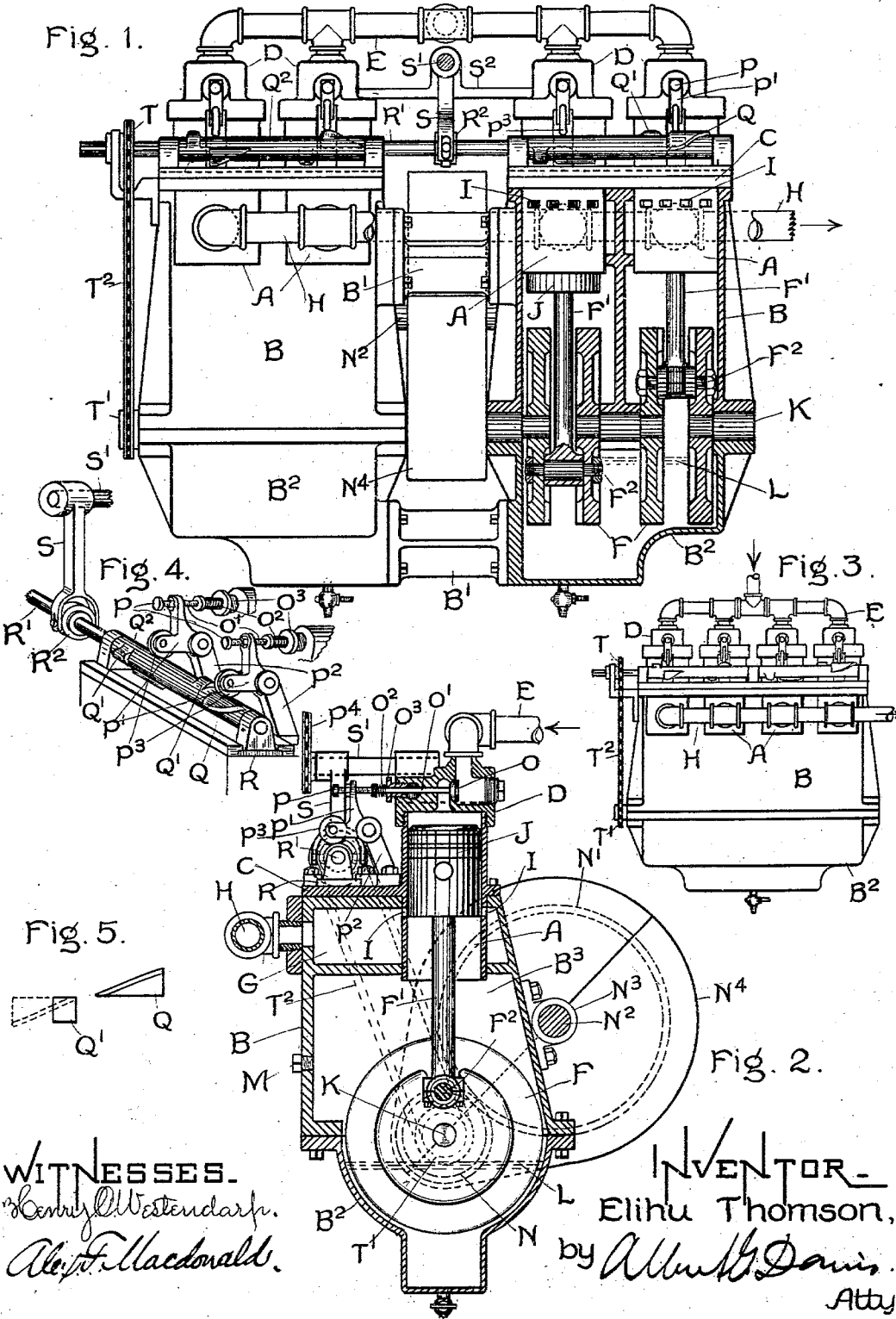


E. THOMSON.
FLUID PRESSURE ENGINE.
APPLICATION FILED MAR. 31, 1900.

NO MODEL.

Fig. 1.



WITNESSES.
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UNITED STATES PATENT OFFICE.

ELIHU THOMSON, OF LYNN, MASSACHUSETTS.

FLUID-PRESSURE ENGINE.

SPECIFICATION forming part of Letters Patent No. 740,203, dated September 29, 1903.

Application filed March 31, 1900. Serial No. 10,982. (No model.)

To all whom it may concern:

Be it known that I, ELIHU THOMSON, a citizen of the United States, residing at Lynn, county of Essex, State of Massachusetts, have
 5 invented certain new and useful Improvements in Fluid-Pressure Engines, (Case No. 1,636,) of which the following is a specification.

My present invention relates to fluid-pressure engines, and more particularly to those
 10 designed to operate with steam superheated to a high degree. The engine is, however, capable of working with compressed air or other fluid.

