

A. B. CASPER.
EXPLOSIVE OR INTERNAL COMBUSTION ENGINE.
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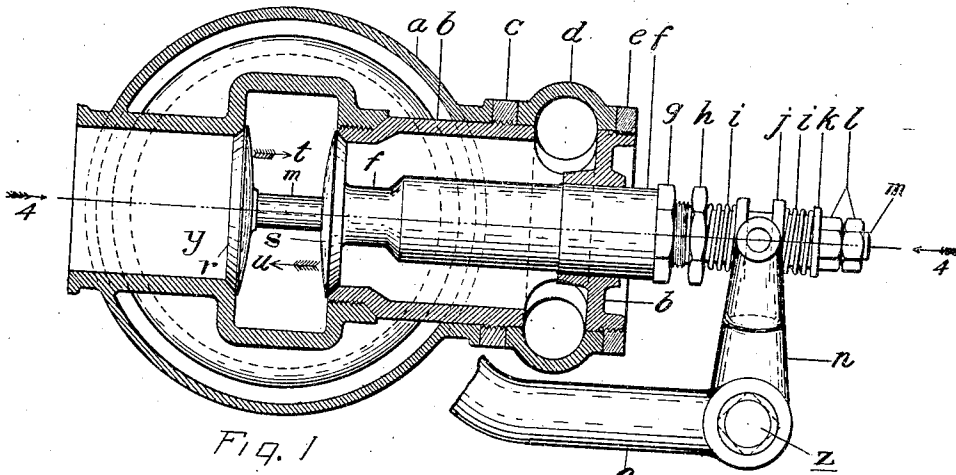


Fig. 1

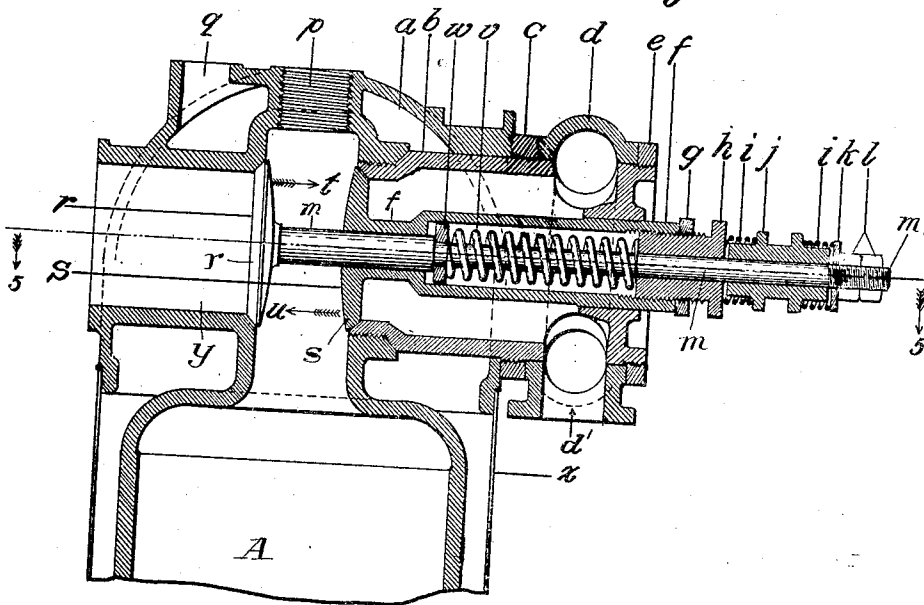


Fig. 2

WITNESSES:

Fred W. Buddemeyer.
Walter F. Leiben Guth.

INVENTOR;

Anthony B. Casper.

UNITED STATES PATENT OFFICE.

ANTHONY B. CASPER, OF KINGSTON, PENNSYLVANIA.

EXPLOSIVE OR INTERNAL-COMBUSTION ENGINE.

1,036,451.

Specification of Letters Patent.

Patented Aug. 20, 1912.

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To all whom it may concern:

Be it known that I, ANTHONY B. CASPER, a citizen of the United States, residing at Kingston, in the county of Luzerne and State of Pennsylvania, have invented certain new and useful Improvements in Explosive or Internal-Combustion Engines, of which the following is a specification.

My invention consists in certain novel features, combinations, and details of explosive or internal combustion engines, pertaining more particularly to the inlet and exhaust valves and their housings.

