

MONARCHS *of the* WEST

From Omaha to the West Coast, Union Pacific entrusted trains to its fleet of 800-series 4-8-4's, and even contemplated a "Super 800"

BY WILLIAM W. KRATVILLE



ONE NIGHT IN FALL 1958, I was on Union Pacific train 104, the *City of Los Angeles*. As we streaked east across Nebraska, the lead E unit developed a hot wheel bearing. The diesel was set out at Grand Island and 4-8-4 No. 844—destined for future fame but then just another racer with her best passenger days behind her—was brought over to take 104 into Omaha, 144 miles. The delay put us about 60 minutes behind schedule. Once we were on the move again, from my seat in one of the dome coaches I began to realize that the 844 was getting up to Streamliner speed. Mile by mile,

smoke pouring back over the dome, we raced against 104's time, and the big 4-8-4 pulled into Omaha Union Station just 20 minutes off the card. It was a remarkable feat for an engine that had been bumped into freight service years before, but one that was once routine for UP's fleet of superb 4-8-4's.

The American Locomotive Company, rather than the road itself, was largely responsible for UP's first 4-8-4's. As early as 1927, Alco had urged the road to look at such a locomotive because increasing passenger demands were taxing UP's fleet of 60 Mountain types. Doubleheading was almost stan-

dard on some trains in the summer, the 4-8-2's not being able to handle the heavier trains and keep time.

Alco and UP were well acquainted through years of the builder being the principal supplier of UP power. A. H. Fetters, UP's top locomotive design man, went over Alco calculations and put a draftsman to work on a preliminary drawing for a 4-8-4 in 1929. But the Depression shelved plans for new power, and the drawing went unused.

As the economy improved in the mid-1930's, the road began to look at new passenger and freight power. Freight brought in the higher revenue,



HENRY R. GRIFFITHS JR.

so the first order was for Alco-designed fast-freight 4-6-6-4's, delivered in 1936.

The 4-6-6-4's took their name from a budget-fare passenger train UP had inaugurated the year before between Chicago and Los Angeles. By 1937 the *Challenger* was often operating in multiple sections in the summer, and requiring helpers to keep time on grades.

By this time too, famous UP motive power man Otto Jabelmann was head of the new Research and Mechanical Standards Department, but Fetters had already convinced top management that new passenger power would be an economically good decision both in

eliminating helper assignments and increasing train speeds and tonnage.

Impressed with New York Central's Hudson types, UP considered a 4-6-4 as its new passenger engine. Although they would have been the largest of their type, the road determined that even such a super Hudson would not have the power required. Again, a preliminary sketch for a 4-8-4 was made.

FEF-1: THE "LITTLE 800'S"

The new 4-8-4's were the last program for Fetters, who had been influential in UP power design since early in the century. Alco took the lead in de-

No. 800 herself dashes away from Boise with the second section of train 18, the *Portland Rose*, not long before the 1953 reassignment of all FEF's to the east end.

signing key elements such as the boiler, firebox, rods, and valve gear, but Jabelmann made improvements to the Alco design before construction began.

The smokebox front-end arrangement utilized Master Mechanics units, with five locomotives employing a new design called the Economizer or "Thompson" front end, thanks to urging by its supplier, which promised operating economies. The smokebox door

was designed large enough to enable easier flue and front-end work.

Although UP's 4-8-2's carried road numbers in the 7000 series, the 20 new 4-8-4's began at 800 because low numbers fit with Jabelmann's penchant for modernization. The class was officially listed as FEF-1 (Four-Eight-Four, first group), the proud road refusing to use "Northern" because of its association with the Northern Pacific. (UP also called its Santa Fe types TTT's!)

The FEF-1's were not filled with "firsts" on the UP, but followed proven Alco design. Their 77-inch drivers and smaller overall size relative to subsequent FEF's led the original group to become known as "little 800's."

The original assignments included handling the *Challengers*, *Overland Limited*, *Los Angeles Limited*, *Pacific Limited*, *Portland Rose*, and *California Fast Mail*. The longest runs were from

Omaha to Ogden, Utah (990 miles), Salt Lake City (1026 miles), and Huntington, Ore. (1394 miles).

In train performance the new locomotives proved even better than anticipated. The success of the type proved to the road that Alco's initial warning that a 4-8-4 could not run fast due to piston thrust fears was unwarranted.

