May 17, 1966 T. W. McGRATH 3,251,256

FLUID ACTUATED TOOLHOLDER

Filed June 26, 1964 2 Sheets-Sheet 1

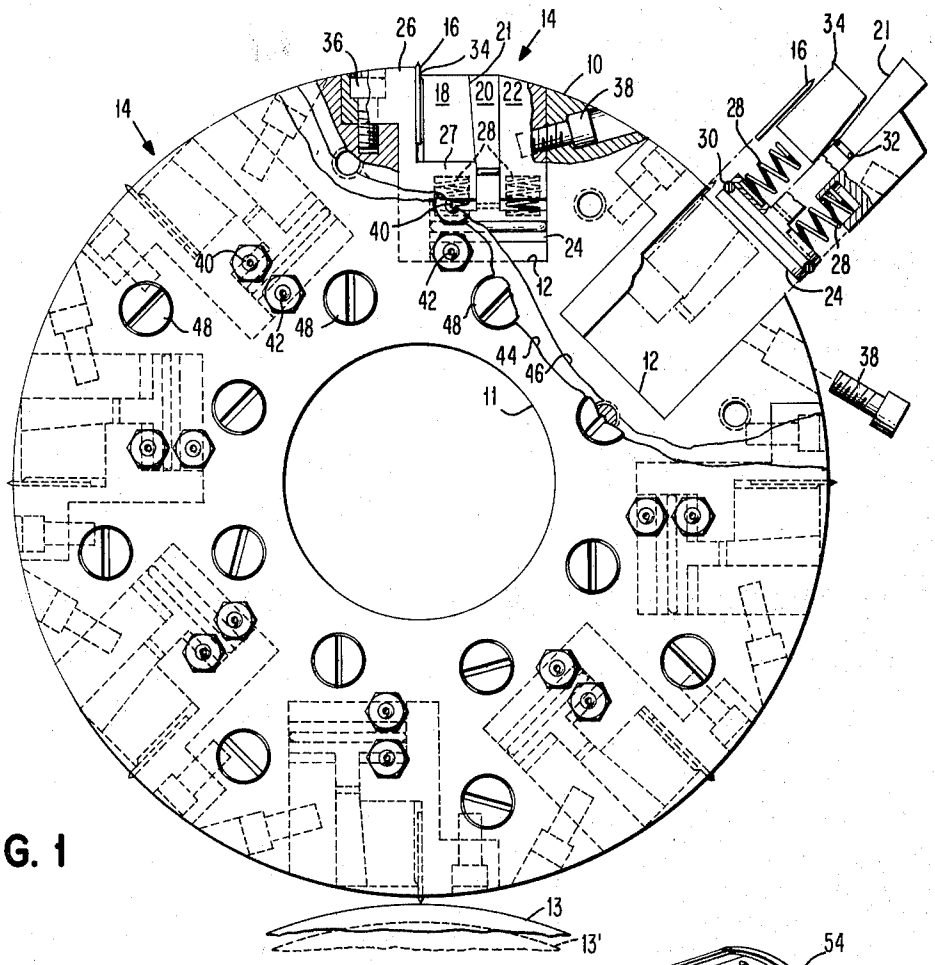



FIG. 1

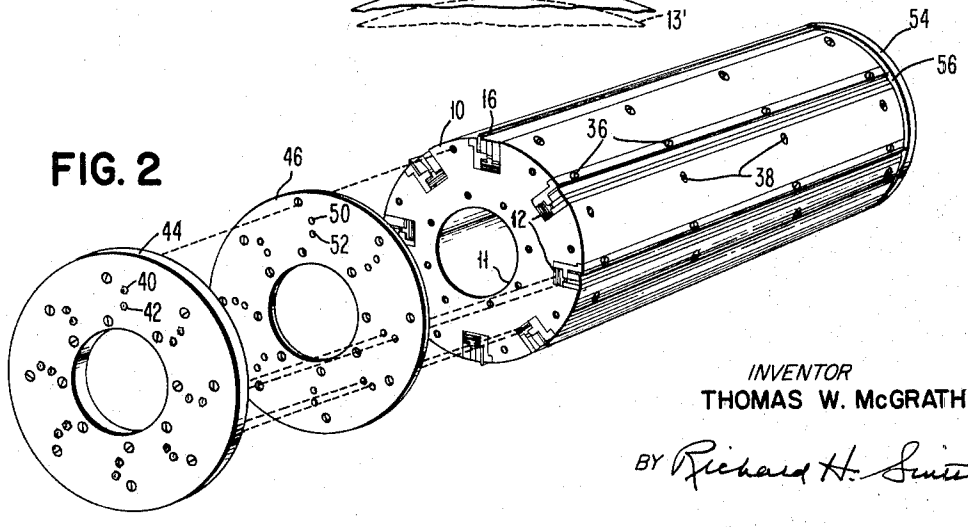