The object of the invention is to simplify and improve the construction and operation of engines, particularly of the type above referred to, although, as will be evidenced by the specification and drawings, certain of the
 15 improvements can be used in connection with other types of engines.

In the accompanying drawings, which are attached to and made a part of this specification, Figure 1 illustrates a front elevation of an engine embodying my invention. Fig. 2 is a section through one of the cylinders. Fig. 3 is a front elevation of a slightly modified form of the engine in which all of the cylinders open into a common chamber. Fig. 4 is a perspective view of the valve mechanism, and
 20 Fig. 5 is a diagram illustrating a form of cam for operating the cut-offs.

The type of engine shown is provided with four single-acting cylinders A, two of which
 35 are shown in section, the other two being covered by a part of the casing. The cylinders, as shown in the drawings, are placed side by side and occupy vertical positions; but, if desired, they may be placed in horizontal positions or they may radiate from a common center—such as the main shaft, for example. Again, the two cylinders forming the pair may be disposed on opposite sides of the main shaft. For simplicity of construction it is
 40 preferable to divide the engine into two parts and to provide two cylinders and two pistons for each part. Each pair of cylinders is inclosed in a casing B, and the two casings are held in proper alinement by the frame-pieces
 45 B'. In Fig. 3, however, a single casing is made to inclose all of the cylinders.

The construction of the cylinders and the

means employed for securing them in place is best shown in Fig. 2. The cylinders A are formed integral with and are supported by
 55 the plate C, which plate is bolted to the upper part of the casing B. The cylinders each extend above and below the plate, and to the upper end of each cylinder is secured a cast-metal cap D, containing the valve mechanism,
 60 the lower end of each cylinder opening into the chamber in the casing B. The steam-pipe E is also connected to the several caps by suitable connections. The casing B is made in two parts B and B², which parts are secured by bolts. The lower part is curved to
 65 conform to the shape of the crank-disks F, and in the central lower side is formed a receptacle for the lubricating-oil. The upper part of the casing is provided with an exhaust chamber G, which communicates with
 70 the exhaust-pipe H and with the cylinders by means of a number of small exhaust-ports or valve-openings I, which are covered and uncovered at suitable intervals by the
 75 pistons J. The lower end of each cylinder is extended through the top plate of the casing and also the part forming the lower wall of the exhaust-chamber and opens into the
 80 chamber B², formed in the main casing. Extending horizontally through the chamber B² and mounted in suitable bearings in the walls thereof is a main or driving shaft K. Mounted on the shaft are crank-disks or fly-wheels
 85 F, two disks or wheels being provided for each piston. The pistons are cup-shaped and are made of substantial length to avoid the use of guides and piston-rods and their necessary stuffing-boxes. Pivotaly secured to
 90 each piston, at or about the center thereof, is a connecting-rod F', which is connected to the crank-pin F² by a suitable bearing. The relation of the pistons, connecting-rods, and cranks is such that a certain amount of clearance or dead space is provided between the
 95 end of the piston and the cylinder-head. The lower part of the casing B² is filled with lubricating-oil up to about the line L, the precise point, however, being immaterial so long as there is sufficient oil to lubricate the moving parts. Oil can be introduced into the
 100 chamber by removing the plug M, or any one of the well-known devices may be utilized for maintaining a continuous feed. When the

engine is running, oil is thrown around in the inside of the chamber in a manner to thoroughly lubricate all of the working parts.

Mounted on the main or driving shaft is a pinion N, shown in dotted lines, and meshing therewith is a gear N', also shown in dotted lines, and inclosing the gearing is a casing N⁴. The gear N' is mounted on a shaft N², and bearings N³ are provided on the rear of the casing for this shaft.

The admission of steam to each cylinder is controlled by an outwardly-opening puppet-valve O, covering the inlet-ports, which valve gives a quick opening. The valve has a conical seat and is mounted on the end of a stem or rod O', which is normally held in the position shown by the compression-spring O². The outer end of the stem or rod is provided with a head against which abuts the end of an adjusting bolt or stop P, and surrounding the stem or rod is a suitable stuffing-box O³. The bolt or stop P is mounted on one arm of a bell-crank lever P', which in turn is pivotally supported in a frame P². In the second arm of the lever is mounted a roller P³, which engages with cams Q and Q' for controlling the movements of the valve.

