No. 893,480. PATENTED JULY 14, 1908.

C. E. GOODRICH.

EXPLOSIVE ENGINE.

APPLICATION FILED JUNE 25, 1907.

4 SHEETS—SHEET 1.

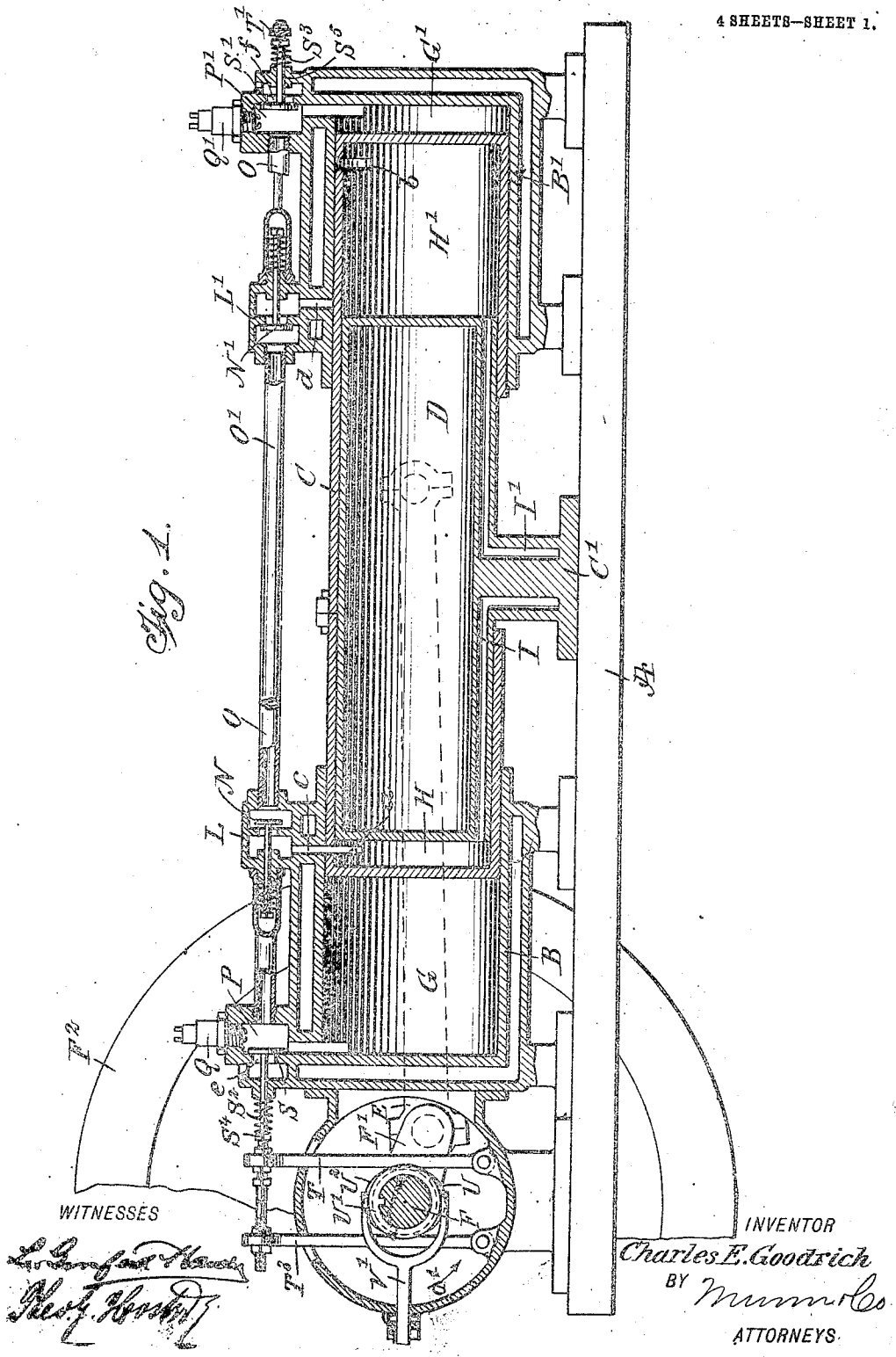


Fig. 1.

WITNESSES

INVENTOR

Charles E. Goodrich

BY Munn & Co

ATTORNEYS

No. 893,480. PATENTED JULY 14, 1908.

