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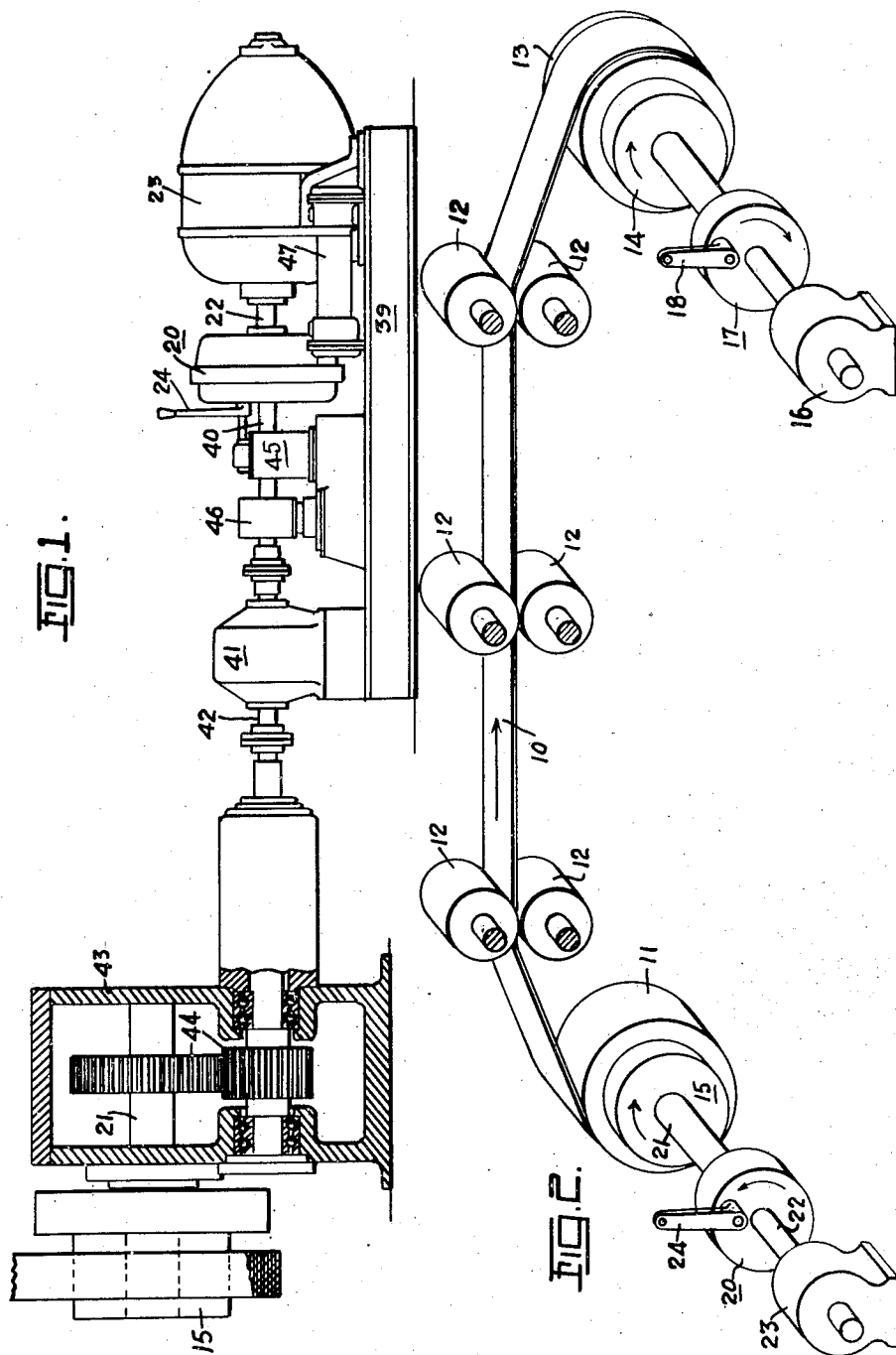
J. D. ROSEBROUGH

