Feb. 16, 1960 R. M. CONKLIN ET AL 2,925,089

PNEUMATIC TOOL

Filed Jan. 31, 1956

FIG-1

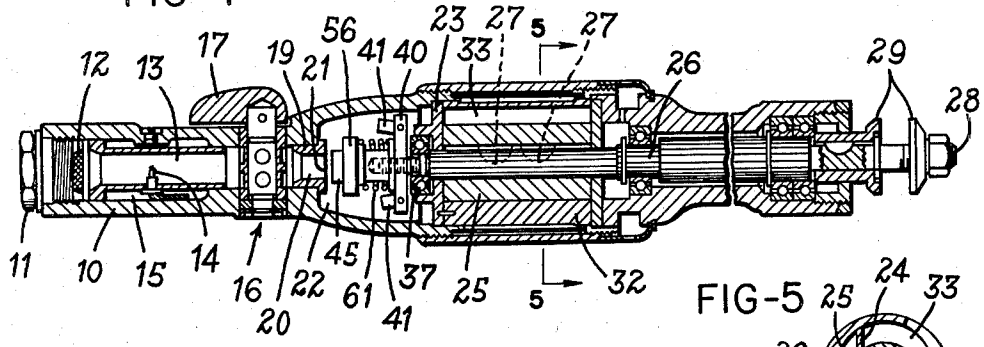


FIG-2

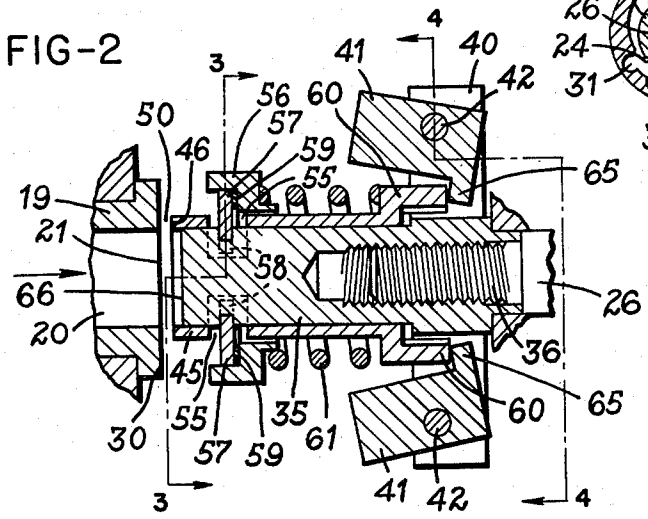


FIG-5

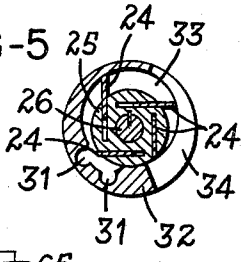


FIG-3

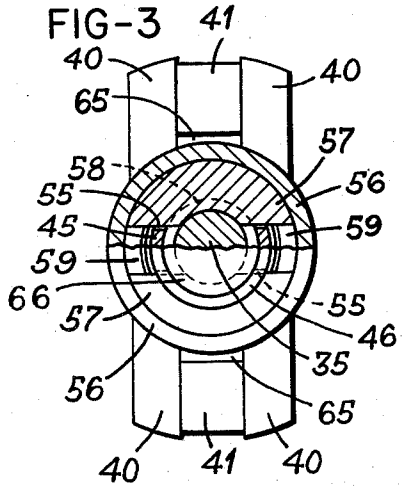
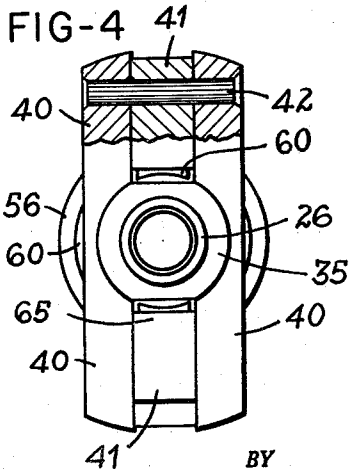


FIG-4



BY

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2,925,089

PNEUMATIC TOOL

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3 Claims. (Cl. 137—33)

This invention relates to pneumatically driven power tools and, more particularly, to a speed responsive governing valve for controlling the admission of driving air in power tools having a pneumatic motor.

