No. 862,448. PATENTED AUG. 6, 1907.

G. CORNILLEAU.

EXPLOSIVE ENGINE.

APPLICATION FILED APR. 20, 1906.

2 SHEETS—SHEET 1.

Fig. 3.

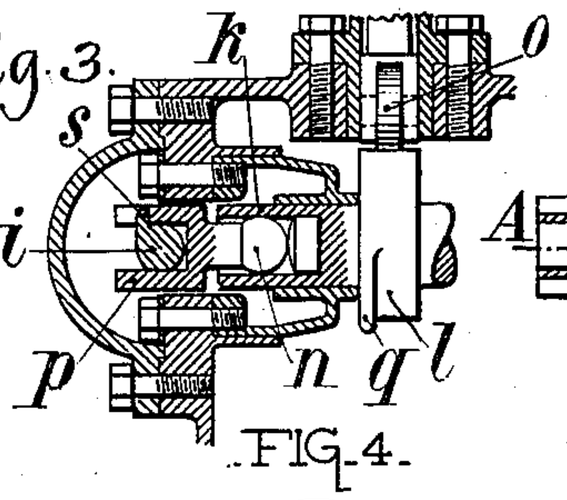


FIG. 1.

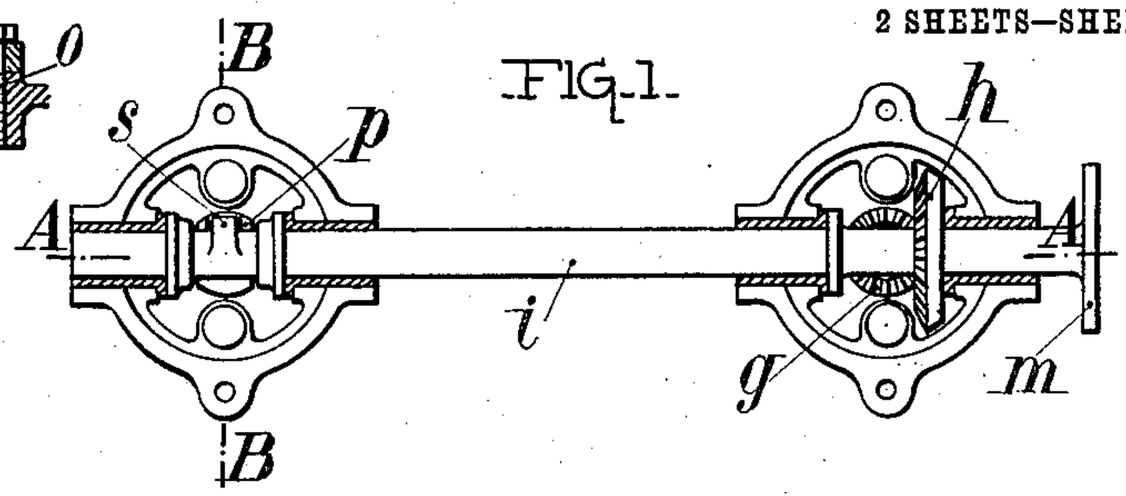


FIG. 4.

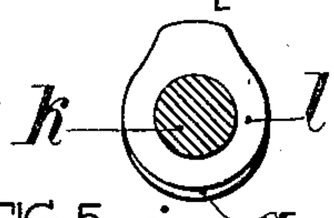


FIG. 5.

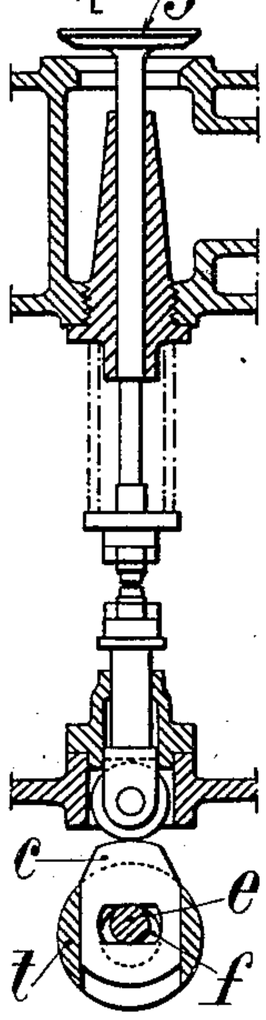


FIG. 6.

