raise a weight of 14,151 pounds 3.33 feet high, the weight being attached directly to the end of the piston rod, as shown in Fig. 9.

Now, it must be readily understood that the mean effective steam pressure on each square inch of piston will lift a portion of this weight of 14,151 pounds, and the amount that the pressure per square inch of piston will lift is 90 pounds, hence, dividing 14,151 pounds by 90 pounds, we have $\frac{14,151}{90} = 157.2$ square inches. This means that the total piston area must be 157.2 square inches. But we have two cylinders; therefore $\frac{157.2}{2} = 78\ 6$ square inches in the area of one piston; and a piston having an area of 78.6 square inches, must be 10 inches diameter. Hence a locomotive having four driving wheels, with 20,000 pounds placed upon them, the driving wheels being 45 inches in diameter, and a meam effective steam pressure of 90 pounds per square inch, will require cylinders 10 inches in diameter and 20 inches stroke.

Here we have calculated the diameters of the cylinders suitable for a given weight placed on the drivers. We may reverse the order of calculation, and find the necessary weight that must be placed on the drivers, when the dimensions of cylinders and diameters of driving wheels are given.

EXAMPLE 5.—The diameters of each cylinder is 10 inches; stroke, 20 inches; diameter of driving wheels, 45 inches; mean effective steam pressure, 90 pounds per square inch of piston. What is the tractive power of such an engine? And how much weight must be placed on the drivers?

The area of a piston 10 inches in diameter is 78.54 square inches. Multiplying the area of the piston by the steam pressure per square inch, we have 78.54 X 90 = 7058.6 pounds total steam pressure on one piston; but there are two pistons, hence 7068.6 X 2 = 14137.2 pounds, which is the total steam pressure on both pistons. The stroke is 20 inches, and during the time that the wheel makes one turn, the piston has traveled through twice the length of the stroke, hence 20 X 2 = 40 inches, or 3.33 feet, which is the distance through which the piston has traveled during one revolution of the wheel. Multiplying the total steam pressure on the pistons by 3.33 feet, we have 14137.2 X 3.33 = 47076.876 foot-pounds, or units of energy the cylinders can exert during one revolution of the wheel. The driving wheels are 45 inches in diameter, hence the circumference of each wheel will be 141 37 inches, or 11. 78 feet.

A CURIOUS OPTICAL ILLUSION.

Which is the tallest of the three persons figured in the annexed engraving? If we trust to our eyes, we shall certainly say it is No. 3. But if we take a pair of compasses and measure, we shall find that we have been deceived by an optical illusion. It is No. 1 that is the tallest, and it exceeds No. 3 by about 0·080 inch.

The explanation of the phenomenon is very simple. Placed in the middle of the well calculated vanishing lines, the three silhouettes are not in perspective. Our eye is accustomed to see objects diminish in proportion to their distance, and seeming to see No. 3 rise, concludes therefrom that it is really taller than the figures in the foreground.

The origin of the engraving is no less curious than the engraving itself. It serves as an advertisement for an English soap manufacturer, who prints his name in vanishing perspective between each of the decreasing lines, and places the cut thus formed in a large number of English and American newspapers. The soap merchant completes this curious advertisement by giving a name to the three figures. No. 1 is Lord Churchill, No. 2 is Salisbury, and No. 3 is Gladstone.—*La Nature.*

ROLLED gold is thus manufactured: An ingot of brass is cast and while it is yet hot a thin layer of gold alloy is poured upon it. When the ingot thus covered becomes cold it is forced between steel rollers until a long thin ribbon is produced, of which the proportion of gold and brass is, of course, the same as that of the ingot. The percentage of gold is often reduced very low—sometimes to two and three per cent. This rolled gold in cheap bracelets and watch chains lasts for ten years.

HOW SMOKE IS FORMED.

The following are the views of a correspondent in the London *Iron* on this subject.

"It is well known to every one that when fresh coals are placed on a fire in an open fire-grate, smoke arises immediately and the cause of this smoke is not very far to seek, as it will be easily understood that before the fresh coals were put upon the fire within the grate, the glowing coals radiated their heat and warmed the air above, and thereby enabled the rising gases at once to combine with the warmed air to produce combustion; but when the fresh coals are placed upon the fire they absorb the heat and the air above remains cold.

"By gases, I mean the gases arising from coals while on or near a fire; and it may not be known to every one that we do not burn coals, oils, tallow or wood, but only the gases arising therefrom. I can make this clear by the lighting of a candle, which will afford all the information required. By lighting the candle fire is set to the wick, which by its warmth melts a small quantity of tallow below; and this melted tallow is directly absorbed by the capillary tubes of the wick, and thereby so very finely and thinly distributed that the burning wick has heat enough to be absorbed by the small quantity of dissolved tallow to form the same into gases, and these gases burning, combined with the oxygen in the atmosphere, give the light of the candle. A similar process is going on in all other materials; but coal contains already about 17 per cent. in weight of gases, which liberate themselves as soon as they get a little warm. The smaller the coal, the more rapidly will the gases be liberated, so that in many cases only part of the gases are consumed.

"To return to the subject, the fact is that the volatile rising gases from the coal cannot combine with the cold air for combustion, still a combination does take place in the following way: The cold air in the act of combination, absorbs a part of the warmth of the rising gases, which they cannot spare, and therefore must condense, so much so that all particles are formed, which aggregate, and are called smoke, and, when collected, produce soot; but so long as these particles and gases are floating they cannot burn or produce combustion, as they are surrounded by a tin film of carbonic acid. It is only when collected and the acid is driven off that they burn rapidly.

"I have now shown that cold air is the cause of smoke, which may be greatly reduced by care. In the open fire-grate the existing fire ought to be drawn to the front of the grate and the fresh coal placed behind or on the back of the fire. The fire in the front will then burn more rapidly, warm the air above, and prepare the rising gases for combustion. In this way smoke is diminished, as the gases from the coals at the back rise much more slowly than when placed upon the fire and the air partly warmed. The same process may be applied to kitcheners, thereby almost entirely preventing smoke after the first lighting. For stoves and boilers, warm air may be produced for the entire combustion of all gases."

Miscellaneous Notes.

—THE Trinity House committee, has, for the past twelve months, been making experiments to decide upon the relative merits of gas and electricity as lighthouse illuminants. It has been found that, for ordinary purposes mineral oil is the most suitable and economical illuminant, while for prominent points, electricity affords the greatest advantages.

SMALL articles, such as clock, drawer, piano tuning and door keys, rings, buckles, spurs, etc., are made of cast iron in sand moulds, exactly as the most massive castings are turned out. Ornamental "steel" articles, such as hair pins, shawl clasps, etc., are made of cast iron. So small are some of these castings that it takes more than one hundred to make a pound, and the sand used must be carefully sifted to find all the results of the day's casting.

THE population of the State of Nevada has dwindled down to 12,000 in consequence of the collapse of the mining interest, and there are scarcely enough inhabitants left to maintain a State government. The saltpetre beds, however, may induce a fresh immigration, and add to the population. The deposits are very favourably situated for working, being in the vicinity of a rich farming country, with an abundant supply of wood and water close at hand.