No. 883,340. PATENTED MAR. 31, 1908.

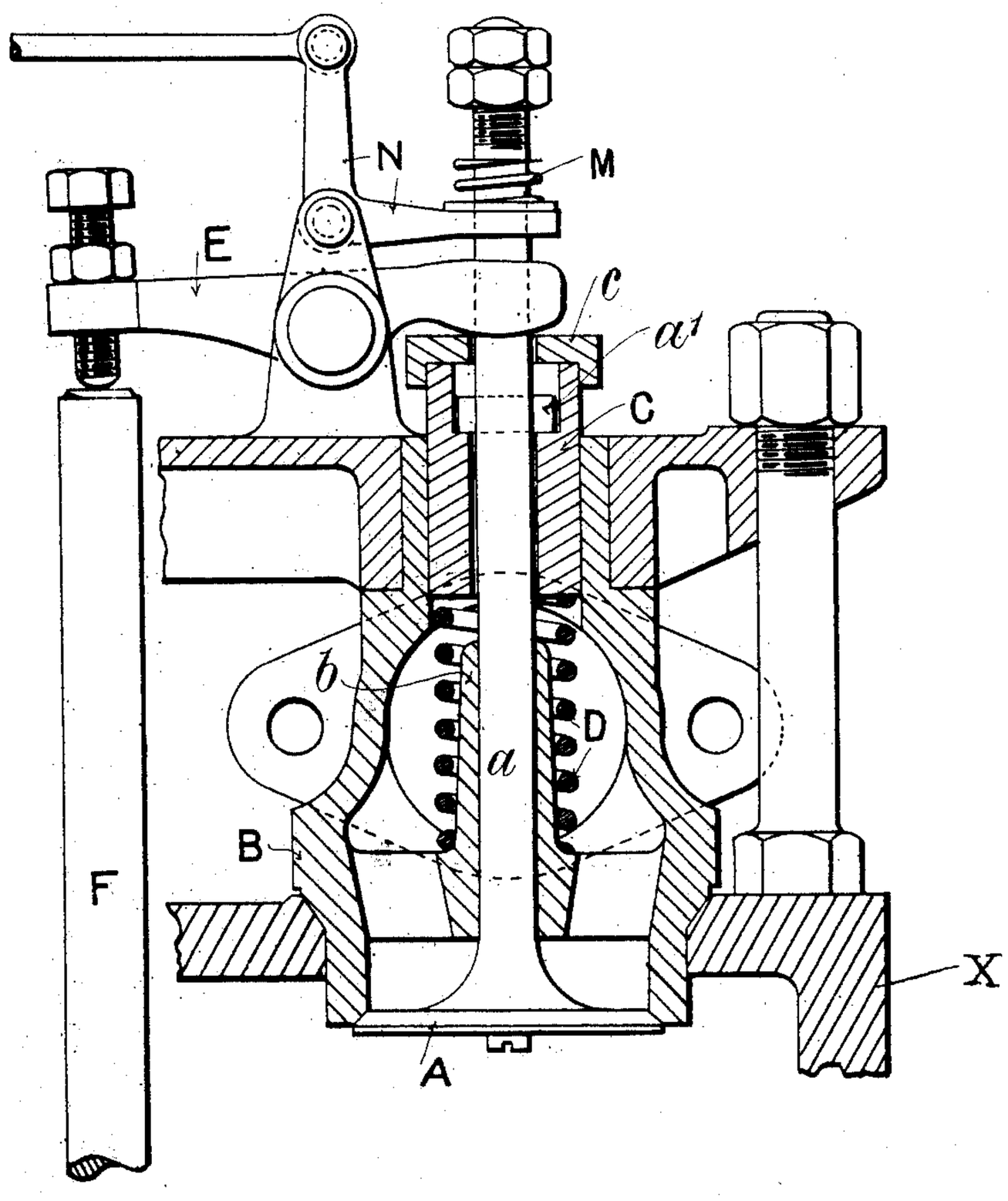
R. E. PHILLIPS.

