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[54] **PAYOFF REEL CONTROLLER**
9 Claims, 3 Drawing Figs.

[52] **U.S. Cl.** **72/289,** 242/78
[51] **Int. Cl.** **B21c 1/02**
[50] **Field of Search** ..... 72/287, 288, 289, 423, 425, DIG. 11, 10, 17, 19; 226/178; 242/77.2, 78, 129

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ABSTRACT: A drawing block having a die box, a rotatable block for drawing stock through the die box, and a motorized payoff reel for feeding stock in a generally arcuate path to the die box and having a sensing rotor mounted for sensing inward movement of the arcuate stock feed path. A pair of variable resistors are connected in series with the field of the payoff reel drive motor and a switch operated by a speed-sensitive actuator rotated by the sensing rotor provides for selectively shunting one of the variable resistors to increase the motor speed when the sensing rotor is engaged and rotated by the stock.

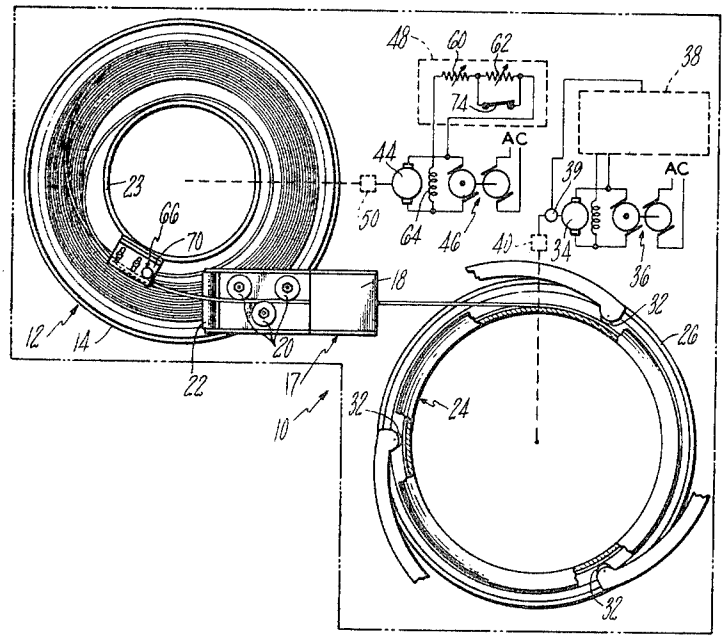


FIG. 1

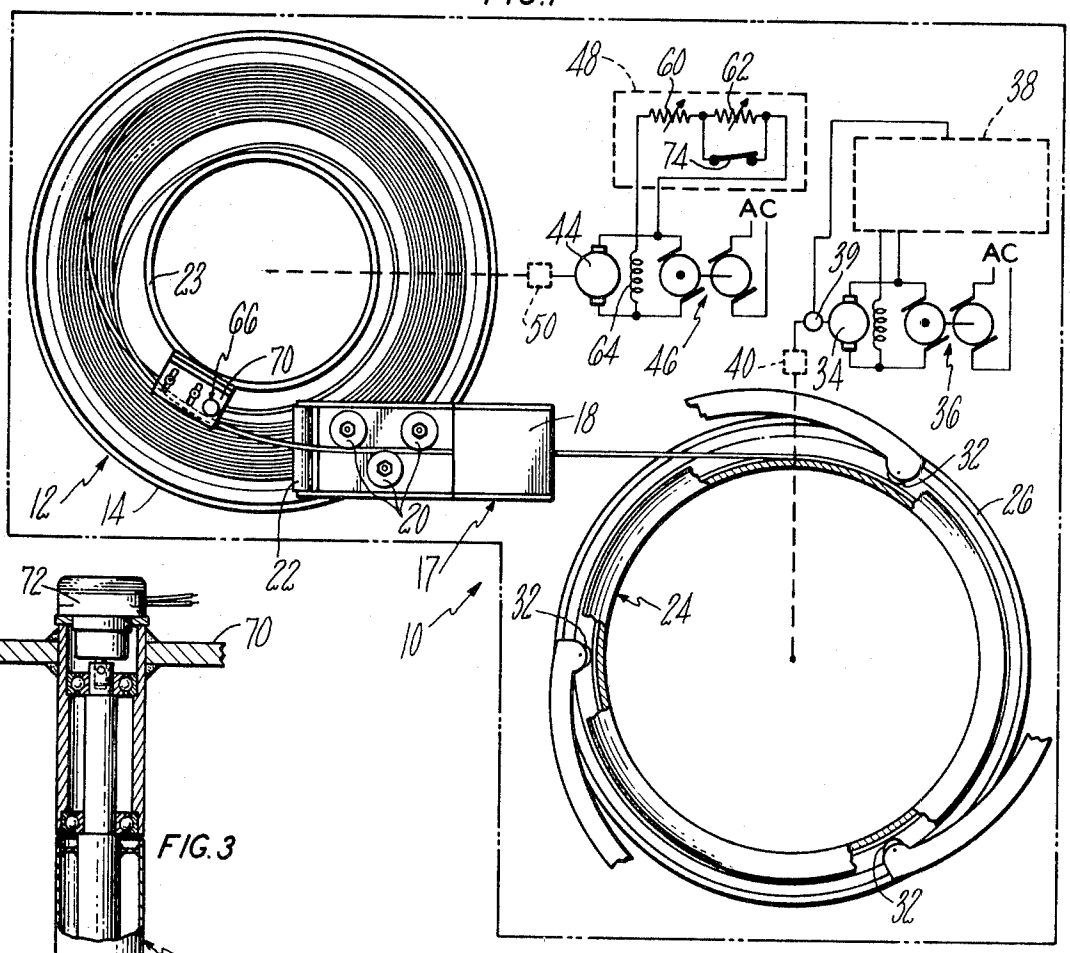
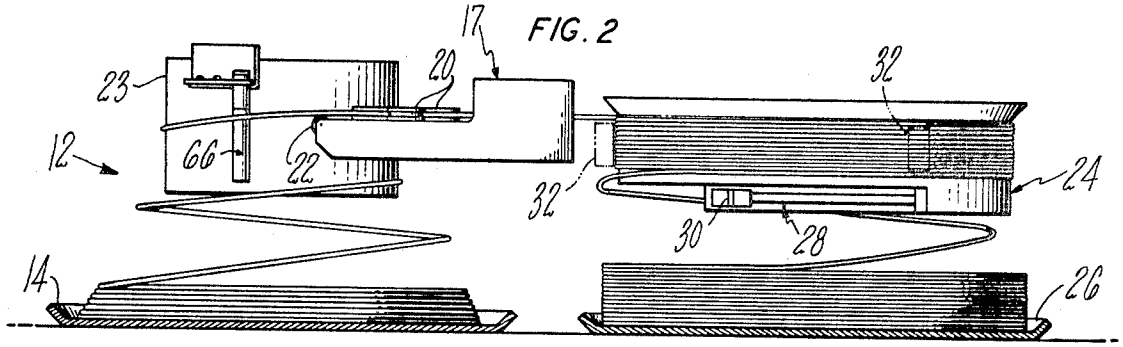


FIG. 3

FIG. 2



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PAYOFF REEL CONTROLLER

BRIEF SUMMARY OF THE INVENTION

The present invention relates generally to motorized payoff reels for paying off stock to, for example, a drawing block, and relates more particularly to a new and improved motor controller for controlling the payoff of stock.

It is a principal aim of the present invention to provide a new and improved payoff reel controller which permits high speed stock payoff without risk of stock breakage or tangling.

It is another aim of the present invention to provide a new and improved payoff reel controller which permits unattended operation of the payoff reel.

It is a further aim of the present invention to provide a new and improved payoff reel controller useful with existing machinery such as, for example, drawing blocks.

