No. 671,394. Patented Apr. 2, 1901.

N. CURTIS.

ENGINE.

(Application filed Apr. 6, 1900.)

(No Model.)

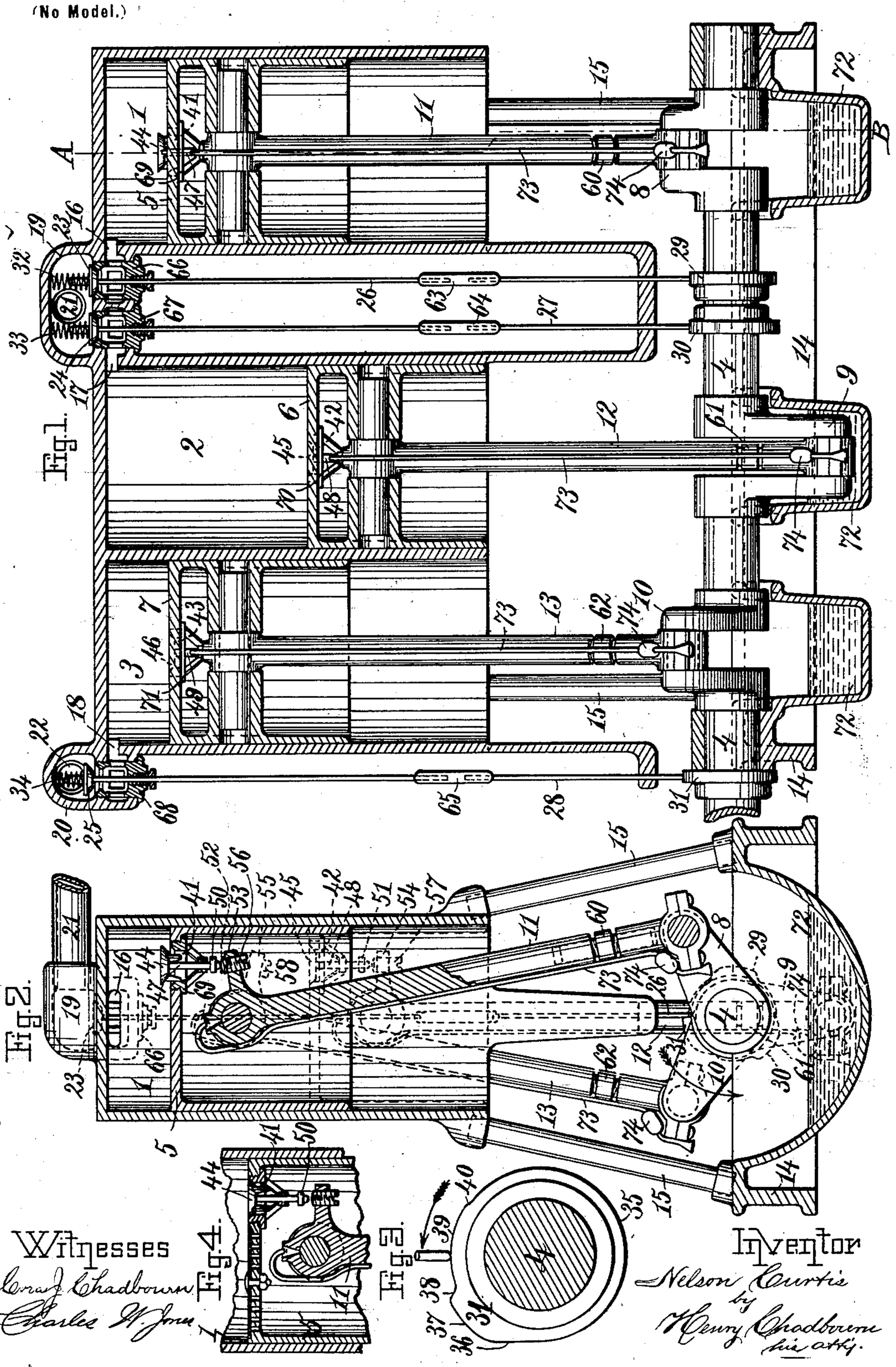

Fig. 1.

Fig. 2.