INDUCTION VALVE FOR INTERNAL COMBUSTION ENGINES.

APPLICATION FILED APR. 22, 1904.

3 SHEETS—SHEET 1.

Fig. 1.



WITNESSES:

G. V. Symes.

Hedley J. Harrop.

INVENTOR.

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3 SHEETS—SHEET 2.

FIG. 2.

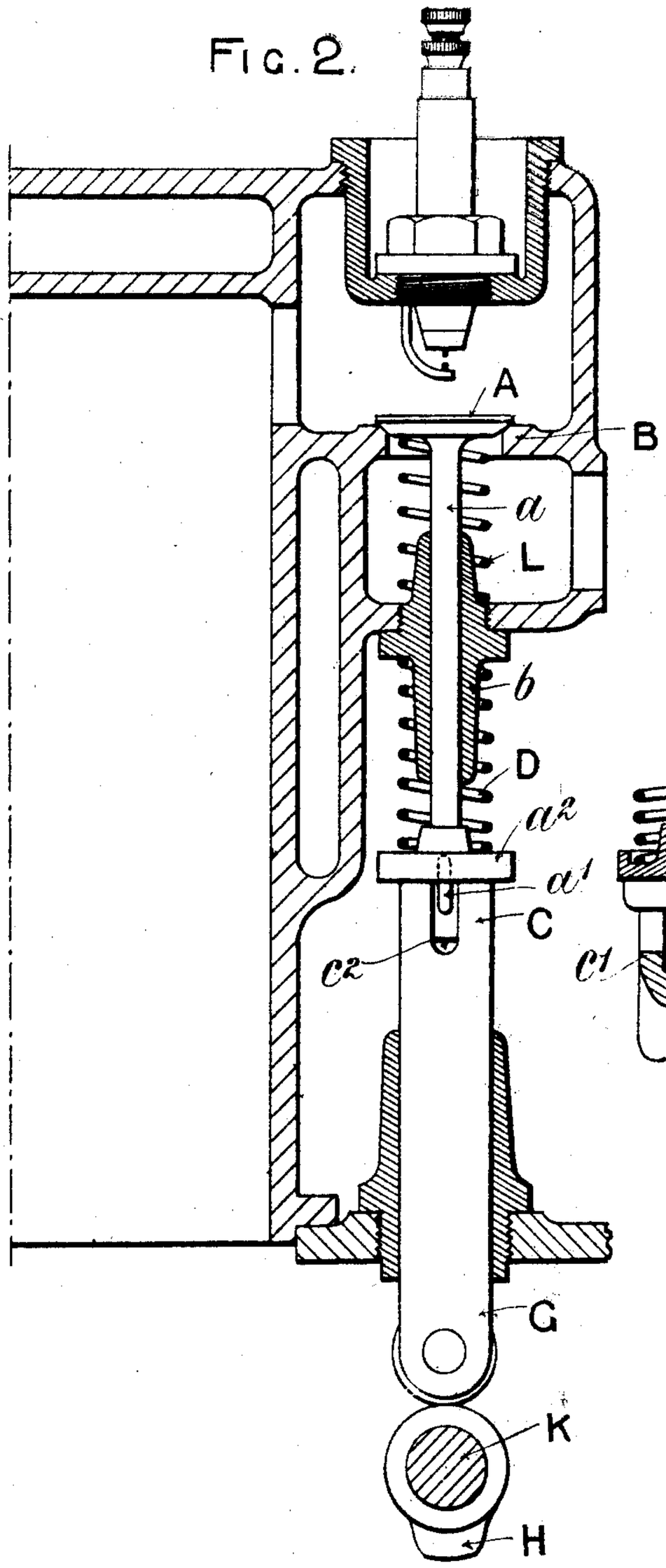
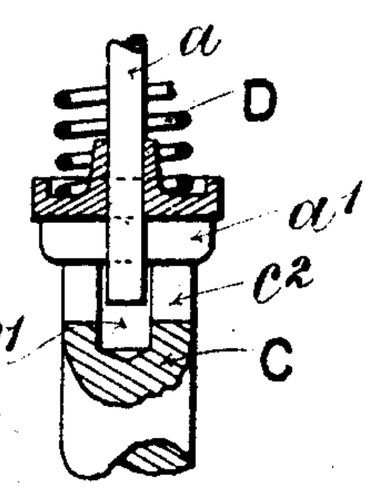


FIG. 5



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3 SHEETS—SHEET 3.

