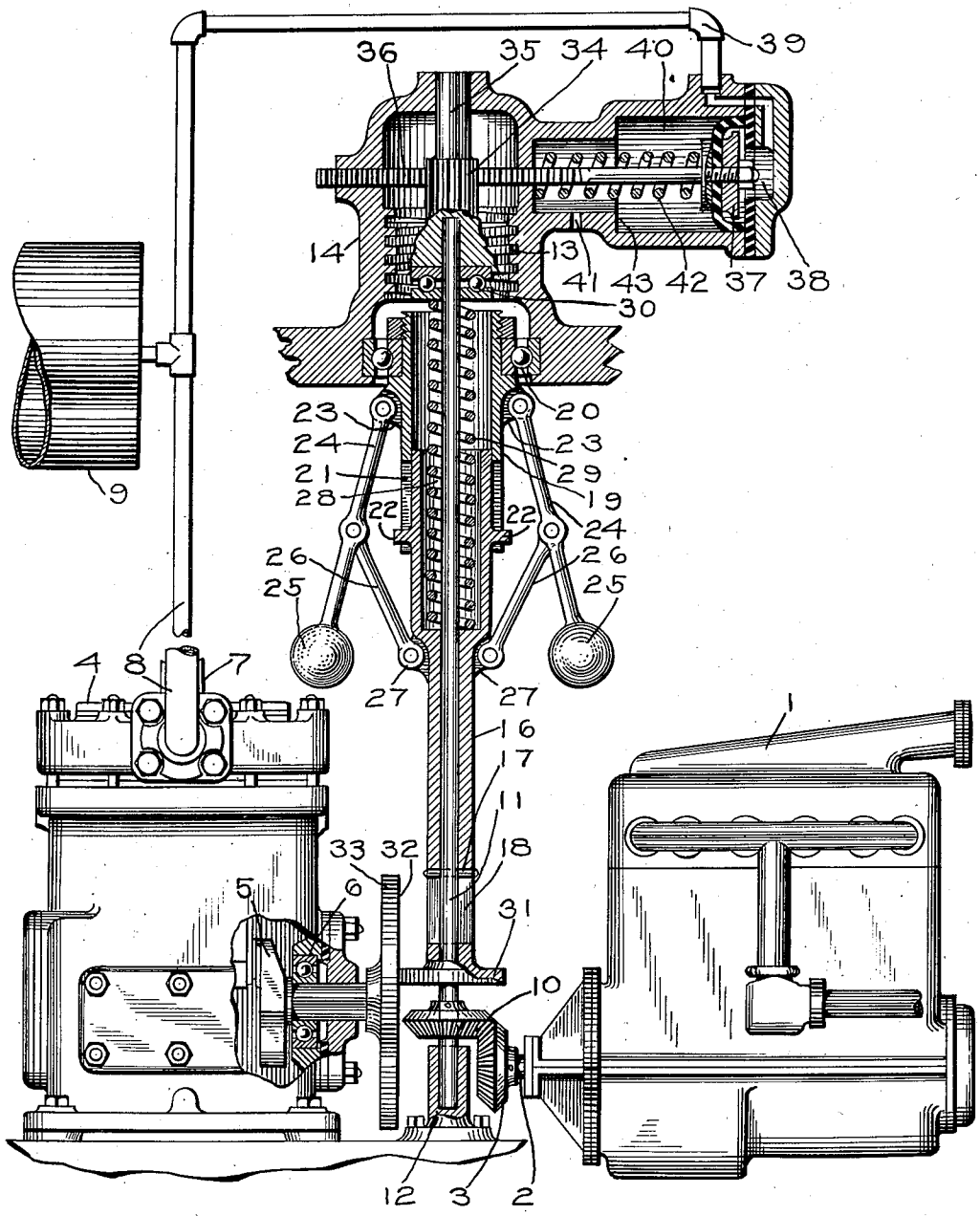
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DRIVE MECHANISM

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DRIVE MECHANISM

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This invention relates to air compressors and more particularly to a drive mechanism therefor.

The Diesel type internal combustion engines employed for driving, either directly or indirectly, locomotives such are used for hauling certain modern, high speed, stream-lined trains, operate over a considerable range of speed which varies from a relatively low idling speed, employed when a train is stopped or when coasting down a grade, to a relatively high speed for producing sufficient torque to haul the train at high speed.

