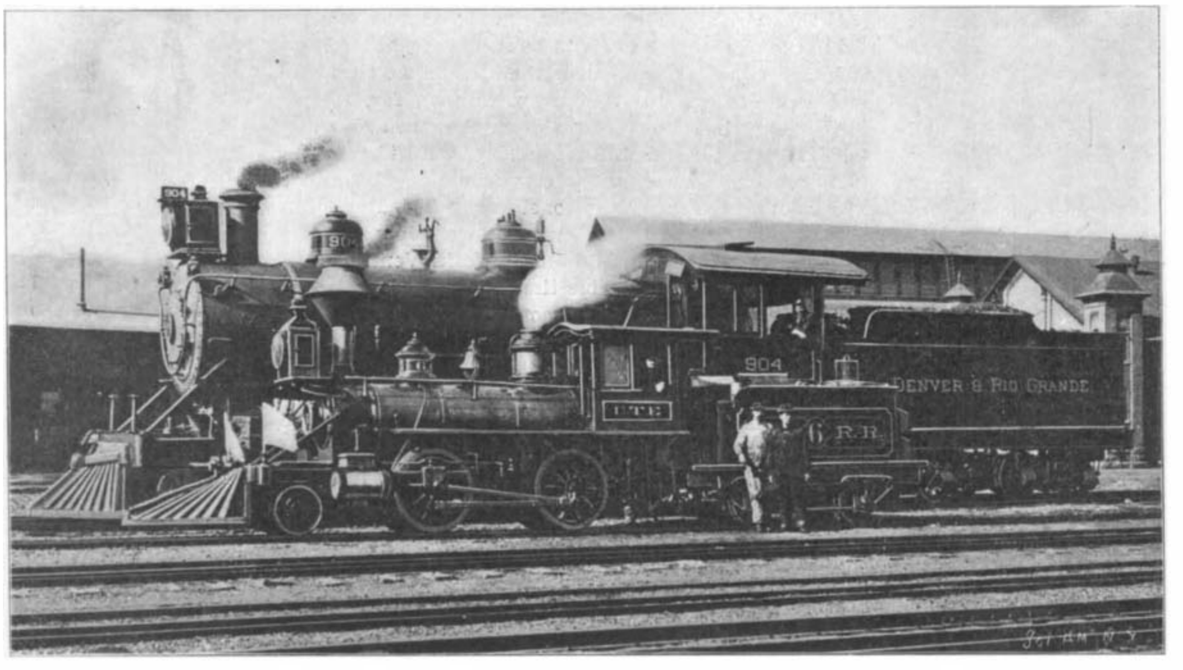
## THIRTY YEARS' GROWTH OF THE LOCOMOTIVE.

The accompanying photograph shows a phase of railroad development in this country in the demand for additional locomotive power as traffic has increased. In 1871 the smaller engine was ordered for the Denver & Rio Grande Railroad Company, and built according to the specifications of the railroad officials. It was utilized to haul both freight and passenger trains, and, at the time, was the average size locomotive in service in the West. Its companion represents one of the latest placed in service on the same system, and, as will be noted, it is a mechanical giant beside the other.

The great difference in the locomotives will be appreciated by a comparison of their dimensions. While the larger has cylinders 22 by 28 inches, those of the smaller engine are 9 by 16 inches; while the driving-wheel base of the latter is but 6 feet 2½ inches, as compared with 14 feet 8 inches on that of the former. It has a pony truck and four coupled driving wheels, while the diameter of its boiler is but 34½ inches, 40 inches less than that of the other; its tank is a pail compared with the equipment of the modern engine, for it carries but 450 gallons, whereas the capacity of the other is 6,000 gallons. The diminutive locomotive was constructed when the track of the Denver & Rio Grande Railroad was but 3 feet gage, and it is now utilized on small feeders of the system to haul light loads. The smaller engine and tender are no longer over all than the engine of its successor, while the smokestack is not as high as the top of the other's boiler.

No. 6, however, has been kept in good condition, and is in daily service, despite the fact that it weighs but twelve and one-half tons. The new type weighs ninety-two tons. Both engines were built at the same works, and the little fellow was considered in its day to be an up-to-date and first-class locomotive in every respect.



Locomotives of 1871 and 1901 on the Denver & Rio Grande Railroad. Respective weights, 12½ and 92 tons.

