Oct. 7, 1952 M. N. WEBER 2,613,078

APPARATUS FOR MAINTAINING LOAD ON LENGTHWISE MOVING WORKPIECES

Filed Aug. 1, 1950 2 SHEETS--SHEET 1

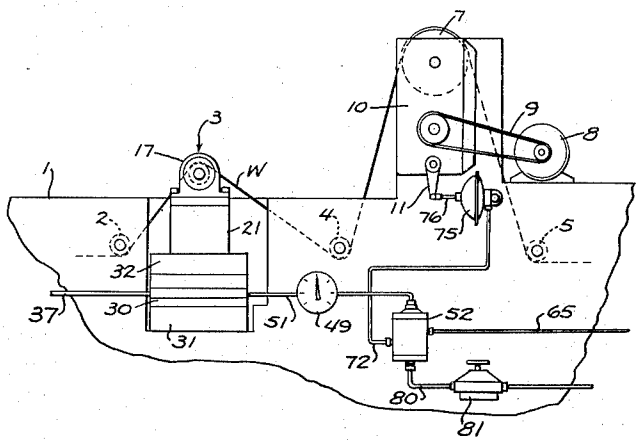



Fig. 1.

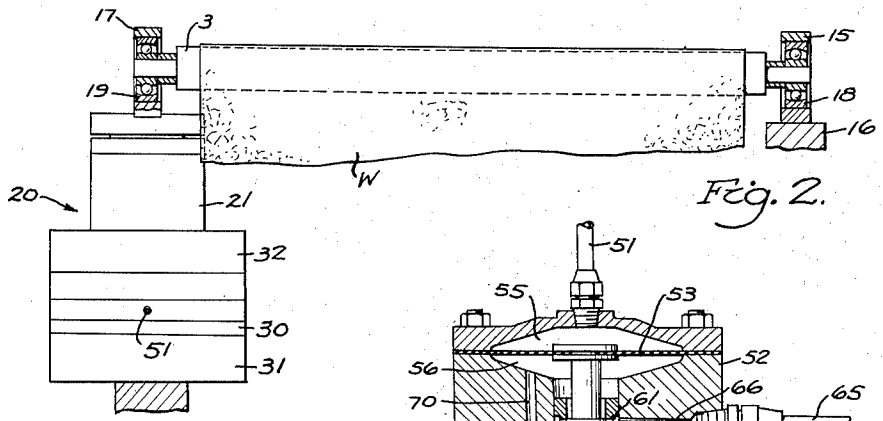



Fig. 2.

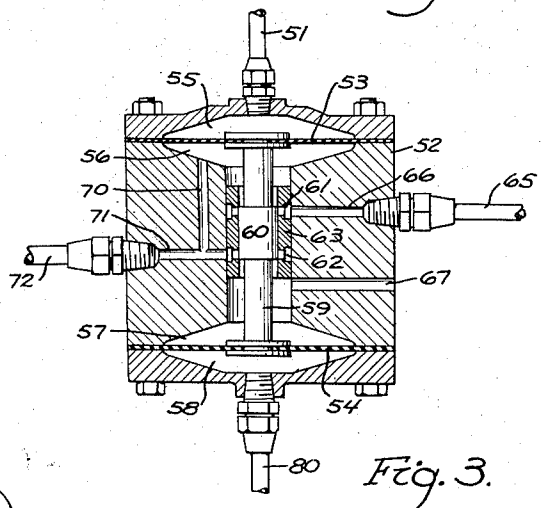



Fig. 3.

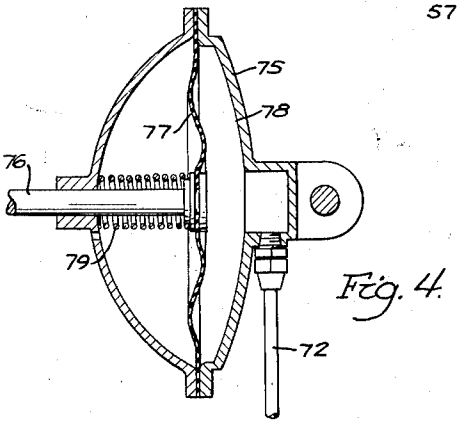



Fig. 4.

