

[72] Inventor **Horst Muensterer**
 Oklahoma City, Okla.
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[73] Assignee **Alcan Research and Development Limited**
 Montreal, Quebec, Canada

[54] **WEB-WINDING APPARATUS**
 10 Claims, 4 Drawing Figs.

[52] **U.S. Cl.**..... **242/55,**
 242/67.1
[51] **Int. Cl.**..... **B65h 75/02**
[50] **Field of Search**..... **242/55, 56,**
 56.1, 56.2, 56.6, 56.9, 64, 65, 66, 67.1, 67.2, 67.3,
 67.4, 67.5, 76

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Primary Examiner—**Stanley N. Gilreath**
Assistant Examiner—**Werner R. Schroeder**
Attorneys—**Christopher C. Dunham, Robert S. Dunham, P. E.**
 Henninger, Lester W. Clark, Gerald W. Griffin, Howard J.
 Churchill, R. Bradlee Boal and Robert Scobey

ABSTRACT: In apparatus for winding a web (e.g. of metal foil or the like) on a rotating reel, an ironer assembly for smoothing the web as it is added to the reel, including an ironer roll which rides on the reel, a pivotally suspended frame larger in mass than the ironer roll, and springs under compression between the frame and roll for resiliently supporting the frame on the roll, so that the weight of the frame augments the pressure exerted by the roll on the web.

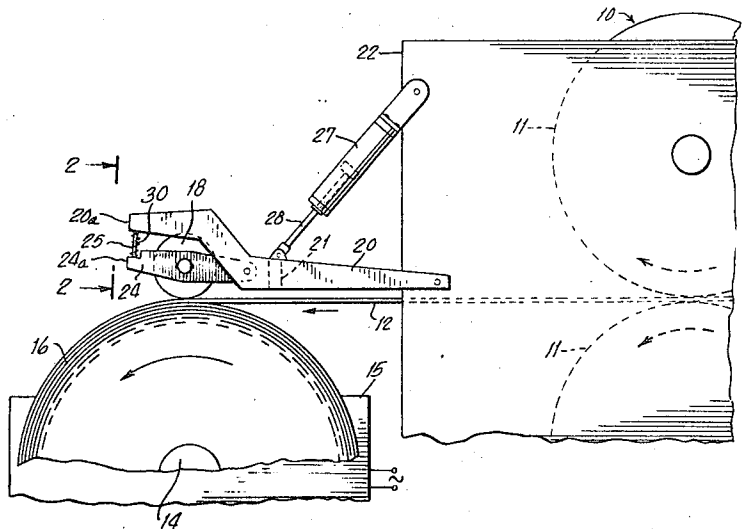


Fig. 1.