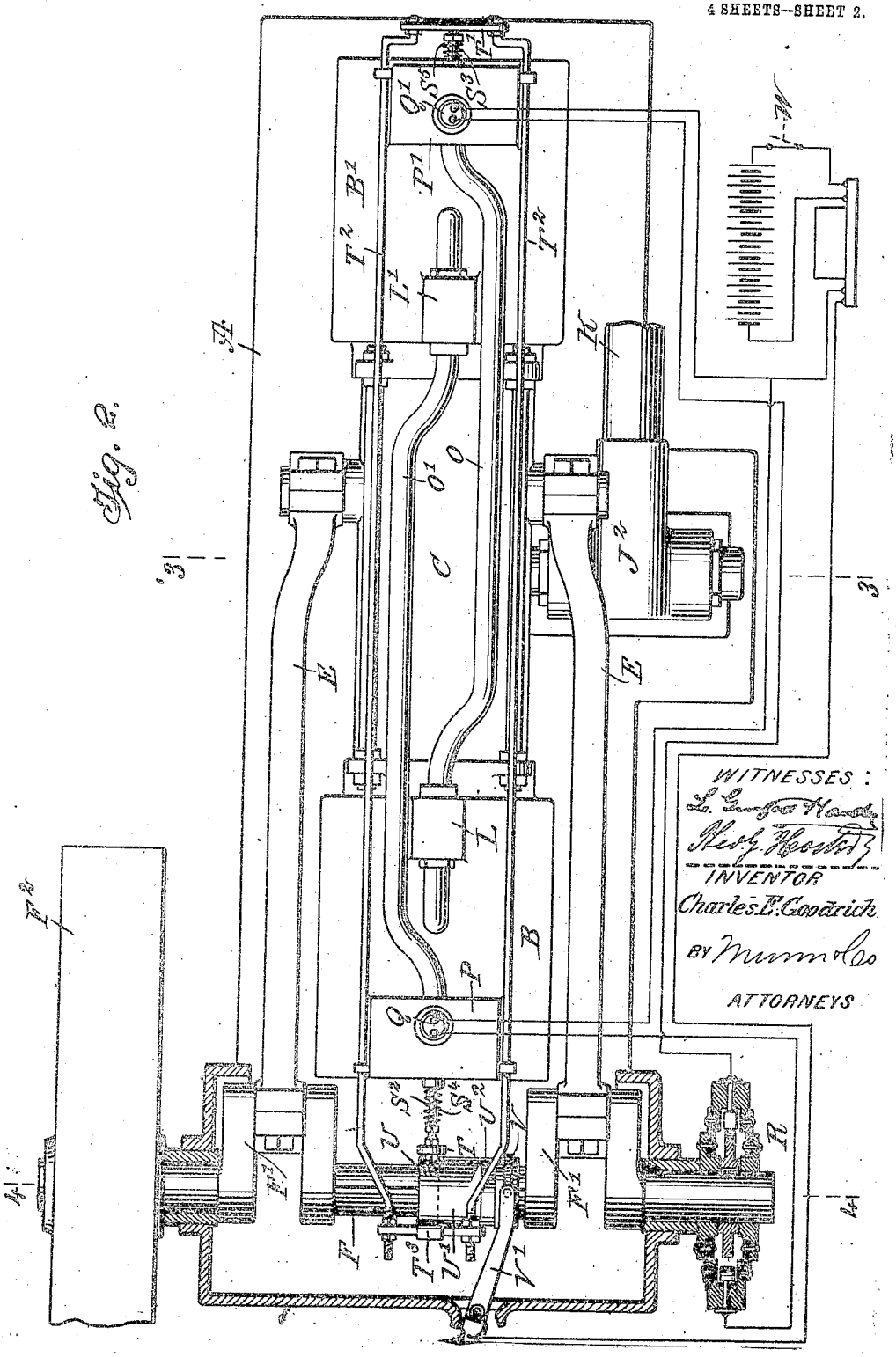
C. E. GOODRICH.

EXPLOSIVE ENGINE.

APPLICATION FILED JUNE 25, 1907.

4 SHEETS—SHEET 2.

Fig. 2.



No. 893,480. PATENTED JULY 14, 1908.

