



This fireworks display in Radio City Music Hall cost \$50,000, took two years to build and required 24,000 incandescent bulbs

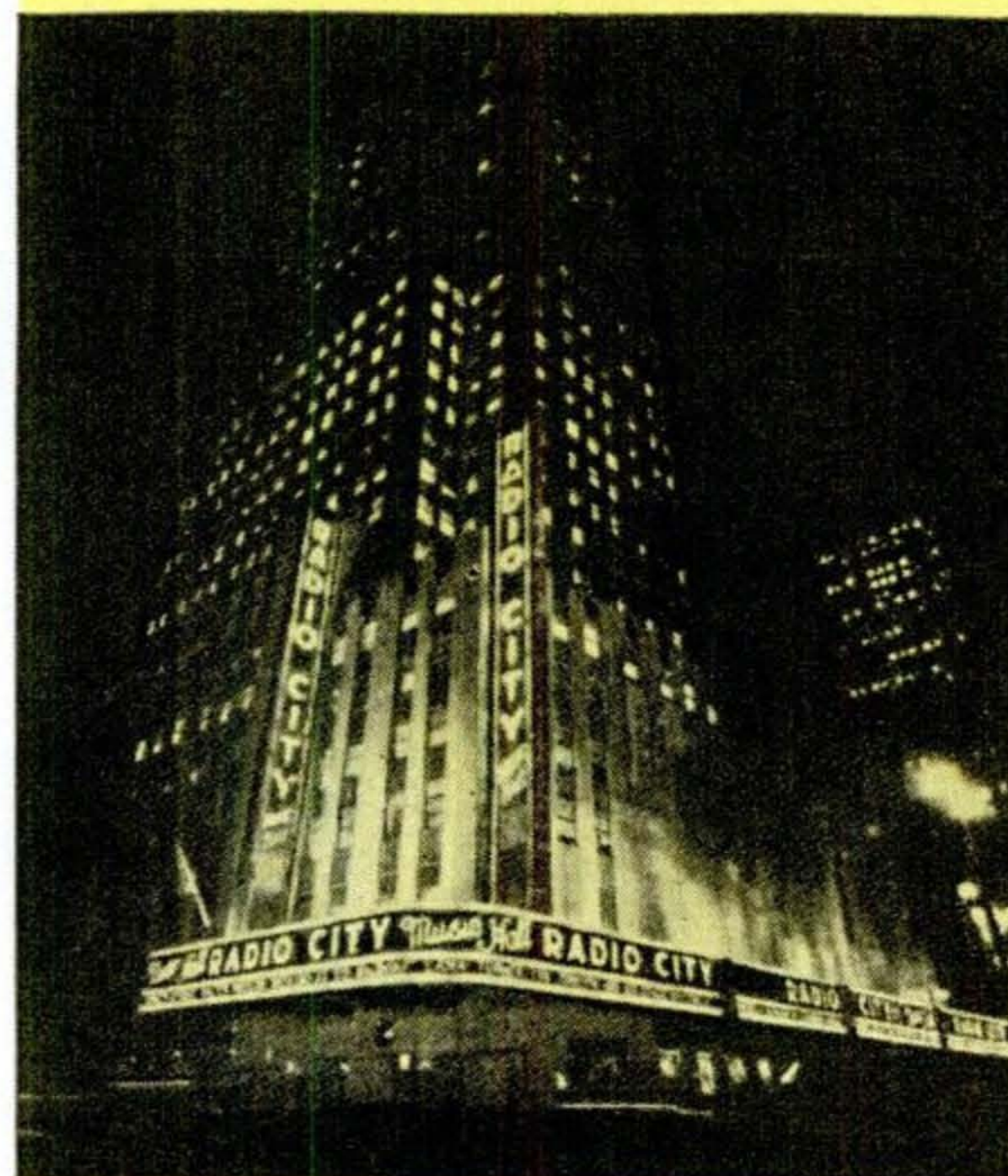
By **Richard F. Dempewolff**

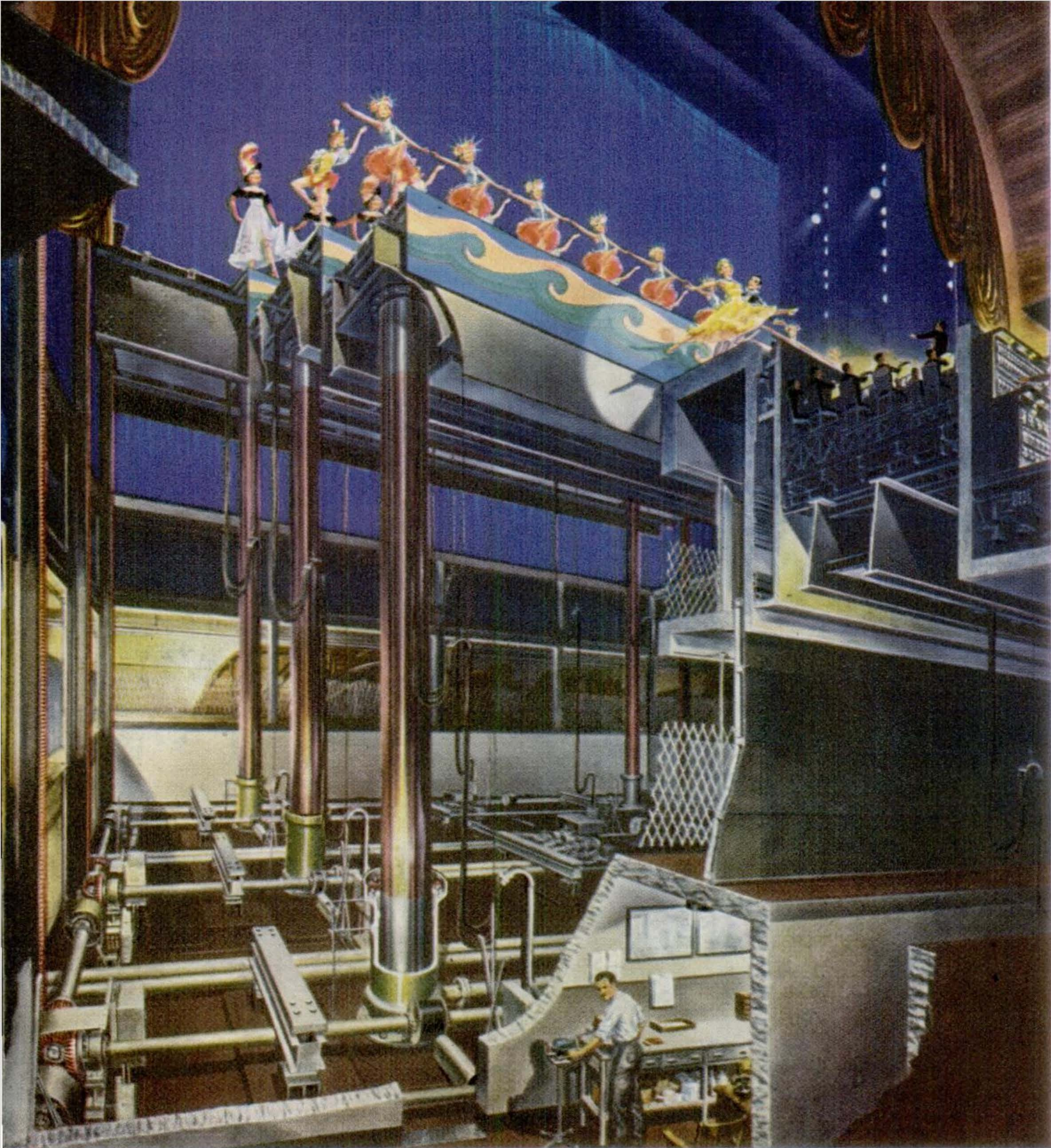
**H**IGH ABOVE a revolving carrousel, studded with gaudy incandescent bulbs, skyrockets burst in star-spangled glory. Staccato explosions banged a tympanic din over a musical background provided by a 65-piece orchestra, a 30-voice chorus and the rumble of the biggest organ in existence. Showers of colored light twinkled over the dazzling face of a whizzing pinwheel. Aerial bombs let go a barrage of fiery streamers. Then, with one great boom, a hundred-foot wall of colored light cascaded over everything, as the applause of 6000 spectators joined the tidal wave of sound tumbling across the gold-plated dome of light overhead.

