

May 23, 1961

L. ROCKSTROM ET AL
ROLL REWINDING DEVICE

2,985,398

Filed Oct. 11, 1956

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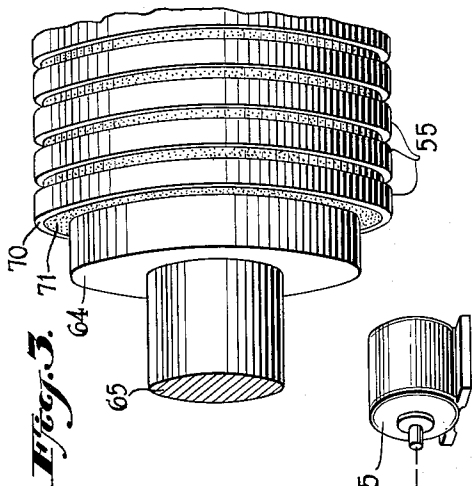
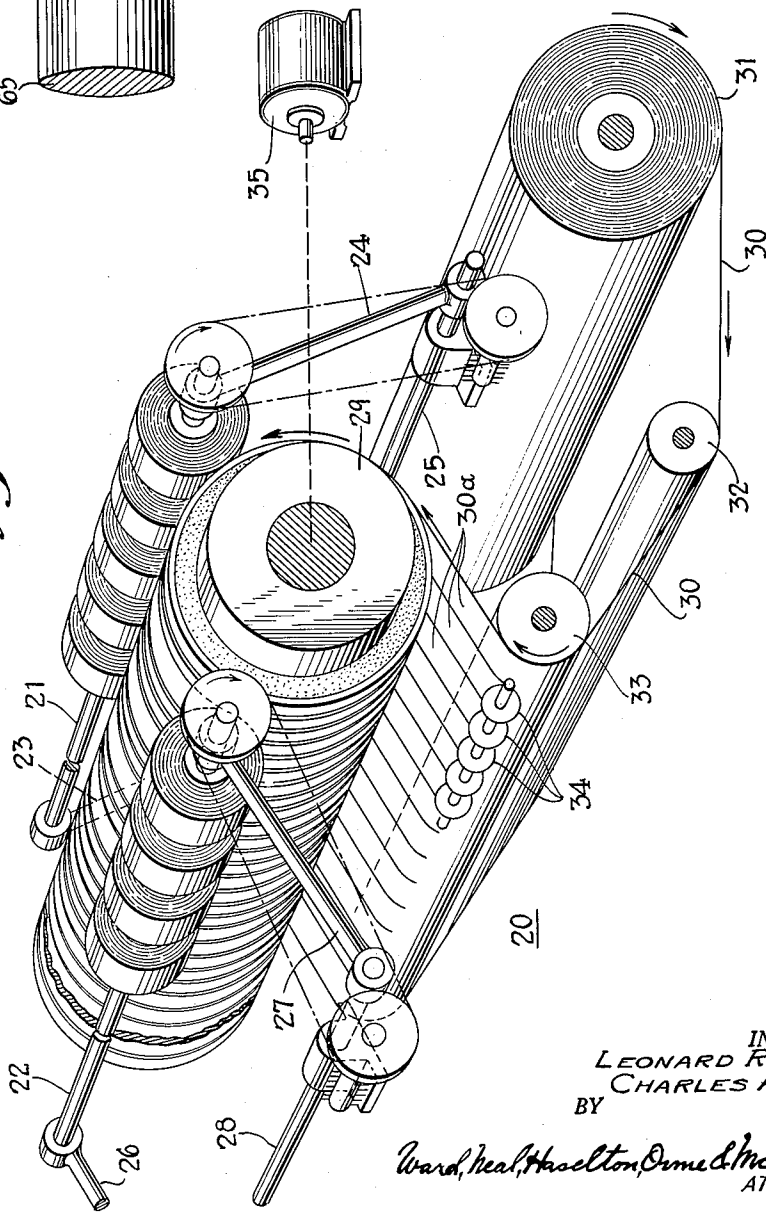


Fig. 1.



