April 23, 1935. E. J. KINGSBURY 1,998,873

FLUID PRESSURE FEEDING MECHANISM FOR METAL WORKING TOOLS

Filed Jan. 10, 1930 2 Sheets-Sheet 1

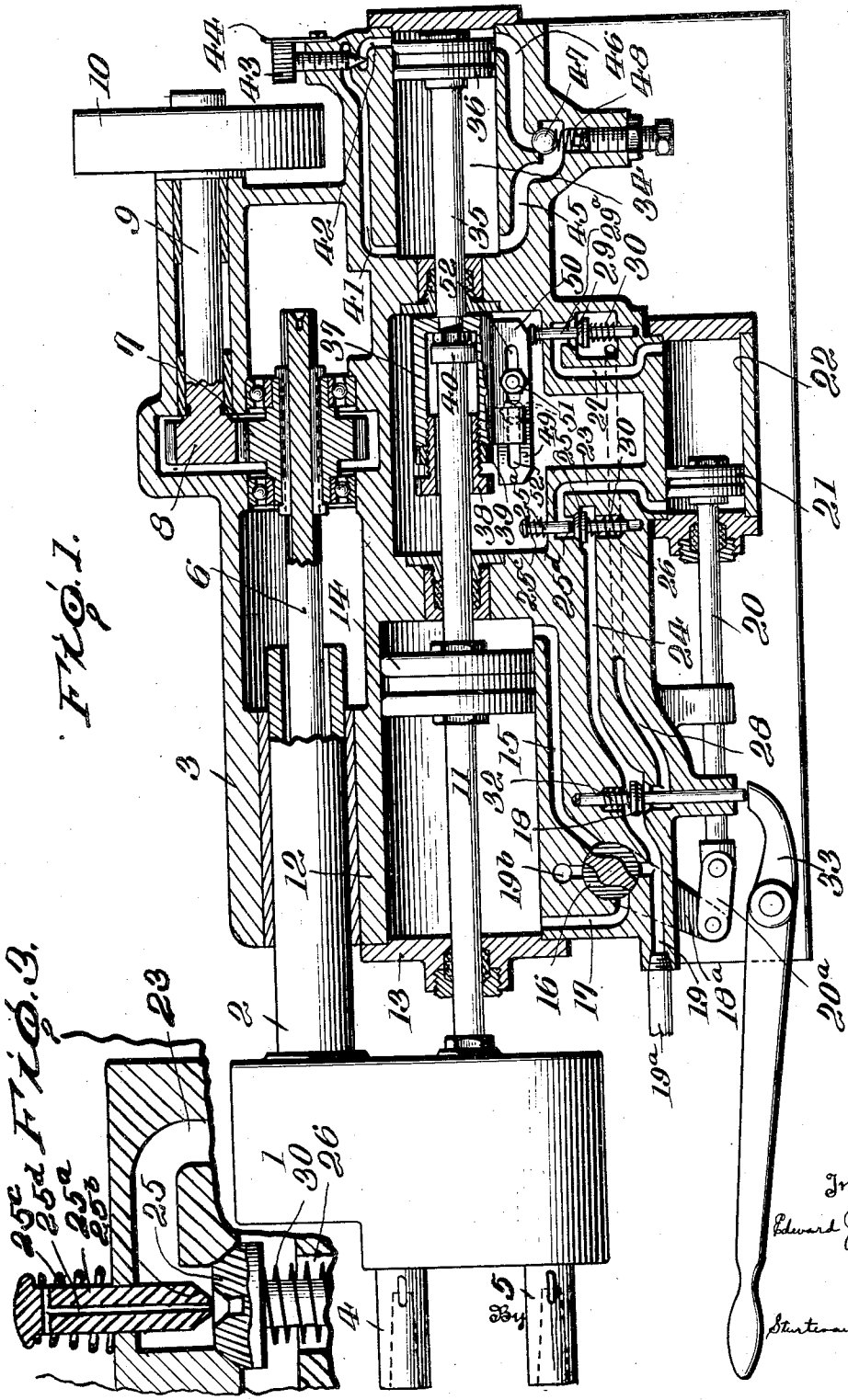

Fig. 1.



Fig. 2.

