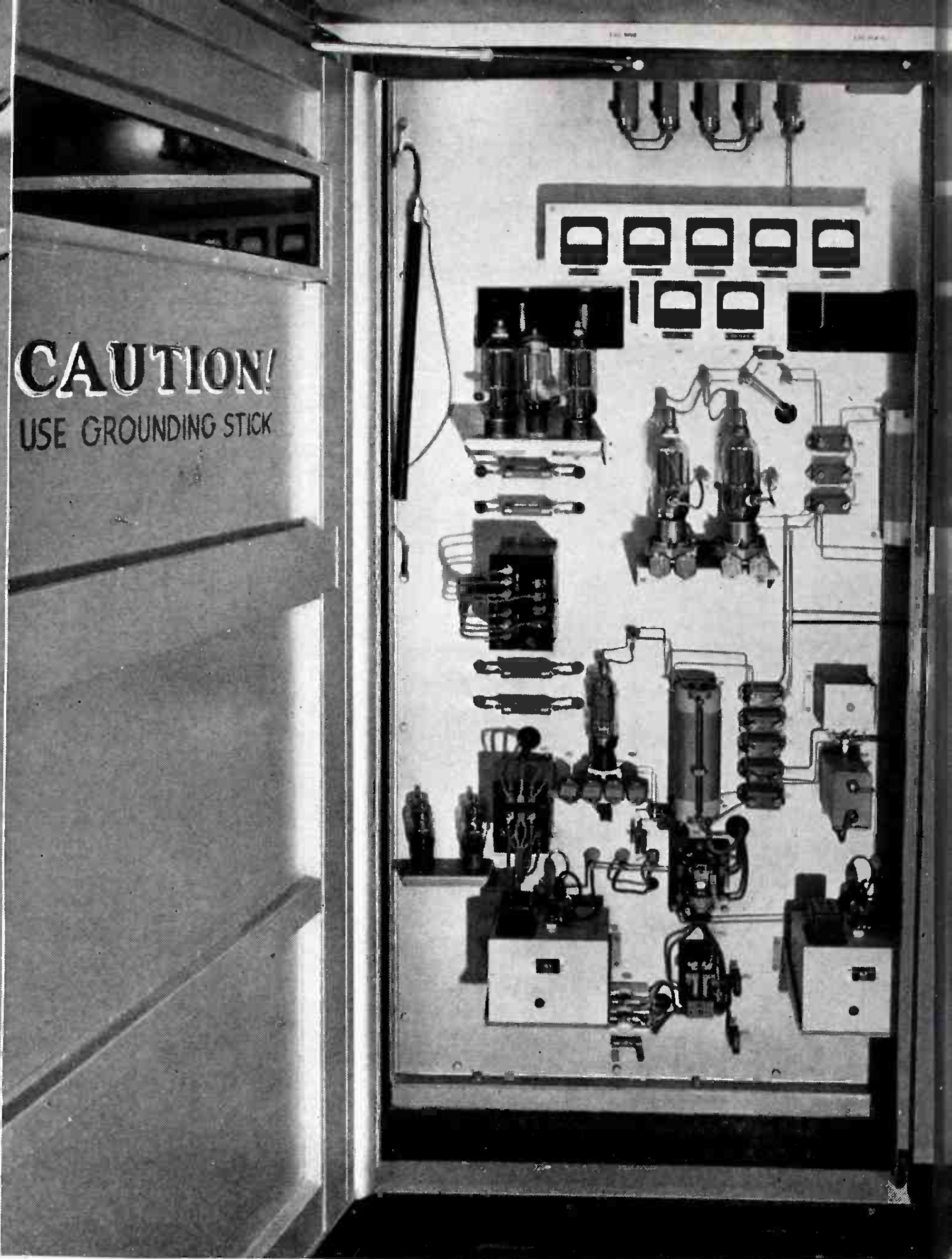
uninterrupted service, the 10 KW RCA 10-E transmitter remains in its original position and is employed as an auxiliary.

AN OUTSTANDING ENGINEERING ACCOMPLISHMENT

With the completion of the 50 KW installations described above the "Richards Stations" now boast of three fifty-kilowatters (WGAR, WJR, KMPC)—the most powerful group of independent stations in the country. This is a goal which they have been striving toward for nearly ten years. It was not achieved without many setbacks and delays. In the beginning there were allocation problems that had to be solved, then hearings, preliminary grants, revocations, more hearings. When CP's were finally granted there were postwar shortages to contend with. However, in spite of all the disappointing delays the management and its engineers kept constantly pressing forward. Particular credit goes to the engineering staff which, under Morrie Pierce's direction, painstakingly solved the allocation problems one by one until they had a clear track; then, without slackening pace, solved the vexing shortage problems in similar fashion. The stations, as they stand today, are a tribute both to their patience and to their engineering skill.

