Dec. 15, 1953 E. W. LARSEN ET AL 2,662,697

TENSION CONTROL APPARATUS

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FIG. 1

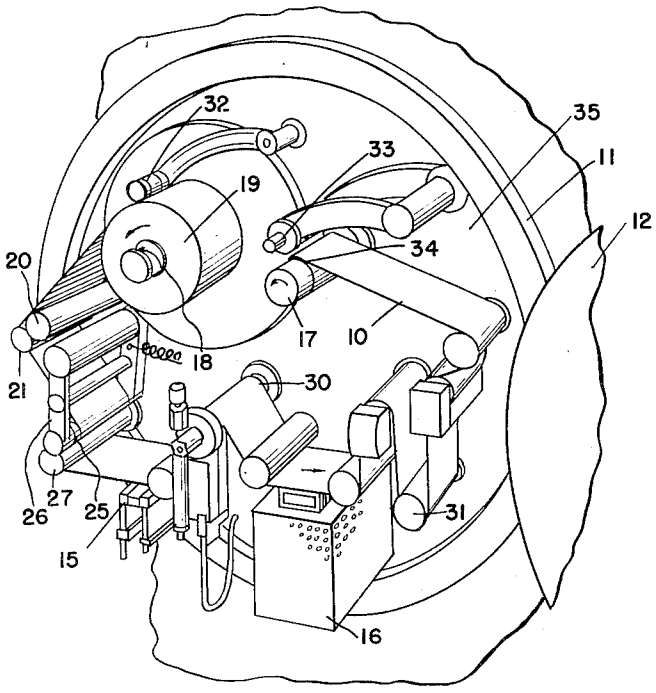


FIG. 6

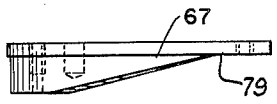


FIG. 7

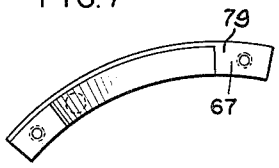


FIG. 4

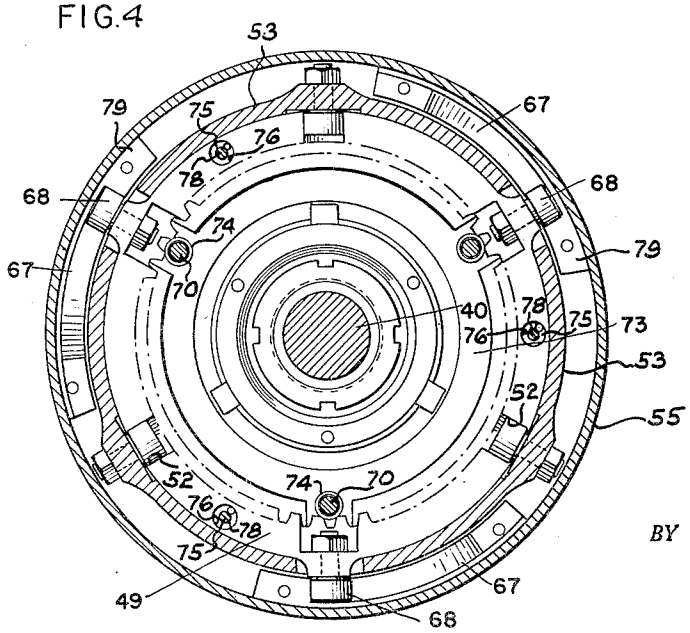
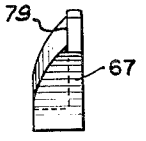