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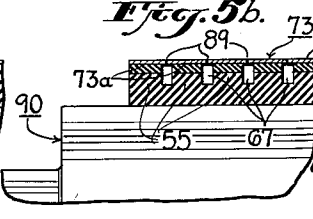
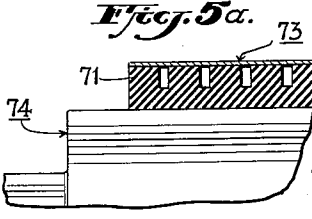
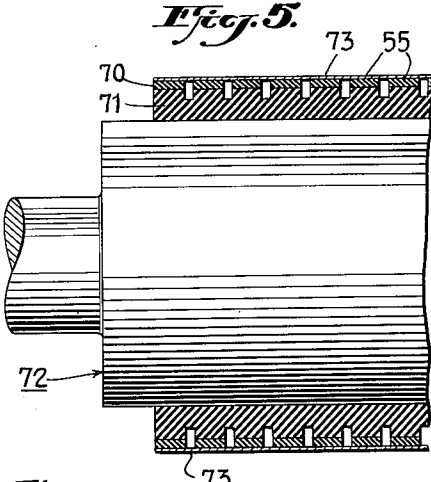
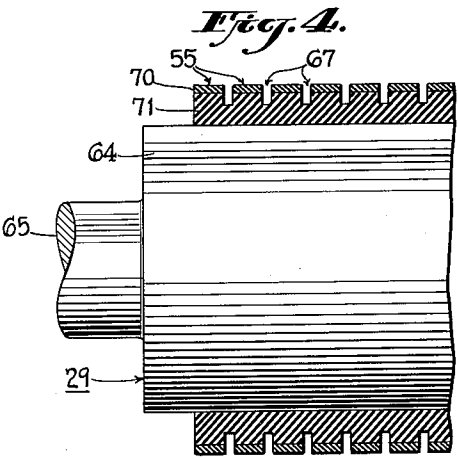
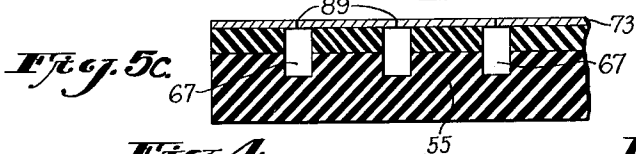
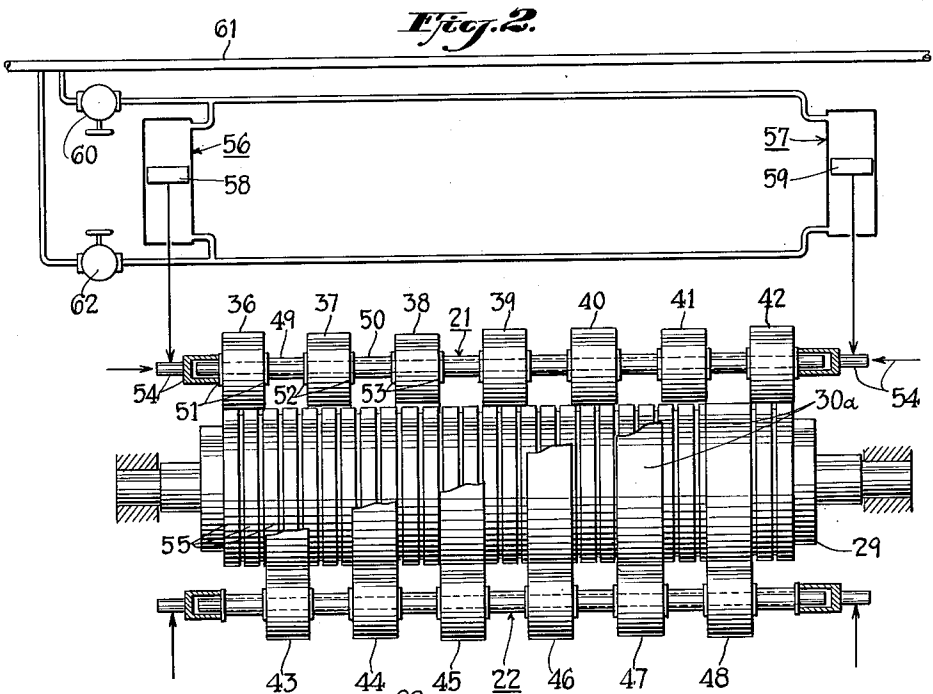
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Fig. 7.

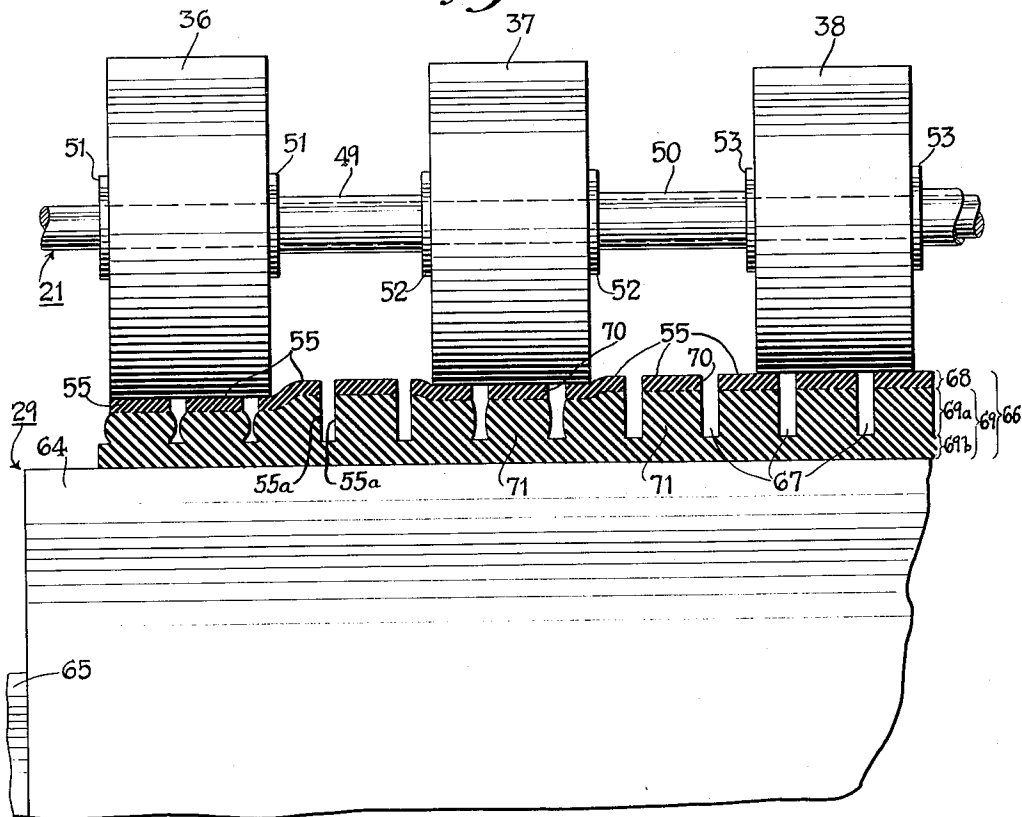
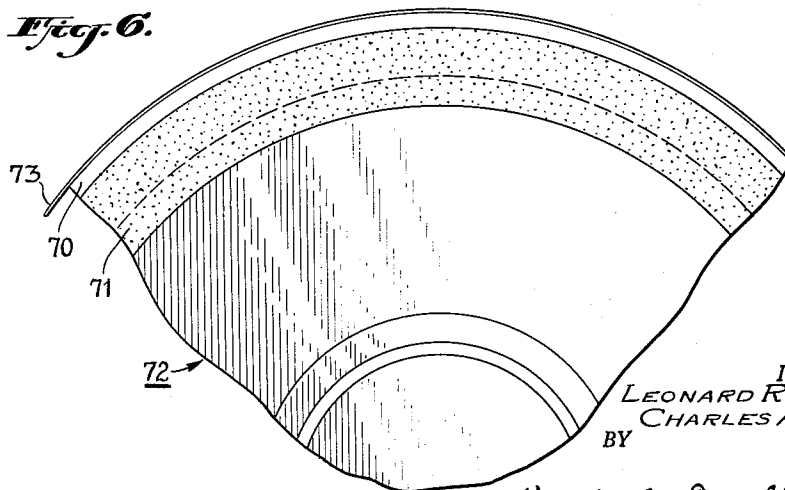


Fig. 6.