MORE KMPC PICTURES ON Pg. 66 & 67




CAUTION!
USE GROUNDING STICK


DANGER!
HIGH VOLTAGE
OVERHEAD

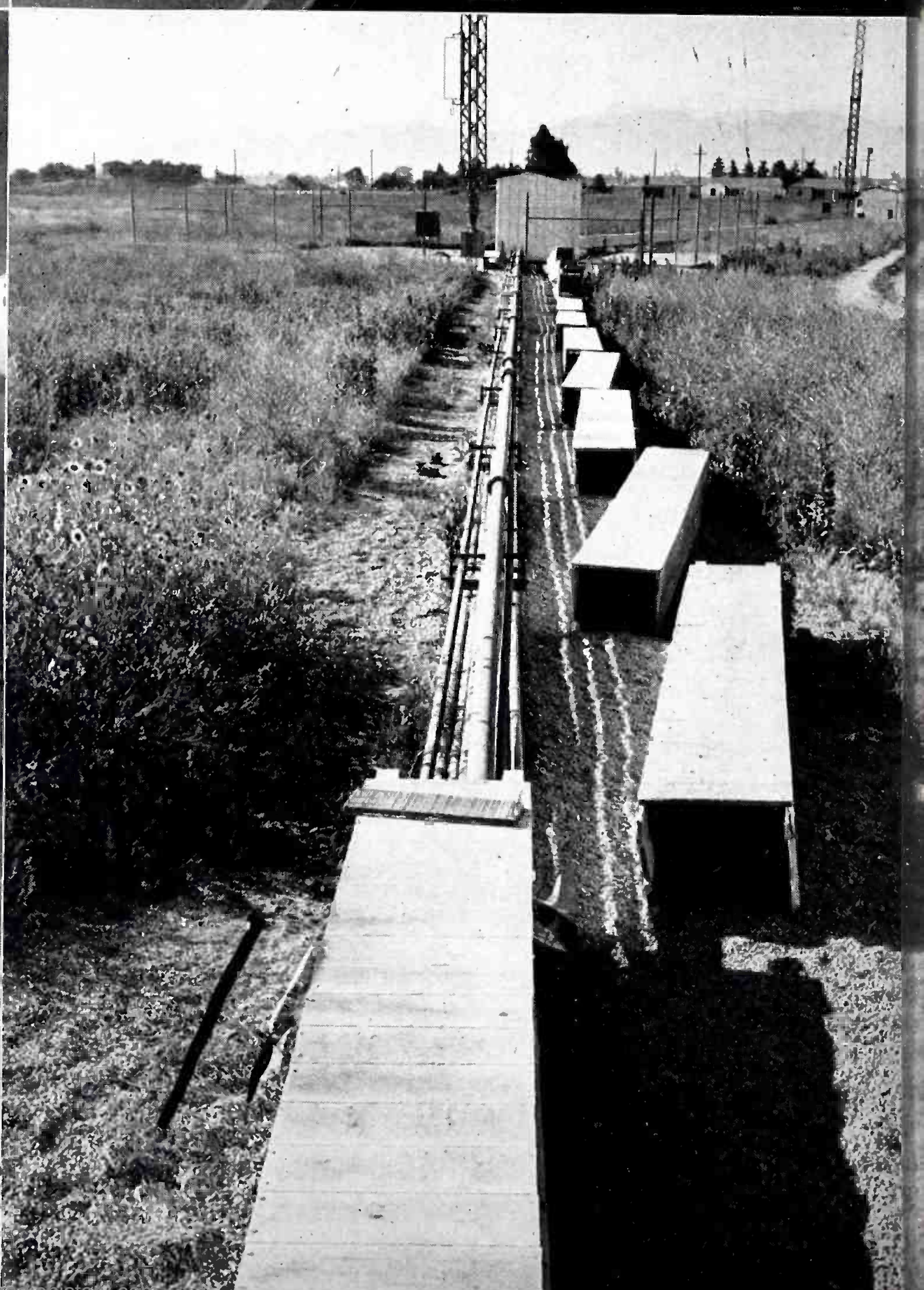


FIG. 29. (above) *Another view of the KMPC transmitter room. Windows along back wall provide good lighting during daylight hours.*

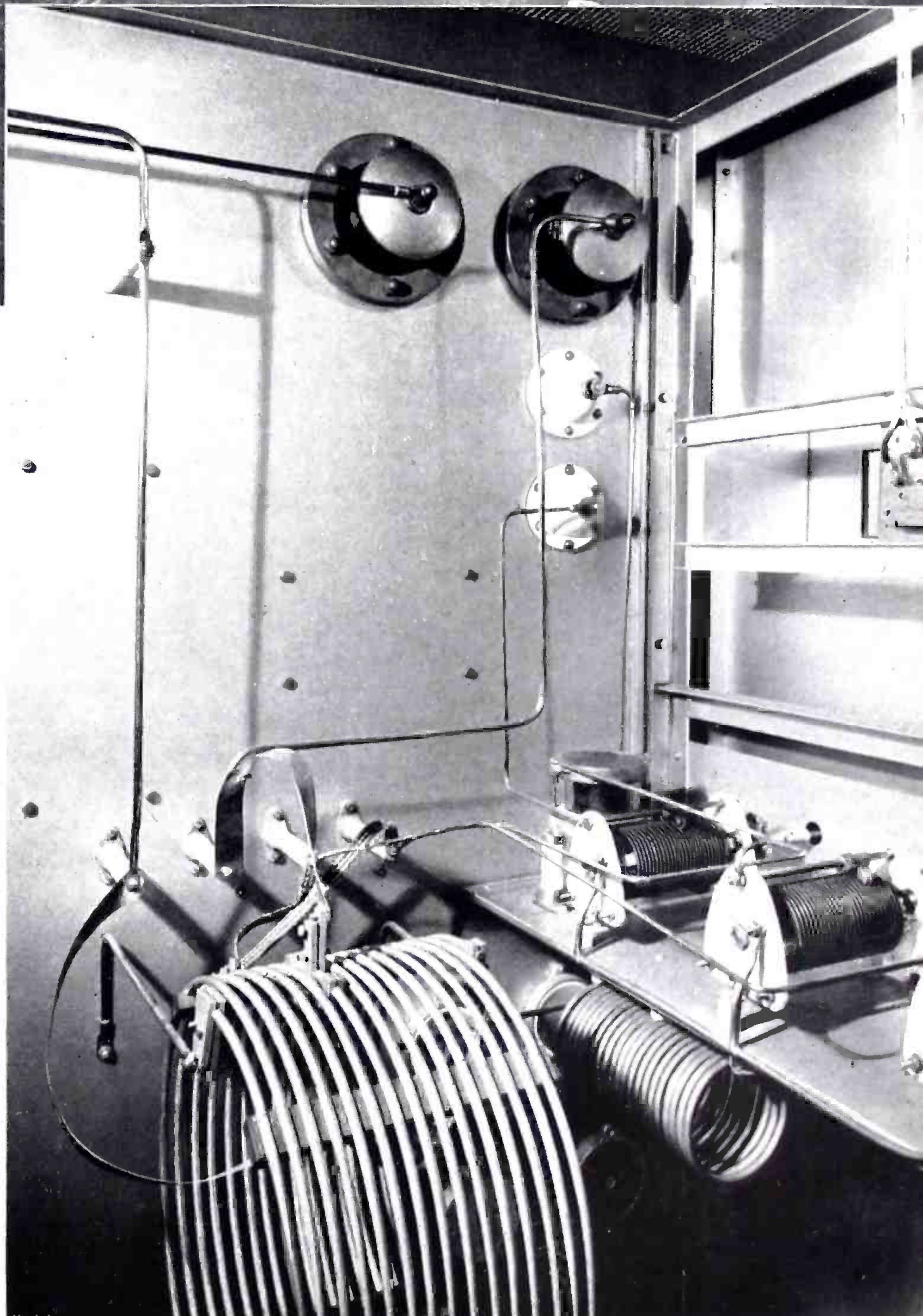


FIG. 30. (right) *Interior view of KMPC phasing network which is located directly behind the two left-hand panels in the view above (Fig. 25).*

MORE KMPC PICTURES

◀

Illustrations on opposite page

FIG. 25. (top, left) *Frequency, modulation and phase monitors mounted in right-hand compartment of KMPC's 10-E transmitter.*

