Modeling the Santa Fe's

STEAM EJECTOR AIR

A traveling environment free from temperature extremes and noxous vapors is taken for granted aboard today's streamliners but 50 years ago it was quite another story.

According to John H. White in his excellent book, *The American Railroad Passenger Car*, many forms of so-called air conditioning methods were tried starting as far back as 1855. These schemes were variants on using ice for cooling and letting the motion of the car move the "cooled" air through the car. Various fans and blowers evolved and the Santa Fe equipped as many as 33 diners with ice activated systems and electric fans. Ice, however, was simply not the answer as it could take 4,500 pounds of ice — per car— to travel 360 miles! Mechanical air conditioning, as such, began to develop in the late 1920's with one man named Willis Carrier and the Santa Fe Railway in the lead.

In 1929 Carrier installed an ammonia refrigeration compressor system aboard a dining car belonging to the Baltimore and Ohio (*Martha Washington*). The system was so successful that by the end of 1930 the B&O had equipped enough cars to make the *Columbian* the first completely air conditioned train in the United States.

A few months later, the Santa Fe installed a similar system on diner 1418 and, while a success, the Santa Fe ordered no further cars with Carrier's mechanical system but instead jumped whole-hog into a steam ejector system developed by Carrier and manufactured by the Safety Car Heating and Lighting Company and the Vapor Heating Corporation. By 1932, the Santa Fe had ten diners working with the steam system.

The Santa Fe's transcontinental route undergoes significant extremes in altitude from Chicago to Los Angeles. Consider that the temperature at Dearborn station on a given day may be 70 degrees, but by the time the train stops at Flagstaff it may be below freezing; further west in the desert at Barstow, it may be over 100 and upon arriving at Los Angeles the temperature may be back to 70.

These extremes, coupled with the availability of good steam producing locomotives convinced Santa Fe mechanical officials to select steam ejector air conditioning exclusively on the heavyweight cars (and until the late 1940's on most of the lightweights) of the passenger fleet.

Critics of the system said it was a "steam hog," but at the end of 1936, the Santa Fe had converted a total of 187 passenger cars to steam ejector air conditioning. By the beginning of 1939, this total was up to 306 and all but one car (diner 1418) was equipped with the steam ejector system.

A complete description of how you get *cold* air out of *hot* steam is beyond the scope of this article but if you are really interested, check out the fascinating treatise found in White's book, the 1931, 1937 and 1940 issues of the *Car Builders Cyclopedia* and the new *Pullman Plan Book* on the Santa Fe from RPC Publications. I have included a diagram (Figure 1) that shows how the system works to get an idea of the components.