FIG. 8



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TENSION CONTROL APPARATUS

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FIG. 2

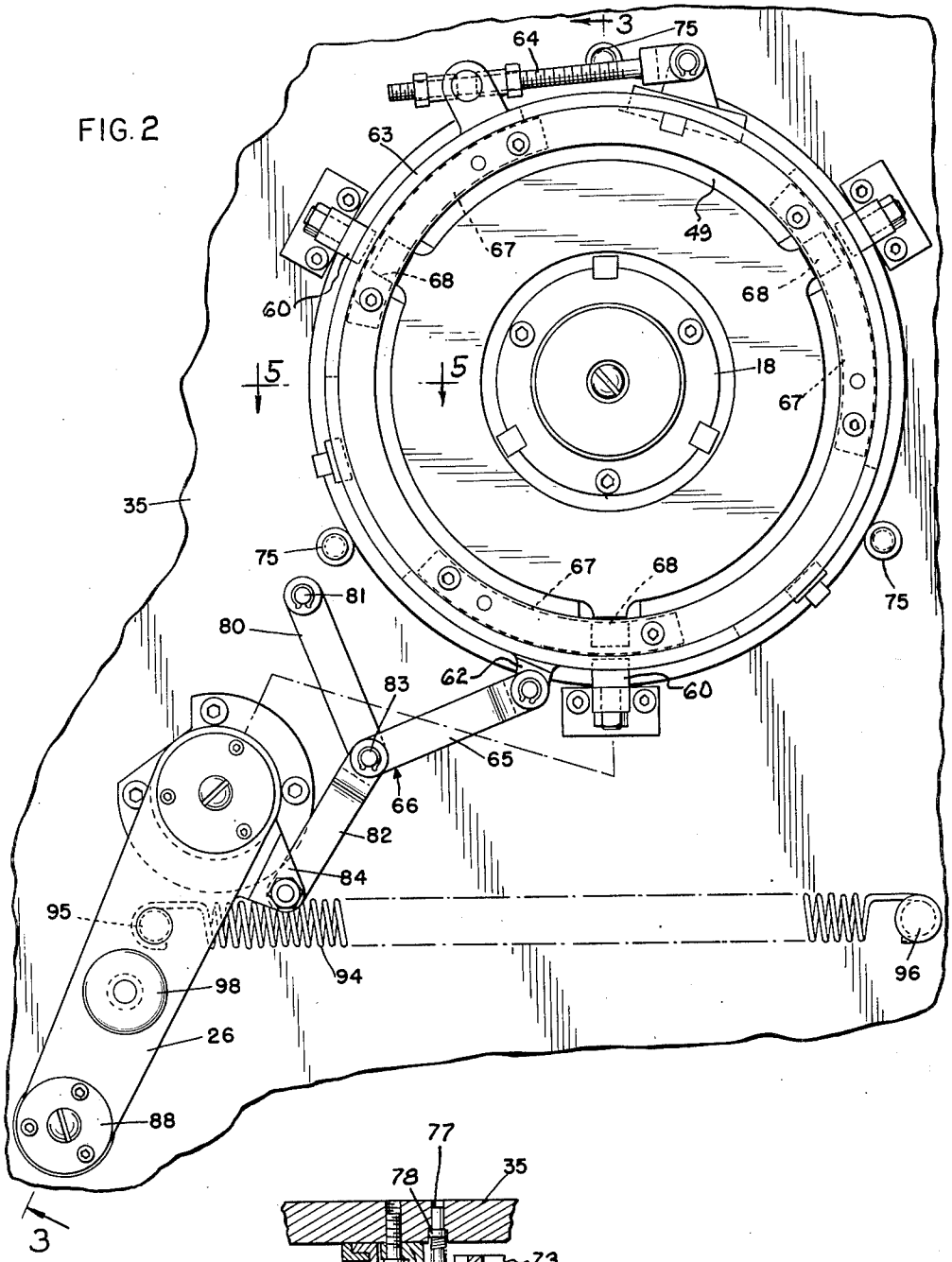
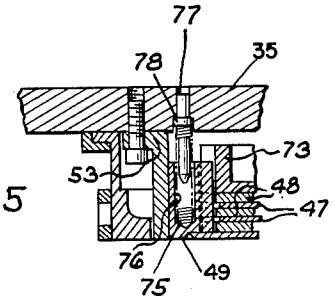


