Sept. 4, 1951 H. D. PAXSON 2,566,629

EXPANSIBLE MANDREL

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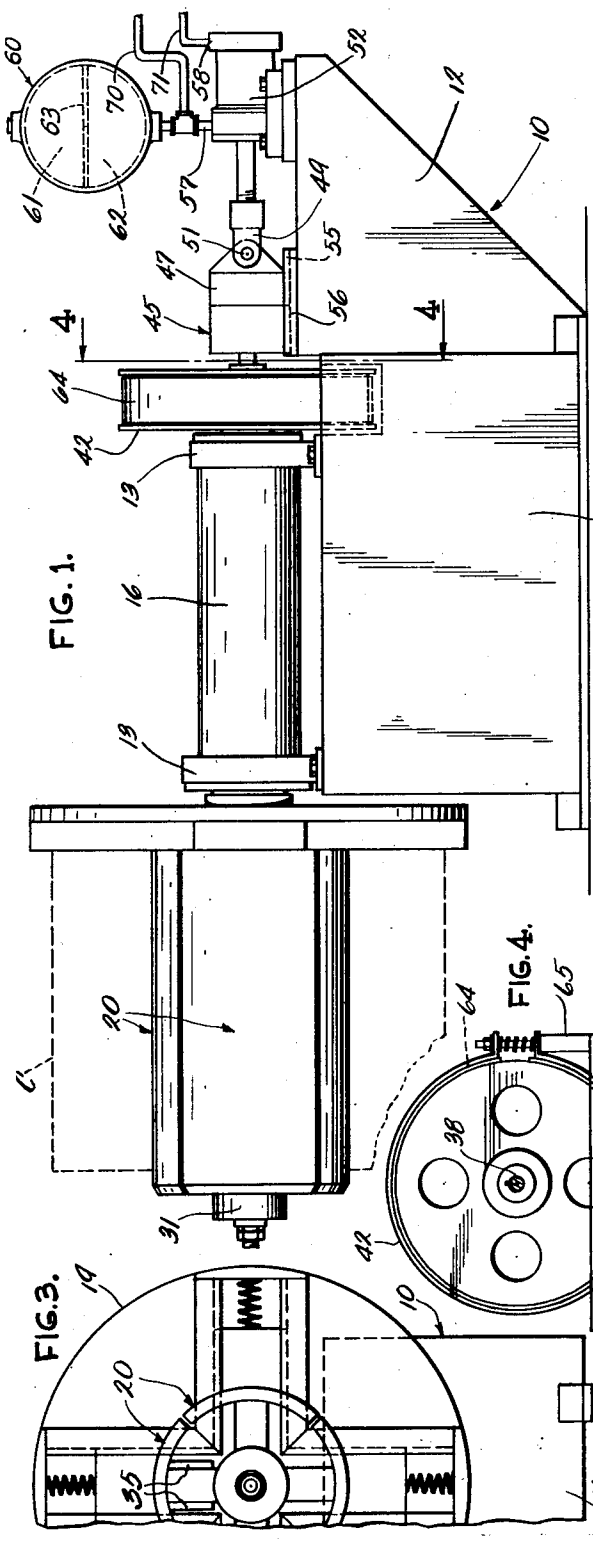


FIG. 1.

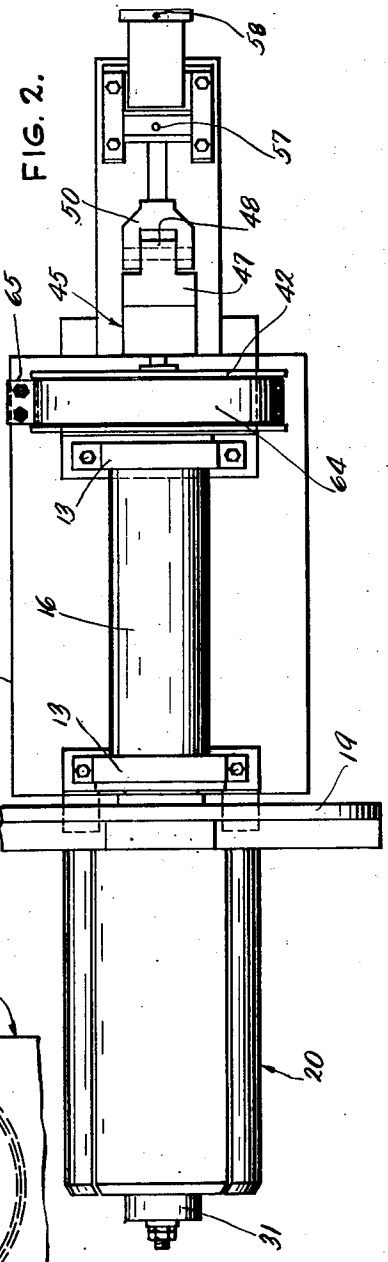


FIG. 2.