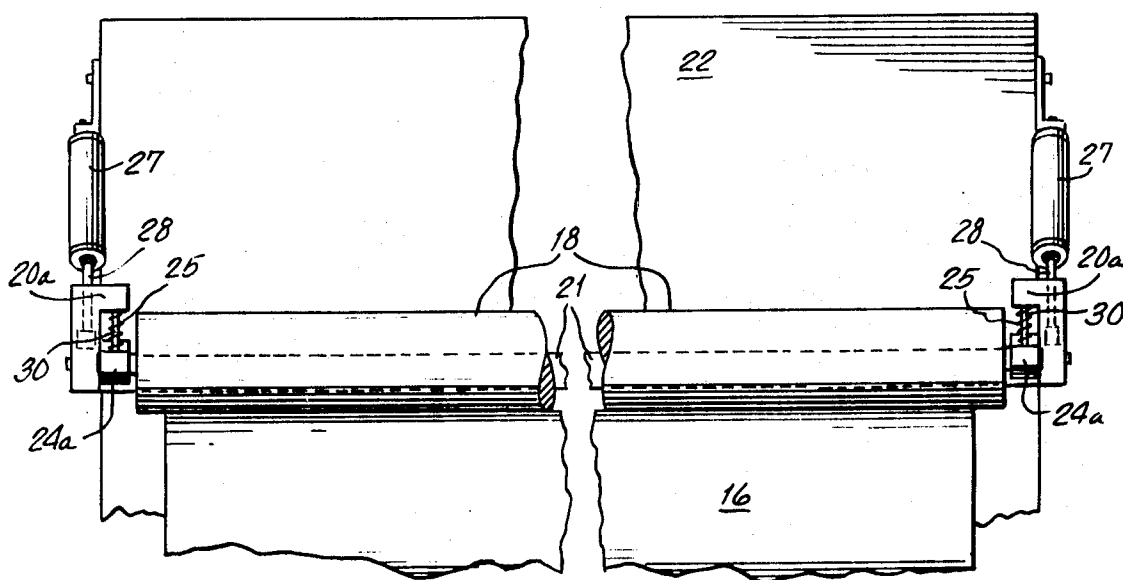
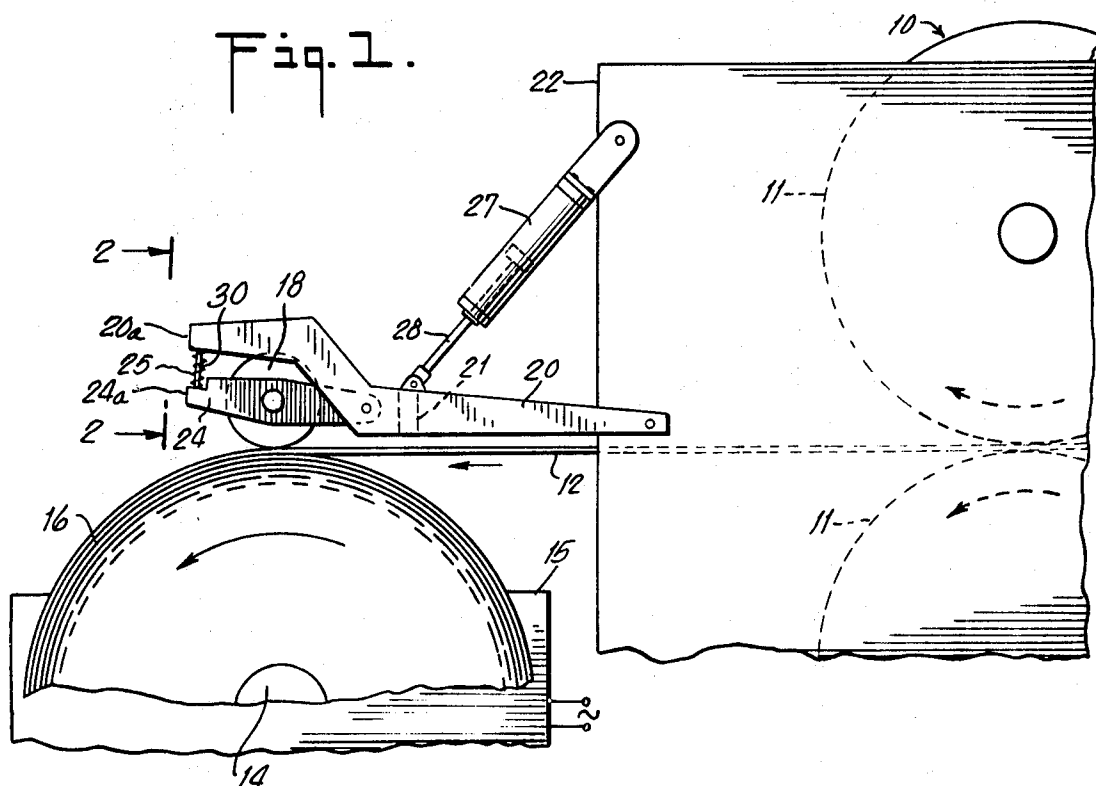


Fig. 2.

INVENTOR.
HORST MUENSTERER
BY
Christopher C. Quaban
ATTORNEY

Fig. 3.