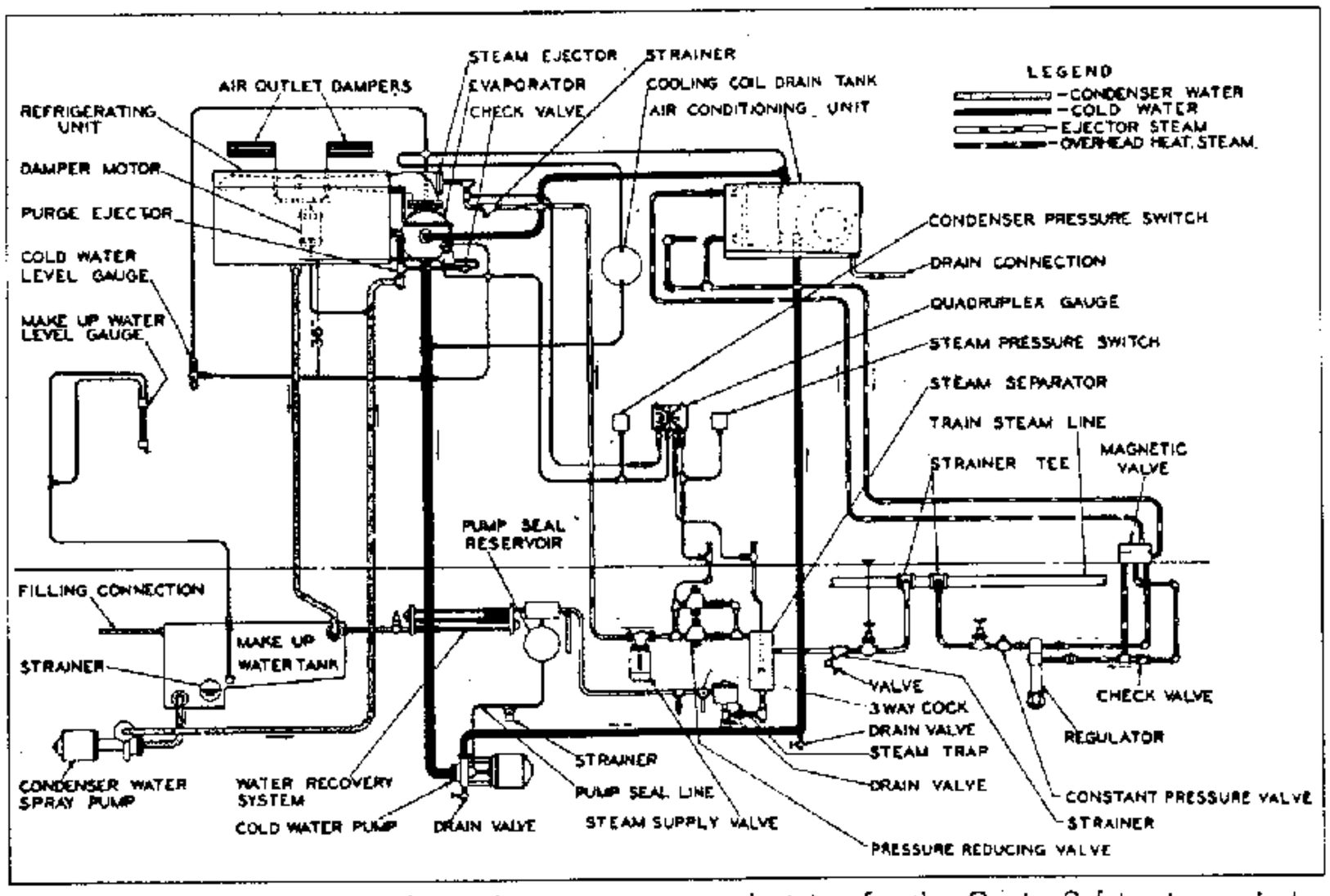
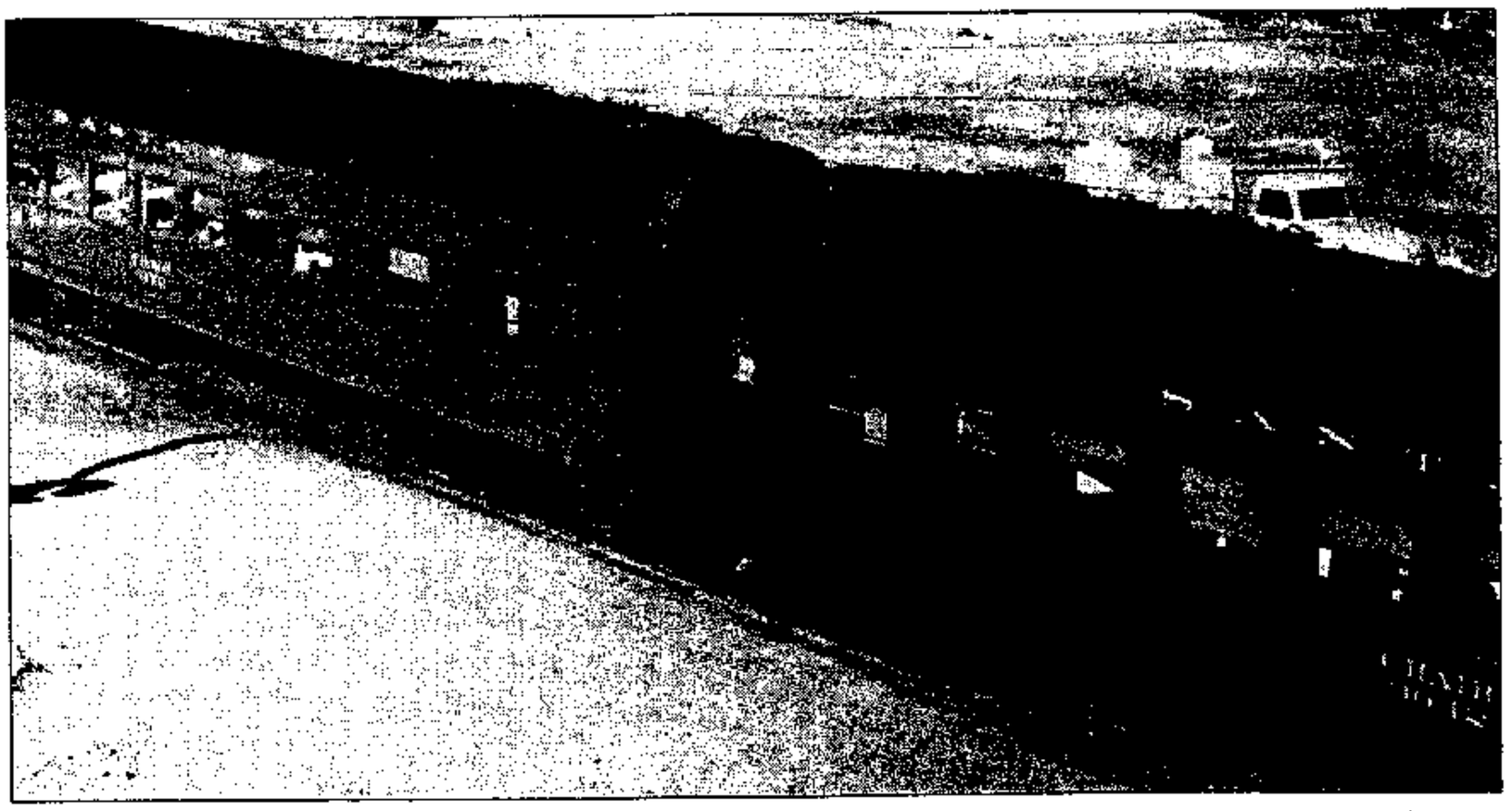


Figure 1. This line drawing shows the components and piping for the Carrier-Safety steam ejector system. The line running through the drawing near the bottom indicates which parts are under the car.
Reproduced from the 1940 *Car Builders Cyclopedia*.



