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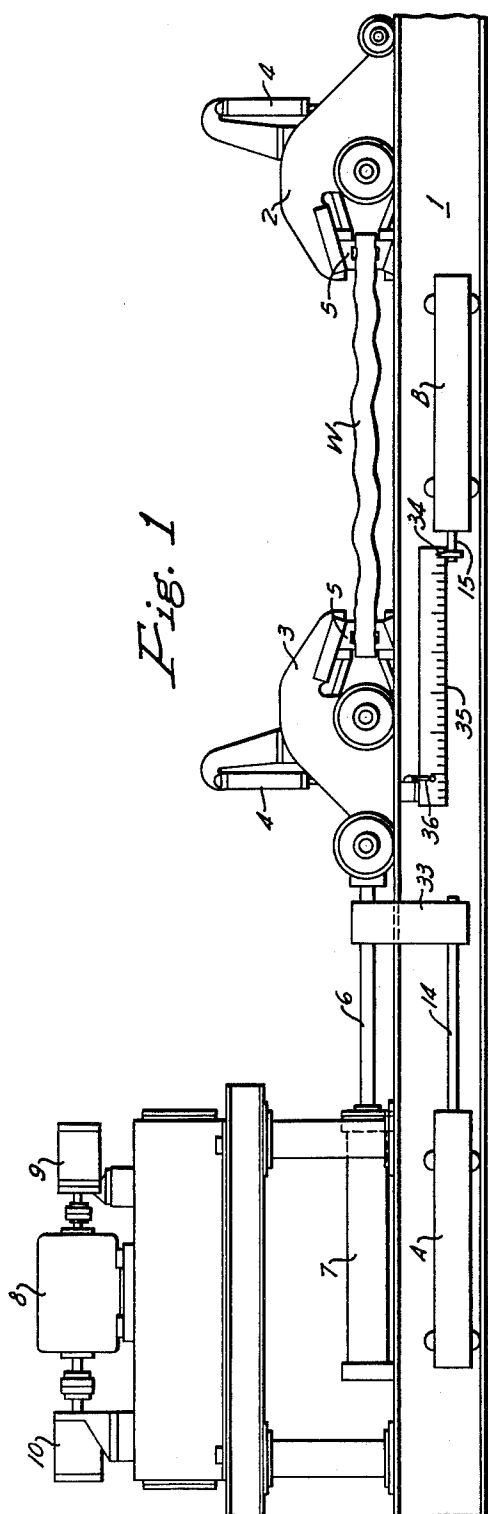
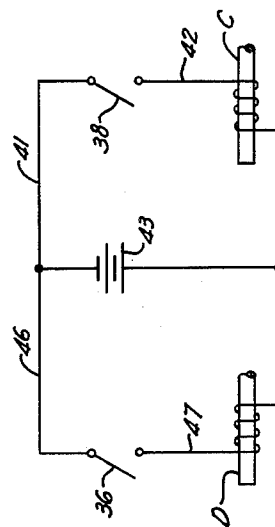
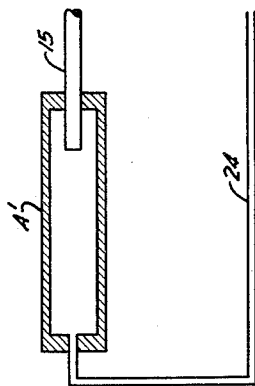
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STRETCH MEASURING AND LIMITING DEVICE FOR STRETCHING MACHINES