2,469,004

BACK TENSION DRIVE

Filed Oct. 23, 1944

3 Sheets-Sheet 1



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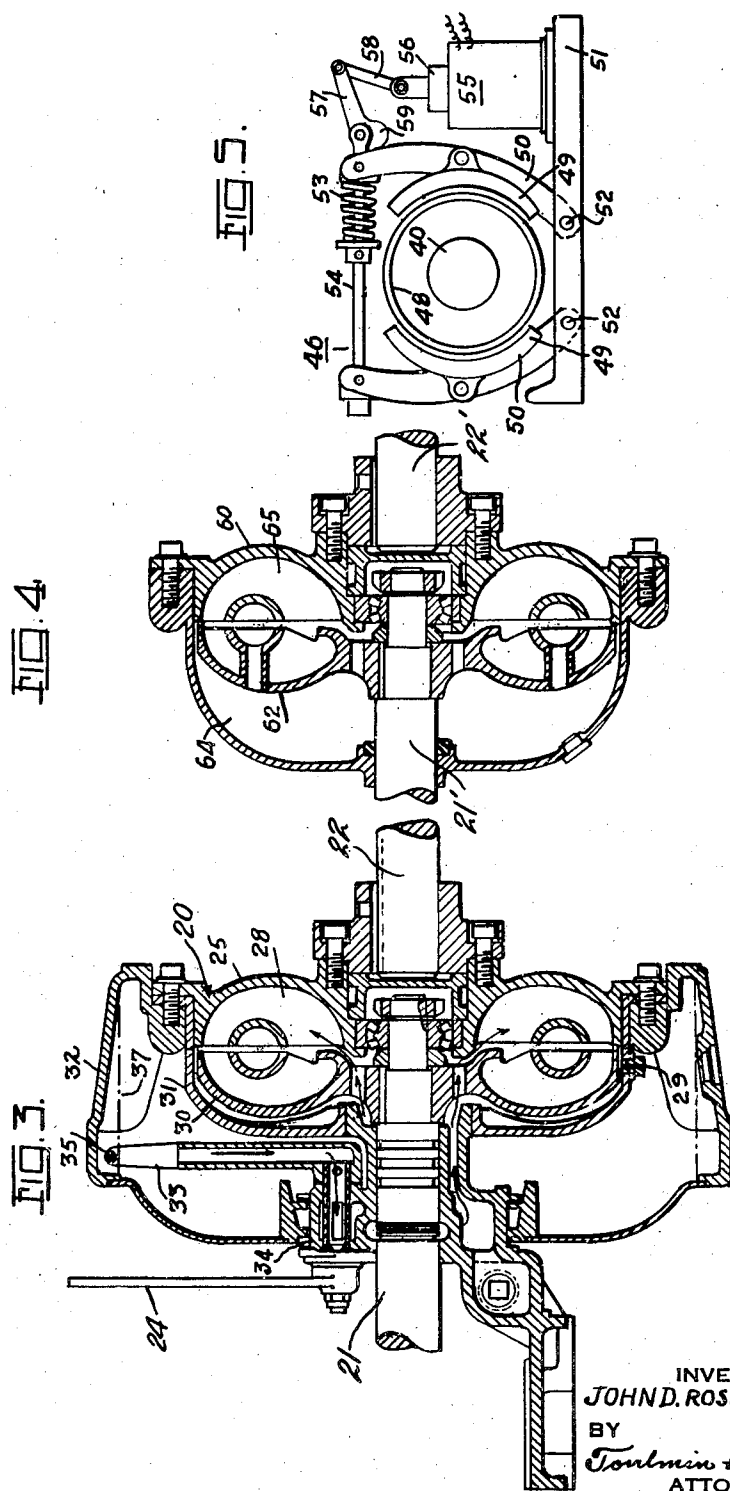
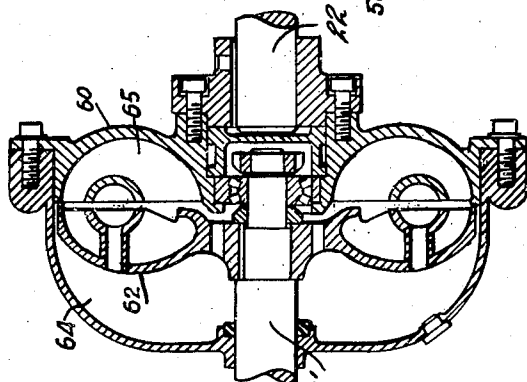
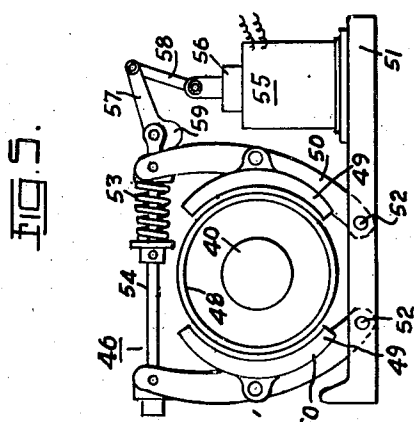
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2,469,004