FIG. 5



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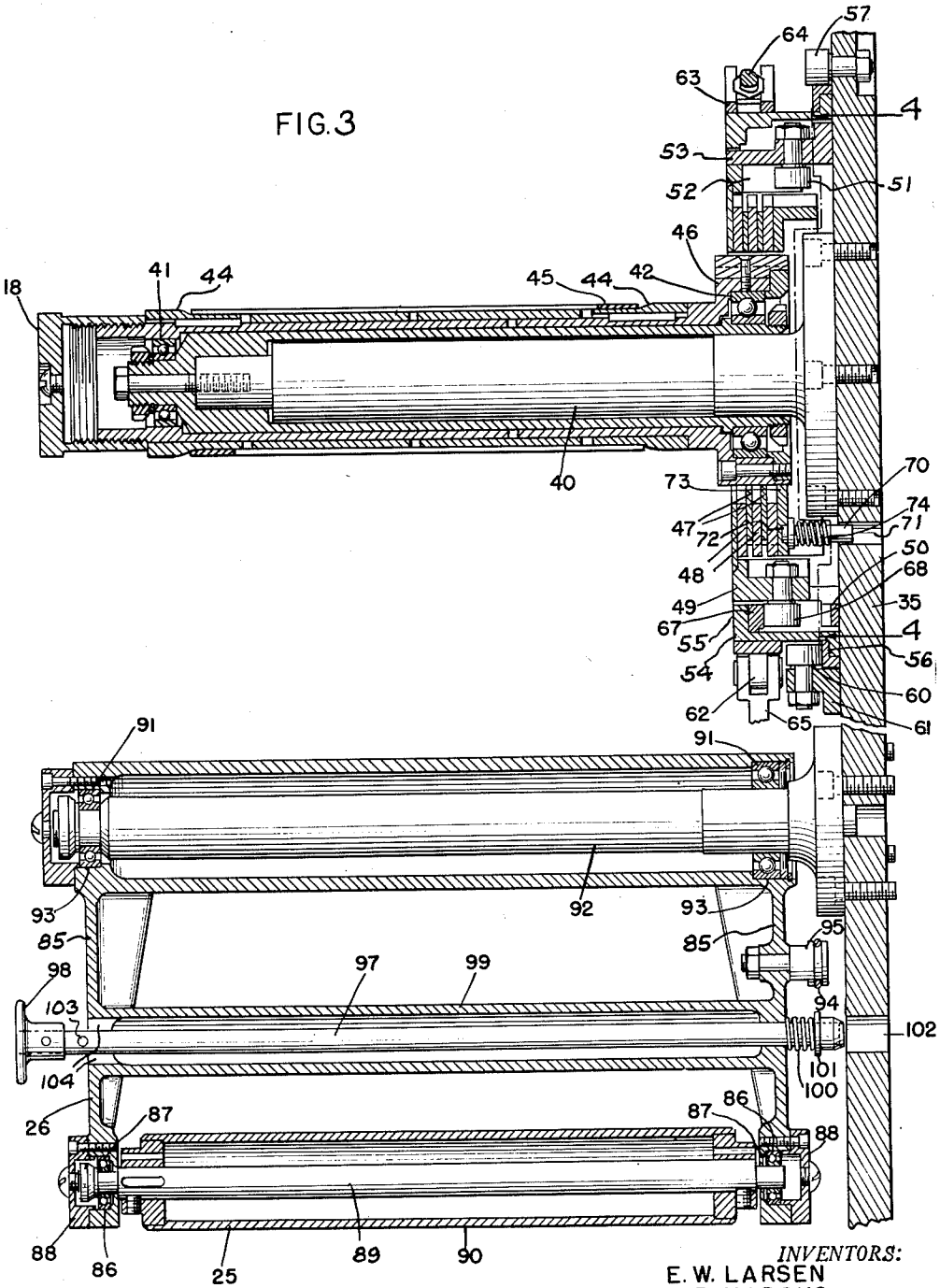
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FIG.3



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2,662,697

TENSION CONTROL APPARATUS

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Application April 15, 1952, Serial No. 282,358

9 Claims. (Cl. 242—75)

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This invention relates to tension control apparatus, and more particularly to braking systems of strand-supplying apparatus.

In strand-handling apparatus wherein it is essential to have a long continuous length of a strand for each operation of the apparatus, such as, for example, an apparatus for metallizing a web of paper in a hermetically sealed chamber under a high vacuum, close control of the strand-supplying mechanism and the tension of the strand has been a problem difficult of solution because of the weight of the strand supply. With past known apparatus, it has been impossible to provide sufficient braking power to prevent over-running of the strand-supplying mechanisms and still provide sensitive tension control.

An object of the invention is to provide new and improved tension control apparatus.

Another object of the invention is to provide new and improved braking systems of strand-supplying apparatus.

A further object of the invention is to provide strand supply braking systems of large braking power, which are highly sensitive.

