R. CONRADER.

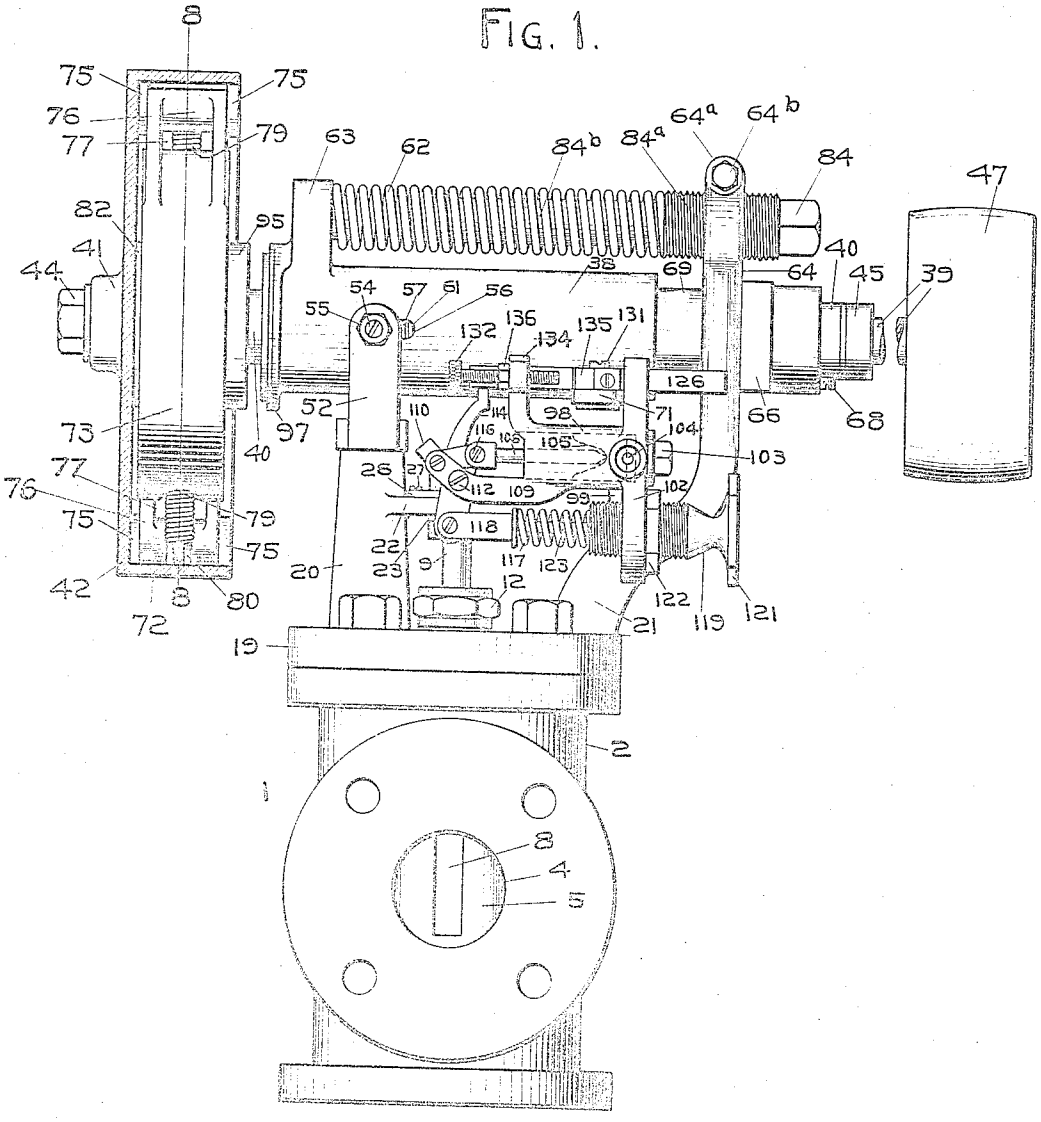
AIR COMPRESSOR GOVERNOR.

APPLICATION FILED OCT. 26, 1910. RENEWED JULY 12, 1912.

1,053,904. Patented Feb. 18, 1913.

5 SHEETS—SHEET 1.

FIG. 1.



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5 SHEETS—SHEET 2.

FIG. 2.