BACK TENSION DRIVE

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3 Sheets-Sheet 2



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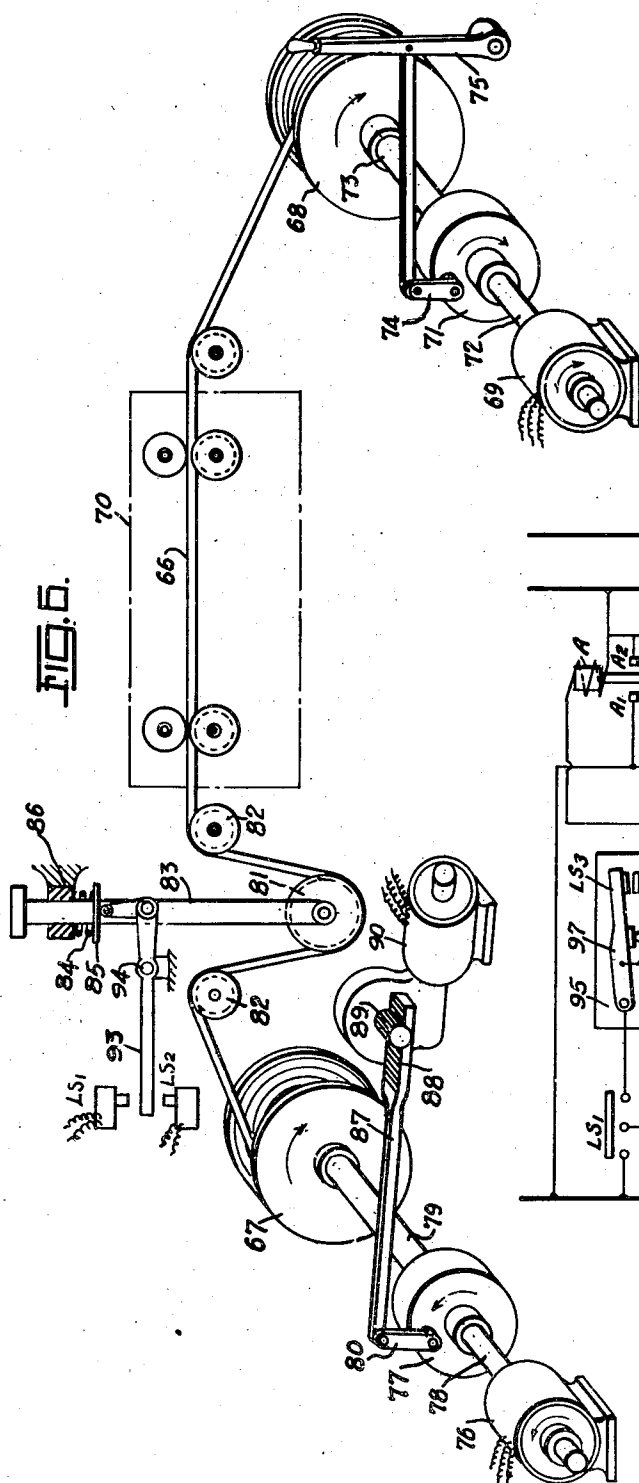
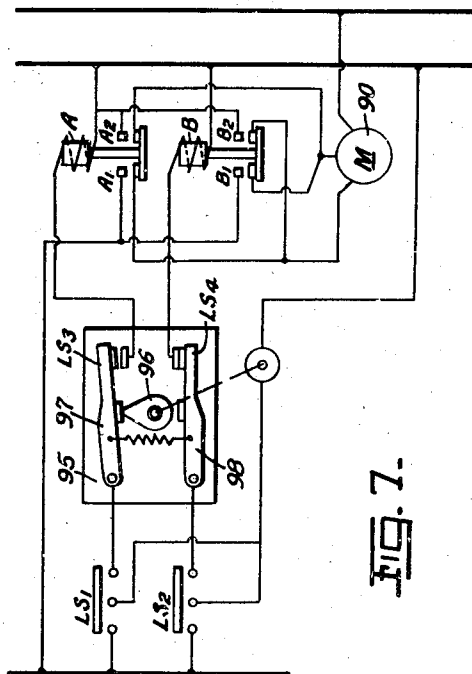
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2,469,004

BACK TENSION DRIVE

Filed Oct. 23, 1944

3 Sheets-Sheet 3



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UNITED STATES PATENT OFFICE

2,469,004

BACK TENSION DRIVE

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a corporation of Michigan

Application October 23, 1944, Serial No. 559,966

9 Claims. (Cl. 242—75)

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This invention relates to apparatus for controlling or regulating the tension on a wire, web or strip during its travel through a processing apparatus.

An object of the invention is to provide a tension control for regulating the tension on material as it passes through processing apparatus by the use of fluid couplings.

Another object of the invention is to provide a back tension control for maintaining tension substantially constant on a web of material that is being removed from one piece of mechanism and transferred to another piece of mechanism.

Still another object of the invention is to provide a fluid coupling for maintaining substantially constant back tension on a web of material that is being removed from an apparatus controlled by the fluid coupling.

Still another object of the invention is to provide a back tension regulating apparatus for regulating the tension on material being removed from a mechanism controlled by the apparatus wherein a fluid coupling provides the means for establishing the desired tension upon rotation of the impeller and runner of the fluid coupling in opposite directions.

Still another object of the invention is to provide an apparatus for establishing and maintaining substantially constant tension upon material that is being transferred from one device to another wherein a fluid coupling is used in the driving connection to the apparatus from which the material is being withdrawn, and this fluid coupling has the runner and impeller thereof rotating in opposite directions to establish a reverse torque upon the apparatus from which the material is being withdrawn and thereby establish a controlled tension upon the material while it is being withdrawn from the apparatus.

Still another object of the invention is to provide a tension regulating apparatus in accordance with any of the foregoing objects wherein the fluid coupling that establishes the reverse torque or back tension upon the material as it is being withdrawn from the source of supply is a variable speed fluid coupling to permit changes in regulation in the tension upon the material as it is being withdrawn.

Still another object of the invention is to provide a tension regulating mechanism using a fluid coupling with the runner and impeller thereof rotating in opposite directions to establish a reverse torque to obtain the desired tension control, and also to provide an apparatus for automatically controlling the operation of the

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fluid coupling to regulate the same in response to changes in tension applied upon the material being paid out by the apparatus.

Further objects and advantages will become apparent from the drawings and the following description.

In the drawings:

Figure 1 is an elevational view, a part of which is in cross-section, illustrating an apparatus incorporating the features of this invention.

Figure 2 is a diagrammatic elevational perspective view of an apparatus for processing a web of material that is adapted to have the tension upon the same regulated during processing.

Figure 3 is a cross-sectional view of a variable speed fluid coupling that may be used to produce the result desired in this invention.

Figure 4 is a cross-sectional view of a traction type of fluid coupling that may be used to regulate back tension on material in certain industrial uses.

Figure 5 is an elevational view of brake mechanism that is adapted to hold the winding head or the unwinding head against rotation.

Figure 6 is a diagrammatic view illustrating a processing apparatus for material wherein apparatus responsive to the tension applied on the material is provided for regulating the fluid coupling.

