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WINDING MECHANISM

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2 Sheets-Sheet 1

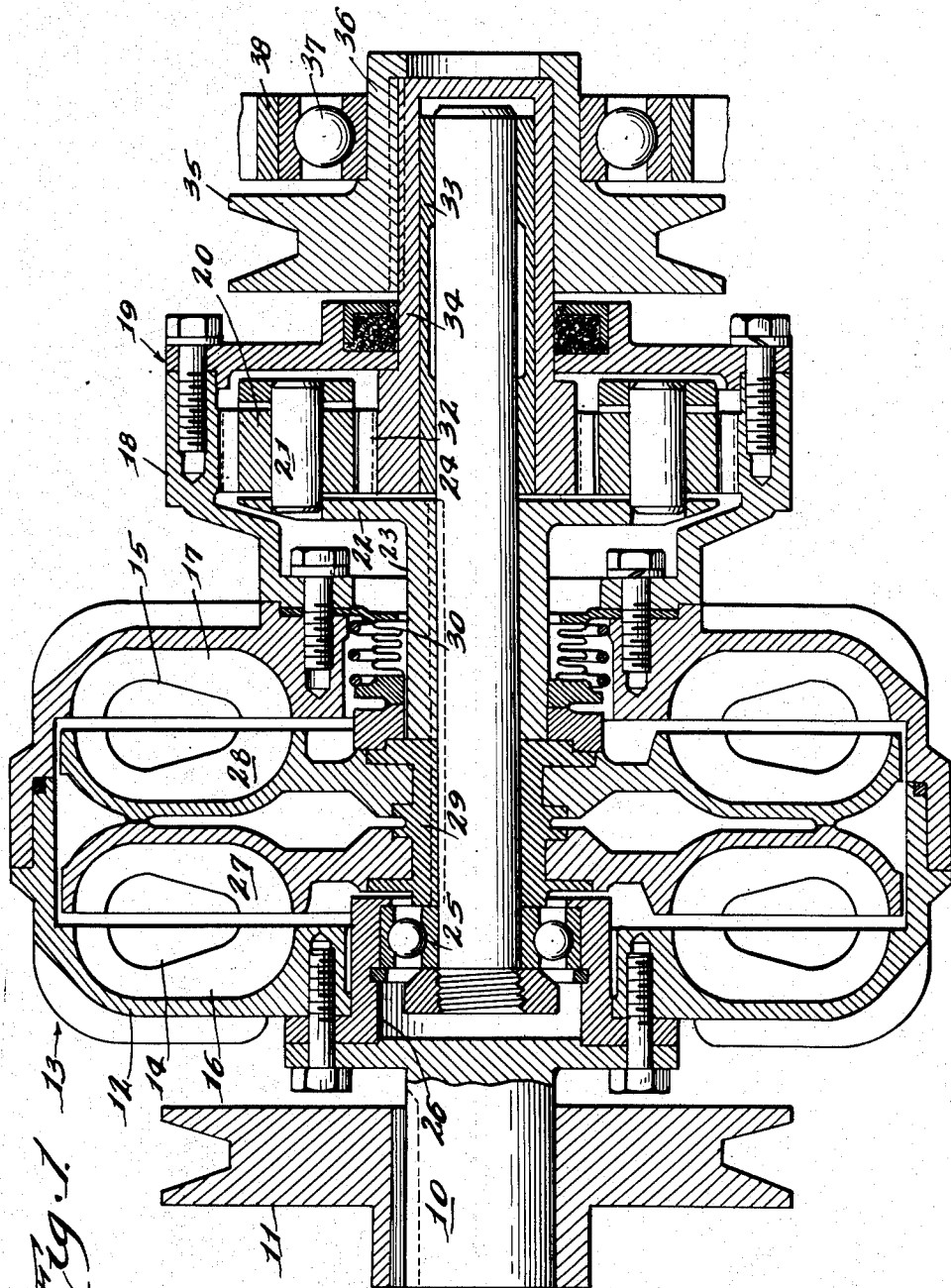


Fig. 1

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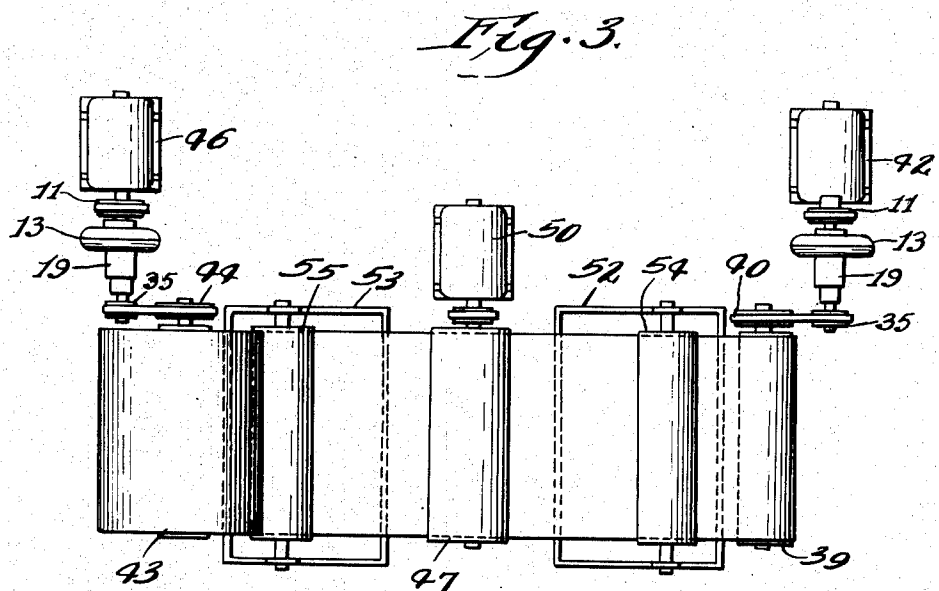
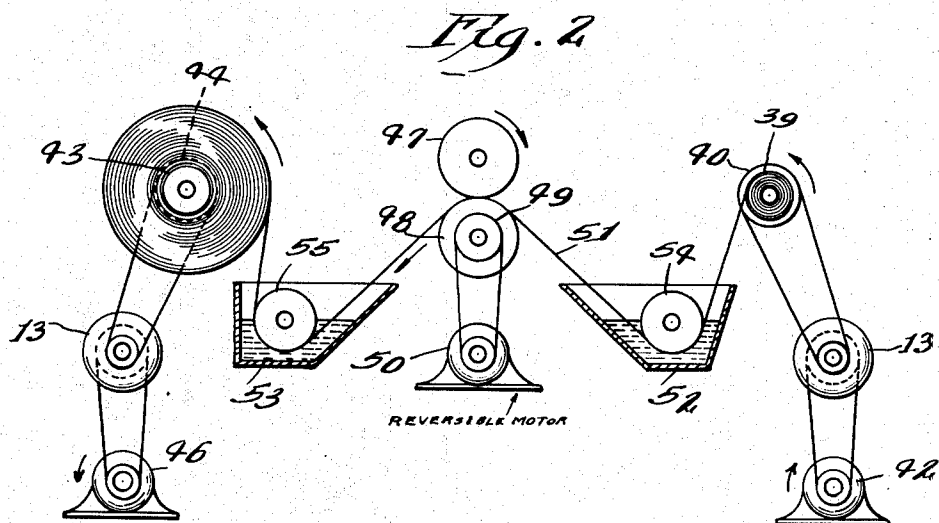
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WINDING MECHANISM

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4 Claims. (Cl. 242-75)

1

My invention relates to a winding mechanism for handling web or strip material under constant tension while the web is periodically moved in opposite directions through coating, dyeing or other conditioning material.

In mechanisms as now employed, the web is alternately wound on one roll while being unwound from another roll and, between the rolls, the web is passed through one or more baths containing the liquid to be applied. After each traverse of the web through the baths, the direction of movement of the web is reversed and these reversals continue until the desired conditioning or treatment of the web has been completed. A serious problem with such mechanisms is the maintenance of a substantially constant tension on the web during both directions of movement between the rolls.