Close cropping of a 1958 shot of the *Grand Canyon* at Trinidad, Colorado showing rich roof hatch detail on these chair cars. Note that the air duct, for some reason, is on the opposite side on chair car 1170. This may be a class difference between it and the 3000 series at the right.
Photo by R.S. Plummer from Bassett Collection.

CONDITIONING

BY JAY H. MILLER

Beyond that, lets accept the fact that hot water is made to boil at a low temperature in a vacuum and it worked. Further, by opening and closing some valves, the system was easy to switch to heat the cars as well. That flexibility (remember, you can be freezing in Flagtaff in June) was put to the test on the Santa Fe.

From a modelers point of view, the Santa Fe's decision makes a big difference. Many modelers are now building layouts with minimum track elevations in excess of 50 inches from the floor. This is great for operation and a multitude of other reasons but it makes the roofs of the cars— especially passenger cars— very noticeable. And with steam ejector air conditioning what you notice most is the wealth of roof detail on the heavyweight cars.

When I built my *Scout* passenger train, I used Walthers kits for the lounges, dining and chair cars. As you may know, the Walthers roofs are made of ABS plastic and totally devoid of any detail whatsoever. Modern brass car models, B.C.Y. (before Coach Yard), really did not put much detail in their roofs either.

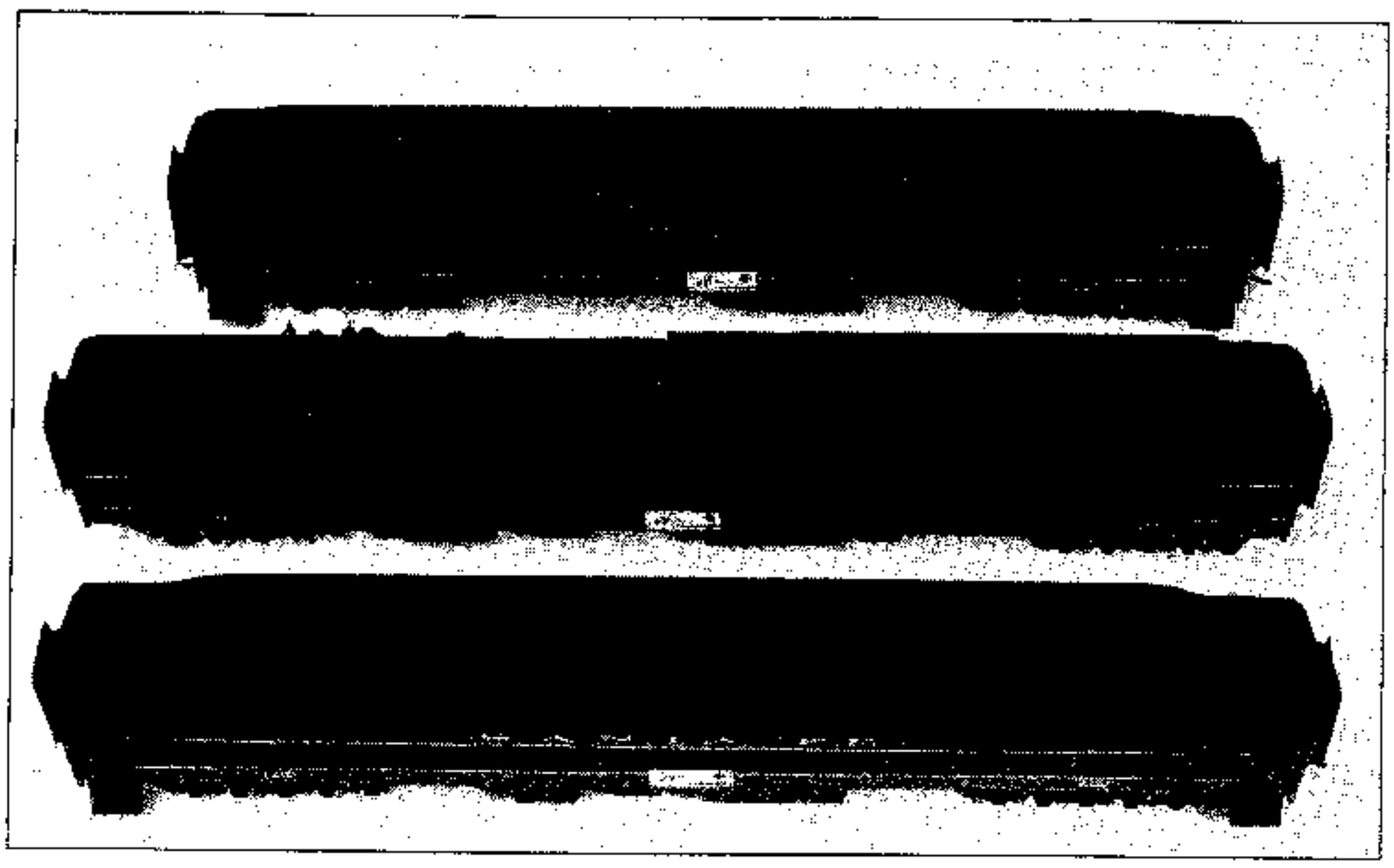
My research on the *Scout* cars (and other Santa Fe heavyweights) indicates that the air conditioning details were present on virtually all name-train revenue cars by the end of the 1930's.