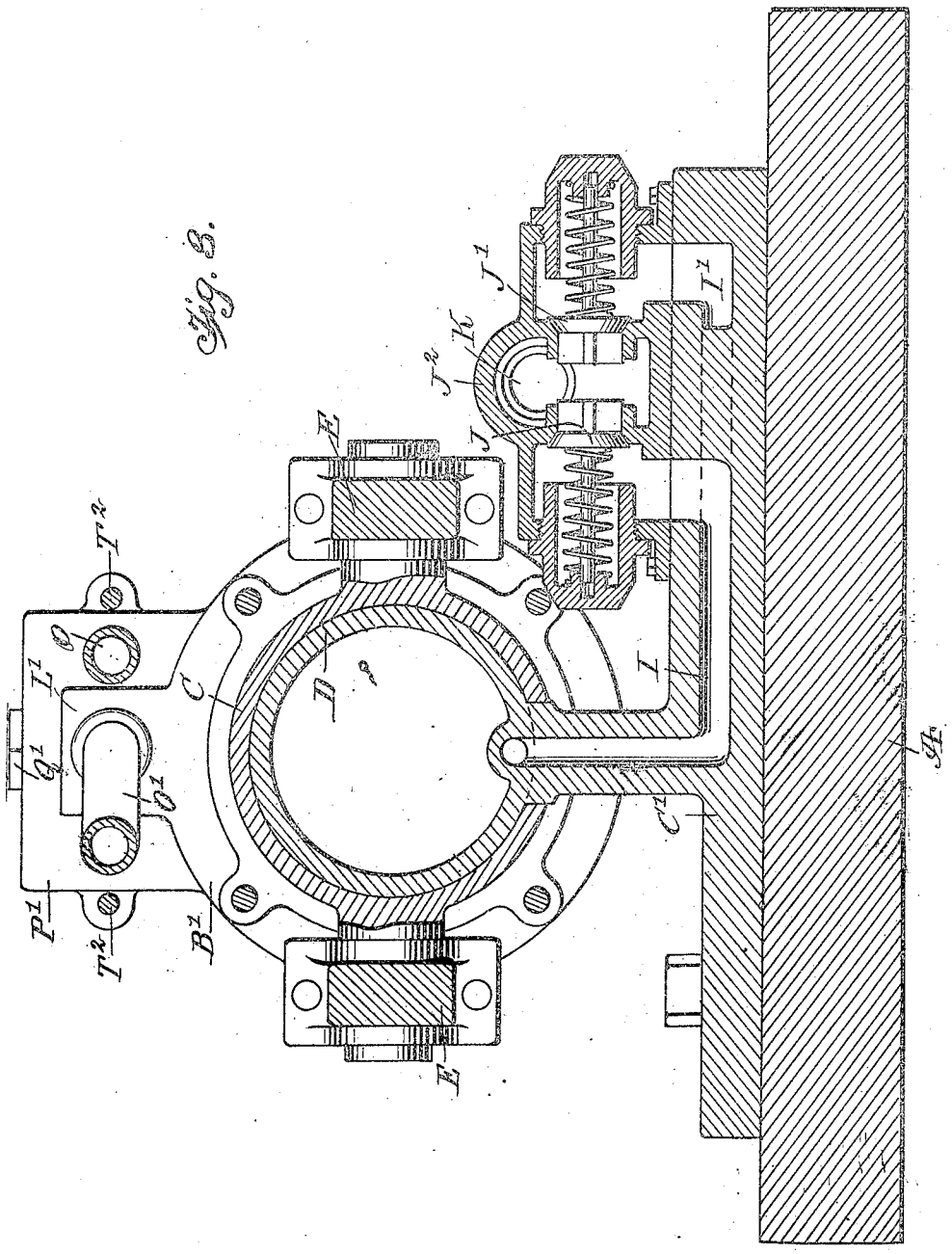
C. E. GOODRICH.

EXPLOSIVE ENGINE.

APPLICATION FILED JUNE 25, 1907.

4 SHEETS—SHEET 3.

Fig. 3.



