H. C. L. HOLDEN & G. K. B. ELPHINSTONE.

STARTING MECHANISM FOR INTERNAL COMBUSTION ENGINES.

APPLICATION FILED OCT. 28, 1907.

904,616. Patented Nov. 24, 1908.

5 SHEETS—SHEET 1.

Fig. 1.

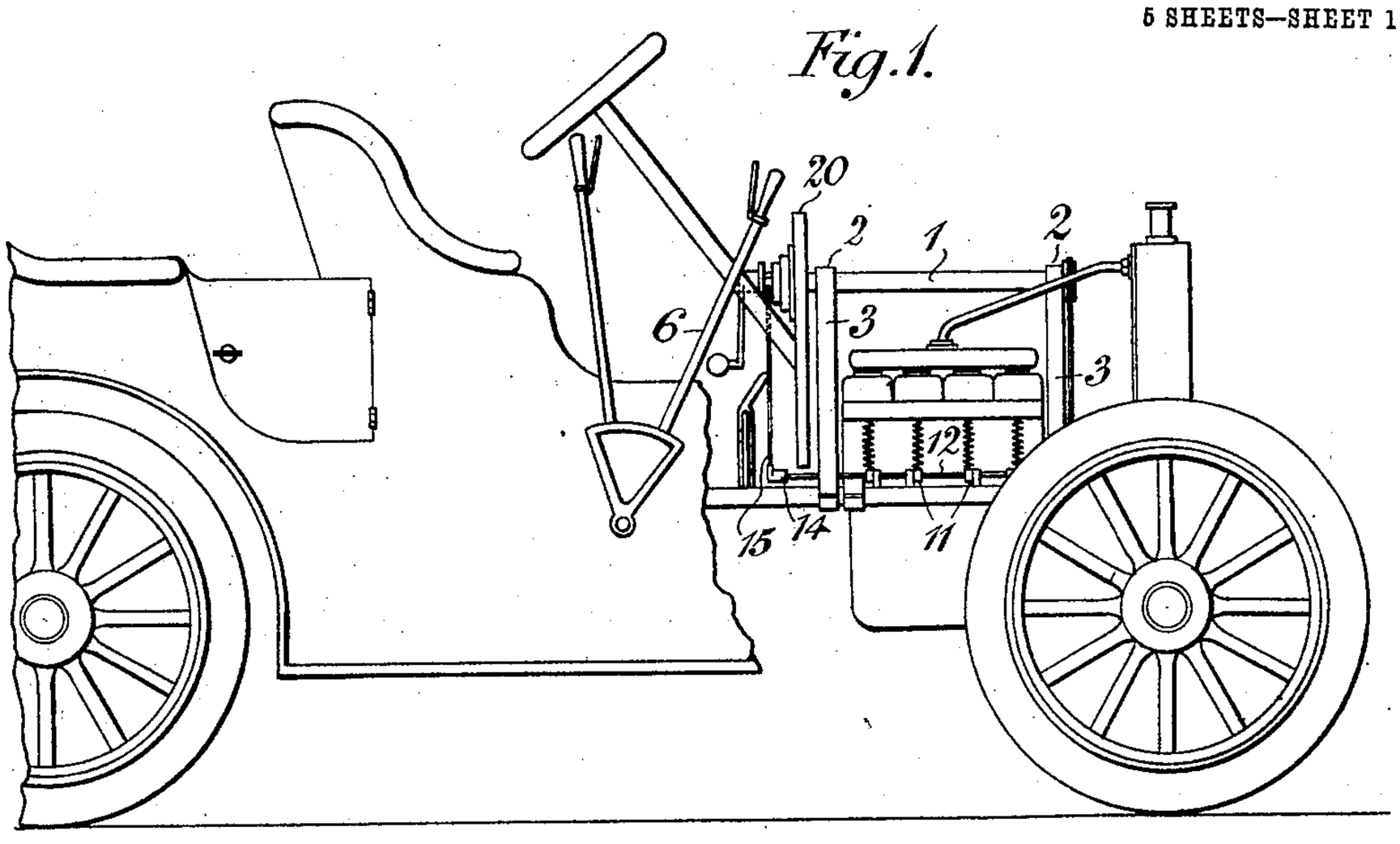

Fig. 2.