Filed May 15, 1956

2 Sheets-Sheet 1



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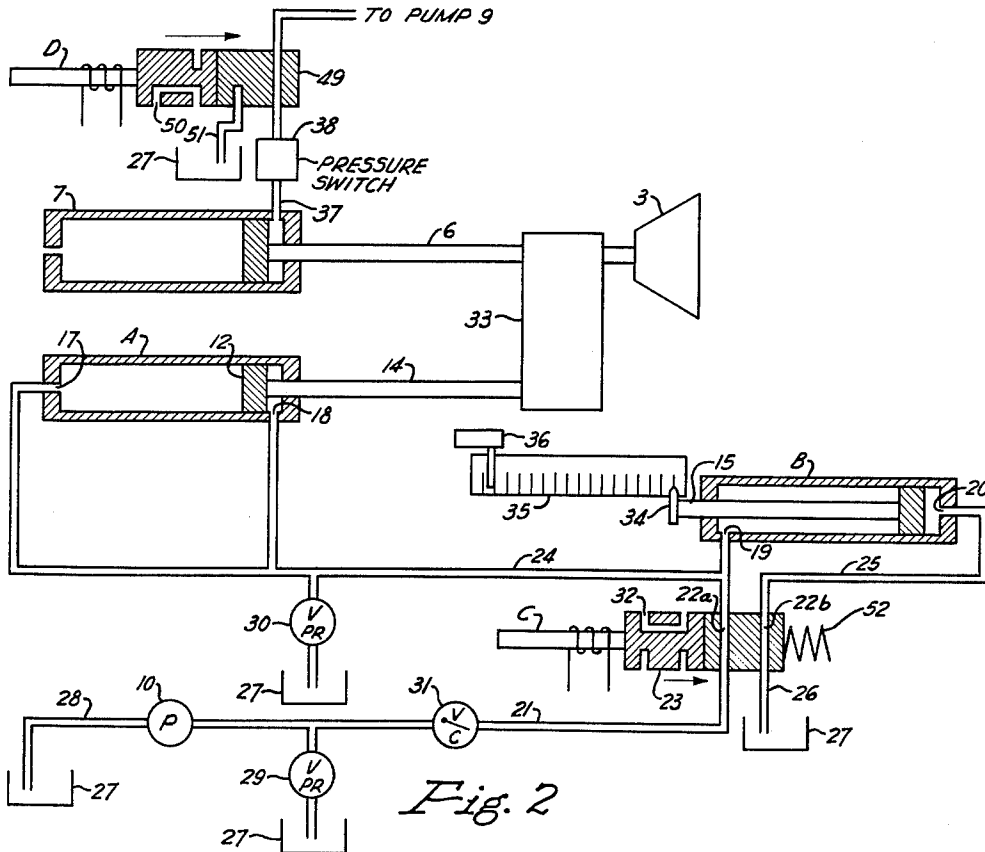
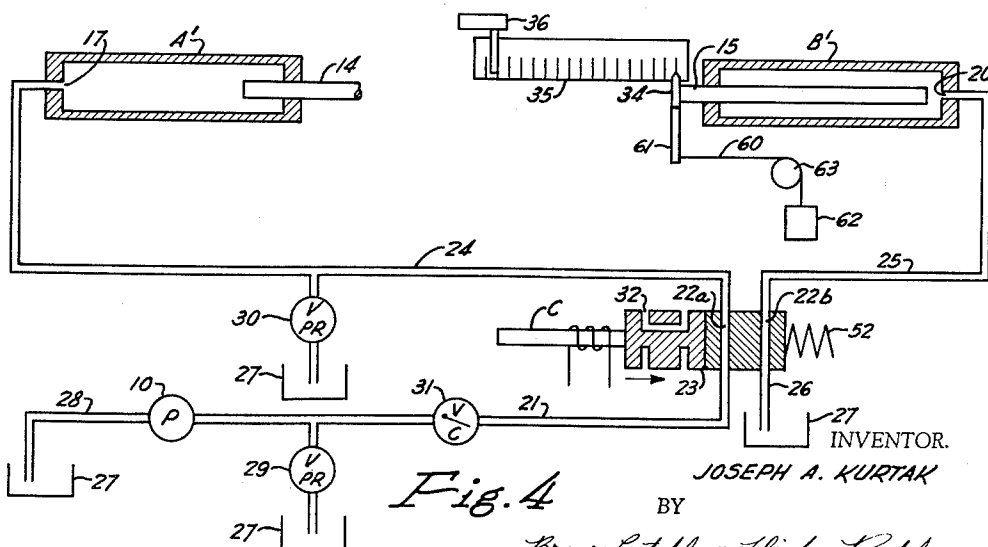
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2 Sheets-Sheet 2



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STRETCH MEASURING AND LIMITING DEVICE FOR STRETCHING MACHINES

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9 Claims. (Cl. 153—35)

This invention relates to a device for measuring and, if desired, automatically limiting the stretch imparted to a workpiece in a stretching machine of the type to straighten or cold work bar stock and other material. A significant feature of the invention is its ability to measure accurately the stretch of the workpiece, regardless of the amount of initial slack therein that must be taken up before actual stretching begins.