FIG. 4.

FIG. 3.

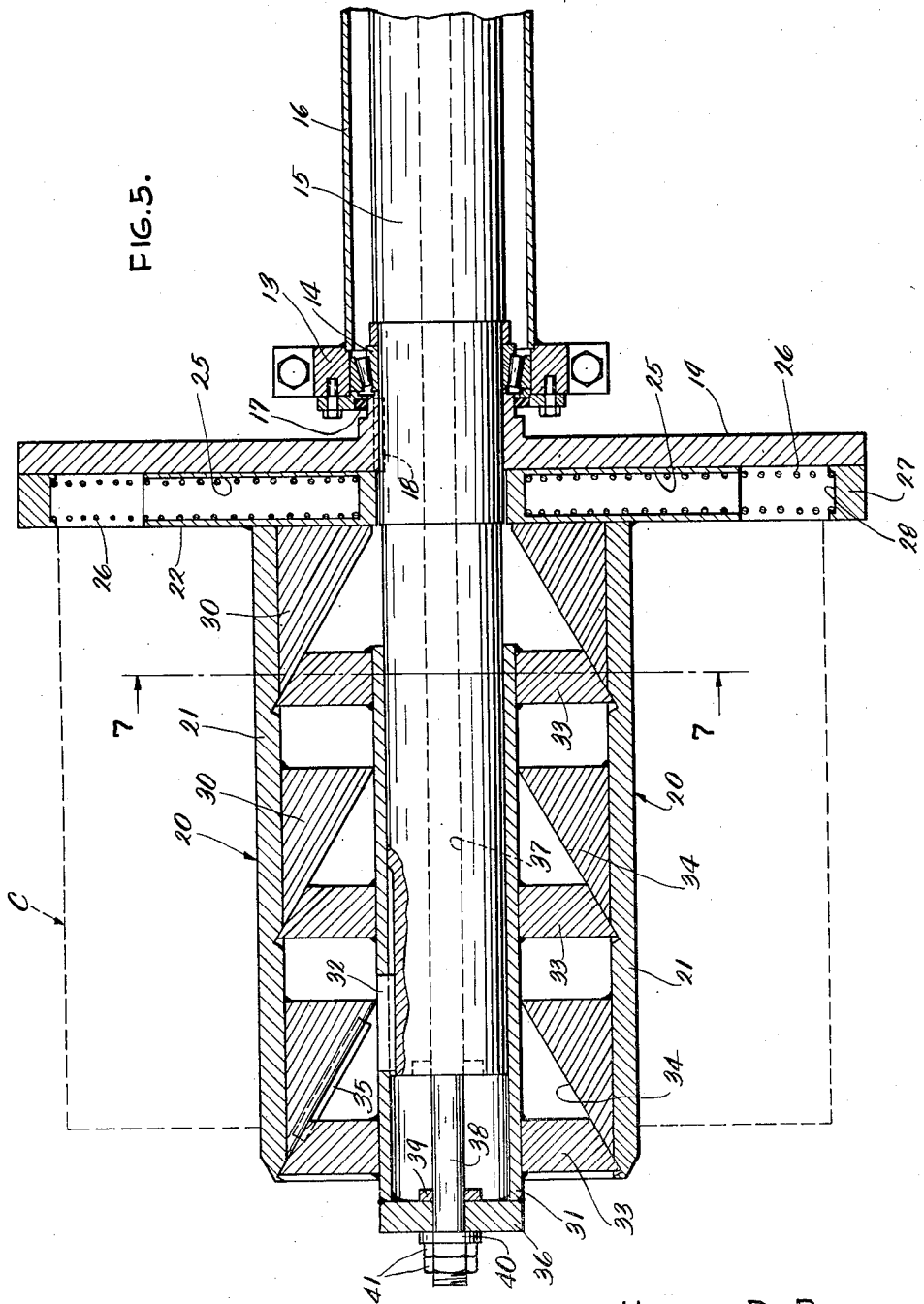
HOMER D. PAXSON
INVENTOR
BY Michael Williams
ATTORNEY

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FIG. 5.