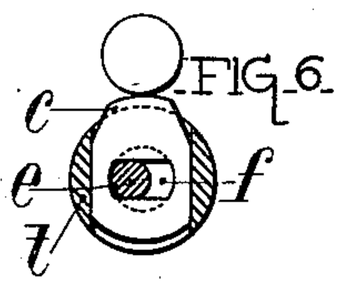


FIG. 7.

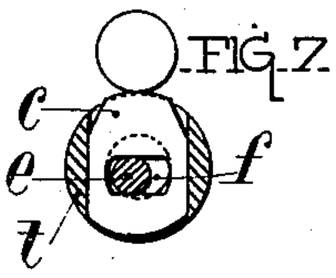
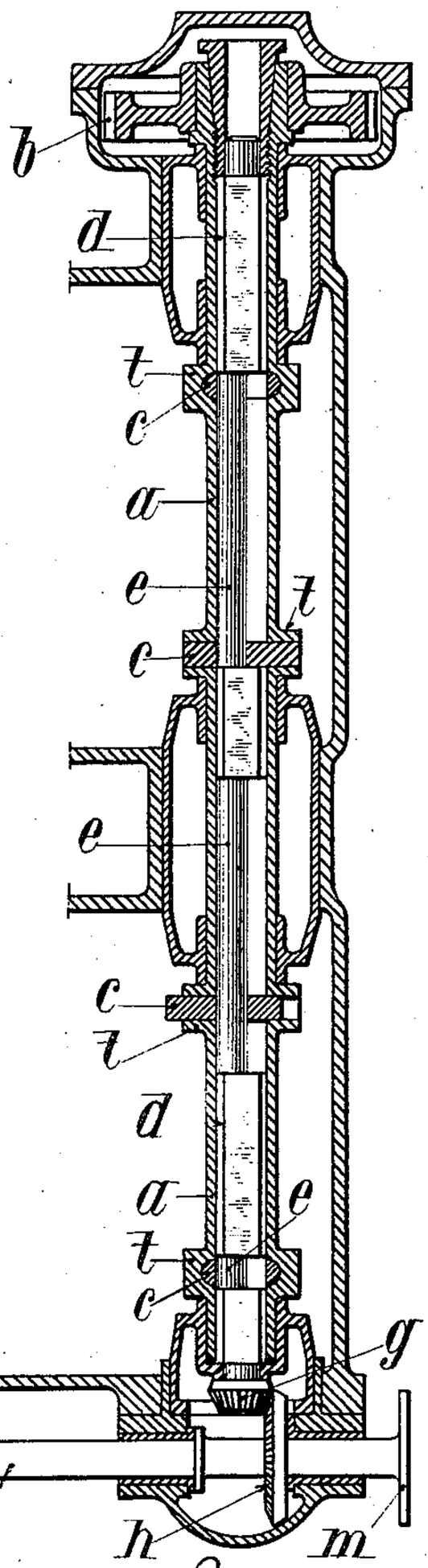


FIG. 2.



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No. 862,448. PATENTED AUG. 6, 1907.

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2 SHEETS—SHEET 2.

Fig. 8.

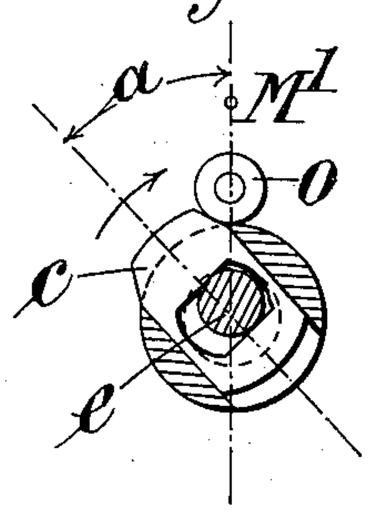


Fig. 9.

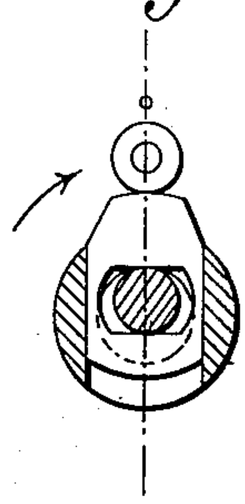


Fig. 10.

