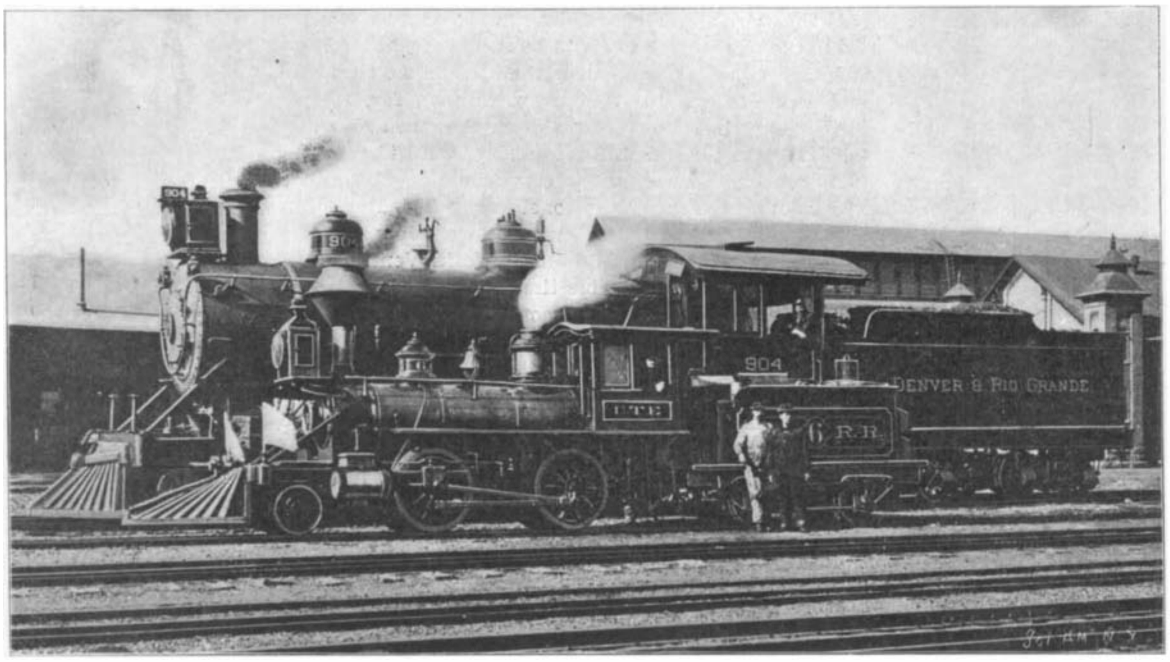
THIRTY YEARS' GROWTH OF THE LOCOMOTIVE.

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.

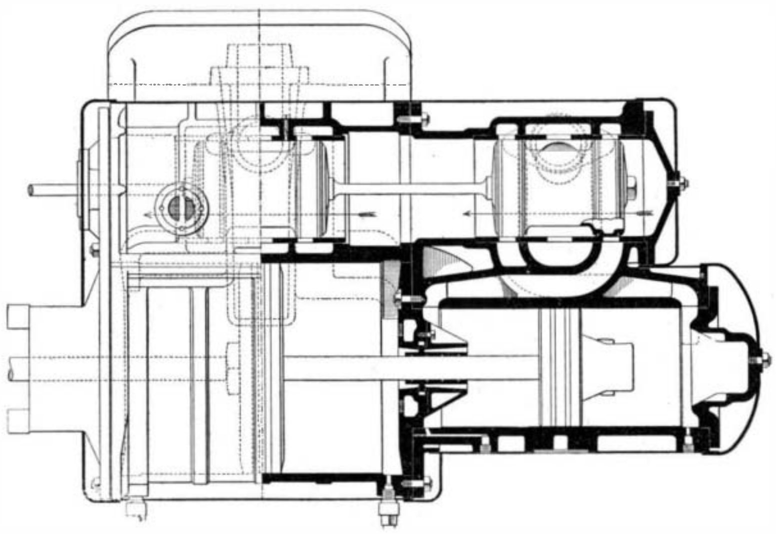
THIRTY YEARS' GROWTH OF THE LOCOMOTIVE.

