A HOME-MADE STEAM ENGINE.

BY GEORGE M. HOPKINS.

A steam engine carefully made is a piece of mechanism to be proud of, no matter what its particular design may be. A double-acting engine of good proportions with a bored cylinder and forged crank and crank shaft, and other parts made in keeping, is, of course, the better form of steam engine to make, but, as we are presuming that not every amateur has the facilities for building such an engine, a description of a simple single-acting engine which could be made by anyboy handy with tools is given. It can be made with an ordinary light foot-lathe, as no boring is required, nor is there any turning to be done that does not come within the range of such a lathe.

A view of the engine and boiler together is given, and also a sectional view showing the construction of the valve and valve-operating cam, and the steam passages in the base.

The cylinder consists of a piece, *A*, of mandrel-drawn steel tubing (which needs no boring) 2$\frac{1}{4}$ inches long and $\frac{1}{2}$ inch internal diameter. The thickness of the metal forming the tube is $\frac{1}{16}$ inch. This piece of tubing is fitted to a boss, *a*, about $\frac{1}{8}$ inch high, formed on the brass block, near one end. This block is 1$\frac{1}{2}$ inches long and $\frac{1}{2}$ inch thick, and is provided with lugs for receiving screws, by which it is attached to the base plate. In this block are formed the steam passages, *b c*, and valve chamber. The hole drilled from the front backward and forming the passage, *b*, receives the steam supply pipe, *B*. A hole is drilled from the rear end of the block forward to a point about opposite the center of the cylinder, forming with the hole, *d*, the steam duct, *c d*. Near the rear end of the block is drilled a $\frac{3}{16}$-inch hole, from beneath, which forms the valve seat, *e*, just beyond the passage, *b*. A $\frac{3}{16}$-inch hole is started at the valve seat, *e*, and continued to the top of the block. This smaller hole is counter-bored from the top with a $\frac{5}{16}$-inch drill, leaving the valve chamber. The counter-bored portion of this hole receives the plug, *f*, which is bored longitudinally to receive the valve stem, *g*, of the conical valve, *e'*. The valve stem is about 3$\frac{1}{4}$ inches long, and is provided with the adjustable collar, *h*, between which and the plug, *f*, is placed a spiral spring which tends to keep the valve normally closed. The steam passages, *b* and *c*, are closed with screw plugs, as shown.

To the steel tube which forms the cylinder is fitted a piston of cast iron. It is about 1$\frac{1}{8}$ inches long and is packed by the steam or water contained in the grooves in the piston. The upper end of the piston is slotted to receive the lower end of the connecting rod, which is pivoted therein upon a $\frac{1}{8}$-inch pin passing through the piston and lower end of the connecting rod, as shown in dotted lines in the sectional view.

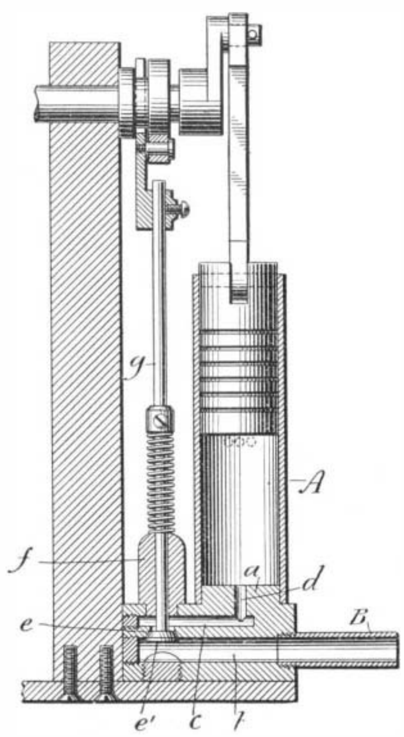
The brass block which supports the cylinder has lugs on opposite sides receiving screws which pass through them into the base plate. This plate is 4 inches wide, 5 inches long and $\frac{1}{8}$ inch thick. At the rear of the valve chamber is a post formed of a $\frac{1}{2}$-inch square brass rod 4$\frac{3}{8}$ inches long, secured to the base plate by a screw passing upward through the plate into the end of the post. A similar post is placed near the rear end of the base plate. The ends of the posts are squared in the lathe. Both posts are bored transversely near the top to receive the shaft, which is $\frac{1}{4}$ inch in diameter and 5 inches long. The space between the posts is 2 inches, and the distance between the shaft and base plate is 3$\frac{7}{8}$ inches. On the shaft, between the posts, is placed the iron flywheel, which in the present case consists of an old valve wheel 4$\frac{1}{2}$ inches in diameter, bushed to fit the shaft and fastened with a set screw.