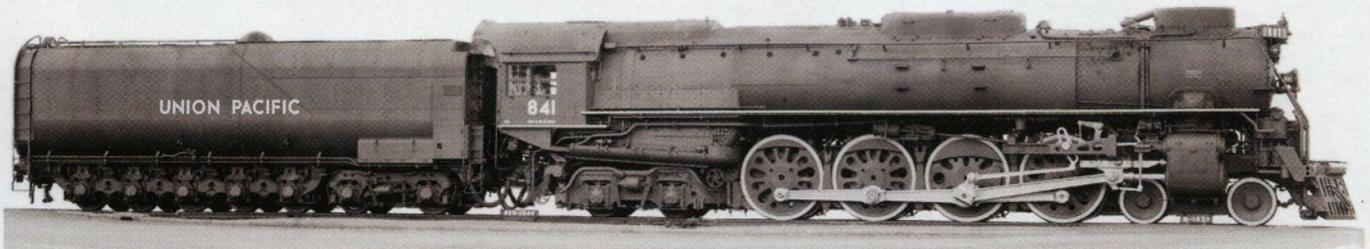
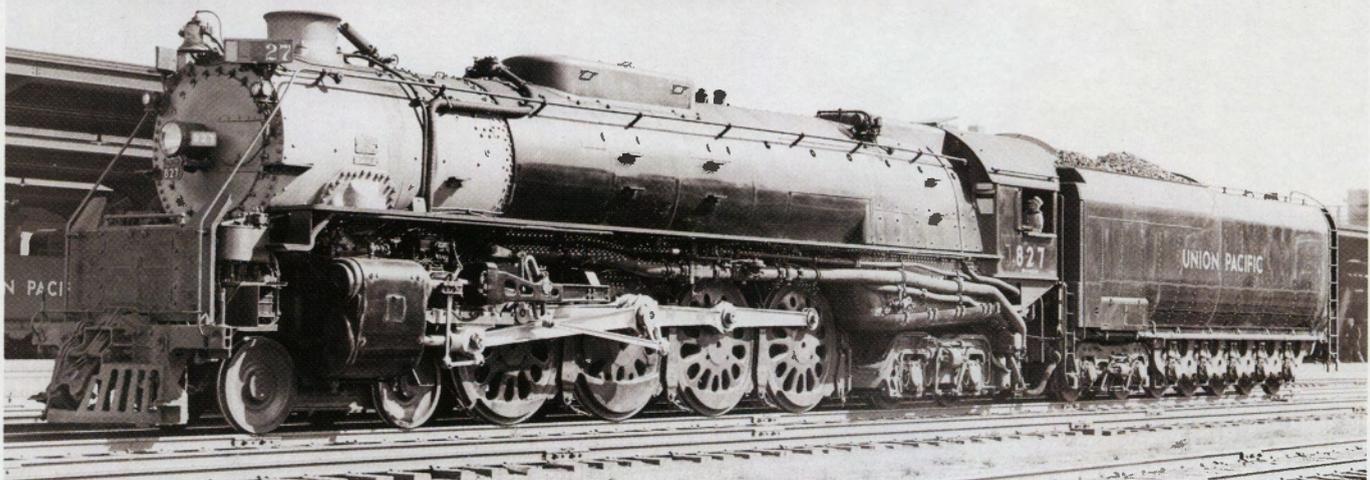
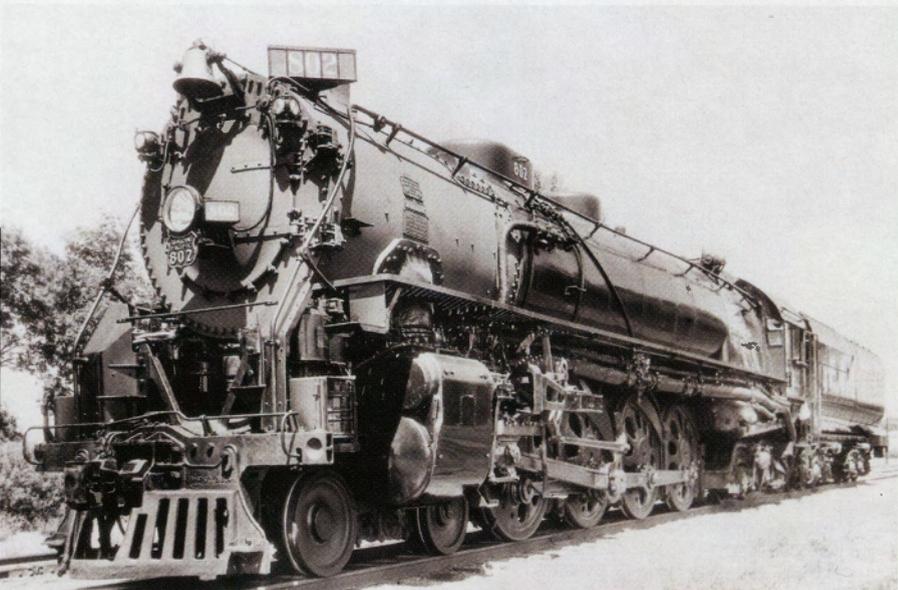
FEF-2: JABELMANN'S OWN