The objects of the invention are generally to simplify and improve the construction of such engines, and to provide for properly cooling and keeping cool the said valves, whereby their regular and efficient operation may be insured.

In the accompanying drawings, Figure 1 is a horizontal section on the line 5-5 of Fig. 2, taken through the head or top of the engine and its valve shell or casing; and Fig. 2 is a vertical section on the line 4-4 of Fig. 1, some portions of both figures being shown in plan or elevation to better illustrate the construction.

The valve construction here shown is more particularly intended for engines of the four cycle type, though not necessarily restricted thereto.

In all engines of the explosive or internal combustion type, it is important to maintain the valves in free working condition, yet to avoid undue looseness or play of parts. This is peculiarly difficult because of the high temperature to which the parts are subjected while the engine is in operation, and the consequent expansion and binding of parts which, when cool, are free and easily operated. It is also highly desirable so to construct the valves and their fittings as that they may be readily removed for inspection, repair or adjustment, and as readily replaced, and that the outlet valve opening be of adequate size as compared with the inlet opening. These results I attain by the construction now explained, with reference to the drawings.

A indicates the cylinder of an engine embodying my invention, which cylinder has cast integral with it and joined to it by a tubular neck, a hemispherical head *a*. The head *a* has a depending skirt, somewhat larger in diameter than the cylinder,

and shouldered, as shown in Fig. 2, to receive an outer shell or jacket *x*, between which and the body of the cylinder is a chamber designed to contain water or other cooling medium. The shell *x* is advisably made of copper, because of its heat-conducting and radiating capacity, though other metal may be used.

The dome-shaped or hemispherical head *a* is cast or formed with a horizontal tubular shell *y*, opening at one end through one side of the dome to form an exhaust outlet, and having at the other end and within the dome an internally threaded mouth to receive the threaded inner end of a valve cage or shell *b*. Between its ends the shell *y* is enlarged to afford proper space for the play of an inlet valve *s*, and an exhaust valve *r*, and an internally threaded sparking-plug socket *p*, opens from the top of said enlargement, being thus located in axial alinement with the cylinder *A* and with the tubular neck connecting the dome or head *a* therewith.

The valve cage or shell *b* is of hollow cylindrical form, its inner end being necked or reduced somewhat in diameter as compared with its body, and being screw-threaded to enter the open inner end of shell *y*, as above mentioned. The body of valve cage or shell *b* is of a diameter to closely-fit an opening in the dome *a* coaxial with the inner shell *y*, but just outside of said dome it has an external screw thread to receive a collar or jam nut *c*. After the valve cage is screwed firmly into the end of shell *y*, the collar or nut *c* is screwed firmly against the mouth of the neck on the dome *a*, and the cage is thereby made secure and a tight joint is effected where the shell passes through the wall of the dome. It will be seen from this description that the shell *y* and valve cage or shell *b* jointly constitute a cross shell extending through the dome-shaped head *a*, but connecting therewith only at opposite sides of said head. Said cross shell is hence exposed on all sides to the circulating water employed for cooling the cylinder, and thus the cross shell, with its contained valve seats and valves, is kept cool. This is the first object of the cross shell. Other objects are,—to facilitate the introduction and removal of the valves, to permit the use of oppositely-acting valves with a single spring common to both, and to

permit the employment of valves bearing any desired relative areas, at the same time guarding effectually against any possible leakage of cooling water into the cylinder.

Valve cage *b* is extended outward beyond the nut or collar *c* and is encircled by a ring or annulus *d*, which may conveniently be made of semicircular cross section, as seen in Figs. 1 and 2, to form around the cage *b* an annular intake chamber. The casting *d* is held in place upon the cage *b* by a nut or collar *e* screwed upon the threaded outer end of said cage *b*, as shown.

The inner end of valve cage *b*, and the opposing mouth of the shell *y*, are beveled or chamfered to form seats for the inlet valve *s* and the exhaust valve *r*, as shown in both figures.

Inlet valve *s*, which controls the ingress of the explosive charge, is formed with a tubular stem *f*, which is advisably somewhat smaller where it joins the valve disk than at a distance therefrom, the body of said stem being of such size as to receive within it the stem *m*, of exhaust valve *r*; and a coiled spring *v*, which encircles said stem and serves to seat both of said valves.