On these locomotives the air compressors which furnish compressed air for the control of the brakes on trains, are usually driven directly from the Diesel engines or from any other suitable source of power which is dependent upon the operation of said engines, and which therefore varies in speed in proportion to the engine speed. The compressors are thus operated at relatively high speed and capacity under high engine torque conditions at which time the brakes on the train are released and the requirements for compressed air on the train are at a minimum. When a train is coasting down a grade with the Diesel engines idling, the requirements for compressed air on the train are at a maximum for controlling the brakes on the train, but at this time, as will be evident, the air compressors operate at relatively low speeds proportional to the idling speed of the engines. The output of the compressors is thus reduced when the air requirements on the train are greatest. Obviously if a compressor is capable of producing a sufficient quantity of compressed air at the low idling speed of the Diesel engines to insure safe braking of the train, then an excessive and a substantially useless amount of compressed air is provided when the Diesel engines are operating at high speed with the brakes on the train released. Air compressors of very large size, weight and cost are therefore required to adequately meet the requirements on these trains, and in case the compressors are designed for their greatest output efficiency at relatively low speeds where the air requirements are usually greatest, then it will be evident that when the compressors are operating at higher speeds, an excessive waste of compressed air results. Further, the operation of the compressors at these high speeds is inefficient and accompanied with a waste of operating power as well as excessive heating of the compressors, excessive oil consumption and undue wear of the parts of the compressor.

From the above remarks it will be apparent that the compressed air requirements on a train are independent of the speed of the driving engines or the like, since under certain conditions the demand for compressed air is greatest when the engines are operating at idling speed. The drive for the air compressors should therefore be such as to effect operation thereof at substantially the most efficient speed when the air demands on the train are greatest and at no time should the compressors be operated at speeds greatly in excess of those for which the compressors are designed. The compressors on high speed locomotives operate continuously, so it is therefore obvious that except when the air demands are heavy and up to the capacity of the air compressors, the compressors could be operated at a reduced speed with a resultant reduction in the wear of parts, of oil consumption and also excessive heating of the compressors could be avoided. Further, the compressors could be designed to operate at the desired, most efficient speed when the air requirements of the train are greatest and at all other times operate at reduced speeds and thus overcome the difficulties or shortcomings incident to the systems of compressor drive now in use on high speed trains, as above described.

One object of the present invention is to provide an improved drive for air compressors from a variable speed prime mover adapted to overcome the difficulties of conventional types of drive now in use in high speed trains, as above described.

Another object of the present invention is to provide an improved drive for air compressors from a variable speed prime mover, adapted to drive the compressor at a speed in proportion to the air requirements on the train, that is, at a relatively high, most efficient speed at the time the air requirements on the train are greatest and at a reduced speed at all other times or when the air requirements on the train are at a minimum.

It is important to note that in order to meet the heavy demands for compressed air required for braking a train a compressor need only operate at capacity a relatively small portion, such as twenty five percent, of the running time of a train. During the other portion of the running time of the train the air demands on the train are relatively low and in high speed trains where these compressors operate continuously they need therefore only operate at relatively low speed to meet such reduced demands. By controlling the

speed of the compressor in accordance with the air requirements on the train it will be evident that the compressor will operate the major portion of the running time of a train at a relatively low speed and thereby effect a very material saving in actuating power and lubricant with a resultant lengthening of the life of the compressor and complete avoidance of excessive heating thereof.

Other objects and advantages will be apparent from the following more detailed description of the invention.

In the accompanying drawing, the single figure is a diagrammatic, sectional view of the improved drive mechanism shown connecting a prime mover to an air compressor.

Description of parts

In the drawing the reference numeral 1 indicates a prime mover of any desired, variable speed type such as a Diesel, internal combustion engine which is provided with a crankshaft 2 extending from one end thereof and adapted to operate at varying speeds over a range between an idling speed and a high speed corresponding to the speeds of such engines as obtained in high speed train service. A bevel gear 3 is adapted to be turned by the crankshaft 2 in any desired manner, but for the purpose of illustration is shown secured directly to the end of said shaft so as to rotate with and at the same speed as the shaft.

The reference numeral 4 indicates an air compressor adapted to be operated from the engine 1. The air compressor 4 may be of any desired construction but for the purpose of illustration comprises a casing, a crankshaft 5 journaled in a bearing 6 in the casing and one or more pistons (not shown) operatively connected to the crankshaft for reciprocation thereby. These pistons are adapted upon reciprocation to operate in the well known manner to draw air from the atmosphere through an intake pipe 7 and to compress said air and discharge same into a discharge pipe 8 which in the present embodiment of the invention leads to a storage reservoir 9. This reservoir may be a main air supply reservoir on a locomotive and is employed for storing up a supply of compressed air delivered from the air compressor for use in controlling the brakes on the train or for other uses.