FIG. 26. (top, right) *R-F exciter unit of the KMPC 50-E transmitter. Grounding stick and shelves for spare tubes are station ideas.*

FIG. 27. (bottom, left) *Rear of the 50-E transmitter. All doors are interlocked so personnel can enter this area.*

FIG. 28. (bottom, right) *KMPC uses concentric transmission lines which are protected by easily-removed wooden housing.*

KRON

THE FM SERVICE OF THE SAN FRANCISCO CHRONICLE

by R. A. ISBERG

Chief Engineer, KRON-FM, San Francisco

Significant of KRON-FM, the San Francisco Chronicle's FM station, has been the favorable reaction of critical listeners to the excellent quality and to the absence of noise. Reports have been received of reception at Stocton, Sacramento, and Monterey, 130 miles distant. Listeners reports are substantiated by actual distortion and fidelity measurements. To date, these measurements indicate that the performance of our 3 kilowatt RCA FM transmitter (see Figure 1) and associated equipment exceeds the published specifications. KRON's program policy is in keeping with the traditions of the San Francisco Chronicle, and only programs in good taste will be broadcast—with emphasis on classical and semi-classical music. Brief news summaries on the hour are featured and many programs are planned which feature live talent.

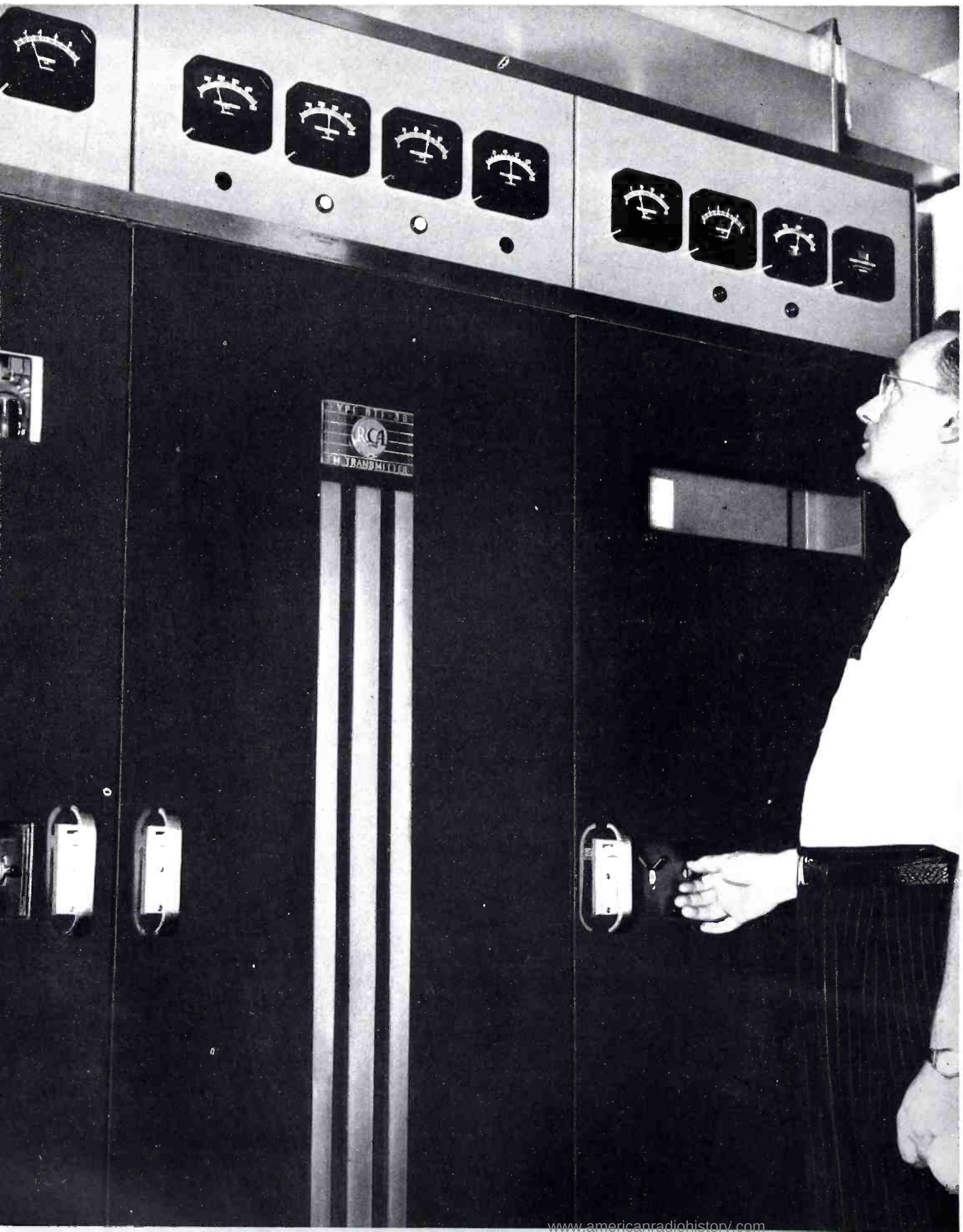


FIG. 1. (Left) *KRON's 3 kilowatt FM transmitter, RCA type BTF-3B, which is setting the standard for FM quality in San Francisco. The clean carrier and absence of noise has enabled FM dealers to demonstrate the superiority of FM. The transmitter is now located in the Chronicle building, a temporary site.*

STUDIO ACOUSTICAL TREATMENT

Another factor contributing to high-quality performance at KRON is the employment of the latest principles of acoustical treatment and sound isolation in the construction of the KRON-FM studios. This step was necessary since the studios are located in the San Francisco Chronicle building where printing presses are also located. Room within room construction was employed, and during construction, vibration and noise measurements were made to insure that the theoretical noise reduction was not compromised. The construction was supervised by the author, who also acted as architect.

Although the studios are located on the second floor between the press room and the stereotype room, both of which create an extraordinary amount of noise and vibration, the mechanical noise level in the studios is approximately 55 db below program level, except during peak operation of the printing plant when it increases to approximately 45 db below program level. This noise level has not been objectionable on the air since the entire printing plant is operated only a small percentage of the time; hence the usual background noise is limited to the ventilating noise which is —50 db below program level. The ventilating noise is chiefly caused by the turbulance of the air in the Anemostats, which are operated at a very low velocity. Other noise in the ducts is absorbed by duct linings and plate cells constructed from Air Acoustic sheets (as shown in Figure 3). The noise reduction through the plate cells was slightly greater than the theoretical values published in the American Society of Heating and Ventilating Engineers Guide.

