




# NBC's Air Castles





## **Seven Air Castles**

### **Serving the Nation**

From the Atlantic to the Pacific—in New York, Washington, Cleveland, Chicago, Denver, San Francisco and Hollywood—stand the seven NBC Air Castles, modern triumphs of electrical engineering, that are the nerve centers of the National Broadcasting Company's network system.

These Air Castles or "plants" as they are known more prosaically have their similarities of design—similarities that indicate the engineer's practical tendency to standardize as far as is possible. Obvious, too, are differences in the design and structure of these seven Air Castles. In some instances these differences are due to the limitation of a particular situation and to experience with previous construction and operation, but for the most part the differences are those between older and newer studios at plants which have been expanded in varying stages.

This booklet, "NBC's Air Castles," describes in text and illustrations the functions and construction of the seven NBC headquarters—truly Air Castles which have sprung miraculously into existence in less than two short decades to serve the American public with the scientific wizardry of modern broadcasting, television and radio recording.

## Master Builder of Air Castles

### O. B. HANSON

*Vice President and Chief Engineer of  
The National Broadcasting Company*

The acoustical perfection of the studios in the seven NBC headquarters—the intricate master control desk, brain-center of the NBC Network, where nation-wide networks are opened and closed by the pressure of finger-tips—and the smooth operation of an army of engineers and technicians spread from coast to coast—all this was planned and conceived by one man. That man is O. B. Hanson, who combines his skill as an acoustical engineer, his brilliance in radio and electrical engineering, and his ability as an executive most capably to fill the important post of Vice President and Chief Engineer of the National Broadcasting Company.

Mr. Hanson began his radio career thirty-five years ago in 1912, when, as a boy, he built and operated his own amateur wireless station. A year or two later he applied for an engineering job with the Marconi Company of America, only to be informed that engineers were recruited from the ranks of ship operators. So, after study at the old Marconi School in New York, young Hanson went to sea. Those were the romantic early days of wireless on the high seas when all ships operators were known as "Sparks." One of the ships on which Hanson served—the liner *Stephano*—was sunk off Nantucket Light in 1916 by a German submarine.

Early in 1917 Hanson joined the Marconi Company's plant at Aldene, New Jersey, and six

months later was named chief testing engineer. In 1920 he took another quick turn at sea, this time on South American runs.

Returning from his stint at sea, Mr. Hanson found commercial broadcasting taking its first uncertain steps in the early 1920's. He joined WAAM in Newark as chief engineer, operating engineer, program director and announcer. Dusty archives do not reveal if the early WAAM numbered anyone else on its payroll, but Hanson's love of radio persisted even through this multiple-job, and from that early beginning he has continued to be associated with commercial broadcasting companies.

In 1922, shortly after the station first went on the air in August, Hanson accepted a position as assistant to the plant engineer of WEAJ, then owned and operated by the American Telephone and Telegraph Company. Two years later he became plant engineer of WEAJ, and continued in that capacity when the National Broadcasting Company was formed in 1926, and purchased WEAJ as its key station in New York.

From this time on radio broadcasting grew at a tremendous rate, and the contributions O. B. Hanson made to the development of the new industry are many and varied. Hundreds of his suggestions have been built into the superlative equipment developed at NBC, and he is credited with numerous significant inventions in the

allied fields of acoustics, radio broadcasting and television. Some of these are: an improved method for regulating the acoustical qualities of walls, ceilings and movable screens; the volume control system that was first employed by major networks and broadcasting stations; and a new and improved system for the transmission of television signals, whereby proper relationship and perspective between the television pictures and the accompanying audio or sound signals may be produced.

In 1938 Mr. Hanson's service to the National Broadcasting Company was rewarded with a vice presidency.

As Chief Engineer of NBC, a post to which he was named several years after the network began operations, Hanson has exercised a powerful influence in the growth and development of modern television broadcasting. In his supervision of the over-all activities of NBC's staff of television engineers, he has displayed remarkable vision and comprehension of the problems to be overcome in the successful technical and engineering development of television. Hanson's contributions to this swiftly growing new art extend throughout the entire technical field, including construction of new television working quarters in Radio City, and are of major significance and interest to the entire industry.



O. B. HANSON, *Vice President and Chief Engineer of the National Broadcasting Company.*



## World's Greatest Air Castle — Radio City, New York

Dominating the fabulous slabs of steel and stone that rise in the heart of Manhattan to form Rockefeller Center, is the 70-story RCA Building, home of the National Broadcasting Company.

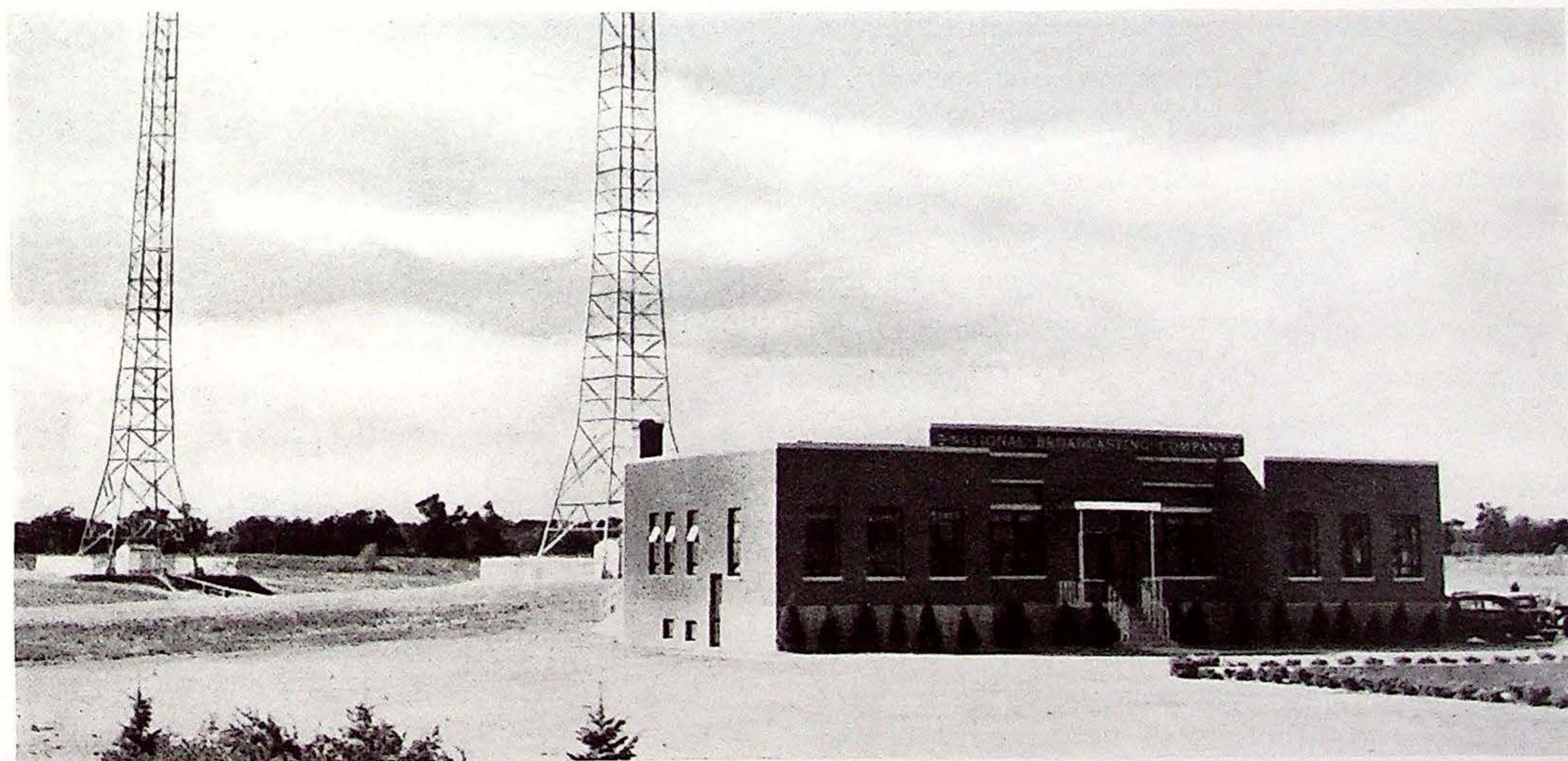
The Radio City headquarters of NBC is a modern wonderland in itself. Here, hour after hour of programs are conceived, written, carefully put together, rehearsed and finally broadcast to millions of listeners throughout America, and by short wave all over the world to our occupation forces and to the peoples of far away nations.

Up and down the corridors of Radio City daily pass famous stars of stage, screen and opera as well as radio personalities who have become

household legends in millions of American homes, renowned scientists, diplomats, authors, composers, conductors—of all nations—men and women who are leaders in their fields of endeavor.

Radio City is the focal point of a vibrant, humming activity that expresses itself in the constant stream of programs of education, public service, war effort, news, entertainment, sports and music reproduced in millions of American homes throughout the day and night, every day of the year.

The vitality and significance of this tremendous flow of creative activity is expressed in the architecture, the functional design of studios and control rooms, the general decor and finally the



Transmitter building and vertical radiators of WNBC at Port Washington, L. I. 50,000 watt key-station of NBC in New York.

actual technical equipment that are the component elements of Radio City. It is with these that "NBC's Air Castles" is concerned—the miraculous achievements of the engineer's slide-rule and the architect's blue-print, the smooth coordination of complex mechanisms that assures the listener of flawless reception.

### **Fresh Air and No Noise**

The eleven floor studio section, planned exclusively for broadcasting, was completed during the fall of 1933 as an integral part of the RCA Building. So that street noise might be excluded from the studios, only two of the eleven floors—the second and fifth—have windows to the open air. The entire section with its four-and-one-half million cubic feet of space is air conditioned summer and winter by one of the world's largest systems, which is more fully described in another section of this booklet.

### **Wanted: Studios**

In the early days of broadcasting, demand for program rehearsal space was very slight, because in those times few programs were rehearsed. As programs improved in quality and became more elaborate, more and more rehearsal space was required. Operation experience has shown that the ratio of rehearsal time to program time has been rising constantly for years and now stands at approximately seven to one. This means that every hour of present day programs requires an average of seven hours' rehearsal.

The National Broadcasting Company operates its network for eighteen hours a day with the key station, WNBC, formerly WEA, in Radio City many times carrying local programs. This means that there are two studios on the air simultaneously and many more in rehearsal.

Despite the fact that twenty-nine studios are now available, the demand for studio space often exceeds the supply. The situation occurs because in addition to the many rehearsals that must be provided for, it is frequently necessary to split the network into several groups and to originate separate programs not only for each of these groups but also for local station WNBC. Frequently there are occasions when as many as four or five programs are being produced simultaneously.

### **Search for Stars**

To the average radio listener "broadcasting" means only the finished program product which he hears coming from his radio receiver. Actually a great amount of work and activity must precede the broadcasting of any program. First and always present problem in the development of radio programs is the finding of new talent. Thousands of auditions are held each year by the program board in the unending search for the talent which will become the stars of tomorrow. Incidentally, it is interesting to note that *anyone* making proper application may secure an NBC audition. Technical facilities figure importantly in giving the hopefuls every opportunity to be heard at their best. Necessary for auditions are studios, monitoring loudspeakers, audition rooms and equipment for recording the audition for file purposes.

### **Round and Round They Go**

Another NBC activity, complementary to actual broadcasting, and of vast and increasing importance, is recording.

Now occupying its greatly expanded and streamlined quarters in Radio City the NBC



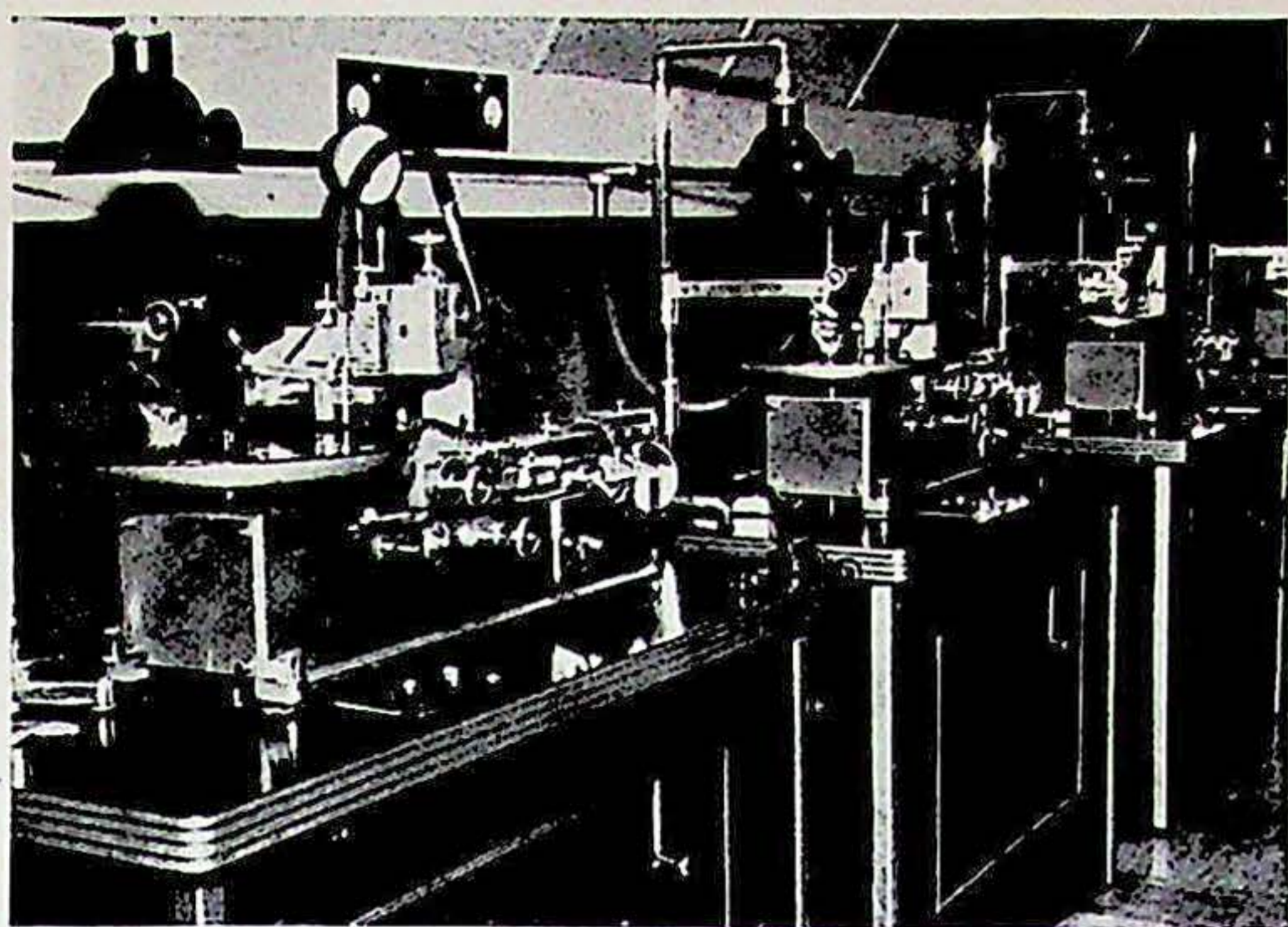


FIG. 1

Radio-Recording Division is preparing to utilize the new techniques, services and materials developed during the war years in the production of records for scores of peace-time purposes.

Under its new set-up the NBC Radio-Recording Division not only cuts the masters of records, but also processes the pressings. From these pressings the RCA Manufacturing Company produces the hundreds of thousands of finished records and electrical transcriptions which are used by radio stations all over the world. One of the best known and most widely used record services of the NBC Radio-Recording Division is the *NBC Thesaurus*, a standard recorded music library which is maintained with the periodic addition of new recorded selections, and is used by radio stations in the United States and in many foreign lands for building recorded musical programs.

With the coming of war, the Radio-Recording Division greatly expanded its operations to work with governmental agencies in the production of records for the war effort. These activities increased steadily as the war progressed and for the first time recordings became a weapon of war, going around the world to fight for freedom. Records were produced for enlisting and re-

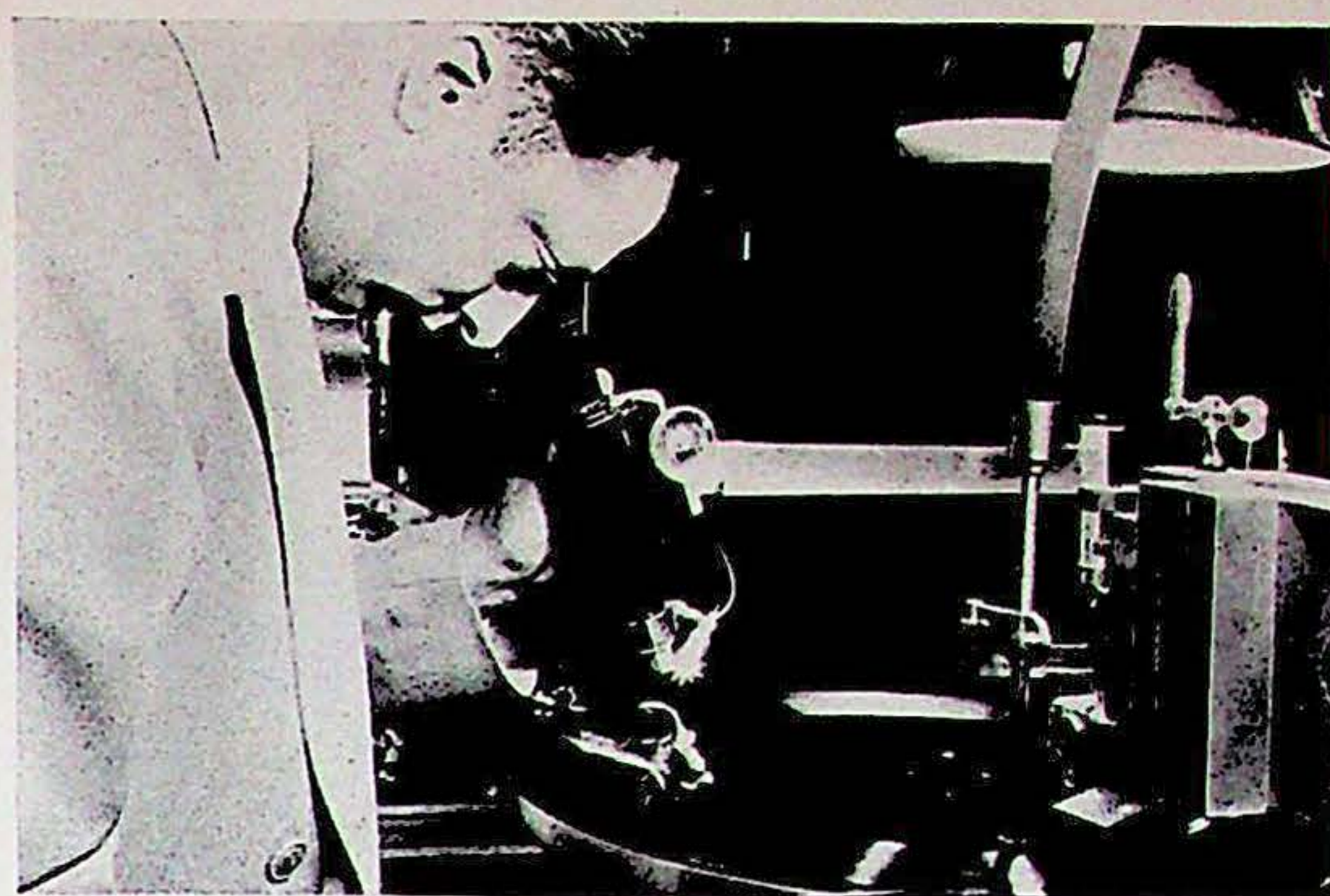
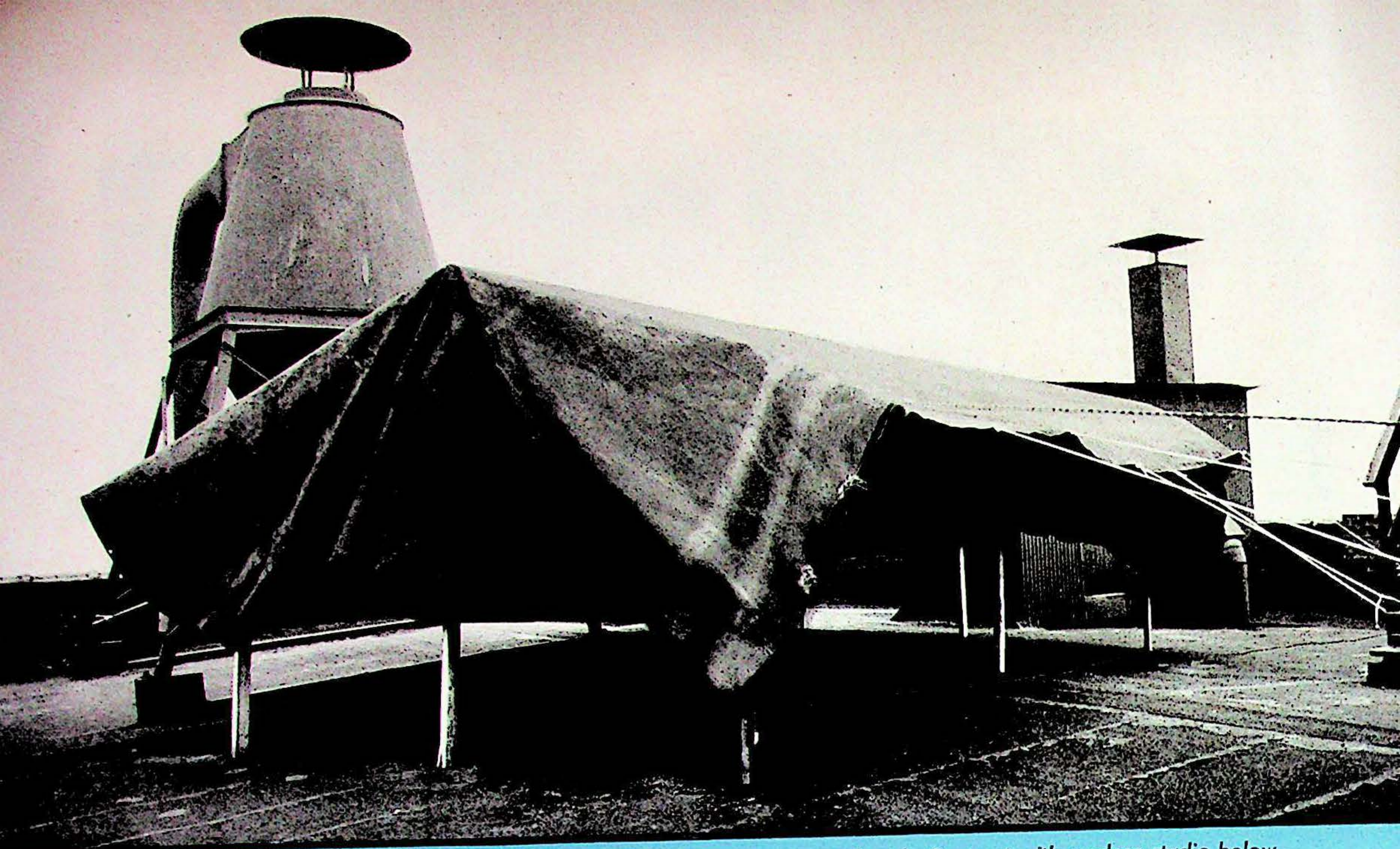


FIG. 2

cruiting for the armed services, for Army and Navy training, for Red Cross and War Bond Drives, for the dissemination to the public of rationing and war effort information, for educational and good will promotion among the peoples of the Western Hemisphere, for propaganda uses abroad, and for the entertainment and morale boosting of American troops throughout the world. In the latter connection, V-Discs, recordings made by NBC of popular and standard classics by most of the great artists and musical organizations of the day, were distributed to troops all over the world. Important, too, are the recordings of popular NBC network shows, which, with their commercial messages removed, are short-waved around the world.

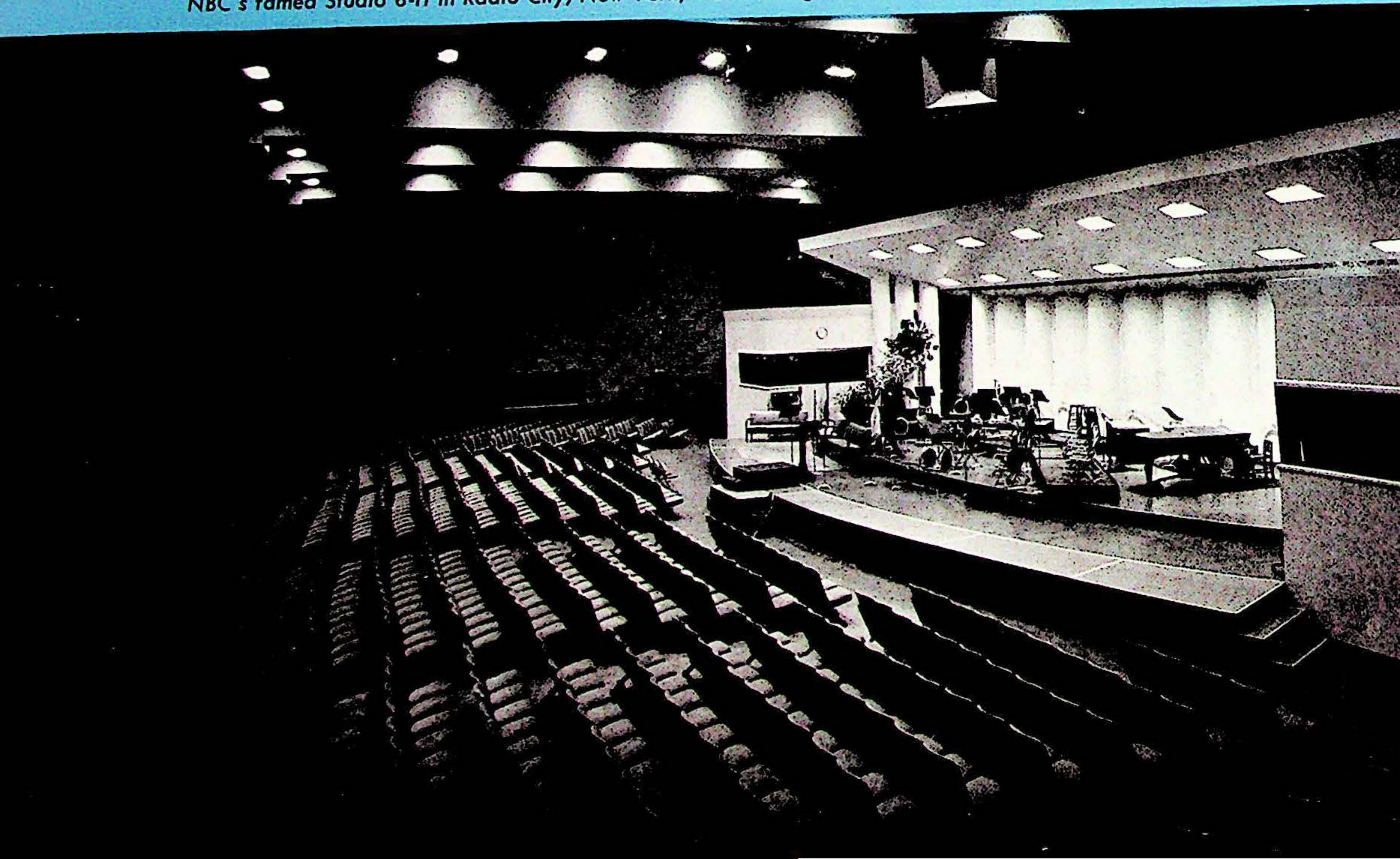
In addition, routine use is made of records in the recording of auditions and the recording of programs for file and reference purposes. During 1945 the total number of these recordings made at the Radio City office alone approximated 250,000.

Figures 1-2 show a partial view of the recording room equipment which consists of many high quality recording machines, several copying tables and a number of reference recorders and playback tables.



*KDKA's early "tent" studio atop Westinghouse factory building in Pittsburgh. Contrast with modern studio below.*

*NBC's famed Studio 8-H in Radio City, New York, world's largest studio built especially for broadcasting.*



## News as It Happens

During the past decade, as the world moved from one major crisis to another, finally bursting into war flames, the broadcasting of news has assumed steadily increasing significance and importance to the listening public until today news broadcasts hold first rank in radio's service to the public.

Into the structure of every shortwave pickup from overseas, every foreign rebroadcast by recording, every special and regularly scheduled domestic news broadcast is interwoven the work and achievement of the radio engineer. Technical progress and engineering skill form the foundation on which the entire edifice of NBC's justly famed News Department is built.

Without long months of technical planning, preparation, testing and achievement by the engineers, the NBC News Department could not have scored the triumph it did on June 6, 1944—historic D-Day. For nearly twenty-four hours, the NBC coast-to-coast network schedule was wiped clear of all regularly scheduled commercial and sustaining programs and the nation listened as one individual, while NBC reporters took to the air over France and landed on the beaches of Normandy—as they told in never-to-be-forgotten words the story of that bravest and most daring of military operations—the invasion of Hitler's Festung Europa.

During 1945 the collapse of Germany and the surrender of Japan again found NBC writing history with on-the-spot and world-wide reaction broadcasts made possible by engineering skill and superiority of technical equipment.

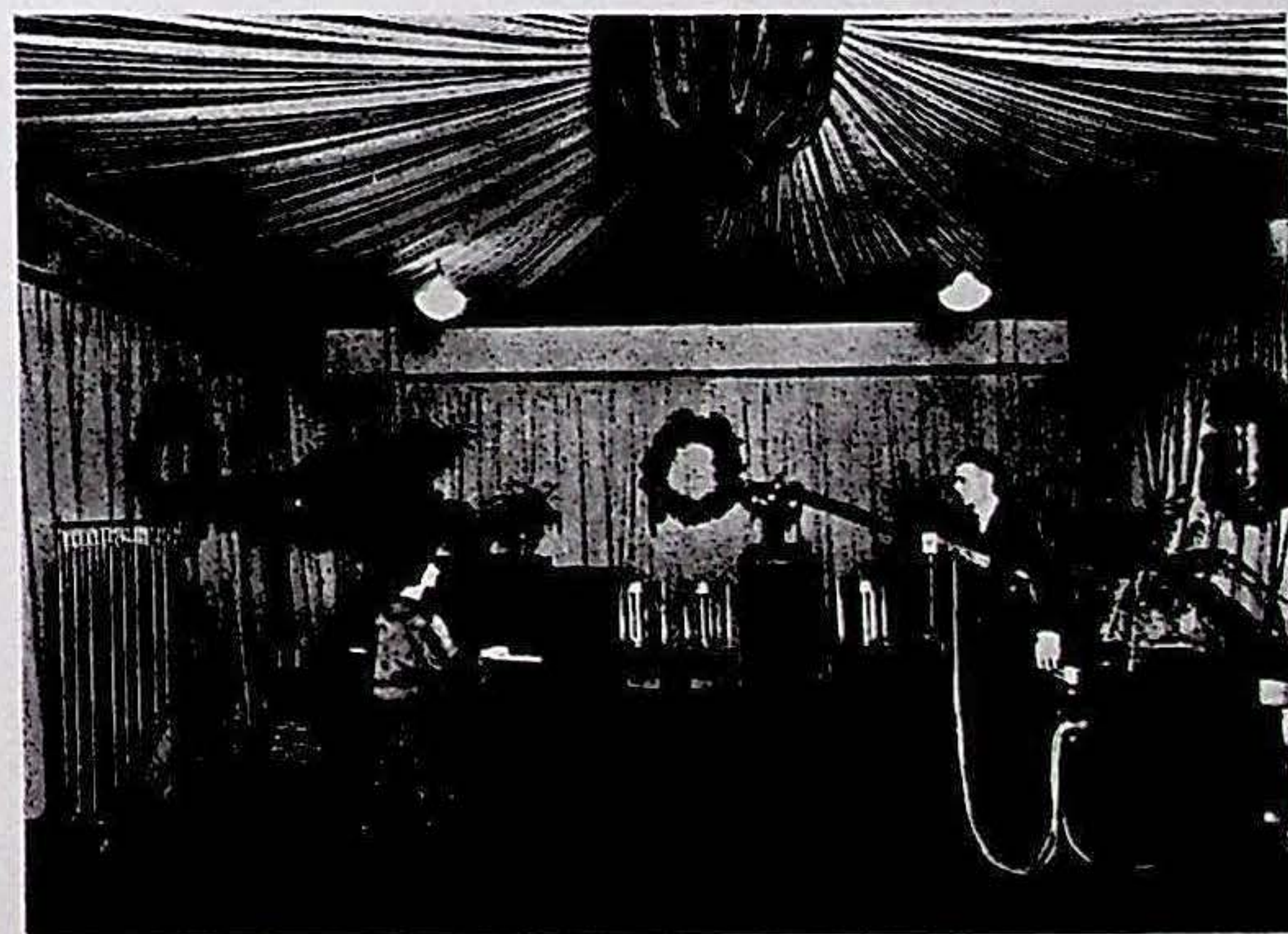
All short wave pickups from such places as Europe, Africa, Iceland and Central and South America are received at Riverhead, Long Island, over RCA Communications, Inc., by an elabo-

rate system of so-called "diversity receivers" to minimize fading and noise, and are then fed by wire line to the NBC Radio City studios. Similarly broadcasts from the Pacific are received by RCAC at Point Reyes and Bolinas, California, and are fed from there by wire line to NBC's San Francisco office, where they are put on the network. Other world-wide pickups are received over facilities of the American Telephone and Telegraph Company.

Each of the seven NBC Air Castles is equipped with complete teletype news service for the compilation of network and local news broadcasts.

