Feb. 28, 1939. F. K. PLYMPTON ET AL 2,149,069

STRAIGHTENING MACHINE

Filed Aug. 6, 1936 3 Sheets-Sheet 1

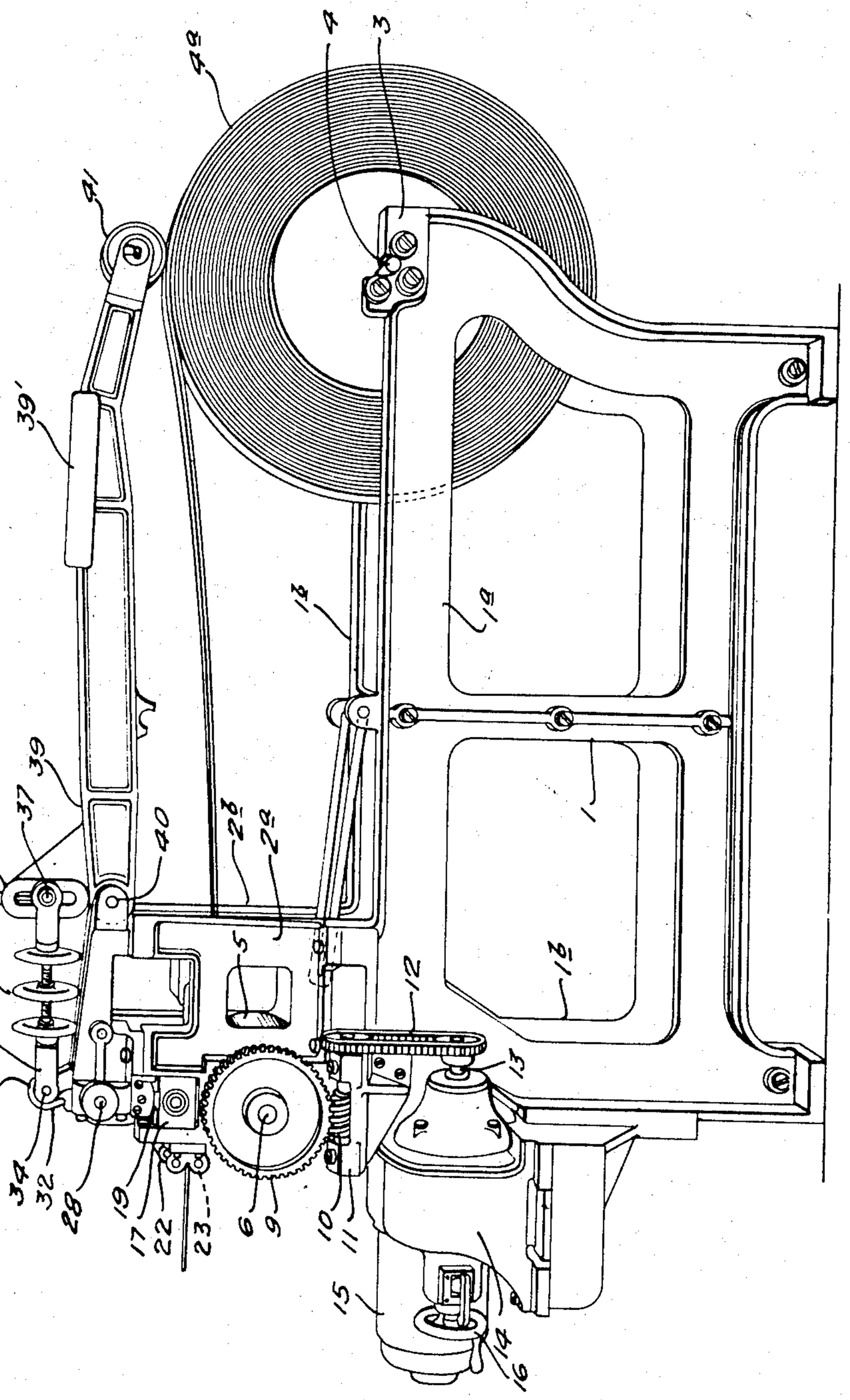

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Fig. 2.