It is therefore one object of my invention to devise a winding mechanism in which a web material is periodically moved in opposite directions between a pair of rolls which alternately act as winding and unwinding rolls and in which provision is made for maintaining constant tension on the web.

A further object is to provide a mechanism of the character indicated in which the rolls are individually connected to independent power sources through power transmissions, that transmission which is connected to the winding roll being arranged to automatically and instantaneously adjust its output speed and torque to meet varying load conditions while the other transmission functions as a brake, both transmissions cooperating to maintain a substantially constant tension on the web.

These and further objects of the invention will be set forth in the following specification, reference being had to the accompanying drawings and the novel means by which said objects are effectuated will be definitely pointed out in the claims.

In the drawings:

Fig. 1 is a sectional elevation of a power transmission forming part of the winding mechanism.

Fig. 2 is a diagrammatic elevation of a winding mechanism which incorporates the transmission shown in Fig. 1.

Fig. 3 is a plan view of the mechanism shown in Fig. 2.

Referring to Fig. 1, the numeral 10 designates an input shaft having keyed thereto a pulley 11 and whose delivery end is connected to one end of an annular housing 12 forming part of an hydraulic coupling 13. The housing 12 includes

2

spaced, transverse walls which are respectively provided internally of the housing with a plurality of radial blades 14 and 15 to thereby form the spaced, facing and connected impellers 16 and 17, respectively, of the coupling and which cooperate in the usual manner with twin runners or turbines presently described.

Bolted to the other end of the housing 12 is an internal ring gear 18 forming part of a planetary gear train 19. The ring gear 18 meshes with a plurality of planet pinions 20, each of which is journaled on a stub shaft 21 mounted in a carrier 22 that includes a sleeve 23 keyed or splinedly connected to a shaft 24 coaxial with the impellers. The left end of this shaft, as viewed in Fig. 1, is piloted in a bearing 25 whose outer race is mounted in a sleeve 26 having a flange portion gripped between the flanged end of the shaft 10 and the adjacent, transverse wall of the housing 12. The opposite end of the shaft 24 is journaled by means presently described.

Oppositely facing, bladed runners 27 and 28 are symmetrically positioned between the impellers 16 and 17 in working relation thereto, respectively, and their inner portions are secured to a hub 29 which is keyed or splined to the shaft 24. Accordingly, the rotating speed of the planet pinion carrier 22 is always equal to that of the runners. Leakage of liquid from the coupling at the right end is prevented by a bellows seal generally indicated by the numeral 30 and at the opposite end by the inner end of the shaft 10.

The planet pinions 20 also mesh with a sun gear 32 which is journaled on a sleeve 33 that fits on the shaft 24. The sun gear 32 is provided with an extension 34 that is keyed to an output member, denoted by the pulley 35, which includes a sleeve 36 journaled in a bearing 37 that is mounted in a supporting frame 38.

The winding mechanism which includes the above transmission is schematically illustrated in Figs. 2 and 3 to which reference will now be made, parts which are identical with those shown in Fig. 1 being designated by the same numerals. It includes a first winding roll 39 having fast to one end thereof a pulley 40 which is connected to the output pulley 35 of a power transmission, including the coupling 13 and gear train 19 as shown in Fig. 1. The input pulley 11 of the transmission connects with a motor 42 which runs at constant speed in a clockwise direction as shown in Fig. 2. A second winding roll 43, spaced a convenient distance from the roll 39, has fast on one end thereof a pulley 44 which is connected to the output pulley 35 of a power transmission, identical with

that shown in Fig. 1. The input pulley 11 of the latter transmission connects with a motor 46 which runs at constant speed in a counterclockwise direction as shown in Fig. 2.

Between the winding rolls 39 and 43 is positioned gripping or pinch rolls 47 and 48, the latter having a pulley 49 which is drivenly connected to a reversible motor 50. It will be understood that any convenient driving connection may be provided between the rolls 47 and 48, such as gears (not shown), and that the surfaces of these rolls are related so that they exert a gripping or pinching action on the web 51 passed therebetween and move the web at a substantially constant linear speed. The driving and gripping relations of rolls of this type are well known in the art.