FIG. 3.

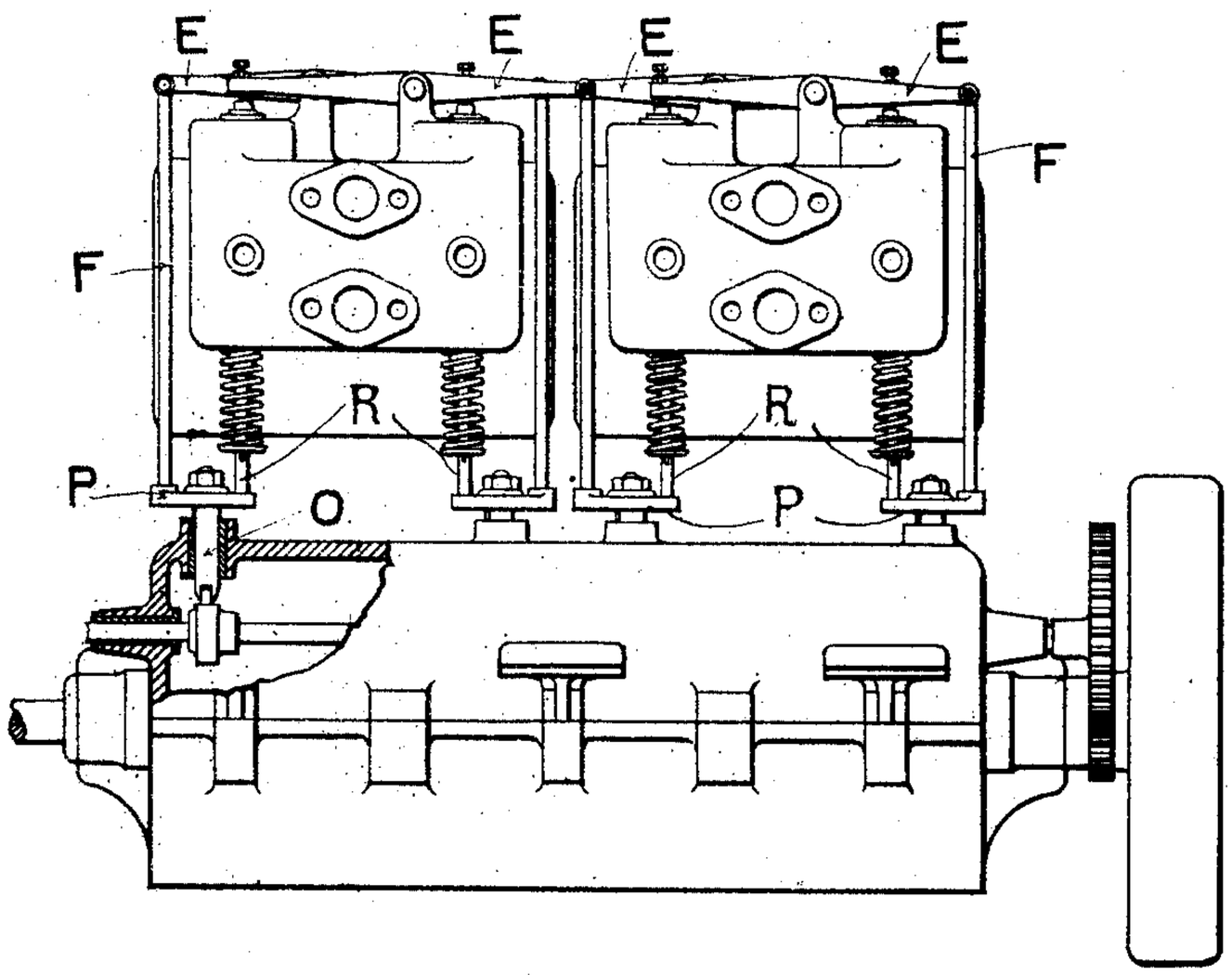
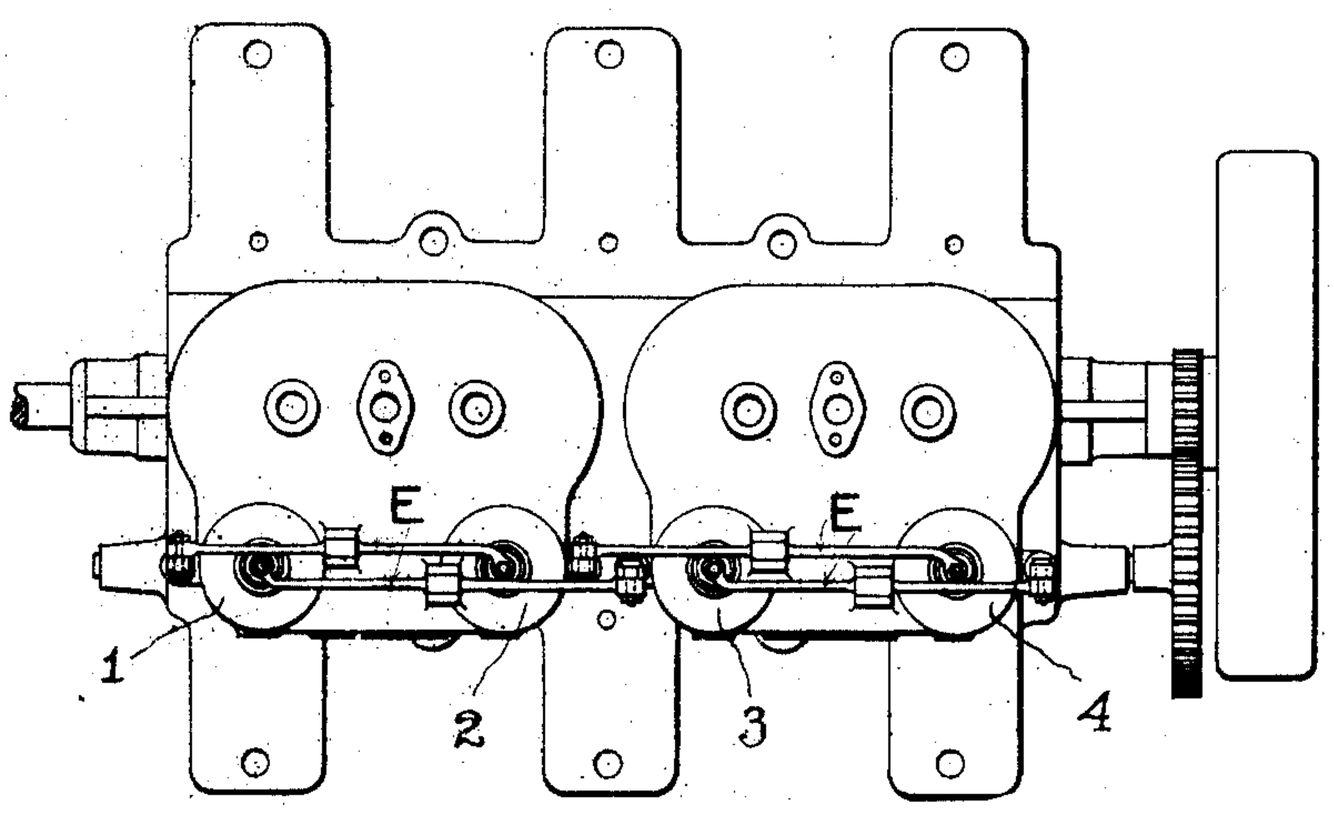


FIG. 4.



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UNITED STATES PATENT OFFICE.