Thanks to the success of the FEF-1's and a desire to further the economies to more runs, UP management approved further passenger-power addi-

tions in 1938. Designed by Jabelmann's group, the new power would, as part of his broad program of standardization and improvement, incorporate several advances over the little 800's.

Passenger power was always desired to be in place by early summer, so the design team quickly evaluated the FEF-1's performance and design faults. Actually, much of the work had been done by the group in continual testing, particularly in front-end designs influenced by Leonard Botteron, a designer enamored of the idea of "opening up" locomotives to reduce back pressure.

FEF's, as built: No. 802 shows the original FEF-1 look of twin pump shields, 77-inch drivers, 12-wheel tender. FEF-2's like 827 had a single, full-width shield, combined sand and steam dome, 80-inch drivers, and centipede tender. The 841 has the FEF-3's double smokestack and beefier GSC pilot. Later, some engines got full-width pump shields, twin stacks, and big tenders; all received smoke "wings" and Mars warning lights.



TOP, RAIL PHOTO SERVICE; MIDDLE, RICHARD KINDIG; BOTTOM, ALCO



ROBERT HALE

The new FEF-2's retained the large smokebox door of the little 800's, but many other items were completely redesigned by necessity, such as rods, or desire, such as larger tenders. The latter was a new UP design utilizing a cast bed with 10 wheels for the water load and a 4-wheel truck for stoker and coal loads. The early 4-8-4's often ran short on water, and the new 14-wheel "centipede" tender increased capacity.

The FEF-2's also featured 80-inch drivers, which were better for long, fast running. Cylinder diameter was increased to 25 inches, but the 32-inch stroke was retained. The General Steel Castings drop-coupler pilot introduced on the FEF-1's had proved effective and was retained. Overall, the 15 new 800's, received from Alco in 1939, were longer and heavier than the little 800's. Nos. 820-834 were designed for 120 mph, although continuous maximum horsepower was provided at 90 mph.

The 820's came with four-port nozzles in the front end below a single stack of 2 1/2-inch diameter. Hollow pistons were used to reduce reciprocating weight while retaining strength.

For water delivery, the new 4-8-4's utilized the exhaust steam injector with the check valve located on top of the boiler to supply water downward

for better heat transference. The larger MB model stoker replaced the BK models used on the 800-819. Also, force-feed lubrication was installed on almost any point subject to movement. Another improvement was the use of the Alco lateral springing device on the drivers.

From the start, the big 800's were plagued with smoke problems. As one top mechanical engineer later said, "Everyone knew what the problem was—Botteron had opened up the locomotives too far." This led to the addition of large sheet-metal smoke "wings" beginning in 1945. Eventually, the little 800's got the wings as well.

FEF-3: WAR BABIES

UP's last series of 4-8-4's came from Alco in 1944 following a government directive to all western roads to prepare for a 25 percent increase in business as the war effort swung to the Pacific. The 10 engines, classified FEF-3 and numbered 835-844, were virtually identical to the 820's, though material shortages necessitated heavier rods and other items. Most noticeable changes were a double smokestack and a cast pilot with enclosed coupler pocket.

