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C. R. ALDEN

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SPEED CONTROL

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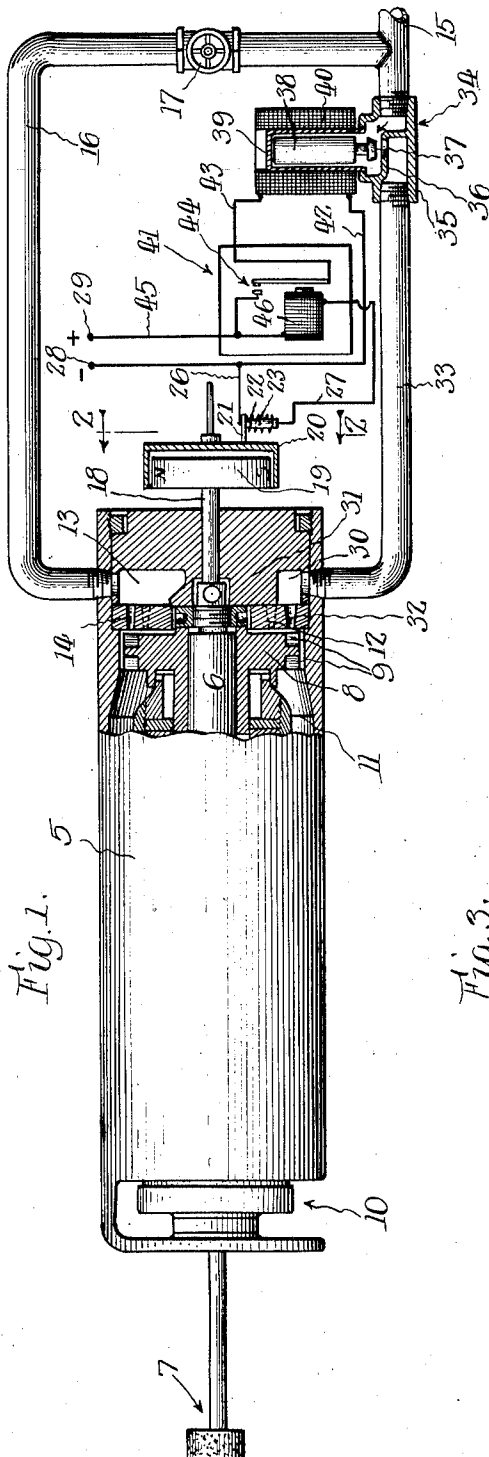


Fig. 1.

Fig. 2.

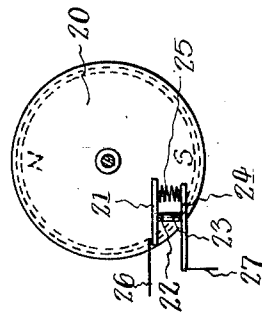
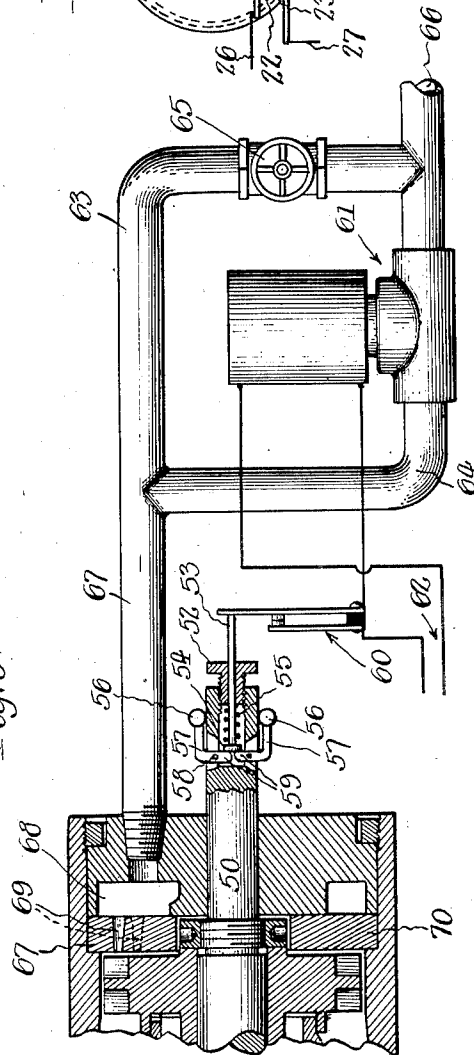


Fig. 3.



