DIESEL'S HEAT MOTOR.

It is a well known fact that the steam engine, in spite of the splendid service which it has rendered since Watt first made it practicable, and the great advance which has been made in its construction, especially of late years, is a most extravagant machine. In the process of burning fuel in a boiler furnace to produce steam, and expanding the steam in a cylinder to secure useful work, only a small percentage of the energy stored in the coal is available as power on the shaft.

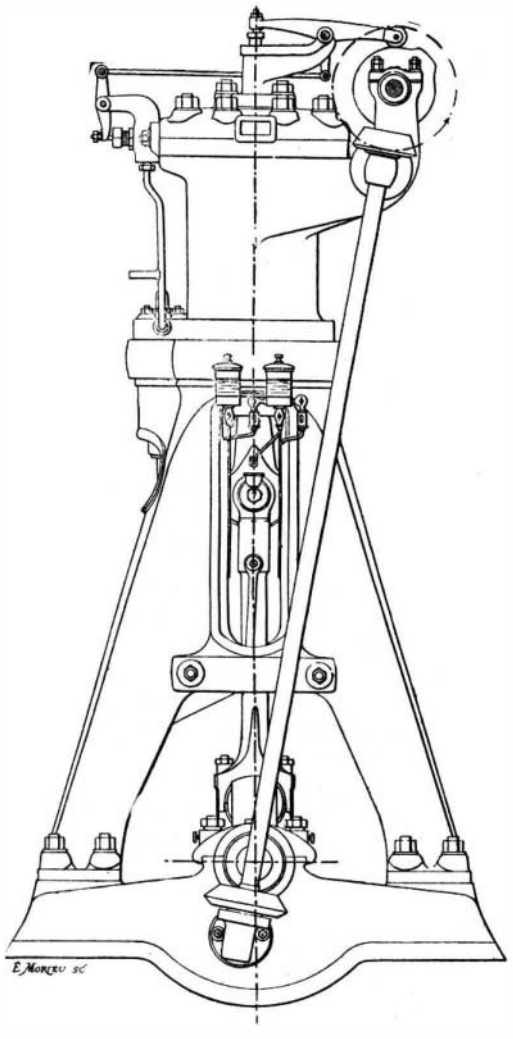


Fig. 1.—SIDE ELEVATION AND PLAN OF DIESEL'S 20 H. P. THERMIC MOTOR.

Both theoretically and by actual test it can be shown that a high pressure steam engine of the common type and the smaller sizes utilizes only from 4 to 6 per cent of the energy contained in the coal. If we test an up-to-date Corliss engine, we shall find only 8 or 9 per cent of the energy accounted for; and if we take one of the largest multiple expansion engines with the best modern improvements in condensers. cut-off, etc., the best return will be from 12 to 14 per cent of the energy contained in the coal.

The causes of this enormous loss are well known. There is a loss in the furnace through imperfect combustion, resulting in the emission of smoke from the smokestack. There is a further loss due to the impossibility of absorbing all the heat from the gases before they pass to the uptake, where in some marine boilers their temperature has been sufficient to render the base of the smokestacks red hot. There is an enormous loss due to the latent heat of evaporation—heat absorbed in the effort to turn water at 212° F. into steam at the same temperature. This heat is never, in the simple high pressure engine, returnable as work on the engine shaft. There is a further loss by condensation and re-evaporation in the engine cylinders, and a general loss at all points of boiler, engine and steam pipe connections by condensation and radiation.

An important step in the direction of economy was realized when the internal combustion motors were introduced. These, whether using gas or oil, abolish the steam boiler altogether and develop the energy of the fuel within the cylinder itself. The fuel is first introduced into the cylinder, then compressed by the return stroke and ignited. The combustion is so rapid as to amount to an explosion, and the initial pressure is much higher than that in a steam cylinder. With these motors an efficiency of about 20 per cent is realized under favorable conditions.

