



Equipment for Television Broadcasting Systems

FM-TELEVISION-AM
GENERAL  ELECTRIC



TELEVISION BROADCASTING

It is the belief of the General Electric Company that television will come to many cities in this country soon after the war. This belief is based on our evaluation of the technical state of the art and on our conviction that television will become the great new home-entertainment industry of the post-war period.

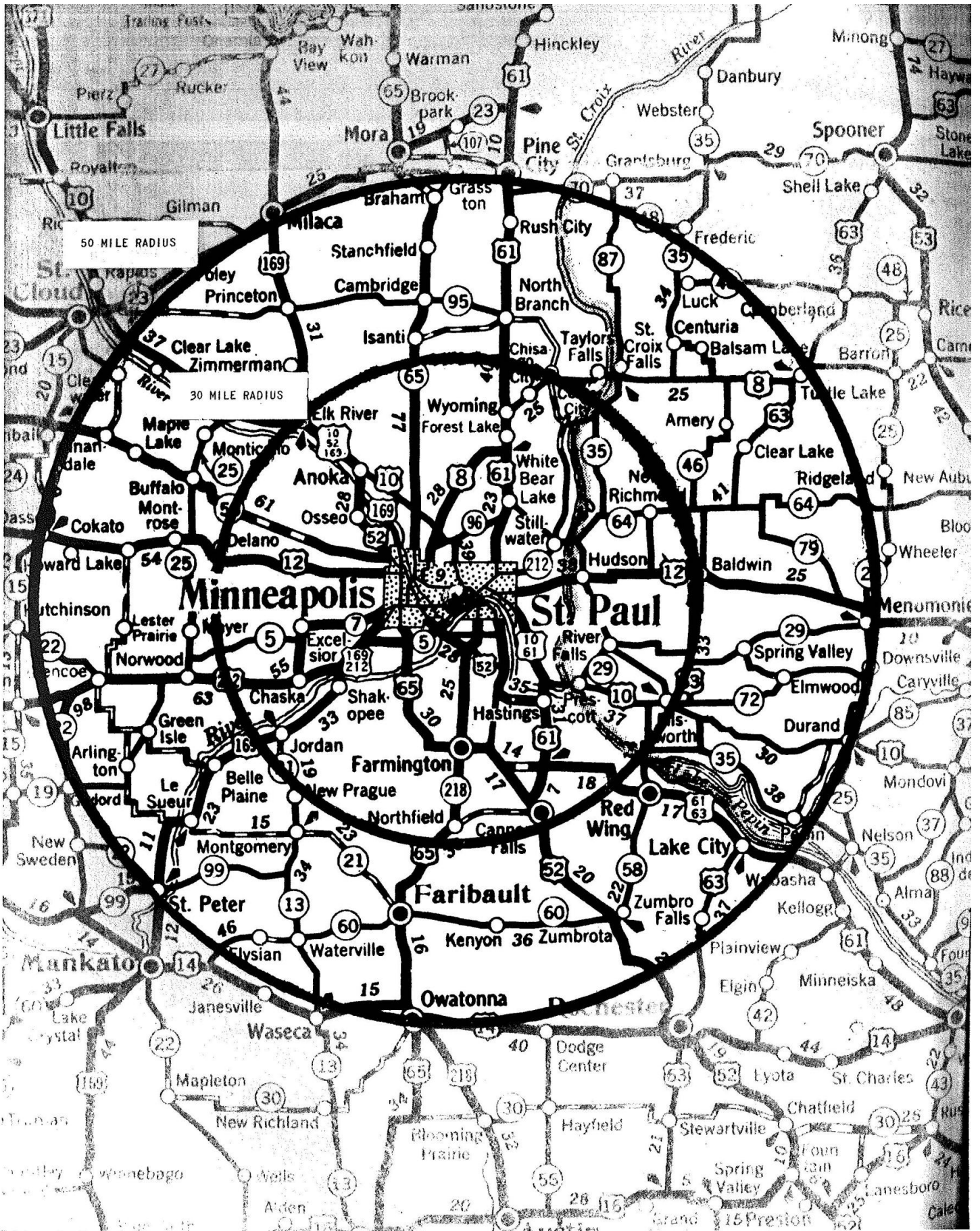
The National Status of Television Today

Television stations are now in operation in Chicago, Los Angeles, New York City, Philadelphia, and in Schenectady, broadcasting live talent and film programs on regular schedules. The stations in these cities are bringing television entertainment to many thousands.

Stations already are planned or being planned for San Francisco, Detroit, Boston, Denver, Cleveland, Salt Lake City, Milwaukee, Washington, D. C., and a number of other cities. These stations will be established as soon as broadcasting equipment again becomes available.

Station WRGB -- General Electric's Proving-Ground Station

In 1941, the present General Electric television station was built at Schenectady to test in a practical manner both television equipment and operating techniques. As a result of the work done at WRGB, a wealth of data on programming and station operation is available to those planning to enter the business of television broadcasting. The work of WRGB has attracted national attention, and today a number of advertisers and advertising agencies are experimenting at Schenectady with product commercials.



ESTIMATED COVERAGE OF A TELEVISION STATION

The map illustrates the coverage which might be expected with a television station located in the Twin Cities. The circles, representing radii of 30 and 50 miles, on the map show the approximate coverage with television transmitters of the two standard ratings -- 4 kilowatts and 40 kilowatts.

An empirical formula which is sometimes used in the calculation of approximate coverages for ultra-high-frequency radio stations is:

$$R = \sqrt{\frac{W (h_1 h_2) (f) 10^{-2}}{E}}$$

In this formula, R is the radius of coverage in miles; W is the average carrier power in watts; h_1 and h_2 are the height in feet of the transmitting and receiving antennas respectively; f is the frequency of operation in megacycles; and E is the desired minimum signal in microvolts.

