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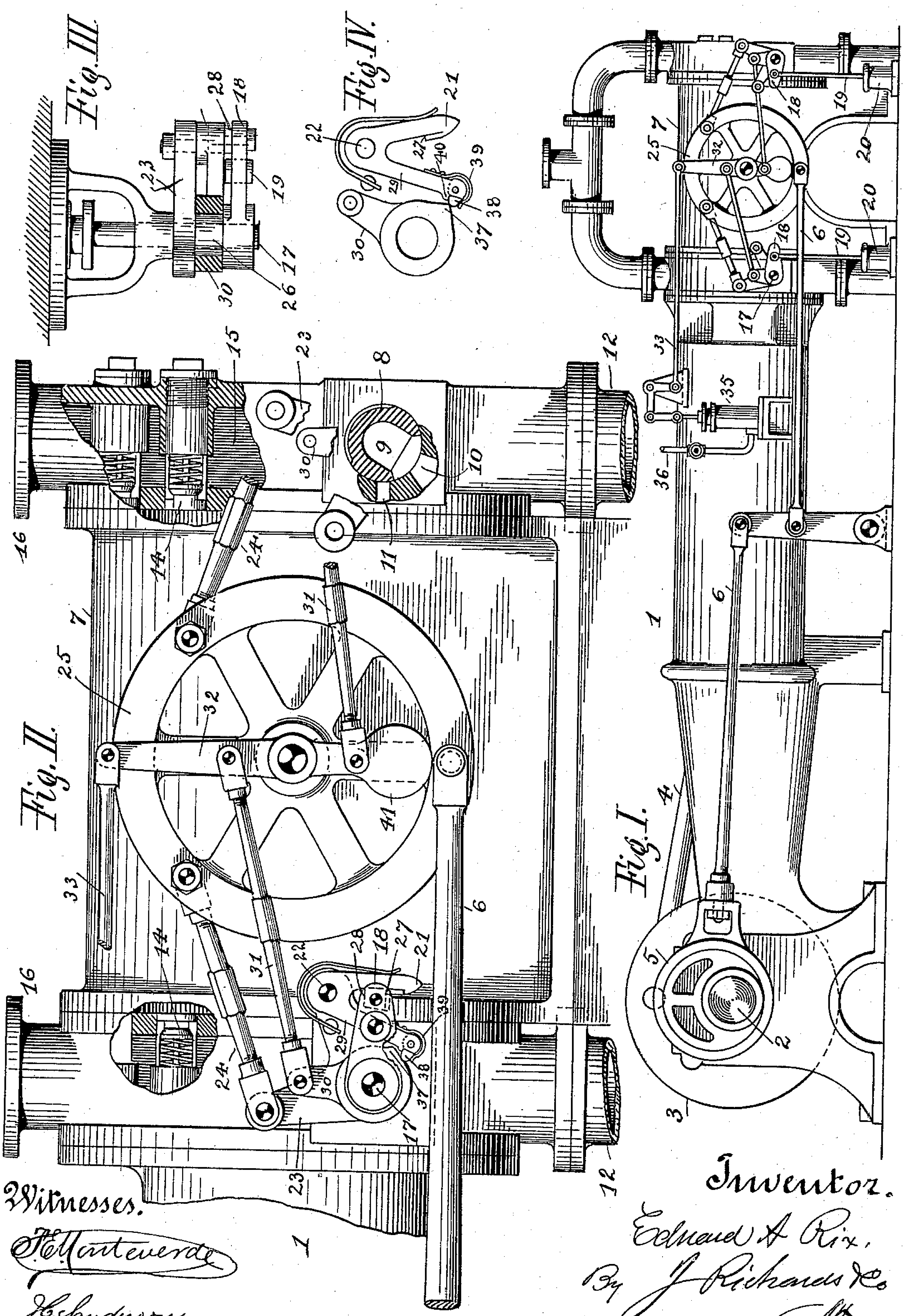
E. A. RIX.

AIR COMPRESSING ENGINE.

(Application filed June 30, 1898.)

(No Model.)



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UNITED STATES PATENT OFFICE.

EDWARD A. RIX, OF SAN FRANCISCO, CALIFORNIA.

AIR-COMPRESSING ENGINE.

