$$D = \frac{\sqrt{33{,}000 \times I.H.P. \times 4.}}{\pi \times p \times S}$$

The speed of the piston is the distance in feet which the piston goes per minute. The speed, of course, varies from nothing at the beginning and end of each stroke to a maximum near the middle, and the speed reckoned in the mean speed. This is obtained by multiplying the number of strokes per minute by the length of the stroke in feet. It is usual for long-stroke engines to have a greater piston speed than short-stroke engines.

Some Piston Speeds.

From some notes given to me by a designer of marine engines, I find that the piston speeds used in that type of engine vary from 600 ft. per minute up to 1,200 ft. per minute. The former is the speed used for ordinary marine engines of a fair size; the latter for engines of torpedo-boat destroyers. Large mill engines run at from 400 ft. to 800 ft. per minute piston speed; locomotive engines from 800 ft. to 1,000 ft. per minute. Obviously, the first thing that the designer of a special type of engine has to find out is the piston-speed usual to that type.

Concerning the length of the stroke, no definite rule can be given. It is usually a definite proportion of the diameter of the cylinder, and varies from about 1.5 to 3.5 times the diameter. It depends, in vertical engines, how much head-room can be spared for this purpose, and in horizontal engines it is the floor-space which must be considered.

Ratios of Cylinder Volumes.

In designing compound or triple-expansion engines, we have to determine the relative volumes of the cylinders. We must decide upon the distribution of the power between the cylinders, the range of temperature in the cylinder, and the distribution of the initial loads on the piston. In all engines in which the cylinders are not arranged to run tandem, the total power should be equally divided between the cylinders. It is also advisable that the maximum loads on the pistons should be equal. It is difficult to find any empirical rules for the relative volumes of the cylinders of compound and triple-expansion engines. One of the rules which may be followed is that if P be the gauge pressure in pounds per square inch, then we have:

$$\frac{\text{volume of L.P. cylinder}}{\text{volume of H.P. cylinder}} = \frac{4P + 40}{100}$$

This holds only for compound engines. For triple-expansion engines we get a ratio of about the following:

With steam of 120 lbs. gauge pressure the ratios of volume of H.L. to I.P. to L.P. is as 1 : 2.5 : 5; with steam pressure of 180 lbs., the ratios become 1 : 3 : 8. It must be remembered, however, that the great idea of the engine designer is to expand the steam to the lowest pressure possible, and to distribute the work done by the cylinders evenly between them.

Thickness of Cylinder Barrel.

Steam cylinders must be made of either cast iron or cast steel; the former metal is the most usual; It is now quite common to fit a liner to the cylinder. In such cases the joint at the top of the liner is made steam-tight by means of a copper ring dovetailed in a recess. The space between the liner and the cylinder barrel is often used as a steam-jacket. For the thickness of the liner we use the empirical formula:

$$t = \frac{pD}{3{,}500} + \tfrac{1}{2} \text{ for cast iron.}$$

$$\text{or } t = \frac{pD}{3{,}000} \text{ for steel.}$$

p is the steam pressure in pounds per square inch, and D is the diameter of the cylinder in inches. If no liner is used, the thickness of the barrel of the engine cylinder is found from the first of the above formulæ.

The thickness of the cylinder flange is usually about 1.25 times that of the cylinder barrel. The width of the flange varies according to the diameter of the bolts used. Enough space should be left for screwing up the nuts and to allow for the bolt heads. Studs are usually employed for cylinder covers.

Diameter of Piston Rod.

The breaking load of a column fixed at one end and guided at the other is given by the following formula:

$$w = \frac{fS}{1 + \frac{16}{9}a\frac{l^2}{d^2}}$$

Where w = crushing load in lbs.
" S = area of rod $(.785d^2)$.
" $a = \frac{1}{2{,}250}$
" l = length of rod in inches.
" d = diameter of rod in inches.
" f = crushing stress.

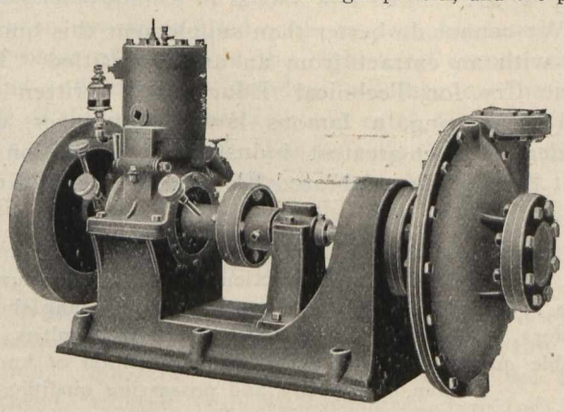
For the material of which piston rods are usually made f = 36,000 lbs. per square inch, but we allow a large factor of safety, and the value most usual is 4,000.

It is obvious that w is the maximum load on the piston.

It should be remembered that the screwed part of the rod is designed only for tension.—Engineering Times.

GASOLINE CENTRIFUGAL PUMP.

The accompanying illustration shows a gasoline centrifugal pump built by the Smart-Turner Machine Co., Limited, Hamilton. This is their standard centrifugal pattern, and the pump



shell is bolted to the hood of the base in such a manner that by simply loosening four nuts the pump may be swivelled upon its axis without detaching it from the base or without disturbing any of its rotating parts, thus allowing the discharge to be taken off at any angle, or in any direction. The gasoline engine is of the 2-cycle marine pattern, equipped with either make-and-break or jump spark ignition. It is very readily started, and as it is made up without any valves, there is practically nothing to get out of order. The speed is adjusted either by the throttle or by advancing the spark. It is so arranged that there is only one lubricator and two grease cups on the engine. The whole equipment is built in a strong and substantial manner, designed for service in exposed places. Further particulars will be cheerfully furnished by the makers.

CANADIAN GOVERNMENT OFFICES IN ENGLAND.

The Canadian Government have secured premises at 73 Basinghall St., London, E.C., where an office has been opened under the designation of "Canadian Government Trade Enquiry Branch," for the convenience of the commercial community.

In due course it is intended to equip and maintain a display room illustrating the products, resources and manufactures of the Dominion. In the meantime, a Canadian representative attends daily to deal with enquiries and applications in connection with Canadian import and export trade, and to supply information about Canadian matters generally. Personal appointments can be arranged when desired.