Figure 7 is an electrical wiring diagram illustrating the manner of connecting the electrical elements of the system and including a mechanism for intermittently energizing the control circuits.

This invention relates to an apparatus for establishing and maintaining a relatively constant tension upon material that is being transferred from one apparatus to another. The invention has particular merit in connection with maintaining proper tension on webs or strips of material that are withdrawn from a supply roll and passed through a processing apparatus, the web of material discharging from the processing apparatus being taken up by a suitable take-up apparatus. Tension control apparatus is especially desirable in connection with wire drawing processes or in connection with processes used in steel strip mills. In the application of the apparatus to strip mill operation, or to wire drawing operation, the material is drawn through suitable processing apparatus by means of take-up rolls, the material being supplied from supply rolls and delivered to take-up rolls that are conventionally termed the unwinding head and winding head respectively.

In processing the material it is essential that a proper degree of back tension be maintained upon the material as is well-known in the art. Many complex and complicated devices and apparatus have been utilized for the purpose of maintaining proper back tension control on the material that is being processed. However, the applicant's invention eliminates the use of complex control units and permits the use of a fluid coupling for the purpose of establishing and maintaining constant back tension upon the material that is being withdrawn from the supply roll.

In Figure 2 there is illustrated in diagrammatic form an apparatus for processing a web of material 10. The web of material 10 is contained upon supply roll 11 and is adapted to be drawn through the processing rolls 12 by the take-up roll 13. The take-up roll 13 may be suitably mounted upon a winding head 14 while the supply roll 11 may be carried upon an unwinding head 15.

The winding head 14 is driven by an electric motor 16 through the intermediary of a fluid coupling 17. The fluid coupling 17 may be of the traction type or of the variable speed type, but preferably is of the variable speed type so as to permit a change of the speed and/or of the tension of the web 10 through the processing rolls 12 whenever desired. The fluid coupling 17 provides a convenient way of driving the winding head 14, and is thus used in its conventional manner wherein the impeller of the fluid coupling is driven by the electric motor 17, the impeller in turn causing the runner of the fluid coupling to rotate in a manner that is well-known in the art to thereby cause rotation of the winding head 14. By changing the quantity of oil in the working circuit between the impeller and the runner of the coupling 17, it is possible to change the rate of speed of rotation of the winding head 14, the use of such fluid coupling in this manner being well-known in the art.

A suitable control lever 18 is provided for regulating the apparatus for controlling the amount of fluid in the working circuit between the runner and the impeller of fluid coupling 17 in a manner that will be hereinafter described.

The unwinding head 15 is connected to a fluid coupling 20 by a shaft 21, and specifically, the shaft 21 of the unwinding head 15 is connected to the runner or driven member of the fluid coupling 20. The impeller or driving member of the fluid coupling 20 is connected by means of the shaft 22 to an electric motor 23. The fluid coupling 20 may be of the traction type or of the variable speed type, but preferably is of the variable speed type to permit a change in the quantity of oil in the working circuit between the impeller and runner of the coupling 20 to permit a change in the speed relationship between the driving shaft 22 and the driven shaft 21 and the torque effort that is developed as a result of the quantity of fluid in the working circuit of the coupling. The control of the quantity of fluid in the working circuit is regulated by the control member 24 in a manner to be hereinafter described.

Insofar as the fluid couplings 17 and 20 are concerned, they may be of identical construction, one form of variable speed fluid coupling being illustrated in Figure 3.

The variable speed fluid coupling illustrated in Figure 3 comprises an impeller 25 and a runner 30. The impeller 25 is direct connected to a drive shaft 26 that is driven by a suitable source of power, which in this instance may be either of

the electric motors 16 or 23. The runner 30 is direct connected to the driven shaft 27, which may be the shaft that is connected to either the winding head 14 or the unwinding head 15.

The work chamber 28 provided between the impeller 25 and the runner 30 contains oil that is circulated between the impeller and the runner to produce a torque effort upon the runner tending to cause the same to follow the rotation of the impeller 25 in a manner that is well-known in the art. A leak port 29 is provided in the shell 31 that surrounds the runner 30 and constantly passes fluid from the work chamber 28 into the exterior casing 32 that is carried by the impeller 25. The oil in the casing 32 is circulated through a cooler of any conventional construction and returned back into the working circuit of the coupling in a conventional manner.

Various means may be employed to control the total quantity of oil in the work chamber 28 to regulate the speed differential between the impeller 25 and the runner 30 but as illustrated in this invention, a scoop tube 33 is provided for this purpose. The scoop tube 33 is eccentrically mounted upon a rotatable member 34 so that the end 35 of the scoop tube 33 will move eccentrically relative to the casing 32. The rotatable member 34 is controlled by the lever 24.

When the fluid coupling illustrated in Figure 3 is in operation, a body of oil is contained in the outer periphery of the casing 32 as illustrated by the dot-dash line 37. With the scoop tube 33 in position with the end completely dipping into the body of oil 37, there is a maximum flow of fluid into the working chamber 28 of the coupling to maintain the chamber completely filled with oil. However, when the scoop tube is rotated about the axis of the rotatable member 34, the end 35 of the scoop tube 33 approaches the axis of rotation of the casing 32 and thus partially leaves the body of oil 37 to thus reduce the quantity of oil that is scooped into the end of the tube 33. Also, the end 35 of the scoop tube 33 can be placed in a position wherein it will not engage the body of oil 37, and at this time the work chamber 28 will empty itself of oil through the leak port 29.

