Nov. 10, 1953 L. J. WOLF 2,658,692

WINDING MECHANISM

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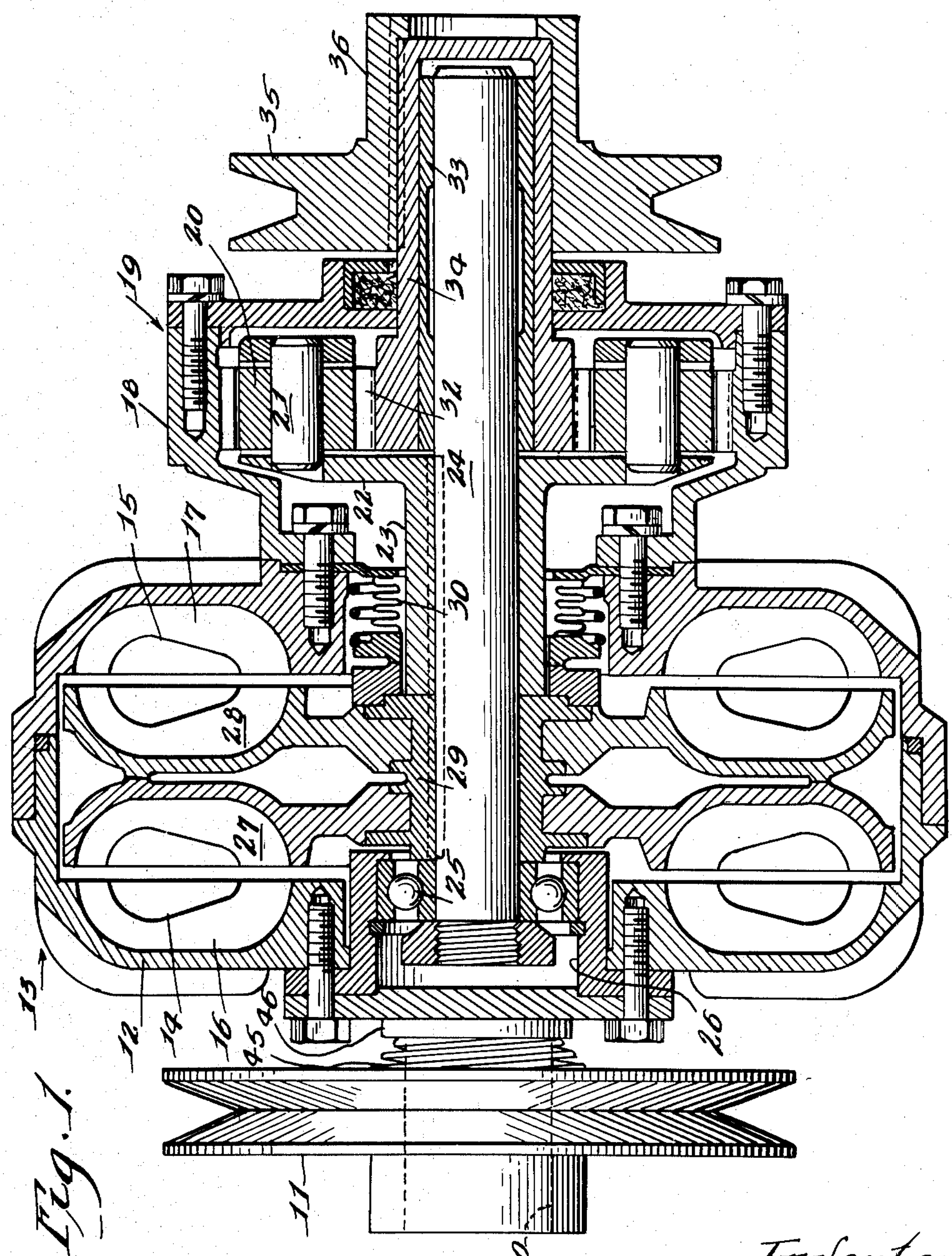

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Fig. 2.