HOMER D. PAXSON
INVENTOR
BY Michael Williams
ATTORNEY

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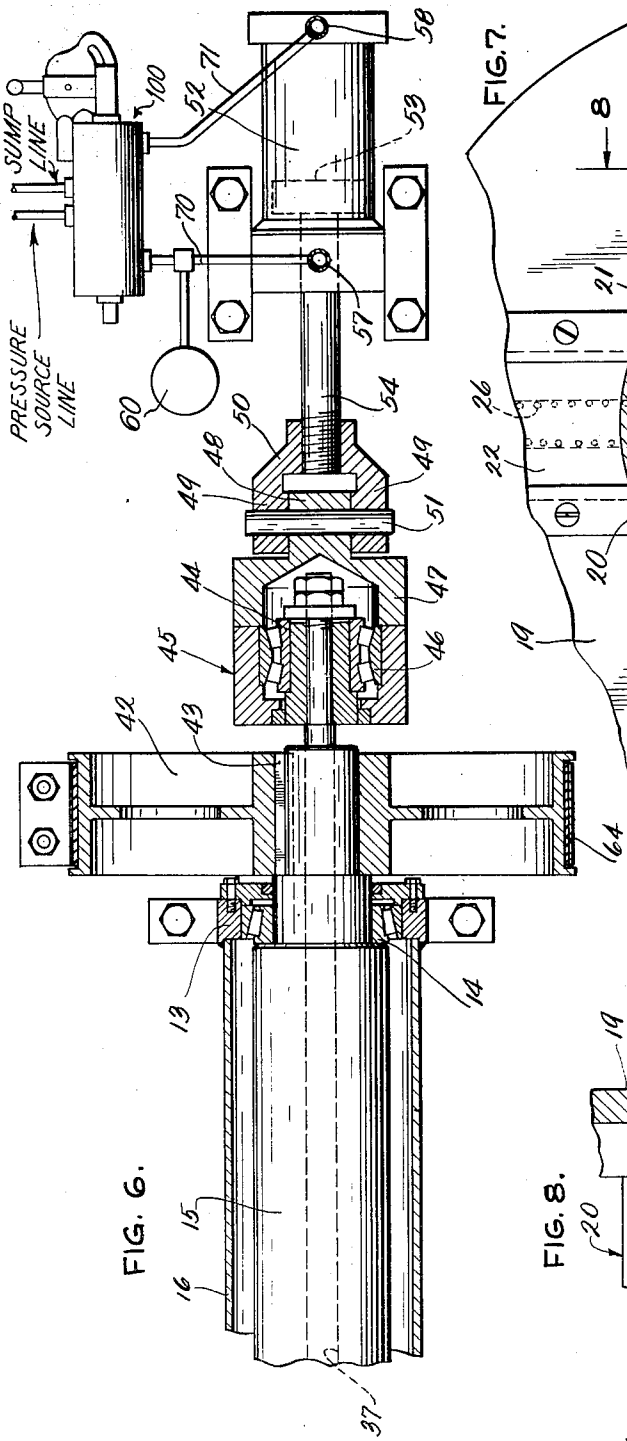


FIG. 6.