Baths 52 and 53 for holding the treating or conditioning liquid are located between the gripping rolls and the winding rolls 39 and 43 and idler rolls 54 and 55 are mounted in the baths 52 and 53, all respectively. The web 51 extends between and has its opposite ends appropriately secured to the winding rolls 39 and 43 and between the latter rolls, it extends partially around the idler rolls 54 and 55 in the respective baths and also between the gripping rolls 47 and 48 whose engagement with the web is sufficient to move the same in the direction determined by the rotation of the latter rolls. The baths 52 and 53 are merely intended to illustrate a typical use of the mechanism and do not form any part of the invention.

In the operative condition as shown in Fig. 2, the web 51 is moving from right to left, i. e., it is being unwound from the roll 39 and wound on the roll 43. Accordingly, the motor 50 is rotating counterclockwise and since the motor 46 is rotating in the same direction, the latter's drive of the winding roll 43 also moves the web in the same direction and maintains a substantially constant tension on the web between the roll 43 and the gripping rolls 47 and 48. At the same time, the motor 42 is rotating in a clockwise direction which means that the impellers 16 and 17 of the connected transmission are rotating in the same direction, but the pull of the gripping rolls 47 and 48 rotates the roll 39 in an unwinding or counterclockwise direction and this rotational movement is imparted through the planetary gear of the latter transmission to the runners 27 and 28 thereof which accordingly rotate oppositely to the cooperating impellers. Hence, the hydraulic coupling 13 that is connected to the roll 39 acts as a hydrodynamic brake on the web movement in the direction shown in Fig. 2 and serves to maintain a substantially constant tension on the web between the roll 39 and the gripping rolls 47 and 48.

The rotational speed of the output pulley 35 of the transmission that is connected to the roll 43 is controlled by the load imposed thereon and the interaction between the component parts of the planetary gear train arising from the cooperative action of the mechanical and hydraulic drives of the latter transmission. The load on the output pulley of the transmission 45 is represented by the winding roll 43 for the web direction shown and its increasing weight as the web is wound therearound. Due to the flexible characteristics of the last named transmission arising from the ability of its coupling and planetary gear train components to respectively rotate relative to each other, the output speed and torque automatically and instantaneously

adjust to this varying load condition. The available horsepower therefore remains substantially constant and the motor 46 operates under optimum conditions. Further, the relative slip of the runners 27 and 28 in the transmission connected to the roll 43 are controlled by the gear ratio of the gear train so that heating of the coupling never exceeds that which can be adequately cooled.

It will be understood that at the beginning of the operation, i. e., when the roll 43 is empty or nearly empty, its rotational speed is considerably greater than when the roll is full or nearly full. In other words, this roll speed varies from a maximum to a minimum during the winding operation, with the web 51 being fed to the roll 43 at a substantially constant linear speed. The mechanism automatically compensates for these rotational speed changes through the rotational slippage provided by the planetary gear and coupling and at the same time constantly increases its torque delivery so as to maintain a substantially constant pull on the web as the combined diameter of the roll 43 and the wound web increases. On the other side of the gripping rolls 47 and 48, the web 51 is drawn thereby at substantially constant linear speed from the then unwinding roll 39 and the coaction between the gripping rolls and the roll 39 also maintains a substantially constant tension on the portion of the web therebetween.

When the roll 39 has been unwound sufficiently, the motor 50 is reversed in an appropriate manner, but the motors 42 and 46 continue to rotate in the directions indicated in Fig. 2. The roll 39 then becomes the winding roll and the roll 43 the unwinding roll so that the web 51 moves from left to right. Under these conditions, the transmission connected to the roll 39 functions in the same manner as described for the transmission connected to the roll 43 when this was being wound, and the latter transmission then acts as a brake, all to maintain the web tension substantially constant. The web movement is periodically reversed in the above manner until the desired conditioning has been accomplished.

