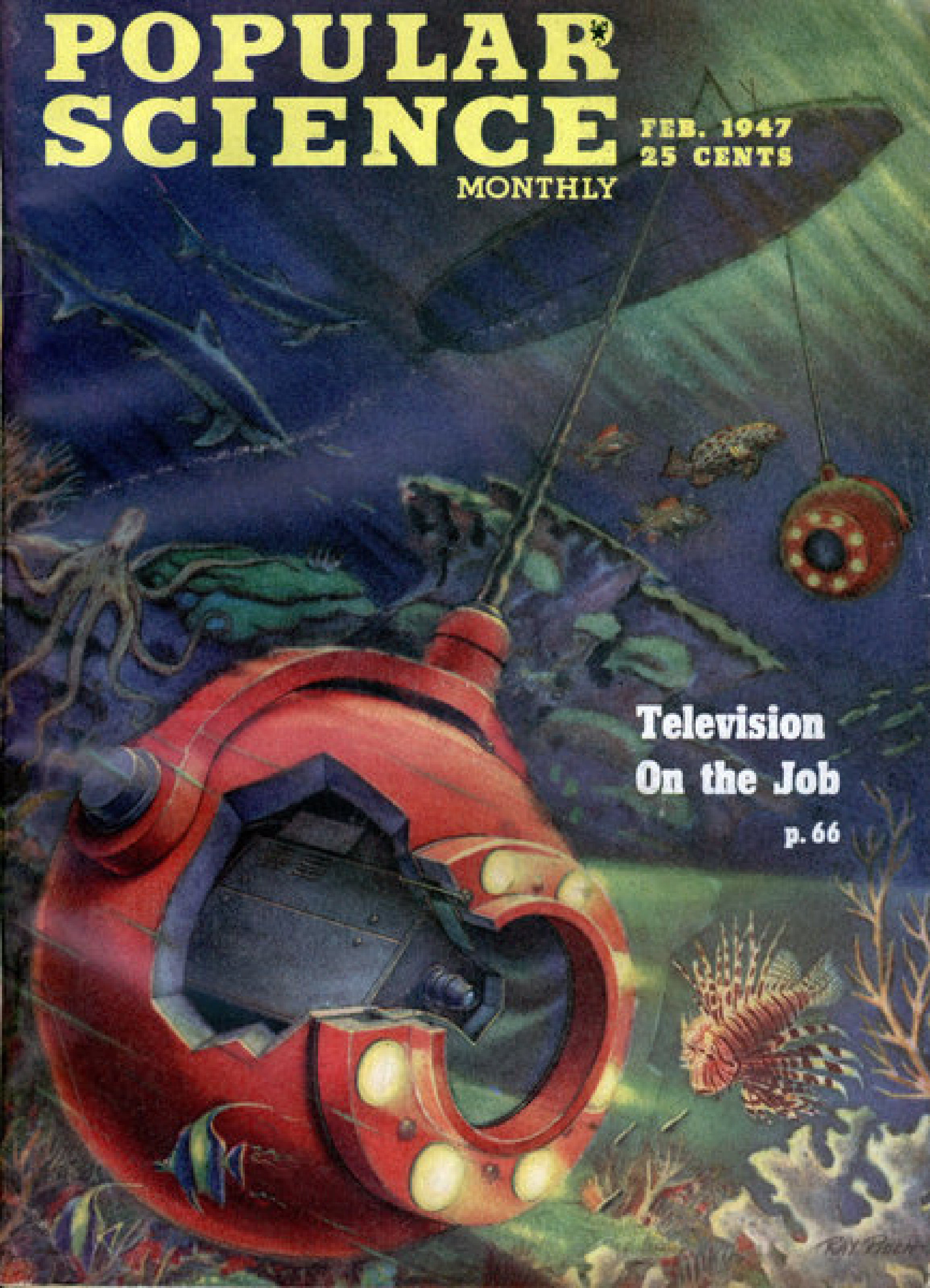
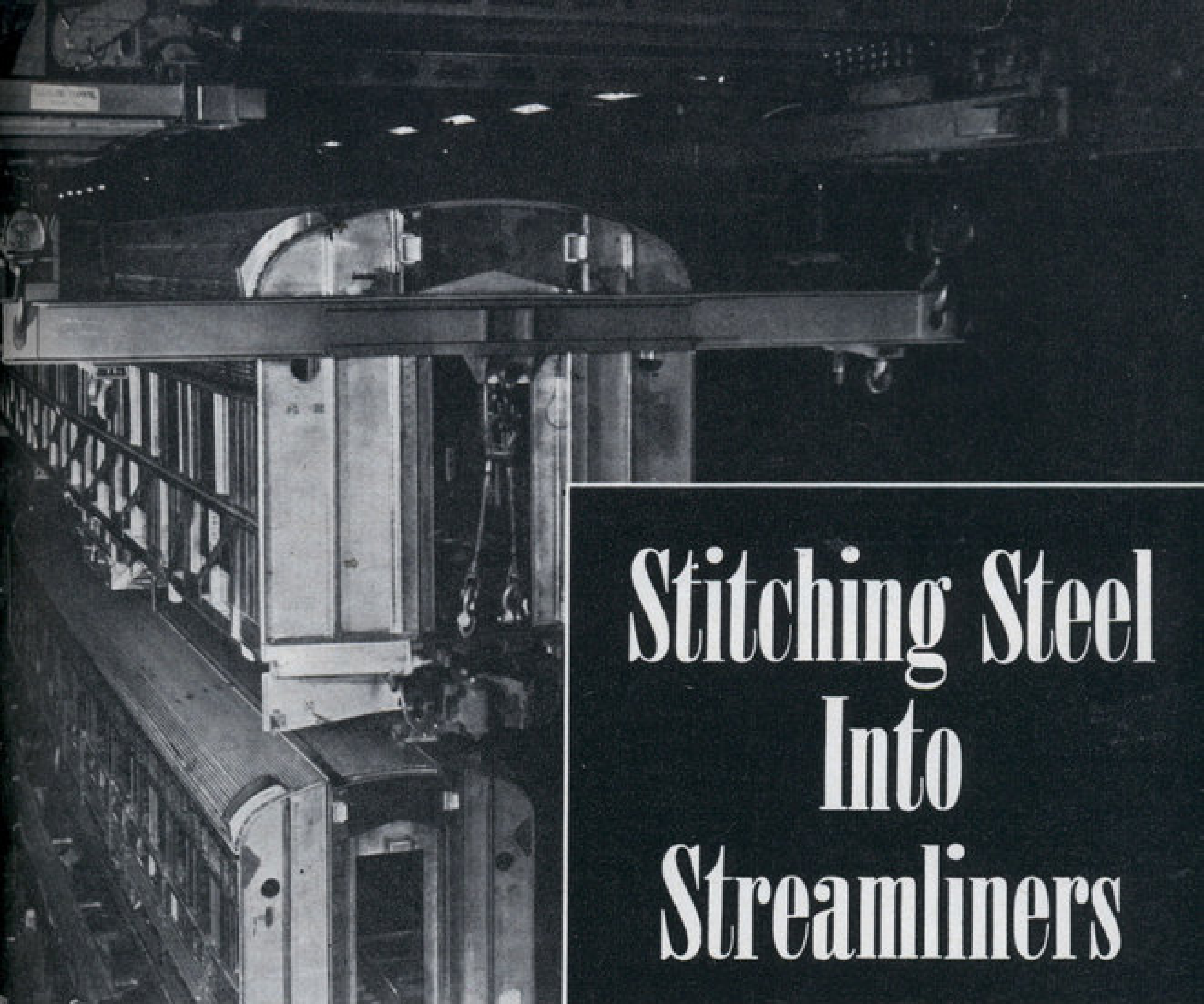
POPULAR SCIENCE MONTHLY

FEB. 1947
25 CENTS



Television On the Job

p. 66



Stitching Steel Into Streamliners

By MORTON C. WALLING

Budd's new assembly line rolls out cars like cans.