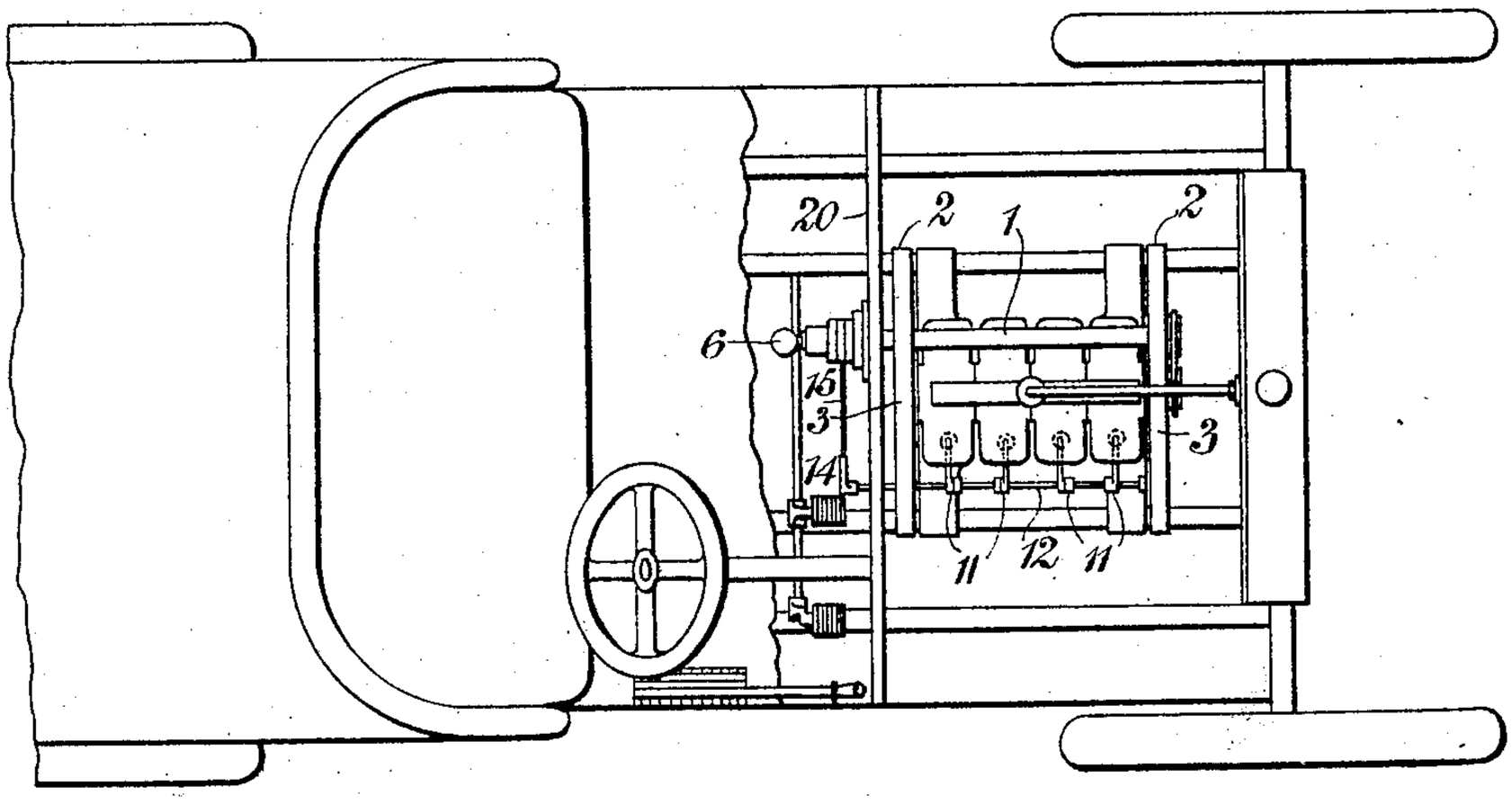

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Fig. 3.