WITNESSES

INVENTOR

Charles E. Goodrich

BY Munn & Co

ATTORNEYS

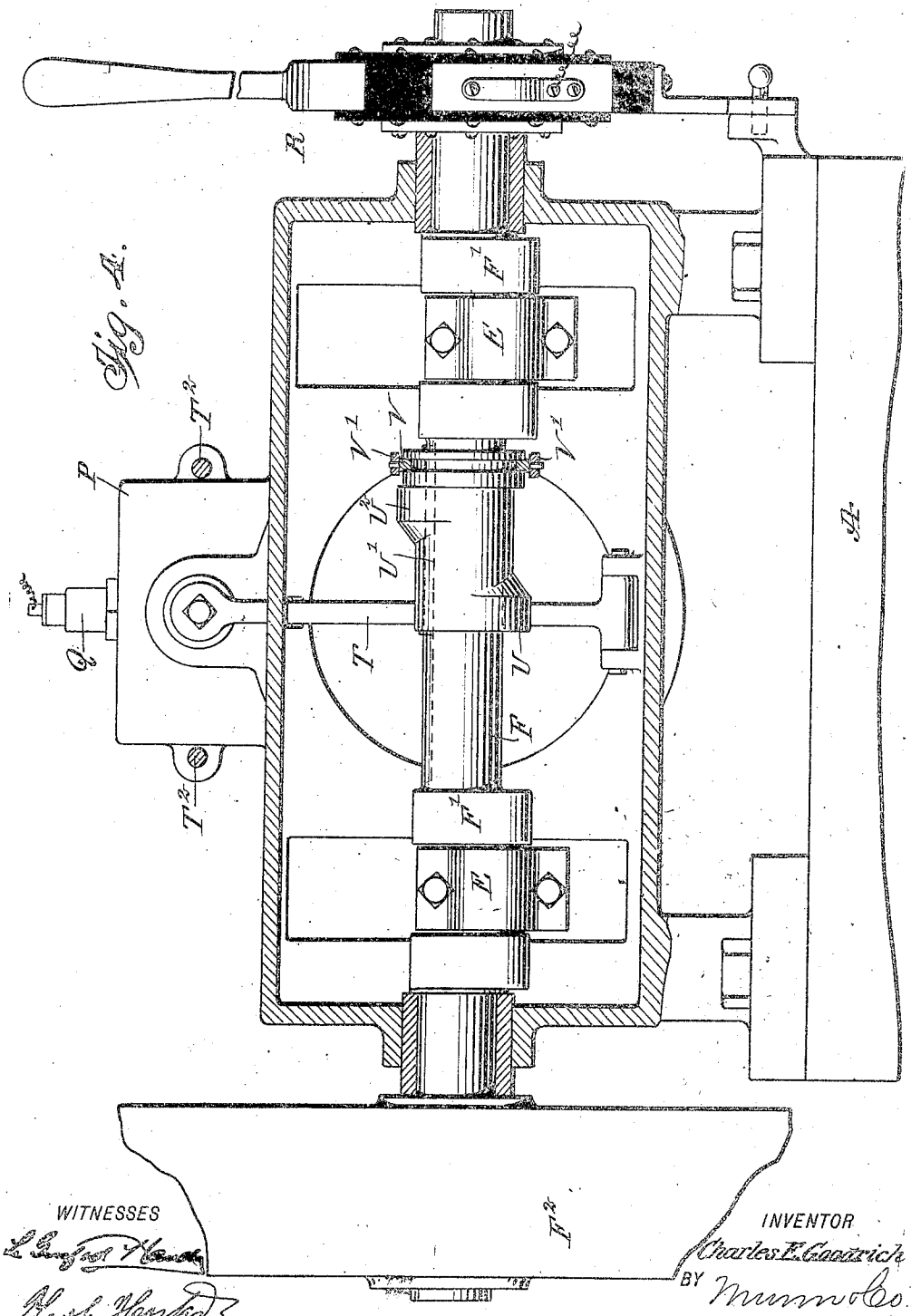
No. 893,480. PATENTED JULY 14, 1908.

C. E. GOODRICH.

EXPLOSIVE ENGINE.

APPLICATION FILED JUNE 25, 1907.

4 SHEETS—SHEET 4.



WITNESSES

INVENTOR

Charles E. Goodrich

BY Munn & Co.

ATTORNEYS.

UNITED STATES PATENT OFFICE.

CHARLES EBENEEZER GOODRICH, OF DAGGETT, CALIFORNIA.

EXPLOSIVE-ENGINE.

No. 893,480. Specification of Letters Patent. Patented July 14, 1908.

Application filed June 25, 1907. Serial No. 380,810.

To all whom it may concern:

Be it known that I, CHARLES EBENEEZER GOODRICH, a citizen of the United States, and a resident of Daggett, in the county of San Bernardino and State of California, have invented a new and Improved Explosion-Engine, of which the following is a full, clear, and exact description.

The object of the invention is to provide a new and improved explosion engine of the internal combustion type, and arranged to give two impulses to the reciprocating piston for every revolution of the main shaft, and to insure utilizing of the explosive charge to the fullest advantage.

The invention consists of novel features and parts and combinations of the same, which will be more fully described hereinafter and then pointed out in the claims.

A practical embodiment of the invention is represented in the accompanying drawings forming a part of this specification in which similar characters of reference indicate corresponding parts in all the views.

Figure 1 is a longitudinal central sectional elevation of the improvement; Fig. 2 is a plan view of the same, parts being in section; Fig. 3 is an enlarged cross section of the same on the line 3—3 of Fig. 2, and Fig. 4 is a similar view of the same on the line 4—4 of Fig. 2.

