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F. E. NORTON & I. H. REYNOLDS.

REGULATOR FOR COMPRESSORS.

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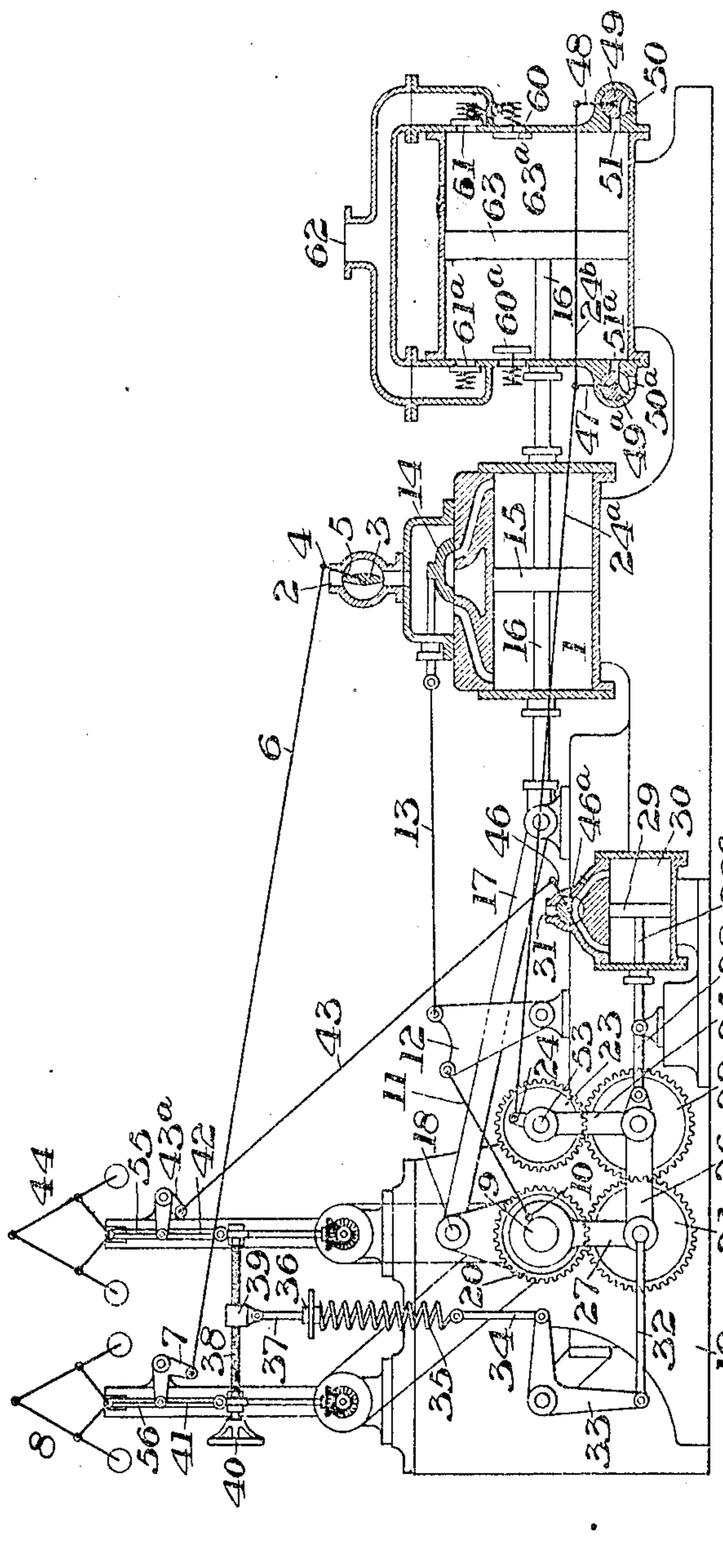

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REGULATOR FOR COMPRESSORS.

No. 882,338. Specification of Letters Patent. Patented March 17, 1908.

