

time, describe the vertical axis of the ordinates; and if, on the contrary, the cannon recoiled before the piston began its movement, the style would describe a portion of the horizontal axis of the abscissas before beginning to trace a portion of the curve. Now in reality we always find that the trace of the style, forming the curve of recoil, detaches itself clearly and mathematically from the very angle formed by the meeting of the two axes, thus demonstrating that the recoil commences precisely at the moment when the piston (and consequently the projectile) begins its motion; and this takes place even in rifled cannons whose projectiles are provided with bands which are forced into the grooves; although it might have been expected that in these cannons the piston, which is free in its socket, would rather have begun its movement a little before the projectile.

It is hardly necessary to point out all the applications that may be made of the accelograph. It need only be said, in conclusion, that it can evidently be employed in the observation of other phenomena than those attending the combustion of gunpowder. It has, for example, already been used for measuring the variations of pressure that take place, at the moment of firing, in the cylinders filled with water and

mission of a small quantity of fluid down a tube leading to the bag or vessel containing the chemicals, or by liquefying the gas and liberating the liquefied gas into the vessels. The costliness and uncertainty of these methods, in deep water, led Mr. Brown to the use of combustible compositions for the purpose.

A suitable composition is gunpowder, or a mixture of nitrate of potash, nitrate of soda, nitrate of baryta, or other oxygen-bearing substance, and carbon, together with some such substances as red ocher, whiting, or glycerine. These, on combustion, give off a definite volume of gas, which is used for inflation. The purpose of the whiting or red ocher or glycerine in the composition is to regulate the speed of combustion. If four parts of nitrate of potash, one of carbon, and one of whiting be used, the resultant gas is mainly carbon monoxide, which is lighter than air, and has not been liquefied, and the speed of combustion is not too quick. If sufficient nitrate of potash is employed, the resultant gas is principally carbon dioxide. But carbon monoxide is preferable because: (1) It is lighter than the other; (2) its evolution is accompanied by less heat; (3) it can be used under great pressure, without liquefaction. Four parts of nitrate

being first connected to the vessel by chains or ropes, he uses the apparatus shown in section at Fig. 3, and in which *a* is the gas chamber, *b* the tube containing the combustible composition, and which is so secured to the cover of the chamber, *a*, that it can be readily removed for recharging. This buoy and its attachments are lowered to the submerged object by the opening of a cock or valve, *n*, on the top of the vessel, *a*, whereby the air is released from it, and water enters at the lower part, and so the apparatus sinks. The water is prevented from entering the perforations, *v*, by a waterproof band, *b*<sup>2</sup>, but which gives way on the firing of the charge. The buoy being connected with the submerged structure which is to be raised, the cock, *n*, is closed, the current from the battery is transmitted, and the composition ignited. The gas being evolved passes out through the perforations, *v*, in the tube, *b*, and at the upper part of the chamber, *a*, displacing the water. The buoy will consequently exert a lifting power proportionate to its displacement. The superfluous gas (should there be any) escapes at the lower end by the water.

A convenient apparatus, specially adapted for the lifting of large objects, is shown in transverse section at Fig. 4, where *a* is the shell of the iron vessel, or lighter; *b* the combustible composition chamber, having perforations at the upper part which may be closed against the admission of water in any convenient way; *c* are doors or clacks at the bottom, opened by rods, *p*. The advantage of this apparatus is that it puts large lifting power into a form which allows of convenient handling. The vessel, or lighter, shown in section, may be sailed or towed to the place where it is required, and sunk upon or near the object to be lifted.

Submarine engineers who have had experience of rough-surfaced and swift waters will appreciate the advantages of a system which enables them to place the lifting-power close to the work to be done, and which, besides this, substitutes the electric wire for the flexible hose and pumping engine. We understand that a number of practical experiments have been carried out with Mr. Brown's invention, which have proved both its practicability and utility, thus giving hope of its commercial success. We may add that Mr. Brown has also patented the application of his system to the propulsion of torpedoes, the same being effected in a manner as ingenious as his other inventions.—*Iron*.

#### GOVERNORS FOR MARINE ENGINES.

By W. T. CLARK, Rugby, and W. H. ASHWELL, Bedford, England.