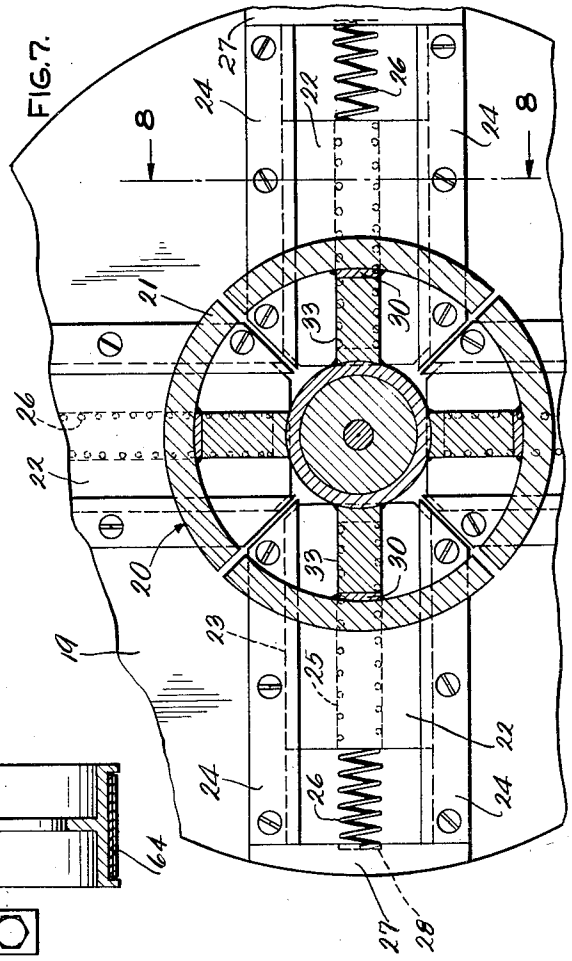


FIG. 7.

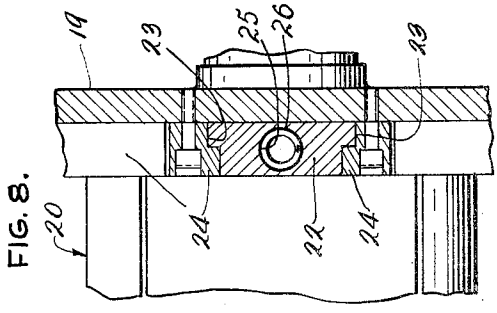


FIG. 8.

HOMER D. PAXSON
INVENTOR
BY Michael Williams
ATTORNEY

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UNITED STATES PATENT OFFICE

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EXPANSIBLE MANDREL

Homer D. Paxson, Salem, Ohio

Application July 19, 1946, Serial No. 684,753

5 Claims. (Cl. 242—72)

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My invention relates to reel mechanism, particularly to such mechanism as is used for coiled flexible material, such as coiled sheet steel, and the principal object of my invention is to provide new and improved reel mechanisms of the character described.

In the production of metal in strip or wire form, it is customary to roll great lengths of such metal into coils, so that it may be readily handled, and will require only a minimum of space when stored or shipped.

My invention may be used with equal utility either in the formation of the coiled metal, or in the uncoiling of the metal preparatory to operations leading to its use. In the embodiment herein shown, the invention is particularly adapted for use as a pay-off reel, for uncoiling material.

Heretofore, many attempts have been made to provide a suitable reel, but none has proved commercially successful, since certain principles inherent to coiled structure have been overlooked. One such principle is that the forces tending to maintain the coiled structure change as the structure is either increased or decreased. For instance, when material is removed from the coil, the forces tending to maintain the coil lessen, so that jaws moved to a predetermined radial outward position to press against the surfaces defining the opening of the coil would lose proper interengagement with such surfaces. Therefore, with prior construction, the entire line of machinery would have to be stopped so that the jaws may be retightened, or a retaining plate would be required on the reel to keep the coil from working off the reel.

Further, prior attempts have failed to consider the necessary distribution of forces exerted by and through the jaws which engage the coil, and thus such attempts have proved commercially unsuccessful because of constructional failure.

In the drawings accompanying this application, and forming part of this specification, there is shown, for purposes of illustration, an embodiment which the invention may assume, and in these drawings:

Figure 1 is a side elevational view of a machine illustrating an embodiment of the invention,

Figure 2 is a top plan view of the machine,

Figure 3 is a fragmentary end elevational view of the machine,

Figure 4 is a vertical sectional view corresponding generally to the line 4—4 of Figure 1.

Figure 5 is an enlarged horizontal sectional view of a part of the machine,

Figure 6 is an enlarged horizontal sectional view of the remainder of the machine,

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Figure 7 is a fragmentary sectional view corresponding generally to the line 7—7 of Figure 5, and

Figure 8 is a transverse sectional view corresponding generally to the line 8—8 of Figure 7.