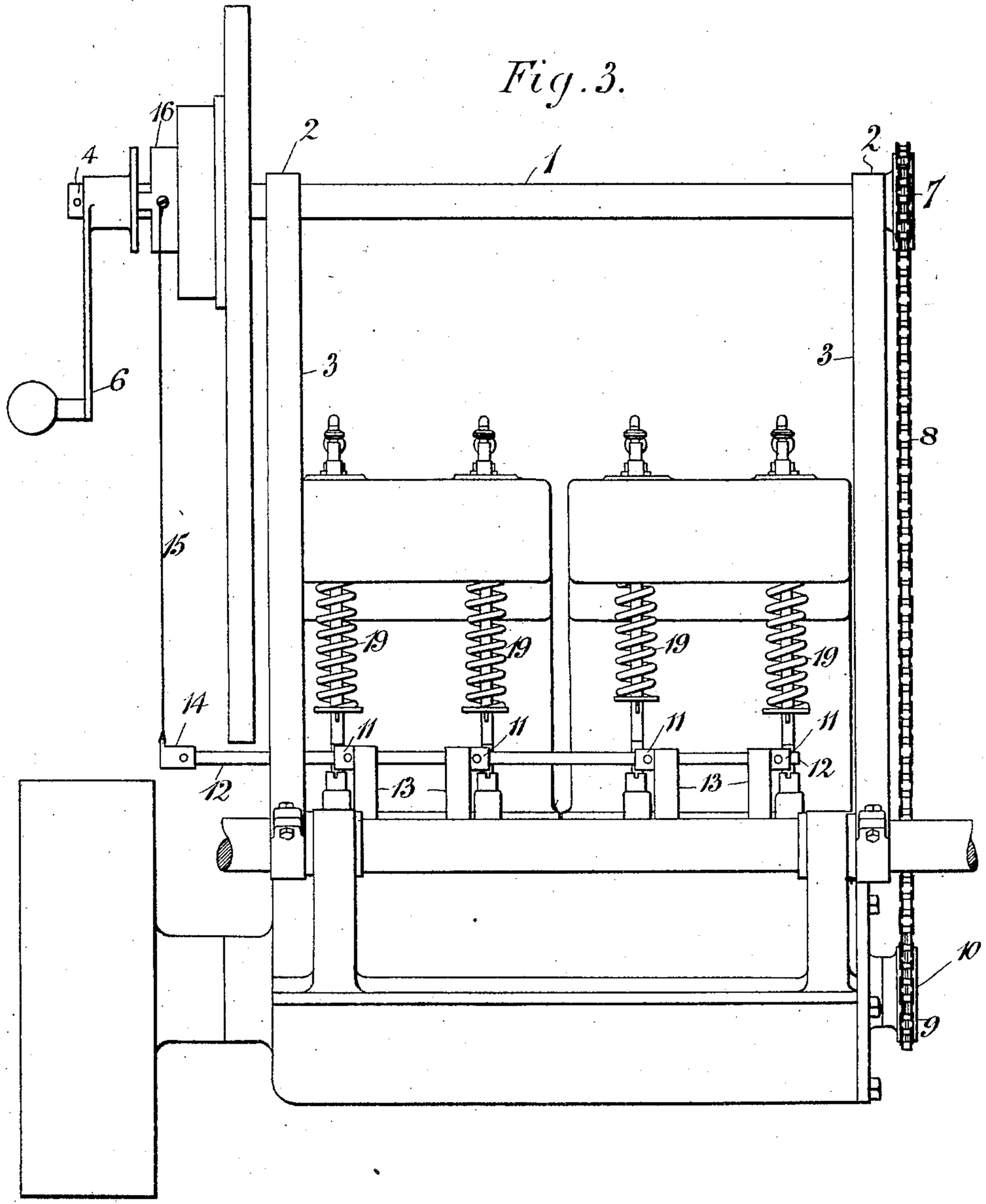

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Fig. 4.

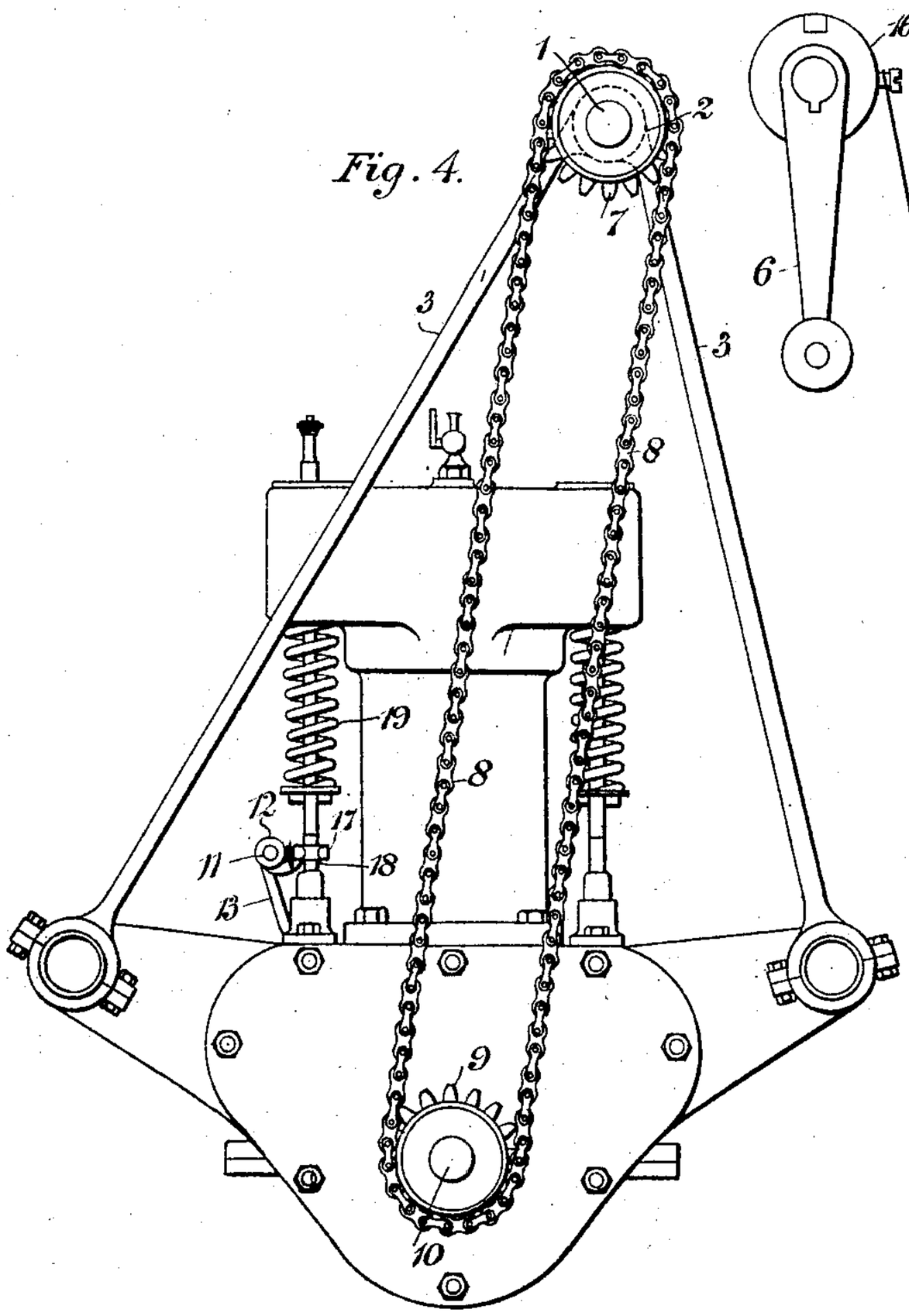

Fig. 5.