The device includes two hydraulic cylinders, each having a fluid port and a fluid actuated rod extending from one end of the cylinder. The rod of the first cylinder moves with the stretcher head that grips the workpiece in the machine. The rod of the second cylinder is normally urged to a limiting position and kept there until the stretcher head has taken up the slack in the workpiece and begins actually to stretch it. At this point, the sudden increase in resistance offered by the workpiece actuates a control means that, in turn, actuates a fluid valve in the hydraulic system associated with the two cylinders to lock those cylinders in a closed hydraulic circuit, so that further movement of the stretcher head in actually stretching the workpiece is accurately measured by the stroke of the rod of the second cylinder. A predetermined stroke, corresponding to the actual stretch desired, trips a limit switch or other control device to stop further stretching.

A preferred embodiment of this invention is illustrated in the attached drawing, in which

FIG. 1 shows the stretch measuring and limiting device mounted on the side of a conventional stretching machine;

FIG. 2 is a schematic diagram showing the hydraulic circuits of the stretch measuring and limiting device, together with related parts of the stretching machine;

FIG. 3 shows a modification of cylinders A in FIG. 2;

FIG. 4 shows modifications of both cylinders A and B in FIG. 2; and

FIG. 5 is a schematic wiring diagram showing the electrical connections between certain elements of FIG. 2.

The stretching machine is conventional. It has the usual bed frame 1, adjustable fixed head 2 for holding one end of the workpiece W, movable stretcher head 3 for gripping the other end of the workpiece, pneumatic cylinders 4 for operating jaws 5 on each head, and a piston rod 6 attached to the stretcher head 3 and actuated by a hydraulic cylinder 7. An electric motor 8 drives hydraulic pumps 9 and 10; the former is connected to the cylinder 7, and the latter to the hydraulic system of the stretch measuring and limiting device.

That device is shown mounted on the side of the frame 1 and includes two hydraulic cylinders A and B, provided respectively with pistons 12 and 13, piston rods 14 and 15, and fluid ports 17—18 and 19—20. The associated hydraulic conduits include a supply line 21 normally connecting pump 10, through passage 22a of valve 23 and through line 24, to ports 17 and 18 of cylinder A and to port 19 of cylinder B, i.e., to the port of cylinder B that is adjacent the piston rod receiving end of that cylinder. Port 20 of cylinder B is connected by a line 25 through a passage 22b of valve 23 and through discharge line 26, to a fluid reservoir 27. The inlet 28 of pump 10 is also connected to the reservoir

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27, as are pressure relief valves 29 and 30 in lines 21 and 24. A check valve 31 is inserted in the supply line 21, between pump 10 and valve 23.

Valve 23 is a two position valve and is normally in the position shown in the drawing. It is actuated by a solenoid C, which moves the valve to the right when energized to disconnect supply line 21 and from line 24 and also to disconnect discharge line 26 from line 25; at the same time, this movement of the valve connects the two lines 24 and 25 through bypass 32, thereby locking the two cylinders A and B in a closed hydraulic circuit.

Piston rod 14 of cylinder A is connected by a suitable member 33 to the stretcher head 3 and moves only in response to movement of that head, which is controlled by higher forces from cylinder 7 than obtains from cylinder A. Piston rod 15 of cylinder B carries a pointer 34, adjacent to a scale 35 attached to the stretcher frame. A limit switch 36, the position of which may be adjusted, is adapted to be tripped, as by pointer 34, when piston 13 in cylinder B has travelled a predetermined distance proportional to the actual stretch to which it is desired to subject the workpiece.