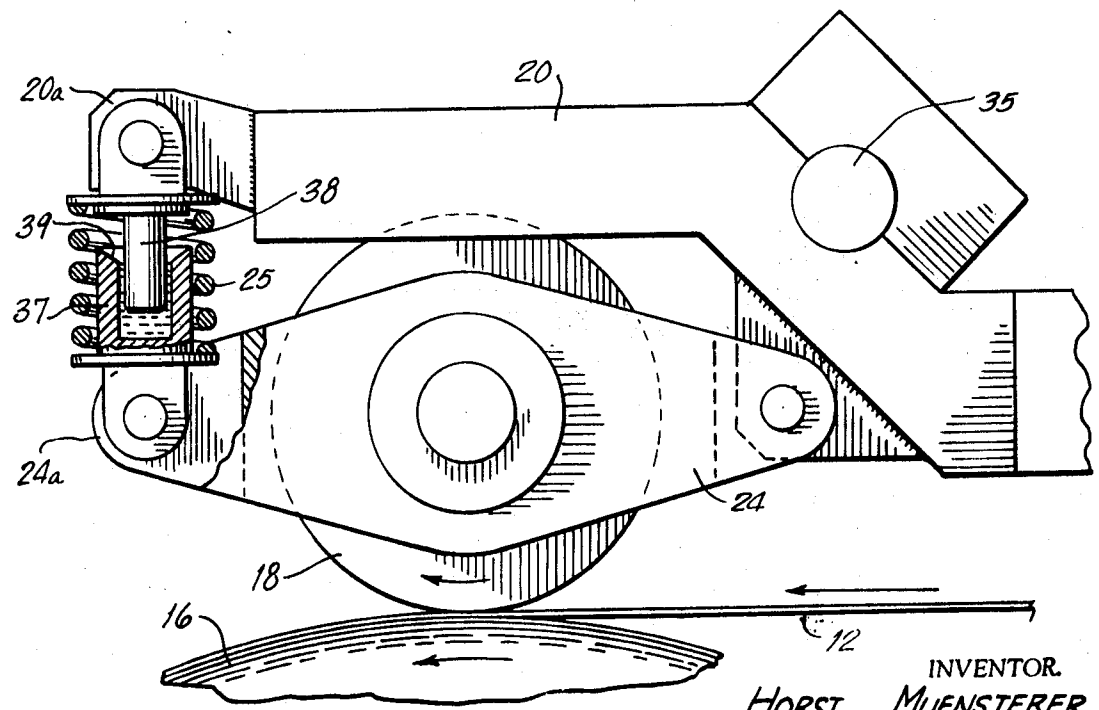
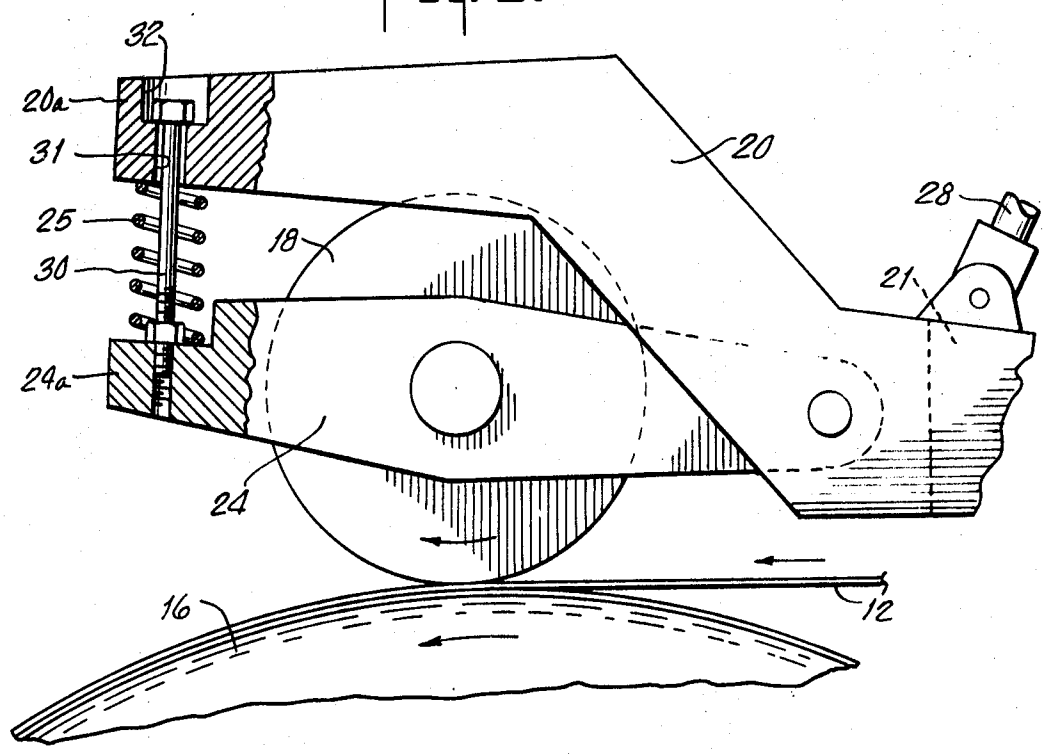


Fig. 4.

INVENTOR.
HORST MUESTERER
BY
Christopher C. Dredman
ATTORNEY

WEB-WINDING APPARATUS

BACKGROUND OF THE INVENTION

This invention relates to web-winding apparatus and in particular to a new and improved ironer assembly for smoothing a web as it is wound onto a reel. In one important specific aspect, the invention is directed to foil-winding apparatus incorporating such assembly.

Many industrial operations involve the winding of an elongated web of flexible sheet material onto a reel. A common requirement, in such operations, is that the coil of web material be smoothed as it is wound. Stated broadly, the present invention is applicable to web-winding equipment generally, e.g. in winding webs of such materials as paper, plastic, films of various types, and even woven fabrics, as well as metal foils and the like. However, for purposes of illustration the invention will be described herein with reference to the winding of metal foil, and specifically aluminum foil, i.e. foil fabricated of aluminum metal or alloys thereof.

In a typical aluminum foil-rolling mill, the foil emerges from the rolling operation at a very high linear speed and is power wound on a spool at an equal linear rate, in order to form a coil or reel of the foil for storage. The foil, in order to be acceptable commercially, must be essentially completely free of surface imperfections such as wrinkling, creasing, and other nonuniform bending of the foil web. To this end, conventional foil-winding apparatus includes an ironer roll which rides on the reel surface near the point of tangency between the rotating reel and the approaching web of foil. The pressure exerted by the ironer roll, in conjunction with the winding tension produced in the foil web by the powered takeup of the rewind spool, smooths the foil as it is wound onto the reel and builds a uniform, dense coil.

Ironer rolls as heretofore employed have been relatively large in mass so as to provide adequate pressure for smoothing the foil and eliminating air that might otherwise be trapped in pockets between a newly added layer of foil and the previous bed of layers in the reel. While use of an ironer roll is very important for attainment of proper smoothness of the foil, it is found in many cases that the ironer roll itself may cause wrinkling of or other damage to the foil being wound, unless special care is taken and relatively low winding speeds are used. Such limitation of foil winding rate impairs the efficiency of the foil-producing operation.