This was no outdoor Coney Island fireworks display. It was one of the outstanding indoor spectacles produced by the largest and most incredible theater in the world: Radio City Music Hall.

Because it is even more grandiose than the grandeur it produces, the famous theater must always outdo itself in the extravaganza department. Any ordinary show would be lost in the cavernous maw of its 60 by 100-foot proscenium arch, which backs off over the heads of the audience in a series of concentric golden coves depicting a vast stylized sunset. From auditorium doors to curtain is a city block's distance; its massive stage is nearly half the size of a

## Hall of a Thousand Illusions





Courtesy Socony Vacuum Corp.

Some of the magic of Music Hall staging is made possible by the three stage elevators which operate on 57-foot pistons. The famous dancing Rockettes are shown above performing on three different levels (also below across the two pages). The 65-piece orchestra rides a separate elevator and sits in sort of a band wagon on wheels that moves across the stage elevators to front or rear sections much to the surprise of the audience. To the right of the orchestra is part of the light console which has 4305 switches for presetting any of 20 different light combinations on any of the units in the huge theater. There are 25,000 bulbs in the place





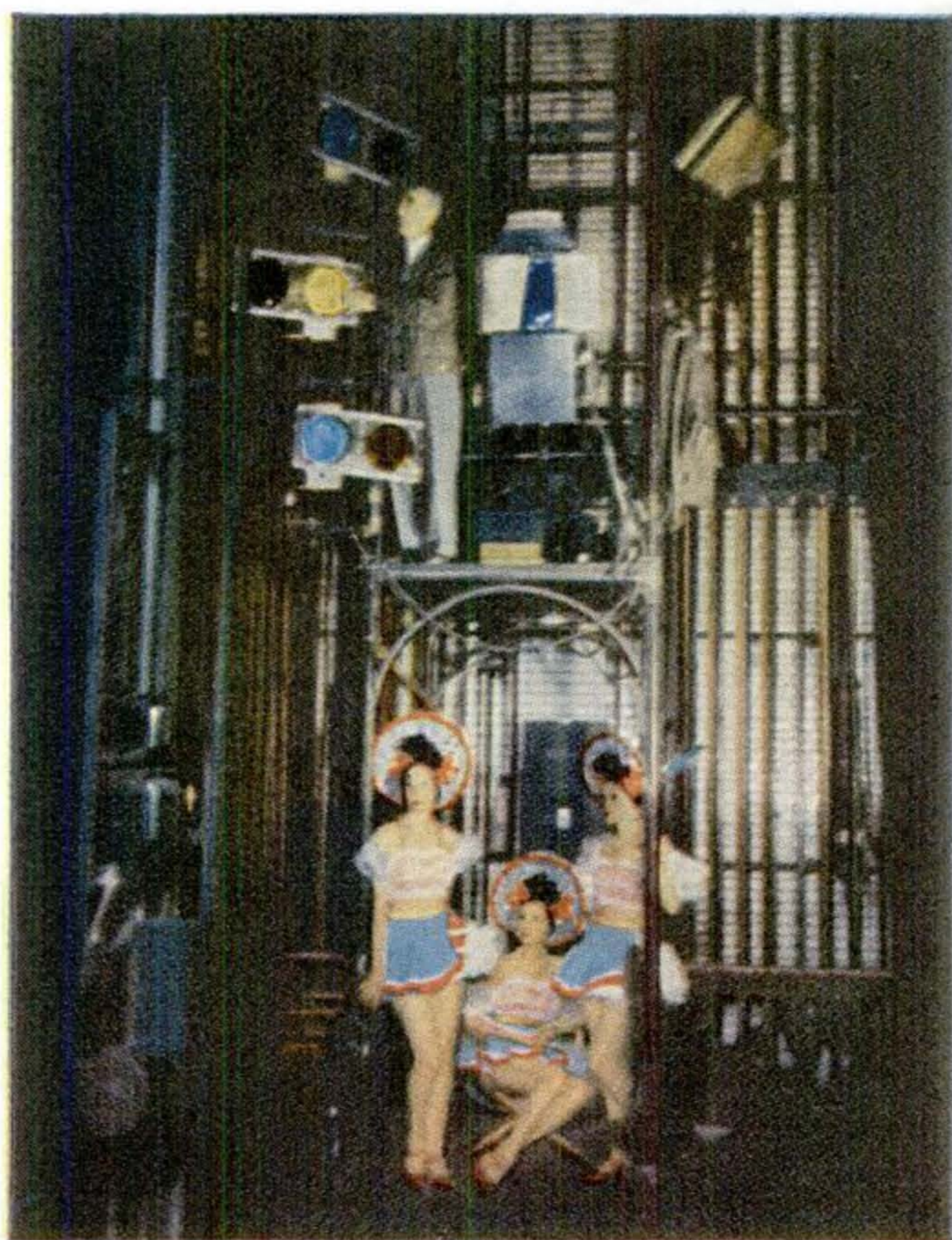
Audience gasped when an observation car appeared on the stage. Below, light technician rides mobile stand