## The Architecture of Air Castles

It is a far cry from the crude studio of the early KDKA in Pittsburgh, where a tent was erected on a factory roof in a primitive effort to retard the echo and reverberation of an untreated room, to the technical and acoustical perfection and functional comfort of today's modern studios. An interesting sidelight is that the next studio development following the "tent" studio literally moved the tent indoors, early studio



*Draped ceiling and walls in KDKA's first real studio in 1922.*

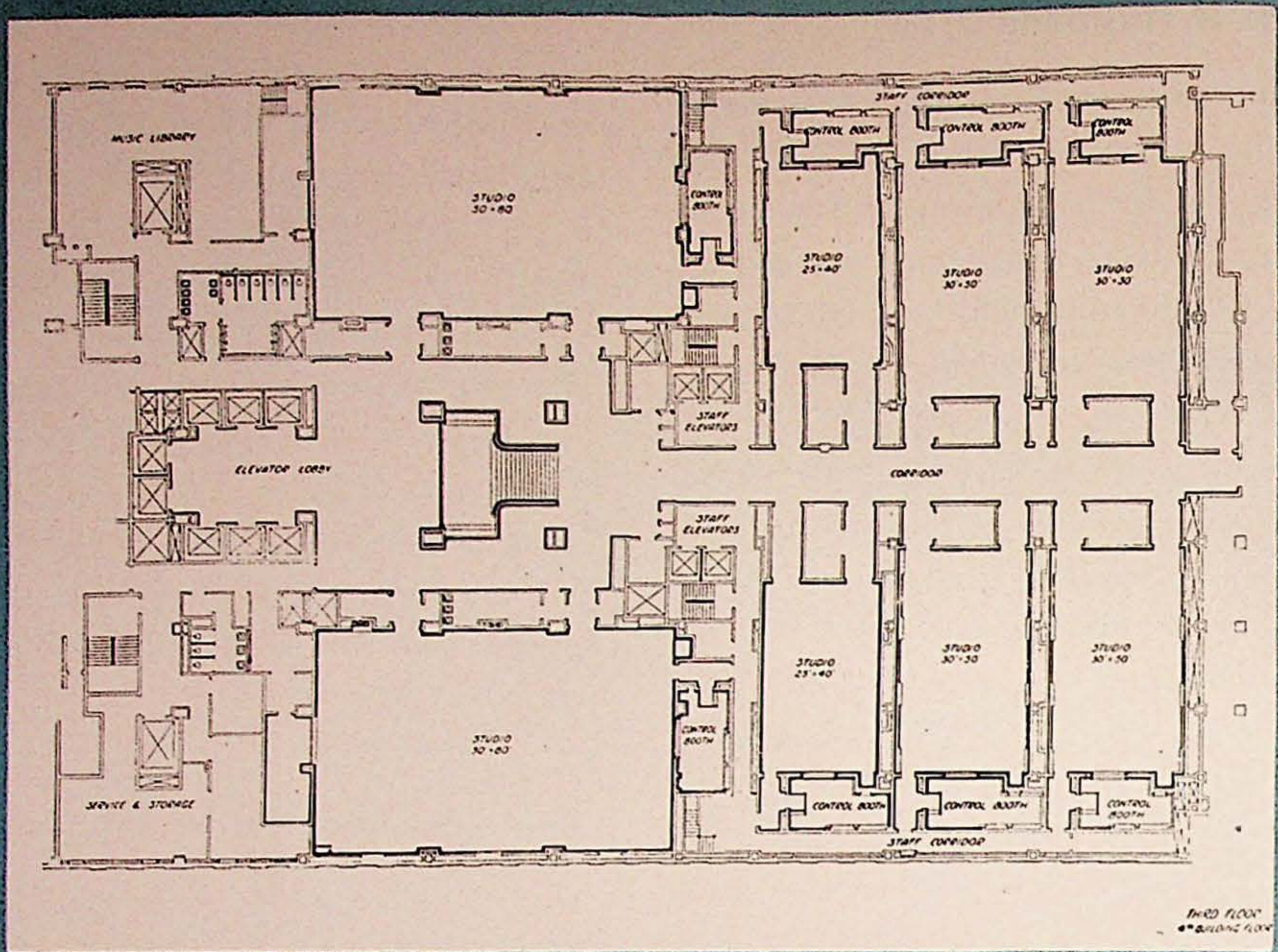


FIG. 3

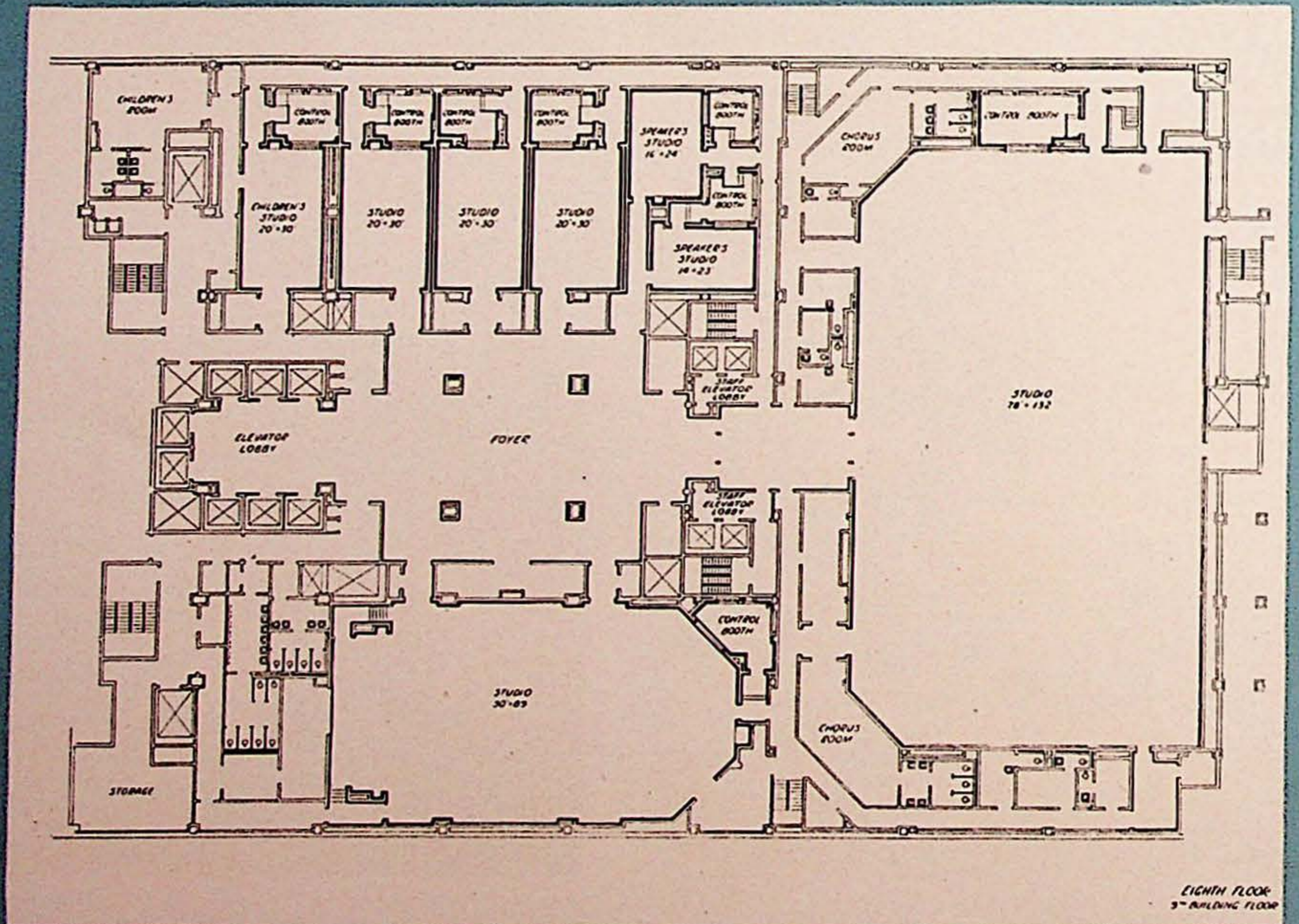


FIG. 4

walls being covered with burlap for sound absorption.

In NBC's Radio City Air Castle, studios of all sizes are available—most of them in duplicate. Experience has proved this to be the best arrangement where program origination demands are great and competition for desirable studio space is keen. The studios range in size from the small speaker's room, 14 x 23 x 9 feet high, figure 5, to studio 8-H, the world's largest radio broadcasting studio, 78 x 135 x 30 feet high, accommodating an audience of 1300 persons. Figures 3-4 show the floor plans of the building.

The most recently designed studios in Radio City are three located on the sixth and seventh floors—figures 6-7-8. These are auditorium-studios, in many details duplicates, and their structure reflects the knowledge accumulated through long experience with the problems of studio planning. The rear wall of the stage acts as a sound dispersing area, made up of convexly curved plaster surfaced pilasters, which retain the brilliance characteristic of the stage section, but prevent separate or individual sound reflections. Other advanced features are indirect cove lighting which entirely eliminates direct glare, a steeply raised auditorium greatly improving

the visibility from the rear, heavily upholstered seats of the latest design, a stage control room commanding a full view of both stage and auditorium, a client's room situated at the best angle for view of both stage and auditorium, and decorative appointments that are at once attractive, simple and easy to maintain.

### Floating Studios

In the construction of a modern radio studio, two general classifications of sounds must be considered. The first of these embraces the sounds desired for register by the microphones. Every effort is made to build characteristics into the studio which will result in a room sympathetic to the desired sound qualities. At the same time, equal attention and effort must be given to the elimination of extraneous sounds and foreign noises. Studio microphones are so extremely sensitive that thorough isolation from sound disturbance is an essential element in studio construction.

In discussing the sound problem here, two terms will be used—sound isolation and acoustical treatment. Sound isolation is applied to the elimination of sounds that might filter through doors, observation partitions, air duct lining and

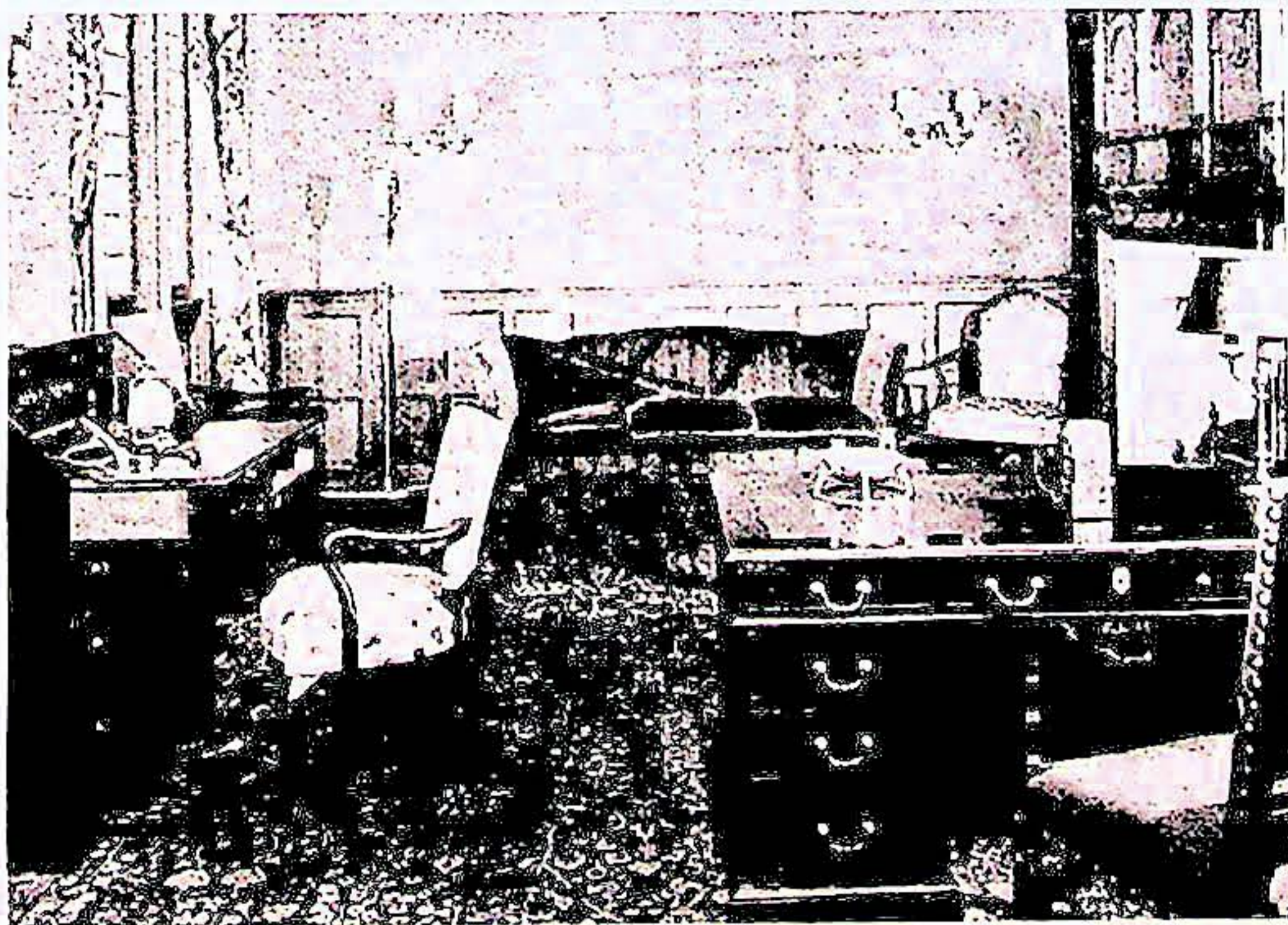


FIG. 5

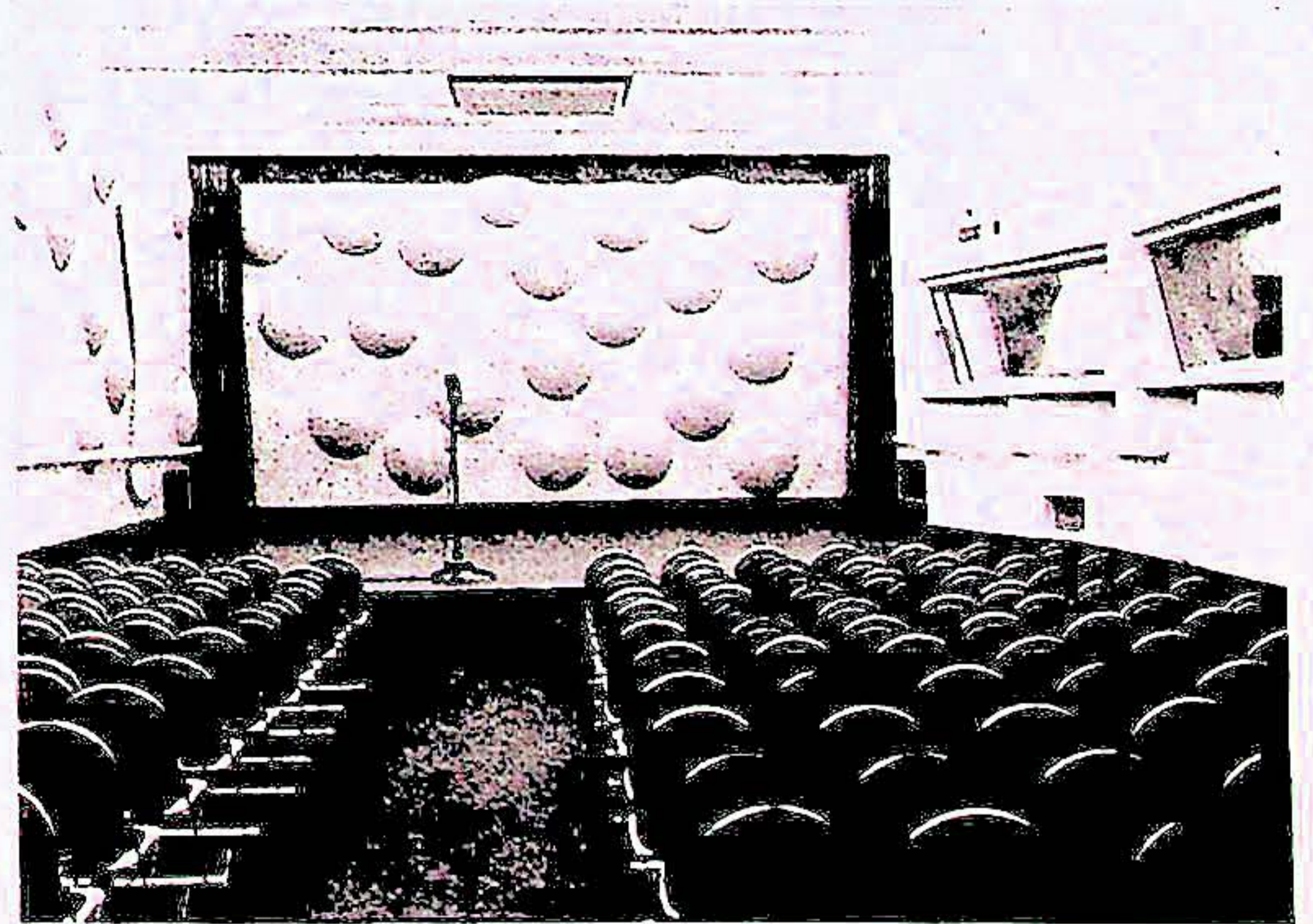


FIG. 6

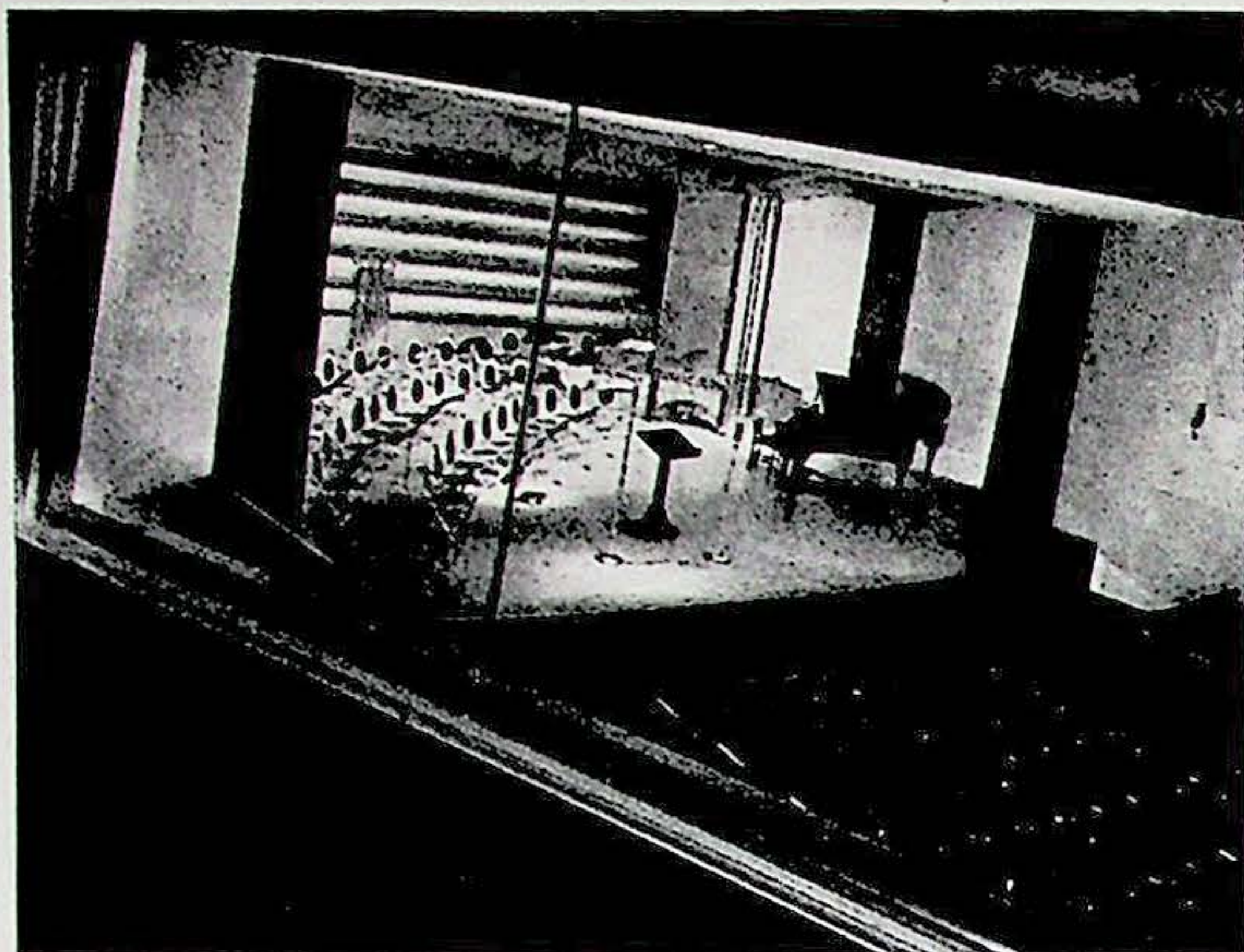


FIG. 7

wrapping, machinery vibration isolators and even the masonry itself. Experience has shown that the heavier the floor and walls of a studio the better they prevent unwanted sounds from filtering through. Extra caution must be taken when studios are adjacent. Under such circumstances, the NBC policy is to build two solid six-inch cinder block partitions side by side, separated by an air space of several inches. In general, floor, slab and fill amount to about six inches in thickness.

The construction of sound isolation inside the masonry shell is illustrated in figures 9 to 13

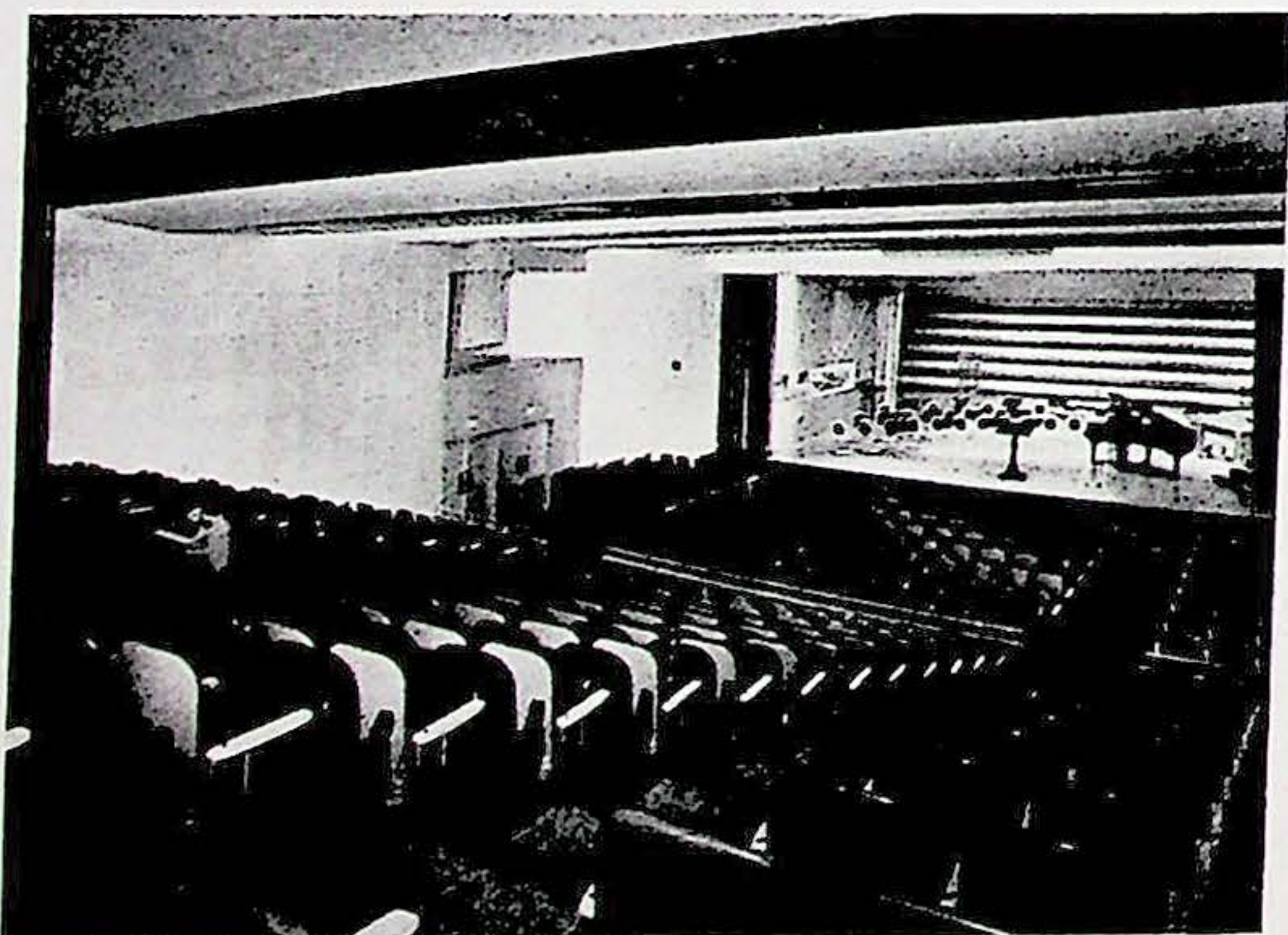


FIG. 8

inclusive. Two-inch channels are placed back to back on the floors, supported by hair-felt-covered spring clips, which are fastened to the masonry by cement grouts. The number of clips and channels is determined, of course, by the loading for which the studio floor is designed. The space between the channels is filled with a light, fluffy, fireproof limestone product known as Rockwool. A two-and-one-quarter-inch reinforced concrete slab is formed over the wire lath as in figure 10, with a minimum of one-half-inch clearance being allowed between the slab perimeter and the wall. After the slab has set, hair-felt is wedged between the wall and the edge of the slab so that transmission of vibration by direct contact is minimized.

Wall isolation is similar in principle to the floor isolation just described, differing principally in that it is a much lighter construction. Horizontal one-inch channels are first fastened to the wall masonry by felt-lined spring clips as shown in figure 12. Black building paper is folded down over each clip so that any plaster that may later fall through the wire lath will not drop on the felt and thus short circuit the isolation. The vertical channels fastened to the horizontal ones with wire are held well clear of the masonry. Wire laths cover this criss-cross channel assembly; ordinarily three coats of plaster are applied where the finished wall is not to be treated acoustically. If acoustical treatment is called for, then only two coats of plaster are applied, the white or finish coat being omitted. Good examples of this isolation construction are clearly shown in figures 9 to 13.

From a study of the illustrations shown here it will be seen that the NBC studios actually "float." That is, the studios are suspended within an outer room. This is known by engineers as the "box within a box" type of studio con-

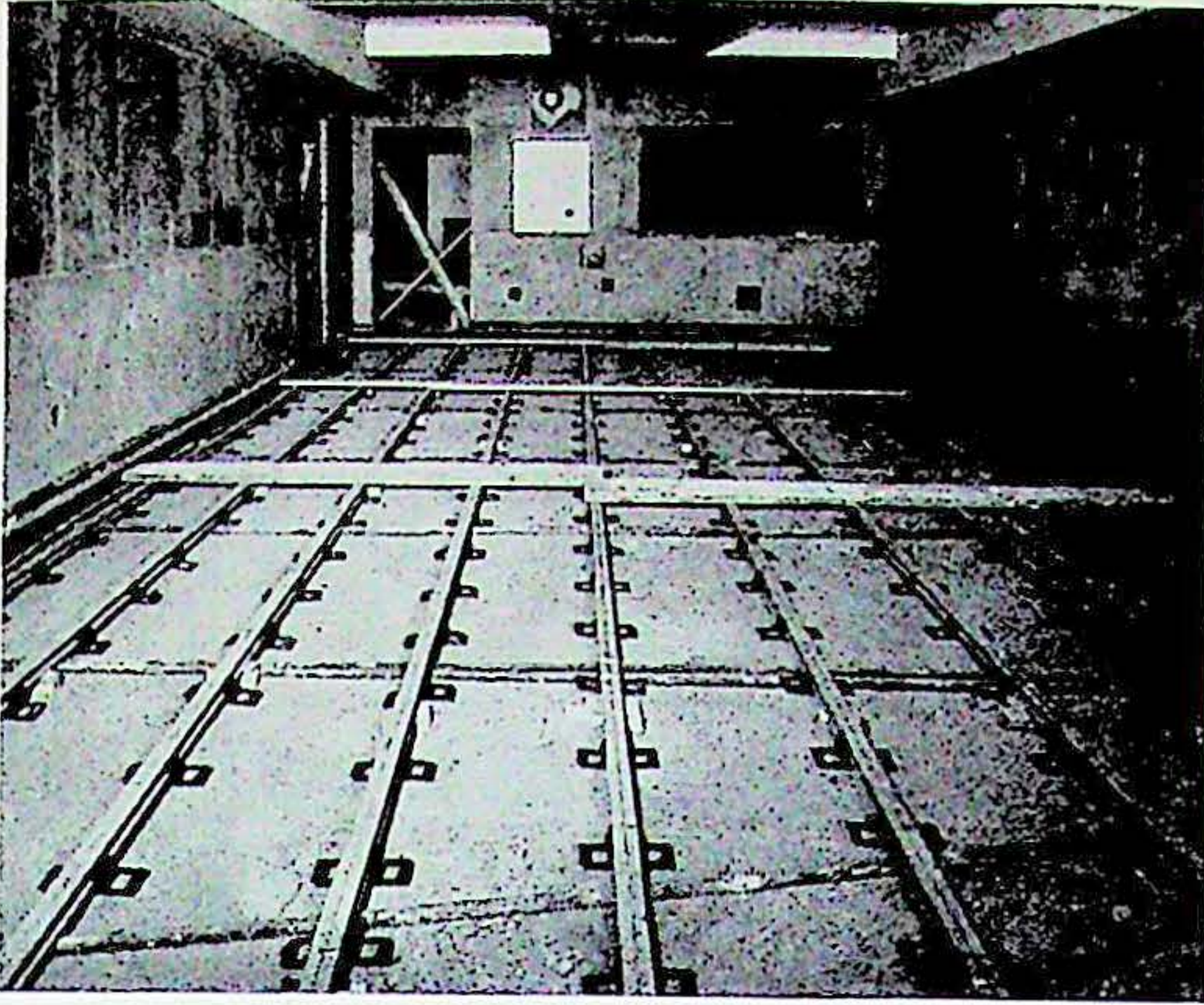


FIG. 9

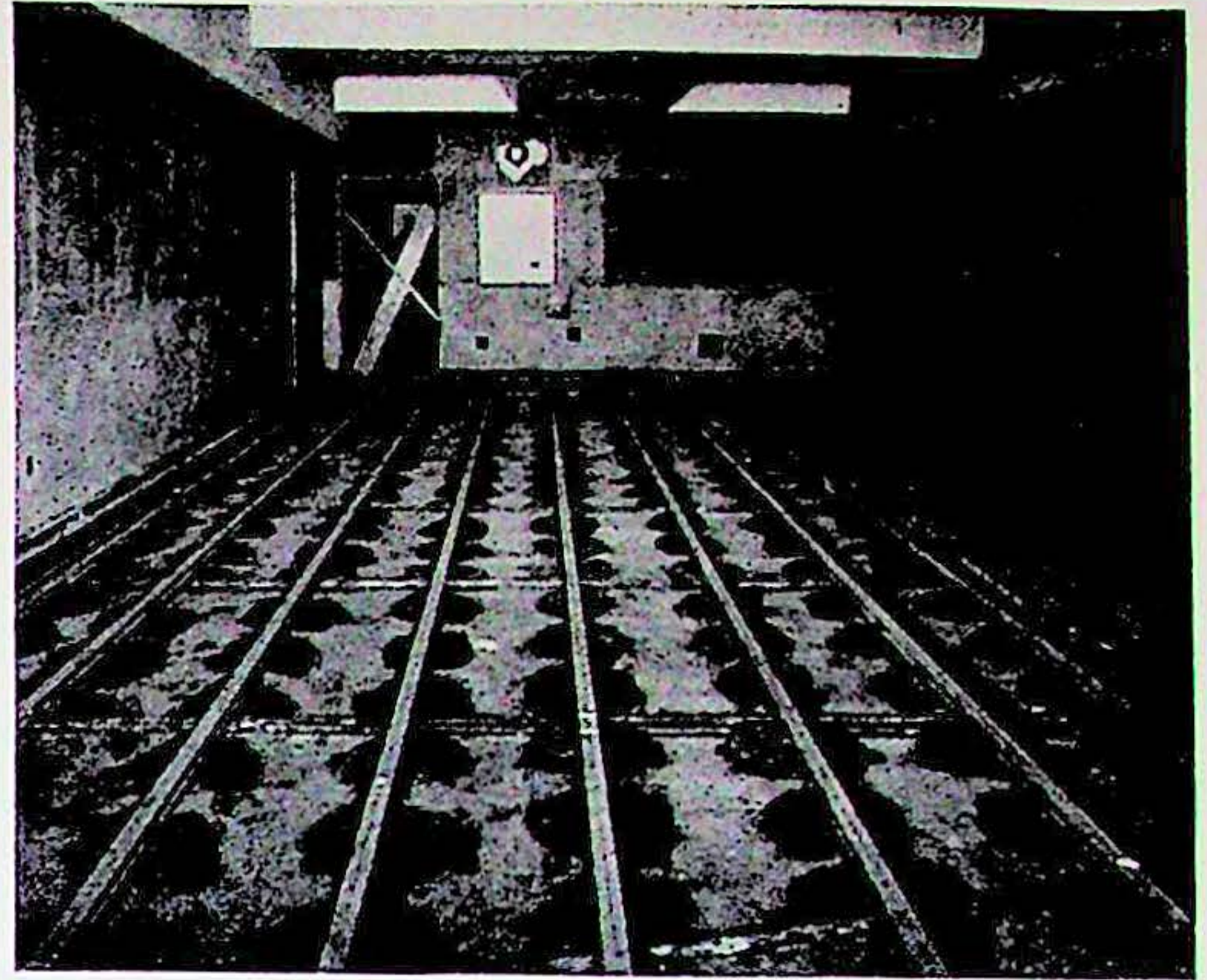


FIG. 10

struction. One doesn't look to engineers for poetry, but what more fitting than that NBC's Air Castles should have "floating studios"!

The effectiveness of the most careful floor, ceiling and wall isolation would be largely nullified by poorly insulated doors, by air conditioning ducts not carefully lined and wrapped, or by other neglect of proper insulation. Consequently the greatest care was exercised in the construction of the Radio City studios to make certain that all such supplementary parts of the sound

insulation were comparable in their efficiency with the sound isolation treatment given studio walls and floors.