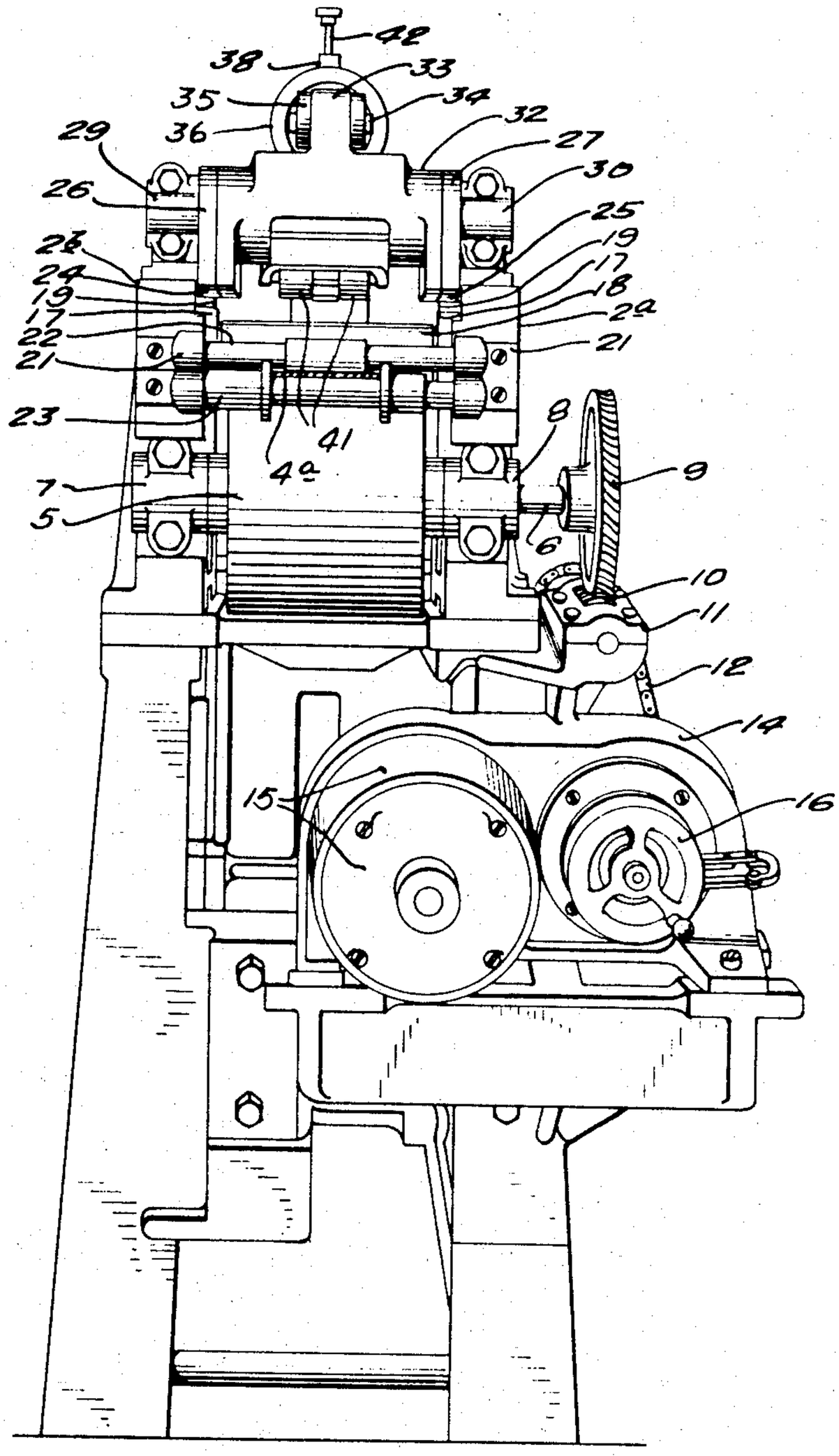

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Fig. 3.

