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Whitehouse

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[54] **FLUID OPERATED TOOL HAVING SELF-COMPENSATING THROTTLE VALVE**

[75] Inventor: **Hugh L. Whitehouse,** Lyndhurst, Ohio

[73] Assignee: **The Stanley Works,** New Britain, Conn.

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[63] Continuation of Ser. No. 208,217, Dec. 15, 1971, abandoned.

[52] **U.S. Cl.** **173/169;** 91/59; 91/468; 137/529

[51] **Int. Cl.**[2] **B23B 45/04;** F15B 13/04

[58] **Field of Search** 251/77, 285, 322, 82, 83; 91/59, 418, 468; 173/12, 169; 137/529

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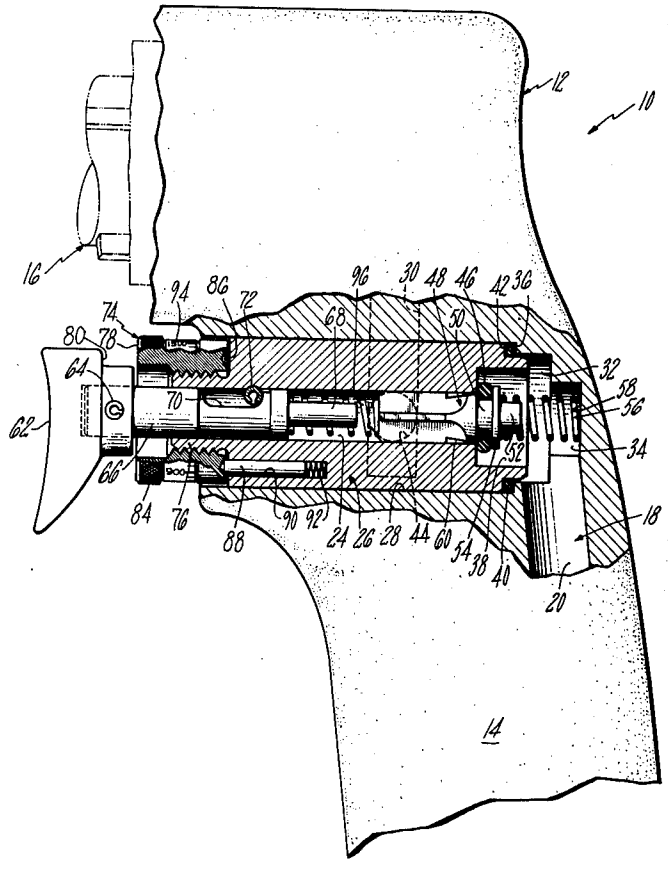
Primary Examiner—Irwin C. Cohen