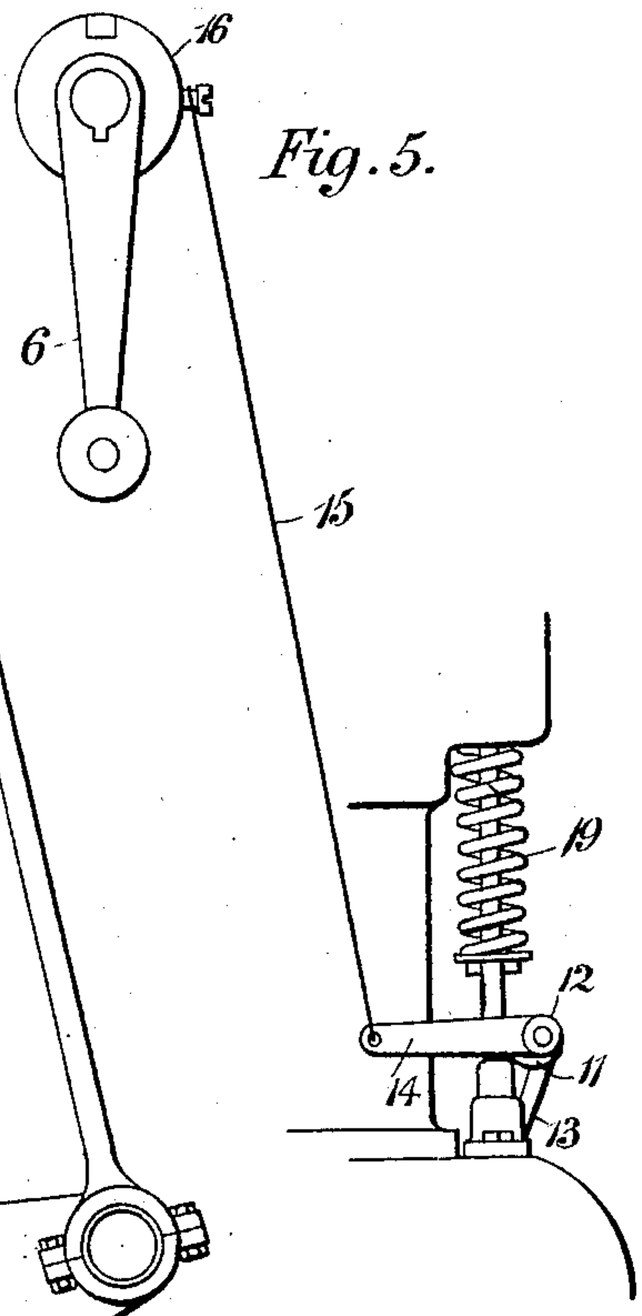

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Fig. 6.