A further improvement, marking an advance as important in its way as that of the internal combustion motors over those using external combustion, has been made by Mr. Rudolph Diesel, of Munich. The experiments which led to the construction of the present successful machine, which is known by the name of the inventor, began in 1882, and the conditions which govern the machine were fully formulated in 1893. In the ordinary forms of gas or oil engine the charge is ignited by a jet, hot tube or electric spark, and as we have stated, the combustion is so rapid as to be practically explosive. In the Diesel motor the igniting spark or jet is dispensed with altogether, and the temperature of ignition is secured by the compression of pure air. After the air has reached the temperature of ignition of the mixture through compression, the fuel is introduced gradually into the cylinder and is burnt steadily during the stroke of the piston. The result is that the combustion is effected at a practically constant temperature.

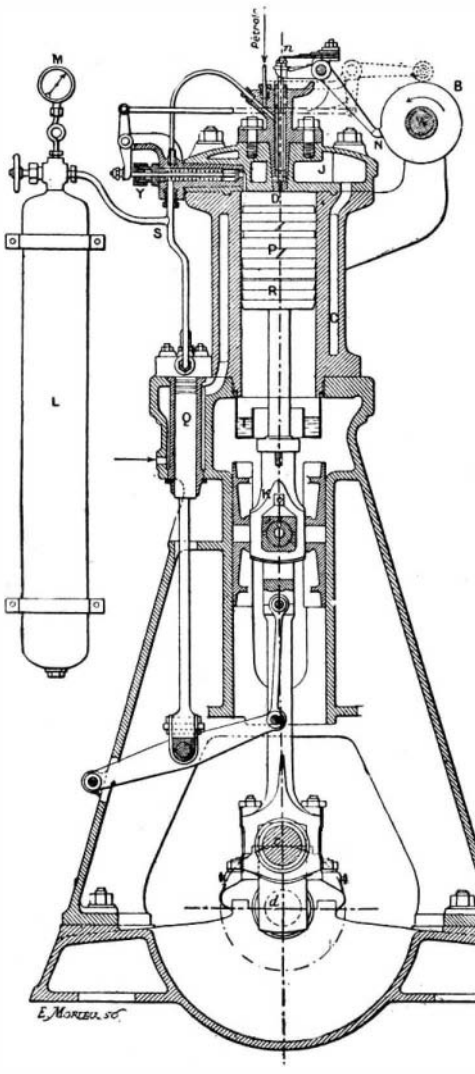


Fig. 2.—TRANSVERSE SECTION.