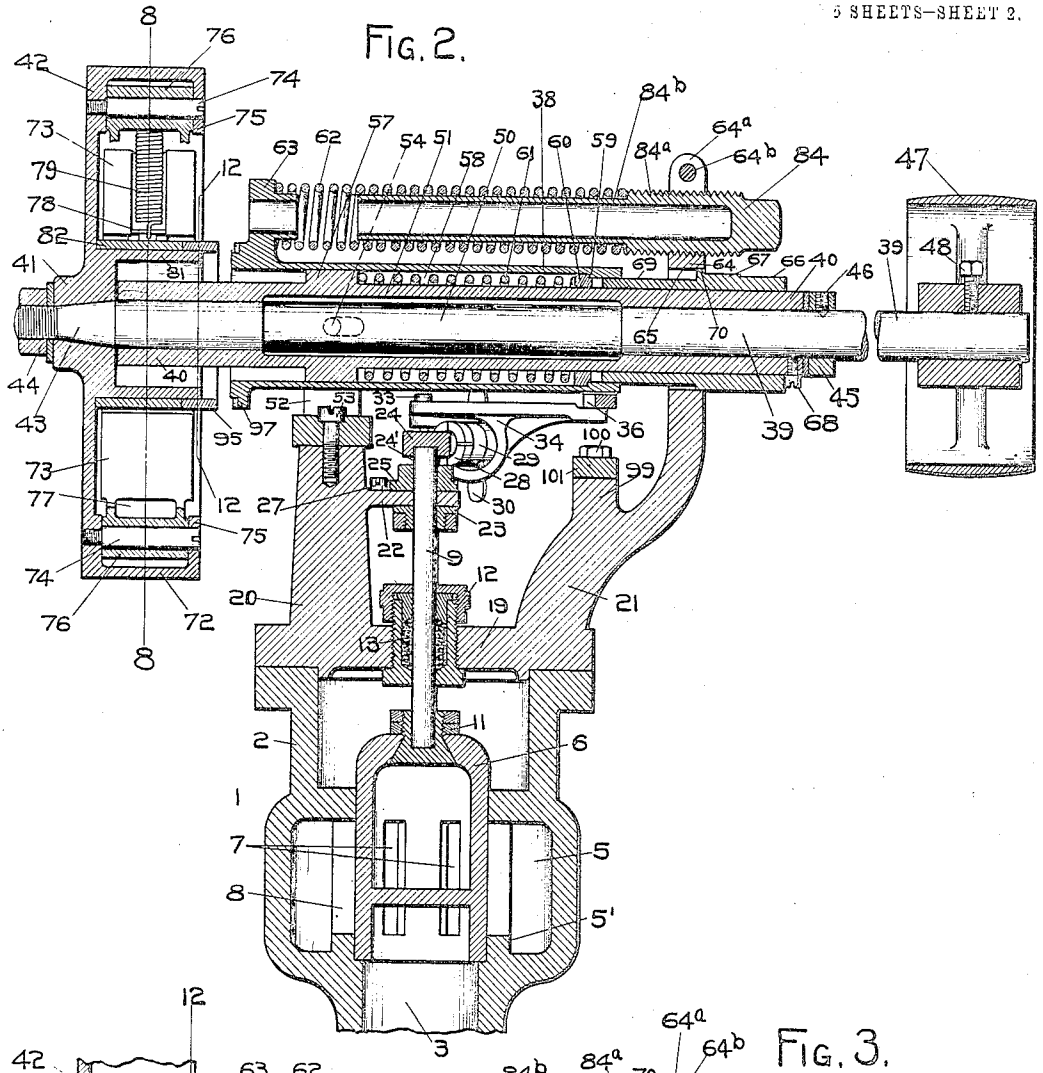
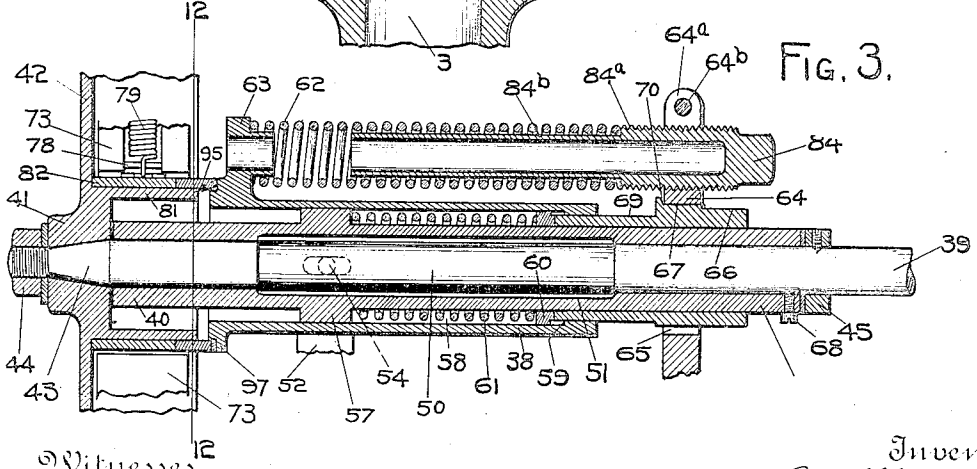


FIG. 3.



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5 SHEETS—SHEET 3.

FIG. 4.

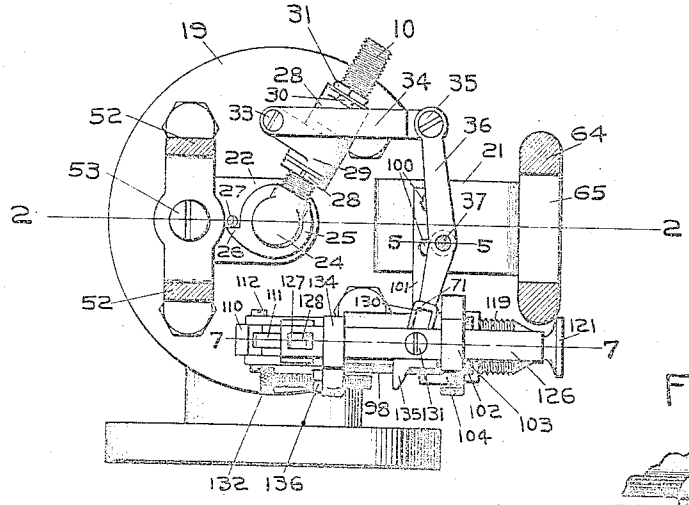


FIG. 5.

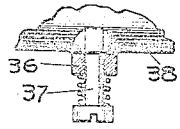


FIG. 6.

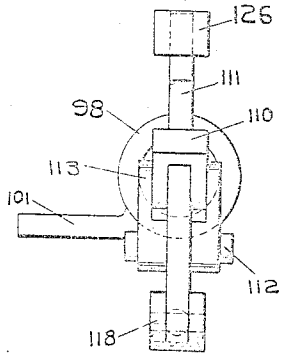
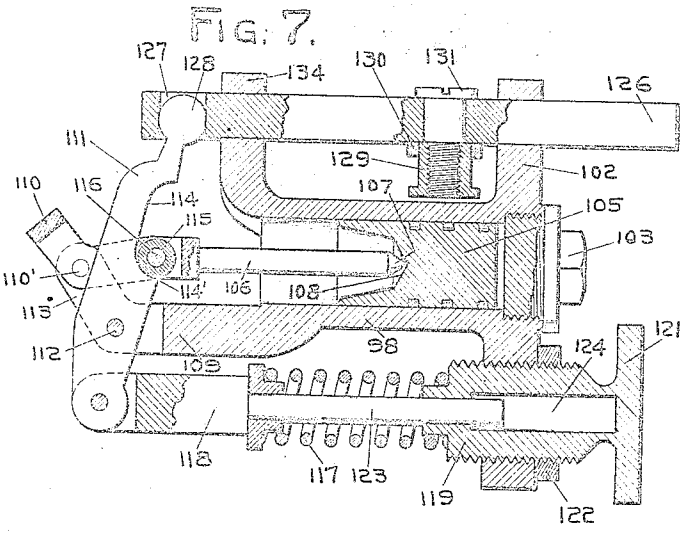


FIG. 7.