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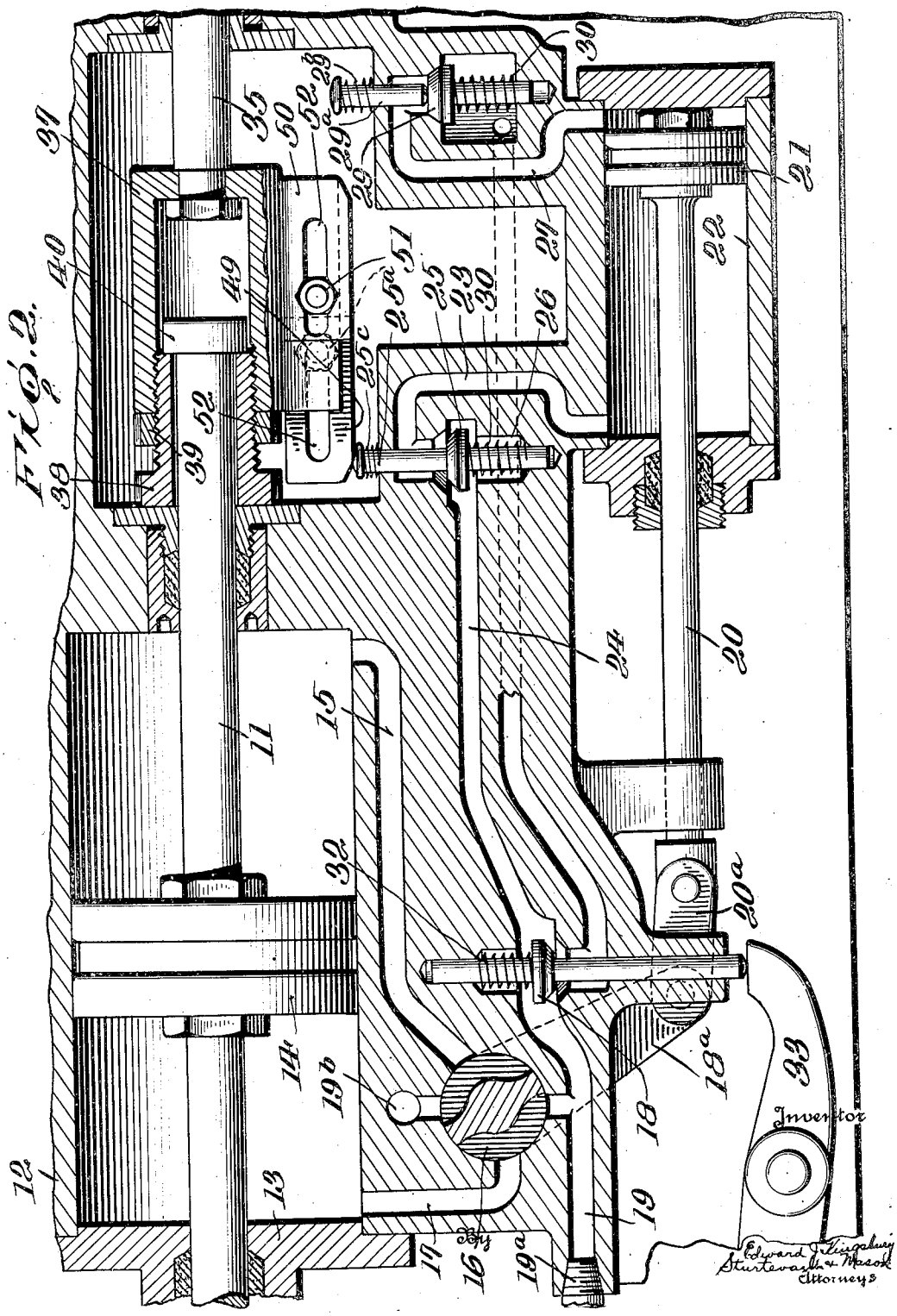

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1,998,873

## FLUID PRESSURE FEEDING MECHANISM FOR METAL WORKING TOOLS

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2 Claims. (Cl. 121—45)

The invention relates to new and useful improvements in a fluid pressure feeding mechanism for metal working tools.

An object of the invention is to provide an automatic fluid pressure controlled means used in conjunction with a fluid pressure feeding mechanism for moving the metal working tool back and forth, which fluid pressure controlled means may be manually rendered effective or ineffective.

