J. H. FITCH.

ROTARY ENGINE.

APPLICATION FILED MAR. 18, 1907.

907,023.

Patented Dec. 15, 1908

3 SHEETS—SHEET 1.

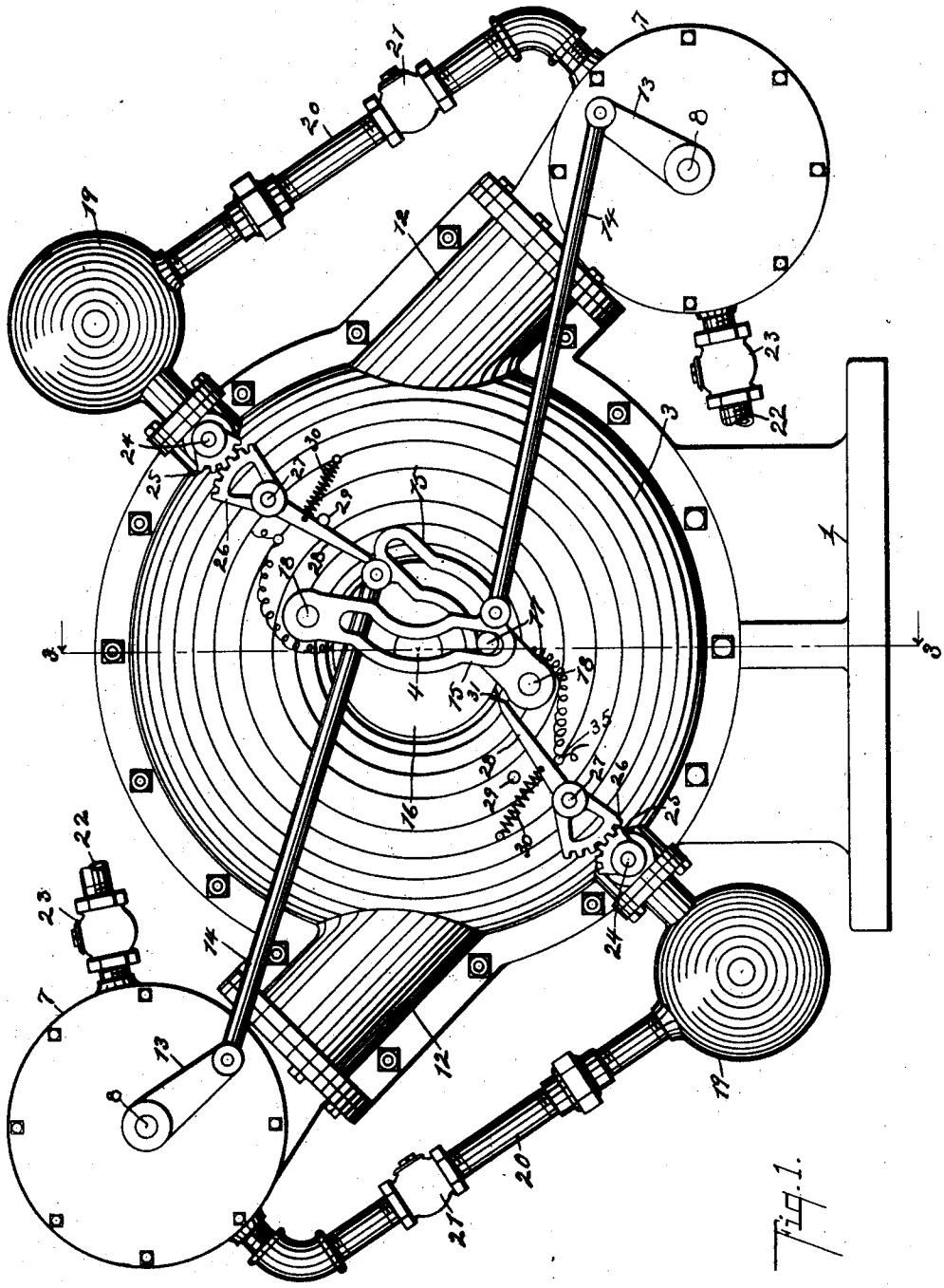


Fig. 1.

Witnesses:

A. F. Brandt.

Lulu Greenfield

Inventor,

John H. Fitch

By Chappell & Earl

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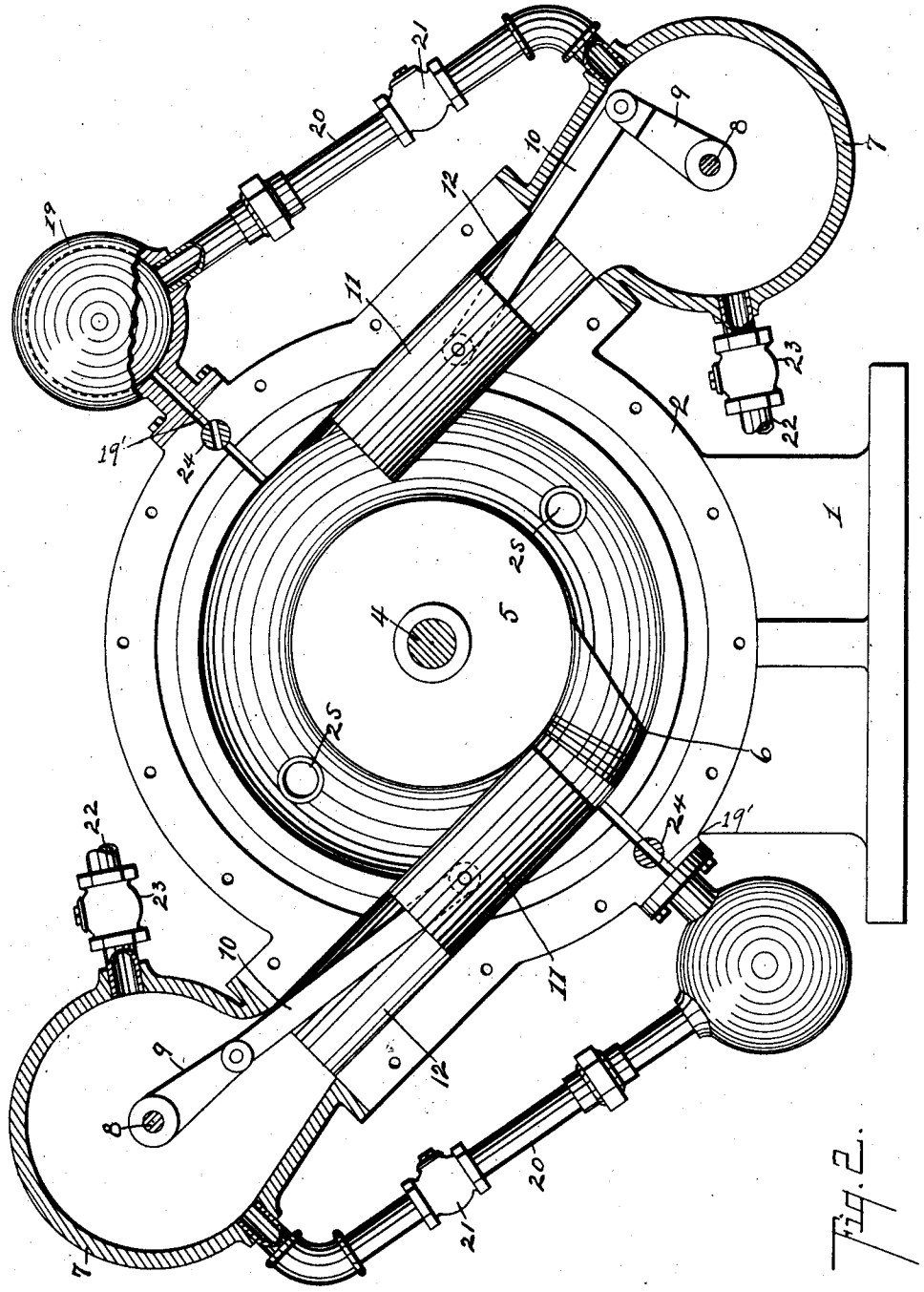


Fig. 2.

Witnesses:

A. D. Adams

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3 SHEETS—SHEET 3.

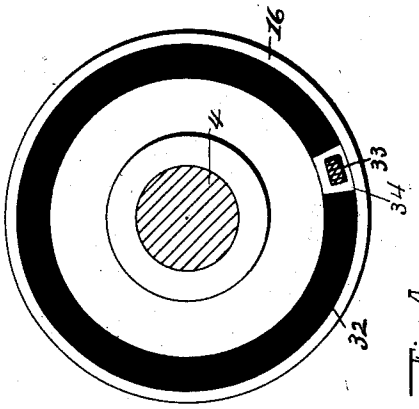


Fig. 4.

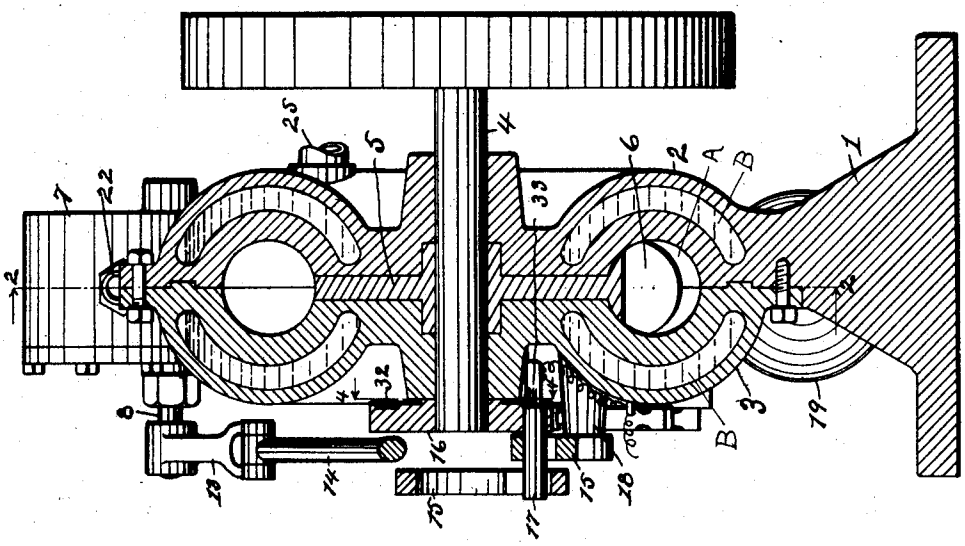


Fig. 5.

Witnesses:

Lulu Greenfield

Inventor,

John H. Fitch

By Chappell & Earl

Att'y.s

UNITED STATES PATENT OFFICE.

JOHN H. FITCH, OF LUDINGTON, MICHIGAN.