The bevel gear 3 meshes with a bevel gear 10 which is secured to a vertically operating shaft 11 for turning said shaft. The shaft 11 is journaled at its lower end in a suitable bearing member 12 while the upper end of the shaft is rotatably mounted in a suitable bore provided in a nut 13. The nut 13 is screw-threaded into a suitable opening provided in a member 14 which is secured in any desired manner in predetermined relation to the bearing member 12 so as to rigidly support the shaft 11 at right angles to the axes of the crankshafts 2 and 5.

A sleeve 16 is slidably mounted on the shaft 11 and a pin 17 extends through said shaft into oppositely disposed slots 18 provided in the sleeve 16 for turning said sleeve with said shaft, said slots providing for limited movement of said sleeve longitudinally of the shaft 11.

The upper end of the sleeve 16 is telescoped within and supported by a sleeve 19 which is secured at its upper end to the inner race of a ball bearing 20 secured in member 14 in coaxial alignment with the nut 13. This ball bearing 20 supports the sleeve 19 against movement longitudinally of the shaft 11. The sleeve 19 is provided at its lower end with two longitudinally extending slots 21 disposed opposite each other. The sleeve 16 is provided on each of its opposite sides with a driving finger 22, the two fingers being mounted to slide in the two slots 21.

The sleeve 19 is provided adjacent the bearing 20 with a pair of oppositely disposed ears 23. One end of a lever arm 24 is pivotally connected to each of the ears 23 while at the other end of said arm there is provided a mass in the form of a governor weight 25. Each of the arms 24 is pivotally connected intermediate its ends to one end of a link 26 the opposite end of which is pivotally connected to an ear 27 provided on the sleeve 16, it being evident that the two links 26 and ears 27 are arranged opposite each other at opposite sides of the sleeve 16.

The sleeve 16 is provided in its upper end with a counterbore 28 which opens to a bore extending through the sleeve 19 in axial alignment with the lower face of the nut 13. A governor control spring 29 is disposed in the counterbore 28 with the lower end of the spring engaging the bottom of the counterbore while interposed between the upper end of said spring and the adjacent face of the nut 13 is an antifriction bearing 30 adapted to provide free rotation of the spring 29 with the sleeve 16 and 19 relative to the nut 13.

The sleeve 16 is provided at its lower end with a disk 31 the peripheral face of which is disposed in frictional driving engagement with the friction face 32 of a driven disk 33 which is secured to the end of the compressor crankshaft 5 for turning said crankshaft and for thereby operating the air compressor 4.

Movement of the sleeve 16 lengthwise of the shaft 11 is adapted to effect movement of the disk 31 radially of the friction face of the driven disk 33, such movement being limited by engagement of the pin 17 with the ends of the slots 18. These slots are of such length as to permit movement of the disk 31 from near the center of the disk 33 as shown in the drawing outwardly to a position defined by engagement of said pin at the opposite ends of slots 18 and in which the peripheral edge of the disk 31 is in engagement with the disk 33 adjacent its outer peripheral edge.

The nut 13 is provided on its upper face with an integrally formed gear 34 beyond which there extends a shaft 35 journaled at its outer end in the member 14 for cooperation with the nut to support said nut in coaxial relation with the shaft 11. A gear rack 36 is slidably mounted in suitable bearings in the member 14 at right angles to the axis of the gear 34 and is provided with gear teeth meshing with those on said gear. One end of this rack is connected for movement with a piston 37 which has at its outer face a chamber 38 connected through a pipe 39 to pipe 8 leading to reservoir 9 whereby fluid at the pressure delivered by the air compressor 4 and acting in said reservoir will at all times be in said chamber acting on the piston 37. At the opposite side of the piston 37 there is provided a non-pressure chamber 40 which is open to the atmosphere through a breather port 41 and in which there is provided a release spring 42 which encircles the rack 36 and bears at one end against the end of said chamber and at the opposite end against the piston 37 for opposing movement of the piston by the air pressure acting in chamber 38.