The scoop tube control illustrated in Figure 3 is one means for regulating the quantity of oil that is circulated through the work chamber 28 of the fluid coupling. However, there are other means for accomplishing this same result, such as by the use of a separate pump control, the delivery from which is regulated to supply the desired quantity of oil into the work chamber of the fluid coupling.

The fluid coupling disclosed in Figure 3 is therefore a substantially conventional form of coupling that is used for the purpose of driving an apparatus. The coupling illustrated in Figure 3 is therefore one form of fluid coupling that can be used between the motor 16 and the winding head 14, taking the place of the coupling 17 wherein the driven shaft 21 of the fluid coupling illustrated in Figure 3 is connected to the winding head 14 and the driving shaft 22 is connected to the electric motor 16. By properly regulating the quantity of oil in the work chamber 28 of the fluid coupling, the correct amount of tension is maintained on the web of material 10 coming from the rolls 12, which may be power driven independently of the winding head 14.

In many processes it is desirable, and in many instances necessary that the unwinding head 15 shall be prevented complete freedom of rotation, and in fact the unwinding head is depended upon

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for establishing and maintaining tension upon a web of material 10 that is being withdrawn from the unwinding head 15 by the winding head 14, or by the work rolls 12.

In this invention the fluid coupling 20 is provided for establishing a back torque upon the shaft 21 of the unwinding head 15 and thereby brake the rotation of the unwinding head 15. The fluid coupling 20 is in all respects constructed in the manner disclosed in Figure 3. The runner 30 of the fluid coupling disclosed in Figure 3 is connected to the driven shaft 21 of the unwinding head 15 while the impeller 25 is connected to the drive shaft 22 of the electric motor 23.

With the strip of material 10 being moved in the direction of the arrow thereon, the unwinding head 15 will be rotating in a clock-wise direction, thus rotating the runner 30 of the fluid coupling 20 in a clock-wise direction as viewed in Figure 2.

In this instance, however, the impeller 25 provided in the fluid coupling 20 is rotated in a counterclock-wise direction so that the impeller is thus rotated in the opposite direction to the runner, the impeller of the fluid coupling 20 being driven in this opposite direction of rotation by the electric motor 23.

The effect accomplished by rotation of the impeller of the fluid coupling 20 in the opposite direction of rotation of the runner of the fluid coupling is that the oil in the work chamber between the impeller and the runner circulates between these members attempting to force the runner to rotate in the same direction as the impeller, and thereby produces a reverse torque upon the driven shaft 21 connected to the unwinding head 15 that causes back tension upon the web of material 10. In view of the fact that the fluid coupling is inherently a slip device, the reverse torque or back tension developed by the fluid coupling 20 will be substantially constant as long as the speed of rotation of the electric motor is constant and the quantity of fluid circulating in the work chamber of the fluid coupling remains substantially constant. However, variation in speed of withdrawal of the web 10 as caused by the operation of the processing apparatus or by the winding head 14 will effect the tension or back torque developed by the fluid coupling 20 in view of the fact that the unwinding head 15 tends to rotate the runner of the fluid coupling at a greater speed. This tendency, however, can be readily corrected by reducing the quantity of oil in the work chamber 28 of the fluid coupling to reduce its torque effort.

Variable speed motors can be used covering a great variety in the speeds and of the sizes of material handled by the combination.

It will also become apparent that the degree of back tension upon the web of material 10 can be controlled, or set, by regulating the quantity of oil placed into the active work chamber 28 of the fluid coupling, the maximum back tension on the web 10 being obtained when the scoop tube 33 dips completely into the body of oil 37 to maintain the work chamber completely filled with oil, the back tension on the trip being gradually reduced as the scoop tube 33 is gradually withdrawn from the body of oil 37 to reduce the quantity of oil delivered into the work chamber 28 of the fluid coupling.

When there is a large quantity of heat to dissipate from the oil because of a considerable amount of slippage in the coupling, then in using the scoop tube type of variable speed fluid

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coupling it becomes possible to take the oil picked up by the scoop tube out of the coupling and put it through an oil cooler and then back into the coupling. The oil would travel from orifice 35 of the scoop tube 33 back into the coupling, and would be cooled upon passage through a suitable oil cooler. There is sufficient force in the impact of the oil on the scoop tube orifice 35 to overcome the resistance of the cooler.

In Figure 1 there is illustrated a typical installation for driving the unwinding head 15 wherein the electric motor 23 is mounted upon a base 39. The electric motor 23 is connected to the impeller of the fluid coupling 20 by means of the drive shaft 22. The runner of the fluid coupling 20 is connected to the drive shaft 40 that connects with a gear reducing mechanism 41. The gear reducing mechanism 41 has a drive shaft 42 extending therefrom into a bearing box 43 containing the gears 44 that drive the shaft 21 connected to the unwinding head 15.

A control mechanism 45 may be provided to control the operation of the scoop tube of the fluid coupling 20 by changing the radial position thereof within the coupling as previously described with regard to Figure 3, and thereby control the functioning of the same to supplement the manual control lever 24, or the control mechanism 45 may be the sole control for the fluid coupling 20. Any suitable hydraulic, pneumatic or electrical apparatus adapted to rotate the scoop tube can be provided for this purpose and which device can be made responsive to the work being done by the coupling as more specifically disclosed with reference to Figure 6.

