

[54] WEB-SPLICING APPARATUS

296,380 8/1928 Great Britain.....242/58.1

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[57] ABSTRACT

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Apparatus is disclosed for automatically splicing the beginning of one roll of paper or the like onto the approximate end of a second roll of paper or like material without discontinuing the flow of paper to a utilizing device. The apparatus includes a support stand having means for supporting the first and second rolls of paper in rotatable relationship therewith; a festooner arrangement carried by the support stand for establishing an elongated path of travel for paper of the second roll moving through the apparatus and for allowing the utilizing device to feed upon the paper carried by the festooner when the second roll of paper has stopped rotating; and clamping, severing and splicing means responsive to the halt of the second roll of paper for clamping the paper of said second roll at a first predetermined location, severing the paper of said second roll at a second predetermined location, below the first predetermined location, and for joining the beginning of said first roll to the severed end of said second roll; whereby the utilizing device will begin feeding on the paper of the first roll of paper. In addition, there is disclosed preparing apparatus operatively positioned on the support stand for treating the beginning end of the first roll of paper such that it may be subsequently joined to the trailing end of the second roll of paper.

[52] U.S. Cl.242/58.1, 242/56 R, 156/506, 226/104

[51] Int. Cl.B65h 19/18

[58] Field of Search.....242/54, 55.01, 56, 58.1, 58.2, 242/58.3, 58.4, 58.5; 226/104, 105, 106, 107; 156/504, 505, 506

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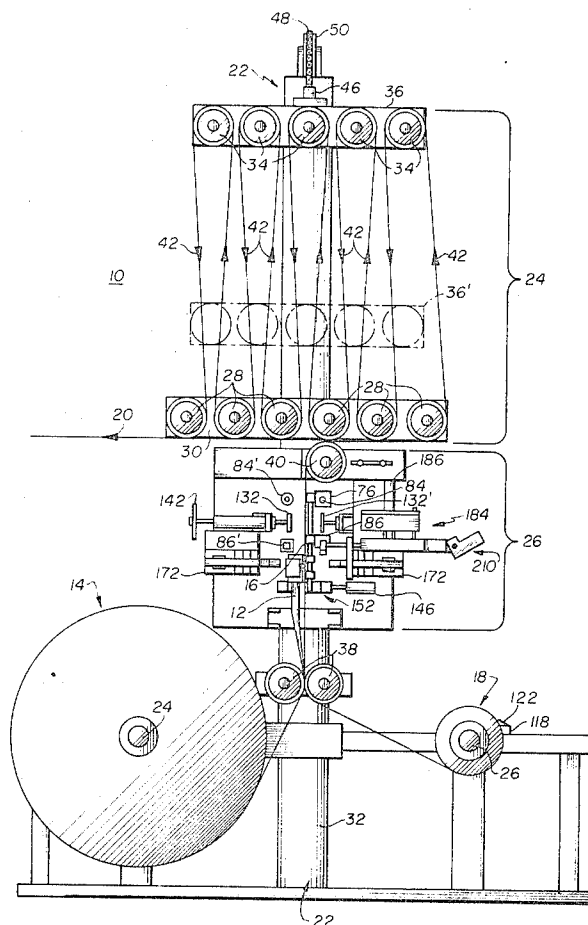
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30 Claims, 10 Drawing Figures



