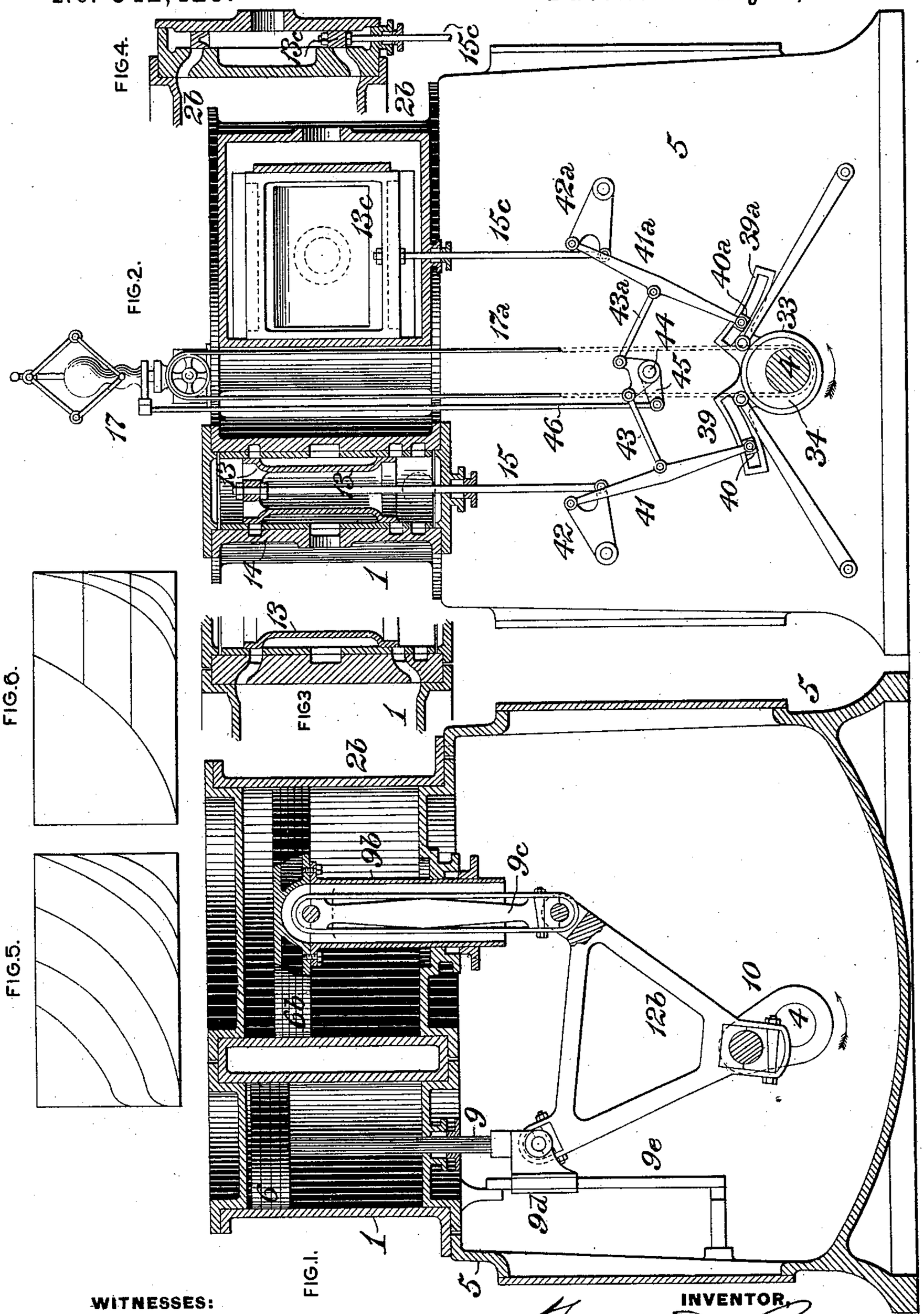
(No Model.) 3 Sheets—Sheet 1.

F. M. RITES.

MEANS FOR ELASTIC FLUID COMPRESSION.

No. 542,425. Patented July 9, 1895.



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(No Model.) 3 Sheets—Sheet 2.

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MEANS FOR ELASTIC FLUID COMPRESSION.

No. 542,425. Patented July 9, 1895.