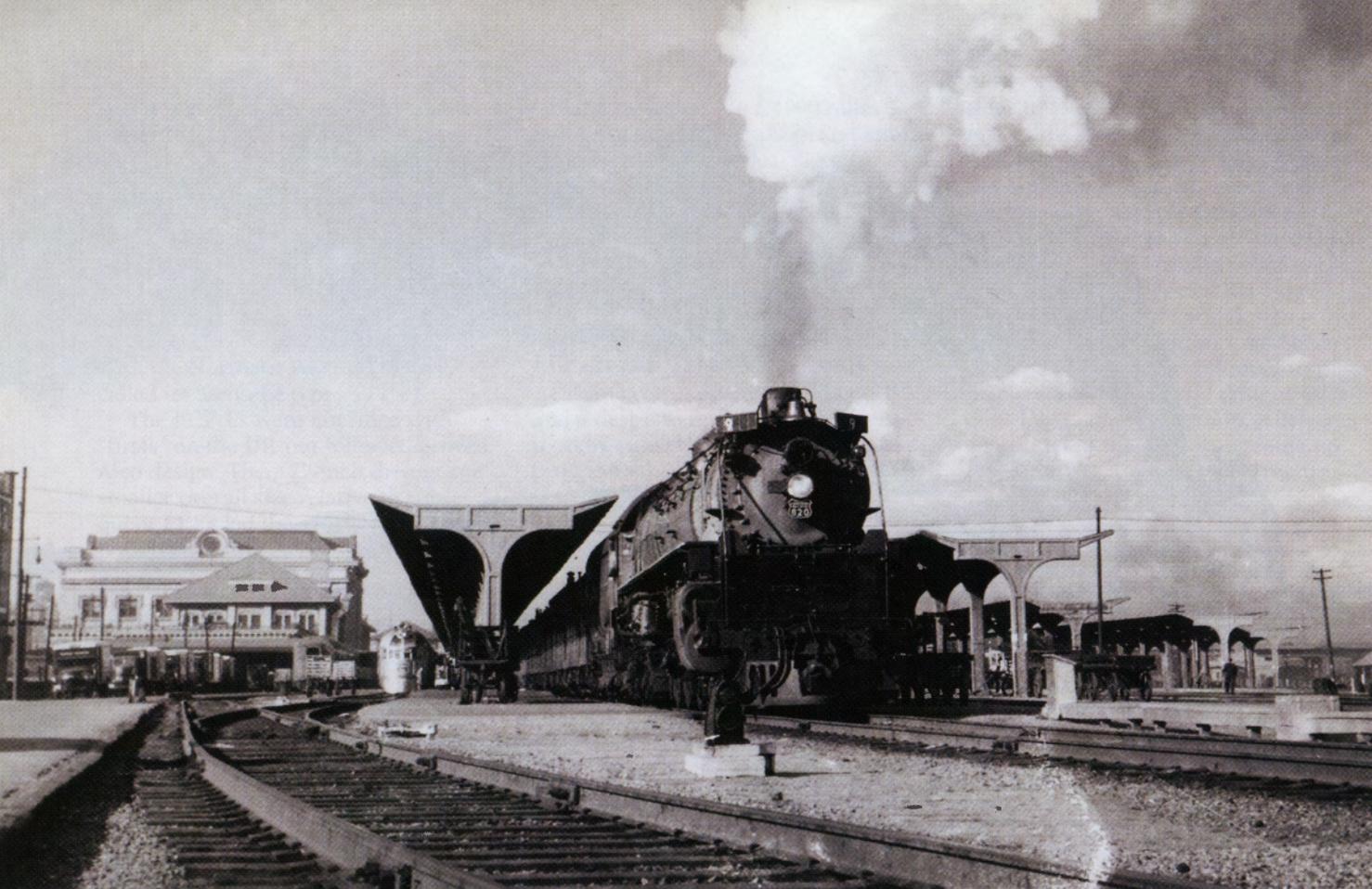
Even though Otto Jabelmann is best known for his super steam designs on the UP, he had long been a believer in

Flying up Wyoming's Sherman Hill in the mid-1950's, FEF-1 815 carries in her numberboards the identity of the train she's helping: 101, the westbound *City of San Francisco*.

diesel power, even to preparing a dieselization plan as early as 1942. In fact, the only reason the 1944 4-8-4's (and the last Challengers and Big Boys) came was the war situation—Jabelmann would never have recommended more steam had the need for more motive power not been so pressing; he wanted diesels, but wartime production restrictions made them unavailable. In addition, UP was internally divided on its motive-power future.