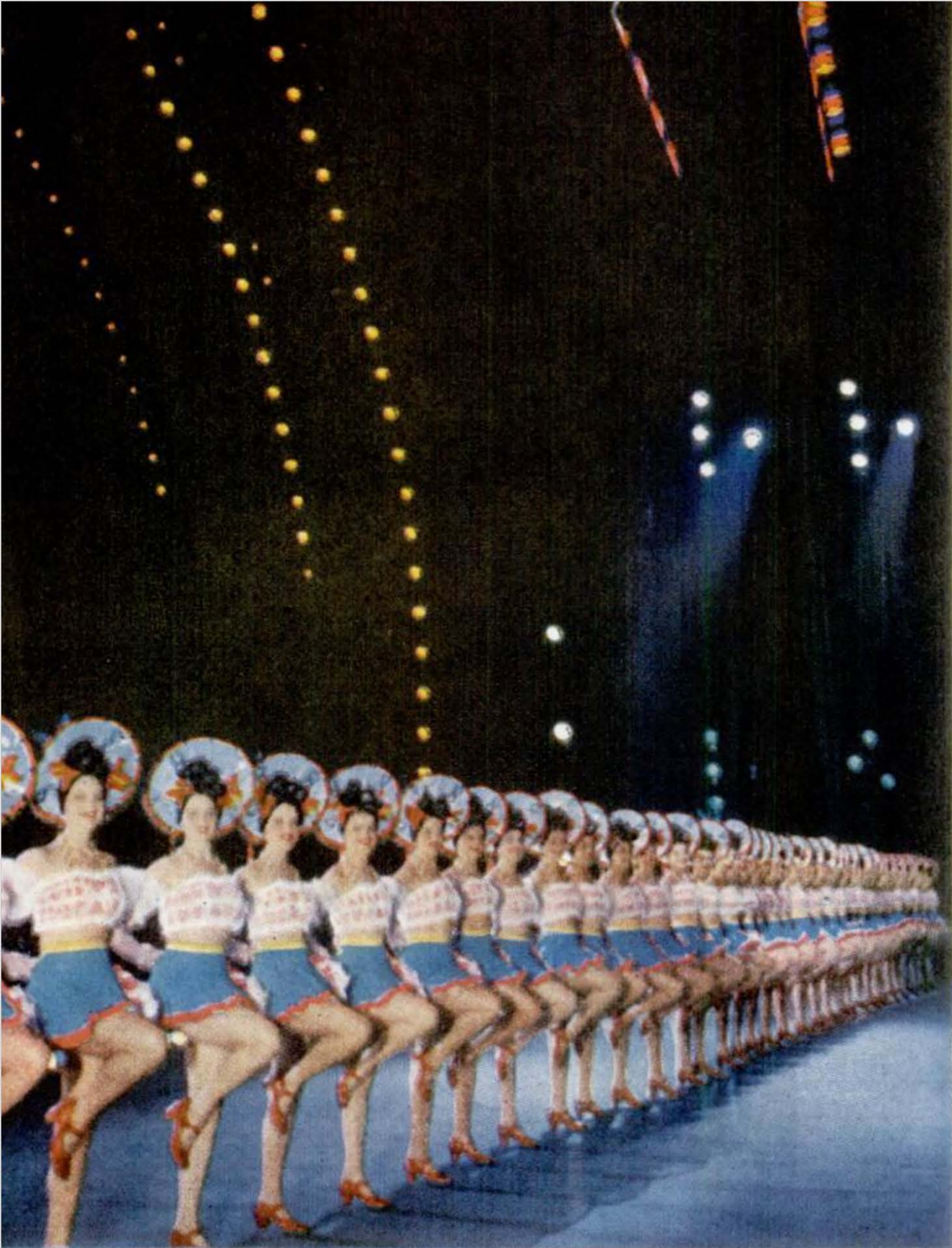
football field. More than 2000 lights illuminate that stage, and its contour curtain weighs three tons.

Eight million people a year, half from out of town, pour through the Music Hall's air-conditioned five-story foyer to fill its 6200 seats daily, and it takes miracles like the recent fireworks to keep them coming.

To stage such gaudy displays, the theater's producers: Leon Leonidoff, Russell Markert, Florence Rogge and an army of some 60 technical assistants, don't spare the horses. Those fabulous rockets and bombs could not have been the genuine "made-in-China" variety, or there'd have been a few scorched patrons. So, for two years and at a cost of \$50,000, the stage-lighting director, Eugene Braun, and his men worked over a maze of bewildering blueprints in the hall's own shops to construct twelve 600-pound lighting panels. When finished, they towered 42 feet against the back wall of the stage, filling it from side to side.

The dazzling 3½-minute display called for 24,000 incandescent bulbs in eight





Spotlights from booth on third mezzanine throw beam 190 feet to stage where the beautiful Rockettes are doing precision dance

colors, 300,000 feet of copper wiring, a nightmare of automatic relays run on a battery of electric motors, thousands of blank cartridges and an automatic synchronized firing device that would chal-

lenge an Einstein. The whole thing had to go through its automatic routine at the touch of a single button.

For 17 years, Leonidoff, Braun and other Music Hall geniuses have been staggering a goggle-eyed public with stage trickery that beggars description. Daily, the orchestra pit containing its quota of Maestro Alexander Smallens and 65 artists is swallowed up by the floor. It may reappear a few minutes later, slowly rising out of the back of the stage — or the front. Once, without dropping the curtain, an entire scene depicting outdoor circus grounds suddenly changed to an interior of the big top, with cages of wild animals, while the baffled audience blinked 12,000 eyes during a brief five-second blackout.

Regularly, the famous Rockettes, whirling in gorgeous costume, rise out of the stage floor and silently disappear beneath it, while other acts replace them as mysteriously. Whole sets rotate and change before your eyes.

Hurricanes, with drenching rain (from perforated pipes high above the stage), have swept across the place, blown by a 10-foot propeller-type fan located in the wings. The water is trapped in a tarpaulin over a slightly lowered elevator and drained off. A phony but impressive Niagara Falls has disgorged itself into a monstrous hidden drain from huge tanks of an

Behind railing at stage level is a full-size swimming pool. Divers operated from boards at left end of pool



