placed by five locks; at Little Falls the four present locks are replaced by three enlarged locks; at Newark, the three locks of the present canal are replaced by one lock, and at Lockport the present five locks are replaced by three double locks. These and other changes in the number and type of locks reduce the total number on the entire canal, from the Hudson River to Buffalo, from 71 to 44 locks, making a decided reduction in the time necessary for passage of boats between those points, and effecting, of course, a material difference in the cost of maintenance and operation.

As we have already explained, the canal between Troy and Rexford Flats will lie almost continuously in the bed of the Hudson and Mohawk rivers, the change of elevation from one river to the other being secured by diverting the canal to the shore at suitable locations and building the locks in the rising ground. While the river presents more than sufficient width for canal purposes, it will have to be dredged to give the necessary depth. The section of the canal where it lies in the beds of the rivers will be 200 feet wide on the bottom, and must present at all stages at least 12 feet of water. The section on the Erie Canal itself will be that which was proposed in what is commonly known as the Nine Million improvement of 1895-6, and is shown in the accompanying drawings. In general this section is 50 feet wide on the bottom, with side embankments of 1¼ to 1, and a depth of 9 feet, except over aqueducts and permanent structures, where 8 feet of depth is provided for. The proposed improvement includes the cost of additional water supply for the summit level between Utica and Syracuse, which is secured by building reservoirs on various streams that lie to the south of the present Erie Canal.

From an engineering point of view, the most interesting part of the proposed reconstruction is the splendid flight of locks which is to be built at Cohoes to enable the canalboats to surmount the obstacle presented by the Cohoes Falls. The appearance of the locks is shown very clearly in the accompanying perspective view. The total difference of level between the Hudson and Mohawk rivers of 121 feet is overcome by three lifts of about 40 feet each, instead of the sixteen lifts which are necessary in the present canal on the westerly side of the river. The locks, which are built of concrete and masonry, are 328 feet long between the hollow quoins and 28 feet wide in the clear. The operation of locking is so well understood that it needs no detailed description here; but we may briefly state that the water is led from lock to lock by gravity through culverts which are built in the solid masonry, one on each side of each lock and parallel to its axis. These culverts are of the arched type, 5 feet in width and 7 feet in height. The water is led from the culverts into the chamber by means of two cast-iron pipes on each side. These pipes are 2 feet in diameter and 8 feet in length. The water supply to the culverts is controlled by butterfly valves at each end of the culvert.

The passage of a barge through the locks is as follows: After the barge has entered the first lock, the pair of miter gates behind it is closed, and the culvert valves are opened, allowing the water to flow from the first to the second chamber until it is at the same level in both. The miter gates separating the two chambers are then swung open, the barge passes through, the gate is closed behind it, and the second set of culvert valves is opened, repeating the process between the second and third chambers. These operations are repeated until the barge has passed through the whole series. The gates are of the type which has been used very successfully in the Canadian canals. They are 47.8 feet high, and with a full lock there will be a total pressure against each leaf of the gates of 607 tons. The gates are built of solid beams of timber, thoroughly well bolted together. Each beam is keyed to the next succeeding one, and iron rods extend through the whole from top to the bottom.

