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TENSION DEVICE FOR WIRE DRAWING BENCHES

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Fig. 1.

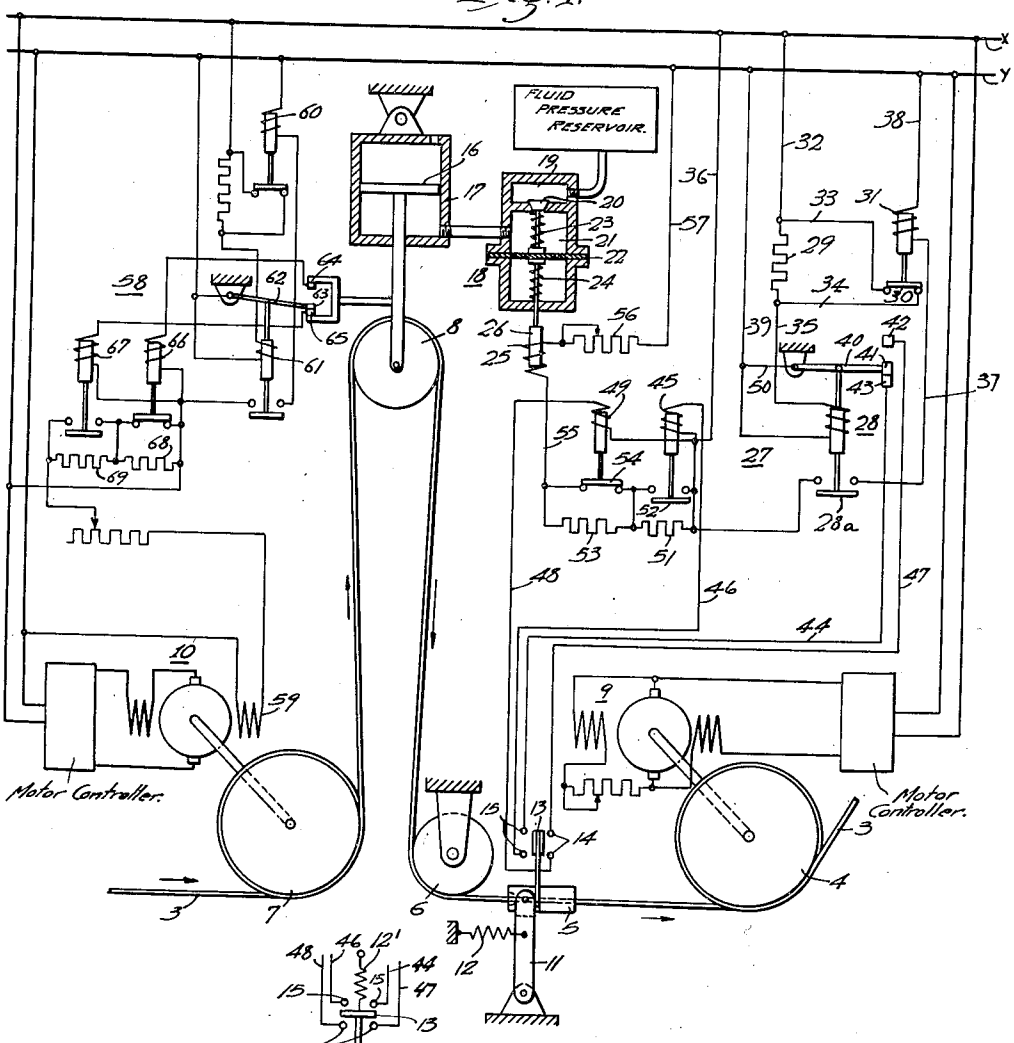
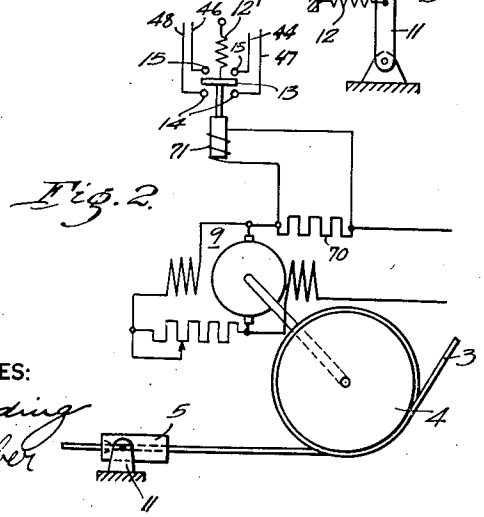


