(No Model.) 4 Sheets—Sheet 1.

W. BARNSDALE.

COMBINED STEAM AND EXPLOSION ENGINE.

No. 571,147. Patented Nov. 10, 1896.

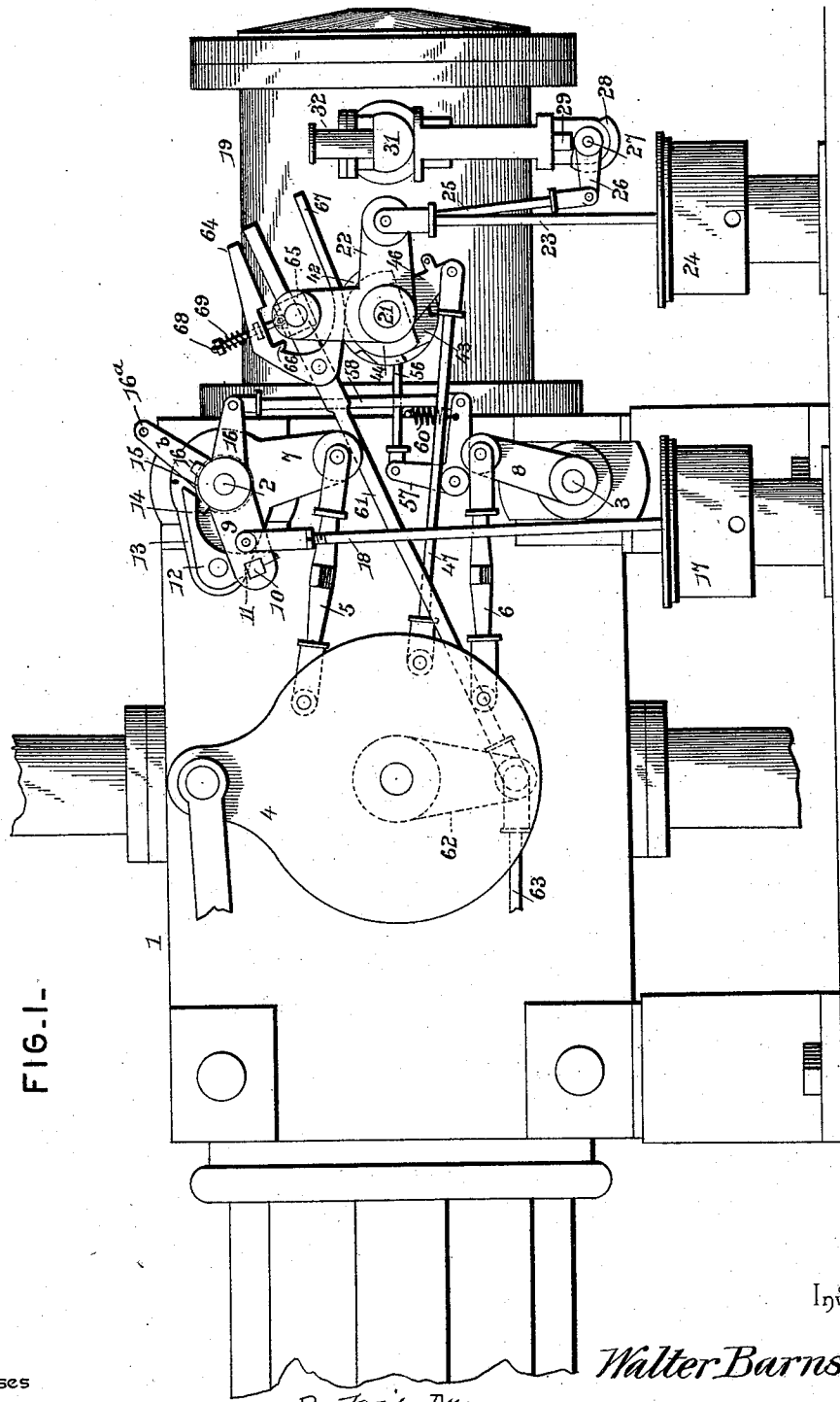


FIG. 1.

Witnesses
Jas. K. McCathran
C. E. Hoole

Inventor
Walter Barnsdale
By his Attorneys.
C. A. Snow & Co.