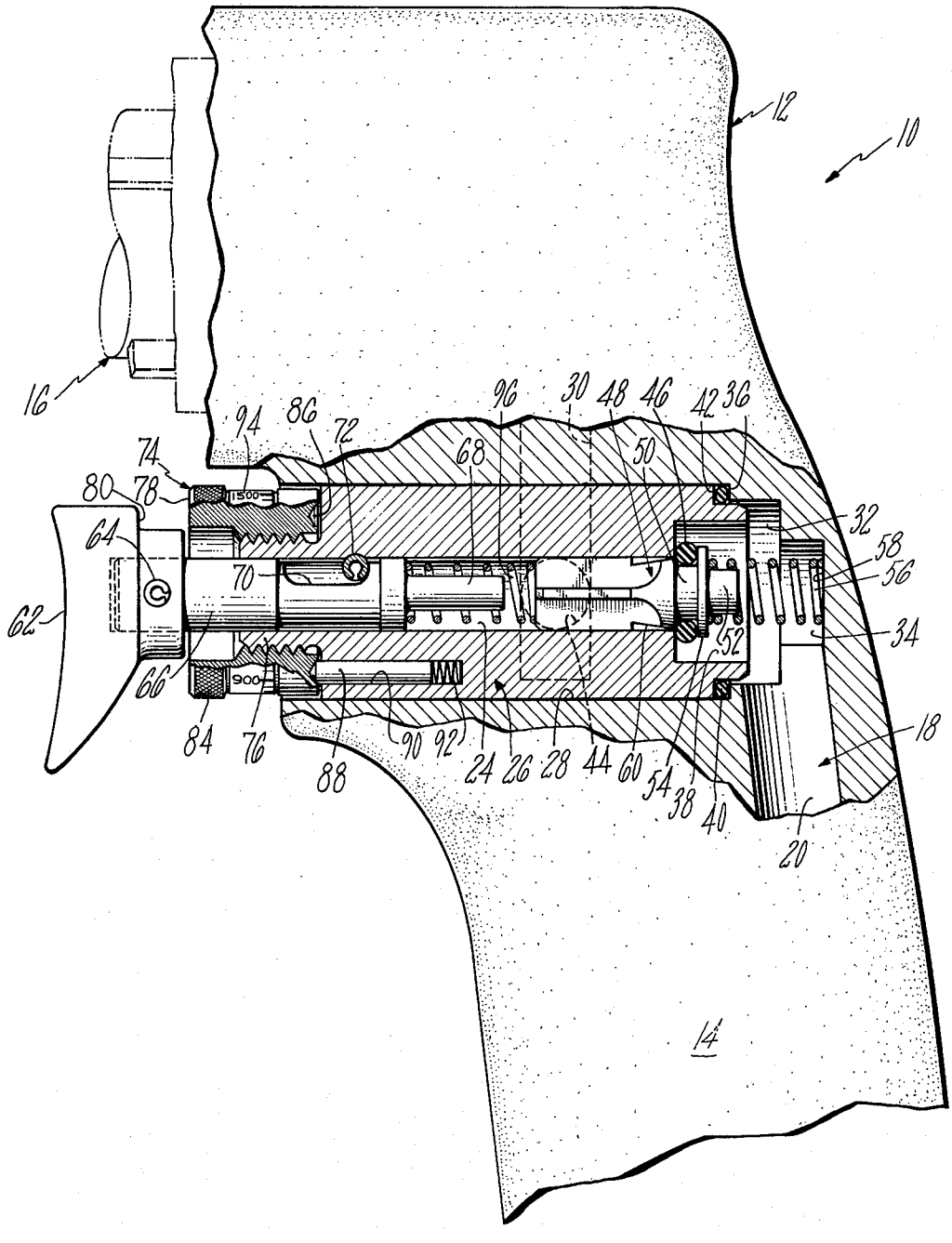
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[57] **ABSTRACT**

A tool housing having a fluid supply passage leading to a fluid motor, a throttle valve received for movement in the passage between an open flow control position and a closed position, and a throttle control including a positively operated throttle actuator and a spring between the throttle valve and its actuator, the spring being preloaded upon operation of the actuator for effecting movement of the throttle valve independently of its actuator for automatically controlling fluid flow in the passage.

3 Claims, 1 Drawing Figure




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FLUID OPERATED TOOL HAVING SELF-COMPENSATING THROTTLE VALVE

This is a continuation of application Ser. No. 208,217, filed Dec. 15, 1971, and now abandoned.

This invention generally relates to power tools and particularly concerns a fluid operated power tool having a so-called self-compensating throttle valve.

A primary object of this invention is to provide a fluid operated tool having a new and improved self-compensating throttle valve which is positively actuated by a manually operable trigger and which then automatically varies fluid flow to a fluid motor responsive to change in the operating speed of the tool to effect a controlled torque output while the trigger remains fully actuated.

Another object of this invention is to provide a self-compensating throttle valve of the type described which is quick and easy to manufacture and install on a fluid operated tool and which is readily adjustable for desired tool performance over a broad range of operating requirements.