TANDEM COMPOUND LOCOMOTIVE FOR THE NORTHERN PACIFIC RAILWAY.

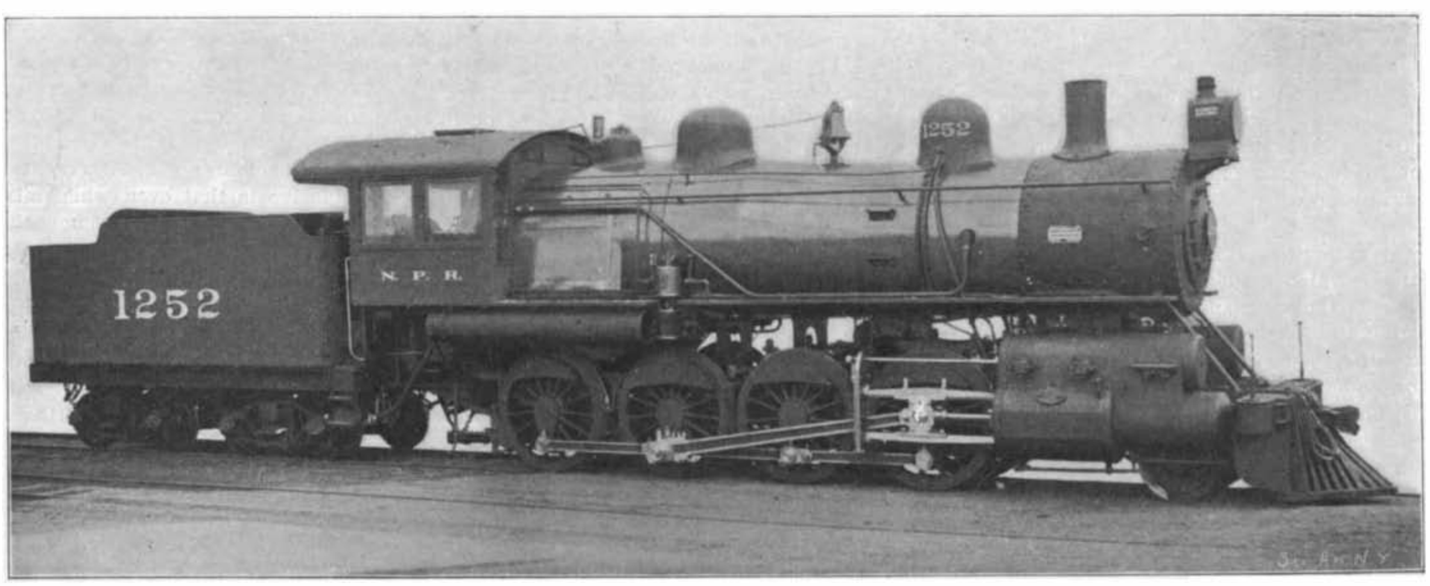
The accompanying photograph and line drawing show the general appearance and details of the tandem cylinder of an experimental four-cylinder tandem compound locomotive, which was built by the Schenectady Locomotive Works for the Northern Pacific Railway. After a year of service the new type has proved 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.

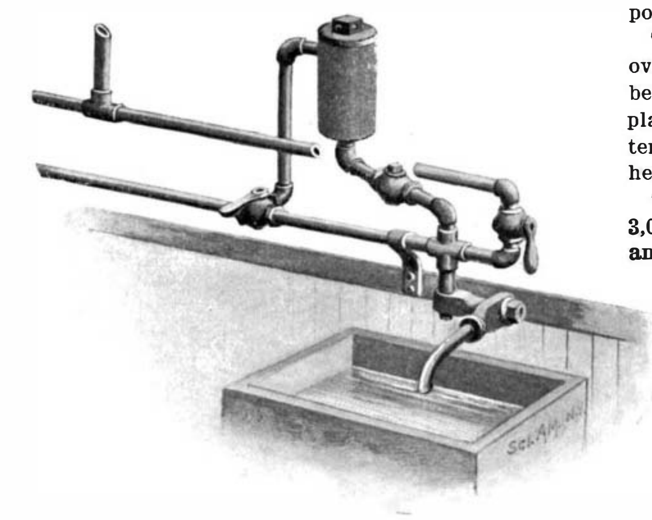
TANDEM COMPOUND LOCOMOTIVE FOR THE NORTHERN PACIFIC RAILROAD

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 illustrate his system in London. Unfortunately there was really no necessity for the invention in those days. An invention to be of use must come at the proper time. There must be the want for it, otherwise it died. This accounted for the fact that the system of wireless telegraphy, which was now associated with the name of Lindsay, had been neglected.

