ABSTRACT: An air motor governor including a pair of pivotally mounted blades having valve elements on one end biased apart by a spring to permit unrestricted flow of air therebetween at rotational speeds below a predetermined level, and weights on the other end which are forced outwardly by centrifugal force at increased speeds to cause the valve elements to move together thereby cutting off a portion of the air flow.
3,535,982

AIR MOTOR GOVERNOR

BACKGROUND OF THE INVENTION

The present invention relates generally as indicated to an air motor governor valve and more particularly to an improved governor construction for efficiently and effectively controlling the speed of air-powered motors.

High speed hand tools such as grinders and the like operate most efficiently when driven at a substantially constant speed which may be maintained with the use of a suitable speed-control governor operatively connected to the air motor for the hand tool. However, the governors that are presently available for this particular purpose are generally quite complicated and expensive to manufacture, being comprised of a great many moving parts which not only add to the overall cost of manufacture, but also provide increased friction with consequent wear and poor response. Likewise, the governors are usually much too large for use with small air motors, and even the large sized motors may require major modification to receive the governors because of their poor capacity to size ratio which may greatly affect the size and appearance of the motor. Regardless of these modifications, the governors may unduly restrict the flow of air when fully open, thus reducing the power of the motor.

SUMMARY OF THE INVENTION

With the foregoing in mind, it is a principal object of the present invention to provide an air motor governor which is more responsive and provides less restriction to air flow when fully open than previous known governors, and yet is quite compact and simple in construction, thereby greatly reducing the cost of manufacture and making it suitable for use with both small and large sized motors with little or no modifications required.

Another object is to provide such a governor with relatively few parts, and of a well-balanced design with minimum friction.

Still another object is to provide a governor of the type described having a very high capacity to size ratio.

A further object is to provide such a governor in combination with an air motor having an adjustable air nozzle for permitting variations in the maximum speed of the tool when the governor is fully closed.

These and other objects of the present invention may be accomplished by providing the governor with a pair of pivotally mounted blades having valve elements on one end which are biased apart by a spring to permit substantially unrestricted flow of air theretebetween when the speed of the governor is below a predetermined level, and having weights on the other end which are forced outwardly by centrifugal force as the speed increases to move the valve elements toward each other thereby cutting off a portion of the air flow as required to maintain the air motor at a substantially constant speed. The edges of the valve elements may be contoured to make use of the aerodynamic effects of the incoming air to improve response, and the bearing surfaces about which the blades pivot may be protected from the incoming air so as not to be affected thereby or by foreign objects in the air.

The free end of each valve element is in mating engagement with an angularly disposed cam surface on the other valve element for keeping the blades in phase with each other during pivotal movement of the valve elements between the fully open and fully closed positions.

To the accomplishment of the foregoing and related ends, the invention, then, comprises the features hereinafter fully described and particularly pointed out in the claims, the following description and the annexed drawing setting forth in detail a certain illustrative embodiment of the invention, this being indicative, however, of but one of the various ways in which the principle of the invention may be employed.

BRIEF DESCRIPTION OF THE DRAWING

In the annexed drawing:

FIG. 1 is a fragmentary side elevation view of an air-operated handtool of conventional type having portions thereof broken away to show the manner of attachment of the governor of the present invention to the air motor;

FIG. 2 is an exploded isometric view of the governor of FIG. 1 showing the various parts thereof in disassembled form;

FIG. 3 is a schematic top plan view of the air motor governor of FIG. 1 showing the valve elements in the fully opened position, taken on the plane of the line 3-3;

FIGS. 4 and 5 are schematic top plan views similar to FIG. 3, but showing only the valve elements in the partially and fully closed positions, respectively;

FIG. 6 is an enlarged side elevation view of the governor of FIG. 1 with the nozzle of the handtool shown in position closely adjacent to the valve elements;

FIG. 7 is a fragmentary transverse section through such elements and nozzle, taken on the plane of the line 7-7 of FIG. 6;

FIG. 8 is a fragmentary transverse section through the bearing mount for one of the valve elements of the governor, taken on the plane of the line 8-8 of FIG. 6.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring now more particularly to the drawing and first especially to FIG. 1, there is shown by way of example an air-operated handtool 1 which may be of conventional type, including a generally cylindrical housing 2 containing an air motor 3 similar, for example, to that shown in U.S. Pat. No. 2,830,560, granted to Roland E. Doedeen on Apr. 15. 1958. Projecting from one end of the cylindrical housing 2 is a sleeve 4 covering the chuck element for releasably gripping the shank or arbor 5 on which a suitable tool such as a grinding element may be mounted.