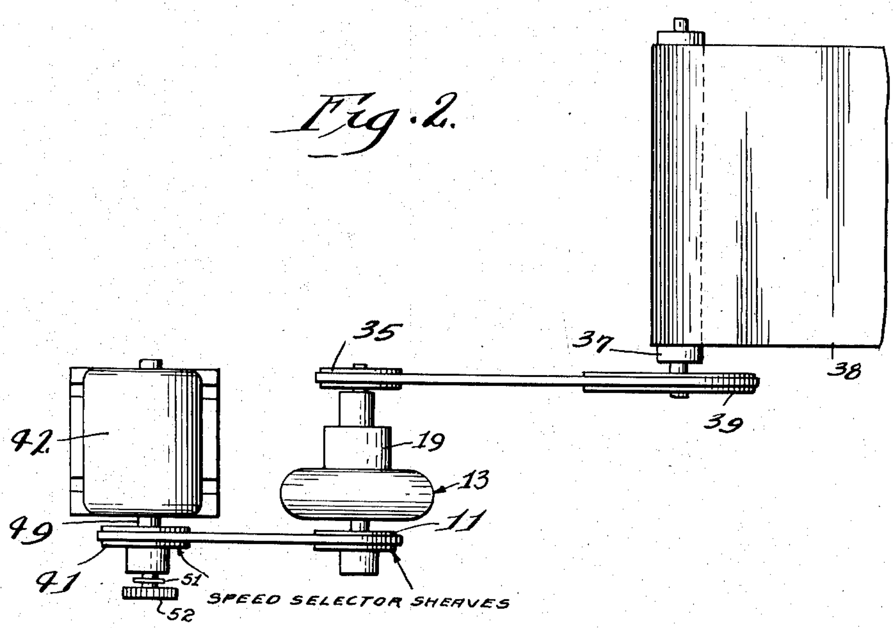

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Fig. 5.

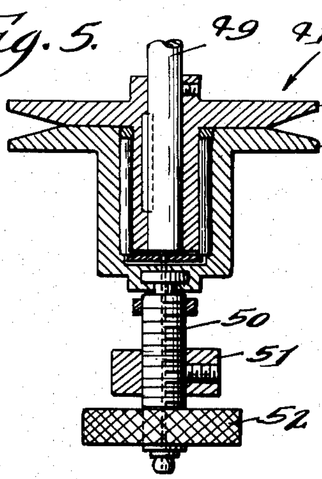


Fig. 4.

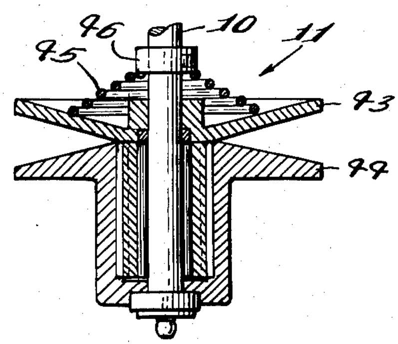


Fig. 6.