FIG. 2

INVENTOR
THOMAS W. McGRATH

BY Richard H. Smith

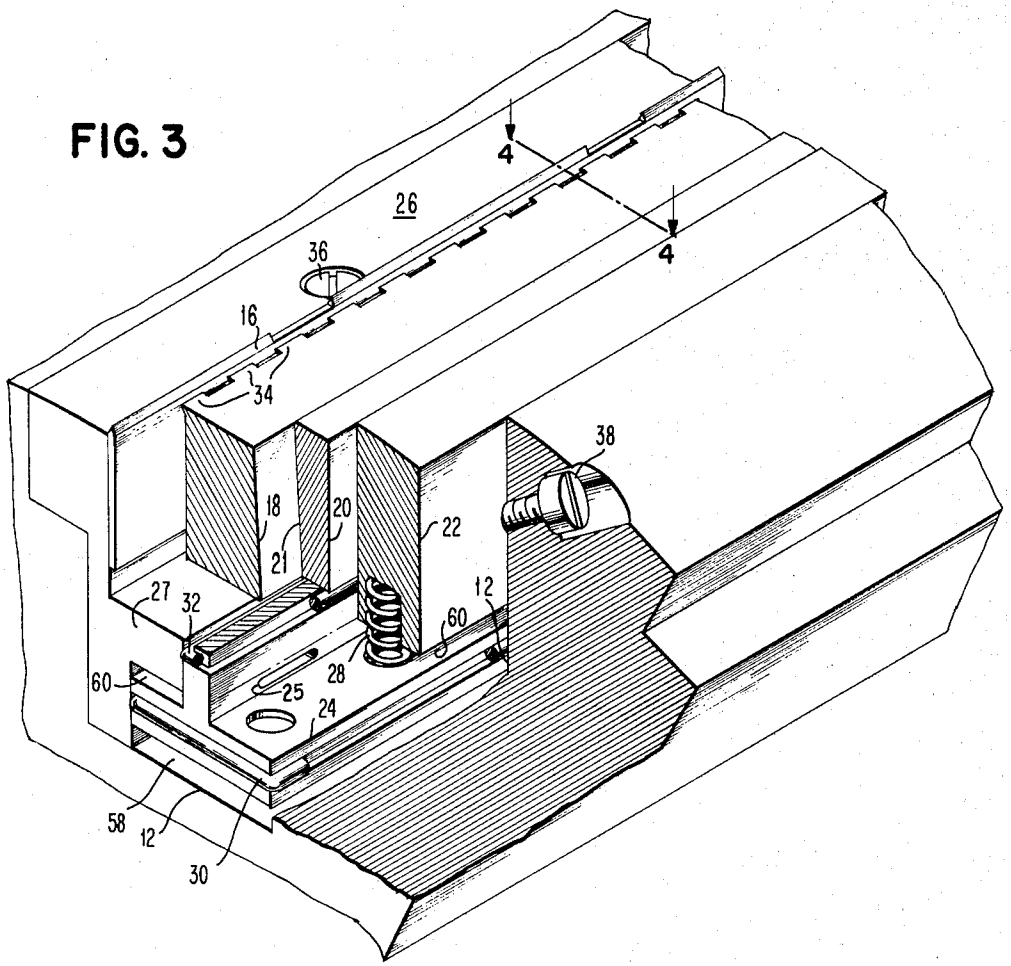
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FLUID ACTUATED TOOLHOLDER