I gathered every picture I could find of the roof hatches and underbody detail from photo collections and books and began a systematic review of the air conditioning system. Further, I examined, measured and photographed two Santa Fe heavyweight cars in a museum collection. Since I had quite a few cars to model, I made patterns of the roof hatches and underbody details and made RTV moulds to make polyester resin castings from them. What I did, and how I did it could make for a great improvement in your passenger car fleet— unless you can afford it all in brass!

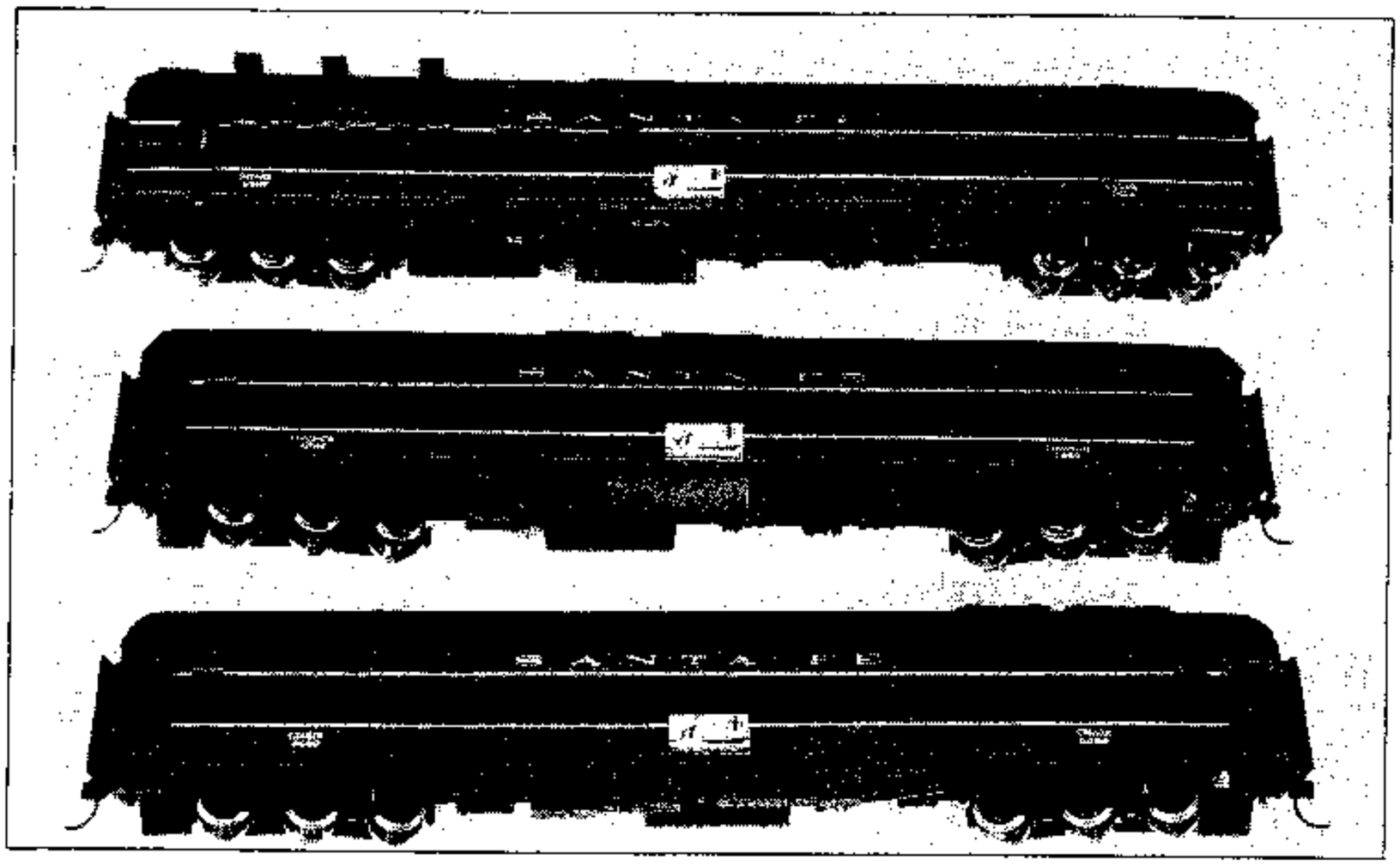
The steam ejector system was used on all Santa Fe owned cars and on most Pullman owned cars operating over the Santa Fe. The Pullman Company developed its own type of mechanical air conditioning system in 1935, but cars so equipped were a rare sight on the Santa Fe. Pullman cars in Santa Fe service that did not have steam ejector systems were usually limited to tourist sleepers in pool service found on trains like the *Grand Canyon*. That is a big point when you are modeling the *Scout* because these Pullman tourist cars were in dedicated service and therefore had steam ejector systems.

There are five integral detail parts that make up "modelable" system: the air conditioning unit (roof hatch), the refrigeration unit (roof hatch), fresh air intakes, the "conditioned air" duct and the make-up water tank / valve closet under floor assembly.

The accompanying photographs were made of two Santa Fe cars in the collection of the Southwest Railway Historical Society at Fair Park in Dallas. The cars were acquired in the 1960's and, at one time, the SRHS folks had the system working but age and lack of spare parts ended that convenience.

