April 29, 1930. C. R. ALDEN 1,756,671

SPEED RESPONSIVE DEVICE

Filed Jan. 30, 1926

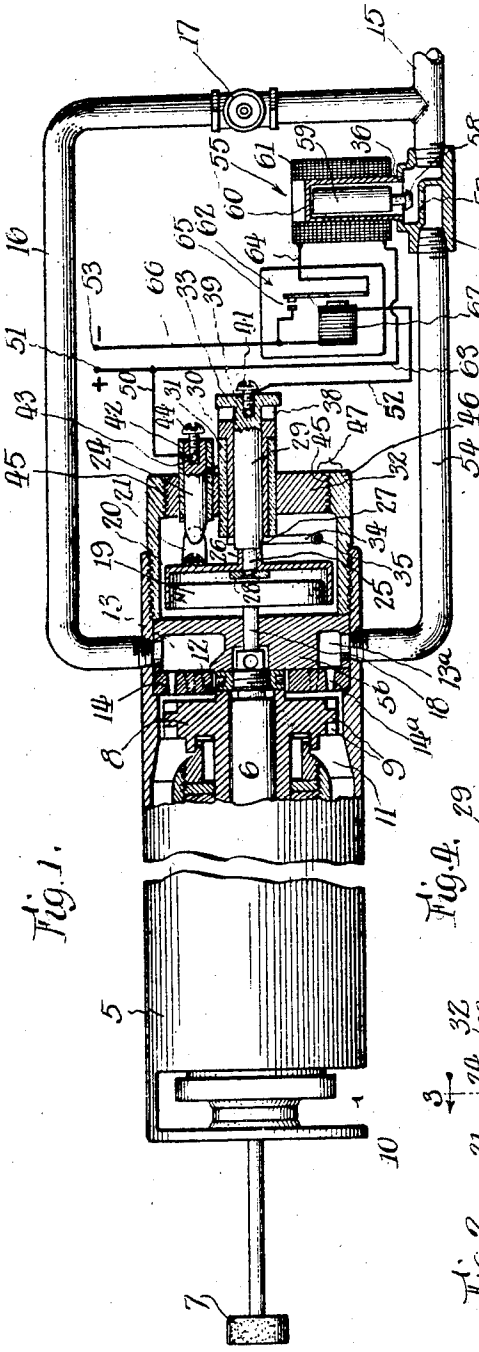


Fig. 1.

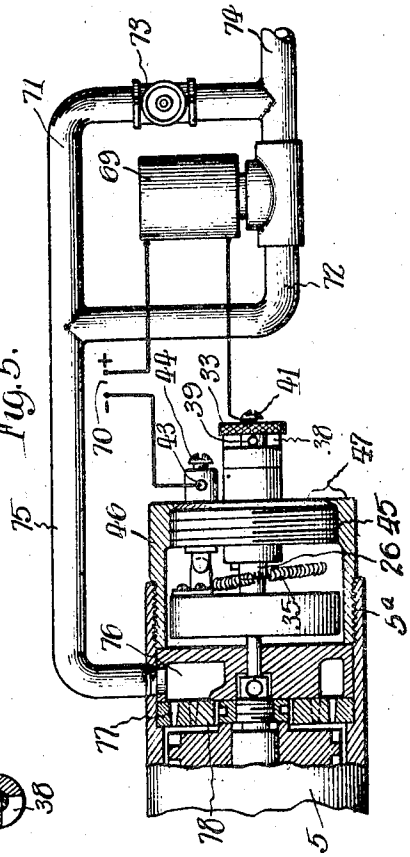


Fig. 5.

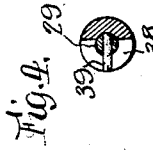


Fig. 4.

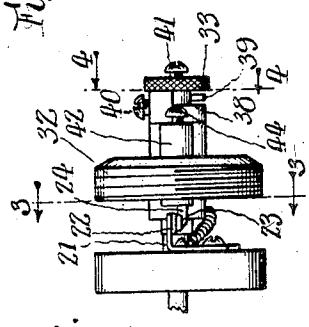


Fig. 2.

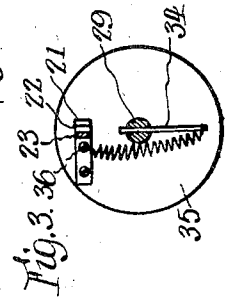


Fig. 3.

Inventor:
Carroll Russell Alden,
By Chisholm Parker Carlson
Attys.