Assuming a minimum signal of 100 microvolts, an operating frequency of 60 megacycles, antenna heights of 350 and 30 feet, and a carrier power of 1 kilowatt (4 kilowatts peak), the calculated radius of coverage is approximately 44 miles.

Using the same assumptions as those above except that the carrier power is 10 kilowatts (40 kilowatts peak), a radius of coverage of approximately 79 miles may be expected.

These radii of coverage are usually not obtained in actual practice because they assume that the ground is a flat plane. Under actual conditions, radii of the order of two-thirds of the figures given above should be used for estimating purposes. The range of the 4-kilowatt transmitter is estimated to be 30 miles, with a coverage of about 2900 square miles. The range of the 40-kilowatt transmitter is estimated to be 50 miles, and its coverage, about 7500 square miles. These figures are presented as approximations only since the actual coverage can be determined only by an engineering survey.

EQUIPMENT FOR TELEVISION STUDIO AND CONTROL ROOM

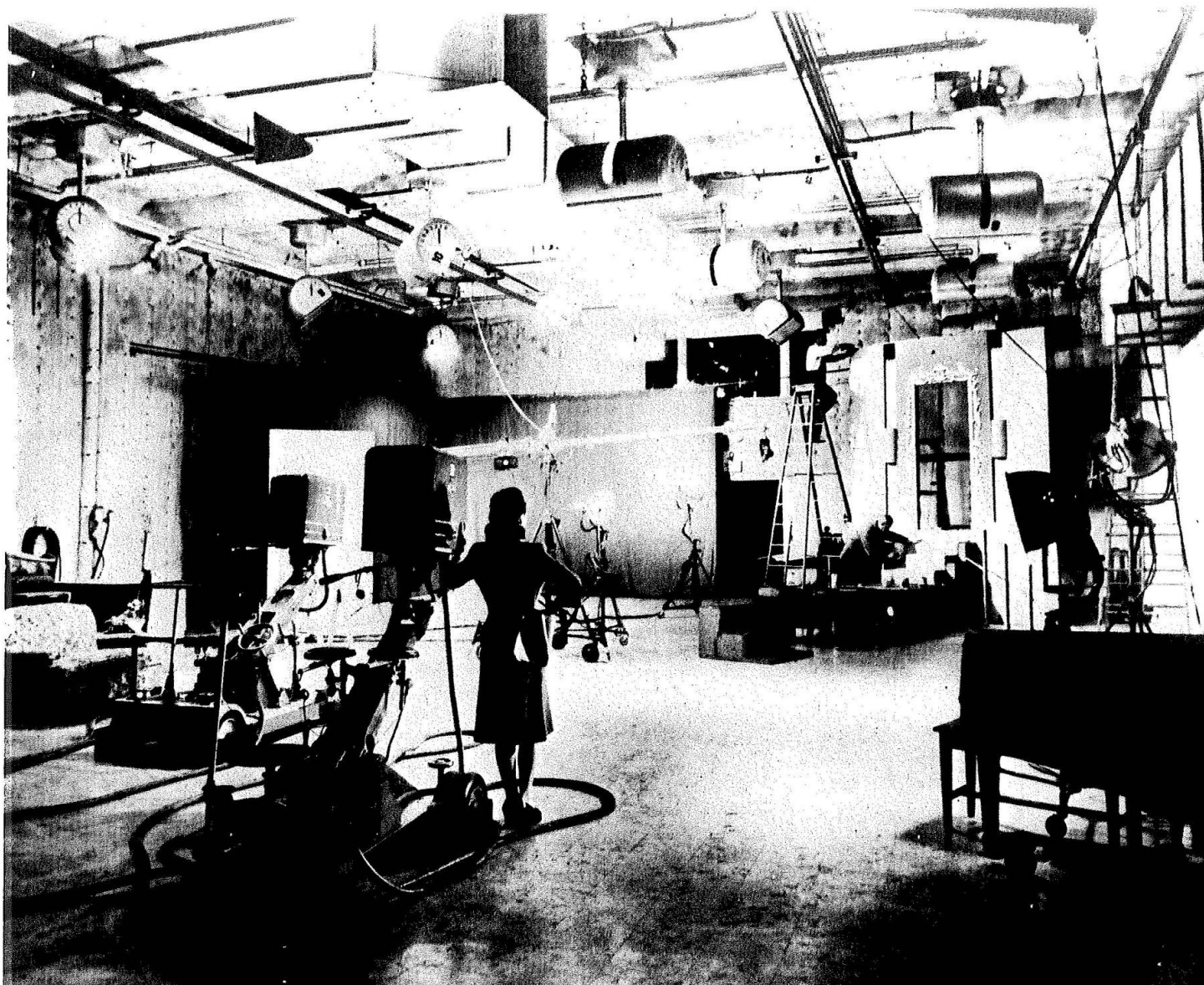
The picture on the opposite page shows the main studio of Station WRGB. The essential equipment, other than sound proofing, air conditioning, scenery, and lighting, includes studio cameras, microphones, microphone booms and stands, and the necessary interconnecting cables.