On a suitably constructed bed plate A are mounted the alined cylinders B, B′, closed at their outer ends and having their open ends opposite each other, as plainly shown in Fig. 1. Into the open ends of the cylinders B, B′ extend the ends of a hollow piston C mounted to slide on a cylindrical abutment D, preferably made hollow, and attached at its middle by a bracket C′ to the bed plate A. The sides of the piston C are connected by pitmen E with the crank arms F′ of the main driving shaft F, having a suitable pulley F² for connecting the engine with other machinery to be driven.

The ends of the piston C form with the closed ends of the cylinders B and B′ explosion chambers G and G′, and the ends of the abutment D form with the ends of the piston C compression chambers H, H′ in which the explosive mixture is compressed previous to delivering it to the explosion chambers G′, G, as hereinafter more fully explained.

Supply passages I and I′ extend through the abutment D into the compression chambers H and H′, to fill the same with the explosive mixture, and the said passages I and I′ are controlled at their outer ends by spring-pressed valves J, J′ arranged in a valve body J² attached to the bracket C′ and connected by a supply pipe K with a carbureter or other suitable source of explosive mixture supply.

The piston C is provided near its ends with ports *a* and *b* adapted to register with ports *c* and *d* formed in the cylinders B and B′ and leading to chests L, L′ arranged on the cylinders B and B′ and containing check valves N, N′. From the chests L and L′ lead pipes O and O′, of which the pipe O′ connects with the ignition chamber P arranged on the cylinder B and opening into the explosion chamber G. The pipe O leads to the ignition chamber P′ arranged on the cylinder B′ and leading to the explosion chamber G′. The ignition chambers P and P′ are provided with suitable igniters Q and Q′ controlled by a controlling device R connected with the main shaft F, to time the explosion, as hereinafter more fully described. From the ignition chambers P and P′ lead exhaust ports *e* and *f* to the outside, and the said exhaust ports *e* and *f* are controlled by valves S and S′ normally held to their seats by springs S² and S³, but moved periodically off their seats into an open position by devices actuated from the main shaft F, and arranged as follows: The outer end of the stem S⁴ of the valve S is engaged by the upper end of a lever T receiving a swinging motion by a cam U formed on a sleeve U′ mounted to turn with and to slide on the main shaft F, and the stem S⁵ of the valve S′ is connected with a cross bar T′ attached to longitudinally extending rods T² mounted to slide in suitable bearings arranged on the ignition chambers P and P′ (see Fig. 2). The rods T² are connected with a lever T³ engaged by the cam U diametrically opposite the lever T, so that the exhaust valves S, and S′ are alternately opened and closed when the engine is running. When it is desired to reverse the engine the sleeve U′ is shifted so as to engage the levers T and T³ with a reversing cam U² formed on the sleeve U′, the latter being provided with a shifting collar V engaged by a shifting lever V′ under the control of the operator and connected with the ignition controlling device R, so as to correspondingly change the actuating of the ignition devices Q and Q′ at the time the engine is reversed.

When the engine is running and the shaft F is turning in the direction of the arrow a' and the several parts are in the position illustrated in the drawings, then the piston C is near the end of its stroke to the right, having compressed during this stroke the explosive mixture previously drawn into the compression chamber H. At this time the ports a and c register with each other so that the compressed explosive mixture can pass from the compression chamber H into the chest L and from the latter by way of the check valve N and pipe O into the ignition chamber P′ and into the explosion chamber G′, in which the charge is ignited as soon or shortly after the crank arm F′ has reached a dead center position, it being understood that the charge in the explosion chamber G′ is ignited by the igniting device Q′. When this takes place the piston C is caused to travel from the right to the left, whereby the charge previously drawn into the compression chamber H′ is compressed while a new charge is drawn into the compression chamber H by way of the passage I, the valve J and supply pipe K. When the piston C is on the return stroke from the right to the left, as above mentioned, then the valve S is opened by the action of the cam U on the lever T, so that the products of combustion are forced out of the explosion chamber G into the open air by way of the exhaust port e. When the piston C reaches nearly the end of its stroke from the right to the left, then the port b registers with the port d, so that the compressed charge in the compression chamber H′ can pass by way of the said registering ports b and d, the chest L′, pipe O′ and ignition chamber P into the explosion chamber G, in which the compressed explosive mixture is ignited, as soon as the crank arms F′ have reached or passed the other dead center position so that the piston C is forced on its forward stroke from the left to the right. During this stroke from the left to the right, the products of combustion in the explosion chamber G′ are exhausted by way of the exhaust port f, and the valve S′ is held open during this period by the action of the cam U on the lever T³ connected with the valve stem S⁵, as previously explained.