I claim:

1. Winding mechanism for web material comprising a pair of rolls, reversible gripping means between which the web is passed for alternately moving the web in opposite directions between the rolls to direct the web towards one roll for winding thereon while unwinding from the other roll, and transmitting means for each roll including an hydraulic coupling having an impeller driven at constant speed in a direction to wind the associated roll, a runner cooperably related to the impeller, and planetary gear means interposed between the runner and the associated roll including a plurality of gear elements, one of the elements being connected to the impeller, another element being connected to the runner and another element being connected to the associated roll, one coupling serving to transmit power to one of the rolls for winding and to assist the movement of the web and the other coupling acting as a hydrodynamic brake on the unwinding of the other roll whereby a substantially constant tension is maintained on the web in each direction, and each planetary gear means automatically adjusting to the changing torque requirements as the weight of the associated roll changes.

2. Winding mechanism for web material com-

prising a pair of rolls, reversible gripping means between which the web is passed for alternately moving the web in opposite directions between the rolls to direct the web towards one roll for winding thereon while unwinding from the other roll, and transmitting means for each roll including an hydraulic coupling having an impeller driven at constant speed in a direction to wind the associated roll, a runner cooperably related to the impeller, and planetary gear means interposed between the runner and the associated roll including a ring gear, a sun gear and a carrier supporting a plurality of planet pinions in mesh with the gears, the ring gear being connected to the impeller, the sun gear being connected to the associated roll and the carrier being connected to the runner, one coupling serving to transmit power to one of the rolls for winding and to assist the movement of the web and the other coupling acting as a hydrodynamic brake on the unwinding of the other roll whereby a substantially constant tension is maintained on the web in each direction, and each planetary gear means automatically adjusting to the changing torque requirements as the weight of the associated roll changes.

3. Winding mechanism for web material comprising a pair of rolls, a pair of gripping rollers between which the web is passed to move the same towards one roll for winding while unwinding the other roll, a power transmitting means for the winding roll including an hydraulic coupling having an impeller driven at constant speed in the direction of the winding roll, a runner cooperably related to the impeller and planetary gear means interposed between the runner and the winding roll including a plurality of gear elements, one of the elements being connected to the impeller, another element being connected to the runner and another element being connected to the winding roll, and a transmitting means for the unwinding roll including an hydraulic coupling having an impeller driven at constant speed in a direction opposite to that of the unwinding roll, a runner cooperably related to the last named impeller and planetary gear means interposed between the last named runner and the unwinding roll including a plurality of gear elements, one of the last named elements being connected to the last named impeller, another last named element being connected to the last named runner and another last named element being connected to the unwinding roll, the last named coupling acting as a hydrodynamic brake on the unwinding roll to assist in maintaining a constant tension on the

web and each planetary gear means automatically adjusting to the changing torque requirements as the weight of the associated roll changes.

4. Winding mechanism for web material comprising a pair of rolls, a pair of gripping rollers between which the web is passed to move the same towards one roll for winding while unwinding the other roll, a power transmitting means for the winding roll including an hydraulic coupling having an impeller driven at constant speed in the direction of the winding roll, a runner cooperably related to the impeller and planetary gear means interposed between the runner and the winding roll including a ring gear, a sun gear and a carrier supporting a plurality of planet pinions in mesh with the gears, the ring gear being connected to the impeller, the sun gear being connected to the winding roll and the carrier being connected to the runner, and a transmitting means for the unwinding roll including an hydraulic coupling having an impeller driven at constant speed in a direction opposite to that of the unwinding roll, a runner cooperably related to the last named impeller and planetary gear means interposed between the last named runner and the unwinding roll including a ring gear, a sun gear and a carrier supporting a plurality of planet pinions in mesh with the gears, the last named ring gear being connected to the last named impeller, the last named sun gear being connected to the unwinding roll and the last named carrier being connected to the last named runner, the last named coupling acting as a hydrodynamic brake on the unwinding roll to assist in maintaining a constant tension on the web and each planetary gear means automatically adjusting to the changing torque requirements as the weight of the associated roll changes.

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