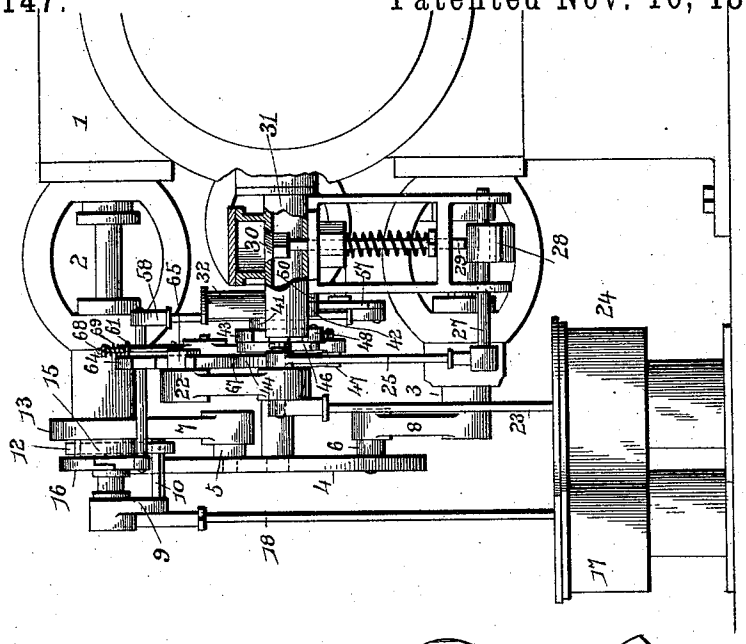
(No Model.) 4 Sheets—Sheet 2.

W. BARNSDALE.

COMBINED STEAM AND EXPLOSION ENGINE.

No. 571,147. Patented Nov. 10, 1896.

FIG. 2.



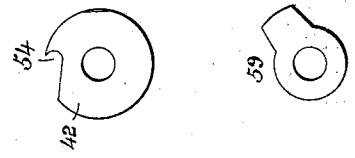


FIG. 6.

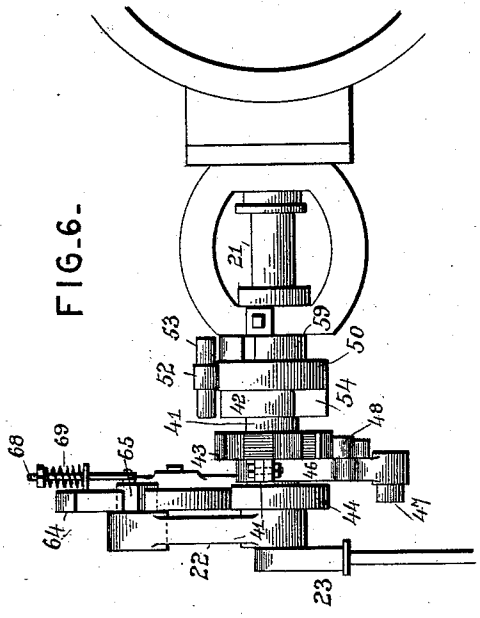
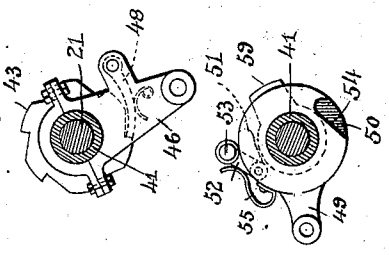
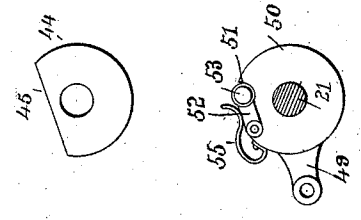


FIG. 7.





Witnesses
Jas. K. McCathran

Inventor
Walter Barnsdale

By Its Attorneys.
C. A. Snow & Co.

(No Model.) 4 Sheets—Sheet 3.

W. BARNSDALE.

COMBINED STEAM AND EXPLOSION ENGINE.

No. 571,147. Patented Nov. 10, 1896.

FIG. 3.