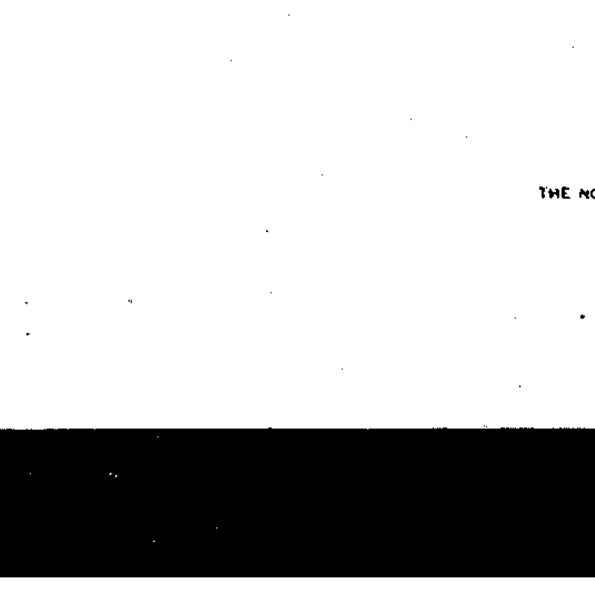

Fig. 4.

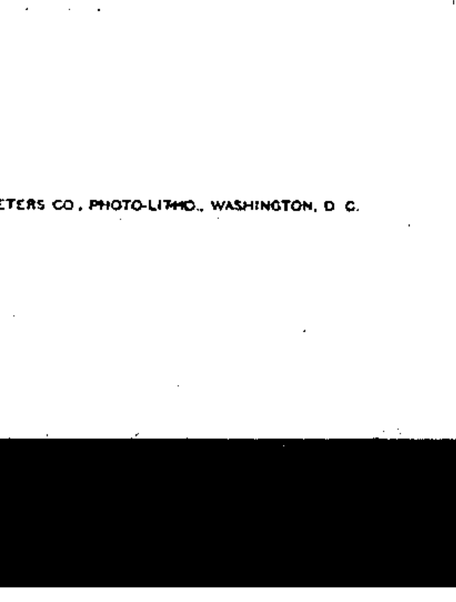

Fig. 3.

Witnesses

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NELSON CURTIS, OF BOSTON, MASSACHUSETTS.

ENGINE.

SPECIFICATION forming part of Letters Patent No. 671,394, dated April 2, 1901.

Application filed April 6, 1900. Serial No. 11,892. (No model.)

To all whom it may concern:

Be it known that I, NELSON CURTIS, of Boston, in the county of Suffolk and State of Massachusetts, have invented certain new and useful Improvements in Engines, of which the following is a specification.

This invention relates to improvements in engines, and more especially in single-acting engines, using as a motive power steam, hot air, or other motive fluid under pressure.

It has for its objects to cheapen the construction, reduce the complications of parts, increase the efficiency, and lessen the liability of getting out of order.

The invention consists of the novel construction, arrangement, and combinations of parts, as will be fully described hereinafter and set forth in the claims hereunto annexed and made a part of this specification.

The invention is carried out substantially as illustrated on the accompanying drawings, forming an essential part of this specification, and whereon—

Figure 1 represents a longitudinal section of my improved engine. Fig. 2 represents a cross-section of the same on the line A B shown in Fig. 1. Fig. 3 represents a detail side elevation of one of the cams used to operate the inlet-valves of the engine; and Fig. 4 represents a cross-section of the upper end of one of the pistons, showing a slightly-modified form of the valves carried by said piston.

Like characters refer to like parts wherever they occur on the different parts of the drawings.

A series of cylinders 1, 2, and 3, open at one end and closed at the opposite end, are preferably arranged in line with each other and above the driven shaft 4, which is to be driven by the engine, as hereinafter described, and which forms a part of the engine. These cylinders are provided with the respective pistons 5, 6, and 7, which reciprocate within the cylinders and which are connected to the respective cranks 8, 9, and 10 on the driven shaft 4 by means of the respective connecting-rods 11, 12, and 13. It will be seen that the reciprocations of the pistons within the cylinders will cause the rotations of the shaft 4 in its bearings in the base 14 of the engine. The cylinders are preferably cast in one piece with each other, as shown on the drawings, and are supported upon the base by means of the rods 15 15 15 or by other equivalent means. The cylinders are provided at their upper ends with the respective inlet-ports 16, 17, and 18. Two chests 19 and 20 are preferably cast in one piece with the cylinders and form connection with the upper ends of the cylinders, by which said cylinders are cast together. These chests have inlets in open communication with the supply of motive fluid by means of the respective supply-pipes 21 and 22. Communication between the chest 19 and the respective ports 16 and 17 is controlled by the respective valves 23 and 24 and between the chest 20 and port 18 by the valve 25. These valves are provided with the respective valve-stems 26, 27, and 28, guided within suitable bearings or guides, which stems are acted upon by the respective cams 29, 30, and 31 to cause said valves to be forced from their seats or allowed to be seated again, as hereinafter set forth, in order to open or close communication between the chests and their respective cylinders. The valves 23, 24, and 25 are opened against the inlet-pressure in the chests 19 and 20 or are seated by the inlet-pressure according to the part of the cams which is in contact with their respective valve-stems, or they may be seated by means of suitable springs 32, 33, and 34, if desired, which springs are preferably placed within the chests above their respective valves, substantially as shown on the drawings.