A tension control apparatus illustrating certain features of the invention may include a rotatable strand holder, and means for advancing a strand from the holder at a predetermined rate of speed. There also may be provided a braking mechanism for the holder, a feeler responsive to tension on the strand and a toggle-joint linkage system actuated by the feeler for operating the braking means. The braking mechanism includes light yieldable means urging operation of the mechanism for tension control and positive non-yielding means for operating the mechanism on movement of the feeler when the strand breaks.

A complete understanding of the invention may be obtained from the following detailed description of a tension control apparatus forming a specific embodiment thereof, when read in conjunction with the appended drawings, in which

Fig. 1 is a fragmentary, perspective view of a device including a tension control apparatus forming a specific embodiment of the invention;

Fig. 2 is an enlarged, fragmentary, front elevation of a portion of the apparatus shown in Fig. 1;

Fig. 3 is an enlarged, vertical section taken along line 3—3 of Fig. 2;

Fig. 4 is an enlarged, vertical section taken along line 4—4 of Fig. 3;

Fig. 5 is a horizontal section taken along line 5—5 of Fig. 2;

Fig. 6 is an enlarged, side view of an element

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forming a portion of the apparatus shown in Fig. 1;

Fig. 7 is an enlarged face view of the element shown in Fig. 6, and

Fig. 8 is an enlarged, perspective view of the element shown in Fig. 6.

Referring now in detail to the drawings, there is shown in Fig. 1 a machine for vaporizing metal on one face of a paper strip 10 under a high vacuum in a chamber 11, which is provided with a door 12 to provide access to the interior of the chamber. Applicators 15 and 16 apply the metal to the strip as it is advanced continuously thereover at a uniform rate of speed by a takeup arbor 17 driven by suitable means (not shown). The takeup arbor advances the strip from an expansible supply arbor 18 mounting a paper supply roll 19 thereon. The strip travels from the supply roll 19 over a roller 20 rotatable on a fixed axis and over a roller 21 also rotatable on a fixed axis. The strip then travels partially around a roller 25 mounted on a pivoted frame 26 and a roller 27 rotatable on a fixed axis. The strip goes from the roller 27 sequentially past the applicator 15, guide rollers 30, the applicator 16 and guide rollers 31. Pressing rollers 32 and 33 are spring-urged against the supply roll 19 and a takeup roll 34 being formed on the takeup arbor 17, respectively. Each of the above-described strip-guiding elements is supported by a wall 35 of the housing 11.

A post 40 (Figs. 3 and 4) secured to the wall 35 supports bearings 41 and 42, which, in turn, mount the supply arbor 18 rotatably on the post. The supply arbor includes a slit sleeve 45 for mounting the paper roll 19 and holding the paper roll against rotation relative to the arbor 18. Wedges 44 expand the slit sleeve 45 to key the supply roll 19 to the arbor 18. A hub 46 of the arbor 18 has brake discs 47 splined thereto, and brake discs 48 interleaving the discs 47 are splined to an outer pressure cup 49 keyed to a ring 50 by rollers 51 fitting in slots 52 in the rim of the cup 49. The ring 50 is fixed to the wall 35, and the rollers 51 are mounted on arcuate segments 53 projecting from the ring 50. An actuating drum 54 having flanges 55 and 56 is S-shaped in cross-section, and is mounted rotatably by rollers 57 mounted on the wall 35 and rollers 60 mounted on brackets 61 secured to the wall 35.

A lug 62 fixed adjustably to the drum 54 by a split band 63 (Figs. 2 and 3) and an adjustment screw 64 transmits force to the drum from an arm 65 of a toggle-joint linkage 66. The linkage 66 serves to turn the drum when actuated. Arcuate