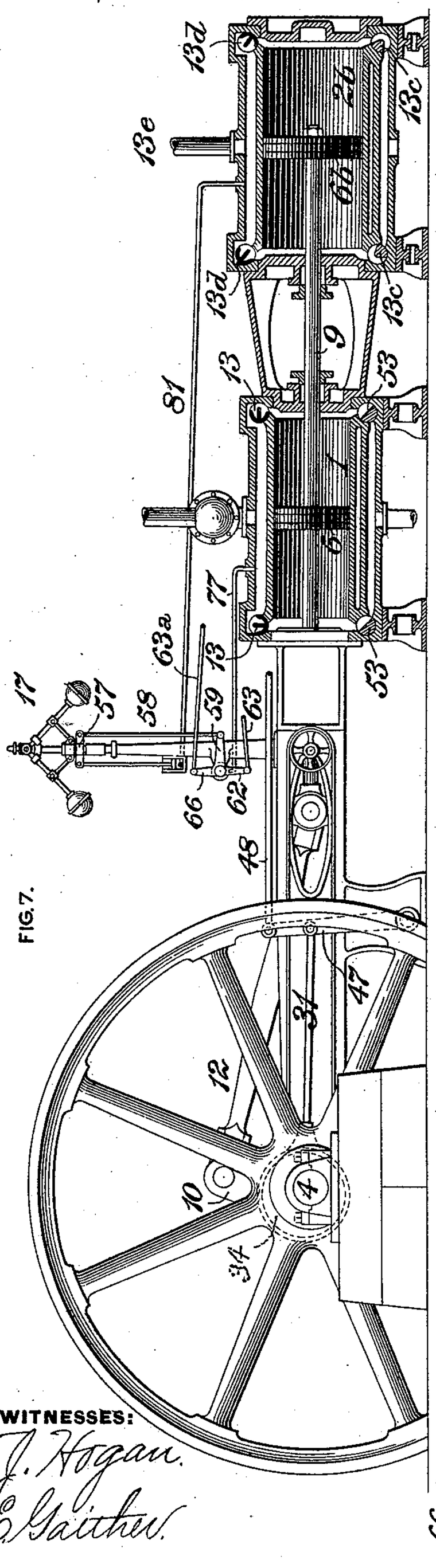

FIG. 7.

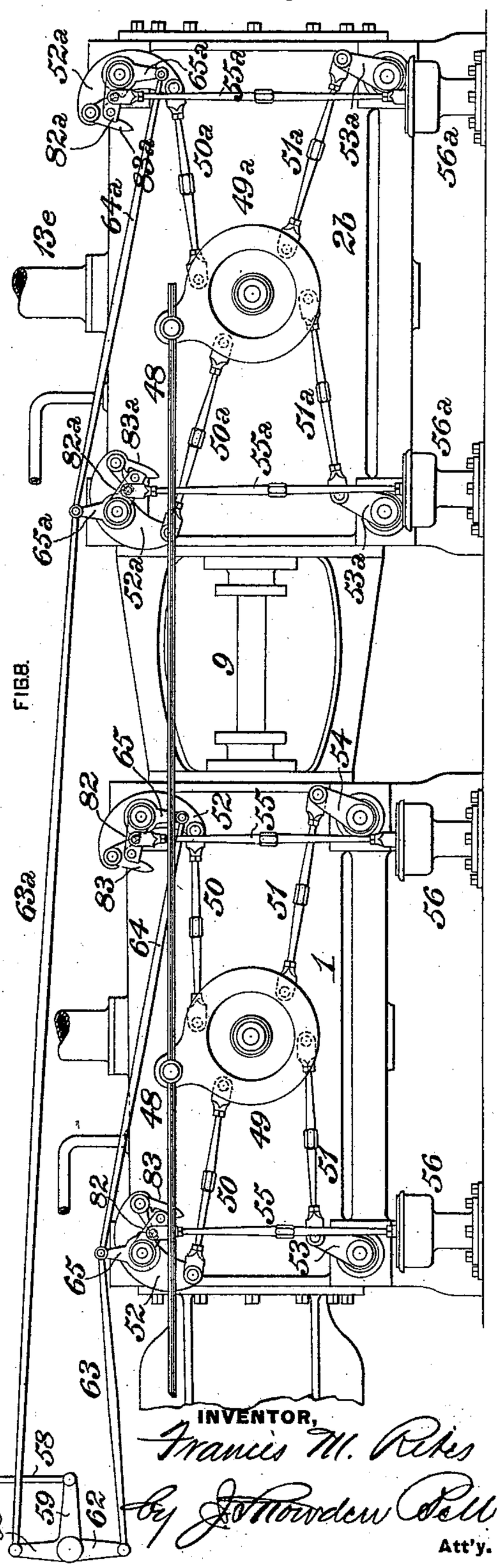

FIG. 8.

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MEANS FOR ELASTIC FLUID COMPRESSION.

No. 542,425. Patented July 9, 1895.

FIG. 10.