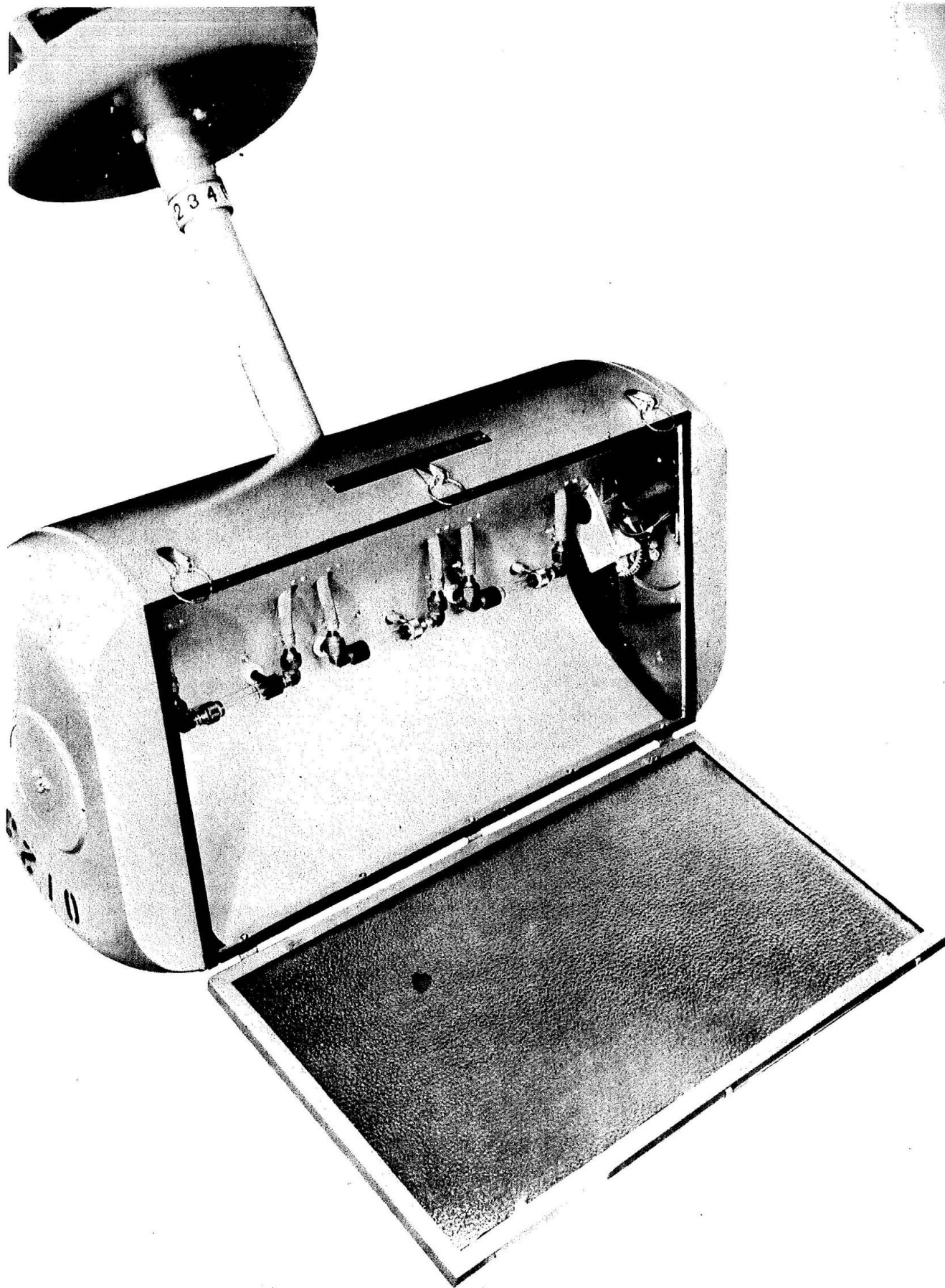
The studio cameras are mounted on dollies to allow rapid movement throughout the studio. With the present design of dolly the cameraman rides the mount while a second man guides the dolly into position and elevates or depresses the mount. Tripod mountings may also be used for scenes from fixed locations.

The microphone rarely appears in the television picture. For most scenes one microphone mounted on a boom is sufficient. The boom is operated by one man who controls the placement of the microphone at all times.

Earphones are provided for the cameramen, dolly operators and boom operator so that they may receive instructions from the director in the control room.

The control room equipment is described on the next page.





MERCURY-VAPOR STUDIO LIGHTING

General Electric first exhibited its water-cooled mercury-vapor lamps for television studio lighting at the New York World's Fair in 1939 and made a complete installation in the studios of Station WRGB in the fall of 1941. At the present time twelve 3-kw remote-controlled ceiling units (see opposite page) are used, as well as four portable 3-kw water-cooled mercury-vapor floor lamps.