Application filed March 8, 1907. Serial No. 361,239.

To all whom it may concern:

Be it known that we, FRED E. NORTON and IRVING H. REYNOLDS, both of Youngstown, Mahoning county, Ohio, have invented a new and useful Regulator for Compressors, of which the following is a full, clear, and exact description, reference being had to the accompanying drawing, forming part of this specification, in which the figure is a diagrammatic side and sectional view of a gas-compressor embodying our invention.

Our invention relates to an improved system of regulation for air or gas compressors in which the amount of fluid compressed per stroke may be reduced, while the speed of the compressor is increased so that a constant amount of driving force may be made to deliver a constant amount of compressed gas.

The main object of our invention is to provide a means of regulation for compressors which are driven by means of motors which can only exert a certain limited amount of driving force, such as gas engines, electric motors, water motors, steam engines, etc.

The invention is of peculiar benefit in the case of air compressors driven by gas engines against a variable air pressure. The gas engine is able to deliver only slightly more work per stroke than its rated economical amount, and for many purposes the average normal air pressure is far below the maximum required.

For blast furnace blowing engines, it has been customary to provide gas engine cylinders of a capacity greatly in excess of normal requirements in order to meet the demands at extraordinary pressure under temporary conditions which arise in the operation of blast furnaces.

A further object of the invention is to secure a diminished quantity of discharged air at the same time maintaining the compressor in motion at a speed sufficient to insure that the compressor shall not stop.

The present application is supplementary to the pending application of Fred Elmer Norton (one of the present applicants), Serial No. 311,033, filed April 11th, 1906, and embodies new and useful modifications of the governing system described in that application.

The accompanying drawing shows a complete diagrammatic view of one embodiment of our invention, in which 1 is a motor cylinder receiving a suitable working fluid at 2, the amount of which is controlled by a throttle valve 3, which is operated by a speed governor 8, through a bell crank 7, rod 6, and arm 5. The piston 15 of the motor cylinder is connected by a piston rod 16 to the piston 63 of the compressor cylinder 63^a, and by a connecting rod 17 to a crank 18 on the engine shaft 9.

The compressor cylinder 63^a is fitted with voluntary inlet valves 60, 60^a, and with outlet valves 61 and 61^a, controlling the admission of air and its discharge into pipe 62 in the way usual for compressors.

In addition to the inlet valves 60, 60^a, are the rolling valves 49, 49^a which control the inlet ports 50, 51 and 50^a, 51^a, respectively. The valves 49 and 49^a are driven by the arms 47 and 48 and by the rods 24^b, 24^a, from a crank 24 on a shaft 53, which, in turn, is driven from the engine shaft 9 by the gears 20, 21, 22 and 23.

The gears 21 and 22 are mounted on swinging links 25, 26 and 27, so that as the arm 27 rotates on the shaft 9 and the arm 25 rotates on the shaft 53, the gears 20 and 21 are maintained in mesh by the link 27, the gears 21 and 22 by link 26, and the gears 22 and 23 by the link 25.

The link 26 is attached by a link 28 and a rod 28^a to the piston 29 of a cylinder 30.

The cylinder 30 receives a supply of working fluid at 31 which is controlled by valve 46^a. The valve 46^a is actuated by a governor 44 through a link 55, bell crank 43^a, rod 43 and arm 46.

The link 26 is also attached to a rod 32 which is connected to a bell crank 33, a rod 34 and spring 35 being connected to the other arm of this bell-crank. The spring 35 is attached to the two governors 8 and 44 by means of an adjusting screw 37 and hand wheel 36, nut 39 and screw 38. The screw 38 is suspended from the governors 8 and 44 by the links 41 and 42.

14 is the slide valve for the cylinder 1, actuated by the connecting rod 13, the rocker 12, and the crank 10 from the engine shaft 9.