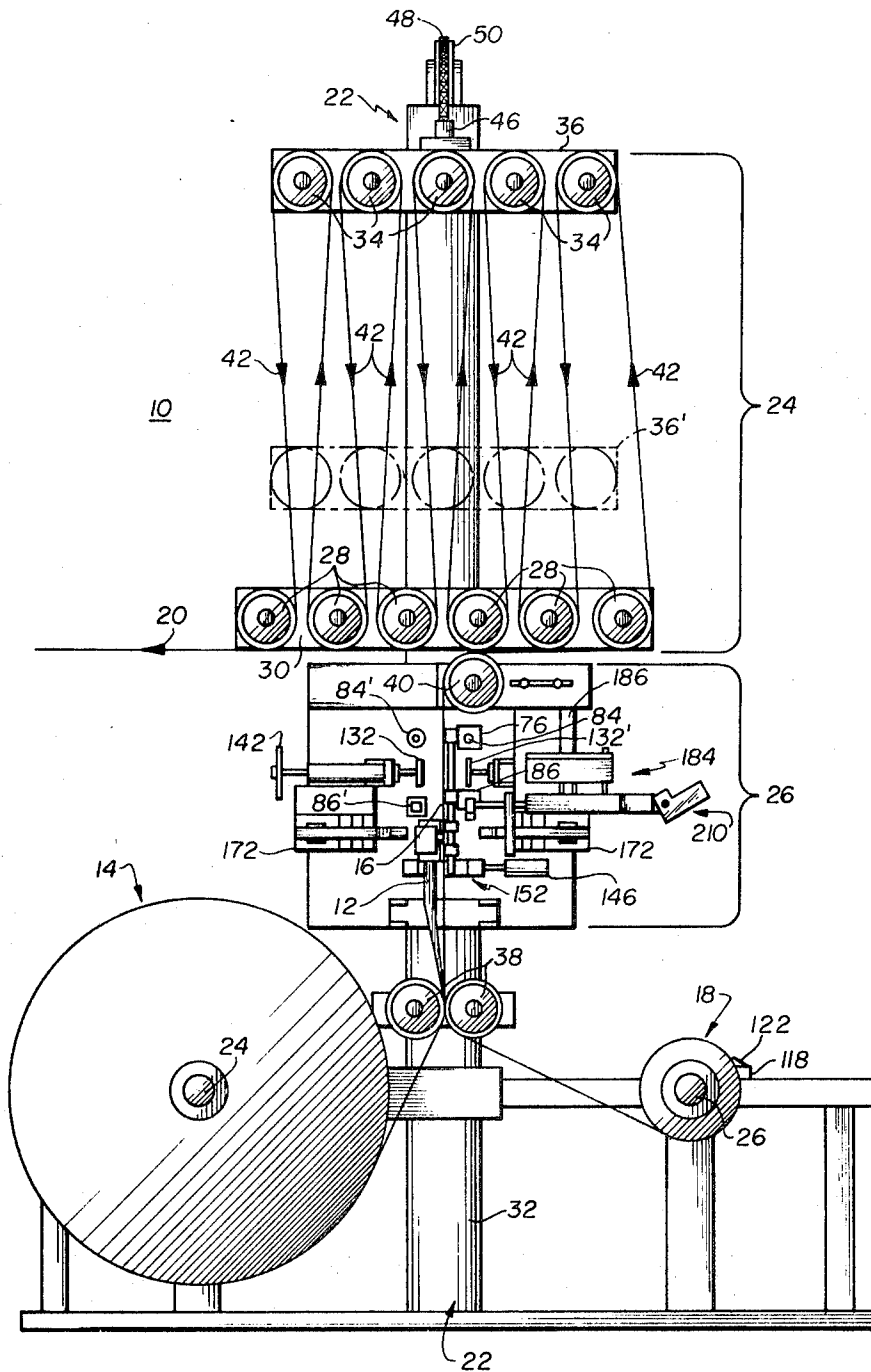


FIG. 1

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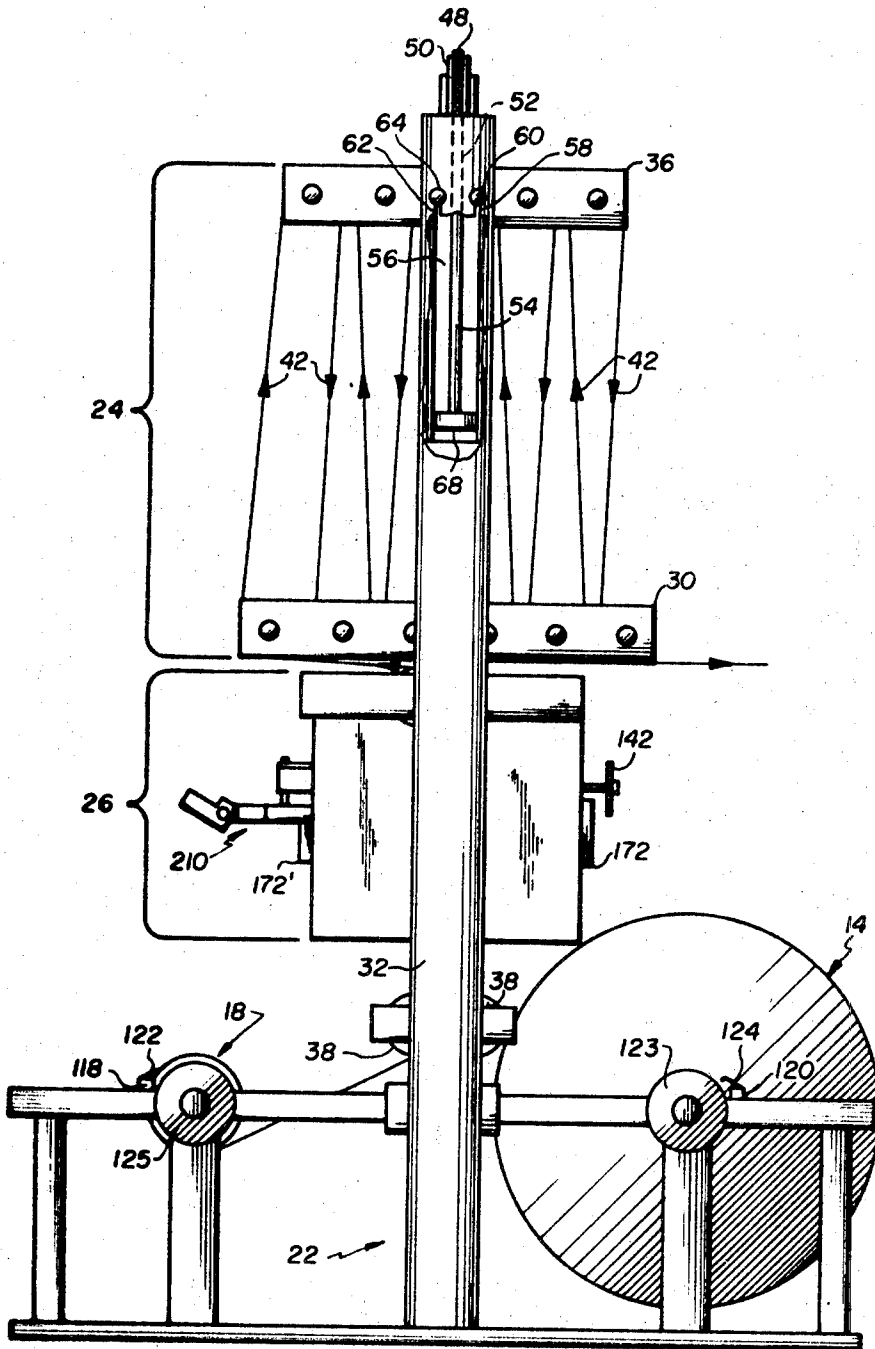