Referring particularly to Figures 1 through 4, the machine illustrating an embodiment of the invention is supported by a base 10, comprising a main section 11 and a ledge section 12. Extending from the upper surface of the main section 11 is a pair of bearing blocks 13, each supporting a combined thrust and roller bearing 14 (see particularly Figures 5 and 6) for journalling a shaft 15.

Extending between the bearing blocks 13, and rigid therewith, is a tube 16 which provides means for resisting displacement of the bearing by action of torque forces. The tube 16, in combination with end seals 17, also provides means for keeping undesirable foreign matter from entering the bearings 14.

Secured for rotation with the shaft, as by means of a key 18 (Figure 5) is a supporting plate 19. Jaws 20, herein shown to be four in number, extend from a side surface of the plate, and are radially expansible and contractible so as to permit their entry into the opening of the coil C and their expansion against the surfaces defining the opening of the coil.

Each of the jaws 20 comprises an arcuate section 21 having its inner end fixed, as by welding, to a slide 22. Each of the slides 22 has longitudinally extending bearing surfaces 23 on its opposite sides, adapted to cooperate with gibs 24 which are bolted to the adjacent surface of the supporting plate 19. The slides are thus held to move toward or away from the axis of the supporting plate 19, and such movement provides for radial expansion or contraction of the jaws 20. As best seen in Figure 7, the jaws 20 form a tubular support adapted to fit within the opening of the coil C.

Each of the slides 22 is formed with an aperture 25 stopping short of the inner end of the slide to form a bottom for one end of a helical coil spring 26. The other end of the spring extends outwardly of aperture 25, and bears against an abutment 27 rigidly carried by the supporting plate 19. Each abutment is recessed, as shown at 28, to receive a portion of the spring 26, and to prevent its displacement. It will be clear that the springs 26 urge the slides 22 radially inwardly toward the axis of the supporting plate 19, such inward movement being halted either by interabutment of the arcuate sections 21, or by abutment of the inner ends of the slides 22 with the shaft, or by both. If desired, any other suitable limiting means may be employed.

Each of the arcuate sections has wedge parts

30 secured to its inner surface, as by welding. The wedge parts 30, here shown to be three in number and spaced-apart longitudinally with respect to the arcuate section, extend radially inwardly of the tubular support formed by the jaws 20.

Actuator means are provided for expanding the jaws 20, and as herein shown, the actuator means comprises a sleeve 31 slidable along a portion of the shaft 15. The sleeve is held to rotation with the shaft by suitable means, such as key 32, the keyway receiving the key 32 being extended so as to permit sliding of the sleeve 31 along the portion of the shaft 15.

The sleeve 31 has a series of radially extending wedge parts 33, the series being in number to correspond to the number of arcuate sections 21, and each series comprising three wedge parts to correspond to number of wedge parts 30. The wedge parts 30 and 33 have cooperating wedge surfaces 34, preferably angled at 30° to provide for desired transmission of power, combined with smoothness and rapidity of action.

It will be clear that proper disposition of parts will enable the actuator means to maintain the jaws equidistant from the central axis at all times. The springs 26 are so constructed and arranged that their force will always maintain the cooperating wedge surfaces 34 in engagement.

Any suitable means may be employed to maintain the wedge surfaces 34 in proper alignment. In the embodiment shown to illustrate the invention, plates 35 are rigidly secured, as by welding, to opposite sides of one of the wedge parts 30, the plates 35 having surfaces disposed to engage opposite surfaces of the corresponding wedge part 33 and thus prevent relative radial movement of the arcuate sections 21 and the actuator means.

The free end of the sleeve 31 is closed by a plate 36 which is rigidly secured to the sleeve, as by welding. Slidable through an aperture 37 in the shaft 15 is a rod 38 which has one end secured to the plate 36 by means of a collar 39, welded to the rod 38 and abutting one surface of the plate, and a washer 40 held against the opposite surface of the plate by nuts 41 threaded on the threaded extremity of the rod 38. Thus, the sleeve 31 is held to reciprocable and rotatable movement with the rod 38.

A wheel 42 is secured for rotation with the shaft 15, as by a key 43. The rod 38 extends outwardly of the shaft 15 and is secured to the inner race 44 of a combination roller and thrust bearing 45. The outer race 46 of the bearing 45 is rigidly secured to a housing 47 which terminates in a tongue 48. The tongue 48 fits between furcations 49 of a yoke 50, and a pin 51 connects the tongue 48 with the yoke 50.