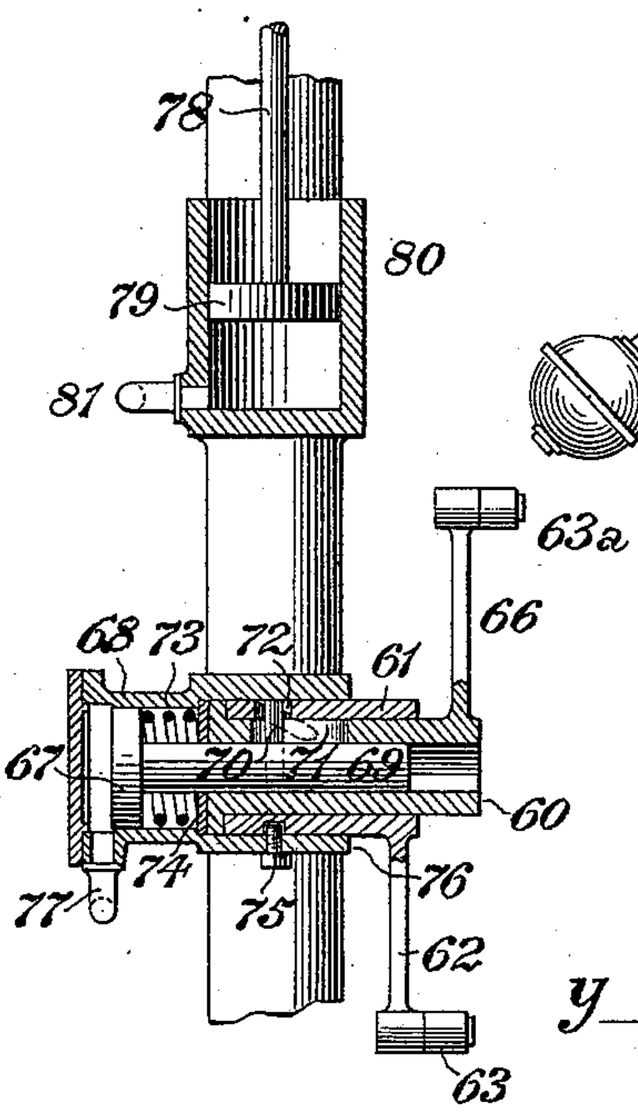

FIG. 9.

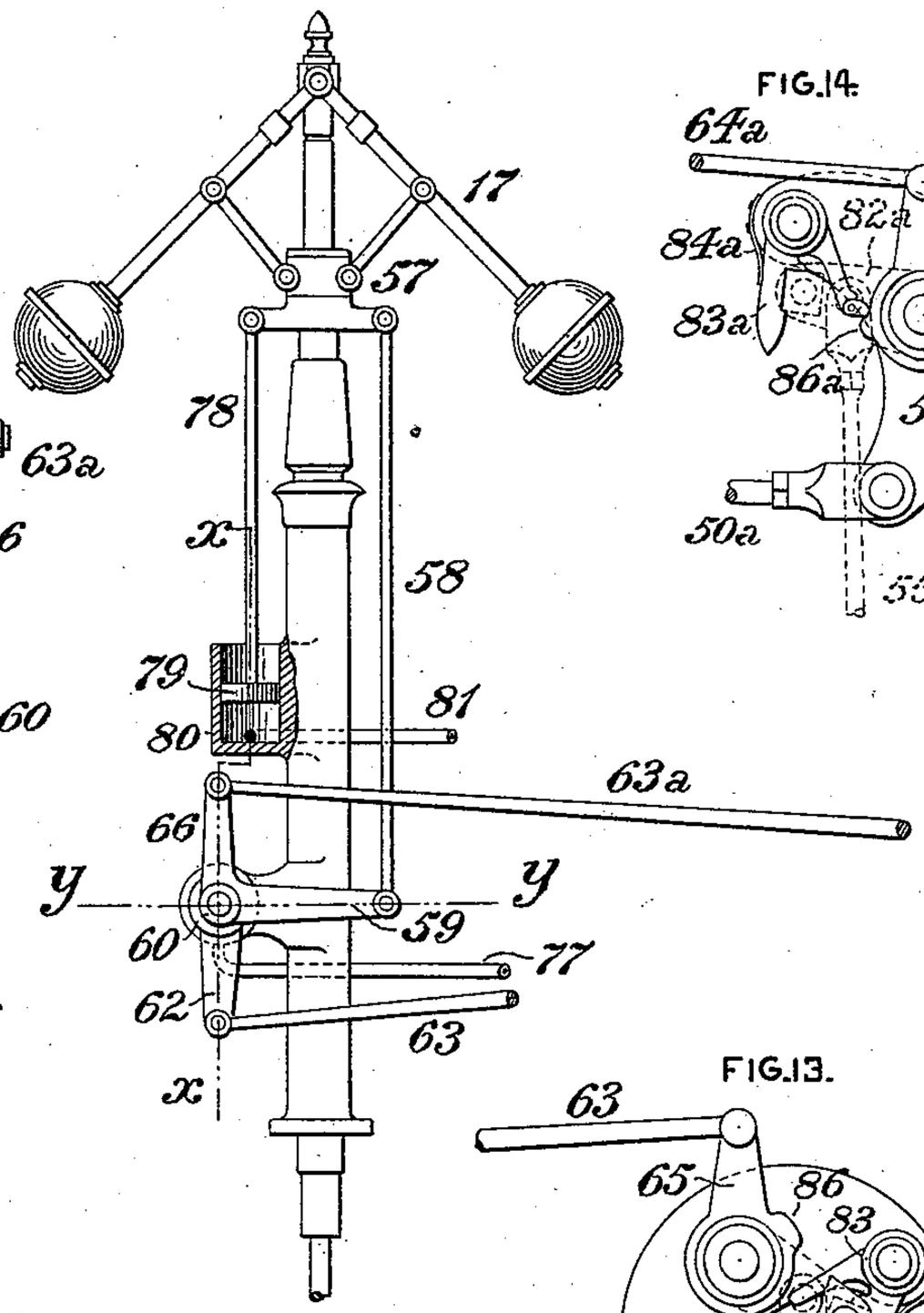

FIG. 14.

FIG. 11.