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

UNITED STATES PATENT OFFICE.

CARROLL R. ALDEN, OF DETROIT, MICHIGAN, ASSIGNOR TO EX-CELL-O TOOL & MANUFACTURING CO., A CORPORATION OF MICHIGAN.

SPEED CONTROL.

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This invention relates to a speed control for rotary tools 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 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 supplied 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 is necessary.

The present invention aims to provide an automatic speed control for such tools.

One object of the invention is to provide an electrically operated control for the power supply to maintain a substantially constant speed of the tool.

A further object is to provide an auxiliary power supply having such a control.

A still further object is to provide an auxiliary speed-controlled driving force for the spindle in addition to the normal driving force.

In the accompanying drawings the invention is illustrated as embodied in an air driven turbine motor for driving very small grinding elements similar to that shown.

In the drawings, Figure 1 is an air driven motor showing a portion of the rotor region in cross section, the fluid supply system including a solenoid valve in cross section, a speed governor, and electrical circuits.

Fig. 2 shows a plan view of the speed governor of Figure 1 viewed in elevation from the line 2—2 of Figure 1.

Fig. 3 shows a modified form of the invention including modifications in the motor, the governor, and the fluid supply system.

It will, of course, be understood that the application of the invention is not limited to the present disclosure nor is the invention to be construed as limited by the construction illustrated in the drawings. To those skilled in the art, it will appear that the invention is subject to various changes and modifications of the arrangements illustrated in the drawings, and hereinafter described in detail, the true nature and scope of the invention being expressed in 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 8 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 control 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 control a speed governor is attached to the motor. This is preferably provided on a rearward extension 18 of the spindle 6. The governor may be of any preferred form and in the present instance it is arranged to open an electric switch on at-

taining a certain desired speed. The type of governor preferably employed is particularly adapted for high speed spindles because of its smooth and balanced action and because of, the absence of mechanical joints and connections. The governor shown in the drawings comprises a magnetic disc 19 having north and south poles as indicated. Adjacent this disc is a movable metallic member dragged by the magnetic force. It consists preferably of a surrounding metallic cup 20 rotatably mounted on an axis coincident with the axis of the disc. 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. A spring 25 between the parts 24 and the cup 20 is provided as a means forcing the two contacts into closed position to close an electric circuit between wires 26 and 27 connected to the contacts. The wire 26 is connected to one terminal 28 of a source of electric power, whereas the other wire 27 is connected to the other terminal 29 of such source through suitable means operable to control the fluid supply. The rotation of the magnetized disc 19 drags the cup 20 with it against the action of the spring 25 and at a definite speed breaks the contact.

In Figure 1 the motor is shown having two fluid compartments, compartment 13 already described, and a second compartment 30 separated from the compartment 13 by a partition 31 which is part of the casing. One or more nozzle holes 32 similar to the holes 14 are provided in the plate 12 on the side of the center opposite the holes 14. A fluid line 33 connects compartment 30 and the primary fluid pressure source 15. In the line 33 there is an electrically controlled fluid regulating means such as the solenoid valve 34. This valve comprises a casing 35 having a valve seat 36 and a valve head 37 which is herein shown as normally held seated by the fluid pressure of the line. The valve head 37 is carried by a magnet core 38, the whole forming a rigid structure which is housed within a tight casing 39 of which the valve casing 35 is a part. A solenoid coil 40 surrounds the part of the casing 39 which houses the core 38. A relay device 41 is preferably interposed between the solenoid valve and the circuit of wires 26 and 27, the current for operating the solenoid passing from the terminal 28 through wire 42, solenoid 40, wire 43, relay switch 44 and wire 45, to the other terminal 29. The relay magnet 46 is placed in series with wires 27 and 45.