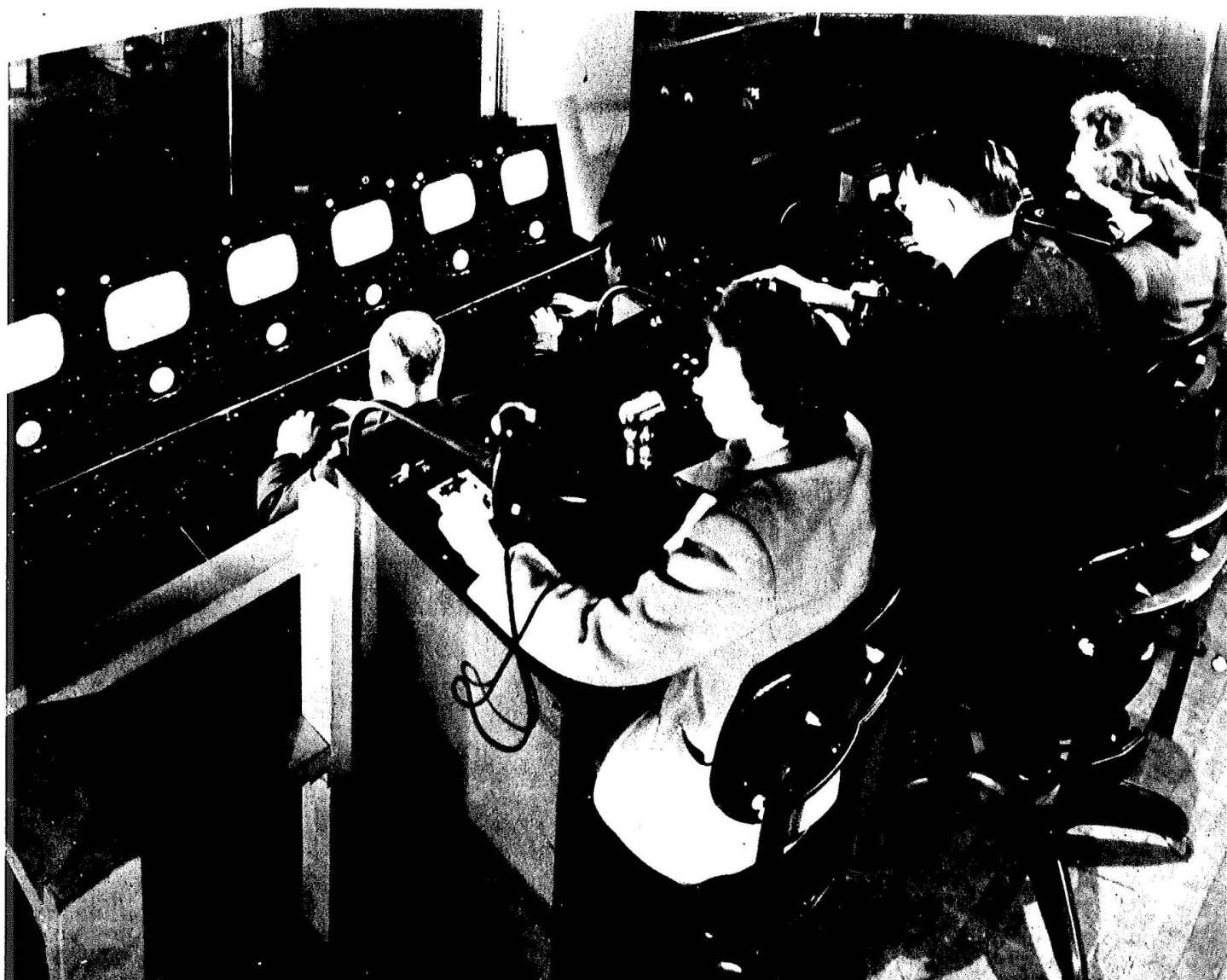
Proper lighting of a studio scene requires a high intensity of illumination. The mercury-vapor lamps installed at Station WRGB make it possible to provide a lighting intensity of several hundred foot-candles.

Before the introduction of the water-cooled mercury-vapor lamps, incandescent lamps were generally used for television studio lighting. These latter units generated a great deal of heat and thereby caused great discomfort to performers. The water-cooled mercury-vapor light, however, allows a higher intensity of lighting without the resulting heat. Boxing and wrestling matches are regularly held in the studios of Station WRGB, and although a very high intensity of illumination is employed the participants experience no discomfort.

To provide extreme flexibility in lighting the studio the General Electric mercury-vapor lamps are provided with remote control which allows them to be turned and tilted over wide angles. The remote-control console can be located in the control room, thereby giving the director instantaneous command of the lighting at all times.

The high efficiency of these units allows a lower operating cost than would be attained by incandescent lighting for an equivalent level of illumination.

It is expected that in the post-war period many television studios will employ this G-E mercury-vapor lighting.



EQUIPMENT FOR TELEVISION CONTROL ROOM

The control room is located so that the directors and the operators of the control equipment have a full view of the studio. On the opposite page is shown the television control room at Station WRGB. Seated at the elevated consoles are the program producer, the technical director, and the audio operator. On the lower level the shading- and picture-control operators are seated before the monitoring picture tubes. In this installation six monitors are available - one for each of the three cameras on the studio floor, two for the projection room cameras, and one for the picture being broadcast.

The program and technical directors and the audio operator have intercommunication microphones immediately available for communication with the cameramen, dolly operators, and microphone boom operators on the floor of the studio as well as the projectionist in the projection room. The technical director has complete facilities on his console for remote starting of the motion picture projectors and the switching of cameras both on the studio floor and in the projection room. The audio operator controls the level of the sound pick-up of the microphones in the studio. Transcription and recording equipment are also available for use by the audio operator.

The two shading - and picture-control operators on the lower level have complete control facilities available for maintenance of picture quality from all of the studio and projection-room cameras.

Located back of the program and technical directors' consoles are the equipment racks containing power supplies, synchronizing signal generators, camera amplifiers, and audio equipment.

All apparatus is attractively styled and designed for ease of operation and maintenance. Camera monitoring consoles may be added to the system at any time without modification of other equipment.