AS YOU stand on a catwalk high above the plant you can scarcely see where it ends, dim in the distance, five city blocks away. The workmen dwindle to mere specks, the gigantic U-shaped welders become tiny tweezers. Toward you stretch three long, silver caterpillars: assembly lines. Here and there comes a flicker of blue flame from an arc welder, reflected and reflected again from shining stainless steel. Occasionally there is a rumbling medley of thumps from shot welders; otherwise there is only a low hum from the thousands of workmen and machines.

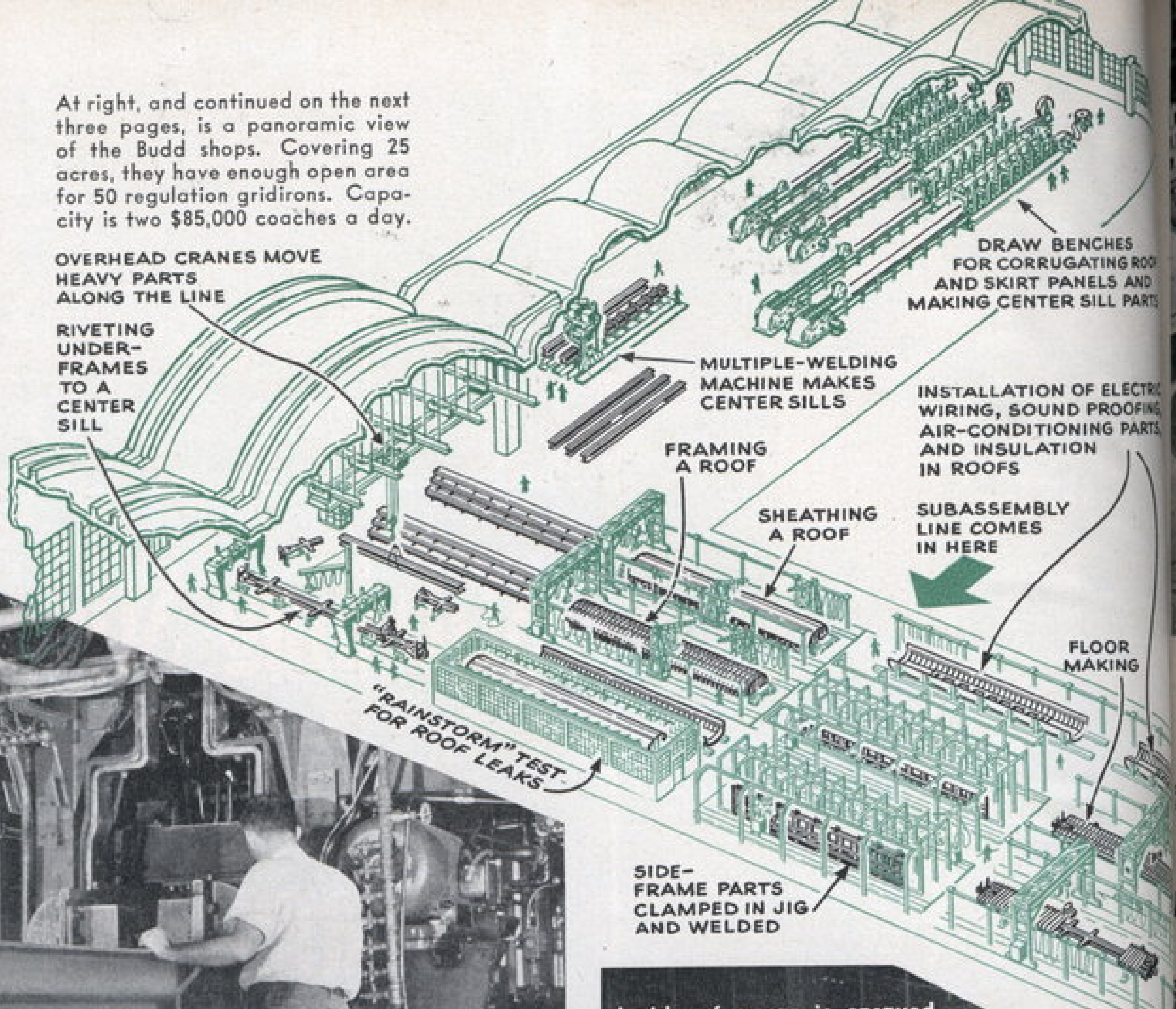
Here is modern technology in action—the assembly-line system the auto industry made famous. But as the great cranes swoop down along the line and the silvery bodies roll nearer and nearer you can see they are too shiny for automobiles—and too big. Each is as long as half a dozen motor cars—a stainless steel railway coach.