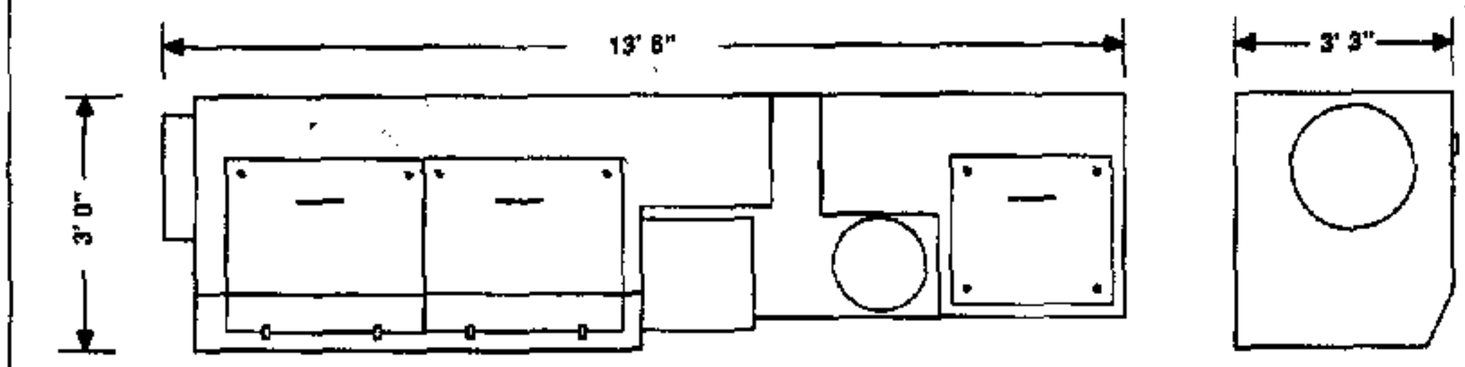


These Walthers passenger car kits (t. to b. lounge, diner, chair) have been fitted with polyester resin castings as described in the text. Note how the roof texture is enhanced by masking tape strips.

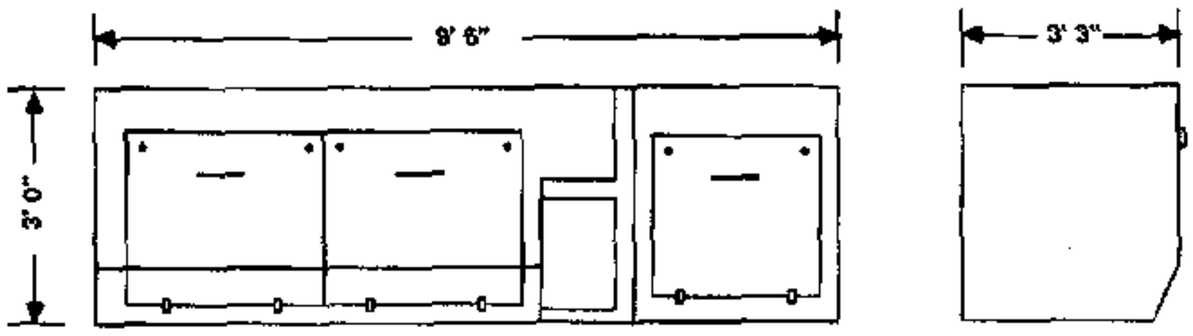


Side view of cars showing the new underbody details (t. to b. diner, lounge, chair). Battery boxes are stock Walthers parts and brake details are Cal-Scale. Placement of details is greatly aided by prototype photos.

All photos by the author unless noted.



UNDERFRAME UNIT VALVE CLOSET AND MAKE-UP WATER TANK FOUND MOSTLY ON DINERS, LOUNGES AND TOURIST PULLMANS



UNDERFRAME UNIT VALVE CLOSET AND MAKE-UP WATER TANK FOUND MOSTLY ON CHAIR CARS

Figure 2. These drawings can be used to make your own patterns for the underbody details.

The two huge roof units were mounted in the clerestory portion of the cars and all you can really see of the equipment are the two roof hatches and various vents and such. On some cars, notably lounges and diners, one hatch (usually the refrigeration unit) will be at the end of the car and the other will be at the center. This may have had something to do with other mechanical equipment that took up too much space at the end of the car or for better air flow in passenger areas. Check out specific photographs if this is an issue on cars you are modeling. I have seen some chair cars with this arrangement as well, but not often.

The underbody details are really home-brew. About all there is to model is a "valve closet" containing several large valves and a make-up water tank. This component is almost always on the side of the car with the roof duct, running the length of the passenger compartment. I counted several vartations of these valve closets in photographs and, upon inspection at Fair Park, found them to be basically the same inside, but with different outside appearances depending on their placement underneath the car.

The roof hatch patterns were made from .010 styrene. I had a friend use his rivet machine to emboss a row of rivets around the edges and scored the centerline to make a slight bend. I then filled up the ends with putty to make them solid. The details were added with pieces of styrene strip and nut and bolt castings. I drilled pilot holes for the grab irons. I did not attempt to make the hold down clamp gizmos as they would probably not survive in an operating environment. Note how well, however, Coach Yard did in brass with their fine models.