At the beginning of a stretching cycle, but before any slack in the workpiece has been taken up, the various elements described are disposed as shown in the drawing, pump 10 is working and discharging through one of the relief valves 29 and 30, solenoid C is deenergized, and pointer 34 is held by fluid pressure in the system at its extreme right hand position at the lower limit of scale 35.

As stretcher head 3 moves to the left, taking up slack, piston 12 in cylinder A moves to the left in unison with the head against the pressure of fluid in lines 21 and 24. Some of the fluid displaced to the left of piston 12 through port 17 returns to the same cylinder through port 18; but due to the displacement of the piston rod 14 inside cylinder A, less fluid can return to this cylinder than is displaced therefrom. The excess fluid creates back pressure in line 21, closing check valve 31; and the excess is discharged through relief valve 30, while pump 10 discharges through relief valve 29.

As stretcher head 3 continues to move to the left, it will reach a point where the slack in the workpiece is taken up and actual stretching begins. This point is marked by a sharp increase in the resistance offered by the workpiece, and a similar increase in the fluid pressure in cylinder 7 and in line 37 between that cylinder and pump 9. A pressure switch 38, inserted in line 37 and adapted to be actuated at a predetermined pressure, closes an electrical circuit, through conductors 41 and 42 and source of current 43, to energize solenoid C, which shifts valve 23 to the right to lock cylinders A and B in a closed hydraulic circuit through lines 24 and 25 and bypass 32. As soon as the hydraulic circuit is closed, further movement of the stretcher head 3 (and piston 12) to the left, in actually stretching the workpiece, causes a proportional movement of piston 13 in cylinder B. If the piston rods of cylinders A and B are of equal diameter, which is generally preferable, the movement of stretcher head 3 will cause pointer 34 to move an equal distance, since the cylinders function, when connected in the closed hydraulic circuit, as single acting cylinders and the displacement of the pistons in each cylinder is proportional to the cross-sectional area of the piston rods. Accordingly, the stroke of piston rod 15 will equal the stretch of the workpiece W. If the piston rods are not matched in diameter, the movements of stretcher head 3 and pointer 34 will be proportional, though not equal; but, by suitably calibrating scale 35, the pointer will still accurately measure the stretch of

the workpiece. During this stretching phase, pump 10 will discharge through relief valve 29; and relief valve 30 will normally be inactive, since there is no appreciable resistance to the movement of piston 13 and rod 15.

When piston rod 15 has moved a predetermined distance to the left during the actual stretching operation, it will contact limit switch 36 and close a normally open electrical circuit, through conductors 46 and 47 and source of current 43, to energize solenoid D. The latter then shifts a decompression valve 49 to the right to cut off the supply of fluid from pump 9 to the right hand end of cylinder 7 and to decompress that end of the cylinder and line 37 by bringing bypass 50 into registry with lines 37 and 51, the latter discharging into reservoir 27, thereby stopping further stretching of the workpiece. When the pressure in line 37 falls below the actuating pressure switch 38, solenoid C will be deenergized, and valve 23 will return to its initial position under the urging of spring 52 and will reconnect supply line 21 with line 24 and discharge line 26 with line 25. Pump 10 will then force piston 13 in cylinder B and indicator 34 back to their initial positions and maintain them there until solenoid C is again energized at the start of the stretching phase in the next cycle. Piston 12 in cylinder A will, of course, follow the movements of stretcher head 3. Other controls, either automatic or manual, for returning valve 49 to its initial position at the appropriate time and for otherwise operating the stretcher head, form no part of this invention and are not shown.

Since the movement of piston rod 14 of cylinder A is controlled exclusively by stretcher head 3, and since the only function of that cylinder is to discharge a given volume of fluid (equal to the area of rod 14 multiplied by its stroke) into cylinder B, piston 12 and port 18 can be dispensed with, without in any way affecting the operation of the system previously described. Such a modification is shown in FIG. 3, where cylinder A' is the same as cylinder A of FIG. 2, except that it has only a single port 17 and no piston. Both cylinders A and A' (assuming their rods have equal cross-sectional areas and the same stroke) will discharge the same volume of fluid into line 24. This follows from the fact that some of the fluid displaced through port 17 of cylinder A flows back into that cylinder through port 18, the excess that is discharged into line 24 being equal to the product of the cross-sectional area of rod 14 and its stroke, irrespective of the diameter of the piston itself. In other words, cylinders A and A' are equivalents in so far as their functions in this system are concerned.