In pneumatic driven rotary power tools, it is important to provide a speed responsive governing device or throttle valve for the air inlet to provide protection against possible damage of the tool due to overspeeding of the motor with fluctuations in load, to assure idling at a safe speed, and to limit air consumption during idling in use. If a so-called fly-ball or centrifugal governor is provided as the speed responsive device for actuating a throttle valve to control the air input to the pneumatic motor, the device must be sufficiently large and with sufficient fly-ball weight to close the throttling valve against such opposed forces as spring means biasing the throttling valve open and any components of force against the valve caused by the inrush of driving air to be throttled.

If a throttling valve is provided in which the inrushing air impinges directly against the valve itself tending to force the valve open, greater force is needed from the speed responsive device to close the valve. Also, in such a construction, the sensitivity of the valve may be reduced and, if the inlet air flow impinges directly on the closing valve, a substantial reduction of output horsepower may result at speeds approaching the governed speed. Furthermore, if the inlet air to be throttled impinges directly upon the valve itself, pneumatic forces caused thereby and acting to urge the valve open must be overcome by the speed responsive mechanism before the air can be throttled, and such pneumatic forces, being a function of inlet pressure, also may affect the speed range in which the governor will operate.

According to this invention, however, a speed responsive governing valve is provided to throttle the inlet air flow into the pneumatic motor of a pneumatically driven rotary tool so that a predetermined operating speed will be effectively maintained despite fluctuations in driving air pressure or sudden relaxation of the load on the tool. Such structure includes a sleeve type throttling valve disposed with respect to the air inlet so that the inrushing driving air does not impinge directly upon the valve in a manner to oppose closing the valve, yet, since the valve sleeve is correlated in size and positioning with respect to the air inlet, a continuously open and unobstructed air admission control port is maintained. With a structure according to this invention a conveniently compact speed responsive throttling or governing valve is provided with enhanced sensitivity and is substantially independent of air inlet pressures in a manner to provide properly controlled output horsepower maintained at speeds closely approaching the predetermined governed speed.

It is one object of this invention to provide in a pneumatic tool of the character described a speed responsive

governing valve for throttling the driving air input at a predetermined speed with a sleeve type valve operating with respect to the air inlet to vary the area of a continuously open and unobstructed air inlet control port to maintain such a predetermined speed effectively under changes in load and pressure of the air supply.

A further object of this invention is to provide in a tool of the character described a sleeve-type throttling valve disposed and correlated with an air inlet so as to provide throttling through a continuous annular control port and yet avoid the impinging of inrushing air on the valve member in a manner to oppose closing of the valve.

Another object of this invention is to provide in a device of the character described a speed responsive governing or throttling valve which may be compactly constructed and mounted in the device on a rotating shaft therein yet without rotating engagement of the valve members with stationary parts of the device such as might cause wear and inaccuracy of the valve.

Still another object of this invention is to provide in a device of the character described a speed responsive governing valve for throttling input air into the device by varying the size of a single input control port which is maintained at all times continuously open and unobstructed for uninterrupted air flow therethrough.

Other objects and advantages of this invention will be apparent from the following description, the accompanying drawing and the appended claims.

In the drawings,

Fig. 1 is a view partly in section of a pneumatic tool of the character described having the invention applied thereto;

Fig. 2 is a sectional view on an enlarged scale of a speed responsive governing or throttling device embodying the invention;

Fig. 3 is a view partly in section along the line 3—3 of Fig. 2;

Fig. 4 is a view partly in section along the line 4—4 of Fig. 2; and

Fig. 5 is a transverse section along the line 5—5.