The acoustical treatment, of the KRON sound isolation walls, is shown in the cross-sectional view of Figure 2. Announce studio A is a combination of Johns-Manville studio element and low frequency element behind splayed walls and ceiling. Perforated transite was used on the ceiling, which is specially supported as illustrated in Figure 4, and on the walls above the

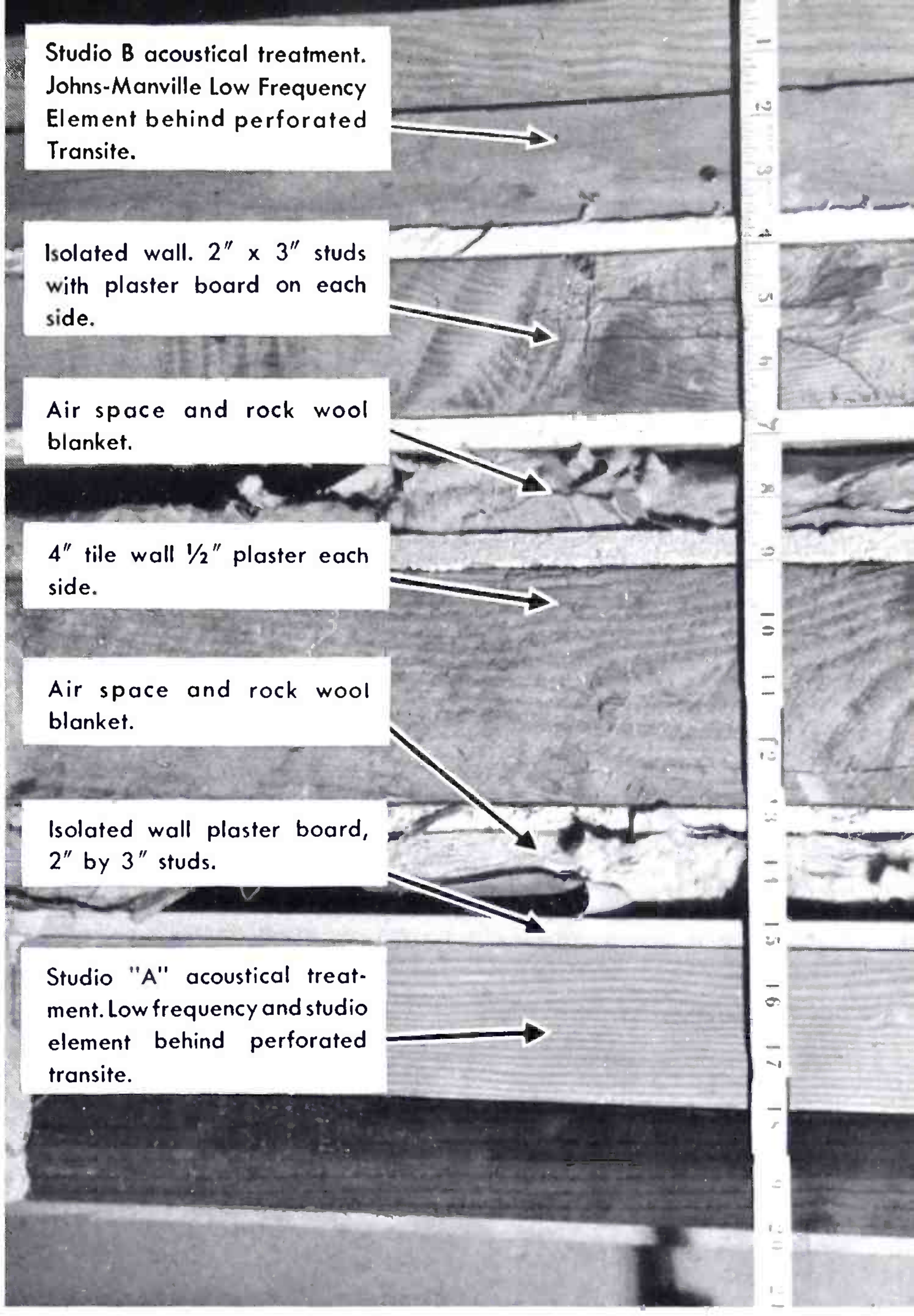


FIG. 2. (Above) *Cross-sectional view illustrating the acoustical treatment employed in the construction of KRON's Sound Isolation Walls.*