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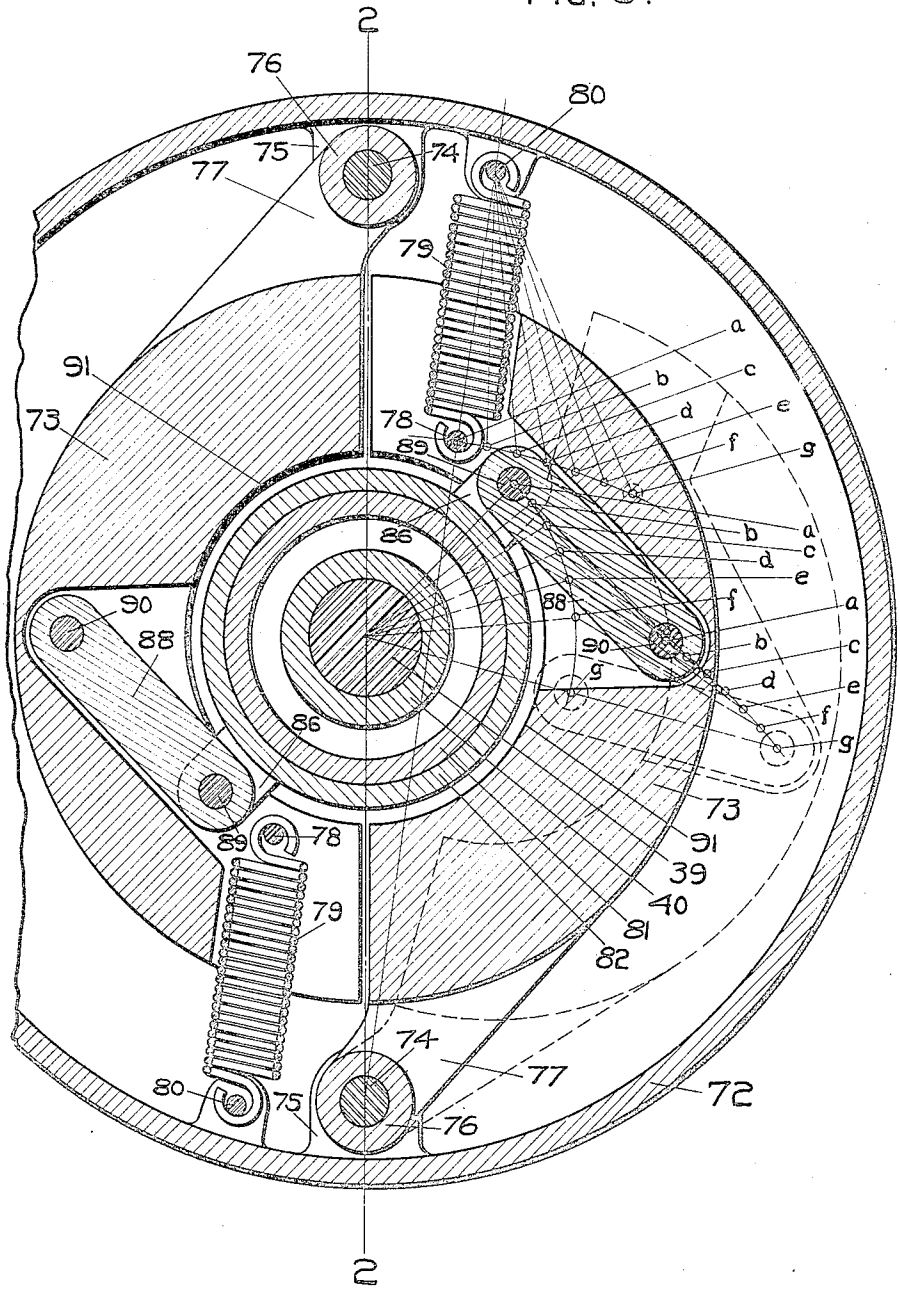
5 SHEETS—SHEET 4.

FIG. 8.



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5 SHEETS—SHEET 5.

FIG. 9.

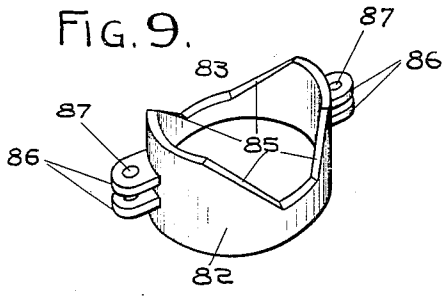


FIG. 10.

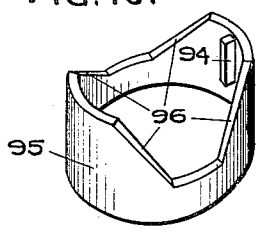


FIG. 11.

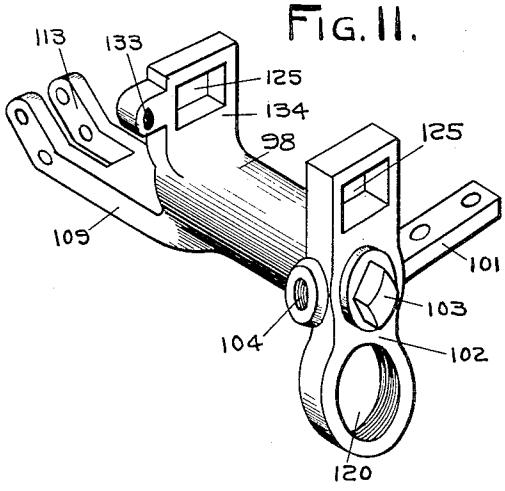


FIG. 12.

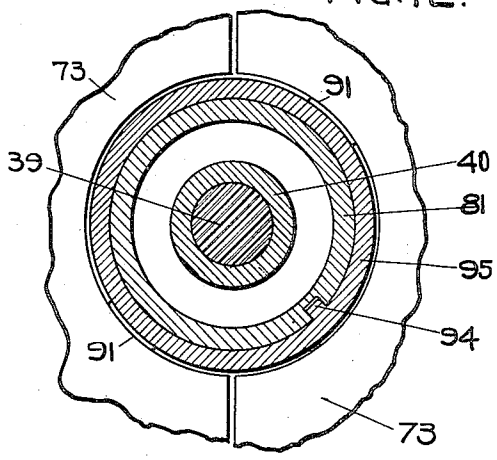
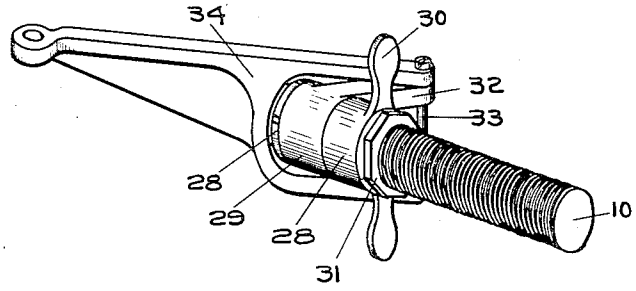


FIG. 13.