wedges 67 fastened rigidly to the drum, when the toggle-joint linkage is actuated to rotate the drum counterclockwise, as viewed in Fig. 2, force rollers 68 fastened to the outer pressure cup 49 to the right, as viewed in Fig. 3, to press the brake discs 48 against the brake discs 47. Since the cup 49 is held against rotation, there is a braking action on the arbor 18. Flanged pins 70 mounted slidably in bores 71 and 72 in the wall 35 and an inner pressure cup 73, respectively, are urged by compression springs 74 against the cup 73. The cup 73 is splined to the rim 49. The springs 74 are of such a strength as to limit the pressure between the discs 47 and 48 except when the wedges 67 force the inner cup 73 against the wall 35 near the extreme actuating position of the drum 54. When the drum 54 is at the other or non-actuating extreme of its travel, the springs 74 are fully extended so that there is no pressure on the braking discs. The cup 49 is urged to the left, as viewed in Fig. 3, by light compression springs 75 (Fig. 5) seated in sockets 76 formed in the rim of the pressure cup 49 and on flanged pins 77 mounted in sockets 78 formed in the wall 35. The springs 75 are just strong enough to keep the rollers 68 in engagement with the cams 67 when the drum 54 is in its extreme non-actuating position in which the rollers 55 engage dwell portions 79 of the cams.

The toggle 66 includes an arm 80 (Fig. 2) mounted on a pin 81 secured to the wall 35, and the arms 65 and 80 are pivotally connected to one another and to an arm 82 by a pin 83. The arm 82 is pivotally secured to a bracket 84 fastened rigidly to the frame 26 nearer the pivot point thereof, which is the end thereof opposite to the end carrying the roller 25, than to the end carrying the roller 25. The frame 26 is provided with arms 85 having aligned sockets 86 therein mounting bearings 87. Caps 88 close the sockets 86, and a shaft 89 mounts a sleeve 90 of the roller 25. Bearings 91 on a post 92 secured to the wall 35 fit in sockets 93 in the frame 26. A tension spring 94 secured at one end to a grooved pin 95 fastened to the frame 26 is secured at its other end to a pin 96 on the wall 35 and urges the frame 26 in a counterclockwise direction, as viewed in Fig. 2.

A rod 97 having a knob 98 on one end is mounted slidably in a sleeve 99 of the frame 26, and is urged to the right, as viewed in Fig. 3, by a compression spring 100 bearing against the frame 26 and a collar 101 on the rod. For stringing up the machine, the frame is swung in a clockwise direction to a non-braking position, and the rod is turned manually to a position in which a pin 103 is laterally aligned with slots 104 and is released to permit the rod 97 to enter a hole 102 in the wall 35 to hold the brake off. When the rod 97 is in the position thereof shown in Fig. 3, the pin 103 keeps the rod 97 from moving into the hole 102.

Operation

The supply roll 19 is placed on the supply arbor 18 and is held against movement relative to the arbor by the expansible arbor 18. The frame 26 is held against movement by the rod 97 (Fig. 3) projecting into the hole 102 in the wall 35 to hold the frame against movement and permit rotation of the arbor 18 while stringing up, and the strip 10 is threaded through the machine and secured to the takeup arbor 17. The rod 97 then is pulled out of the hole 102 and is turned to its latched retracted position. The door 12 then is closed, the air in the chamber 11 is removed and the takeup arbor 17 is rotated to advance the strip past the applicators 15 and 16 at a uniform rate of speed. The tension on the strip is kept uniform by the braking action on the supply arbor 18, which is regulated by the position of the frame 26.

If the braking action on the supply arbor 18 is too great, the strip 10 swings the frame 26 in a clockwise direction, as viewed in Figs. 1 and 2, against the action of the spring 94. This movement of the frame pulls the link 82 downwardly, and the link 65 pulls the drum 50 in a clockwise direction. This moves the wedges 67 in such directions as to move thinner portions of the wedges into contact with the rollers 68 to lessen the compression of the springs 74, thereby reducing the pressure between the discs 47 and 48. The lessened pressure on the braking discs reduces the braking action on the supply arbor 18.

If there is not sufficient braking action on the supply arbor 18, the strip 10 permits the spring 94 to move the frame 26 in a counterclockwise direction, as viewed in Figs. 1 and 2. This actuates the toggle-joint linkage 66 to move the drum 54 in a counterclockwise direction to force the rollers 68 to the right, as viewed in Fig. 3, which forces the outer pressure cup 49 therewith to increase the compression of the springs 74, which increases the pressure between the discs 47 and 48. The increased pressure increases the braking action on the arbor 18.

If the strip 10 breaks, the spring 94 immediately swings the frame 26 to its extreme brake-actuating position, in which position the output force of the toggle-joint linkage 66 is very high to force the rim of the cup 73 hard against the wall 35, and the brake discs 47 and 48 are forced very hard together to stop the rotation of the arbor 18 immediately. Thus, overrunning of the supply arbor 18 is prevented so that a long length of the strip is not unwound.