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Filed Aug. 1, 1950 2 SHEETS—SHEET 2

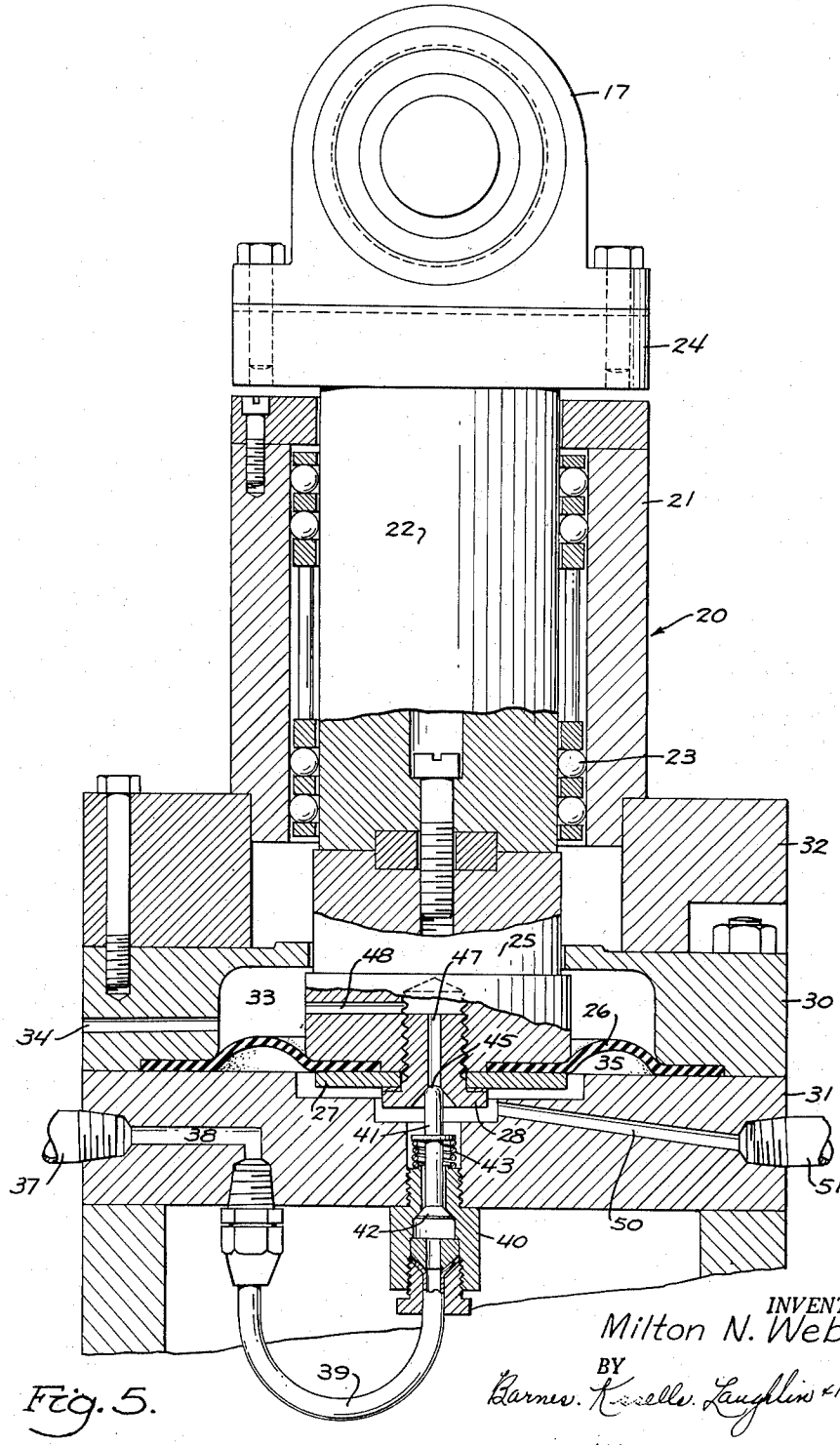



Fig. 5.

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## APPARATUS FOR MAINTAINING LOAD ON LENGTHWISE MOVING WORKPIECES

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6 Claims. (Cl. 271—2.3)

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This invention is directed to the matter of maintaining a substantially uniform action on work material which is being moved through a machine and in so doing passes over guiding elements such as rollers.