The other end of the cylindrical housing 2 has an end cap 6 threaded or otherwise connected thereto, and provided with a handle extension 7 to which may be connected an air supply hose 8. An air-throttling sleeve 10 or other such device may be mounted on the handle extension 7 for selectively opening and closing communication between the interior 11 of the handle extension 7 and the air supply hose 8, from whence the air passes through a central opening 12 in the end cap 6 into a cavity 13 defined by the end cap 6 and the adjacent end of the air motor 3.

Within the cavity 13 there is disposed a speed-control governor valve 15 constructed in accordance with this invention, which as clearly shown in FIGS. 2—8 comprises three main parts, a carrier or base plate 16; a pair of blades 17, 18 suitably pivotally mounted on said base plate; and a spring 19 interconnecting the blades 17, 18 in a manner to cause the blades to be caused to assume a position to be subsequently fully explained. Pins 20 pressed into openings 21 on diametrically opposite sides of the base plate 16 provide the pivotal mounts for the blades 17, 18, such blades having sleeves 22 brazed or otherwise secured thereto that are adapted to be telescoped over the pins 20. Recesses 25 (see especially FIG. 8) may be provided in the inner ends of the sleeves 22 for receipt of hardened steel balls 26 which provide bearing surfaces for the ends of the pins 20 to minimize friction and wear. The balls 26 may be permanently mounted within the recesses 25 by peening over the edges of the recesses.

Each of the blades 17, 18 are desirably of the same generally V-shape configuration, one of the arms 25 of the blades 17, 18 constituting a valve element 26, and the other arms 27 having weights 28 attached thereto, which may be in the form of solid pins extending in the same general direction as the pivot sleeves 22 and parallel thereto. The sleeves 22 are attached to the blades 17, 18 at the intermediate section 29.

The inner edges 30, 31 of the arms 25, 27, respectively, are preferably straight and intersect to provide an included angle therebetween somewhat greater than 90°. The outer edges 32, 33 of the arms 25, 27 preferentially angulate approximatively 110° with the inner edges 30 of the arms 25 and inner edges 31 of arms 27 parallel to each other. The outer
end 32 of the arm 25 for each blade is also desirably straight and disposed at an angle so that it is parallel to the inner edge 31 of the arm 27 of the other blade for mating and sliding engagement therewith. Accordingly, when the blades 17, 18 are properly assembled on the base plate 16 with the valve elements 26 in side by side relation and the inner edges 31 of the arms 27 extending outwardly adjacent the outer ends 32 of the arms 25 of the other blades and in mating engagement therewith, as shown in FIGS. 3—8, the governor 15 is substantially perfectly balanced, regardless of the position of the blades 17, 18 since the mating engagement between the inner edges of the arms 27 and the outer ends 32 of the blades serve to keep the blades 17, 18 in phase with each other.

The valve elements 26 are yieldably maintained in the fully open position with the outer ends 32 of the arms 25 in full mating engagement with the inner edges of the arms 27 by the bias of the spring 19 as shown in FIG. 3 which may have its ends 35 hooked over the weights 28 where they are confined in narrow notches 36 therein.

To install the governor 15 in the handtool 1, the end cap 6 is removed and the base plate 16 is threadedly connected or otherwise attached to the exposed end of the rotor shaft 37 for rotational movement therewith. At the same time, an air nozzle 38 is axially received in the central opening 12 in the end cap 6 may be axially adjusted to establish the desired clearance 40 between the inner end 39 of the nozzle and the blades 17, 18 of the governor 15, for a purpose to be fully explained hereafter. Now the end cap 6 is threaded into the cylinder housing 2, after which the air throttling sleeve 10 may be moved to the “on” position permitting air to flow from the air supply hose 8 through the nozzle 38 into the cavity 13. With the valve elements 26 fully open as shown in FIG. 3, the governor 15 provides substantially no restriction to the air flow despite its relatively compact size which permits it to be installed in a cavity 13 of relatively small diameter and length, for example, a governor 15 of the type disclosed herein for use with a two horsepower air motor will operate in a cavity approximately eleven-sixteenths inch deep by 1 1/16 inch diameter, with very little restriction to air flow when fully open. Thus, as can be seen, the governor 15 has a very high capacity to size ratio and because of its size, it can be used to govern very small motors with little or no modifications required which would affect the size or appearance of the tool.