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UNITED STATES PATENT OFFICE.

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AIR-COMPRESSOR GOVERNOR.

1,053,904. Specification of Letters Patent. Patented Feb. 18, 1913.

Application filed October 26, 1910, Serial No. 589,229. Renewed July 12, 1912. Serial No. 709,064.

To all whom it may concern:

Be it known that I, RUDOLPH CONRADER, a citizen of the United States, residing at Erie, in the county of Erie and State of Pennsylvania, have invented new and useful Improvements in Air-Compressor Governors, of which the following is a specification.

This invention relates to air-compressor governors, and consists in certain improvements in the construction thereof as will be hereinafter fully described and pointed out in the claims.

The purpose of the invention is to so control the compressor as to regulate the receiver pressure. In applicant's device, both the centrifugal governor and a regulator device actuated directly by the receiver pressure are utilized. Governors of this type have heretofore been invented by me, patents for which were issued to me as for instance: #664,468 dated Dec. 25, 1900, #775,391 dated Nov. 22, 1904. With these governors, an approximately constant receiver pressure is maintained. In the patent to John L. Osborne, July 12, 1910, #963,803 a compressor governor is shown purporting to maintain a constant receiver pressure. To illustrate my invention, I show the same construction of pressure actuating regulating device, feed valve and some other features as are shown in said patent.

The invention is illustrated in the accompanying drawings as follows:

Figure 1 is a side elevation of the combined devices mounted upon a fluid supply valve casing and showing the balance wheel in section, all of the mechanism being as positioned when the compressor is not running. Fig. 2 is a vertical longitudinal section of Fig. 1. Fig. 3 is a longitudinal section of the shaft mechanism similar to that shown in Fig. 2 illustrating the elements as positioned when the compressor is in full operation. Fig. 4 is a top view of the mechanism shown in Fig. 1 with the entire shaft and its carried mechanisms removed and showing the pneumatic regulator upon the valve casing top. Fig. 5 is a detail sectional view of the spring pivot mechanism. Fig. 6 is an end view of Fig. 7. Fig. 7 is a vertical longitudinal section of the pneumatic regulating mechanism. Fig. 8 is a section on the line 8—8 in Figs. 1 and 2 showing a detail of the centrifugal weights and their mounting and connections. Fig. 9 is a perspective view of the cam collars of the governor. Fig. 10 is a perspective view of the cam collars of the governor. Fig. 11 is a perspective view of the main frame portion of the pneumatic regulator. Fig. 12 shows a section on the line 12—12 in Figs. 2 and 3. Fig. 13 is a perspective view of the valve lever and its adjusting toggle connections.

It is to be understood that the compressor engine is actuated by the fluid received thereby through the fluid supply valve 1 of the usual construction known as a ported rotary valve. This valve mechanism, plainly shown by the sectional view thereof designated Fig. 2 comprises the T-shell 2 with the inlet port 3 and outlet port 4, having the chamber 5 accommodating the rotatable bowl-shaped valve member 6, which is provided with suitable ports 7, which ports are adapted to be brought into and out of registry with the ports 8 of corresponding size in the inner casing 5′ of the chamber 5, and thus by rotation of said valve 6 regulating the flow of the supplied fluid through said valve casing. Extending upwardly from said valve 6 is positioned the valve stem 8 having secured upon the top thereof the actuating arm 10. The valve stem 9 is fixed to the valve by the securing means 11 and passes vertically through the stuffing box 12 provided in the aperture 13 in the circular top plate 19 positioned upon said T shell 2. Said plate 19 forms the base support for the combined mechanisms forming the present invention and has mounted thereon, and preferably integral therewith as here shown, the posts 20 and 21 positioned upon opposite sides of said perforation 13, which latter is substantially central of said plate. The radial arm 22 extending inwardly from the post 20 is provided with a bushing member 23 through which extends said valve stem 9, while the upper part 24 thereof is provided with said lever 10 constructed integral therewith and also with a base flange 25 having a projecting lug 26 formed thereon and adapted to contact the pin 27 at the assumption by the lever 10 of the position at which the fluid supply valve 1 is completely closed, said pin being upon the arm 22 and the pin 24′ securing the valve stem to said part 24. The toggle connection for operating said valve

stem lever 10 is shown in detail in Fig. 13 and comprises the split nut 28 having the collar 29 journaled thereon and which is easily adjusted upon said exteriorly-threaded lever arm 10 by the projecting wings 30 and is locked in adjustment by the set nut 31. Said collar 29 employs the perforated lugs thereof 32 for journaling the pin 33 extending therethrough and pivoting thereto the connecting yoke arm 34 of the toggle, while the opposite end of said arm is pivoted as at 35 to the connecting lever 36 spring pivoted as at 37 to the sleeve 38 for the purpose hereinafter fully set forth.

A governor shaft 39 belted to the main drive or crank shaft of the compressor or its motor, is journaled within the sleeve 40 through which it extends and projects for a suitable distance for receiving the hub 41 of the balance wheel 42 which is secured to the tapered end 43 thereof by the set nut 44, while for preventing any possible movement of the shaft longitudinally of the sleeve 40, there is provided the stop ring 45 fixed to the shaft by the screw pin 46. While such mounting of the governor shaft directly upon the valve casing is preferred, other mountings may be used for accommodating the present mechanisms, but in either event the driving belt pulley 47 is secured to said shaft as by the set bolt 48. Within the sleeve 40 said shaft is reduced throughout the central portion 50 thereof for reducing the friction between the same and said sleeve within which it is journaled, said sleeve also having a correspondingly enlarged bore portion 51.

