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INDUCTION SPEED GOVERNOR

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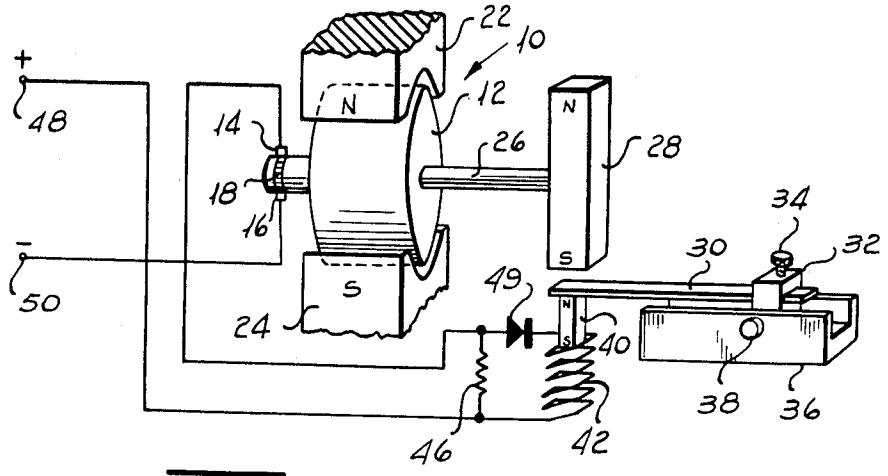


Fig 1

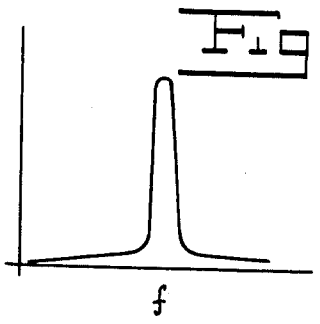


Fig 3

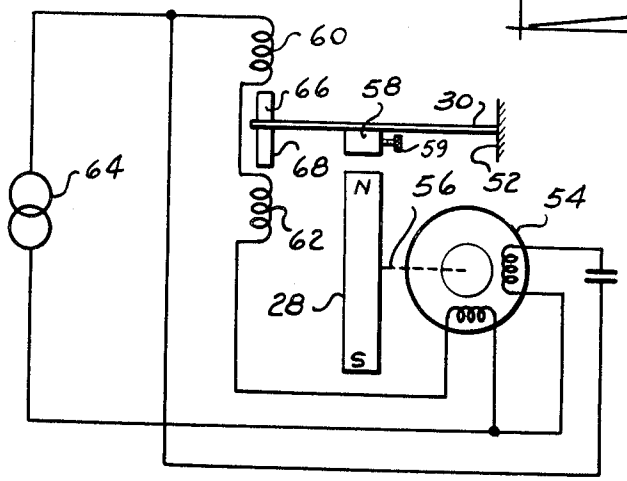


Fig 2

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INDUCTION SPEED GOVERNOR

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Original application Dec. 20, 1960, Ser. No. 77,089, now Patent No. 3,129,370, dated Apr. 14, 1964. Divided and this application Sept. 12, 1963, Ser. No. 315,732
2 Claims. (Cl. 318—329)

This application is a division of our copending application Serial No. 77,089, now Patent No. 3,129,370 filed December 20, 1960.

Our invention relates to an induction speed governor and more particularly to an improved speed governor which is more reliable and which is more easily adjusted than are speed governors of the prior art.

There are known in the prior art governors for regulating the speed of electric motors. One type of governor consists essentially of a centrifugal switch connected in the motor supply line which opens and inserts a resistance in the line when certain speeds are attained. The speed at which the switch opens is determined by the governor setting. While the governor is operating, the current to the motor is continuously established and is partially interrupted by the centrifugal switch.

Governors of the type described above embody a number of disadvantages. First, since they embody vibrating contacts, problems of arcing and contact point burn out exist. Thus the life of the governor is limited by the life of the contact points. Secondly, the unit is not as reliable as is desired, since the contacts become dirty and, in an extreme case, they may fuse. A further disadvantage of governors of this type is that the motor must be stopped to permit the setting of the governor to be changed. Moreover, a change in the setting affects the dynamic balance of the rotor.