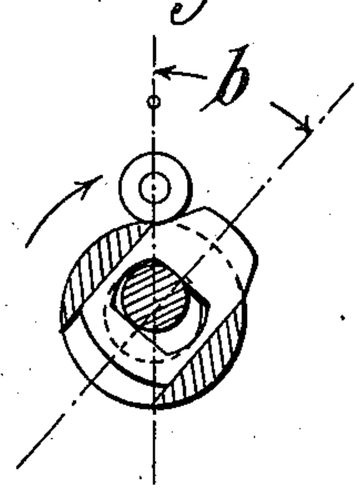


Fig. 11.

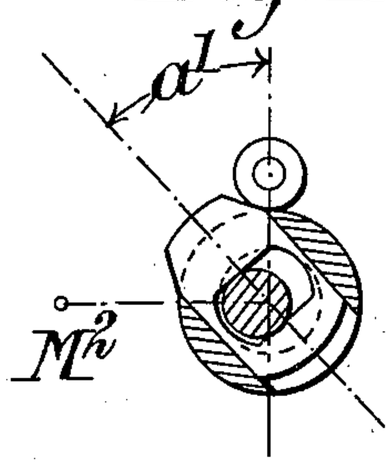


Fig. 12.

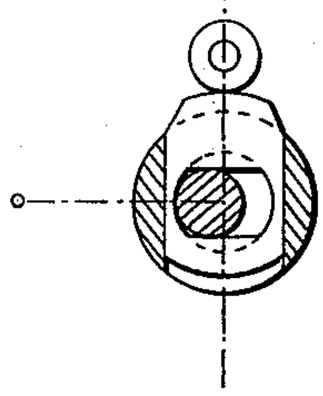


Fig. 13.

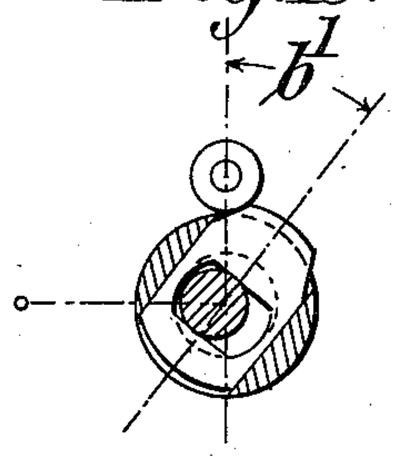


Fig. 14.

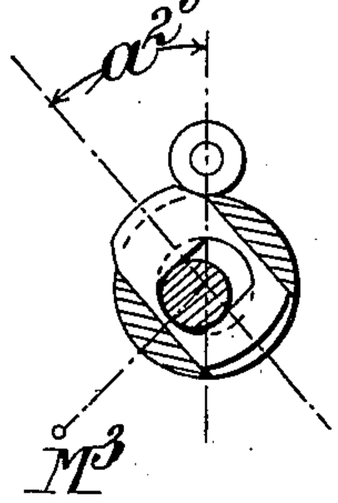


Fig. 15.

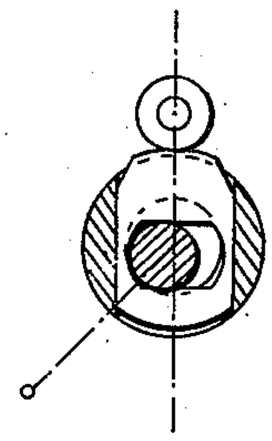


Fig. 16.

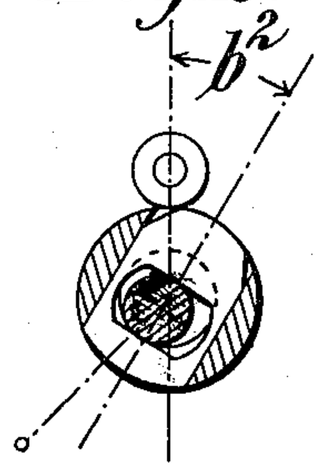
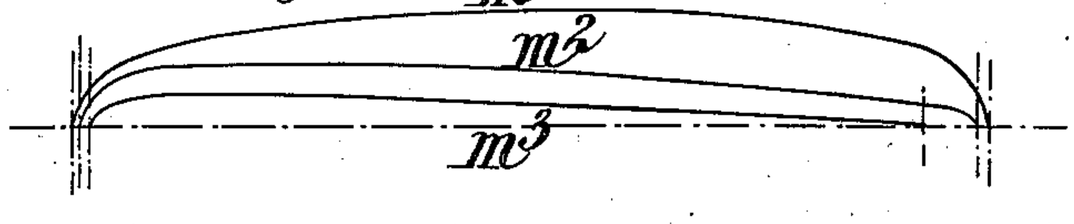


Fig. 17.