It is another aim of the present invention to provide a new and improved payoff reel controller which functions to vary the rate of payoff in accordance with variations in the rate of use of the stock by the machinery associated in line therewith.

Other objects will be in part obvious and in part pointed out more in detail hereinafter.

A better understanding of the invention will be obtained from the following detailed description and the accompanying drawing of an illustrative application of the invention.

BRIEF DESCRIPTION OF THE DRAWING

In the drawing:

FIG. **1** is a generally diagrammatic top plan view of a drawing block incorporating an embodiment of a payoff reel controller of the present invention;

FIG. **2** is a generally diagrammatic elevation view, partly broken away, of the drawing block; and

FIG. **3** is an enlarged elevation view, partly broken away and partly in section, showing a sensing rotor of the controller.

BRIEF DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring now to the drawing in detail, a drawing block **10**, of the type conventionally employed for forming tubular stock, for example for reducing the diameter and/or wall thickness of tubular stock, is shown incorporating an embodiment of a payoff reel controller of the present invention. The drawing block **10** comprises a payoff reel **12** having a suitable turntable or basket **14** adapted to support a coil of stock and for paying off the stock along an arcuate path to a die box unit **17** having a die box **18** for forming the stock and suitable rollers **20** and **22** mounted forwardly of the die box **18** for straightening the stock and guiding it to the die box. The payoff reel **12** is also shown having a cylindrical drum **23** located centrally above the basket **14** for assisting in guiding the stock inwardly from the coil and via an arcuate path to the die box unit **17**.

A generally cylindrical block or drum **24** is provided for drawing the stock through the die box **18**. The block **24** shown employs the continuous shedding principal which permits drawing of unlimited coil weights. The stock is drawn through the die box **18**, is coiled onto the block **24** as the block is rotated and is shed down the cylindrical surface of the block onto a takeup turntable or basket **26** mounted underneath the block. The block **24** has a suitable gripper **28**, and a typical draw cycle commences with the insertion of the stock through the die and into jaws **30** of the gripper **28**. The gripper jaws are then closed and the block **24** and payoff and takeup reels are accelerated to thread speed which is conventionally approximately 10 percent of running speed. After a predetermined number of coils have been wrapped onto the block **24**, suitable holddown rolls **32** are pivoted into engagement with the stock windings on the block **24** to maintain the block in driving engagement with the stock. The end of the stock is then sheared from the gripper jaws **30**, whereupon the block **24** and payoff and takeup reels are accelerated to running speed and the stock continuously spirals down the block onto the takeup turntable **26**. When the end of the stock passes through the die box **18** the holddown rolls are withdrawn to free the remaining coils of stock encircling the block **24** to drop onto the turntable **26**.

The block **24** and takeup turntable **26** are driven by a suitable shunt wound DC motor **34** which is shown powered by a motor generator set **36** to provide for accurately maintaining the established speed of operation of the block. The speed is controlled and set with a suitable control system **38** shown connected for adjusting the field current of the motor **34** and which may employ a suitable tacometer **39** for assisting in maintaining the desired speed. Additionally where a substantial speed operating range is desired suitable change speed gearing **40** (shown diagrammatically in broken lines in FIG. **1**) may be provided between the motor **34** and the block **24**.

The payoff reel **12** is shown driven in a similar fashion by a shunt wound DC motor **44** powered by a motor generator set **46**. A control circuit **48** is provided for setting and controlling the speed of the motor **44**, and suitable change speed gearing **50** (shown diagrammatically in broken lines in Fig. **1**) may be provided for increasing the speed range of the payoff reel.

In a conventional manner the control system **38** for the drive motor **34** is adapted to be manually set for establishing the thread and running speeds of the block in accordance with the nominal rate of stock feed desired. The control system **48** for the payoff reel is adapted to be manually set for adjusting the speed of the payoff reel in accordance with the speed of operation of the block and the particular drawing operation, it being understood that the desired rate of stock payoff depends upon a number of factors which may vary slightly during the particular paying out operation, for example the diameter of the winding of stock being paid off from the reel **12**, and, in the case of a drawing operation, the amount of cross-sectional reduction in the stock brought about by the drawing die and the stock size before and after the drawing operation.