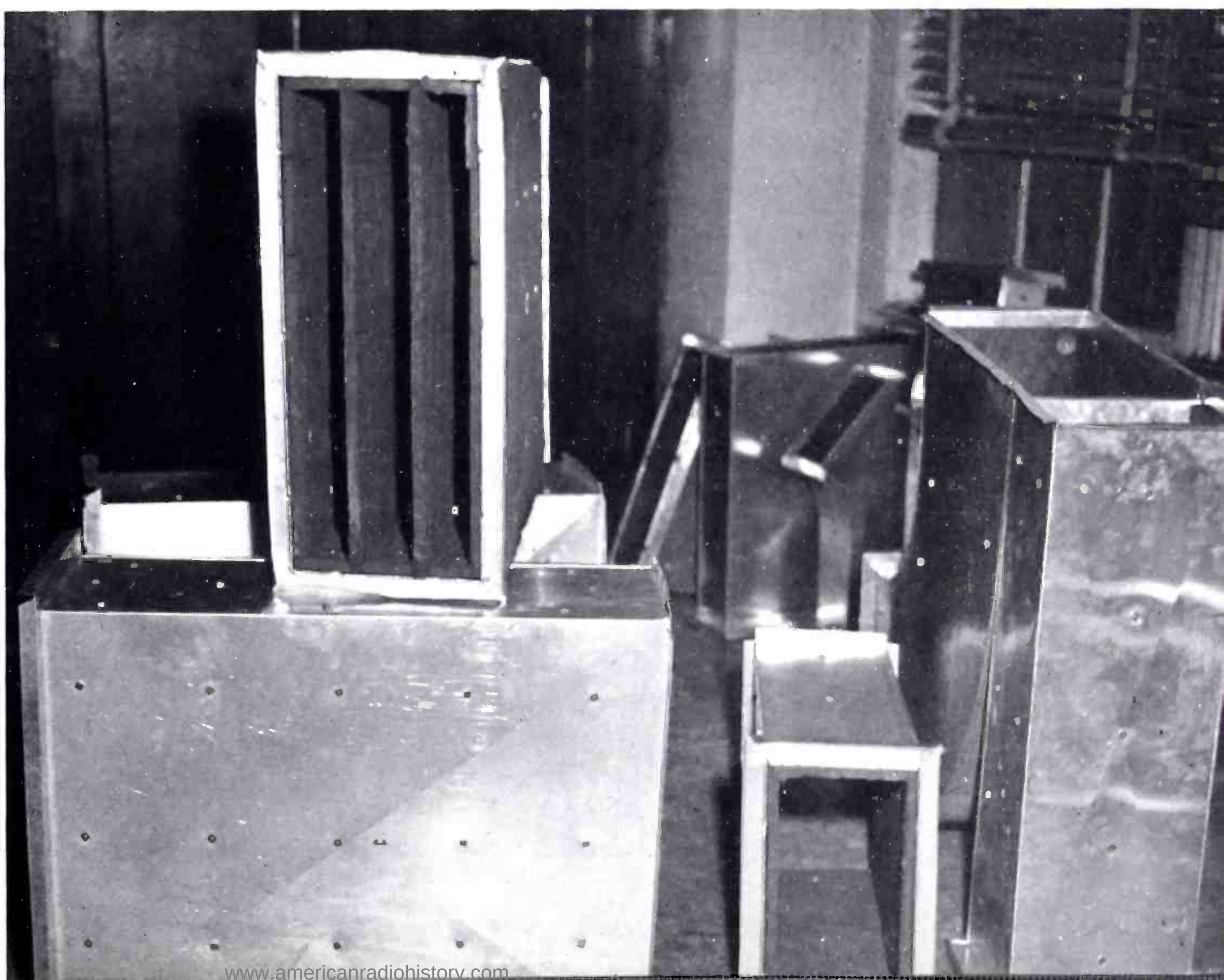


FIG. 3. (Right) *The ventilating ducts were lined with air acoustic sheets and the main air duct was divided into a three section plate cell. A plate cell 13 feet long in the main air duct used in conjunction with the duct linings effectively prevents sound transmission.*

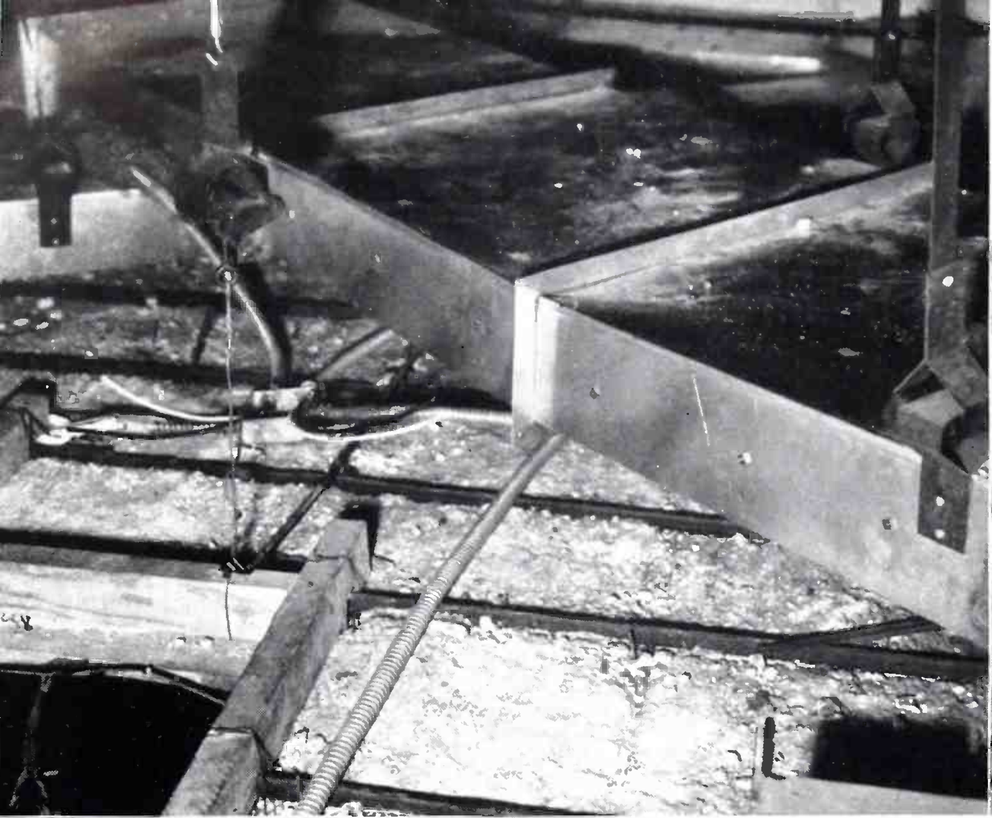


FIG. 4. (Left, Above) *The KRON ceilings are supported at their edges by the isolated walls, and by felt isolators attached to the concrete slab above. Ventilating ducts are similarly supported by felt isolators.*

FIG. 5. (Right, Above) *Polycylinders prefabricated from 1/8" tempered masonite over randomly spaced ribs were scribed to fit the ceiling contour. Half-round moulding strips were milled to cover nailing strips. Where Polycylinders were joined, masonite was counter sunk and perforated paper tape and Egyptian cement were used to cover cracks.*

FIG. 6. (At Left) *The KRON studio floors are concrete slabs floating on felt supported steel rails. The space under the slab is filled with granulated rock wool to absorb the sound of footfalls. Isolated studio walls rest on isolated floors.*

wainscote. Below the wainscote, hard board or unperforated transite was used. The reverberation time for the announce studio was calculated to be .5 second and essentially flat over the audible spectrum. The volume of this studio is 675 cubic feet and it was designed for occupancy by two persons. This studio is live and crisp and lacks the dull boomy quality which usually has been associated with announce studios. One typical comment was made by an announcer's wife, who said, "At last you really sound like yourself when you are on the air."

Large studio B is 21 feet x 24 feet x 9 feet which is a 1/3 octave relationship. The low ceiling height and utilization of available space between columns influenced the shape of this studio. The acoustical treatment includes polycylinders on three walls (the polycylinders used are shown in Figure 5), panels of Johns-Manville studio element behind perforated transite alternating with polycylinders on the ceiling, and Johns-Manville low frequency element in two strips above and below the windows on the wall adjacent to the control room. This studio is live and its quality on voice and music is very pleasing. The reverberation time is calculated to be .6 seconds.

The floors in both studios are linoleum covered concrete slabs floating on felt isolators (see Figure 6). The mass of the floor and its loading was chosen so that its natural period of vibration would be lower than the predominant vibration frequencies of the building. Only one heavy newspaper machine has been isolated from the building structure and this was a 30-inch power driven paper cutter. It was mounted on U. S. Rubber Co. Permacel pads and its isolation has been very successful.