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UNITED STATES PATENT OFFICE.

GUSTAVE CORNILLEAU, OF PARIS, FRANCE.

EXPLOSIVE-ENGINE.

No. 862,448. Specification of Letters Patent. Patented Aug. 6, 1907.

Application filed April 20, 1906. Serial No. 312,782.

To all whom it may concern:

Be it known that I, GUSTAVE CORNILLEAU, a citizen of the French Republic, residing at Paris, France, have invented certain new and useful Improvements in or Relating to Explosion-Engines, of which the following is a specification.

This invention relates to apparatus to enable the power of explosion engines to be varied by regulating the volume of the mixture admitted, and, by means of a single controlling part, to relieve compression so as to facilitate the starting of the engine.

According to this invention the variation of the power of the engine is effected by means of a device provided with expansible cams arranged on the spindle operating the inlet valves, in such manner that the duration of the admission period varies in proportion to the work to be effected. This mechanism is, moreover, arranged in such manner as to act on the exhaust valves, in order to open them for the purpose of varying the degree of compression at the moment of starting the engine.

In the accompanying drawing:—Figure 1 is a vertical section through the operating spindle common to both the devices for regulating the inlet, and the exhaust or compression relief. Fig. 2 is a horizontal section on the line A—A of Fig. 1, showing the same spindle and the operating spindles for the inlet and exhaust valves. Fig. 3 is a partial section on the line B—B of Fig. 1, chiefly showing the operating device for regulating the exhaust valves. Fig. 4 shows in elevation one of the cams of the exhaust valves. Fig. 5 is a vertical section through one of the inlet valves and its operating cam. Figs. 6 and 7 are sections showing the same cam in two positions corresponding each to a given and different degree of opening of the inlet valve. Figs. 8 to 17 are diagrammatic figures illustrating the differences in the movement given to the inlet valve owing to varying positions of the said cam.

According to this invention, the cams for operating the inlet valves of a four-stroke explosion engine, taken by way of example, are made expansible or adjustable and to that end they are arranged in a hollow shaft *a* driven by a toothed wheel *b*, so as to rotate at half the speed of the engine shaft.

For a four-cylinder engine, the shaft *a* is provided with four projections *t* provided with openings in each of which can transversely move the corresponding cam *c* which is caused to rotate together with the said shaft. In the valve gear taken by way of example, the cams *c* are arranged at an angle of 90° relatively to each other.

In the interior of the hollow shaft *a*, is arranged a spindle *d* having eccentric rods or portions *e* which pass through a slotted opening *f* made in each cam *c*. This spindle *d* is provided, outside the hollow shaft *a* and at the end opposite the toothed wheel *b*, with a bevel pinion *g* engaging with a bevel wheel *h*, the spindle *i* of which can be operated by means of a crank or head *m* or any other suitable part, so as to bring the eccentric rods *e* into the desired set positions. It follows from this arrangement that, owing to the continuous rotation of the hollow shaft *a*, the cams *c* controlled by the eccentric rods *e*, will slide or reciprocate in their bearings *t*, and their projecting parts project beyond the said bearings to an extent corresponding to the position occupied by the said eccentric rods *e* in the hollow shaft *a*.

As shown respectively in Figs. 5, 6 and 7, it will be seen that for similar position of the cams *c*, valve lifts or travels of different heights, correspond to the different positions of the rods *e*, the volume of gas admitted for producing the required work in the engine, thus being regulated. In this device, the lifting of the suction or admission valve *j* always takes place practically at the same point of the piston stroke, the closing alone of the said valve being advanced. The different motions of the admission valve owing to the varying action of the cam *c* under different positions of the eccentric rod *e* are shown in Figs. 8 to 17.

Figs. 8, 9 and 10 show the various relative positions of the cam *c* and roller *o* when the eccentric *e* is positioned with its greatest radius on the line M′. In Fig. 8, the cam, turning in the direction of the arrow, comes in contact with the roller of the valve-rod: In Fig. 9 the valve is fully open, in Fig. 10 it is closed. The curve, corresponding to this movement of the valve is shown at *m′* Fig. 17. The angles *a* and *b* described by the cam on each side of the roller from the commencement of the opening to complete closure of the valve are practically equal. This is not the case in the positions shown in Figs. 11, 12, and 13, and in Figs. 14, 15, and 16, in which the eccentric is respectively positioned on the lines M^2 and M^3, to which positions respectively correspond the curves m^2 and m^3 of Fig. 17.