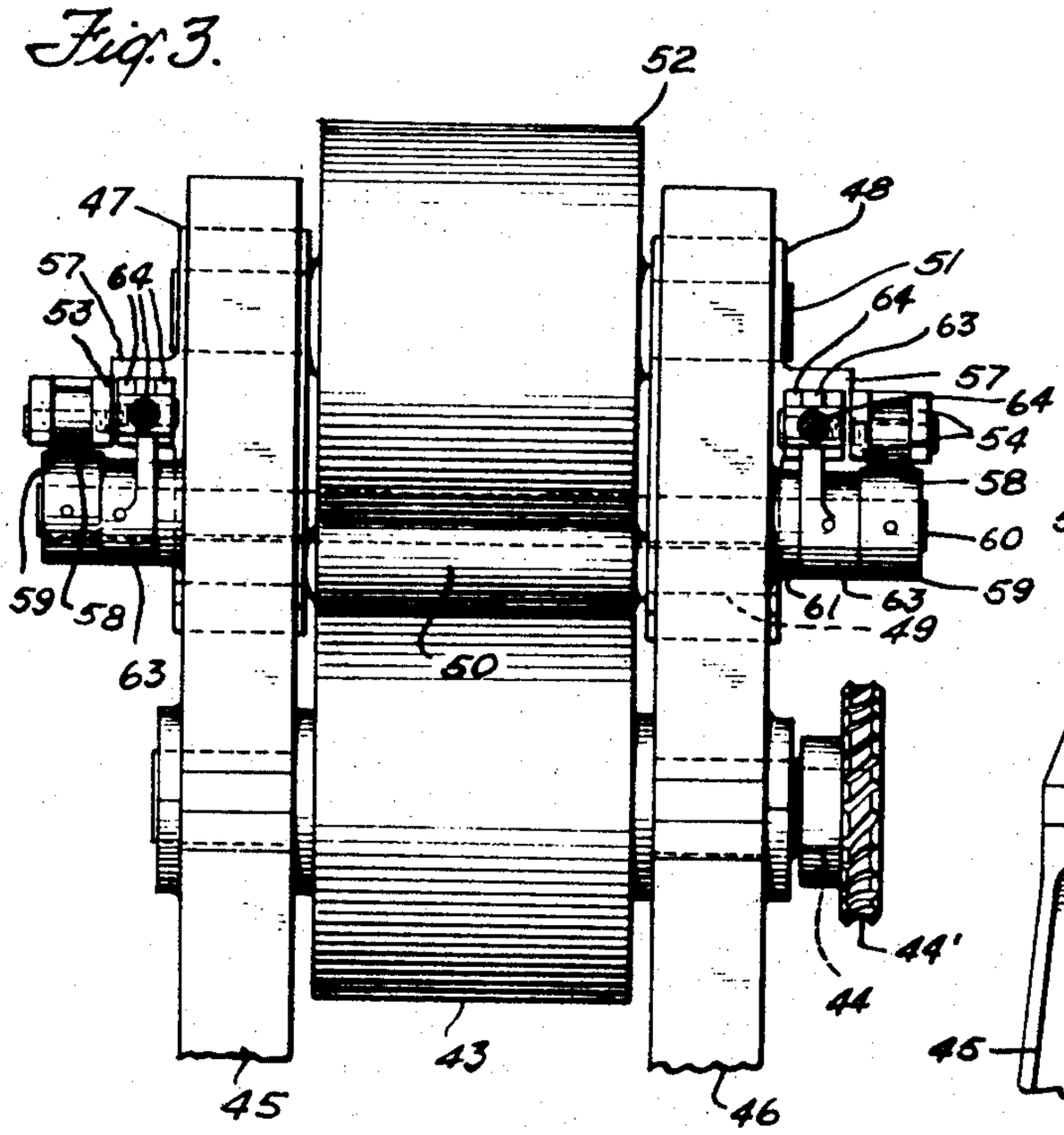