The pistons 63 and 15 are shown in mid position, the motion of the crank is clockwise, and the pistons are moving to the right. The governor motor piston 30 is in mid stroke, and the valve 46^a is closed, holding the piston in this position. The swinging links 25, 26 and 27 are also in mid position and consequently the crank 24 is at its mid travel relatively to the engine crank.

In the position shown, it is assumed that the supply of working fluid admitted to cylinder 1 is just sufficient to maintain the compressor in motion at speed determined by governor 8 against the discharge pressure in the compressor. The crank 24 has just closed the port 51, by means of the valve 49 and the piston 63 is just about to begin to compress the air or gas in the cylinder 63ª. The previous part of the stroke of the piston 63 has simply pushed the air back through ports 51 and 50 without compressing it enough to lift valves 61 against the discharge pressure. The compressor is therefore only delivering half the air corresponding to displacement of piston 63.

Consider now that the discharge pressure in 62 is increased. The supply of working fluid admitted by throttle 3 will be insufficient to maintain the speed, and the governors 8 and 44 will fall. The governor 8 will open valve 3, but we will assume that the supply of working fluid is already at its maximum and therefore cylinder 1 cannot restore the speed. The governor 44 will admit fluid to the cylinder 30 in such a way as to force the piston 29 to the left and consequently the links 25, 26 and 27 will roll the gears 21 and 22 on the gears 20 and 23 in such a way as to turn the gear 23 to the right in relation to the crank pin 18. As the gear 23 and pin 24 are rotating to the left or counter clockwise, this motion corresponds to a retardation of phase of the crank 24 in relation to the main crank 18. The time of closing of the valve 49 will therefore be retarded and hence less air will be compressed by piston 63 during its stroke. The motion of the link 26 to the left will increase the tension on spring 35 and hence the governors 8 and 44 will be loaded and the speed must increase in order to raise them. If the supply of working fluid is sufficient, the speed will increase until the governor 8 raises sufficiently to throttle the supply.

The governor 8 should preferably be very sensitive, while the governor 44 should be very insensitive to secure proper relative action. The governor 44 should run at its highest position, while governor 8 runs at its lowest position under full load conditions.

The effect of increasing the pressure in pipe 62 is to reduce the work done by piston 63 per stroke and at the same time to increase the speed of compressor.

By a suitable adjustment of the spring 35, the speed may be made to increase in proportion as the displacement of the piston 63 is reduced, so that the quantity per minute discharged by cylinder 63ª may remain constant, although the pressure in pipe 62 may vary through wide limits.

The spring 35 is shown as acting on the center of the screw 38 and consequently loads both governors 8 and 44 alike. Suppose now that the nut 39 is moved to the right by turning screw 38 by hand wheel 40. The load on governor 44 will be increased, causing it to fall and thus cause the piston 29 to move to the left. This will turn the crank pin 24 backward in phase relation to engine crank 18 and cause a diminished effective displacement of piston 63. The governor 8 will be unloaded and will rise, thus throttling the supply of fluid to cylinder 1 and diminish the speed of the compressor. By a suitable proportion of the parts, the effective displacement of piston 63 may be reduced to zero, while the compressor may be maintained at any desired speed. This speed may be adjusted by means of hand wheel 36 and screw 37 acting to vary the tension on spring 35.

By moving the nut 39 to the left, the speed of the compressor may also be increased and the effective displacement of piston 63 also be increased if the supply of fluid to cylinder 1 is sufficient to maintain the speed against the increased discharge.

With the nut 39 in central position, as shown, the compressor may be made to deliver a constant quantity of air to pipe 62 against a variable pressure, and with a variable supply of working fluid to cylinder 1.

The drawing shows a motor cylinder suitable for water, steam or other fluid, but it is evident that the governor 8 may be attached to a gas engine, electric motor or other source of power.