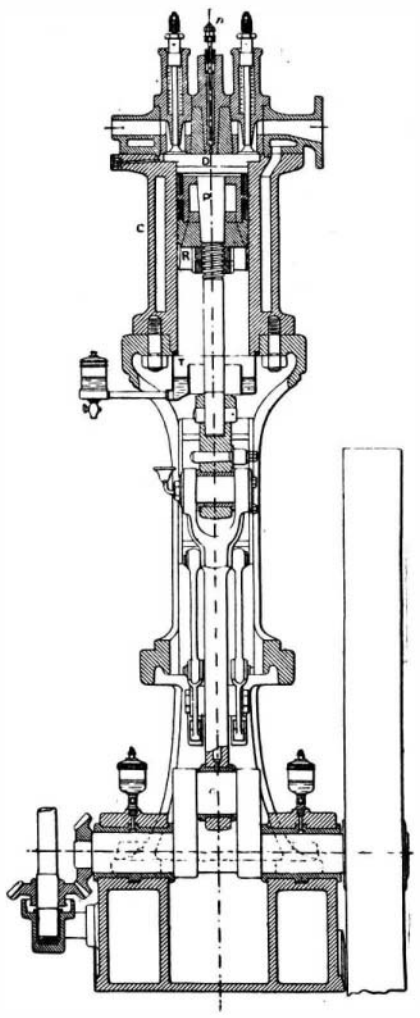
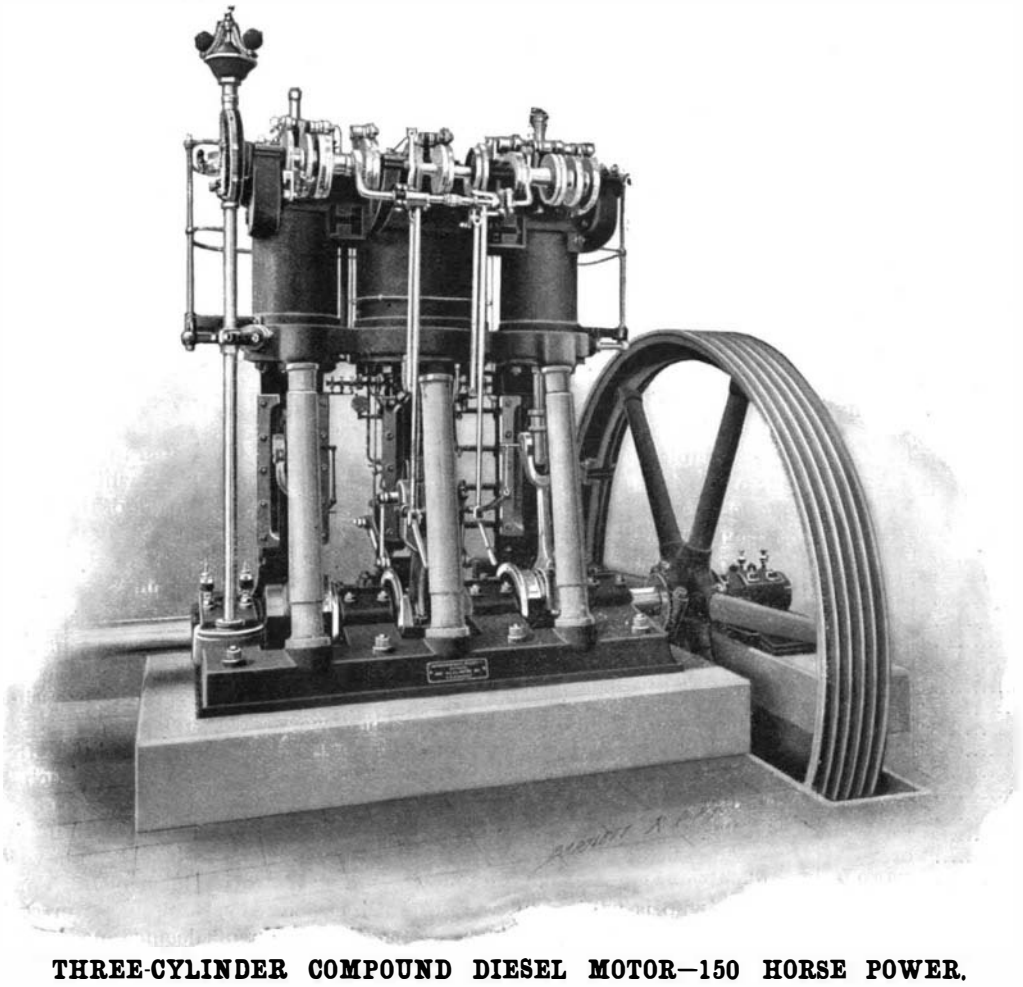


Fig. 3.—LONGITUDINAL SECTION.

We present four views (Figs. 1 to 3) of a 20 horse power Diesel motor which was tested early in 1897, by Prof. Schröter, of the Polytechnic School of Munich, when an efficiency of 34·7 per cent was realized.

The motor consists essentially of an air pump, a compressed air reservoir, an expansion cylinder, a fuel injector actuated by a small pump, and valves for controlling the pump, reservoir and the expansion cylinder. The pump compresses air into the reservoir, L, at a pressure of between 500 and 600 pounds to the square inch. This pressure is transmitted through the pipe, S, to the injection chamber, D. The fuel, kerosene, is injected into the same chamber by means of a small pump. The injection of the fuel is controlled by an injection needle valve, which rises under the action of a cam during the period of combustion. The duration of the admission, the beginning of the injection, and the pressure in the cylinder, L, may be modified according to the power to be produced. The injection needle, the admission valve and the expansion cylinder are controlled by a set of cams mounted upon a shaft near the top of the cylinder, which is driven by bevel wheels on the main shaft and has an angular velocity equal to half that of the driving shaft—a condition required by the four cycle operation of the expansion cylinder. There are five of these cams in all; two of them set the motor in operation through the compressed air contained in the reservoir and three others operate during the running of the motor. The movement of a lever shown in