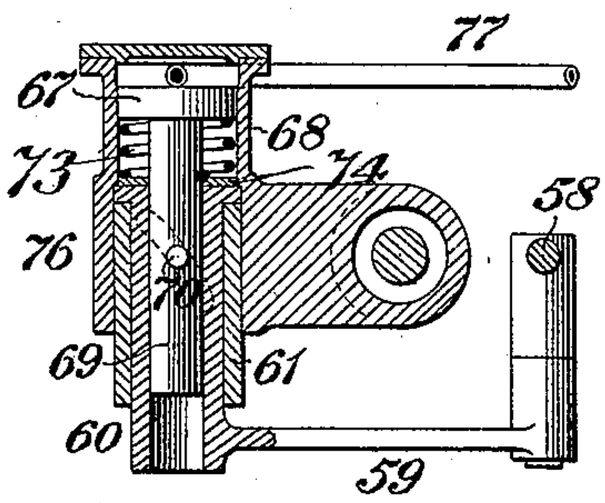

FIG. 13.

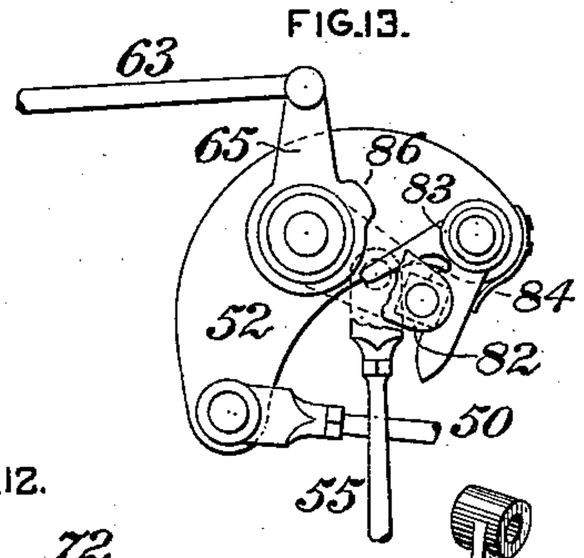

FIG. 12.

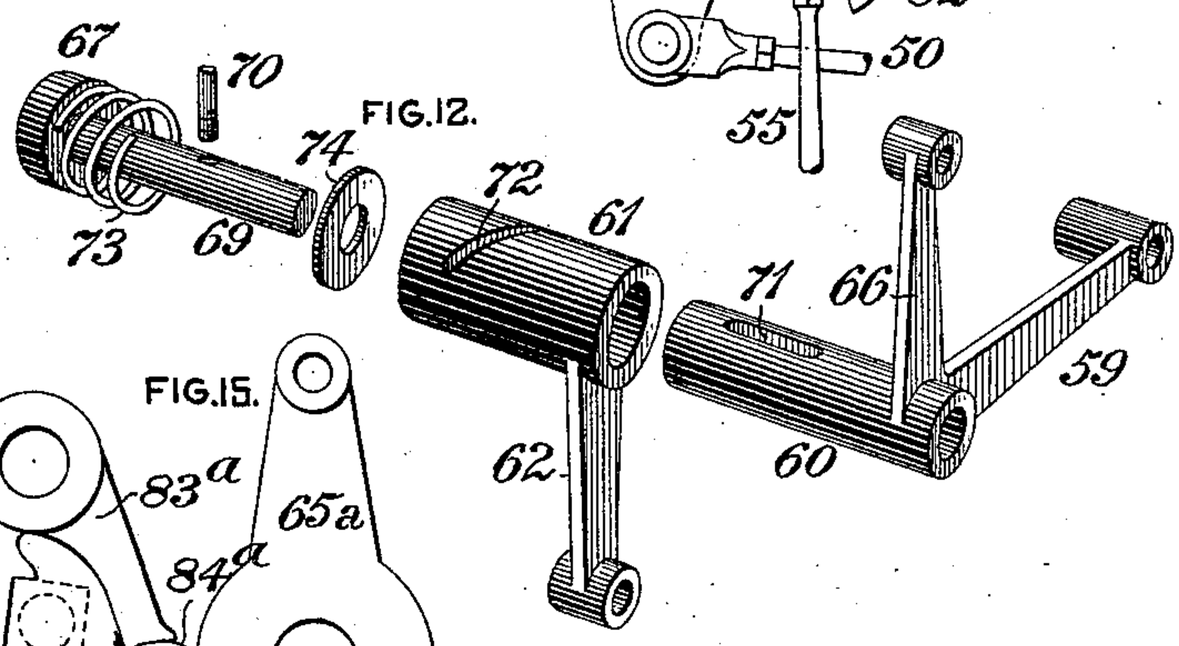

FIG. 15.

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UNITED STATES PATENT OFFICE.

FRANCIS M. RITES, OF PITTSBURG, PENNSYLVANIA.

MEANS FOR ELASTIC-FLUID COMPRESSION.

SPECIFICATION forming part of Letters Patent No. 542,425, dated July 9, 1895.

Application filed October 16, 1894. Serial No. 526,043. (No model.)

To all whom it may concern:

Be it known that I, FRANCIS M. RITES, a citizen of the United States, residing at Pittsburg, in the county of Allegheny and State of Pennsylvania, have invented or discovered a certain new and useful Improvement in Means for Elastic-Fluid Compression, of which improvement the following is a specification.

The object of my invention is to provide means for the compression of air or other elastic fluid, by mechanism of comparatively simple and inexpensive construction, with a high degree of operative economy, and at a materially higher speed than has heretofore been found attainable.

To this end my invention, generally stated, consists in the combination of a motor-cylinder, a compressor-cylinder, valve mechanisms independently effecting distribution functions of said cylinders, and connections to said mechanisms whereby said distribution functions are coincidently and positively varied by a common controlling element.