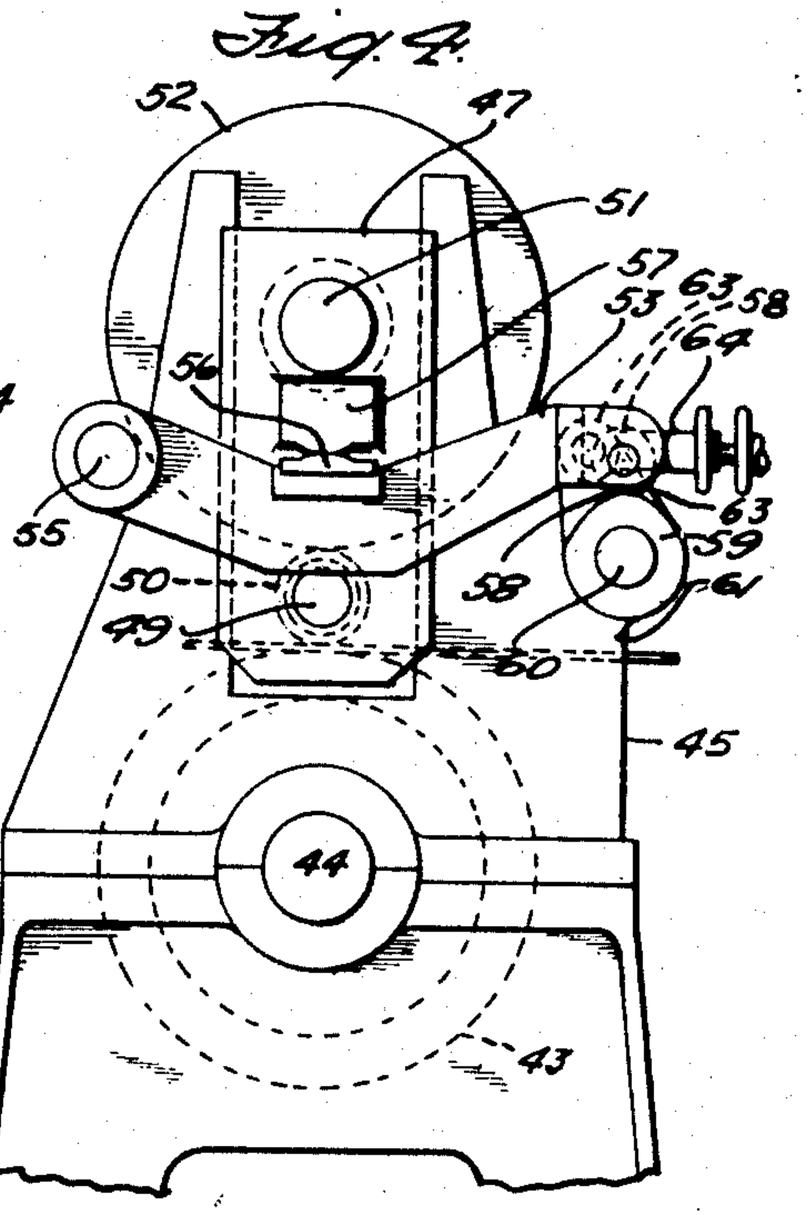