FOR marine purposes the improved governor consists of a cylinder which is in direct communication with the sea through an opening in the stern of the ship. Within the cylinder is an inner vessel connected by a rod to levers or cranks for working the throttle valve of the engines, so that while the water outside the ship covers the blades of the propeller the cylinder is filled with water, and the inner vessel being thereby raised, the full pressure of steam is admitted to the engines; but when the vessel pitches and the

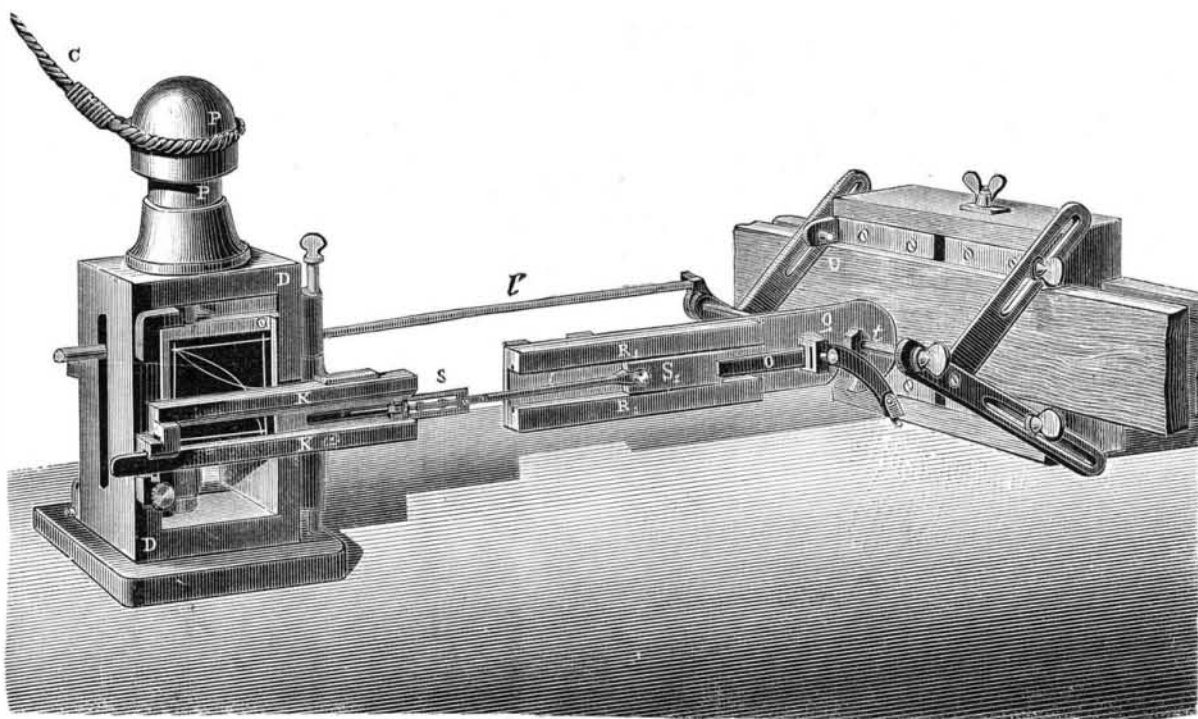


FIG. 9.—DETAILS OF APPARATUS SHOWN IN FIG. 8.

### THE ACCELOGRAPH.—AN APPARATUS FOR MEASURING THE PRESSURE OF GUNPOWDER

air, or water alone, which serve as brakes in the new hydraulic carriages for guns of large caliber.

In all these applications for measuring pressures suddenly developed it has the advantage over the ordinary manometric apparatus in use in being able to register rapid oscillations of pressures, this being something that the latter are powerless to accomplish. But it gives these pressures only in an indirect way and by the aid of delicate readings and pretty long calculations.

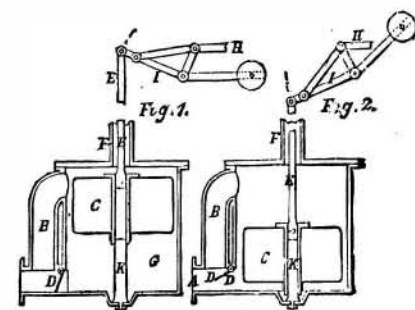
#### RAISING SUBMERGED VESSELS.