Fig. 2.



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TENSION DEVICE FOR WIRE DRAWING BENCHES

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My invention relates, generally, to wire drawing machinery and, more particularly, to a system for maintaining the proper back tension upon a wire as it is being drawn through a die.

In the manufacture of wire, it is common practice to pull the wire stock through a die to reduce its section by rotating a drum upon which the wire is mound, then unwinding the wire from the drum and drawing it through a succeeding die to further reduce its section by winding it upon another drum and thus continuing through successive dies until the desired reduction has been obtained.

It has been found desirable to maintain a back tension upon the wire between each drum and the next succeeding die. This back tension makes it possible to pass larger stock through a given die than could be passed without back tension and thus reduces the number of dies required for a given reduction. This back tension also reduces the work required to be done in each die for a given reduction of wire section and thus decreases the heating of the wire caused by drawing it through the die. For this reason, the wire may be drawn through the die at a greater speed than when back tension is not employed, with the same amount of heating.

For a given material, a given forward pull, a given desired reduction and a given speed of material feed, a definite ratio exists between the forward pull on the wire and the back tension which will give the best results. It follows that such changes in the physical characteristics of the material, such as ductility, hardness and cross section area, as would increase the drawing resistances in the die would increase the forward pull on the wire and would not provide the proper ratio between the forward pull on the wire and the back tension if the back tension were a fixed amount.

This ratio varies with different forward tensions and is always such that an increase in forward tension requires that there be an increase in back tension to secure the best drawing results.

If the forward pull and die resistance are allowed to become great enough, there is danger of the wire being pulled apart. By providing the proper increase in back tension with increase of die resistance and front pull, this danger is eliminated.

The object of my invention is to provide a device which shall function to vary the back tension on a wire which is being drawn through a die in response to variations of the physical characteristics of the wire.

A further object of the invention is to provide a device which shall function to increase the back tension on a wire which is being drawn through a die in response to an increase in resistance-to-drawing as the wire passes through the die.

Another object of the invention is to provide a control system which shall function to increase the back tension on a wire as it is being drawn through a die in response to an increase in load on the motor that is drawing the wire through the die.

A further object of my invention is to provide a device which shall function to maintain a substantially constant back tension on a wire as it is being drawn through a die.

Another object of my invention is to provide a device for maintaining a substantially constant back tension on a wire as it is being drawn through a die so long as the front tension on the wire remains substantially constant.

A further object of my invention is to provide a system for so controlling the relative speed of two successive wire block motors as to maintain a substantially constant back tension on a wire as it is drawn through a die.

A further object of my invention is to provide a system for drawing wire which shall function to produce a given reduction of the wire with a minimum of apparatus, a minimum number of steps in the drawing process and at a maximum speed.

Another object of my invention is to provide a system for drawing wire which shall function to prevent breaking of the wire during the drawing process by automatically limiting the stress on the die block during the drawing operation.

These and other objects and advantages of my invention may be readily understood by reference to the following detailed description taken in connection with the accompanying drawing, in which:

Figure 1 is a diagrammatic illustration of the elements of structure of the preferred embodiment of my invention and their cooperative relationships; and

Fig. 2 is a diagrammatic illustration of a modification of the structure illustrated in Fig. 1.