### Open Sesame!

Every studio door at the NBC Air Castle in Radio City is a door opening into wonderland. For the established stars of the radio world the studio door swings silently ajar and miraculously opens millions of other doors in friendly Amer-

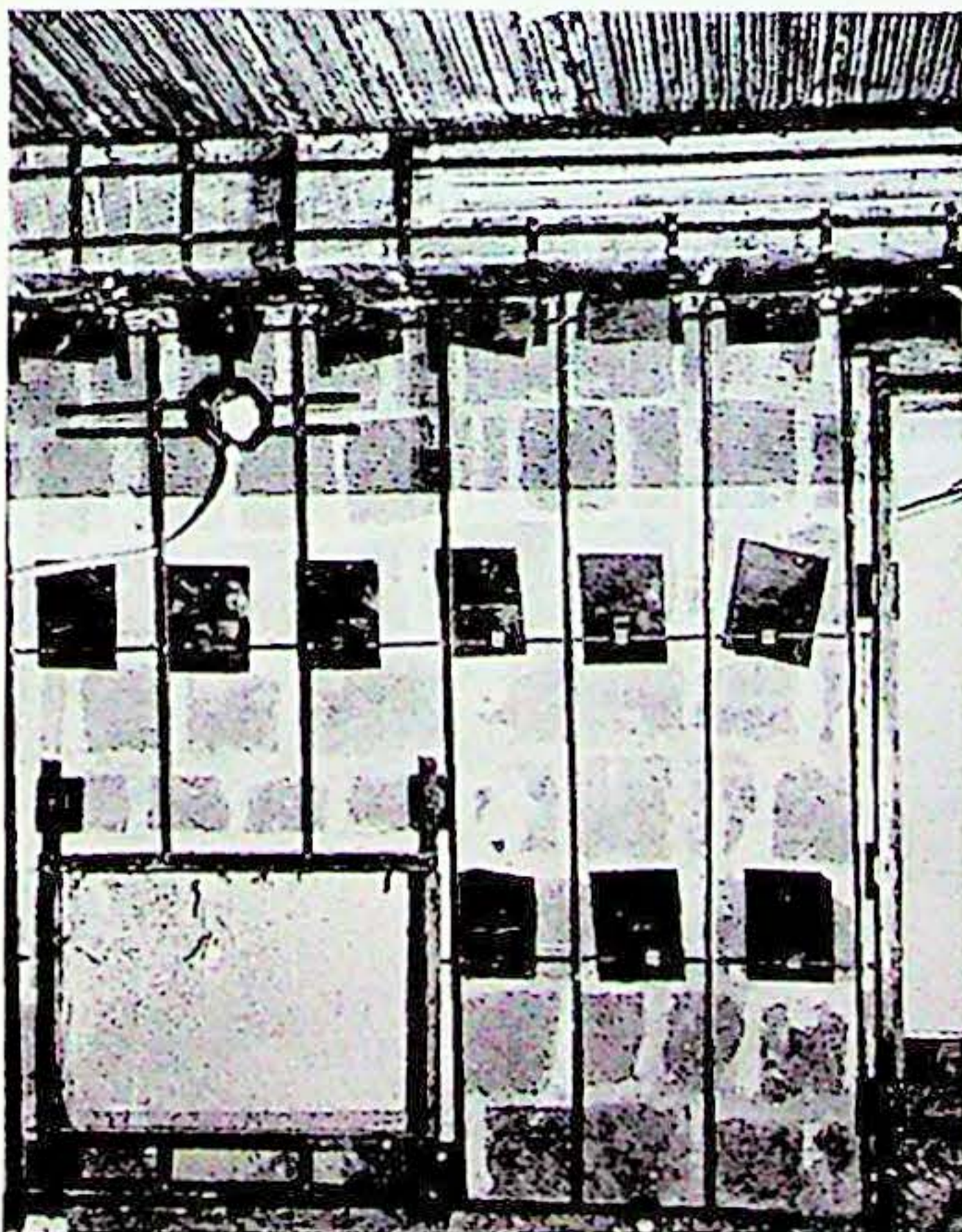


FIG. 11

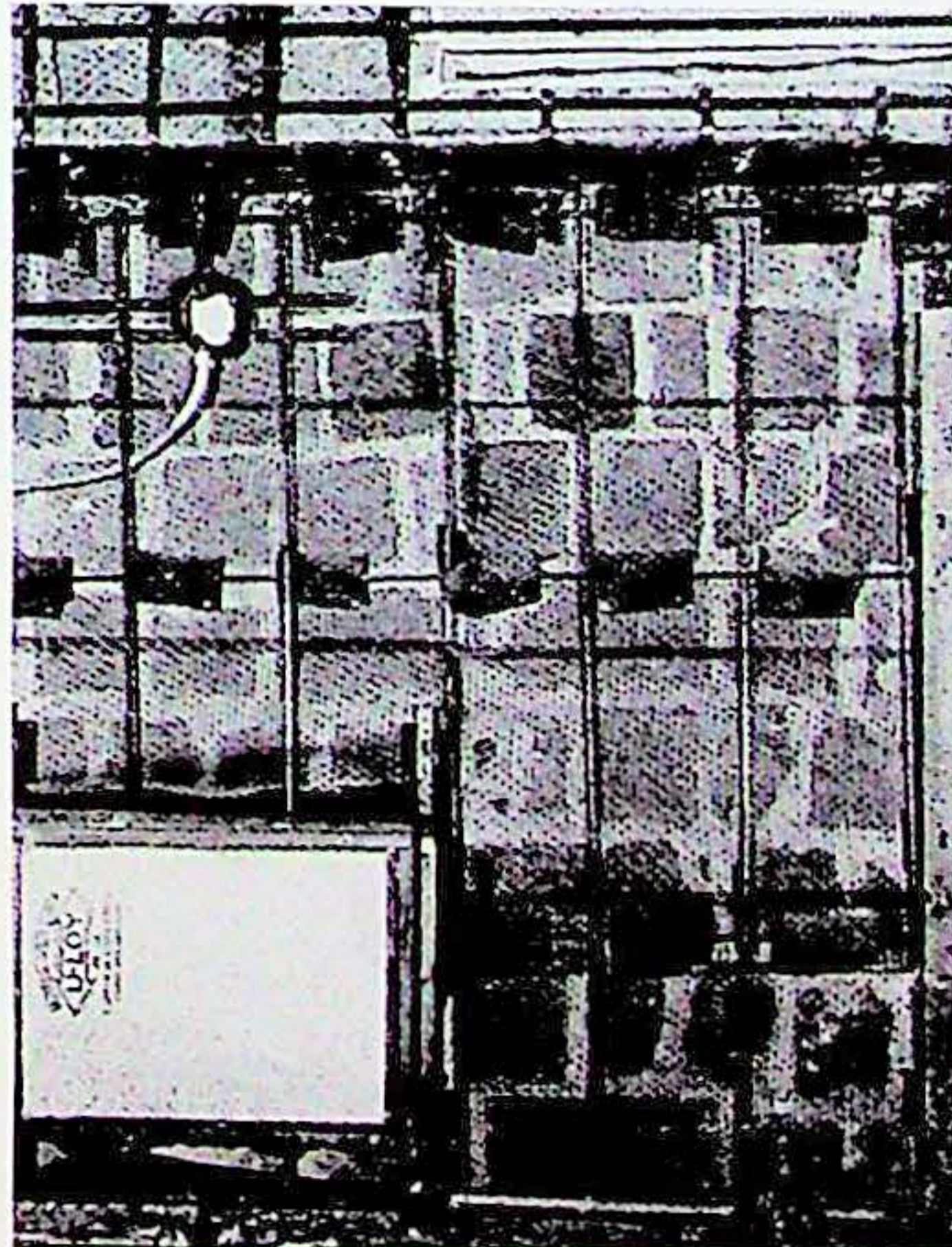


FIG. 12

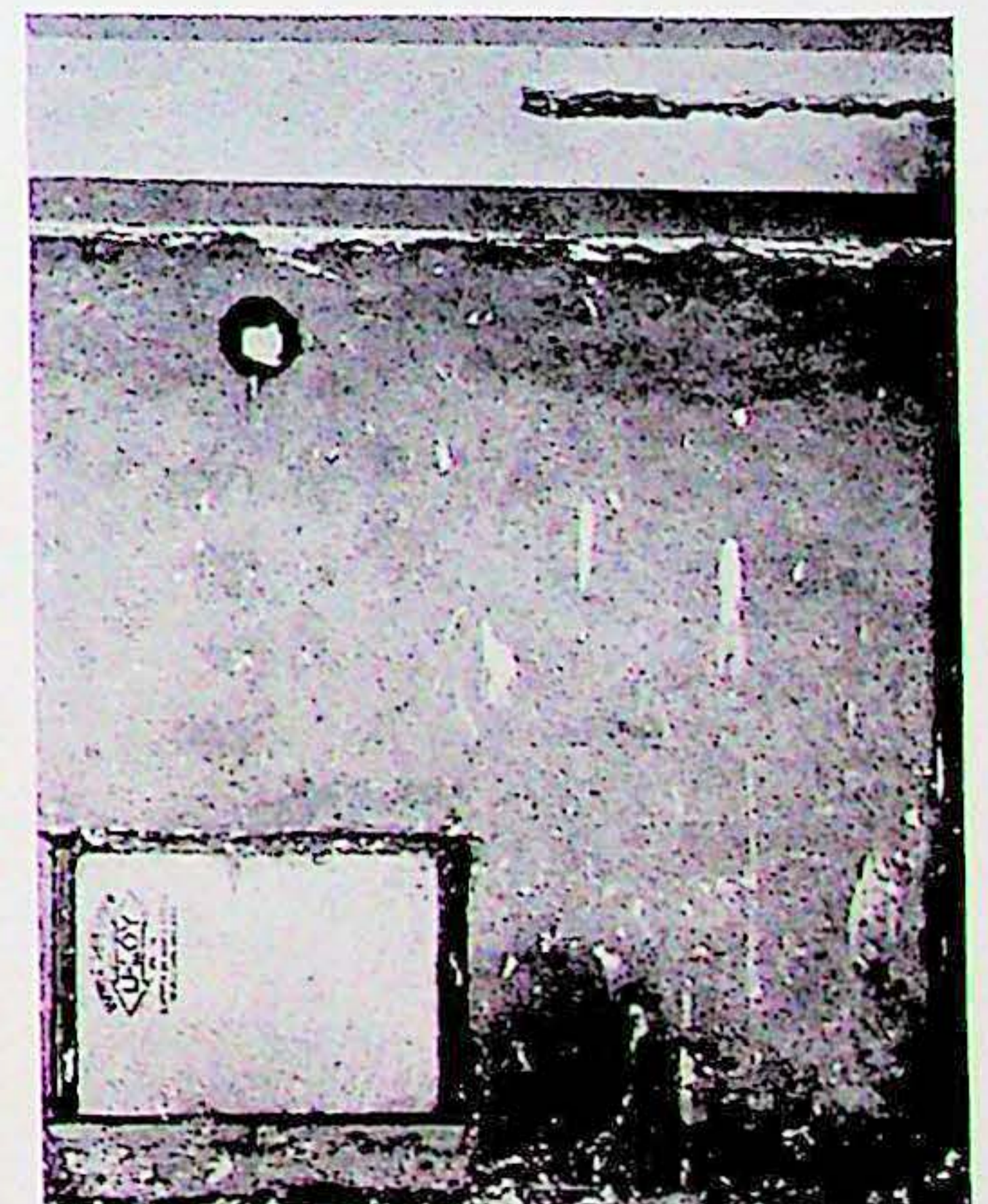


FIG. 13

ican homes throughout the forty-eight states. For the newcomer the studio door swings open, inviting him to step inside and display his talent to a vast and sympathetic audience. Fame and fortune lurk just inside the studio doors. Certain it is that no other doors in all the history of the world ever opened the way to so many careers, so many opportunities, so many homes and so many huge audiences.

Magical in possibilities as these studio doors may be, they also are practical in use. In general, the studio doors at Radio City are of three types, depending upon the kind of partition in which they are installed and their location. Type A doors, three-inches thick and double lead-lined, are in the sound isolated partitions between studios and vestibules. Type B doors, two-and-five-eighth-inches thick but without lead lining, are found in the sound isolated partitions between studio control rooms and vestibules. Type C doors, two-and-one-quarter-inches, are installed in the ordinary masonry partitions between vestibules and corridors, or foyers. All three type doors have automatic plunger mechanisms to seal the space between the bottom edge and the sill. The attenuation or weakening of sound through the sound lock combination of two doors and acoustically treated vestibule is at least 60 decibels,\* which is equal to a loss of volume to one-one millionth.

## Room With a View

The nerve center of each studio is its control room, where microphones are opened and closed, the correct volume level is maintained

\*The decibel is a unit for measuring the loudness of sound. It is equivalent to the loss in power in a mile of standard cable at 860 cycles.

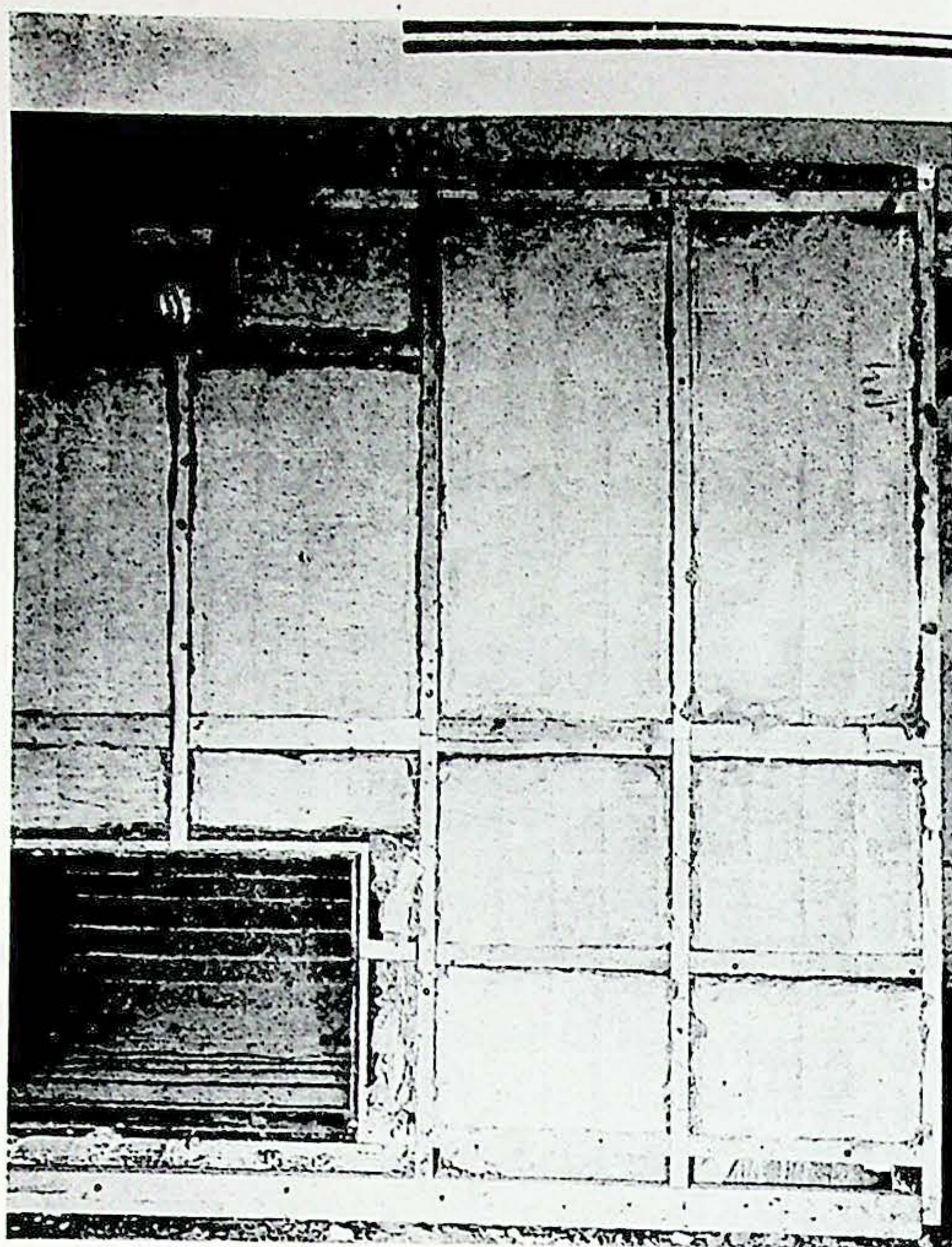


FIG. 14

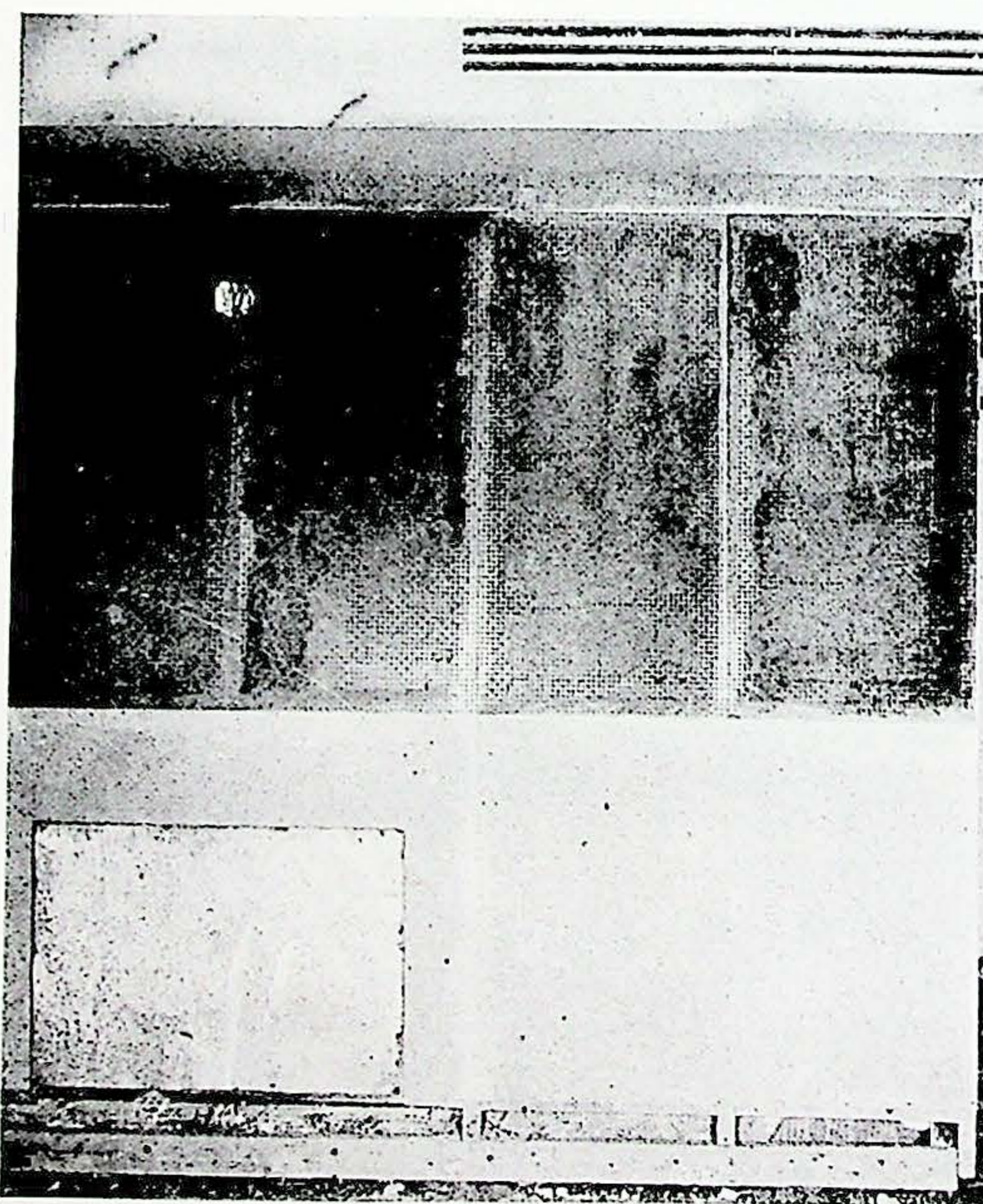


FIG. 15





so, all rotating machinery, such as motor generators, air conditioning fans, compressors and pumps, likely to cause interference with broadcasting because of vibration, is mounted on shock absorbing bases.

## OK for Sound

The preceding paragraphs on sound conditions of studios have dealt with the elimination of extraneous or unwanted sound. Just as important is the problem of *controlling* sound—in this case the voices or music eventually reproduced in the receiving set—inside the studio, so that the correct acoustical characteristics are obtained.

A studio with hard interior surfaces sounds *live*, and if large will have a pronounced echo or reverberation. On the other hand, too much acoustical treatment makes the same studio sound *dead*. The quantity and placement of acoustical treatment required for each studio is determined by mathematical computation.

In most cases studios are designed to have but one fixed acoustical characteristic. Sometimes, however, a means of varying the area of treatment and thus allowing variable acoustical characteristics is included. This is true of the four 30 feet by 50 feet studios on the third floor of the Radio City plant. These studios are equipped with sliding acoustical panels which may be moved back and forth manually or by motor control to cover or expose a hard, serrated, plaster surface. Figure 17 illustrates one of these studios while figure 18 shows one type of serrated, plaster surface. The panels themselves are treated with Rockwool blanket and covered with perforated metal. This method of construction allows more or less of the acoustically treated area to be exposed simply by pressing a button

in the studio control room. The reverberation may be varied from .65 seconds with the hard surface completely covered to 1.20 seconds with the maximum hard surface exposed. Reverberation time is defined as the time in seconds required for a sound of a given steady state pressure to decay to one one-millionth that pressure. While Rockwool is used in the basic treatment in the Radio City studios, other types of material are employed to a minor extent.

Serration is a type of surfacing required when hard surfaced walls of a studio are parallel to each other. If the latter condition exists and no precautions are taken, the result is that separate or individual sound reflections occur, seriously impairing sound quality in the studio. The serration of these parallel surfaces not only eliminates such reflections, but also by causing the direct and reflected sound to mix in such a way that the studio is more uniformly *brilliant* over the whole audible frequency range than it otherwise would be.

## Made-to-Order Caves

When a dramatic script calls for a scene in a vast temple, or an adventure series depicts action in

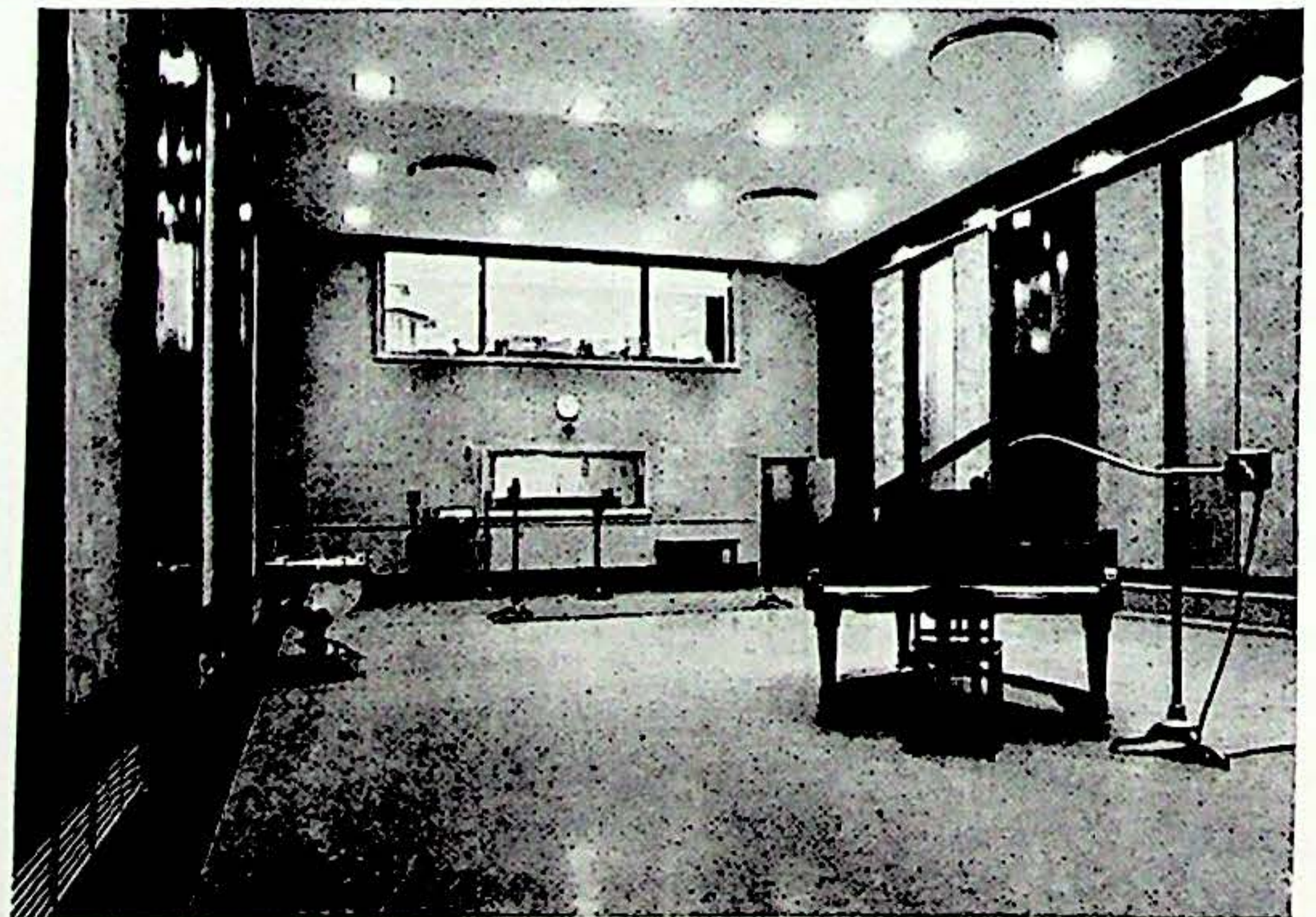


FIG. 17

a cave far underground, then the ingenuity of the engineer is displayed in the construction and use of echo chambers, or, more correctly, reverberation chambers.

The echo or cave effect is created by feeding a portion of the studio microphone output into a loud speaker which is mounted in a room called an echo chamber. The hard, inside surfaces of this room reflect the sound issuing from the loud speaker in a heterogeneous pattern. This sound is then picked up by a microphone also mounted in the echo chamber. The outputs of the microphones in the echo chamber and the studio are electrically mixed in the desired intensity relation. On the air the result of this mixing is a surprisingly realistic illusion of sound in a highly reverberant room or cave. Figure 19 illustrates an echo chamber.

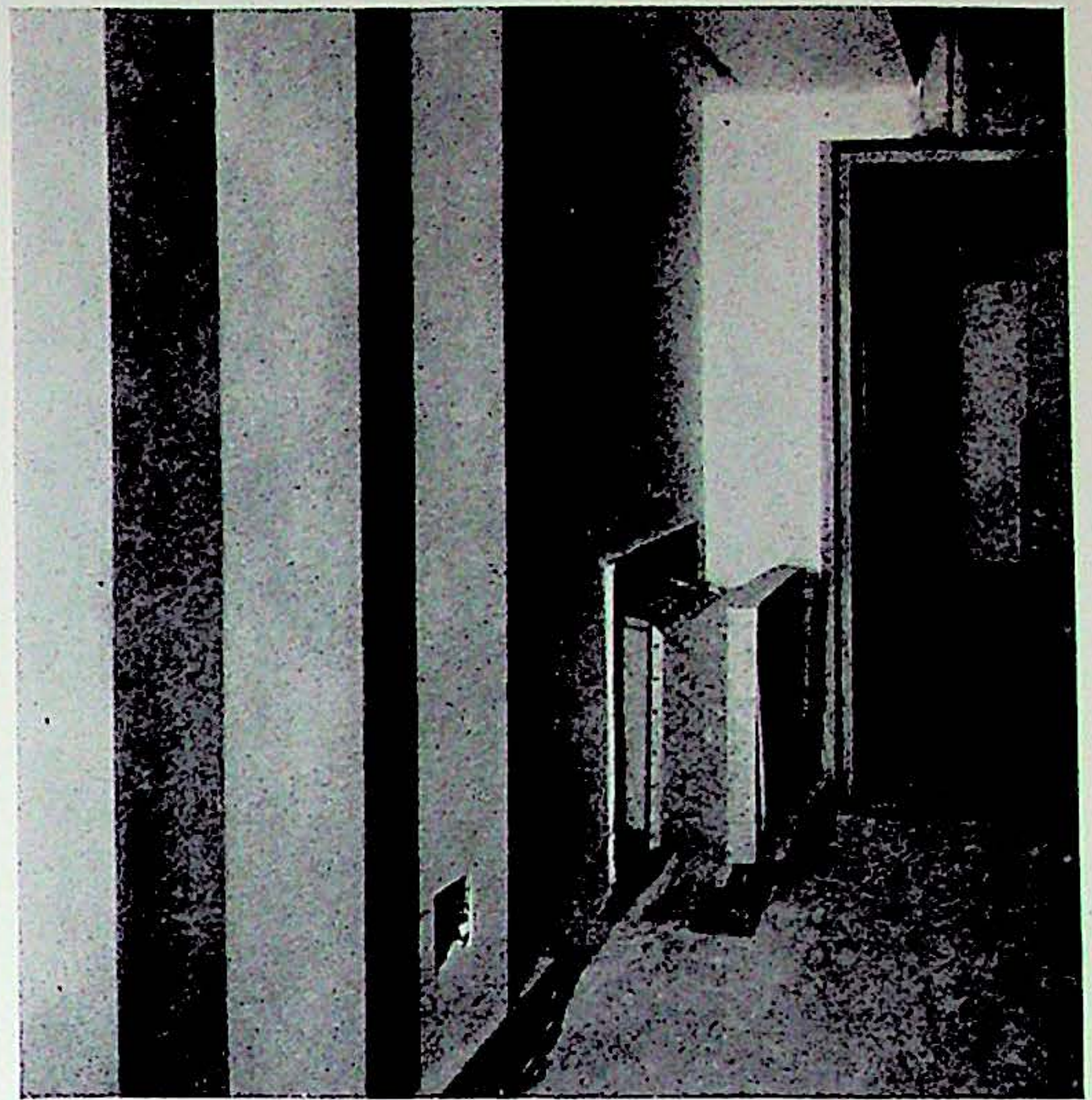


FIG. 18

### Visibility: One Hundred Per Cent

Broadcasting studio lighting requirements are exacting for several obvious reasons. Shadows or glare on scripts or musicians' music sheets cannot be tolerated, although light must be of sufficient intensity to provide illumination for quick and easy reading.

It has been found that an illumination intensity of at least twenty foot candles on a uniform working plane—the plane at which scripts are held for reading—gives the best studio lighting conditions. The controlled lens lighting system employed in the NBC Radio City studios meets all the requirements of the modern studio, and, in addition, has the very desirable characteristic of high efficiency based on foot candles output per watt input. This not only places less heat load on the air conditioning system, but assures the requisite illumination at low operating cost. A typical, recessed luminaire is shown in figure