A further object of this invention is to provide a new and improved self-compensating throttle valve for use with fluid operated tools and which is of simplified but rugged construction for reliable service over an extended period of time.

Other objects will be in part obvious and in part pointed out in more detail hereinafter.

A better understanding of the objects, advantages, features, properties and relationships of the invention will be obtained from the following detailed description and accompanying drawing which set forth an illustrative embodiment indicative of the way in which the principle of this invention is employed.

The drawing shows a fragmentary view, partly in section and partly broken away, of a fluid operated power tool incorporating a preferred embodiment of this invention.

Referring to the drawing in detail, a fluid operated power tool such as a pneumatic drill **10** is shown for illustrative purposes, although it is to be understood that this invention may be used in a variety of different types of fluid operated power tools. The drill **10** has a housing **12** with a contoured depending pistol grip **14**, and a fluid motor, such as a conventional rotary vane type air motor **16**, is mounted in the housing **12** for driving a work engaging element of the tool, not shown. Compressed air for driving the motor **16** is supplied through a coupling, not shown, at the bottom of the pistol grip **14** and flows through a passage **18** comprising a series of passageways, leading to the air motor **16**.

An inlet supply line **20** and a motor outlet line **30** (depicted by broken lines) of the passage **18** are interconnected through a valve chamber **24**, defined by a cylindrical valve body **26** suitably secured in a bore **28** extending across the housing **12**. The valve bore **28** has a multiple diameter inner end providing a pair of coaxial compartments **32** and **34** which connect the valve chamber **24** with the supply line **20**. Compartment **32** is of an intermediate size relative to the full diameter portion of the valve bore **28** and its reduced terminal compartment **34**, and a concentric annular shoulder **36** is formed in the housing **12** at the juncture of the intermediate compartment **32** with the full diameter portion of the valve bore **28**.

The elongated axially extending valve chamber **24** of the valve body **26** terminates in a concentric compartment **38** of enlarged diameter within a cup-shaped inner end of the valve body **26**. An "O" ring seal **40** is disposed between a shoulder **42** adjacent the inner end of the valve body **26** and shoulder **36** of the housing **12** to prevent undesired air leakage past the valve body **26** and the surrounding portions of the housing **12**. The valve chamber **24** is accordingly suited to serve as a part of the fluid supply passage **18** to communicate its inlet supply line **20** with the motor outlet line **30** via a port shown in broken lines at **44** which will be understood to extend radially outwardly through the valve body **26** to interconnect its valve chamber **24** with the motor outlet line **30**.

For controlling air flow through the passage **18**, a valve member **46** is provided on a throttle valve **48** reciprocably mounted within the chamber **24**. In the specifically illustrated embodiment, the valve member **46** is provided by an "O" ring seal disposed within an annular groove **50** on a rearwardly extending coaxial stem **52** of the throttle valve **48**. The main body of the valve **48** is enlarged relative to its stem **52** which is provided with an annular flange **54** on one side of which is formed the groove **50** on the stem **52**, within which the "O" ring seal is mounted, and the other side of which seats a valve closure compression spring **56**. The spring **56** is biased between the flange **54** and a housing portion defining an end wall **58** for the bore **28** to hold the throttle valve **48** in its illustrated normally closed position with the valve body surrounding the inner end of the chamber **24** and providing a valve seat for member **46**.

The throttle valve **48** is shown having its full diameter main body suitably contoured with a symetrically fluted construction to permit fluid flow past the valve **48** within its chamber **24** responsive to its being moved in a valve opening direction from left to right as viewed in the drawing. The inner end of the main valve body is tapered as at **60** from its juncture with the stem **52** in a direction away from the valve member **46** to provide a graduated reduced intermediate portion for metering inlet airflow to the motor **16** upon opening the throttle valve **48**.