KRON's CONTROL ROOM SETUP

As may be noted from the floor plan of Figure 7 and the photo of Figure 8, Studio "A" is presently being used as a combination control room and announce booth. Equipment consists of an RCA 76-B4 Consolette, two RCA 70-C Turntables mounted side by side, and the usual RCA microphones. Glides were at-

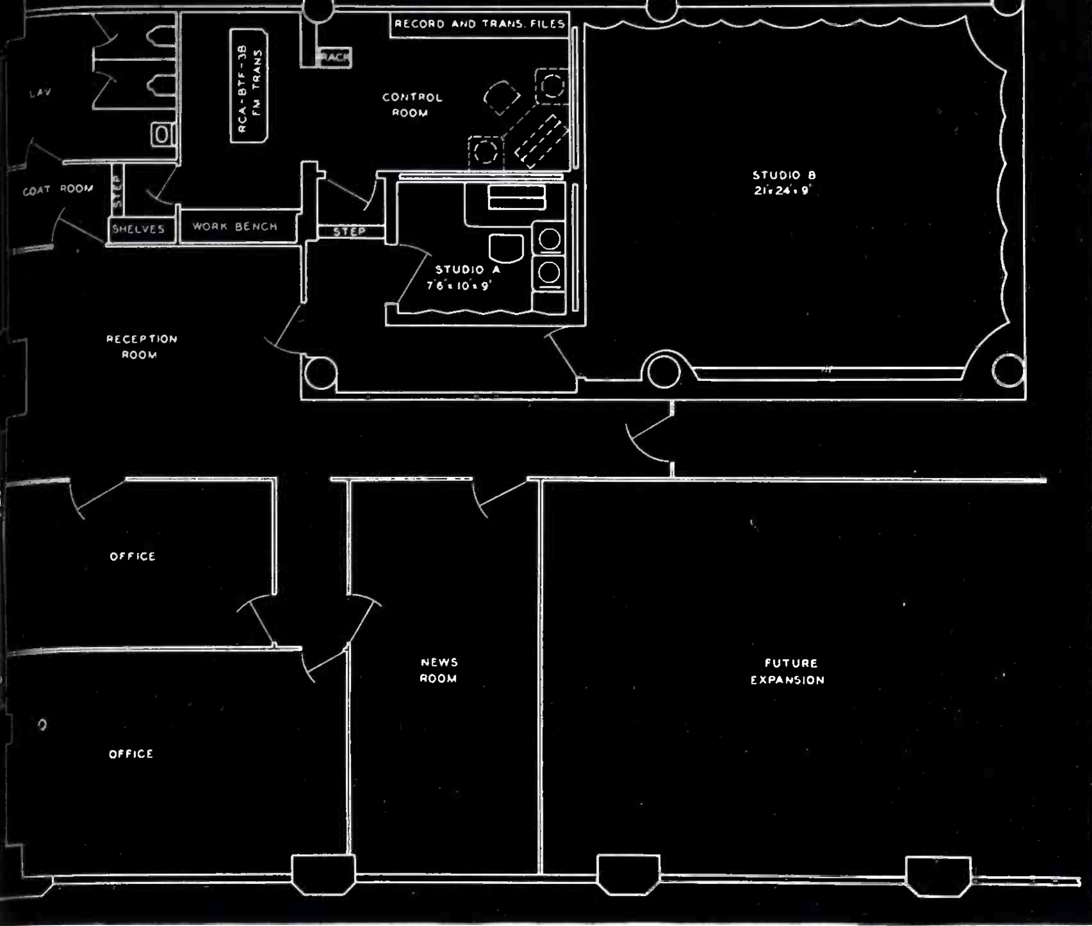


FIG. 7. (Above) *Floor plan of KRON. When the FM transmitter is moved to its permanent site, the studio "A" control equipment will be installed in the main control room. Record and transcription files will then move into the present transmitter room.*

FIG. 8. (Above, Right) *View of a corner of studio "A" which is presently being used as a combination control room and announce booth. Note the push button installed, in the finger rest of the 70-C4, for cuing records. An auxiliary amplifier and speaker permit cuing without disturbing program controls.*

FIG. 9. (At Right) *Looking into studio "B" from the main control room which is designed to control both studios. Equipment consists of an RCA 76-B4 consolette, two 70-C turntables and RCA microphones. Large double plate glass windows are used to provide good visibility into studios.*

tached to the base of the Consolette so that it can be readily moved forward on the table for servicing. The cable form was laced so that it hinges, thus facilitating the movement of the Consolette. The power supply was likewise mounted on glides and can easily be moved out from under the table for servicing. The Studio 'A" control equipment will be moved to the main control room after the FM transmitter is installed at its new and permanent site. Transcription and record files will then be moved into the space the FM transmitter now occupies.

The main control room, which is designed to control both studios, is on a raised platform and excellent visability into the studios is afforded by large double-plate glass windows (see Figure 9). The transcription files are also located in this control room, thus facilitating their filing and also providing storage in a dust-free room. The air coming into the studios and control room is filtered and electrostaticaly precipitated. This was deemed advisable because of the prevalence of paper dust, ink and smoke which would soon soil the ceilings around the Anemostats and collect on the records and thus increase their surface noise. An air exhaust duct attached to the top of the transmitter and connected into the studio exhaust system effectively removes the heat from the control room.

The grounding system is particularly worthy of mention since very little "R. F. in the audio" trouble was encountered in spite of the fact that the BTF-3B transmitter is located within 15 feet of the Consolette. The microphone cables are twisted pairs shielded and rubber covered and pulled through Greenfield. The shields are grounded only at the input terminals of the Consolette. A 4-inch wide strip of 1/32 inch copper connects from the Consolette to a 4-inch water main which is about 3 feet from the transmitter. As a further precaution, the cathodes, filaments, grid and plate returns and 115 v. a. c. line into the BA-2B Booster amplifiers for the turntable were also bypassed with 100 mmf ceramicon capacitors.

FM TRANSMITTER INSTALLATION

The 3 kilowatt FM transmitter, type BTF-3B, as now installed in the Chronicle building, faces the main control room (see floor plan). Adequate working and walk-around space was provided behind the transmitter. Special care was taken throughout the installation to see that adequate grounds were used in order to avoid the possibility of circulating r-f currents. The 3 KW transmitter is grounded to a water main (as was the Consolette described earlier) by means of a 4-inch wide strip of copper which was installed between the cubicles of the transmitter and transmitter base. Two ground busses connecting to this copper strip were installed in the transmitter, one connecting to the exciter and the other to the two 7C24 plate tanks. The paint around the bolt holes in the end shield and the door hinges was removed thus insuring a good contact between the shield and the transmitter frame. The exciter ground was installed during the course of noise and distortion measurements and reduced the carrier noise about six db.