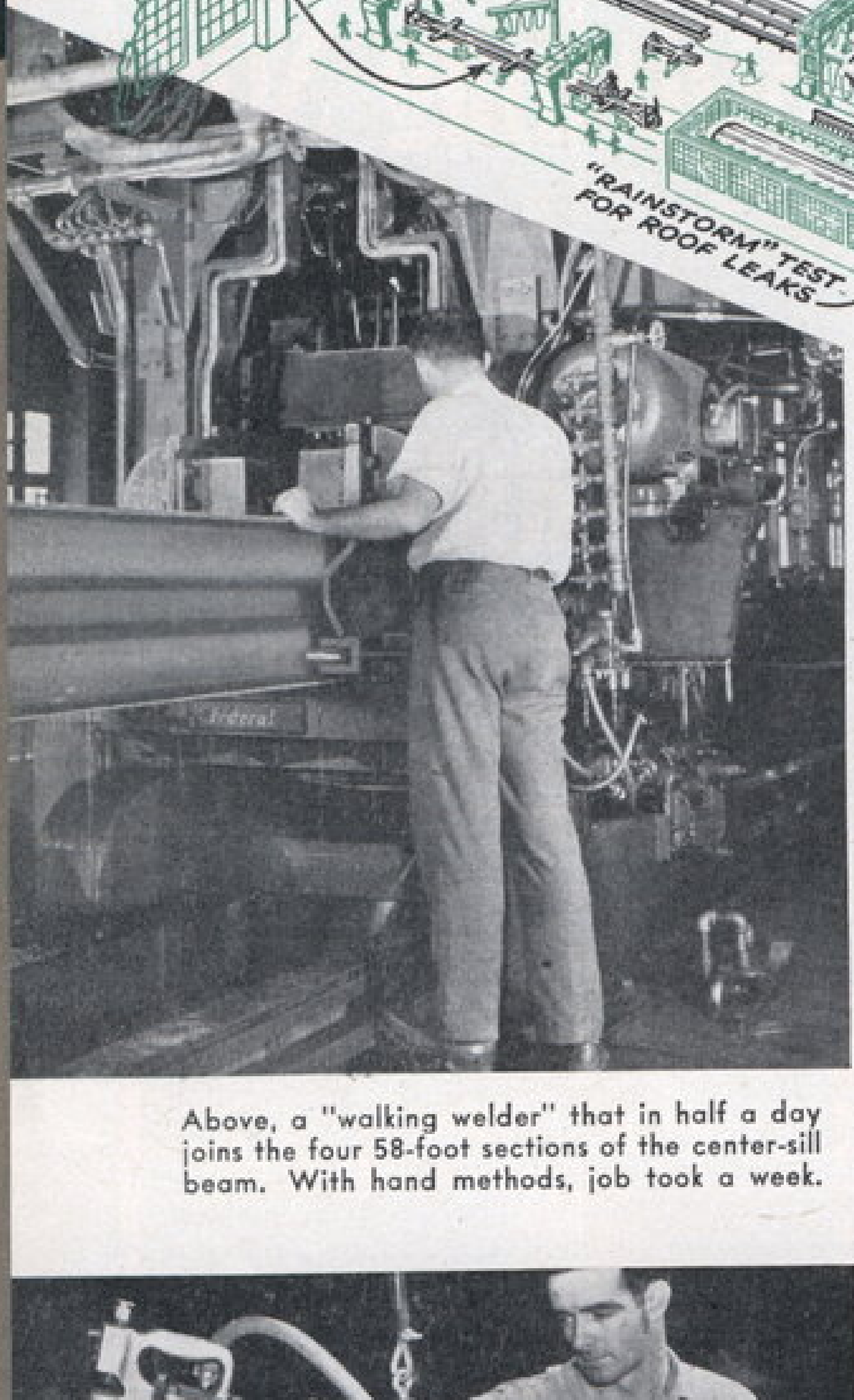
For this is the plant of the Budd Company, where the high-speed step-by-step assembly techniques they have long used in making all-steel auto bodies are applied to railway cars. And the result will be a new standard of comfort in railway travel, at a reasonable cost. By the application of Detroit methods to Philadelphia, what starts out as stacked rolls of stainless steel, varying from 1/10 to 1/4 inch in thickness, emerges a short time later as a finished railroad car, ready to be towed out and put behind a locomotive. In between are some quarter-million shot welds, 200 rivets—and some highly intelligent engineering.

The first stainless steel train, the Chi-

STORY CONTINUED ON PAGE 126, FOLLOWING FOUR PAGES OF PICTURES

At right, and continued on the next three pages, is a panoramic view of the Budd shops. Covering 25 acres, they have enough open area for 50 regulation gridirons. Capacity is two $85,000 coaches a day.



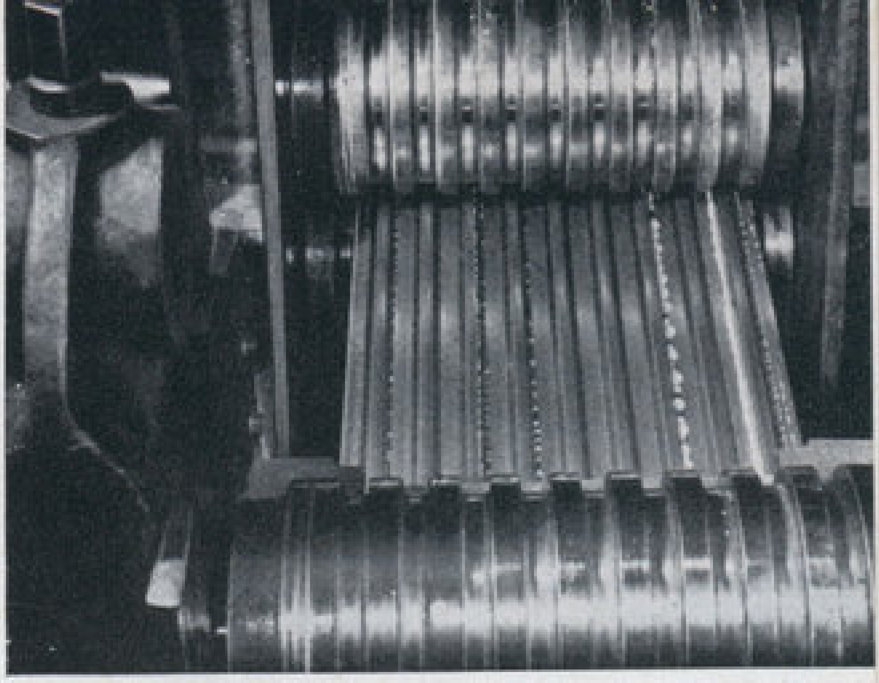


Above, a "walking welder" that in half a day joins the four 58-foot sections of the center-sill beam. With hand methods, job took a week.

Inside of a car is sprayed with insulating material. Fiberglas batts will be added later.

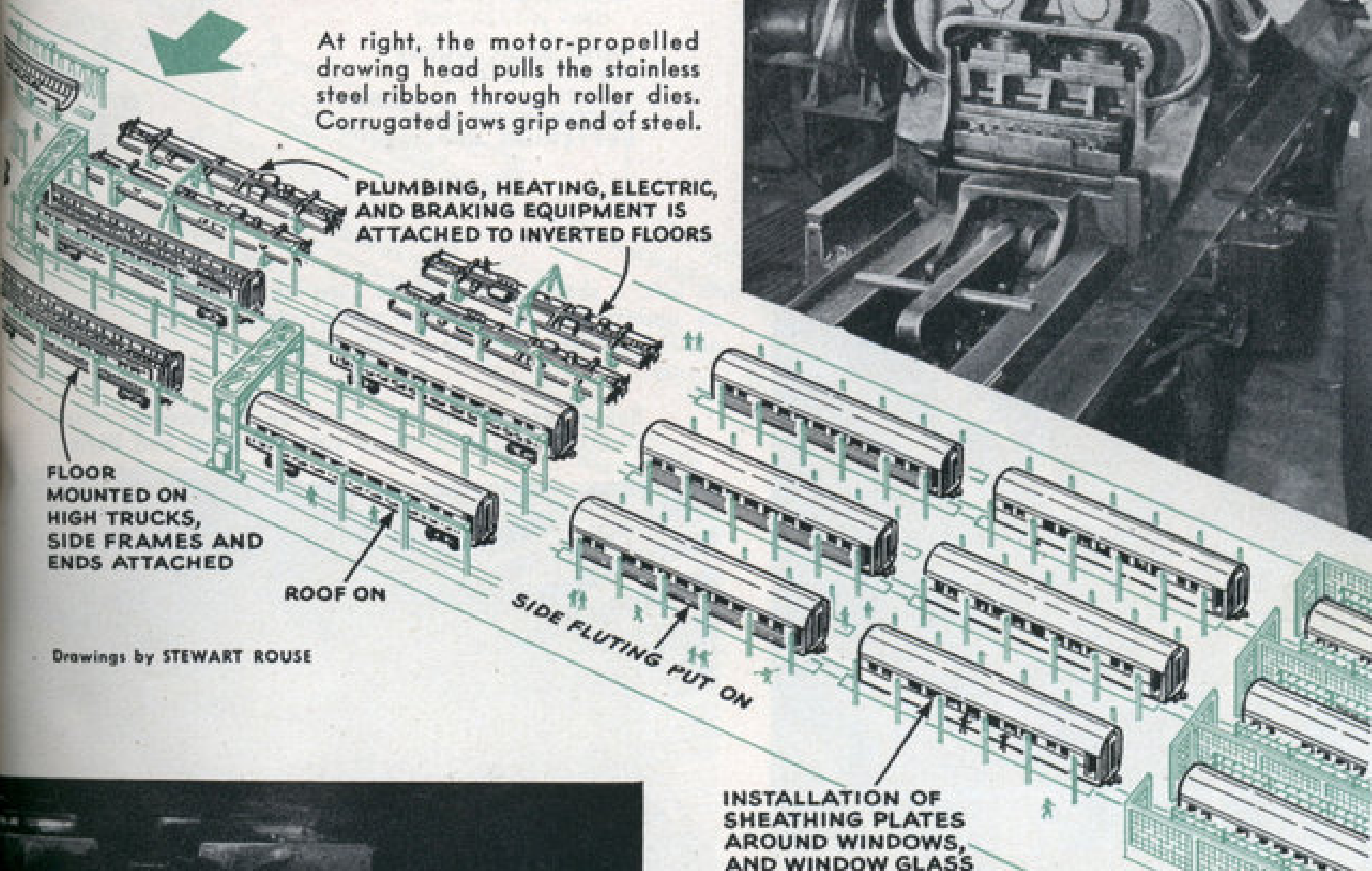
At left, a button is pushed and the shot welder fixes roof panels in place. Roof is assembled right side up, inverted for more installations.