A further modification is shown in FIG. 4, in which the double acting cylinders A and B of FIG. 2 are replaced by single acting cylinders A' and B'. Cylinder A' is the same as that shown in FIG. 3, and cylinder B' is similar to it. Except as shown, the hydraulic circuit and other elements are the same as in FIG. 2; and, with the following comments, the operation of cylinders A' and B' will be clear by reference to FIG. 2. Since rod 15 of cylinder B' has no piston, it cannot be returned to its initial right hand position by the hydraulic means shown in FIG. 2. However, a variety of other means can be used, such as, for example, a cable 60 having one end attached to an arm 61 on the free end of rod 15, and the other end attached to a counterweight 62, the intermediate portion of the cable passing over a sheave 63. The counterweight is sufficiently heavy not only to maintain the rod normally at its extreme right hand position against accidental displacement (there is normally no fluid pressure urging the rod out of that position), but also to return it to that position after the workpiece has been stretched to the desired extent. In other words, the counterweight performs the same function with respect to rod 15 that was performed by pump 10 in FIG. 2.

It will be readily understood that pump 10 can be replaced by any suitable source of fluid, preferably, but not necessarily, under pressure. The pump has the following functions: (1) it keeps the system full of fluid, i.e., makes up for fluid discharged through the relief valves 29 and 30 and the discharge line 26; and (2) in the arrangement shown in FIG. 2, it also holds piston 13 in its extreme position and returns it to that position. For neither purpose is it essential. Its first function can be performed by connecting line 21 to a fluid reservoir below the level of liquid therein. Its second function, restricted to the arrangement of FIG. 2, can be performed by a counterweight (as shown in FIG. 4), or by other suitable means. It will also be understood that check valve 31 serves only to isolate the pump 10 from the cylinder system A—B during motions of the stretcher head to the right, protecting the pump from shocks that may be set up in the cylinder system due to sudden or erratic motions of stretcher head, so that the check valve is not essential in the operation of the systems shown. If check valve 31 is eliminated, relief valve 30 is needed only to protect the closed hydraulic circuit against damage from too high pressures due to an obstruction in the circuit. It will, of course, be set to operate at a pressure high enough that will not interfere with the normal operation of the device.

It is among the advantages of the present invention that it can discriminate between movements of the stretcher head in taking up slack in the workpiece, such as is due to twists and bends, and in actually stretching the workpiece; that it can accurately measure the actual strength, regardless of the amount of slack previously taken up; and that it can limit the stretch to a predetermined amount, either automatically as described, or by obvious manual means under the control of the operator, so as to stop the stretcher head after the pointer 34 reaches a predetermined point on scale 35.

According to the provisions of the patent statutes, I have explained the principle of my invention and have illustrated and described what I now consider to represent its best embodiment. However, I desire to have it understood that, within the scope of the appended claims, the invention may be practiced otherwise than as specifically illustrated and described.

I claim:

1. A stretch measuring and limiting device for use with a stretching machine having a hydraulically movable head for gripping and stretching a workpiece, said device comprising two hydraulic cylinders, the first cylinder having a fluid displacing rod extending through one end of the cylinder, the second cylinder having a fluid port at each end and a piston and a piston rod extending through one end of the cylinder, the rod of the first cylinder being connected to the head and movable with it, a hydraulic supply line normally connected to the first cylinder and to the first port of the second cylinder adjacent its piston rod receiving end, a hydraulic discharge line normally connected to the second port of the second cylinder, a pump for supplying fluid under pressure to the supply line to maintain the piston in the second cylinder normally at one end of that cylinder, valve means for disconnecting the pump from the supply line and the discharge line from the second port of the second cylinder and for connecting the first cylinder and the second port of the second cylinder in a closed hydraulic circuit, valve actuating means operative in response to a predetermined force exerted by the head on the workpiece, and limiting means adapted to be actuated by a predetermined relative movement between the second cylinder and its piston rod for stopping further stretching movement of the head.