Patented Apr. 29, 1930 1,756,671

UNITED STATES PATENT OFFICE

CARROLL R. ALDEN, OF DETROIT, MICHIGAN, ASSIGNOR TO EX-CELL-O AIRCRAFT AND TOOL CORPORATION, OF DETROIT, MICHIGAN, A CORPORATION OF MICHIGAN

SPEED-RESPONSIVE DEVICE

Application filed January 30, 1926. Serial No. 84,814.

This invention relates to speed-responsive devices such as governors and particularly to those which operate at a definite predetermined speed to close an electric switch. The invention is especially directed to the provision of a governing device for high speed light weight tool-carrying spindles and involves a drag effect in order to eliminate the mechanical connection between the governing and the governed device. A governing unit embodying the principles of this invention is particularly applicable to speed control for rotary tools of the above named character which are subject to speed slackening loads when in use. The invention is particularly adapted for fluid driven turbine motors and particularly for motors of a class used for driving small high speed rotary tools such as grinding wheels.

For example, an air driven turbine wheel may be used to drive a grinding wheel spindle, such a motor being used when the grinding wheel is of a small size requiring little power but great speed. Such a wheel is used in internal grinding of very small holes and for many other grinding operations. When idling the wheel will be revolved at a suitable high speed by the air motor but when in contact with work there will be a slackening of speed depending upon the amount of feed or the character of the work. The speed variation of such a wheel is troublesome and undesirable in that no uniform action can be obtained from the wheel. Sometimes in order to obtain a certain cutting speed for the tool the fluid supply to the motor under load is excessive for the idling rotation of the wheel, thus causing the motor and the wheel to run at a dangerous speed unless controlled. To overcome these conditions a manual adjustment of the fluid supply has been employed in the past.

The primary object of the invention is to provide a speed-responsive device which can be placed adjacent to, but not mechanically connected to, a rotating part to effect an electric switch closure at a predetermined speed, and further to use the switch closure to control the power supply for the spindle.

The present invention further aims to provide a governing unit which may be alined alongside a magnetized rotary disk located on the governed shaft; which has an electric switch therein operated at a predetermined speed of the governed shaft to effect the power supply; which is a compact structural unit capable of being sealed if desired to guard against unauthorized inspection thereof; and which is so constructed that it affords a minimum of resistance to the rotation of the governed shaft.

In the accompanying drawings, an exemplary embodiment of the invention is shown as employed in the power control system disclosed in my copending application Serial No. 73,165, filed December 4, 1925, showing a small fluid turbine-driven grinding spindle.

In the drawings, Figure 1 illustrates the turbine spindle shown in cross section, the fluid supplying system therefor, including an electrically controlled valve, and the governor unit of the present invention attached to the rotor end of the spindle casing for operating the valve.

Fig. 2 shows the governor mechanism removed from its housing, the view being a plan elevation of the device shown in Fig. 1.

Fig. 3 is a front elevation of the device shown in Fig. 2 taken along the line 3—3 of Fig. 2.

Fig. 4 is a cross sectional view of the adjusting construction taken along the line 4—4 of Fig. 2.

Fig. 5 is a cross sectional view of the governor unit mounted on a turbine involving a modified system of control.

It is to be understood that the form of the device is not limited to the details of construction disclosed in the drawings and hereinafter more fully described and that the use of the device is not limited to governing turbine-driven spindles. To one skilled in the art numerous uses will no doubt be found for the device and various modifications and structures may be devised. However, the invention in its broadest aspect contemplates other constructions and uses as will appear from the character and scope of the appended claims.

In the drawings 5 illustrates a casing or-

housing of an air driven motor. The housing encloses a spindle 6 which carries at its forward end a work tool, in the present instance this being a grinding tool 7 suitably mounted for rotation with the spindle. The rear end of the housing 5 has a turbine rotor 8 rigid on the spindle 6. In the present instance the rotor has spiral blades 9 thereon which receive driving fluid directed substantially axially of the spindle. The fluid strikes the rotor from the rear of the casing, passes therethrough and is exhausted at the forward end in the region designated 10. A substantially annular fluid passage 11 is provided along the length of the housing so that the driving air cools the spindle bearings. A fixed plate 12 is located adjacent the rotor 8 separating it from a fluid pressure compartment 13. A suitable nozzle structure is provided in the plate, this comprising in the present instance one or more nozzle holes 14 for admitting fluid from the compartment 13 onto the rotor blades 9. A source of fluid supply represented by pipe 15 is connected by a pipe line 16 to the compartment 13, and a regulating shut-off valve 17 is placed in this line. The apparatus so far described represents the basic device upon which the speed governing unit of the invention is applied. It is obvious that no control of motor speed can be obtained without some control of the valve 17.