SPECIFICATION forming part of Letters Patent No. 640,949, dated January 9, 1900.

Application filed June 30, 1898. Serial No. 684,828. (No model.)

To all whom it may concern:

Be it known that I, EDWARD A. RIX, a citizen of the United States, residing at San Francisco, county of San Francisco, and State of California, have invented certain new and useful Improvements in Air-Compressing Engines; and I hereby declare the following to be a full, clear, and exact description of the same, reference being had to the accompanying drawings, forming a part of this specification.

My invention relates to improvements in engines for compressing and forcing air or other elastic fluids and to a means of varying and regulating the duty or work of such engines at each stroke, while the speed and range of the piston remain the same.

My improvements consist in so constructing and operating such engines of the double-acting type that the volumetric capacity of the cylinder can be varied by changing the point of closing the induction-valves in respect to the stroke of the piston, so as to entrap and compress the volume of air required for use and no more, thus producing a constant pressure and variable volume while the piston is moving at a uniform speed and range.

My invention further consists of devices to regulate automatically by means of the pressure in a receiver or in the eduction-pipes of the engine the amount of air entrapped and compressed at each stroke.

The objects of my invention are to distribute the work or duty of a compressing-engine over all its strokes without circulating or wholly cutting out the air and without changing the engine's stroke or speed, thus adapting it without loss of efficiency to a wide range of duty.

Referring to the drawings, Figure I is a side elevation of a double-acting air-compressing engine constructed and operating according to my invention, or a single-acting compressing-engine if one end only be considered. Fig. II is an enlarged side view of the main cylinder and the valve-gearing therefor. Fig. III is a top view of the escapement or valve-engaging devices. Fig. IV is a front view of Fig. III with the valve-actuating crank removed.

In the operation of an air-compressing engine there is commonly a variable consumption of air, especially in mining operations. When compressed air is employed to operate rock-drilling machines, they vary in number and in the constancy of use, and other intermittent work—such as hoisting minerals, water, or other weights—demand a constantly-varying amount of power. This variation in the amount of the compressed air consumed has hitherto been provided for either by changing the speed of the compressing machinery, by modifying or attenuating the charges of air in the cylinders, or by cutting out the air-supply to the cylinders during whole strokes, but not, so far as I am aware, by positively regulating the compressing range of the pistons in the manner of my invention, as hereinafter explained in this specification and illustrated in the drawings herewith, forming a part thereof.

Referring to Figs. I and II, the main frame 1, crank-shaft 2, crank-disk 3, connecting-rod 4, eccentric 5, eccentric-rods 6, and main cylinder 7 all correspond to common practice for engines having oscillating valves, commonly called "Corliss" valves.

The valves and their operating-gearing correspond to common practice, consisting of oscillating cross-valves 8, having longitudinal chambers 9, that cover and connect the ports 10 and 11, the former communicating with the air-supply pipes 12 and the latter with the cylinder 7.

The eduction-valves 14 are independent and of the usual automatic construction, opening into the chamber 15, in communication with the discharge-ways 16, as shown in Fig. II.

The induction-valves 8 are operated by the concentric stems 17, on the outer ends of which are fastened the cranks 18, connected by links 19 to dash-pots 20, as seen in Fig. I, the latter assisting to close the valves by a partial vacuum formed in the dash-pots 20, also serving to cushion the valve and its connecting parts, which suddenly reverse when released. The valves 8 are opened by means of the claw-hooks 21, pivoted on the pins 22 in the oscillating bell-cranks 23, the latter receiving motion by the links 24, attached to the oscillating disk 25, operated by the cam-rod 6, as seen in Fig. I. The claw-hooks 21 when moved upward engage the blocks 28 at 27 on the cranks 18, and after moving these cranks, with the stems and attached valves, throughout a certain required range the claw 21 is disengaged by means of the arm 29, formed integral with the claw-hooks 21, operating in the following manner: Between the cranks 18 and 23 and on the bosses 26 of the bell-cranks 23 are mounted the tripping-cranks or levers 30, provided on their circular periphery with projecting cams 37, as shown in Fig. II. These tripping-cams 30 are connected by the links 31 to a lever 32, mounted and turning loosely on the stud that supports the disk 25. This lever 32 is connected by rod 33 to the piston-rod 34 of the regulating-cylinder 35 by means of a bell-crank and link, as shown in Fig. I.