CONSIDERABLE ingenuity has from time to time been brought to bear upon the subject of raising sunken ships and other submerged objects. The latest, but by no means the least ingenious, of the numerous inventions for effecting this object is that devised by the Rev. Cowell Brown, of Ellesmere Road, Sheffield, who is the inventor of the "Nautilus" apparatus, a very simple and efficient means of saving life from drowning. Mr. Brown's present invention relates chiefly to a special means of inflating apparatus for raising submerged objects. Hitherto it has been proposed to use airproof bags under water, the bags being inflated by air, and in some cases by gases generated in the bags themselves by bringing together certain chemical substances, or by the ad-

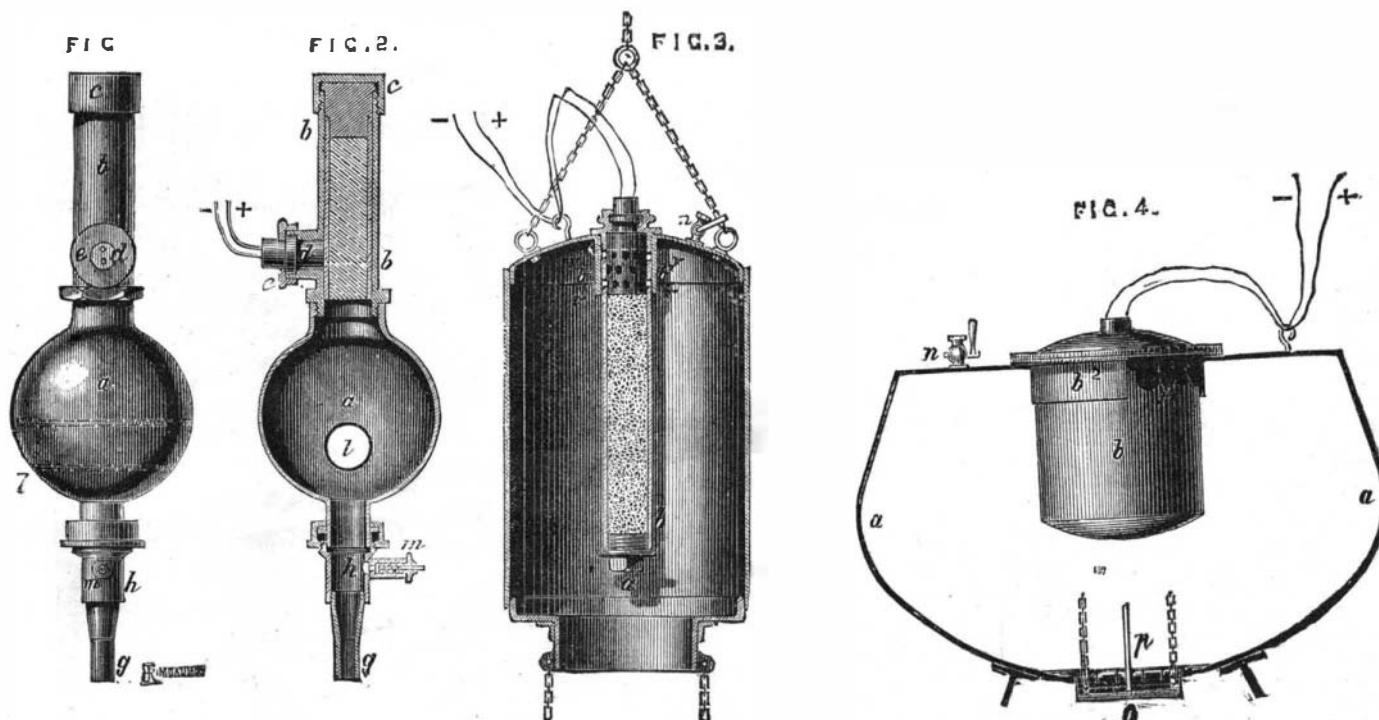
of potash, with one of carbon, slightly moistened with glycerine, is also a suitable compound; likewise gunpowder ground into a stiff paste with glycerine. Where large quantities of gas are required, as in the case of floating docks, coal dust and nitrate of soda may be employed. The mixture may be fired by electricity, percussion, or time fuse.

Figs. 1 and 2 of our engravings show the apparatus for inflating flexible pontoons. It consists of a spherical chamber, *a*, with a metal tube, *b*, screwed into it, as shown in section at Fig. 2. This tube, *b*, contains the combustible charge, and is closed water-tight by a cap, *c*; *d* is a plug of non-conducting material through which the wires pass; it is secured by a cap, *e*, which screws on to a hollow projection on the tube, *b*. The flexible pontoon to be inflated is connected to this apparatus by the nozzle, *g*. On the ignition of the charge the evolution of the gas instantly commences, and the hot gas evolved is rendered perfectly cool by coming in contact with the inside surface of the chamber, *a*, and with the water-tube, *h*, which passes through the chamber. The tube, *h*, is provided with a safety valve, *m*, so that the surplus gas may escape without the fear of the bag or pontoon bursting.