The 3 KW FM transmitter (see Figure 10) which is being operated at the Chronicle building on an interim basis will later be moved to a higher location. The interim antenna is a composite 6-bay turnstile which has a theoretical power gain of 4.3. It is mounted on a guyed 73-foot surplus tower and although its height is only 150 feet above sea level, reception may be had anywhere in the bay area.

Even though the wiring of the transmitter was done by electricians who were unfamiliar with it, not one misconnection was made. The only adjustments made by KRON personnel and R. J. Newman, San Francisco RCA Engineering Products sales representative, were in accordance with the instruction manual. This is indeed a tribute to the care in engineering, manufacturing, and the writing of the instruction manual. During the two-month period that KRON-FM has been in operation, no air time has been lost and no erratic operation has been experienced. The fact that the carrier is so clean has been a delight to the engineering staff.

FIG. 10. (Left) *A partial view, taken during installation, of the 3 kw RCA FM transmitter. Chief Engineer R. A. Isberg is shown holding an anode connector for one of the 250-watt driver tubes just installed. I.P.A. and Final amplifiers are located in the same left hand cabinet. The cabinet at the right houses the direct FM exciter and its power supply. The high-voltage power supply and control circuits are in the extreme right-hand cabinet (not shown in this view).*

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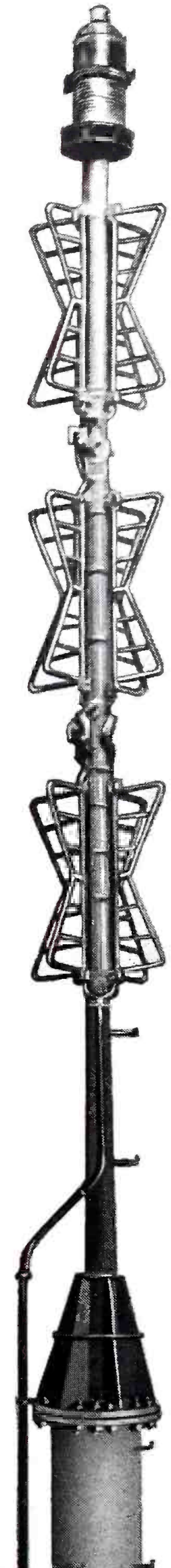

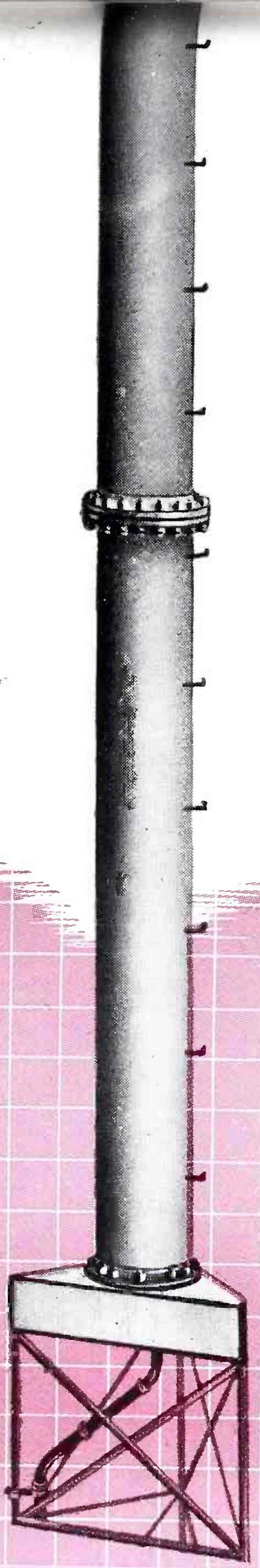

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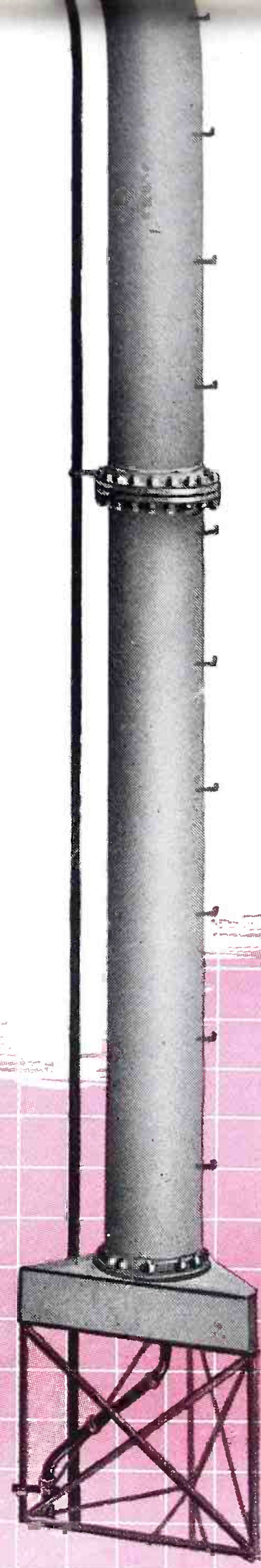