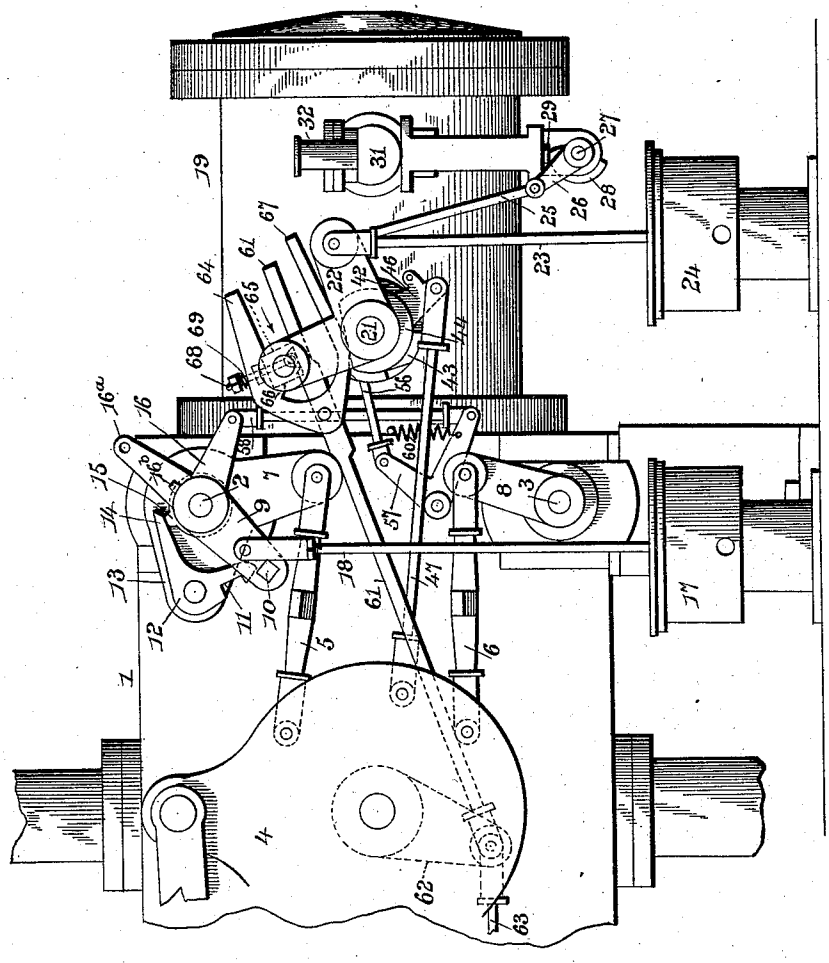


FIG. 5.

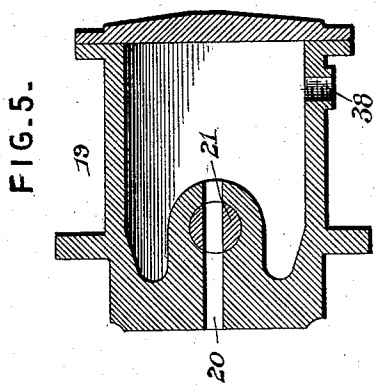
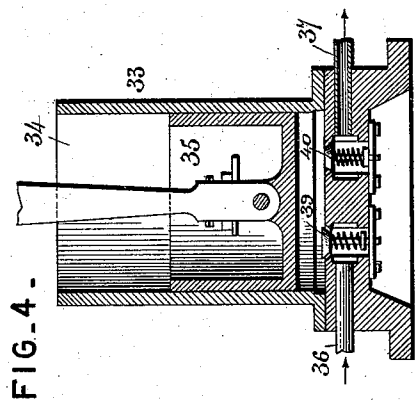


FIG. 4.



Witnesses
Jas. K. McCathran
[illegible]

Inventor
Walter Barnsdale
By his Attorneys.
C. A. Snow & Co.

(No Model.) 4 Sheets—Sheet 4.

W. BARNSDALE.

COMBINED STEAM AND EXPLOSION ENGINE.

No. 571,147. Patented Nov. 10, 1896.

FIG. 8.