As is conventional, an oil cooler 47 may be provided for cooling the oil removed from the fluid coupling 20 and returned to the same during operation of the coupling.

Under certain circumstances, a brake mechanism 46, more particularly disclosed in Figure 5, may be provided for engaging the drive shaft between the fluid coupling 20 and the gear reducing mechanism 41 when an emergency stop of the apparatus is to be made. The brake can also serve a function in the starting of a run as described later.

The brake 46 may consist of a brake drum 48 mounted upon the shaft 40 between the fluid coupling 20 and the gear reducer 41. The brake shoes 49 are carried upon levers 50 pivotally mounted upon the base 51 by the pivot pins 52.

The brake shoes 49 are retained in inactive position by a spring 53 positioned around an actuating rod 54.

The brake 46 may be actuated electrically by a solenoid 55 having the armature 56 thereof connected to a lever 57 by a link 58, a cam 59 being provided on the arm 57 to actuate the brake arms or levers 50 upon energization of the solenoid 55.

A brake such as that disclosed in Figure 5 can be provided on each of the shafts between the fluid couplings 17 and 20 and their respective winding head 14 and unwinding head 15 so that before starting the winding of the web the winding roll can be inched around to properly take up the slack between it and the work rolls. This is accomplished by periodically releasing the brake. Once the slack is taken up and the web is taut, the brake can be permanently released during the continuation of that run.

In certain processes or conditions of operation, it may be possible to establish the tension desired upon the web, which tension thereafter will remain constant. Under these circumstances a

traction type of fluid coupling, such as that illustrated in Figure 4, may be substituted for either of the fluid couplings 17 or 20 or both. The traction type of fluid coupling always has a predetermined quantity of fluid in the work chamber between the impeller and the runner to establish a predetermined torque. The torque can be established either as a driving unit or as a back tension unit as previously described, as determined by the manner in which the coupling is to be used.

The traction type coupling disclosed in Figure 4 may consist of an impeller 60 connected to the driving shaft 61 and a runner 62 connected to the driven shaft 63. A housing 64 encloses the runner and is secured to the impeller 60. The work chamber 65 is filled with a predetermined quantity of oil to establish the desired speed relationship between the drive shaft and the driven shaft and the torque fluid to be developed therebetween. In this figure the numeral 22' indicates the driving shaft and 21' the driven shaft.

In Figures 6 and 7 inclusive there is illustrated diagrammatically a system for maintaining a constant back tension upon a web of material by apparatus that is responsive to the tension applied upon the web, and which apparatus automatically controls the fluid coupling that regulates the back tension on the web for adjusting the same in accordance with the tension applied upon the web.

The apparatus disclosed may consist of a processing apparatus 70 through which the web 66 passes. A web 66, or other material to be worked upon or processed, is withdrawn from an unwinding head 67 and transferred to a winding head 68, the web 66 passing through the processing apparatus 70. The winding head 68 is driven by an electric motor 69 that is connected to a variable speed fluid coupling 71 by a shaft 72, which coupling in turn is connected to the winding head 68 by a shaft 73. The speed of the electric motor 69 can be changed or the quantity of fluid in the work chamber between the runner and impeller of the fluid coupling 71 can be changed to vary the speed of rotation of the winding head 68. The fluid coupling 71 is provided with a scoop tube control like that disclosed in Figure 3 that is operated by a lever 74 connected to the manually operated lever 75.

The unwinding head 67 is connected to an electric motor 76 that is connected to the fluid coupling 77 by a shaft 78, the fluid coupling in turn being connected to the unwinding head by a shaft 79. The fluid coupling 77 is of the variable speed type having a scoop tube control of the type illustrated in Figure 3, which scoop tube control is actuated by the lever 80. The runner of the fluid coupling 77 is driven in a clock-wise rotation by the unwinding head 67 while the impeller of the fluid coupling 77 is driven in a counter clock-wise direction by the motor 76. The operation of the back tension drive is the same as that previously described.

Illustrative of means for automatically controlling the back tension upon the web 66 at a constant level by automatically varying the quantity of oil in the work chamber between the runner and impeller of the fluid coupling 77 as controlled by the scoop tube control lever 80, there is illustrated in Figures 6 and 7 a diagrammatic system of control for this purpose.

The control system may consist of a roller 81 urging the web 66 downwardly between the rollers 82, the roller 81 being carried upon an arm 83

that is spring-pressed downwardly by the spring 84 retained between a collar 85 on the arm 83 and a stationary support and guide member 86 for the arm 83. The tension on the web 66 is thus balanced against the pressure of the spring 84, the compression of the spring 84 being adjustable if desired.

The scoop tube control operating lever 80 of the fluid coupling 77 is connected to an actuating arm 87 having a rack 88 on one end thereof that engages the spur gear 89 that is driven by the electric motor 90 in one direction of rotation or another, depending upon the direction of rotation of the motor 90. Control of the motor 90, and its direction of rotation, will thus control the position of the scoop tube actuated by the lever 80 to adjust the quantity of oil in the work chamber between the impeller and runner of the fluid coupling 77.

To control the motor 90, and its direction of rotation, there is provided a pair of limit switches LS1 and LS2, either of which may be engaged by an actuating arm 93 for closing the limit switches LS1 and LS2. The actuating arm 93 is connected to the arm 83 and is pivoted on the pivot pin 94.