Means are provided for reciprocating the rod 38, and as here shown and preferred, the means takes the form of a hydraulic cylinder 52 which contains the usual piston 53. Extending outwardly of the cylinder 52 is the piston rod 54 which has its extremity connected to the yoke 50, as by interengaging screw threads.

The cylinder 52 is secured to the upper surface of the ledge section 12, as shown in Figure 1, so as to be rigid therewith. The housing 47 of the bearing 45 is formed with a tongue 55 extending in line with the axis of the rod 38, the tongue fitting between gib surfaces of a slide 56 carried by the ledge section 12, the construction being such that the housing 47 may reciprocate with the rod 38, yet is held against rotation therewith. In this manner, the piston 53 is relieved of wear which would be caused if it were held to rotation with the rod 38.

The cylinder 52 is provided with the usual ports 57, 58, either of which may be inlet or outlet. The ports 57, 58 are connected in the usual manner, by means of conduits 70, 71 to a valve 100. The valve is of the common two position and neutral type, so that with the valve in one position, the port 57 is connected to pressure and the port 58 is connected to sump, and with the valve in another position, the ports 57, 58 are respectively connected to sump and pressure.

In neutral position, both ports 57, 58 are blocked against connection with either pressure or sump. When pressure is admitted to the port 57, the piston 53 is urged to the right, as viewed in Figure 6, resulting also in movement of the rod 38 and sleeve 31 in this direction. Such movement will cause the wedge parts 33 to urge the wedge parts 30 and connected arcuate sections 21 simultaneously and equally radially outwardly. When the valve is moved to connect the port 58 with pressure, the piston 53 is moved in the reverse direction, thus moving the wedge parts 33 so that the springs 26 will urge the arcuate sections 21 radially inwardly.

Without any further provisions, if the valve were moved to neutral position after expanding the jaws 20 to tight engagement with the surfaces defining the opening of the coil, such engagement would gradually loosen, caused in part by leakage of fluid past the piston 53, and in part by irregularity of the coil opening changing to concentricity with the tubular support formed by the jaws 20, and in part by the fact that as the coil is in the process of unwinding, the forces tending to restrict the opening into the coil lessen, and this opening enlarges.

My invention provides means whereby slippage between the surfaces defining the coil opening and jaws 20 is prevented, so that the coil is always firmly retained on the reel. Such means provide a pressure on the piston 53 in a direction to constantly urge the jaws to expand. In the embodiment herein shown, such means takes the form of a pressure accumulator 60, which in one commercial form, is a hollow sphere divided into two chambers 61, 62 by a diaphragm 63.

The chamber 62 is connected to the conduit leading to the port 57, and the chamber 61 is charged with a fluid under pressure. In one commercially available accumulator, the chamber 61 is charged with nitrogen under pressure. In the embodiment herein shown, the gas in the chamber 61 is at less pressure than the working pressure of the hydraulic system.

When the valve is so positioned that fluid under pressure urges the piston 53 to expand the jaws, the gas in chamber 61 is also compressed to the working pressure of the hydraulic system. Now, if the valve is returned to neutral position, fluid from the pressure source and to the sump is blocked. However, the chamber 62 of the accumulator 60 is in direct communication with the cylinder, and pressure from the chamber 61 is transmitted to the piston 53 so as to urge it to the right, as viewed in 6, and thus automatically expand the jaws 20 to take up any looseness at the coil opening.

If more rapid movement of the jaws 20 is required, during expansion caused by the accumulator 60, the exhaust from the cylinder 52 may be connected to sump through a line containing a regulatable orifice in any suitable manner.

It will be appreciated that the springs 26 have

such compression factor that they readily permit expansion of the jaws 20, yet equally readily return the jaws to contracted relation once the actuator means is retracted by action of the piston 53. Thus, the spring pressure should be less than hydraulic pressure, but great enough to overcome any frictional and mass forces opposing movement of the jaws 20.

In the case, as is herein shown, where the reel is used for pay-off purposes, it is desirable to restrict undue free rotation of the tubular support which carries the coil. In the embodiment shown to illustrate the invention, a brake band 64, carrying suitable brake lining, is disposed about the periphery of the wheel 42, one end of the band being anchored, as at 65, to the main section 11 of the base 10, and the other end being adjustable to vary the braking effect provided. Thus, the reel is prevented from over-running feed of material from the coil, or from rotating when no material is taken from the coil.