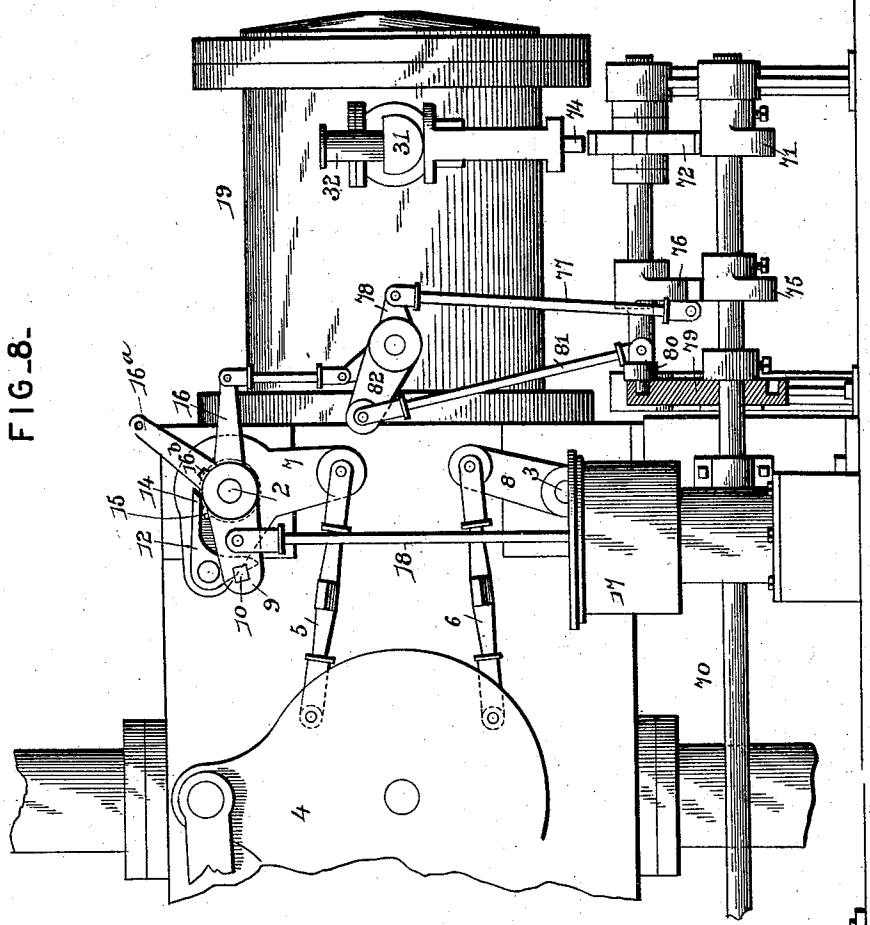
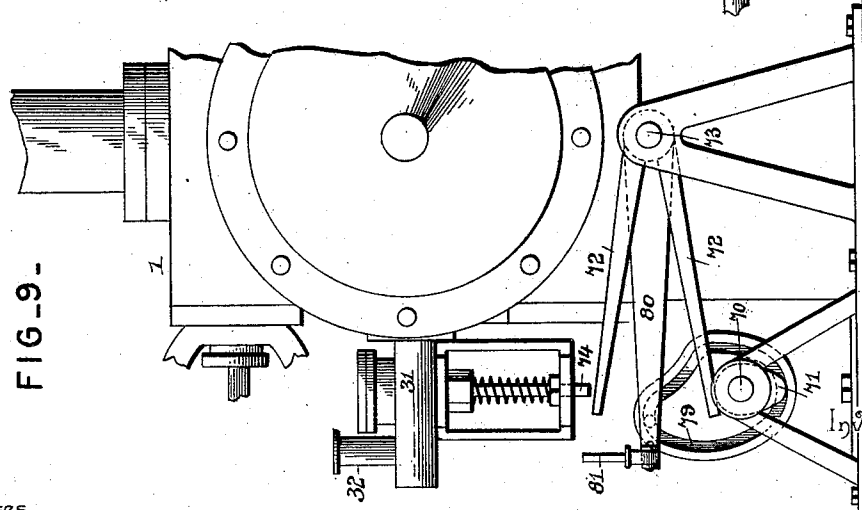


FIG. 9.



Witnesses
Jas. K. McCathran
[illegible]

Inventor
By his Attorneys. Walter Barnsdale
C. A. Snow & Co.

UNITED STATES PATENT OFFICE.

WALTER BARNSDALE, OF PLOVER, WISCONSIN.

COMBINED STEAM AND EXPLOSION ENGINE.

SPECIFICATION forming part of Letters Patent No. 571,147, dated November 10, 1896.

Application filed May 11, 1895. Serial No. 548,968. (No model.)

To all whom it may concern:

Be it known that I, WALTER BARNSDALE, a citizen of the United States, residing at Plover, in the county of Portage and State of Wisconsin, have invented a new and useful Attachment for Steam-Engines, of which the following is a specification.

My invention relates to engines employing fluid-pressure motive power, and particularly to steam-engines, the object in view being to provide means for preventing the condensation of steam in the cylinders of steam-engines by maintaining the cylinder at a temperature equal to or in excess of that of the initial steam, the agent employed for maintaining the cylinder at the desired temperature being also utilized to impart impulses at longer or shorter intervals to the piston.

Further objects and advantages of this invention will appear in the following description, and the novel features thereof will be particularly pointed out in the appended claims.