The invention is concerned with work material which may be in the form of paper or a sheet of webbing which is moved in the making of paper, or any other sheet material, such as fabric, or other elongated work material, such as yarn, or other fibers. While the invention is concerned with a situation where a rather delicate control is desired, the invention may be used with work material of metal.

Generally, the elongated work piece is moved through an apparatus by one or more propelling rollers with the work piece running over suitable guide devices or rollers. In order to maintain a substantially uniform tension or load on the work piece, an air pressure control, in accordance with the present invention, is employed. A roller or guide sensitive to the load is under the influence of a balancing pneumatic pressure. This pressure varies with variation in the load and the change in the pressure is effective to vary the action of the propelling mechanism so that the desired load condition is restored and maintained.

Fig. 1 is a general view of schematic nature showing a suitable machine for propelling a work piece through the same.

Fig. 2 is an enlarged view partly in section showing a sensitive roller.

Fig. 3 is an enlarged sectional view taken through a controlling valve.

Fig. 4 is an enlarged sectional view taken through a pneumatic motor.

Fig. 5 is a further enlarged sectional view taken through the pressure balancing mechanism.

In the drawings, the work piece is indicated at *w*, and is shown as being in the form of a web or sheet. It is to be moved through an apparatus which has a body or base portion 1 and a series of guide devices or rollers generally indicated at 2, 3, 4 and 5. The web or sheet also passes over a driving roller 7 which is driven by suitable means such as an electric motor 8 which, through a suitable means such as a belt 9, drives the roller 7 through a variable speed transmission generally indicated at 10.

The details of the construction of the variable speed driving device or transmission 10 need not be considered at length herein because such device is available on the market. Suffice it to say, that with the motor 8 running at a constant

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speed, the speed ratio between the motor and the driving roller 7 may be varied by the shift of a control lever 11 of the transmission.

As indicated in Fig. 2, the roller 3 is journalled in a pillow block 15 at one end fixedly supported by a support 16 and a pillow block 17 at its opposite end. The bearings in the pillow blocks are advantageously of the anti-friction bearing type with each bearing being shown in the form of a ball bearing. The outer races 18 and 19 have concaved faces which engage the balls as shown and thus one pillow block may be raised or lowered, or shifted laterally as far as that is concerned, without binding. The pillow block 17 is supported on what may conveniently be termed a load cap generally illustrated at 20 and shown in detail in Fig. 5. This load cap includes a housing portion 21 in which a post 22 is mounted for up and down movement as Fig. 5 is viewed, and the post is preferably mounted for movement in an anti-friction member as by means of ball bearings 23. The pillow block 17 is mounted on this post as by means of a base member 24. The lower end of the post has a portion 25 clamped to a diaphragm 26 as by means of a plate or washer 27 and a cap screw 28 which is also a valve member. The lower portion of the load cap is comprised of body members 30, 31 and 32 and the outer periphery of the diaphragm is engaged between the members 30 and 31, as indicated, and this arrangement provides an exhaust chamber 33 above the diaphragm which has an exhaust port 34 and a pressure chamber 35 below the diaphragm.

Air under pressure is supplied through a pressure line 37 which connects into a passageway 38 and thence to a tube 39 which connects into a fitting 40. The fitting 40 has a valve seat and a valve member 41 has a head 42 held on the seat by a spring 43. The valve member 41 has an upper end 45 arranged to seat and engage the seat in the cap screw valve 28. The cap screw 28 has a passage 47 therein which communicates with the passage 48 leading to the chamber 33.

Extending from the pressure chamber 35 is a passage 50 which connects to a line 51 which may have a pressure gauge 49 therein and the line 51 extends to a control valve generally indicated at 52. This control valve, as shown in Fig. 3, has two interconnected diaphragms 53 and 54 forming chambers 55 and 56 and chambers 57 and 58.