The construction and arrangement of the valve mechanism are best shown in Fig. 4. Secured to the plate C are two guides, and mounted for movement between them is a plate R, having uprights at each end forming bearings for the shaft R'. By moving the plate back and forth the operation of the admission-valves is controlled. Surrounding the shaft is a sleeve Q², and formed on the periphery or otherwise secured thereto are cams Q and Q', which control the in and out movements of the rods O', and consequently the valves. The mechanism for shifting the cams is a simple one. Sleeved on the shaft R' and held against lateral movement independent of the shaft by fixed collars thereon is a collar R². On the periphery of the collar are two pins working in slots formed in the forked actuator S. The actuator is rigidly mounted on a rock-shaft S', which in turn is provided with a bearing in the piece S², bridging the cylinder-caps D, Fig. 1. By rotating the rock-shaft slightly in either direction by the sprocket and chain P⁴, Fig. 2, the position of the cams with respect to the rollers will vary—that is to say, the width of the cam in the path of the roller P³ can be changed. The cam-shaft R' is rotated in any suitable manner. In the present instance the rotation is accomplished by a sprocket-wheel T, which is splined on the end thereof, and motion is transmitted from the engine-shaft by a sprocket T' and chain T². The parts are so arranged that one revolution of the engine-shaft makes one revolution of the cam-shaft.

The cams may be of any suitable shape to vary the intervals that the puppet-valves are opened and closed. There are two cam-surfaces for each valve, one controlling the forward and the other the backward rotation of

the engine-shaft. The cam Q, Fig. 4, regulates the forward rotation of the engine and is substantially a right-angled triangle in shape, with the apex extending away from the roller P³. With this arrangement the maximum amount of steam is admitted to the cylinder at the moment of starting, and by moving the cam laterally to the left the roller will travel over a narrower portion of the cam, and consequently the interval during each piston-stroke that steam is admitted to the cylinder will be decreased. The cam Q' for regulating the backward rotation of the engine-shaft differs in the present instance from the first-mentioned cam in that it is substantially rectangular in shape, being merely an enlargement on one portion of the sleeve. The reason for the difference is that while a number of speeds are necessary for forward rotation only a single backward speed is found desirable for the particular class of work for which this engine is intended—namely, automobile propulsion. When the engine is designed for use where a number of forward and backward speeds are desired, both cams will be made alike, or substantially so.

It will be noticed that the bases or the broad ends of the cams are adjacent to each other, with an intermediate non-acting space between. This I have found to be the more desirable arrangement, since it gives full opening of the valve O at the start for either direction. On the other hand, I have tried the engine with the cams arranged as shown in Fig. 5—that is to say, with the point or apex of cam Q extending toward the second cam. In dotted lines the cam Q' has been extended to form the counterpart of cam Q, the apices pointing toward each other. With this last-mentioned arrangement the minimum amount of steam is admitted at the start, which amount is increased by moving the cam in either direction from a given central position. The particular shape and relation of the cams may readily be varied to suit the various kinds of work demanded of the engine, and I embrace such a variation in the claims.

The cams for controlling the admission of steam to one cylinder are so set with respect to those of the other cylinders that they will admit steam at every quarter of the stroke to first one and then another of the cylinders, thereby maintaining a continuous rotation of the engine-shaft. The valve-controlling mechanism is all mounted at one side of the cylinder s because they are all in the same vertical plane; but when the cylinders are placed on opposite sides of the crank-shaft they would be placed in the most convenient position—namely, between the cylinders.

No means are shown for regulating the passage of steam from the boiler to the engine, as it forms no part of the present invention; but it is to be understood that I may employ any suitable type of throttle-valve.

The engine shown in Fig. 3 is in all re-

spects the same as the one shown in the other figures except that the casing B incloses all of the ends of the cylinders, the cranks, and the connecting-rods, and the casing for inclosing the gears is a trifle modified in order to be properly joined to the main casing.

The operation of my invention is as follows: Steam or other fluid under pressure on being admitted to the pipe E will pass from it to the first-opened puppet-valve O, thence to the cylinder controlled thereby. This will start the piston into operation, and when it has moved through approximately a quarter of its stroke a second puppet-valve will open and a second cylinder will receive steam, and so on. As soon as the roller P³ moves off from its cam the compression-spring O³ will close the valve and the balance of the stroke will be due to expansion. At the end of the stroke the valve-openings or exhaust-ports I are uncovered by the piston, and the steam or other fluid is permitted to enter the exhaust-chamber G, from whence it passes out by the exhaust-pipe H and said pipe being the common exhaust for all of the cylinders. On the return stroke more or less of the steam or other source of energy may be compressed, due to the resistance offered to the passage of the exhaust or to the short period of exhaust; but this will in no way injure the engine or interfere with its operation, for the valves O are so arranged that they will open automatically when the back pressure exceeds the steam-pressure and permit the compressed charge to reënter the steam-pipe E. The operation of the other pistons and cylinders being similar, no further description is necessary.