FIG. 2

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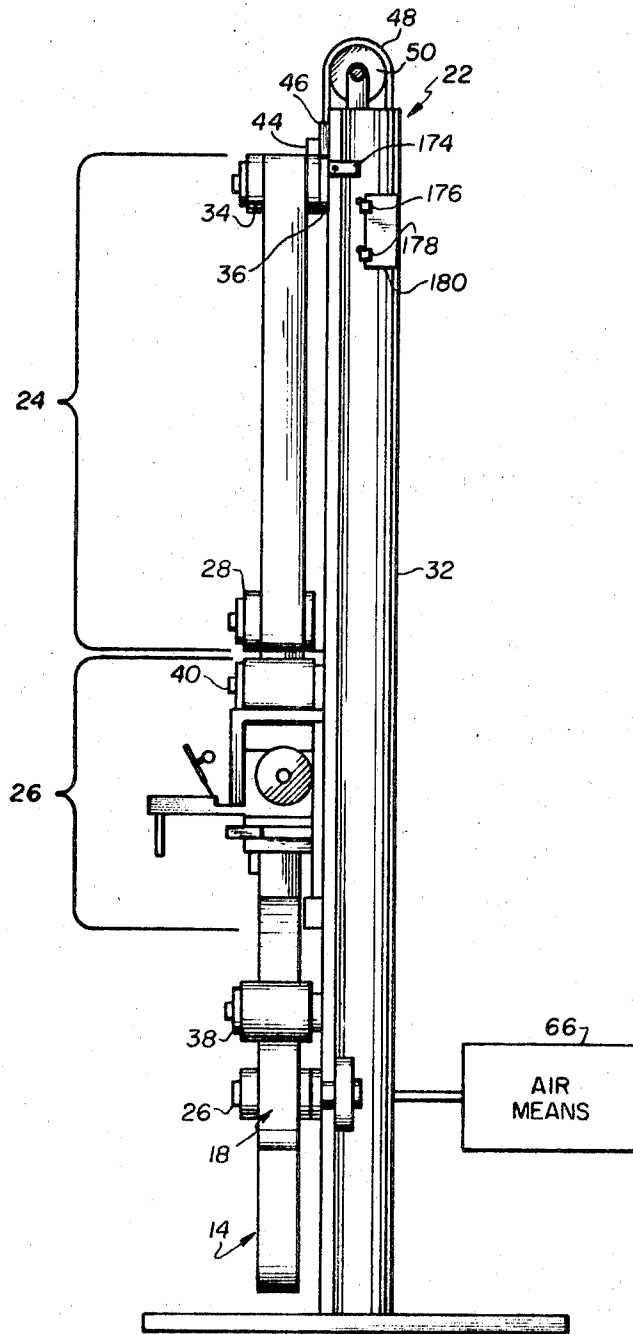