ROTARY ENGINE.

No. 907,023. Specification of Letters Patent. Patented Dec. 15, 1908.

Application filed March 18, 1907. Serial No. 362,980.

To all whom it may concern:

Be it known that I, JOHN H. FITCH, a citizen of the United States, residing at the city of Ludington, county of Mason, State of Michigan, have invented certain new and useful Improvements in Rotary Engines, of which the following is a specification.

This invention relates to improvements in rotary engines.

My improved rotary engine is particularly designed by me as an explosion engine, but certain features thereof may be embodied in steam engines.

The main objects of this invention are, first, to provide an improved rotary engine which is very effective in the utilization of the power units. Second, to provide in a rotary engine of the explosion type an improved charging and valve-operating mechanism. Third, to provide in a rotary engine of the explosion type an improved sparking mechanism.

Further objects, and objects relating to details of construction, will definitely appear from the detailed description to follow.

I accomplish the objects of my invention by the devices and means described in the following specification.

The invention is clearly defined and pointed out in the claims.

A structure embodying the features of my invention is clearly illustrated in the accompanying drawing, forming a part of this specification, in which,

Figure 1 is a side elevation of a structure embodying the features of my invention. Fig. 2 is a central vertical section taken on a line corresponding to line 2—2 of Fig. 3, certain parts being shown in full lines. Fig. 3 is a vertical transverse section taken on a line corresponding to line 3—3 of Fig. 1. Fig. 4 is an enlarged vertical section taken on a line corresponding to line 4—4 of Fig. 3, showing details of the sparking mechanism.

In the drawing, the sectional views are taken looking in the direction of the little arrows at the ends of the section lines, and similar numerals of reference refer to similar parts throughout the several views.

Referring to the drawing, I provide a suitable base as 1 on which the cylinder is mounted, the cylinder being made up of sections 2 and 3, divided on a central line, the section 2 being preferably formed integral with the base and the section 3 being suitably secured thereto. The main cylinder is adapted to receive the disk-like piston 5, which is provided with a piston head 6. The outer portion of the cylinder chamber is preferably cylindrical in cross section; see Fig. 3. The cylinder is preferably provided with suitable water chambers. The piston 5 is mounted upon a shaft 4 which is arranged in suitable bearings arranged centrally of the main cylinder.

At each side of the main cylinder I arrange a compression-chamber 7. The plunger cylinders open at one end into these compression chambers and at the other into the main cylinder, the plunger cylinders being of the same diameter as the outer portion of the main cylinder and being arranged tangentially thereto, so that the plungers 11 may pass into the main cylinder, and, when in their inner position, close the same or form a partition across the same, as clearly appears in the drawing. The plungers 11 are operated through the crank shafts 8 provided with arms 9 which are connected to the plungers 11 by suitable pitmen, as 10. The crank shafts 8 are provided with suitable arms 13 on their outer ends, which arms are connected by the pitmen 14 to a pair of pivoted levers 15. These levers are pivoted on the main cylinder at 18, and are provided with longitudinal cam slots through which the crank pin 17, carried by the crank disk 16, is arranged. This crank disk is mounted on the shaft 4 of the engine. It is obvious that as the shaft 4 revolves, the crank pin 17 actuates the levers 15, moving from end to end of the slots therein. These levers are oppositely-arranged, so that the movement of the two plungers is properly timed. On account of the cam slots in the levers,—the central portion of each slot being preferably curved, the curvature of the slots corresponding to that of an arc of the circle described by the crank pin 17,—the plungers are given an irregular movement, being held at the inner end of their stroke a short time to form a substantially fixed abutment for the explosion.

The parts are so arranged that the plungers move into the cylinder behind the piston head at the same, or substantially the same, rate of movement, the crank pin 17 being at this time at the inner end of the slot of one of the levers and at the outer end of the slot of the other. This same movement provides for the quick retraction of the plungers in advance of the piston head.

The explosive mixture is delivered to the

compression chambers 7 from suitable source, as through the pipes 22, the check valves 23 being provided for these pipes. On the return stroke of the plunger, the explosive mixture is compressed and forced into the charge or delivery chambers 19, which are mounted upon the cylinder and connected thereto by suitable passages as 19′. The delivery chambers are connected to the compression chambers by suitable pipes as 20, the pipes 20 being provided with check valves as 21. The connections and valves are indicated in conventional form. The passages 19′ are controlled by the valves 24. On the stems of the valves are segments 25 with which the segments 26 on the valve-actuating levers 28 are arranged to mesh. These levers 28 are pivotally mounted on the pivots 27. On the crank disk 16 are trips 31, adapted to engage the levers 28 as the piston revolves, thereby opening the valves to admit the charge. These parts are so arranged that the valves are opened immediately after the piston head 6 passes the inlet passages 19′. The plungers 11, passing into the cylinder behind the piston, properly confine the charge. The valve-actuating levers are also adapted to serve as part of the igniter mechanism, the same being arranged to engage the contact members 35, and thus complete the circuit, the crank disks being provided with a suitable contact member 34 adapted to engage the fixed contact members 33 mounted on the engine casing. As the electrodes form no part of this invention, they are not here illustrated. The valve-actuating levers 28 are returned to their initial position, which also closes the valves, by means of the springs 30. Suitable stops, as 29, are provided therefor.

A pair of exhaust ports 25 is provided. These exhaust ports are located midway between the inlet ports 19′ and are preferably of relatively large diameter, so that the engine exhausts freely. As both ports are always open, there are no compressions to retard the piston.