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 41 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 wheel 7 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 Figure 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 34 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 34 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 33 may also be considered as two independent immediate sources of power for the motor.

In Figure 3 there is shown a simpler modification of the invention based upon the preferred method of operation of the apparatus just described. Several modifications of structure are involved. First, a different type of speed governor and switch is employed. The main spindle of the motor is provided with a larger rear extension shaft 50 having a fly-ball governor. The extension shaft 50 has a well 51 formed in the end thereof, which well is screw-threaded at its opening to receive an adjusting nut 52, through which passes a plunger 53 having a head 54 within the well. A spring 55 is compressed between the nut 52 and the plunger head 54. Two or more fly balls 56 carried on a bell-crank stem 57 are pinned at 58 into the shaft 50. The free ends 59 of the stems are

arranged to press on the plunger head as the increased speed moves the balls outwardly. A simple switch designated generally as 60 is operated by the plunger to open at a predetermined speed depending upon the adjustment of the nut 52. The switch 60 and a solenoid valve 61 corresponding to the valve 34 of Figure 1 are placed in series in a simple electric circuit 62, but it will be understood that the relay connection is also contemplated.

The second modification employed in the device of Fig. 3 concerns both the idling fluid supply and the auxiliary fluid supply which correspond generally to the supply lines 16 and 33 of Figure 1. In the device of Fig. 3 these supply lines are designated 63 and 64, the lines 63 having an idling valve 65 of the regulating shut-off type. A single primary fluid pressure source is designated as 66. The lines 61 and 62 unite beyond their valves and the supplies of both lines are caused to act together upon the motor through a single line 67. It is obvious that this is not essentially different from the arrangement in Figure 1. However, in order to effect speed control, the volume relation of the valves 61 and 65 and the pressure fluid source 66 must be such that the opening of the auxiliary supply 64 at the solenoid valve effects a substantial increase in driving fluid or driving force over what normally passes through the idling valve 65.

The third modification of Fig. 3 concerns the motor construction. The use of but one fluid supply line 67 to the motor does not require two supply compartments adjacent the rotor, consequently but one compartment 68 is employed with only one set of nozzle holes 69 in plate 70 which corresponds to the plate 12 in Figure 1.

In the above described embodiments of the invention air is contemplated as the driving fluid but it is to be understood that a liquid fluid supply is equally within the scope of the invention when embodied in fluid motors.

I claim as my invention:

1. For a high speed turbine-driven rotary cutter adapted to receive intermittent working loads, a speed-controlled motor comprising, in combination, a casing, a tool carrying spindle therein, a rotor on said spindle, two independent nozzle structures for said rotor, a fluid supply connected to one nozzle structure for effecting an idling speed of the tool above a predetermined speed, an auxiliary fluid supply connected to the second nozzle structure, means to cut off said auxiliary supply, a speed governor operated by the motor to cause said supply to be opened below said predetermined speed, and operating means actuated by the governor to effect operation of the cut-off means, whereby an excessive speed-slackening load on the

tool causes the governor to open the auxiliary fluid supply to maintain the predetermined speed of the tool.

2. For a high speed turbine-driven rotary cutter adapted to receive intermittent working loads, a speed-controlled motor comprising, in combination, a casing, a tool-carrying spindle therein, a rotor on said spindle, two independent nozzle structures for said rotor, a fluid supply connected to one nozzle structure for effecting an idling speed of the tool above a predetermined speed, an auxiliary fluid supply line connected to the second nozzle structure, a solenoid valve in said auxiliary supply line, an electric switch arranged to cause said solenoid valve to open and close, a speed governor operated by the motor to open and close said switch at said predetermined speed during an excessive speed-slackening load on said tool, whereby to maintain said predetermined speed.

3. For a high speed turbine-driven tool adapted to receive intermittent working loads, a speed controlled motor comprising, in combination, a casing, a tool-carrying spindle therein, two independent means for supplying driving fluid to said spindle, a fluid supply for each means, one of said supplies being sufficient to maintain the tool above a predetermined speed in the idle rotation of the tool, the other supply being an auxiliary supply effective when an excessive speed-slackening load is applied to the tool, a speed governor operated by the motor, and means operated by the governor to cut in and out said auxiliary supply.