The regulating-cylinder 35 is connected by a pipe 36 to a receiver, where the air compressed by the engine is stored, or to the eduction pipes or ways having a like pressure therein, so that any increase of pressure acts under a piston in the cylinder 35 and raises the piston-rod 34 and by the connections described moves the lever 32 and the tripping-cranks 30, thus adjusting the cams 37 and the point at which the claw-hooks 21 will be disengaged and the valves closed. A diminished pressure in the receiver and in the cylinder 35 permits a reverse motion of the bell-crank 32 by reason of the weight 41, thus causing an earlier closing of the valves 8, as will be presently explained. To this point it will be seen that the valves 8 and the actuating-gearing therefor correspond to similar devices employed for steam-engines of the Corliss type, except as to the regulating-gearing being operated by the pressure in the cylinder 35 instead of by a centrifugal governor; but this analogy ends here, as will now be pointed out.

In a steam-engine provided with mechanism such as has been described for the induction-valves the cranks 30 are provided on the periphery of their circular portion with angular cams 37, that come in contact with the arms 29 of the cam-hooks 21 on the upward movement of the latter and press this arm 29 outward, releasing cam-hooks 21, permitting the crank 18 to descend and close the valves 8, cutting off the steam at some portion of the forward stroke. I also employ this same gearing for the induction-valves of my air-compressing engines, the cam 37 tripping the cam-hooks 21, as seen in Fig. II, but in a different manner and to produce a different result, primarily because I never wish to trip the hook on its upward course, as in steam-engine practice, but only at the top of its course or at some point in its downward stroke, for reasons hereinafter explained. In the ends of the arms 29 I place pivoted pawls 38, held in their normal position by the springs 39. These pawls when in this position abut against the ledges 40 on the arms 29, so as to be rigid in one direction, but are free to yield in the other direction or on the upward stroke.

At the beginning of the stroke of the main piston 42 the cam-hooks 21 rise after engaging at 27 with the block 18, and the pawls 38 on the lower ends of the arms 29 yield and pass over the cams 37, so that the valves 8 are not released on the upward stroke of the claw-hook, but remain open until some point in the downward stroke determined by the position of the cranks 30. When pawls 38 then come in contact with the cams 37, the arms 29 are pressed outward and the cam-hooks 21 disengage, permitting the cranks 18 to drop by gravity and action of the dash-pots 20, and thus close the valves 8. The valves may thus be closed at the end of the stroke of the main piston, entrapping the cylinder full of air, or at any point during the return stroke following for a less volume. It will be obvious that the pivoted pawls 38 can be mounted on either the arm 29 or the crank 30 and their operation be the same. In this manner it will be seen that where less than the full volumetric capacity of the compressing-engine is required the induction-valves are opened at the beginning of each stroke of the main piston, are held open during the whole stroke and closed at some portion of the return stroke determined by the pressure of air accumulated acting in the cylinder 35, and that the effective or working range of the main piston depends on the point at which the valves 8 are closed and the amount of air admitted to the cylinder 7 through these valves; also, that the point of closing these valves determines the volumetric capacity of the engine at each stroke the same as if its range was lengthened or shortened or its speed changed in the same proportion.