The bias of the spring 19 should be sufficient to maintain the valve elements 26 in the fully open position up to the optimum speed for the tool, as for example 11,000 r.p.m. At increased speeds, the weights 28 will be forced outwardly in the end cavity 38 due to centrifugal force to cause the valve elements 26 to move closer together into overlying relationship with a portion of the nozzle 38 as shown in FIG. 4 (the nozzle being shown in phantom lines) thereby restricting the air flow into the cavity 13 and causing a reduction in the speed of the motor. The extent of movement of the valve elements will be dependent upon the speed of rotation of the motor above the design speed; if the speed continues to increase the valve elements 26 will completely close with the inner edges 30 in direct mating engagement with each other as shown in FIG. 5, permitting minimum air flow through the clearance 40 between the inner end 39 of the nozzle 38 and closed valve elements. The extent of the clearance 40 which may be adjusted as aforesaid will thus regulate the maximum speed of the motor when the governor is fully closed.

From the above discussion, it can now be seen that the governor of the present invention is very simple in construction and has a minimum number of parts which are extremely simple and easy to manufacture. There are only two moving parts which provide a well-balanced design, and the bearing mounts for the movable parts reduce the friction to a minimum, thus improving the response of the governor and minimizing wear. The response may be further improved by beveling the inner edges 30 of the valve elements 26 on the side opposite the nozzle 38 as perhaps best seen in FIG. 7 to make use of the aerodynamic effects of the incoming air.

Because of the location of the bearing surfaces 30 within the sleeves 22, they are protected from the incoming air which might otherwise form a shellac substance on these surfaces which could affect the governor performance. Likewise, foreign objects in the air cannot affect the bearing mounts, and the governor is capable of giving excellent and safe performance for an extended period of time. In the event of failure of the governor spring, the weights 28 will be forced radially outwardly by low centrifugal force, causing the governor to shut off for fail-safe operation.

1. A governor valve comprising a base plate, a pair of blades pivotally mounted intermediate their ends on diametrically opposite sides of said base plate, said blades being of a generally V-shaped configuration formed by a pair of diverging arms which provide said ends of said blades, one of said arms of each blade constituting a valve element and the other of said arms of each blade having weights thereon, and spring means interconnecting said other arms of said blades for biasing said valve elements apart, said weights at excessive rotational speeds of said governor valve being forced outwardly by centrifugal force to cause said valve elements to move toward each other, the inner edges of said other arms of each blade being straight and substantially parallel to each other, and the outer ends of said other arms also being straight and substantially parallel to the inner edges of said other arms of the other blade and in mating and sliding engagement therewith for maintaining said blades in phase with each other during pivotal motion toward and away from each other.

2. The governor valve of claim 1 wherein the inner edges of said one arms of said blades are also straight and substantially parallel to each other for direct mating engagement with each other during movement of said valve elements toward each other, and the inner edges of both arms of each of said blades intersect to provide an included angle therebetween greater than 90°.

3. The governor valve of claim 2 wherein said included angle is approximately 110°.

4. The governor valve of claim 1 wherein said base plate has a pair of pins projecting therefrom, and each of said blades has a sleeve attached thereto intermediate said arms which is telescoped over said pins to provide such pivotal mounts for said blades, said sleeves having recesses in their inner ends for receipt of hardened metal balls which provide bearing surfaces for the ends of said pins to minimize friction and wear.

5. The governor valve of claim 1 wherein the inner edges of said valve elements are straight and beveled to provide an aerodynamic surface for improved response.

6. The governor valve of claim 1 wherein said weights are in the form of solid pins, said solid pins having notches therein for receipt of the hooked ends of said spring means.

7. The governor valve of claim 1 further comprising means mounting said base plate for rotation adjacent an air passage for controlling the air flow through said air passage by movement of said valve elements toward and away from each other into and out of overlying relation with said air passage, and an axially adjustable air nozzle in said air passage for varying the clearance between said valve elements and nozzle through which air continues to flow when said valve elements are completely closed.

8. The governor valve of claim 1 wherein said inner edges of said other arms limit movement of said one arms away from each other by engagement by the outer ends of said one arms with said inner edges.