ROBERT E. PHILLIPS, OF WESTMINSTER, LONDON, ENGLAND.

INDUCTION-VALVE FOR INTERNAL-COMBUSTION ENGINES.

No. 883,340. Specification of Letters Patent. Patented March 31, 1908.

Application filed April 22, 1904. Serial No. 204,448.

To all whom it may concern:

Be it known that I, ROBERT EDWARD PHILLIPS, a subject of the King of Great Britain and Ireland, residing at 30 George street, Hanover Square, in the city of Westminster, in the county of London, England, have invented a new and useful Improvement in Induction-Valves for Internal-Combustion Engines, (for which I have applied for Letters Patent in Great Britain, No. 9,097, bearing date the 22d day of April, 1903;) and I do hereby declare the following, when taken in connection with the accompanying drawings and the letters of reference marked thereon, to be a full, clear, and exact description of the same, and which said drawings constitute part of this specification, and represent, in—

Figure 1 a view in elevation—partly in section—showing an arrangement in which the valve opens by gravity. Fig. 2 is a view in elevation—partly in section—showing an arrangement in which the valve opens by a spring action. Figs. 3 and 4 are views in elevation and plan respectively showing the application of this invention to an engine with four cylinders employing but four cams and four strikers or lifters for operating the whole of the induction and exhaust valves. Fig. 5 is a sectional view of the connection of the valve stem with plunger shown in Fig. 2.

Throughout the views similar parts are marked with like letters of reference.

This invention relates to internal combustion or explosion engines of the "Otto" or four-cycle type, and consists of improved induction valve operating mechanism whereby the supply valve is permitted to open automatically; *i. e.*, without any assistance due to the difference of pressure in the inlet pipe and cylinder respectively due to the suction stroke of the piston, and is closed positively by mechanical means, the object being to combine the good and eliminate the bad points of both the atmospheric and the mechanically-operated valve.

According to this invention the induction valve, which is of the lift type, is so arranged that it will leave its seat automatically as soon as the pressure in the cylinder falls to the pressure in the induction pipe, without any assistance either mechanically or from the suction stroke of the piston. The valve is retained on its seat by a spring strong enough to insure its positive closing and to prevent its being opened during the suction stroke of the piston. The pressure of this spring is removed from the valve in advance of the time it is due to open, and is restored to it to cause it to close, by suitable mechanical means, such, for instance, as that usually employed in mechanically-operated valves, viz., by a cam on the half-motion shaft. Owing to the pressure in the cylinder during the exhaust stroke of the piston, the valve is retained on its seat after the pressure of the spring is removed from it by the pressure of the exhaust gases in the cylinder alone, and consequently it is free to open automatically immediately the pressure in the cylinder falls to that in the induction pipe. For the same reason it is immaterial within certain limits at what part of the exhaust stroke of the piston the pressure of the spring is removed from the valve so long as it is in advance of the time when the valve should open. The valve may either be arranged to open downwards so that it opens by gravity or to open upwards, in which case a spring the strength of which is but slightly more than sufficient to balance the weight of the valve is employed to lift it.

Referring to Fig. 1. The induction valve A is fitted in a valve casing B to which the supply conduit i attached, which casing is preferably removable from the cylinder wall X and carries the induction valve A and seat therefor, and is provided with a long boss *b* for the stem *a* to pass through so as to insure its being efficiently guided. In the upper part of the casing B is fitted a hollow plunger C adapted to slide in the said casing without frictional contact with the stem *a* of the valve. This is important as any friction between the plunger and the stem of the valve would tend to open said valve when the pressure in the cylinder is low due to throttling on the supply of mixture to the engine. Encircling the boss *b* is a spring D which operates to keep the valve closed down on its seat by acting between a spider supporting the boss *b* and a projection *a'* on the stem *a* of the valve through the plunger C. The said projection *a'* may conveniently take the form of a cotter as shown, in which case the upper end of the plunger C is recessed to receive the cotter. The necessary motion for operating the plunger C may be taken from any suitable part of the motor, preferably from a cam on the half-motion shaft carrying the cams for operating the exhaust valve, the said motion being transmitted to

the plunger C through a connecting rod or link F and a rocking lever E. The upper end of the plunger is provided with a cap *c* for the lever E to engage with, but this is not obligatory.