In accordance with the present invention the control system **48** for the motor **44** comprises a pair of variable resistors **60,62** connected in series with the field **64** of the motor. The variable resistors are adapted to be individually set and the variable resistor **60** is set to establish a motor speed providing a base rate of payout which is different in a controlled direction from the nominal rate of feed required for the running speed of the block **24** and the particular forming operation. Preferably the base rate of payout is less than the nominal rate of feed to the die box and the difference or introduced error is greater than the expected maximum variation in the rate of stock feed through the die box **18** due to variations in the stock size (diameter, tube wall thickness, etc.), diameter of the coil windings, etc. Thus, for example if the expected maximum variation would be $\pm$ 10 percent of the nominal rate of feed, the resistor **60** would preferably be set to establish a motor speed providing a base rate of payout approximately 20 percent less than the required nominal rate of feed. As such the payoff reel will payoff stock at a base rate which is less than the minimum rate of feed to the die box.

A sensing rotor **66** is mounted adjacent to and inside the arcuate path of stock feed from the payoff reel to the die box unit **17** such that when the rate of payoff is less than the rate of feed of stock to the die box **18**, the stock feed path will move inwardly and the stock will engage the rotor **66**. The rotor is rotatably mounted on a frame **70** which is laterally adjustable as shown in Fig. **1** such that the rotor **66** may be accurately positioned with respect to a "normal" or preferred stock feed path and so that the stock engages the rotor to rotate the rotor after the stock path has moved for example approximately 2 inches from its "normal" path. The rotor **66** is preferably of lightweight construction and is provided with a suitable friction surface so that the stock will rapidly accelerate the rotor **66** without damaging the stock.

The rotor **66** is shown connected to rotate a speed responsive actuator **72** having a switch **74** (Fig. **1**) and which may be

adjusted to actuate the switch when the rotor **66** reaches a preselected speed which is preferably less than thread speed so that the actuator **72** will function to regulate the rate of payoff during the threading operation as well as when the drawing block and payoff reel are at running speed. In addition the actuator **72** is preferably of the type which tends to brake the rotor rotation through eddy current action to assist in decelerating the rotor **66** when the stock feed path moves outwardly from the rotor.

As seen in Fig. **1** the normally closed switch **74** is connected to shunt the variable resistor **62** for permitting the variable resistor **60** to establish the base motor speed. When the stock engages the rotor **66** and accelerates it to the preselected speed, the actuator **72** opens the switch **74** to increase the resistance in series with the motor field and to thereby accelerate the motor **44**.

The variable resistor **62** is set such that the variable resistors **60, 62** together will establish a motor speed for paying out stock at a rate which is preferably substantially greater than the nominal rate of feed to the die box **18**. Thus, if the maximum variation in the rate of feed were ± 10 percent of the nominal rate and the resistor **60** were set to establish a base rate of payout of 80 percent of the nominal rate of feed, the variable resistor **62** would preferably be set to establish a high rate of payout at least 30 percent higher than the base or low rate of payout provided by the resistor **60** alone or in other words a high rate of payout at least 10 percent higher than the nominal rate of feed and at least equal to the maximum expected rate of feed to the die box **18**. As a result when the switch **74** is open the motor **44** will be accelerated to increase the rate of payoff to at least equal to but preferably greater than the maximum rate of feed required.

It can be seen therefore that the motor speed will be practically continuously changing between the base or low speed condition established by the variable resistor **60** alone and the high speed condition established by the combination of the resistors **60, 62**. Such practically continuous modulation of the rate of payoff will ensure that the stock is freely fed to the die box **18** irrespective of variations in the rate of feed to the die box and variations in stock size, diameter of coil windings, etc., that the stock will not break due to overtensioning, and that the stock will not tangle due to an excessive low or high rate of payoff.