Several factors entered into the steam-vs.-diesel debate. One was that Jabelmann had led a dual career with the UP. He had risen in the ranks of steam designers, but also was a major figure in the original Streamliner lightweight diesel passenger-train program of the 1930's. Thus he had been exposed to the efficiencies and performance of diesels. The other major influence was the road's president, William M. Jeffers, a died-in-the-wool steam devotee.

Aware of the performance of the Electro-Motive FT demonstrators on



In the early '50's, FEF-2 820 pulls out of Denver Union Station with train 9, carrying cars for L.A. and San Francisco. Across the platform is CB&Q's famous *Pioneer Zephyr*, assigned to a Denver-Cheyenne run at the time.

FEF-1 803 and an SP E7 rub elbows outside Los Angeles Union Passenger Terminal in the late '40's as they wait to back down onto their respective trains. The diesel is for the *Golden State*; 803 will likely haul the *Los Angeles Limited*.



TOP, RON PALMQUIST; ABOVE, HERBERT JOHNSON

their 1939-40 tour, Jabelmann felt that an acceptable diesel freight locomotive was at hand. It was under these circumstances that Jabelmann told his top aide to develop a dieselization plan. It was an earnest effort to plot a course for the road's locomotive progress the moment the war ended.

However, Jeffers was on a different course, and when Jabelmann's plan was introduced it was met with a less than enthusiastic reception. Jeffers' response amounted to, "Go back and draw up a better steam locomotive!"

SUPER 800'S, 1942 VERSION

Thus, in 1942, Jabelmann directed his staff to began work on a better,

dual-service steam design. As an aside, he also said, "We know were going to diesel after the war, but we have to lay out a steam proposal too."

First the existing locomotive fleet was reviewed and the decision to go with a 4-8-4 rather than an articulated was made, because an articulated would be costlier to maintain and total lengths would be difficult to accommodate systemwide without turntable and roundhouse expansions.

The emphasis was on keeping with the Jabelmann theory—standardize to the fullest to achieve the lowest possible maintenance and operating costs. In line with this thinking was a thorough evaluation of all items then in

use on the road's modern power.

The new power did not necessarily have to be bigger, but it did have to be better. However, the demands of freight consists were not the same as those of passenger trains. So to be a dual-service type as desired by Jeffers, boiler size and efficiency were critical to sufficient steam supply.

It was found that the most efficient boiler on the UP was that used on the FEF-2's and 3's. Although calculations were developed for larger boilers, the final conclusion was that the boiler would be sufficient if the firebox could be slightly increased in size and the combustion chamber given enough size to allow efficient gas travel.

'The King of wheel arrangements'



NORTHERN PACIFIC A-2 CLASS 4-8-4 2651, WESTBOUND AT VALLEY CITY, N.DAK.; LINN H. WESTCOTT PHOTO

Just as the 4-4-0 American type was the standard general-service locomotive for most of the 19th century, the 4-8-4 filled that role from the late 1920's until the end of steam. Northern Pacific got the first ones, built by Alco in 1926-27 for passenger service. NP gave its name to the type, though this was soon shortened to "Northern." (Several roads used alternate names, including Pocono [DL&W], Dixie [NC&StL], Greenbrier [C&O], Wyoming [LV], Potomac [RF&P], and Niagara [NYC].)

The Canadian National system, which ultimately had the largest 4-8-4 fleet (203, of the 1115 built), got its first ones in 1928, and considered them dual-service engines. Other roads followed suit, for the Northern had both the power for fast

freights and the speed for passenger work. The four-wheel lead truck provided stability, and the four-wheel trailing truck allowed a large firebox for sustained steam production. The 4-8-4 found wide acceptance: the only major western road without them was the Texas & Pacific, while the only eastern roads lacking them were those with fleets of high-drivered 2-8-4's, the B&O, and the Pennsy. In the post-steam era, some of the most active excursion engines have been 4-8-4's.

George H. Drury, in his *Guide to North American Steam Locomotives*, described the 4-8-4 as "the ultimate development of non-articulated steam power." British author Brian Hollingsworth called it simply "the King of wheel arrangements."