A further object of the invention is to provide a fluid pressure mechanism for feeding a metal working tool, with means for controlling the movement of the tool whereby said tool may be advanced quickly to a position for engagement with the material, after which it is slowly fed forward as the material is operated upon.

A further object of the invention is to provide a control for a fluid pressure feeding mechanism of the above character wherein the metal working tool may be quickly retracted after the cutting operation is finished.

These and other objects will in part be obvious and will in part be hereinafter more fully disclosed.

In the drawings which show by way of illustration one embodiment of the invention:—

Figure 1 is a view showing more or less diagrammatically and in section a fluid pressure feeding mechanism embodying the invention, shown as applied to a multiple spindle drill press.

Fig. 2 is a detail showing the feeding mechanism as having moved the operating tool up to a point where it is about to engage the material and the retarding fluid control mechanism which retards the feed so that it may be slowly fed during the operation of the tool on the material.

Fig. 3 is an enlarged detail in section showing the construction of the exhaust valve associated with the means that controls the main valve of the feeding mechanism.

The invention is directed to a fluid pressure feeding mechanism for a metal working tool which includes a reciprocating feed shaft which is moved forward and back for advancing and retracting the metal working tool by a piston which is subjected to a fluid pressure. Associated with this feed shaft is a retarding means somewhat in the nature of a dashpot. There is a fluid controlled means which comes into action to retard the forward movement of the feed shaft so as to prevent the tool from striking the material as it is brought into position for operation. The control means is preferably connected to the feed shaft by a lost motion coupling which permits the feed shaft to move rapidly to present the tool to the material for operation. This control means is provided with a fluid which moves from one side of a piston in a cylinder to the other side thereof through a by-pass which is controlled by a needle valve. There is also a by-pass from one side of this piston to the other which is controlled by a one-way ball valve. This is so arranged that when the feed shaft is retracted the retarding means is in a large measure inactive to retard the movement thereof so that it may be quickly retracted.

Also associated with this fluid pressure feeding mechanism is an automatic reversing device which reverses the fluid pressure on the piston carried by the feed shaft when the feed shaft has moved forward to a predetermined set position. It also reverses the movement of the feed shaft when it has been retracted to a predetermined set position. This is a fluid pressure control and associated therewith is a manual means for rendering the same ineffective when it is desired to stop the machine.

Referring more in detail to the drawings, the invention is shown as applied to a multiple spindle drill press which is provided with a supporting head 1 carried by a sleeve 2 mounted for reciprocating in a supporting frame 3. In this head 1 are two drill spindles 4 and 5. These drill spindles are operated by suitable devices which are connected to an actuating shaft 6. The one actuating shaft operates both drill spindles. This operating shaft 6 carries a gear wheel 7 which meshes with a gear wheel 8 on the main actuating shaft 9 which is driven by a belt pulley 10 as shown in the drawings. The operating shaft 6 has a splined connection with the gear wheel 7 so that it can move endwise in said gear wheel. This is for the purpose of permitting the drill spindle head to be advanced and retracted for presenting the tools to the material to be operated upon and for feeding the tools during the operation on the material.

The spindle carrying head 1 is attached to a feed shaft 11. This feed shaft 11 is mounted for reciprocating in the main supporting frame 3. Said frame is provided with a cylinder 12 closed by a suitable cylinder head 13 and in this cylinder is a piston 14 which is fixed to the feed shaft. The frame is provided with a port 15 which leads from a valve chamber 16 to one end of the cylinder 12 and a port 17 leading from said valve chamber to the other end of said cylinder 12. Mounted in this valve chamber is a control valve 18. The operating fluid which is preferably air is supplied to the valve chamber from an inlet

port 19 connected to a supply pipe 12a. An exit port 19b is connected to the chamber 16 which takes the exhaust from the cylinder 12. The valve 18 is operated by a fluid controlled device which, as shown in the drawings, consists of a piston rod 20 carrying a piston 21 which is mounted for reciprocating in a cylinder 22 formed in the main frame 3.

At one end of said cylinder 22 is an inlet port 23 which is connected through a port 24 with the inlet port 19. A valve 25 is provided in this inlet port 24, which valve is normally held closed by means of a spring 26. This valve is released by a dog which is moved by the feed shaft as will be more fully described later.

Associated with the valve 25 is an exhaust valve 25a. Said exhaust valve is in the form of a sleeve having a tapered end 25b which fits in a seat in the top of the valve 25. A spring 25c normally forces this valve in an upward direction. The opening 25d centrally of the sleeve is a port for allowing the exhaust of the air from the cylinder 22. This port 25d leads to a cross port which in turn leads to the atmosphere.