In the drawings, Figure 1 is a side view of a mechanism embodying my invention applied in the operative position to an ordinary Corliss engine. Fig. 2 is an end view of the same. Fig. 3 is a partial side view showing the members of the mechanism in the positions which they assume at the time of admitting the explosive agent to the cylinder. Fig. 4 is a detail view in section of the pump. Fig. 5 is a longitudinal vertical section of the explosion-chamber. Fig. 6 is a detail view of the mechanism for operating the valves in the explosion-chamber and disconnecting the inlet steam-valve, the parts being shown in the same position as in Fig. 2. Fig. 7 is a detail view of the clutch mechanism, including the ratchet-wheel, swinging arm, and pawl carried by the latter. Fig. 7^a is a similar view of the cam detached. Fig. 7^b is a similar view of the clutch-disk detached. Fig. 7^c is a detail view of the crank and clutch-arm detached. Fig. 7^d is a detail view of the crank, clutch-arm, and clutch-disk. Fig. 7^e is a detail view of the trip-cam. Fig. 8 is a side view showing slightly-modified means for communicating motion to the valves in the explosion-chamber and to the means for tripping the steam-inlet valve. Fig. 9 is an end view of the construction shown in Fig. 8.

Similar numerals of reference indicate corresponding parts in all the figures of the drawings.

1 designates the cylinder, having inlet and exhaust valves 2 and 3, a wrist-plate 4 connected to receive a rocking movement from the piston operating in the cylinder and connected by rods 5 and 6, respectively, to the crank-arms 7 and 8, whereby the inlet and exhaust valves receive motion.

The crank-arm 7 of the inlet-valve is loosely mounted upon the spindle of said valve and is normally locked to the same by means of an auxiliary arm 9, having a stud 10 to engage a notch 11 in a latch 12, this latch being pivotally mounted upon and carried by a disk 13, which is fixed to the inlet-valve stem. Said latch is provided with a trip-arm 14, arranged in the path of a cam 15, carried by a rocking lever 16, also fulcrumed upon or concentric with the inlet-valve stem, whereby when the long arm of the lever is depressed or moved in one direction the cam 15 engages the trip-arm 14 and by turning the latch upon its pivot disengages its notch 11 from the stud 10 and thereby allows the crank-arm 7 to turn loosely upon the valve-stem without imparting motion to the valve.

The valve mechanism above described is substantially the same as used on various engines of the type in connection with which my invention is illustrated, and a dash-pot 17, of which the piston-rod 18 is connected to the arm 9, is employed to close the steam-inlet valve 2 when the latch 12 is disengaged from the stud 10. This disengagement is accomplished by the ordinary governor (not shown) operating through a lever 16^a, carrying a cam 16^b to engage the arm 14 when the engine is operating under the impulse of steam.

Communicating with the cylinder is an explosion-chamber 19, and in the construction illustrated in the drawings I have shown the end of this explosion-chamber fitted in the end of the cylinder in lieu of the ordinary cylinder-head, and thereby performing the functions of the ordinary cylinder-head during a portion of the operation of the mechanism, said explosion-chamber being provided with a channel 20, which communicates with the cylinder

and which is normally closed by means of a valve 21. The stem of this valve 21 is fitted outside of the explosion-chamber with a bell-crank lever 22, to one arm of which is connected the piston-rod 23 of a dash-pot 24, also designed to prevent excessive jarring of the mechanism, and said arm of the bell-crank lever is also connected by means of a pitman 25 with a crank-arm 26, secured to a rock-shaft 27. This rock-shaft carries a cam 28, arranged to engage and impart linear movement to a valve-stem 29, and said valve-stem carries a valve 30, arranged to control the admission of gas to an ignition-chamber 31, communicating with an ignition-tube 32. This ignition-tube may be heated in any suitable manner and maintained at such a temperature as to cause the instantaneous explosion of gas coming in contact therewith.

An explosive mixture of fluids or gases is supplied to the explosion-chamber under pressure, while the valve 21 remains closed, and at the moment that the valve 21 is opened to allow communication with the cylinder the valve 30 is similarly operated to cause the ignition of the explosive agent by allowing said agent to come in contact with the ignition-tube. This explosion-chamber is supplied with the explosive agent, in the construction illustrated in the drawings, by means of a pump 33, having a cylinder 34, in which operates a plunger 35, an inlet-pipe or conductor 36, extending from a suitable reservoir, (not shown,) communicating with said cylinder, and an exhaust-pipe or conductor 37 also communicating with the cylinder and extending to the explosion-chamber, which it taps, as at 38. Inlet and outlet valves 39 and 40 control the inlet and outlet pipes or conductors 36 and 37, said valves being arranged in reverse positions, as will be seen by reference to the detail section shown in Fig. 4.