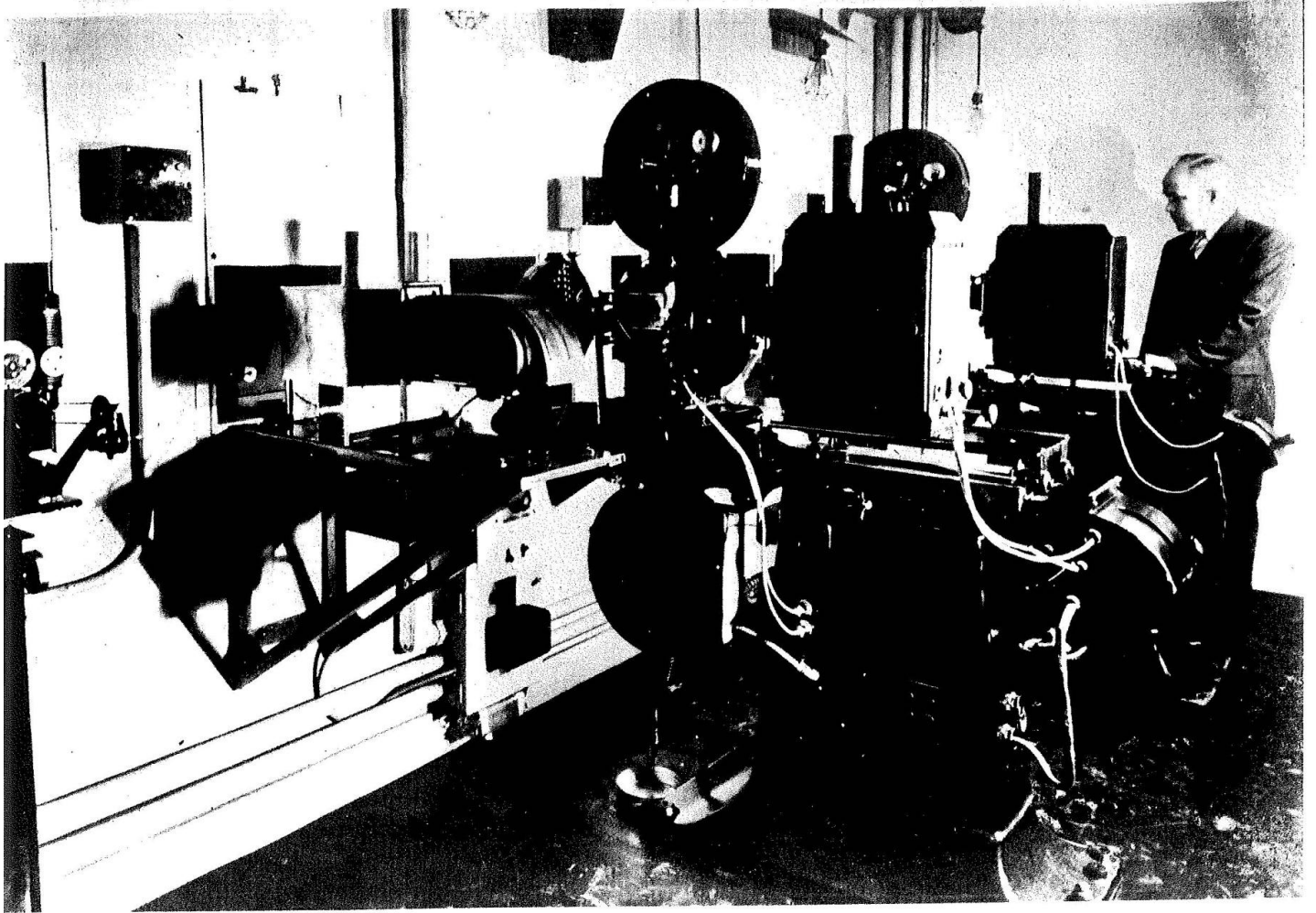
PROJECTION ROOM EQUIPMENT

The picture on the opposite page shows the projection room at Television Station WRGB. On the right are two 35-millimeter sound-on-film projectors. The cameras which are used to pick up the projected image are visible through the openings in the wall.

The projectors are de luxe models designed for high-quality theater projection. Extensive modifications, however, are made to allow these units to be used for television projection. These modifications include special shutters and film-drive mechanisms.

Normally two projectors are used so that multi-reel film features may be projected without interruption.

In addition to the 35-millimeter film projectors at Station WRGB, a combined slide and postcard projector is used for titling. Facilities are also available for the projection of 16-millimeter film.



TELEVISION RELAY EQUIPMENT

The WRGB studio is located in downtown Schenectady and the transmitter is located high in the Helderberg mountains 12½ miles away.

A radio relay system has been set up for the transmission of both sound and picture from the studio to the main transmitter. These facilities provide economical transmission of both the picture and the high-fidelity sound over a long distance without the use of wire lines and coaxial cables.

The equipment for this system incorporates specially designed low-powered transmitters and receiver units with directional antennas. The system operates at ultra-high frequencies and provides a link unequalled for quality and reliability.

The studio-to-transmitter voice and picture relay transmitters and the transmitter monitor are small and compact. They are located in the control room at WRGB. (Upper right and left illustrations.) The directional antennas (lower left) are mounted on a tower immediately outside the studio. The picture and voice signals are beamed at separate receiving antennas at the main transmitter and go through receiver-converters to the main transmitter.

TELEVISION'S FIRST NETWORK

Programs originating in New York City are regularly broadcast by WRGB, 129 miles away. As the programs are broadcast from the Empire State Building, they are picked up by special receiving equipment at the General Electric relay station and transmitted to the main WRGB transmitter 1½ miles distant. From this point they are broadcast to the Albany-Schenectady-Troy area.