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FIG. 3



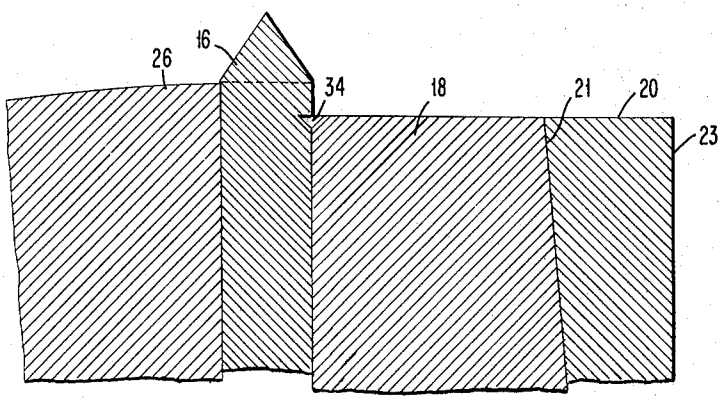




FIG. 4

United States Patent Office 3,251,256 Patented May 17, 1966



3,251,256

# FLUID ACTUATED TOOLHOLDER

Thomas W. McGrath, Vestal, N.Y., assignor to International Business Machines Corporation, New York, N.Y., a corporation of New York

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12 Claims. (Cl. 83—674)

The present invention relates to a toolholder operable by means of fluid action, and, more particularly, relates to a fluid actuated toolholder of the self-locking type.

In the art of perforating paper forms to render them readily separable from one another, the usual apparatus employed to cut the perforations is known to the art as a perf or cutting cylinder. This cylinder comprises a rotatable drum having a plurality of longitudinally extending perforating blades protruding from its periphery. It is mounted adjacent to and is rotatably driven in conjunction with an anvil cylinder which has a smooth, hardened surface to provide a cutting surface for the perforating blades. Blades up to 35 inches and longer in length may be employed. A web of forms fed between the rotating cutting and anvil cylinders has a series of spaced perforate divisions cut across its width.

The type of cuting cylinder currently found in use employs a manually operable blade holder. To change a perforating blade, an operator must first loosen a series of bolts, usually one for approximately each two inches of blade length, to free the blade. A new blade is then placed in the holder at a height calculated to be slightly above the correct cutting height and the bolts are partially tightened to what the operator feels is about one quarter of the final clamping pressure. This initial loading permits some blade slippage and enables adjustment of the blade to the exact height required for proper cutting. This adjustment is effected by rolling the cutting cylinder over so that the blade makes contact with the anvil cylinder and is thus seated to the proper height. After this, the clamping bolts are fully tightened to firmly secure the blade.

There are several drawbacks to this manual tool changing system. The most critical drawback is the length of time it takes to change a blade. The operator must separately loosen, then partially tighten and finally fully tighten as many as 18 or more bolts to change a single blade. Such time consuming manipulations make the cost of blade changes, in terms of machine down time, very high.

A further difficulty is that when the operator initially tightens the clamp bolts, he must essentially guess at the pressure which will permit proper blade slippage during the blade seating operation. If he tightens the bolts too much, the cutting cylinder will jam against the anvil cylinder and possibly break or bend the blade. If he doesn't tighten the bolts enough the blade is likely to slip out of position between the time it is seated and the time the bolts are finally tightened. If he tightens some bolts more than others the blade is likely to seat unevenly.

Some attempts have been made to develop pneumatically actuated toolholders to replace such bolt actuated devices. However, results have been unsatisfactory since devices thus far developed have required that fluid pressure be maintained against the tool in order to keep the tool in place. The presence of even a slight amount of leakage in the fluid system can therefore lead to gradual loosening of the tool in operation, creating work spoilage and occasional dangerous tool breakage.