It is understood that during the stroke of the piston from the left to the right, a charge is drawn into the compression chamber H′ by way of the passage I′, the valve J′ and supply pipe K, to fill the compression chamber H′ previous to the return stroke of the piston C from the right to the left.

In order to reverse the engine, the operator opens the ordinary switch W (see Fig. 2) of the electric current for the electric igniting devices Q, Q′, so that the latter are rendered inactive.

As the engine is still running in the direction of the arrow a', the explosion chambers G and G′ fill with unconsumed explosive mixtures, and when the operator now shifts the reversing lever V′ to a central position, then the electric current for the controller R is broken, as the said lever V′ also acts as circuit breaker for the controller R, besides shifting the cam sleeve U′. When the lever V′ is in central position the exhaust valves S, S′ are rendered inactive, that is, are held in a closed position, and hence the reciprocating piston C compresses the explosive mixtures in both explosion chambers G, G′ until the pressure in both chambers G, G′ is equal and the engine comes to a stop, with the piston C in an approximately central position and the crank arms F′ in an approximately central position.

The switch W is now closed and the lever V′ is swung completely over, to close the current for the controller R and to shift the cam sleeve U′ to bring the cam U² in operative engagement with the levers T and T³, so that one of the exhaust valves S or S′ is opened, that is, the exhaust valve S′ is opened if the crank arms F′ stand upward, and the exhaust valve S is opened in case the crank arms F′ point downward. The opening of the exhaust valve S or S′ relieves the corresponding explosion chamber G or G′ of its unconsumed charge, while the charge in the other explosion chamber G′ or G is ignited by the corresponding igniting device Q′ or Q, on the operator quickly moving the lever V′ in the opposite direction, to make contact, for instance, at the opposite side, to set off the corresponding igniting device Q or Q′, after which the lever V′ is immediately returned to proper running position. Now when the explosion occurs in the corresponding explosion chamber G or G′, the piston C is moved in the reverse direction, to cause the engine to run in the reverse direction of the arrow a'.

From the foregoing it will be seen that the reversing of the engine is controlled by reversing the exhaust valves and reversing the controller R for the igniting devices Q and Q′.

The engine is provided with the usual packing devices at points where needed, as well as oil cups and other expedients usually employed on explosion-engines.

The cylinders are preferably of the water-cooled type as indicated in the drawings.

Having thus described my invention, I claim as new and desire to secure by Letters Patent:

1. An explosion engine comprising alined cylinders open at opposite ends, a reciprocating hollow piston common to both cylinders and forming with the closed ends thereof explosion chambers, a fixed abutment on which the said piston is mounted to slide and forming with the latter compression chambers for the explosive mixture, and means for conducting the compressed explosive

mixture from the compressing chamber at one end of the piston to the explosion chamber adjacent to the other end of the piston.

2. An explosion engine comprising alined cylinders open at opposite ends, a reciprocating hollow piston common to both cylinders and forming with the closed ends thereof explosion chambers, a fixed abutment on which the said piston is mounted to slide and forming with the latter compression chambers for the explosive mixture, means for conducting the compressed explosive mixture from the compressing chamber at one end of the piston to the explosion chamber adjacent to the other end of the piston, and valve-controlled supply passages in the said fixed abutment and leading to the said compression chambers to fill the latter with explosive mixtures.

3. An explosion engine comprising alined cylinders open at opposite ends, a reciprocating hollow piston common to both cylinders and forming with the closed ends thereof explosion chambers, a fixed abutment on which the said piston is mounted to slide and forming with the latter compression chambers for the explosive mixture, chests on the said cylinders and having ports adapted to register with ports in the said piston to connect the said compression chambers with the said chests, and a connection between the chest on one cylinder and the explosion chamber on the other cylinder.

4. An explosion engine comprising alined cylinders open at opposite ends, a reciprocating hollow piston common to both cylinders and forming with the closed ends thereof explosion chambers, a fixed abutment on which the said piston is mounted to slide and forming with the latter compression chambers for the explosive mixture, chests on the said cylinders and having ports adapted to register with ports in the said piston to connect the said compression chambers with the said chests, a connection between the chest on one cylinder and the explosion chamber on the other cylinder, and valved exhausts on the said cylinders and connected with the said explosion chambers to exhaust the products of combustion.

5. An explosion engine comprising alined cylinders open at opposite ends, a reciprocating hollow piston common to both cylinders and forming with the closed ends thereof explosion chambers, a fixed abutment on which the said piston is mounted to slide and forming with the latter compression chambers for the explosive mixture, chests on the said cylinders and having ports adapted to register with ports in the said piston to connect the said compression chambers with the said chests, a connection between the chest on one cylinder and the explosion chamber on the other cylinder, and valve-controlled supply passages in the said abutment and leading to the said compression chambers to fill the latter with the explosive mixtures.