One significant specific cause of damage to foil layers by an ironer roll is the variable dynamic force that may be imposed on the roll, in a direction radial to the reel, by eccentricity of the reel. Ordinarily, a reel of aluminum or other metal foil being wound develops some degree of eccentricity, and as the reel rotates this eccentricity imparts acceleration to the ironer roll (riding on the reel surface) in a direction radial to the reel and at the frequency of reel rotation. In other words, each time the reel rotates, the ironer roll moves radially away from and then back toward the reel axis, tending to bounce on the reel, as the eccentricity or "bulge" of the reel passes the ironer roll; consequently, the force exerted by the ironer roll on the reel is not constant but varies in magnitude during each rotation of the reel. Especially at high winding speeds, this variable dynamic force may become large enough to cause telescoping of or other damage to the foil layers on the reel, and hence may necessitate use of undesirably low winding rates. Such development of a variable dynamic force of destructive magnitude exhibits characteristics of a resonance phenomenon, in that it is encountered specifically at particular rates of reel rotation.

Another difficulty sometimes encountered is that the ironer roll may undergo a wobbling motion of its ends about its center of gravity in the vertical plane containing its axis; this type of vibration produces rapid telescoping of, and consequent serious damage to, the reel. Still another cause of damage to foil by ironer rolls is the so-called backlash phenomenon which occurs when the reel is decelerated by

braking as may be necessary during or at the conclusion of the winding operation. Although the relatively massive ironer roll normally rotates with a surface velocity equal to that of the reel surface, the momentum of the roll may cause it to run at a faster rate than the reel upon deceleration of the reel. This difference in velocity loosens the outer layers of foil on the reel, causing wrinkling or other damage thereto.

The foregoing problems are especially critical for the winding of metal (e.g. aluminum) foil, owing to the particular properties of foil. However, undesired modes of ironer roll motion such as those discussed above may also create problems in the winding of other types of web material, i.e. when an ironer roll is used to smooth the foil of web being wound.

SUMMARY OF THE INVENTION

An object of the present invention is to provide in web-winding apparatus, a new and improved ironer assembly enabling operation at advantageously high winding speeds without damage to the web being wound. Another object is to provide web-winding apparatus having an ironer assembly including an ironer roll, wherein web-damaging modes of ironer roll motion are minimized. A further object is to provide such apparatus wherein the variable dynamic force imposed on the ironer roll by reel eccentricity is advantageously reduced as compared to the force thus imposed in conventional winding apparatus. A still further object is to provide such an ironer assembly in apparatus for winding metal foil at relatively high speed.

To these and other ends, the present invention contemplates improvements in web-winding equipment of the type including rotatable means for accepting wound layers of web material, means for rotating the rotatable means so as to wind the web thereon to constitute a reel or coil of layers, and an ironer roll rotatably adapted to ride by the force of gravity against, and to exert pressure on, the outermost layer of the web on the reel. The improvement in accordance with the invention broadly comprises the provision of a body having a mass substantially greater than the mass of the ironer roll; means for movably connecting the ironer roll to the body; including resilient means acting between the body and the ironer roll, disposed and arranged so that relative movement of the body and the ironer roll effects resilient deformation of the resilient means, for supporting the body on the ironer roll and transmitting to the body motion of the ironer roll occurring in a direction that is radial with respect to the reel; and means for restraining the body for movement along a path so disposed that the ironer roll rides against the outermost layer of the web on the reel and the weight of the body acts on the ironer roll through the resilient means to augment the pressure exerted by the ironer roll on the outermost layer of the web.

In an exemplary embodiment of the invention, the aforementioned body constitutes a frame structure pivotally mounted above the reel, and the ironer roll is pivotally suspended by rocker arms from this frame structure, while the resilient means constitutes a pair of springs under compression between the frame structure and the rocker arms holding the ironer roll. Auxiliary means may also be included for damping relative motion of the ironer roll and the body (i.e. the frame structure) toward each other, and/or for limiting the extent of relative separation of the ironer roll and the body. Very preferably the mass of the aforementioned body or frame structure is at least about two times the mass of the ironer roll.

In this arrangement of elements the pressure exerted by the ironer assembly on the reel being wound is determined by the mass of both the ironer roll and the body or frame structure resiliently supported thereon, since the body bears on the reel through the connecting resilient means and the ironer roll. However, the magnitude of the variable dynamic force imposed on the ironer roll by reel eccentricity is a function of the ironer roll mass. The mass of the ironer roll itself may be relatively small as compared to conventional ironer rolls heretofore used, because as stated, the larger mass body contributes

to the ironing pressure. This reduction in ironer roll mass, together with the resilient connection between the ironer roll and the larger mass body, very significantly reduces the variable dynamic force imposed on the ironer roll by reel eccentricity (as compared to the force thus imposed in conventional winding equipment) and hence minimized likelihood of damage to the web resulting from such force at any given winding speed.

In other words, the structure of the present invention permits reduction in ironer roll mass without concomitant reduction in ironing pressure. The reduced ironer roll mass, and consequent lowering of inertia of the ironer roll, also minimizes other undesired and potentially deleterious modes of ironer roll motion.