It is therefore a primary object of the present invention to provide a toolholder that eliminates the above-cited deficiencies in the prior art.

Another object is to provide an improved toolholder for use in cutting cylinders and the like which is adapted



to be operated rapidly, thereby reducing costly machine down time during tool changing operations.

A further object is to provide a toolholder which automatically supplies a correct, uniform amount of initial clamping pressure to a tool whereby the tool may be adjusted to a correct operating position prior to being given final clamping pressure.

Still another object is to provide a fluid actuated toolholder that does not depend on fluid pressure to keep the tool in place during operation.

Still a further object is to provide an improved toolholder for use in cutting cylinders and the like which may be operated expediently by an operator possessing only a minimum amount of training.

In accordance with a first feature of the present invention a fluid actuated piston, acting through a tapered camming element, applies a closing force to a pair of tool clamping jaws. An additional feature provides the apparatus with a self-locking capability whereby the tool clamping force may be maintained even though the initial fluid actuating force is withdrawn. Further features provide the apparatus with a fluid driven tool release mechanism and with automatic means for applying a uniform, accurate light clamping force to the tool so that it may be adjusted to a correct operating position prior to being finally clamped.

The foregoing and other objects, features and advantages of the invention will be apparent from the following more particular description of a preferred embodiment of the invention, as illustrated in the accompanying drawings.

In the drawings:

FIG. 1 is an elevation view, partially cut away, of a preferred embodiment of a cutting cylinder in accordance with the present invention. One of the toolholders is exploded to show the manner in which it is assembled.

FIG. 2 is a perspective view of the cylinder of FIG. 1, showing the manner in which end plates and end plate gaskets are fitted to the cylinder to create airtight chambers therein.

FIG. 3 is a perspective view, partially sectioned, of a preferred embodiment of a single toolholder in accordance with the principles of the present invention, showing details of the fluid driven clamping mechanism.

FIG. 4 is a sectional view taken along the line 4—4 of FIG. 3 and illustrates the manner in which a tool is engaged by the clamping jaws of the preferred toolholder.

With reference to the drawings, a detailed description of a preferred embodiment of the present invention will hereinafter be given.

As shown in FIGS. 1 and 2, the rotatable cutting cylinder in which the present invention is incorporated comprises a cylinder **10** having an axial opening **11** whereby the cylinder may be rotatably mounted on the drive mechanism of a suitable paper forms press. A plurality of longitudinally extending perforating blades **16** protrude from the periphery of the cylinder **10** and are firmly held at a correct cutting height by a plurality of toolholding units **14**, hereinafter described in detail. The cylinder **10** rotates in conjunction with an anvil cylinder **13** which provides a cutting surface for the blades **16**. The spacing between the cylinders **10** and **13** is adjustable as indicated by the dashed lines **13'** in order to allow for webs of different thickness.

When a web of paper or like material is fed between the rotating cylinders **10** and **13**, the blades **16**, acting against the surface of the anvil cylinder, cut the desired perforation slits across the width of the web. Details concerning the drive mechanism with which the cutting cylinder **10** is associated are neither shown nor described herein since they form no part of the present invention.

Referring now to FIGS. 1 and 3, a detailed description

of a preferred embodiment of a toolholding unit **14** of the present invention will hereinafter be given. Each of the identical units **14** is housed in a longitudinally extending, rectangular slot **12** in the cylinder **10**. A back-up block **22** is fastened to the right hand side of the slot **12** by bolts **38**. A stationary jaw member **26** is bolted to the left hand side of the slot **12** by the bolts **36**. The member **26** has a horizontally extending shoulder **27** protruding to approximately the center of the slot **12**.