6. An explosion engine comprising alined cylinders open at opposite ends, a reciprocating hollow piston common to both cylinders and forming with the closed ends thereof explosion chambers, a fixed abutment in which the said piston is mounted to slide and forming with the latter compression chambers for the explosive mixture, chests on the said cylinders and having ports adapted to register with ports in the said piston to connect the said compression chambers with the said chests, a connection between the chest on one cylinder and the explosion chamber on the other cylinder, and check valves in the said chests.

7. An explosion engine comprising alined cylinders open at opposite ends, a reciprocating hollow piston common to both cylinders and forming with the closed ends thereof explosion chambers, a fixed abutment on which the said piston is mounted to slide and forming with the latter compression chambers for the explosive mixture, chests on the said cylinders and having ports adapted to register with ports in the said piston to connect the said compression chambers with the said chests, a connection between the chest on one cylinder and the explosion chamber on the other cylinder, exhaust valves on the said cylinders and connected with the said compression chambers, and means for periodically opening and closing the said exhaust valves.

8. An explosion engine comprising alined cylinders open at opposite ends, a reciprocating hollow piston common to both cylinders and forming with the closed ends thereof explosion chambers, a fixed abutment on which the said piston is mounted to slide and forming with the latter compression chambers for the explosive mixture, chests on the said cylinders and having ports adapted to register with ports in the said piston to connect the said compression chambers with the said chests, a connection between the chest on one cylinder and the explosion chamber on the other cylinder, and spring-pressed inlet valves connected with a supply and with supply passages extending through the said abutment and leading to the said compression chambers.

9. An explosion engine comprising alined cylinders open at opposite ends, a reciprocating hollow piston common to both cylinders and forming with the closed ends thereof explosion chambers, a fixed abutment on which the said piston is mounted to slide and forming with the latter compression chambers for the explosive mixture, a crank shaft, a pitman connecting the crank shaft with the said piston, valved supply passages extending through the said abutment to the said compression chambers, chests on the said

cylinders, and pipes connecting the chest on one cylinder with the explosion chamber on the other cylinder.

10. An explosion engine comprising alined cylinders open at opposite ends, a reciprocating hollow piston common to both cylinders and forming with the closed ends thereof explosion chambers, a fixed abutment on which the said piston is mounted to slide and forming with the latter compression chambers for the explosive mixture, a crank shaft, a pitman connecting the crank shaft with the said piston, valved supply passages extending through the said abutment to the said compression chambers, chests on the said cylinders, pipes connecting the chest on one cylinder with the explosion chamber on the other cylinder, exhaust valves for the said explosion chambers, and means actuated from the said crank shaft for controlling the opening and closing of the said exhaust valves.

11. An explosion engine comprising alined cylinders open at opposite ends, a reciprocating hollow piston common to both cylinders and forming with the closed ends thereof explosion chambers, a fixed abutment on which the said piston is mounted to slide and forming with the latter compression chambers for the explosive mixture, a crank shaft, a pitman connecting the crank shaft with the said piston, valved supply passages extending through the said abutment to the said compression chambers, chests on the said cylinders, pipes connecting the chest on one cylinder with the explosion chamber on the other cylinder, and check valves in the said chests.

12. An explosion engine comprising alined cylinders open at opposite ends, a reciprocating hollow piston common to both cylinders and forming with the closed ends thereof explosion chambers, a fixed abutment on which the said piston is mounted to slide and forming with the latter compression chambers for the explosive mixture, chests on the said cylinders and having ports adapted to register with ports in the said piston to connect the said compression chambers with the said chests, a connection between the chest on one cylinder and the explosion chamber on the other cylinder, valved exhausts on the said cylinders and connected with the said explosion chambers to exhaust the products of combustion, igniting devices for the said explosion chambers, and means for alternately opening and closing the said exhaust valves.

13. An explosion engine comprising alined cylinders open at opposite ends, a reciprocating hollow piston common to both cylinders and forming with the closed ends thereof explosion chambers, a fixed abutment on which the said piston is mounted to slide and forming with the latter compression chambers for the explosive mixture, chests on the said cylinders and having ports adapted to register with ports in the said piston to connect the said compression chambers with the said chests, a connection between the chest on one cylinder and the explosion chamber on the other cylinder, valved exhausts on the said cylinders and connected with the said explosion chambers to exhaust the products of combustion, igniting devices for the said explosion chambers, a controller for the said igniting devices, and actuating means for periodically opening and closing the said exhaust valves.