The spring 42 is so designed that when the pressure of air delivered by the compressor 4 to reservoir 9 and acting in chamber 38 exceeds a chosen degree the piston 37 will be moved against said spring and into engagement with the end wall 43 of the non-pressure chamber 40, but when said pressure is less than said chosen degree, the spring 42 will move the piston 37 away from said wall in the direction of the right hand to a position depending upon the degree of reduction in air pressure in chamber 38 below said chosen pressure.

It will be evident that since the piston 37 is connected through the gear rack 36 to the gear 34, movement of said piston will effect rotation of said gear and thereby of the nut 13. The screw-threads on the nut 13 and those in the member 14 with which said nut cooperates are so designed that as the piston 37 is moved against the spring 42 said nut upon being turned will be moved in the direction of the rack 36 and thus act to relieve the pressure of the governor control spring 29 on the sleeve 16. When the piston 37 is moved by the action of the spring 42 in the opposite direction, the rack 36 and thereby the gear 34 will operate to turn the nut 13 and move same in a direction away from the rack 36, so as to thereby increase the pressure of the spring 29 acting on the sleeve 16.

Operation

When the engine 1 is operating and turning the crankshaft 2 the bevel gear 3 is operated to turn the gear 10 and thereby the shaft 11. This rotation of the shaft 11 acts through the pin 17 to turn the sleeve 16 and thereby the disk 31. Since the disk 31 is in frictional driving contact with the compressor disk 33, rotation of disk 31 effects rotation of said compressor disk and thereby operation of the compressor 4 to compress air into the pipe 8 and thence to the main reservoir 9 and pipe 39 leading to pressure chamber 38 at one side of the speed change piston 37.

Rotation of the sleeve 16 acts through the ears 27 to rotate the links 26 and thereby the governor arms 24 and weights 25 and through the ears 23 to turn the sleeve 19 in the bearing 20 provided in the member 14. Due to the action of centrifugal force on the governor balls 25 said balls will move outwardly away from the sleeve 16 and during such movement will move the sleeve 16 along the shaft 11 in the direction of the nut 13. This movement of the sleeve acts to compress and thereby increase the force of spring 29 opposing such movement and will continue until the force of said spring is increased to a degree sufficient to counteract the action of centrifugal force on the governor balls 25. If the speed of rotation of the engine crankshaft 2 and thereby of the shaft 11 and governor balls 25 is increased said balls will operate to draw the sleeve 16 still further in the direction of the nut 13 until the pressure of the spring 29 is further increased sufficiently to counteract the increased action of centrifugal force on the governor balls 25. In case the speed of rotation of the engine crankshaft is reduced, the reduced action of centrifugal force on the governor balls 25 permits the spring 29 to expand and move the sleeve 16 away from the nut 13 to a position in which the pressure of said spring is reduced to a degree where it is counterbalanced by the action of centrifugal force on the governor weights 19. In other words the governor device including the arms 24, balls 25 and links 28 will operate to position the sleeve 16 on the shaft 11 in a position corresponding to the speed of the driving engine 1.

Movement of the sleeve 16 in the direction of the nut 13 effects movement of the driving disk 31 outwardly toward the peripheral edge of the driven disk 33 and said driving disk will assume a position with respect to the friction face of the driven disk corresponding to the position obtained by the governor balls 25 as determined by the speed of operation of the engine 1. If the speed of the engine 1 is increased the driving disk 31 will be moved outwardly further toward the peripheral edge of the driven disk 33, while in case the speed of the engine is reduced the driving disk 31 will be moved in the opposite direction toward the center of the driven disk 33.

The speed with which the air compressor 4 is operated from the engine 1 depends upon the length of path on the driven disk 33 traversed by the peripheral face of the driving disk 31 and it will be obvious that as the driving disk 31 is moved outwardly toward the edge of the driven disk 33 the length of this path is correspondingly increased and since such outward movement is in proportion to the increase in speed in the driving engine 1 it will be evident that the speed of the air compressor 4 will not increase with that of the engine. In case the speed of the engine 1 is reduced the governor device including spring 29 and balls 19 act to move the driving disk 31 in the direction of the center of the driven disk 33, the degree of such movement depending upon the reduction in engine speed. In other words, for a certain air pressure acting on the piston 37 and thereby holding the nut 13 against movement, the driving disk 31 will assume a position radially of the driven disk 33 dependent upon the engine speed, and the parts of the mechanism may be so designed that in the operation so far described, the speed of the air compressor will remain substantially the same for all engine speeds.