FIG. 3

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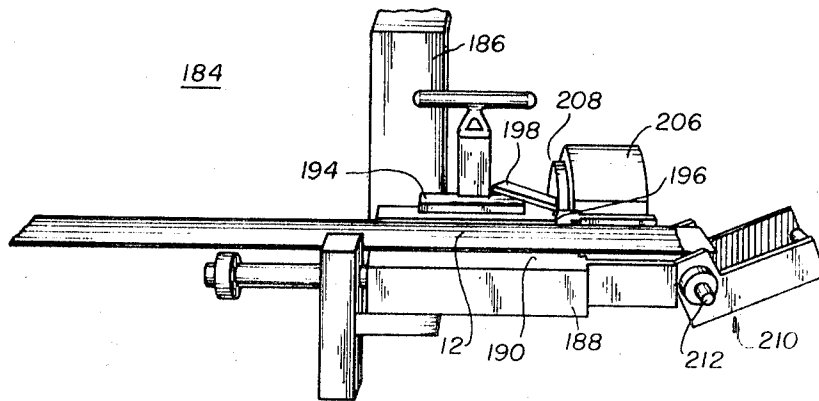


FIG. 4

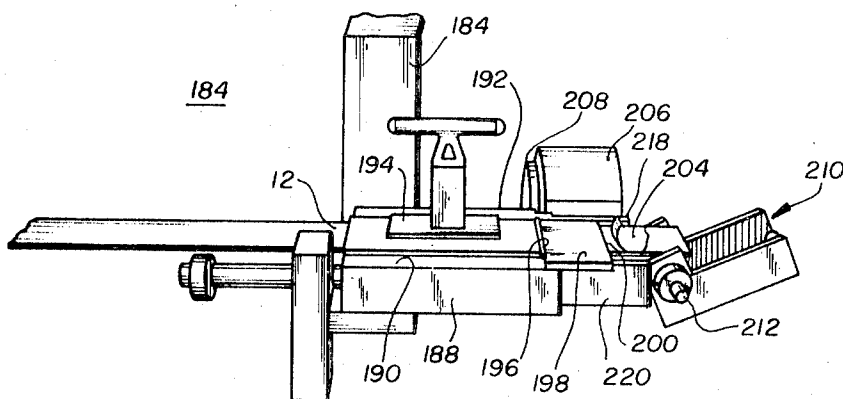


FIG. 5

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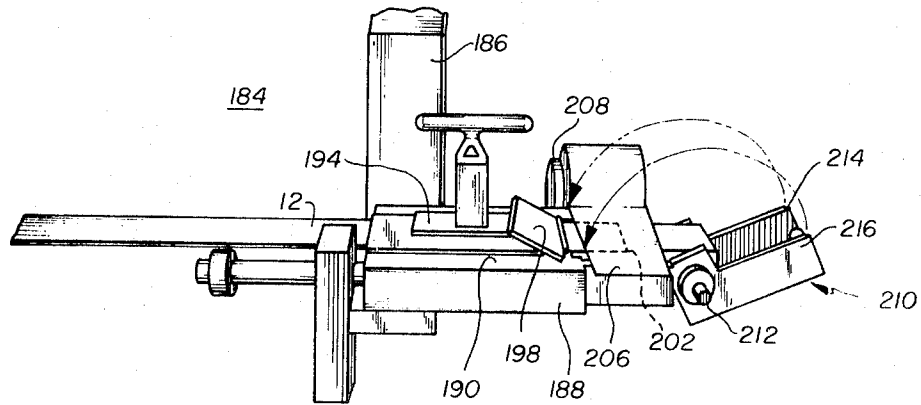