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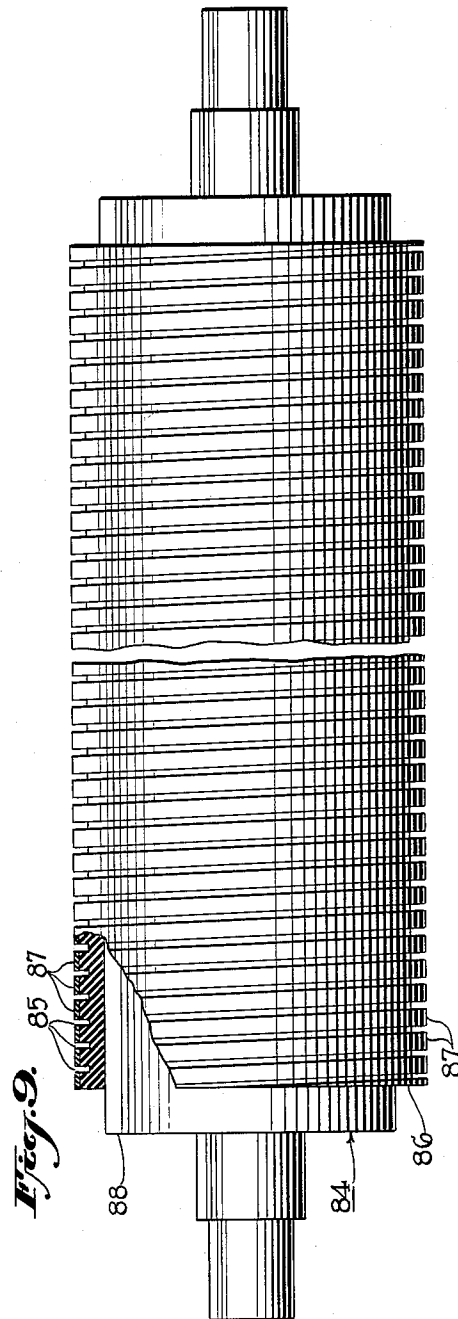
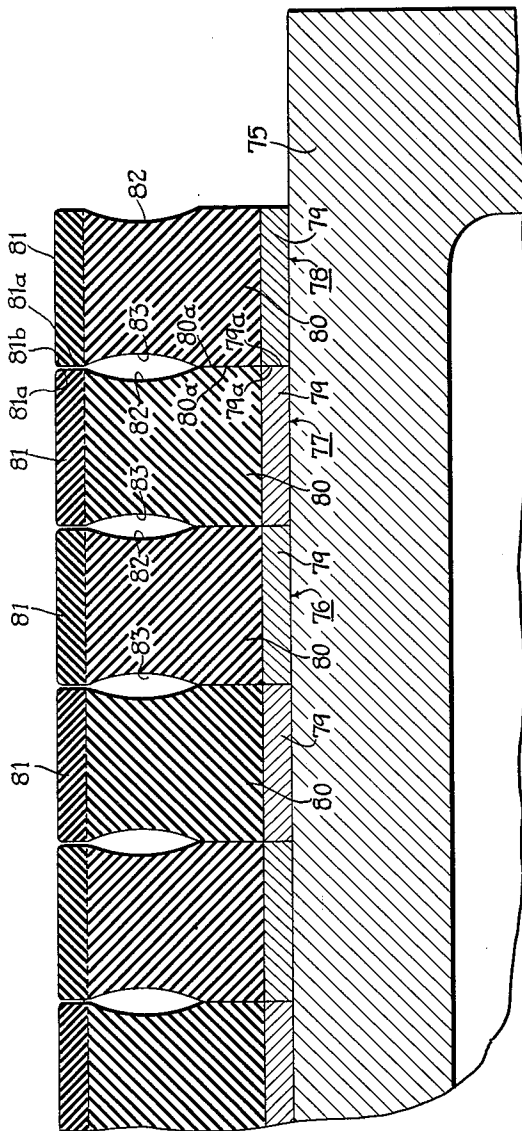
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2,985,398

ROLL REWINDING DEVICE

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8 Claims. (Cl. 242—65)

This invention relates to improvements in rewinding machines, and more particularly to improvements in slitting and rewinding machines for the purpose of insuring that all of a plurality of rewind rolls on a common rewind shaft, some being of slightly smaller diameter than others, are in peripheral engagement with a driven rotating drum referred to as a contact or platen drum, this being required for certain types of material for insuring the production of rewind rolls of satisfactory density and desired internal tension having adequately straight sides, such differences in diameter being due to variations in thickness across the width of a relatively wide web from a parent roll from which relatively smaller widths are slit for the formation of such rewind rolls.

It is, of course, important in such machines to maintain a careful control of those factors which provide in the rewind rolls a desired roll density, internal tension and other quality factors, such as straightness of roll edge or straightness of roll side.

In prior art slitting and rewinding apparatus substantial problems have arisen in controlling the quality of the rewind rolls due to such differences in rewind roll diameters occurring during rewinding, particularly in slitting and rewinding slippery material, usually of plastic.

In slitting and rewinding machines of this type a relatively wide web from a parent roll is caused to pass a slitting station where it is slit into a plurality of smaller widths. Such smaller widths in turn are caused to pass partially around the aforementioned contact or platen drum which is preferably driven at a constant speed. These smaller widths thence pass to the rewind rolls, all of which are desired to engage peripherally such platen drum, the rewind rolls being wound upon driven rewind shafts, that is, rewind shafts which are positively driven by torque exerted directly thereupon, such torque being referred to as center rewind shaft torque. Usually there are two such rewind shafts, each supporting its group of rewind rolls. Where two such rewind shafts are employed, the machine is referred to in the art as of the duplex type. However, certain features of this invention are useful in machines of other types. The reason why it is desirable for all of the rewind rolls peripherally to engage the contact or platen drum is that for certain types of material, as aforementioned, it has been found that all of such rolls should be subjected to a small peripheral contact pressure with the driven contact drum for the purpose of giving better control of the tension within the rewind rolls, the density thereof and the straightness of their sides.