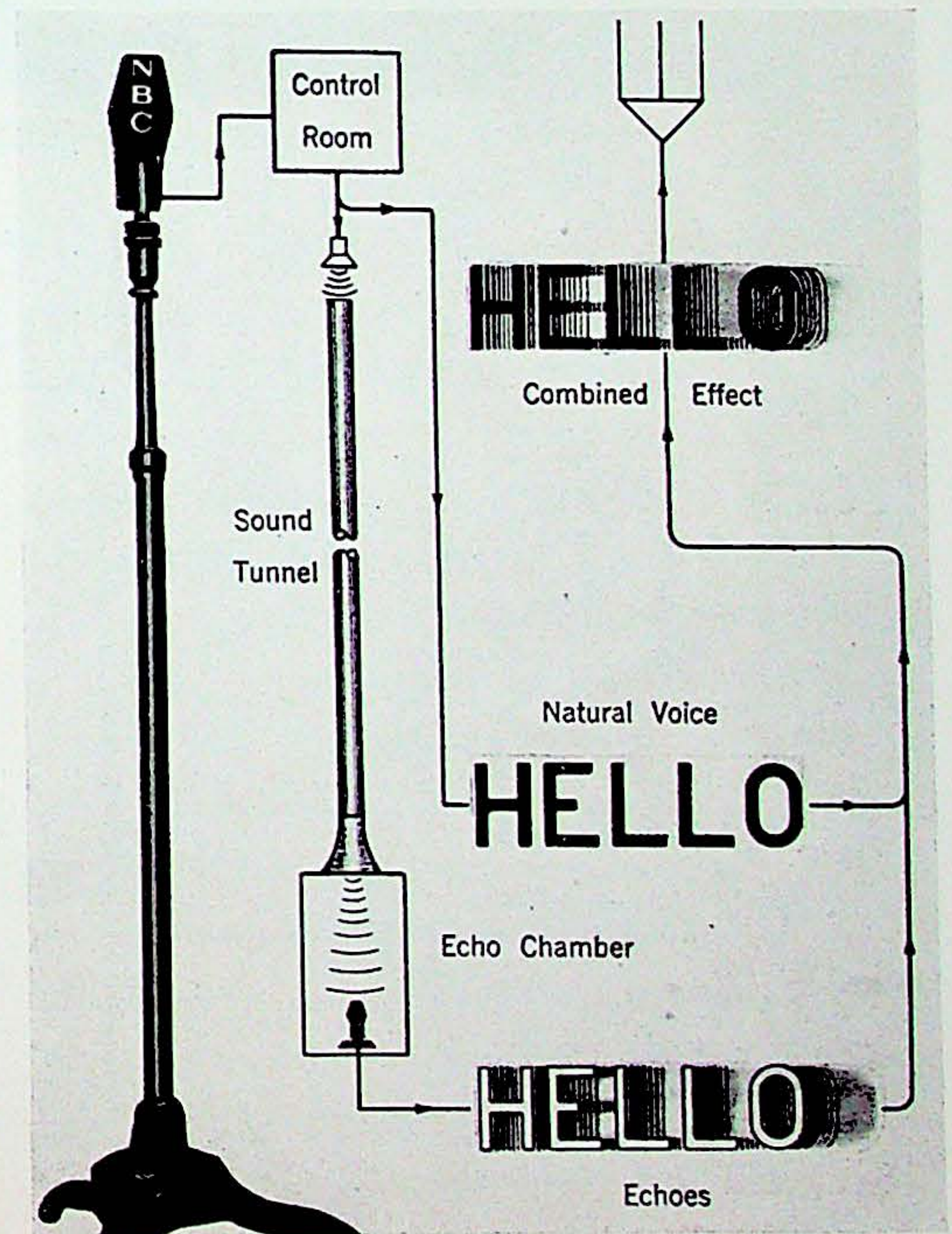


FIG. 19

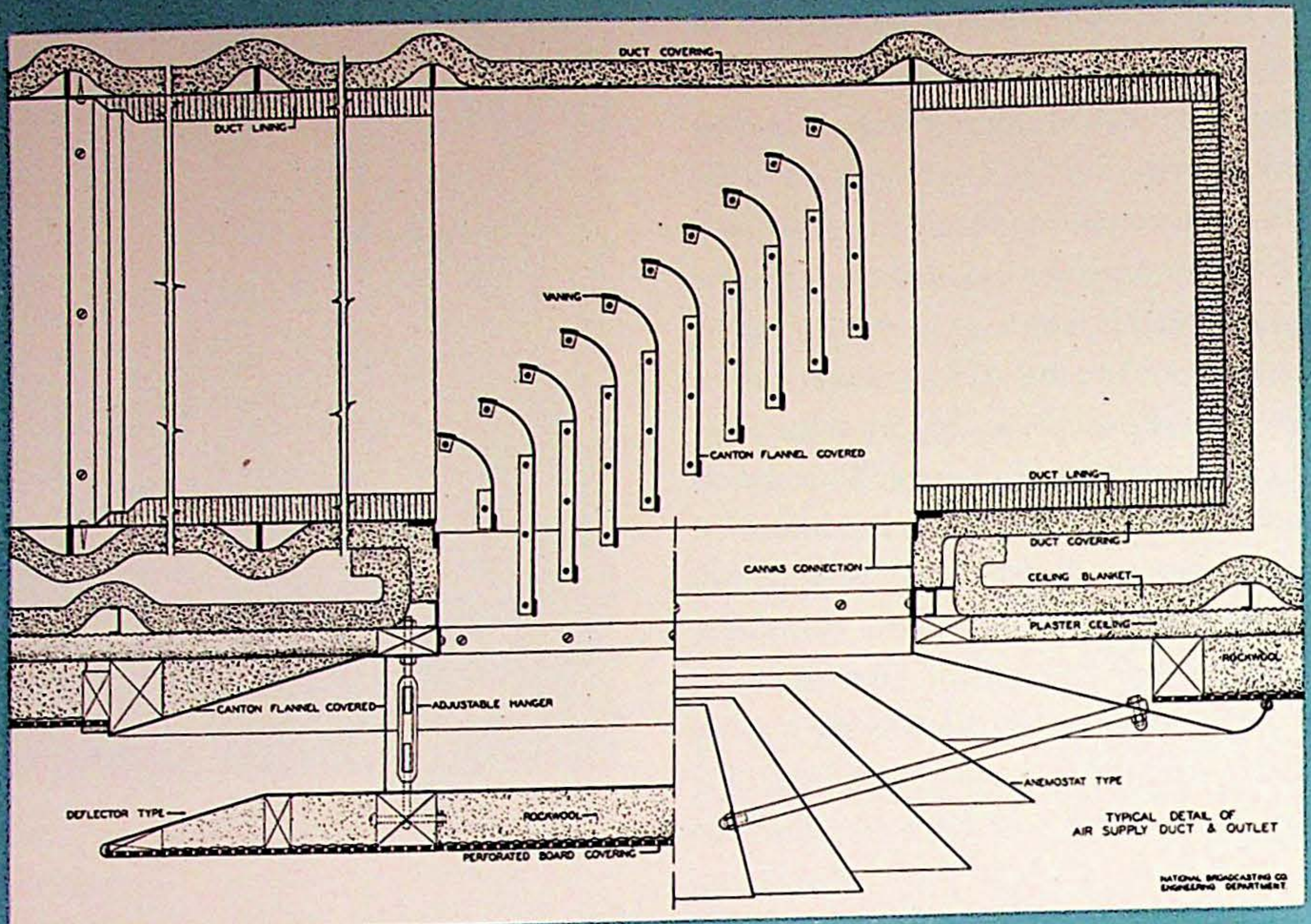


FIG. 21

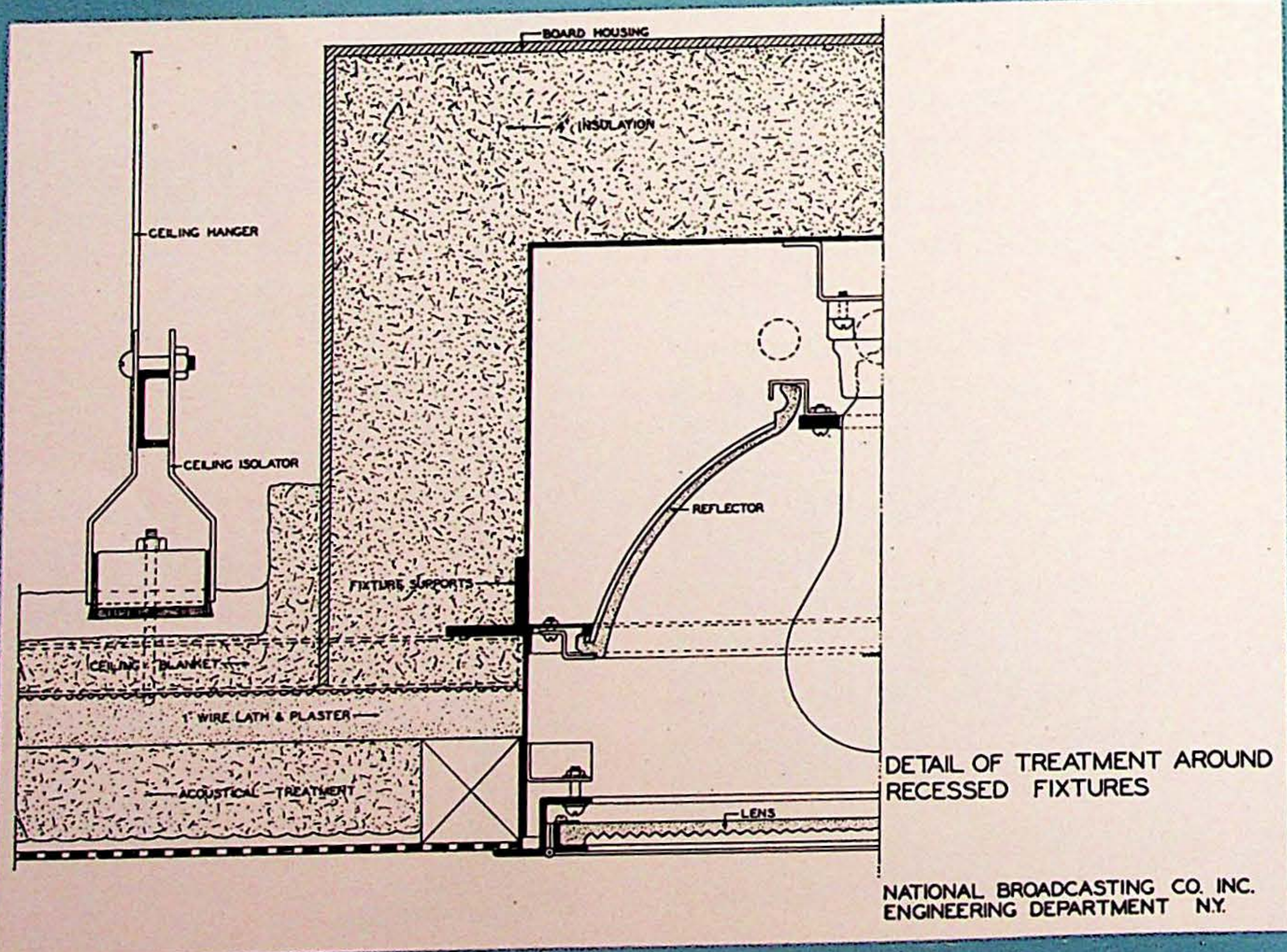


FIG. 20

20. Rockwool heat insulation surrounds the fixture to reduce the heat that escapes to the space above the furred ceiling where the cold air ducts are situated. The light flux distribution of the typical unit simulates, except for greater dispersion, the distribution through a clear plano-convex lens.

## Mark Twain to the Contrary

If Charles Dudley Warner, who really said it, could have lived to visit and broadcast from NBC's Radio City Air Castle, Mark Twain would never have been accredited with the famous remark, "Everybody talks about the weather but nobody ever does anything about it."

The weather in the studio section of NBC headquarters in Radio City is literally made-to-order. Every ten minutes during the warm season four-and-one-half-million cubic feet of the air are filtered, cooled and de-humidified so that the temperature and relative humidity are always within the "comfort zone."

The machinery used to accomplish this miracle of man-made weather is tremendous. Four huge refrigeration compressors with a combined total of 1200 horsepower and ice-making capacity of 900 tons per day, form the heart of this vast air conditioning system. Chilled water is fed from these compressors by centrifugal pumps in the basement of the RCA Building, to four dehumidifying tanks on the tenth floor. The water required for the cooling of the refrigerant is pumped from the basement to the two cooling towers on the roof at the rate of 1350 gallons per minute.

Fresh air is drawn into the building by four large supply fans, each directly connected to its respective spray tank, wherein the refrigerated water spray from hundreds of nozzles washes

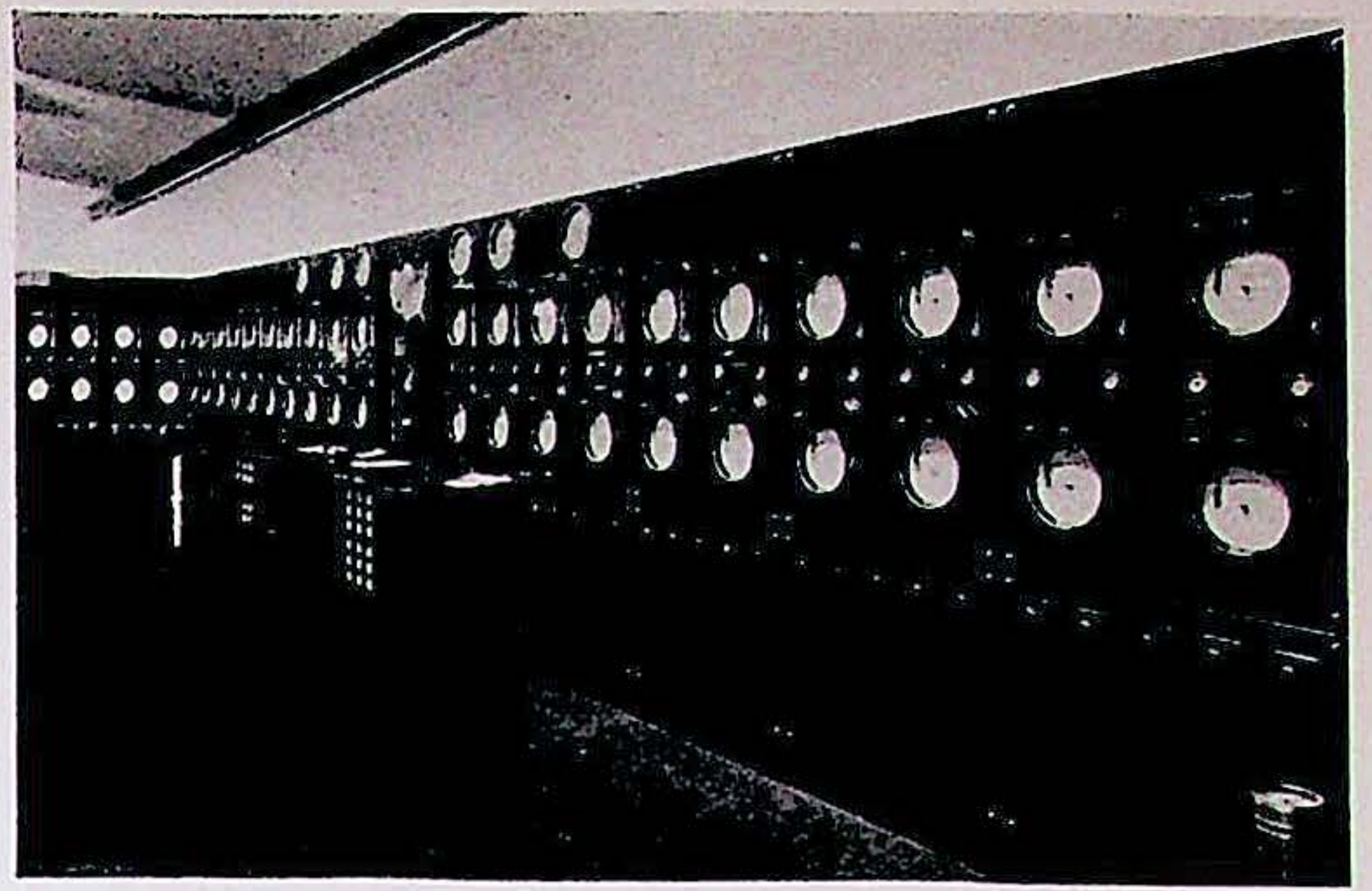


FIG. 22

and extracts the excess moisture from the air. The entire volume of air circulated—and this may include a maximum of 40% re-circulated air—is filtered through oil-coated glass wool filters. In all there are 1400 filter sections each measuring 20 inches by 20 inches by one inch.

A composite cross section of an air supply duct outlet is shown in figure 21. The distribution vanes in the duct are flannel-covered so that the air direction is changed with a minimum of air rush noise. Two types of room distributors are shown: the flat deflector and the concentric cone assembly.

The system used to control and distribute this cooled, filtered, washed air is both extensive and complicated. Figure 22 shows the main control board with its 64 temperature recording controllers. Each of these instruments not only gives a graphic 24-hour temperature record, but also automatically maintains at fixed temperature a selected location—a studio exhaust duct for example. The expansion and contraction of vapor with the varying of temperature is employed to effect this automatic control. A small diameter copper tube connects the controller mechanism with a comparatively large metal bulb in the air duct. Some of these tubes are as long as 375 feet. Both bulb and tube are filled with vapor, the

pressure of which is characteristically sensitive to small temperature changes. A difference of temperature in the bulb brought about by a slight change in temperature of the air in the duct is immediately transferred back through the vapor in the tube to the controller, which in turn controls compressed air to operate dampers and duct steam heater valves.

In some of the small rooms not on the main recorder control system, electrically operated dampers and heaters maintain the desired temperature. There are fifty-five such locations at which the temperature may be read by a key-operated, resistance indicating thermometer at the main control board.

Warning lights are placed around the entire control board below the second row of recording controllers. Each light burns when the fan to which it is wired is shut down for any reason.

Thus by merely glancing at the control board the operator can tell immediately how many fans are out of operation and where these fans are located.

## Nerve Center of a Network

Scientific studio construction, sound insulation, air conditioning—these are all essential elements of the modern broadcasting studio, but they leave the studios mere lifeless chambers, incapable of fulfillment of their primary purpose. To complete the picture of the NBC Radio City Air Castle studios we must visualize that maze of wires that threads its way through the studios like the nerves of the human body, pulsating with electric current and carrying the vibrations that will eventually be transformed into words and music in millions of American homes.



FIG. 23

The center of this labyrinth of metal nerves—the “brain” of the NBC network—is the master control desk, pictured in figures 23 and 24. Here it is, from this imposing control desk, that all the impulses go out from the studios to the desired channels or circuits at the right moment.

Although this would seem an enormously complicated process with the master control desk literally covered with keys, buttons and winking lamps; the possibility of error has been reduced to a minimum. With keys properly set well in advance of switching time, and only the final set-up and release left to the announcers in the studios, this nerve center of the network is an amazingly efficient electric brain that performs with incredible accuracy and reliability.

The desk itself consists of a middle supervisory board and of functionally duplicate left and right sections upon which the studio switching controls are mounted. There are, in all, fourteen program channels; connections to them are completed by relays—switchbanks—controlled from the desk. Eight switchbanks are available at each end of the desk so that all switching operations may be carried out at either end or divided between them.

As an example of a typical switching operation, suppose studio 8A is to be connected by means of switchbank 7 to channels 1, 3, 5 and 6. Referring to figure 24, the upper three rows of keys are typical control positions for studios 8A, 8B, 8C and so forth. The two lower rows of keys at the right are the controls of switchbanks 7 and 8. The switching sequences are as follows: the seventh key—from the left—of studio 8A position is turned on and the studio is thus connected with switchbank 7. Now if keys 1, 3, 5 and 6 of switchbank 7 are also turned to the “on” position, the four channels corresponding to these numbers will be connected with studio

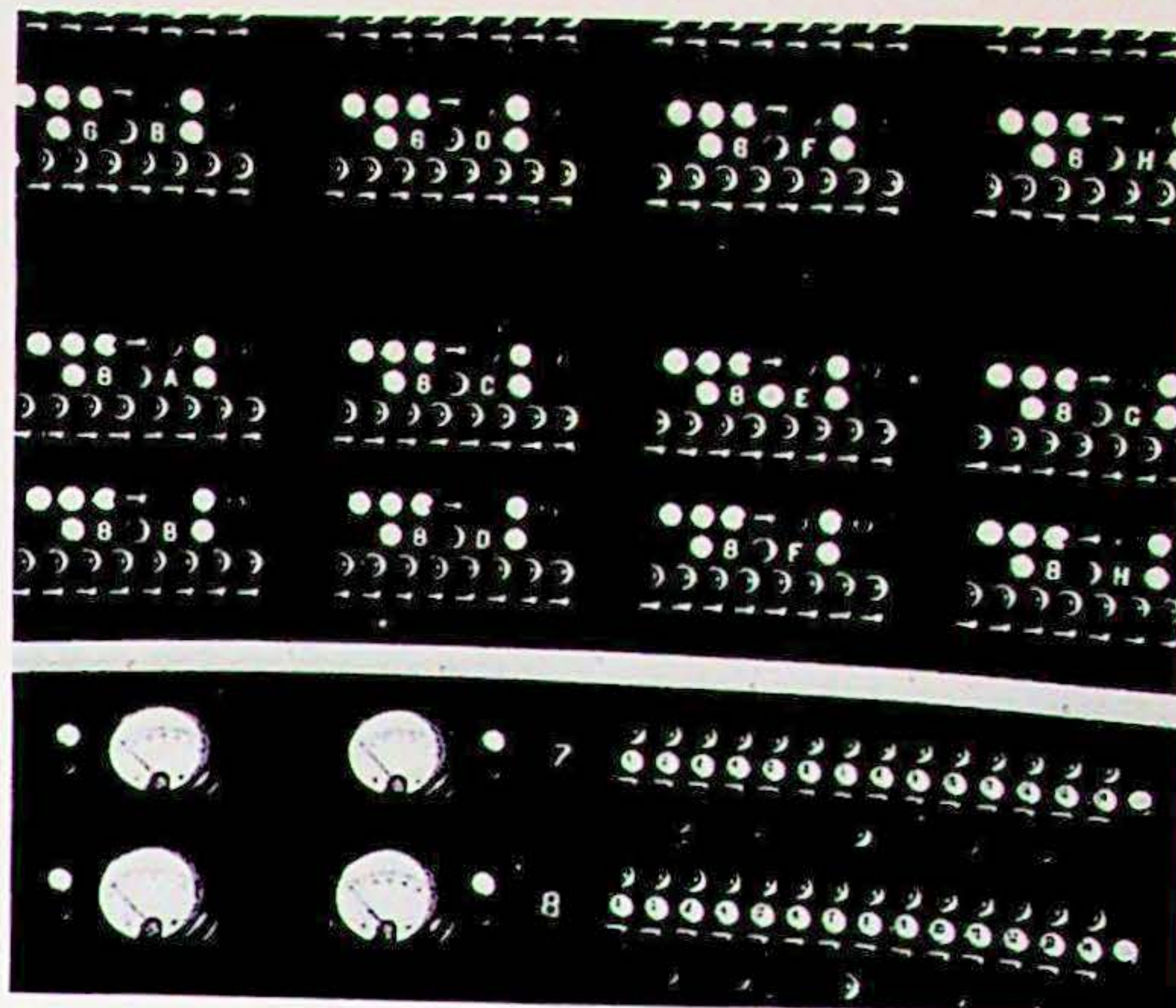


FIG. 24

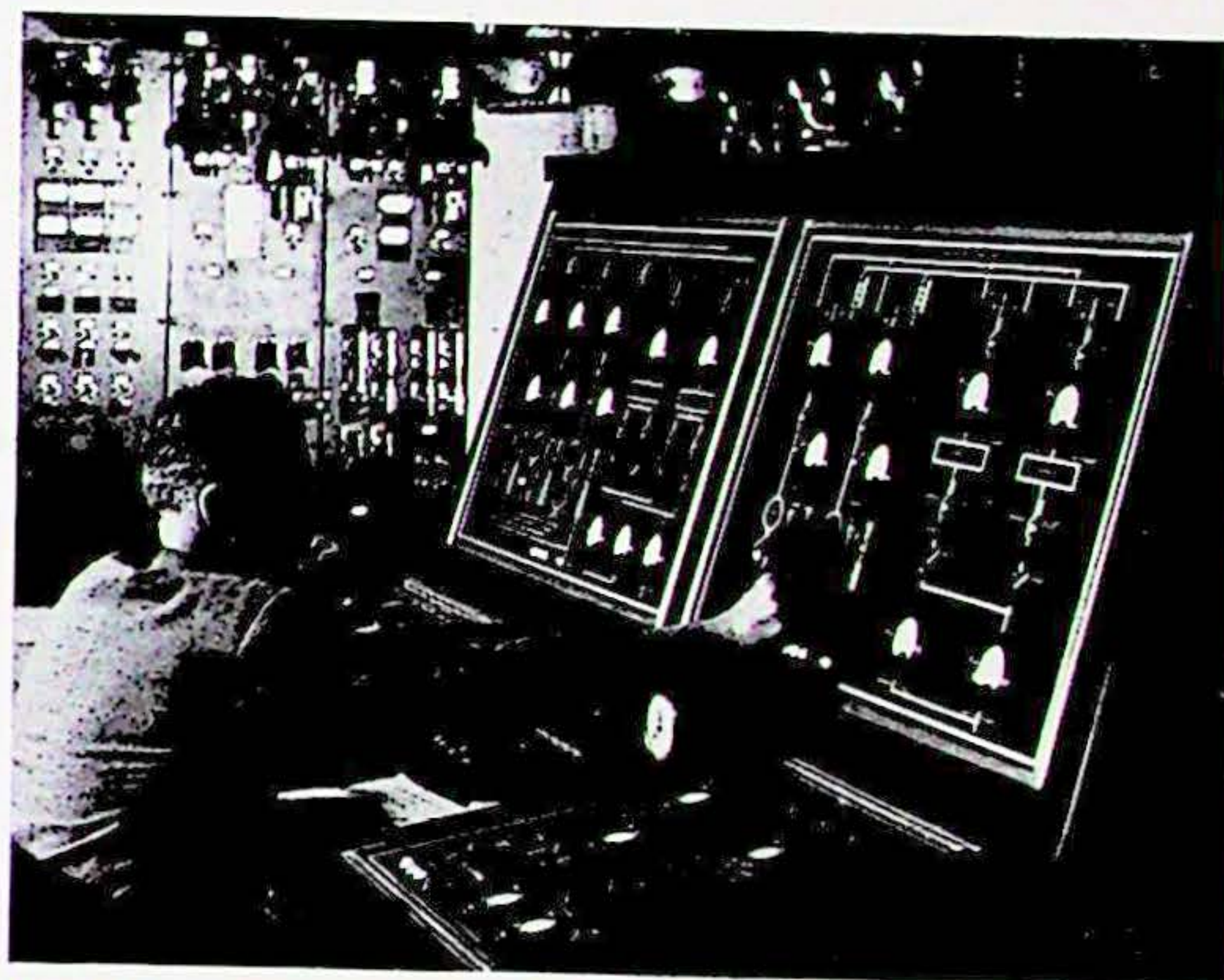


FIG. 25

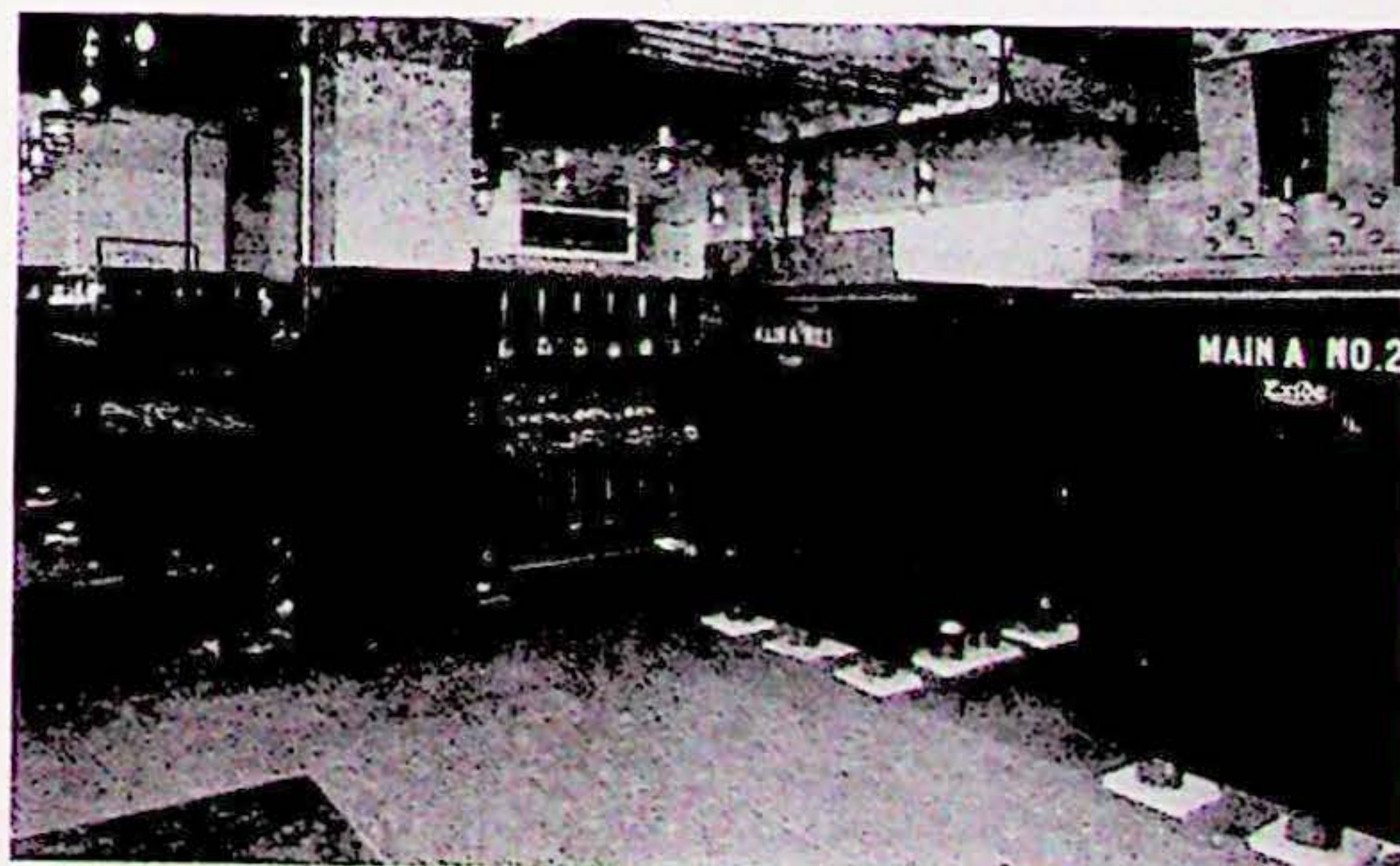


FIG. 26

8A through switchbank 7. Only one operation remains to complete the connection: the announcer in studio 8A must depress the set-up button on his studio control panel. When this is done a green carrier signal on this panel lights up only after the assigned channels are clear. The system is interlocked so that no busy channel can be used until after it has been released by the other studio. Should the announcer in the studio miss his cue, the set-up and release can be made at the master desk.

The supervisory portion of the master control desk—the middle section in figure 23—has, for the most part, duplicate facilities. The supervisor on watch here has the means to monitor program volume level and quality on any incoming or outgoing studio circuit merely by turning switch keys or by dialing studios on the program monitoring system. In addition he has at his disposal a ten position PLX board for communication with such places as the traffic department, supervisor of announcers, and telegraph room and telephone company offices. Other facilities provide telephone, teletypewriter, and Morse wire service to those locations outside of the building where programs originate.

The transmission board, termination point of all incoming program lines, is also in the main control room to the right of the main control desk. The engineer on watch at this board is responsible for the switching of the incoming lines and for their testing and equalization. Normally he has little to do with outgoing lines—the fourteen program channels—because they all connect with either the American Telephone and Telegraph Company office or the New York Telephone Company Exchange. Any manual by-pass connections required at this point because of audio equipment failure are made by

the transmission engineer at the jack panels provided for that purpose.

## **"We Interrupt This Program—"**

When you are quietly listening in your home to your favorite NBC network program and hear the music or words abruptly interrupted by "we interrupt this program to bring you a special news flash" you may be sure that momentous news is about to be reported to listening millions. Broadcasting important bulletins over the network within a few seconds after they have been received in the NBC Newsroom is accomplished by means of remarkably ingenious special news flash equipment which is an integral part of the master control.

This equipment provides both the chief announcer and the special events director with microphone facilities for making news broadcasts, and once either of these positions has been set up at the master control desk the news flash can be on the network within ten seconds. This rapid cut-in is made possible by a motor operated volume control which reduces the volume of the existing program from normal level to cut-off within that short interval of time. As soon as the network has thus been cleared, a go-ahead signal light is automatically turned on in the news room or at the chief announcer's desk, and the news item is read. At its conclusion the channels are released and the original program is brought back, again within ten seconds, to its normal volume.

## **Wizard's Workshop**

A large percentage of the studio equipment in the NBC Radio City Air Castle—amplifiers, the master control desk, switchbank relays, radio re-



ceivers for the house monitoring system—is centralized on the fifth floor.

This audio equipment is the electrical apparatus that breathes radio life into the words and music picked up by the studio microphones—that boosts many thousands of times those infinitesimal electrical vibrations recorded by the microphone, until they are of sufficient strength to be fed into the network lines, and from there to NBC affiliated stations throughout the country. The centralization of all such equipment greatly simplifies problems of routine maintenance and prompt correction of trouble. Naturally, when the plant was designed great care was taken to select the best equipment available. The response characteristic of the audio frequency system, substantially flat from 80 to 12,000 cycles per second, drops off slightly only

at the extreme ends of the audible range—20 to 15,000 cycles per second.

### Power House

Fifty tons—100,000 pounds of batteries—are used to power the audio equipment in use on the fifth floor of NBC's Radio City Air Castle. Shown in figure 26, the batteries are operated float-charge from the motor generators, shown in figure 27, and furnish energy for as many as 150 Direct Current operated program amplifiers. The main "A" and "B" battery 8-hour capacities are respectively 1000 and 15 amperes. Spare batteries of lower capacities are also available. The power room desk, shown in figure 25, is equipped with miniature supervisory control panels which enable the operator to read the generator and battery currents of the "A" and "B" systems.

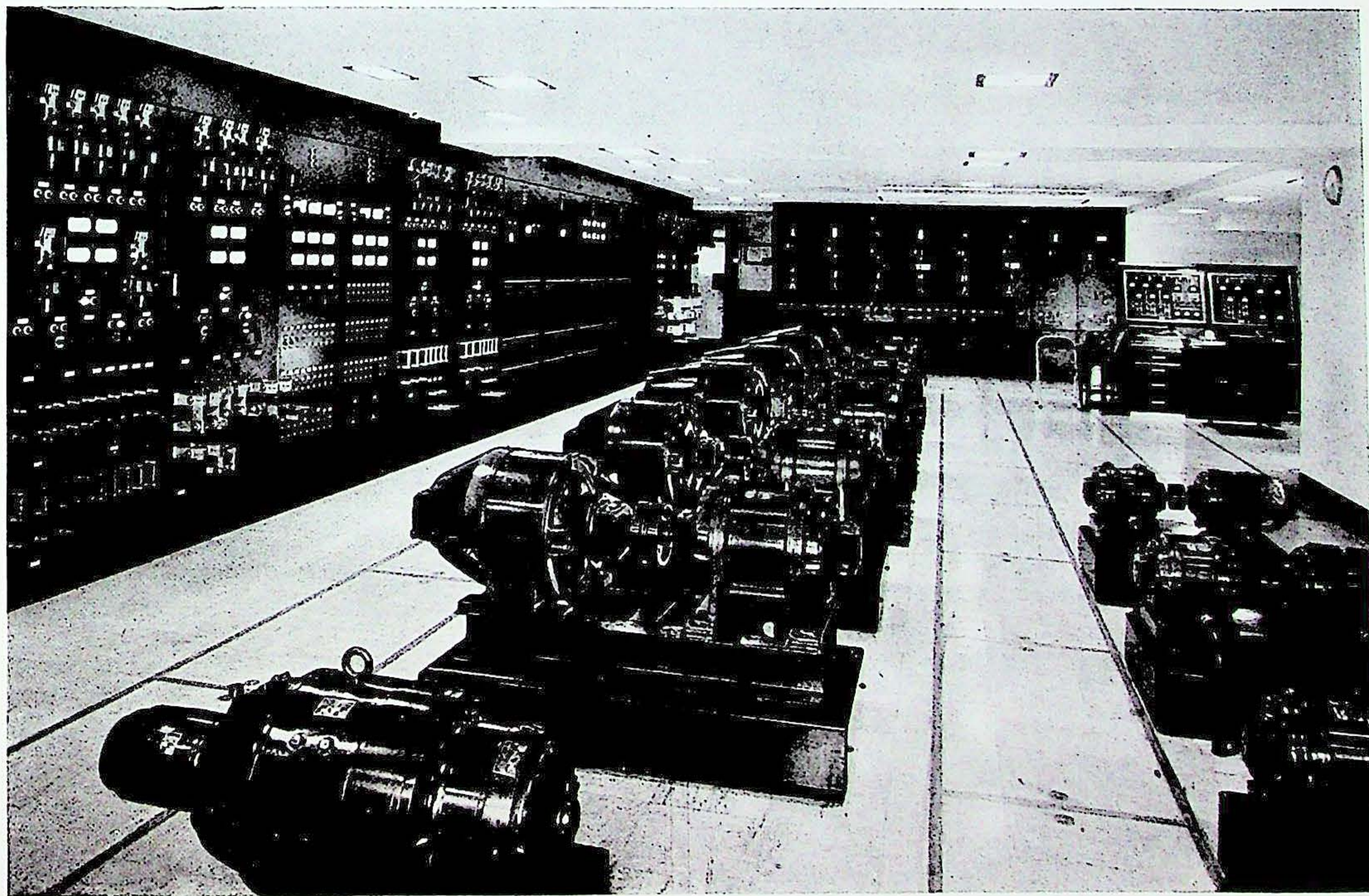


FIG. 27

## At Your Fingertips

Final link in the audio equipment of NBC's Radio City Air Castle is the installation of office program monitors with high fidelity loud speakers and desk dial selector boxes. One of these installations is shown in figure 28. Any studio in the building may be dialed, as well as all important local standard broadcast and frequency modulation stations. In most cases, auditions, too, may be dialed and heard on these monitors, though occasionally auditions are restricted to those persons directly concerned.