Fig. 4.



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2,149,069

STRAIGHTENING MACHINE

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5 Claims. (Cl. 92—70)

The invention herein disclosed relates to a machine for straightening sheet material, such, for example, as paper, pulp-board, photographic prints, coated sheet material and similar materials of a somewhat flexible nature that have a tendency to curl.

When straightening materials such as these in the manner that is customarily employed, there is a tendency for the surface of the material to check or crack. Because of difficulties encountered in the paper and pulp board mills it is not possible to obtain single ply paper and pulp board in thickness of five hundredths of an inch or greater in roll form. However, laminated paper and pulp board of almost any thickness is readily made by pasting together any caliper paper or pulp board. But because of the checking and cracking of the surface when such stock is straightened in the customary manner, it has not heretofore been feasible to supply such stock in roll form as the checking and cracking of built-up stock is even more serious than the single ply stock.

By using a machine constructed in accordance with this invention, these difficulties are eliminated as paper or pulp-board stock of any caliper that is now used may be straightened from a roll without checking or cracking the surface of the stock. In accordance with the invention, there is provided a machine which includes a roller having a resilient surface and a metal roller positioned to cooperate with the resilient-surface roller. The stock to be straightened passes between these rollers and the metal roller is urged against the resilient-surface roller with a force, the magnitude of which is in accordance with the character of the stock and the extent of the curl in the stock.

An advantage of a machine constructed in accordance with this invention is the fact that when operating upon stock in roll form it simultaneously unwinds and straightens the stock. Another advantage of the invention is the fact that stock of various thickness may be straightened on the same machine, and a further advantage is the fact that in certain forms of the machine the straightening effect is automatically adjusted in accordance with the extent of the curl in the stock.

A machine embodying the invention and certain modifications thereof are illustrated in the accompanying drawings in which:

Fig. 1 is a side elevation of the machine;

Fig. 2 is a front elevation of the same;

Fig. 3 is a front elevation of a modified form of the machine;

Fig. 4 is a fragmentary, side elevation of the machine shown in Fig. 3;

Fig. 5 is a front elevation of another modified form of the machine; and

Fig. 6 is a side elevation of the same.

The machine illustrated in Figs. 1 and 2 includes a frame that comprises a bed 1 and an upright 2 at one end of the bed. The bed consists of spaced frame elements 1*a* and 1*b* and the upright likewise consists of spaced frame elements 2*a* and 2*b* extending upwardly from the frame elements of the bed. At the end of the bed opposite to that end from which the upright extends, there is provided a bracket on each frame element such as the bracket 3. These brackets are of a type well known in the art and are provided with a depression in which is received a shaft 4 that supports a roll of stock 4*a*. In mounting a roll of stock on the machine, the shaft 4 is inserted through the hole in the core provided therefor and the shaft is placed in the depressions in the brackets 3.

Mounted between the upright elements 2*a* and 2*b*, there is a roller 5 which may have a metal core but does have a resilient surface that is preferably formed of rubber. This roll is mounted on a shaft 6 that is journaled in bearing brackets 7 and 8 part of each of which is formed in the uprights 2*a* and 2*b* and part of which is formed by bearing caps as illustrated. On one end of the shaft 6 there is mounted a worm gear 9 which meshes with a worm 10 mounted in a bracket 11 on the side of the upright element 2*a*. The worm 10 is driven through a chain 12 which engages a sprocket on the end of the shaft on which the worm is mounted and another sprocket on the end of a shaft 13 that extends from a reduction gearing indicated by the casing 14 enclosing the gearing. The reduction gearing is of the usual type and connects an electric motor 15 and the shaft 13. Preferably, the reduction gearing may be a variable speed gearing in which case a manually operative control element such as the hand wheel 16 is provided for varying the speed at which the roller 5 is rotated. Directly above the bearing brackets 7 and 8 in which the shaft 6 is journaled, the uprights 2*a* and 2*b* have formed therein U-shaped recesses. In each of these recesses there is mounted a bearing block such as the bearing block 17, the bearing blocks being slidably mounted in the recesses. In these bearing blocks there is journaled the shaft of a steel roller 18 which is positioned to cooperate with the resilient-surface roller 5. The metal roller 18 is approximately one-fifth the diameter of the resilient-surface roller 5 and it is adapted to bear against the resilient roller. Cam elements such as the cam element 19 on the block 17 are provided on the upper edge of these slidably mounted bearing blocks. These cam elements, which have a convexed surface, cooperate with other cam elements which act to force the slidably mounted bearings downwardly and thus cause the metal roller 18 to bear against