THREE-CYLINDER COMPOUND DIESEL MOTOR—150 HORSE POWER.

the plan of the motor causes the cams to slide upon the shaft and places them in gear for starting or operating. In starting, the two cams above mentioned put the cylinder in communication alternately with the valve, V_1, which admits the air under pressure, and with the exhaust valve, V_2. When the pistons acquire sufficient velocity the controlling lever is thrown over, causing the cams to slide along on their shaft and assume a position corresponding to the four cycle operation. The starting cams are now out of service; of the other three, the first admits air coming from the pump through the pipe, S, the second operates the fuel injection valve at D, and the third the exhaust valve, V_2. The cylinder is cooled by means of a water jacket and it is lubricated by means of an annular reservoir, T, filled with oil, into which the lower half of the piston dips at the bottom of its stroke. From this brief description it will be seen that in the Diesel motor there is no vaporization and no special ignition of the combustible mixture. The compression of the air to about forty atmospheres raises its temperature sufficiently to cause it to ignite the kerosene which comes into contact with it gradually during the stroke of the piston. The explosion is prolonged, the expansion is isothermic and the combustion, on account of the excess of air contained in the cylinder and its high temperature, is perfect. In addition to its high economy, the Diesel motor has the advantage that the power is easily regulated by acting upon the fuel injector, and the running at a variable charge is done without any break, since the compression always raises the air to the temperature of ignition of the mixture. The motor is always ready to be started, and, as the combustion is perfect, there is no fouling of the interior of the cylinder and the odor of the exhaust gas is practically imperceptible.

We also show a perspective view of a later and much more powerful motor, with three cylinders, which is rated at 150 horse power. It works with compound compression and compound expansion and is now running in the works of the Augsburg Machine Company, Augsburg, Bavaria.

Fighting Forces of the World.

The latest addition to the military census of the world presents some queer figures. At the present time Europe has 3,500,000 men under arms. The following are the figures of the different armies on a peace footing, says The New York Sun:

	Men.
Denmark	10,000
Servia	20,000
Holland	22,000
Greece	25,000
Portugal	36,000
Roumania	47,000
Belgium	52,000
Sweden and Norway	57,000
Spain	80,000
Switzerland	125,000
Turkey	180,000
Great Britain	200,000
Italy	240,000
Austria	360,000
France	570,000
Germany	580,000
Russia	896,000

The above armies employ 550,000 horses in time of peace.

In Asia there are about 800,000 men under arms, divided as follows: Persia, 25,000; Japan, 100,000; India, 200,000; China, 270,000; and the remainder in the other Asiatic countries.

North and South America are set down as the least protected, considering the extent of territory. They foot up, on a peace footing, of course, only 160,000 regular soldiers, scattered as follows: Mexico, 40,000; the United States, 30,000; and 90,000 in Brazil, the Argentine Republic, Chile, Paraguay, Peru, Venezuela, and Colombia.

In Africa and the archipelagoes of Oceanica there are about 150,000 regulars.

The standing armies of all civilized nations amount to 4,610,000 soldiers, with 700,000 horses. The cost of keeping this military population amounts to about five billion dollars a year.

So much for the armies in time of peace. Now let us take a look at the figures in war paint. Here they are:

	Men.
Turkey	700,000
Spain	190,000
Servia	210,000
Sweden and Norway	430,000
Roumania	160,000
Denmark	60,000
Belgium	167,000
Austria (including all reserve forces)	2,000,000
Italy	3,000,000
Russia	5,000,000
Germany	4,500,000
France	4,380,000
England	660,000
Japan	500,000
South American republics	600,000
China	850,000
United States	200,000