The rear or outer end of the tubular stem *f* of valve *s* passes outward through a central opening in the otherwise closed head of valve cage *b*, the opening through which it passes being formed in an elongated boss of said head which gives a long bearing for the stem.

The outer end of tubular stem *f* is internally threaded to receive a nut *h*, which is of sufficient length to enable it to serve as a means of varying considerably the compression of spring *v*, for one end of which it forms an abutment, and also to receive a jam nut *g*, which being screwed against the end of tubular stem *f*, effectually locks the nut *h* and prevents it from working loose or accidentally changing its relation to the stem. The nut *h* also affords a long bearing and guide for the stem *m* of valve *r*, said stem passing axially through and extending some distance beyond the nut, as shown.

The inner end of spring *v* rests against a washer or collar *w* which encircles stem *m* of valve *r* and which is itself seated against a shoulder on said stem, which shoulder, when both valves are seated, stands a short distance within, or beyond the end wall of the enlarged spring space of valve stem *f*. This precaution is taken to insure the free and perfect seating of valve *s*, without impedance or arrest by the inner end of the spring or the washer *w*.

Loosely encircling the stem *m* of valve *r* outside of or beyond the nut *h* is a sleeve *j*, provided with two circumferential flanges or collars, between which are received the pins or rollers of a valve-actuating yoke-

shaped lever *n*, here represented as carried by an upright shaft or spindle *z*, provided at a suitable point in its length with an arm *o*, designed to receive motion at proper times from a cam or other moving part connected with the fly wheel shaft of the engine, directly or indirectly. The construction and arrangement of the cam may vary as desired, and any usual type may be employed.

Beyond or outside of the sleeve *j*, the valve stem *m* is provided with a washer *k* and with two nuts *l* one of which serves as a lock or jam nut for the other. A slight space is left between the ends of the sleeve *j* and the opposing ends of nuts *h* and *l*, and springs, *i*, are interposed between the circumferential flanges of the sleeve and said nuts. The purpose of these springs is to prevent the hammering and noise which might be produced in their absence, and yet to allow the slight play of the valves independent of the lever *n*, necessary or advisable to insure perfect seating of the valves.

The valve cage or casing *b* has a series of openings which register with or fall within the open interior of annulus *d*, so that the charge which enters the annular chamber of the ring through inlet *d* may pass freely to the interior of the valve shell. Said cage is further adapted to receive a wrench or like tool, by which to unscrew it from the shell *y*, the jam nut *c* being first backed to free it. This may be either a polygonal seat or socket formed in the flanged head or outer end of the cage, or a polygonal outer end of the boss through which valve stem *f* passes.

A suitable connection will be made for the introduction of water or other cooling medium into the dome and the space surrounding the cylinder and an outlet for its escape, such outlet being shown at *g*.

It will be observed that by reason of the dome shape given to the head of the engine, and its joining the cylinder by a central tubular neck, which receives the spark plug, the casting can be turned and machined with exceptional ease and thoroughness, and the spark is caused to ignite the charge centrally in line with the axis of the cylinder, which is found advantageous in practice. It will be noted also that after drawing off the water of the shell to a point slightly below the level of valves *r*, *s*, so as to prevent it from entering the cylinder, the valve cage *b*, with both valves, may be readily removed by merely backing the jam nut *c* and unscrewing cage *b*. This enables the valves to be examined, dressed, adjusted and replaced with ease, and with the certainty that they are in proper condition and relation. By the construction thus set forth a single spring *v* is caused to seat both valves, each

acting as a support or abutment for the spring as it acts upon the other. This is indicated in Figs. 1 and 2. When outlet or exhaust valve *r* opens in the direction of arrow *t*, the spring *v* finds its seat or support against nut *h* in the stem of valve *s*, which valve is then pressed to its seat by said spring *v*, and when valve *s* opens in the direction of arrow *u*, the spring finds its support upon washer *w* on stem *m* of valve *r*, which valve is at the time pressed to its seat by the spring *v*. Thus the opening of either valve tends to insure the perfect seating of the other.

The valve cage *b* passes through the water chamber and is surrounded by the water, hence is kept always relatively cool, and the same is true of the exhaust shell *y* in which is formed the seat for valve *r*. The charge of mingled gas or vapor and air, itself cool, enters and passes through valve cage *b*, in which is formed the seat of valve *s*, and thus said cage and valve seat and the disk and stem *f* of the valve are cooled. The stem *m* of valve *r*, being within the stem *f* of valve *s* is by it protected and kept cool, the conductivity of the metal in contact with valve cage *b*, in turn surrounded by water, also tending to insure the cooling of the valve stems. Finally the charge in entering the cylinder passes about valve *s* and between the two valve disks, and envelops the portion of stem *m* between said disks, and hence it is likewise cooled to a considerable extent.