In carrying out the preferred embodiment of my invention, I provide a floating sheave over which the wire passes in travelling from a wire block to the succeeding die block. The sheave is carried by a piston which is movable in a

cylinder by fluid pressure which is applied to the cylinder. The sheave and piston are so mounted as to increase the back tension of the wire when fluid pressure in the cylinder is increased. The die block is so mounted as to be deflected by the front tension on the wire, or the frictional resistance of the wire in the die block, the degree of deflection being proportional to the front tension or frictional resistance. The deflection of the die block is made to control a regulator which, in turn, causes increase of the fluid pressure in the cylinder to increase the back tension on the wire.

A regulator is controlled by the positioning of the back tensioning sheave to vary the speed of the preceding wire block motor to air in maintaining increased back tension without the necessity of continuous movement of the sheave supporting piston.

A modification of this system operates to regulate the fluid pressure in the cylinder in response to changes in the loading of the wire block motor which is drawing the wire through the die.

Referring to Fig. 1 of the drawing, wire 3 is wrapped around motor-driven drum 4, and is drawn through die 5 to reduce it in section. Wire 3 is fed to the die 5 over guide sheave 6, after being unfound from motor-driven drum 7 and passing over tensioning sheave 8. Drums 4 and 7 are driven by motors 9 and 10, respectively.

The die 5 is mounted on a pivoted arm 11, which is biased by spring 12 to move in a direction opposite to that in which the wire is moving. A contact element 13 is mounted on arm 11, and is disposed to close a set of contacts 14 in the event that the pull of the wire on the die exceeds a predetermined amount, and to close contacts 15 in the event that the pull on the die is less than a predetermined amount.

The tension on the wire 3 as it passes between the drums 4 and 7 is regulated by fluid pressure operated piston 16, which moves in the pivotally mounted cylinder 17 under force of fluid pressure supplied by regulating valve 18, which regulates the fluid pressure supplied from the pressure reservoir to the cylinder 17.

The pressure regulating valve 18 comprises a chamber 19, valve 20 and chamber 21, which is connected to cylinder 17. The flexible diaphragm 22 forms one wall of chamber 21, and is connected by rod 23 to the valve 20. Spring 24 acts on the underside of the diaphragm 22 to hold the valve 20 in such a position as will supply a predetermined pressure to cylinder 17.

Variation of the pressure in cylinder 17 is brought about by a variation in the pressure on the lower side of diaphragm 22 which is effected by varying current flowing in a solenoid coil 25, which acts upon a solenoid core 26 to exert a force on the diaphragm 22 opposite to the force of spring 24.

A regulator 27 so governs the current in solenoid coil 25 as to supply a pressure in cylinder 17, which varies with the displacement of the die block 5. This regulator comprises a relay 28, which is connected across the supply lines X—Y, in series with a resistance 29, which is normally shorted by the contact element 30 of relay 31. The circuit for relay 28 extends from the supply conductor X through conductor 32, resistance 29, which is shorted by contact element 30 through conductors 33 and 34, conductor 35, the coil of relay 28, and conductor 39 to the other side of the source of supply Y. When relay 28 is energized, its contact element 28a closes a circuit through the coil of relay 31 which extends from the supply conductor X, through conductor 36, contact element 28a, conductor 37, the coil of relay 31 and conductor 38 to the other side of the source of supply Y.

With relays 31 and 28 connected as described, it will be seen that relay 28 is being intermittently energized and deenergized by the shorting of resistance 29 by the contact element 30 of the relay 31 and the removal of the short from the resistance 29 by a contact element 30 of relay 31 when relay 31 is energized through the closure of contact element 28a of relay 28. This produces a vibration of arm 40, which is operated by relay 28, and produces a movement of movable contact element 41 between stationary contacts 42 and 43.

It will be seen that one of the contact elements 15, associated with the die 5, is connected by conductor 44 with the lower stationary contact 43 and that the other contact element 15 is connected to the coil of relay 45 through conductor 46. It will also be seen that stationary contact 42 of the regulator is connected through conductor 47 to one of the contact elements 14, and that the other contact element 14 is connected through conductor 48 to the coil of relay 49.