14. An explosion engine comprising alined cylinders open at opposite ends, a reciprocating hollow piston common to both cylinders and forming with the closed ends thereof explosion chambers, a fixed abutment on which the said piston is mounted to slide and forming with the latter compression chambers for the explosive mixture, chests on the said cylinders and having ports adapted to register with ports in the said piston to connect the said compression chambers with the said chests, a connection between the chest on one cylinder and the explosion chamber on the other cylinder, valved exhausts on the said cylinders and connected with the said explosion chambers to exhaust the products of combustion, igniting devices for the said explosion chambers, a controller for the said igniting devices, actuating means for periodically opening and closing the said exhaust valves, and means for reversing the said actuating means and the said controller.

15. An explosion engine comprising alined cylinders open at opposite ends, a reciprocating hollow piston common to both cylinders and forming with the closed ends thereof explosion chambers, a fixed abutment on which the said piston is mounted to slide and forming with the latter compression chambers for the explosive mixture, chests on the said cylinders and having ports adapted to register with ports in the said piston to connect the said compression chambers with the said chests, means establishing communication between the chest on one cylinder and the explosion chamber on the other cylinder, exhaust valves for the said explosion chambers, a cam on the engine shaft, and means for controlling the exhaust valves from the said cam.

16. An explosion engine comprising alined cylinders open at opposite ends, a reciprocating hollow piston common to both cylinders and forming with the closed ends thereof explosion chambers, a fixed abutment on which the said piston is mounted to slide and forming with the latter compression chambers for the explosive mixture, chests on the said cylinders and having ports adapted to register with ports in the said piston to connect the said compression chambers with the said chests, a connection between the chest on one

cylinder and the explosion chamber on the other cylinder, exhaust valves for the said explosion chambers, a cam mechanism on the engine shaft and connected with the said exhaust valves for periodically opening and closing the same, and means for reversing the said cam mechanism.

17. An explosion engine comprising alined cylinders open at opposite ends, a reciprocating hollow piston common to both cylinders and forming with the closed ends thereof explosion chambers, a fixed abutment on which the said piston is mounted to slide and forming with the latter compression chambers for the explosive mixture, chests on the said cylinders and having ports adapted to register with ports in the said piston to connect the said compression chambers with the said chests, a connection between the chest on one cylinder and the explosion chamber on the other cylinder, exhaust valves for the said explosion chambers, a cam mechanism on the engine shaft and connected with the said exhaust valves for periodically opening and closing the same, igniting devices for the said explosion chambers, a controller for the said igniting devices, and manually controlled means for reversing the said cam mechanism and the said controller.

18. An explosion engine, having a compression chamber for compressing the explosive mixture, a chest containing a check valve and having a port adapted to communicate with said compression chamber, an explosion chamber, and a connection between the said chest and the explosion chamber, to conduct the compressed explosive mixture into the explosion chamber, the latter at the time of the transfer of the explosive mixture being larger in size than the compression chamber.

19. An explosion engine having a compression chamber adjacent to one end thereof for compressing the explosive mixture, a chest having a port adapted to communicate with said compression chamber when the explosive mixture is compressed therein, a check valve in said chest, an explosion chamber at the other end of said engine, a piston reciprocating in the said explosion chamber, an ignition chamber opening into the said explosion chamber, and means for conducting the compressed explosive mixture from the said chest to the ignition chamber, the explosion chamber at the time of the transfer of the explosive mixture being larger in size than the compression chamber.

20. An explosion engine comprising alined cylinders open at their inner ends, a reciprocating hollow piston closed at each end and common to both cylinders and forming with the closed outer ends of the cylinders explosion chambers, a fixed cylindrical abutment on which the said piston is mounted to slide, the ends of the abutment forming with the closed ends of the piston compression chambers for the explosive mixture, a crank shaft, pitmen connecting the sides of the piston with the crank arms of said shaft, means for conducting the explosive mixture to the compression chambers, and means for conducting the compressed explosive mixture from the compression chamber at one end of the piston, to the explosion chamber adjacent to the other end of the piston.

21. An explosion engine having an explosion chamber, a piston reciprocating in the explosion chamber, a chest provided with a port, a fixed abutment forming with the piston a compression chamber, the compression chamber having a port adapted to register with the port of said chest, an ignition chamber opening into the explosion chamber, a pipe connecting the said chest and the ignition chamber, means for conducting the explosive mixture to the compression chamber, and a valve controlled exhaust port leading from the ignition chamber.

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

CHARLES EBENEZER GOODRICH.

Witnesses:
J. H. SLOAN,
J. O. WHITE.