When a machine of this type slits and rewinds a parent roll of a material which varies substantially in thickness across the width of the web it often happens that one or more of the rewind rolls on the same rewind shaft will be of larger diameter than the others and hence will prevent the smaller rewind rolls from peripherally contacting the contact or platen drum, and hence will deprive the smaller rolls of the benefits of what is known in the art as combined center rewind torque and periph-

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eral contact pressure with a driven contact drum which are needed for adequate quality control in the slitting and rewinding of many types of material.

The above disadvantage occurs in the prior art apparatus because the contact or platen drum thereof is usually of an unyielding nature, such as one made of steel.

It has been heretofore proposed to overcome this problem by employing what has become known as the differential slip drive (or differential slip disc drive) of the several rewind rolls which refers to driving means wherein each rewind roll is driven by a pair of parallel driven discs which press the roll therebetween. For example, each of the several rewind rolls upon a rewind shaft employing this drive will not depend for its center rewind driving torque upon an engagement with the rewind shaft per se but rather will depend upon a frictional engagement with its two side discs, one on either side, such discs being keyed to the rewind shaft for rotation therewith but capable of axial movement thereupon by virtue of such key engagement. Suitable sleeve means are employed for separating the several rewind rolls and suitable means are provided for exerting axial pressure upon such rolls, discs and sleeves of a selected intensity whereby the rewind rolls are driven by the frictional connection with such side discs. The rewind shaft, under these circumstances, is driven at a speed slightly in excess of the speed necessary to obtain a common peripheral velocity for the rewind rolls in contact with the platen drum, or the driven contact drum. The platen drum, as aforementioned, is normally driven at a constant speed by any suitable power means and the rewind shafts are driven at variable speeds which decrease as the rewind roll diameter increases. The drive and speed control means for said contact drum and rewind shafts may be similar to that shown and described in U.S. Patent No. 2,650,039, granted August 25, 1953, to Thomas N. Carter. The driving of the rewind shaft at a speed, as aforementioned, slightly in excess of that required, causes the side discs to slip slightly with respect to those rewind rolls which are in peripheral contact with the contact drum. However, less slippage occurs with respect to those rewind rolls which, due to their smaller diameter, are not in peripheral contact with the contact drum. Thus the failure of such smaller rewind rolls to contact the contact drum will cause such smaller rewind rolls to be driven at a slightly greater angular velocity than the larger rolls which in fact are in such peripheral contact. Such driving means having this differential in slippage at least partially compensates for the failure of the smaller of the rewind rolls to engage the contact drum peripherally. However, it has not adequately compensated for this defect and often the smaller of the rewind rolls which are out of contact with the contact drum at least part of the time are of unsatisfactory density, internal tension and quality of sides. The latter, for example, may not be entirely straight.

One of the objects of this invention is to overcome the above disadvantages or to reduce same to negligible proportions.

A further object is to provide novel contact or platen drum means having a flexible periphery which all of the rewind rolls can engage peripherally regardless of relatively small differences in the diameters of such rolls.

The invention, in a preferred form thereof, comprises broadly the combination of a platen or contact drum having a resilient and yielding surface instead of an unyielding one, a rewind roll shaft parallel to the drum, and means for urging together said drum and shaft whereby a relatively small force exerted by such means will cause all of the rewind rolls thereon, despite differences in their diameters, to engage peripherally the surface of the drum. Such drum preferably is constructed having a rigid core,

for example, of metal, but with a resilient covering of rubber or rubber-like material to permit the contact drum to yield in a radial direction in response to pressure acting on its surface. Thus where the contact or platen drum rotates upon a fixed axis, a relatively slight "in-pressure" acting upon the rewind roll shaft will cause all of the rewind rolls to engage the contact drum peripherally despite the differences in their diameters. There is thus obtained for all rolls the advantages of combined contact drive (due to peripheral contact with the driven contact drum) and the aforementioned "differential slip disc drive" (due to rewind torque applied directly to the rewind shaft and transmitted to the rewind rolls via the driven discs frictionally engaging each side of each roll). However, the invention is not limited to such differential slip disc drive for the rewind rolls.

The invention in another aspect thereof includes in combination, a rewind roll shaft adapted for the winding thereupon of a plurality of separate rewind rolls, a contact drum positioned for engagement with such rewind rolls during the winding thereof, the contact drum comprising a rigid shaft which supports a series of resilient annular surface elements positioned coaxially upon said shaft in axially spaced relation, the peripheral surfaces of such spaced annular surface elements being normally in coincidence with a single surface of revolution formed by moving a straight line about the axis of such contact drum while parallel thereto. Means are provided for urging together the rewind roll shaft and such contact drum whereby all the rewind rolls are caused peripherally to engage the contact drum despite differences in their diameters. The contact drum is usually mounted on stationary journals and the rewind roll shaft on movable journals. However, either or both of these parts may be urged toward one another by a force of selected intensity of sufficient strength to insure that the rewind rolls of smallest diameter engage the contact drum in a contact pressure of desired intensity.

This, of course, will cause the rewind rolls of larger diameter to engage the contact drum at a somewhat larger contact pressure, but not of an appreciable amount, whereby all of the rewind rolls ultimately have a substantially uniform density, internal tension and straight sides. This result is brought about by the local flexibility of the periphery of the contact drum at the region of peripheral contact with each individual rewind roll.

Further objects and advantages of the invention will more fully appear from the following description taken in connection with the accompanying drawings which show, by way of example, the present preferred form of the invention.

Referring to the drawings in which the same reference characters indicate the same parts in the various views:

Fig. 1 is a schematic perspective view of one form of apparatus embodying the present invention with certain parts omitted for clarity;

Fig. 2 is a plan view of certain principal parts of the apparatus shown in Fig. 1 and in addition means for urging together the rewind shaft and contact drum;

Fig. 3 is a perspective view of a contact drum embodying the present invention;

Fig. 4 is a fragmentary longitudinal cross-sectional view of the drum shown in Fig. 2;

Fig. 5 is a longitudinal cross-sectional view of a modified form of the drum shown in Fig. 3;

Figs. 5a and 5b are longitudinal fragmentary sectional views of further modified forms of the drum shown in Fig. 3;

Fig. 5c illustrates a portion of Fig. 5b on an enlarged scale.