2. A device according to claim 1, in which the stretch limiting means includes a limit switch and electrical means controlled by the switch for stopping stretching movement of the head.

3. A device according to claim 1, in which the valve

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actuating means includes a pressure switch that is actuated by the hydraulic pressure moving the head.

4. A stretch measuring device for use with a stretching machine having a movable stretching member for gripping and elongating a workpiece, said device comprising a first hydraulic element that includes a first cylinder member provided with a fluid port and a first rod member extending through one end of the cylinder member and movable relative thereto, one of said members being rigidly connected to the movable stretching member and adapted to displace fluid from the port in response to movement of the stretching member in taking up slack in and stretching the workpiece, a second hydraulic element that includes a second cylinder member provided with a fluid port and a fluid displaceable member extending through one end of the second cylinder member, one of the members of the second hydraulic element being fixed and the other being movable relative thereto upon an increase of fluid pressure in the second cylinder member, indicating means mounted adjacent the movable member of the second hydraulic element for measuring linear movement of that member, valve means having an operative position that connects the ports of the two cylinder members in a closed hydraulic circuit, and valve actuating means responsive to a predetermined force exerted by the stretching member on the workpiece for shifting the valve means to its operative position.

5. Apparatus according to claim 4 that also includes a fluid discharge line and in which the valve means has a second operative position that connects the port of the second cylinder member to the discharge line.

6. A stretch measuring device for use with a stretching machine having a movable stretching member for gripping and elongating a workpiece, said device comprising a first hydraulic element that includes a first cylinder member provided with a fluid port and a rod member extending through one end of the cylinder member and movable relative thereto, one of the members being rigidly connected to the movable stretching member and adapted to displace fluid from the port in response to movement of the stretching member in taking up slack in and stretching the workpiece, a second hydraulic element that includes a second cylinder member provided with a fluid port at each end and with a piston and a piston rod extending through one end of the second cylinder member and movable relative thereto and with said piston secured

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to the inner end of the piston rod, a hydraulic supply line connecting the port of the first cylinder member with that port of the second cylinder member that is adjacent its piston rod receiving end, a source of hydraulic fluid, a hydraulic discharge line, valve means operative in a first position to connect the source of hydraulic fluid to the supply line and to connect the discharge line to the other port of the second cylinder member and operative in a second position to disconnect the source of hydraulic fluid and the discharge line from said ports and to interconnect the ports of both cylinder members in a closed hydraulic circuit, and actuating means responsive to a predetermined force exerted by the stretching member on the workpiece for shifting the valve means from its first to its second position, indicating means mounted adjacent the outer end of the piston rod of the second cylinder member for measuring linear movement of that rod relative to the second cylinder member.

7. Apparatus according to claim 6, in which the stretching member is operated by fluid pressure and the valve actuating means includes a pressure sensitive device adapted to be actuated at a predetermined pressure of the fluid operating the stretching member.

8. Apparatus according to claim 6 that also includes control means actuated by movement of the piston rod of the second cylinder member through a predetermined stroke and operative to stop further stretching movement of the stretching member.

9. Apparatus according to claim 4 that also includes control means actuated by movement of the fluid displacement member of the second hydraulic element through a predetermined stroke and operative to stop further stretching movement of the stretching member.

References Cited in the file of this patent

UNITED STATES PATENTS

2,261,444	Nuebert	Nov. 4, 1941
2,371,893	Hyland	Mar. 20, 1945
2,690,205	Stary	Sept. 28, 1954
2,714,917	Siegerist	Aug. 9, 1955
2,782,603	Beecroft	Feb. 26, 1957
2,790,340	Cross	Apr. 30, 1957

FOREIGN PATENTS

581,095	Great Britain	Oct. 1, 1946
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