Comparing on the one hand, Figs. 8, 11 and 14, and on the other hand Figs. 10, 13 and 16, it is seen that the angle *a* diminishes to a very slight degree, becoming *a′* in 11 and a^2 in 14, while on the contrary the proportional diminution is greatly accented in Figs. 10, 13 and 16 for the angle *b* which becomes *b′* in 13 and b^2 in 16. The quantity of explosive mixture admitted, cannot, therefore, exceed the volume determined by the piston up to the moment of the closing of the valve. The work produced by the explosion corresponds therefore strictly to the said volume.

The inner spindle *d* is provided, in the portions of the shaft *a* which form bearings for it, with flat portions which produce at that point a cross-section corresponding to the openings *f* of the cams. Owing to this arrangement it is sufficient for fitting or removal of the

spindle *d*, to cause the said spindle to slide and to rotate in such manner that its flattened portions should successively pass through the openings *f* of the cams *c*.

In a four-stroke explosion engine, it is necessary, when the shaft of the engine is rotated in order to start it, that the compression of the mixture admitted should not offer any resistance. The device hereinafter described (the operating part of which is combined with that of the adjustable cams) enables the exhaust cams to be controlled in such manner as to keep the corresponding valves opened during a certain portion of the compression period, thus preventing any resistance due to compression. This arrangement consists in mounting the spindle *k* carrying the exhaust cams *l*, in such manner that it shall be able to slide longitudinally to a certain extent in its bearings. A strong spring *r* arranged in a tubular recess at one of its ends, keeps it in a given position, so that the cams *l* shall normally remain in contact with the roller *o* for lifting the exhaust valves (Fig. 3). In this position, the cams *l* bear with one of their faces against the corresponding projections of the bearings for the spindle *k*. At its end, opposite the spring *r*, the spindle *k* is provided with another recess for receiving a spherical head *n* bearing against a piece of hard steel arranged at the bottom of the said recess. This head *n* is provided with a fork or yoke *p* embracing the driving spindle *i*, the upper branch of the said fork being provided with a slot for receiving a finger or lug *s* on the said driving spindle *i*. The slot in the fork *p* is cut in such manner that the finger *s* strikes the bottom of the slot when brought into vertical position.

The proportion between the toothed wheels *h* and *g* is such that the regulating spindle *d* of the suction valves rotates to the extent of one half revolution for each quarter revolution of the driving spindle, so that during the various rotary motions which are imparted to the spindle *d* for regulating the inlet valves, the finger *s* can freely move backwards in the recess of the fork *p* without exercising any action on the spindle *k*.

The exhaust cams *l* are provided at the end opposite to that of their ordinary boss, with a flange or beading *q* (Fig. 4) arranged near one of the edges of their cylindrical portion and outside the ordinary path of the roller *o* which effects the lifting of the exhaust valve. This flange or beading ends in inclined faces, which make its contact with the said roller *o* more gradual. In accordance with this arrangement, when it is desired to start the engine, the driving spindle *i* is turned so as to bring the finger *s* in the direction of its application against the bottom of the fork *p*. In this movement the finger *s* moves the spindle *k* longitudinally, which movement is sufficient to bring the beadings or flanges *q* into the path of the roller *o* of each cam *l*. In these conditions, when, immediately after having thus operated the driving spindle *i*, the spindle of the engine is operated for starting, the cam *l* of the cylinder in which compression would otherwise take place, will meet with its flange *q* the roller *o* which will raise the corresponding exhaust valve to a sufficient extent to diminish the pressure existing in the cylinder, by the discharge of the air or gas which was stored therein before the starting of the corresponding piston. Moreover, the compression of the mixture which is admitted in the first place, being prevented from being as strong as in normal working, the result will be that this compression will not offer undue resistance to the starting which could then be effected with the greatest ease. Moreover, there will remain in the cylinders, at the moment when the ignition takes place, a sufficient quantity of explosive mixture to enable the engine to be started without load, that is to say before it is thrown into gear. As soon as the engine has been started, the spindle *i* is operated so as to bring back the cams *l* to their normal working position and allow, moreover, the adjustable admission-cams *c* to be arranged in a position corresponding to the work to be done. The whole of this arrangement enables therefore not only the starting of the engine to be facilitated, but also its working to be regulated as desired, by controlling the quantity of mixture admitted by means of the same operating parts.