While the invention is broadly applicable to the winding of a wide variety of web material, i.e. continuous webs of materials such as paper, plastics, films of various types, and woven fabrics, in one important specific aspect the invention is embodied in apparatus for high-speed winding of a continuous web of metal foil. It is found that the ironer assembly of the invention is especially effective in avoiding undesired modes or ironer roll motion, and the damage to foil associated therewith, at advantageously high foil-winding speeds in such apparatus.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a simplified schematic side elevational view of foil rolling and winding equipment incorporating the structure of the invention in an illustrative embodiment;

FIG. 2 is a fragmentary front elevational view taken along the line 2—2 of FIG. 1;

FIG. 3 is an enlarged side elevational detail view, partly in section, of the ironer assembly of the FIG. 1 apparatus; and

FIG. 4 is a view similar to FIG. 3, showing a modified embodiment of the invention.

DETAILED DESCRIPTION

The invention will be particularly described, by way of illustration, as embodied in apparatus for winding aluminum foil, it being understood, however, that the invention may also be used in winding other metal foils and other types of continuous webs.

Referring first to FIGS. 1—3, the invention in the embodiment there illustrated is incorporated in generally conventional foil rolling and winding equipment including a foil-rolling mill represented schematically at 10, wherein sheet aluminum is reduced to foil thickness by passage between successive pairs of arrays of rolls 11. From the mill, a continuous web 12 of aluminum foil advance to an axially horizontal rotatable spool 14 for accepting wound layers of foil. The spool 14 for accepting wound layers of foil. The spool 14 is rotated by a motor drive 15 so as to wind the foil on the spool to constitute a reel or coil 16 or foil layers for subsequent storage, shipment or other handling.

An ironer roll 18, journaled at its ends for rotation about its longitudinal axis, is disposed in axially parallel relation to the spool 14 and in contact with the top surface of the reel 16 near the point of tangency between the reel and the approaching foil web 12. This roll 18 rides by the force of gravity against, and exerts pressure on, the outermost layer of foil on the reel, being rotated by frictional contact with the motor-driven reel.

In accordance with the invention there is provided a body or frame structure having a mass substantially greater than the mass of the roll 18 and comprising (in the embodiment of FIGS. 1—3) a first pair of relatively massive rocker arms 20 disposed above, and respectively on opposite ends of, the reel 16. The rocker arms may be rigidly interconnected by a horizontal cross member 21. Each of these rocker arms is pivotally mounted at one end on a fixed frame 22 positioned on the side of the reel 16 from which the foil advances to the reel. The pivotal mounting of the rocker arms 20 is such that both arms pivot about a common horizontal axis parallel to

the axis of the spool 14, and extend generally horizontally from the frame 22 toward the reel in parallel relation to each other.

A second and shorter pair of rocker arms 24 are respectively pivotally secured to the rocker arms 20 for pivotal movement about a common horizontal axis parallel to the axis of spool 14, at localities intermediate the pivoted ends and the outer or free ends of the rocker arms 20. The outer end 24a of each of the arms 24 underlies the outer end 20a of the arm 20 on which it is mounted. The rocker arms 24 constitute the mounting for the ironer roll 18, which has its opposite ends respectively journaled in the two arms 24.

Two helical springs 25 are respectively disposed between the ends 20a of the arms 20 and the ends 24a of the arms 24. Each of these springs 25 is under compression between the end 20a of one of the arms 20 and the subjacent end 24a of the arm 24 mounted on that arm 20. These springs 25 support the arms 20 on the ironer roll 18 (the weight of the arms 20 being transmitted to the roll 18 through the springs 25 and thence through the arms 24), and transmit to the arms 20 any motion of the ironer roll occurring in a direction that is radial with respect to the reel 16; the springs are so disposed and arranged that relative movement of the arms 20 and the ironer roll 18 effects resilient deformation of the springs. In combination with the pivoted rocker arms 24, the springs constitute means for movably connecting the ironer roll to the arms 20.

It will be understood that the described ironer assembly including the roll 18, arms 20 and 24, and springs 25 is restrained by the fixed frame 22 and the pivotal connection of arms 20 thereto, for movement along a path so disposed that the ironer roll 18 rides against the outermost layer of foil on the reel 16 and the weight of the arms 20 acts on the ironer roll through the springs 25 to augment the pressure exerted by the ironer roll on the outermost layer of foil on the reel.

As shown, means comprising a pair of adjustable fluid-actuated cylinders 27 mounted on the fixed frame 22 and having a pair of pistons 28 respectively connected to the two arms 20 may be provided for exerting a lifting force on the arms 20, i.e. when operated by suitable conventional control means (not shown), to reduce the pressure exerted by the roll 18 on the reel 16 and/or to raise the ironer assembly above the reel upon completion of a foil-winding operation. Also, means may be provided for limiting the extent of relative separation of the outer ends of arms 20 and 24, to partially precompress the springs and restrict the permitted amount of spring relaxation. This limiting means is shown in FIGS. 1—3 as a pair of bolts 30 respectively threaded in the ends 24a of the two arms 24 and projecting upwardly therefrom into bores 31 in the ends 20a of the arms 20, with the heads of the bolts received in enlarged upper portions 32 of the bores. The bolts are slidable within the bores, which are so shaped as to permit free upward movement of the bolts (i.e. corresponding to motion of the arms 24 toward the arms 20) but to limit downward movement of the bolts and thereby to restrict displacement of the arms 24 away from the arms 20. The maximum permitted separation of the arm ends 20a and 24a may be varied by lightening or loosening the bolts in the ends 24a.