With a four cycle engine, the intake or suction stroke lasts through one half a revolution or 180° and the exhaust stroke lasts through two thirds of a revolution or 240°, and as the shaft makes two revolutions to complete the cycle of intake, compression, explosion and exhaust, the exhaust valve stem is in full contact with the cool surface of the intake valve stem during one and one sixth part of each two revolutions, and is exposed to the hot gases only during the time of explosion, which is equal to one third of a revolution, or 120°.

The arrangement of valves shown secures an absolutely free and unobstructed outlet for the discharge of the spent gases, and insures a thorough cleaning of the cylinder after each explosion. It will be noted too that long bearings are provided for both valve stems, stem *m* of valve *r* having a long bearing in the inner end of stem *f* and in the nut *h* at its outer end, and stem *f* having a correspondingly long bearing at its inner end upon stem *m*, and at its outer end in the boss or neck in the head of valve cage *b*. Both valve seats are readily accessible for grinding and can be made true and smooth.

The central tubular neck extending from the top of the cylinder to the valve shell or casing, and the casting of the cylinder, neck,

valve shell or casing and the outer dome in one piece, except for the screw-joined section of the valve shell, which becomes by such screw joint practically integral, preclude all possibility of the cooling water entering the cylinder or the valve shell, yet said shell and the valves are effectively and adequately cooled. It will be noted also that by reason of the construction above set forth, the discharge passage and the exhaust valve and its seat may be made as large as or larger than the intake passage, its valve and seat, which is matter of great importance in facilitating free and prompt scavenging without back pressure. The central tubular neck insures the introduction of the charge in line with the axis of the cylinder, and the ignition of the charge similarly in line with said axis.

Parts not here described or shown may be of usual or approved form and construction.

Having thus described my invention, what I claim is:—

1. In an engine of the class described, a cylinder; a neck of less diameter than the cylinder extending from the head thereof, and provided with a tubular cross shell or casing adapted to receive inlet and outlet valves; and a dome-shaped head encompassing said valve shell or casing and of diameter larger than the cylinder, said cylinder, neck, shell and dome-shaped head being formed in one integral casting, substantially as and for the purpose set forth.

2. In an engine of the class described, a cylinder; a neck of less diameter than the cylinder extending from the head thereof, and provided with a tubular cross shell or casing adapted to receive inlet and outlet valves; a dome-shaped head encompassing said valve shell or casing and of diameter larger than the cylinder, said cylinder, neck, shell and dome-shaped head being formed in one integral casting, and the valve shell or casing having a removable section connected with the main or permanent section by a screw joint, substantially as and for the purpose set forth.

3. In an explosive engine, a cylinder provided with a dome-shaped head connected with the cylinder by a tubular neck of less diameter; a tubular cross shell within the dome-shaped head to receive the valves; inwardly opening inlet and outlet valves arranged within said cross shell on opposite sides of the tubular neck, the cylinder, neck, valve casing and head being formed in one integral casting; and a shell or casing joining the skirt of the dome and encircling the same but set away therefrom, to form a water chamber surrounding the cylinder and the valve shell or casing.

4. In an explosive engine, the combination of a cylinder; a jacket therefor; a hol-

low dome above the cylinder head communicating with the space between the cylinder and its jacket; a two-part tubular valve shell extending across the interior of the dome, said cylinder, tubular neck, dome and body of the cross shell being formed in one integral casting, and the dome being wholly closed against communication with the interior of the cylinder; whereby circulation of cooling water about the tubular valve shell is permitted.

5. In an explosive engine, the combination of a cylinder; a hollow dome above the cylinder head; a two-part tubular cross shell extending across the interior of the dome, said dome and a section of the cross shell being connected with the cylinder by a reduced tubular neck integral with said parts, and the dome being wholly closed against communication with the interior of the cylinder; valve seats within the said cross shell; and inwardly opening valves arranged within said shell and upon said valve seats on opposite sides of the tubular neck.