HENRY R. GRIFFITHS JR.

Wearing the two-tone gray livery UP adopted for the FEF's in 1946, No. 818 wheels the *Portland Rose* up King Hill, east of Boise, in the early 1950's.

A larger firebox meant use of the MB stoker to assure adequate coal delivery to all locations in the firebox. The Northwest and South Central districts were oil territory, so the use of new power there would require some of the engines to be equipped as oil burners. Instead, any new power would go only to the Nebraska and Wyoming divisions, with some Challengers released for oil conversion and reassignment.

The smokebox size was not changed but there was many a debate over the exhaust system. For years the road had been experimenting with various front-end designs. Leonard Botteron's efforts to reduce back pressure by opening up the steam passages was taken a step





What would a Super 800 have looked like? Artist Gil Bennett gives an answer in this painting for *STEAM GLORY* of No. 867 with the second section of the *Utahn* above Buford on Sherman Hill in June 1948. Following UP drawings (like the side view below) and specs, he's created a machine with four stacks, poppet valves, and a vestibule cab. Like the FEF-2 and 3, the "FEF-4" would have had a 14-wheel centipede tender with a cast-steel frame (opposite page).

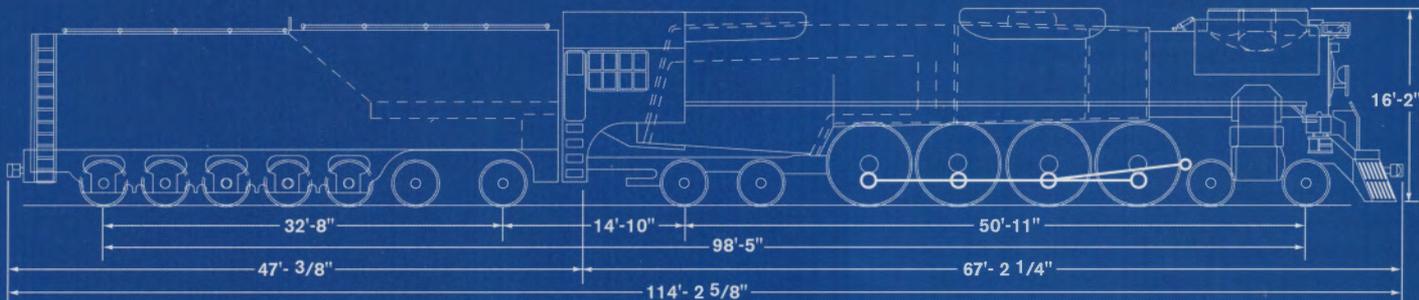
further, and the 1942 preliminary design proposed *four* smokestacks.

As with the existing 800's, frames and cylinders were to be integrally cast and no changes in size envisioned. The 80-inch driving-wheel size was retained in the interests of standardization and because no increase in speeds was anticipated.

The new engines would have

Walschaerts valve gear with Franklin reverse gear. The throttle was of the front-end type. The pilot, trailing, and tender truck wheels were all of 42-inch diameter, the largest possible. All these features matched big 800 specs.

Jabelmann had long wanted the full use of roller bearings, a desire influenced by his study of Norfolk & Western practices. However, others in the





PAINTING BY GILBERT BENNETT

mechanical department had always thwarted his desire to fully utilize them. On the 1942 design, Jabelmann was at last able to specify roller bearings throughout.

The air-brake system would feature integral cast reservoirs and the compressors would be mounted on the pilot deck. Aftercooling would feature the Wilson sump design which elimi-

nated the maze of piping common on most power. The team wanted to keep the general appearance clean.

The pilot was to be the latest version of the massive GSC retractable-coupler model. It had been found that the GSC (with gate closed) gave the best possible deflective protection in grade-crossing collisions.

A unique feature was to be a revolving light mounted on a bracket above the standard Pyle-National headlight. This "safety" light idea was initiated by the success of the Streamliner lighting and was to be activated by a pressure switch incorporated in the air-brake line, the relay being activated when an emergency application was made. The light would be red in emergency situations and white during normal use.

Two tender designs were considered. One would utilize a four-axle truck at each end, while the other would retain the famous "centipede" design. UP's Transportation Department did not like the centipede because of derailments caused by its longer rigid wheelbase, but the load factor was better with this design, so the individual-truck idea was discarded.