Loosely mounted upon or concentric with the stem of the valve 21 is a sleeve 41, carrying a clutch-disk 42, a ratchet-wheel 43, and a cam 44, having a flat face 45. Also loosely mounted upon or concentric with the stem of the valve 21 is a swinging arm 46, connected by means of a connecting-rod or pitman 47 with the wrist-plate 4. This swinging arm carries a spring-actuated pawl 48, whereby as the arm is oscillated through the pitman 47 by means of the wrist-plate 4 the ratchet-wheel 43 receives a step-by-step movement in the direction indicated by the arrow placed contiguous thereto. This step-by-step rotary movement of the ratchet-wheel causes a corresponding movement of the cam 44 and the clutch-disk 42. Loosely mounted upon or concentric with the stem of the valve 21, parallel with and contiguous to the plane of the clutch-disk, is a crank-arm 49, having a disk-like hub 50, having a peripheral recess 51, in which is mounted a pivotal spring-actuated arm 52, carrying a pin 53 for engagement by the notch 54 of the clutch-disk. The pivotal arm 52 is actuated by a spring 55 to hold the pin 53 permanently in engagement with the periphery of the clutch-disk during the advance movement thereof caused by the mechanism above described, and it is obvious that when the ratchet and clutch-disk have made a complete revolution the pin 53, by reason of the spring 55, will fall into the notch 54 of the clutch-disk, and hence will be in position to cause a further advance movement of said clutch-disk to impart a partial rotary movement to the hub 50, and hence a swinging movement to the crank-arm 49. This crank-arm is connected by means of a rod 56 to a bell-crank lever 57, and the other arm of this bell-crank lever is connected by a rod 58 to the rocking lever 16. Hence the oscillating movement imparted to the swinging arm 46, through the pitman 47, by the wrist-plate 4 will cause a step-by-step movement in a uniform direction of the clutch-disk 42, and when said clutch-disk has made one complete revolution by any desired number of steps, depending upon the intervals between the notches of the ratchet-wheel 43 and the extent of movement of the arm 46, the clutch-pin 53, which is carried by the hub of the arm 49, will drop into engagement with the notch 54 of the clutch-disk, and hence will be in position to receive motion from the clutch-disk when it again advances by reason of the oscillation of the arm 46.

Fixed upon the machine in the path of the clutch-pin 53 is a trip-cam 59, and the above-described forward movement of the trip-pin, while in engagement with the notch and clutch-disk, brings said pin at the end of the first forward step into engagement with the trip-cam. Hence the succeeding forward movement of the trip-pin caused by the clutch-plate deflects the trip-pin from engagement with the notch of the clutch-plate and allows the return of the crank-arm 49, the lever 16, and connecting parts to their normal positions by means of a return-spring 60, which is connected to one arm of the bell-crank lever 57.

From the foregoing description it will be understood that motion is imparted by the wrist-plate to the inlet-valve of the cylinder through intermediate connections, which are thrown out of operative relation by a movement of the rocking lever 16, and as this movement of the rocking lever is accomplished, as stated, at the end of each complete revolution of the clutch-plate 42 it is obvious that at predetermined intervals, during which the piston of the engine will give a certain number of strokes, varying according to the relative size of the parts and particularly the number of notches in the ratchet-wheel and the amount of swinging movement of the arm 46, the inlet-valve 2 will be thrown out of gear and will remain out of gear during one stroke of the piston, after which the parts will be returned to their normal positions and the operation of the engine will

proceed as before. During this interval, however, when the inlet-valve is at rest and is closed to prevent the admission of steam to the cylinder, it is my object to actuate the piston by an explosive agent contained in the explosion-chamber hereinbefore mentioned, and hence I provide such connections with the bell-crank lever 22 that when the steam-valve-operating mechanism is out of gear the bell-crank lever will receive motion, which will be communicated through the connections above described to open the valve 30, and thus allow the explosive agent to enter the ignition-chamber. The means employed for imparting this motion to the bell-crank lever 22 may consist of a reciprocating bar 61, connected to a crank-arm 62, which receives an oscillatory movement through an eccentric-rod 63 and a clutch 64, carried by said reciprocating bar and adapted, when depressed to the proper position, to engage a stud 65, carried by one of the arms of the bell-crank lever 22. This clutch is provided with a finger 66, which is normally held out of operative relation with the stud 65 by means of a guide-arm 67, which traverses the cam 44, and the finger 66 is only allowed to come into relative relation with the stud 65 when the presentation of the flat surface 45 of the cam 44 allows the guide-arm 67, and hence the clutch of which it forms a part, to drop to the position shown in Fig. 3. The flat surface of the cam 45 is brought into said operative relation with the clutch at the moment that the inlet-valve 2 is disconnected from its operating mechanism, and hence simultaneously with the disconnection of the steam-inlet valve the bell-crank lever 22 receives an impulse in the direction indicated by the arrow on said lever, the valve 21, to the stem of which the said bell-crank lever is attached, is opened to allow communication between the explosion-chamber and the cylinder, and the valve 30 is opened to allow the admission of the explosive gas to the ignition-chamber. The clutch 64 is held normally in a given position by means of a stem 68, attached to the reciprocating bar 61, and a spring 69, coiled upon said stem and bearing against the upper side of the clutch. This provides for the yielding of the clutch independently of the reciprocating bar.