Fig. 6 is a fragmentary transverse cross-sectional view on an enlarged scale of the contact drum shown in Fig. 5;

Fig. 7 is a fragmentary sectional view longitudinally of the axis of the contact drum showing the varying degrees of compression of the several resilient peripheral

sections of the contact drum while engaged by the rewind rolls of varying diameters;

Fig. 8 is a side elevation, partly in section and with parts broken away, of a further modified form of the contact drum embodying the present invention; and

Fig. 9 is a side elevation, also partly in section and with parts broken away, of a further modified form of a contact drum embodying the present invention.

This invention can be advantageously employed in the invention disclosed in our copending U.S. patent application Serial No. 498,809, filed April 4, 1955, now Patent No. 2,872,126, for Rewinding Machine.

Referring to Fig. 1, the apparatus comprises a slitting and rewinding device generally designated 20 which includes a pair of rewind shafts 21 and 22 which are respectively the front and rear rewind shafts. The front rewind shaft is supported by a pair of rewind arms 23 and 24 which at the inner ends thereof, that is, the lower ends as viewed in this figure, are mounted for angular movement about a fixed or primary axis, such inner ends of the arms for this purpose being mounted upon a pivot shaft 25 which is journaled for angular movement in the frame of the apparatus.

The rewind shaft 22 in turn is supported by a pair of rewind arms 26 and 27 which, at the inner ends thereof, are mounted upon a pivot shaft 28 which also is mounted for angular movement in suitable journals in the frame of the apparatus whereby said rewind arms 26 and 27 also are adapted for angular movement about a primary axis, namely, that of shaft 28.

The rewind shafts 21 and 22 are shown in lowered or operating relationship with respect to a contact or platen drum 29, partially about which passes the web material which is slit and thereafter wound into rolls of smaller width upon the rewind shafts 21 and 22.

Such web is designated by the numeral 30 and is drawn from a parent roll 31 from which it passes over an idler drum 32 and thence to a cutter drum 33 and thence to the contact or platen drum 29. A plurality of spaced coaxial slitter wheels 34 are pressed against the cutter drum 33, the web 30 being interposed therebetween whereby the web is cut into a plurality of smaller and preferably equal widths or subwebs 30a, alternate ones of which are re-wound upon the rewind shaft 21 and the others upon the rewind shaft 22 after passing partially around the contact drum 29.

In one form of the invention the contact drum 29 is driven at a constant speed by any suitable means, such as a motor 35, and the rewind shafts 21 and 22 are driven at variable speeds by suitable means (not shown), which speeds decrease as the rewind roll diameter increases. The drive and speed control means for the drum 29 and the shafts 21 and 22 may be similar to that shown and described in the aforementioned U.S. Patent 2,650,039.

There may be employed with the present invention the following systems which are similar to those shown in the above-mentioned copending U.S. patent application Serial No. 498,809:

(a) The system for counterbalancing the static weight of the arms for supporting the rewind shaft and also the weight of the rewind shaft;

(b) The system for counterbalancing the progressively increasing weight of the rewind rolls as their diameters increase during rewinding; and

(c) The system for counterbalancing the variable web pull torque (brought about by center rewind torque acting on each rewind shaft) against the belt pull torque (brought about by the drive belt for effecting such center rewind torque), both torques acting upon a support arm pivot axis. These systems are not described herein.

There is employed also in this invention suitable means for urging each rewind roll shaft toward the contact drum with sufficient force to cause all of the rewind rolls peripherally to engage the contact drum despite differences in the diameters of such rewind rolls, this being

possible because of the resilient surface of such drum as will appear hereinafter. Such means for urging together said drum and shaft are referred to as "in-pressure" means and the system for effecting this is referred to as the "in-pressure" system. If desired, such a system can be employed in this invention which is similar to the "in-pressure" system shown and described in the aforementioned U.S. patent application Serial No. 498,809.

For purposes of clarity there will be described below an "in-pressure" system for one of the rewind shafts, namely, 21.

Referring now to Fig. 2, there will be described the situation which exists when no special force is exerted upon the rewind shaft for the purpose of causing all of the rewind rolls to engage the contact drum, there being differences in the rewind roll diameters. However, in Fig. 7 there is a showing of the rewind shaft 21 upon which there is exerted sufficient "in-pressure" to cause all of the rewind rolls to engage the resilient periphery of the contact drum 29. The parent web 30 (Fig. 1) is subdivided into the subwebs 30a by means of the slitter wheels 34 and, as is well shown in Fig. 2, several of such subwebs are rewound on the rewind shaft 21 to form rewind rolls 36-42, and several other such subwebs are rewound upon the other rewind shaft 22 to form rewind rolls 43-48, inclusive.

Variations in caliper or thickness of such web 30 transversely thereof can produce the rewind rolls of varying diameter illustrated, by way of example, in Fig. 2. Thus certain of the rewind rolls on shaft 21 which are drawn from the thicker portions of the web, such as rolls 36, 39, 40 and 42, will be of slightly greater diameter than certain of the other rolls, such as 37, 38 and 41. Also, illustratively, certain of the rewind rolls on rewind shaft 22, such as rolls 45, 46 and 48, are of greater diameter than the rolls 43, 44 and 47, the larger rolls in this instance peripherally engaging the drum 29, whereas the rolls 45, 46 and 48 of smaller diameter are held out of such peripheral engagement by the action of the larger ones. The situation, as shown in Fig. 2, exists when all of the above-mentioned counterbalancing systems are in operation but when only a sufficient "in-pressure" upon the two rewind shafts is exerted to achieve a peripheral engagement of the rewind rolls of larger diameter with the contact drum.