The integral post 20 hereinbefore described has mounted thereon a yoke member 52 secured as by the screw 53 and forming a rigid attachment, while its opposite arms are provided with alining perforations receiving stub shafts 54 retained therein by the set nuts 55. Said stub shafts 54 extending through the longitudinal slots 56 in the outer casing 38 are received at opposite points within sockets diametrically positioned in the exterior periphery of the sleeve 40 and at the enlarged or shouldered portion 57 thereof and by which means said shaft 39 is pivoted in the yoke 52 and so supported upon the plate base 19.

The bore of the sleeve 38 having a contracted portion adjacent the inner end thereof provides the shoulder 59 against which is seated the collar 60 surrounding the sleeve 40 while the enlarged portion 57 of said sleeve provides shoulders on the opposite sides thereof for seating one end of the coil spring 61.

The post 21 terminates in a rectangular head 64 having the rectangular opening 65 through which and of less diameter than which, extends the sleeve 66 having a central rectangular ridge 67, the extreme front end 69 of which sleeve enters the sleeve 38, while the outward movement thereof is limited by the pin 68 mounted upon the sleeve 40, both end portions of the sleeve being cylindrical.

In the operative position of the parts as shown in Fig. 3, the inner portion 69 of the sleeve 66 is so positioned as to slightly compress the encircling spring 61 by the engagement of the inner end of said sleeve with the movable collar 60, which movement also positions the collar 60 out of engagement with the shoulder 59, during the operation of the device. The squared middle portion 67 being provided with the front wedge-shaped ridge 70, such ridge is received through the rectangular opening and protrudes therefrom, having the remaining upper face of the rectangular ridge 67 flatly contacting the inner face of the head 64.

The governor shaft as here illustrated has certain parts thereof arranged designedly for a belt connection between the pulley 47 thereof and a driving shaft positioned substantially in vertical relation therewith and belted thereto.

It is to be understood that the present combined governor regulator is essential to the perfect operation of the air compressor and that the same is in complete control of the compressor at all times during the operation of the latter. This being so, a belted relation between the governor shaft 39 and the compressor motor or engine is a constant one, excepting in cases of an accidental breaking of the belt connection or the removal of the belt effecting the same.

It is essential that the present devices be in complete control at all times during the operation of the compressor, that there is provided the automatic means whereby should an accidental breaking or slipping off of the belt communicating with the pulley 47 occur, the air compressor will be at once brought to a dead stop. This result it will be seen is readily accomplished by the mechanisms just described and during which action of the parts their positions are relatively changed from that shown in Fig. 3 to the disclosures thereof in Fig. 2. In such operation the spring 61 acting to expel the sleeve 66 from the receiving sleeve 38 is normally prevented from effecting such an expulsion by the forced retention of the wedge-shaped bridge 70 protruding through the rectangular opening 65 and contacting the inner face of the frame 64 thereof, in which contacting relation said parts are maintained by the normal upward pull of the belt upon the pulley 47 at all times during the operation of the device. Upon a releasing of the belt tension for any reason, the outward exertion of the spring 61 forces the sleeve 66 outward, with the wedge-shaped ridge 71 sliding within and substan-

tially through the opening 65 of the head 64 and such outward movement being limited by the pin 68 before noted. The spring 61 being seated upon the collar normally held out of engagement during the running position with the shoulder 59 is brought into forcible engagement therewith during the above described outward movement of the parts, so that after the contacting of said collar 60 with the shoulder 59 during the outward movement thereof, an outward movement would also be imparted to the containing sleeve 38, which latter as before noted has pivoted to the underneath side thereof as at 37 the lever 36 effecting communication between said collar 38 and the actuating lever 10 of the fluid supply valve 1. The result therefore of the removal of the belt is to trip the retaining sleeve 66 and release the spring 61 whereby the sleeve 38 is moved outwardly and the fluid supply valve 1 of the compressor motor completely closed. For this operation the position of the opposite slotted end 71 of the lever 36, as hereinafter fully described is immaterial as such end in this connection affords only the fulcrum point for said lever operated by the application of power at the pivot point 37 upon the actuating sleeve. For providing a belt connection below or at either side of the shaft, the sleeve 66 may be rotated as many quarter turns as desired, and then seated as before within the opening 85.

The centrifugal governor member is as follows: The construction thereof consist of the fly or balance wheel 42 in the form of an annular casing 72 provided with the internally arranged weights 73 pivoted at diametrically opposite points therein upon the pins 74 positioned through perforations provided in integral projecting lugs 75 carried by the inner periphery of said casing These weights are so pivoted at the perforated ends 76 thereof, that said perforation being designated as 77 in Figs. 1 and 8, while the outer ends are provided with the pins 78 to which the coil springs 79 are attached. The opposite ends of these springs are attached to hooks 80 on the inner portions of said casing. Surrounding the inner hub flange 81 and freely positioned for rotation thereon is the collar 83 forming the four cam faces thereon, said cam collar having oppositely projecting ears 86, the ears being connected with the weights by links 88, the pins 89 extending through the ears and the link, and the pins 90 through the weights and links for this purpose as is clearly shown in Fig. 8. The cam collar 95 is mounted on the hub flange 81 of the balance wheel and has the cam surfaces 96 which engage the surfaces 85 so that as the collar 82 is rotated the collar 95 is moved axially. The collar 95 is provided with the spline 94 which extends into a groove on the hub to lock the collar against rotation on the hub. The annular engaging shoulder 97 on the outer longitudinally movable sleeve 38 is normally in contact with the cam collar 95 as clearly shown in Fig. 3, so that the rotary movement of the cam sleeve 82 is through the cam faces communicated to the axial movement in the sleeve 38. This movement being resisted, however, by the spring 62. The spring 62 extends between posts 63 extending upwardly from the sleeve 38 and the end of the adjusting screw 84^a, the adjusting screw is screwed through a post 64. The upper end of the post being split forming the clamp ends 64^a which are clamped to the screw 64^b. The screw has the squared end 84 by means of which the tension of the spring 62 may be adjusted, and the adjustment may be locked by means of the clamp screw 64^b. The screw has the extension 84^b extending from the spring through the posts 63 thus forming a guide for the spring. In this manner, the spring 62 forms a part of the centripetal element of the governor. The general operation of these governing weights will be apparent. The weights form the centrifugal element of the centrifugal governor. The spring 79 and the spring 62 the centripetal element. The spring 62 it will be noted opposes the outward movement of the weights through the cam sleeve. With the ordinary speed governor, the spring tension should theoretically balance the centrifugal force of the weights at each position. This is known as theoretic tension, and the governor as astatic. In practice, however, this is not desirable as the governor would then race and the weights would swing in and out. The speed governor to properly operate, however, should approximate this balancing of forces, and to accomplish it, the centrifugal force should increase as the weights move outwardly so as to maintain approximately the same force as the weights at each position at a constant speed. By observing Fig. 8 it will be noted that as the weights swing outwardly, the effective lever arm forced by the ears 86 with the axis of the shaft as a center rapidly decreases in length. In Fig. 8 I have shown diagrammatically how this decrease in leverage is accomplished. The centers of the pins 89 and 90 with the weights closed are marked *a*—*a*, and dash lines connect these points and the positions of the pin 89 with relation to the center. By this arrangement, the effective leverage of the weights against the spring 62, varies as the weights open and this leverage with the increase in spring tension is much more than sufficient to balance the weights at each position provided a constant speed were maintained. The springs 79 have an initial position in line with the pivots of