Let it be assumed that the pressure of air delivered by the compressor to reservoir 9 and acting in chamber 38 is sufficiently low to permit spring 42 to hold the piston 37 in its extreme right hand position as shown in the drawing. In this position of piston 37 and also of the nut 13 the compressor 4 is adapted to be operated at its maximum and most efficient speed and it will be noted that this speed will remain substantially constant regardless of variations in speed of the engine 1, for reasons hereinbefore described. It should however be noted that the pressure in reservoir 9 will usually only be reduced sufficiently for the piston 37 to be moved to the position described when a large amount of compressed air is being used from the reservoir 9 for the control of brakes on the train at which time the engine 1 will be idling. However even though the engine is sped up it will have no material effect upon the speed of the compressor.

Now as the pressure of fluid delivered by the compressor 4 to the reservoir 9 and acting in chamber 38 on the piston 37 is increased and overcomes the pressure of spring 41, the piston 37 is moved in the direction of the nut 13 and acts to turn the gear 34 and thereby the nut 13 relative to the member 14 in such a direction as to move said nut toward the rack 36 thereby permitting an upward movement of the adjacent end of spring 29 and in effect a corresponding reduction in the pressure of said spring on the

sleeve 16. As the pressure of the spring on sleeve 16 is thus relieved the action of centrifugal force of the governor balls 25 throws said balls outwardly to a position where spring 29 is again compressed to a degree sufficient to offset the reduction of pressure thereof on sleeve 16 due to the action of the nut 13. As a consequence of this action due to the increase in pressure in reservoir 9, the driving disk 31 is pulled outwardly toward the outer peripheral edge of the driven disk 33 and thereby causes a corresponding slowing down of the compressor 4.

As the pressure delivered by the compressor 4 to the reservoir 9 and piston chamber 38 is further increased, the piston 37 is moved further in the direction of gear 34 and thereby effects further movement of nut 13 in the direction of rack 36, whereupon the governor balls 25 are permitted to move outwardly to a new position sufficient to counteract the changed condition of said spring and consequently effect movement of the driving disk 31 still further towards the peripheral edge of the cylinder disk 33 thereby causing a still further reduction in speed of the air compressor 4.

As the pressure of fluid delivered by the compressor is still further increased the piston 37 will continue to be moved in the direction of the gear 34 until such time as said piston engages the wall 43, at which time the nut 13 and thereby the spring 29 will be conditioned to permit such outward movement of the balls 25 as to effect maximum slowing down of the compressor 4. With the reservoir 9 thus charged to the maximum pressure it is desired to carry, the nut 13 and thereby the adjacent end of the governor control spring 29 will be so conditioned, that the operation of the governor weights 25 will be enabled to so position the driving disk 31 relative to the driven disk 33 that the speed of the compressor will be relatively low and below its most efficient speed even though the engine 1 may be operating at high speed to haul a train. Under this pressure condition variations in speed of engine 1 will not effect any material change in speed of the compressor however, as will be evident.

If the pressure of fluid in the reservoir 9 and thereby in chamber 38 acting on the piston 37 is reduced sufficiently, due to being used for the control of brakes on the train or the like, the piston 37 and nut 13 will operate in a manner just the reverse of that described to change the condition of spring 29 so as to provide increased resistance to the action of centrifugal force of the governor balls 25 and thereby move the balls inwardly to a position dependent upon the reduction of pressure in the reservoir 9. A corresponding movement of the driving disk 31 toward the center of the driven disk 33 is thus effected and as a result a corresponding increase in speed of the air compressor 4 is obtained for replenishing the compressed air supply. As will be evident, the piston 37 will obtain a position in chamber 38 which varies according to the degree of reduction in the pressure in the reservoir 9 and therefore through the action of the nut 13 and the governor device, the disk 31 will obtain a corresponding position with respect to the driven disk 33 and effect a corresponding increase in speed of the compressor 4. In other words regardless of the speed of the engine 1, the compressor 4 will operate at a speed depending upon the position of the piston 37 in its cylinder and therefore in accordance with the amount of compressed air used from the reservoir 9. When the piston 29 is in its extreme left hand position the compressor will operate at its maximum and most efficient speed, while when in its other extreme position it will operate at a reduced speed. It is important to note that the speed of the compressor varies only with the pressure of air delivered thereby, since the governor control of the drive with engine 1 merely acts to offset changes in speed of said engine.