The relative disposition of the rewind rolls and the contact drum exemplified by Fig. 2 has occurred in prior art apparatus of this general type by virtue of the fact that the contact drum has heretofore had an unyielding surface. When such an unyielding contact drum is used it would be undesirable or impossible to urge the respective rewind shafts toward the contact drum with sufficient force to cause all of the rewind rolls of all diameters to engage the drum periphery. Where certain of the rolls are held out of peripheral engagement with the contact drum during the rewinding due to the unyielding nature of such drum, rewind rolls are produced of wide variation in roll density, internal tension and some with unsatisfactory straightness of roll sides, all of which is undesirable. Consequently, the above-described differential slip disc drive has been suggested, which is known, and which does not comprise per se a part of this invention.

Referring to rewind shaft 21 (Fig. 2), such differential slip disc drive includes the following construction: Spacer sleeves, such as 49 and 50, are interposed between the rewind rolls, such as 36, 37 and 38, such sleeves embracing such rewind shaft. Keyed to the rewind shaft for being angularly driven thereby (but normally free to shift axially thereupon) are the above-mentioned pairs of side discs for each roll, such as discs 51 for roll 36, discs 52 for roll 37 and discs 53 for roll 38. By virtue of axial compression exerted upon such sleeves and discs by means schematically shown at 54, it will be seen that substantial frictional force will be exerted by such side

discs upon the cores for and the sides of the rewind rolls thereby to drive the rewind rolls in such a manner that, when the rewind shaft 21 is driven at a speed slightly in excess of the speed which will attain equal peripheral velocities of both contact drum and rewind roll, the side discs driving the rewind rolls in peripheral engagement with the contact drum can slip slightly relative thereto whereas the discs driving the smaller of the rewind rolls, such as 37, 38 and 41, will slip a relatively smaller amount because their rolls are not in peripheral engagement with the contact drum. Despite the use of such differential slip drive means with contact drums heretofore suggested having an unyielding surface, the quality of the rewind rolls has not been entirely satisfactory. To overcome this disadvantage the contact drum 29, as aforementioned, is provided with a resilient surface consisting of a plurality of resilient, coaxial annular sections 55 axially spaced from one another and having sides 55a. Such sections 55 provide local resilience at the area peripherally engaged by each of the rewind rolls in such a manner that the rewind rolls of larger diameter, under the influence of suitable "in-pressure," will compress the resilient annular sections which they engage in a sufficient amount to permit the rewind rolls having smaller diameter peripherally to engage the drum also.

As aforementioned, such "in-pressure" may be obtained by suitable adjustment of the "in-pressure" system described in the patent application Serial No. 498,809 or by adjustment of the "in-pressure" system schematically shown in Fig. 2 wherein power cylinders 56 and 57 are employed having pistons 58 and 59, respectively, which are operatively connected to opposite extremities of the rewind shaft 21 for urging same toward the contact drum 29 under the influence of: (a) the adjustment of a hand valve 60 which controls the flow of the pressure medium from a main line 61 to the uppermost pressure chambers of said cylinders 56, 57; and (b) the adjustment of a hand valve 62 for controlling the pressure from such line 61 to the lowermost of the pressure chambers in such power cylinders.

Analogous "in-pressure" means can be employed for the other rewind shaft 22.

The application of a suitable "in-pressure" will bring about the situation exemplified in Fig. 7 by the three rewind rolls 36, 37 and 38, all of which compress the resilient surface of the contact drum 29 in differing degrees because of their differing diameters.

Referring now to Figs. 3, 4 and 7, there will be described the details of construction of a preferred form of contact drum having the above-mentioned resilient, coaxially spaced annular sections 55.

The contact drum 29 embodying the present invention comprises a rigid core or inner drum 64 which in turn is mounted upon a shaft 65 which is journaled for rotation in suitable bearings (not shown). The rigid core 64 mounts the plurality of resilient coaxial annular sections 55 above mentioned. For the purpose of achieving a desired degree of durability of contact drum surface, together with radial resilience, the resilient annular sections 55 may be formed by covering the core 64 with an initially continuous layer of rubber or rubber-like material 66 (Fig. 7) in which a plurality of spaced coaxial grooves 67 are formed. In the form of Fig. 7 such grooves are of a depth less than the thickness of the layer 66, although the invention is not limited thereto. For example, as shown in Fig. 7, each of the annular resilient elements 55 is approximately $\frac{3}{8}$ inch in width as measured parallel to the axis of core 64 and is separated by approximately $\frac{1}{8}$ inch from the next element, it being understood again that the invention is not limited to these dimensions.

The innermost surface of the resilient layer 66 is bonded by well known means to the outer surface of the rigid core 64, the latter preferably being of metal.

We have found it desirable to form flexible layer 66

of two sublayers 68 and 69, the former being the outermost and the latter the innermost layer. The outermost layer 68 is substantially harder than the innermost. For example, we have found it desirable to form the layer 69 having a range of Durometer hardness between 20 and 40, and the outermost layer 68 having a range of Durometer hardness between 60 and 70.

In the formation of the novel contact drum 29, the layer 69 may be applied first to the core 64, and thereafter the layer 68 may be applied, said layers initially being continuous when so applied. Thereafter the layer 68, by virtue of its greater hardness, can be ground with accuracy to the desired diameter. Thereafter the grooves 67 can be formed to the desired depth by well known grooving means.

In those instances where the grooves 67 are not sufficiently deep to penetrate to the rigid core 64, it will be seen that the layer 69 (Fig. 7) will consist of an interrupted and grooved layer 69a and therebeneath a continuous or uninterrupted and ungrooved layer 69b. Thus each of the resilient coaxial annular sections 55 (Fig. 7) consists of an outer annular layer 70 comprising its respective part of the outermost and harder layer 68, and a portion 71 consisting of its respective part of the inner and softer layer 69.

Such resilient annular sections 55 are held in their spaced relationship by virtue of the bonding of the inner layer 69 to the core 64 and by the continuous inner layer 69b.

The annular sections 55 are spaced apart a sufficient distance to permit a transverse bulging thereof when compressed, as is well shown by the sections engaging the rewind roll 36 (Fig. 7).

Each of the elements 55 thus has a relatively hard surface for the purpose of resisting wear and also a relatively softer and resilient inner part to provide a desired resilient quality.