The use of a full vestibule cab was also discussed, but it was initially believed difficult to employ such a design because of clearance restrictions, so the idea was shelved.

The final design was a 4-8-4 with highly standardized parts, clean lines, and proven appliances and design. It would have developed approximately the same horsepower as the big 800's, but would operate more efficiently in both freight and passenger service.

When the calculations were finished, they were reviewed by Jabelmann and his staff and sent to Jeffers. By this time Jeffers was busy as the nation's wartime "Rubber Czar" and the plans went mostly unnoticed. They were finally filed away for "postwar projects." In the following year, 1943,

UP lost its motive-power genius when Jabelmann died suddenly on a government trip to Britain.

SUPER 800'S, 1945 VERSION

The super 4-8-4 project was revived in August 1945, as the war was almost over and the builders had begun directing their efforts toward diesel production. Jeffers was preparing to step down but still was very much in command, so the steam ideas were pushed to the top of the list as "designs for a new high-speed freight locomotive."

The initial step was to roll out the 1942 specs. A larger firebox was laid out with a larger boiler and the smoke-box dimensions increased correspondingly. All this required a longer frame, increasing total engine length. Adjustments would have to be made in certain terminal and mainline curvature.

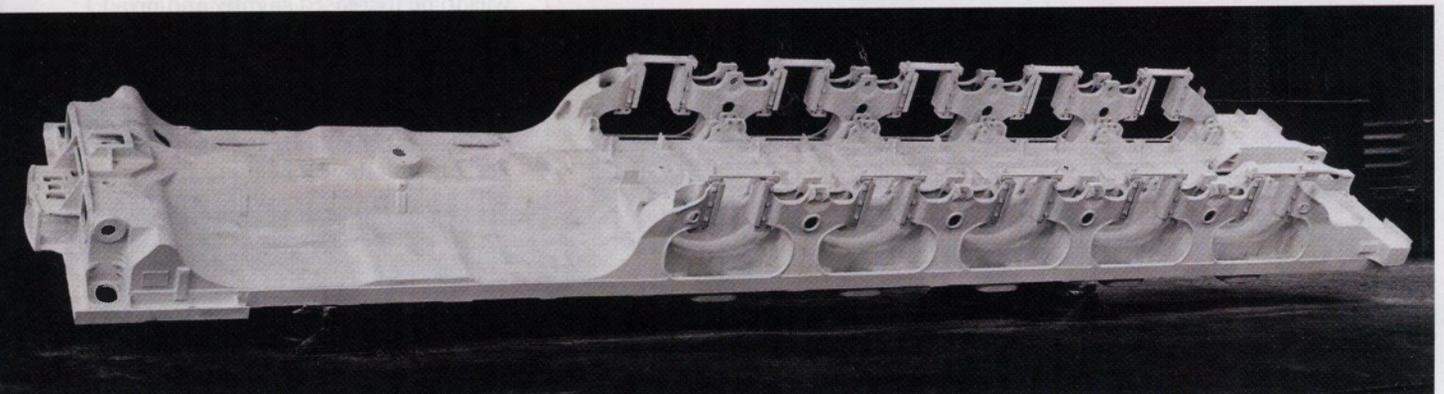
Boiler tube and flue quantities had been virtually reversed in the FEF-3's of 1944, resulting in a net loss of evaporating and superheat surfaces. The new power would again reverse the flue-tube quantity to allow greatest possible evaporative surface. The MB stoker was retained and additional arch capacity incorporated. The combustion chamber was redesigned for the larger boiler and firebox values.

Boiler efficiencies were to be aided by use of the Type A superheater, which had proven easier to maintain than the Type E. Water delivery was to be through a Worthington SA unit, found to be successful on the 835's.

The net effect of the changes would be to produce a locomotive with adequate steam supply for the service intended. The GSC pilot would be used with the same arrangement for air pumps and aftercooling.

On the new design, a Canadian National short-type smoke wing was planned, as were overfire jets.

Steam admission was discussed, and the road had watched with inter-



GENERAL STEEL CASTINGS CORP.