the weights so these also increase in leverage much more rapidly than would be required for an astatic governor. This is necessary because it is desired to have a much greater normal speed with the weights at their outer position, than at their inner position, commonly several times as great. The springs, therefore, must not only take care of the increased force due to the outer position of the weights, but must also take care of this desired increase of speed. By arranging the nut 84ª the force of the spring 62 may be adjusted and consequently the centripetal force easily varied so as to give various normal speeds with each position of the weights. The outward impulses effected upon the weights by the centrifugal action results in the longitudinal inward variations of movement of the sleeve 38, and the return thereof being effected by the spring 62, it is evident that the lever 36 is constantly moved upon its pivotal connection 37 with the sleeve upon all variations in speed of the governor shaft; while there is occasioned thereby a consequent partial rotation to the valve stem 9 which obviously results in an opening or closing of the valve 1 for varying the supply of the actuating fluid to the compressor engine or motor. In the lever connections through which these operations are effected. it is evident that the operations of the weights upon the fluid valve may be limited by varying the determined length of some of said connections through the agency of the positioning of the nut as desired upon the screw threaded valve stem lever 10; it being further noted that the position of the sleeve 38 is constantly changing when the governor shaft is in motion, thus employing the said end 71 of the lever 36 as the fulcrum point, while movement is imparted by said sleeve 38 to said lever at the point of said spring pivot connection 37 therebetween.

The pressure regulator of the governor will now be described. It is similar to that shown in the Osborne patent heretofore referred to. The main frame work of this structure as shown separated from all other parts in the perspective view, Fig. 11 is mounted upon the offset 99 of said post 21 by the bolts or other securing means 100 engaging the bar 101 of said frame work, and which extends at substantially right angles thereto. The main feature of said frame work consists of the pneumatic cylinder 98 having at one end thereof the cross head 102 which has a port opening alining and communicating with said cylinder which port is normally closed by the screw-threaded plug 103. Adjacent said ported end the cylinder is provided with the inlet port 104 adapted for connection with the pumped compressed air or the storage receptacle therefor and thus communicating the varying pressure of the pumped air upon the piston 105 operatively positioned within the cylinder. The aforesaid cylinder is open at its outer end allowing the entrance of the piston rod 106 having a pointed end 107 freely resting within the circular socket 108 formed in the outer end of the piston and by which construction the air pressure actuating said piston forces outwardly the piston rod, which latter is in turn pivoted to the arm 109 of the frame through the agency of the angularly bent link 110. The lever 111 adapted to be actuated by said pneumatic means is pivoted upon the pin 112 and within the slotted extension 113 of said arm 109 of the frame, while said lever 111 further extends through the link 110 and upon the curved inner face 114 of which the roller bearing 115 is adapted to bear, said roller bearing being journaled within the link 110 and upon the pin 116 extending through the end of the piston rod. For returning the piston rod and piston inwardly against the air pressure and for regulating the force of said return pressure, is provided the spring 117 encircling and forcing outwardly the link 118 pivoted to the lower extremity of said lever 111, while the movable plug 119 furnishes the other abutment for said spring and whereby through the rotation of said plug within the screw-threaded opening 120 of the cross head 102, the resiliency of said spring is easily adjusted. Said plug is preferably provided at its outer end with wings or extensions 121 for easily turning the same while a set nut 122 retains the member in the desired adjusted position, the entrance of the reduced extension 123 of the link 118 within the bore 124 of the plug being evident from an inspection of the sectional view of the structure. Within the rectangular alining openings 125 of the frame, is slidably-mounted bar 126 with the slot 127 provided through its outer end, in which slot and bearing upon the sides thereof when being actuated is the rounded or cylindrical upper end 128 of the lever 111. Pivotally-mounted upon said slide rod at a point thereon between its supports is the adjacent end of the lever 36, such pivoting being accomplished by the positioning of the spool 129 within the slot 130 of the lever end 71 heretofore referred to, this spool being secured to the slide rod by the screw 131.

From the above descriptions will be noted the link and pivot connections between the rotatable valve stem 9 and the slide rod 126 and an actuation of the latter to its fullest extent will obviously result in a complete closing of the fluid inlet valve 1. In the actuations of said valve by this pneumatic element, the sleeve pivot 37 constitutes the fulcrum.