By my improved rotary engine, I am enabled to attain both speed and power with an economical use of fuel. The charging and valve-operating mechanism is very effective and also by this arrangement, I secure the proper timing of the sparking.

I have illustrated the mechanism for obtaining the movement of the plungers 11, which I find simple and effective, but I am aware that it may be very greatly varied or other movements substituted without departing from my invention.

I have illustrated and described my improved rotary engine in detail in the form preferred by me on account of its structural simplicity and economy. I am aware, however, that it is capable of considerable variation in structural details without departing from my invention, and I desire to be understood as claiming the same specifically as illustrated as well as broadly.

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

1. The combination with a main cylinder, the outer portion of which is cylindrical in cross section, of a shaft; a disk-like piston mounted thereon; a cylindrical head for said piston; a pair of delivery chambers; a pair of oppositely-arranged delivery passages therefor; a pair of compression chambers; connecting pipes for said compression chambers to said delivery chambers; check valves therefor; supply pipes for said compression chambers; check valves for said supply pipes; a pair of plunger cylinders opening into said main cylinder and compression chambers, said plunger cylinders being of the same diameters as the said cylindrical portion of the main cylinder and arranged tangentially thereto; a pair of plungers adapted to pass into said main cylinder to close the same when in their inner position; a pair of crank shafts arranged in said compression chambers; crank arms thereon; pitmen connecting said crank arms to said plungers; a pair of crank arms on the outer ends of said crank shaft; a crank disk on said piston shaft; a pair of oppositely-arranged pivoted levers having cam slots therein; a crank pin on said crank disk arranged in said slots in said levers; pitmen connecting said levers to said arms on the outer ends of said crank shafts; valves for said delivery passages; segments on the stems of said valves; a pair of pivoted valve-actuating levers having segments arranged to mesh with said segments on said valve stems; springs for returning said levers to their initial position, whereby said valves are held normally closed; trips on said crank disk adapted to actuate said valve levers; a contact member carried by said crank disk; a fixed contact member adapted to coact therewith; and contact members arranged to be engaged by said actuating-levers when in their actuated position, coacting for the purpose specified.

2. The combination with a main cylinder, the outer portion of which is cylindrical in cross section, of a shaft; a disk-like piston mounted thereon; a cylindrical head for said pistons; a pair of delivery chambers; a pair of oppositely-arranged delivery passages therefor; a pair of compression chambers; connecting pipes for said compression chambers to said delivery chambers; check valves therefor; supply pipes for said compression chambers; check valves for said supply pipes; a pair of plunger cylinders opening into said main cylinder and compression chambers, said plunger cylinder being of the same diameters as the said cy-

lindrical portion of the main cylinder and arranged tangentially thereto; a pair of plungers adapted to pass into said main cylinder to close the same when in their inner position; a pair of crank shafts arranged in said compression chambers; crank arms thereon; pitmen connecting said crank arms to said plungers; a pair of crank arms on the outer ends of said crank shaft; a crank disk on said piston shaft; a pair of oppositely-arranged pivoted levers having cam slots therein; a crank pin on said crank disk arranged in said slots in said levers; pitmen connecting said levers to said arms on the outer ends of said crank shafts; valves for said delivery passages; segments on the stems of said valves a pair of pivoted valve-actuating levers having segments arranged to mesh with said segments on said valve stems; springs for returning said levers to their initial position, whereby said valves are held normally closed; and trips on said crank disk adapted to actuate said valve levers, coacting for the purpose specified.

3. The combination with a main cylinder, the outer portion of which is cylindrical in cross section, of a shaft; a disk-like piston mounted thereon; a cylindrical head for said piston; a pair of delivery chambers; a pair of oppositely-arranged delivery passages therefor; a pair of compression chambers; connecting pipes for said compression chambers to said delivery chambers; check valves therefor; supply pipes for said compression chambers; check valves for said supply pipes; a pair of plunger cylinders opening into said main cylinder and compression chambers, said plunger cylinders being of the same diameters as the said cylindrical portion of the main cylinder and arranged tangentially thereto; a pair of plungers adapted to pass into said main cylinder to close the same when in their inner position; a pair of crank shafts arranged in said compression chambers; crank arms thereon; pitmen connecting said crank arms to said plungers; a pair of crank arms on the outer ends of said crank shaft; a crank disk on said piston shaft; a pair of oppositely-arranged pivoted levers having cam slots therein; a crank pin on said crank disk arranged in said slots in said levers; pitmen connecting said levers to said arms on the outer ends of said crank shafts; valves for said delivery passages; a pair of pivoted valve-actuating levers therefor; springs for returning said levers to their initial position, whereby said valves are held normally closed; trips on said crank disk adapted to actuate said valve levers; a contact member carried by said crank disk; a fixed contact member adapted to coact therewith; and contact members arranged to be engaged by said actuating levers when in their actuated position coacting for the purpose specified.

