THE KORTING-LIECKFELD GAS ENGINE.

Among other interesting machinery now open for inspection at the International Inventions Exhibition, at London, England, is a Körting-Lieckfeld gas engine built by Messrs. Körting Bros., of London. From the illustration on the opposite page, for which we are indebted to *Engineering*, it will be seen that the engine is of the vertical type, with one cylinder. The working details are so arranged as to be easily accessible for oiling and cleaning, and are so simple in construction that a skilled attendant is not required. The cylinder is open at the top, and, besides being used as the working cylinder, also answers the purpose of a pump to draw in and compress the charge of gas and air previous to its being ignited. The ignition takes place as soon as the piston has passed the dead point, this type of engine being declared by Beau de Rochas in 1862 to be the most economical. Along the front of the engine is placed an auxiliary shaft to which motion is transmitted from the main crank-shaft by means of wheel gearing; this shaft makes only one revolution for every two revolutions of the engine, and its purpose is to control the motion of the different valves, which are actuated by cams. One of the main features of the engine is the mixing-valve, through which the gas and air are drawn in, and by means of which a mixture of perfectly constant proportions is always obtained.

The principle laid down by Beau de Rochas in the year 1862 has been adopted in the old engine of Keithman, in Münich, and also in Otto's new motor, and is briefly this—there is one explosion during every two revolutions of the fly-wheel when the engine is working at its full power. During these two revolutions four distinct operations are performed inside the cylinder, which may be understood from the following table:

	First Revolution.	*Second Revolution.*
Up-strokeof the piston.	The gas and air are drawn in.	The charge is ignited at the dead point, an the motive power developed.
Down-stroke of the piston	The charge is compressed.	The waste gases are expelled to make room for a fresh charge.

In consequence of the ignition taking place at the dead point it is necessary to increase the length of the cylinder, in order that a space may be left behind the piston to contain the charge; the stroke of the piston, therefore, does not reach to the end of the cylinder, and as a result only part of the waste gases are expelled during the return stroke, the remaining part being mixed with the next incoming charge. In the Körting-Lieckfeld engine no attempt has been made to arrange the mixture in any particular manner; there is neither a stratification of the gases nor a uniform weak charge, and the space at the end of the cylinder is no larger than is necessary to obtain the desirable compression of the charge. Accordingly there is no extra dilution of the charge with atmospheric air, and the power of the engines is therefore very great in comparison with their small size; this is a great advantage in cases where it is necessary to economise space.

We come now to the constructional details, and will show in what manner they contribute to the efficiency of the engine. Fig. 4 shows the mixing-valve, together with the inlets for gas and air and the manner in which the gases combine before passing to the cylinder. The gas, as it comes from the main, passes first through the valve *d*, which is opened at the proper time by a cam on the motion shaft. This valve is also used to regulate the speed of the engine by diminishing the number of explosions; thus supposing that the engine is not working at its full power, the governor balls will be raised, and, acting through the bell-crank shown at the top of the engraving, will force the rod *e*, which is pivoted on the valve spindle away from the rod *f*, and, the connection being thus broken between the cam and the gas valve *d*, the latter will remain close until the engine recovers its normal speed, and no explosion will occur during the interval.

The gas has a free passage into the mixing-valve through the slits *b*, which are made in the movable part of the valve. This is opened by the partial vacuum caused when the piston makes its first up-stroke, and immediately uncovers the small gas ports. The air ports, marked *a* in the engraving, are also opened at the same moment. The chief thing to be noticed in this valve is that, whatever be the extent of its opening, the quantities of gas and air drawn in are always in the same relative proportion to each other, so that the ultimate mixture in the cylinder never varies. The mixed charge is now drawn along the passage into which the end of the igniter protrudes, and from there the greater part passes into the cylinder, mingling with the waste gases which remain from the last explosion, while a small proportion is retained in the passage. A back-pressure valve, placed immediately under the igniter, intervenes between the two, and closes as soon as the piston has finished the first up-stroke. The down-stroke is now commenced, and the charge, is compressed to from two to three atmospheres. The ignition then takes place, the arrangement by which this is effected being a peculiar feature of Mr. Körting's engine, which we will now proceed to describe with the help of Figs. 5 and 6; *a* is the body of the casting, having in its lower end a movable hollow ram, bored with holes immediately above the conical valve *d*, and in its upper part a solid ram or plunger to which motion is imparted from a cam on the auxiliary shaft. While the compression is going on the upper ram *m* is pressed down on the valve seat *t*, and closes the communication between the outside flame and the inside of the cylinder, as shown in Fig, 5. As soon as the charge is sufficiently compressed, the upper ram is suddenly lifted, and the pressure on the lower end of the loose ram *k* forces it up against its seat *d*, again preventing any escape of the charge except through the extremely fine hole at the bottom of the hollow cone, which allows only a very small quantity to pass; the explosive mixture coming through this finds its way to the outside flame, as shown in Fig. 4, where it ignites, and the flame retires at once into the cone. The ignition cannot be communicated to the charge through the small hole, owing to the great velocity of the gases issuing therefrom, but the flame continues to burn at that part of the cone where the gradually decreased velocity allows the combustion to take place. When the piston has reached the dead point and it is desired to effect the explosion, the upper ram *m* is forced down upon its seat, and the lower ram *k* falls about 1-10th inch (see Fig. 5), allowing the flame contained in the hollow cone to ignite the charge, the communication between the two being made by the small holes at *d*, already referred to, through which the flame passes along the channel *v* into the cylinder. The compressed charge is therefore ignited, and the piston is driven upward; on its return part of the waste gases are expelled, the exhaust-valve through which they are allowed to escape being opened at the proper time by a cam on the motion shaft. A certain proportion of the waste gases are retained in the cylinder, as already stated, to mix with the next incoming charge.—*Mech.*

THE WHEELOCK ENGINE.

Messrs. D. Adamson and Co., of Dukenfield, near Manchester, are the exhibitors of a horizontal non-condensing engine fitted with the Wheelock expansion gear, invented by Mr. Jerome Wheelock, Worcester, Mass., and of which they are the makers in this country. This engine, which is of excellent design, is shown by the engravings which we illustrate; it has a cylinder 16 in. in diameter and 3 feet stroke. The special features of the Wheelock gear are shown by separate views of the cylinder (Figs. 4 and 5). From these views it will be seen that the steam passages are at the bottom of the cylinder, so as to insure thorough drainage of the latter, the passages at each end of the cylinder leading to a bored chamber fitted with a partially rotating valve. This valve acts like an ordinary slide valve, placing the cylinder passage in communication with either the steam or exhaust. Between the two main valve chambers is a central steam chamber with which the steam pipe communicates, the admission of the steam from this chamber to either of the valve chambers being controlled by the cut-off valves shown. These cut-off valves, it may be noticed, have their faces hollow out, so that when moved from their shut position the steam can pass them in two ways. This arrangement enables the cut-off valves to give the requisite amount of opening with a very small movement. It will be noticed that no steam can leak into the exhaust from the steam chamber without passing both the cut-off and main valves.

Both the main and cut-off valves are keyed on hardened steel spindles, which support them, and which, on the driving ends, are fitted with steel bushes ground to a steam-tight fit in the long boss on each valve chamber cover. The inner end of each bush and a collar on the valve spindle against which it abuts are also carefully ground. No packing is used, a steam-tight, and, at the same time, practically frictionless, joint being obtained by the use of the bushes just described. At