As before explained, the downward stroke of the piston in the regulating-cylinder 35 is caused by the weight 41, attached to or formed integral with the lever 32. This weight 41, moving in an arc, offers cumulative resistance to the upward movement of the piston-rod 34, thus preventing a too-sudden range of its movement and of the cams 37. This describes the manner of applying my invention to double or single acting air-compressing engines of a type sufficiently large to use the oscillating form of valves; but a large proportion of air-compressing engines being too small to introduce within the proper limits of expense valves of this type such compressors I construct of the single-acting type, and regulation of these by my invention requires a different construction, by which the operative stroke or, in effect, the length of the main cylinder is varied by a sliding plate to lengthen or shorten an aperture or port extending the whole length of the piston's stroke, as shown in Figs. V and VI. Referring now to these figures, illustrating a single-acting compressing-engine, the main frame 51, crank-wheel 52, and connecting-rod 56, all being of the usual construction and purpose, do not require description. The cylinder 70, being single-acting, is open at the front end 58, provided with a close-fitting piston 59, and the usual valves at the rear end communicating with the open air and with the chamber 61 in the cylinder-cover 62, which chamber is connected in the usual manner by means of a pipe 63 to a receiver or to apparatus for applying compressed air. In one side of the cylinder 70 (here shown at the bottom) is a sliding section 65, forming a portion of the cylinder's walls, occupying ten to twenty degrees of arc, or enough so that when this movable section is moved outward or withdrawn a free passage 66 is opened to the external air, and the piston 59 will on its inward stroke begin its work at the inner end of the movable section 65, entrapping and compressing the contained air from this point to the end of the stroke. This construction provides, in effect, a cylinder whose length and cubic capacity can be adapted to the requirements of the work to be done, a fly-wheel 67 equalizing the rotative motion of the engine over its inactive range. The movable section 65 is, after being fitted in the cylinder 70, bored at the same time therewith and forms a uniform portion of its walls. Outward pressure on this movable section 65 is fully resisted by the flat joints at 69, the latter being surfaced and scraped or ground and rendered impervious by internal pressure, as will be understood.

By wholly closing the slide 65 the engine will operate in the usual manner, drawing in and expelling full charges through the common valves in the head 62.

To render the action of the slide 65 automatic or self-regulating, I employ a separate fluid-cylinder 71, having a piston 72, piston-rod 73, and an arm 74, connecting to the sliding member 65, as seen in the drawings. The piston 72 and slide 65 are moved to the right and left or outward and inward by means of fluid under pressure, preferably water or oil, acting in the cylinder 71 and on the ends of the piston 72. The operating fluid is supplied to the cylinder 71 by the pipes 75 and 76, leading from a common distributing-valve in the chamber 77, and is derived from some suitable source or pressure through a pipe 78 and is discharged or exhausted through a pipe 79 from either end of a cylinder 71 in the manner of a common reciprocating engine. A common distributing-valve in the chamber 77, not requiring description, is moved by a stem 80 and lever 81, the latter being operated by any of the usual devices for regulation. These latter-named devices I do not illustrate, as they are well understood and do not form a part of my invention. If the lever 81 and weight 82 are raised, fluid is sent through the pipe 75 to the inner end of the cylinder 71, forcing the piston 72 and the movable slide 65 outward, lengthening the aperture 66 and shortening the working range of the piston 9 accordingly. If the lever 81 is depressed, a reverse movement and result is attained. The piston 72 and section or slide 65 are moved inward, shortening the aperture 66 and increasing the effective stroke of the piston 59 accordingly. The cylinder 70 is surrounded by spaces 84 for cooling water and other parts not directly involved in my improvement and are of the usual construction.

It will be understood that instead of a single free passageat 66 a series of ports—apertures covered and uncovered by a valve—will accomplish the same purpose as the sliding section 65.

In the operation of motive engines operated by steam or air the general method of regulating the power is to admit to the cylinder at each stroke enough of the impelling fluid to perform the regular work, cutting off the supply at various points of the stroke accordingly. In my invention this same method of regulation is in substance applied to engines for impelling fluids—that is, admitting into the cylinders the required amount of fluid by cutting out or preventing induction until such point in the stroke is reached as will entrap the required amount of fluid, attaining thereby results hitherto accomplished by changing the speed of the pistons, attenuation of the air, or cutting out whole strokes by non-admission or circulating the air.

Devices to accomplish my improved manner of operating may be greatly varied in their construction, and I do not confine myself specifically to the devices shown in the drawings. They are in this form practically operative and the best I am able at this time to devise.

Having thus described my improvements, their nature, objects, and manner of their application to double and single acting air-compressing engines, what I claim as new, and desire to secure by Letters Patent, is—

In an air-compressor, having a cylinder, piston, and inlet and outlet valves, the combination with the inlet-valves of mechanism to actuate said valves, and means exposed to the pressure in the outlet-pipe controlling the operation of said mechanism, whereby the inlet-valves are closed at some point of the compression-stroke varying with and dependent on the pressure in said outlet-pipe or its connection, substantially as specified.

These features I believe to be novel and useful and ask that Letters Patent be granted therefor.

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