It will be clear that the reel built in accordance with the teachings of my invention is sturdy in construction and efficient in operation. For example, the cooperating wedge parts 30, 33 eliminate all necessity for links, pins, bushings and the like, and thus eliminate points of trouble. Reaction forces, set up by expansion of the jaws against the surfaces of the coil opening are equitably taken up by the wedge parts, so that no single portion of the reel mechanism is stressed unduly. Accordingly, the invention permits the machine to be designed for powerful operation without requiring excessively bulky parts.

From the foregoing, it will be appreciated by those skilled in the art that I have accomplished at least the principal object of my invention, and it also will be apparent to those skilled in the art that the embodiment herein described may be variously changed and modified, without departing from the spirit of the invention, and that the invention is capable of uses and has advantages not herein specifically described; hence it will be appreciated that the herein disclosed embodiments are illustrative only, and that my invention is not limited thereto.

I claim:

1. A reel construction, for flexible material, comprising: a plurality of generally radially movable jaws; fluid-pressure actuated means for moving said jaws radially outwardly, including pressure accumulator means for constantly exerting pressure to move said jaws radially outwardly.

2. A pay-off reel for coiled flexible material, comprising: jaw means, adapted to fit within the opening of the coil, and having portions adapted for movement outwardly in a generally radial direction; fluid-pressure actuated means; including pressure accumulator means constructed and arranged to constantly urge said jaw portions radially outwardly into firm engagement with the surfaces defining the opening of said coil, regardless of the changing characteristics of said coil opening.

3. A pay-off reel for coiled flexible material, comprising: an expansible-contractible mandrel; a fluid operated piston, movable in opposite directions to provide for expansion or contraction of said mandrel; valve means, connectable to a source of fluid pressure, for controlling flow of fluid under pressure to one or the other sides of said piston, and for blocking off fluid flow to and from either side of said piston, fluid flow to one side moving said piston to provide for expansion of said mandrel, and fluid flow to the other side moving said piston to provide for contraction of said mandrel; and pressure accumulator means, connected to said one side of said piston, and operable when said valve means is in fluid blocking position to maintain a pressure on said one side of said piston, thereby providing for expansion pressure on said piston to compensate for changing pressure conditions caused by changing characteristics of said coil opening.

4. A pay-off reel for coiled flexible material, comprising: an expansible-contractible mandrel; means exerting a constant force tending to contract said mandrel; a fluid operated piston, movable in opposite directions to provide for expansion or contraction of said mandrel; valve means, connectable to a source of fluid pressure, for controlling flow of fluid under pressure to one or the other sides of said piston and for blocking off fluid flow to and from either side of said piston, fluid flow to one side of said piston providing a force greater than said constant contracting force to move said piston and provide for expansion of said mandrel, and fluid flow to the other side of said piston moving said piston to provide for contraction of said mandrel through action of said constant contracting force; and pressure accumulator means, connected to said one side of said piston, providing a force greater than said constant contracting force, and operable when said valve means is in fluid blocking position to maintain a constant pressure on one side of said piston, thereby providing for expansion pressure on said piston which will expand said mandrel to follow up changing characteristics of said coil opening.

5. A pay-off reel for coiled flexible material, comprising: a rotatable plate; a plurality of jaws carried by said plate and extending from a surface of said plate to form an expansible-contractable tubular support adapted to fit within the opening of the coil, said jaws having slidable connection with said plate so as to be movable in a generally radial direction, and each of said jaws having first wedge means extending inwardly of said tubular support; resilient means, urging said jaws in a radially inward direction; actuator means, disposed within said tubular support and mounted for reciprocable movement axially of said tubular support, said actuator means having second wedge means cooperable with said first wedge means to move said jaws radially outwardly against the force of said resilient means upon predetermined movement of said actuator means; and fluid-pressure actuated means, for moving said actuator means, including pressure accumulator means constructed and arranged to constantly act on said actuator means to constantly urge said jaw portions radially outwardly into firm engagement with the surfaces defining the opening of said coil, regardless of the changing characteristics of said coil opening.

HOMER D. PAXSON.

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