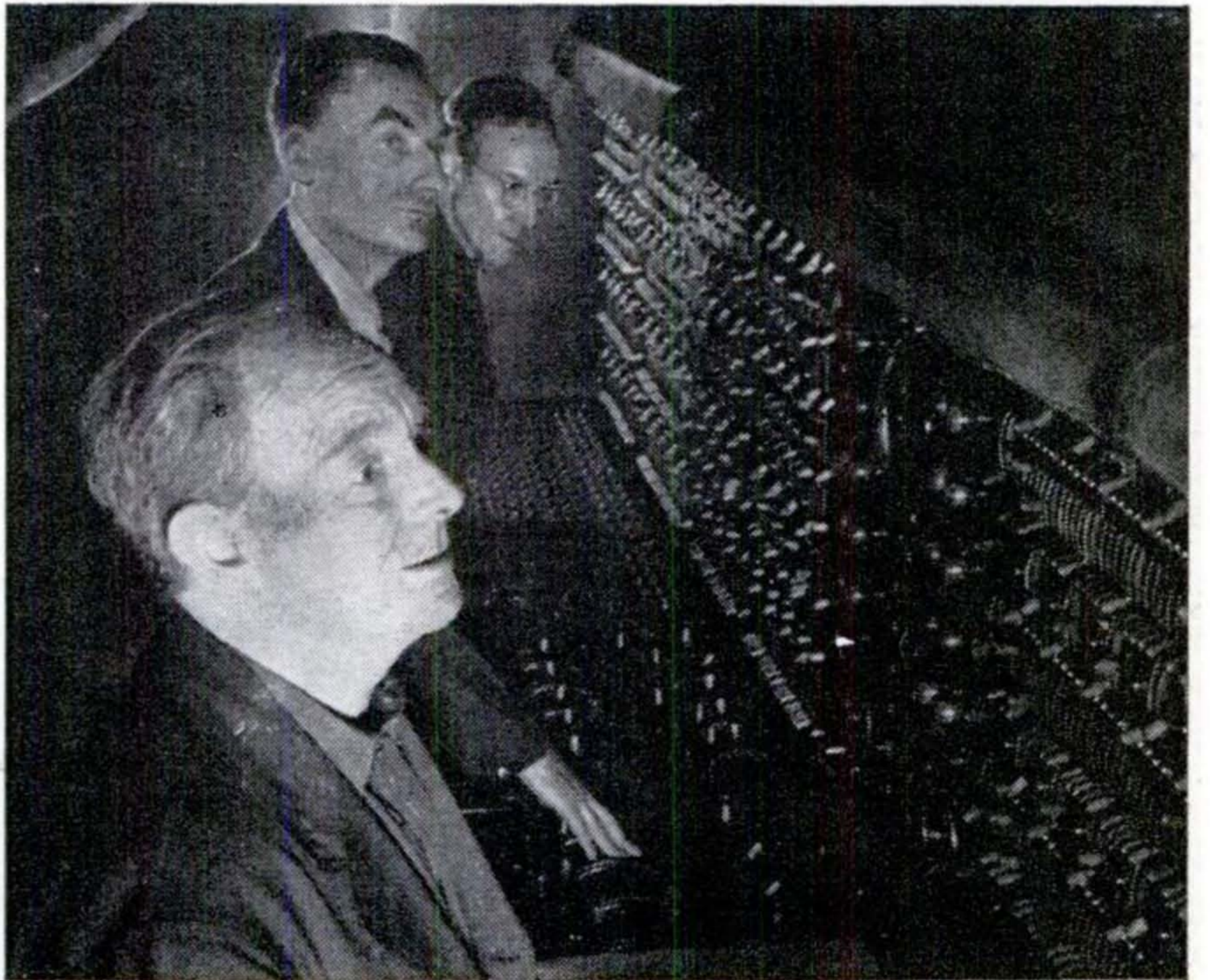
agitated soap solution. An ocean-going ship was once torpedoed on the stage, broke in two and sank beneath the waves as pretty as you please. Another time, a life-size observation car of a train was hauled off the stage by a chugging locomotive, and a moment later the whole train was seen winding its way across the rolling hills in the background. Elephants, helicopters, a troupe of 30 horses and a full-size swimming pool—all have been accommodated from time to time.

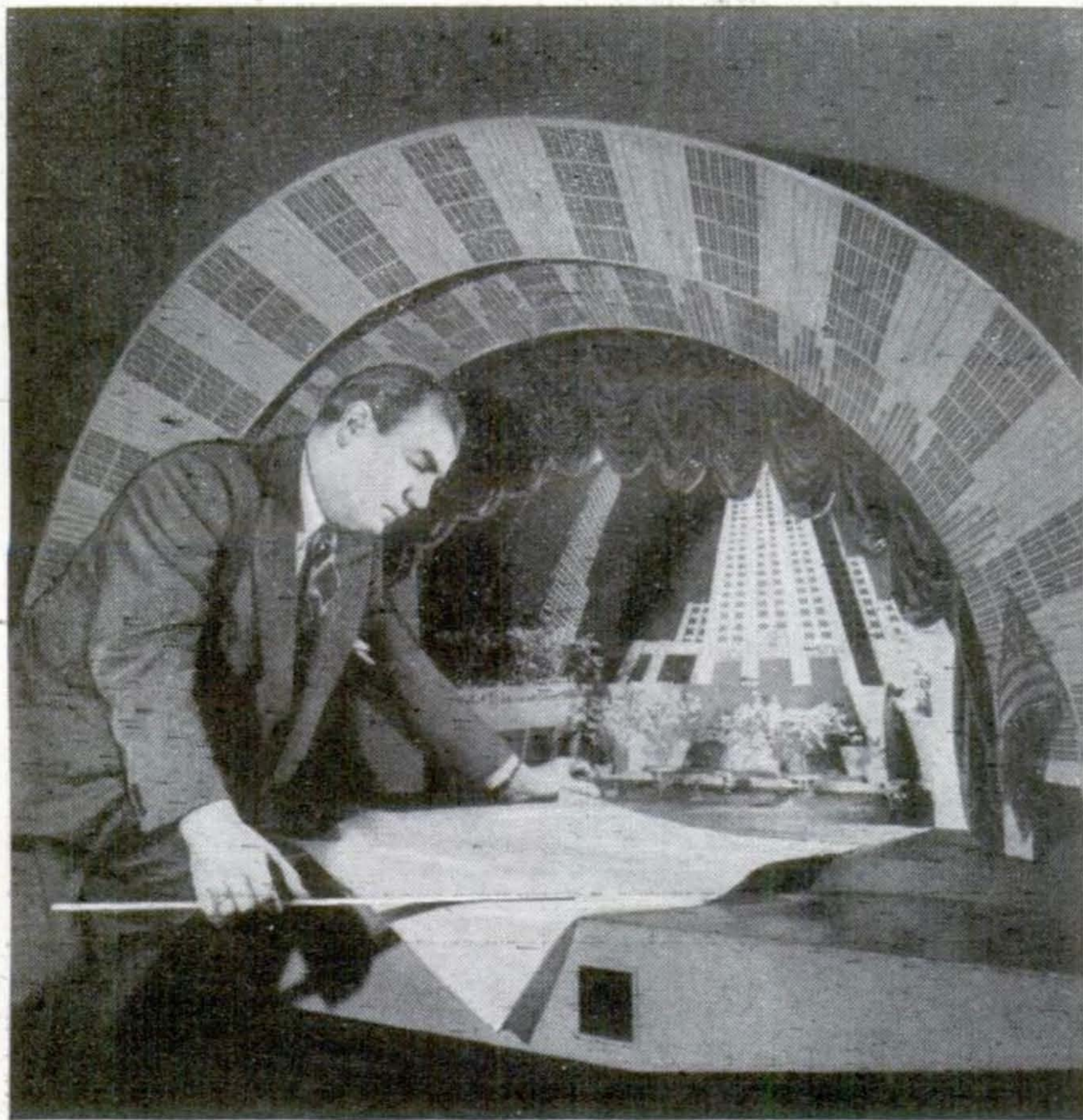
Much of the magic of the Music Hall can be laid to the hydraulic mammoths beneath its stage. There, in the dungeonlike subcellar where footsteps of Rockettes dancing overhead are never heard, and blaring music comes as a muffled thrum, a hydraulic engineer keeps an eye on the real magicians—eight gigantic pistons, whose shiny steel sides glisten with oil in the gloom. Each piston, almost two feet in diameter, and 57 feet high, fits into a cylinder whose casing plunges 67 feet down into bedrock. The ponderous shafts can move the stage in whole or in part, from 27 feet below stage level to 13 feet above it, at the touch of buttons on the master control board located behind the wings upstairs.