A generally rectangular piston **24** is adapted to slide vertically within the chamber formed in the slot **12** beneath the shoulder **27** and the block **22**. Extending upwardly from and connected to the piston **24** is a taper bar **20**. One side of the taper bar **20** slidably engages the block **22** and the other side of the bar, which includes a tapered surface **21**, engages a tapered surface of a movable jaw member **18**. The jaw **18** is slidably disposed on the upper surface of the shoulder **27**. It is readily seen that as the piston **24** and taper bar **20** are moved downwardly, the movable jaw **18** is cammed toward the stationary jaw **26** and clamps the blade **16** thereagainst. A plurality of teeth **34** are provided at the upper edge of the jaw **18** and are caused to sink into the blade **16** upon application of full clamping pressure, in a manner to be hereinafter described. It is to be understood that the elements **18**, **20**, **22**, **24**, **26** and **27** all extend the full length of the slot **12**.

A plurality of compression springs **28** reside in appropriate openings formed in the lower sides of the block **22** and shoulder **27** (as best seen in FIG. 1). These springs bear on the upper surface of the piston **24** and impart to the piston a constant downwardly acting bias force. It can be seen that this bias force exerts a clamping force on the blade **16**. An appropriate spring constant is chosen for the springs **28** so that the clamping force transmitted to the jaw **18** is sufficient to firmly press the teeth **34** against the blade **16** but is insufficient to sink the teeth into the blade. This "pre-loading" force is desirably about one quarter of that required for final clamping. This renders the blade **16** vertically slideable for purposes of adjustment, to be subsequently described.

A pair of end plates **44** and **54** and a pair of end plate gaskets **46** and **56** (FIG. 2) are fitted to the ends of the drum **10** and are held in place by a plurality of bolts **48**. These end plates and gaskets render the chambers **60** and **58**, above and below the piston **24** (FIG. 3), substantially air tight. A pair of resilient sealing rings **30** and **32**, surrounding the piston **24** and a lower portion of the taper bar **20**, respectively, prevent substantial air leakage at the sliding surfaces. Extending through the end plate **44** and aligned with the chambers **60** and **58**, respectively, are a pair of nozzle openings **40** and **42**. The openings **50** and **52** (FIG. 2) in the gasket **46** allow the nozzles **40** and **42** to communicate with the chambers **60** and **58**. A plurality of slots **25** provided through the base of the taper bar **20** (FIG. 3) allow air entering the nozzle **40** to act against the full upper surface of the piston **24**. Application of 60 to 80 p.s.i. of air pressure (commonly available in most machine shops) to the nozzle **40** drives the piston **24** downward and causes the movable jaw **18** to be forcefuly driven against the blade **16**, sinking the teeth **34** of the jaw into the blade and rendering the blade, for all practical purposes, immovably fixed between the jaws **18** and **26** (see FIG. 4).

The taper, measured as shown in FIG. 4, of the surface **21** of the taper bar **20** is designed so that the taper bar **20** is "self-locking." It has been found that a taper of 2.25° gives satisfactory results. The term "self-locking" as herein used means that when the taper bar **20** is drawn downwardly by a proper locking force, the reaction forces exerted normal to surfaces **21** and **23** of the taper bar **20** by the jaw **18** and back-up block **22**, respectively, create static friction forces at those surfaces which are greater than the component of force acting upon the surface **21** in a direction tending to move the bar **20** upwards. The friction forces acting on the taper bar **20** are sufficient, therefore, to maintain the rigid clamping relationship between the jaws **26** and **18** and the blade **16**, even though the initial actuating force is withdrawn.



In order to overcome this locked relationship to release the blade **16**, air pressure of approximately 60–80 p.s.i. is applied to the lower nozzle **42**. This creates an upward force on the piston **24** which causes the total upward force exerted on the taper bar **20** to exceed the static friction forces acting thereon, thereby driving the bar out of its locked state.

Any suitable air hose having a nozzle designed to snap-connect to the nozzles **40** and **42** and including a manually operable pressure shut off valve may be used. A compressed air supply of from 60 to 80 p.s.i., as previously brought out, operates satisfactorily to both lock and unlock the tool holder.