It will be understood that the number of cylinders used on my engine may vary as desired and that the number of cylinders govern the relative positions of the cranks on the driven shaft. When three cylinders are used, as shown, the cranks 8, 9, and 10 are arranged upon the shaft 4 at an angle of one hundred and twenty degrees from each other, or one-third of a complete rotation of the shaft, and so that their respective pistons will be one-third of their complete reciprocation ahead or behind the other pistons. By this arrangement of the cranks and pistons it will be seen that at least one of the pistons is exerting a pressure on its connected crank tending to rotate the shaft at all times.

The cams 29, 30, and 31 are placed upon the shaft 4 in positions similar to that of the cranks and are so shaped that the closing movement of each of the valves 23, 24, and 25, which is controlled by said cams, is divided into two distinct parts, one of these parts being sufficient to practically cut off the supply of motive fluid, leaving a slight leakage of the motive fluid for such further part of the rotation of the shaft 4 as will be sufficient to bring the next cylinder into position to take its supply of motive fluid, when the second part of the closing movement of the valve will take place to complete the closing of the valve. In order to accomplish this result, I provide the surface of the cams, which operates upon the stem of the valve, with the circular surface 35, concentric with the center of the shaft 4, which surface is in engagement with the stem of the valve while the valve is in a closed position; also, with the inclined surface 36, which is brought into engagement with the stem of the valve in order to open the valve against the inlet-pressure thereon; also, with the circular surface 37, concentric with the center of the shaft 4, which surface is in engagement with the valve-stem in order to hold the valve in an open position; also, with the inclined surface 38, upon which surface the valve-stem moves during the closing movement of the valve and which allows the valve to nearly close, leaving only a very slight leakage of the motive fluid through the valve and into the cylinder; also, with the circular surface 39, concentric with the center of the shaft 4, which surface retains the valve in a slightly-open position for the purpose set forth, and finally with the inclined surface 40, upon which the valve-stem moves to finally and completely close the valve. By making the surfaces 38 and 40 inclined instead of abrupt I prevent the valves from pounding when reaching their seats and also prevent the valve-stems from striking hard against the lower surfaces of the cams when moving from a higher surface.

The pistons 5, 6, and 7 are provided with the respective ports 41, 42, and 43, which form the exhaust-ports from the pressure-chambers of the cylinders. These ports are controlled by the respective valves 44, 45, and 46, having their seats on the inner or pressure-chamber side of the pistons, and are opened against the pressure of the motive fluid in the pressure-chamber by peculiar mechanism, to be described hereinafter.

The valves 44, 45, and 46 are provided with the respective valve-stems 47, 48, and 49, which extend from the valves through the ports in the pistons and are guided in suitable guides attached to the pistons. These stems of the valves are provided with the respective collars 50, 51, and 52, which prevent the stems of the valves from leaving their guides even though the engine is turned entirely over.

The peculiar mechanism to operate the exhaust-valves in the pistons is constructed substantially as follows: The upper ends of the connecting-rods 11, 12, and 13 are each provided with the respective side projections 53, 54, and 55, which project into a position directly under the respective valve-stems 47, 48, and 49, and which projections are brought into contact with the projecting ends of the valve-stems by the swinging or pendulum motion of the connecting-rods upon their connections to the pistons, and thereby cause the valves to be forced from their seats and to open the exhaust-ports through the pistons. By varying the length of the stems of the exhaust-valves or, what is equivalent thereto, by varying the position of the contacting surface of the projections on the connecting-rods in relation to the connecting-rods themselves I am able to vary the time of opening the exhaust-ports in relation to the position of the pistons and obtain the most desired results. In order to adjust the time of opening the exhaust-ports, as above set forth, I prefer to provide the side projections on the connecting-rods with the respective set-screws 56, 57, and 58, substantially as shown; but it is not absolutely necessary that such an adjustment should be provided, as it may be entirely dispensed with and the length of the stems be made sufficiently accurate before being placed in position in the engine. If from any cause the motive fluid should be cut off by the action of the cams at such a position of the piston that the expanding of the motive fluid within the pressure-chamber to a pressure equal to that of the atmosphere would fail to force the piston to the end of its stroke, there would be a tendency to form a vacuum in the pressure-chamber by the completion of this outward stroke, which vacuum would act to retard the completion of the stroke and would prevent the perfect operation of the engine. To prevent this tendency to create a vacuum in the pressure-chamber, the valves 44, 45, and 46, which are made in the form of puppet-valves, will open and admit the atmosphere-pressure to the pressure-chamber and place the piston in equilibrium before a back pressure detrimental to the operation of the engine has been created by the vacuum so formed. In order to lessen the liability of creating a vacuum in the pressure-chamber, I may provide the pistons with a more sensitive valve than the puppet-valves above described, which sensitive valve is preferably made in the form of a clapper-valve 59, substantially as shown in Fig. 4, and is to be used in connection with the puppet-valves. In most of the cases it is thought that the puppet-valves will be sufficiently sensitive to prevent a vacuum, which would materially interfere with the operation of the engine.