In the construction shown by Fig. 2 the plunger C is formed in one with the striker G contacting the cam H on the half-motion shaft K, the plunger engaging a collar a^2 through which the pressure of the spring D operates to retain the valve A on its seat, the end of the plunger having a recess c' to receive the end of the stem *a* of the valve and a transverse slot c^2 to clear the cotter a'.

When the valve is arranged to open upwards as shown in Fig. 2, a light spring, such as L, acting between the plunger C and the stem of the valve, is employed to slightly more than balance the weight of the valve. To force the valve from its seat in case it should become "stuck up" from any cause, and thereby not have opened automatically, the plunger C is arranged to contact the stem of the valve either directly or indirectly at a time subsequent to the time the said valve should have opened automatically. In the construction shown in Fig. 1, this end is attained by making the clearance between the top of the cotter a' and the under side of the cap *c* of the plunger C less than the total movement of the engaging end of the lever E. In the construction shown by Fig. 2, the same end is attained by making the clearance between the end of the stem *a* of the valve and the bottom of the recess c' in the plunger C′ less than the total movement of the end of said lever.

When the admission valve is arranged to open downwards as shown by Fig. 1, a light spring, such as M, may be employed to break the fall of the valve on opening. To vary the lift of the valve for regulating purposes, a device such as the bell-crank lever as shown in Fig. 1, may be employed to vary the amount the valve shall open. As all that is necessary in this method of operating inlet valves is that the pressure of the spring on the valve should be removed from the valve in advance of the time at which the valve should open, the shape of the cam for operating the said spring is of secondary importance, and the same cam that operates the exhaust valve may be employed for the purpose of obtaining the necessary motion to operate the spring of the induction valve. In engines with single or double cylinders this may conveniently be done by taking the motion from the exhaust cam at an angle of 90° from the point at which the motion is taken for operating the exhaust valve. In engines with four cylinders the motion for operating the admission valve can be taken direct from the lifters or strikers O operating the exhaust valves, as shown in Figs. 3 and 4, by mounting cross-heads P on the said lifters or strikers so that they can engage both the stems R of the exhaust valves and the rods or links F operating the springs of the inlet valves through the rocking levers E. In the arrangement illustrated the cylinders are set to operate—by way of example—in the following order:—1, 2, 4, 2:—so that the exhaust cam of No. 1 cylinder operates the inlet valve of No. 2 cylinder, the exhaust cam of No. 2 cylinder the inlet valve of No. 4 cylinder, the exhaust cam of No. 3 cylinder the inlet valve of No. 1 cylinder, and the exhaust cam of No. 4 cylinder the inlet valve of No. 3 cylinder. It will be seen that this arrangement materially reduces the number of working parts as it enables the whole of the eight valves to be operated by four cams and four lifters or strikers.

I claim:—

1. In induction valve mechanism for internal combustion or explosion engines of the four-cycle type, a valve casing carrying an induction valve and seat therefor and having a guide for the stem of the valve, a projection on the valve stem, a hollow plunger sliding in the casing and adapted to engage the said projection and through which the stem of the valve passes, a spring between the casing and the plunger acting to retain the valve in its closed position, and mechanical means for depressing the plunger to compress the spring and thus relieve the valve of its pressure.

2. In induction valve mechanism for internal combustion or explosion engines of the four-cycle type, a valve casing carrying an induction valve and seat therefor and having a guide for the stem of the valve, a projection on the valve stem, a hollow plunger sliding in the casing and encircling but not in frictional contact with the stem of the valve, said plunger being adapted to engage the projection on the valve stem, a spring operating between the casing and the plunger to retain the valve in its closed position, and mechanical means for depressing the plunger to compress the spring and thus relieve the valve of its pressure.