The stage itself really consists of three hydraulic elevators which divide it lengthwise into 70-foot strips, about 15 feet wide. There are two pistons per elevator. The fourth pair is for the elevator on which the orchestra sits in front of the apron. Any one of the elevators can be raised or lowered independently—or all three stage elevators can be locked together and moved. That way, a whole show can disappear from sight.

And how does the orchestra

**Top, sound-board operator in booth on third mezzanine sets dials as he watches show. Center, light-control console directly in front of orchestra. Right, Leon Leonidoff, producer, directs show rehearsal. Board enables him to talk to anyone in the theater**



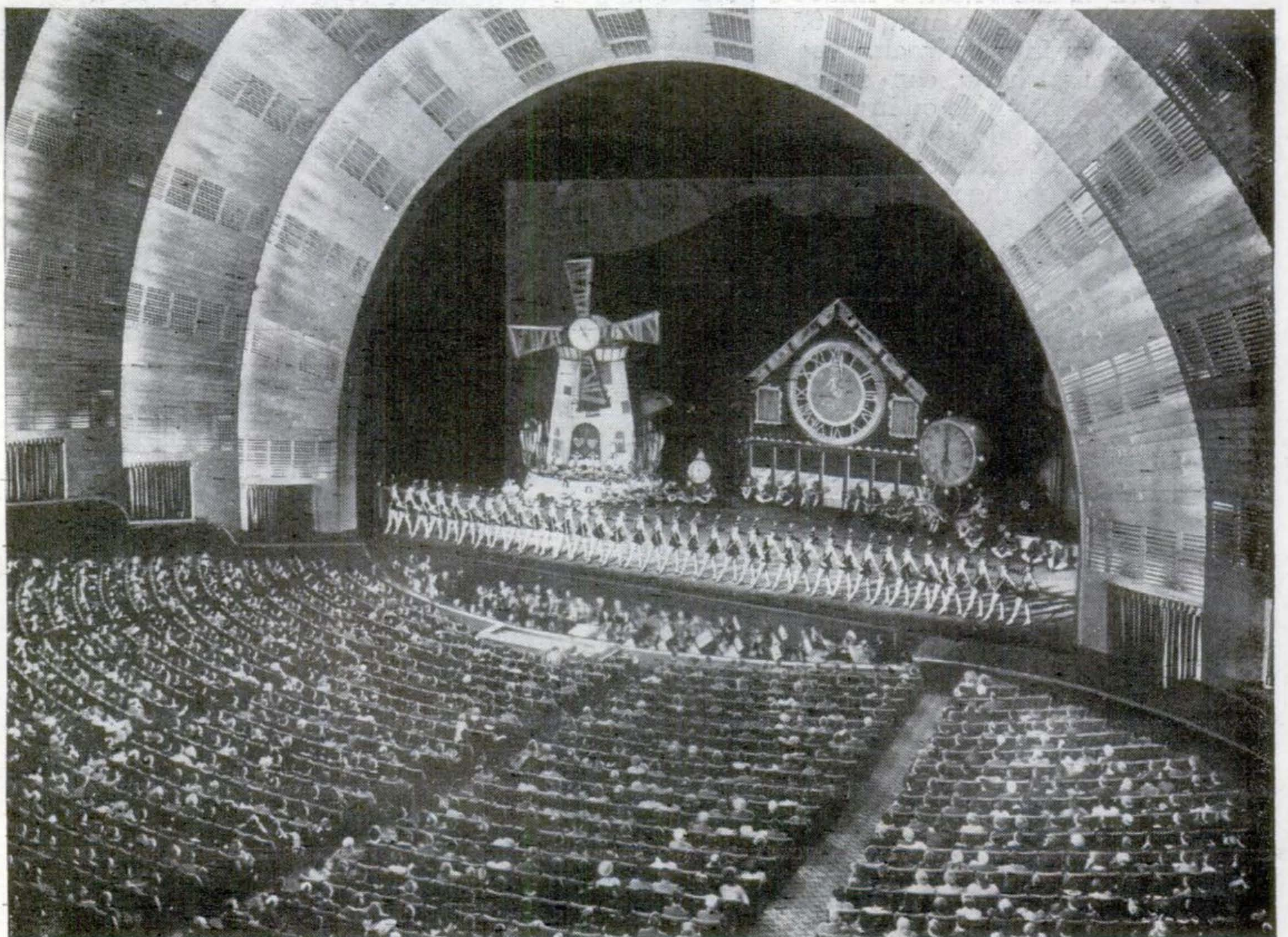


All scenes are worked out on a model stage. Here Bruno Maine, art director, works out a skyscraper scene. Stage even has elevators  
 Proscenium arch, 60 feet high and 100 feet long, frames theater's renowned 36 Rockettes. Sunburst covers of ceiling extend to the back

get moved around so eerily? Atop the orchestra elevator sits something known as the "band wagon," a sort of self-propelled boat on wheels. While the overture is going on, the whole stage is lowered to basement level. When it's over, the orchestra subsides to the same depth. An electric motor on the band wagon sends the whole shebang scuttling across the lowered stage elevators to the desired position on the front or rear section (the middle one is too narrow to take it), and up goes the stage. The whole operation only takes a minute or so and, when the curtain goes up, there's the orchestra blithely sawing away where no one ever expected to see it.

The band wagon can also be raised to stage level and go gliding across the elevators in stage position.

That's not all the acrobatics the stage can perform. Cut into the top of the three stage elevators, like a freshly cut cookie waiting to be lifted





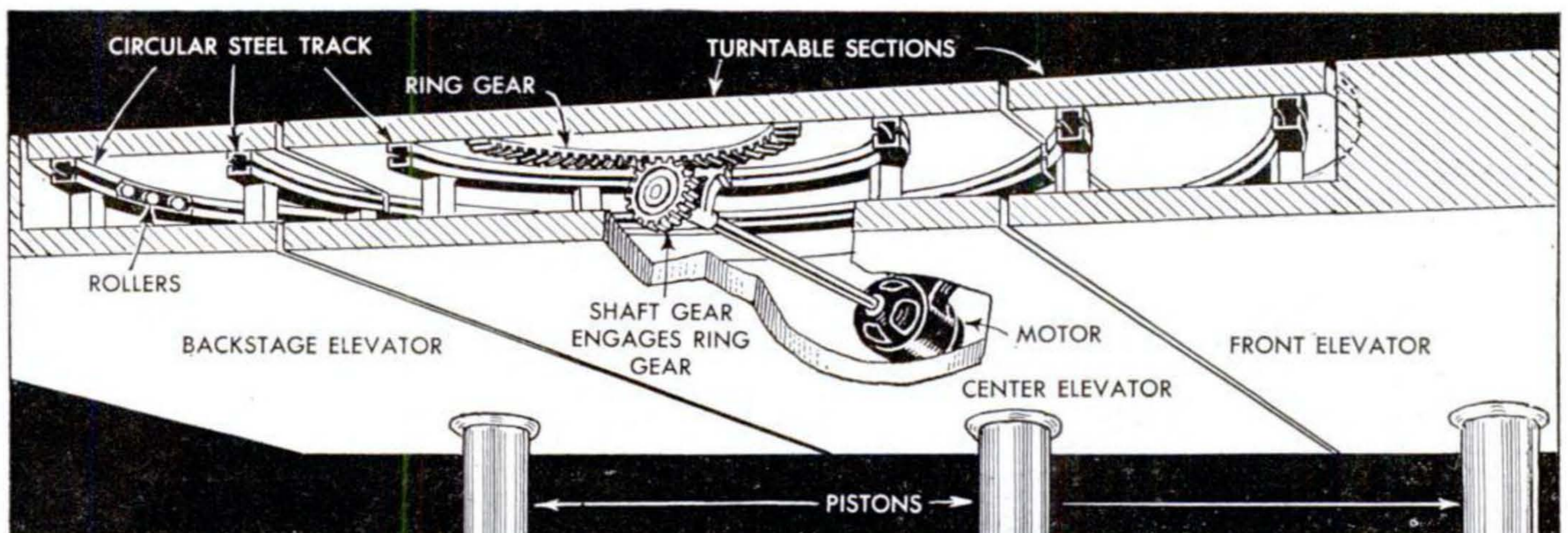
Central panel on stage-manager's control board regulates giant curtain; sliding buttons show preset pattern