## OPERATION

With reference now to FIG. 1 the operation of the present invention will hereinafter be described. To change a blade **16** an operator rotates the cutting drum **10** until the blade to be changed is in a top vertical position. The air hose is applied to the nozzle **42** of the tool-holding unit **14** associated with the blade desired to be changed. By releasing air pressure the operator is able to unlock the taper bar **20** and cause it to be pushed upward against the bias of the springs **28**. With the air pressure still applied, the operator slides back the movable jaw **18** and frees the blade **16** from the teeth **34**.

A new blade is inserted between the jaws **26** and **18** and the valve of the air hose is closed, cutting off the pressure on the piston **24**. When the hose is disconnected from the nozzle **42**, the springs **28** force the taper bar downward, as previously described, so that the blade becomes lightly clamped between the jaws. In this condition, shown in FIG. 1, the teeth **34** are pressed against but do not bite into the blade **16**. The blade has purposely been left to protrude somewhat more than required for cutting.

The cylinder **10** is then rotated a sufficient amount so that the newly inserted blade makes contact with the anvil cylinder. As the two cylinders continue to rotate, this contact pushes the blade down to a proper level. After the blade has thus been correctly seated it is held in position by the pressure of the springs **28** until the operator applies the air hose to the nozzle **40** and opens the pressure valve, causing the piston **24** to force the taper bar **20** downwardly into a locking condition. The blade is then sufficiently clamped in order to cut paper satisfactorily. After removal of the air hose from the nozzle **40** the cylinder is ready for operation.

It can be seen that the toolholder of the present invention enables fast, simple tool changes. Further, the springs **28** provide the exact pressure necessary for the initial, light clamping of the tool which enables the tool to be adjusted to a proper operating position prior to being finally clamped. The self-locking taper provided on the taper bar **20** eliminates the need for sustaining air pressure on the piston **24** during operation of the cutting cylinder, thereby obviating the danger of the blade **16** becoming loose during operation.

While the invention has been practicularly shown and described with reference to a preferred embodiment thereof, it will be understood by those skilled in the art that various changes in form and details may be made therein without departing from the spirit and scope of the invention.

I claim:

**1.** A fluid actuated toolholder, comprising:

a pair of relatively movable jaws including a pair of clamping faces, said faces being parallel to one an-

other and perpendicular to a direction along which said jaws are relatively movable;

a self-locking taper bar adapted to coact with a surface of one of said jaws so as to move it toward the other jaw to clamp a tool in response to a locking force;

a fluid expansible chamber adapted to act against said taper bar; and

means for momentarily forcing fluid under pressure into said chamber to apply a locking force to said taper bar, said means removing said pressure after said locking force has been applied, whereby said chamber is maintained in a non-pressurized condition during operation of said tool.

2. A fluid actuated toolholder, comprising:

a pair of relatively movable jaws including a pair of clamping faces, said faces being parallel to one another and perpendicular to a direction along which said jaws are relatively movable;

a self-locking taper bar adapted to coact with a surface of one of said jaws so as to move it toward the other jaw to clamp a tool in response to a locking force;

a first fluid expansible chamber adapted to act against said taper bar;

means for momentarily forcing fluid under pressure into said first chamber to apply a locking force to said taper bar, said means removing said pressure after said locking force has been applied, whereby said chamber is maintained in a non-pressurized condition during operation of said tool;

a second fluid expansible chamber adapted to act against said taper bar in a direction opposing the direction of action of said first chamber; and

means for forcing fluid under pressure into said second chamber to release said tool.

3. A fluid actuated toolholder, comprising:

a pair of relatively movable jaws including a pair of clamping faces, said faces being parallel to one another and perpendicular to a direction along which said jaws are relatively movable;

a self-locking taper bar adapted to coact with a surface of one of said jaws so as to move it toward the other jaw to rigidly clamp a tool in response to a locking force;

spring means acting against said taper bar to apply an intermediate clamping pressure to said tool, said intermediate pressure being light enough to permit the sliding of said tool into a correct operating position;

a fluid expansible chamber adapted to act against said taper bar; and

means for forcing fluid under pressure into said chamber to apply a locking force to said taper bar.