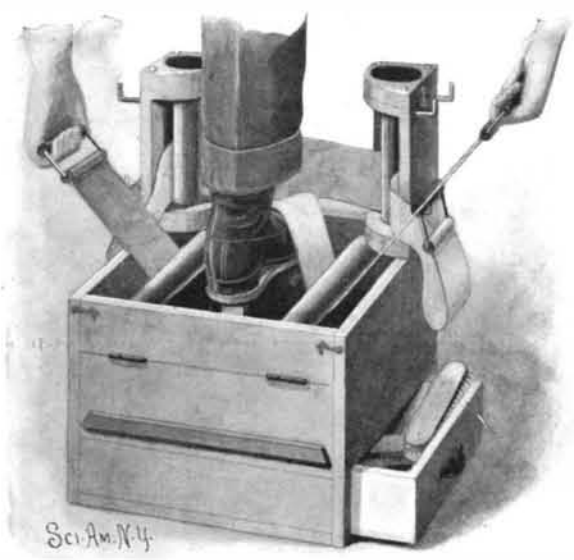
No doubt the statistician, while wading through the above flood of figures, forgot some of the National Guard of the United States, but one can easily afford to forgive him. His discoveries are interesting all the same.

Death Rate of the Spanish Army in Cuba.

Inspector-General Losada, of the Spanish forces in Cuba, recently issued his official report, says The Medical News, in which are indicated losses almost without precedent in modern times. His report shows that out of the 200,000 soldiers sent by Spain to put down the insurrection in the island from the beginning of February, 1895, to the beginning of December of the year just terminated, not more than 53,000 (a little over one-fourth) are at this moment fit for active service. The 147,000 are either dead or sent back to the motherland ill or wounded. The causes of this unprecedented death rate and sick list are (besides casualties in action) mainly three: (1) the inappropriateness of the clothing furnished to the European troops; (2) fatigue; and (3) lack of food. The report, which does not apparently err on the score of reticence, paints a lurid picture of military service in the chief Spanish colony. Under successive generals the three years' campaign, in spite of numberless royalist "victories," leaves Cuba as precarious a Spanish possession as ever; while a whole generation must intervene before island and motherland alike can recover from the loss of blood, property and treasures.

A SHOE POLISHING DEVICE.

To facilitate putting a high polish on boots and shoes, the outfit shown in the engraving has been invented and patented by Robert F. Burwell, No. 902 Chapel Street, New Haven, Conn. It comprises a box or stand having in its lower portion a drawer for brushes, dauber, etc., while in its open top is a foot rest, on opposite sides of which are rollers, one end of



BURWELL'S POLISHING APPARATUS.

the box having a hinged portion to allow of conveniently removing the rollers. Under the rollers and over the rest on which one's boot or shoe is placed extends a polishing band having handles at each end, by means of which the band may be passed rapidly back and forth over the front of the shoe. A second set of rollers is journaled in vertical posts on one end of the box, the tops of the posts being recessed to contain blacking boxes, and a band passed around these rollers and around the rear of the shoe is similarly operated to polish the heel portion.

Good Advice to Boys.

You are learning a trade. That is a good thing to have. It is better than gold. Brings always a premium. But to bring a premium, the trade must be perfect--no silver plated affair. When you go to learn a trade, do so with determination to win. Make up your mind what you will be, and be it. Determine in your own mind to be a good workman.

Have pluck and patience. Look out for the interests of your employer—thus you will learn to look out for your own. Do not wait to be told everything. Remember. Act as though you wish to learn. If you have an errand to do, start off like a boy with some life. Look about you. See how the best workman in the shop does, and copy after him. Learn to do things well. Whatever is worth doing at all is worth doing well. Never slight your work. Every job you do is a sign. If you have done one in ten minutes, see if you cannot do the next in nine. Too many boys spoil a lifetime by not having patience. They work at a trade until they see about one-half of its mysteries and then strike for higher wages. Act as if your own interest and the interest of your employer were the same. Good mechanics are the props of society. They are those who stick to their trades until they learn them. People always speak well of a boy who minds his own business, who is willing to work and who seems disposed to be somebody in time. **Learn the whole of your trade.—Ex.**

Science Notes.

Vaticana is the name given to one of the latest asteroids discovered, No. 416, in honor of Father Boccardi, of the Vatican Observatory, who has computed its course.