4. The combination with a main cylinder, the outer portion of which is cylindrical in cross section, of a shaft; a disk-like piston mounted thereon; a cylindrical head for said piston; a pair of delivery chambers; a pair of oppositely-arranged delivery passages therefor; a pair of compression chambers; connecting pipes for said compression chambers to said delivery chambers; check valves therefor; supply pipes for said compression chambers; check valves for said supply pipes; a pair of plunger cylinders opening into said main cylinder and compression chambers, said plunger cylinders being of the same diameters as the said cylindrical portion of the main cylinder and arranged tangentially thereto; a pair of plungers adapted to pass into said main cylinder to close the same when in their inner position; a pair of crank shafts arranged in said compression chambers; crank arms thereon; pitmen connecting said crank arms to said plungers; a pair of crank arms on the outer ends of said crank shaft; a crank disk on said piston shaft; a pair of oppositely-arranged pivoted levers having cam slots therein; a crank pin on said crank disk arranged in said slots in said levers; pitmen connecting said levers to said arms on the outer ends of said crank shafts; valves for said delivery passages; a pair of pivoted valve-actuating levers therefor; springs for returning said levers to their initial position, whereby said valves are held normally closed; and trips on said crank disk adapted to actuate said valve levers, coacting for the purpose specified.

5. The combination with a main cylinder, the outer portion of which is cylindrical in cross section, of a shaft; a disk-like piston mounted thereon; a cylindrical head for said piston; a pair of delivery chambers; a pair of oppositely-arranged delivery passages therefor; a pair of compression chambers; connecting pipes for said compression chambers to said delivery chambers; check valves therefor; supply pipes for said compression chambers; check valves for said supply pipes; a pair of plunger cylinders opening into said main cylinder and compression chambers, said plunger cylinders being of the same diameters as the said cylindrical portion of the main cylinder and arranged tangentially thereto; a pair of plungers adapted to pass into said main cylinder to close the same when in their inner position; a pair of crank shafts arranged in said compression chambers; crank arms thereon; pitmen connecting said crank arms to said plungers; a pair of crank arms on the outer ends of said crank shaft; a crank disk on said piston shaft; a pair of oppositely-arranged pivoted levers having cam slots therein; a crank pin on said crank disk arranged in said slots in said levers; pitmen connecting said levers to said arms on the outer ends of said crank shafts;

and valves for said delivery passages, coacting for the purpose specified.

6. The combination with a main cylinder, having an outer annular portion, of a shaft; a disk-like piston having a head, mounted on said shaft; a pair of delivery chambers connected to said cylinder by suitable inlet ports; a pair of compression chambers connected to said delivery chambers; a pair of plunger cylinders opening into said main cylinder and compression chambers, said plunger cylinders being of the same diameters as the said outer annular portion of the main cylinder and arranged tangentially thereto; a pair of plungers adapted to pass into said main cylinder to close the same when in their inner position; a pair of crank shafts arranged in said compression chambers; pitmen connecting said crank shafts to said plungers; a crank disk on said piston shaft; a pair of oppositely-arranged pivoted levers having cam slots therein; a crank pin on said crank disk arranged in said slots in said levers; pitmen connecting said levers to said crank shafts; valves for said inlet port; segments on the stems of said valves; a pair of pivoted valve-actuating levers having segments thereon arranged to mesh with said segments on said valve stems; springs for returning said levers to their initial position, whereby said valves are held normally closed; trips on said crank disk adapted to actuate said valve levers; a contact member carried by said crank disk; a fixed contact member adapted to coact therewith; and contact members arranged to be engaged by said valve-actuating levers when in their actuated position, coacting for the purpose specified.

7. The combination with a main cylinder, having an outer annular portion, of a shaft; a disk-like piston having a head, mounted on said shaft; a pair of delivery chambers connected to said cylinder by suitable inlet ports; a pair of compression chambers connected to said delivery chambers; a pair of plunger cylinders opening into said main cylinder and compression chambers, said plunger cylinders being of the same diameters as the said outer annular portion of the main cylinder and arranged tangentially thereto; a pair of plungers adapted to pass into said main cylinder to close the same when in their inner position; a pair of crank shafts arranged in said compression chambers; pitmen connecting said crank shafts to said plungers; a crank disk on said piston shaft; a pair of oppositely-arranged pivoted levers having cam slots therein; a crank pin on said crank disk arranged in said slots in said levers; pitmen connecting said levers to said crank shafts; valves for said inlet port; segments on the stems of said valves; a pair of pivoted valve-actuating levers having segments thereon arranged to mesh with said segments on said valve stems; springs for returning said levers to their initial position, whereby said valves are held normally closed; and trips on said crank disk adapted to actuate said valve levers, all coacting for the purpose specified.

8. The combination with a main cylinder, having an outer annular portion, of a shaft; a disk-like piston having a head, mounted on said shaft; a pair of delivery chambers connected to said cylinder by suitable inlet ports; a pair of compression chambers connected to said delivery chambers; a pair of plunger cylinders opening into said cylinder and compression chambers, said plunger cylinders being of the same diameters as the said outer annular portion of the main cylinder and arranged tangentially thereto; a pair of plungers adapted to pass into said main cylinder to close the same when in their inner position; a pair of crank shafts arranged in said compression chambers; pitmen connecting said crank shafts to said plungers; a crank disk on said piston shaft; a pair of oppositely-arranged pivoted levers having cam slots therein; a crank pin on said crank disk arranged in said slots in said levers; pitmen connecting said levers to said crank shafts; valves for said inlet port; a pair of pivoted valve-actuating levers therefor; springs for returning said levers to their initial position whereby said valves are held normally closed; trips on said crank disk adapted to actuate said valve levers; a contact member carried by said crank disk; a fixed contact member adapted to coact therewith; and contact members arranged to be engaged by said valve-actuating levers when in their actuated position, coacting for the purpose specified.