In the operation of the described apparatus, a web 12 of foil produced in the mill 10 advances from the mill at a constant and relatively rapid linear speed toward the spool 14 on which it is to be wound. The spool is positively driven to wind up the foil web into a reel 16 of foil layers, being rotated in such manner that the external surface speed of the reel is constant and equal to the speed of the advancing web 12. Thus, as successive foil layers build up in the reel 16, increasing the reel diameter, the angular velocity of the reel is decreased as necessary to maintain this constant surface speed.

As the reel is wound, the ironer roll 18, riding by gravity against the outermost foil layer on the reel, is rotated by its frictional contact with the reel at the same surface velocity as the reel outer layer. The ironer roll presses downwardly on this outer foil layer with a force augmented by the weight of the rocker arms 20 as transmitted to the ironer roll 18 through

the springs 25; this pressure, together with the tension imparted to the foil web 12 by the powered drive of the spool 14, serves to smooth the newly added foil layer on the reel.

Usually, as the winding operation proceeds, the reel 16 develops some degree of eccentricity i.e. some variation in radial thickness from point to point around its periphery. Each time the bulge or eccentric portion of the reel passes the ironer roll, the ironer roll moves first upwardly and then downwardly in a direction that is radial with respect to the reel. In other words, the eccentricity of the reel effects a periodic acceleration and consequent oscillation of the ironer roll; as a result, a variable dynamic force is imposed on the ironer roll at a frequency determined by the angular velocity of the reel.

The magnitude of the variable force thus imposed on the roll 18 is a function of the mass of the roll. Owing to the fact that in the present structure, the weight of the arms 20 as well as the weight of the roll contributes to the pressure exerted by the roll on the reel surface, the mass of the ironer roll itself in this structure may be made very substantially smaller than that of a conventional ironer roll as heretofore used, without diminution of the pressure applied by the roll to the outermost foil layer on the reel. This decrease in ironer roll mass, together with the energy-absorbing effect of the resilient connection of the ironer roll to the larger mass represented by arms 20, very significantly lessens the variable dynamic force imposed by the reel eccentricity on the ironer roll, even at high winding speeds, and thus enables use of fast and efficient winding speeds without danger of damage to layers of foil on the reel by the ironer roll. In other words, this reduction in variable force is achieved because the present ironer assembly is a resiliently linked two-mass system rather than a rigid single mass. The springs 25 are selected to have a stiffness such that the resonance frequency of the assembly is substantially above the frequency of oscillation of the ironer roll by the eccentric reel.

The reduction in ironer roll mass permitted by the ironer assembly of the present invention also aids in avoiding development of other undesired modes of ironer roll motion. For example, whereas a conventional ironer roll sometimes tends to wobble about its center of gravity in a plane containing its longitudinal axis, with resultant telescoping of and damage to foil layers on the reel, such wobbling tendency is markedly decreased in the present structure because the mass, and consequently the inertia, of the ironer roll 18 is substantially lower than that of a conventional ironer roll. Again, the tendency of a conventional ironer roll to rotate with a faster surface speed than the reel during deceleration of the reel — owing to the momentum of the ironer roll — is lessened or even completely avoided when a relatively low mass ironer roll (with concomitantly reduced momentum) is used in the present structure. In many instances, this obviates the need to provide special brakes to slow the ironer roll upon braking deceleration of the reel.

For optimum realization of the advantages of the invention, especially with respect to minimization of variable dynamic force imposed on the ironer roll by reel eccentricity, the larger mass body or frame structure represented by arms 20 should have a mass equal to at least twice that of the ironer roll. It will be understood that as herein referred to, the mass of the body or frame structure is that part of the total mass of the ironer assembly which bears downwardly on and compresses the springs 25, while the mass of the ironer roll is the remainder of the total ironer assembly mass (i.e. including the ironer roll, and also portions of its mounting) bearing against the reel 16. Stated in other words, the ratio of the mass of the frame structure to the ironer roll mass, as defined above, should be at least 2:1; a convenient range of values for this mass ratio is that between about 2:1 (preferably at least about 3:1 and about 4:1, the latter value constituting a practical or preferred upper limit for that mass ratio).

In addition, the ironer roll itself should be made as light as possible, consistent with provision of adequate structural

strength for the roll, to minimize the ironer roll mass. However, since structural considerations (in particular, the requirement of adequate strength for the roll) impose a practical lower limit on the magnitude of the ironer roll mass in the present ironer assembly, the total weight of the assembly may in some instances have to be so large — in order to satisfy the minimum or optimum mass ratio values set forth above — that it would exert excessive pressure on the reel. In such case, the cylinders 27 may be operated to partially unload the ironer roll (i.e. to partially support the frame structure mass), thereby reducing the pressure on the reel to an acceptable value. This unloading of the ironer roll does not impair the effectiveness of the system in minimizing variable dynamic force on the ironer roll, because the oscillating masses remain unchanged.