In the drawing, in which like reference characters refer to like parts throughout the several views thereof, a pneumatically driven grinding tool is shown generally in Fig. 1 as having a handle member 10 at one end of which is a fitting 11 to receive an air hose (not shown) to provide driving air to the tool. The air enters the tool through fitting 11, a filter or screen 12, and an air passage 13 where droplets of lubricating oil are entrained in the air from wick 14 fed from a lubricating oil reservoir 15 in handle 10. The admission of air is controlled by an off-on valve indicated generally at 16 and operated by a trigger member 17. Valve 16 admits driving air through a bushing or sleeve 19, having air inlet passage 20 and a discharge end 21, into chamber 22. From chamber 22 the driving air passes through admission passages 31 through plate 23 and cylinder 32 to impinge upon the vanes 24 of rotor 25 mounted on main shaft 26 within the eccentric bore 33 of cylinder 32 and coupled to shaft 26 as by keys 27, thereby rotatably driving rotor 25 and shaft 26 in the well-known manner of operation of pneumatically driven motors of the character described. After impinging upon vanes 24, the air escapes through exhaust openings 34 in cylinder 32 and thence outside the casing of the tool through exhaust slots (not shown) as is well-known. The output end 28 of main shaft 26 carries a suitable fitting or arrangement 29 to receive and mount an abrasive grinding wheel or the like, also in known manner.

Referring more particularly to Fig. 2, air inlet passage 20 terminates with its discharge end 21 having a free and open cross section surrounded by a flange surface 30 substantially normal to the direction of flow of the air through passage 20 as indicated by the arrow in Fig. 2. Spaced from the discharge end 21 of air inlet passage 20 and coaxially aligned therewith is a spindle 35 coupled to one end of main shaft 26 by the threaded member 36 and mounted for rotation with shaft 26 in suitable bearings 37. At one end of spindle 35 is mounted for rotation therewith a centrifugally operated speed responsive device including cross bars 40 affixed to spindle 35 and carrying at opposite ends thereof weights or fly-balls 41, each of which is pivotally mounted between cross bars 40 by pins 42.

Also mounted on spindle 35 but free to slide axially with respect thereto is valve sleeve 45 having a throttling end 46 spaced from and aligned with the discharge end 21 of air inlet passage 20. The inner diameter of valve sleeve 45 is preferably substantially the same or at least as large as the inner diameter of discharge end 21 of air inlet passage 20, and end 46 of valve sleeve 45 defines with flange surfaces 30 of inlet passage 21 an annular continuously open control port 50 through which an uninterrupted flow of air is maintained from air inlet passage 20 into chamber 22 and thence to the air motor 24, 25, etc. during operation of the tool.

Two annular slots 55 are provided in valve sleeve 45 intermediate the ends thereof, and a retaining ring 56 is provided around valve sleeve 45. Retaining ring 56 is axially positioned on spindle 35 by annular keys 57 received in keyways 58 in spindle 35 through slots 55 in sleeve 45. Adjusting shims 59 of various thicknesses may be provided between keys 57 and retaining ring 56 for accurately adjusting the positioning of ring 56 along spindle 35 and of the preload on spring 61 referred to below.

The end of valve sleeve 45 opposite to throttling end 46 is provided with a flange or shoulder portion 60 of enlarged diameter, and a compression spring 61 is mounted around valve sleeve 45 with the opposite ends of spring 61 abutting against retaining ring 56 and flange 60 of sleeve 45 respectively, thereby urging sleeve 45 axially along spindle 35 away from discharge end 21 of air inlet passage 20 (i.e., to the right in Fig. 2). The arrangement of keys 57 and retaining ring 56 also provides for readily and quickly disassembling and/or replacing the entire assembly of parts on spindle 35 when repair, replacement or adjustment of the governing device is desired, as well as maintaining ring 56 centered about sleeve 45 to avoid friction or binding therebetween.

As will be understood from the foregoing, as the incoming driving air causes rotor 25 and shaft 26 to rotate by impinging upon the vanes 24, spindle 35 and its associated parts also rotate. As the speed of rotation increases, centrifugal force causes fly-balls 41 to pivot radially outwardly about pins 42, thereby causing arms 65 on fly-balls 41 to bear against flange 60 on sleeve 45 and force it toward the left in Fig. 2 against the contrary biasing action of spring 61, thereby diminishing the annular area of control port 50 between throttling end 46 of sleeve 45 and flange surfaces 30 of the discharge end 21 of air inlet passage 20. The limits of axial sliding movement of sleeve 45 along spindle 35 toward and away from air inlet passage 20 are defined by the axial width of slots 55 through which keys 57 engage keyways 58 in spindle 35, and the biasing force of compression spring 61 which must be overcome by centrifugal force (and, hence, the speed at which the governing device will operate) may be accurately adjusted by varying the thickness of shims 59 between keys 57 and retaining ring 56.