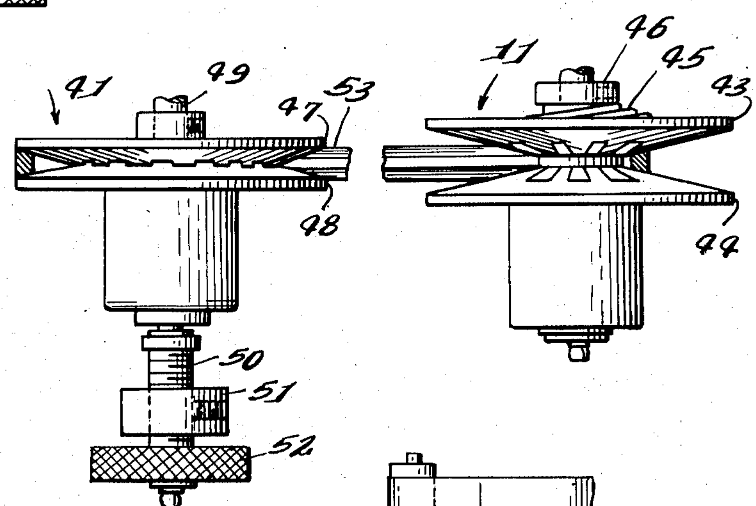
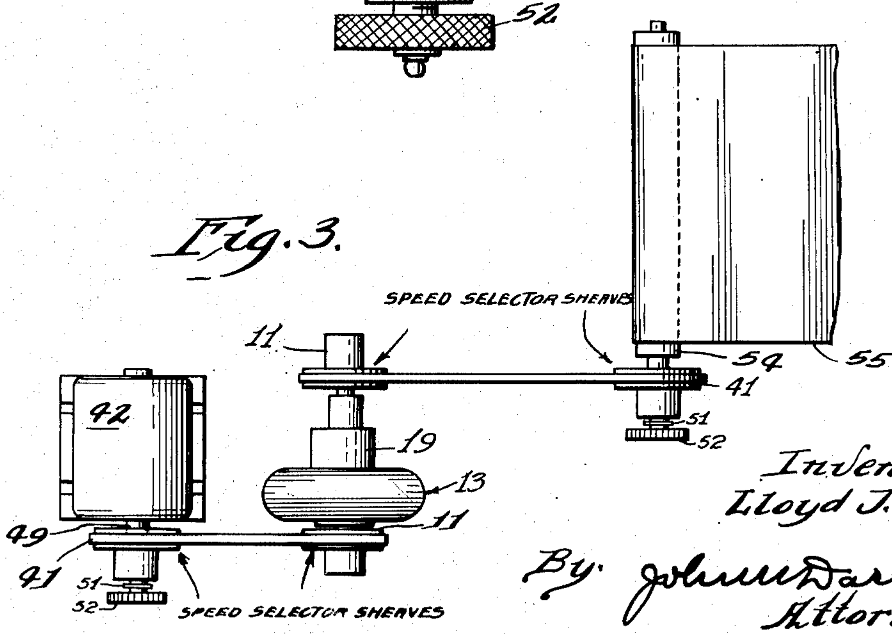


Fig. 3.



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WINDING MECHANISM

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Application February 28, 1950, Serial No. 146,662

6 Claims. (Cl. 242—75)

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My invention relates to a winding mechanism and more particularly to an arrangement of this character for winding webs, strips and the like on a roll where the operating requirements vary with respect to maintaining a certain speed and tension on the web.

In the processing of web or strip material which includes the winding of the web on a roll under tension, variant conditions are encountered. In some instances, the speed of the web as fed to the winding roll is substantially constant, but the tension requirements will vary with the width and thickness of the web, but in other cases, there are wide ranges in web speed and tension requirements. For example, a relatively heavy web may require a relatively high tension and relatively low winding speed, while a lighter web may require a relatively low tension and a relatively high velocity. According to present practice, these variable requirements can only be met by employing a plurality of mechanisms each designed to accommodate a defínte speed and tension, or at the most, a very limited range of these characteristics.

It is therefore one object of my invention to provide a mechanism for winding webs and the like at constant speed and with varying tensions which includes, interposed between the power source and the winding roll, a power transmission whose output shaft speed and torque automatically and instantaneously adjusts to meet varying load conditions.

A further object is to provide a winding mechanism of the character indicated which is additionally conditioned for winding webs requiring varying winding speeds and tensions.

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.

Figs. 2 and 3 are plan views of two variations of the mechanism incorporating the transmission shown in Fig. 1.

Figs. 4 to 6, inclusive, show cooperating, speed selector sheaves which are employed to vary the input speed to the transmission and the output speed from this unit to the winding roll if the latter adjustment is necessary.

Referring to Fig. 1, the numeral 10 designates an input shaft having keyed thereto an adjustable sheave 11 forming one component of a pair of selector speed sheaves presently described. The delivery end of the shaft 10 is connected to one end of an annular housing 12 forming part of an hydraulic coupling 13. The housing 12 includes 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.