## Splitting Seconds

Time is the very essence of modern radio network broadcasting. Commercial sponsors spend thousands of dollars weekly for time on the network. As an advertising commodity, broadcasting time is analagous to magazine and newspaper space. Therefore the instruments by which radio time is measured are of prime importance, not only in assuring smooth operation,

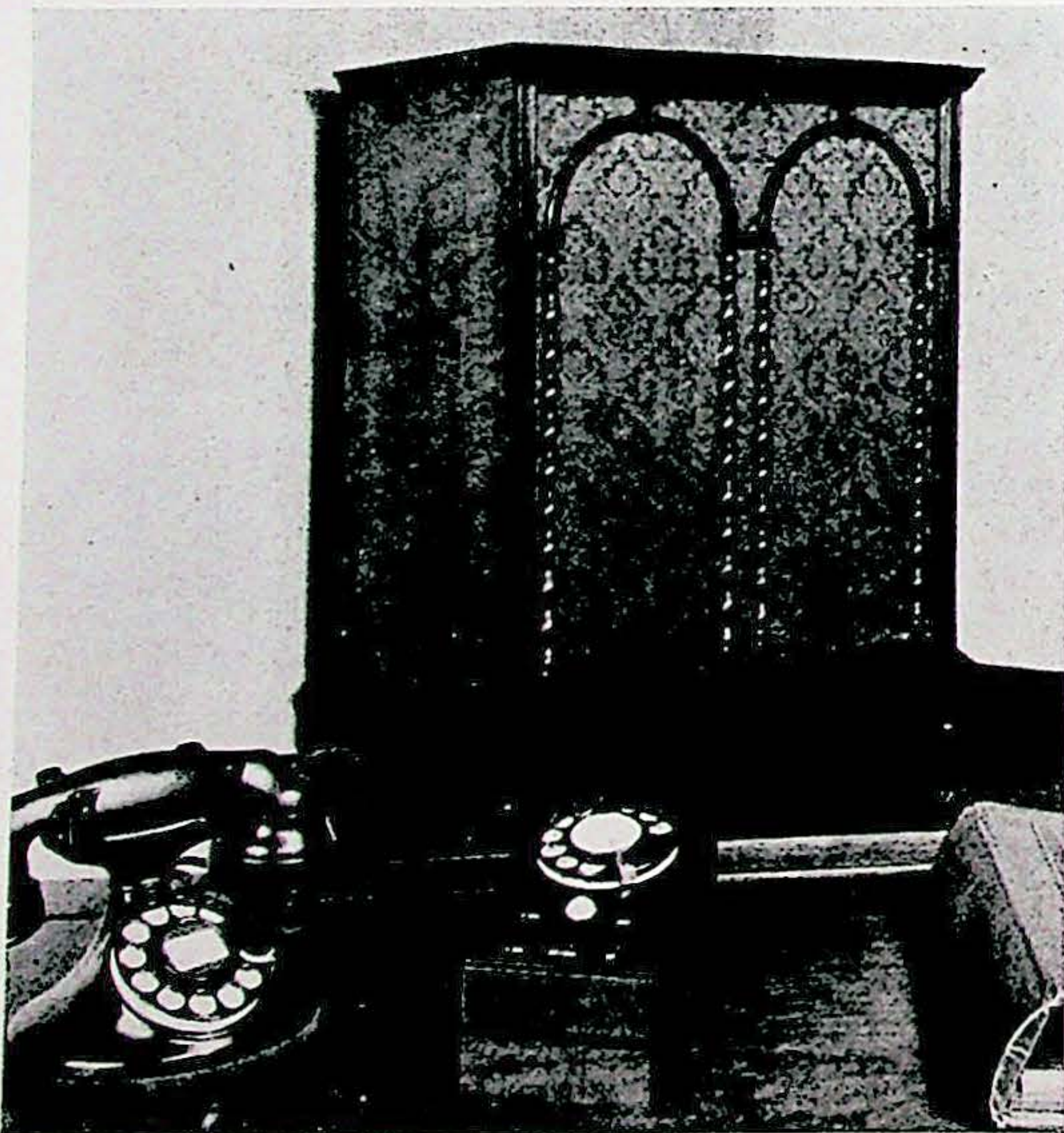


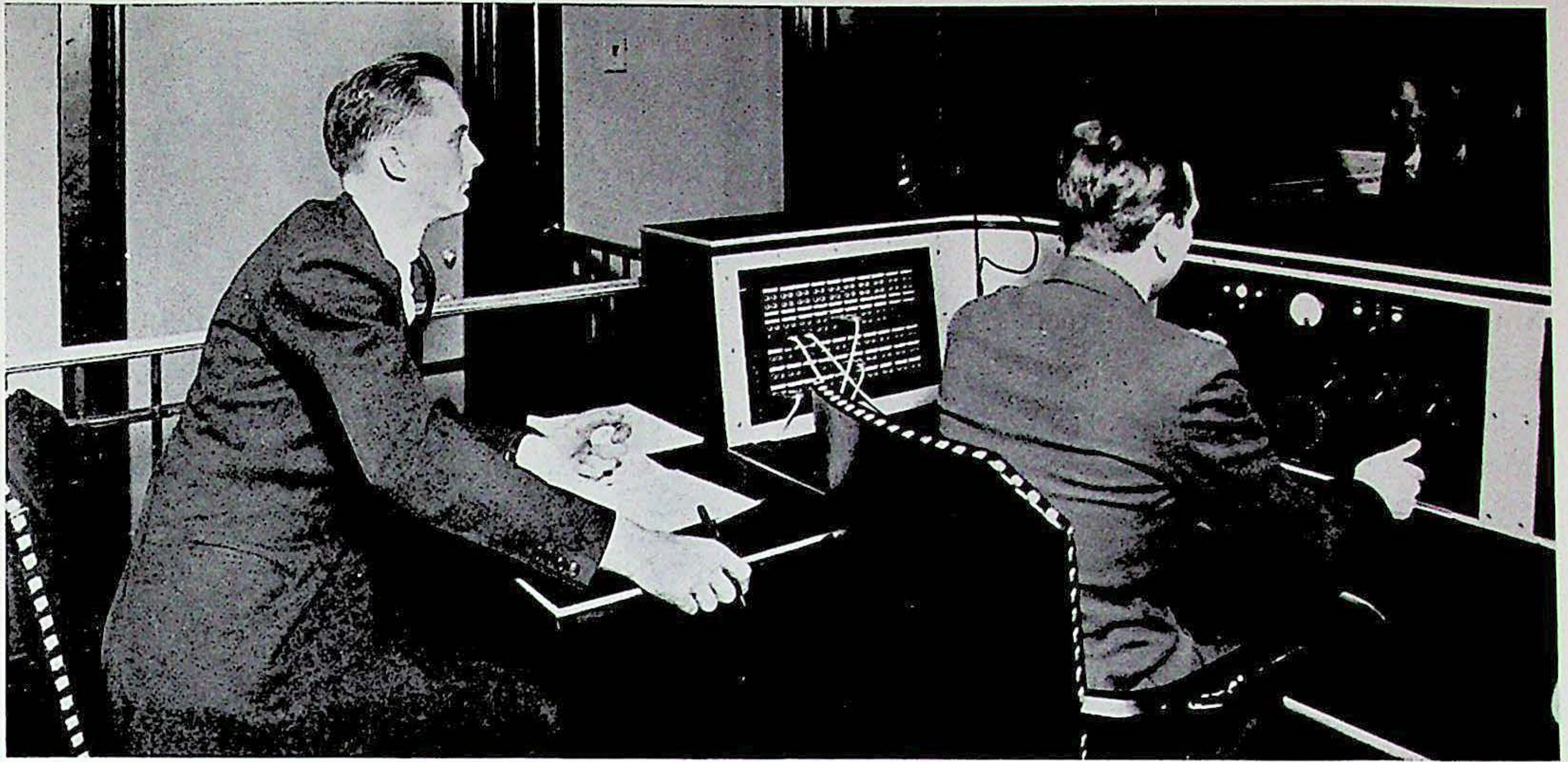
FIG. 28

but in the satisfactory commercial operation of the network.

The clocks at every station in the NBC network must indicate identical time—with allowances for geographical differences of time zones. If a program is scheduled to commence on the hour, all clocks must indicate the start of that hour at the same instant. Failing this, the opening or closing commercial announcements might be cut or lost completely to some stations.

So it might be said that the precise timing of NBC programs is the corollary to an even more precise timing system with which, in its present modernized form, an accuracy of one part in better than 100,000—less than one second in 24 hours—is easily maintained at each NBC plant. Daily checks are made against the time signals of the United States Naval Transmitter at Arlington, Virginia to insure complete and official accuracy.

Except for the number of clocks in operation and their grouping, the NBC Radio City timing system is typical of that employed in each of the other six NBC Air Castles. It consists of 275 synchronous electric clocks divided into four groups serving—1. the studios; 2. the studio control rooms; 3. miscellaneous studio section rooms; and 4. the office section. The clocks are operated by the output of a precision 60-cycle tuning fork-vacuum tube amplifier combination. If the daily time check indicates a correction, 55 and 65 cycle tuning fork-amplifier combinations are available for respectively slowing down or speeding up all clocks for the period necessary to bring about the desired change. A 110-volt, 60-cycle AC operated motor-generator set energizes the forks and amplifiers, while a throw-over switch effects an automatic and practically instantaneous change to battery operation—should the power line fail.

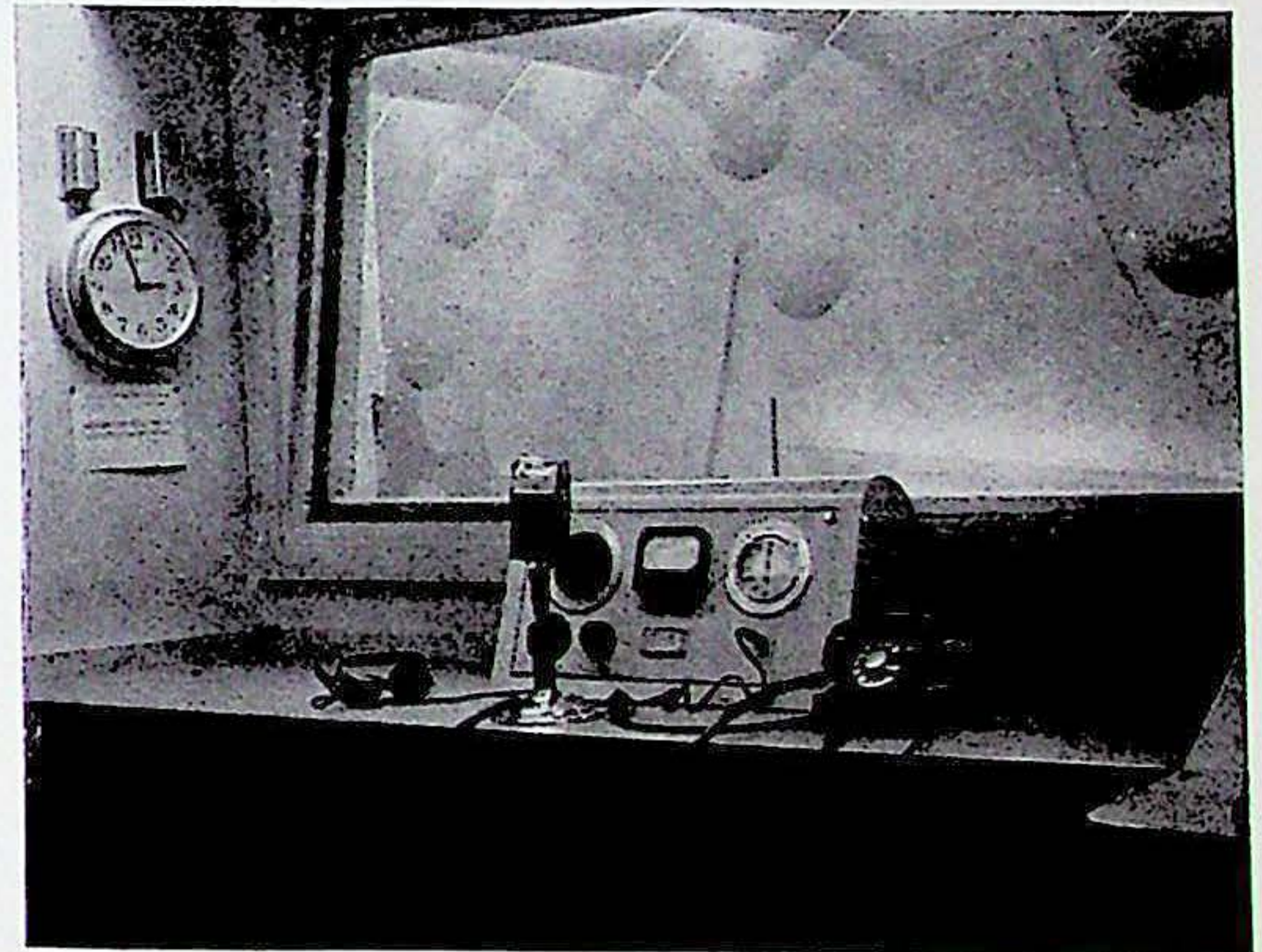


*Typical studio control room in Radio City, where director times program with stop-watch and the engineer monitors sound level.*

### **Period Furniture: 20th Century**

Simple and practical—these are the characteristics around which furnishings and equipment for all NBC Radio City studio and control rooms are designed and built.

The production man and the engineer direct the program from the studio control room, where all the equipment required to carry out their functions is located. Although there are exceptions, the usual control console is equipped with a seven position “mixer” panel—that is, it has seven volume controls—and a volume unit meter to assist the engineer in maintaining the proper program volume level. A studio address microphone wired to a loud speaker in the studio wall permits the production men and the engineer to make suggestions and comments to the artists during rehearsal. Other equipment in the control room includes a high fidelity loud speaker for monitoring the program in the studio, rack mounted microphone amplifiers and test jack panels.



*Control room of most recently designed NBC studio.*

Should trouble be experienced during a program, the studio engineer has only to pick up a telephone handset, turn a key, and a trouble alarm rings until answered at each of four locations—the master control desk, the transmission board, the power room, and equipment and maintenance shop. Thus, prompt correction of all technical difficulties is assured.

## NBC TELEVISION—First in the Public Eye

Since the dawn of history man has dreamed of seeing at a distance. The folklore of all nations is filled with wonder tales of crystal balls, magic mirrors and enchanted pools wherein the images of distant scenes and persons miraculously appear.

But it remained for the true wonder-workers, the wizards of modern electronics, to clutch the dream of distant vision and transform it into a reality—at first a flickering, uncertain reality in the experimental laboratories, and later a clear, distinct picture viewed in thousands of homes equipped with television receivers.

In 1928 RCA began its laboratory experiments in television. Two years later, in 1930, RCA television had outgrown its swaddling laboratory clothes to the point where experience under actual operating conditions was necessary for further exploration of the new medium.

For this purpose RCA inaugurated, in cooperation with NBC, an exhaustive and comprehensive series of field tests. The next few years saw the development of the first all-electronic television system as the most practical and satisfactorily functioning medium yet devised for seeing at a distance.

Early in 1941, WNBT, NBC's station—pioneer television station of the United States—received the first commercial television license. On July 1, 1941, WNBT, operating with an all-electronic television system, began transmission as the world's first commercial television station.

So successful was this all-electronic system of television that in the few short months between

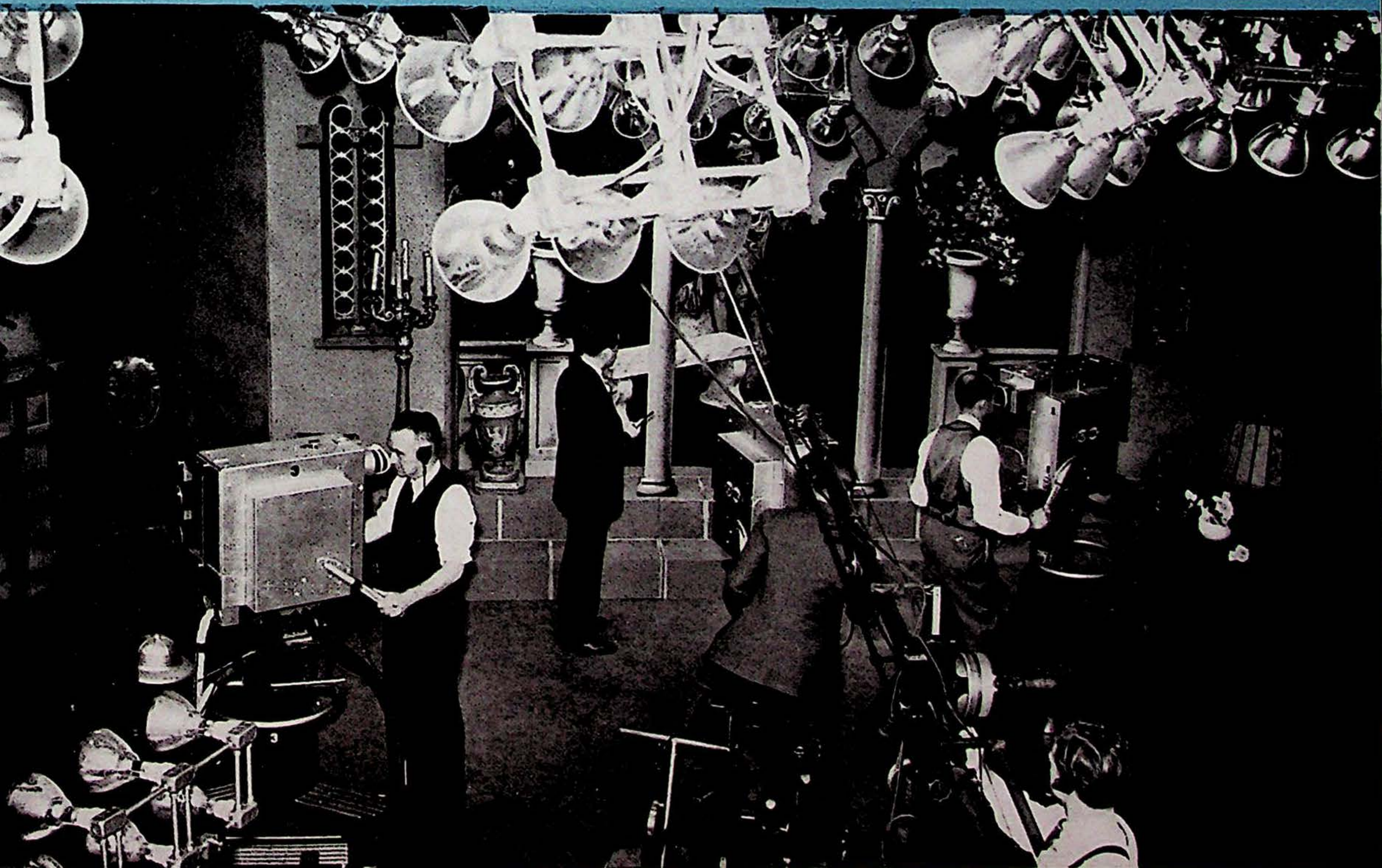
July 1 and Pearl Harbor, the following December, WNBT developed a constantly expanding and ambitious program of live talent and film television shows—many of them commercial—while the number of television receivers in the New York area increased to approximately 5,000.

With the coming of Pearl Harbor, the waxing lights of television waned dim and television became another near casualty of the war. WNBT activities were curtailed to a bare minimum as technical experts took their places in the armed forces and new equipment became increasingly difficult to secure. During the war years of 1942 and 1943 WNBT concentrated its activities on the war effort by conducting a series of training programs in cooperation with civic and governmental agencies for thousands of Civilian Defense Volunteer Officers and other volunteer defense workers. In cooperation with the New York City Police Department, eighty television receivers—one in every police station precinct classroom throughout the five boroughs of New York City—were installed. Two and a half hours were given over every Monday to the transmission of a training course which was a required part of the basic training of all air raid wardens before they could advance in service. From 4:00 to 5:00 each Monday afternoon there were fifteen viewers in each precinct house; from 7:00 to 8:30 each Monday night, thirty viewers per receiver. The number of these viewing posts combined with the number of times each lecture in the television training series was repeated made it possible to train 107,499 New York City



FIG. 29

FIG. 30



air raid wardens. Undertaken in the middle of 1942, this work was completed late in 1943.

Early in November, 1943, the second important civilian defense training course was inaugurated by NBC television. This was the two-month Fire Guard Course which terminated December 27, 1943, and resulted in the training of 14,400 Fire Guards.

Late in 1943, NBC installed television receivers in the Halloran General Hospital, and the U. S. Naval Hospital, St. Albans, New York. Later, eight other such installations were made so that convalescing veterans might enjoy television pickups of a variety of sporting events from Madison Square Garden and St. Nicholas Arena. The veterans were also enabled to view the latest Army and Navy films over WNBT.

The year 1944 saw a gradual but unmistakable resurgence of activity in WNBT television. More and more technical experts returned from the service to resume their positions at NBC. Ambitious program plans were drafted for post-war television, designed to launch the new industry as one of the brightest hopes of the peace-world. Program and technical staffs of WNBT were increased, hours were added to the program schedule, live talent telecasts were resumed, Studio 3-H was refurnished and re-equipped, commercial telecasts returned to the video screen, and as the year drew to a close WNBT was airing television programs for five commercial sponsors.

Throughout the industry there was a vastly increased interest in television—an interest that quickly communicated itself to the general public and was expressed in widespread curiosity as to the quality of the television picture and programs—and the price and availability of television receivers once the demands of war lessened

and resumption of receiver manufacture was again possible.

During 1945 and '46 NBC television engineering, program and production personnel returned from the services; a regular and expanding program schedule was set up; and sponsors again presented commercial television programs over WNBT.

Late in 1945 the NBC television department was centralized in new and enlarged quarters in the RCA Building. Here additional office, production and working space was available, and construction of a new studio went swiftly ahead. Plans were inaugurated to speed the production and increase the quality of television programs. In the Spring of 1946 WNBT's technical and transmission equipment underwent a similar refurbishment. A more compact and efficient transmitter was installed in the Empire State Building, and the television antenna atop the world's tallest building was replaced with a new one of revolutionary design. The new system delivered an effective radiated signal 100% more powerful than its predecessor. In May, 1946, WNBT resumed broadcasting, located on Channel 4 on its newly assigned higher frequency. At the same time, there was a steadily rising public interest in television shows and receivers, and a widespread desire throughout many industries to explore the possibilities of the new medium.

The eventful months of 1945 saw numerous history-making broadcasts over WNBT. V-E and V-J Days were observed with special on-the-spot television broadcasts of the crowds on Times Square, interviews with important personages, and summaries of the war through skilled editing of newsreel pictures. In October, President Truman made his first television appearance on a special Navy Day program broadcast over

WNBT. From Central Park, the Manhattan reception for General Eisenhower was fully covered, and Admiral Nimitz visited the WNBT studio to address veterans in hospitals in the New York area. In the sports field, WNBT's broadcast of the Army-Navy football game climaxed a year that brought to NBC viewers a complete schedule of outstanding football games, weekly pickups of the boxing bouts at Madison Square Garden, and the major league baseball games played in local fields.

The WNBT staff of producers and directors greatly increased the stature of television's dramatic offerings with their Sunday night dramatizations of famous plays. Some of the most notable of these were "The Devil and Daniel Webster," "Abe Lincoln in Illinois," "Angel Street," and "Winterset." This series presents full length Broadway productions and has received the enthusiastic acclaim not only of WNBT viewers but of New York critics and such famous producers as John Golden.

The nature and quality of program material seen on WNBT clearly indicates that television will not depend solely on radio, the theater or motion pictures for its offerings, but will employ the techniques and talents of each, while it develops its own stars and production procedure. Likewise technical equipment will be developed which will partake of characteristics of equipment employed in other media, adapted and re-designed for television usage.

How soon will NBC operate a television network? The answer is that since 1941 a television network has been in operation between New York, Philadelphia and Schenectady. In 1946 NBC inaugurated a network offering commercial network service between New York and Washington, D. C. Plans are to extend this ser-

vice to Boston in 1947. By means of this eventual East Coast network NBC will be able to provide television program service to approximately one quarter of the nation's population. As soon as practicable, other regional networks will be established using Chicago, Cleveland and Los Angeles as locations for key stations.

### **On Stage at NBC**

Studio 3H in NBC's Radio City Air Castle, originally intended for sound broadcasting, was converted to television in 1936. As the direct result of experimental telecasts, many important improvements were incorporated in this model studio during the years that followed. Figure 29 gives a view of the historic studio as it appears today. While this studio is acoustically treated and air conditioned, as are the sound broadcasting studios, it has additional features which mark it as radically different. Numerous scene changes and varying illumination for each change give Studio 3H a distinctly "backstage" appearance as may be seen in figure 30.

### **Wizard's Eye**

In October, 1945, RCA and NBC demonstrated for the press and trade the new RCA Image Orthicon, a culmination of wartime research and applied electronics. Extremely sensitive, this new electronic "eye" can transmit a television picture at ordinary room illumination and all the way down the illumination scale to such low light intensity as that afforded by candle or match light. Even more spectacular is the Image Orthicon's ability to "see" in an apparently dark room, making use of infra-red lighting which is invisible to the human eye.

This new marvel of the RCA laboratories has a number of advantages, such as its ability to

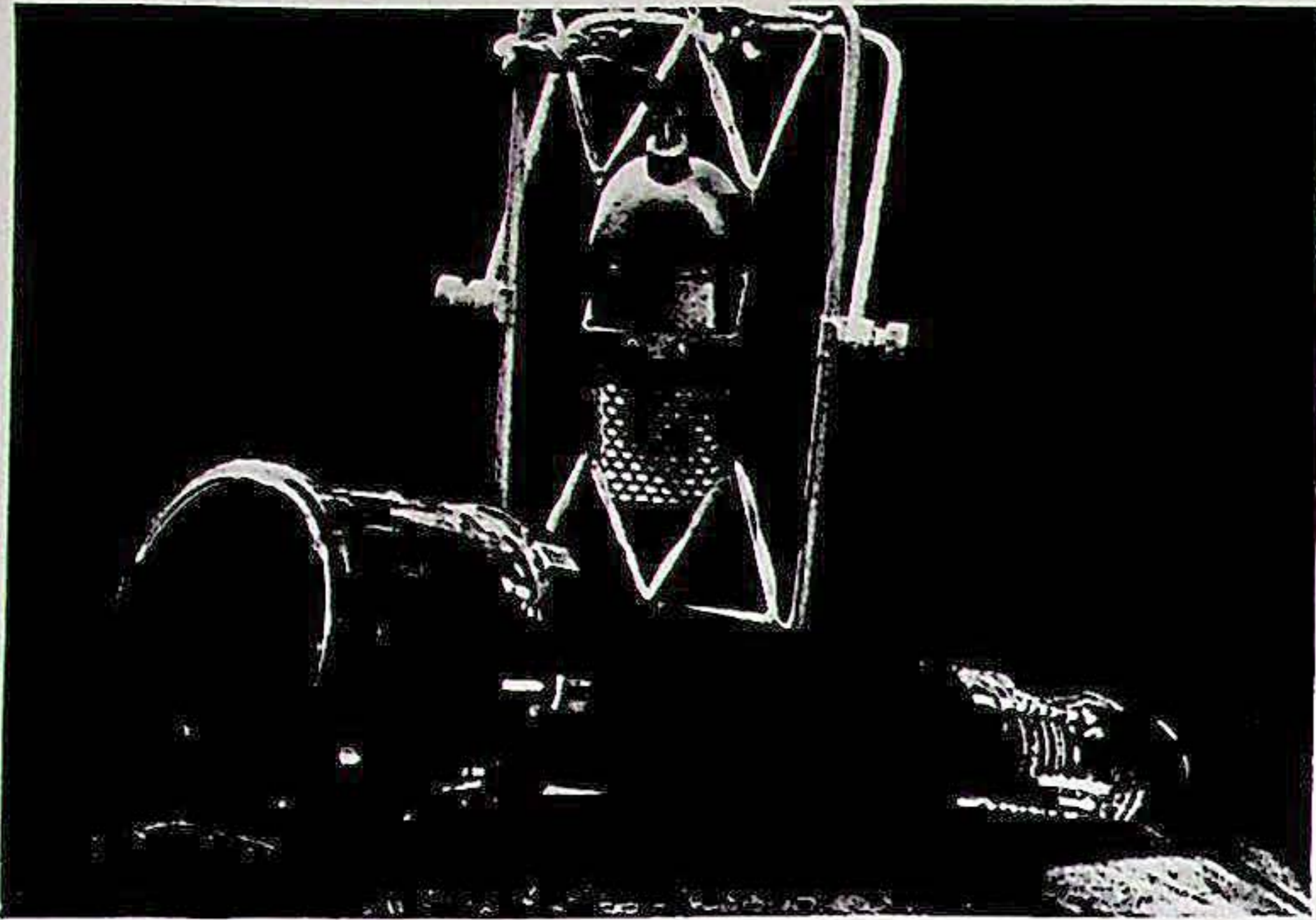


FIG. 31

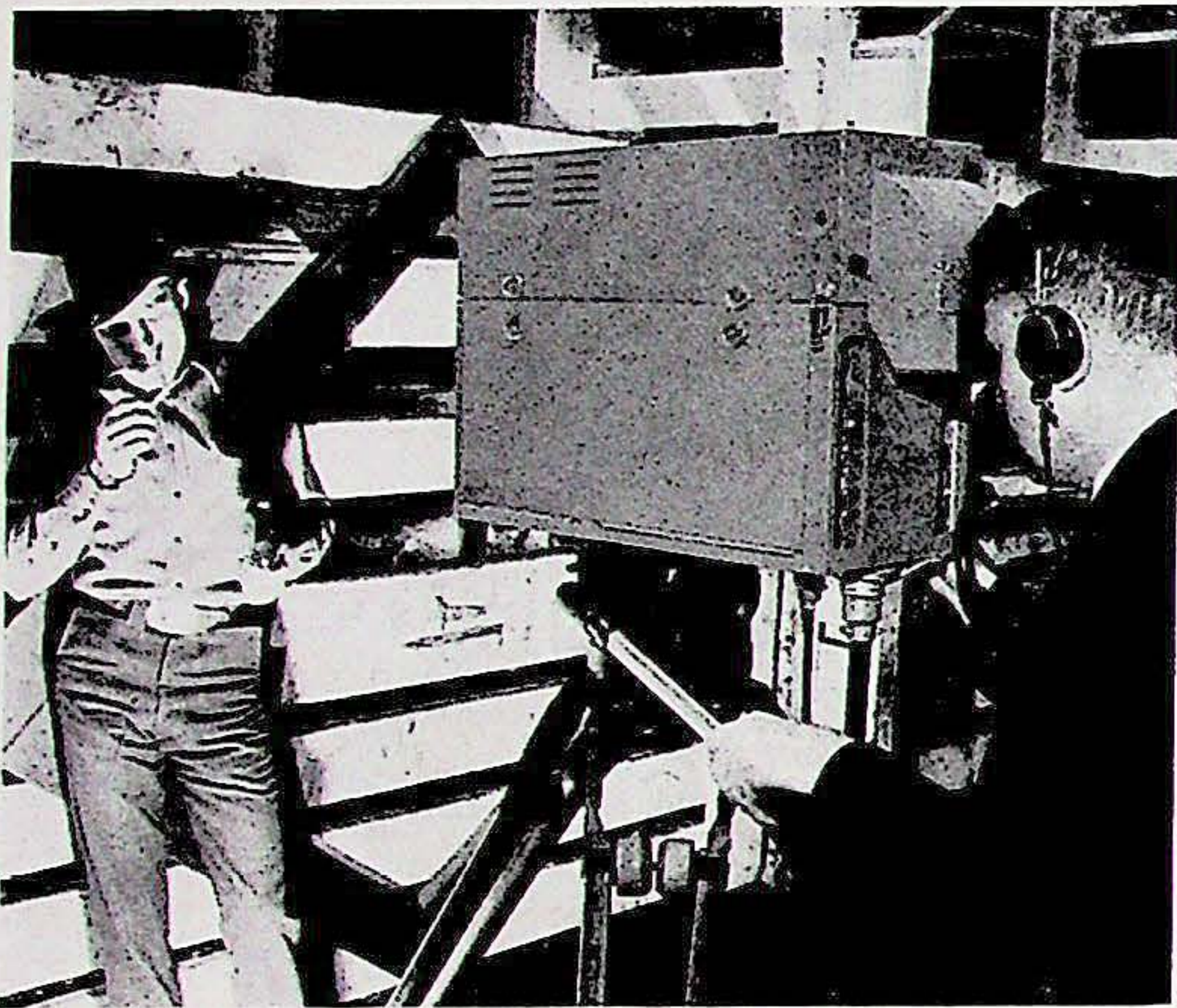


FIG. 32



FIG. 33

widen the range of programming operations to all-outdoor events and indoor pickups where lighting conditions cannot be regulated and where low lighting often prevails. Due to its stability, the image is protected against sudden bursts of brilliant light such as photoflash bulbs. The improved gain control system provides unvarying transmission despite wide fluctuations of light and shadow. The greater sensitivity of the tube results in an increased depth of perception and clearer viewing as well as sharp background, which might otherwise be blurred. However, telecasts originating from the studio, where ideal lighting conditions may be maintained, possess a texture and quality of picture that is as yet unequaled by the versatile Image Orthicon. Experts believe it is only a matter of a short time until further tests will be completed which will make the Image Orthicon unequaled for studio televising. The Image Orthicon is illustrated in figure 31.

Figure 32 illustrates the new, super-sensitive television camera in which the Image Orthicon is incorporated. The instrument is portable, lightweight, simple to operate and quickly set up and put in operation. The standard type Iconoscope is illustrated in figure 33.

### **Bright Lights of Television**

In the early days of television, an illumination intensity of about 1500 foot candles on the studio set was considered necessary. Improvements in sensitivity of equipment have substantially lowered this illumination requirement.

The principal source of illumination consists of 22 batteries of six 300-watt incandescent lamps and two batteries of twelve 500 watt lamps, all suspended from a pipe grill attached to the ceiling. Each battery of lamps is controllable as to



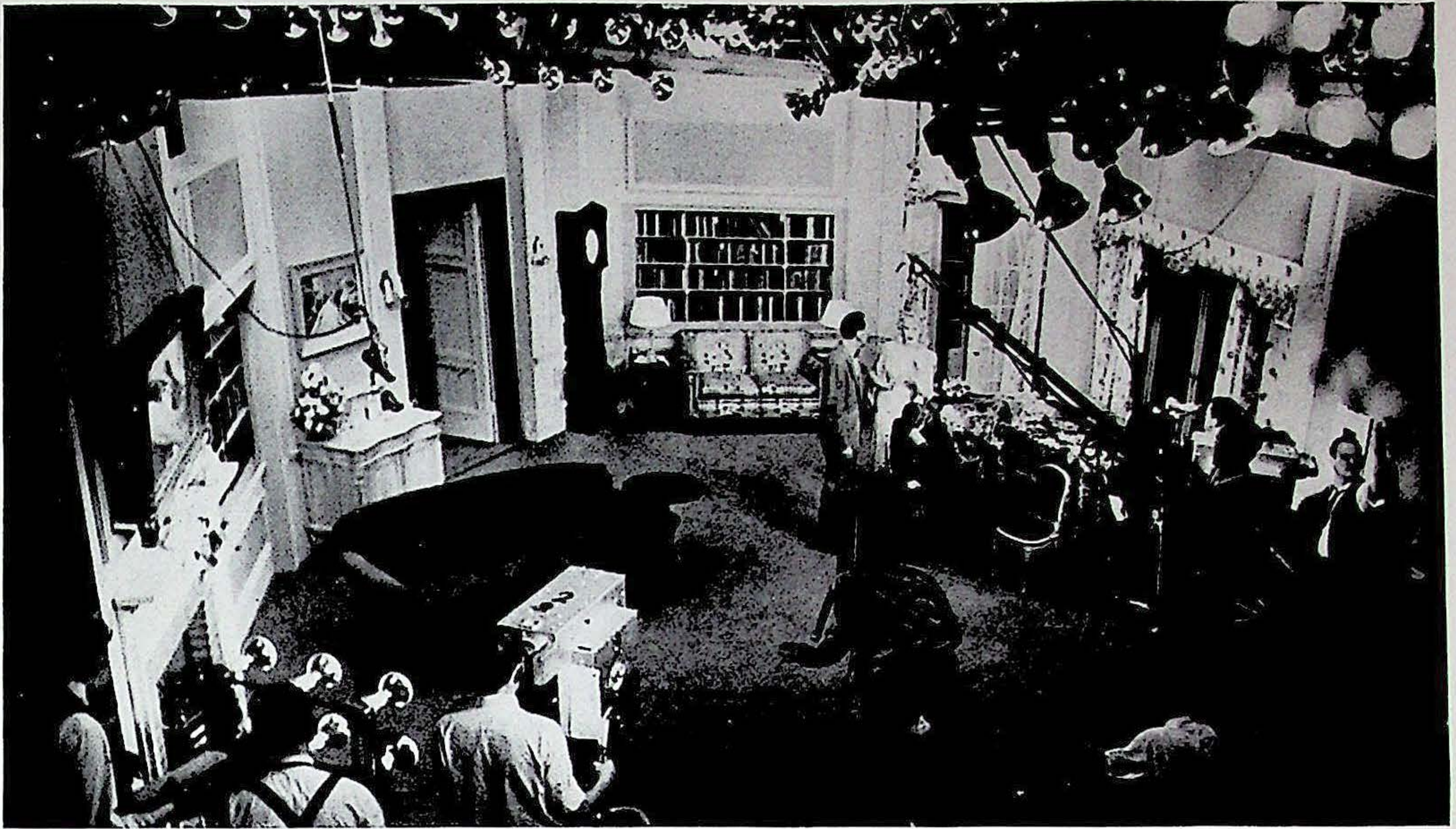


FIG. 34

direction, from a control platform or bridge in a corner of the studio near the control room. Lamps may be turned on or off in groups of three. This overhead system is augmented by two arc and several incandescent floor units. Other sources of studio illumination such as high pressure mercury vapor and fluorescent lamps have been investigated experimentally, but to date incandescent lamps have proved the most satisfactory. Research on other types of illumination continues. See figure 34 for illustration of television studio lighting.