In order to properly adjust the length of the connecting-rods as well as the length of the stems of the inlet-valves, I prefer to provide said parts with the respective right and left screw-threaded couplings 60 61 62 and 63 64 65 or with some other common and

well-known equivalent device; but it is not absolutely necessary that said parts should be provided with any adjustment.

For the sake of convenience in manufacturing the engine and in making repairs in the valves I prefer to provide screw-threaded perforations for the reception of the valves, to form the seats of the valves on the ends of the respective screw-threaded thimbles 66, 67, and 68 and 69, 70, and 71, and screw said seats into proper position within the cylinder or piston in a manner substantially as shown on the drawings.

When the cylinders are arranged, as shown, with their open ends on the bottom of the cylinders and the piston working in a vertical line, it is very inconvenient to supply a proper lubricant to the pivotal connection of the connecting-rods to the pistons. In order to properly and automatically supply the lubricating material to said joint, I provide the base 14 of the engine with the oil-pans 72, preferably one for each crank, and also supply each connecting-rod with a tube 73, which extends from the lower end of the rod to a position directly over an oil-hole in the top of the connecting-rod. The lower end of the tube is preferably flared, as shown, and is so placed upon the rod that its open mouth will enter the oil or other lubricant in the pan 72 when the crank is rotated, and a small quantity of the lubricant will be forced up into the tube through a suitable check-valve 74 in the tube, preferably located near the lower end of the tube, as shown, which check-valve has not been shown in detail on the drawings, as its construction may be of any of those now in common use. It will be seen that the end of the tube 73 enters and leaves the lubricant contained in the pan 72 by each complete rotation of the crank, and therefore there will be a small quantity of the lubricant forced into the tube by each rotation of the crank, which lubricant will finally be delivered from the upper end of the tube into the oil-hole in the connecting-rod and will lubricate the joint between the rod and the piston. It will also be seen that by means of the end of the crank entering the lubricant in the pan the joint between the connecting-rod and its crank will be automatically kept lubricated. Thus there will only be the bearings of the driven shaft in the base of the engine to be lubricated by hand.

On the drawings the cylinders have been shown as being arranged vertically above the shaft 4, and such is the preferred arrangement of the cylinders; but I may arrange them in a horizontal plane passing through the center of the driven shaft, if so desired, or they may be placed in any other convenient place in relation to the driven shaft, and, in fact, the cylinders may be made separate from each other and be arranged radially around the center of the shaft, or they may be arranged radially in two planes and be so that one cylinder will overlap the next cylinder, and thereby lessen the length of the completed engine.

Having thus fully described the nature, construction, and operation of my invention, I wish to secure by Letters Patent and claim—

1. An engine consisting of a series of cylinders open at one end, a piston in each cylinder, a driven shaft, a series of cranks on the driven shaft, a connecting-rod between each of said cranks and one of said pistons, an inlet-valve for each cylinder, a cam on the driven shaft for each of said inlet-valves and operating the valve, and an exhaust-valve on each piston, for the purpose set forth.

2. In an engine, a plurality of cylinders, a piston in each cylinder, a driven shaft rotated by the movements of said pistons, an inlet-valve for each cylinder, a cam on the engine for each inlet-valve, to operate its valve, each cam having cam-surface to cause the closing of the valve to be divided into two distinct movements whereby said valve will nearly close to cut off the motive fluid at the first movement of the valve, but will leave a slight leakage of said fluid until the next cylinder is in position to take the motive fluid when the second movement will complete the closing of the valve, for the purpose set forth.

In testimony whereof I have affixed my signature in presence of two witnesses.

NELSON CURTIS.

Witnesses:
HENRY CHADBOURN,
D. E. KEMPSTER.