In order to furnish a convenient control the speed governor is preferably associated with a rearward extension 18 of the spindle 6. A governor is arranged to operate an electric switch at a predetermined speed and to operate from the turbine spindle without mechanical connection thereto thereby offering little or no resistance to its high speed and its smooth running qualities. The governor shown in the drawings comprises a magnetized concentrically mounted disk 19 having north and south poles as indicated. A disk is preferred because of the high speed character of the spindle and because the inherent smooth quality of the disk offers little resistance to rotation. Adjacent this disk is a movable metallic element arranged to be dragged by magnetic force. It consists preferably of a parallel and adjacent disk, being a surrounding cup 20 rotatably mounted on an axis coincident with the axis of the disk 19. A finger or plate 21 rigid with the cup bears an electrical contact 22. A second and fixed electric contact 23 is carried on a part 24 rigid with the machine unit.

The cup 20 turns upon a stationary pin shaft 25, a sleeve bearing 26 formed on the cup abutting a shoulder 27 on the pin. A washer 28 is located on the inside of the cup and the end of the pin is upset to hold the washer. The pin 25 extends rearwardly from the shoulder 27 as an enlarged portion designated 29, the pin being rotatable and bearing in a metallic sleeve 30 which is itself held fixed in an insulating sleeve 31 secured into a mounting plate or disk 32. The shaft 29 is fixed longitudinally in its sleeve 30 by the provision of a knurled head 33 on the rear end of the pin shaft and by an arm 34 on the inner end of the pin shaft adjacent the ends of sleeves 30 and 31. A coiled spring 35 extends from the end of the pin arm 34 to a point on cup 20, the spring being preferably connected by a screw 36 to a part of the finger 21. The knurled head 33 permits an adjustment of the angular position of the pin arm 34 to vary the tension of the spring on the cup. A limited adjustment is permitted by the provision of a recessed portion 38 in the sleeve 31 and a cross pin 39 carried by the shaft 29 in the recess. A set screw 40 in the sleeve 30 holds the pin arm in fixed adjustment. A screw 41 is provided in head 33 for securing a connecting wire thereto.

The contact 23 above mentioned is also carried on the disk 32. The part designated 24 is a metallic plug held in an insulating sleeve 42 mounted in the plate 32. A hole 43 and screw 44 are provided in the sleeve and plug respectively, for securing a connecting wire thereto.

Any suitable means may be provided for mounting the governor mechanism-carrying disk 32. However, a closed housing is preferred in order to completely enclose the governor mechanism. For this reason the disk 32 is threaded as at 45 to close one end of a housing sleeve 46 externally threaded at its other end for being screwed into a threaded socket therefor concentric with the governed shaft or spindle. In the present instance the casing 5 is extended rearwardly to provide an internally threaded flange 5^a to receive the housing 46. The disk 32 is entered into its housing 46 from the end opposite that in which it is mounted, and the parts are so threaded that it will not pass through the sleeve 46. The end of the housing and the other face of the disk 32 are arranged to produce a flush surface 47, which may bear a seal if desired. By this construction it becomes impossible for one to remove the governor unit mechanism from its housing 46 without first removing the housing from the machine upon which it is mounted, and when sealed, one may not have access to the mechanism without breaking the seal.

The governor may be used in various ways as indicated in Figs. 1 and 5. In Fig. 1 a wire 50 is connected to one terminal 51 of a source of electric power, whereas any other wire 52 is connected to the other terminal 53 of such source through suitable means operable to control the fluid supply. The rotation of the magnetized disk 19 drags the cup 20 with it against the action of the spring 35 and at a definite speed breaks the contact.

In Fig. 1 the motor is shown having two fluid compartments, compartment 13 already described, and a second compartment 13^a separated from the compartment 13 by a partition 5^b which is part of the casing. One or more nozzle holes 14^a similar to the holes 14 are provided at the compartment 13^a on the plate 12 on the side of the center opposite the holes 14. A fluid line 54 connects compartment 14^a and the primary fluid pressure source 15. In the line 54 there is an electrically controlled fluid regulating means such as the solenoid valve 55. This valve comprises a casing 56 having a valve seat 57 and a valve head 58 which is herein arranged to be normally held seated by the fluid pressure of the line. The valve head 58 is carried by a magnet core 59, the whole forming a rigid structure which is housed within a tight casing 60 of which the valve casing 56 is a part. A solenoid coil 61 surrounds the part of the casing which houses the core 59. A relay device 62 is preferably interposed between the solenoid valve and the circuit of wires 50 and 52, the current for operating the solenoid passing from the terminal 51 through a wire 63, solenoid 61, wire 64, relay switch 65 and wire 66, to the other terminal 53. The relay magnet 67 is placed in series with wires 52 and 66.