### **New Directions for a New Art**

The television control room, shown in figure 35, from which the television program and technical directors carry out their assignments during the program, is about twelve feet above the floor, thereby affording an unobstructed view of the studio action. The glass observation parti-

tion is covered with a neutral density cellulose filter to reduce the brilliance of the studio scene as it is viewed from the control room, where a low illumination level must be maintained so that the Kinescope monitors can be observed distinctly. (The Kinescope is a receiving cathode ray tube on which the television image appears.)

The control room includes three consoles, one each for the technical director, the picture control operator and the sound control operator. The technical director is responsible for all pickup and transmission details—and ordinarily no two programs present identical problems. It is his task to have everything in readiness so that the operation may be carried out smoothly. Unlike motion pictures, there can be no “re-takes” in television. Performances and technical details must be right when the show is on the air. The control room Kinescopes, acting as monitors for each studio camera, afford the

necessary check so that each switch may be affected deftly.

The picture control operator or "video man" operates controls to adjust picture quality and brightness for all three "camera-chains" in the studio. As an aid in adjusting signal level or volume in picture signals, small cathode ray tubes are used as "video volume indicators" at this console.

The sound control operator or "sound man" operates controls very similar to those now used in sound broadcasting—with one important difference. "Boom microphones" are employed and care must be taken to prevent the microphone from appearing in the television picture, while at the same time capturing the best possible sound pickup.

The frequency band transmitted by video equipment is extremely wide, ranging from 30 to approximately 4,000,000 cycles per second. Such wide band transmission necessitates the use of coaxial cable in all equipment wiring and in the transmission of the video signals from Radio City to the WNBT transmitter in the Empire State Building. The terminations of the coaxial cable are made through shielded blocks



FIG. 35

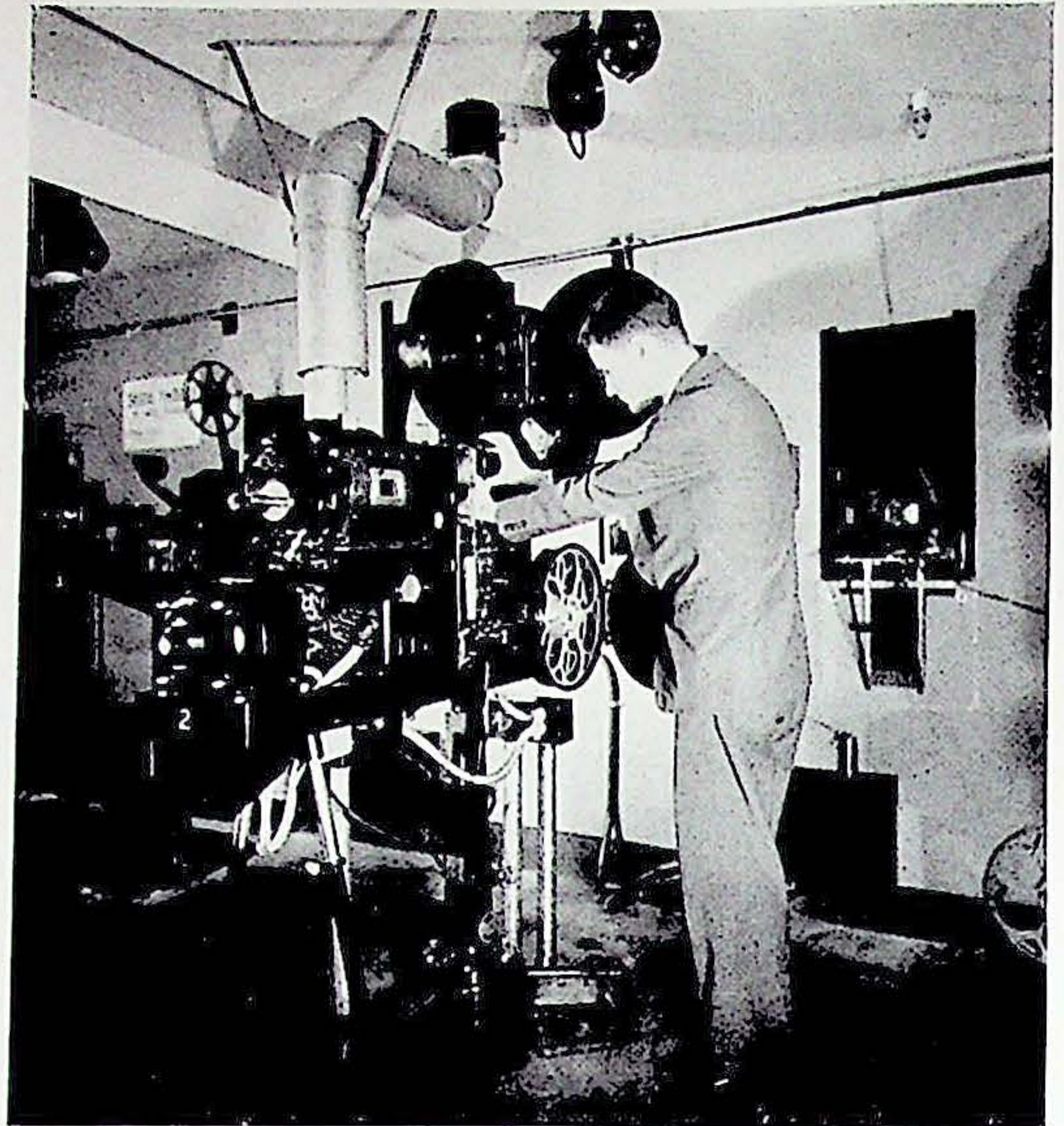


FIG. 36

to avoid impedance irregularities which might cause multiple image pictures, and also to avoid stray coupling between circuits, which might result in interference patterns or a peculiar "snow storm" effect in the picture.

The operation of the Iconoscope cameras and the Kinescope monitors depends, among other things, on deflection and blanking impulses of definite wave shapes. These impulses are produced by electronic synchronizing generators installed in the equipment room. In addition to the deflecting and blanking impulses these generators also produce a locking frequency which automatically synchronizes home receivers with studio cameras.

### Scanning the Movies

The NBC television film scanning studio in Radio City comprises a projection room, a film vault and a control room. The equipment consists of two 35-mm projectors with sound heads, two 16-mm projectors without sound and one

still slide projector. These are illustrated in figure 36. The two Iconoscope cameras which may be moved back and forth on tracks to line up with the desired projectors, have no lenses. The focusing of the film image on the Iconoscope mosaic is done instead with the lens system of the projector. The projection room also has facilities for cutting, splicing and rewinding film.

To comply with the building code and provide adequate fire protection, fire extinguishers as well as sand and water pails are placed strategically around the room. As a further precaution, the film storage vault is built of extra heavy masonry and its ceiling as well as the film storage cabinets themselves are equipped with automatic water sprinkler heads. In addition, the film cabinets have vents to the outdoors and a series of two metal fireproof doors closes off the vault from the projection room.

The film studio control room is more compact but is functionally similar to the control room of studio 3H.

## Television On-The-Spot

The mobile television units illustrated in figure 37 and designated as 1A and 1B make possible

many interesting on-the-spot telecasts originating outside the Radio City studios. Each unit measures approximately 26 feet in length and carries portable television broadcasting equipment. In unit 1A a synchronizing generator supplies deflection, blanking and synchronizing impulses. Brightness, shading, focusing and contrast control equipment is available for two camera chains. Two video monitors are also available, as well as the audio equipment for the sound microphones.

Unit 1B transports the video transmitter, used as the link between the point of program origination and the Radio City studios. The sequence of transmission is as follows: the picture is sent first from this transmitter to a receiving station atop the RCA Building, then by coaxial wire line to the fifth floor television equipment room where it is monitored, amplified and relayed by coaxial cable to the Empire State Building from whence it is broadcast by station WNBT.

Both telemobile units 1A and 1B are supplied with power at the locality from which the field program originates. To compensate for differences in supply voltages that are encountered both units have induction regulators for raising



FIG. 37

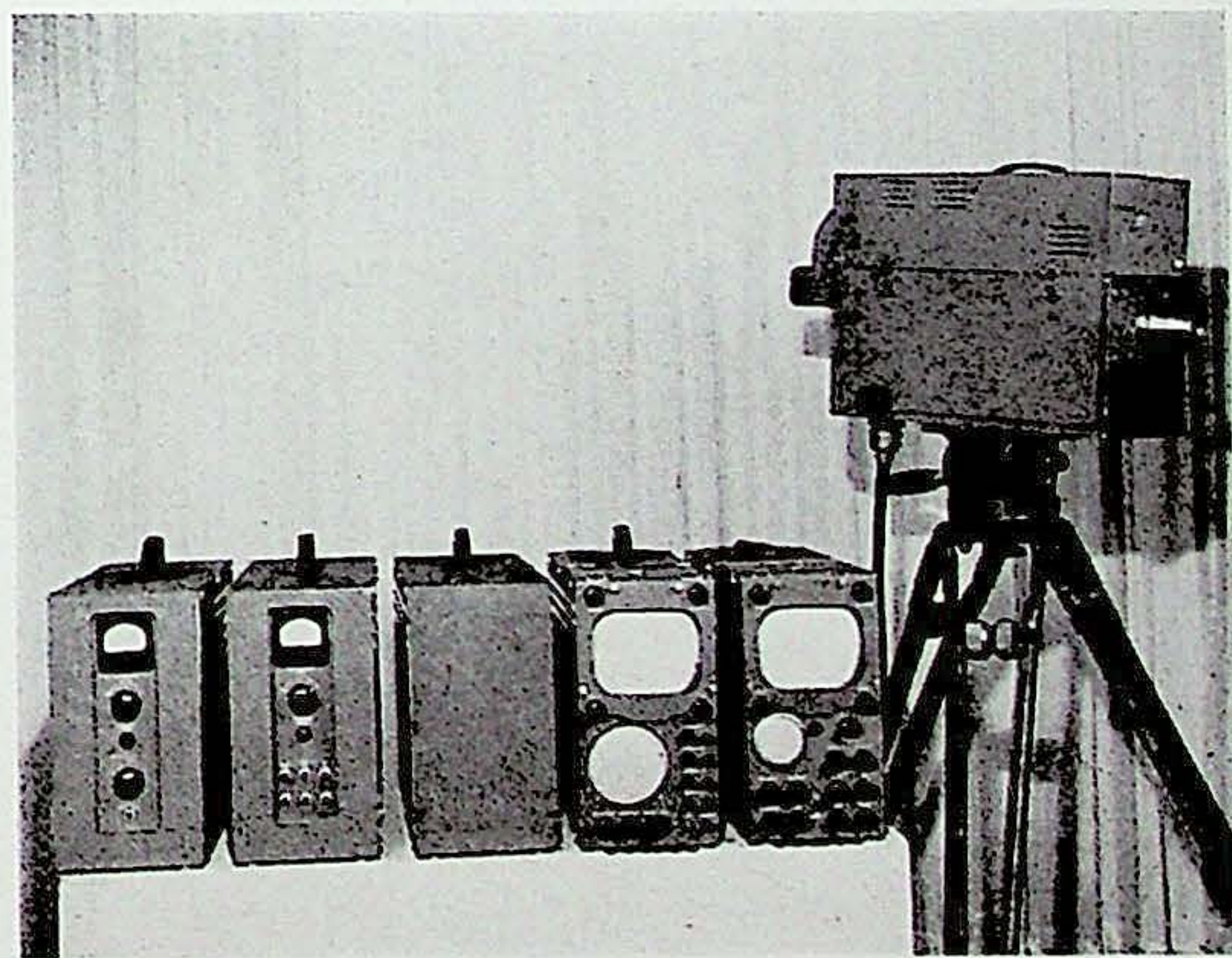


FIG. 38



*Gen. David Sarnoff televised by NBC at N. Y. World Fair.*



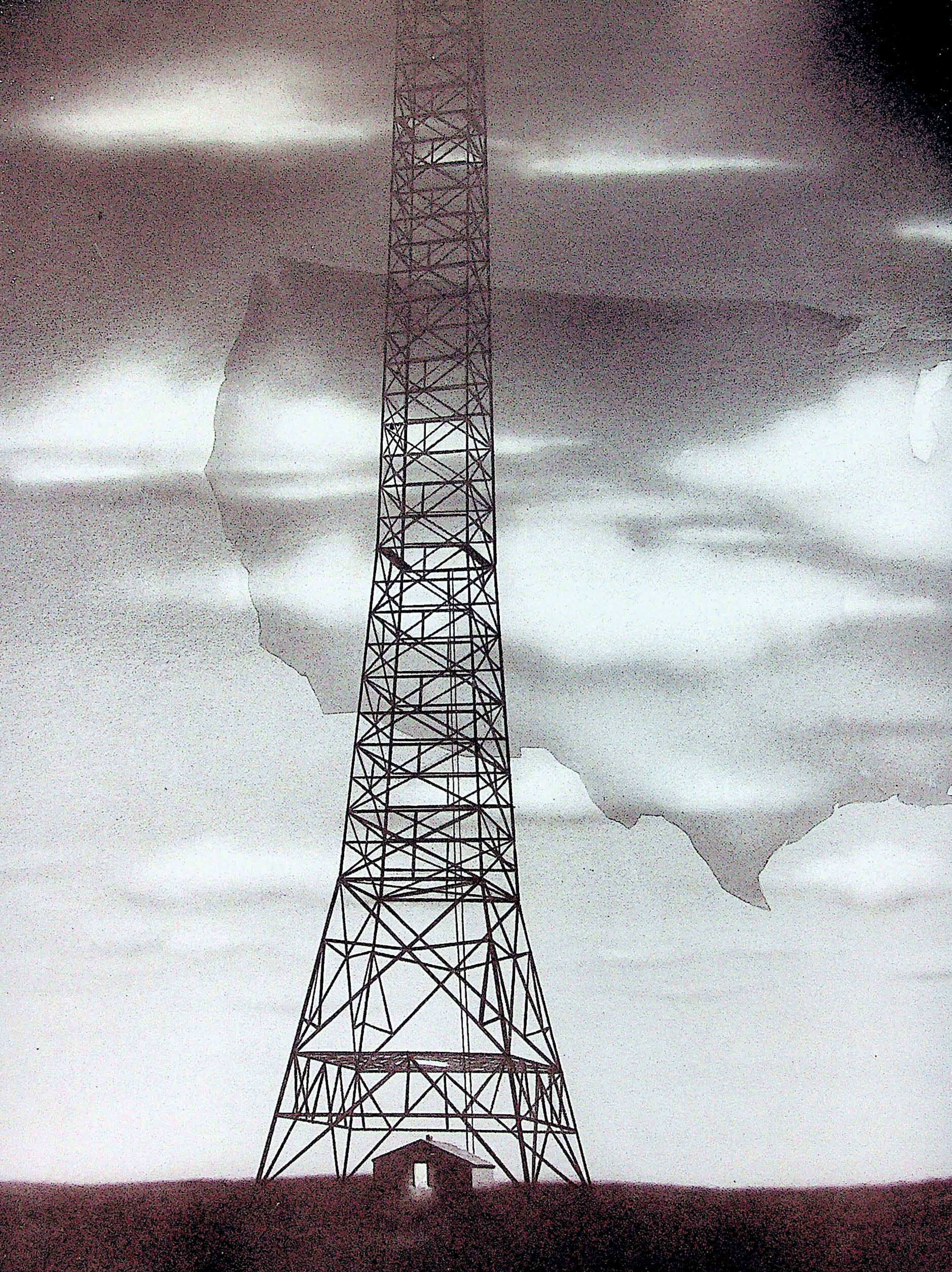
*Louis-Conn fight telecast from Madison Square Garden.*



*NBC telecast of football game, Columbia vs Lafayette.*



*Felix—stand-in for stars in early era of video's hot lights.*

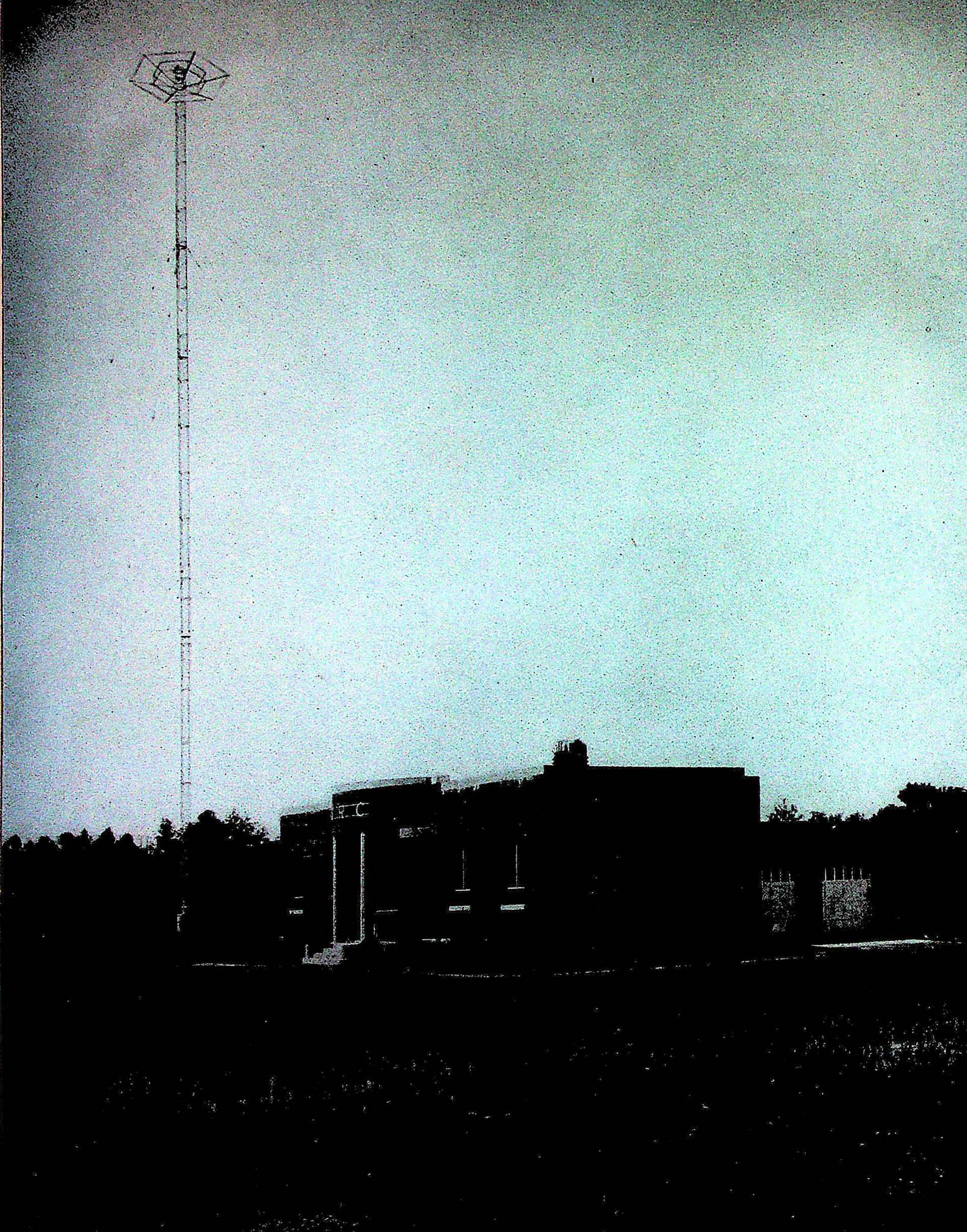




## **NBC— Atlantic to Pacific**

Strategically placed in key cities of important sections of the nation, stand the remaining six NBC Air Castles, whose construction and equipment serve the same purposes in their locations as do those of the NBC Radio City Air Castle described on the preceding pages.

Out from New York—in Washington, in Cleveland, in Chicago, in Denver, in San Francisco and in Hollywood—stand the continental NBC Air Castles, managed and operated by the National Broadcasting Company. These six plants serve as regional centers for the NBC activities in their sections. No ivory towers are these Air Castles, but humming bee-hives of activity, striving to mirror in their local programs the atmosphere, culture and civic interests of the regions which they serve, while, at the same time, they bring their local listeners the programs of national interest over NBC.



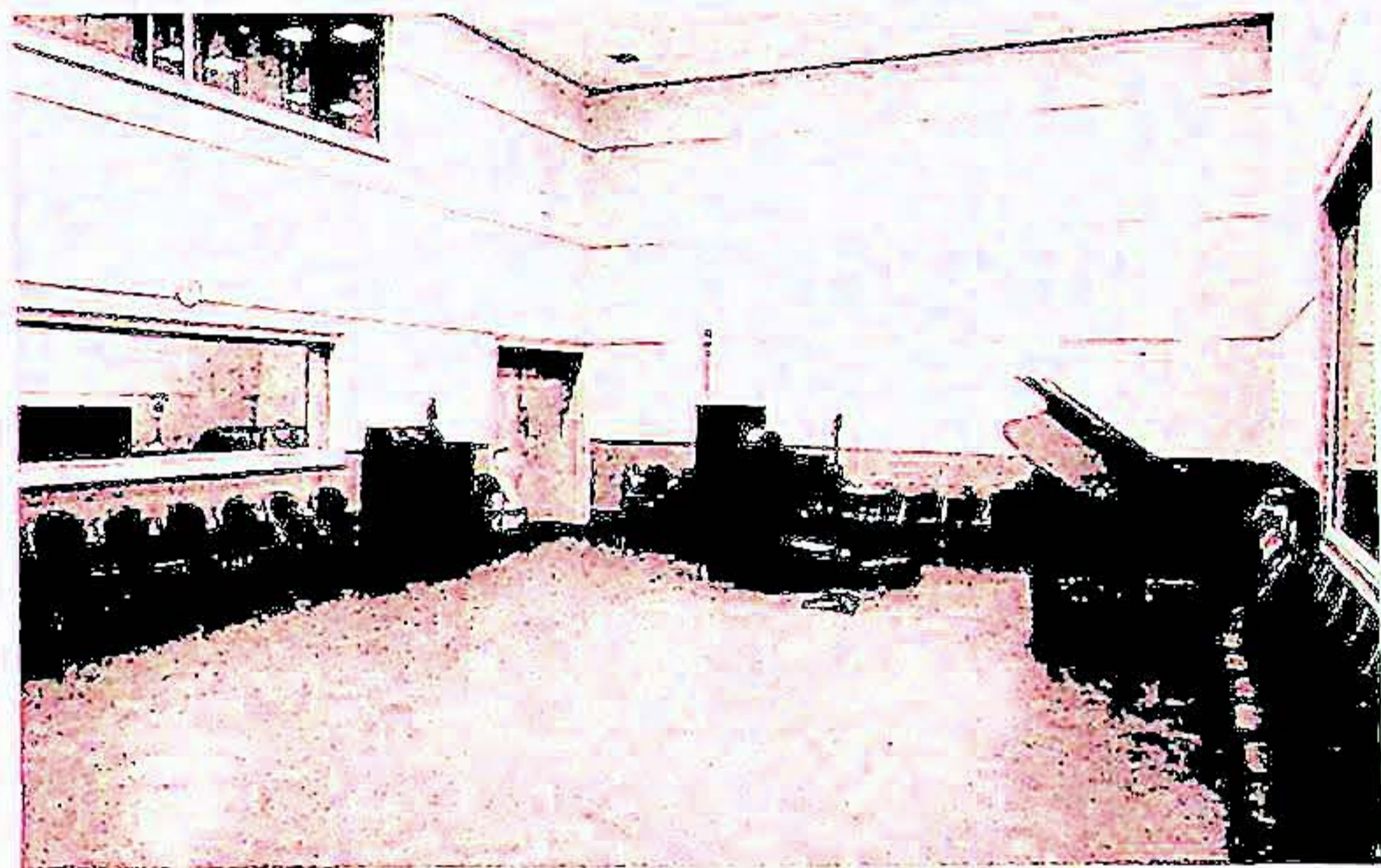
## The Nation's Capital

With the eyes of the world on Washington as one of the world capitals of major prestige in the waging of the war and the building of the peace world, the importance of the NBC Washington plant has increased tremendously in the last few years.

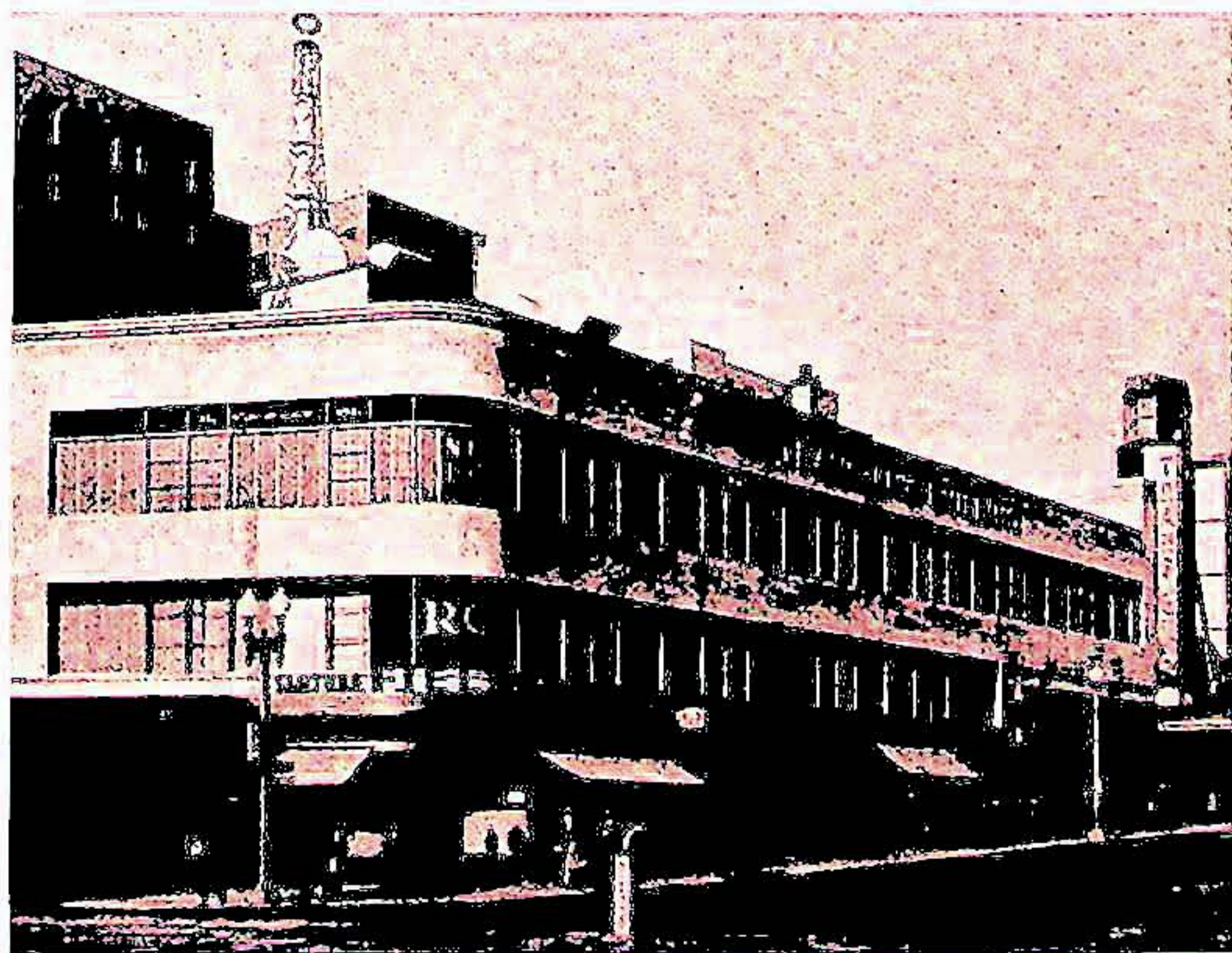
The majority of national network programs originating at NBC's WRC in Washington are political and economic rather than musical and dramatic, but at the same time Washington is also an important network outlet for programs produced at other NBC studios. The space on the mezzanine floor of the Trans-Lux Building was planned and equipped to meet these two conditions by providing relatively small studios suitable for speakers, rather than spacious auditoriums for groups of artists and large audiences. The facilities include seven studios and the usual offices. But without a doubt the most famous broadcasts originating in Washington

are those emanating from America's most famous home—the White House.

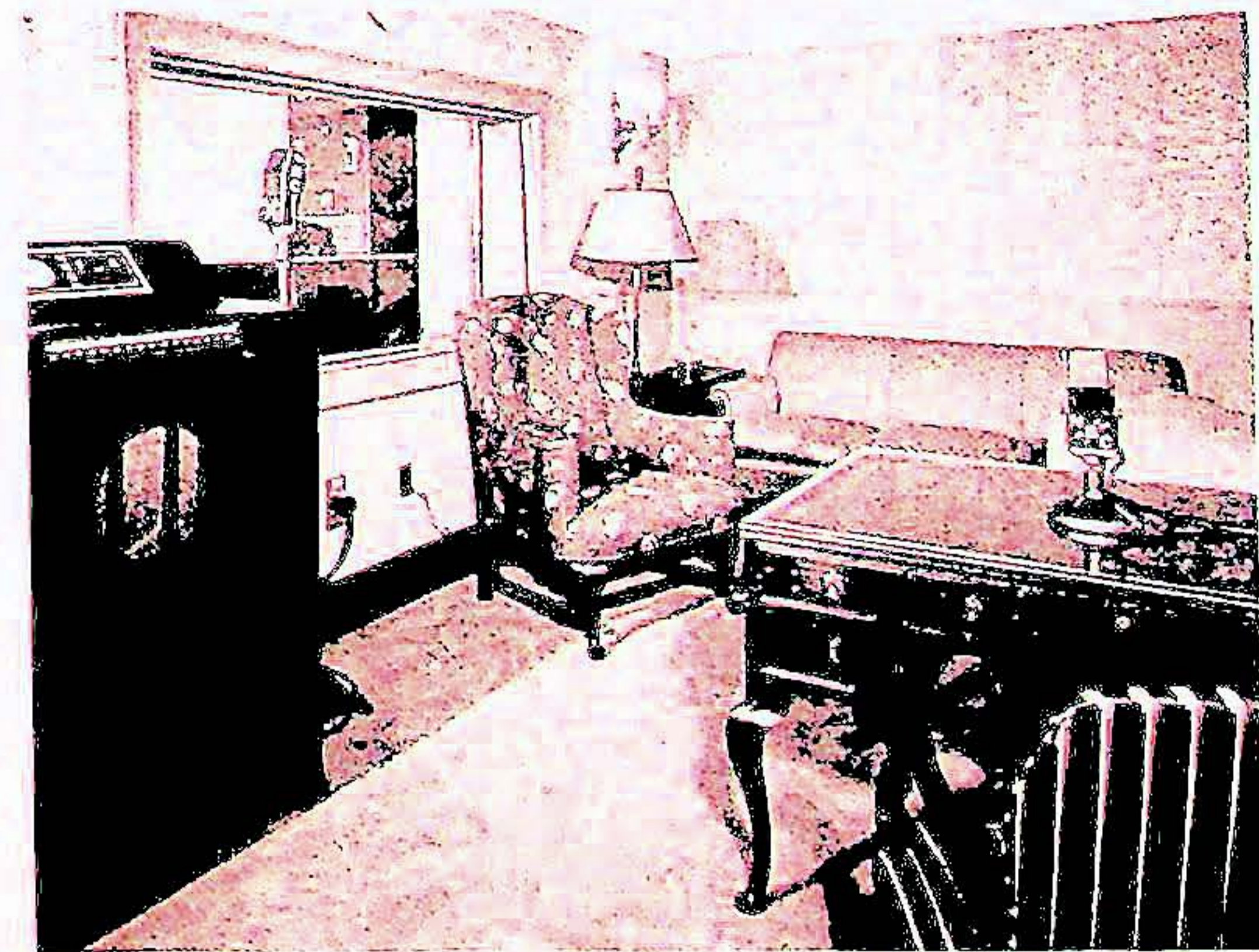
The entire floor housing the NBC facilities in the Trans-Lux Building is air conditioned, and all studios are sound isolated and acoustically treated. Audio equipment is comparable in technical characteristics with similar equipment at other NBC plants.



Auditorium studio "A" of WRC, NBC's Washington outlet.