Reverting to Figs. 5 and 6, for the purpose of overcoming the tendency of the outer edges of the resilient elements 55 to mark the peripheries of the rewind rolls, we have found it desirable to employ the construction shown in such Figs. 5 and 6 wherein a contact drum 72 is employed which is identical in construction with that shown in Figs. 1-4 and 7 with the exception that a resilient overall and continuous sleeve-like covering 73 is employed therefor which tightly embraces same for the purpose of bridging the gaps between the coaxial resilient elements 55. The sleeve-like covering 73 can be of plastic or rubber or rubber-like material and is designed to accomplish the above purpose without altering the radial resilience of the roll. Sleeve 73 can be secured in place by a suitable adhesive.

Referring now to Fig. 5a, there is shown a further modified form of the contact drum, such drum being indicated at 74 and which is identical to that shown in Fig. 5 with the exception that the relatively harder outer annular portions 70 are omitted. Thus the layer 68 (Fig. 7) is omitted in forming such drum. Consequently, the flexible sleeve-like covering 73 embraces the axially spaced resilient annular portions 71 without the intervention of the relatively harder sections 70.

Referring now to Fig. 8, there is shown a modified form of the novel contact drum comprising a rigid core 75 upon which there is a peripherally grooved coaxially mounted resilient covering made up of a plurality of annular resilient surface sections or elements, portions of three of which are shown in cross-section at 76, 77 and 78. Each of these surface elements is composed of three annular subelements, namely, an inner metallic hoop or ring 79 which is mounted upon the rigid core 75 and which in turn mounts and is embraced by an inner or primary resilient subelement 80, the latter in turn mounting and being embraced by an outer or secondary resilient subelement 81, the latter being relatively harder than the former. For example, subelement 81 is prefer-

ably of a Durometer hardness within the range 60-70 and subelement 80 of a Durometer hardness within the range 20-40. Such surface elements as 76-78 are either conformed or spaced in such a manner that sides 81a of the subelements 81 are positioned close to but spaced from one another by a relatively very small interval, for example, .003 inch, this being for the purpose of minimizing tendency of outer edges 81b of the sides 81a to mark the peripheries of the rewind rolls.

In order to facilitate inward radial compression of each of such surface elements of Fig. 8, the opposite sides thereof are formed respectively with concavities, as at 82, 83. This is accomplished preferably by forming such concavities in the opposite sides of the subelements 80. Thus adjacent sides of each adjacent surface element are provided with adjacent concavities thereby permitting the resilient material of each surface element to bulge transversely as a result of radial compression thereof.

In the form shown in Fig. 8, each of the surface elements 76-78 is a separate entity and may be mounted upon the rigid core 75 by axially sliding and clamping same into place thereon. The inner rings 79 of such surface elements under these circumstances can be in consecutive engagement with one another. That is, such inner rings are in consecutive engagement along their adjacent side surfaces 79a, and if desired, adjacent inner annular side surfaces 80a of the subelements 80 also may be in engagement, the outer circumference of such annular surfaces 80a marking the inner boundary of the adjacent concavities 82, 83.

If desired, annular shims can be placed between the adjacent rings 79 for the purpose of adjusting the interval between the aforementioned sides 81a of the subelements 81.

Furthermore, it is desirable, although not mandatory, to round or fillet the outer edges 81b of the subelements 81 in order further to minimize the tendency of such edges to mark the rewind rolls.

Referring now to Fig. 9, instead of employing a plurality of axially spaced coaxial annular or ring-like resilient surface sections 55 covering the rigid inner core, such resilient surface can be in the form of a helix. The cross-sectional construction of the helix may be analogous to any one of the embodiments hereinbefore described. Thus instead of forming in the resilient surface of the contact drum a plurality of separate coaxial and spaced grooves, there may be substituted one or more helical grooves. For example, in the modified form of contact drum 84 (Fig. 9) exemplifying this embodiment, a single helical groove 85 is formed in resilient surface 86, such groove, for example, being analogous in depth to the grooves 67 of Fig. 7 and forming a single continuous helical resilient thread 87 which may be analogous in width and depth to the resilient section 55 of Fig. 7.

The drum 84 of Fig. 9, with the exception of its different form of groove and resilient section, can be constructed in a manner similar to that described for any of the previous embodiments of the contact drum.

If desired, the helically grooved contact drum of Fig. 9 can have attached thereto a flexible outer sleeve (not shown) analogous to the sleeve 73 of Fig. 5.

A single helical groove 85 formed in the resilient circumferential covering 86 of the contact drum 84 thus forms a helical thread 87 upon the rigid core 88 of the drum. The pitch of the thread in this particular form of the invention, if desired, can be equal to its lead although the invention is not limited thereto. Also, if desired, a plurality of coaxial helical threads can be formed in the surface of the drum 84, said threads starting at a common axial location along the length of the drum.

Referring to Fig. 5b, a contact drum construction is shown which is identical to that shown in Fig. 5 with the exception that the resilient outer covering 73, which is

firmly cemented to the outer surface of the resilient coaxial sections 55, has formed therethrough a plurality of coaxially spaced cuts or slits or divisions 89, each of which is located at the mid-point of the mouth of its respective groove 67. Such modified form of contact drum of Fig. 5b is generally designated at 90. Thus, the outer covering 73 is divided intermediate the opposite outer edges of the peripheral grooving of the resilient layer as shown in Fig. 5c. The spaced coaxial slits 89 provide greater radial flexibility and resilience to the outermost sleeve-like covering 73, such latter covering at the same time preventing marking of the peripheries of the rewind rolls which otherwise might be caused by the corners of such resilient sections 55. The slits 89 thus form a plurality of annular bands 73a, each of which overhangs on both sides its respective resilient section therebeneath. Alternatively, each band 73a can be individually applied to its respective resilient section.

It is, of course, possible to cover the helically grooved structure of Fig. 9 with a resilient continuous covering 73 in the manner shown in Fig. 5. And also such covering, as applied over the helically grooved surface, can be helically slit or cut along a helical path following the center of the helical groove.

The "in-pressure" exerted upon a rewind shaft is preferably not greater than a value required to obtain light peripheral pressure between the contact drum and the rewind roll of smallest diameter. However, if desired, such "in-pressure" may be of greater value under those special circumstances which require it, for example, when rewinding thick or stiff material.