3. In induction valve mechanism for internal combustion or explosion engines of the four-cycle type, a valve casing carrying an induction valve and seat therefor, and forming a guide for the stem of the valve, a projection on the valve stem, a hollow plunger sliding in the said casing and encircling but not in frictional contact with the valve stem and adapted to engage the said projection, a spring operating between the casing and the plunger, and a rocking member for operating the plunger.

4. In induction valve mechanism for internal combustion or explosion engines of the four-cycle type, a valve casing carrying an induction valve and seat therefor, the stem of the said valve having a projection, a

hollow plunger adapted to engage the said projection and sliding in the casing and through which the stem of the valve passes, a spring operating between the casing and the plunger, and means to depress the plunger to thereby relieve the valve from the action of the spring.

5. In an internal combustion or explosion engine of the four-cycle type, the combination with an induction valve of the lift type arranged to open downwards, of a spring acting between the stem of the valve and its seat to retain said valve in its closed position, means for removing the pressure of said spring from said valve so that it is free to open by gravity, a spring adapted to break the fall of the valve on opening, and means for restoring the pressure of the closing spring to the valve.

6. In an internal combustion or explosion engine of the four-cycle type, the combination with an induction valve of the lift type, of a closing spring acting between the stem of said valve and its casing and operating to retain the valve upon its seat, means for compressing the spring to thereby remove the pressure of said spring from said valve, means independent of the valve operating mechanism of the engine for varying the amount said valve opens, and means for restoring the said pressure of said spring to said valve.

7. In an internal combustion or explosion engine of the four-cycle type, the combination with the induction valve A, of the removable-valve casing B for said valve, the hollow plunger C sliding in the casing B and passing over the stem *a* of the valve A without frictional contact, the projection on the stem of the valve with which the upper end of the plunger engages, the spring D acting between the casing B of the valve and the plunger C to retain said valve on its casing, and the means for operating said plunger to remove the pressure of said spring from and restore it to said valve.

8. In an internal combustion or explosion engine of the four-cycle type the combination with the induction valve A, of the valve casing B for said valve, the hollow plunger C sliding in the casing B and passing over the stem *a* of the valve A without frictional contact, the projection on the stem of the valve with which the upper end of the plunger engages, the spring D acting between the plunger C and the casing B to retain the said valve on said casing, the means for operating the said plunger to remove the pressure of the spring from and restore it to said valve, and the spring M for breaking the fall of the valve.

9. In an internal combustion or explosion engine of the four-cycle type the combination with the induction valve A, of the valve casing B for said valve, the hollow plunger C sliding in the casing B and passing over the stem *a* of the valve A without frictional contact, the projection on the stem of the valve with which the upper end of the plunger engages, the spring D acting between the plunger C and the casing B to retain the valve on said casing, the means for operating the said plunger to remove the pressure of the spring from and restore it to said valve, the spring M encircling the stem of the valve and arranged to break the fall of said valve, and the device N for regulating the amount the said valve A opens.

10. In an internal combustion or explosion engine of the four-cycle type, the combination with the induction valve A, of the valve casing B for said valve, the hollow plunger C sliding in the casing B and passing over the stem *a* of the valve A without frictional contact, the projection on the stem of the valve with which the upper end of the plunger engages, the spring D acting between the plunger C and the casing B to retain the valve on said casing, the means for operating the said plunger to remove the pressure of the spring from and restore it to said valve, and the means for mechanically forcing said valve from its casing in case it does not open automatically.

11. In an internal combustion or explosion engine of the four-cycle type, the combination with the induction valve A, of the valve casing B for said valve, the hollow plunger C sliding in the casing B and through which the stem *a* of the valve A passes without frictional contact, the projection on the stem of the valve with which the upper end of the plunger engages, the spring D acting between the plunger C and the casing B to retain said valve on said casing, the means for operating the said plunger to remove the pressure of said spring from and restore it to said valve, the spring M for breaking the fall of the valve, and the means for mechanically forcing said valve from its seat in case it does not open automatically.

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Witnesses:
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