The limit switch LS1 is electrically in series with a relay coil A that operates the relay contacts A1 and A2, see Figure 7, whereby the current to the motor 90 is controlled for causing the motor 90 to rotate in one direction. The limit switch LS2 is electrically in series with a relay coil B for controlling the relay contacts B1 and B2, see Figure 7, whereby the current to the motor 90 is controlled to cause the same to rotate in the reverse direction. Thus, depending upon whether relay switch LS1 or LS2 is closed, the direction of rotation of the motor 90 is controlled to change the position of the scoop tube control lever 80 and thus change the quantity of oil being delivered to the work chamber between the impeller and runner of the fluid coupling 77 as determined by an increase of tension on the web 66, resulting in upward movement of the arm 83 or a decrease in tension on the web 66, resulting in a downward movement of the arm 83. Thus, regardless of the factors influencing a change of tension on the web 66, the fluid coupling 77 will be adjusted to maintain a reverse torque at the proper level to retain a constant back tension on the web 66.

To prevent an over-adjustment of the fluid coupling 77 when the motor 90 is energized, a circuit breaker 95 is provided having a contactor LS3 in series with the limit switch LS1 and a contactor LS4 in series with the limit switch LS2. This circuit breaker 95 is provided with a cam 96 that intermittently operates the arms 97 and 98 to break the circuit through the contactors LS3 and LS4, the cam 96 being driven by an electric motor 99 that is energized whenever either limit switch LS1 or LS2 is closed. Thus, the electric motor 90 will only operate for short periods and will adjust the position of the scoop tube control lever 80 in short steps of movement.

The automatic control system disclosed in Figures 6 and 7 is only illustrative of a system that can be used to automatically regulate the back tension on the web 66 in response to the tension on the web, and other control apparatus can perform this function so long as the apparatus is responsive to the tension of the web 66 and is connected with the fluid coupling 77 to control the quantity of fluid delivered into the work chamber between the impeller and runner of the fluid coupling. Also, the automatic control sys-

tem can be made to control the operation of an independent pump that supplies fluid to the work chamber of the fluid coupling 77 by suitably regulating the fluid discharge from the separate pump, either by way of controlling the speed of operation of the pump or restricting the delivery from the pump. The control system may also regulate the speed of the motor 76 through means of a rheostat or other suitable electrical regulating means if desired.

While the apparatus disclosed and described herein, as well as the method of controlling the back tension on a web or material being processed, illustrates a preferred form of the invention, yet it will be understood that the apparatus and the method of operation is capable of modification without departing from the spirit of the invention, and that all modifications that fall within the scope of the appended claims are intended to be included herein.

Having thus fully set forth and described my invention, what I claim as new and desire to secure by Letters Patent is:

1. An apparatus for establishing and maintaining back tension upon a length of material being processed that includes in combination, an apparatus for supporting a source of the material, mechanism for withdrawing the material from the said source, means for establishing and maintaining a torque effort upon the said apparatus in the reverse direction to that produced by the said mechanism upon withdrawal of material from the said apparatus comprising a variable speed fluid coupling including runner and impeller elements, means for controlling the quantity of oil between said runner and impeller elements, means drivingly connecting one of said elements to said apparatus which thereby drives the same, means drivingly connecting the other of said elements to a source of power for rotating the said other element in a direction opposite to the first element and thereby producing a torque effort between said elements opposed to that applied upon the said apparatus by the said mechanism, and apparatus actuated by the tension applied upon the length of material for operating the said means which controls the quantity of fluid between the runner and impeller elements of said fluid coupling.

2. An apparatus for producing back tension upon material being processed that includes in combination, an apparatus for supporting a supply of material and from which it will be unwound, means for withdrawing the material from the said source and thereby unwinding the same, means for producing back tension upon the material while being unwound comprising a fluid coupling connected to said first apparatus having one element thereof rotated thereby and the second element thereof connected to a source of power and rotated in the opposite direction, and an apparatus responsive to changes in tension upon material being processed and changing the operating effect of the said last mentioned means to maintain substantially constant back tension upon the material.

3. An apparatus for producing back tension upon material being processed that includes in combination, an apparatus for supporting a supply of material and from which it will be unwound, means for withdrawing the material from the said source and thereby unwinding the same, means for producing back tension upon the material while being unwound comprising a variable speed fluid coupling having one rotatable ele-

ment thereof connected to the said apparatus and the second rotatable element thereof connected to a source of power and rotated in the opposite direction to the first element, means for changing the quantity of fluid circulating between the two said elements in the fluid coupling, and an apparatus actuated in response to a change in tension upon the material being processed operably connected to the said last mentioned means for operating the same to change the quantity of fluid between the said elements in response to a change in tension upon the material being processed.

4. An apparatus for producing and regulating tension upon web material that includes, a driven apparatus for moving a web of material in one direction, driving means for driving said apparatus to cause said movement of the web and for regulating the speed of the said movement, a second apparatus engaging the web of material as moved by the first apparatus and driven by the web, and a second driving means for drivingly urging said second apparatus in a direction opposite to that at which it is driven by the web of material engaged thereby including a variable speed fluid coupling adapted for having the quantity of fluid therein changed to change the speed or torque output thereof and having the cooperating work producing members thereof operably connected respectively to said second driving means and said second apparatus to establish and maintain an opposed torque between said first and second apparatus and thereby establish tension upon a web of material extending therebetween, and means for changing the quantity of fluid in said coupling for changing the torque output of said fluid coupling and thereby change the tension upon the web of material that extends between said first and second apparatus.