from a sheet of dough, is a 43-foot turntable. Of course, the elevators must be at the same level before it can operate, since it is made up of sections from all three elevators. Fastened to the underside of the center stage section, off to one side of the turntable, is an electric motor that turns a shaft, which, in turn, meshes into a ring gear beneath the turntable. A hundred and two little rollers on three guide tracks under the turntable carry the big circle of stage around like a pie tin twirling in water.

It was by using the turntable that the circus exterior became an interior so quickly. On one side of the circle sat the tents; on the other side, the animal cages.

The audience takes all this magic machinery pretty much for granted. But not the producers or the stage manager, Irving Evans, who must keep the magic within the limitations of the Music Hall machinery. Every show is worked out in detail beforehand on a working model of the complicated stage in the office of Bruno

Ingenious turntable is made in three sections extending over the three stage elevators; it is 43 feet wide





**Giant Music Hall stage easily takes in entire East Side dead-end street on full scale including washlines**

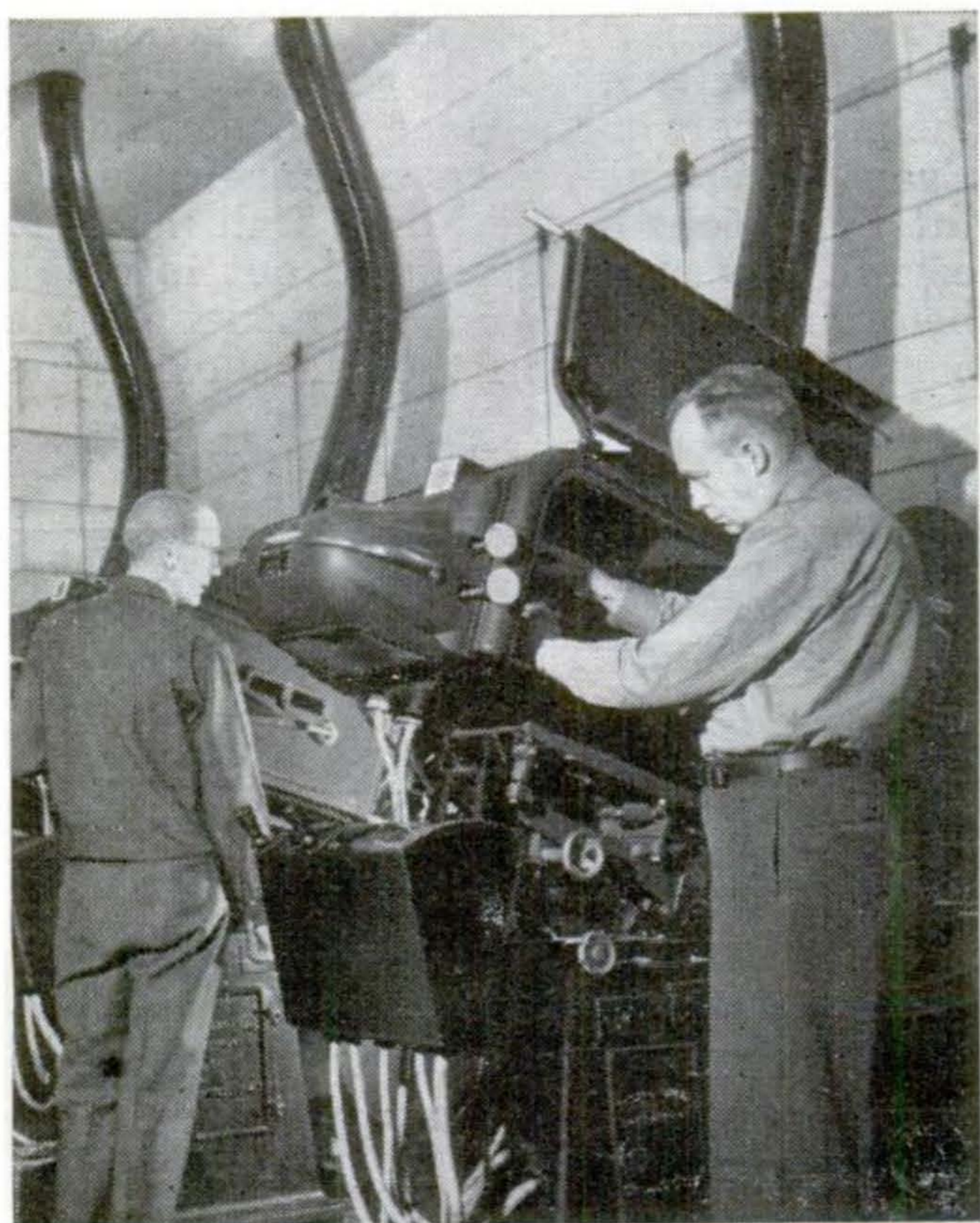
Maine, art director. The model is scaled 1½ inches to the foot and will do everything the big stage does. Its tiny pistons work by air pressure, send the elevators up and down at a lively clip. It has an electrically controlled curtain, lights and all. Every set is built in miniature and tested

on the model before it goes into production.

After that, the problem falls on the hydraulic engineers down in their jungle of pipes and pistons. The show must not be too heavy for this equipment. Special water, treated against bacteria, is pumped through a spaghetti maze of pipe at 400 pounds pressure per square inch by a pair of humming 250-horsepower pumps. The huge system, including the great 20,000-gallon pressure tank, is built to raise or lower 190 tons of stage. Above that, the elevators can hoist a weight of 96,000 more pounds. Any more, and somebody might get wet. Twice, the head of one pump has blown with a crack like a cannon and the deluge was something fearful.