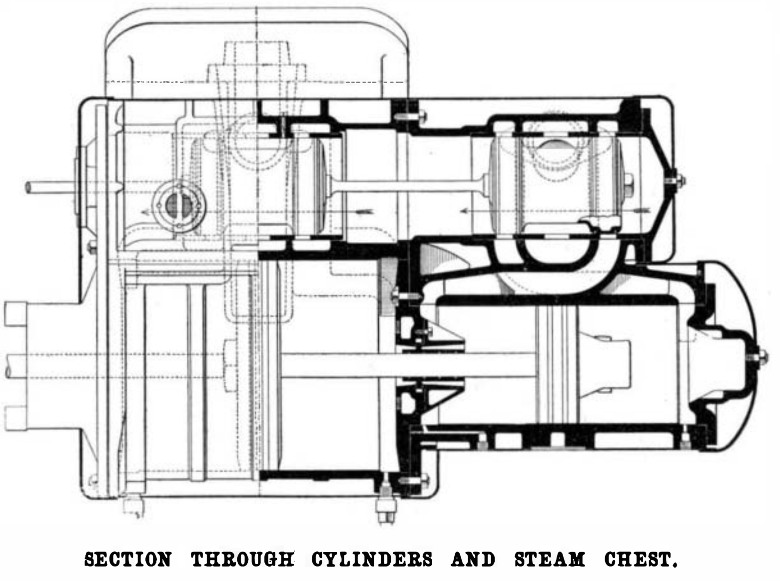
THIRTY YEARS' GROWTH OF THE LOCOMOTIVE.

## TANDEM COMPOUND LOCOMOTIVE FOR THE NORTHERN PACIFIC RAILWAY.

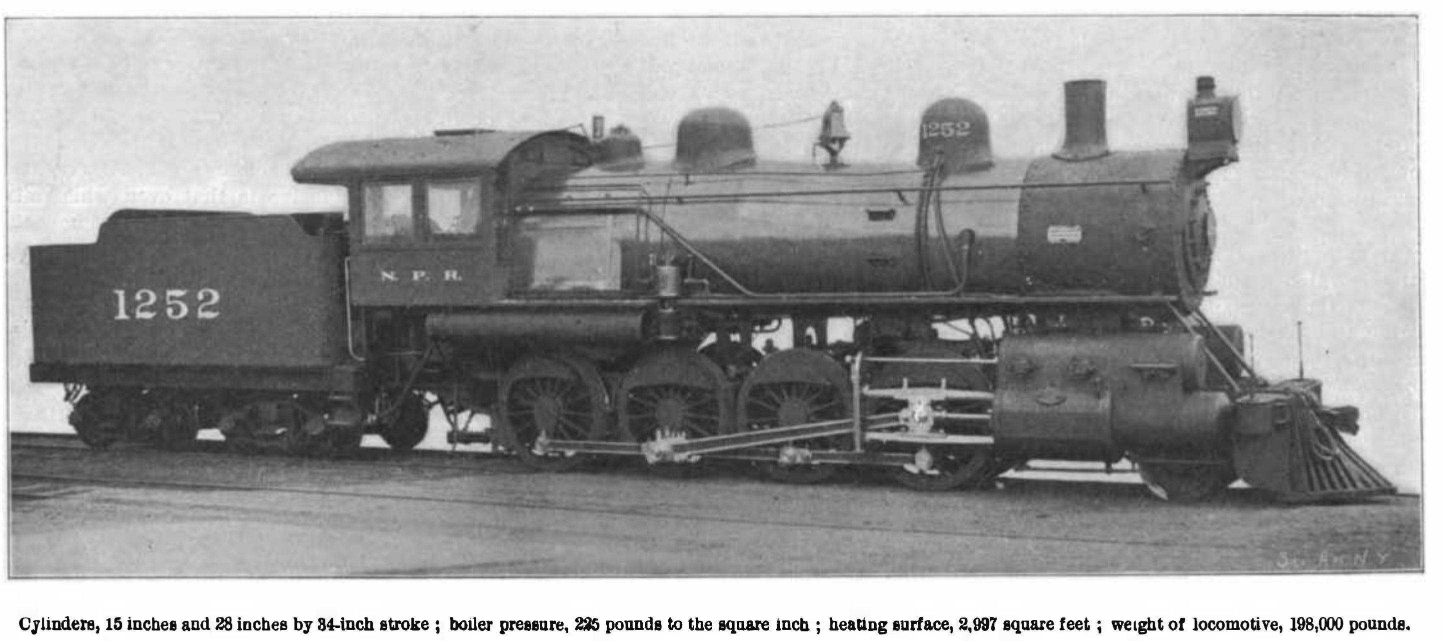
The accompanying photograph and line drawing show the general appearance and details of the tandem cylinder of an experimental four-cylinder tandem compound locomotive, which was built by the Schenectady Locomotive Works for the Northern Pacific Railway. After a year of service the new type has proved so satisfactory that the Schenectady firm is building twenty-six more locomotives of the same type for the Northern Pacific and forty for the Atchison, Topeka and Santa Fé Railroad.