the resilient-surface roller 5 and effect a pressure between these two rollers. In front of the rollers 5 and 18, there are, journaled in bearing brackets 21, guide rollers 22 and 23 of a type that is commonly used in the art. Similar guides may also be provided on the opposite or entering side of the rollers 5 and 18.

For the purpose of forcing the roller 18 against the roller 5, constantly increasing cam surfaces 24 and 25 are formed respectively on lever elements 26 and 27. These lever elements are mounted upon a shaft 28 that is journaled in bearing brackets 29 and 30 on the upright elements 2*b* and 2*a*. The cam levers are secured to a casting 32 that is pivotally mounted upon the shaft 28 intermediate the cam levers 26 and 27. These cams are preferably made of hardened steel and are secured to the casting for movement therewith. On the upper end of the casting there is formed a projection 33 which has an opening therethrough to receive a pin 34. The pin 34 pivotally secures the projection 32 to the bifurcated end of a link 35. The link 35 has intermediate its ends a common form of adjustment mechanism denoted generally by the numeral 36 for the purpose of adjusting the length of the link. The opposite end of the link 35 is also bifurcated and a pin 37 extends between the bifurcated end of the link. The pin 37 also extends through a slot in a bracket 38 that extends substantially perpendicular from a lever 39.

The lever 39 which is provided with a slidable weight 39' is pivoted between the uprights 2*a* and 2*b* on a shaft 40 that extends between the uprights and is secured thereto. On the opposite end of the lever, there is mounted a roller 41 which rides upon a roll of stock, such as the roll 4*a*, mounted in the machine. The pin 37 is secured to an adjusting screw 42 that is threaded into the upper end of the bracket 38 and which extends into the slot in the bracket, longitudinally thereof. By rotating the screw 42, the pin 37 may be adjusted longitudinally of the slot 38. It will be seen that the integral arm or bracket 38 with the lever 39 constitute a bell crank lever and the crank or throw of this bell crank lever in so far as its action on the link 35 is concerned, may be adjusted by the adjusting screw 42. This adjustment is provided for the purpose of adjusting the pressure to be exerted on the stock in accordance with the thickness of the stock being passed through the machine. The adjusting mechanism 36 in the link 35 controls the positioning of the cam surfaces 24 and 25 so that these may be positioned in relation to the roll of stock such that the straightening action will be uniform upon rolls of similar diameter and stock.

In the operation of the machine, the stock from the roll 4*a* is fed, through guide rollers, between the rollers 18 and 5 and between the guide rollers 20 and 23. The motor 15 rotates the roller 5 and thus feeds the stock through the machine. The roller 41 on the lever 39 rests upon the surface of the roll of stock. As the roll decreases, the lever 39 swings about its pivot 40, the outer end of the lever moving downwardly towards the center of the roll of stock. This downward movement of the lever 39, through the bracket 38, pulls upon the link 35 and swings the casting 32 about the shaft 28 thus causing the cam levers 26 and 27 to move forwardly or to the left from the position shown in Fig. 1. As these cam levers move forwardly their constantly increasing radii press upon the cams secured to the bearing brackets in which the roller 18 is journaled and thus force the roller with a force of increasing magnitude against the resilient-surface roller 5. The pressure between the rollers 18 and 5 is thus graduated or varied in accordance with the diameter of the roll of stock on the machine. In other words, since the curl or curvature of the stock increases as it is closer to the core on which it is wound, the pressure between the rollers 18 and 5 is increased in accordance with the increase in the curl of the stock.

