As an illustration take a freight car loaded with 40,000 pounds on a side track. To remove this a certain amount of power is required, a locomotive or possibly two or three horses. Yet a man with an ordinary pinch bar inserted between the car wheel and the rail will move this immense load, and in physical exertion only exercise about one-half a man power or less than 100 pounds pressure.

The principle of the engine is the same simple idea. The piston is the car wheel, the cylinder is the rail, and the steam is the pinch bar, constantly pinching the wheel over the rail, thus practically losing no energy in the complication of moving parts which are indispensable to the reciprocating engine. Unlike the reciprocating engine, it has a variable piston area. When the pressure is greatest the area is small and increases gradually as the pressure decreases by the expansion of the steam. This equalizes the force acting on the crank and crank pin, so that instead of a constantly varying strain, as in the case of reciprocators, there is an almost constant pressure equal from instant to instant, and always acting at right angles to the throw of the crank

THE CAS ENCINE.

By R. A. Fraser.

The question of ignition is the last factor which we may take up for consideration, and yet perhaps of all the functions in the internal combustion engine, the one of most importance—viewed from the point of getting successful results in operation—and it may be well to state here that the question of ignition is at the root of fully ninety per cent. of so-called gas-engine troubles. Space will not permit my reviewing the earlier systems, such as "flame" ignition, "hot-tube" ignition, "wipe-spark," etc., etc.

At the present time there are but two systems in general use, namely, what are known as the "make and break" and the "jump-spark" system, and but two means of furnishing the electric current, either chemically, by means of batteries, or mechanically, by means of a dynamo or magneto.

In the case of the "make and break" system, an electric circuit from a battery, or some other source of electric energy, is closed by means of the contact points within the compression space, the current passing through an inductive resistance, in the form of a spark coil, on its way from the source of energy. Upon breaking the circuit, the inertia produced by the induction raises the pressure of the circuit, and causes a hot spark to jump across the terminals. You will note that two conditions are necessary, in order to obtain a spark sufficiently hot and strong to ignite the charge, that is a comparatively strong electric current has to be available, and the mechanism of the igniter must be in good order, so as to produce a sharp break at the points. In other words, the current may be strong, but the igniter sluggish in operation, which would be fatal to obtaining a good spark, so that, in the case of having trouble with an engine it is always wise, in addition to make sure that electric current is sufficiently strong, to examine the igniter, so as to make sure that the springs have not become weakened, and it will often be found that by increasing the tension on the igniter springs the intensity of the spark can be increased, and the efficiency of the ignition mechanism materially improved.

In summing up, the strong points which go far towards efficiency in mechanical construction, are simplicity, durability, first-class material and workmanship.

Regarding simplicity, a man does not need to be an expert to appreciate the fact that the fewer number of working parts an engine, or, in fact, any machine, has and still works well, the better, as the less there is to renew, and the less renewals will cost.

Weight and speed are the two factors which make for durability. An engine must have weight, which also means

* Continued from June issue.

strength to resist the stresses due to pressure and temperature, also an engine must run at a moderate speed to live long. If two engines pulling the same horse-power are set side by side the heavier built and slower speed machine will certainly outlive the higher speed light machine.

There only remains the question of workmanship and material, and these must necessarily be of the best. The only point to emphasize is the necessity of every portion being accurately machined, and the desirability of having all parts absolutely interchangeable.

In concluding, I may just remark, that no one man or firm can combine and retain all the points necessary to produce a perfect machine. All engineering, like everything else, is more or less in the nature of a compromise, and the best we can do is to endeavor to increase our efficiency from the point we have reached by careful study and well directed effort.

A MOTOR-BOAT AND AUTOMOBILE VISE.

It is often necessary and always convenient when an unfereseen break occurs about a motor-boat or automobile to have at hand some form of vise, it being a very difficult matter to file off more than a very small amount of metal when holding the work by hand.

The Pittsburgh Automatic Vise and Tool Company of Pittsburgh, Pa., have devised a vise suitable for the many requirements of this particular work.

To the deck, floor, running board or seat is attached a



The Pittsburgh Vise.

small unobtrusive base, 1³/₄-inch in diameter, and the vise is attached to this when it is to be used. At other times it is packed away in the tool box. The vise is set in the socket, in which it is free to turn in a complete circle. As soon as the jaws are tightened on a piece of work, the vise is automatically clasped in its base and cannot move. Release the work and the vise is again free to swivel.

There is another swiveling motion. The jaws can be swung around on the axis of the screw, and, as in the case of the horizontal movement, the tightening of the jaws on the work clamps the swivel automatically. These movements make it possible to get the work into almost any imaginable position for convenience of access.

The vise has 134-inch jaws, opening three inches, weighs 33% pounds, and is finished in both nickel and aluminum.

The parts subjected to stresses are of alloy steel, and the screw is a steel forging, all parts are interchangeable. The base is so designed as not to be affected by the clogging or accumulation of mud, dirt, water or any other substance, By the use of extra bases the vise can be utilized anywhere; work-bench, shop or wherever a base can be secured.

The output of gold in the Transvaal for the month of April was valued at \$11,155,947. The coal at \$308,170; silver, \$37,659.