By arranging the centripetal element of

the centrifugal governor so that it increases in power as the weights move outwardly more rapidly than does the centrifugal force of the weights, a variable speed governor results. In other words, the normal speed of the governor varies with the position of the weights. If, therefore, the pressure device actuated by the pressure of the pumped fluid moves the pin 131 and consequently the fulcrum of the lever 36 with relation to its operation by the centrifugal governor. The primary result of this movement of the pin 131 is to operate the feed valve, and this results in a variation in speed of the engine resulting in a change in the position of the governor weights. If the centrifugal governor were balanced in the manner of an ordinary centrifugal governor, that is, with the springs forming the centripetal element at practically theoretic tension, the centrifugal governor would to the extent of its capacity maintain the speed of the engine constant, thus neutralizing the effect of the fulcrum movement under the influence of the pressure device. With the centrifugal governor arranged as here shown, however, with the force of the springs increasing to a pronounced extent above theoretic tension as the weights move outwardly, the change in movement of the weights incident to the closing of the valve by the pressure device practically brings into play a different governor, the normal speed of which is changed through the change in position of the centrifugal weight. In the normal operation of the governor under normal conditions, the travel of the weights from full opening of the valve to full closing is but a small part of the total possible travel of the weights. Thus as the compressor device changes the fulcrum of the lever 36, the weights so change their position as to form within the limits of normal conditions, a governor device having a normal speed entirely different for each position. Thus, with the increase of pressure and a change of the lever 36 so as to primarily close the valve 1, the compressor is slowed down and the weights are drawn in by the centrifugal element by reason of this decrease in speed. With each change of position of the fulcrum 131, the feed valve is brought to a complete closure with a different position of the governor weight. Thus, as the fulcrum is moved under the influence of the pressure of the pumped fluid, the feed valve is closed with a position of the weights nearer the center of the governor shaft. When, therefore, the valve is primarily closed through the influence of the pressure device, and the compressor slowed down so that the weights seek a new position nearer the center of the shaft, they do not travel inwardly as far as they would with an ordinary speed governor because as the weights move inwardly the springs weaken much more rapidly than they would if approximating theoretic tension. Consequently, as the fulcrum 131 moves under the influence of the pumped fluid, the closure of the feed valve is accomplished at a much lower speed than with the fulcrum 131 at its extreme position under the influence of the spring 117 or in the position it assumes in the absence of pressure on the pressure device, the governor weights having a possible travel very much in excess of what is required to move the feed valve from maximum opening to a practical closure. In consequence of this, when the fulcrum 131 is changed, and the weights are brought to a new position, the weights will, in this new position, control the speed at the new position within the practical limits of the valve, that is, from full opening to full closure without varying materially this new normal speed. The result of this arrangement is to change the effective force of the centripetal element within the power of the centrifugal element, and thus to change the normal speed of the engine with each position of the pressure device, and the consequence of this is that the governor will seek that speed between the maximum and minimum which will supply the immediate demand from the receiver, for instance, if the maximum speed is 150 revolutions, and the minimum speed is 50 revolutions, and 100 revolutions will satisfy the demand, the governor will find that intermediate position which will give to the engine a speed of 100 revolutions. The pneumatic regulator may be set to operate between any desired limits by the adjustment of the tension adjusting means of the piston return spring 117. This controls the point at which the piston begins to travel and to thus change the position of the fulcrum 131. The adjustment of the nut 29 upon the valve lever 10, it will be noted, changes the length of the lever connections between the pivoted member 36 and said lever, while the changing of the position of such nut upon the lever results in accurately determining the length of the reciprocations of which the sleeve 38 is capable, under the influence of the centrifugal governing means.

It will be noted that the lower portion of the curved bearing face 114 of the lever 111 is curved abruptly to form an end seat 114′ for the roller bearing 115, so as to position the same at its lowest point of movement with the connected piston rod 106 in a substantially horizontal plane. In connection with the function and operation of the angular link 110 in its rocking movement during the contracting of its rocking movement during the contracting of its roller member 115 with the lever face

114, it will be seen that the angular fixed positions of the fulcrums of the several different parts are such that considering the pivot 112 of the lever 111 in connection with the pivot 110′ of the link 110, both pivots being in the arm 109, and also together with the piston rod pin 106, upon an outward movement of the piston under the influence of the increased pumped fluid pressure, the distance between the members 116 and 112 is increased and the leverage vantage is enhanced thereby to a corresponding degree while simultaneously therewith the tension of the spring 117 increases.

In using the pneumatic regulator in connection with a single acting compressor it is essential that provision be made against the complete closing of the fluid supply valve which would possibly result in stalling the compressor on a dead center. This is provided by positioning the adjustable pin 132 within the opening 133 of the cylinder extension 134, which extension also supports the slide rod and is opposed to the head 102; and in further placing upon said slide rod the stop lug 135, which being in a line with the inner free end of the pin 132, is adapted to engage the same upon its reciprocation with the slide rod 126, and thus the throw of said rod is limited as desired, said pin being adjustably retained by the set nut 136.

What I claim as new is:

1. In a pump governor, the combination of a valve controlling the flow of motive fluid actuating the pump; of a centrifugal governor member having a centrifugal element comprising a rotating weight and a centripetal element, said elements being arranged with a pronounced increase in tension over theoretic tension as the weights move outwardly; a pressure device; a connection between centrifugal governor member and the valve; and means actuated by said pressure device and acting on said connection for varying the relative positions of said member and the valve.

2. In a pump governor, the combination of a valve controlling the flow of motive fluid actuating the pump; a centrifugal governor having a centrifugal element comprising a rotating weight and a centripetal element having a pronounced increase in tension over theoretic tension as the weights move outwardly; a pressure device; a connection between the centrifugal governor member and the valve; and means actuated by said pressure device and acting on said connection for varying the relative positions of said member and the valve.

3. In a pump governor, the combination of a valve controlling the flow of motive fluid actuating the pump; a centrifugal governor member having a centrifugal element comprising a rotating weight and a centripetal element, the said elements being opposed and arranged to have a pronounced increase in tension over theoretic tension as the weights move outwardly; a pressure device; a connection between the centrifugal governor member and the valve, comprising a lever; and means actuated by said pressure device and acting on the fulcrum of the lever for varying the relative positions of said member and valve.

4. In a pump governor, the combination of a valve controlling the flow of motive fluid actuating the pump; a centrifugal governor member having a centrifugal element comprising a plurality of weights and a centripetal element, comprising a pressure-exerting device connected to and operating on both weights, the device and connection between the device and weights giving a pronounced increase in tension over theoretic tension as the weights move outwardly; a pressure device; a valve actuated connection between the centrifugal governor member and the valve; and means actuated by said pressure device and acting upon said valve actuating said connection for varying the relative positions of said member and the valve.

5. In a pump governor, the combination of a valve controlling the flow of motive fluid actuated by the pump; a centrifugal governor member having a centrifugal element and a centripetal element, the centripetal element comprising a spring without the plane of the weights, and the centripetal element having a pronounced increase in tension over theoretic tension as the weights move outwardly; a pressure device; a connection between the centrifugal governor member and the valve; and means actuated by said pressure device and acting on said connection for varying the relative positions of the said member and the valve.