Above, the drawing bench puts wrinkles in stainless steel roof and side panels. A similar bench forms sections that make center sill, or car backbone.

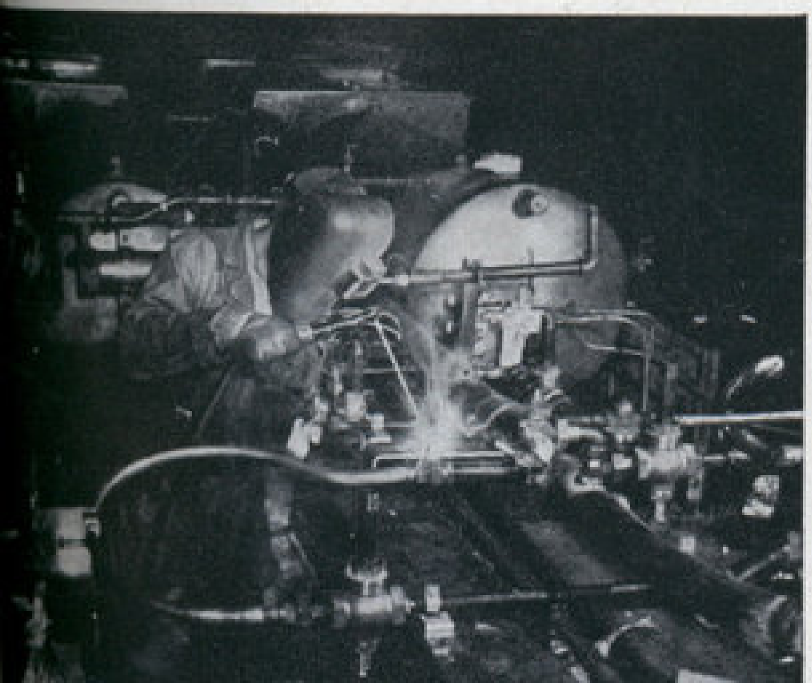


Roller dies above are the super-tough wringers that actually wrinkle the metal. Part of the drawing bench. Each costs as much as $5,000.

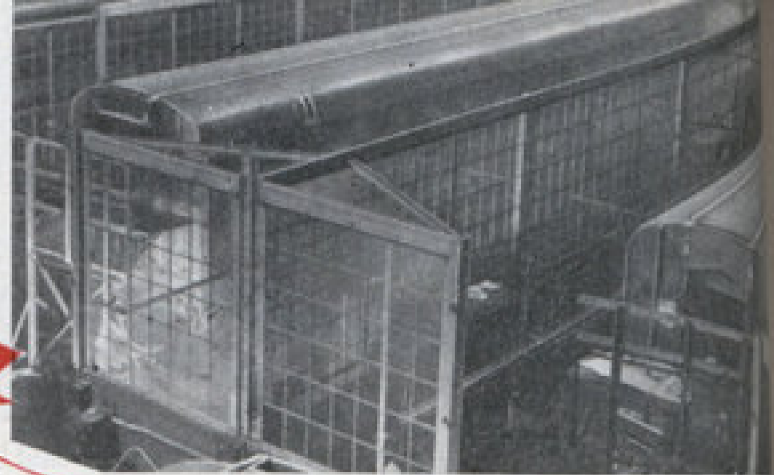
At right, the motor-propelled drawing head pulls the stainless steel ribbon through roller dies. Corrugated jaws grip end of steel.