The frame 26 and the roller 25 keep the tension on the strip uniform even during adjustments of the braking force inasmuch as the tension on the spring 94 is substantially uniform throughout the operating range of portions of the frame 26. The apparatus also stops the supply arbor 18 sharply when the strip breaks, thereby preventing overrunning of the supply roll 19 even when the supply roll is very heavy.

It is to be understood that the above-described arrangements are simply illustrative of the application of the principles of the invention. Numerous other arrangements may be readily devised by those skilled in the art which will embody the principles of the invention and fall within the spirit and scope thereof.

What is claimed is:

1. A tension control apparatus, which comprises a rotatable elongated material holder, means for advancing elongated material from the holder, a braking element keyed to the holder, a second braking element held against rotation for engaging the first braking element, a feeler responsive to tension on the material, means responsive to the feeler for exerting a force on the elements in one direction to move the braking elements together, yielding means urging the braking elements together in the opposite direction when the force from the element-moving means is below a predetermined value, and non-yielding means exerting a force on the braking elements in said last-mentioned direction

when the force from the element-moving means is of or greater than said predetermined value.

2. A tension control apparatus, which comprises an arbor, means mounting the arbor rotatably, a brake disc splined to the arbor, a brake disc held against rotation mounted slidably on the arbor adjacent to the first brake disc, a presser plate slidable axially of the arbor on one side of the disc, a second presser plate slidable axially of the arbor on the other side of the discs, a feeler movable in accordance with tension on a strip being withdrawn from the arbor, means responsive to movement of the feeler in one direction for moving the first plate toward the other plate, stop means for positively limiting movement of the second plate by the first plate, and yieldable means normally holding the second plate away from the stop means.

3. A tension control apparatus, which comprises an elongated material supply holder, means mounting the holder rotatably, a support rotated by the arbor, a brake disc splined to the support, a brake disc fixed against rotation mounted slidably on the support adjacent to the first brake disc, a presser plate slidable axially of the support on one side of the discs, a second presser plate slidable axially of the support on the other side of the discs, a feeler movable according to tension on material being withdrawn from the holder, means responsive to movement of the feeler in one direction for moving the first plate toward the other plate, stop means for positively limiting movement of the second plate by the first plate, and yieldable means normally holding the second plate away from the stop means.

4. A tension control apparatus, which comprises an arbor for supporting a supply of an elongated material, a post mounting the arbor rotatably, a plurality of brake discs splined to the arbor, a plurality of brake discs axially movable and held against rotation relative to the post in positions interleaving the first brake discs, a presser plate slidable axially of the post on one side of the discs, a second presser plate slidable axially of the post on the other side of the discs, a feeler movable by elongated material being advanced from the arbor in accordance with tension on the material, means responsive to movement of the feeler in one direction for moving the first plate toward the other plate to press the discs together, stop means for positively limiting movement of the second plate by the first plate, and yieldable means normally holding the second plate away from the stop means.

5. A tension control apparatus, which comprises an arbor for mounting a supply roll fixedly thereon, fixed means mounting the arbor rotatably, a plurality of brake discs splined to the arbor, a presser cup having a flange thereon and a rim encircling the brake discs, said flange being on one side of the discs, means permitting axial movement of the cup and preventing rotation thereof, a plurality of brake discs splined to the rim and interleaving the first-mentioned discs, a presser plate mounted on the other side of the discs, means urging the plate toward the flange on the cup, means limiting movement of the plate against the plate-urging means, a feeler for contacting a strip being unwound from the arbor and movable by changes in tension on the strip, and means responsive to movement of the feeler for moving the cup toward and away from the presser plate.

6. A tension control apparatus, which comprises an arbor for mounting a supply roll fixedly

thereon, a fixed means mounting the arbor rotatably, a plurality of brake discs splined to the arbor, a presser cup having a flange thereon and a rim encircling the brake discs, said flange being on one side of the discs, means permitting axial movement of the cup and preventing rotation thereof, a plurality of brake discs splined to the rim and interleaving the first-mentioned discs, a presser plate mounted on the other side of the discs, means urging the plate toward the flange on the cup, means limiting movement of the plate against the plate-urging means, a plurality of rollers secured to the cup in positions projecting radially outwardly from the rim, a ring, thrust means mounting the ring rotatably with respect to the cup, a plurality of wedges secured to the ring adjacent to the rollers, a feeler for contacting a strip being unwound from the arbor and movable by changes in tension on the strip, and means responsive to movement of the feeler for turning the drum to move the wedges relative to the rollers.