At the other end of the cylinder 22 is an inlet port 27 which connects with an inlet port 28 which in turn connects with the inlet port 19. There is a valve 29 which closes this inlet port 27 and this valve is raised by means of a spring 30. The valve 29 is likewise operated by this control dog which will be described later.

There is an exhaust valve 29a associated with the valve 29 and held normally raised by a spring 29b. There is a port through this valve similar to that shown in detail in Fig. 3 in connection with the valve 25a. When the dog engages the upper end of the exhaust valve 29a it forces it downward, causing it to engage the seat on the valve 29. This closes the exhaust port and a further downward movement of the valve 29a will unseat the valve 29 and allow the fluid to pass into the right hand end of the cylinder 22. When the dog 49 engages the valve 25a, likewise, it will be forced downward into engagement with the valve 25 thus closing the port through the valve 25a and unseating the valve 25. Just as soon as the dog 50 releases the valve 29a it will be raised by the springs 30 and 29b so as to seat the valve 29 and unseat the valve 29a.

Between the inlet port 28 and the inlet port 19 is the valve 18 which is normally forced to closed position by a spring 32 and when in closed position it cuts off communication between the port 19 and the port 28. This valve is lifted by a hand lever 33 which is operated manually when it is desired to start the machine and set the feeding mechanism into operation. As long as this valve is raised the feeding mechanism will continue to move back and forth and be automatically reversed by this control device which has just been described in detail. In the drawings the hand lever is depressed, the valve raised and the machine in operation.

The shaft 20 is connected by means of a link 20a to an arm 18a connected to the shaft carrying the valve 18.

Associated with this fluid pressure feeding mechanism is a fluid controlled governing mechanism which permits the tool to be quickly advanced to a point adjacent the material after which it is moved slowly into contact with the material and for the feeding of the tool during the cutting of the material. This governing device includes a cylinder 34 formed in the main frame 3. Mounted in said cylinder is a piston rod 35 carrying a piston 36. Mounted on the end of the feed shaft 11 is a coupling head 37. This coupling head is rigidly attached to the piston rod 35. Said coupling head is sleeve formed and the end of the feed shaft 11 extends into said coupling head. There is an adjustable member 38 which closes the coupling head and this member slides freely on the shaft.

A set nut 39 is used for locking said member 38 in adjusted positions. On the extreme end of the feed shaft 11 is a fixed collar 40. The coupling head is free to move on the feed shaft 11 until this collar 40 engages either the inner end of the coupling head or the member 38. The cylinder 34 is preferably filled with oil. There is a port 41 leading from the left hand end of said cylinder 34 and a port 42 leading from the right hand end of said cylinder. The needle valve 43 controls the flow of the oil from the left hand end of the cylinder to the right hand end of the cylinder. This needle valve is capable of being adjusted and is held in set positions by a spring finger 44. There is also a port 45 leading from the left hand end of the cylinder 34 and a port 46 leading from the right hand end of said cylinder.

These ports are connected and the connection is controlled by a ball valve 47 which is spring pressed upwardly by means of a spring 48. This ball valve is so positioned that the oil can flow freely from the right hand end of the cylinder to the left hand thereof but cannot flow through the ports 45 and 46 from the left hand end to the right hand end.

Mounted on the coupling head 37 are the control dogs which bring about a reversal of the direction of movement of the feed shaft. There are two dogs one of which is indicated at 49 and the other at 50. The dog 50 is adjustably secured to the coupling head by a body 51 passing through a slot 52 in the dog. The dog 49 is held in adjusted positions by a similar bolt passing through a slot in the dog which are shown in broken lines in Fig. 1 of the drawings. The dog 50 operates upon the stem of the valve 29 and the dog 49 operates upon the stem of the valve 25. As shown in Fig. 1 the dog 50 has depressed the valve 29 and allowed fluid to pass to the right hand end of the cylinder 22.