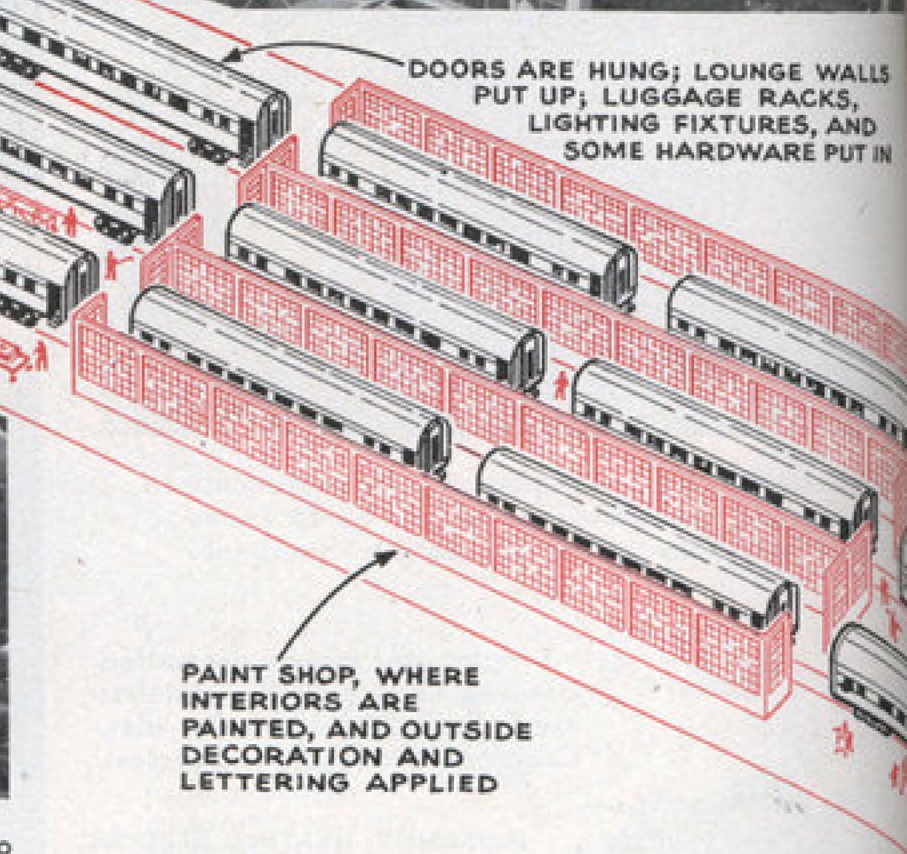
Drawings by STEWART ROUSE

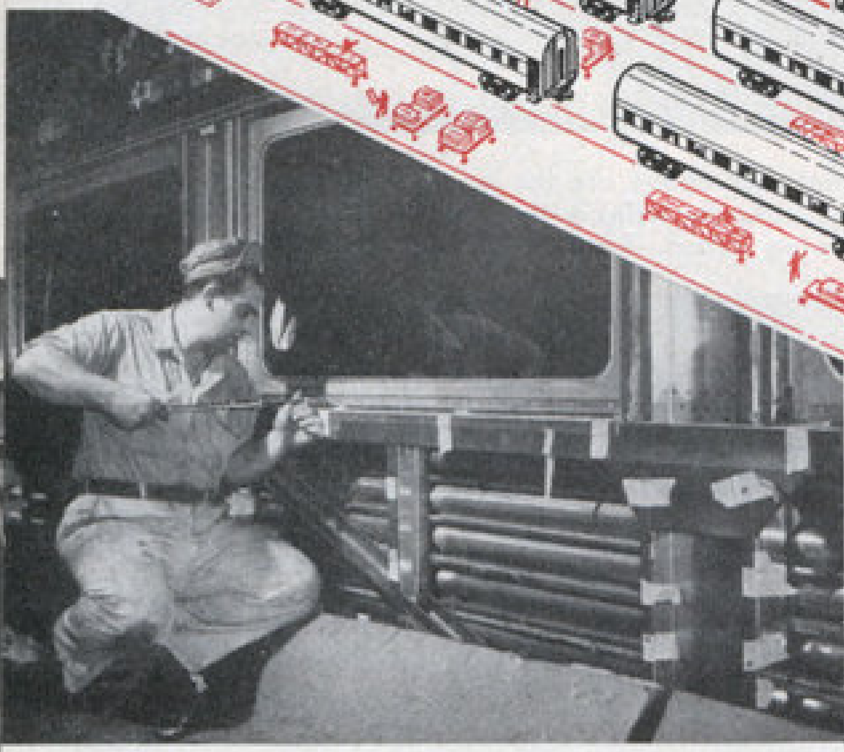


At left, underframe is upside down for installation of auxiliary equipment such as air brakes, heaters, plumbing. Arc welding does the job.



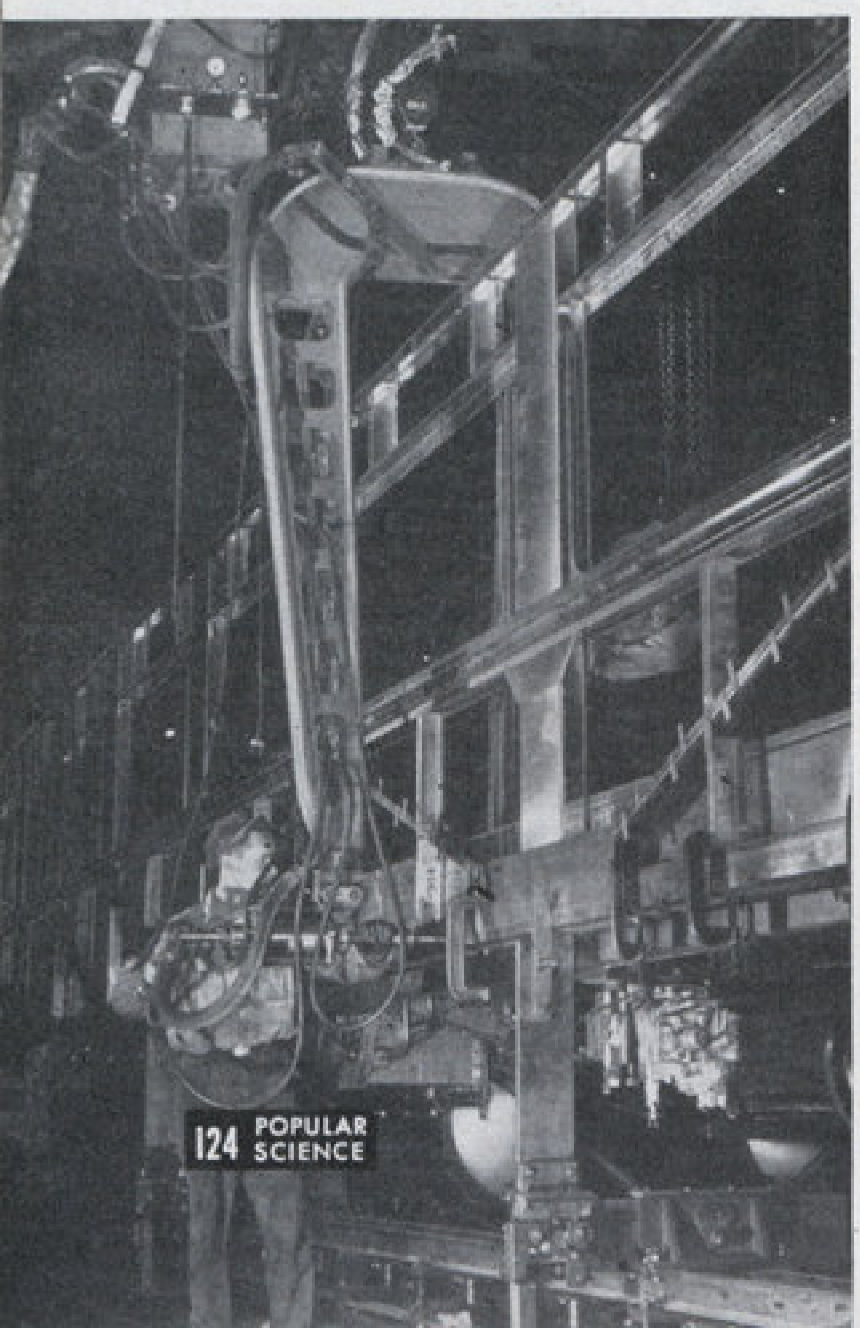
The final water-test chamber, right, reproduces 80-m.p.h. trip in driving rain.