Summary

From the foregoing it will be evident that with this improved drive mechanism for an air compressor which is driven from a variable speed prime mover, the compressor may be designed to operate at a certain maximum speed for greatest efficiency and the drive mechanism will operate to prevent increasing the speed of the compressor over said maximum even though the prime mover may operate over a considerable range of different speeds.

It will be further noted that with this improved mechanism the compressor will operate at its greatest speed only when there is a heavy demand for compressed air and at all other times will operate at a relatively low speed. The compressor may thus be designed to operate most efficiently, with a minimum consumption of power; it may be of minimum size, weight and cost for the use intended; and excessive oil consumption of the compressor and undue wear of the parts thereof as well as excessive heating of the compressor are avoided; all of which combined to increase the reliability and length of life of the compressor.

While one illustrative embodiment of the invention has been described in detail it is not the intention to limit the scope to such embodiment or otherwise than by the terms of the appended claims.

Having now described my invention, what I claim as new and desire to secure by Letters Patent, is:

1. In combination, an air compressor comprising a rotatable drive shaft, a variable speed rotatable power shaft for turning said drive shaft, a speed change mechanism connecting said shafts and adjustable to vary the speed ratio between said shafts, and means controlled jointly by the speed of said power shaft and the pressure of the air delivered by said compressor for controlling the adjustment of said mechanism.

2. In combination, an air compressor comprising a rotatable drive shaft, a variable speed rotatable power shaft for turning said drive shaft, a speed change mechanism connecting said shafts and adjustable to vary the speed ratio between said shafts, means responsive to variations in speed of said power shaft for adjusting said mechanism to compensate for such variations, and means responsive to changes in the pressure of air delivered by said compresssor for also controlling the adjustment of said mechanism.

3. In combination, an air compressor comprising a rotatable drive shaft, a variable speed rotatable power shaft for turning said drive shaft, a speed change mechanism connecting said shafts and adjustable to vary the speed ratio between said shafts, and means controlled jointly by the pressure of air delivered by said compressor and the speed of rotation of said power shaft for adjusting said mechanism to compensate for variations in speed of said power shaft and for also adjusting said mechanism to increase the speed of said compressor drive shaft

upon a decrease in the pressure of air delivered by said compressor and to decrease the speed of said compressor drive shaft upon an increase in the pressure of air delivered by said compressor.

4. In combination, an air compressor comprising a rotatable drive shaft, a variable speed rotatable power shaft for turning said drive shaft, a speed change mechanism connecting said shafts and adjustable to vary the speed ratio between the shafts, and means for controlling the adjustment of said mechanism including speed governor means responsive to variations in speed of said power shaft to adjust said mechanism to compensate for such variations in speed, and pressure sensitive means controlled by the pressure of air delivered by said compressor and operative to adjust said mechanism to increase the speed of said compressor drive shaft upon a reduction in said air pressure and to decrease the speed of said compressor drive shaft upon an increase in the degree of said air compressor.

5. In combination, an air compressor comprising a rotatable drive shaft, a variable speed rotatable power shaft for turning said drive shaft, a driven friction disk secured to the said compressor drive shaft, a driving friction disk secured to said power shaft for rotation therewith and cooperative with said driven disk to turn said drive shaft for operating said compressor, one of said disks being movable radially relative to the other to vary the speed ratio between said disks, and means controlled jointly by the speed of said power shaft and the pressure of air delivered by said compressor for controlling the position of the one disk radially of the other disk.

6. In combination, an air compressor comprising a rotatable drive shaft, a variable speed rotatable power shaft for turning said drive shaft, a driven friction disk secured to said compressor drive shaft, a driving friction disk secured to said power shaft for rotation therewith and cooperative with said driven disk to turn said drive shaft for operating said compressor, one of said disks being movable radially relative to the other to vary the speed ratio between said disks, a speed governor device responsive to variations in speed of said power shaft for moving said one disk relative to the other to compensate for such variations in speed, and means responsive to the pressure of air delivered by said compressor for modifying the response of said governor device to the speed of said power shaft for increasing the speed of said compressor drive shaft upon a reduction in the pressure of air delivered by said compressor and for reducing the speed of said compressor drive shaft upon an increase in said air pressure.

7. In combination, an air compressor comprising a rotatable drive shaft, a variable speed rotatable power shaft for turning said drive shaft, a speed change mechanism connecting said shafts and adjustable to vary the speed ratio of said shafts, a spring, a speed governor device connected to operate with said power shaft and controlled by the opposing forces of said spring and centrifugal force for operating said mechanism to compensate for variations in speed of said power shaft, and means for varying the action of said spring on said governor device for operating said governor device to adjust said mechanism to vary said speed ratio.