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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 journaled 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.

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 that is appropriately journaled.

One form of the winding mechanism is illustrated in Fig. 2 and it includes a winding roll 37 around which is wound a web 38 that is drawn under tension from any convenient source, such as from a pair of pinch rolls between which the web passes, or from an unwinding roll which rotates under a suitable restraint. One end of the roll 37 carries a pulley 39 which is driven by the pulley 35 that is fast on the output sleeve of the power transmission, including the coupling 13 and gear train 19. The speed selector sheave 11 on the input end of the coupling 13 is driven by a cooperating, speed selector sheave 41 that is secured to the shaft of a constant speed motor 42. The sheaves 11 and 41 are well known in the art and they provide a convenient means of achieving a stepless speed control on driven equipment by varying the radial distances of the belt from the axes of the respective sheaves. For convenience, the essential structural features of these sheaves are shown in Figs. 4 to 6, inclusive, to which reference will now be made.

The sheave 11 is illustrated in Fig. 4 and it includes components 43 and 44 which have splined engagement with each other so that they will rotate together, but the component 43 may slide axially relative to the component 44, the latter being suitably held against axial movement. The component 43 is also splined to the input shaft 10 of the coupling 13 so that it may move axially of the shaft while rotating therewith. The components tend to be maintained in the limiting position shown by a loading spring 45 interposed between the component 43 and a collar 46 attached to the shaft 10, but will separate automatically to some position as determined by the adjustment of the sheave 41 as presently described.

Referring to Fig. 5, the sheave 41 also comprises a pair of components 47 and 48, the former being keyed to the motor shaft 49 and both components having splined engagement with each other so that the component 48 will rotate with the component 47, but may move axially relative thereto. One end of an adjusting screw 50 is rotatably attached to the component 48 and threaded through a fixed part 51 for connection to a finger disk 52 so that axial movements of the screw will effect corresponding movements of the component 48 and hence will vary the spacing of the latter from the component 47.

A typical relation of the sheaves 11 and 41 is illustrated in plan view in Fig. 6. The components of the sheave 41 are adjusted to their closest positions, while the components of the sheave 11 are relatively separated against the loading of the spring 45. This relation provides one speed ratio between the sheaves. If it is desired to change this ratio, the disk 52 is rotated to further separate the components of the sheave 41. Temporarily, this adjustment loosens the belt 53 so that the spring loaded component of the sheave 11 moves towards its coacting component to again grip the belt. Hence the speed ratio of the sheaves is capable of infinite adjustments to provide any desired speed output.

These sheaves are utilized in the winding mechanism shown in Fig. 2 as a simple and easily adjustable means of regulating the input speed to the coupling 13 to accommodate webs of varying width and thickness. Variations in tension requirements are met by varying the input speed to the coupling by suitably adjusting the sheave 41 which also automatically adjusts the sheave 11 as already described. For example, higher tension requirements necessitate higher input speeds than do lower tension demands, but, in all cases, the speed of the web at the winding roll remains substantially constant.

The rotational speed of the output pulley 35 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 transmission. The load on the output pulley 35 is represented by the winding roll 37, its increasing mass as the web is wound thereabout and the tension pull on the web. Due to the flexible characteristics of the 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 42 operates under optimum conditions. Further, the relative slip of the runners 27 and 28 is 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 37 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 38 being fed to the roll 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 and the wound web increases.

Where there is a wide range in the web speed and tension required, these variant situations can be handled by the single mechanism shown in Fig. 3 which is a modification of the Fig. 2 mechanism in that means are provided to adjust the speed of the winding roll. Like parts in Figs. 2 and 3 are identified by the same numerals.

The pulley 35 is removed from the output sleeve 34 of the transmission and a speed selector sheave 11 is substituted therefor. The latter is drivably connected to a speed selector sheave 41 secured to one end of a winding roll 54 around which a web 55 is to be wound. Hence, it is possible to vary the input and output speeds of the transmission and to therefore satisfy on the same mechanism the requirements of a low velocity, high tension, heavy web and a high velocity, low tension, light web. The characteristics of the transmission in the Fig. 3 mechanism are identical with those described in connection with Fig. 2.