The weight and dimensioning of fly-balls 41, as well as the off-center placement of pins 42 with respect thereto, are correlated with the length of the cross bars 40 and the strength and adjustment of compression spring 61 so that, when a predetermined desired maximum speed of rotation is reached, the centrifugal force tending to cause fly-balls 41 to fly radially outwardly will have moved arms 65 thereof sufficiently to force sleeve 45 enough to the left in Fig. 2 to diminish the size of control port 50 and throttle the inlet air admitted to vanes 24 of rotor 25 so that the speed of rotation will not increase beyond the predetermined maximum desired. Conversely, as the speed of rotation decreases, the lessened centrifugal force acting upon fly-balls 41 permits spring 61 to force sleeve 45 toward the right in Fig. 2, thereby enlarging the annular area of control port 50 to admit into chamber 22, and thence to vanes 24, a greater driving force of air.

As will be understood from the foregoing, the inrushing air through passage 20 does not impinge directly upon the throttling valve, but is directed against the end 66 of spindle 35 to be deflected radially outwardly through control port 50 into chamber 22. Since control port 50 is open and unobstructed throughout its entire annular area, subdivision of the air flow radially deflected from the rotating end 66 of spindle 35 is avoided, as compared with a situation where the air flow, after having been deflected from the rotating spindle, is interrupted by a plurality of individual radially positioned ports.

Furthermore the force of air entering through passage 20 does not impinge directly upon movable parts of the throttling valve in a manner or direction substantially opposing closing of the valve thereby avoiding dynamic pneumatic effects from this cause from the inflowing air from the governing system. Also adverse static pneumatic effects from pressure differences inside and outside sleeve 45 are minimized by the reduced valve surface area 46. Thus, a construction embodying the invention avoids not only loss of available horsepower from interrupting air flow through a number of baffled control ports and from having incoming air flow oppose the closing of a throttling valve by the air driven motor, but also the accuracy and sensitivity of the throttling valve is enhanced and made substantially independent of inlet air pressure, and, to a greater extent than heretofore, of both the static and dynamic pneumatic effects of prior constructions, and a more compact arrangement is provided. Also rotating bearing engagement between stationary and rotating parts of the throttling mechanism is avoided.

While the form of apparatus herein described constitutes a preferred embodiment of the invention, it is to be understood that the invention is not limited to this precise form of apparatus, and that changes may be made therein without departing from the scope of the invention which is defined in the appended claims.

What is claimed is:

1. In combination with a pressure fluid driven motor having a casing and a fluid driven rotor mounted for rotation in said casing, a control chamber in said casing having connections to supply motive fluid to said rotor, means for admitting fluid into said chamber including an inlet nozzle having a through passage coaxially with the axis of rotation of said rotor, a spindle in said chamber mounted to rotate with said rotor and terminating at one end adjacent and in freely spaced relation to said nozzle defining therewith an uniterrupted annular flow passage through which fluid enters said chamber, said one end of said spindle being at least the same in cross-sectional size as the passage through said nozzle to deflect all of the stream of pressure fluid entering said chamber from said nozzle through said annular flow passage, a proximity governor valve controlling the flow of fluid through said annular passage including a sleeve slidably mounted about said one end of said spindle, a biasing spring surrounding said sleeve and acting thereon to urge said sleeve normally away from said nozzle for fully opening said annular passage, fly-weights pivotally mounted on said spindle and acting upon said sleeve in opposition to said spring for restricting said annular passage when the

rotational speed of said motor attains a predetermined limit, and means for mounting said fly-weights radially externally of both said valve sleeve and said biasing spring.

2. Apparatus as defined in claim 1 including means limiting movement of said valve sleeve to prevent contact thereof with said nozzle and other stationary parts within said casing.

3. Apparatus as defined in claim 1 including adjustable means coacting between said valve sleeve and said biasing spring for varying the force of said biasing spring which must be overcome by said fly-weights.

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