GEORGE SPEIR

The 800's finished up on freights across Nebraska. Working a long stock-car train east near Kearney in September 1958 is a grimy 832.

est various attempts to employ poppet valves. UP's own poppet experience dated to 1929 and a stint with the Caprotti gear, the experiment ending in the usual problem of the gear not being able to withstand U.S. conditions.

There was much discussion over coal or oil firing, but with oil becom-

ing more readily available at terminals, that fuel was preferred. This would eliminate the planned MB stoker and among other benefits would cut down on the annual prairie fire problem.

The full roller-bearing concept was retained because, besides the obvious maintenance factors, rollers would help reduce servicing times.

Another big improvement was to be a vastly extended network of lubrication for virtually all moving parts. The largest model force-feed lubricators were to be used along with steam heat-

ed lube lines wherever required.

During the war, new techniques had been employed in mechanical design and fabrication and the design team believed some should be utilized in railroad work. Among these was the expanded use of welding. The 1945 4-8-4's were to have welded flues.

The road had always experienced problems with cab comfort in winter storms, particularly in Wyoming, so an all-weather cab was designed. Because of the increased firebox size, the cab space was to be smaller, but it was felt that this would not be a problem because the latest cabs were more than generous, even for four men.

The already large sand box casing was to be increased slightly and provided with a pipe system to eliminate wet sand problems.

The headlight originally specified was the standard Pyle-National model, but sealed-beam designs were on the horizon and the UP held meetings with suppliers for possible furnishing of twin sealed-beam lighting, and twin units were shown on early sketches.

The centipede tender was used again, but with a "full top" design allowing 25,000-gallon capacity and 6000 gallons of oil.

In operation, no thought was given

UP's 4-8-4 family

Class	FEF-1	FEF-2	FEF-3
Nos.	800-819	820-834	835-844
Builder, year	Alco, 1937	Alco, 1939	Alco, 1944
Cylinders (in.)	24½x32	25x32	25x32
Boiler pressure (PSI)	300	300	300
Driver dia. (in.)	77	80	80
Tractive effort (lbs.)	63,600	63,800	63,800
Engine weight (lbs.)	465,000	483,000	490,700
Wheelbase	97 ft. 6 in.	98 ft. 5 in.	98 ft. 5 in.
Fuel (all changed to oil in 1946)	Coal	Coal	Coal
Tender	12-wheel	14-wheel	14-wheel
Fuel capacity (tons)	25	25	25
Water capacity (gals.)	20,000	23,500	23,500

to eliminating helpers on severe grades, but the new power was proposed to handle trains then headed by 2-10-2's and 4-12-2's at much higher speeds and at greatly reduced costs.

Under the new power plan, the Sherman and Ogden grades would be handed over to Big Boys and Challengers, the new locomotives being assigned Green River-Laramie and east of Cheyenne. Driver size was to remain at 80 inches and other wheels at 42.

Two numbering schemes were suggested. The most popular was sticking with the 800 series because it was not felt that many locomotives would actually be built. The other was starting with 900, but this was ruled out and the series assigned to new passenger diesels and older renumbered passenger units.

Even as the 1945 design was progressing, the builders came in with diesel proposals. Jeffers retired, and his successors did not share his faith in steam. After that, all steam efforts were pointed toward immediate, short-term economic improvements to existing designs, because it was thought that steam would vanish within a decade.

A GREAT LEGACY

A super 4-8-4 never came to pass on the UP, but the 45 FEF-1's, 2's, and 3's established a sterling record in passenger service all across the vast system. Enginemen loved them, particularly the second and third groups, ranking them as the best-riding and most comfortable power on the line. Even during slack periods, they were not assigned to freight work until the mid-1950's, when diesels took over more and more of their passenger assignments. They closed their careers on freights between Omaha and Cheyenne.

It is appropriate that No. 844, the only steam locomotive never to have been retired from a Class 1 railroad, still holds a slot on the UP roster. Decades after her sisters went cold, she is undergoing a major shopping at UP's Cheyenne steam shop, preparing for her 60th birthday and another 30 years of operation in excursion service. Even though he saw early on that diesels were the way of the future, Otto Jabelmann would be proud! **I**

Thanks to mergers, excursion star 844 has gone places her sisters never imagined. In June 1997, she passed through Belden, Colo., on the soon-to-be-closed Tennessee Pass line of the old D&RGW.

C. W. EDINGER