What I claim as my invention, and desire to secure by Letters Patent is:—

1. Regulating mechanism for explosion engines comprising a rotary spindle, an adjustable inlet-valve-operating cam mounted thereon, an exhaust valve-operating shaft, a cam thereon in combination with a controlling shaft for said inlet and exhaust operating devices, a connection intermediate the controlling shaft and the inlet operating cam spindle for adjusting the throw of the cam mounted thereon and a connection for longitudinally moving the exhaust operating cam shaft substantially as set forth.

2. Regulating mechanism for explosion engines comprising a hollow rotary shaft, a cam operating spindle within said hollow shaft, an adjustable inlet-valve-operating cam mounted thereon, an exhaust valve-operating shaft, a cam thereon in combination with a controlling shaft for said inlet and exhaust operating devices, a connection intermediate the controlling shaft and the inlet operating cam spindle for adjusting the throw of the cam mounted thereon and a connection for longitudinally moving the exhaust operating cam shaft substantially as set forth.

3. Regulating mechanism for explosion engines comprising a hollow rotary shaft, a cam operating spindle within said hollow shaft, having an eccentric portion, a slotted cam mounted on said eccentric portion and projecting through the tubular shaft, an exhaust valve-operating shaft, a cam thereon in combination with a controlling shaft for said inlet and exhaust operating devices, a connection intermediate the controlling shaft and the inlet operating cam spindle for adjusting the throw of the cam mounted thereon and a connection for longitudinally moving the exhaust operating cam shaft substantially as set forth.

4. Regulating mechanism for explosion engines comprising a rotary spindle, an adjustable inlet-valve-operating cam mounted thereon, an exhaust valve-operating shaft, a cam thereon in combination with a controlling shaft for said inlet and exhaust operating devices, a connection intermediate the controlling shaft and the inlet operating cam spindle for adjusting the throw of the cam mounted thereon, a slotted forked connection between the operating shaft and the longitudinally movable exhaust valve operating shaft and a projection on the operating shaft engaging the slot in the fork, substantially as set forth.

5. Regulating mechanism for explosion engines comprising a hollow rotary shaft, a cam operating spindle within said hollow shaft, an adjustable inlet-valve-operating cam mounted thereon, an exhaust valve-operating shaft, a cam thereon in combination with a controlling shaft for said inlet and exhaust operating devices, a connection intermediate the controlling shaft and the inlet operating cam spindle for adjusting the throw of the cam mounted thereon, a slotted forked connection between the operating shaft and the longitudinally movable exhaust valve operating shaft and a projection on the operating shaft engaging the slot in the fork, substantially as set forth.

6. Regulating mechanism for explosion engines comprising a hollow rotary shaft a cam operating spindle within said hollow shaft, having an eccentric portion, a slotted

cam mounted on said eccentric portion and projecting through the tubular shaft, an exhaust valve-operating shaft, a cam thereon in combination with a controlling shaft for said inlet and exhaust operating devices, a connection intermediate the controlling shaft and the inlet operating cam spindle for adjusting the throw of the cam mounted thereon, a slotted forked connection between the operating shaft and the longitudinally movable exhaust valve operating shaft and a projection on the operating shaft engaging the slot in the fork, substantially as set forth.

7. In regulating mechanism for explosion engines of the kind described an inlet valve cam adjusting device consisting of a rotatory tubular shaft, a transverse cam opening therein, a rotatable cam operating spindle in said hollow shaft, a portion of said spindle fitting the interior of said shaft and a portion being eccentric thereto, a slotted cam mounted upon the eccentric portion of the spindle and projecting through the transverse opening in the tubular shaft in combination with means for turning the spindle independently of the rotary shaft substantially as set forth.

8. In regulating mechanism for explosion engines of the kind described a controlling shaft, a bevel gear thereon for operating the inlet-valve cam spindle and a projection thereon for operating the longitudinally movable exhaust valve cam shaft substantially as set forth.

In testimony whereof I have signed my name to this specification in the presence of two subscribing witnesses.

GUSTAVE CORNILLEAU.

Witnesses:
HANSON C. COXE,
GEORGES BONNEUIL.