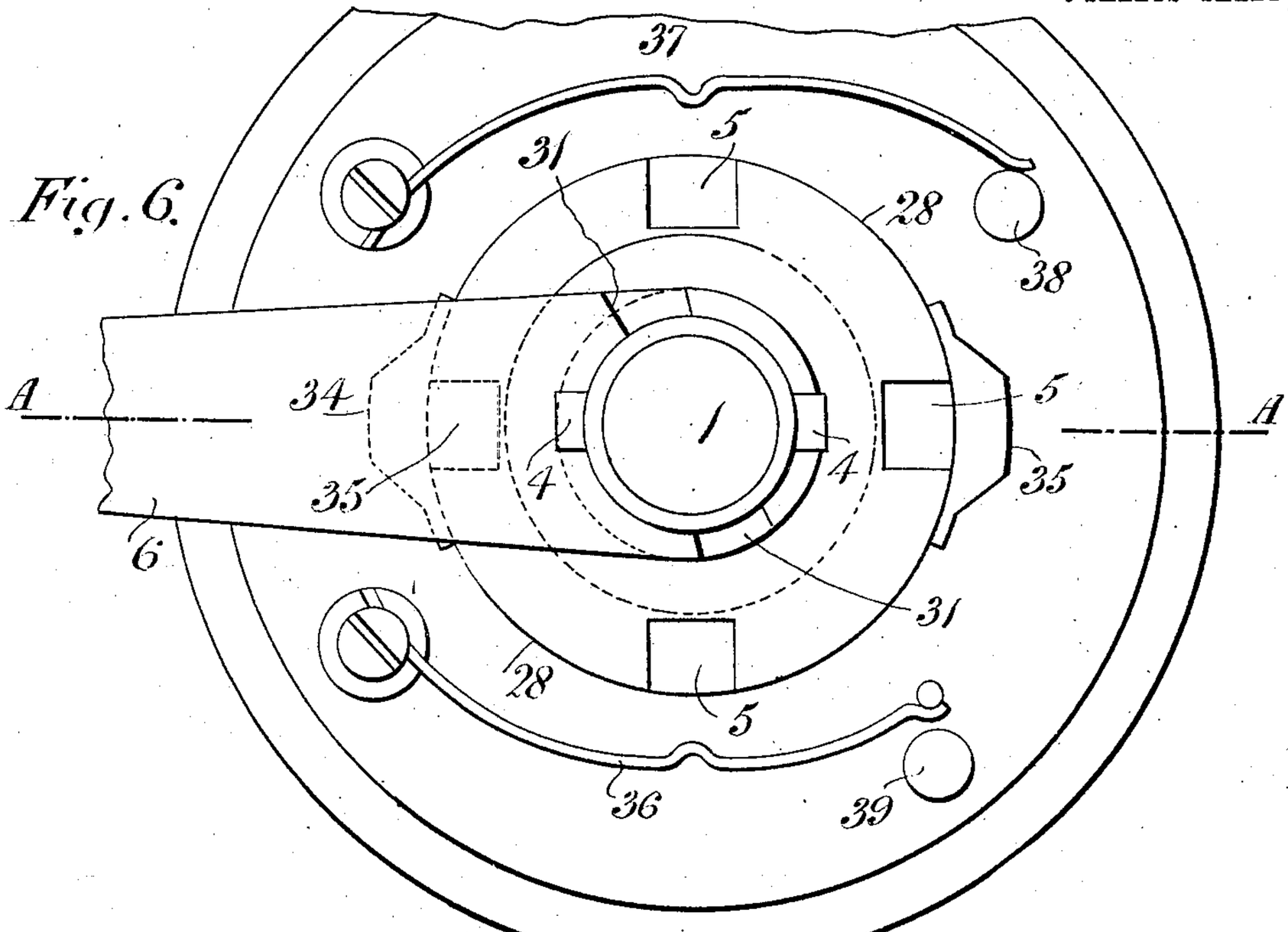
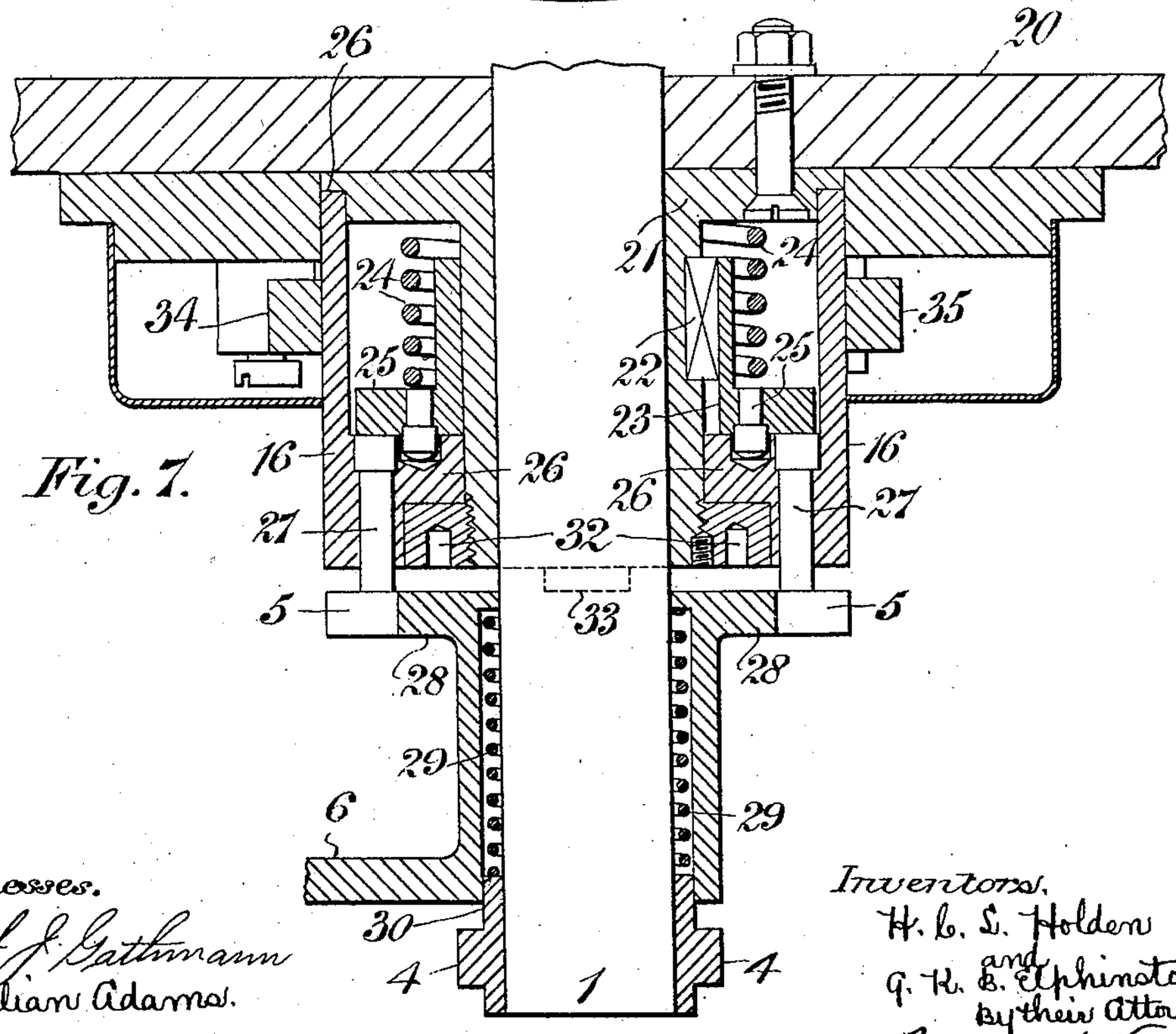


Fig. 7.