8. In combination, an air compressor comprising a rotatable drive shaft, a variable speed rotatable power shaft for turning said drive shaft, a speed change mechanism connecting said shafts and adjustable to vary the speed ratio of said shafts, a spring, a speed governor device connected to operate with said power shaft and controlled by the opposing forces of said spring and centrifugal force for operating said mechanism to compensate for variations in speed of said power shaft, and means responsive to variations in the pressure of air delivered by said compressor to vary the action of said spring on said governor device for thereby operating said governor device to adjust said mechanism to vary said speed ratio.

9. In combination, an air compressor comprising a rotatable drive shaft, a variable speed rotatable power shaft for turning said drive shaft, a speed change mechanism connecting said shafts and adjustable to vary the speed ratio of said shafts, a spring, a speed governor device connected to operate with said power shaft and controlled by the opposing forces of said spring and centrifugal force for operating said mechanism to compensate for variations in speed of said power shaft, and means controlled by the pressure of air delivered by said compressor and operative to vary the action of said spring on said governor device for thereby effecting operation of said mechanism to increase and decrease the speed of said compressor drive shaft upon a reduction and an increase, respectively, in said air pressure.

10. In combination, an air compressor comprising a rotatable drive shaft, a variable speed rotatable power shaft for turning said drive shaft, a speed change mechanism connecting said shafts and adjustable to vary the speed ratio of said shafts, a spring, a speed governor device connected to operate with said power shaft and controlled by the opposing forces of said spring and centrifugal force for operating said mechanism to compensate for variations in speed of said power shaft, a nut acting on said spring and adjustable axially for varying the action of said spring on said governor device, and means controlled by the pressure of air delivered by said compressor and operative upon an increase in said air pressure to actuate said nut to reduce the action of said spring on said governor device and upon a reduction in said air pressure to increase the action of said spring on said governor for thereby effecting operation of said mechanism to increase and decrease the speed of said compressor drive shaft upon a reduction and an increase, respectively, in the pressure of air delivered by said compressor.

11. In combination, an air compressor comprising a rotatable drive shaft, a variable speed rotatable power shaft, a driven friction disk secured to said drive shaft for turning same, a driving friction disk secured to said power shaft for rotation therewith and cooperative with said driven disk to turn said drive shaft for operating said compressor, one of said disks being movable radially relative to the other to vary the speed ratio between said disks, a spring, a speed governor device connected to rotate with said power shaft and connected to said one disk, said speed governor device being controlled by the opposing pressures of said spring and centrifugal force and being operative in accordance with variations in speed of said power shaft to vary the radial position of said one disk with respect to the other to compensate for such variations in speed, an axially movably nut backing up said

spring for controlling said governor device, and means controlled by the pressure of air delivered by the compressor and connected to said nut and operative upon a reduction in said air pressure to turn said nut in a direction to relieve the action of said spring on said governor device and upon an increase in said air pressure to turn said nut in the opposite direction to increase the action of said spring on said governor device for thereby varying the speed ratio between said disks inversely according to the pressure of air delivered by said compressor.

12. In combination, an air compressor, a driven friction disk for operating said compressor, a prime mover, a driving friction disk rotatable by said prime mover and having a peripheral face frictionally engaging an end face of said driven disk for driving said compressor, a spring, a speed governor device connected to rotate with said driving disk and subject to the opposing forces of said spring and centrifugal force and operative in accordance with variations in the rotative speed of said driving disk to move said driving disk radially of said driven disk to compensate for such variations, an axially movable nut backing up said spring, and means for actuating said nut to vary the action of said spring on said governor for thereby varying the speed of said driven disk.

13. In combination, an air compressor, a driven friction disk operable upon rotation to operate said compressor, a prime mover, a shaft spaced from one end of said disk and disposed at right angles to the axis thereof and secured to rotate with said prime mover, a sleeve slidably mounted on said shaft lengthwise thereof, a friction disk secured to rotate with said shaft and movable with said sleeve radially of said driven disk and having a peripheral face in frictional driving engagement with the end face of said driven disk, a governor control spring acting on said sleeve for opposing movement of said driving disk in the direction of the perimeter of said driven disk, a speed governor device rotatable by said shaft and connected to said sleeve controlled by the opposing forces of said spring on said sleeve and centrifugal force for moving said driving disk radially of said driven disk to positions to compensate for variations in speed of said prime mover, a second spring, a piston subject to the opposing pressure of said second spring and of the pressure of air delivered by said compressor and connected to said governor spring for varying the action thereof on said governor device, said piston being operative when said air pressure exceeds the pressure of the second named spring to change the action of the governor spring on said governor device so as to shift said driving disk inwardly of said driven disk for increasing the speed of said compressor and being operative when the pressure of fluid acting on said piston exceeds the opposing pressure of said second named spring for relieving the action of said governor spring on said governor device for thereby rendering the governor device operative to move said driving disk outwardly of said driven disk to thereby reduce the speed of said compressor.