In displacing water contained in submerged rigid buoys or pontoons to which Mr. Brown's apparatus is connected for the purpose of raising submerged bodies, the pontoon



propeller emerges, the water in the cylinder will run off and the inner vessel will descend, thereby imparting a pulling motion to the rod which closes the throttle valve and stops the supply of steam to the engines; the object being to prevent the "racing" of the engines when, from the pitching of the ship, the propeller is temporarily relieved from work. There are two arrangements described for effecting this part of the invention, and another arrangement applicable for stationary engine governors. The illustration shows the cylinder and inner vessel referred to. The port, *A*, is open to the sea, and the water entering therein closes valve, *D*, and passing up port, *B*, fills the cylinder and causes the inner vessel, *C*, to rise on its guide, *K*, and impart an upward stroke to the rod, *E*, thereby com-

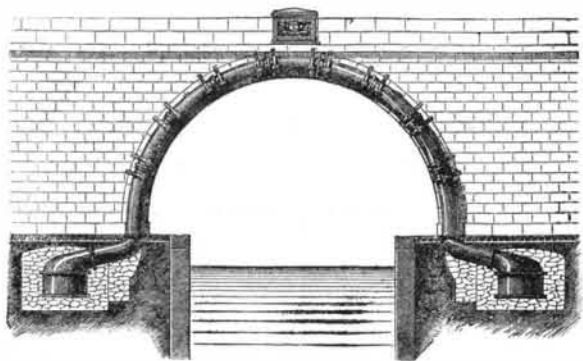


### APPARATUS FOR RAISING SUBMERGED VESSELS.

municating the opening motion to the throttle valve through the crank, I, and connecting rod, H. When the sea recedes from the propeller the water escapes from the cylinder by valve, D. For governors for stationary engines a current of water is forced by a rotary pump beneath a piston weighted by a spring or weight, the piston rod either imparting direct action to the throttle valve or operating the slide valve of a steam or hydraulic cylinder for the same purpose.

#### SIPHONS FOR SEWERS.

In the construction of sewers, it is often necessary to carry them through water-courses. Hitherto there has usually been employed for this purpose an immersed siphon on a system proposed by M. Belgrand. But this arrangement, in addition to the trouble and expense attending all constructions under water, has the grave inconvenience that, although it does very well for clean water, it is apt to get choked up when used for sewage purposes, owing to the deposition of solid matters in the lower parts of the inverted siphon. A new solution of the difficulty has recently been devised by M. Lévy, engineer in chief of Ponts et Chaussées, Paris, and described by him in a paper communicated to the French Academy. It became a question of leading the sewage waters from Bercy to the other side of the Canal Saint-Martin. For this purpose, M. Lévy constructed a true siphon *over* the stream, and one in which by a peculiar arrangement, it is impossible for solid matters to accumulate at any point whatever. This siphon is a tube of large diameter backed with masonry and exhibiting nothing peculiar in its construction, the interest and novelty connected with it being the method adopted to keep it charged. At the top of the siphon the pressure is only one-fifth atmosphere, and consequently the disengagement of the dissolved gases is quite notable, and had not tromps been utilized to draw these off the siphon would have emptied itself very rapidly. The tromps used are actuated by the city water, which, at this point, has a very strong pressure. As well known, these apparatus, which are now frequently used in laboratories, permit the rarefaction of air or gases to be carried to a high point. A preliminary experiment with a tromp of suitable size showed that it would draw off the quantity of gas disengaged during a flow of two cubic cen-