9. The combination with a main cylinder, having an annular outer portion, of a shaft; a disk-like piston having a head, mounted on said shaft; a pair of delivery chambers connected to said cylinder by suitable inlet ports; a pair of compression chambers connected to said delivery chambers; a pair of plunger cylinders opening into said main cylinder and compression chambers, said plunger cylinders being of the same diameters as the said outer annular portion of the main cylinder and arranged tangentially thereto; a pair of plungers adapted to pass into said main cylinder to close the same when in their inner position; a pair of crank shafts arranged in said compression chambers; pitmen connecting said crank shafts to said plungers; a crank disk on said piston shaft; a pair of oppositely-arranged pivoted levers having cam slots therein; a crank pin on said crank disk arranged in said slots in said levers; pitmen connecting said levers to said crank shafts; valves for said inlet port; a pair of pivoted valve actuating levers therefor; springs for returning said levers to their

initial position, whereby said valves are held normally closed; and trips on said crank disk adapted to actuate said valve levers, coacting for the purpose specified.

10. The combination with a main cylinder, having an outer annular portion, of a shaft; a disk-like piston having a head, mounted on said shaft; a pair of delivery chambers connected to said cylinder by suitable inlet ports; a pair of compression chambers connected to said delivery chambers; a pair of plunger cylinders opening into said main cylinder and compression chambers, said plunger cylinders being of the same diameters as the said outer annular portion of the main cylinder and arranged tangentially thereto; a pair of plungers adapted to pass into said main cylinder to close the same when in their inner position; a pair of crank shafts arranged in said compression chambers; pitmen connecting said crank shafts to said plungers; a crank disk on said piston shaft; a pair of oppositely-arranged pivoted levers having cam slots therein; a crank pin on said crank disk arranged in said slots in said levers; pitmen connecting said levers to said crank shafts; and valves for said inlet port, coacting for the purpose specified.

11. The combination with a main cylinder, having an outer annular portion adapted to receive the piston head, of a shaft; a disk-like piston mounted thereon; a head for said piston; a pair of delivery chambers; a pair of oppositely-arranged delivery passages therefor; a pair of compression chambers; connecting pipes for said compression chambers to said delivery chambers; check valves therefor; supply pipes for said compression chambers; check valves for said supply pipes; a pair of plunger cylinders opening into said main cylinder and compression chambers, said plunger cylinders being of the same diameters as the said outer annular portion of the main cylinder and arranged tangentially thereto; a pair of plungers adapted to pass into said main cylinder to close the same when in their inner position; driving connections for said shaft to said plungers; valves for said delivery passages; a pair of actuating levers for said valves; and trips carried by said shaft adapted to actuate said valve levers, coacting for the purpose specified.

12. The combination with a main cylinder, having an outer annular portion adapted to receive the piston head, of a shaft; a disk-like piston mounted thereon; a head for said piston; a pair of delivery chambers; a pair of oppositely-arranged delivery passages therefor; a pair of compression chambers; connecting pipes for said compression chambers to said delivery chambers; check valves therefor; supply pipes for said compression chambers; check valves for said supply pipes; a pair of plunger cylinders opening into said main cylinder and compression chambers, said plunger cylinders being of the same diameters as the said outer annular portion of the main cylinder and arranged tangentially thereto; a pair of plungers adapted to pass into said main cylinder to close the same when in their inner position; and driving connections for said shaft to said plungers, coacting for the purpose specified.

13. The combination with a main cylinder having an outer annular portion adapted to receive the piston head, of a shaft; a disk-like piston mounted thereon; a head for said piston; a delivery chamber connected to said cylinder by a suitable port or delivery passage; a compression chamber; a connecting pipe for said compression chamber to said delivery chamber; a check valve therefor; a supply pipe for said compression chamber; a check valve for said supply pipe; a plunger cylinder opening into said main cylinder and compression chamber, said plunger cylinder being of the said diameter as the said outer portion of the main cylinder and arranged tangentially thereto; a plunger adapted to pass into said main cylinder to close the same when in its inner position; driving connections for said shaft to said plunger; a valve for said delivery passage; an actuating lever for said valve; and a trip carried by said shaft adapted to actuate said valve lever.

14. The combination with a main cylinder, having an outer annular portion adapted to receive the piston head, of a shaft; a disk-like piston mounted thereon; a head for said piston; a delivery chamber connected to said cylinder by a suitable port or delivery passage; a compression chamber; a connecting pipe for said compression chamber to said delivery chamber; a check valve therefor; a supply pipe for said compression chamber; a check valve for said supply pipe; a plunger cylinder opening into said main cylinder and compression chamber, said plunger cylinder being of the same diameter as the said outer portion of the main cylinder and arranged tangentially thereto; a plunger adapted to pass into said cylinder to close the same when in its inner position; and driving connections for said shaft to said plunger.

15. The combination with a main cylinder, having an outer annular portion adapted to receive the piston head, of a shaft; a disk-like piston having a head, mounted on said shaft; a delivery chamber connected to said cylinder by a suitable inlet port; a compression chamber connected to said delivery chamber; a plunger cylinder opening into said main cylinder and compression chamber, said plunger cylinder being of the same diameter as the said cylindrical portion of the main cylinder and arranged tangentially thereto; a plunger adapted to pass into said main cylinder to close the same when in its inner position; a crank shaft arranged in said compression chamber; a pitman connecting

said crank shaft to said plunger; a crank disk on said piston shaft; a pivoted lever having a cam slot therein; a crank pin on said crank disk arranged in said slot in said lever; a pitman connecting said levers to said crank shaft; a valve for said inlet port; an actuating lever therefor; a spring for returning said lever to its initial position, whereby said valve is held normally closed; a trip on said crank disk adapted to actuate said valve lever; a contact member carried by said crank disk; a fixed contact member adapted to coact therewith; and a contact member arranged to be engaged by said valve actuating lever when in its actuated position.