As will be apparent to persons skilled in the art, various modifications, adaptations and variations of the foregoing specific disclosure can be made without departing from the teachings of the present invention.

I claim:

1. In a payoff reel for paying off stock from a coil thereof to associated apparatus comprising a rotatable coil support, a variable speed electric motor connected for rotating the coil support for paying out stock from a coil supported thereon to said apparatus along an arcuate path, and motor control means for controlling the motor speed for paying out stock at a rate according to the rate of feed to the apparatus, the improvement wherein the motor control means comprises first control means for establishing a base motor speed providing a base rate of payout with an introduced error in a controlled direction, and second control means operable for changing the motor speed to change the rate of payout in the opposite direction by an amount at least equal to said introduced error, a sensing rotor mounted adjacent said arcuate path and such that upon movement of the path due to said introduced error the rotor is engaged by the stock and is rotated thereby, and a controller driven by the sensing rotor and adapted to operate the second control means when the sensing rotor reaches a predetermined rotational speed.

3. In the payoff reel of claim **1** wherein the first control means establishes a base motor speed providing an introduced error in the rate of payout in the direction toward a lower rate of payout and wherein the second control means is operable to increase the motor speed to increase the rate of payout by an amount greater than said introduced error.

30 In the payoff reel of claim **1** wherein the second control means is operable to change the motor speed to change the rate of payout in said opposite direction by an amount substantially greater than said introduced error.

4. In the payoff reel of claim **1** wherein the first and second control means comprises first and second variable resistor means independently adjustable for establishing the base motor speed and the amount of said change in the motor speed.

5. In the payoff reel of claim **1** wherein the variable speed motor has a shunt wound field, wherein the first control means comprises first variable resistor means connected in series with the motor field, and wherein the second control means comprises second variable resistor means connected in series with the first resistor means and the shunt wound field and switch means connected in parallel with the second variable resistor means and operable when closed to shunt the second variable resistor means, and wherein the controller is operable to open and close the switch means.

6. In the payoff reel of claim **1** wherein the second control means provides for changing the motor speed to rate of payout by at least 10 percent more than the introduced error.

7. In the payoff reel of claim **6** wherein the first control means establishes a base motor speed providing a base rate of payout with at least a 10 percent introduced error and wherein the second control means provides for changing the motor speed for changing the rate of payout by at least 20 percent.

8. In a drawing block comprising a drawing die unit; a payoff reel having a rotatable coil support for paying off stock from a coil thereof to the drawing die unit, a first variable speed electric motor connected for rotating the coil support, and first motor control means for controlling the speed of the first motor; a rotatable block for drawing stock through the die unit, a second electric motor connected for driving the rotatable block, and second motor control means for operating the second motor at substantially constant speed, the coil support and die unit being relatively located such that stock is adapted to be paid-out to the drawing die unit via an arcuate path determined by the relative rates of payout of stock from the reel and feed of stock through the drawing die unit, the improvement wherein the first motor control means comprises first settable control means adapted to be set for establishing a base motor speed providing a base rate of payout which differs by an introduced error in a controlled direction from a nominal rate of feed corresponding to the speed of the block, second settable control means adapted to be set for changing the base speed of said first motor to change the rate of payout by an amount sufficient to more than overcome said introduced error, a sensing rotor mounted adjacent said arcuate path and such that upon movement of the path due to said introduced error the rotor is engaged by the stock and is rotated thereby, and a controller driven by the sensing rotor adapted to operate the second settable control means to change the speed of the first motor when the sensing rotor reaches a predetermined rotational speed.

9. In the drawing block of claim **8** wherein the first and second settable control means comprise first and second variable resistor means connected to the first motor for controlling the speed thereof and settable to establish said base speed of the first motor and the amount of said change in the base speed of the first motor.