4. A fluid actuated toolholder, comprising:

a pair of relatively movable jaws including a pair of clamping faces, said faces being parallel to one another and perpendicular to a direction along which said jaws are relatively movable;

a self-locking taper bar adapted to coact with a surface of one of said jaws so as to move it toward the other jaw to rigidly clamp a tool in response to a locking force;

spring means acting against said taper bar to apply an intermediate clamping pressure to said tool, said intermediate pressure being light enough to permit the sliding of said tool into a correct operating position;

a first fluid expansible chamber adapted to act against said taper bar;

means for forcing fluid under pressure into said first chamber to apply a locking force to said taper bar;

a second fluid expansible chamber adapted to act against said taper bar in a direction opposing the direction of action of said first chamber; and

means for forcing fluid under pressure into said second chamber to release said tool.



5. A fluid actuated toolholder, comprising:

a stationary jaw having a clamping face;

a movable jaw having a clamping face parallel to said clamping face on said stationary jaw, said movable jaw being movable in a direction perpendicular to said clamping faces;

a fixed backing surface;

a taper bar slidably engaging said backing surface and said movable jaw, said taper bar being adapted to act in response to an actuating force to cam said movable jaw toward said stationary jaw to clamp a tool between the clamping faces thereof;

a substantially airtight chamber;

a piston connected to said taper bar, said piston being slidable in said chamber;

spring means acting on said piston to apply a light actuating force to said taper bar, said light actuating force causing said tool to be clamped loosely in said jaws, whereby said tool may be adjusted to a correct operating position; and

means for forcing air under pressure into said chamber to cause said piston to apply a substantial actuating force to said taper bar, whereby said tool is rigidly clamped in said jaws.

6. A fluid actuated toolholder, comprising:

a stationary jaw having a clamping face;

a movable jaw having a clamping face parallel to said clamping face on said stationary jaw, said movable jaw being movable in a direction perpendicular to said clamping faces;

a fixed backing surface;

a self-locking taper bar slidably engaging said backing surface and said movable jaw, said taper bar being adapted to act in response to a locking force to effect the clamping of a tool between said clamping faces of said jaws and to create friction forces sufficient to maintain said clamping relationship;

a substantially airtight chamber;

a piston connected to said taper bar, said piston being slidable in said chamber; and

means for momentarily forcing air under pressure into said chamber to cause said piston to apply a locking force to said taper bar, said means removing said pressure after said locking force has been applied, whereby said chamber is maintained in a non-pressurized condition during operation of said tool.

7. A fluid actuated toolholder, comprising:

a stationary jaw having a clamping face;

a movable jaw having a clamping face parallel to said clamping face on said stationary jaw, said movable jaw being movable in a direction perpendicular to said clamping faces;

a fixed backing surface;

a self-locking taper bar slidably engaging said backing surface and said movable jaw, said taper bar being adapted to act in response to an actuating force to cam said movable jaw toward said stationary jaw to loosely clamp a tool between said clamping faces, said taper bar being further adapted, when said actuating force is increased to a locking force, to rigidly clamp said tool and to create friction forces sufficient to maintain said rigid clamping relationship;

a substantially airtight chamber;

a piston connected to said taper bar, said piston being slidable in said chamber;

spring means acting on said piston to apply an actuating force to said taper bar, whereby said tool is supported for adjustment to a correct operating position; and

means for forcing air under pressure into said chamber to cause said piston to apply a locking force to said taper bar.

8. A fluid actuated toolholder, comprising:

a stationary jaw having a clamping face;
a movable jaw having a clamping face parallel to said clamping face on said stationary jaw, said movable jaw being movable in a direction perpendicular to said clamping faces;
a fixed backing surface;
a self-locking taper bar slidably engaging said backing surface and said movable jaw, said taper bar being adapted to act in response to a locking force to effect the clamping of a tool between said clamping faces of said jaws and to create friction forces sufficient to maintain said clamping relationship;
a substantially airtight chamber;
a piston connected to said taper bar, said piston being slidable in said chamber;
means for momentarily forcing air under pressure into said chamber on a first side of said piston to cause said piston to apply a locking force to said taper bar, said means removing said pressure after said locking force has been applied, whereby said chamber is maintained in a non-pressurized condition during operation of said tool; and
means for forcing air under pressure into said chamber on a side of said piston opposite first side to effect the release of said tool.