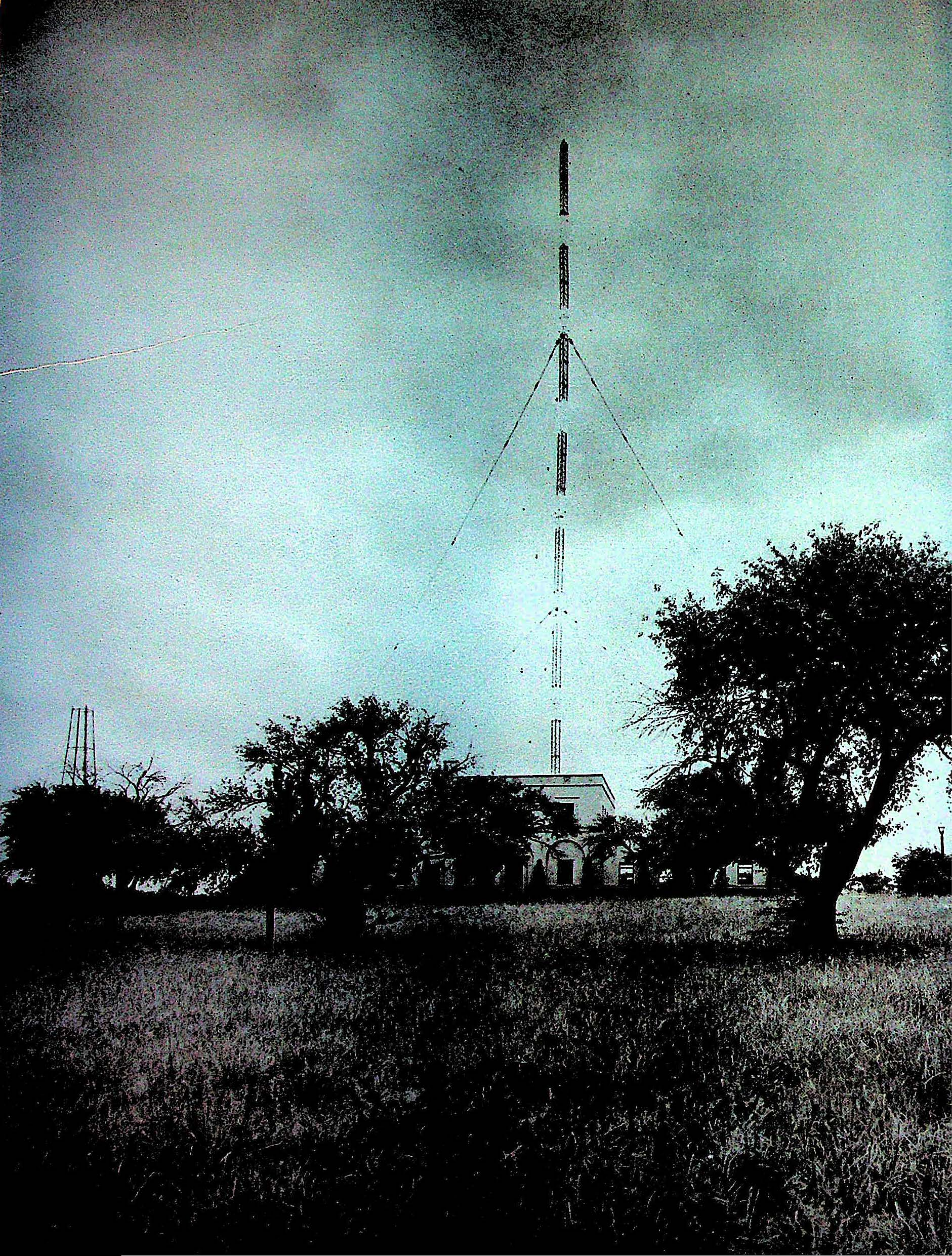


Washington, D. C. location of WRC's studios and offices.



WRC Speaker's Studio, where statesmen address the nation.





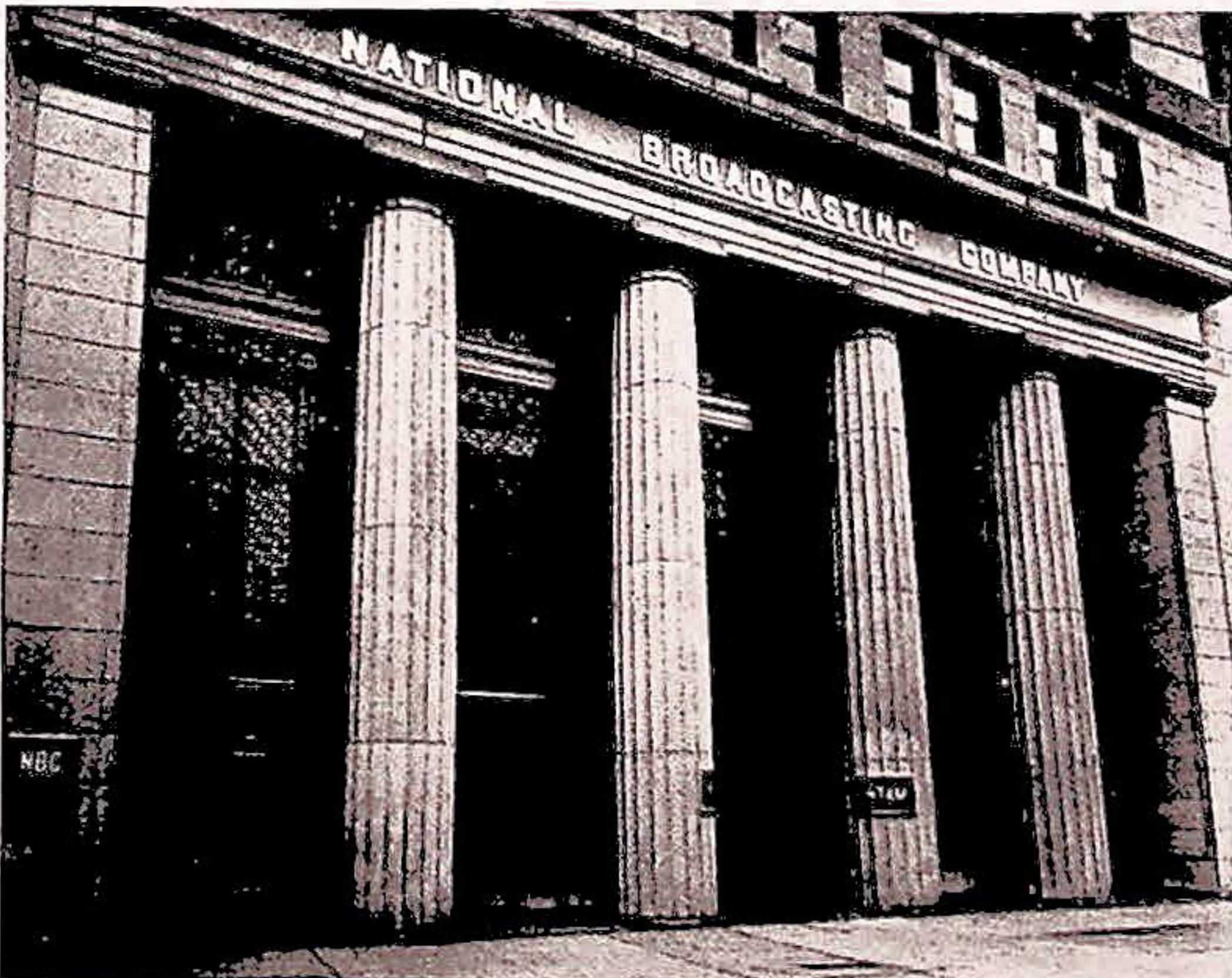
## Beautiful Ohio

Westward, across the nation, is the NBC Air Castle in Cleveland, Ohio, at 815 Superior Avenue. This NBC plant is a striking example of the adaptation of a building not originally intended for the housing of broadcast equipment to a modern and efficient Air Castle.

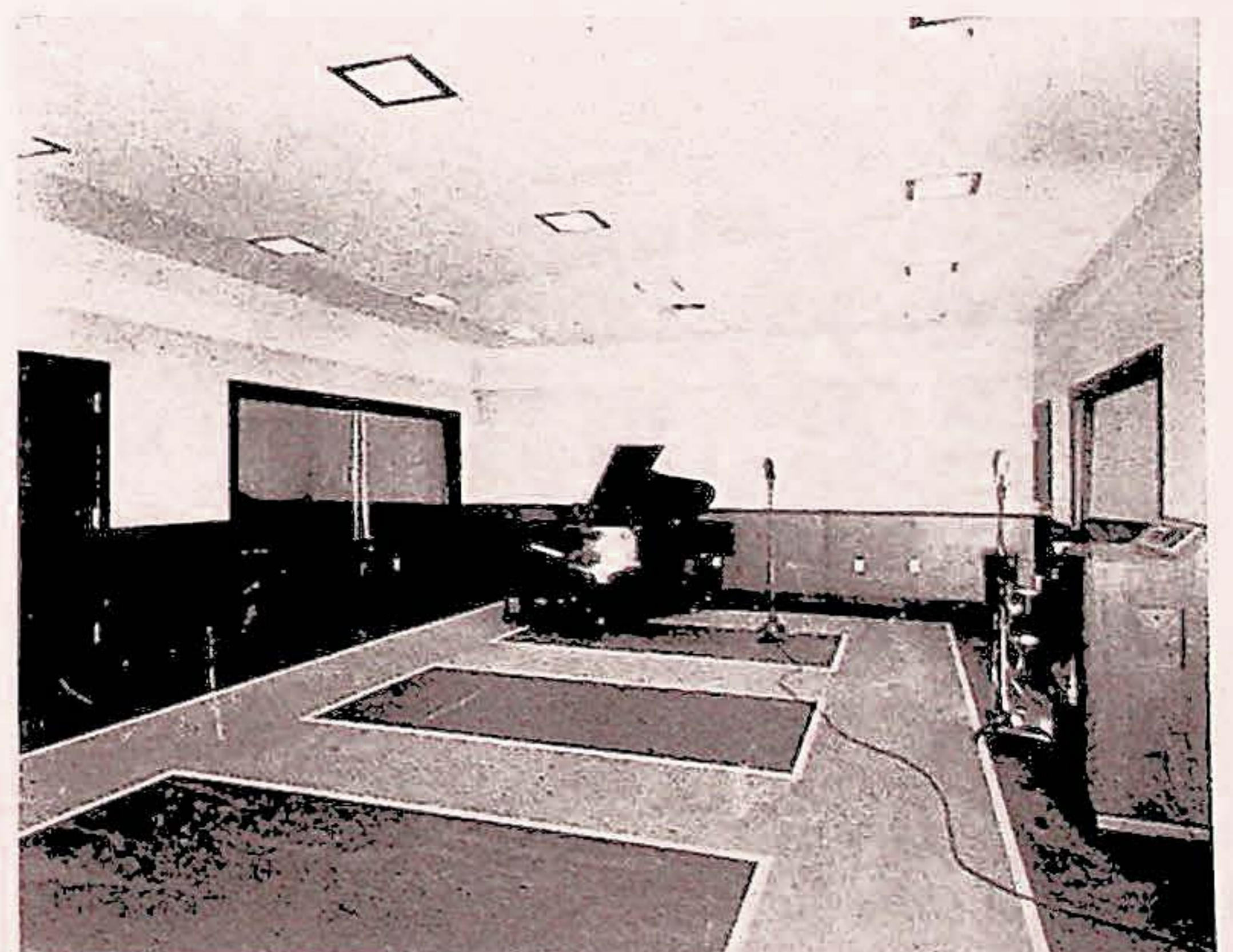
Extensive interior alterations were necessary to convert the original quarters into an efficient broadcasting headquarters. In many respects such construction challenges the ingenuity of engineers to a greater degree than the planning of entirely new facilities from the ground up. While an ideal arrangement is rarely attained

under such conditions, nevertheless, the finished job in this case is favorably comparable to other similar sized NBC plants. The studios are acoustically treated, sound isolated and air conditioned in accordance with the usual NBC practice. It goes without saying that the technical equipment installed in the Cleveland Air Castle is of the customary NBC high standard.

Although national network programs originate in the WTAM Cleveland Studios of NBC, this plant is important, as well, as the origin of many local programs that rank high in the favor of the listeners of Cleveland and its environs.



Home of WTAM studios and offices in downtown Cleveland.



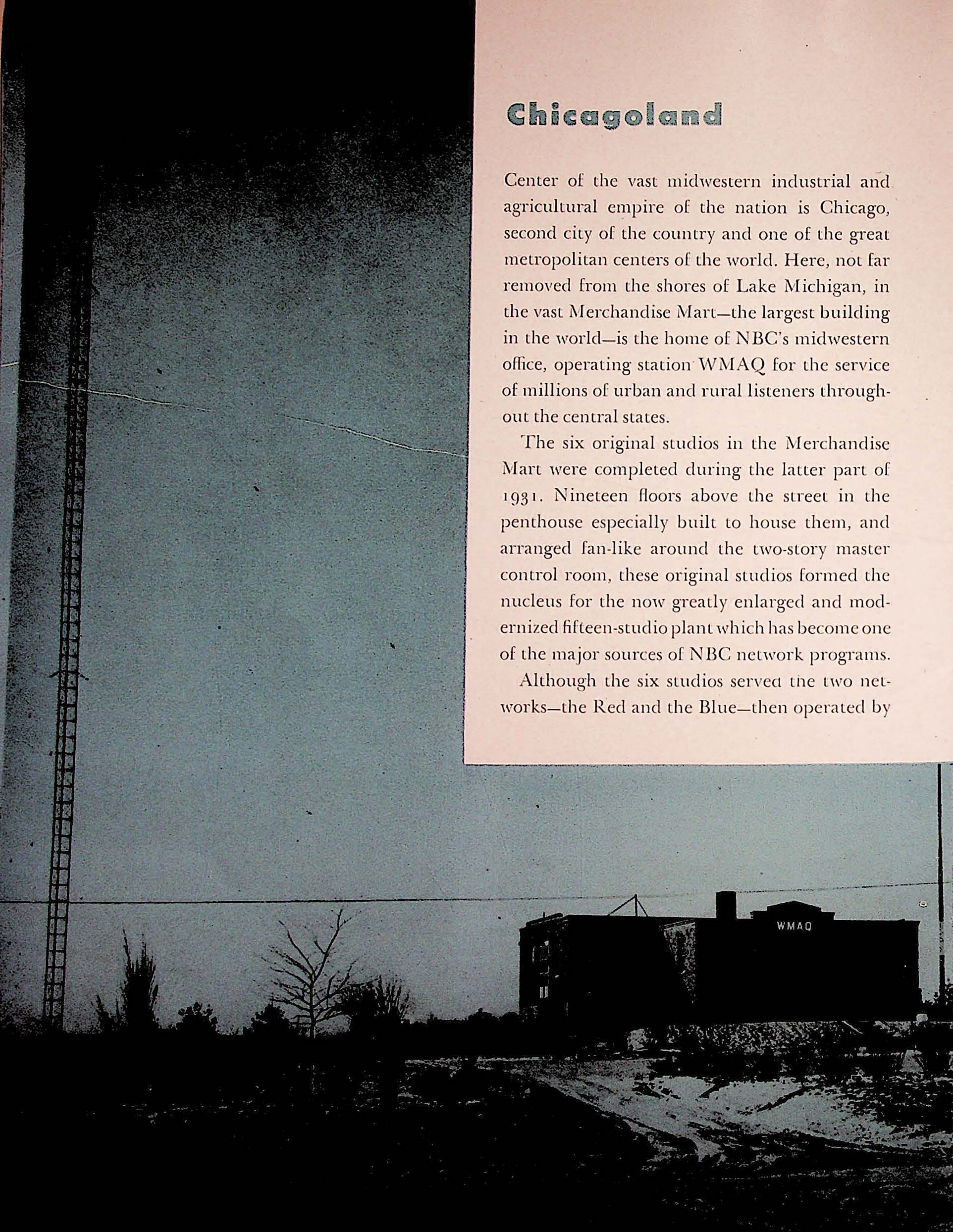
One of six studios comprising WTAM's efficient quarters.

## Chicagoland

Center of the vast midwestern industrial and agricultural empire of the nation is Chicago, second city of the country and one of the great metropolitan centers of the world. Here, not far removed from the shores of Lake Michigan, in the vast Merchandise Mart—the largest building in the world—is the home of NBC's midwestern office, operating station WMAQ for the service of millions of urban and rural listeners throughout the central states.

The six original studios in the Merchandise Mart were completed during the latter part of 1931. Nineteen floors above the street in the penthouse especially built to house them, and arranged fan-like around the two-story master control room, these original studios formed the nucleus for the now greatly enlarged and modernized fifteen-studio plant which has become one of the major sources of NBC network programs.

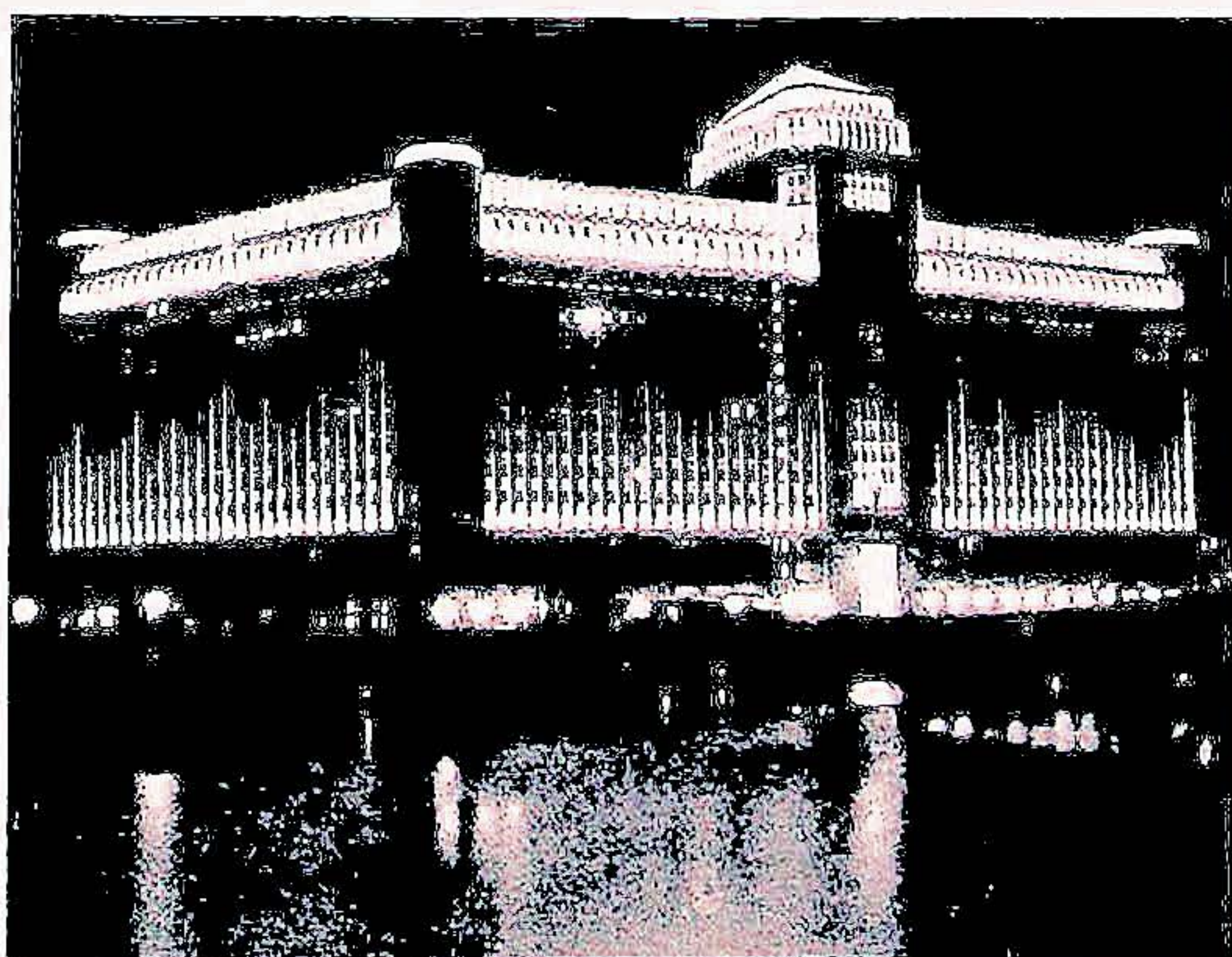
Although the six studios served the two networks—the Red and the Blue—then operated by



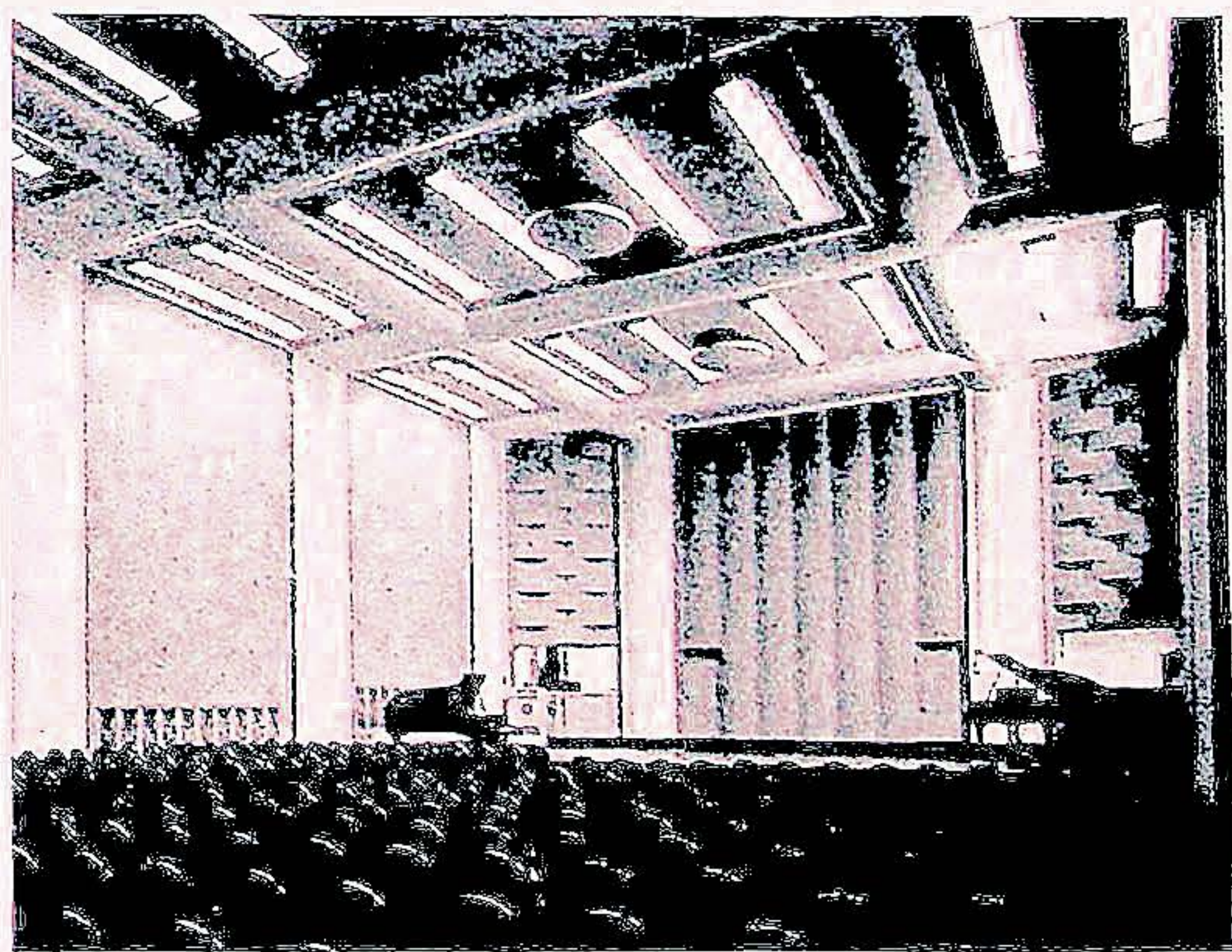
the National Broadcasting Company and its local stations—until 1936, it was evident as early as 1935 that these studios were insufficient to serve efficiently the ever expanding business. Early in 1936 three additional studios were completed on the nineteenth floor of the tower immediately adjacent to the penthouse. In addition to this construction, extensive alterations were made to the master control room, including the addition of three booth-type studios. At the same time, the capacity of the air conditioning system was sufficiently enlarged to service the added space. These augmented facilities met the steadily increasing demand for space until 1941 when three more medium sized studios were completed in a wing of the nineteenth floor tower. It was also found necessary to install additional recording facilities, to make further changes in the master control room and to modernize the air conditioning system.

As usual, all the studios are acoustically treated and air conditioned while the earlier ones are also completely sound isolated. The latest three studios have sound isolated ceilings and floors, while the walls, although they are double masonry partitions, are not isolated. Trapezium in shape, rather than oblong, the plan of these newest studios is calculated to avoid opposite parallel wall surfaces. This construction is especially interesting when contrasted with the system adopted at the Radio City New York studios in treating the surfaces of opposite parallel walls to combat sound reflections.

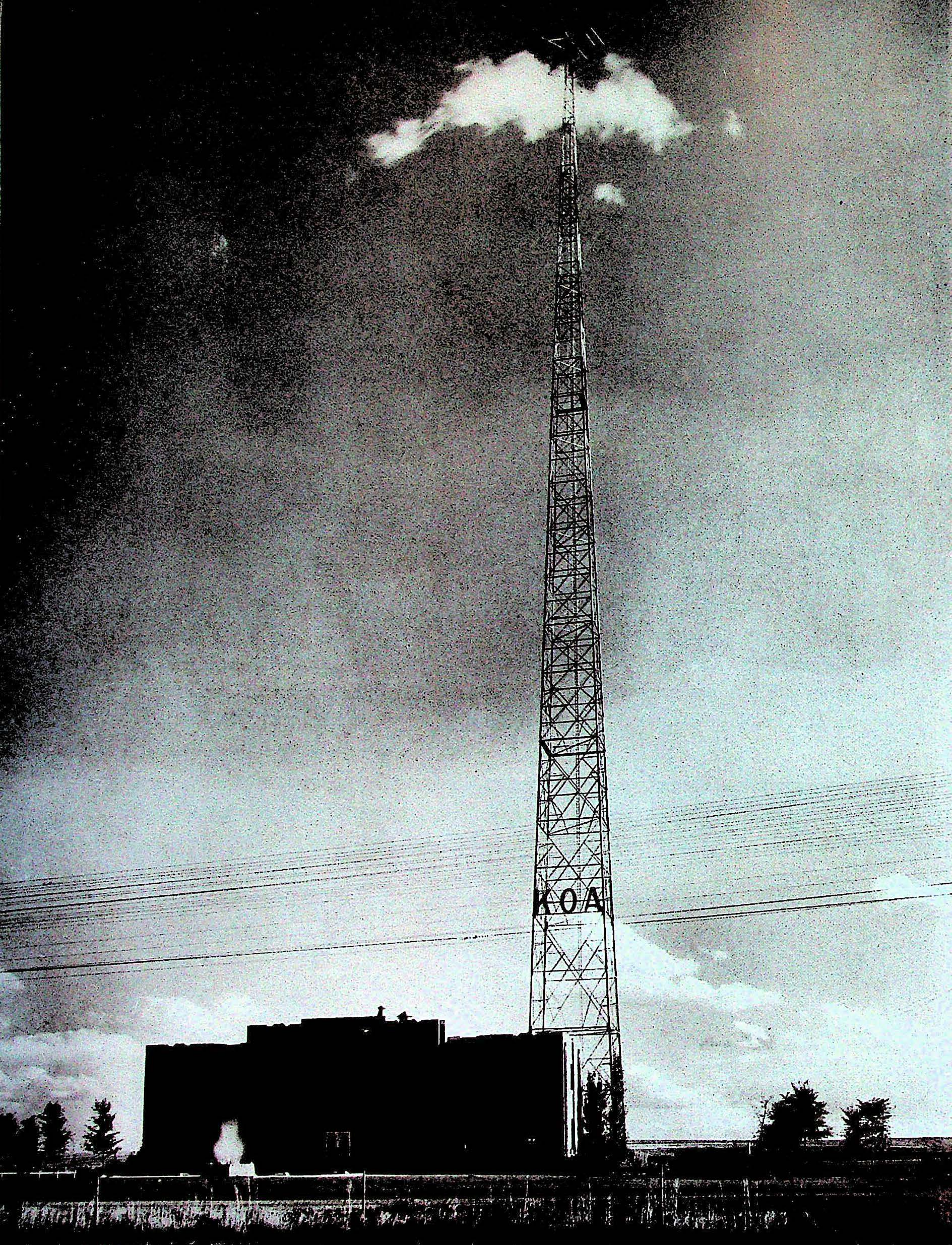
The comparison of the new with the old is always interesting and often constructive. This is especially true in the case of the NBC Chicago Air Castle, with its striking differences in design of the older studios from the new ones. Here is a graphic example of the modern trend toward simplicity and practicability in respect to interior architectural trim and illumination.



*World's largest bldg., Merchandise Mart, home of WMAQ.*



*Auditorium studio of WMAQ, serving listeners of Chicago.*



KO A

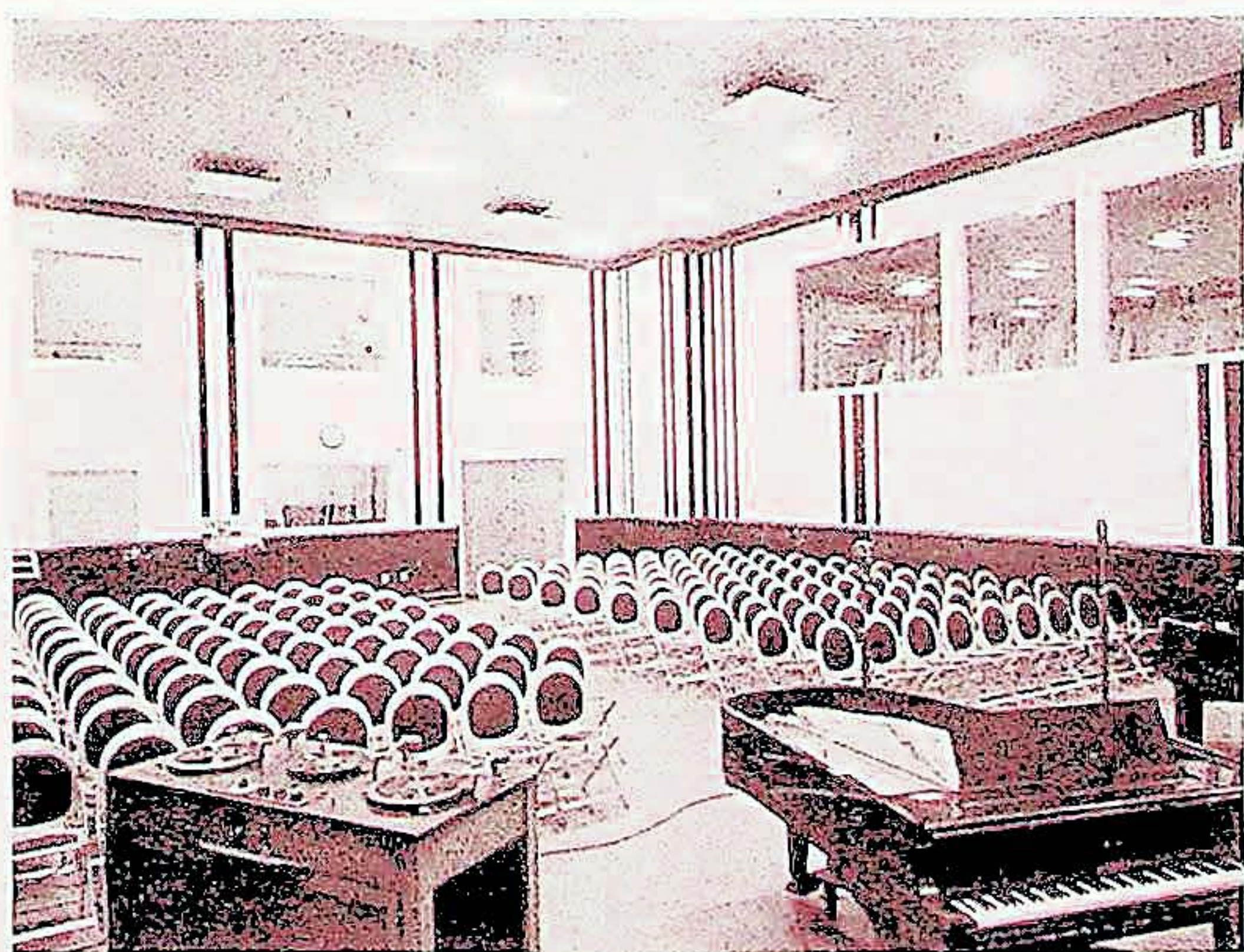
## Rocky Mountain Metropolis

Far removed from the large talent centers though it is, nevertheless the NBC plant at Denver frequently contributes programs of a musical nature to the national network. These programs reflect the climate and exhilarating surroundings of this mountain-high NBC Air Castle, and give to the nation something of the pioneer spirit of the people who founded and built this modern city, flung high in the solitude of the vast Rocky Mountain Range.

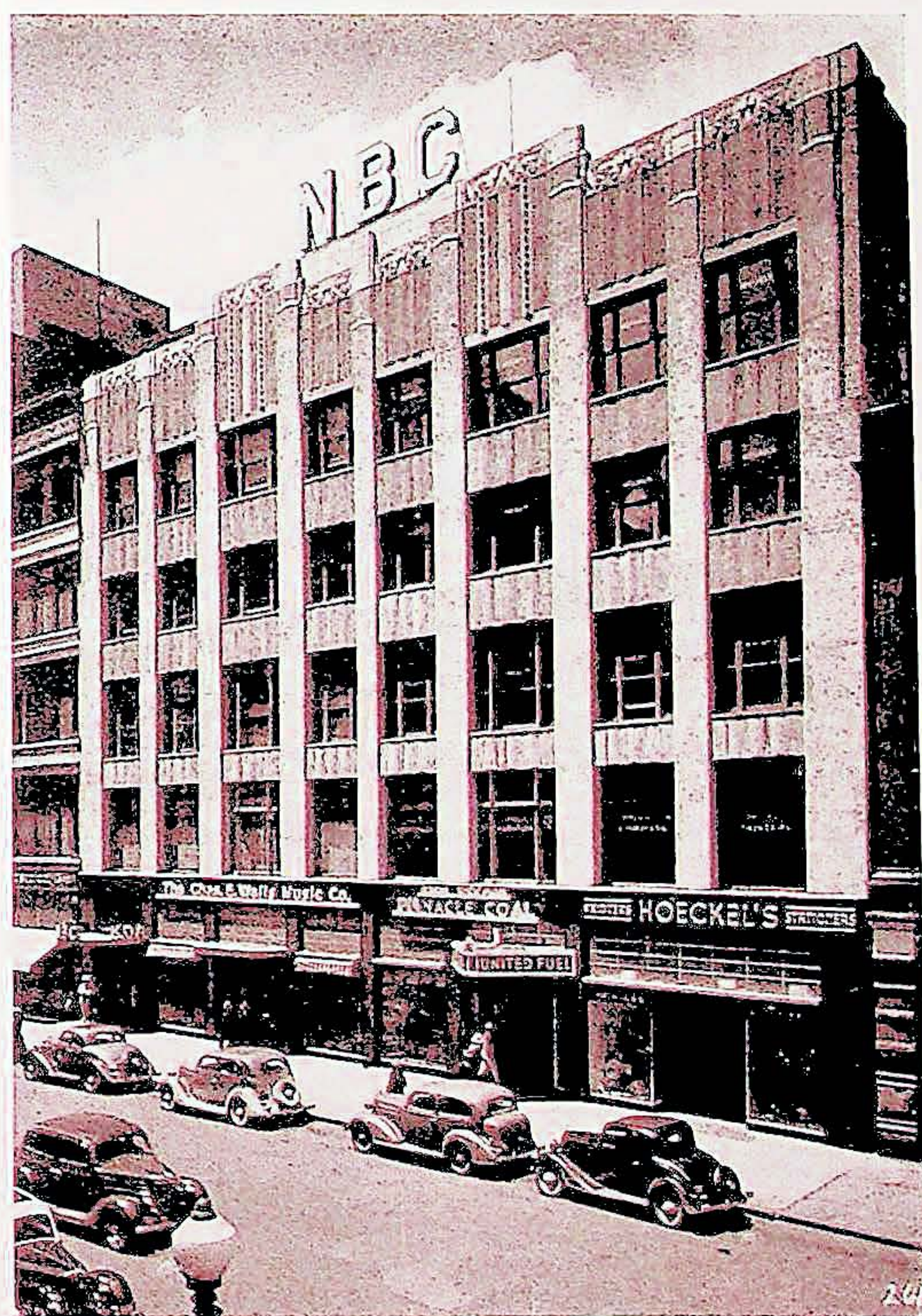
Four studios are adequate for the production of many outstanding local broadcasts and network programs over station KOA. The broadcast equipment is designed and built to NBC's high technical standard, while all of the studios are acoustically treated and three of them are sound isolated.