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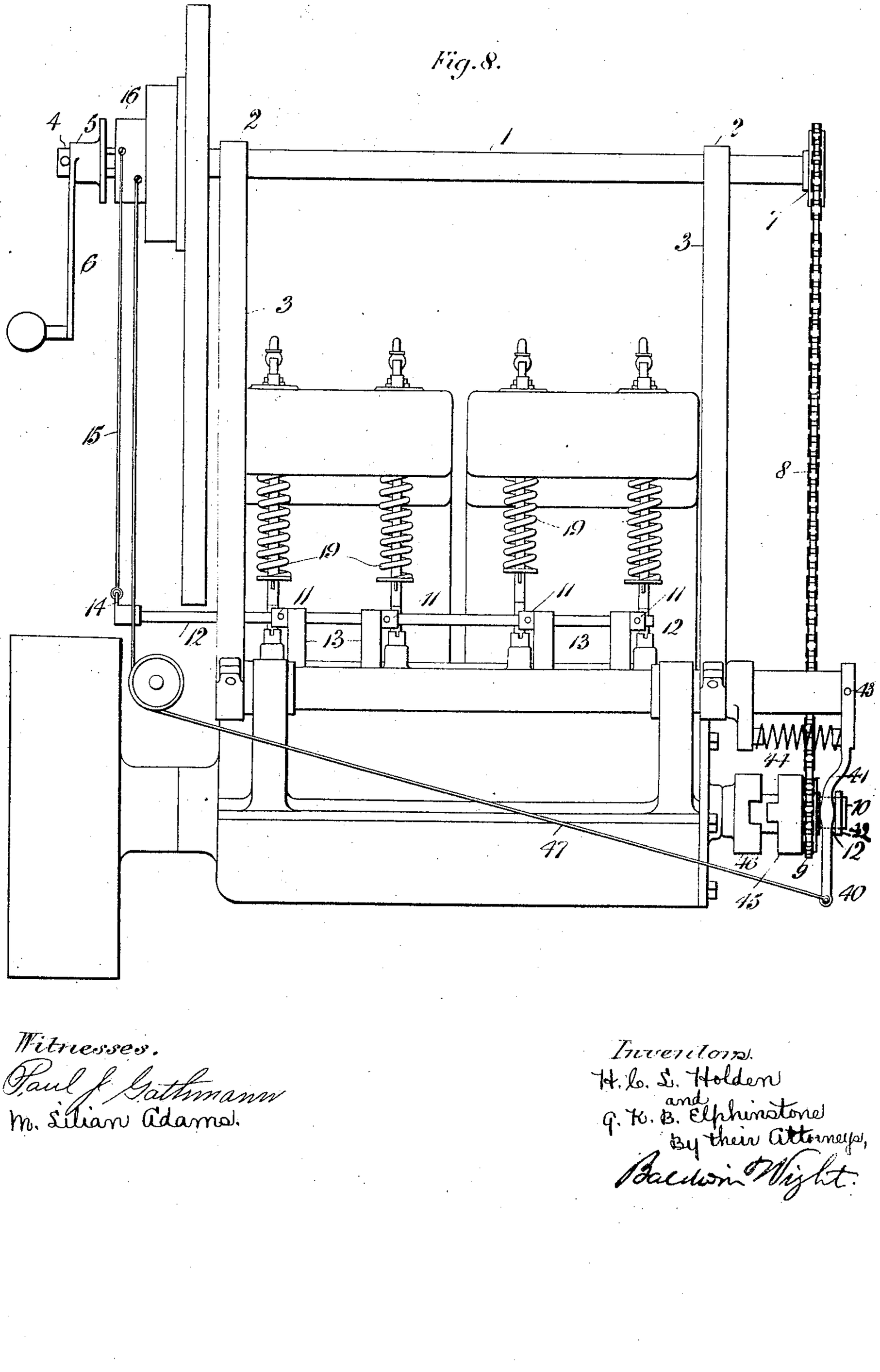
5 SHEETS—SHEET 5.

Fig. 8.



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UNITED STATES PATENT OFFICE.

HENRY CAPEL LOFFT HOLDEN, OF BLACKHEATH, AND GEORGE KEITH BULLER ELPHINSTONE, OF LEWISHAM, ENGLAND.

STARTING MECHANISM FOR INTERNAL-COMBUSTION ENGINES.

No. 904,616. Specification of Letters Patent. Patented Nov. 24, 1908.

Application filed October 28, 1907. Serial No. 399,594.

To all whom it may concern:

Be it known that we, HENRY CAPEL LOFFT HOLDEN, colonel Royal Artillery, and GEORGE KEITH BULLER ELPHINSTONE, engineer, subjects of the King of Great Britain, residing, respectively, at 2 St. John's Park, Blackheath, and at Century Works, Lewisham, both in the county of Kent, England, have invented new and useful Improvements in Starting Mechanism for Internal-Combustion Engines, of which the following is a specification.

This invention relates to mechanism for facilitating the starting of internal combustion engines having two or more cylinders. In such engines we provide electrical sparking mechanism for, as heretofore, firing the charges in the several cylinders at the proper times.

To facilitate the starting we provide means for holding open the inlet valves of all the cylinders of the engine while the crank shaft has a few turns given to it which can be done with the greatest ease as there will be but little or no compression in the cylinder or cylinders. We also provide means for breaking the sparking circuit while this is being done. As the engine is being turned the cylinders fill with explosive compound as their pistons make their out strokes. After a few turns and when a rich explosive mixture is drawn into the cylinders at each out stroke the inlet valves are all allowed to close at a time when the piston of that one of the cylinders in which a spark would pass if the sparking circuit were complete has made say about half its out stroke. The sparking circuit is then completed and explodes the mixture in this cylinder and the engine is thereby started.

As but little force is required when the inlet valves are open for turning the engine to prepare it for being started, mechanism for effecting this (to be operated either by hand or by compressed air or other convenient means) may be placed within reach of the driver so that the driver may not have to leave his seat to start the engine.

Interlocking devices may also be provided for insuring that the sparking circuit cannot be completed until the inlet valves have been allowed to resume their normal position and that the valves are not allowed to do this until the cylinder in which a spark would first pass contains sufficient explosive mixture to start the engine when fired. The interlocking device may also be so arranged that the means used for giving the few preliminary turns to the engine can only be brought into action when the sparking circuit is broken. The movement of the interlocking devices may be effected by a knob or handle to be held by hand into one position while the engine is having the few preliminary turns given to it and which can only return to its normal position when the crank shaft of the engine is in proper position for allowing the inlet valves to resume their normal positions and for the sparking to be started.

The holding open of the inlet valves while the engine is having a few turns given to it to prepare it for starting may be effected by an arrangement of levers or in the case of mechanically operated valves it may be effected by disks alongside the cams on the cam shaft by which the inlet valves are operated so that by a longitudinal movement of the cam shaft the cams may be put out of action and the valves held open by the disks.