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88-96	6	4	54	10,497	BF-14C
96-108	6	4	54	10,497	BF-14D
TELEVISION SUPER TURNSTILES (for installation on Heavy-Duty Pylons)					
55-66	3.3 to 3.7	3	56′ 3″	4,666	TF-3B
66-88	3.3 to 4.1	3	48′ 1″	3,120	TF-3B
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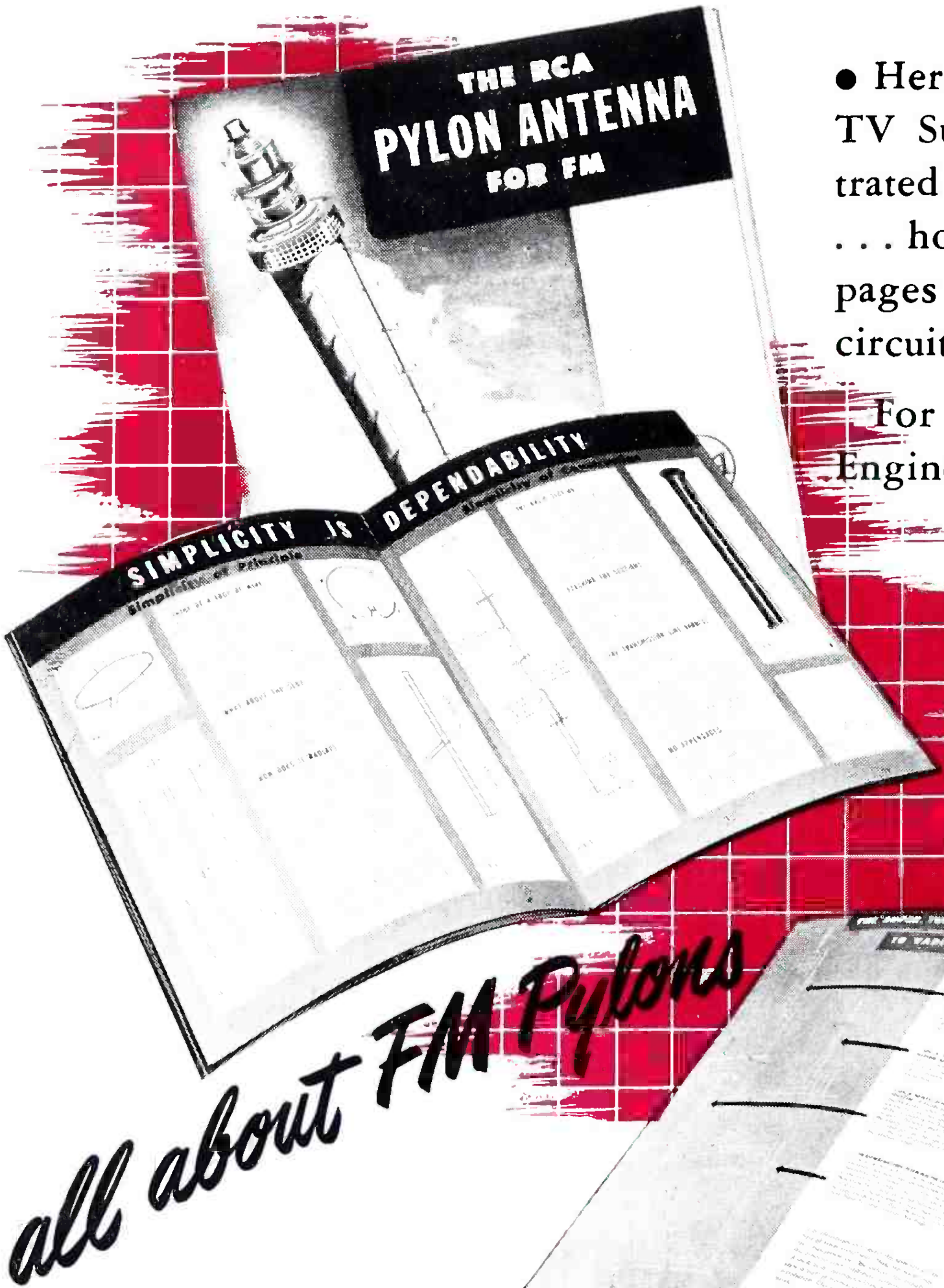

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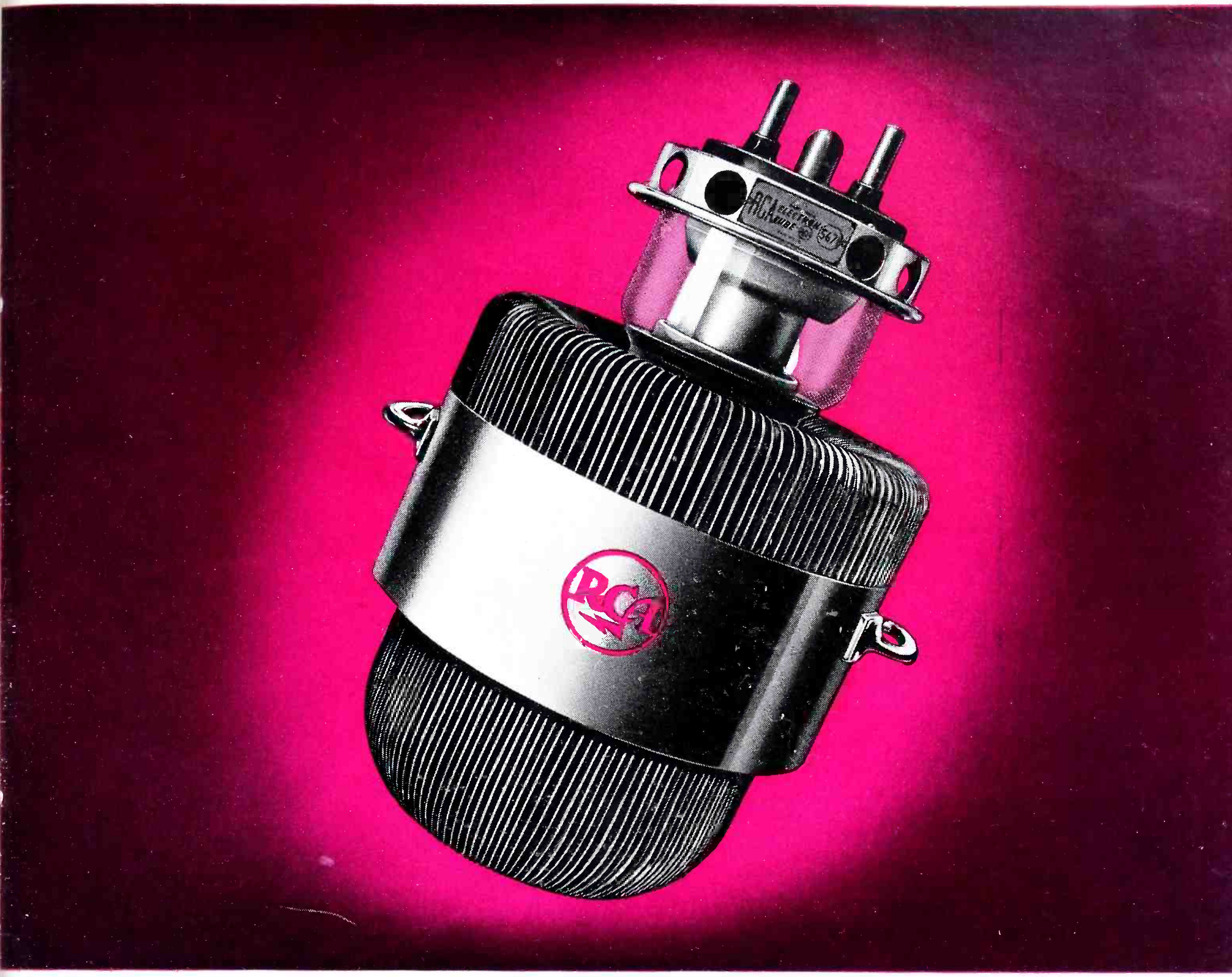

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