The diaphragms are connected by a rod 59 which has a valving portion 60 arranged to function with ports as indicated at 61 and 62 with a valve member 63. Air pressure is introduced to

the valve member through a line 65 which, in turn connects with passage 66 which communicates with the ports 61. There is a vent 67 for the chamber 57. A passage 70 in the valve 52 joins with a passage 71 which connects to the ports 62 and to a pressure line 72 which leads to a pneumatic motor 75. This motor has a diaphragm 77 with a piston rod 76 thereon for connection to the control lever 11 of the variable speed transmission. The motor has a chamber 78 on one side of the diaphragm into which line 72 connects and the diaphragm may be acted on by a spring 79 operating in opposition to pressure in the chamber 78.

Connected into the valve 52 is a pressure line 80 in which there is a pressure regulator valve 81. The pressures entering through line 51 and line 80 are opposing as will be appreciated by reference to Fig. 3 and act in a balancing manner.

In considering the operation of the apparatus it may be assumed that the apparatus shown in Fig. 1 is operating with the work piece being propelled through the machine by the driving roller 7. Assume also that air under pressure is being supplied through line 37 and through lines 65 and 80. Pressure entering the load cap arrangement through the line 37 flows to the valve 42. If the pressure in chamber 35 just balances the pressure of the work on the roller 3, the valve 42 is closed and the valve at 45 is closed and the system at that moment is static. If the load on the roller 3 is increased, as may result from an increase in the tension on the work piece, the pressure in chamber 35 is inadequate and so one end of the roller 3 and the plunger 22 shifts downwardly under the load. This opens valve 42 and instantly air under pressure enters chamber 35, elevates the pillow block 17 and restores the situation. If the load on the roller 3 decreases the air pressure in chamber 35 pushes the pillow block 17 upwardly thus opening valve 45 and some of the air in chamber 35 is exhausted through the passageways 47 and 48 which lead to the chamber 33 which, in turn, is open to atmosphere through passage 34. This discharge lessens the pressure in chamber 35 and the parts are restored to a normal condition.

It is to be pointed out that the movements vertically of the pillow block 17 and the post 2 is almost infinitesimal. From the practical standpoint, there is no substantial movement. The total movement will usually not exceed very few thousandths of an inch since it takes only an extremely small increment of movement to open the valve 42 and valve 45.

The pressure required to balance the load is transmitted through line 51 into the valve 52 and this pressure may be gauged if desired at the gauge 49. The pressure entering the valve 81, reacts against the pressure entering through the line 51. Thus, by manipulation of valve 81, an operator may determine the pressure to be maintained in the chamber 35. Thus, the critical operating pressure exerted by the work piece on the roller 3 may be determined.

Let it be assumed that the condition exists where there is increase in pressure on the roller 3. This, as above explained, lets air into the chamber 35 until the increased pressure is balanced. This increase in pressure is also transmitted to the chamber 55 of valve 52 and the valve 60 is depressed thus opening port 61 for the entrance of air under pressure from line 65. Air flows into chamber 56 until valve 60 is closed and this increased pressure is transmitted to the motor 75 and specifically to the chamber 78 which causes a shift of the diaphragm 77 and the rod 76 which actuates the lever 11 to reduce the speed of the roller 7. This entire action takes place in much less time than it takes to describe the same. In brief, the tension on the work piece was too high and the resultant increase of pressure causes a slight reduction in speed of the roller 7.

On the other hand, if the webbing is loosened resulting in less pressure on the roller 3 the valve 45 opens and some of the air under pressure in chamber 35 is exhausted. This correspondingly lowers the pressure in chamber 55 and the pressure in chamber 58 pushes the valve 60 upwardly thus opening the port 62 and allowing a discharge of air from the motor 75 through the vent 67, thus again actuating the lever 11 to increase the speed of the driving roller 7 and increase the tension on the work.

It will be appreciated how the tension on the work piece can thus be accurately maintained and furthermore can be regulated by means of the regulating valve 81 which governs the pressure in chamber 58 which acts in opposition to the pressure in chamber 55 which is the same as the pressure in chamber 35. Because only an infinitesimal amount of movement is necessary in the pillow block 17 only one end of the roller 3 need be so equipped with the mechanism of this invention.