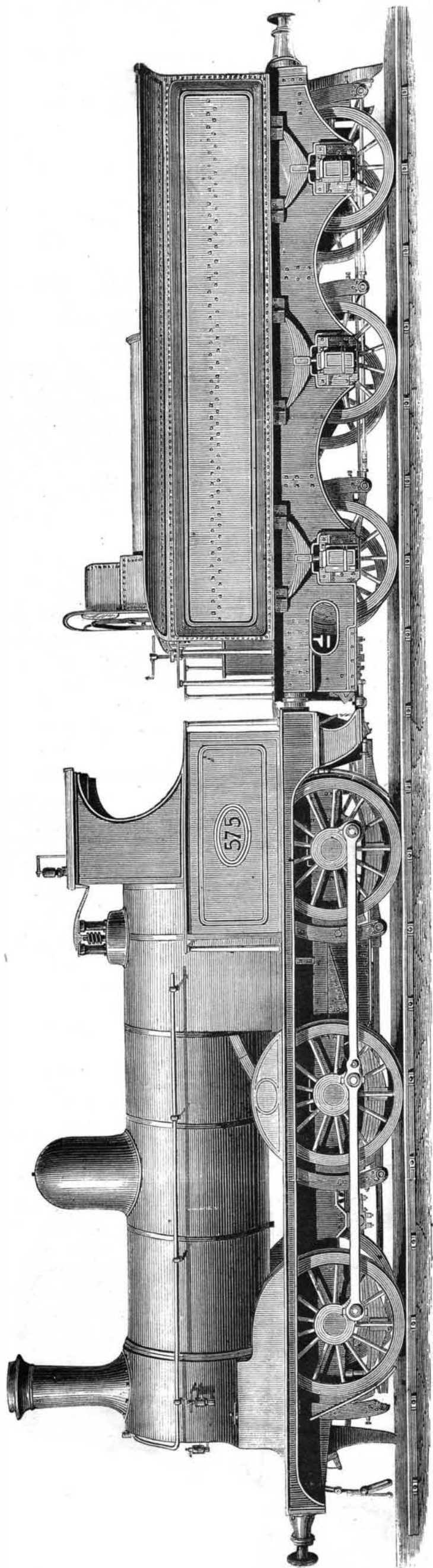
SEWAGE SIPHON OVER THE CANAL SAINT-MARTIN.

timeters per second. For the sake of greater security, however, M. Lévy constructed three tromps which were capable with certainty of keeping the siphon charged, even during a flow greater than the normal one. When the flow reaches a certain amount, however, recharging is no longer necessary, the velocity with which the liquid flows being amply sufficient to draw along the gases naturally. As it is useless to keep the tromps in constant operation, since their action is only necessary when it is feared that the siphon is about to empty itself, M. Lévy devised a valve which is capable of being moved automatically by a float. This valve, when the quantity of gas disengaged is small, closes the orifice of the tromp, and opens it when the quantity becomes great enough to stop the operation of the siphon. By this ingenious arrangement a great saving is effected in the use of water. Although there are three tromps, one is sufficient to keep the siphon charged, the three together being set in operation only when the siphon has become emptied by any cause whatever. As it was feared that the sewage waters containing solid matters in suspension might be sucked into the tromps and thus obstruct them, a chimney was constructed to a height of thirty-four feet above the level of the canal and closed on every side, and at the top of this is located the tube which puts the siphon in communication with the tromps. As even in a perfect vacuum water can rise only to a height of thirty-four feet, there is no fear that the suction pipe will ever be entered by the matters above mentioned. The siphon here described has now been in operation since the 10th of last March, and has thus far worked satisfactorily. The engineering problem which has been solved here is of course applicable only in cities provided with a supply of water having considerable pressure.

#### SIX-COUPLED LOCOMOTIVE.

We illustrate here one of fifty goods engines recently ordered by the Lancashire and Yorkshire Railway Company, constructed by the Vulcan Foundry Company, Newton-le-Willows, from the designs of Mr. W. Barton Wright, locomotive superintendent, Lancashire and Yorkshire Railway. The cylinders are  $17\frac{1}{2}$  in. diameter, with a stroke of 26 in. The wheels are 4 ft. 6 in. diameter and the wheel base 15 ft. The grate surface is large— $19\frac{1}{2}$  square feet. The heating surface of the tubes is  $943\frac{1}{2}$  square feet, and that of the fire-box  $90\frac{1}{2}$  square feet—total, 1,034 square feet. In sixteen engines the boiler is to be of Lowmoor, and in sixteen engines of Bowling iron, and the remainder may be made of either one or other. The inside fire-box and the stays to be of copper; the tubes are to be of iron with 6 in. of solid copper tube brazed on at the fire-box ends. The tender is peculiar; it is fitted at the front end with Sharp's patent arrangement of cab, tool box, and filling hole combined. The wheels are 3 ft.  $1\frac{3}{4}$  in. diameter; the engine and tender will be fitted with Hardy's vacuum brake. —*The Engineer*.

THERE is a tree in Virginia called Mountain Mahogany, of a rich red color and very hard. When used for fuel it produces such intense heat as to burn out stoves more rapidly than any coal. It blazes as long as ordinary wood would last, and then becomes converted into a sort of charcoal that lasts twice as long as ordinary wood.



SIX-COUPLED GOODS ENGINE, LANCASHIRE AND YORKSHIRE RAILWAY.

CONSTRUCTED BY THE VULCAN FOUNDRY COMPANY, NEWTON-LE-WILLOWS, FROM THE DESIGNS OF MR. W. BARTON WRIGHT, LOCOMOTIVE SUPERINTENDENT, LANCASHIRE AND YORKSHIRE RAILWAY.