We have invented an induction speed governor which overcomes the disadvantages of governors of the prior art pointed out hereinabove. The setting of our governor may be changed without stopping the motor and without affecting the dynamic balance of the rotor. Our improved governor has no vibrating contacts so that problems of arcing and contact point burn out are eliminated. Thus, our governor is more reliable than are governors of the prior art.

One object of our invention is to provide an induction speed governor the setting of which may be changed without stopping the motor which it controls.

A further object of our invention is to provide an induction speed governor which has no vibrating contacts.

A still further object of our invention is to provide an induction speed governor which is more reliable than are governors of the prior art.

Other and further objects of our invention will appear from the following description.

In general, our invention contemplates the provision of an induction speed governor in which a magnet driven by the motor to be controlled vibrates a reed at a frequency somewhat less than the natural frequency of vibration of the reed. In response to reed vibration, there is produced an electrical effect which increases with the amplitude of vibration to control motor speed. In one form of our invention we feed a voltage generated in response to vibration in the reed to the armature of a direct current motor to oppose the armature voltage. In another form of our invention in response to changes in reed vibration the inductance of an inductor in the circuit of an alternating current motor varies.

In the accompanying drawings which form part of the necessary specification and which are to be read in conjunction therewith and in which like reference characters are use to indicate like parts in the various views:

FIGURE 1 is a schematic view of one form of our induction speed governor used to control the speed of a direct current motor.

FIGURE 2 is a schematic view of another form of our induction speed governor used to control the speed of an alternating current motor.

FIGURE 3 is a curve illustrating the response of the reed of our induction speed governor.

Referring now to FIGURE 1 of the drawings, a direct current motor indicated generally by the reference character **10** has an armature **12** adapted to be supplied with energy by brushes **14** and **16** in engagement with a commutator **18**. The field for the motor **10** may be provided by a permanent magnet having a north pole **22** and a south pole **24**. When armature **12** is energized, shaft **26** rotates in a manner known to the art.

We mount a permanent magnet **28** on shaft **26** for rotation therewith. Magnet **28** is an elongated bar magnet having a north pole at one end thereof and a south pole at the other end. We mount a reed **30** formed from a suitable resilient material in a supporting bracket **32** in which the reed **30** is secured by a screw **34**. Bracket **32** may be adjustably positioned on a suitable stationary support **36** by means of a set screw **38** or the like.

We secure a small permanent magnet **40** to the reed **30** for movement therewith. As the bar magnet **28** rotates it alternately attracts and repels the magnet **40** thus to impart a vibration to the reed **30**. It will be appreciated from the description of the second form of our invention given hereinafter that we could alternately make the reed **30** of a magnetic material in which case the rotation of the permanent magnet **28** would cause the reed to vibrate. We dispose the magnet **40** in a position at which upon vibration of reed **30** it moves into and out of a winding **42** to induce a voltage in the winding. We connect a rectifier **44** and a resistor **46** in series across the coil **42** so that a direct current potential of the polarity indicated exists across resistor **42**. We connect the terminals of the resistor **46** respectively to brush **14** and to the positive terminal **48** of a source of direct current potential the negative terminal of which is connected to brush **16**.

Referring now to FIGURE 3, we have shown the response curve of the reed **30** as a plot of the amplitude of the vibration as a function of the frequency to which the reed vibrates. As can be seen by reference to the curve, when the reed is driven at its natural frequency, then the amplitude of the vibration is extremely large. We so construct and support the reed **30** as to have a natural frequency of vibration which is somewhat greater than the frequency at which the motor drives the reed when the motor is operating at its desired speed. Thus if the motor tends to speed up, the amplitude of vibration of the reed **30** will increase as well as its frequency of vibration with the result that magnet **40** enters further into coil **42** and the voltage of register **46** increases. It will be seen that this voltage opposes the motor armature voltage so that as the voltage on resistor **46** increases then the motor slows down.