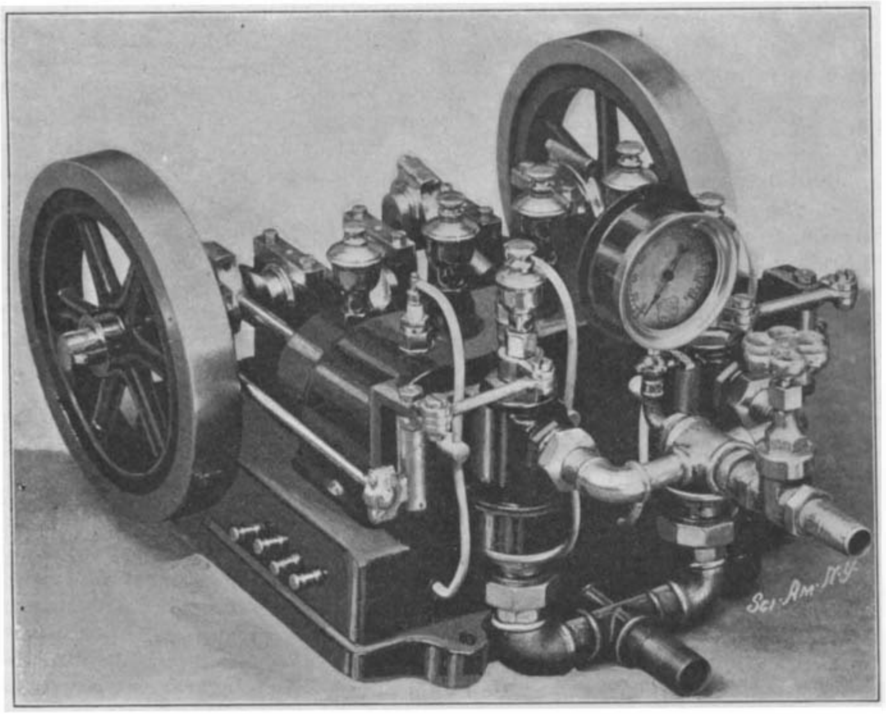
The enlarging of the canal to a depth of 9 feet and the lengthening of the locks will make it possible to greatly increase the size of the canalboats, or barges, as they will then be called. Instead of the present boats, capable of carrying only 240 tons of merchandise or 8,000 bushels of wheat, the canals will accommodate boats with a capacity of 800 tons or 30,000 bushels of wheat. Moreover, the time of transit from Buffalo to New York will be reduced from 430 to 400 hours, a saving of a day and a quarter, while it is estimated that the capacity of the canal will be increased from 3 1-3 tons an hour to 9 tons, about trebling the capacity.

A SELF-STARTING GASOLINE MOTOR OF NOVEL DESIGN.

The four-cylinder motor shown in the annexed illustration is the invention of Mr. G. Keller, of New York city. The motor is constructed somewhat similarly to a steam engine, and the adaptation of the principles of the latter to a gasoline explosive motor is the most interesting feature about it.

The gas from the carbureter enters through the main inlet pipe, on which is seen the throttle valve, and passes into each of the two valve chambers through simple, suction-lifted inlet valves, such as are found in any gasoline motor. It is then directed to one cylinder or the other by oscillating piston valves, the ports of which correspond with ports leading to the cylinders. These latter ports are also connected by the oscillating valves to the exhaust pipes seen at the bottom, when the pistons are on their upstrokes.

The oscillating piston valves that make this connection are operated by eccentrics on the motor shaft. One of these can be seen beside the right-hand flywheel, while the connecting rod of the other, with universal joint, is in plain view in the foreground. The sparking plugs are connected to two Splitdorf spark coils with vibrators, and the battery connections are seen on the base.



THE KELLER SELF-STARTING GASOLINE MOTOR.

The principle of operation of the motor is as follows: As the piston starts to descend, it begins to draw in a charge of explosive mixture. Electric sparks jumping across the gap at the spark-plug points continuously, immediately explode this gas, which drives the piston down. On the upstroke the burnt gas is exhausted, after which a fresh charge is drawn in and exploded as the piston starts to descend a second time. Thus it will be seen that we have practically a two-cycle motor that does not compress its charge. As the cylinders are four in number, 4 inches bore by 6 inches stroke, and as an impulse is obtained every one-quarter of a revolution, the motor will develop between 3 and 4 horse power at medium speeds, and will have a nearly constant torque. By compressing the gas in a small compressor (which can be located in the base of the motor) and introducing it under pressure to the cylinder, the same power can be obtained as from four ordinary two-cycle cylinders of the same size. The motor is light for its power, weighing complete about 150 pounds.

The motor, after it has been running a minute or two, can be stopped and started as often as desired, simply by switching off or on the electric current to the igniters. This was satisfactorily demonstrated to our representative by the inventor, who also ran two cylinders of the motor on gasoline and the other two on illuminating gas at the same time.

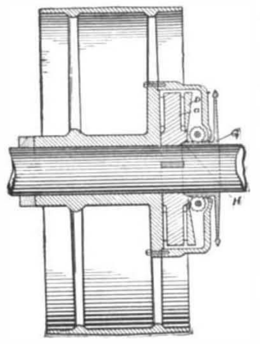
The motor can, furthermore, be run by steam or compressed air, and when so run is very powerful. A steam carriage equipped with a motor of this type would have an advantage over the ordinary vehicle of that character, in that, if the boiler should burn out, the operator could still proceed by connecting the inlet pipe of the engine to a suitable carbureter, and switching on the electricity to the spark coils and plugs.

The inventor has been four years in bringing the machine to its present state of perfection, and now makes it public for purposes of exploitation.

A GAS-ENGINE FRICTION CLUTCH.