In Figs. 8 and 9 I have shown a slightly-modified arrangement of the mechanism embodying my invention in which the essential features, including the explosion-chamber and the means for igniting the explosives and allowing access thereof to the ignition-chamber, are identical with those hereinbefore described. The means for disconnecting the steam-valve-operating mechanism from the valve are also similar to those described above, including the latch 12, having a trip-arm 14, and a cam-lever 16, carrying a cam 15 to engage the trip-arm, but instead of the above-described mechanism for imparting motion to said lever for opening the valve controlling the communication between the explosion-chamber and the cylinder and the means for operating the valve whereby communication is established with the ignition-chamber I employ apparatus constructed as follows:

70 represents a shaft connected by any suitable means to receive a continuous rotary motion and carrying a cam 71, in the path of which is arranged one arm of a bell-crank lever 72, pivoted at 73. The other arm of this lever is arranged in position to engage the stem 74 of the valve 30 when the lever is actuated by the cam 71. A second cam 75 is also carried by this shaft 70, and arranged in the path thereof is a swinging arm 76, connected by means of a pitman 77 to a bell-crank lever 78, which in turn is connected to the lever 16. In addition to the above a grooved cam 79 is fixed to the shaft 70 and operates an arm 80, connected by a pitman 81 with a crank-arm 82, fixed to the stem of the valve 21. It is obvious that simultaneously with the disconnection of the valve mechanism from the steam-inlet valve the valve 21 will be opened to allow communication between the explosion-chamber and the cylinder and the valve 30 will be opened to allow access of the explosive agent to the ignition-chamber.

In the same way various other similar arrangements of devices may be employed to accomplish the same purpose in substantially the same way, special adaptations of the devices being necessitated by the construction of the different engines with which it may be employed. It is obvious, however, that the essential feature, as above described, is to maintain the cylinder at a high temperature equal to or in excess of the steam by admitting thereto an explosive which is held in reserve during a greater or less number of strokes of the engine under the impulse of steam and is admitted to the cylinder only when the usual motive agent is excluded. In this way the explosive agent may be admitted to the cylinder at intervals of two, three, or more strokes, as required or preferred, the construction illustrated in the drawings being designed to allow communication between the explosion-chamber and the cylinder at each sixth stroke, this being sufficient under ordinary conditions; and in addition to thus raising the temperature of the cylinder sufficiently to prevent condensation of the steam therein the explosive agent imparts an impulse to the piston during that stroke in which the steam is idle, and thus takes the place of the ordinary motive agent, the gas generated by the explosion being exhausted during the return stroke of the piston through the ordinary exhaust-valve provided for carrying off the exhaust-steam.

It will be seen from the drawings that the valve-gear at the opposite end of the cylinder from that to which the mechanism embody-

ing my invention is applied is omitted, such gear forming no part of my invention and being of the ordinary construction.

Various changes in the form, proportion, and the minor details of construction may be resorted to without departing from the spirit or sacrificing any of the advantages of this invention.

Having described my invention, what I claim is—

1. An attachment adapted to be substituted for the head of a steam-engine cylinder and having an explosion-chamber, a controlling-valve for a port connecting the explosion-chamber with the cylinder, operating connections between said controlling-valve and the steam-inlet valve of the cylinder whereby the inlet-valve is closed and the controlling-valve opened simultaneously, and means for igniting the contents of the explosion-chamber simultaneously with the opening of the controlling-valve.

2. An attachment adapted to be substituted for the head of a steam-engine cylinder and having an explosion-chamber, a controlling-valve for a port connecting the explosion-chamber with the cylinder, an ignition-chamber having a port in communication with the explosion-chamber, a controlling-valve to normally close said port, and connections between said valves and the steam-inlet valve of the cylinder, whereby the simultaneous opening of the controlling-valves is accompanied by the closing of the steam-inlet valve, substantially as specified.