14. In combination, an air compressor, a driven friction disk operable upon rotation to operate said compressor, a prime mover, a shaft spaced from one end of said disk and disposed at right angles to the axis thereof and secured to rotate with said prime mover, a sleeve slidably mounted on said shaft lengthwise thereof, a friction disk secured to rotate with said shaft and movable with said sleeve radially of said driven disk and having a peripheral face in frictional driving engagement with the end face of said driven disk, a governor control spring acting on said sleeve for opposing movement of said driving disk in the direction of the perimeter of said driven disk, a speed governor device rotatable by said shaft and connected to said sleeve controlled by the opposing forces of said spring on said sleeve and centrifugal force for moving said driving disk radially of said driven disk to positions to compensate for variations in speed of said prime mover, an axially adjustable nut backing up said governor spring and operative upon rotation to vary the action of said spring on said governor, a gear secured to said nut for turning same, a gear rack for rotating said gear, a second spring, a piston connected to said rack and subject to the opposing pressures of said second spring and of air delivered by said compressor, said piston being operative when the pressure of said second spring exceeds that of the air delivered by the said compressor to actuate said gear and nut to change the action of said governor spring on said governor device for thereby rendering said governor device operative to move said driving disk inwardly of said driven disk to increase the speed of said compressor, said piston being operative by the pressure of air delivered by said compressor when said air pressure exceeds that of the second named spring to actuate said gear and nut for relieving the action of said governor spring on said governor device to thereby render said governor device effective to move said driving disk outwardly of said driven disk to reduce the speed of said compressor.

15. In combination, an air compressor, a driven friction disk operable upon rotation to operate said compressor, a prime mover, a shaft spaced from one end of said disk and disposed at right angles to the axis thereof and secured to rotate with said prime mover, a sleeve mounted to slide on said shaft in the direction of its length and secured to rotate with said shaft, a friction driving disk having a peripheral friction face in frictional driving engagement with an end face of said driven disk, said driving disk being secured to turn with said sleeve and being movable radially of said end face upon movement of said sleeve lengthwise of said shaft for varying the speed ratio between said disks, a speed governor device operative in accordance with the speed of rotation of said prime mover for moving said sleeve on said shaft and for thereby moving said driving disk relative to said driven disk to vary the speed ratio between said disks to compensate for variations in speed of said prime mover, and means responsive to changes in the pressure of air delivered by said compressor to vary the operation of said governor device for varying said speed ratio to vary the speed of said compressor inversely to the pressure of air being delivered by said compressor.

16. In combination, an air compressor, a driven friction disk operable upon rotation to operate said compressor, a prime mover, a shaft spaced from one end of said disk and disposed at right angles to the axis thereof and secured to rotate with said prime mover, a sleeve mounted to slide on said shaft in the direction of its length and secured to rotate with said shaft, a friction driving disk having a peripheral friction face in frictional driving engagement with an end face of said driven disk, said driving disk being secured

to turn with said sleeve and being movable radially of said end face upon movement of said sleeve lengthwise of said shaft for varying the speed ratio between said disks, a second sleeve secured against axial movement and having a telescopic connection with the first sleeve and secured for rotation therewith, a spring extending through said second sleeve and acting on said first sleeve urging same and thereby said driving disk in the direction of the center of said driven disk, a speed governor device operatively connected to said sleeves and rotatable therewith, said speed governor device being controlled by the opposing forces of said spring and centrifugal force for sliding said first sleeve on said shaft to vary the position of said driving disk with respect to said driven disk so as to compensate for variations in speed of said prime mover, and means responsive to variations in the pressure of air delivered by said compressor for varying the action of said spring on said governor device to actuate said governor device to reduce the speed ratio between said disks upon a reduction in air pressure and increase said speed ratio upon an increase in air pressure.

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