The device above described is subject to two modes of operation, the first of which uses but one line of fluid supply to the motor. First assume the valve 17 to be tightly closed so that the fluid line 16 may be disregarded in the first mode of operation. The governor switch contacts 22 and 23 will be closed below a certain speed of the motor. The contact closure operates through the relay 62 to open the solenoid valve and to open the supply of pressure fluid. The primary source of fluid supply in the pipe 15 is so chosen that under working conditions the spindle has a sufficient speed. As soon as work is removed from the wheel or the work load is sufficiently lightened, the speed will increase and at the desired point the governor contacts will separate, thus permitting the solenoid valve to close. The speed will thus be reduced which will again cause the valve to open. When operated in this manner the solenoid valve will flutter to maintain the speed substantially near the speed setting of the governor. For this reason the relay operation is desirable as the solenoid takes considerable current which one would not wisely pass through the governor contacts.

The second operation of the device of Fig. 1 is the preferable one. It differs only from the first mode of operation in that the valve 17 is opened a sufficient amount to maintain a driving force on the spindle when the solenoid valve is shut. The idling valve 17 is preferably set to maintain the wheel idly rotated at a desired speed which is preferably just above the speed at which the governor operates. The application of a load to the wheel sufficient to reduce the speed will cause the solenoid valve 65 to open and to permit the supply of an auxiliary driving force on the rotor, thereby causing it to increase in speed. This auxiliary line is then operated under speed control for the purpose of maintaining a constant speed. When the primary supply 15 is the only power source the idling supply line 16 may be considered as a by-pass around the valve 55 and the regulating valve 17 as a means for making this a variable by-pass. But it is not essential that a single source of power be used, so that the lines 16 and 54 may also be considered as two independent immediate sources of power for the motor.

In Fig. 5 there is shown a simpler modified application of the invention based upon the preferred method of operation of the apparatus just described. Several modifications of structure are involved. The governor unit switch and a solenoid valve 69 corresponding to the valve 55 of Fig. 1 are placed in series in a simple electric circuit 70, but it will be understood that the relay connection is also contemplated.

The first modification employed in the arrangement of Fig. 5 concerns both the idling fluid supply and the auxiliary fluid supply which correspond generally to the supply lines 16 and 54 of Fig. 1. In the device of Fig. 5 these supply lines are designated 71 and 72, the line 71 having an idling valve 73 of the regulating shut-off type. A single primary fluid pressure source is designated as 74. The lines 71 and 72 unite beyond their valves and the supplies of both lines are caused to act together upon the motor through a single line 75. It is obvious that this is not essentially different from the arrangement in Fig. 1. However, in order to effect speed control, the volume relation of the valves 73 and 69 and the pressure fluid source 74 must be such that the opening of the auxiliary supply 72 at the solenoid valve effects a substantial increase in driving fluid or driving force over what normally passes through the idling valve 73.

The second modification of Fig. 5 is incidental to the first and concerns the motor construction. The use of but one fluid supply line 75 to the motor does not require two supply compartments adjacent the rotor, consequently but one compartment 76 is employed with only one set of nozzle holes 77 in plate 78 which corresponds to the plate 12 in Fig. 1.

It will thus be seen that the invention provides a simple speed responsive device which consumes little power and which may readily be attached to a spindle casing and associated with a power supply for the spindle to regulate the speed thereof.

I claim as my invention:

1. In a governor device of the class de-

scribed having governing mechanism responsive to the rotation of a spindle, a housing comprising a sleeve adapted to be mounted at one end in a machine frame concentric with the spindle, a closure carried by the sleeve at the other end, said closure being entered into the sleeve from the first end and serving to mount the governing mechanism.

2. In a speed-responsive device of the character described having mechanism responsive to the rotation of an element, a casing adapted to be mounted on one face about the element, a plate carried by the casing entered therein through said face and serving to mount said mechanism.

3. In a speed-responsive device of the character described, a mounting member, an insulating sleeve in said member, a conducting pin in said sleeve, a metallic element rotatable on said pin, a spring arranged to resist the rotation of said element, contact points disposed between said member and element, and driven means for inducing a rotative movement of said element against the tension of said spring, the extent of said movement being relative to the driven speed of said means.

4. In a governing device of the character described, a mounting member, an insulating sleeve in said member, a rotatable conducting pin in said sleeve, adjusting means to turn the pin in said sleeve, a metallic element rotatable on said pin, an arm projecting from said pin, a spring arranged between the end of said arm and said element to resist rotation of said element, contact points disposed between said plate and said element, and driven means for inducing a rotative movement of said element against the tension of said spring, the extent of such movement being relative to the driven speed of said means.

In testimony whereof, I have hereunto affixed my signature.

CARROLL R. ALDEN.