The valve closets/make up water tank patterns were built out of styrene and nut and bolt castings as well. I made two varieties— one for diners and lounges and one for chair cars based on what I saw at Fair Park and in photographs. While I was at it, I made a water tank to replace the unremarkable one furnished in the Wathers kits.

My pattern was then moulded in RTV rubber from Castolite products (see their classified ad each month in *Model Railroader*) and the parts were made from their polyester resins.

I made the intakes by filing down some Wathers box vent castings (part number 941-950) and round styrene rod.

With one pour, I could make all the parts for one car except the air intakes. If I did it again, I would make patterns for them as well as the RTV casting process (thanks to many experiments by noted modelers like Lloyd Keyser, Richard Hendrickson, Frank Peacock and Eric Bronsky) really yields excellent results.

After the parts have set and been removed from the mould, I let them cure for a day or so before handling. Holes for the grab irons can then be drilled and grab irons fashioned from .015 brass wire. Apply them with ACC.

The Wathers roofs are rounded and our hatch castings have flat bottoms. To solve this incompatability, I set up my Unimat as a vertical mill and, using a 1/4" carbide end mill, milled out the area where the casting was to fit. This process

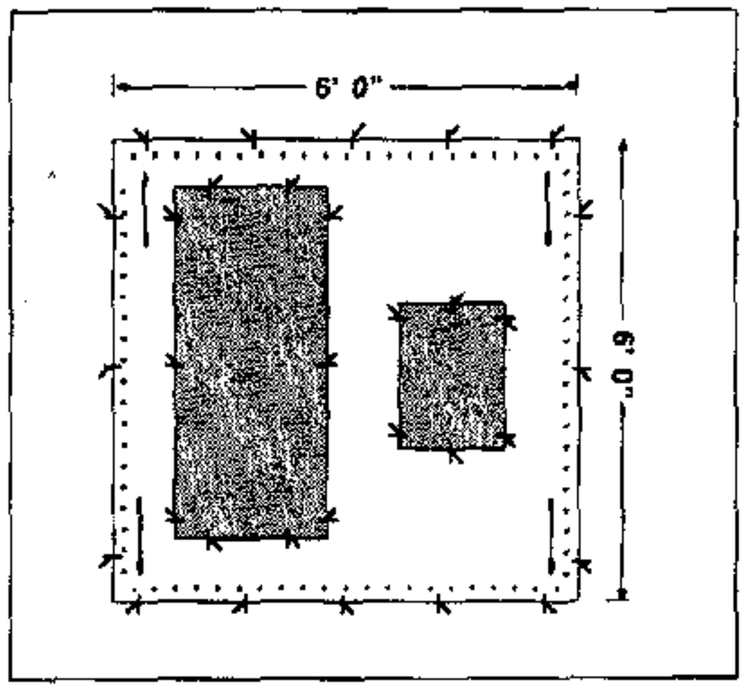


Figure 3. Roof hatch drawing for Type ACF air conditioning unit.

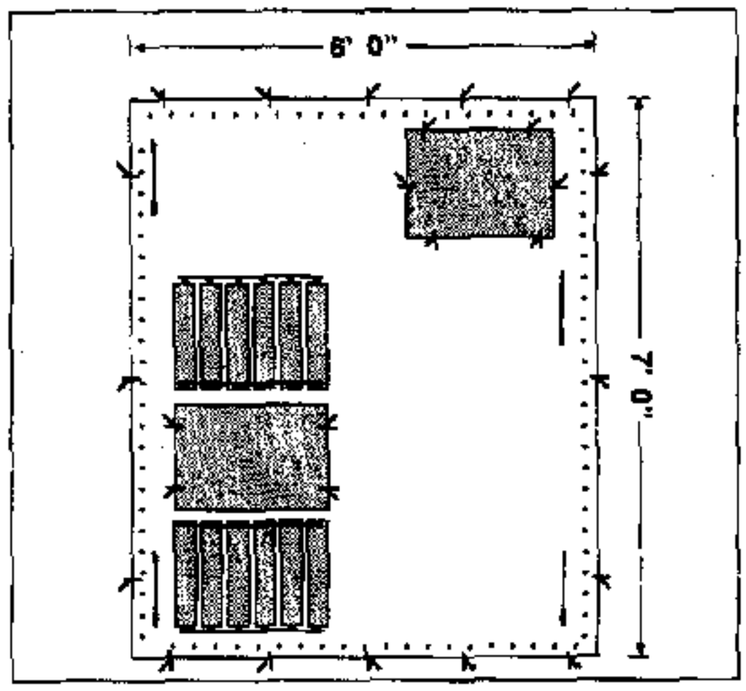


Figure 4. Roof hatch drawing for Type RA refrigeration unit.

works very well but you should first practice on a scrap roof (the roofs are available separately from Walthers through your hobby shop).

I then added the conditioned air duct (Wathers part number 944-436) according to the photographs and sanded the assembly smooth. Chair cars almost always had one duct. Other types of cars have one duct on each side but check photos to be sure.

The roof still looked too plain so I applied 3/4" wide masking tape to simulate the slight ribbed effect. This also created some very credible texture when the whole roof was sprayed with Floquil grimy black. Roof grabs and hand rails complete the detail job.