The improvement claimed is hereinafter fully set forth.

It is well recognized in practice that in all fluid-compressors whose motor-cylinder is controlled by an automatic cut-off mechanism, a proper relative variation of the distribution functions of the motor and compressor cylinders must be effected in order to attain an advantageous and economical result. As the pressure in the reservoir or receiver changes, so as to vary the amount of work required from the motor-cylinder, and consequently to vary its point of cut-off, the period of opening communication from the compressor-cylinder must also vary and in the same direction. In other words, as the point of cut-off or closure of fluid supply from the generator to the motor-cylinder becomes earlier in the stroke, by reason of decreased load, the point of eduction or discharge of compressed fluid from the compressor to the reservoir must become correspondingly earlier in the stroke for the same reason. Inasmuch as the distribution-valve functions corresponding with the closure of supply and discharge are what may be called "inverse valve functions," it has not heretofore been considered practicable to positively control them, and it has been the practice to control the valves of the motor and compressor cylinders independently, and, while making those of the former dependent for control on the governor, to make those of the latter wholly dependent on the terminal-pressure in the compressor-cylinder—that is to say, while the distribution functions of the valves of the motor-cylinder are varied with the change of load through connection with the governor, the distribution functions of the valves of the compressor-cylinder are varied by the direct action of the pressure in said cylinder.

The valves of compressor-cylinders are ordinarily of the class of check or seating valves, opening for supply to the cylinder by the external pressure as soon as a partial vaccum is created in the cylinder by the movement of the piston therein and opening for eduction or discharge from the cylinder to the reservoir or receiver as soon as a slight excess of pressure is attained by compression in the cylinder. In another class of compressors the valves are not raised from and returned to their seats, but are moved over plane or segmental seats in the manner of slide-valves, and are, as in the former case, moved to open and close the ports which they control by the direct action of the varying pressures in the cylinder and reservoir. It has further been proposed to provide a compressor-cylinder with valves of the Corliss type, fitted with a tripping mechanism by which they are caused to open to the reservoir when the pressure in the cylinder reaches that in the reservoir, such a construction being set forth in the patent of E. Reynolds, No. 378,336, dated February 21, 1888. It will be seen that in this case, also, the valve operation of the compressor-cylinder is directly dependent upon the action of the variation of pressure as between the compressor-cylinder and the receiver.

The essential and characteristic feature of my invention, as contradistinguished from those of the prior art, as above indicated, and so far as my knowledge and information extend, is the control of the distribution function of the compressor-cylinder directly and wholly by the same action which controls the distribution of motive fluid to the motor-cylinder. The pressure in the compressor-cylinder has no influence upon the valve functions

thereof, except in so far as variation of pressure therein affects the load on the motor-cylinder, and thus varies the distribution functions of the motor-cylinder through the governing mechanism which controls them and which coincidently varies the distribution functions of the compressor inversely or in opposite direction to those of the motor-cylinder.

In the accompanying drawings, Figure 1 is a vertical central section through an apparatus for the compression of elastic fluid adapted to the practice of the method and illustrating one form of the means which constitute my invention; Fig. 2, a side view, partly in elevation and partly in section, through the valve-chests; Figs. 3 and 4, longitudinal sections through the valve and valve-chests of the motor-cylinder and the compressor-cylinder, respectively; Figs. 5 and 6, indicator-cards illustrating graphically the variation of distribution of elastic fluid in the motor-cylinder and the compressor-cylinder, respectively; Fig. 7, a side view, partly in elevation and partly in longitudinal central section, of another apparatus for the compression of elastic fluid adapted to the practice of my invention; Fig. 8, a partial side view in elevation and on an enlarged scale, showing the valve-actuating mechanism; Fig. 9, a view on a similar scale of the governor and its connections; Figs. 10 and 11, sections on a further enlarged scale at the lines $x\,x$ and y respectively, of Fig. 9; Fig. 12, a view in perspective of the separated moving parts of the mechanism shown in Fig. 11; Figs. 13 and 14, views in elevation of the actuating and releasing mechanism of the inlet-valves of the motor-cylinder and the discharge-valves of the compressor-cylinder, respectively; and Fig. 15, a detail view, on an enlarged scale, of the releasing-gear of one of the inlet-valves of the compressor-cylinder.

The drawings illustrate two different mechanisms, differing materially one from the other both in general structure and in detail, but embodying under the same operative principle the essential and characteristic feature of my invention, both in their construction and in their capability of carrying out in practice the method of elastic fluid compression which it comprehends.

Referring first to Figs. 1 to 6, inclusive, I have exemplified my invention in a compressor for air or other elastic fluid, having a motor-cylinder 1 and a compressor-cylinder 2^b, which are fitted with pistons 6 6^b, respectively, and are secured upon the top of a frame or housings 5, in the lower part of which are formed suitable bearings for the journals of a crank-shaft 4. The pistons 6 and 6^b are fixed upon piston-rods 9 9^b, that of the piston 6^b being tubular, while that of the piston 6 is solid and is fixed to a cross-head 9^d, working on guides 9^e on the frame. A link or connecting-rod 9^c is coupled to the piston 6^b and extends outwardly through the tubular piston-rod 9^b thereof. The ends of the piston-rod 9 and link 9^c, exterior to the cylinders 1 and 2^b, are coupled to the two upper angles of a triangular connecting-rod 12^b, the arms of which are set an angle, and which is coupled at its lower angle to the pin of a crank 10 on the shaft 4. The employment of a triangular connecting-rod, by means of which connections from two pistons not having coincident movements in each direction can be made to a single crank, was known in the art prior to my invention and is not claimed as any part thereof, the construction being here shown merely for convenience and simplicity of illustration.