Figure 1 is a side elevation and Fig. 2 a plan of a motor car showing the engine and starting mechanism in their relative positions. Figs. 3 and 4 are side and end elevations to a larger scale of the engine showing the starting mechanism. Fig. 5 shows a detail of the mechanism for lifting the valves. Fig. 6 is a front elevation with the cover removed of the base upon which the operating handle is fixed showing the contact gear. Fig. 7 is a section on the line A—A Fig. 6. Fig. 8 is a similar view to Fig. 3 showing a modification.

Referring to Figs. 1 and 2, 1 is a shaft by means of which the engine is started. The shaft 1 is mounted in bearings 2 which are supported from the frame of the engine as indicated in Fig. 4 upon brackets 3. Attached to one end of shaft 1 are lugs 4 (Figs. 3, 6 and 7) by means of which the shaft can be rotated when the notches 5 in the boss of the handle 6 are caused to engage with the projections. At the other extremity of shaft 1 is a chain wheel 7 upon which is a chain 8 which drives a chain wheel 9. In Figs. 3 and 4 the chain wheel 9 is connected to the main shaft 10 of the engine by means of the well known free wheel arrangement, so that movement of the chain 8 and wheel 9 in one direction causes the engine shaft to rotate, but

when the engine shaft itself rotates in the same direction it gives no motion to the chain 8.

11 are four small cams rigidly attached to the shaft 12 which is mounted in bearings 13 and has at one end an arm 14 which is operated by means of a wire, cord or chain 15, fixed to a sleeve 16 on the shaft 1. The arrangement of these parts is such that when the chain or wire 15 is lifted upwards the arm 14 turns the shaft 12 so that the points of the cams press on the underneath side of the small collars 17 fixed to the rods 18 which serve to lift the valve stems 19 in the ordinary working of the engine.

Attached to the dashboard 20 of the car is a metal socket 21 through the center of which the shaft 1 is free to turn. Sliding loosely upon the metal socket 21 but prevented from turning with relation to it by means of the feather 22 is the sleeve 23 shown in section in Fig. 7. This sleeve is normally pressed as far away as possible from the base of the socket 21 by the coil spring 24. Attached to the flange of the sleeve 23 are pins 25 which can engage with corresponding holes in the flange of the tube 26. Inserted through holes in this flange are two pins 27 which are prevented from coming forward by means of their heads. The small ends of these pins normally abut against a flange 28 which is rigidly connected to the boss of the handle 6, this boss being pressed back against the ends of the pins 27 by means of the spring 29 which is inserted between the shoulder in the boss of flange 28 and a collar 30 rigidly attached to the shaft 1. This spring 29 is weaker than the spring 24 so that notwithstanding the pressure of spring 29 in the upward direction as seen in Fig. 7 the sleeve 23 with its pins 25 is kept pressed firmly downward. The function of spring 29 is merely to keep the handle 6 from engaging with the projections 4.

Two slots 31 are cut in the boss of the handle 6 for the purpose of engaging with the projections 4.

The sleeve 23 is prevented from coming right forward by means of the nut 32 which is rigidly screwed to the tubular portion of the socket 21.

Cut in the periphery of the flange 28 which is attached to the handle 6 are four or more notches 5 arranged to engage with two extensions 33 on the lower edge of the sleeve 16.

When the handle 6 is pressed inwards (or referring to Fig. 7 upwards) the sleeve 23 is pressed back against the spring 24 by means of the pins 27 and the notches 5 engage in the extensions 33 and enable a portion of a turn sufficient to open the inlet valves to be given to the sleeve 16. When the forward pressure on the handle 6 is relieved, the pins 25 engage in the corresponding holes in the sleeve 16 before the extensions 33 have left the notches 5 so that the sleeve 16 remains in the position in which it has been placed and the inlet valves remain open.

When the handle 6 is drawn forward (or as seen on Fig. 7 drawn downward) the projections 4 can engage in the slots 31 in the handle, and a rotary motion can then be imparted by means of the handle 6 to the shaft 1 and so to the main shaft 10 of the engine. The cylinders can in this way be filled with explosive mixture and the pistons be set in the proper position for starting.

Attached to the sleeve 16 are two cams of insulating material 34 and 35 which can engage against projections in the springs 36 and 37. When the cam 35 is turned in a direction opposite the hands of the clock it causes the spring 37 to break contact from the insulated pin 38 and so open the circuit between the ordinary firing battery and the system of a high tension ignition. At the same time the cam 34 by engaging with the projection on spring 36 causes this spring to make contact with the insulated pin 39 so that the pin and spring can be used to short circuit the armature of a magneto generator when a low tension magneto system is used for ignition purposes on a car. Only in certain cases will the two arrangements illustrated on Fig. 6 both be necessary at the same time on a car.

Attached to sleeve 16 (Fig. 5) is a cord or wire 15 by means of which the valves are lifted, and the relative angles of the cams 34 and 35 and the length of the cord 15 are so adjusted that where both types of ignition are used the high tension circuit is broken between the spring 37 and the insulated pin 38 and the low tension circuit is short circuited between the spring 36 and the insulated pin 39 before the cord or wire 15 is sufficiently tightened to cause sufficient rotation of the shaft 12 to take place to raise the four inlet valves 19 off their seats, and conversely when the handle 6 is pressed inwards (or as seen in Fig. 7 upwards) so as to reëngage the notches 5 with the projections 33 in the sleeve 16 and by means of further inward pressure to release the pins 25 from the sleeve 16 a movement in the direction of the hands of a watch will restore the valves 19 to their seats by slackening the cord or wire 15 before it is possible for either the high tension circuit or the low tension circuit to be restored to their normal working conditions by means of the springs 36 and 37 so that it is impossible for any ignition to take place until the valves are restored to their normal working positions.