**9.** A fluid actuated toolholder, comprising:
a stationary jaw having a clamping face;
a movable jaw having a clamping face parallel to said clamping face on said stationary jaw, said movable jaw being movable in a direction perpendicular to said clamping faces;
a fixed backing surface;
a self-locking taper bar slidably engaging said backing surface and said movable jaw, said taper bar being adapted to act in response to an actuating force to cam said movable jaw toward said stationary jaw to loosely clamp a tool between said clamping faces, said taper bar being further adapted, when said actuating force is increased to a locking force, to rigidly clamp said tool and to create friction forces sufficient to maintain said rigid clamping relationship;
a substantially airtight chamber;
a piston connected to said taper bar, said piston being slidable in said chamber;
spring means acting on said piston to apply an actuating force to said taper bar, whereby said tool is supported for adjustment to a correct operating position;
means for forcing air under pressure into said chamber on a first side of said piston to cause said piston to apply a locking force to said taper bar; and
means for forcing air under pressure into said chamber on a side of said piston opposite said first side to effect the release of said tool.

**10.** A cutting device comprising:
a rotatable cylinder;
at least one fluid actuated toolholder mounted on the periphery of said cylinder, said toolholder comprising:
a stationary jaw having a clamping face;
a movable jaw having a clamping face parallel to said clamping face on said stationary jaw, said movable jaw being movable in a direction perpendicular to said clamping faces;
a fixed backing surface;
a self-locking taper bar slidably engaging said backing surface and said movable jaw, said taper bar being adapted to act in response to an actuating force to cam said movable jaw toward said stationary jaw to loosely clamp a cutting tool between said clamping faces, said taper bar being further adapted, when said actuating force is increased to a locking force, to rigidly clamp said tool and to create friction forces sufficient to maintain said rigid clamping relationship;
a substantially airtight chamber;
a piston connected to said taper bar, said piston being slidable in said chamber;
spring means acting on said piston to apply an actuating force to said taper bar, whereby said tool is supported for adjustment to a correct operating position;
means for momentarily forcing air under pressure into said chamber on a first side of said piston to cause said piston to apply a locking force to said taper bar, said means removing said pressure after said locking force has been applied; and
means for forcing air under pressure into said chamber on a side of said piston opposite said first side to effect the release of said tool.

**11.** A fluid actuated toolholder, comprising:
a pair of relatively movable jaws between which a tool is adapted to be clamped in an operating position;
a self-locking taper bar adapted to coact with a surface of one of said jaws so as to move it toward the other jaw to clamp a tool in response to a locking force, said taper bar being so constructed and arranged as to move said jaw in a direction perpendicular to the direction of operating forces to be applied to said tool;
a fluid expansible chamber adapted to act against said taper bar; and
means for momentarily forcing fluid under pressure into said chamber to apply a locking force to said taper bar, said means removing said pressure after said locking force has been applied.

**12.** A fluid actuated toolholder, comprising:
a pair of relatively movable jaws including a pair of clamping faces, said faces being parallel to one another and perpendicular to a direction along which said jaws are relatively movable;
a taper bar adapted to coact with a surface of one of said jaws so as to move it toward the other jaw to rigidly clamp a tool in response to a clamping force;
spring means acting against said taper bar to apply an intermediate clamping pressure to said tool, said intermediate pressure being light enough to permit the sliding of said tool into a correct operating position;
a fluid expansible chamber adapted to act against said taper bar; and
means for forcing fluid under pressure into said chamber to apply a clamping force to said taper bar.


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WILLIAM W. DYER, JR., *Primary Examiner.*

J. M. MEISTER, *Assistant Examiner.*