For positively actuating the throttle valve, a manually operable trigger **62** is shown suitably secured, e.g., by a roll pin **64**, to an actuating shaft **66** axially extending into the valve chamber **24** and having an integral concentric throttle pin **68** of reduced diameter extending rearwardly of the shaft **66** for positively actuating the throttle valve **48**. The actuating shaft **66** has an intermediate portion of reduced size forming a longitudinally extending notch **70** through which is extended a second roll pin **72** to retain the shaft **66** and its trigger **62** in assembly with the valve body **26** while yet permitting limited freedom of longitudinal reciprocating movement of the actuating shaft **66** within the valve chamber **24**. In its illustrated normal rest position, the throttle pin **68** of the actuating shaft **66** is spaced apart a preselected distance from the throttle valve **48** in its normally closed position.

From the foregoing description, it will be seen that upon squeezing the trigger **62**, the actuating shaft **66** will be depressed rearwardly into the valve chamber **24**, from left to right, as viewed in the drawing, and its integral throttle pin **68** will positively engage the throttle valve **48** to unseat its valve member **46** and permit air to flow through the passage **18** to actuate the motor **16**.

To preselect a desired motor operating speed under free running conditions, an adjustment nut **74** is threadably mounted on an externally threaded, forwardly projecting, reduced end portion **76** on the valve body **26.** The nut **74** has a forward abutment stop face **78** for engagement with surface **80** of the trigger **62.** Accordingly, the abutment stop surface **78** may be axially adjusted relative to the valve body **26,** and thus to the trigger **62** and its actuating shaft **66,** by simply rotating a knurled shoulder **84** of the adjustment nut **74** such that the maximum rearward trigger displacement from its normal rest position may be selectively limited to a desired throttle valve opening upon initial actuation of the air motor and, accordingly, set its speed of operation during idling under no load conditions.

To maintain the adjustment nut **74** in a selected position, an annular series of detent recesses such as at **86** will be understood to be formed around the inside wall of the adjustment nut **74** confronting the valve body **26.** A detent pin **88** is received in an opening **90** formed in a lower portion of valve body **26** and a suitable spring **92** is fitted within the opening **90** to urge the detent pin **88** axially outwardly for registration with the annular series of detent recesses **86** and to maintain the adjustment nut **74** in a selected angular position. The angular position of the adjustment nut **74** relative to the valve body **26** is readily established by an operator for a desired idling speed by suitable indicia **94** marked on the adjustment nut **74,** it being understood that the indicia **94** is calibrated to different motor idling speeds as determined by the extent of the throttle valve opening displacement for a given air supply pressure and a given size air motor.

With a conventional throttle valve having a solid integral shaft connected to the trigger, as normally associates with such power tools, a change in throttle valve opening displacement would not only change the idling speed but also the available torque. To maintain torque characteristics at slower idling speeds, the valve must open further in response to torque loading. A force is available for this in that as an air motor is loaded, its speed decreases, its airflow demand decreases, and its operating pressure downstream of the restricting speed controlling throttle valve rises.

As noted above, upon squeezing the trigger **62,** the throttle pin **68** positively engages the throttle valve to unseat the valve member **46** and move it to an open flow control position as established by the extent of actuator movement permitted by the adjustment nut **74** to allow air flow through the passage **18** to the motor under idle or free running conditions. Actuation of the throttle valve **48,** however, simultaneously compresses a compensating spring **96** located in valve chamber **24** between actuating shaft **66** and throttle valve **48.** As the tool **10** is loaded and the motor operating speed decreases, the preloaded resilient force of the compressed compensating spring **96,** together with the increased downstream motor operating pressure within the valve chamber **24,** jointly act upon the throttle valve **48** to move it further in a valve opening direction from left to right, as viewed in the drawing, against the opposing upstream line pressure and biasing force of the valve closure spring **56** to automatically provide increased air flow through the valve chamber **24** past the throttle valve **48** to increase the motor operating speed and the output force of the motor **16** during increased loading of the tool **10.**

Upon trigger release, the bias effected by the compensation spring **96** is also released, and the biasing force of the valve closure spring **56** is sufficient to overcome the motor operating pressure in the valve chamber **24** and to close the valve member **46** into sealing engagement with its valve seat and through the compensating spring **96,** to return the actuating shaft **66** and operating trigger **62** to their illustrated normal rest position.