Roentgen rays have proved of great assistance to the surgeons of the British army in dealing with gunshot wounds among the troops engaged in the luckless expedition on the Indian frontier.

Oxford University has been obliged to lock up the books in the Radcliffe camera, where the reference books of the library are kept, owing to so many volumes being stolen. The worst offenders are said to be undergraduates preparing for examination, and the greatest sufferer the department of history.

The immense balloon hall in the barrack yard of the Berlin aeronautical department, where the steerable aluminum air ship invented by Engineer Schwarz had been stored with the sanction of the department up to two months ago, is now being torn down, as it has been decided not to resume the experiments with the Schwarz balloon.—Staats Zeitung.

High prices are paid for butterflies, and some private collections, such as that of the Hon. W. Rothschild at Tring, Herts, are said to be worth £100,000 more or less. Some New Guinea butterflies have fetched £50 apiece. One of the Rothschilds is said to have paid £200 for a Papilio, now quite common. The demand for rare specimens has led to dishonesty. The insects are dyed or else wings from one species are fastened to the bodies of other species.

The map of James Cook, 1778, was the first to bear the name "Alaska," which was a corruption of the India Al-ak-shack or "Endless land." The United States began to treat with Russia for the acquisition of Alaska under Presidents Polk (1845 to 1849) and Buchanan (1857 to 1861), and the matter was opened again in 1866 by Seward, who was then Secretary of State, and closed the transaction on March 31, 1867, Russia ceding all claim to Alaska for the consideration of $7,200,000.

M. Martel, the well known French cave hunter, has explored an "aven" or natural pit, in the limestone of the Lozère, France, with remarkable results. After descending a vertical shaft for about 200 feet, he found an immense hall, sloping downward, and at the lower end a "virgin forest" of stalagmites, resembling pine and palm trees Many of them are very beautiful, and one, over 90 feet in height, reaches nearly to the vault of the cavern. Nothing like this forest of stone has been observed in any other known cave or pit.

While almost all the civilized countries of the earth have made it a point to assist the important work of the international survey of the earth, by joining the new association for this purpose, the Argentine Republic has refused, according to the Nat. Ztg., to become a member. The fact that so rich and large a country as the Argentine Republic, with a territory of almost 3,000,000 square kilometers and a population of more than 4,000,000 people, does not want to spend a few hundred dollars annually for such an important problem has caused great surprise in scientific circles.

Agostini, the author of the beautiful monograph on the Orta Lake, has been occupied since last spring with the exploration of the volcanic lakes in the old Latium, regarding the depth of which nothing definite was known. The result of about 3,000 soundings which Agostini has taken in the Bolsena Lake, whose area is 114 square kilometers, was a maximum depth of 146 meters; the lake of Mezzano, which is situated west thereof, has a depth of 31 meters. The temperature on the bottom of the Bolsena Lake was constantly 7·1 degrees (C. ?) The investigations are being continued on the lake of Bracciano, etc.

Kutscher has succeeded in cultivating the mycelium of a fungus from decaying wood, which is strongly phosphorescent, thus proving that the luminosity of that substance is due to an organized body and not to purely chemical causes, as Hartey and De Bary have assumed. The mycelium obtained from pine trees exhibiting the phosphorescent phenomenon was cultivated in decoctions of beech bark and agar-agar, forming a white brilliantly luminous growth. The fructification of the fungus has not yet been obtained; consequently its botanical characters cannot be decided.—Jour. de Pharm. (6), vi, 504, after Zeitsch. für phys. Chem.

We regret to state that the publication of Garden and Forest has ceased with the last issue for the year 1897, which completes the tenth volume. For ten years the experiment has been tried of publishing a weekly journal devoted to horticulture and forestry and absolutely free from all trade influences. This experiment, which has cost a large amount of time and money, has shown conclusively that there are not persons enough in the United States interested in the subjects which have been presented in the columns of The Garden and Forest to make a journal of this class and character self-supporting; therefore, it was wisely deemed necessary to suspend the publication, very much to the regret of its many friends.