A SOAP-DELIVERY ATTACHMENT FOR WATER PIPES.

A simple invention, patented by Charles R. Walker,



A SOAP-DELIVERY ATTACHMENT FOR WATER PIPES.

of Jamestown, N. D., provides a means whereby soap or water mixed with soap can be delivered at a kitchen sink. The inventor employs a double T or four-way coupling, which is connected with a hot-water supply pipe and with a cold-water supply pipe by means of its two horizontal arms. With the upper vertical arm of the T a pipe leading from a soap receptacle is connected. The soap receptacle is likewise connected by a pipe with the hot-water supply pipe, the pipe at its junction with the hot-water line being provided with a three-way valve. The lower vertical arm of the four-way T is connected with a pipe having a nipple and a discharge faucet adjustable relatively to the lower vertical arm of the T. All of the pipes are valved. By a proper manipulation of the valves it is possible to permit cold water, hot water, hot and cold water, hot water and soap, cold water and soap, or hot and cold water and soap to flow through the faucet.

A CALIFORNIA MARINE RAILWAY.

BY ENOS BROWN.

The first marine railway yet installed upon the Pacific coast has just been completed at Oakland, Cal. It is one of the Crandall type and is used in a ship-yard for hauling vessels out of the estuary, when repairs below water-line are required. It has been in use for several months, and has proved expeditious and efficient. The railway itself consists of a platform 255 by 76 feet, resting upon trucks running upon four tracks, which themselves rest upon three tiers of pine timbers. The rails are flat, the inside 1⅜ by 10 inches and the pair outside 1⅜ by 5 inches in dimensions. There are seventeen standards on each side of the cradle, the bilge blocks, sliding on rails, being worked by a small winch on top of the standards. Patent relieving bilge blocks, which are released by a small wrench, are used. The total length of track is 700 feet, ending in 30 feet of water and inclining at an angle of 1 in 22.

Four chains 570 feet long are employed in hauling the cradle. Each link is 8 inches long and made of 2 1-16 iron. The power for raising and lowering the marine tramway is supplied by duplicate engines, working on a main shaft 12 inches in diameter. The engines have a stroke of 18 inches, with cylinders 14 inches in diameter. Together they are of 240 horse power, and they are geared up to 2,000 horse power. The foundations are of massive concrete resting upon piles driven to a great depth, and in large numbers. Steam is supplied by the boilers of the shipyard. The entire iron work of the engines is of the most solid and massive character, the main gears being 11 feet in diameter with a 14-inch face, the two weighing 24,000 pounds. They work at an average of 160 revolutions.

The endless chains for hauling up the platform pass over a gypsy, cast-steel, sprocket wheel, each link being caught as the wheel revolves. The speed of the platform is controlled by brakes acting upon the countershaft. These are used only when descending with heavy loads.

The railway is capable of hauling out a vessel of 3,000 tons' displacement. The largest yet handled was an English bark weighing 1,500 tons with 300 tons of load, making a total weight of 1,800 tons. This vessel was lifted in 20 minutes.

The terminus of the railway is 10 feet below the channel of the stream. The vessel to be docked is brought between two massive blocks of piles, which mark the situation of the cradle when under water. With the keel resting upon the center blocks the bilge blocks are worked up to the sides and the ship is secured.

It is claimed that this method of docking vessels is superior to the drydock, or the ordinary ways, inasmuch as the frame is subjected to less strain and much time is saved. An advantage is also secured in the easy operation of the machine.