Because of the dry climate of Denver and the plentiful supply of cold water, the air condi-

tioning problem was relatively simple. The three largest studios are ventilated by air that is passed through a cold water spray tank—refrigeration of the water being unnecessary. The heat produced by the racks of amplifiers in the combination master control and equipment room is absorbed by a direct expansion room cooler unit which also serves the smallest studio immediately adjacent.



Rocky Mountain life is mirrored in shows from KOA studios.

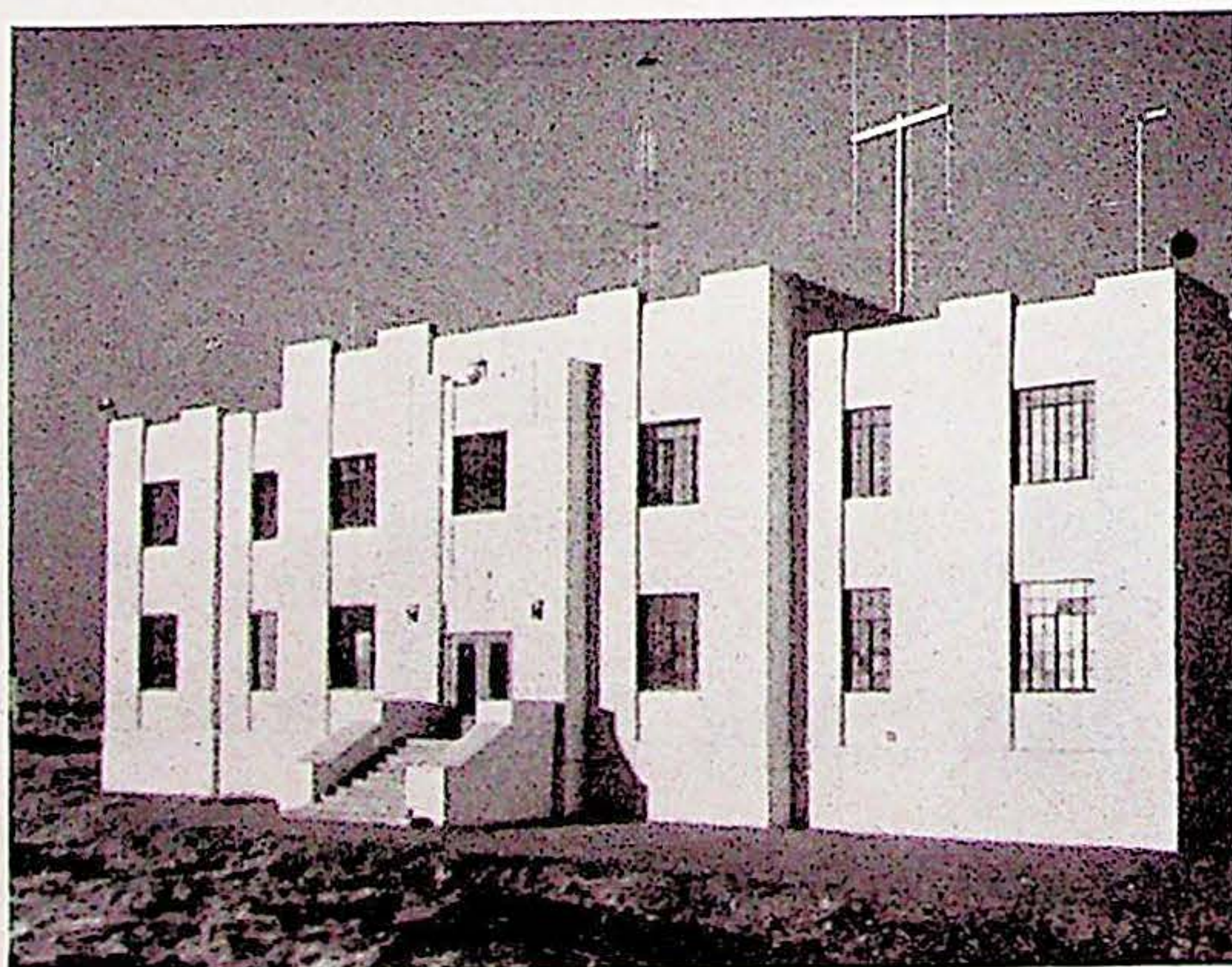


KOA occupies three upper floors of NBC Building, Denver.

## In Old San Francisco

San Francisco, one of the most historically interesting cities as well as one of the principal business centers of the west coast, now boasts a truly modern broadcast plant. This latest addition to the group of NBC Air Castles spread from the Atlantic to the Pacific was completed on the corner of Taylor and O'Farrell Streets during the spring of 1942. It replaced the old studios at 111 Sutter Street which had been in use since the spring of 1927. Except for the ground floor, the new building is devoted entirely to broadcasting. Ten studios, including a 72 ft by 41 ft x 19 ft auditorium with a 40 ft by 22 ft stage provide ample and modern facilities for the production of radio programs over station KPO, one of the pioneer broadcasting stations of the west coast.

Instead of windows to the open air, the second, third and fourth floors of the five story concrete building housing the NBC San Francisco



*KPO's modern transmitter building at Belmont, California.*

Air Castle have translucent glass brick strips which run practically the entire length of the building on both streets. The entire building is air conditioned; all studios are acoustically treated and all but the three smallest studios are sound isolated. Provision has been made for public observation of the news and traffic rooms and the two small studios H and J on the third floor. Large observation partitions have been built into the walls of these rooms so that visitors may observe what goes on behind the scenes. Technical equipment in use at this plant is in strict accordance with NBC's high standards.

The three hours' difference in time between the east and west coasts creates a problem for the coast-to-coast network broadcasts. For example, a program produced in New York at 7 PM, an ideal hour to reach the dinner audience on the east coast, would be on the air at 4 PM San Francisco time. This would be far too early to

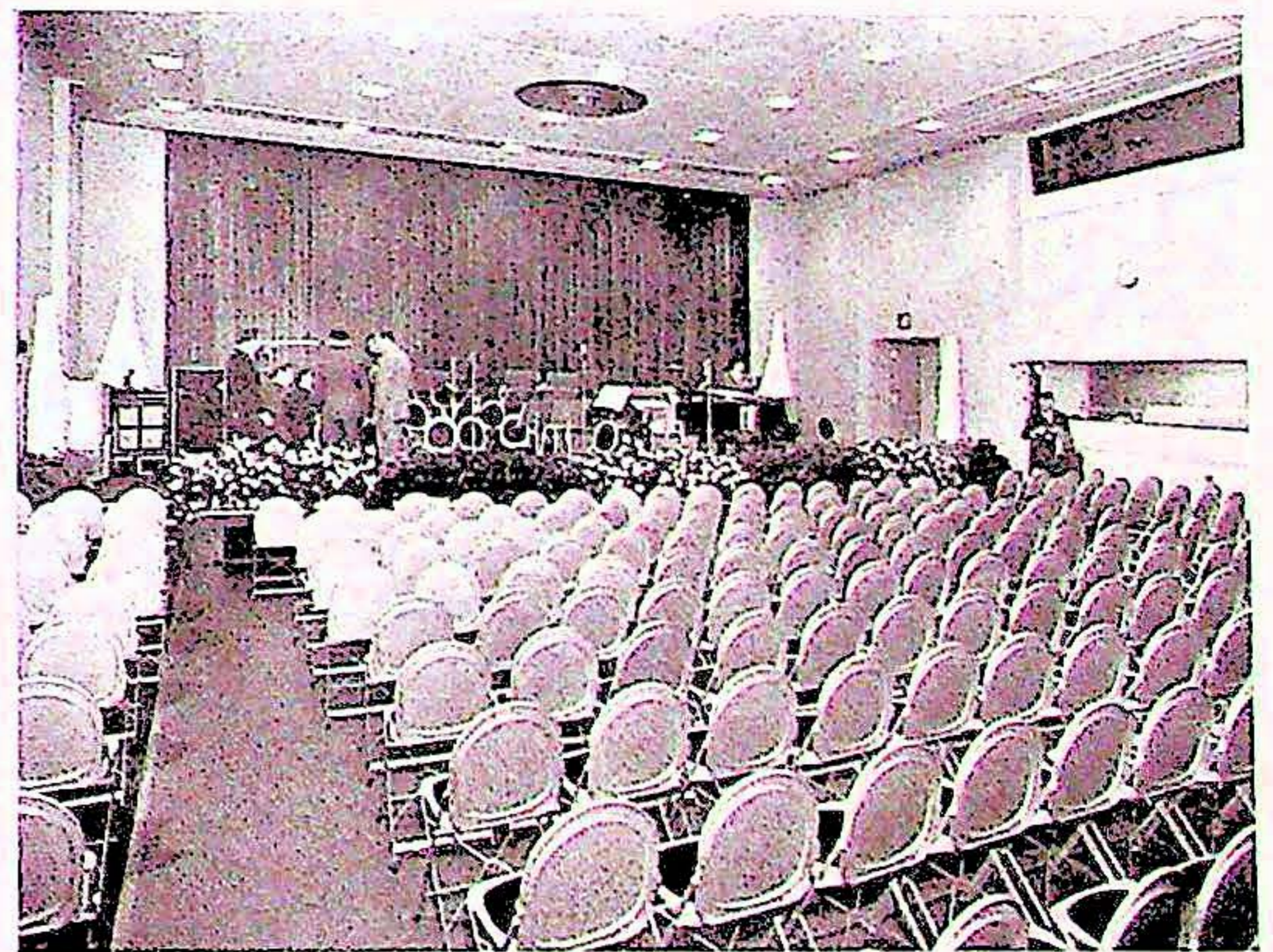
be effective either as dinner music or as advertising planned for the circumstances surrounding the hour. This difficulty is surmounted in several ways.

Sometimes the New York broadcast is repeated three hours later and routed by wire line direct to the west coast. This is called a "repeat broadcast." At other times the earlier program is taken from the network lines and recorded at Denver, Hollywood or San Francisco, depending upon the circumstances.

By far the major portion of the activity in the San Francisco Studios is concerned with the origination of local programs. Many excellent programs are planned and produced for broadcasting by a group of stations on the west coast known as the Regional Pacific Network. In addition, many local programs are planned and produced at San Francisco after the New York studios have closed down for the night.

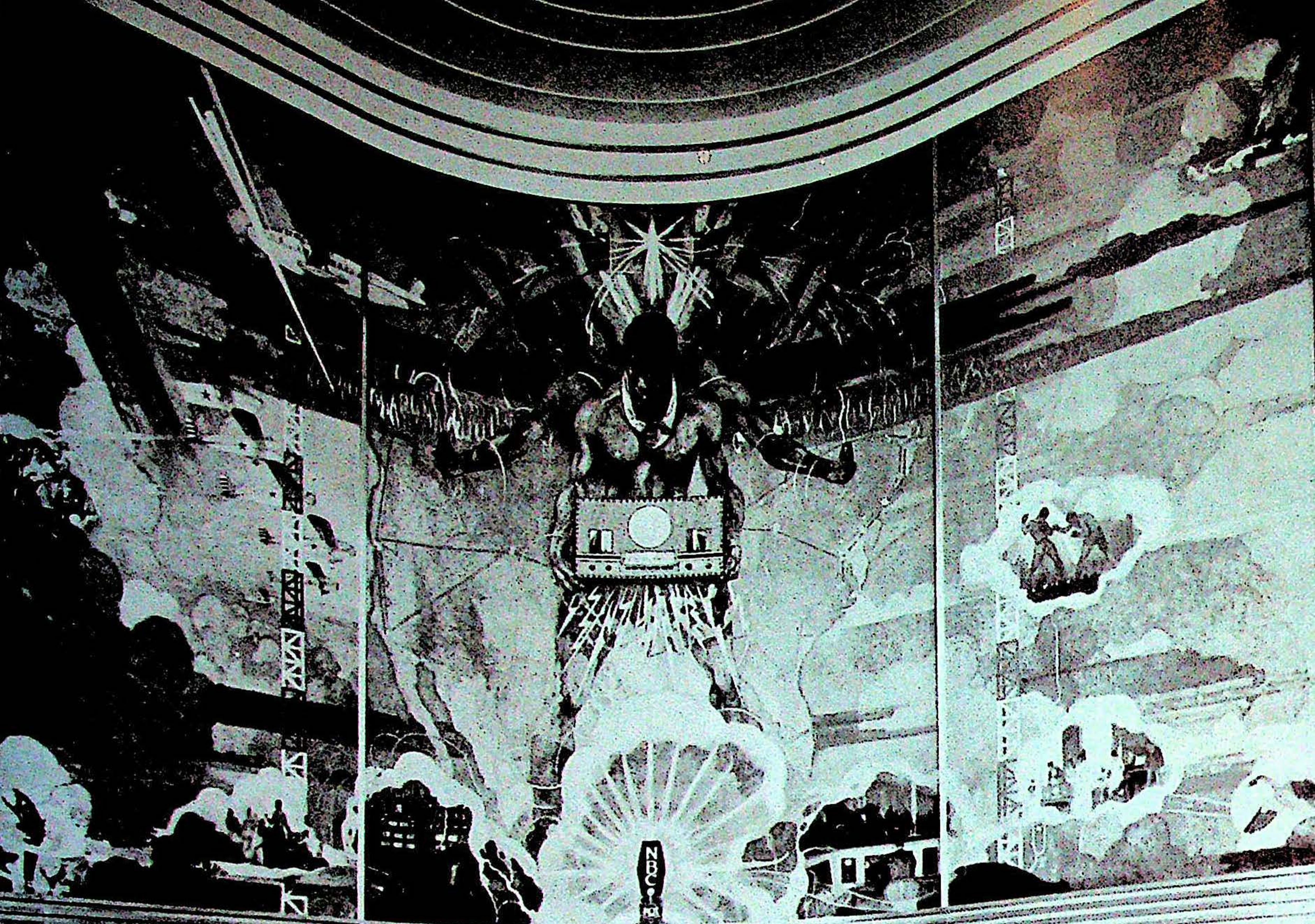


View of NBC-KPO studio and office building, San Francisco.



KPO's efficient auditorium Studio "A", set up for broadcast.





## Bagdad on the Pacific

Hollywood, fabulous capital of the motion picture industry, where the tinsel and glamour of make-believe are concentrated to an almost unbelievable degree, has come to be one of the foremost entertainment centers of the world, its celluloid romance girdling the globe and its stars and personalities known to peoples of all kinds in all nations.

Quite naturally Hollywood in recent years has become one of the most important points of origin for many of radio's best known programs. As a natural Mecca for famous names of stage, screen and radio, Hollywood is a talent magnet that is peculiarly adapted for the production of outstanding radio shows.

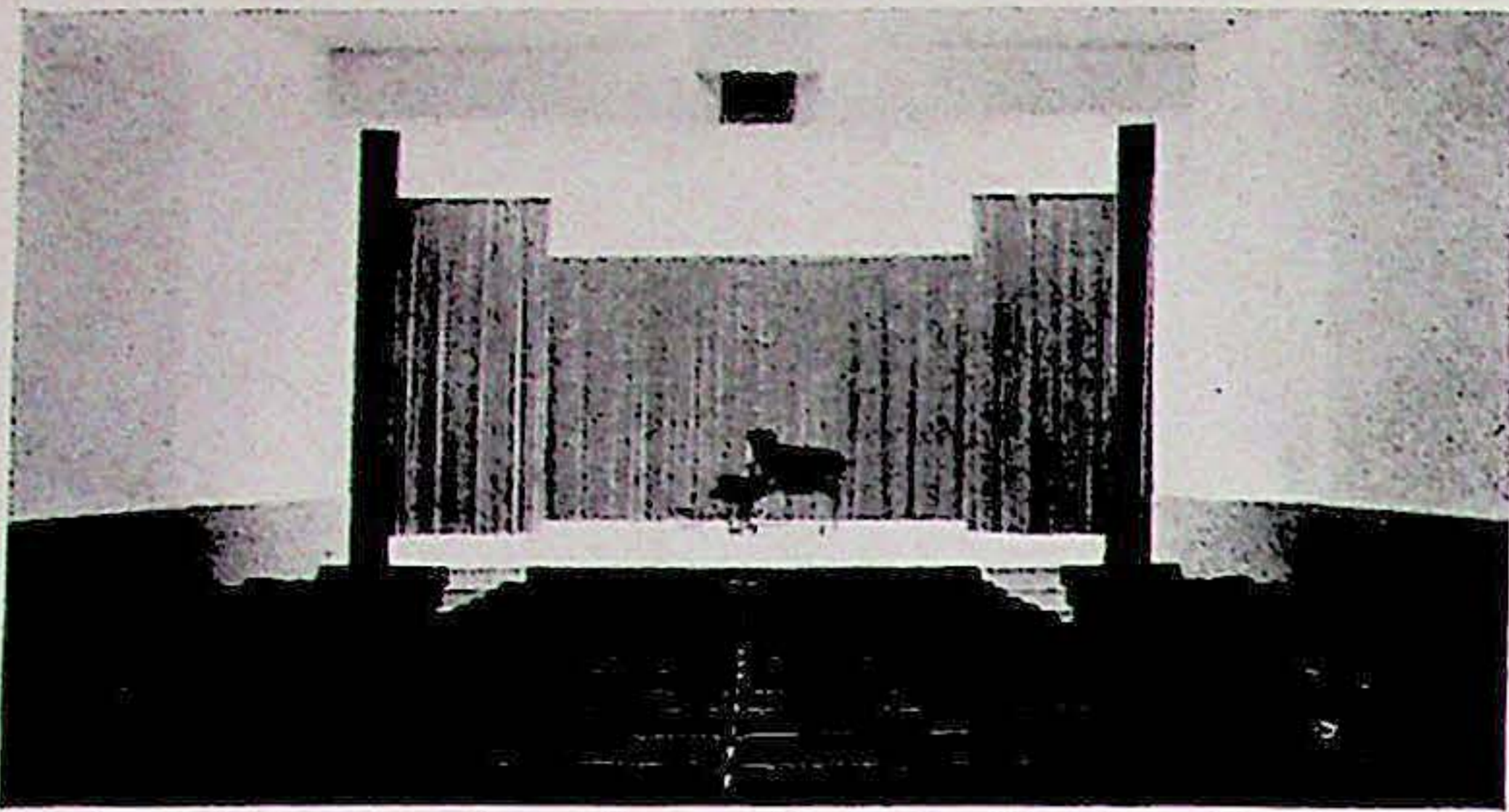
Accordingly the NBC Air Castle in Hollywood is one of the most elaborate, novel and efficient in construction of all air rialtos. This plant differs from the other NBC Air Castles in that, while the Hollywood offices and studios are NBC owned and operated, the local outlet, station KFI, is an independent NBC affiliate, identifying itself with Los Angeles.

Theoretically—and practically—one of the

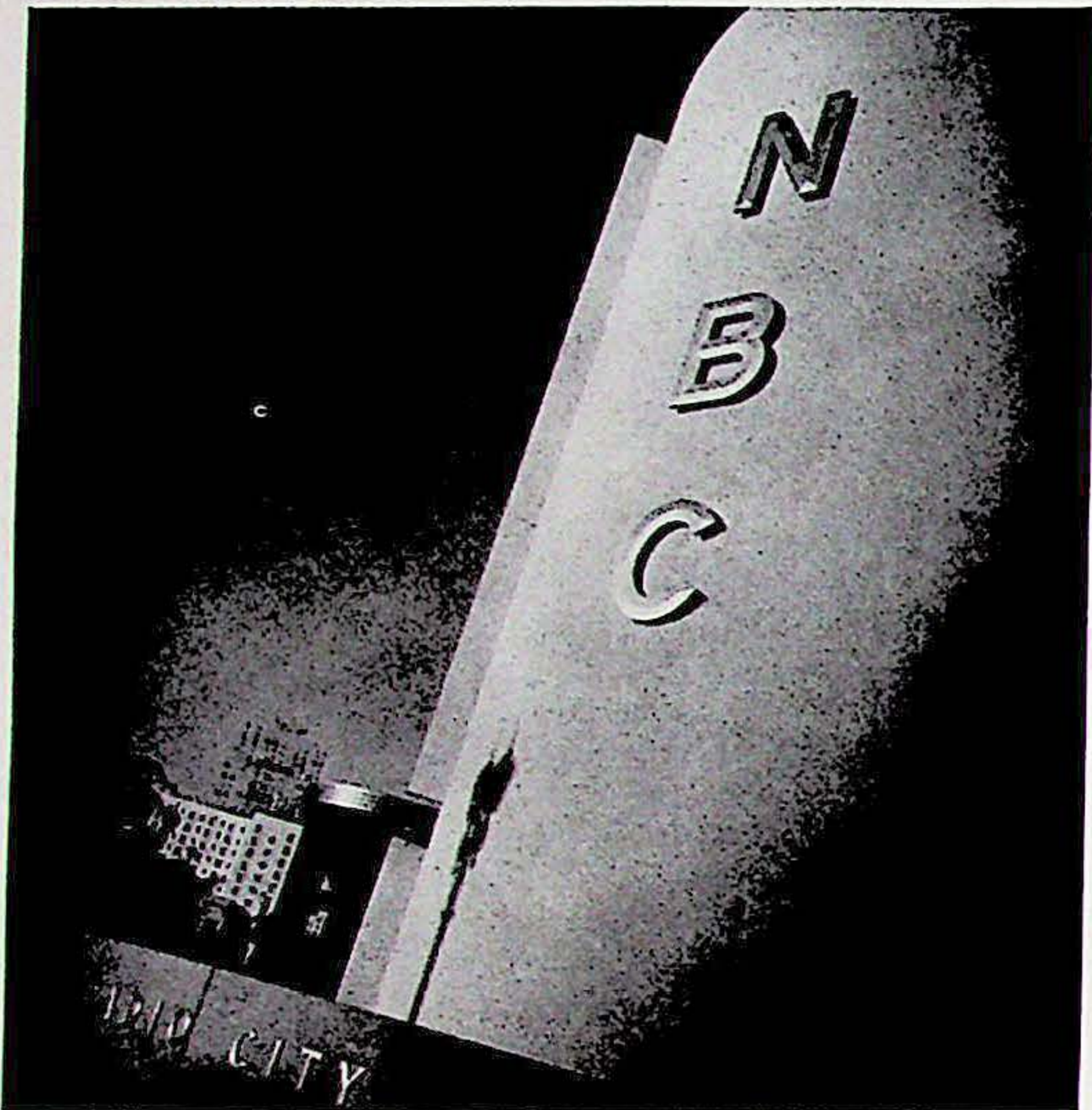
best arrangements for the broadcast studios from the operating and constructional viewpoint is the horizontal plan in which all studio entrances are at ground level. Although land values in most large cities ordinarily runs up the cost so as to prohibit or render impractical such construction, the plan proved to be economically practicable in Hollywood. The NBC studios and offices at Sunset Boulevard and Vine Street occupy a building 370 feet in length, 260 feet in width, but only 45 feet in height. The structure is a welded steel frame with architectural concrete walls, but eight of the studios are actually buildings in themselves. Each has its own foundation of concrete block footings and twelve-inch masonry walls below grade while eight-inch masonry walls extend from grade to the wood truss supported roof. The air space of several inches between adjacent studio walls at the roof is covered by metal flashing, while on the front of the building this space is hidden by metal separation joints. To reduce vibration and noise transmission from one studio to another, the corridor floor slab between studios is insu-



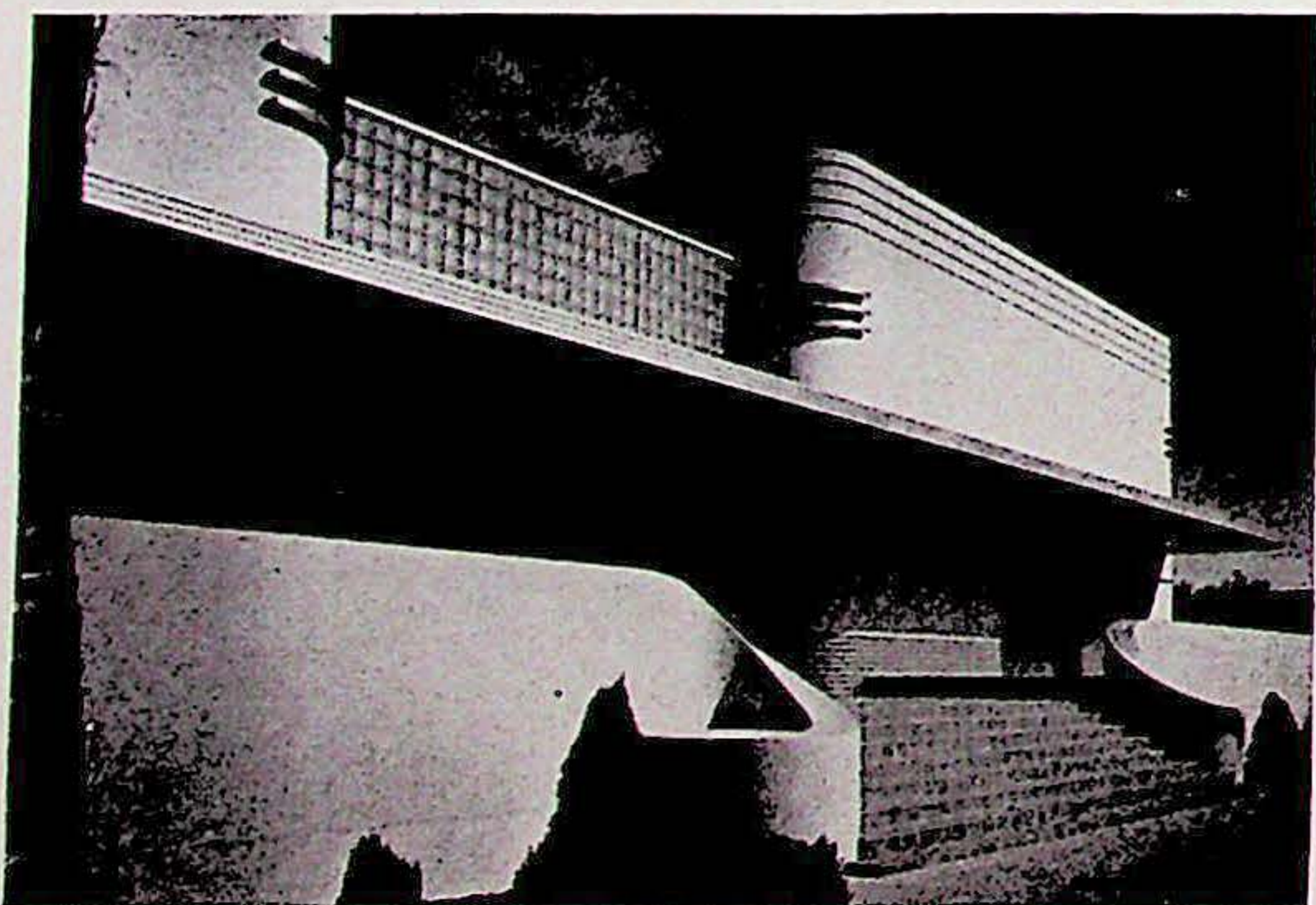
*NBC's Radio City Hollywood, most modern Air Castle, where radio and movie stars shine in coast-to-coast broadcasts.*



*Studio of famous broadcasts from Radio City Hollywood.*



*Modernistic style reflected in Hollywood Radio City building.*



*Stairway to the stars of NBC's Radio City Hollywood plant.*

lated from the walls by cork and mastic compound.

Except for studios G and H, none of the individual studio buildings has a basement—the floor slab resting directly on the soil. What basement there is occupies less than one-half of the entire plot area, housing the heating plant, the electrical transformer vault, the air conditioning machinery and the cold water storage tank.

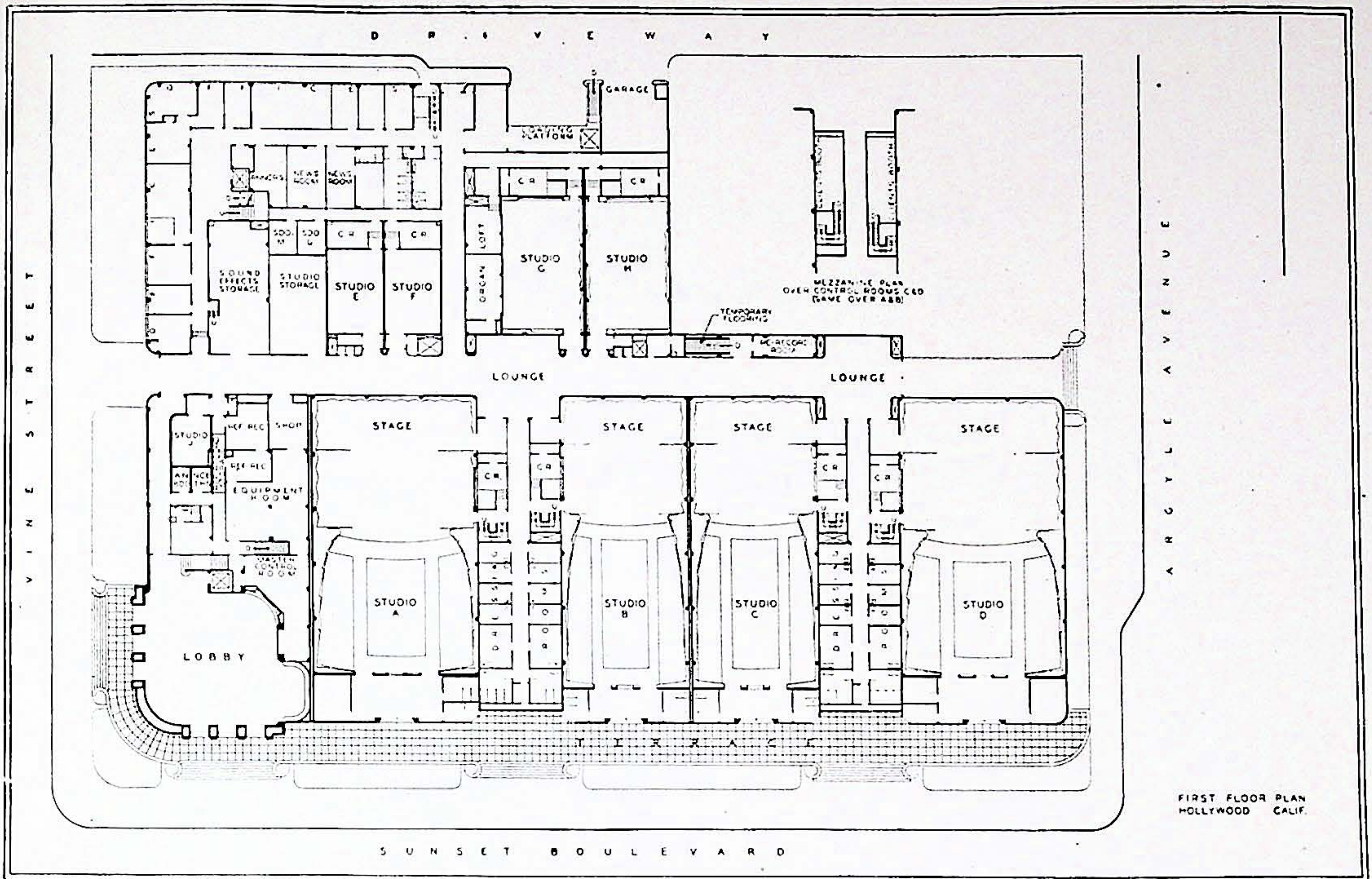
Public entrance to the four auditorium studios, each of which accommodates 340 persons, is directly from the terrace which runs the full length of the building on Sunset Boulevard. The inside wall surfaces of each auditorium are so constructed that no two surfaces are parallel. This method was adopted to avoid the presence of separate or individual sound reflections. Such reflections as do take place are dispersed by the non-parallel surfaces.

Complete sound isolation was applied only to Organ Studio G. The presence of the organ, plus the fact that the studio is situated over the basement where the air conditioning machinery operates, was considered sufficient reason for the precaution.

The other studios have, except for the omission of the sound isolation, similar partitions.



*Modern design utilized in corridor of Radio City Hollywood.*



Particularly effective observation of the master control room from the main entrance lobby, as shown in figure 39, is afforded through a so-called invisible glass window. This window is constructed in such a way that the surfaces of the glass are curved to a continuously different radius from front to back so that reflections are directed away from the observer to an absorbing surface. The view of the master control room is thus unobstructed by highlights in the glass.

The air conditioning system in the NBC Hollywood Air Castle is similar in design to that of other NBC studio plants, except that at Hollywood an 85,000 gallon cold water storage tank has been included. This tank is used to store water at a temperature of 40 degrees to take

peak loads on the system. This method of design allows approximately fifty per cent reduction in the refrigerant compressor capacity over that otherwise necessary, and is economically worth while only because the heat load of the studios is sharply peaked for a comparatively short period.

The audio facilities of the Hollywood plant are modern in every respect and are comparable in electrical characteristics to similar corresponding equipment in the NBC Radio City Air Castle, differing in that they are entirely AC operated. During 1946 work progressed on two additional large studios to enable the western division to accommodate the increasing number of originating programs.

## **Twenty-Five Years of Wonder-Working**

In the olden days when wizards and sorcerers flourished, transformations and magic spells were worked in an instant by the waving of a magic wand.

All that has been related in this booklet regarding the physical construction and equipment of NBC's Air Castles has sprung from a beginning only twenty-seven years ago when Dr. Frank Conrad, operating his experimental radio station, KDKA, in the garage of his home in Wilkinsburg, Pennsylvania, broadcast the first pre-scheduled radio program in history, the Harding-Cox presidential election returns on the evening of November 2, 1920, to an audience of an estimated 500 wireless fans.

Who will question that the wonders worked in this brief quarter of a century by the radio wizards of today are not more marvelous than anything retold in the Arabian Nights Tales? In the long history of mankind, twenty-seven years is a mere twinkling of an eye, and in that "blink of time" our modern magicians have waved their electronic wands and Lo! — voices, music and images—a whole new world of entertainment, news culture and instruction—appear from the void at the casual touch of our fingertips.



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**THE NATIONAL BROADCASTING COMPANY**



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