4. A speed-controlled fluid-operated motor comprising, in combination, a motor casing, fluid driven rotor means therein, two independent nozzle structures for said rotor means, a fluid supply line for each nozzle structure, a regulator in one line adapted to permit said rotor to be driven at a predetermined idling speed, an electrically operated cut-out means in the second line, a speed governor operated by the motor, and a switch operated by the governor at a predetermined speed, said switch being arranged to actuate said electrically operated cut-out means.

5. A speed-controlled fluid-operated motor comprising, in combination, a motor casing, a fluid driven rotor therein, two independent nozzle structures for said rotor, a fluid supply line for each nozzle structure, a regulator in one line adapted to permit said rotor to be driven at a predetermined idling speed, means to cut-off the supply of fluid to the second line, a speed governor operated by the motor, and means operated by the governor at a predetermined speed to effect operation of the cutting-off means of the second line.

6. A speed-controlled fluid-operated motor comprising, in combination, a motor casing, fluid driven rotor means therein, two independent nozzle structures for said rotor

means, a fluid supply line for each nozzle structure, a primary source of fluid supply, separate lines connecting said source to each nozzle structure, a regulating valve in one line, a cut-off valve in the other line adapted to permit said rotor to be driven at a predetermined idling speed, a speed governor operated by the motor, and means actuated by the speed governor to open and close said shut-off valve at a predetermined speed.

7. For a high speed motor-driven rotary tool adapted to receive speed-slackening loads, a speed-controlled driving means comprising, in combination, a motor for the tool, power means for the motor arranged to drive the tool above a predetermined speed in the idle rotation of the tool, a speed governor operated by the motor, an auxiliary source of power arranged to be connected for driving the motor upon a slackening of speed below said predetermined speed, and means actuated by the governor to cut in and out the auxiliary source of power.

8. A speed control for a fluid-driven turbine motor comprising, in combination, a fluid supply line for said motor, a solenoid valve in said line to turn on or off the fluid supply, an electric switch, a circuit containing said switch arranged to open and close the valve, a speed governor operated by the motor and arranged to close said switch below a given speed of the motor and to open said switch above said predetermined speed, whereby an excessive speed of the motor is prevented by the cutting off action of said valve, and other means to supply fluid to the motor when the valved supply is cut off.

9. A speed control for a fluid-driven turbine motor comprising, in combination, a fluid supply line for running the motor, an electrically operated valve in said line, an electric switch, a circuit containing said switch arranged to open and close said valve, a speed governor operated by the motor to open and close said switch at a predetermined speed, whereby an excessive speed of the motor operates through said switch to cut off the valved fluid supply, and other means to supply fluid to the motor for driving said motor at a predetermined idling speed when the valved supply is cut off.

10. A speed control for a fluid-driven turbine motor comprising, in combination, a fluid supply line for running the motor, a valve to open and close the fluid line, electrical means to operate the valve including an electric switch, a speed governor operated by the motor to open and close said switch at a predetermined speed of the motor, and other means to supply driving fluid to the motor to operate said motor at a predetermined idling speed when said valve is closed.

11. A speed control for a fluid-driven turbine motor comprising, in combination, a fluid supply line for running the motor, a

valve to open and close the fluid line, electrical means to operate the valve including an electric switch, a speed governor operated by the motor to open and close said switch at a predetermined speed of the motor, another fluid line to run the motor and a regulating valve in said other line to permit said motor to be driven at a predetermined idling speed.

12. A speed control for a fluid-driven turbine motor comprising, in combination, a source of fluid supply for the motor, electrically operated means to cut-off said supply including an electric switch, a speed governor operated by the motor to open and close said switch at a predetermined speed of the motor, a second source of fluid supply adapted to supply the motor continuously with driving fluid and effective when the first supply is cut off to keep the motor running above the predetermined speed in the idle rotation of the motor.