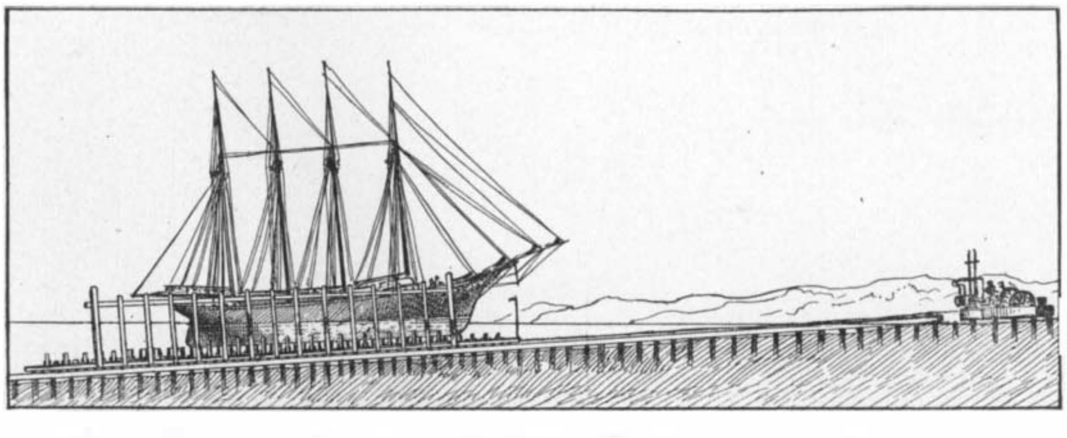
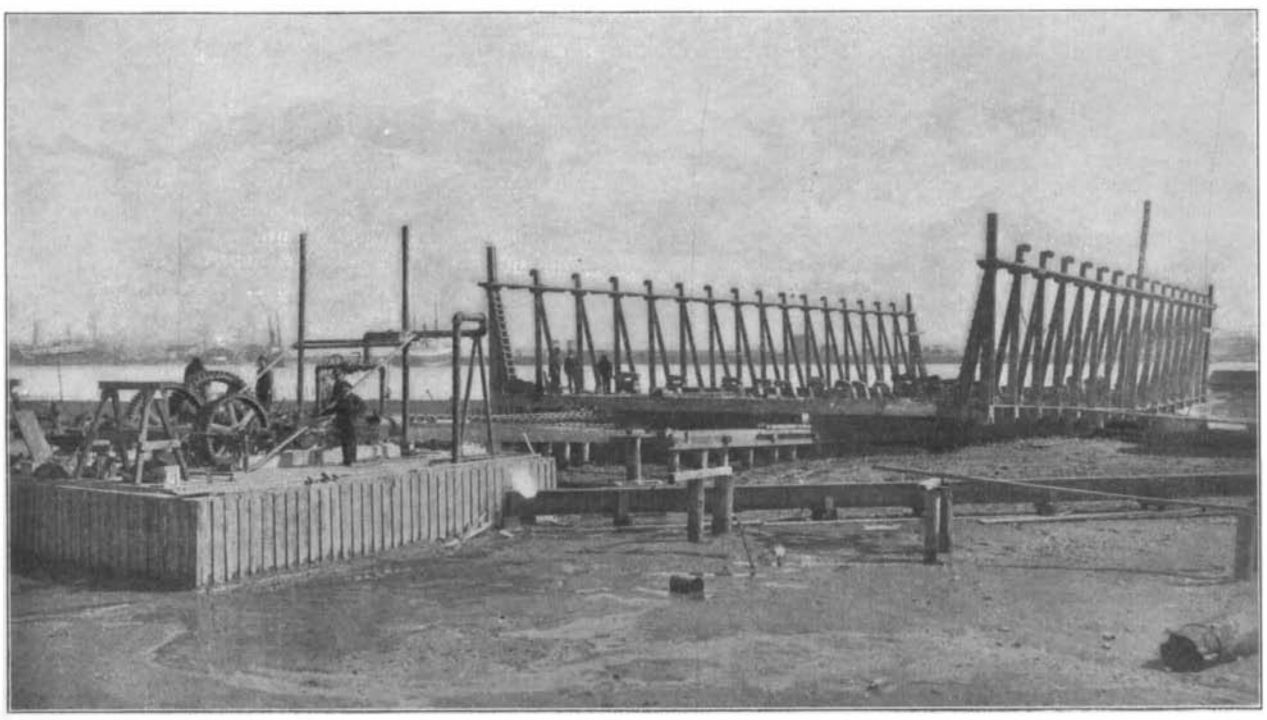


Diagram Showing Vessel Floated Into Cradle and Being Hauled Out by Stationary Engines on Shore.