5. An apparatus for producing and regulating tension upon web material that includes, a driven apparatus for moving a web of material in one direction, driving means for driving said apparatus to cause said movement of the web and for regulating the speed of the said movement, a second apparatus engaging the web of material as moved by the first apparatus and driven by the web, and a second driving means for drivingly urging said second apparatus in a direction opposite to that at which it is driven by the web of material engaged thereby including a variable speed fluid coupling adapted for having the quantity of fluid therein changed to change the speed or torque output thereof and having the cooperating work producing members thereof operably connected respectively to said second driving means and said second apparatus to establish and maintain an opposed torque between said first and second apparatus and thereby establish tension upon a web of material extending therebetween, means for changing the quantity of fluid in said coupling for changing the torque output of said fluid coupling and thereby change the tension upon the web of material that extends between said first and second apparatus, and means responsive to the tension of a web extending between said first and second apparatus for actuating said last mentioned means.

6. An apparatus for producing and regulating tension upon web material that includes, a driven apparatus for moving a web of material in one direction, driving means for driving said apparatus to cause said movement of the web and for

regulating the speed of the said movement, a second apparatus engaging the web of material as moved by the first apparatus and driven by the web, a second driving means having a relatively constant speed of operation thereof for drivingly urging said second apparatus in a direction opposite to that at which it is driven by the web of material engaged thereby, a variable speed fluid coupling adapted for having the quantity of fluid therein changed to change the speed or torque output thereof and having the cooperating work producing members thereof operably connected respectively to said second driving means and said second apparatus to establish and maintain an opposed torque between said first and second apparatus and thereby establish tension upon a web of material extending therebetween, and means for changing the quantity of fluid in said fluid coupling and thereby change the tension upon the web of material that extends between said first and second apparatus.

7. An apparatus for producing and regulating tension upon web material that includes, a driven apparatus for moving a web of material in one direction, driving means for driving said apparatus to cause said movement of the web and including a variable speed fluid coupling for regulating the speed of the said movement, a second apparatus engaging the web of material as moved by the first apparatus and driven by the web, a second driving means having a relatively constant speed of operation thereof for drivingly urging said second apparatus in a direction opposite to that at which it is driven by the web of material engaged thereby, a variable speed fluid coupling adapted for having the quantity of fluid therein changed to change the speed or torque output thereof and having the cooperating work producing members thereof operably connected respectively to said second driving means and said second apparatus to establish and maintain an opposed torque between said first and second apparatus and thereby establish tension upon a web of material extending therebetween, and means for changing the quantity of fluid in said second mentioned coupling for changing the torque output of said second mentioned fluid coupling and thereby change the tension upon the web of material that extends between said first and second apparatus.

8. An apparatus for producing and regulating tension upon web material that includes, a driven apparatus for moving a web of material in one direction, driving means for driving said appa-

atus to cause said movement of the web and including a variable speed fluid coupling for regulating the speed of the said movement, a second apparatus engaging the web of material as moved by the first apparatus and driven by the web, a second driving means for drivingly urging said second apparatus in a direction opposite to that at which it is driven by the web of material engaged thereby, a variable speed fluid coupling adapted for having the quantity of fluid therein changed to change the speed or torque output thereof and having the cooperating work producing members thereof operably connected respectively to said second driving means and said second apparatus to establish and maintain an opposed torque between said first and second apparatus and thereby establish tension upon a web of material extending therebetween, and means for changing the quantity of fluid in said second mentioned coupling for changing the torque output of said second mentioned fluid coupling and thereby change the tension upon the web of material that extends between said first and second apparatus.

9. An apparatus for producing back tension upon material being processed that includes in combination, an apparatus for supporting a supply of material and from which it will be unwound, means for withdrawing the material from the said source and thereby unwinding the same, means for producing back tension upon the material while being unwound comprising a variable speed fluid coupling having one rotatable element thereof connected to the said apparatus and the second rotatable element thereof connected to a source of power and rotated in the opposite direction to the first element, and means actuated in response to a change in tension upon the material for changing the speed relationship between the said elements of the said fluid coupling.

JOHN D. ROSEBROUGH.
The following references are of record in the file of this patent:

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2,164,596	Simonds	July 4, 1939
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2,187,667	Sincian et al.	Jan. 16, 1940
2,343,181	Heinz	Feb. 24, 1944

3. An apparatus for producing back tension upon material being processed that includes in combination, an apparatus for supporting a supply of material and from which it will be unwound, means for withdrawing the material from the said source and thereby unwinding the same, means for producing back tension upon the material while being unwound comprising a variable speed fluid coupling having one rotatable element thereof connected to the said apparatus and the second rotatable element thereof connected to a source of power and rotated in the opposite direction to the first element, and means actuated in response to a change in tension upon the material for changing the speed relationship between the said elements of the said fluid coupling.

4. An apparatus for producing back tension upon material being processed that includes in combination, an apparatus for supporting a supply of material and from which it will be unwound, means for withdrawing the material from the said source and thereby unwinding the same, means for producing back tension upon the material while being unwound comprising a variable speed fluid coupling having one rotatable element thereof connected to the said apparatus and the second rotatable element thereof connected to a source of power and rotated in the opposite direction to the first element, and means actuated in response to a change in tension upon the material for changing the speed relationship between the said elements of the said fluid coupling.