Thus it will be seen that, as contact element 41 of the regulator alternately engages its associated contact elements 42 and 43, relay 45 will be energized in the event that movable contact element 13, actuated by the movement of the die, is in enagagement with contact elements 15, and that relay 49 will be energized in the event that movable contact element 13 is in engagement with contact elements 14.

The operating circuit for relay 45 extends from supply conductor X, through conductor 36, coil of relay 45, conductor 46, contact elements 15, contact element 13, conductor 44, contact elements 43 and 41, arm 40, conductor 50 and conductor 39 to the other side of the source of supply Y. The circuit for relay 49 extends from supply conductor X, through conductor 36, coil of relay 49, conductor 48, contact elements 14, movable contact element 13, conductor 47, contacts 42 and 41, arm 40, conductor 50 and conductor 39 to the other side of the source of supply Y.

The circuit for solenoid 25 extends from supply conductor X, through conductor 36, resistance 51, which may be shorted by the contact element 52 of relay 45 when the relay is energized, resistance 53, which is normally shorted by contact element 54 of relay 49 when relay 49 is deenergized, conductor 55, solenoid coil 25, resistanc 56, and conductor 57 to the other side of the source of supply Y.

It will be seen that energization of relay 45 will raise contact element 52 to short circuit resistance 51, thus decreasing the resistance in series with solenoid 25. This decrease in resistance in the circuit of coil 25 will cause increased current flow in the coil and will cause a decrease in the pressure supplied to cylinder 17. The energization of relay 49 will cause its movable contact element 54 to remove the short from resistance 53, thus increasing the resistance in the circuit of solenoid 25 and causing decreased current flow in the solenoid. This will result in causing valve 20 to increase the pressure in cylinder 17 and to thus cause upward movement of sheave 8.

In order that the travel of the piston 16 may

be limited and the proper tensioning on the wire maintained, a regulator 58, of well known construction, is provided for governing the speed of motor 10 to thus govern the rate of feed of wire 3 to the die 5. The regulator 58 controls the current flow in the field coil 59 of motor 10 in response to predetermined movements of the sheave 8. The regulator comprises relays 60 and 61, which function very much the same as relays 31 and 28, respectively, in regulator 27, hereinbefore described, and produce a vibration of arm 62 to move contact element 63 alternately into engagement with contact elements 64 and 65. Contact elements 64 and 65 are connected to relays 66 and 67, which function in the manner described hereinbefore in connection with relays 45 and 49, respectively, to vary the current in field coil 59 by including resistance 68 in, or removing resistance 69 from, the field winding 59 of the motor 10.

In the operation of the device, in the event that for some reason, such as a change in the hardness of the material of the wire, too great a pull is placed upon wire 3 in passing through die 5, the die will move against the tension of spring 12 to cause movable contacts element 13 to bridge contact elements 14 and close the circuit to relay 49, which circuit will be intermittently completed through contact elements 41 and 42 of the regulator. This intermittent energization of relay 49 will cause its contact element 54 to intermittently remove the short circuit from resistance 53 and thereby decrease the current in solenoid 25. The decrease in current in solenoid 25 will cause valve 20 to increase the pressure in cylinder 17 which will tend to cause an upward movement of piston 16 and sheave 8 to increase the back tension on the wire.

The increase in the back tension on the wire 3, by upward movement of sheave 8, will permit the wire to be drawn through the die 5 without increasing the tension on the wire as it is pulled by drum 4 to such an extent as would be likely to break the wire at the die. In other words the increase in back tension reduces the resistance to drawing and prevents the drawing tension from becoming excessive.

In the event of such a change in the character of the wire as would cause decreased resistance-to-drawing and would allow spring 12 to move die block 5 to the left, decreased tension on the wire would be brought about by closure of contact element 13 to decrease the pressure in cylinder 17 through increase in current in solenoid 25 by energization of relay 45 to short circuit resistance 51.