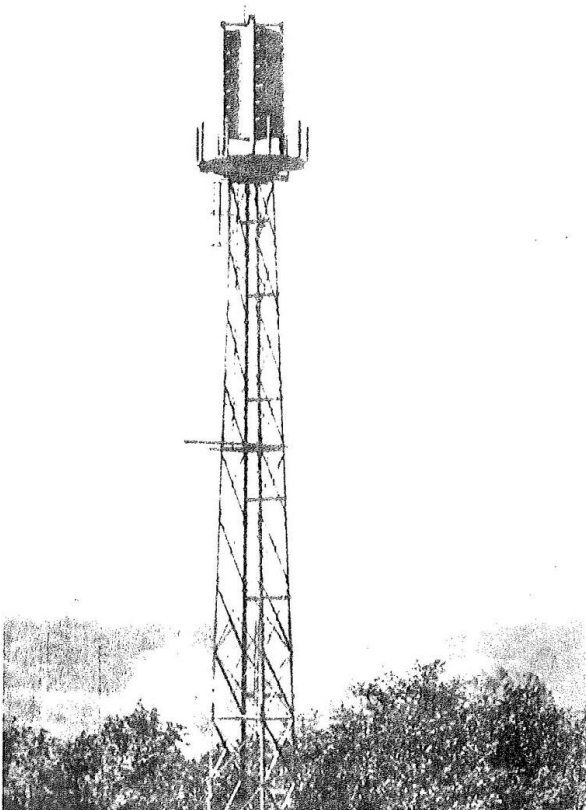
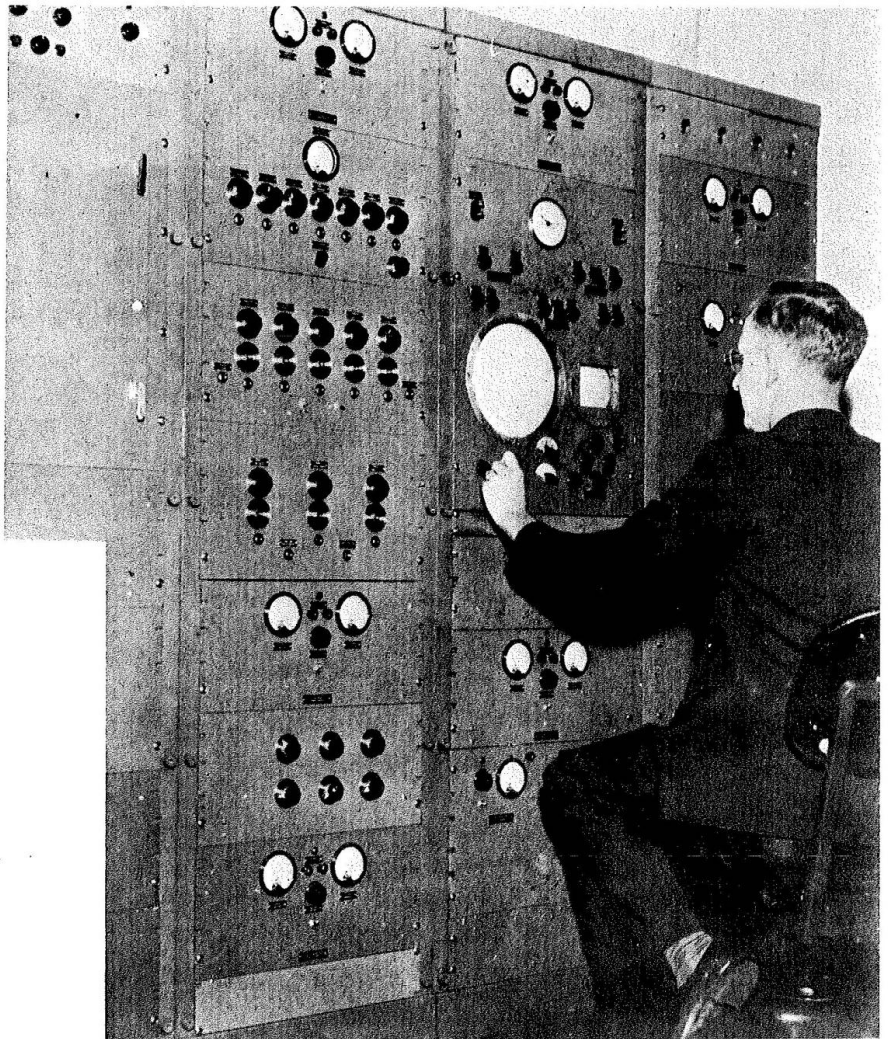
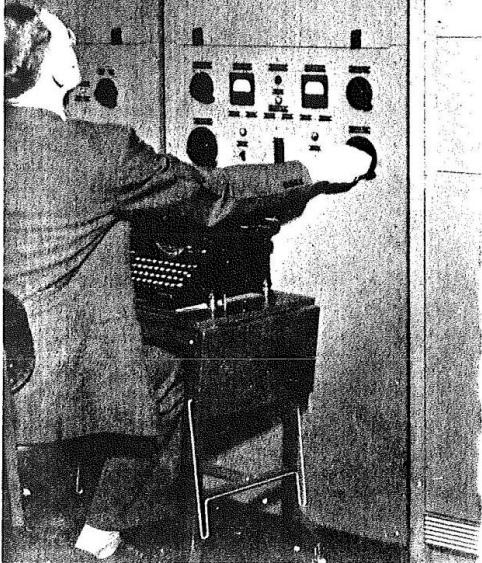
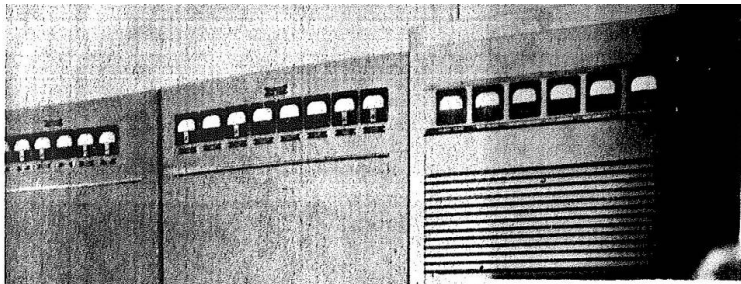
This relay system was engineered and developed by General Electric. It has been in regular operation since its installation in 1940 and is the pioneer television network in the country.