16. The combination with a main cylinder, having an outer annular portion adapted to receive the piston head, of a shaft; a disk-like piston having a head, mounted on said shaft; a delivery chamber connected to said cylinder by a suitable inlet port; a compression chamber connected to said delivery chamber; a plunger cylinder opening into said main cylinder and compression chamber, said plunger cylinder being of the same diameter as the cylindrical portion of the main cylinder and arranged tangentially thereto; a plunger adapted to pass into said main cylinder to close the same when in its inner position; a crank shaft arranged in said compression chamber; a pitman connecting said crank shaft to said plunger; a crank disk on said piston shaft; a pivoted lever having a cam slot therein; a crank pin on said crank disk arranged in said slot in said lever; a pitman connecting said levers to said crank shaft; a valve for said inlet port; an actuating lever therefor; a spring for returning said lever to its initial position, whereby said valve is held normally closed; and a trip on said disk adapted to actuate said valve lever.

17. The combination with a main cylinder, having an outer annular portion adapted to receive the piston head, of a shaft; a disk-like piston having a head, mounted on said shaft; a delivery chamber connected to said cylinder by a suitable inlet port; a compression chamber connected to said delivery chamber; a plunger cylinder opening into said main cylinder and compression chamber, said plunger cylinder being of the same diameter as the said cylindrical portion of the main cylinder and arranged tangentially thereto; a plunger adapted to pass into said main cylinder to close the same when in its inner position; a crank shaft arranged in said compression chamber; a pitman connecting said crank shaft to said plunger; a crank disk on said piston shaft; a pivoted lever having a cam slot therein; a crank pin on said crank disk arranged in said slot in said lever; and a pitman connecting said levers to said crank shaft.

18. The combination with a main cylinder, having an outer annular portion adapted to receive the piston head, of a shaft; a disk-like piston having a head, mounted on said shaft; a plunger cylinder opening into said main cylinder, said plunger cylinder being of the same diameter as the said cylindrical portion of the main cylinder and arranged tangentially thereto; a plunger adapted to pass into said main cylinder to close the same when in its inner position; a crank shaft; a pitman connecting said crank shaft to said plunger; a crank disk on said piston shaft; a pivoted lever having a cam slot therein; a crank pin on said crank disk arranged in said slot in said levers; a pitman connecting said levers to said crank shaft; a valve for said inlet port; an actuating lever therefor; a spring for returning said lever to its initial position, whereby said valve is held normally closed; a trip on said crank disk adapted to actuate said valve lever; a contact member carried by said crank disk; a fixed contact member adapted to coact therewith; and a contact member arranged to be engaged by said valve-actuating lever when in its actuated position.

19. The combination with a main cylinder, having an outer annular portion adapted to receive the piston head, of a shaft; a disk-like piston having a head, mounted on said shaft; a plunger cylinder opening into said main cylinder, said plunger cylinder being of the same diameter as the said cylindrical portion of the main cylinder and arranged tangentially thereto; a plunger adapted to pass into said main cylinder to close the same when in its inner position; a crank shaft; a pitman connecting said crank shaft to said plunger; a crank disk on said piston shaft; a pivoted lever having a cam slot therein; a crank pin on said crank disk arranged in said slot in said lever; a pitman connecting said levers to said crank shaft; a valve for said inlet port; an actuating lever therefor; a spring for returning said lever to its initial position, whereby said valve is held normally closed; and a trip on said crank disk adapted to actuate said valve lever.

20. The combination with a main cylinder, having an outer annular portion adapted to receive the piston head, of a shaft; a disk-like piston having a head, mounted on said shaft; a plunger cylinder opening into said main cylinder, said plunger cylinder being of the same diameter as the said cylindrical portion of the main cylinder and arranged tangentially thereto; a plunger adapted to pass into said main cylinder to close the same when in its inner position; a crank shaft; a pitman connecting said crank shaft to said plunger; a crank disk on said piston shaft; a pivoted lever having a cam slot therein; a crank pin on said crank disk arranged in said slot in said lever; and a pitman connecting said levers to said crank shaft.

21. The combination with a main cylinder,

of a shaft; a piston mounted on said shaft; a pair of delivery chambers connected to said cylinder by suitable oppositely-arranged inlet ports; a pair of compression chambers connected to said delivery chambers; a pair of plunger cylinders opening into said main cylinder and compression chambers; a pair of plungers adapted to pass into said main cylinder to close or form partitions across the same when in their inner position; a pair of crank shafts arranged in said compression chambers; pitmen connecting said crank shafts to said plungers; a crank disk on said piston shaft; a pair of oppositely-arranged pivoted levers having cam slots therein; a crank pin on said crank disk arranged in said slots in said levers; pitmen connecting said levers to said crank shafts; valves for said delivery ports; a pair of valve-actuating levers therefor; springs for returning said levers to their initial position, whereby said valves are held normally closed; trips on said crank disk adapted to actuate said valve levers; a contact member carried by said crank disk; a fixed contact member adapted to coact therewith; and contact members arranged to be engaged by said actuating levers when in their actuated position, coacting for the purpose specified.