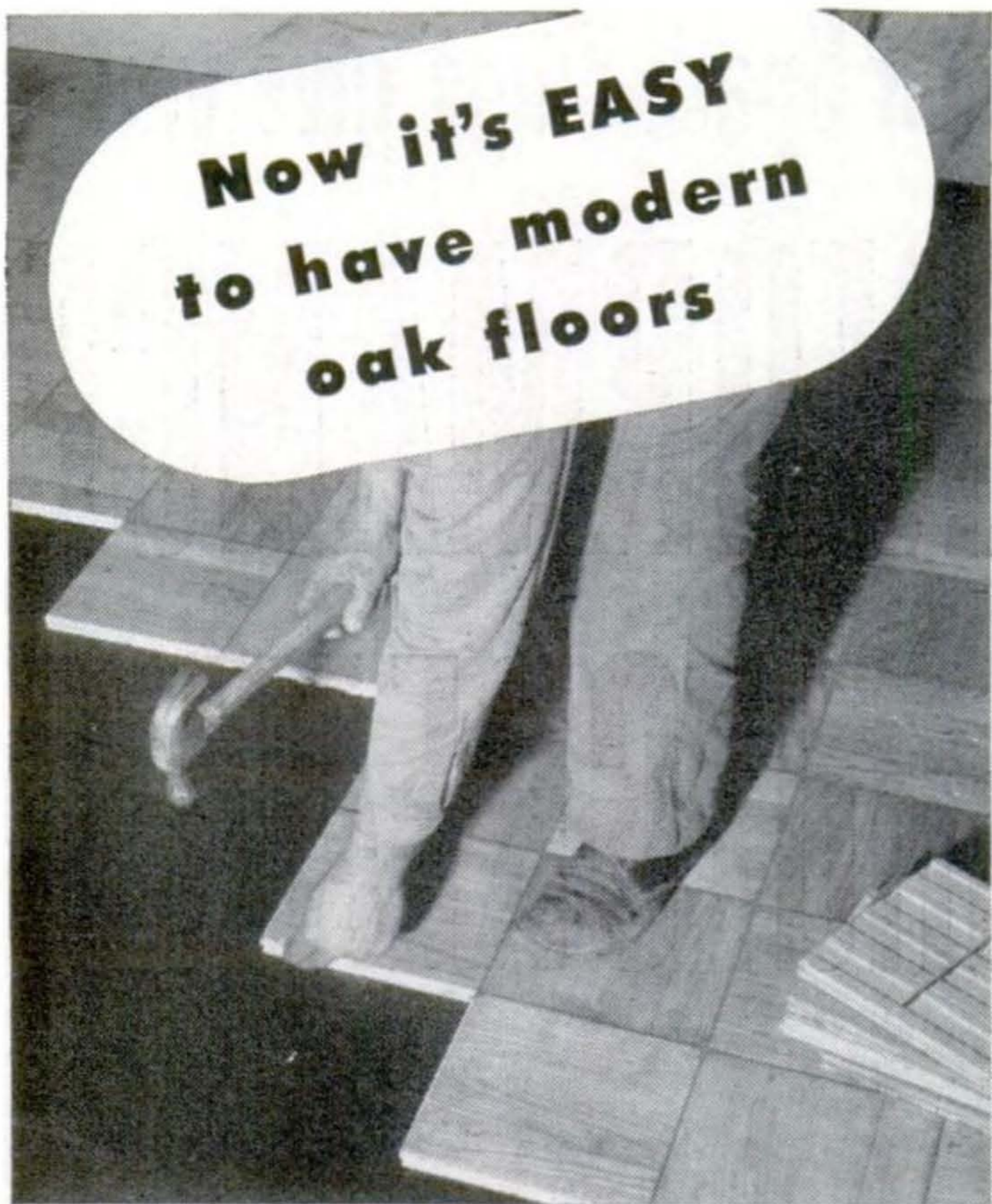
The hydraulic engineer watches his show weights carefully. When Leonidoff and Maine planned the swimming pool for an Eleanor Holm (Rose) exhibition, they wanted a realistic set. The scene was the foredeck of a ship; the back elevator lifted to represent the bridge, the center section lowered to take the big steel swimming pool so it would be flush with the deck. Mirrors at an angle along the ship's bridge would give everyone in the audience a bird's-eye view of what Eleanor did in the pool.

(Continued to page 238)



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## Hall of a Thousand Illusions

(Continued from page 104)

The catch was that the filled pool weighed several tons too many. To handle it, the center stage had to be lowered in advance, shored up with timbers, and the pool set up on it. Temporary flooring was thrown over the gaping hole so the current show could go on uninterrupted.

Then there was the show with the elephants—six of them. They were to be taken aboard in the subbasement and raised two to an elevator, to the show level, where all they had to do was stand in formation and look like elephants. The elevators could stand their weight, but sagged somewhat. That's what the pachyderms didn't like. The first time aboard, they backed off, impelled by some instinct that told them something was hollow under that floor. They milled around, conferred a little and were coaxed to try again. Finally assured that they wouldn't plunge to Kingdom Come, they lumbered aboard like veterans and rode up and down several times a day for the duration of the show.

What the hydraulic personnel hate are the snowstorms that occur above them around Christmas time.

"They've got the biggest snow bag in the world up there in the flies," growls the engineer, "It's a hundred feet long, like a hammock, with dribble holes along the top edges. It stretches the width of the stage. They fill that thing with flameproofed confetti and work it back and forth on a counterweight frame. It might look swell from the audience, but down here it doesn't look so good. That paper sifts through the stage-section cracks, gums up the grease around the pistons, flutters into the automatic switches and insulates them so they won't make contact. We spend a week cleaning house afterward."

Other factors than the stage help produce Music Hall sleight-of-hand. Many quick scene shifts would be ineffective without proper lighting. To handle this the theater has the most elaborate system ever devised. A total of 25,000 bulbs from 2 to 5000 watts illuminate the place, contributing to the hall's annual 6,000,000-kilowatt-hour consumption—enough to light the entire city of Emporia, Kans.

Ten thousand of the lamps have to do with the stage or auditorium, and are remotely controlled from a 15-foot light console right in front of the orchestra pit. The console looks like a super complex telephone exchange, studded with 4305 switches for presetting any of 20 different light combinations on any of the units in the house.

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Once preset, the operator can change colors by a master switch. House lights shift to green, then dim; stage lights move into red; the prima donna gets bathed in gold—and so on for a whole show.

To control color on the 206 spotlights in the hall, a unique trick is employed. These lamps are five feet long and are equipped with a boxlike arrangement in front, holding a frame containing four gelatin color sheets. The frames are mounted on tiny geared tracks and move back and forth in front of the lens, powered by small motors. The electrician sitting at the console presets for blue, throws the master switch, and all over the house tiny motors whir, color frames travel across lenses and soon the whole house is bathed in blue light.

In an ordinary theater, blackout is easy. But in the Music Hall, many of the spots are of the arc type—two sticks of carbon barely separated. When current is passed through them it jumps the gap and creates an arc of light. Eventually, the carbon gets white hot. Shut them off and they glow awhile. One isn't bad, but the 36 in the Music Hall create quite an afterglow. To squelch them, the same system is used as for the color slides. The operator simply throws a switch, and tiny motors automatically roll black slides or "blackout doublers" along the little tracks in front of each arc-

light lens. Result: No glow. Stages can go up and down unnoticed, turntables can whirl and in a few seconds when lights come on, miracles have been performed.