A modified embodiment of the invention is illustrated in FIG. 4. In this embodiment, again, the ironer assembly includes an ironer roll 18 riding on a reel 16 of foil layers, and rocker arms 20 and 24 with springs 25 under compression between them all arranged as in the embodiment of FIGS. 1-3 described above. In the structure of FIG. 4, there is included a crosspiece 35 rigidly interconnecting the two arms 20 and constituting part of the large mass body or frame structure that bears downwardly on the springs 25. The embodiment of FIG. 4 further includes damping means acting between the frame structure mass and the ironer roll mass, and comprising a pair of hydraulic cylinder and piston arrangements acting between the arm ends 20a and 24a for damping motion of the arm ends 20a toward the arm ends 24a, i.e. for damping relative motion of the frame structure and ironer roll toward each other especially in the case of severe vibrations. As shown, each of the arm ends 24a bears upwardly opening cylinder 37, disposed concentrically within the spring 25, and each of the arm ends 20a bears a plunger or piston 38 projecting downwardly into the cylinder 37 on the subjacent arm end 24a and cooperating therewith to constitute a damping system. The cylinders and pistons are (as shown) pivotally mounted on the respective arm ends so as to maintain proper vertical alignment with each other despite minor variation in angular orientation of the arms 20 and 24.

Specifically, each cylinder 37 has an upwardly opening central bore slightly larger in diameter than its associated piston 38, so that there is some degree of clearance between the piston and the central bore wall. Also, each of the cylinders has a bevelled upper lip 39 that taper downwardly into the cylinder bore.

For an understanding of the operation of this damping means, it may be explained that foil rolling and winding apparatus conventionally includes means (not shown) for providing a spray of coolant liquid such as water to the foil in a manner providing spray of the liquid in the vicinity of the reel, i.e. at and around the surface of the reel being wound. The cylinders 37, with their upwardly opening bevelled lips, collect some of this spray, which accumulates in the cylinder bores and serves as the hydraulic fluid therefor. In other words, the clearance between the pistons and the cylinder bore walls is sufficient so that the cylinder bores are maintained filled with roll coolant accumulating from collected spray and condensation. Downward movement of the pistons into the cylinders (incident to relative movement of the arm ends 20a and 24a toward each other) displaces the hydraulic fluid upwardly into the spaces between the pistons and cylinder bore walls; the clearance between pistons and cylinders is small enough so that this fluid displacement dissipates energy in the case of a severe vibration (e.g. imparted to the ironer roll), thereby providing the desired damping effect.

When the invention is used in equipment for winding other types of webs (i.e. webs of materials other than metal foil) similar damping means maybe employed, but in such cases there is ordinarily no coolant supplied to the coil, and hence no circumambient spray to provide hydraulic fluid for the cylinder. In the absence of a supply of coolant spray, the damping means may be an enclosed hydraulic damping device

(cylinder and piston system) containing a confined hydraulic fluid, but generally arranged for cooperation with the ironer roll and frame structure in the same manner as shown in FIG. 4.

By way of further illustration of the invention, reference may be made to the following comparison between use of a typical conventional ironer roll and use of an exemplary ironer assembly embodying the invention, with an aluminum foil reel having an eccentricity Y_o of 0.020 inch, rotating at a constant linear surface speed v (equal to foil mill rolling speed) of 400 inches/second while the reel diameter D increases from 10 inches to 35 inches. Over this range of diameter, the reel frequency f , determined by the relation

$$f = v / \pi D \quad (1)$$

decreases from 12.7 to 3.75 cycles per second. The reel eccentricity as a function of time, $Y(t)$, is given by

$$Y(t) = Y_o \sin(\omega t)$$

wherein t is time and ω , the circular frequency of the reel, equals $2\pi f$; hence the maximum acceleration Y_{max} of the ironer roll dynamic mass by reel eccentricity is

$$\begin{aligned} Y_{max} &= (-) Y_o \omega^2 \quad (3) \\ &= 0.020 \times (2\pi \times 12.7)^2 \\ &= 127 \text{ inches/second}^2 \end{aligned}$$

for the described example of winding operation. the amplitude F_o of the variable dynamic force imposed on the ironer roll mass m by the reel eccentricity is then given by the relation

$$F_o = m Y_{max} / g \quad (4)$$

wherein g is the gravitational constant.

For a conventional ironer roll having dynamic mass m_1 of 180 lbs., the amplitude F_o is

$$F_o = (180 \times 127) = \pm 63.5 \text{ lbs.} \quad (5)$$

and the mass acting on the reel is 180 lbs.