The end of the shaft which projects beyond the post over the cylinder carries a $\frac{1}{8}$-inch crank on which is placed a connecting rod. This rod measures 1$\frac{5}{8}$ inches between the centers of the holes for the crank pin and the pin in the piston.

In the side of the cylinder are drilled three $\frac{1}{16}$-inch holes in a horizontal line, and close together to form the exhaust port of the engine, which is entirely uncovered by the piston when it is in the position shown in the engraving. The exhaust remains open for about a quarter of the revolution. This port is left exposed for clearness, but it may be covered by a hollow ring which encircles the cylinder and receives an exhaust pipe.

On the shaft is placed a cam, in whose boss there is a circumferential groove, and upon the upper end of the valve stem is placed a fork, the upper ends of which slide in the groove in the boss of the cam. A stud inserted in the fork has upon it a roller which rolls on the higher part of the cam and opens the valve at the proper instant. This cam opens the valve just before the piston reaches the lower limit of its stroke, and allows the valve to close just before the exhaust is opened by the piston.

The boiler of this engine consists of a copper float to be found in the market, made by an electrolytic deposit of copper. Such a float forms a seamless boiler capable of withstanding a great pressure, say 100 pounds. The boiler is mounted in a tripod made of band iron and is furnished with a safety valve $\frac{1}{4}$ inch in diameter, the lever of which is about 2 inches long, and graduated and weighted so that it will blow off at 35 pounds, thus insuring perfect safety. (The ordinary copper float is not recommended.) A brass steam pipe, $\frac{1}{8}$ inch internal diameter, is screwed into the safety valve casing below the valve seat, and has at its end a miniature angle valve which is connected to the engine by the inclined pipe, and by elbow and nipple which extends into the base. As the angle valve is a troublesome piece of work, an ordinary stop cock is recommended in its stead. It should be placed in the inclined pipe.



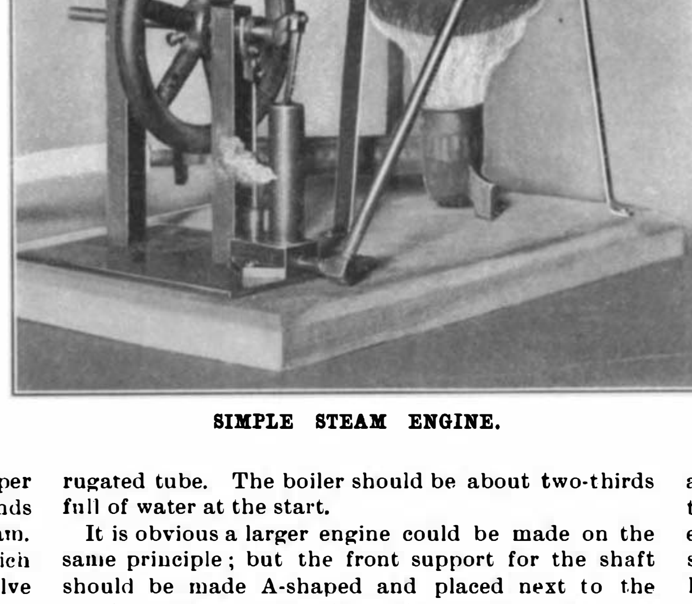
SECTIONAL VIEW OF ENGINE.

The best burner for this boiler is an Argand gas Bunsen burner like that shown. Of course an alcohol lamp will answer, but it is not as safe as the gas burner.

Both engine and boiler should be mounted on a suitable base board.

The engine is capable of making a thousand or twelve hundred revolutions per minute. It must be well balanced for this speed.

The boiler is filled when cold through the safety valve opening by means of a funnel having a slim corrugated tube. The boiler should be about two-thirds full of water at the start.



SIMPLE STEAM ENGINE.

It is obvious a larger engine could be made on the same principle; but the front support for the shaft should be made A-shaped and placed next to the crank, and the cam should be placed between the support and the fly-wheel; the shaft support would then extend over the cylinder-base.