The operation of the device is thought to be obvious from the above description. When the parts are in the position shown in Fig. 1 the feed shaft is at the extreme right of its movement and the operating tool retracted from the material. The retracting movement of the feed shaft through the dog 50 opens the valve 29 and permits fluid under pressure to be supplied from the port 19 to the cylinder 22 and moves the piston 21 to the left hand, and this has reversed the valve 18 so as to permit fluid to pass from the supply port 19 to the right hand end of the cylinder 12. The feed shaft will now move forward and will move very rapidly until the collar 40 engages the member 38 and causes the piston 36 to move with the feed shaft. At this time the oil in the cylinder 34 will retard the forward movement of the feed shaft and thus stop the rapid advancement of the tool before it strikes the material. The by-pass will permit the oil to flow slowly from one side of the piston 36 to the other under the control of the needle valve which may be adjusted and this permits the continued advance movement of the feed shaft 11 and a feed of the tools during the cutting operation on the material.

When the feed tools have finished their forward movement then the dog 49 will engage the

stem of the valve 25 and will open this valve. Meanwhile the valve 29 has been released and closed but is held yieldingly closed. Air under pressure now will pass from the port 24 through the port 23 to the left hand end of the cylinder 22 and this will move the piston 21 along the cylinder 22 and reverse the valve 18 so as to permit air under pressure to pass from the port 19 through the port 17 into the cylinder 12, and thus move the feed shaft to the right. When the feed shaft starts its movement to the right, the collar 40 moves away from the member 38 and will finally contact with the inner end of the coupling head 37. The piston 36 is free to move to the right hand end of the cylinder 34 as the oil is then by-passed through the ports 46 and 45 forcing the ball valve 47 away from its seat. This allows the tool to be very rapidly retracted. This retracting movement of the feed shaft through the dog 50 releases the valve 29 which begins the next feeding cycle.

Just as long as the valve 18 is raised from its seat and fluid is supplied to the port 26 the feed slide will be reciprocated back and forth, continuing its cycles of operation. When the valve 31 is closed, then the air pressure is cut off from the port 26 but not off from the port 24, and therefore, the feed shaft will move until it reaches its fully retracted position when it will stop. This manually controlled valve is a means for rendering the fluid controlled reversing means effective or ineffective. When it is opened, then this fluid controlled reversing means becomes effective and the cycles of operation continue, one after another. On the other hand, when the valve is closed, then the reversing means is rendered ineffective and the feed slide will stop in its retracted position.

While the invention as shown is applied to a multiple spindle drill press, it will be understood that it may be used in connection with a single spindle drill press or as a means for feeding any kind of tools for machining operations.

It will be obvious also that the details of construction and the arrangement of parts may be widely varied without departing from the spirit of the invention as set forth in the appended claims.

Having fully described the invention, what is claimed as new and desired to be secured by Letters Patent, is:—

1. In a metal working machine, the combination of a translatable member, fluid pressure means for moving said member back and forth, a governing means for controlling the forward movement of said translatable member including a cylinder, a piston in said cylinder, a piston rod attached to said piston, a sleeve carried by said piston rod, a member connected to said translatable member and extending into said sleeve, a collar carried by the end of said member extending into said sleeve, an adjustable member for closing the end of the sleeve and serving as a stop for retarding the movement of the translatable member, a needle valve bypass for bypassing fluid from the front side of said piston to the rear side thereof while the translatable member is moving in a forward direction under control of said piston, and a check valve controlled bypass leading from the rear side of the piston to the front side thereof for bypassing the fluid when the translatable member is moving in a backward direction.

2. In a metal working machine, the combination of a translatable member, a fluid pressure motor for moving said member back and forth including a cylinder, a fluid operated piston in said cylinder, a piston rod connecting said piston to said translatable member, means for reversing the flow of fluid pressure to the motor for reversing the movement of the piston and the translatable member, a separate governing means for controlling the forward movement of said translatable member including a cylinder, a piston in said cylinder, a piston rod connected to said last-named piston, a sleeve carried by said last-named piston rod, said piston rod of the fluid pressure motor being extended through the end of the fluid pressure cylinder into said sleeve, a collar on the end of said fluid pressure piston rod, an adjustable member for closing the end of the sleeve and serving as a stop for retarding the movement of the piston rod in the fluid pressure cylinder on the forward stroke of the translatable member, a needle valve bypass for bypassing fluid from the front side of said piston to the rear side thereof while the translatable member is moving on its forward stroke under the control of the governing means, and a check valve controlled bypass leading from the rear side of the piston to the front side thereof for bypassing fluid when the translatable member is moving in a backward direction.

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