What I claim as new, and desire to secure by Letters Patent of the United States, is—

1. In a steam-engine, a plurality of single-acting cylinders, having inlet and exhaust ports and opening at their inner ends into a common chamber, a driving-shaft working in said chamber, pistons in the cylinders, and connecting-rods connecting said pistons with the driving-shaft, an exhaust-chamber which is independent of the common chamber, valves controlling the steam-inlet ports and arranged to open automatically when the compression due to the return stroke exceeds a certain amount, rotatable cam-surfaces of tapering width, stems for the valves projecting toward and adapted to be successively acted upon by the cam-surfaces to open the valves, gearing for continuously rotating said cam-surfaces while the engine is running, and means for moving said cam-surfaces laterally with reference to the valve-stems so as to bring wider or narrower parts thereof into action on the stems with a corresponding variation in the period of steam admission.

2. In a steam-engine, a plurality of single-acting cylinders having inlet and exhaust ports and opening at their inner end into a common chamber, a driving-shaft working in said chamber, pistons in the cylinders, and

connecting-rods connecting said pistons with the driving-shaft, an exhaust-chamber which is independent of the common chamber, valves controlling the steam-inlet ports and arranged to open automatically when the compression due to the return stroke exceeds a certain amount, a rotatable cam comprising a sleeve having thereon acting cam-surfaces tapering from one end to the other, valve-stems for the valves projecting toward the cam and adapted to be acted upon in succession by the cam-surfaces respectively to open the inlet-valves, means for moving said cam laterally with reference to the valve-stems, and gearing for continuously rotating said cam while the engine is running.

3. In a steam-engine, a plurality of single-acting cylinders opening at one end into a common chamber, pistons in said cylinders, a driving-shaft working in said chamber, connecting-rods connecting the pistons with said driving-shaft, exhaust-ports for the cylinders adapted to be opened or closed by the movements of the pistons themselves, inlet-ports for the cylinders, outwardly-opening puppet-valves controlling said inlet-ports, stems for said valves, springs acting on said stems to hold the valves normally closed, and means acting on the valve-stems at proper intervals, for opening the valves against the tension of the springs.

4. In a steam-engine, a plurality of single-acting cylinders opening at one end into a common chamber, pistons in said cylinders, a driving-shaft working in said chamber, connecting-rods connecting the pistons with said driving-shaft, an exhaust-chamber which is independent of the common chamber, exhaust-ports for the cylinders adapted to be opened and closed by the movement of the pistons themselves, inlet-ports for the cylinder, outwardly-opening puppet-valves controlling said inlet-ports, stems for said valves, springs acting on said stems to hold the valves normally closed, a rotatable cam, located in front and adapted to act on the ends of said valve-stems to open the valves against the tension of the springs, said cam comprising a sleeve having thereon two acting cam-surfaces, one of which tapers from its point of greatest width inwardly toward the middle of the sleeve, but is separated at its inner end from the other cam-surface by a non-acting space, gearing for continuously rotating said cam during the running of the engine, and means for moving it laterally in front of the ends of the valve-stems to bring either of the cams or a particular portion thereof, or the non-acting intermediate space thereof, into alinement with said stems.

5. In a steam-engine, the combination of a plurality of single-acting open-ended cylinders placed side by side, a piston for each of the cylinders, a driving-shaft to which the pistons are connected, a casing which incloses the open ends of the cylinders and also the driving-shaft, an exhaust-chamber which is

- independent of the common chamber, a spring-pressed puppet-valve for each cylinder and arranged to open automatically when the compression in the cylinder exceeds that of the steam, a stem for operating each valve, a cam situated at one side of the cylinders and outside of the casing, and means actuated by the cam for opening the valves against the spring-pressure.
6. In a steam-engine, the combination of a crank-casing having a wall dividing off a portion thereof to form an exhaust-chamber, a detachable cylinder which extends through the exhaust-chamber and the wall and is provided with exhaust-ports opening into the exhaust-chamber and with an open end communicating with the main chamber of the casing, a plate which is formed integral with the cylinder and is bolted to one end of the crank-casing, a piston and a valve mechanism which is mounted on the plate.
7. In a steam-engine, the combination of a plurality of cylinders, a puppet-valve for each cylinder, a stem for each valve, a cam, a support for the cam, means for moving the support endwise, and a bell-crank lever for operating a valve, which is so arranged that one arm engages with the cam and the other with the stem of the valve.
8. In a steam-engine, the combination of a cylinder, a puppet-valve therefor controlling the admission of steam and also providing relief for the back pressure, a rotary cam for actuating the valve in a manner to control the admission of steam, supports therefor, guide-plates in which the supports are movable and a rock-shaft for shifting the position of the cam.
- In witness whereof I have hereunto set my hand this 30th day of March, 1900.
- ELIHU THOMSON.
- Witnesses:
DUGALD MCKILLOP,
CHAS. B. BETHUNE.