The effect of running stock through the machine is to permanently straighten the stock while it is being unwound from the roll. It appears that the shortened fibers on the inner surface of the stock are permanently stretched in passing between the rollers 5 and 18 so that as the material passes through the machine a permanent straightening is obtained.

The machine illustrated in Figs. 3 and 4 is for straightening stock having a greater width than the stock for which the machine illustrated in Figs. 1 and 2 is designed. The difference between the machine illustrated in Figs. 3 and 4, and that illustrated in Fig. 1, is the manner in which the force is applied to the metal roller to cause it to bear against the resilient-surface roller. Where a long metal roller is used, and the force is applied at the bearings only, there is a tendency for the roller to bend or bow. The machine illustrated in Figs. 3 and 4 eliminates this tendency as the force is applied more or less uniformly along the metal roller.

In the machine illustrated in Figs. 3 and 4, the resilient-surface roller 43 is mounted upon a shaft 44 that is journaled in bearing brackets formed in the spaced frame elements 45 and 46. On the shaft 44 there is mounted a worm wheel 45 which may be driven in the same manner as the wheel 9 in the machine illustrated in Figs. 1 and 2 is driven. The uprights of the frame elements 45 and 46 have a deep U-shaped slot formed therein and in this slot there is received and slidably mounted therein bearing elements 47 and 48. These bearing elements are elongated and serve as journals for a shaft 49 upon which a relatively small steel roller 50 is mounted and a shaft 51 upon which a relatively heavy, and preferably chilled iron, roller 52 is mounted. As illustrated in Figs. 3 and 4 the chilled iron roller 52 is in rolling contact with the metal roller 50. The weight of the roller 52 is sufficient to apply to the roller 50 a force of a magnitude that will effect a pressure between the rollers 43 and 50 sufficient to straighten the largest caliper stock that is utilized. The bearing blocks 47 and 48 are supported by arms 53 and 54 that are mounted upon a shaft 55 which extends from bosses formed on the upright frame elements 45 and 46. Each arm carries a hardened steel concaved cam element 56 which engages, in line contact, a similarly shaped concaved hardened steel cam block 57 that is mounted upon the bearing block. Movement of the levers 53 about the axes of the shaft 55 varies the effective force that is applied as a result of the weight of the roller 52. It is only when the cam surfaces 56 carried by these arms are out of contact with the cam blocks 57 that the entire weight of the roller 52 is utilized in forcing the roller 50 against the resilient-surface roller 43. This force is not necessary for any of the stocks that are now used.

The arms 53 and 54 each carry a cam roller 58 which rides upon cams 59 mounted upon a shaft 60 that extends between and is journaled in bearing brackets 61. The bearing brackets 61

are secured to the frame elements **45** and **46**. A lever **63** extends from the shaft **60** and to this lever there is secured the bifurcated end of a link **64**. The other end of this link **64** is secured in the same manner as the link **35** of the machine illustrated in Figs. 1 and 2 to a bell crank lever similar to the lever **39**. With this construction it will be seen that as a roll of paper decreases in diameter, the lever will move about its pivotal connection towards the center of the roll and thus exert a pull upon the link **64**. The pull upon the link **64** will cause rotation of the shaft **60** and movement of the cams **59**. The cam rollers **58** will ride down the surface of the cams thus causing the levers **53** to move downwardly about their pivotal axes. As the levers **53** move downwardly about their pivotal axes a greater amount of the weight of the roller **52** is rendered effective for causing pressure between the rollers **43** and **50**. Thus the effective force exerted upon the roller **50** to cause it to bear against the roller **43** is varied in accordance with the diameter of a roll of stock mounted on the machine.