The distribution functions of the motor-cylinder 1 are effected by a distribution-valve 13—in this instance of the piston type—which is fixed upon a stem 15 and fitted to reciprocate in a chest on one side of the cylinder 1. The distribution functions of the compressor-cylinder 2^b are effected by a distribution-valve 13^c—in this instance of the slide type—which is fixed upon a stem 15^c and fitted to reciprocate in a chest on the side of the cylinder 2^b, with its valve-stem 15^c in or adjacent to the vertical plane of the valve-stem 15. The distribution-valves 13 and 13^c are actuated by a valve-gear having the general characteristics of the Allen type, and controlled by a governor 17, driven by a belt 17^a from the crank-shaft 4. Motion is imparted to the valves from said shaft by a single eccentric 34 fixed upon the shaft and having its strap 33 coupled to the valve-stems through angular connections in correspondence with the angular connections of the pistons 6 and 6^b to the crank-pin. Two curved and slotted links 39 39^a are secured to the eccentric-strap 33 and project therefrom at an angle one to the other toward the vertical axial lines of the motor and compressor cylinders. Dies or blocks 40 40^a are fitted to slide in the slots of the links 39 39^a and are coupled by links 41 41^a to pins on rockers 42 42^a, journaled on the frame 5, and said rockers are in turn coupled to the stems 15 15^c of the distribution-valves 13 13^c. The links 41 41^a are coupled by links 43 43^a to a rocker 44, having an arm 45, coupled by a link 46 to a sliding collar on the governor 17, which is raised and lowered, respectively, by the inward and outward movements of the balls of the governor in effecting regulation.

Under the above or any similarly-operating construction it will be seen that the distribution functions of the motor and compressor cylinders are positively and coincidently varied through the connected action upon their valve mechanisms of a common controlling influence, to wit: variation of load resultant upon variation of pressure in the reservoir into which fluid is compressed, which influence is connectedly applied through a single and common controlling element, to wit: the governor. In the instance shown, by reason of the opposite location of the links 39 39^a, the action of the governor in effecting a va-

riation of cut-off or admission in the motor-cylinder simultaneously effects a corresponding variation of eduction or discharge in the compressor-cylinder—that is to say, an earlier cut-off in the motor-cylinder, resultant upon decrease of load is accompanied by a corresponding earlier discharge from the compressor-cylinder and vice versa.

Considering the machine as consisting, essentially, of two cylinders, the indicator-cards from which, as exemplified in Figs. 5 and 6, show relative valve functions, the similar valve functions vary in opposite directions, and as the admission in one grows longer the discharge in the other grows shorter. This seeming paradox will become clear by a recognition of the fact that the point of cut-off is measured from one end of the cylinder, while the point of opening or discharge into the reservoir of compressed fluid is measured from the opposite end of the same cylinder, or, in other words, the piston of the motor-cylinder is moved in one direction from the cylinder-head to produce its card, while the piston of the compressor-cylinder is moved toward the head to produce its card, which is generally similar in appearance to that of the motor-cylinder.

Figs. 7 to 15, inclusive, illustrate an apparatus in which the same coincident variation of distribution functions is effected by a common controlling influence, a wholly different system of valve mechanism being in this instance employed and corrective means added to compensate for variations of pressure in the motor-cylinder independently of variations of load.