There never has been a friction clutch absolutely faultless. The chief defects have been excessive cost of construction and inefficiency. The inventor of the friction clutch which forms the subject of the accompanying engraving has endeavored to provide a device which is intended not only to overcome the difficulties hitherto experienced, but which is also certain, easily handled, clean, self-contained, cheap, automatic, and self-adjusting. Arduous tests extending over some two years have demonstrated the efficiency of the clutch.

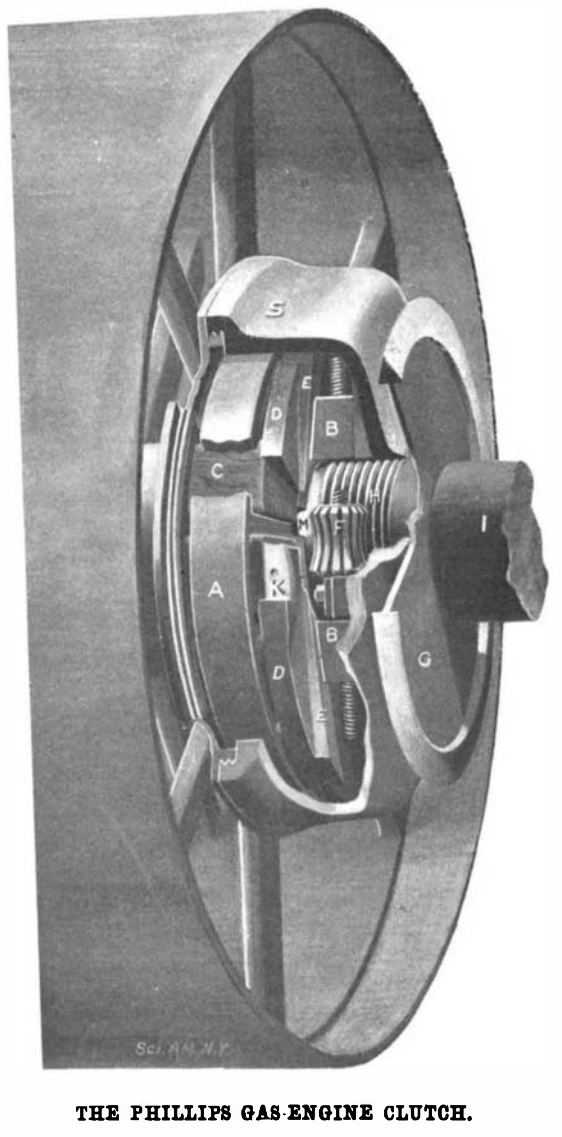
The gas-engine clutch, as its name implies, is peculiarly adapted for gas engines and clutch pulleys. In construction it comprises three principal parts—a crated disk or driver, *A*, containing the friction blocks; a pulley with a friction faceplate cast on the arms, to which the shell, *S* (Fig. 1), is secured by studs; and a starting plate or wheel, *G*.



PARTIAL SECTION.

The disk or driver, *A*, is keyed to the driving shaft. The shell, *S*, contains the worm gears, *F*, right and left hand screws, and wedge blocks, *B*, which work on the inclined planes of the friction plate, *D*. This plate is held tightly in place against the wedge blocks, *B*, by means of two coiled springs (not shown), and is carried around by lugs in the inside of the shell, which lugs fit into notches, *K*, on the edge of the plate. To the starting plate or wheel, *G*, a worm sleeve, *H*, is attached, having a bevel end, which end is in contact with the beveled opening of the crated disk, as shown in the diagram.

The starting and stopping mechanism comprises a lever (not shown), on one end of which is a small brake-shoe, formed with a V-shaped groove, fitted to the edge of the starting plate or wheel, *G*. On the outer end of the lever a sliding weight is carried. By moving the weight inwardly toward the clutch, the brake-shoe is caused to drop away from and to release the starting plate, so that the plate and worm sleeve will revolve with the shaft. The worm now turns the gears, and the resistance of the gears draws the conical end of the worm sleeve, *H*, into contact with the beveled opening of the crated disk, *A*, keyed on the shaft. This contact is sufficiently strong to turn the gears, *F*, and the right and left hand screws, thereby pushing the wedge blocks, *B B*, up inclined



THE PHILLIPS GAS-ENGINE CLUTCH.

planes, *E E*, gradually forcing the friction plate, *D*, into contact with the wooden blocks, *C*, until the load is driven. The heavier the load the greater is the resistance of the gears; hence the conical end of the worm is forced into firmer contact with the beveled