The compound locomotive has not made the rapid progress in this country that it has in some parts of Europe, particularly in France, where the fastest train in the old world is hauled by four-cylinder compounds. Nevertheless, the really good designs of compound locomotives that have been turned out by our builders have fully justified the claims of fuel and steam economy which are commonly made for the compound locomotive, as such. Simplicity of parts and convenience of manipulation have always been characteristics of the American locomotive, and the desire to maintain these features, no doubt, has led our makers to prefer the two-cylinder type of compound to that which uses three or four cylinders. There is an objection to the two-cylinder type, however, arising from the fact that in the larger locomotives, which are now in such increasing demand, the diameter of the low-pressure cylinder becomes so great that its casing projects beyond the loading line permissible by the platforms and tunnels of our railroad systems. Hence we are driven to the necessity of using four cylinders of less diameter. In the well-known Vauclain type, two cylinders, one high and one low pressure, are placed on each side of the smokebox, the high-pressure being above the low-pressure, and the two piston rods connecting to a common crosshead. In Great Britain a type of four-cylinder compound has lately been put in service, in which the four cylinders are placed abreast of each other, two being outside and two inside connected, and all coupled to the forward driving wheels and axle. In France the two inside-connected cylinders drive the forward axle and the two outside-connected cylinders drive the rear axle of the four-coupled driving wheels.

The Northern Pacific engine carries two pairs of high and low pressure cylinders on the outside of the frames and in tandem, the high-pressure cylinder being placed in front of the low-pressure and on the same axial line, a common piston rod carrying the two pistons. There is only one pair of saddle castings and the cylinders are cast separately, the high-pressure cylinders being mounted upon the front of the low-pressure cylinders. Both cylinders are fitted with piston valves with a continuous passage between them. This passage forms the receiver. The valves are made hollow, the high-pressure valves being arranged for inside admission and the low-pressure valves for outside admission. This arrangement, coupled with the crossing of the steam ports of the high-pressure cylinder, has enabled the designer to use a single valve stem. Relief valves are used on the high and low pressure cylinders. On the low-pressure they are attached to the steam chest and act as a bypass when the engine is drifting. The general dimensions of the engine are as follows: Diameter of high-pressure cylinder, 15 inches; of low-pressure, 28 inches; and stroke, 34 inches; the greatest travel of the slide valves is 6 inches, the outside lap is ⅞ of an inch and the inside clearance is ¼ of an inch in the case of the high-pressure and ⅜ of an inch in the low-pressure. The diameter of the driving wheels outside of the tire is 63 inches; the boiler is of the expanded-wagon-top type, with wide fireboxes; the outside diameter of the first ring is 66½ inches. The length of the firebox is 100 1-16 inches and the width is 75¼ inches, and the depth of the front is 70¾ inches and at the back 59¾ inches. There are 338 2-inch tubes, each measuring 16 feet in length over the tube sheets. The heating surface in the tubes is 2,815 square feet; in the water-tubes, 26.46 square feet; in the firebox, 155.64 square feet, making a total heating surface of 2,997 square feet. The grate area is 52.29 square feet. The boiler pressure is 225 pounds to the square inch. The tender, which weighs empty 47,000 pounds, has a water capacity of 5,500 gallons and a coal capacity of 10 tons. The weight of the locomotive, on the drivers, is 175,000 pounds, and the weight of the locomotive in working order is 198,000 pounds.



SECTION THROUGH CYLINDERS AND STEAM CHEST.



Cylinders, 15 inches and 28 inches by 34-inch stroke; boiler pressure, 225 pounds to the square inch; heating surface, 2,997 square feet; weight of locomotive, 198,000 pounds.

TANDEM COMPOUND LOCOMOTIVE FOR THE NORTHERN PACIFIC RAILROAD

### Monument to James Bowman Lindsay.

At Dundee, a granite monument was recently unveiled to the memory of James Bowman Lindsay, an investigator and inventor whose experiments in connection with wireless telegraphy and other scientific advances fifty years ago, ought not to be forgotten. Sir William Preece, in unveiling the monument, remarked that Bowman Lindsay was long before his time. He was a prophet who would compare with any prophet, for in 1834 he wrote that houses and towns would in a short time be lighted by electricity instead of gas, and heated by it instead of coal, and machinery would be worked by it instead of by steam. Sir William Preece recollected that while he was attached to the electrical department of the Electric Telegraphs Company there came from Dundee to London a gentleman with a proposal to dispense with wires and communicate across water. He was attached to Mr. Lindsay, and he made all the arrangements and conducted all the experiments to illus-