A TOY hoop fell into a conduit at Washington recently and caused a temporary suspension of traffic. The police have prohibited the rolling of hoops in the city on this account.

THE AUTOMOBILE SHOW AT MADISON SQUARE GARDEN, NEW YORK.

The Automobile Club of America is to be congratulated on the success which has attended its first annual show at Madison Square Garden, New York. Although it was regarded as being something of an experiment, the really first-class nature of the exhibits and the excellent attendance stamped this venture as being a thorough success from the very start. The liberal floor space of the Garden was devoted to the groups of automobiles shown by the various exhibitors, and an oval track which had been especially constructed for the purpose was given up to the exhibition of automobiles in motion and to various tests of the starting, stopping and steering qualities of the automobiles. One of these trials was an obstacle race, in which the contestants had to steer their way between barrels and other obstructions which had been distributed over the course. We present an illustration of this race, and also an exhibition of the hill-climbing powers of the steam automobile manufactured by the Mobile Company. Anyone who has doubted the hill-climbing potentialities of these machines would have been greatly impressed with the trial, which was carried out on a specially prepared grade built upon the roof of the Garden. The track, which was carried on trestles, extended with a right-angle turn from the roof of the Garden to the side of the great tower, as shown in our illustration. It was built with three grades of 40, 45 and 35 feet in one hundred, and the whole distance was covered at a speed of from 5 to 8 miles an hour. The feat was performed by an ordinary machine taken from stock, the boiler pressure being about 150 pounds at the start and 145 pounds when the climb was completed. In addition to the exhibit on the main floor of the Garden a large number of machines were shown in the Fourth Avenue end of the building, and also in the Annex at the entrance, while the gallery in the main building was devoted to exhibits of automobile tires, gears, lamps, lubricants, and the various sundries of the automobile trade.

At the entrance to the Garden the first machine to attract attention was one of the massive Panhard & Levassor high-powered machines, which have figured conspicuously in the French automobile races. It is driven by a four-cylindered engine of 24 horse power. It won the Marseilles to Nice race in 1897, and in this country it has won the five mile race for gasoline-driven machines. In a trial on the Guttenburg track it has covered one mile in one minute and 27$\frac{3}{5}$ seconds. Adjoining this was a steam omnibus with accommodation for twenty passengers, shown by the New York Motor Vehicle Company. The boiler is of the Climax type and is fired with gasoline. The weight is three tons and its 25 horse power engines are capable of driving it at a speed from 8 to 12 miles an hour.

A feature which attracted much attention in the Annex was the historical collection, which made up in interest what it lacked in numbers. It served to emphasize the fact, too little known, that the automobile is by no means a modern invention. Fairly practicable steam carriages were running in England on regular schedule in the early years of the present century, and the machines in this exhibit show that from thirty to forty years ago inventors in the United States were turning their attention to the subject. A decided curiosity was a steam bicycle built by W. W. Austin, of Winthrop, Mass., in 1868. The designer had taken one of the "bone-shakers" of that day and attached a steam boiler and engine to the frame behind the saddle. The machine weighed 90 pounds and had run in its day 2,000 miles upon its iron-shod, wooden wheels. Another historic relic was the steam car built in 1860 by Richard Dudgeon. This machine was a duplicate of the first car built in 1855 and destroyed by fire at the Crystal Palace in London. Although it looked quaint beside the modern machines with which it was surrounded, the workmanship was highly creditable. The card attached to the exhibit stated that it had run 10,000 miles, and that it has been driven at a speed of 35 miles an hour. Another steam bicycle was one built by E. H. Roper, of Roxbury, Mass., in 1896. The weight of this machine is 150 pounds, and it has been run over a third of a mile course in 37 seconds.

A notable machine among the modern automobiles in the Annex which attracted considerable attention was a De Dion racing tricycle, the winner of the Paris-Toulouse race, in which for 836 miles it achieved a speed of 27 miles an hour. The maximum recorded speed of the tricycle for a short distance is 49 miles per hour. Here is also shown the A. A. Riker electric carriage, which won the Blanchet cup, covering 50 miles on the road in 2 hours 3 minutes and 30 seconds. Another historic automobile in the Annex which must be mentioned was the original Duryea gasoline carriage, which in 1895 won The Times-Herald race at Chicago.

A striking feature of the exhibition was the evidence of the increased attention which is being paid to steam as a motive power for automobiles. The