FIG. 6

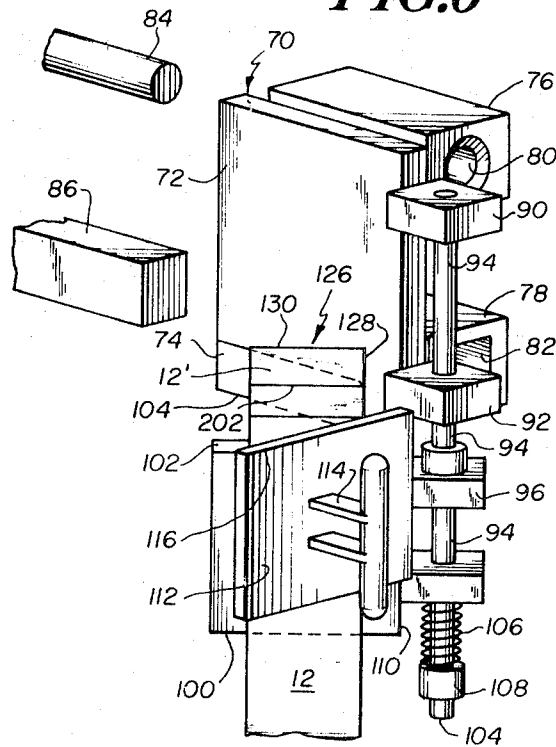


FIG. 7

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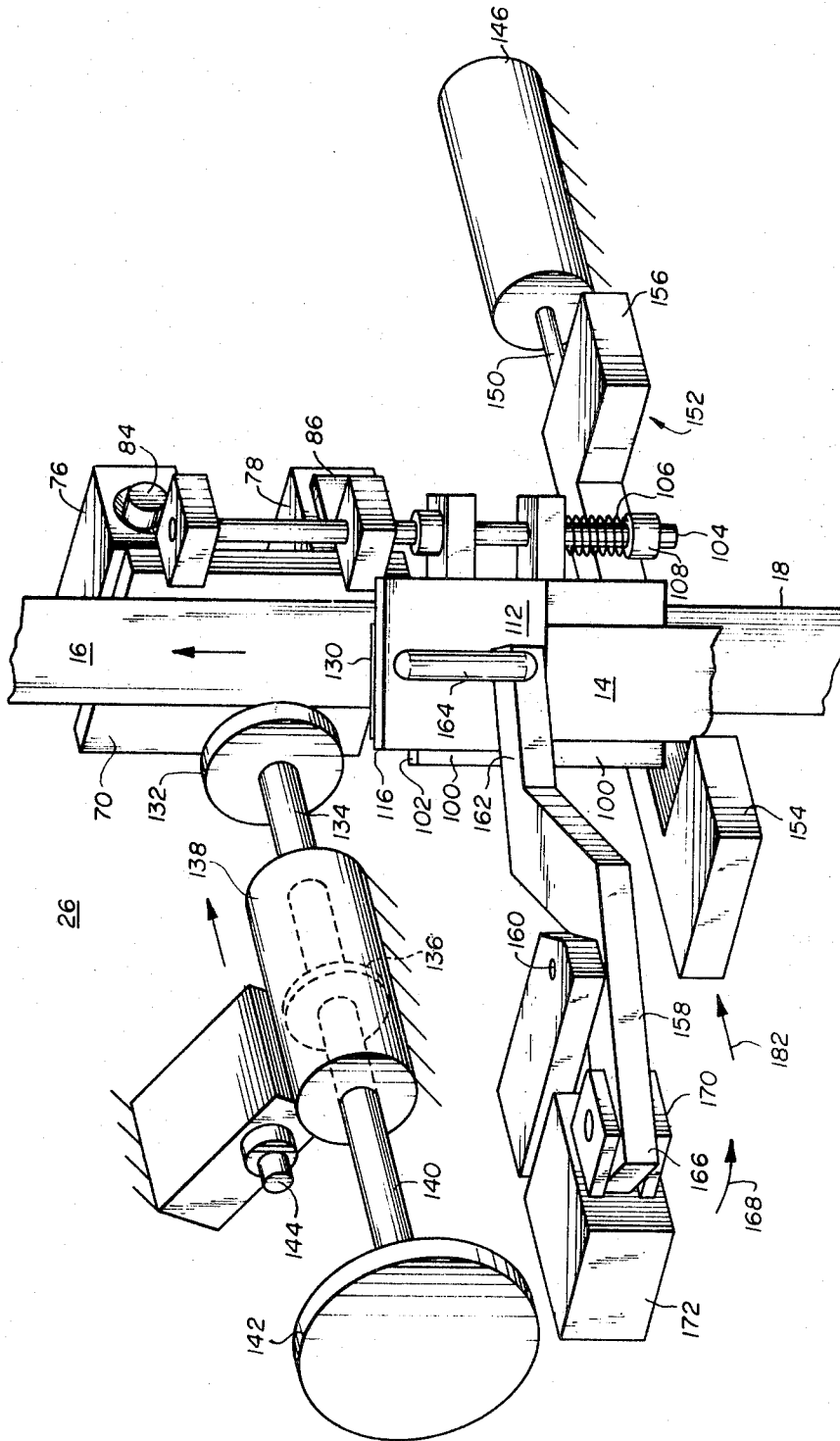