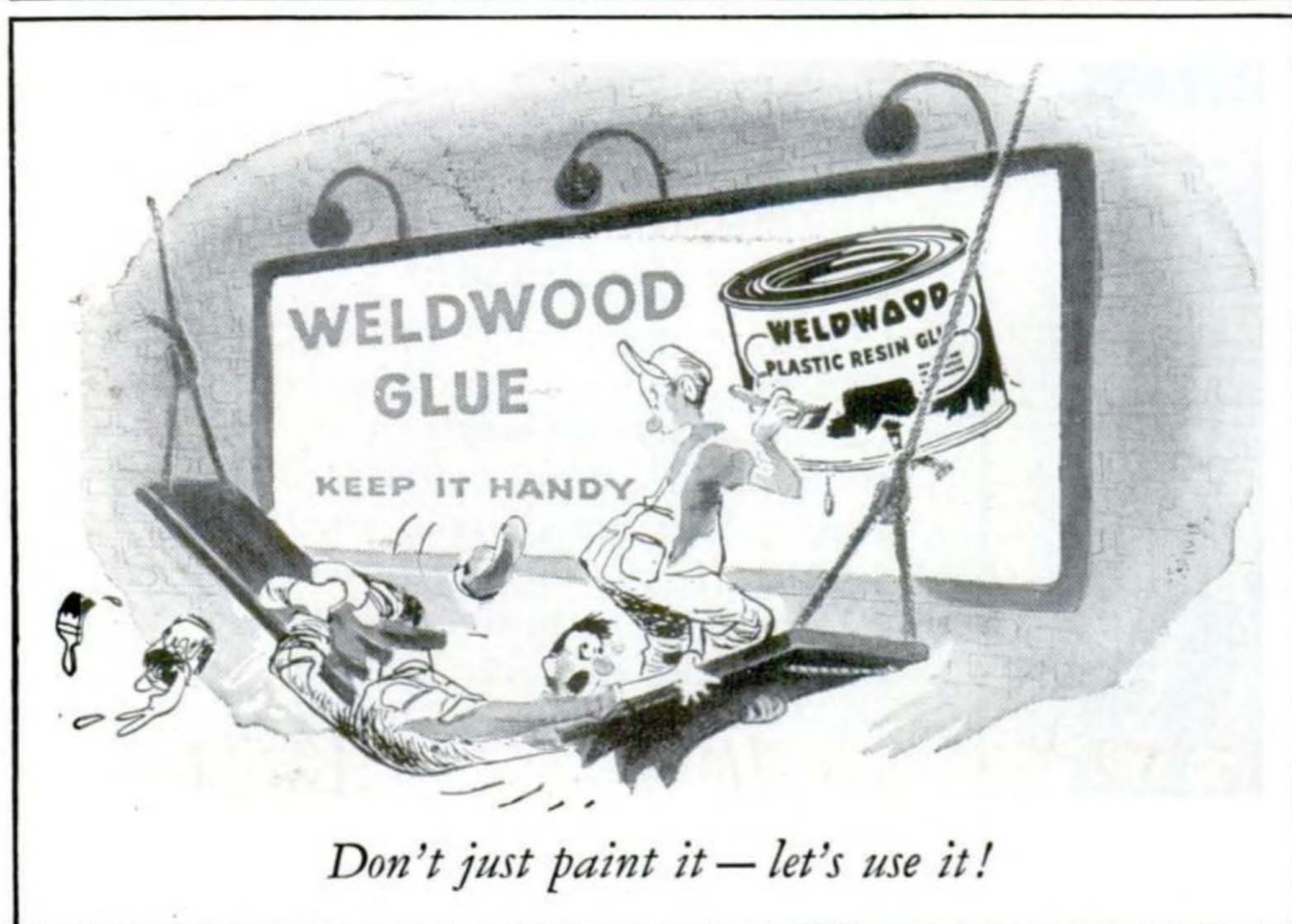
Dozens of other features make the Music Hall the most fantastic showplace on earth. Its three-ton curtain, with 2000 yards of fireproof lining, has nearly a mile of steel cable running through rings sewn in its seams. It can be hauled up and down by three separate motors in a predetermined pattern that is set at the same control board that runs the elevators. When a new curtain was made a year or so ago, it was too big to haul through New York streets and had to be delivered in three sections.

Besides the theater's rain and snow makers, three cloud machines send wispy billows across the stage, and a pipe along the footlights delivers up a steam curtain when desired.

Four projection machines deliver 5000 miles of movie film a year in relays over the 190-foot gap to a monster screen.

To distribute sound evenly in the theater's 1,800,000 cubic feet, the largest mixer in the world carries it from 60 microphones through a series of booster amplifiers and out through 23 loudspeakers distributed through the hall, so that sound reaches top-most seats in the balcony—a city block

(Continued to page 246)



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from the stage— $\frac{1}{6}$  second after the screen image. Presiding over the mixer, in a booth over the third mezzanine, the sound engineer watching the show through binoculars, adjusts the battery of dials that control each whisper.

About the only thing that doesn't need amplifying is the organ. This mammoth, with two consoles that roll out on tracks from either side of the stage, has pipes varying from 32 feet high to the size of a pencil stub. It requires eight separate rooms to house them all. Special deodorant is sprayed through the lofts regularly to keep musty smells from wafting over the customers when it starts blowing its 60 blower fans.

The only time there was really any smell potential in the theater was when the producers moved in a cast of 30 Arabian horses, three jackasses and a camel. All had to be housed in the hall. A special ventilating system was installed over the stage. Paddocks of tanbark were built in the wings for the horses. Dressing rooms became tack rooms. The camel was relegated to the subbasement and sprayed regularly with everything from perfume to kerosene, and the donkeys won the animal room—a ceramic-tiled chamber built especially for four-legged performers—located below the stage level. Nobody in the

audience smelled a thing but pure air. Ordinarily, the theater's own air-conditioning system takes care of odors quite adequately. Some 280,000 cubic feet of fresh air every minute is hauled into the theater by massive subbasement machinery. It drifts evenly over the audience from ceiling apertures, and is sucked out through vents under the chairs.

When the show is all over, and the house darkens, it takes a crew of 100 to clean up the day's debris—which is likely to include everything from chewing gum to diamond bracelets. Anything lost is usually found, however. All trash is sucked through 60 outlets to which cleaners attach vacuum hose. The pull, generated by a pair of 15-horsepower motors downstairs, makes a hiss like a steam engine when all the vents are closed. Everything sucked into the tubes is whipped down to a pair of 10-foot dust tanks in the cellar. Before they're dumped, the dust and dirt is sifted for valuables. One woman, who lost three  $1\frac{1}{2}$ -carat diamonds in the inch-thick pile of the luxurious rugs, got them back next day after the dust had been sifted.

"I knew this place could produce miracles," she announced. "But I still don't know how you do it." Like most Music Hall patrons, she never got a look behind the scenes.



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