In the arrangement shown at Fig. 8, the wheel 9 actuated by the chain 8 is mounted

freely upon the main shaft 10 of the engine and is capable of being moved longitudinally on it by means of the lever 40 which is forked to engage with flanges 41, 42 on the wheel 9. The lever 40 is pivoted at 43 and a spring 44 is arranged between the lever and some part of the framework of the engine so that the wheel 9 and lever 40 are kept as far as possible to the right, that is to say, in such a position that the half 45 of the clutch is disengaged from the other half 46 which is rigidly fixed to and revolved by the main shaft 10 of the engine. Attached to one extremity of the lever 40 is the wire or cord 47 fixed to the sleeve 16 and operated by the handle 6.

The method of operation is as follows:— When the handle 6 is pressed forward the sleeve 16 can be rotated in such a direction as to first tighten the cord 15 which causes the raising of the inlet valves off their seats, and then subsequently to tighten the cord 47 which causes the clutch attached to the driving mechanism to engage with the part of the clutch which is rigidly attached to the main shaft of the engine.

What we claim is:—

1. In an internal combustion engine, the combination of two or more cylinders, an inlet valve for each cylinder through which combustible mixture can be drawn, an electric circuit adapted for firing the combustible mixture in the cylinders, means for simultaneously holding open the inlet valve of all the cylinders while the outlet valves are left free to be opened and closed as in the normal working of the engine, means for breaking the electric circuit while the inlet valves are thus held open, means for giving a few turns to the crank shaft while the several inlet valves are held open and the electric circuit broken, and means for insuring that the mechanism used for giving a few turns to the crank shaft can only be brought into action when the sparking circuit is broken.

2. In an internal combustion engine, the combination of two or more cylinders, an inlet valve for each cylinder through which combustible mixture can be drawn, an electric circuit adapted for firing the combustible mixture in the cylinders, means for simultaneously holding open the inlet valve of all the cylinders while the outlet valves are left free to be opened and closed as in the normal working of the engine, means for breaking the electric circuit while the inlet valves are thus held open, means for giving a few turns to the crank shaft while the several inlet valves are held open and the electric circuit broken, means for insuring that the mechanism used for giving a few turns to the crank shaft can only be brought into action when the sparking circuit is broken, and means for preventing the sparking circuit being again completed before the inlet valves have been allowed to resume their normal working positions.

3. In an internal combustion engine, the combination of two or more cylinders, an inlet valve for each cylinder through which combustible mixture can be drawn, an electric circuit adapted for firing the combustible mixture in the cylinders, means for simultaneously holding open the inlet valves of all the cylinders while the outlet valves are left free to be opened and closed as in the normal working of the engine, means for breaking the electric circuit while the inlet valves are thus held open, means for giving a few turns to the crank shaft while the several inlet valves are held open and the electric circuit broken, and means for preventing the sparking circuit being again completed before the inlet valves have been allowed to resume their normal working positions.

4. In an internal combustion engine, the combination of two or more cylinders, an inlet valve for each cylinder through which combustible mixture can be drawn, an electric circuit adapted for firing the combustible mixture in the cylinders, a crank shaft, a second shaft, a cam shaft, cams on the cam shaft adapted to act on the inlet valves, a handle and a sleeve loose on the second shaft, means for engaging the handle either to the shaft or to the sleeve, gearing connecting the second shaft to the crank shaft, and gearing connecting the sleeve to the cam shaft.

5. In an internal combustion engine, the combination of two or more cylinders, an inlet valve for each cylinder through which combustible mixture can be drawn, an electric circuit adapted for firing the combustible mixture in the cylinders, a crank shaft, a second shaft, a cam shaft, cams on the cam shaft adapted to act on the inlet valves, a handle and a sleeve loose on the second shaft, means for engaging the handle either to the shaft or to the sleeve, gearing connecting the second shaft to the crank shaft, gearing connecting the sleeve to the cam shaft, and a switch in the circuit and on the sleeve adapted to prevent the combustible mixture in the cylinders from being fired when the valves are open.

6. In an internal combustion engine, the combination of two or more cylinders, an inlet valve for each cylinder through which combustible mixture can be drawn, an electric circuit adapted for firing the combustible mixture in the cylinders, a crank shaft, a second shaft, a cam shaft, cams on the cam shaft adapted to act on the inlet valves, a handle and a sleeve loose on the second shaft, means for engaging the handle either to the shaft or to the sleeve, a chain wheel on the second shaft, a chain wheel on the crank shaft and connected to it by free wheel

mechanism, a chain gearing with the chain wheels, an arm fixed to the cam shaft, and a cord fixed to the arm and to the sleeve.

7. In an internal combustion engine, the combination of two or more cylinders, an inlet valve for each cylinder through which combustible mixture can be drawn, an electric circuit adapted for firing the combustible mixture in the cylinders, a crank shaft, a second shaft, a cam shaft, cams on the cam shaft adapted to act on the inlet valves, a handle and a sleeve loose on the second shaft, means for engaging the handle either to the shaft or to the sleeve, a chain wheel on the crank shaft and connected to it by free wheel mechanism, a chain gearing with the chain wheels, an arm fixed to the cam shaft, a cord fixed to the arm and to the sleeve, and a switch in the circuit and on the sleeve adapted to prevent the combustible mixture in the cylinders from being fired when the valves are open.

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