I claim:

1. Mechanism for winding a web under tension comprising a winding roll, a power transmission having its output connected to the roll and including an hydraulic coupling and a connected planetary gear train, cooperating speed selector sheaves respectively connectible to a constant speed power source and the transmission input, each sheave including two cooperating components relatively movable axially, on sheave being manually adjustable to vary the spacing of its components and the other sheave being automatically conditioned for coaction with said one sheave in any adjusted position thereof, and a belt connecting the sheaves.

2. Mechanism for winding a web under tension comprising a winding roll, a power transmission having its output connectible to the roll, cooperating speed selector sheaves respectively connectible to a constant speed power source and the transmission input, each sheave including two cooperating components relatively movable axially, one sheave being manually adjustable to vary the spacing of its components and the other sheave being automatically conditioned for coaction with said one sheave in any adjusted position thereof, and a belt connecting the sheaves,

the transmission including an hydraulic coupling having an impeller constituting the input of the transmission, a runner operatively related to the impeller, and planetary gear means including a plurality of coacting gear elements, one of the elements being connected to the impeller, another element being connected to the runner and another element constituting the output of the transmission.

3. Mechanism for winding a web under tension comprising a winding roll, a power transmission having its output connectible to the roll, cooperating speed selector sheaves respectively connectible to a constant speed power source and the transmission input, each sheave including two cooperating components relatively movable axially, one sheave being manually adjustable to vary the spacing of its components and the other sheave being automatically conditioned for coaction with said one sheave in any adjusted position thereof, and a belt connecting the sheaves, the transmission including an hydraulic coupling having an impeller constituting the input of the transmission, a runner operatively related to the impeller, and planetary gear means 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 constituting the output of the transmission and the carrier being connected to the runner.

4. Mechanism for winding a web under tension comprising a winding roll, a power transmission including an hydraulic coupling and a connected planetary gear train, the coupling and gear train respectively constituting the input and output of the transmission, a first set of cooperating speed selector sheaves respectively connectible to a constant speed power source and the transmission input, a second set of cooperating speed selector sheaves respectively connectible to the transmission output and to the roll, each sheave including two cooperating components relatively movable axially, one sheave in each set being manually adjustable to vary the spacing of its components and the other sheave in each set being automatically conditioned for coaction with said one sheave in each set in any adjusted position thereof, and a belt connecting the sheaves in each set.

5. Mechanism for winding a web under tension comprising a winding roll, a power transmission, a first set of cooperating speed selector sheaves respectively connectible to a constant speed power source and the transmission input, a second set of cooperating speed selector sheaves respectively connectible to the transmission output and to the roll, each sheave including two cooperating components relatively movable axially, one sheave in each set being manually adjustable to vary the spacing of its components and the other sheave in each set being automatically conditioned for coaction with said one sheave in the associated set in any adjusted position thereof, and a belt connecting the sheaves in each set, the transmission including an hydraulic coupling having an impeller constituting the input of the transmission, a runner operatively related to the impeller, and planetary gear means including a plurality of coacting gear elements, one of the elements being connected to the impeller, another element being connected to the runner and another element constituting the output of the transmission.

6. Mechanism for winding a web under tension comprising a winding roll, a power transmission, a first set of cooperating speed selector sheaves respectively connectible to a constant speed power source and the transmission input, a second set of cooperating speed selector sheaves respectively connectible to the transmission output and to the roll, each sheave including two cooperating components relatively movable axially, one sheave in each set being manually adjustable to vary the spacing of its components and the other sheave in each set being automatically conditioned for coaction with said one sheave in the associated set in any adjusted position thereof, and a belt connecting the sheaves in each set, the transmission including an hydraulic coupling having an impeller constituting the input of the transmission, a runner operatively related to the impeller, and planetary gear means 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 constituting the output of the transmission and the carrier being connected to the runner.

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