It will be seen that the self-compensating throttle valve **48** of this invention effects a controlled fluid flow to the motor **16** responsive to the torque loading on the tool **10** as reflected by changes in motor operating speed, due to the combination of opposed spring forces and the opposed pneumatic forces on the throttle valve **48** to provide for opening it further as the downstream motor operating pressure increases, even when the trigger **62** is squeezed and retained in a fully retracted, actuated position.

The above described self-compensating throttle valve is particularly useful with grinders, various fastener tools and similar tools such as the illustrated pneumatic drill. For example, in the use of the pneumatic drill, a proper speed may be selected for the material of the workpeice and the type and diameter drill bit which is to be used. The feed in hand drilling, e.g., is accomplished by arm thrust against the tool. A drill incorporating the disclosed self-compensating throttle valve will normally drill holes easily in a variety of materials with normal arm thrust without burning or snapping the drill bits and without glazing or hardening the workpiece while ensuring that full torque is available at the time the drill bit breaks through the workpiece. The disclosed construction is simplified but rugged and easily manufactured and assembled while at the same time providing reliable performance over an extended period of time with minimum service requirements.

As will be apparent to persons skilled in the art, various modifications, adaptations and variations of the foregoing specific disclosure can be made without departing from the teachings of the present invention.

I claim:

1. In a power tool having a pneumatically operated drive motor, a control valve having a fluid inlet adapted to be connected to a pneumatic pressure source and a fluid outlet connected to the drive motor, a valve bore interconnecting the valve inlet and valve outlet providing a fluid passageway therebetween, a valve seat surrounding the bore intermediate the valve bore inlet and outlet, a valve member mounted in the bore shiftable in first and second opposite axial directions therein respectively to and from a respective closed position thereof for selectively seating on said valve seat and closing said fluid passageway and providing a variable and decreasing fluid restriction between the valve inlet and outlet as the valve member is shifted in said second opening direction from its closed position, the valve member being mounted to be biased in the first closing direction by the valve inlet pressure and in the second opening direction by the valve outlet pressure, the valve member being mounted in the bore such that the net fluid pressure force on the valve member is in said first closing direction and is a function of the pressure drop from the valve inlet to the valve outlet and therefore the fluid restriction therebetween, first spring means biasing the valve member in said closing direction and manually operated valve control means for selectively shifting the valve in said opening direction for

controlling the pneumatic operation of the drive motor, the improvement wherein the manually operated valve control means comprises second spring means biasing the valve member in the opening direction and manual actuator means for manually actuating the valve member in said opening direction from its closed position, said manual actuator means closing the bore at an end thereof and continuously sealing the bore from atmosphere, said second spring means being mounted between said valve member and said manual actuator means, said manual actuator means manually selectively varying the opening spring bias on the valve member in excess of the opposing closing spring bias on the valve member such that the open axial position of the valve member is dependent on the relative opening and closing spring bias on the valve member and on the pressure drop and therefore the fluid restriction between the valve inlet and valve outlet and the valve member automatically compensates for drive motor speed and therefore drive motor load for varying the valve opening in accordance with the drive motor load.

2. A power tool according to claim **1** wherein the second spring means is a compression spring.

3. A power tool according to claim **1** wherein the manual actuator means is selectively operable from a first position to a second position for engaging and initially shifting the valve member in said opening direction from its closed position, and wherein the second spring means, with the actuator means in its second position, has sufficient bias to shift the valve member further in said opening direction so that the valve member thereupon automatically compensates for drive motor speed.

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