In the event that continued increases of tension in the wire are required to maintain the proper balance on the two sides of the die 5, regulator 58 responds to the displacement of contact element 65 which moves with the sheave 8 to increase the current in field 59 of motor 10 to thus tend to decrease the speed of motor 10 and thus increase the back tension on wire 3. This regulation of the field current of motor 10 permits proper tensioning of the wire with a limited displacement of the piston 16 and sheave 8.

In the modification of Fig. 2, I have shown a means for controlling the operation of the regulator in response to variations of the load on motor 9 which are caused by variations in the resistance-to-drawing of the wire in the block 5. In this modification, a resistance 70 is connected in series with the motor 9, and a relay 71 is connected across this resistance so as to be responsive to the voltage drop in the resistance. Like reference characters indicate the same or equivalent elements in the two figures.

In the operation of the modification of Fig. 2, in the event that the resistance-to-drawing in the die 5 increases, the increased load on the motor 9 will cause increased drop in resistance 70, thus causing relay 71 to move contact element 13 against the tension of spring, 12' to bridge contact elements 14. This will close an energizing circuit for the relay 49, as hereinbefore described in connection with the operation of the apparatus shown in Fig. 1, to tend to cause an upward movement of sheave 8 to increase the backward tension on the wire 3.

In a like manner, decrease in resistance-to-drawing in die block 5 will cause a decrease in the current drawn by motor 9 and will permit spring 12' to move contact element 13 to bridge contact elements 15, which will energize the relay 45 to cause the regulator 18 to reduce the pressure in the cylinder 17 and thus decrease the back tension on the wires.

In compliance with the requirements of the patent statutes, I have shown and described herein the preferred embodiments of my invention. It is understood, however, that the invention is not limited to the precise constructions shown and described, but is capable of modification by one skilled in the art, the embodiments herein shown being merely illustrative of the principles of my invention.

I claim as my invention:

1. In a system for drawing wire, means for drawing a wire through a die, means mounting the die for movement in accordance with the drawing force exerted on the die, means for maintaining a back tension on the wire as it is drawn through the die, and means for automatically varying the back tension in response to movement of the die.

2. In a system for reducing the cross-sectional area of a length of material, means for passing the material through a device which will cause reduction in the cross-sectional area of the material including means for exerting a forward tension on the material, means for maintaining a back tension on the material, and pressure fluid-operated means acting on the material responsive to variations in the forward tension for varying the back tension on the material.

3. In a wire drawing system, means for drawing a wire through a die to reduce the cross-sectional area of the wire, means for maintaining a back tension on the wire, means including a fluid pressure operated device acting on the wire for automatically varying the back tension on the wire in response to variations in physical characteristics of the wire.

4. In a wire drawing device, a die, means for pulling the wire through the die, means for maintain a back tension on the wire, means including a fluid pressure operated device acting on the wire for automatically varying the back tension on the wire in response to variations in the resistance-to-drawing of the wire.

5. In a system for drawing wire, means for drawing a wire through a die, means for maintaining a back tension on the wire, means including a fluid pressure operated device acting on the wire for automatically varying the back tension on the wire in response to variations in the loading of the means for drawing the wire through the die.

6. In a system for drawing wire, a die, means

for drawing a wire through the die, means for maintaining a back tension on the wire, means including a fluid pressure operated device acting on the wire for automatically varying the back tension on the wire in response to the variations in the force exerted on the die in drawing the wire through the die.

7. In a system for drawing wire, a die, means for drawing a wire through the die, means for maintaining a back tension on the wire, means including a fluid pressure operated device acting on the wire for controlling the back tension on the wire, and means responsive to the variations in the force exerted on the die in drawing the wire through the die for varying the fluid pressure acting on the fluid pressure operated device to thus vary the back tension on the wire.