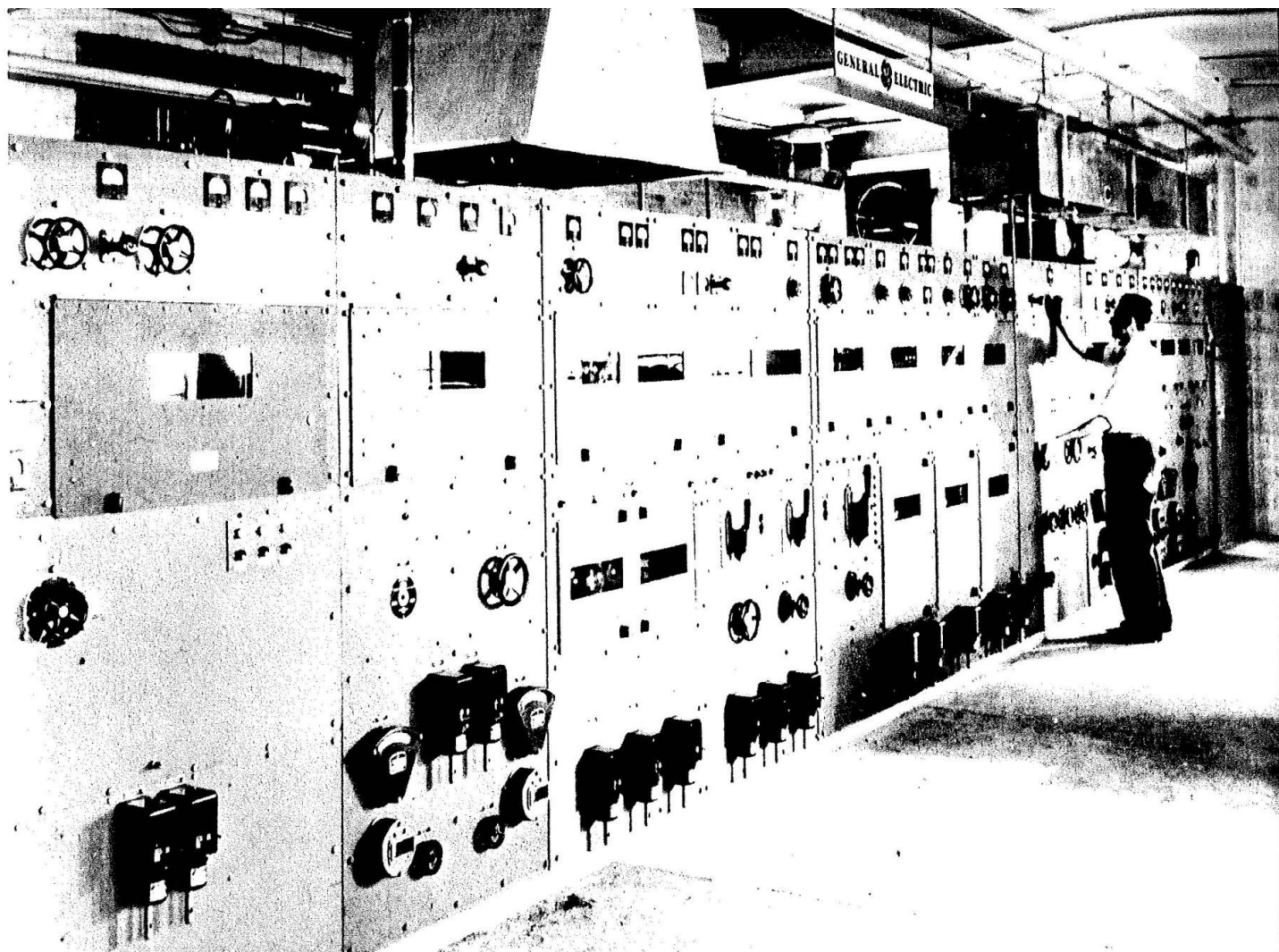
PORTABLE PICK-UP EQUIPMENT

Portable pick-up equipment makes it possible for television stations to broadcast news and special events of all types. After the war this type of equipment will be extensively used by both large and small stations.

Portable pick-up equipment beams picture and sound from the scene of action to the station's main transmitter for re-broadcast to the station's audience.

Portable equipment includes a specially designed truck with two portable cameras, microphones and audio equipment, monitoring and control apparatus, low-powered picture and sound transmitters, and antennas.





PICTURE AND FM SOUND TRANSMITTERS

The photograph on the opposite page shows the 20,000-watt FM sound Transmitter and the 40,000-watt picture transmitter now in use at Station WRGB. The sound transmitter occupies the first three racks, starting from the extreme left of the picture. The picture transmitter occupies the remaining racks extending to the right of the picture.

The 2000-watt FM sound transmitter will occupy two racks, and the 4000-watt picture transmitter will occupy three racks.

S U M M A R Y

EQUIPMENT FOR A 40-KW TELEVISION SYSTEM

- 2 - Studio Camera Channels (each including camera tube and amplifiers, dolly, plugs, and cable, camera sweep generator, video amplifier, monitor console, shading and camera control equipment, distribution and mixing panel).
- 2 - Motion Picture Channels (each including 35-mm projector, film rewinder, splicer and accessories, plugs and cable, pick up camera, mount and tube, sweep generator, video amplifier, monitor console, shading and camera control equipment, distribution and mixing panel).
- 1 - Basic Studio Equipment (including synchronous pulse generator microphones, boom, transcription turntables, audio control panel, line amplifier unit, cables and plugs).
- 1 - 40-Kilowatt Visual and 20-Kilowatt Aural Transmitter, including tubes.

Visual and Aural Antennas, transmission line, miscellaneous test equipment (does not include antenna supporting structure).

Installation engineering, Transportation.