Now that the importers are bringing out super-detailed brass models almost monthly, I'm not sure just how valuable these techniques will be. However, for the Walthers kits– when you can find them at flea markets or dig them out of your closet– these ideas can make a very convincing model for a fraction of the price.

Keep cool!

Many thanks go to John H. White of the Smithsonian Institution, Mike Flick, Charlie Slater, L. O. King, Jr., the members of the SRHS in Dallas, Gordon Bassett and George Traylor for information and advice.

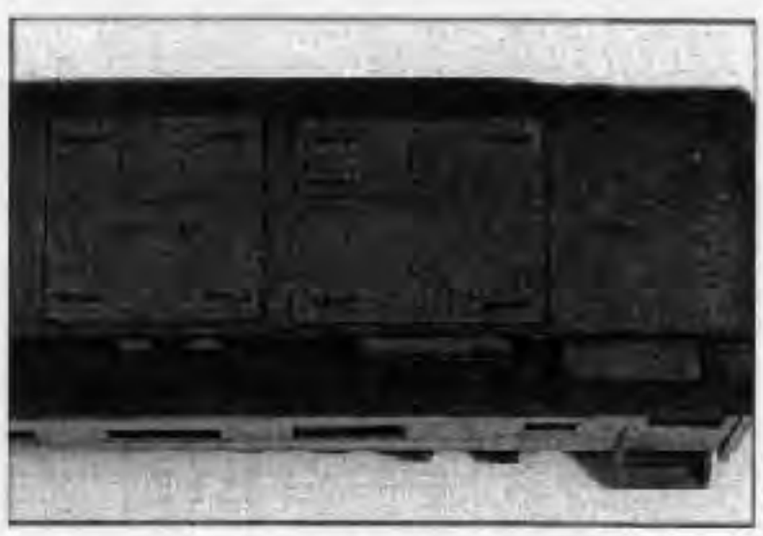
Roof hatch detail on *San Bartolo* (ex 1363 a lounge/dorm) at Fair Park in Dallas. Note air duct on right. Both a/c and refrigeration hatches on end of car. There is a slight variation between the a/c hatch on this car and 3231 to the right.

Close-up of hatch detail on parlor-club 3231 at Fair Park in Dallas. The shutters for the air outlet dampers (see Figure 1) are clearly detailed. Object ahead of the a/c unit is an induction radio antenna. This car was converted in 1935 from a parlor/observation.

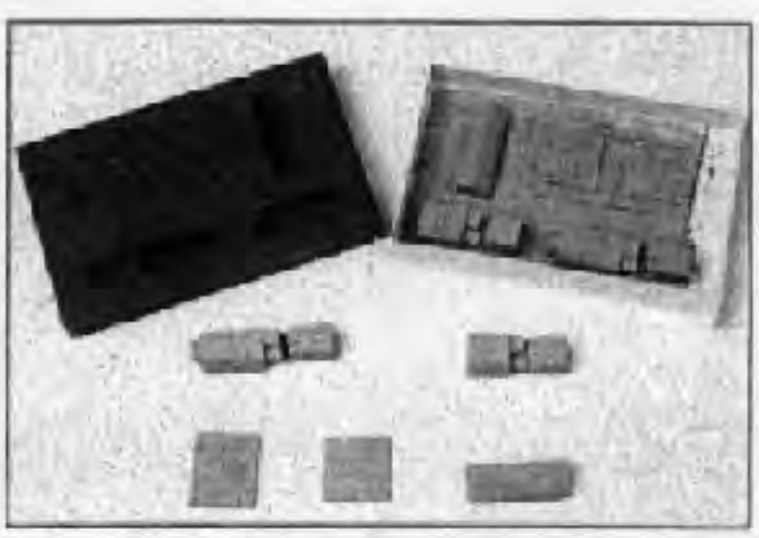
Valve closet and make-up water tank assembly on *San Bartolo*. Unit is on the same side as the air duct. Battery box to far left. Upon opening the doors, I found them to have several large valves and little else. Apparently the liberal use of sheet metal was popular in the mechanical department.

Variation of the valve closet on 3231 is also on the same side of the car as the air duct and the battery box. Box at right was sometimes separated from unit at left on diners and lounges. Arc welder had taken root and could not be moved and obviously is not a part of system!

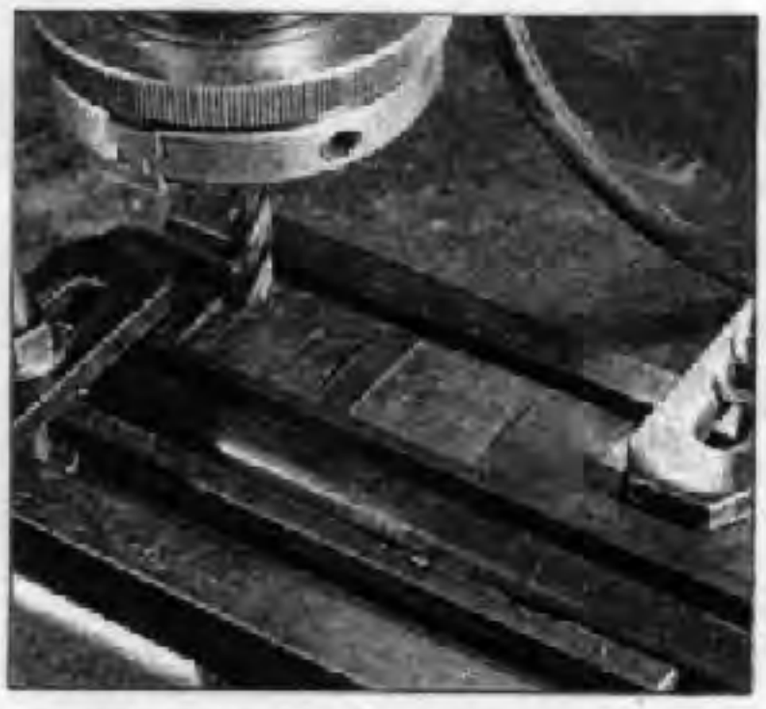
Note the air conditioning duct located in the center of chair car 3001. There's a prototype for everything. Photo by Joe Shine.