22. The combination with a main cylinder, of a shaft; a piston mounted on said shaft; a pair of delivery chambers connected to said cylinder by suitable oppositely-arranged inlet ports; a pair of compression chambers connected to said delivery chambers; a pair of plunger cylinders opening into said main cylinder and compression chambers; a pair of plungers adapted to pass into said main cylinder to close or form partitions across the same when in their inner position; a pair of crank shafts arranged in said compression chambers; pitmen connecting said crank shafts to said plungers; a crank disk on said piston shaft; a pair of oppositely-arranged pivoted levers having cam slots therein; a crank pin on said crank disk arranged in said slots in said levers; pitmen connecting said levers to said crank shafts; valves for said delivery ports; a pair of valve-actuating levers therefor; springs for returning said levers to their initial position, whereby said valves are held normally closed; and trips on said crank disk adapted to actuate said valve levers, coacting for the purpose specified.

23. The combination with a main cylinder, of a shaft; a piston mounted on said shaft; a pair of delivery chambers connected to said cylinder by suitable oppositely-arranged inlet ports; a pair of compression chambers connected to said delivery chambers; a pair of plunger cylinders opening into said main cylinder and compression chambers; a pair of plungers adapted to pass into said main cylinder to close or form partitions across the same when in their inner position; a pair of crank shafts arranged in said compression chambers; pitmen connecting said crank shafts to said plungers; a crank disk on said piston shaft; a pair of oppositely-arranged pivoted levers having cam slots therein; a crank disk on said piston shaft; a pair of oppositely-arranged pivoted levers having cam slots therein; a crank pin on said crank disk arranged in said slots in said levers; pitmen connecting said levers to said crank shafts; coacting for the purpose specified.

24. The combination with a main cylinder, of a shaft; a piston mounted on said shaft; a pair of plunger cylinders opening into said main cylinder; a pair of plungers adapted to pass into said main cylinder to close or form partitions across the same when in their inner position; a pair of crank shafts; pitmen connecting said crank shafts to said plungers; a crank disk on said piston shaft; a pair of oppositely-arranged pivoted levers having cam slots therein; a crank pin on said crank disk arranged in said slots in said levers; pitmen connecting said levers to said crank shafts; valves for said delivery ports; a pair of valve-actuating levers therefor; springs for returning said levers to their initial position, whereby said valves are held normally closed; trips on said crank disk adapted to actuate said valve levers; a contact member carried by said crank disk; a fixed contact member adapted to coact therewith; and contact members arranged to be engaged by said actuating levers when in their actuated position, coacting for the purpose specified.

25. The combination with a main cylinder, of a shaft; a piston mounted on said shaft; a pair of plunger cylinders opening into said main cylinder; a pair of plungers adapted to pass into said main cylinder to close or form partitions across the same when in their inner position; a pair of crank shafts; pitmen connecting said crank shafts to said plungers; a crank disk on said piston shaft; a pair of oppositely-arranged pivoted levers having cam slots therein; a crank pin on said crank disk arranged in said slots in said levers; pitmen connecting said levers to said crank shafts; valves for said delivery ports; a pair of valve-actuating levers therefor; springs for returning said levers to their initial position, whereby said valves are held normally closed; and trips on said crank disk adapted to actuate said valve levers, coacting for the purpose specified.

26. The combination with a main cylinder, of a shaft; a piston mounted on said shaft; a pair of plunger cylinders opening into said main cylinder; a pair of plungers adapted to pass into said main cylinder to close or form partitions across the same

when in their inner position; a pair of crank shafts; pitmen connecting said crank shafts to said plungers; a crank disk on said piston shaft; a pair of oppositely-arranged pivoted levers having cam slots therein; a crank pin on said crank disk arranged in said slots in said levers; and pitmen connecting said levers to said crank shafts, coacting for the purpose specified.

27. The combination with a main cylinder, the outer portion of which is cylindrical in cross section, of a shaft; a disk-like piston mounted thereon; a cylindrical head for said piston; a plunger cylinder opening into said main cylinder, said plunger cylinder being of the same diameter as the said cylindrical portion of the main cylinder and arranged tangentially thereto; a plunger adapted to pass into said main cylinder to close the same when in its inner position; and driving connections for said shaft to said plunger.

28. The combination with a main cylinder, of a shaft; a piston mounted on said shaft; a plunger cylinder opening into said main cylinder, said plunger cylinder being arranged tangentially to said main cylinder; a plunger adapted to pass into said main cylinder to close or form a partition across the same when in its inner position; and driving connections for said shaft to said plunger.

29. The combination with a main cylinder, the outer portion of which is cylindrical in cross section; a plunger cylinder opening into said main cylinder, said plunger cylinder being arranged tangentially to said main cylinder; and a cylindrical plunger adapted to pass into said main cylinder to close the same or form a partition across the same when in its inner position.

30. The combination with a main cylinder, of a plunger cylinder opening into said main cylinder; a compression chamber connected to said main cylinder and to the outer end of said plunger cylinder; and a plunger adapted to pass into said main cylinder to close or form partitions across the same when in its inner position and to act on said compression chamber on its out-stroke.

In witness whereof, I have hereunto set my hand and seal in the presence of two witnesses.

JOHN H. FITCH. [L. S.]

Witnesses:
W. L. HAMMOND,
B. M. ROEHRIG.