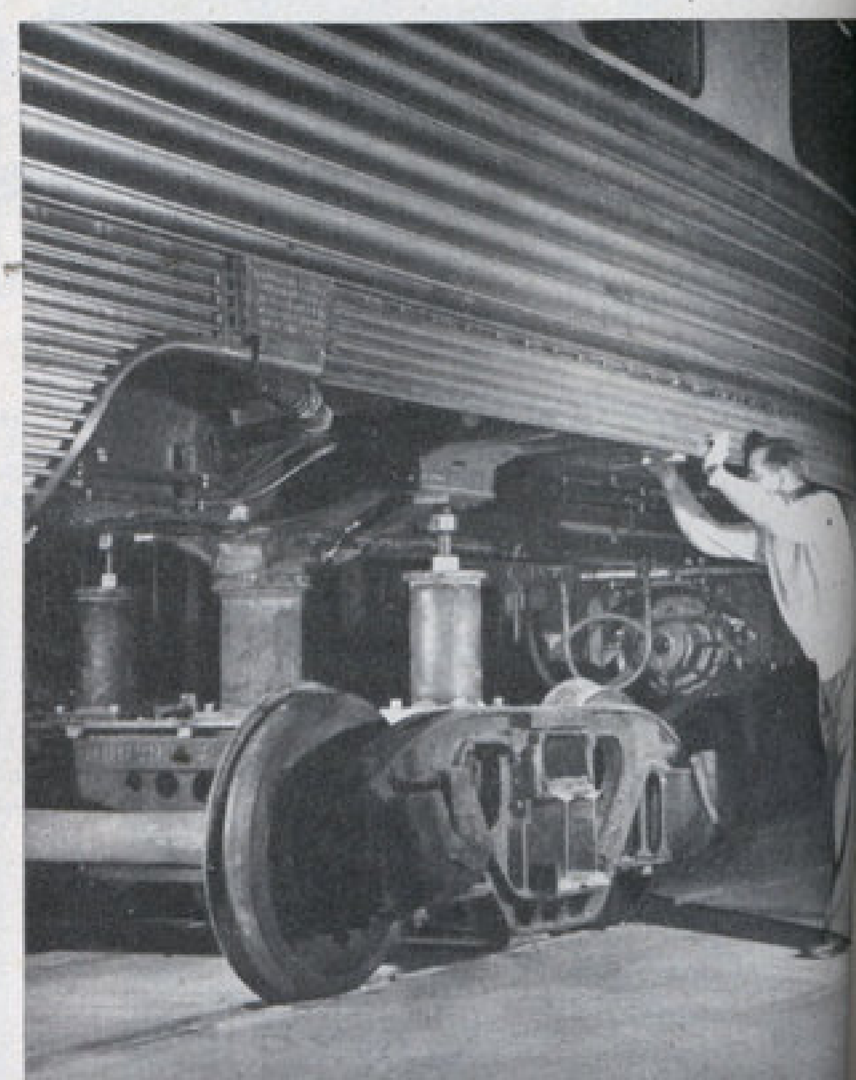


Above, a workman tightens window screws to stop leak discovered during water test.

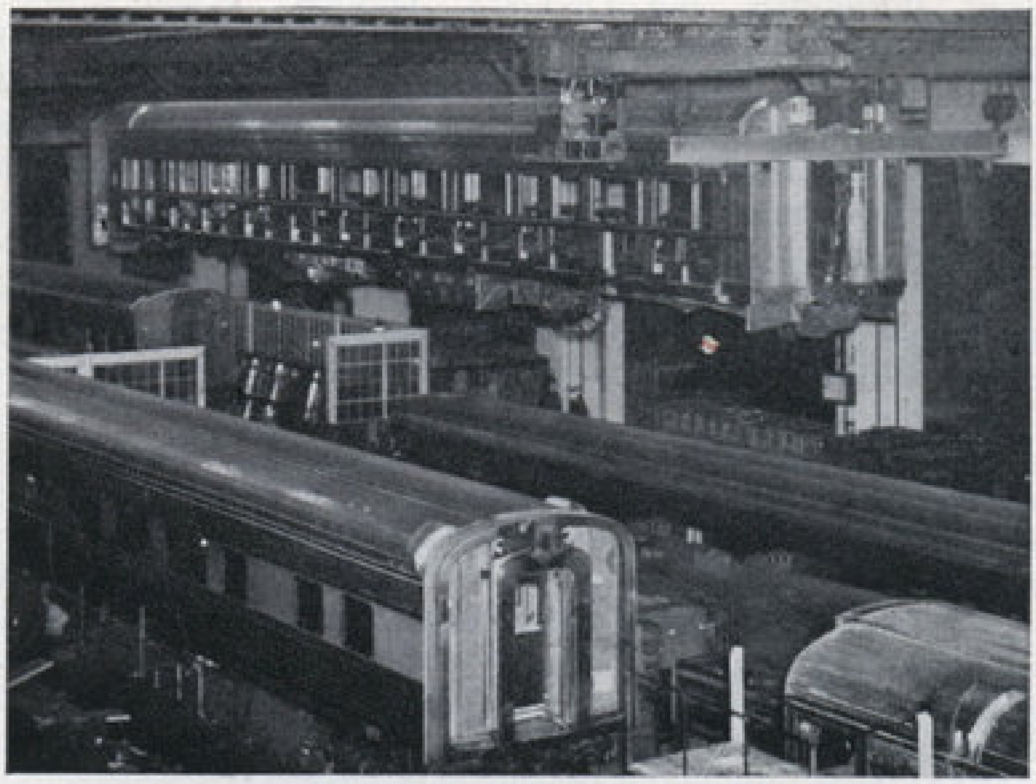
At left, a shot welder joins a side frame to an underframe at the first main assembly position, where skeleton car is formed.



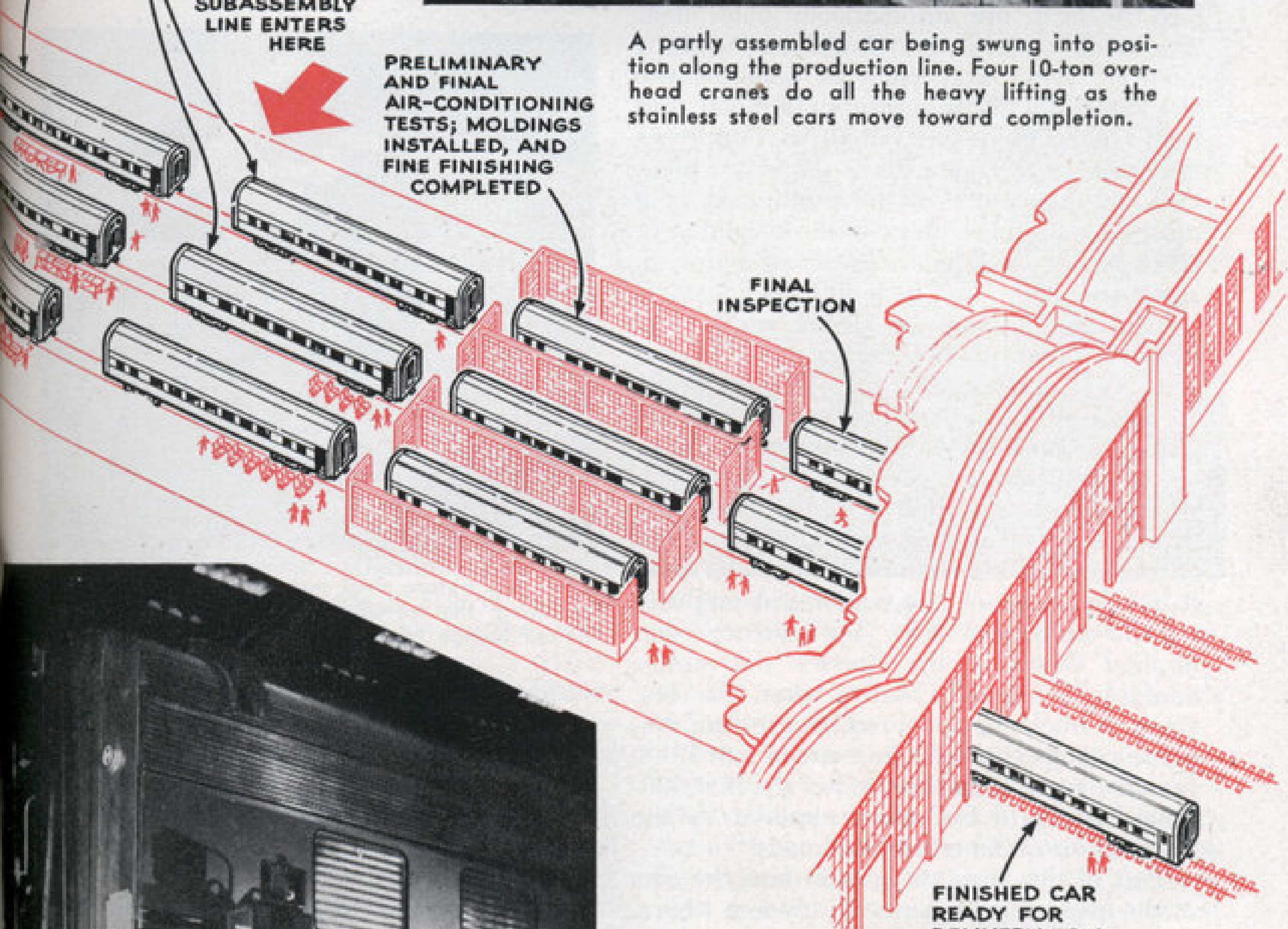
Below, assembled car is set on temporary, raised trucks for application of side paneling and fluting.