Referring now to FIGURE 2, we have illustrated another form of our invention in which reed **30** is fixed in a stationary support **52**. The motor to be controlled in this case may be an alternating current servomotor **54** adapted when energized to drive its shaft **56** carrying the magnet **38**. In this form of our invention we mount a slug **58** of magnetic material on the reed **30** so that when magnet **28** rotates it vibrates the reed **30**. We could, of course, form the reed **30** itself of magnetic material. We connect a pair of induction coils **60** and **62** in series with motor **54** across a source **64** of alternating current. The end of

the reed **30** remote from the support **52** carries for movement therewith a pair of slugs **66** and **68** of magnetic material. When, as magnet **28** rotates, reed **30** vibrates slugs **66** and **68** alternately move into and out of the respective windings **60** and **62** thus to vary the inductance in circuit. We so construct the assembly of the reed **30** and the slugs **66** and **68** as to have a natural frequency of vibration somewhat greater than the frequency of vibration when motor **54** is operating at the desired speed. Thus as the motor speed increases the amplitude of motion of the reed **30** increases and a greater change in inductance in the circuit is produced. Consequently, the current in the motor **54** drops and its speed decreases. It will be understood of course that the reed **30** in the form of our invention shown in FIGURE 2 may be adjusted in length. A screw **59** may be actuated to vary the center of gravity of the reed.

In operation of the form of our invention shown in FIGURE 1 when motor **10** is energized it drives shaft **26** to rotate magnet **28** to cause reed **30** to vibrate. When the motor is operating at the desired speed, the potential across resistor **46** causes the armature potential to be that potential required to keep the motor rotating at its desired speed. If for any reason the motor speeds up the amplitude of motion of reed **30** changes to increase the potential across resistor **46** to decrease the armature potential to cause the motor to slow down. Consequently, if the motor speed drops below the desired speed, the potential across resistor **46** drops and the motor speeds up. The setting of the governor may readily be changed by changing the effective length of reed **30**. This can be accomplished by moving bracket **32** along the length of the reed and by repositioning the bracket properly to locate magnet **40**.

In operation of the form of our invention shown in FIGURE 2 when motor **54** is energized, shaft **56** rotates to cause magnet **28** to vibrate reed **30**. As the reed vibrates, slugs **66** and **68** move into and out of windings **60** and **62** to present a certain effective inductance to the circuit. If the motor is rotating at a great speed, then the inductance is such as will keep the motor rotating at this speed. As, however, the speed of the motor changes, the effective inductance changes in a direction to cause the motor to return to the desired speed.

It will be seen that we have accomplished the objects of our invention. We have provided an induction speed

governor which does not require vibrating electric contacts. Our governor is more reliable than are governors of prior art. We may change the setting of our governor without affecting the dynamic balance of the motor assembly. This setting may be changed without stopping the motor.

It will be understood that certain features and subcombinations are of utility and may be employed without reference to other features and subcombinations. This is contemplated by and is within the scope of our claims. It is further obvious that various changes may be made in details within the scope of our claims without departing from the spirit of our invention. It is, therefore, to be understood that our invention is not to be limited to the specific details shown and described.

Having thus described our invention, what we claim is:

1. An induction speed governor for a motor having a shaft including in combination an element having a natural frequency of vibration, means responsive to rotation of said shaft for vibrating said element at a frequency in the region of said natural frequency, a source of alternating voltage, a variable impedance, means connecting said source and said impedance and said motor in series and means responsive to vibration of said member for varying said impedance.

2. An induction speed governor for a motor having a shaft and having an input circuit for applying a voltage to said motor including in combination a vibratory element, means mounting said element for vibratory movement at its natural frequency of vibration, means responsive to rotation of said shaft for vibrating said element at a frequency below said natural frequency of vibration, an inductance coil connected in said input circuit, a slug of magnetic material and means responsive to vibration of said element for moving said slug in inductively coupled relationship relative to said coil to vary the inductance of said coil.

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