Referring to the drawings, Figs. 7 to 15, inclusive, the motor-cylinder 1 and compressor-cylinder 2^b are fitted, respectively, with pistons 6 and 6^b, fixed upon a common piston-rod 9, which is coupled by a connecting-rod 12 to the pin of a crank 10 on the shaft 4. The distribution-valve mechanism of the motor and compressor cylinders is of the well-known Corliss type and is actuated by an eccentric 34 and controlled by a governor 17, so that, as in the instance first described, the distribution functions of the motor and compressor cylinders are coincidently and inversely varied by the positive action of a common controlling influence. The rod 31 of the eccentric 34 is coupled to a rocker 47, which is coupled, by a rod or link 48, to wrist-plates 49 49^a, journaled on the motor-cylinder 1 and compressor-cylinder 2^b, respectively. The motor-cylinder 1 is provided at each of its ends with an induction valve 13 and an eduction-valve 53, and the compressor-cylinder 2^b is similarly provided with induction or supply valves 13^c and eduction or discharge valves 13^d, the latter controlling the discharge of fluid from the compressor-cylinder 2^b to a pipe 13^e, leading to a reservoir or receiver. The valves of both cylinders are of the ordinary Corliss type. The wrist-plate 49 of the motor-cylinder is coupled by links 50 to arms 52, journaled freely on the stems of the induction-valves 13, and, by links 51, to arms 54, fixed to the stems of the eduction-valves 53. The wrist-plate 49^a of the compressor-cylinder is coupled, by links 50^a, to arms 52^a, journaled freely on the stems of the discharge-valves 13^d, and, by links 51^a, to arms 53^a, fixed to the stems of the supply-valves 13^c. A collar 57 on the governor 17, to which vertical movements are imparted by the movements of the governor-balls due to variation of load, is coupled, through intermediate connections presently to be described, to links 63 and 64, which are, in turn, coupled to arms 65, journaled freely upon the stems of the induction-valves 13 of the motor-cylinder, and is also coupled through intermediate connections to links 63^a and 64^a, which are in turn coupled to arms 65^a, journaled freely upon the stems of the discharge-valves 13^d of the compressor-cylinder. Arms 82 on the stems of the induction-valves of the motor-cylinder are connected by links 55 with the pistons of suitable vacuum dash-posts 56 or other analogous closing mechanism, and arms 82^a on the stems of the discharge-valves of the compressor-cylinder are connected by links 55^a with the pistons of suitable vacuum dash-pots 56^a or other analogous closing mechanism. The induction-valves of the motor-cylinder and the discharge-valves of the compressor-cylinder are engaged with and disengaged from the arms 52 and 52^a, respectively, through the intermediation of releasing or tripping gear of the following construction: A forked lever 83 is journaled to each of the arms 52, which are loose on the stems of the induction-valves 13 of the motor-cylinder, and a substantially-similar forked lever 83^a is journaled to each of the arms 52^a, which are loose on the stems of the discharge-valves 13^d of the compressor-cylinder. One of the arms of the levers 83 83^a is provided with a recess for engagement with a block on the end of the adjacent arm 82 or 82^a, as the case may be, and the other arm of said levers 83 83^a is adapted to bear against a projection 86 or 86^a on the hub of the adjacent arm 65 or 65^a, as the case may be, the circumferential position of the projections 86 and 86^a being in this case determined by the governor. The levers 83 83^a are held in engagement with the blocks on the arms 82 82^a by springs 84 84^a, respectively. The levers 83^a of the compressor-cylinder gear do not bear directly upon the projection of the adjacent arms 65^a, but are provided with pivoted latches 85^a, held in position by springs 85^b, which latches turn on their pivots and pass freely by the projections 86^a on their upward stroke, but engage with said projections on their downward stroke. By such engagement the opposite arm of the lever 83^a is thrown out of engagement with the arm 82^a, and the discharge-valve to which said arm 82^a is connected is quickly opened by the connection 55^a. The arm 82^a and lever 83^a are re-engaged, and the closure of the discharge-valve is effected by the movement of the wrist-plate and

arm 52ª in opposite direction at the end of the stroke of the piston. The engagement and disengagement of the arms 82 and forked levers 83 of the induction-valves of the motor-cylinder are effected similarly, but in reverse direction—that is to say, the lever 83 engages with the projection 86 of the adjacent lever 65 on the upward stroke, and thereby disengages the arm 82, causing the induction-valve, to which said arm 82 is connected, to be quickly closed instead of being opened, as in the case of the valves of the compressor-cylinder. The re-engagement of the arm 82 and lever 83 is effected to effect opening of the induction-valve by the movement of the wrist-plate and arm 52 in opposite direction at the end of the return piston-stroke.

It will be seen that as the adjustment of position of the projections 86 and 86ª, upon which the period of release of the valves depends, is effected by the governor, the period of admission to the motor-cylinder and discharge from the compressor-cylinder is coincidently and positively varied, and as the arms 62 and 66, presently to be described, through which the connections are made from the governor to the valve-stem arms, move in opposite direction the variations of distribution functions will consequently be effected inversely or in opposite directions.

The links 63 and 63ª, through which variation of the distribution functions is effected, are connected with the governor through the intermediation of rocker-arms 62 and 66, which extend in substantially opposite directions from a common axial line, and the arm 62 is adjustable circumferentially relatively to the arm 66. The arm 62 is formed or fixed upon one end of an open-ended tubular rocker-shaft 61, journaled in a bearing 76 on the stand which supports the governor 17. The arm 66 is formed or fixed on a tubular shaft 60, which fits within the tubular shaft 61, and is provided with a straight longitudinal slot 71, located below and extending across a helical slot 72 in the shaft 61. An arm 59 on the shaft 60, at an angle to the arm 66, is coupled by a link 58 to the collar 57 of the governor 17. A cylinder 68 is formed on one end of the bearing 76, and a piston 67 is fitted in said cylinder and provided with a piston-rod 69, which extends into the bore of the inner tubular shaft 60. A helical spring 73 bears against the inner side of the piston 67 and against a plate 74, which fits against the adjacent end of the outer tubular shaft 60. A pin 70, fixed to the piston-rod 69, projects through the straight slot 71 of the shaft 60 into the helical slot 72 of the shaft 61, and a pin or bolt 75, fixed to the bearing 76, projects into a circumferential groove in the shaft 61 and serves to prevent longitudinal movement of said shaft and of the shaft 60 in the bearing 76. A pipe 77 leads from the valve-chest of the motor-cylinder 1 to the outer side of the piston 67.