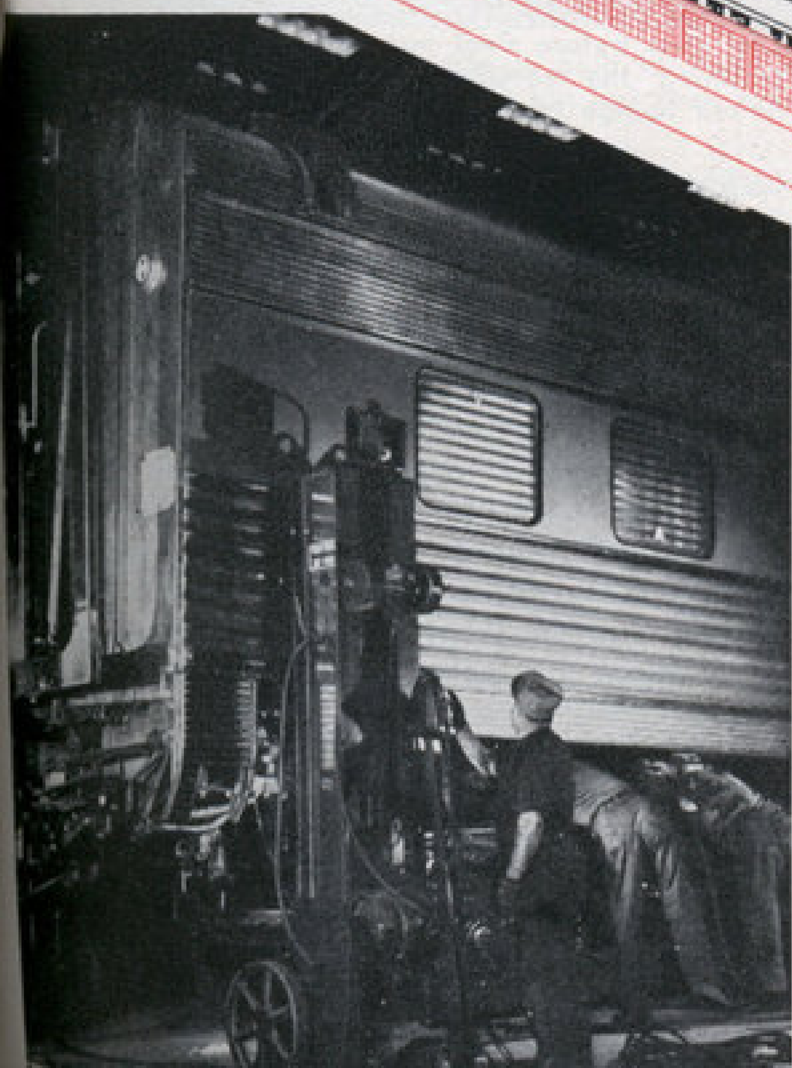


PSM Staff Photos by W. W. MORRIS and ROBERT F. SMITH.



A partly assembled car being swung into position along the production line. Four 10-ton overhead cranes do all the heavy lifting as the stainless steel cars move toward completion.





At left, the permanent trucks are being installed. Heavy-duty jacks are used to raise the cars into the required position for the job.

cago, Burlington, and Quincy's "Pioneer Zephyr," was built by Budd in 1934. Up until the beginning of the war, when all railroad-car production stopped, Budd had built and sold 47 complete trains to 14 railroads. So the firm is an old hand at this big job.

Budd-built railroad cars—except for their trucks, end underframes, and miscellaneous decorations and fittings—are made entirely of welded stainless steel. By a method of electrical stitching, called "shot welding," strips and sheets of stainless steel literally are "sewed" together with rows of uniform spot welds.

Shot welding, a Budd development first used in 1931 to produce the first stainless steel airplane, is a form of electrical-resistance welding. Time and the current, and therefore the heat, are automatically controlled. The result, according to Budd engineers, is a strong weld that changes none of the characteristics of the surrounding metal, and that can be made just about as rapidly as the operator can move his U-shaped welding tool. In the course of the production of a railroad car, more than a dozen different types of shot welders are used, ranging in size from a few feet in length to fifteen.

This combination of strong welds and stainless steel gives Budd cars a heavyweight's strength with a welterweight's body. In a recent test, Budd research engineers placed a standard 118,000-pound stainless steel coach between the jaws of one of the world's most powerful compression-testing machines. The project was to squeeze the car along its main fore-and-aft axis until it buckled in much the way that it might in a head-on wreck. The "big squeeze" was applied slowly so the stresses and strains could be studied. Finally, when the first signs of buckling appeared, the testing machine's gauge showed a pressure of 1,865,000 pounds—more than three times the 500,000-pound standard for safety required by the Association of American Railroads!

Part of this strength is built into the cars at the beginning of the assembly line where, at the No. 1 feeder, the stainless steel for the roof and side panels is corrugated. This work is done by a battery of large draw benches similar to the benches used in drawing wire except that the material is flat instead of round. The ribbon of flat stainless steel is pulled through a series of powerful roller dies until just the right corrugation is obtained to provide maximum stiffness. When a desired length has been drawn, the corrugated sheet is cut off with a toothless Carborundum saw, called a radiac. Except for the cutting operation, the drawing is a continuous process. When one roll of stainless steel is used up, the end of a new roll is welded to it. A novel rolling welder is used for this operation. A metal welding wheel is simply rolled across the joint and the weld is made.