I claim:

1. In combination with a machine having guide devices over which a long work piece moves for passage of the work piece through the machine with lengthwise movement, including a driving roller which the work piece engages and a variable speed driving mechanism for driving the roller to propel the work piece, said variable speed driving mechanism having a control member which is shiftable to vary the speed of the driving roller; an air pressure device for supporting a guide device, valve means sensible to variations in the load on the guide device for varying the air pressure which supports the guide device, means for shifting the control member and means operable incident to variation in the air pressure which supports the guide device for actuating said control means of the variable speed driving mechanism.

2. In combination with a machine having guide devices over which a long work piece moves for passage of the work piece through the machine with lengthwise movement, including a driving roller which the work piece engages and a variable speed driving mechanism for driving the roller to propel the work piece, said variable speed driving mechanism having a control member which is shiftable to vary the speed of the driving roller; an air pressure device for supporting a guide device, valve means sensible to variations in the load on the guide device for varying the air pressure which supports the guide device, means for shifting said control member, a control valve, means for conducting the air under pressure which supports the guiding device to the control valve, means for conducting air under pressure to the control valve and applying the same so that the force thereof acts against the pressure which supports the guide device, said control valve being sensitive to and movable incident to variations in the pressure which supports the guide device and means connecting the control valve with the said means for shifting the control member whereby said

means is actuated upon variation in the supporting pressure.

3. In combination with a machine having guide devices over which a long work piece moves for passage of the work piece through the machine with lengthwise movement, including a driving roller which the work piece engages and a variable speed driving mechanism for driving the roller to propel the work piece, said variable speed driving mechanism having a control member which is shiftable to vary the speed of the driving roller; an air pressure device for supporting a guide device, valve means sensible to variations in the load on the guide device for varying the air pressure which supports the guide device, means for shifting the said control member, a control valve, means for supplying air pressure thereto, a vent in the control valve, an air pressure line extending from the control valve to said shifting means, means for connecting the air pressure which supports the guide device to the control valve, means for supplying air pressure to the control valve so that said pressure acts in opposition to the pressure transmitted to the control valve from the said supporting pressure, said control valve being shiftable upon variation in the air pressure which supports the control device for actuating the control valve to connect said shifting means to the air pressure and to the vent in accordance with the direction of shift of the control valve to thereby vary the variable speed driving mechanism.

4. In combination with a machine having guide devices over which a long work piece moves for passage of the work piece through the machine with lengthwise movement, including a driving roller which the work piece engages and a variable speed driving mechanism for driving the roller to propel the work piece, said variable speed driving mechanism having a control member which is shiftable to vary the speed of the driving roller; an air pressure device for supporting a guide device, valve means sensible to variations in the load on the guide device for varying the air pressure which supports the guide device, a pneumatic motor for shifting said control member, a control valve, means for supplying air under pressure to the pneumatic motor through said control valve, means for transmitting the supporting air pressure to the control valve and the control valve having a movable valve member which is shiftable upon variations in the supporting air pressure, whereby variations in the load on the supporting device causes actuation of the control valve and movement of the pneumatic motor.

5. Apparatus for controlling the load on an elongated work piece which is passing through a machine having guide devices over which the work piece moves and which machine includes a driving roller with which the work piece makes contact and a variable speed driving mechanism for the roller to propel the work piece, said variable speed driving mechanism having a control member which is shiftable to vary the speed of the driving roller; an air pressure device for supporting a guide device, valve means sensible to variations in the load on the guide device for causing variation in the air pressure which supports the guide device, means for shifting the control member and means operable incident to variations in the supporting air pressure for actuating said control means of the variable speed driving mechanism.

6. Apparatus for controlling the load on an elongated work piece which is passing through a machine having guide devices over which the work piece moves and which machine includes a driving roller with which the work piece makes contact and a variable speed driving mechanism for the roller to propel the work piece, said variable speed driving mechanism having a control member which is shiftable to vary the speed of the driving roller; an air pressure device for supporting a guide device, valve means sensible to variations in the load on the guide device for causing variation in the air pressure which supports the guide device, a pneumatic motor for shifting said control member, means for supplying air pressure to and for venting said pneumatic motor, a control valve for governing the supply of air pressure and for venting of a pneumatic motor, means for conducting the supporting air pressure to the control valve, said control valve being shiftable upon variation of the pressure in the supporting air pressure for connecting the pneumatic motor to air pressure and to the vent in accordance with movement of the control valve.

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