8. In a wire drawing device, means for pulling a wire through a die, means for maintaining a back tension on the wire, means including a fluid pressure operated device acting on the wire for controlling the back tension on the wire, and means responsive to the variations in physical characteristics of the wire for varying the fluid pressure acting on the fluid pressure operated device to thus vary the back tension in accordance with variations in the physical characteristics of the wire.

9. In a wire drawing system, a die, means for pulling the wire through the die, means for maintaining a back tension on the wire, means including a fluid pressure operated device acting on the wire for controlling the back tension on the wire, and means responsive to the loading of the pulling means for varying the fluid pressure acting on the fluid pressure operated device to thus vary the back tension in accordance with variations in the loading of the pulling means.

10. In a wire drawing device, in combination, a die, means for pulling a wire through the die to reduce its cross-sectional area, means for so mounting the die as to permit a displacement of the die an amount which is proportional to the force exerted on the die by the wire as it is pulled through the die, means for maintaining a back tension on the wire, means for adjusting the back tension on the wire, and means whereby the back tension adjusting means is actuated in accordance with the degree of displacement of said die.

11. In a wire drawing device, a die, means for pulling a wire through the die comprising a motor, means for maintaining a back tension on the wire, pressure-fluid actuated means acting on the wire for adjusting the back tension on the wire, and means whereby the back tension adjusting means is actuated in accordance with the loading of the motor.

12. In a wire drawing device, a die, means for pulling a wire through the die, means for maintaining a back tension on the wire comprising a member over which the wire travels before entering the die, said member being so disposed as to cause variation of the back tension on the wire when the member is moved, means governing the movement of the member comprising a fluid actuated piston, and means responsive to the force exerted on said die in pulling the wire through the die for controlling the fluid flow to said piston to thereby vary the back tension on said wire in accordance with the force exerted on said die by said pulling means.

13. In a wire drawing device, a die, means for pulling a wire through the die comprising a motor, means for maintaining a back tension on the wire comprising a member over which the wire travels before entering the die, said member being so disposed as to cause variation of the back tension on the wire when the member is moved, means governing the movement of the member comprising a pressure fluid actuated piston, and means responsive to the loading of said motor for controlling the fluid flow to said piston to thereby vary the back tension on said wire in accordance with the loading of said pulling motor.

14. In a wire drawing device, a die, means for pulling a wire through the die comprising an electric motor, means for maintaining a back tension on the wire comprising a member over which the wire travels before entering the die, said member being so disposed as to cause variation of the back tension on the wire when the member is moved, means governing the movement of said member comprising a fluid actuated piston and an electrically controlled valve device for governing the fluid flow to said piston, a current responsive device responsive to the load current to said electric motor, means whereby said current responsive device controls the operation of said electrically controlled valve device to thereby vary the back tension on the wire in accordance with the loading of said electric motor.

15. In a wire drawing device, a die, means for pulling a wire through the die, means for maintaining a back tension on the wire comprising a member over which the wire travels before entering the die, said member being so disposed as to cause variation of the back tension on said wire when the member is moved, means governing the movement of the member comprising an electrically controlled fluid actuated piston, means for so mounting the die as to cause displacement of the die in the direction of travel of the wire in accordance with the force exerted upon the die by the wire as it is drawn through the die, means whereby the displacement of said die controls the operation of said electrically controlled fluid actuated piston to thereby vary the back tension on the wire in accordance with the force exerted upon the die by the wire as it is drawn through the die.

16. In a wire drawing system having a series of motor-driven wire blocks each of which draws a wire through a die and from each of which the wire is fed to the next succeeding die, a die, a member over which a wire which is being drawn travels in passing from a feeding wire block to the die, said member being so disposed as to vary the tenson in the wire between the die and the feeding wire block upon movement of the member, means responsive to the resistance-to-drawing of the wire for moving said member, and means responsive to predetermined movement of said member for varying the speed of the feeding wire block motor.

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