3. The combination with a cylinder having steam inlet and exhaust valves, of an explosion-chamber having valved connection with the cylinder, an ignition-chamber in communication with the explosion-chamber and normally cut off from the same by a controlling-valve, a lever secured to the valve controlling the communication between the explosion-chamber and the cylinder and operatively connected with the valve controlling the communication between the explosion-chamber and the ignition-chamber, and means for operating said lever at intervals to actuate the valves, substantially as specified.

4. The combination with a cylinder having inlet and exhaust valves, of an explosion-chamber and a communicating ignition-chamber, valves controlling the communication between the explosion-chamber and the cylinder and ignition-chamber, means for disconnecting the inlet-valve from the valve-operating mechanism, an arm operatively connected with said means, a clutch mechanism having a rotary member adapted to engage and impart motion to said arm at intervals, and connections between said rotary member and a continuously-moving part of the engine, substantially as specified.

5. The combination with a cylinder, of a steam-inlet valve having a fixed arm, a coaxially loose arm operatively connected with valve mechanism, a latch for connecting said loose and fixed arms whereby motion is communicated from the former to the valve, a lever for tripping said latch, and connections between said lever and the piston operating in the cylinder whereby the lever is operated to trip the latch at intervals, substantially as specified.

6. The combination with a cylinder, a steam-inlet valve, and means including a lever for disconnecting said valve from the valve mechanism, of a swinging arm operatively connected with said lever, a rotary clutch-disk mounted coaxially with said arm and provided with a notch to engage a pin carried by the arm, a ratchet-wheel, a pawl-carrying arm mounted coaxially with the ratchet-wheel and operatively connected with the piston operating in said cylinder, the pawl carried by said arm being adapted to engage the ratchet-wheel, and means for disconnecting the notch of the clutch-disk from the pin at the limit of a prescribed swinging movement of the arm which is connected with said lever, substantially as specified.

7. The combination with a cylinder, a steam-inlet valve, and means including a shifting-lever for disconnecting the valve from the valve mechanism, of a swinging arm operatively connected with said lever, a spring-pressed pin carried by the swinging arm, a clutch-disk having a notch to engage said pin, a ratchet-wheel fixed to the sleeve of the clutch-disk, an oscillating arm operatively connected with the piston to receive a continuous movement, a spring-pressed pawl carried by the last-named arm to engage the ratchet-wheel and impart a step-by-step movement thereto, and a fixed cam arranged in the path of said pin to raise the latter out of engagement with the notch in the clutch-disk at the limit of a prescribed movement of the swinging arm which is connected with the shifting-lever, substantially as specified.

8. The combination with a cylinder, a steam-inlet valve, and means including a shifting-lever for disconnecting the valve from the valve mechanism, of an explosion-chamber, a valve controlling the communication between the explosion-chamber and the cylinder, an arm fixed to the spindle of the last-named valve, a reciprocating bar, a clutch carried by the reciprocating bar and adapted when depressed to engage a stud on said arm, a cam-disk adapted to normally support the clutch out of engagement with said stud, means for imparting motion to the cam whereby the clutch is brought into operative relation with the stud at intervals, and means for operating the shifting-lever to disconnect the steam-inlet valve from the valve mechanism simultaneously with the engagement of the clutch with the arm on the valve controlling communication between the explosion-chamber and the cylinder, substantially as specified.

9. The combination with a cylinder, of an explosion-chamber in communication with

the cylinder and an ignition-chamber in communication with the explosion-chamber, valves 21 and 30 controlling the communication between the explosion-chamber and the cylinder and between the explosion-chamber and the ignition-chamber, respectively, a bell-crank lever fixed to the spindle of the valve 21, means including a shifting-lever for disconnecting the steam-inlet valve from the valve mechanism, an arm 49 mounted coaxially with the bell-crank lever and operatively connected with the shifting-lever, a clutch-disk having a notch to engage a spring-pressed pin carried by the hub of the arm 49, a cam-disk, means for imparting a step-by-step movement in a uniform direction to the clutch-disk and the cam-disk, a reciprocating bar carrying a clutch to engage a stud on the bell-crank lever, the clutch being normally held out of engagement with said stud by the cam-disk, a fixed cam for raising the spring-pressed pin out of engagement with the notch in the clutch-disk, and connections between the bell-crank lever and the valve controlling communication between the explosion-chamber and the ignition-chamber, whereby simultaneously with the opening of the valve 21 the steam-inlet valve is disconnected from the valve mechanism and communication between the explosion and ignition chambers is established, substantially as specified.

In testimony that I claim the foregoing as my own I have hereto affixed my signature in the presence of two witnesses.

WALTER BARNSDALE.

Witnesses:
G. E. McDILL,
R. B. JOHNSON.