These values may be compared with results obtained in use of an ironer assembly according to the present invention, having the general structural arrangement shown in FIGS. 1-3, with an ironer roll mass m_2 of 67 lbs. and a frame structure mass M of 160 lbs. bearing on the ironer roll through a pair of springs each having a static compression of 0.075 inch as a result of the mass M resting on the springs. The total mass of this assembly acting on the reel is 227 lbs. The stiffness C required for each spring, with this static compression value, is

$$C = 1/2 \times M / 0.075 = 1065 \text{ lb./in.} \quad (6)$$

Consequently, the resonance frequency f_{res} of the system is

$$f_{res} = 1/2\pi \sqrt{2Cg/M} = 69 \text{ c.p.s.} \quad (7)$$

well above the range of frequencies (3.75 to 12.7 c.p.s.) encountered in the described winding operation.

From equation (4) above, the amplitude F_o of the variable dynamic force imposed on the ironer roll of the assembly by reel eccentricity is

$$\begin{aligned} F_o &= m_2 Y_{max} / g \quad (8) \\ &= 67 \times 127 / 160 = \pm 23.6 \text{ lbs.,} \end{aligned}$$

or in other words, only about 37.2 percent of the amplitude encountered in use of the above-mentioned conventional ironer roll, even though the total mass of the assembly acting on the reel of foil is substantially greater (227 lbs.) than the conventional roll mass acting on the reel.

It is to be understood that the invention is not limited to the features and embodiments hereinabove specifically set forth, but may be carried out in other ways without departure from its spirit.

I claim:

1. Web-winding equipment, including

- a. rotatable means for accepting wound layers of a continuous web;
- b. means for rotating said rotatable means so as to wind said

web thereon to constitute a reel of layers; and

- c. an ironer roll rotatably adapted to ride by the force of gravity against, and to exert pressure on, the outermost layer of the web on said reel;

wherein the improvement comprises:

- d. a body having a mass substantially greater than the mass of said ironer roll;
- e. means for movably connecting said ironer roll to said body, including resilient means acting between said body and said ironer roll, disposed and arranged so that relative movement of said body and said ironer roll effects resilient deformation of said resilient means, for supporting said body on said ironer roll and transmitting to said body motion of said ironer roll occurring in a direction that is radial with respect to said reel; and
- f. means for restraining said body for movement along a path so disposed that said ironer roll rides against said outermost layer of the web as aforesaid and the weight of said body acts on said ironer roll through said resilient means to augment the pressure exerted by said ironer roll on said outermost layer of the web.

2. Equipment as defined in claim 1, wherein said resilient means urges said ironer roll away from said body.

3. Equipment as defined in claim 2, wherein said resilient means comprises at least one spring under compression between said ironer roll and said body.

4. Equipment as defined in claim 3, wherein said resilient means further includes auxiliary means for damping relative motion of said ironer roll and body toward each other.

5. Equipment as defined in claim 4, wherein said damping means comprises a hydraulic cylinder carried by one of said body and said ironer roll, and a piston movable within said cylinder and carried by the other of said body and said ironer roll.

6. Equipment as defined in claim 5, further including means for supplying coolant liquid to said web in a manner providing a spray of said liquid in the vicinity of said reel, and wherein said hydraulic cylinder is carried by said ironer roll and opens upwardly to receive said spray, said spray constituting hydraulic fluid for said cylinder.

7. Equipment as defined in claim 3, further including means for limiting the extent of relative separation of said ironer roll and said body in the direction of compression of said spring.

8. Equipment as defined in claim 1, wherein said means for restraining said body includes means for exerting an upward force on said body to reduce the effective pressure exerted by the weight of said body through said ironer roll on said outermost layer of the web on said reel.

9. Equipment as defined in claim 1, wherein the mass of said body is at least about two times the mass of said ironer roll.

10. Equipment as defined in claim 1, wherein said body comprises a first pair of rocker arms and a member extending between and connected to said rocker arms; wherein said means for restraining said body comprises a fixed frame and means pivotally connecting said first pair of rocker arms to said fixed frame for pivotal movement of said rocker arms about a horizontal axis; and wherein said means for connecting said ironer roll to said body includes a second pair of rocker arms respectively pivotally connected to said first pair of rocker arms for pivotal movement about a horizontal axis, and further includes resilient means comprising a pair of springs under compression between the rocker arms of said second pair and the rocker arms of said first pair, said ironer roll extending between and being journaled in said second pair of rocker arms.

UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 3,602,448 Dated August 31, 1971

Inventor(s) Horst Muensterer

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

Column 1, line 25, "oil" should read --foil-- ; line 32, "winging" should read --winding-- .

Column 3, line 21, "or" should read --of-- ; line 51, "advance" should read --advances-- ; line 55, "or" should read --of-- .

Column 4, line 57, "lightening" should read --tightening--.

Column 6, line 20, insert a comma (,) after "them" ; line 46, "taper" should read --tapers-- ; line 52, "he" should read --the-- .

Column 7, line 22 should read

$$= 0.020 \times (2\pi \times 12.7)^2$$

Column 7, line 31, equation(5) should read

$$F_o = \frac{180 \times 127}{360} = \pm 63.5 \text{ lbs.}$$

Column 8, line 21, delete the hyphen following "roll" .

Signed and sealed this 21st day of March 1972.

(SEAL)

Attest:

EDWARD M. FLETCHER, JR.
Attesting Officer

ROBERT GOTTSCHALK
Commissioner of Patents