6. In a pump governor, the combination of a valve controlling the flow of motive fluid actuating the pump; a centrifugal governor member having a centrifugal element, comprising a rotating weight, and a centripetal element comprising a spring without the plane of the weight, and an auxiliary spring acting directly on the weight, said centripetal element having a pronounced increase in tension over theoretic tension as the weight moves outwardly; a pressure device; a connection between centrifugal governor and the valve; and means actuated by said pressure device and acting on said connection for varying the relative positions of the said member and the valve.

7. In a pump governor, the combination of a valve controlling the flow of motive fluid actuating the pump; a centrifugal governor member having a centrifugal element, comprising rotating weights and a centripetal element, the centripetal element com-

prising links connected to the weights and increasing the leverage of the connection with the centripetal element as the weights move outwardly, making a pronounced increase in tension over theoretic tension as the weights move outwardly; a pressure device; a connection between the centrifugal governor member and the valve; and means actuated by said pressure device and acting on said connection for varying the relative positions of the said member and the valve.

8. In a pump governor, the combination of a valve controlling the flow of motive fluid actuating the pump; a centrifugal governor member having a centrifugal element comprising rotating weights and a centripetal element, the centripetal element comprising an axially moving cam with the axis of the weights as its center; a rotating cam with the axis of the weights as the center operating upon axially moving cams; a link connection between the rotating cam and the weights, the connection decreasing the leverage of the rotating cam as the weights move outwardly; a pressure exerting device operating upon the axially moving cam, said device and connection giving a pronounced increase in tension over theoretic tension as the weights move outwardly; a fluid actuated pressure device; a connection between the centrifugal governor and the valve actuating connection; and means actuated by said fluid actuated pressure device and acting on said valve actuating connection for varying the relative positions of said member and the valve.

9. In a pump governor, the combination of a valve member controlling the flow of motive fluid actuating the pump; a centrifugal governor member having a centrifugal element and a centripetal element, said elements being opposed and arranged with a pronounced increase in tension over theoretic tension as the weights move outwardly; means for adjusting one of said elements as to the relative force exerted thereby; a pressure device; a connection between centrifugal governor member and the valve; and means actuated by said pressure device, and acting on said connection for varying the relative positions of said member and the valve.

10. In a pump governor, the combination of a valve member controlling the flow of motive fluid actuating the pump; a centrifugal governor member having a centrifugal element and a centripetal element, said elements being opposed and arranged with a pronounced increase in tension over theoretic tension as the weights move outwardly; means for adjusting the centripetal element as to the relative force exerted thereby; a pressure device; a connection between centrifugal governor member and the valve; and means actuated by said pressure device, and acting on said connection for varying the relative positions of said member and the valve.

11. In a pump governor, the combination of a valve controlling the flow of motive fluid actuating the pump; a centrifugal governor member having a centrifugal element comprising a plurality of weights, and a centripetal element comprising a pressure exerting device connected to and operating on both weights, the device and connection between the device and weights giving a pronounced increase in tension over theoretic tension as the weights move outwardly; means for adjusting the pressure exerting device to vary the relative force of the centrifugal and centripetal elements; a pressure device; a connection between the centrifugal governor member and the valve; and means actuated by the said pressure device and acting on said connection for varying the relative positions of the said member and the valve.

12. In a pump governor, the combination of a valve controlling the flow of motive fluid; a centrifugal element comprising a rotating weight; a centripetal element comprising a spring without the plane of the weight; an axially moving cam subjected to the pressure of the spring; a rotating cam operating on the axially moving cam; a connection between the weights and the rotating cam; means for adjusting the tension of the spring; and a connection for communicating the movement of the weights through the valve.

13. In a pump governor, the combination of a valve controlling the flow of motive fluid; a rotating governor weight forming the centrifugal element of the governor; a carrier for said weight; a shaft on which the carrier is mounted; a shaft sleeve forming a connection between the weight and the valve; a centripetal element comprising a spring operating on said shaft sleeve; an axially moving cam moving with said sleeve; a rotatively moving cam operating upon said axially moving cam; a connection between said rotatively moving cam and the weight; a bearing for the shaft within the shaft sleeve; means for adjusting said spring comprising a screw; and means for locking the screw.

14. In a combined governor and regulator for air compressors comprising a feed valve for regulating the supply of motive fluid to a prime mover for driving the compressor, a governor shaft; a centrifugal governor weight mounted on the shaft, said weight forming the centrifugal elements of the governor; a centripetal element operating upon said weight, said elements being opposed and arranged to have a pronounced increase in tension over theoretic tension as the weights move outwardly; and a shift-

able element mounted on the governor shaft and actuated with the movement of said weights, said shiftable element being connected to the feed valve.

15. A combined governor and regulator for air compressors comprising a feed valve for regulating the supply of motive fluid to a prime mover for driving the compressor, a governor shaft; a centrifugal governor weight mounted on the shaft, said weight forming the centrifugal elements of the governor; a centripetal element operating upon said weight, said elements being opposed and arranged to have a pronounced increase in tension over theoretic tension as the weights move outwardly; a shiftable element mounted on the governor shaft and actuated with the movement of said weight; a connection between the shiftable element and the feed valve; and a pressure device actuated by the pumped fluid and acting upon said connection to change the relative positions of the shiftable element to the feed valve.

16. A combined governor and regulator for air compressors comprising a feed valve for regulating the supply of motive fluid to a prime mover for driving the compressor; a governor shaft; governor weights mounted on said shaft and forming the centrifugal element of the governor; a centripetal element operating against the said weights and having a pronounced increase in tension over theoretic tension as the weights move outwardly; a shiftable element mounted on the governor shaft and actuated with said weights; a connection between said shiftable element and the feed valve for controlling the latter when actuated in one direction by the governor weights; and a fluid actuated pressure device acting upon said connection for varying the relative positions between the governor weights and the feed valve.

17. In a combined governor and regulator for air compressors, comprising a centrifugal governor member having centrifugal weights forming the centrifugal element of the governor and a centripetal element, said elements being opposed to each other and arranged to give a pronounced increase in tension over theoretic tension as the weights move outwardly and regulating the motive supply mechanism for the engine controlled by said governor mechanism; a pressure device actuated by the pumped fluid; and an operative connection between said pressure device and the regulating mechanism.

In testimony whereof I have hereunto set my hand in the presence of two subscribing witnesses.

RUDOLPH CONRADER.

Witnesses:
BLANCHE HARTMAN,
C. D. HIGBY.