7. A tension control apparatus, which comprises an expansible arbor provided with a hub thereon for mounting a supply roll fixedly thereon, a wall, a fixed post mounted on the wall mounting the arbor rotatably, a plurality of brake discs splined to the hub of the arbor, a presser cup having a flange thereon and a rim encircling the brake discs, said flange being on one side of the discs, means permitting axial movement of the cup and preventing rotation thereof relative to the post, a plurality of brake discs splined to the rim and interleaving the first-mentioned discs, a presser plate mounted on the side of the discs opposite to that at which the flange of the cup is located, means urging the plate toward the flange on the cup, means limiting movement of the plate against the plate-urging means, a plurality of rollers secured to the cup in positions projecting outwardly from the rim, a ring, a plurality of thrust rollers mounting the ring rotatably on the wall, a plurality of wedges secured to the ring adjacent to the first-mentioned rollers, a feeler for contacting a strip being unwound from the arbor and movable by changes in tension on the strip, a toggle-joint linkage responsive to movement of the feeler, and a band connecting the linkage to the drum for actuating the rim in accordance with movement of the feeler.

8. A strip material supply, which comprises a fixed post, an arbor mounted rotatably on the post for supporting a roll of strip material thereon, a plurality of brake discs splined to the arbor, an outer cup having a rim encircling the discs and a flange facing the discs on one side of the discs, said rim being provided with a plurality of slots, a plurality of rollers mounted on fixed axes fitting in the slots to hold the cup against rotation and permit axial movement thereof, a plurality of brake disc splined to the cup in positions interleaving the first-mentioned brake discs, a plate mounted on the side of the discs opposite to the flange of the cup and splined to the cup, stop means for limiting movement of the plate in a direction away from the flange, means urging the plate toward the flange, a feeler for engaging the strip material and responsive to tension on the strip material, a toggle-joint linkage responsive to the feeler, a plurality of rollers secured to and projecting radially outwardly from the cup, a plurality of wedges movable by the toggle-joint linkage along the last-mentioned rollers in such positions that movement of the feeler from increased tension on the strip

material causes lesser wedging action on the last-mentioned rollers, and resilient means tending to move the feeler against the action of the strip material, said resilient means being of sufficient strength as to cause the movement of the plate to be positively limited by the stop means when the tension on the portion of the strip material engaged by the feeler is below a predetermined value.

9. A strip material supply, which comprises a wall, a post fixed to the wall in a position projecting therefrom, an arbor mounted rotatably on the post for supporting a roll of strip material thereon, a plurality of brake discs splined to the arbor, an outer cup having a rim encircling the discs and a flange facing the discs on the side of the discs opposite to the wall, said rim being provided with a plurality of slots facing the wall, a plurality of rollers mounted on axes fixed with respect to the wall fitting in the slots in the rim of the cup to hold the cup against rotation relative to the wall and permit axial movement of the cup, a plurality of brake discs splined to the cup in positions interleaving the first-mentioned brake discs, a plate mounted between the discs and the wall and splined to the cup, stop means for limiting movement of the plate toward the wall, means urging the plate away from the wall, a feeler mounted pivotally on the wall for engaging the strip material and responsive to tension on the strip material, a toggle-joint linkage responsive to the feeler, a drum having a flange and mounted rotatably on the wall and movable by the toggle-joint linkage, a plurality of rollers secured to and projecting radially outwardly from the cup, a plurality of wedges carried by the flange of the drum in engagement with the last-mentioned rollers on the opposite side thereon from the wall in such positions that movement of the drum from increased tension on the strip material causes lesser wedging action on the last-mentioned rollers, and resilient means tending to move the feeler against the action of the strip material, said resilient means being of sufficient strength as to cause the movement of the plate to be positively limited by the stop means when the tension on the portion of the strip material engaged by the feeler is below a predetermined value.

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