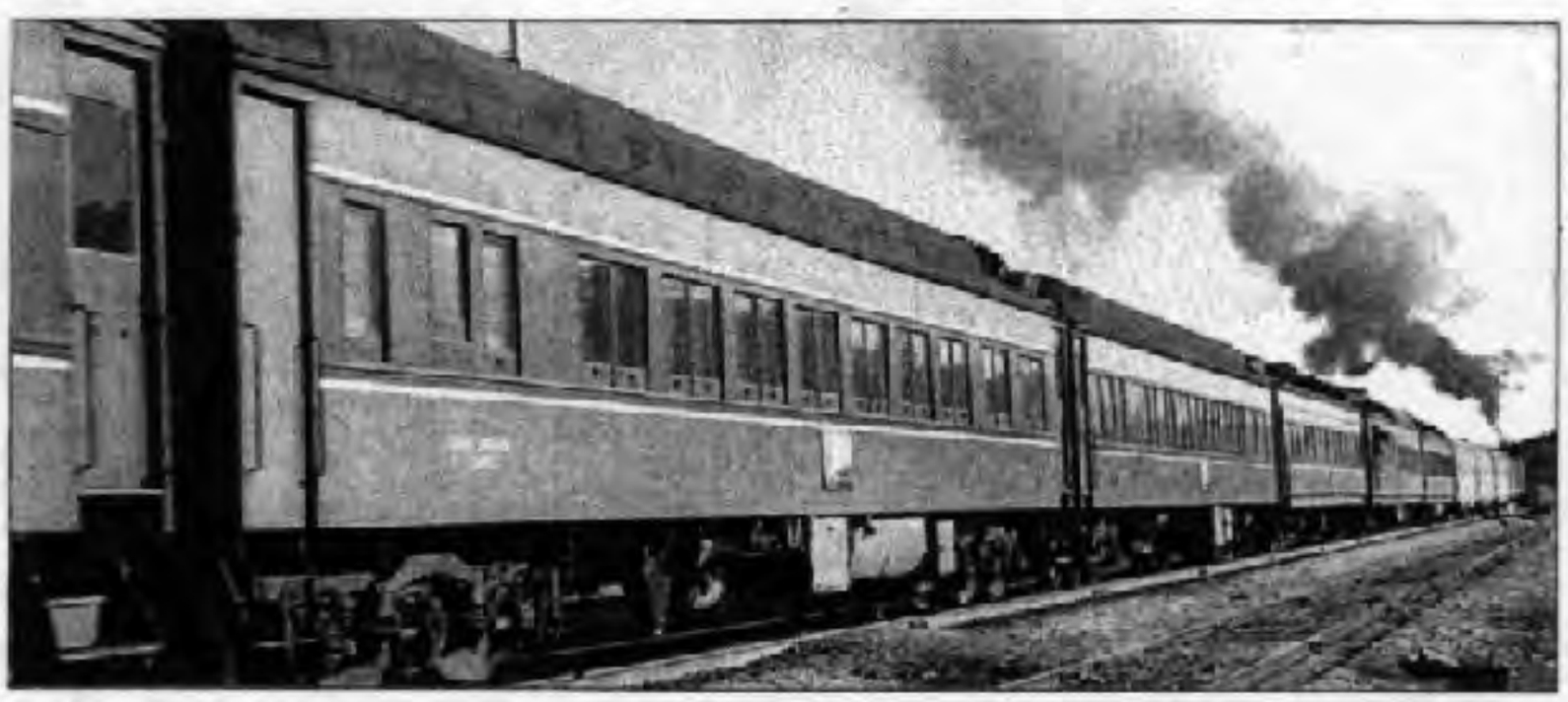
Close-up of the intake ducts on my chair car model. Wathers box vents have been filed to shape. Round styrene tube was used at right.



Pattern, RTV mould and the castings made with Castolite products. With one pour I can make all parts for one car plus a new water tank.



A carbide end-mill on the Unimat is used to mill out the Walthers roofs to accomodate the flat bottomed castings. I cut as far down in the roof as I could. Note the dogs to hold the roof.



A 16 section tourist Pullman equipped with steam ejector air conditioning in Scout service, November of 1941 in Nelson, AZ. These cars had ducts on both sides of the car as there was no passageway on "section" cars. See how the water tank separates the valve closet parts in this photo.
Photo by Ingersoll from Gordon Bassett Collection.