6. In an explosive engine, the combination of a cylinder, a hollow dome above the cylinder; a tubular cross shell extending through said dome from side to side and having a removable section; a tubular neck cast integral with the cylinder head and with a section of the cross shell and with the dome, and forming a connection between said parts; and valves carried by the removable shell section, said removable section and the valves adapted to be bodily applied to and removed from the dome without separation from one another.

7. In an explosive engine, the combination with a shell or casing provided with a passage having opposing valve seats; valves, one for each seat; stems for said valves one passing longitudinally through the other; and a spring interposed between the two valve stems, and tending to move them longitudinally in opposite directions.

8. In an explosive engine, the combination of a cylinder provided with an exhaust neck or shell having a valve seat; a valve cage in axial alinement with said exhaust shell, and also provided with a valve seat; a valve disk adapted to close the exhaust port and provided with an elongated stem extending axially through the valve cage; a second valve disk adapted to fit the seat in the valve cage, and provided with a tubular stem encircling the stem of the exhaust valve; and a spring encircling the inner valve stem and having at opposite ends a bearing against the respective stems, whereby the single spring is adapted to seat both valves.

9. In an explosive engine, the combination of cylinder A provided with dome *a*, having shell *y* cast integral with the dome

and connected with the cylinder by an integral tubular neck; valve cage *b* passing through the wall of dome *a* and connected with shell *y*; and valves *r* and *s* carried and supported by and bodily removable with valve cage *b*, substantially as shown.

10. In combination with cylinder A provided with exhaust shell *y* having a valve seat, valve cage *b*, having a valve seat at its inner end and detachably connected with shell *y*; valve *s* having tubular stem *f*; valve *r* having shouldered stem *m* passing through tubular valve stem *f*; spring *v* arranged within valve stem *f*, and bearing at one end against the shoulder of stem *m*; and nut *h* applied to the outer end of tubular stem *f* and forming an abutment for the other end of the spring.

11. In combination with cylinder A having dome *a* provided with internal shell *y*; valve cage *b*, passing through a wall of the dome and detachably connected with shell *y*; valve *s* arranged to seat upon and close the inner end of cage *b* and having a tubular stem extending through the outer end of said cage; valve *r* arranged to seat upon and close the inner end of shell *y*; spring *v* encircling the stem *m* of valve *r*, seated within the tubular stem *f* of valve *s* and bearing against a shoulder on stem *m*; nut *h*, applied to the rear end of tubular stem *f* and bearing against spring *v*; sleeve *j* loosely encircling stem *m* beyond nut *h*, and provided with circumferential flanges; washer *k* and nuts *l*, *l*, applied to the stem *m* beyond sleeve *j*; and springs *i*, *i*, interposed between the sleeve *j* and the nut *h* and washer *k*.

12. In combination with cylinder A provided with dome *a* having shell *y*; valve cage *b* passing through a wall of the dome and connected with shell *y*; nut or collar *c* applied to cage *b* and abutting against the dome *a*; annulus *d* encircling said cage and having its interior in communication with that of the cage; nut *c* applied to the cage beyond said annulus; valve *s* having tubular stem *f* extending through the outer end of cage *b*; valve *r* having shouldered stem *m* passing longitudinally through tubular stem *f*; spring *v* located within tubular stem *f* and bearing at one end against the shoulder of stem *m*; nut *h* applied to the tubular stem and forming an abutment for the other end of the spring; sleeve *j* provided with a circumferential groove; and a yoke or lever for imparting axial movement to said sleeve, and through it to the valve stems and valves.

13. In an explosive engine, a cylinder provided with a cross shell beyond the cylinder proper and containing oppositely disposed valve seats; valve disks *r*, *s*, adapted to rest upon the respective valve seats; and a spring acting in reverse directions upon said valves, substantially as described and shown, where-

by each is adapted to serve as an abutment for the spring and the single spring is caused to seat both valves.

14. In an explosive engine, a cylinder provided with a cross shell external to the cylinder and with a dome or jacket surrounding said shell and forming a cooling chamber about it; and inlet and outlet valves arranged within the cross shell, adapted to reversely disposed seats therein, and having their stems carried one within the other through the inlet section of the

shell; whereby the shell is kept cool by the surrounding cooling medium, and the valves and stems are cooled by the inflowing charge.

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

ANTHONY B. CASPER.

Witnesses:

PAUL LANG,

WALTER F. LEIBENGUTH.