The fluid-pressure mechanism last above described is provided for the purpose of maintaining the proper relation of variation of the distribution functions of the motor and compressor cylinders under variations of motive-fluid pressure independent of variations of load. In its operation increase of motive-fluid pressure, acting through the pipe 77 on the piston 67, moves said piston toward the arm 62, and the pin 70, acting on the shaft 61 through the helical slot 72 therein, moves said shaft and the connected arm 62 circumferentially, so as to adjust or advance the arm 62 relatively to the arm 66 and thereby cause a proportionately earlier cut-off in conformity with the increase of motive-fluid pressure to be effected in the motor-cylinder. Upon decrease of motive-fluid pressure, the spring 73 moves the piston 67 in the opposite direction, and the pin 70, acting on the shaft 61 through the helical slot 72, correspondingly adjusts the arm 62 in position to cause a later cut-off to be effected.

For the purpose of reducing the speed of the pistons of the motor and compressor cylinders as the pressure of fluid compressed in the receiver or reservoir approximates the maximum within any desired degree, a piston 79 is fitted in a cylinder 80, which communicates with the discharge-valve chest of the compressor-cylinder or with the reservoir through a pipe 81. The rod 78 of the piston 79 is connected with the collar 57 of the governor, and upon the application of the determined degree of reservoir-pressure to the piston such pressure acts to raise the collar and by such movement to assist the action of centrifugal force upon the governor-balls and decrease the speed of the pistons. The degree of pressure at which this device will become operative may be regulated by means of a suitably-loaded check-valve in the pipe 81.

It will be obvious that other distribution valve and controlling mechanisms, differing structurally from those described and shown, may be combined with a motor-cylinder and a compressor-cylinder, so as to effect the same results under the same method of operation, and I do not, therefore, desire to limit myself to the specific combinations of devices under which my invention has been herein exemplified.

I claim as my invention and desire to secure by Letters Patent—

1. In a fluid compressing apparatus the combination of a compressor, a motor for actuating the compressor, and a governing device controlling both the motor and the discharge of fluid from the compressor, substantially as set forth.

2. In a fluid compressing apparatus, the combination of a compressor, a motor for actuating the compressor, and a governing device controlling simultaneously both the motor and the discharge of fluid from the compressor, substantially as set forth.

3. In a fluid compressing apparatus, the combination of a compressor, a fluid motor

for actuating the compressor, and a governing device controlling both the supply of fluid to the motor and the discharge of fluid from the compressor, substantially as set forth.

4. In a fluid compressing apparatus, the combination of a compressor, a motor for actuating the compressor, and a governor actuated by the motor and controlling the discharge of fluid from the compressor, substantially as set forth.

5. In a fluid compressing apparatus, the combination of a compressor, a motor for actuating the compressor, a governor having connections for controlling the motor and the discharge from the compressor, and means for adjusting the connections, substantially as set forth.

6. In a fluid compressing apparatus, the combination of a compressor, a fluid motor for actuating the compressor, a governing device controlling the supply of fluid to the motor and the discharge from the compressor, and means for adjusting the governing device in accordance with variations in the pressure of the motor fluid, substantially as set forth.

7. In a fluid compressing apparatus, the combination of a compressor, a motor for actuating the compressor, a governor controlling the supply of fluid to the motor and discharge of fluid from the compressor, and means for automatically varying the relative effects of the governor on the supply of fluid to the motor and the disharge from the compressor, substantially as set forth.

8. In an apparatus for the compression of elastic fluid, the combination, substantially as set forth, of a motor cylinder, a compressor cylinder, valve mechanisms independently effecting distribution functions of said cylinders, and connections to said mechanisms whereby said distribution functions are coincidently and positively varied by a common controlling element.

9. In an apparatus for the compression of elastic fluid, the combination, substantially as set forth, of a motor cylinder, a compressor cylinder, valve mechanisms independently effecting distribution functions of said cylinders, a governor, and connections from said governor to the distribution valve mechanisms of the motor and compressor cylinders.

10. In an apparatus for the compression of elastic fluid, the combination, substantially as set forth, of a motor cylinder, a compressor cylinder, valve mechanisms independently effecting induction to the motor cylinder and eduction from the compressor cylinder, a governor, and connections from said governor to said valve mechanisms which operate thereon coincidently and in opposite direction.

11. In an apparatus for the compression of elastic fluid, the combination, substantially as set forth, of a motor cylinder, a compressor cylinder, valve mechanisms independently effecting induction to the motor cylinder and eduction from the compressor cylinder, a governor, connections from said governor to said valve mechanisms which operate thereon coincidently, and a fluid pressure device for maintaining a determined relation of variation of distribution functions in the motor and compressor cylinders under variations of pressure in the motor cylinder independently of variations of load.

12. In an apparatus for the compression of elastic fluid, the combination, substantially as set forth, of a motor cylinder, a compressor cylinder, valve mechanisms independently effecting induction to the motor cylinder and eduction from the compressor cylinder, a governor, connections from said governor to said valve mechanisms which operate coincidently thereon, and a fluid pressure device for reducing the speed of the moving parts as the pressure of compressed fluid approximates the maximum within any determined degree.

13. In an apparatus for the compression of elastic fluids the combination, substantially as set forth, of a motor cylinder, a compressor cylinder, valves effecting the induction function of the motor cylinder, valves effecting the eduction function of the compressor cylinder, actuating mechanism detachably connected to said valves, tripping or releasing mechanism for engaging and disengaging said valves to and from the actuating mechanism, a governor, and connections from said governor to the tripping or releasing mechanism for coincidently operating the same on both the motor and compressor cylinders.

In testimony whereof I have hereunto set my hand.

FRANCIS M. RITES.

Witnesses:
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F. E. GAITHER.