The Hauling Engines and the Cradle.

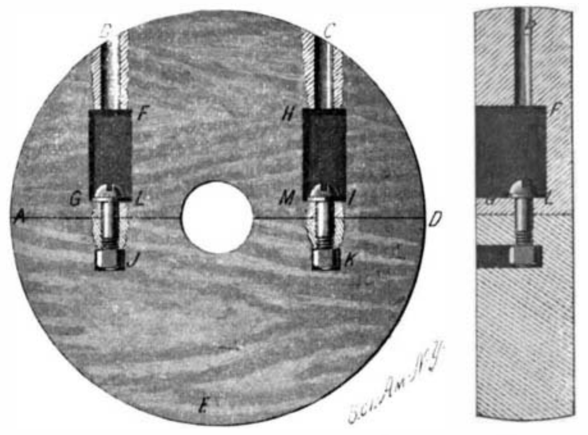
A CALIFORNIA MARINE RAILWAY.

HOW TO MAKE A SIMPLE SPLIT PULLEY.

Sir Charles B. Elliott, general manager of the Cape Government Railways (South Africa), recently paid a visit to this country and called upon the editor of the SCIENTIFIC AMERICAN, and he described an easily constructed split pulley which he had built, and he has given us the following description:

Take two pieces of hard wood and saw them into two semicircular disks, *A B C D* and *A E D*. The diameter, *A D*, may be 15 inches or any other diameter that may be required. The thickness of the wood may be 3 inches, or any other suitable thickness.

Make two rectangular holes about 3 x 1 inches in the upper disk, *F G* and *H I*. These holes should be just large enough for a 3-inch bolt to slip in easily. In the lower disk, *A D E*, cut two holes, *J*, *K*, about 1 x 1 inch, just large enough for the nut of a 3-inch bolt to slip in, so that when the bolt is screwed into it the nut will not turn round. Bore a ½-inch hole between *F G* and *J*, and another between *H I* and *K*, so that a 3-inch bolt may be inserted in *F G* and screwed into the nut at *J*. Bore a hole from *B* to *F*, large enough for a narrow screwdriver to be inserted, so as to screw the bolt into the nut. For this purpose the square edges under the head of the bolt should be filed or turned down, and the head of the bolt should have a slit sawed into it with a hack-saw, to receive the screwdriver. An iron washer, *L*, should be inserted under the head of the bolt. A similar hole



AN EASILY CONSTRUCTED SPLIT PULLEY.

should be bored at *C*, and another bolt screwed into the nut at *K*, with a washer, *M*, under the head of the bolt.

Before finally bolting the two disks together, it is well to place either a piece of veneer or a piece of thin pasteboard between the two disks. When they are firmly bolted together a hole should be bored in the center, the exact diameter of the countershaft on which the pulley is to run. The two disks may now be separated, the veneer or pasteboard removed, and the two disks should again be firmly bolted together on a mandrel the exact size of the countershaft, placed between the lathe centers, and be turned up to the exact dimensions required, rounding off the edges, and finishing with sandpaper. A side view of the finished pulley is represented in the engraving. The disks may be again separated and bolted onto the countershaft.

If the pulley is required to have two or more steps, four instead of two bolts may be used; and these will be sufficiently strong to hold the pulley firmly to the countershaft.

Nature of Lightning.

K. R. Koch (Physikal. Zeitschr.) has found that lightning conductors whose connections have become imperfect through rusting or otherwise, act, nevertheless, in quite an efficient manner in the case of a thunderstorm. This is, in his opinion, due to the oscillating character of lightning discharges. Electromagnetic waves are produced, which act upon the imperfect connections as upon a coherer, restoring their conductivity for a more or less long period. Lightning has hitherto been considered a continuous discharge, which often becomes apparently oscillatory by quick repetition. The author employs a rapidly revolving camera in order to test this question, but does not arrive at any definite conclusion, as the flashes photographed were all too distant.

One of the largest American manufacturers of street and railroad cars is to build a factory in England.