In lieu of the system for mounting the rewind shafts shown in the above-mentioned U.S. patent application Serial No. 498,809, there may be employed in this invention, for example, the system for mounting such shafts disclosed in the copending U. S. patent application of Leonard Rockstrom Serial No. 599,969.

It is understood that the rewind rolls may vary in their relative diameters during the rewinding thereof, for example, one rewind roll may be relatively larger than certain others at the early portion of the rewind period and at a later portion it may be relatively smaller than the diameter of the others. Thus those rolls which are in peripheral contact with the contact drum may vary in identity from time to time during the slitting and rewinding period.

It will be noted that by employing a contact drum, such as that described above, it is possible to provide a high degree of durability and suitable radial resilience and that this is achieved by proper selection of the thickness of the resilient covering for the rigid core and by proper selection of the Durometer hardness of such resilient covering and also by allowing a suitable clearance or spacing between the circumferential segments which permits an adequate degree of bulging of the individual sections of resilient material to permit radial compression.

The novel apparatus herein described is particularly well adapted for the slitting and rewinding of slippery plastic materials which normally require peripheral engagement with the contact drum to achieve uniform density and straight edges at high winding speeds.

The present invention also has the advantage in that it enables the winding of rewind rolls of relatively uniform hardness (or softness) because the resilience of the surface of the novel contact drum does not produce excessive radial resistance to the rewind rolls as caused by varying depths of penetration of the rolls.

In addition to the advantages above mentioned, it is possible to drive all of a plurality of rewind rolls, despite differences in their diameters, by a combination of: (a) peripheral engagement with a driven contact drum, and (b) by the application of torque directly to the rewind shaft, and hence to attain a much softer rewind roll than is presently possible when winding against an unyielding contact drum. This is particularly desirable, for example,

when rewinding copper foil where it is necessary to maintain straight sides of the rewind roll (rewind roll edge alignment) by means of peripheral engagement with a contact drum and yet wind such rolls of sufficient softness to prevent fusing between adjacent layers of the material during subsequent operations.

The novel contact drum embodying the present invention is always driven by an external power source, such as the motor 35. However, it is not mandatory to apply a rewind torque to the rewind shafts. In the event that such a torque is applied to the rewind shafts, it may be transmitted to the rewind rolls either via the above-described differential slip disc construction or in lieu thereof may be transmitted directly to the core of each rewind roll without such disc interconnection.

What is claimed is:

1. In a rewinding machine, the combination including a rewind roll shaft on which a plurality of coaxial rewind rolls are to be wound, a cylindrical contact drum parallel to such rewind shaft and positioned for engaging such rewind rolls during the rewinding thereof, said contact drum comprising a rigid core embraced circumferentially by a resilient covering of rubber-like material, said resilient covering having formed therein axially spaced and coaxial grooving which divides said covering into resilient annular section means, the peripheral surface of such contact drum thus being resilient and normally in coincidence with a single surface of revolution formed by moving a straight line about the axis of such drum, means for driving said contact drum, and means for urging said shaft and drum toward one another with a force adequate to cause the rewind roll of smallest diameter upon said rewind shaft peripherally to engage the surface of said contact drum, the surface of such drum in engagement with the rewind rolls of relatively larger diameter being resiliently compressible radially inwardly by an adequate degree to permit such engagement by said roll of smallest diameter the sides of said resilient annular section means bulging transversely thereof in response to inward radial compression, the dimensions of such grooving being selected to permit such transverse bulging without adjacent bulges during operation pressing upon one another thereby to inhibit further bulging.

2. A machine in accordance with claim 1 including a continuous sleeve-like covering of resilient material embracing said first-mentioned covering.

3. A machine in accordance with claim 1 including a sleeve-like outer covering of resilient material embracing said first-mentioned covering, said sleeve-like outer covering being peripherally divided or cut intermediate the opposite outer edges of said coaxial grooving which divides said covering as aforementioned into resilient annular section means, such peripheral division or cutting of said outer sleeve-like covering thereby forming in same, and with respect to each division or cut, a pair of adjacent side surfaces extending substantially radially of said contact drum.

4. In a winding machine, the combination including a roll shaft on which a plurality of coaxial rolls are to be wound, a cylindrical contact drum positioned for engaging such rolls during the winding thereof, said contact drum comprising a rigid core embraced circumferentially by a covering of resilient material, said resilient covering being circumferentially grooved, such grooving dividing said covering into resilient annular sections, means for driving said contact drum, and means for urging said shaft and drum toward one another with a force adequate to cause the roll of smallest diameter upon said roll shaft peripherally to engage the surface of said contact drum, the sides of said resilient annular sections being bulgeable transversely thereof in response to inward radial compression, the dimensions of such grooving being selected to provide adequate space between adjacent bulges thereby to avoid inhibiting in any substantial degree the compres-

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sion of said annular sections by virtue of adjacent bulges pressing against one another.

5. A machine in accordance with claim 4 including a continuous sleeve-like covering of resilient material embracing said first-mentioned covering.

6. A machine in accordance with claim 4 including a continuous sleeve-like outer covering of resilient material embracing said first-mentioned covering, said sleeve-like outer covering being peripherally divided intermediate the opposite outer edges of each adjacent pair of said resilient annular sections, such division of said sleeve-like outer covering thereby forming in same, and with respect to each such division or cut, a pair of adjacent side surfaces extending substantially radially of said contact drum and in contact with one another.

7. In a winding machine, the combination of a rewind roll shaft on which sheet material is to be wound in a plurality of spaced apart coaxial rewind rolls, a cylindrical contact drum substantially parallel to said rewind shaft and positioned for engagement with such rewind rolls during the rewinding thereof, said contact drum comprising a rigid core embraced by a resilient outer covering, said resilient covering being circumferentially grooved, the width of the grooving being selected to

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allow transverse bulging of the portions of the covering between such grooves and without adjacent transversely bulging portions inhibiting in any substantial degree the compression of such portions resulting from their compressing against one another, power means for rotating said contact drum, and means for urging said shaft and drum together whereby all of said rewind rolls are in peripheral engagement with said contact drum despite differences in diameter of such rolls.

8. A machine in accordance with claim 7 including a continuous sleeve-like covering of resilient material embracing said first-mentioned covering.

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