In the machine illustrated in Figs. 3 and 4, the shaft **51** which carries the relatively heavy roller **52** and the shaft **49** are journaled in the same bearing blocks **47** and **48**. As constructed, shafts **51** and **49** are fixed with respect to each other. It is obvious of course that these shafts may be made relatively movable with respect to each other either by providing separate bearings for the shaft **49** that are slidably mounted in the bearing blocks **47** and **48**, or separating the bearing sections of the blocks **47** and **48** so that the shaft **51** is journaled in separate bearings and the shaft **49** is journaled in other bearings both of which are movable radially of the roller **43** and also movable with respect to each other.

It will be apparent to those skilled in the art that by this invention there is provided a machine which will effectively straighten sheet material that has a tendency to curl. The invention accomplishes this objective irrespective of the thickness of the stock without checking or cracking the surface of even highly finished stock or coated stock.

It will be obvious that various changes may be made in the modifications of the invention disclosed by those skilled in the art within the principle and scope of the invention as expressed in the appended claims.

We claim:

1. In a machine of the type described for straightening sheet material, a frame having provision for rotatably supporting a roll of sheet material, a roller having a resilient surface rotatably mounted in the frame, a hard surfaced roller rotatably mounted in the frame and positioned to cooperate with the resilient-surface roller, and means for applying a force to the hard-surface roller to urge it against the resilient-surface roller including slidably mounted bearings for the hard-surface roller, cams cooperating with the bearings, and means for actuating the cams in accordance with the diameter of a roll of sheet material mounted on the machine.

2. In a machine of the type described for straightening sheet material, a frame having provision for rotatably supporting a roll of sheet material, a roller having a resilient surface rotatably mounted in the frame, a hard surfaced roller rotatably mounted in the frame and positioned to cooperate with the resilient-surface roller, and means for applying a force to the hard-surface roller to urge it against the resilient-surface roller including slidably mounted bearings for the hard-surface roller, cams mounted on the bearings, a lever, cams mounted on the lever and cooperating with the cams on the bearings, and means for actuating the lever in accordance with the diameter of a roll of sheet material mounted on the machine.

3. In a machine for straightening sheet material of the type described, the combination including a frame having provision for rotatably supporting a roll of sheet material, a roller having a resilient surface rotatably mounted in the frame, a hard-surfaced roller rotatably mounted in the frame and positioned to cooperate with the resilient-surfaced roller, means for effecting pressure between the rollers, and means for controlling the pressure between the rollers in accordance with the diameter of a roll of sheet material mounted on the machine including means operative in accordance with the diameter of a roll of sheet material mounted on the machine for relieving the pressure-effecting means.

4. In a machine for straightening sheet material of the type described, the combination comprising a frame having provision for rotatably supporting a roll of sheet material, a roller having a resilient surface rotatably mounted in the frame, a hard-surfaced roller rotatably mounted in the frame and positioned to cooperate with the resilient-surfaced roller, and means for applying a force to the hard-surfaced roller to urge it against the resilient-surfaced roller including slidably mounted bearings for the hard-surfaced roller, a relatively heavy roller positioned to bear upon the hard-surfaced roller, means for varying the effect of said relatively heavy roller including means for supporting the heavy roller and means for varying the effect of said supporting means including a lever and means for positioning the lever.

5. In a machine for straightening sheet material of the type described, the combination comprising a frame having provision for rotatably supporting a roll of sheet material, a roller having a resilient surface rotatably mounted in the frame, a hard-surfaced roller rotatably mounted in the frame and positioned to cooperate with the resilient-surfaced roller and means for applying a force to the hard-surfaced roller to urge it against the resilient-surfaced roller including bearings for the hard-surfaced roller slidably mounted in the frame, a relatively heavy roller positioned to bear upon the hard-surfaced roller, bearings for the heavy roller slidably mounted in the frame, and means for controlling the effective force exerted by the heavy roller in accordance with the diameter of a roll of sheet material mounted on the machine including means for supporting the heavy roller and means operative in accordance with the diameter of a roll of sheet material mounted on the machine for varying the effect of said support.

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