13. A speed control for a fluid-driven turbine motor comprising, in combination, a source of fluid supply for the motor, means to cut off said supply, a speed governor operated by said motor to cause said means to cut in or out said fluid supply at a predetermined speed, and a second source of fluid arranged to supply driving fluid continuously to the motor and effective when the first supply is cut off to keep the motor running above the predetermined speed in the idle rotation of the motor.

14. In combination, a rotary spindle having thereon a high speed fluid turbine driven rotor adapted at one end to receive a small rotary tool, a magnetized disk at the other end of the spindle rigid and concentric therewith, a rotary element adjacent said disk adapted to be dragged by the rotating magnetized disk, a spring positioned to oppose the dragging action, an electric switch associated with the dragged element, said switch being arranged to be operated at a predetermined speed, and a fluid supplying system for the rotor controlled by the electric switch.

15. In combination, a rotary spindle having thereon a high speed fluid turbine-driven rotor, said spindle being adapted at one end to receive a small rotary tool, a disk at the other end of said spindle rigid and concentric therewith, a rotatable element aligned with said disk and concentric therewith, one of said aligned parts being magnetized and closely associated with the other to exert a dragging action between them, means to resist the dragging action, an electric switch associated with the dragged element arranged to be operated at a predetermined speed, and a fluid supply system for the rotor controlled by the electric switch.

16. In combination, a single rotary spindle having thereon a high speed fluid turbine-driven rotor, said spindle being adapted at

one end to receive a small rotary tool, a disk at the other end of said spindle rigid and concentric therewith, a pivoted element closely associated with the disk, one of said associated parts being magnetized to exert a dragging action on the other one, means to resist motion of said element resulting from said dragging action, an electric switch associated with the dragged element arranged to be operated at predetermined speed, and a fluid supply system for the rotor controlled by the electric switch.

17. In combination, a spindle having thereon a high speed fluid turbine-driven rotor and adapted at one end to receive a small rotary tool, a metallic disk rotatable with said spindle, a movable element closely associated with said disk, one of said associated parts being magnetized to exert a dragging force between them to move the element by rotation of the disk, means to resist said motion, an electric switch associated with the moved element to be operated at a predetermined speed of the disk, and a fluid supply system for the rotor controlled by said switch.

18. A speed control for a fluid driven turbine motor comprising, in combination, means to supply pressure fluid to operate the motor at a predetermined speed when idling, an auxiliary fluid supply line for operating

the motor at a predetermined speed under varying loads, and means to control said auxiliary fluid supply line, said means comprising a solenoid valve controlling the passage of fluid thru said line and arranged when deenergized normally to shut off said fluid supply, and a speed governor operated by the motor arranged to energize said solenoid to open said valve at said second mentioned predetermined speed of the motor.

19. A speed control for a fluid driven turbine motor comprising, in combination, a fluid supply line for running the motor at a constant predetermined idling speed, an auxiliary fluid supply line for maintaining the speed of the motor under load, a solenoid valve in said auxiliary line for controlling the passage of fluid therethrough, said valve being arranged to completely shut off the fluid supply when deenergized and to be completely open when energized, and a speed governor operated by said motor adapted to maintain said predetermined speed of said motor under load by energizing and deenergizing said solenoid to produce a fluttering action thereof at that speed.

In testimony whereof, I have hereunto affixed my signature.

CARROLL R. ALDEN.

CERTIFICATE OF CORRECTION.

Patent No. 1,718,935.

Granted July 2, 1929, to

CARROLL R. ALDEN.

It is hereby certified that error appears in the printed specification of the above numbered patent requiring correction as follows: Page 4, lines 5 to 7, claim 6, strike out the words "adapted to permit said rotor to be driven at a predetermined idling speed" and insert the same to follow after the word "line" first occurrence, line 5 of same claim; and that the said Letters Patent should be read with this correction therein that the same may conform to the record of the case in the Patent Office.

Signed and sealed this 13th day of August, A. D. 1929.

(Seal)

M. J. Moore,
Acting Commissioner of Patents.