EQUIPMENT FOR A 4-KW TELEVISION SYSTEM

- 2 - Studio Camera Channels (each including camera tube and amplifiers, dolly, plugs and cable, camera sweep generator, video amplifier, monitor console, shading and camera control equipment, distribution and mixing panel).
- 2 - Motion-Picture Channels (each including 35-mm projector film rewinder, splicer and accessories, plugs and cable, pick-up camera, mount and tube, sweep generator, video amplifier, monitor console, shading and camera control equipment, distribution and mixing panel).
- 1 - Basic Studio Equipment (including synchronous pulse generator, microphones, boom, transcription turntables, audio control panel, line amplifier unit, cables and plugs).
- 1 - 4-Kilowatt Visual and 2-Kilowatt Aural Transmitter, including tubes.
- 1 - Visual and Aural Antennas, miscellaneous test equipment (does not include antenna supporting structure).

Installation engineering, Transportation.

STUDIO-TO-TRANSMITTER OR POINT-TO-POINT RELAY EQUIPMENT

Visual Transmitter and Receiver

Aural Transmitter and Receiver

Antennas

Installation Engineering, Transportation

ACCESSORY EQUIPMENT

Additional Studio Camera Channels

Additional 35-mm Film Channels

Mercury-Vapor Studio Lights

3-Kilowatt Mercury-Vapor Ceiling Lights (including remote-control equipment, wiring, water system and installation)

16-mm Motion-Picture Projector

(for use with 35-mm film channel)

Visual-Frequency Monitor

Visual-Modulation Monitor

Aural-Frequency Monitor

(includes aural-modulation monitor)

PORTABLE PICK-UP EQUIPMENT

2 - Visual Channels (including two cameras, cables, synchronous pulse generator, visual transmitter and receiver, control and monitoring equipment).

2 - Aural Channels (including microphones, amplifiers, cables, aural transmitter and receiver).

1 - Truck, antennas, gas-engine power supply.

Electronics Department
GENERAL  ELECTRIC
SCHENECTADY, N. Y.

TELEVISION BROADCASTING EQUIPMENT

PRE-WAR PRICES

These prices do not necessarily reflect the cost of television equipment after the war. Before the war, television apparatus was manufactured on a custom-built basis, and only a few installations were made before the war stopped all further construction. After the war, many broadcasters plan to install television equipment as soon as it can be built. It may then be possible to realize the economies of quantity production. Therefore, the prices given here are only approximations.

In addition to the cost of necessary apparatus provision must be made for the construction of studio and transmitter buildings and antenna supporting structures. These costs will, of course, vary, depending whether existing facilities are modified or whether new buildings are built.

FM - TELEVISION - AM

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EQUIPMENT FOR A 40-KW TELEVISION SYSTEM

2 - Studio Camera Channels (each including camera tube and amplifiers, dolly, plugs, and cable, camera sweep generator, video amplifier, monitor console, shading and camera control equipment, distribution and mixing panel) at \$14,850.00 each	\$ 29,700.00
2 - Motion Picture Channels (each including 35-mm projector, film rewinder, splicer and accessories, plugs and cable, pick up camera, mount and tube, sweep generator, video amplifier, monitor console, shading and camera control equipment, distribution and mixing panel) at \$24,200.00 each	48,400.00
1 - Basic Studio Equipment (including synchronous pulse generator microphones, boom, transcription turntables, audio control panel, line amplifier unit, cables and plugs).	10,900.00
1 - 40-Kilowatt Visual and 20-Kilowatt Aural Transmitter, including tubes.	150,000.00
Visual and Aural Antennas, transmission line, miscellaneous test equipment (does not include antenna supporting structure).	10,000.00
Installation engineering, Transportation	6,000.00
Pre-War Selling Price	\$255,000.00

EQUIPMENT FOR A 4-KW TELEVISION SYSTEM

2 - Studio Camera Channels (each including camera tube and amplifiers, dolly, plugs and cable, camera sweep generator, video amplifier, monitor console, shading and camera control equipment, distribution and mixing panel) at \$14,850.00 each	\$ 29,700.00
2 - Motion-Picture Channels (each including 35 mm projector film rewinder, splicer and accessories, plugs and cable, pick-up camera, mount and tube, sweep generator, video amplifier, monitor console, shading and camera control equipment, distribution and mixing panel) at \$24,200.00 each	48,400.00
1 - Basic Studio Equipment (including synchronous pulse generator, microphones, boom, transcription turntables. audio control panel, line amplifier unit, cables and plugs).	10,900.00
1 - 4-Kilowatt Visual and 2-Kilowatt Aural Transmitter, including tubes.	35,750.00
1 - Visual and Aural Antennas, miscellaneous test equipment (does not include antenna supporting structure)	10,000.00
Installation engineering, Transportation	6,000.00
Pre-War Selling Price	\$140,750.00

STUDIO-TO-TRANSMITTER OR POINT-TO-POINT RELAY EQUIPMENT

Visual Transmitter and Receiver	\$ 6,000.00
Aural Transmitter and Receiver	5,000.00
Antennas	2,000.00
Installation Engineering, Transportation	3,000.00
Pre-War Selling Price	\$16,000.00

ACCESSORY EQUIPMENT

Additional Studio Camera Channels, each	\$14,850.00
Additional 35-mm Film Channels, each	24,200.00
Mercury-Vapor Studio Lights	
3-Kilowatt Mercury-Vapor Ceiling Lights (including remote-control equipment, wiring, water system and installation) each	1,000.00
16-mm Motion-Picture Projector	
(for use with 35-mm film channel) each	2,500.00
Visual-Frequency Monitor, each	900.00
Visual-Modulation Monitor, each	1,800.00
Aural-Frequency Monitor	
(includes aural-modulation monitor) each	800.00

PORTABLE PICK-UP EQUIPMENT

2 - Visual Channels (including two cameras, cables, synchronous pulse generator, visual transmitter and receiver, control and monitoring equipment)	\$30,000.00
2 - Aural Channels (including microphones, amplifiers, cables, aural transmitter and receiver)	8,000.00
1 - Truck, antennas, gas-engine power supply	7,000.00
Pre-War Selling Price	\$45,000.00

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