The form of compressor and the governor and their connections are also subject to modification, but the method of controlling the discharge of air by means of supplementary inlet valves is preferred, for the reasons set forth in co-pending application of Fred E. Norton, Serial No. 311,033. This method of control of discharge is, however, not essential to this system.

The method of changing the phase relation of the inlet valves is preferred, but this may also be done by a fly wheel governor or any of the usual mechanisms commonly employed for this purpose.

We claim:—

1. In a regulating apparatus for compressors, a compressor motor, a governor controlling the motor, a governor controlling the compressor, and mechanism whereby the motor governor is loaded in proportion as the compressor governor unloads the compressor so as to maintain constant discharge of the compressor; substantially as described.

2. In a regulating apparatus for compressors, a governor for the compressor motor, and a compressor governor with interconnected mechanism to load the motor governor as the compressor is unloaded; substantially as described.

3. In an air compressor, an inlet valve, mechanism for shifting the position of the

valve, a governor for controlling the shifting mechanism, a compressor motor, a governor for the motor, a loading connection between the two governors and means for loading the motor governor as the compressor is unloaded; substantially as described.

4. In an air compressor, a main inlet valve, an auxiliary inlet valve, mechanism for shifting the position of the auxiliary valve, a governor for controlling the shifting mechanism, a compressor motor, a governor for the motor, a loading connection between the two governors, and means for loading the motor governor as the compressor is unloaded; substantially as described.

5. In an air compressor, an inlet valve, mechanism for shifting said valve, a governor for controlling the shifting mechanism, a compressor motor, a governor for said motor, and a connection between the valve shifting mechanism and both governors; substantially as described.

6. In a regulating apparatus for compressors, connections from the unloading mechanism of the compressor, and connections to the motor and compressor governor to adjust the load on the motor governor and on the compressor governor in any desired ratio; substantially as described.

7. In an air compressor, an inlet valve, shifting mechanism for said valve, a governor for controlling the shifting mechanism, a compressor motor, a governor for said motor, and connections to both governors for adjusting the load thereon in any desired ratio; substantially as described.

8. In a compressor having main and auxiliary inlet valves, a compressor motor, a speed governor for the motor, a governing device for the auxiliary valves, and means whereby the relative loads on the two governors may be varied; substantially as described.

9. In a compressor having main and auxiliary inlet valves, a compressor motor, a speed governor therefor, a crank actuated from the engine shaft for actuating the auxiliary inlet valves, and a governor and actuating connections for varying the phase relation of said crank with respect to the main crank of the engine; substantially as described.

10. In a compressor having a main and an auxiliary inlet valve, a compressor motor, a speed governor therefor, connections from the main motor shaft for operating the auxiliary valve, a motive device for controlling the operation of said connections, and a governor for controlling the motive device; substantially as described.

11. In a compressor having a main and an auxiliary inlet valve, a compressor motor, a speed governor therefor, connections from the motor shaft for operating the auxiliary valve, a motive device for controlling the operation of said connections, a governor for controlling the motive device, and connections for loading the two governors in any desired ratio; substantially as described.

12. In a compressor having main and auxiliary inlet valves, a compressor motor, a speed governor therefor, connections from the motor shaft for operating the auxiliary valve, a motive device for controlling the operation of said connections, a governor for controlling the motive device, means operated by the said motive device for loading the said governors, and means whereby the load may be unequally varied between the governors; substantially as described.

13. A compressor having main and auxiliary valves, connections from the main shaft for operating the auxiliary valves, including a shiftable crank, a motive device for shifting said crank, and a governor for controlling the motive device, together with connections from the motive device for varying the load on the governor; substantially as described.

14. In a compressor, a compressor motor, an inlet valve, connections from the motor shaft for actuating the valve, said connections including a crank, a motive device for shifting the phase relation of the crank, a governor for controlling the motive device, and means controlled by the motive device for loading the governors; substantially as described.

In testimony whereof, we have hereunto set our hands.

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Witnesses:
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W. H. ASHBAUGH.