The center sill or main under backbone of the car consists of four ¼-inch formed sections of stainless steel. After being drawn to shape, the sections are moved to an assembly jig where, once they are clamped firmly in place, a motor-driven "walking welder" resembling an animated drill press moves along the assembly and automatically makes the more than 3,000 individual shot welds that bond the section into a strong 58-foot-long beam.

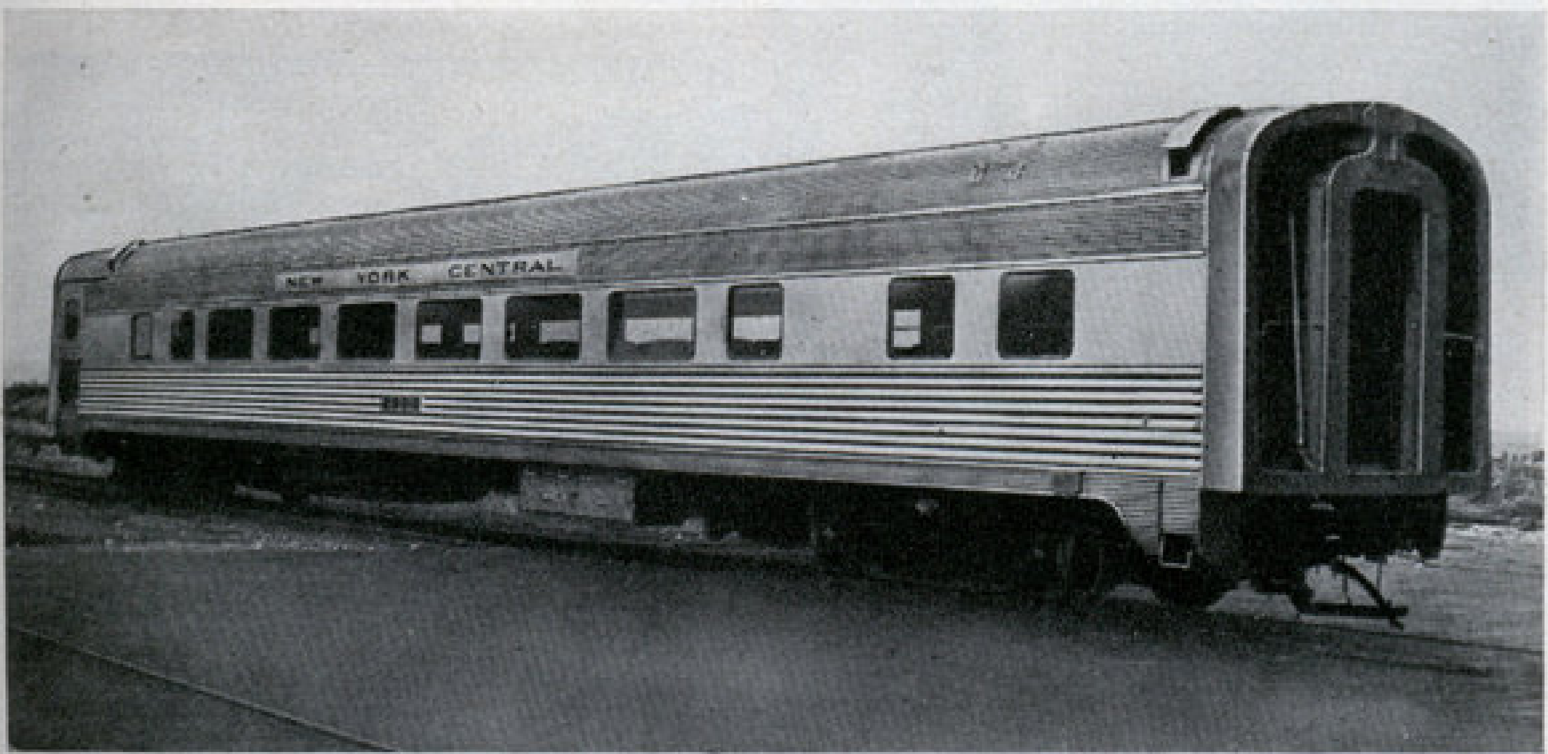
Last step before final inspection is cleaning and polishing the completed car. Note the easily turned lounge seats in this coach.

Once the roof and side panels and the center sill are ready, the main assembly job begins. The center sill is placed in still another jig where a "silent riveter"—a king-size pair of hydraulically operated jaws—squeezes rivets into place easily and noiselessly with its 50-ton pressure to fasten the end underframes to the ends of the center sill. This complete underframe unit is then moved by overhead crane down the line where floor beams and floor are welded into place.

While this operation is in progress, complete car roofs are being fabricated, water-tested for leaks, insulated, soundproofed, and fitted with wiring and air-conditioning ducts. To make it easier for the workmen and to speed the operation, all work done on the inside of the roof is done with the roof upside-down. This is also true of the installation of air brakes, plumbing, heaters, generators, and other equipment on the underside of the floor and underframe assembly. When a roof or a floor is complete with auxiliaries, four 10-ton cranes maneuver into position 100 feet overhead pick up the member as if it were a toy, turn it over in mid-air, and deliver it right-side-up to the first main assembly position. There, roof, side frames, ends, and underframe meet and are shot-welded together to become a skeleton car. Mounted on temporary trucks, which are elevated to make under-the-car work easier, the car then begins its step-by-step progress down one of three pairs of railroad tracks that form the final assembly lines.

From that point on progress is rapid. The cars literally grow as they are moved from position to position along the tracks by portable electric winches, and different teams of expert craftsmen go to work. Stainless steel fluting and side paneling are added. Doors and windows are installed. They enter a special water-test chamber where for two hours they are sprayed with water at 45-lb.-per-sq.-in. pressure to simulate the conditions of a car speeding through a driving rain at 80 m.p.h. Interiors are installed and painted. Linoleum floors are put in place. Permanent trucks are jockeyed into position and mounted with the help of hydraulic jacks that can lift the end of a car with less effort than you can lift the front of your automobile with a bumper jack. If the car is a coach, seats are installed. Then, entering another test chamber farther down the line, the car's air-conditioning system is given a thorough two-hour check to make sure that everything is functioning properly.

Finally, the car is cleaned, preened, polished, and inspected. The next stop is a spur track just beyond the large sliding doors that mark the end of the "line" where a waiting switch engine takes it to the main line for delivery to one of the 16 national railroads who have coaches, sleeping cars, and double-deck observation cars on order for the comfort and pleasure of America's railway travelers.



A finished 52-passenger coach, built by Budd for the New York Central. Coach has just been towed off the end of the assembly line and is on spur track outside the plant. Note large picture windows.

From a hundred feet up in the building's roof, the plant resembles a giant's bakery—with railroad cars for loaves. It has a giant's capacity too. Fifty-one 85-foot cars can be in progressive stages of assembly in the three lines at once. Soon a fourth will be added to produce a double-deck observation car. car. Today, full production is almost entirely a matter of getting in materials and getting up to speed. When it is reached, stainless steel in rolls stacked at one end of the plant in the morning will find itself eight hours later, wrinkled, welded, and part of a smart new 56-passenger streamlined coach or an ultramodern all-bedroom sleeping car, well on its way down the assembly line. END