FIG. 8

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WEB-SPLICING APPARATUS

BACKGROUND OF THE INVENTION

This invention relates to splicing apparatus and more particularly to apparatus for automatically splicing the beginning of one roll of paper or the like on to the approximate end of a second roll of paper of like material without discontinuing the flow of paper to a utilizing device.

In many manufacturing processes it is desirable and indeed sometimes necessary that a particular utilizing device be permitted to feed upon a continuous supply of a stocked material being utilized in the process. For example, in the manufacture of paper-wound electrical cable, it is necessary to spirally intertwine continuously flowing insulating paper with continuously flowing wire to be insulated thereby. However, the length of paper which can be stored on a conventional roll is substantially less than the length of cable which can be stored on large spools which are conventionally utilized in industry. Consequently, there has always been a problem in this industry of how to deal with the differing lengths of stock material, especially at the critical time when the shorter supply (the paper) expires before the longer supply (the wire). A similar problem exists in all industries where basic stocked materials are available in different lengths.

One answer to this problem is simply to halt the intertwining process (or other manufacturing process involved) while a new supply roll of paper is introduced. However, the "downtime" which results is time consuming, expensive and in some processes can not be tolerated at all because of the technical problems involved.

A second solution which has been experimented with for many years is to provide some means for automatically joining or splicing the beginning end of a new roll of paper to the trailing end of the exhausted roll of paper without discontinuing the flow of paper. Unfortunately, until the present invention, such attempts have failed to produce automatic splicing apparatus which is sufficiently simple, reliable, and inexpensive to justify its use to overcome the problem sought to be eliminated thereby.

SUMMARY OF THE INVENTION

The instant invention is, in fact, directed to such apparatus which can automatically splice the beginning end of one roll of paper or the like onto the approximate end of a second roll of paper or the like without discontinuing the flow of paper to a utilizing device. As will be seen, the automatic splicing apparatus of the instant invention is relatively simple and therefore inexpensive to manufacture and operate, and effectively eliminates the problems which have persisted in all industries faced with unequal lengths of basic materials utilized in a manufacturing process.

In its broader aspects, and as will be described in greater detail, the automatic splicing apparatus of the instant invention includes a support stand having means for supporting first and second rolls of paper in rotatable relationship therewith. Also carried on the support stand is a festooner arrangement including at least one set of displaceable rollers for establishing an elongated path of travel for paper of the exhausting roll moving through the apparatus, and for allowing the utilizing device to feed upon the paper carried by the festooner when the second, exhausting roll of paper has stopped rotating to initiate the automatic splicing operation.

Once the exhausting roll of paper has stopped rotating and during the time that the displaceable rollers of the festooner are continually shortening the aforementioned elongated path of travel, such that the utilizing device still has a supply of paper upon which to feed; the clamping, severing, and splicing assembly of the invention performs three functions. First, the clamping mechanism thereof clamps the paper of the exhausting roll between itself and a backing plate positioned on the opposite side of the path of travel of the paper. Second, and virtually immediately after the clamping operation, the severing portion of the clamping, severing and splicing assembly

severs the exhausting roll of paper at a location beneath the position at which the trailing end of the exhausting roll is maintained by the clamp. Third, and virtually simultaneously with the aforescribed severing, the splicing portion of the clamping, severing and splicing assembly joins the previously treated beginning end of the new roll of paper with the severed end of the exhausted roll of paper. Finally, once the clamping, severing and splicing assembly is reset, such that the clamping portion thereof is released from the trailing end of the exhausted roll of paper, the new roll of paper will begin to flow through the festooner rollers and on to the utilizing device.

It will be appreciated that by virtue of the displaceable festooner rollers, which permits the utilizing device to feed upon the paper carried thereby during the clamping, severing and splicing operation, there will be a noninterrupted, continuous flow of paper to the utilizing device during the changeover operation.

As a particularly advantageous feature of the instant invention, the clamping, severing and splicing assembly is, with the exception of the actual clamp thereof, removable supported by the support stand of the apparatus such that the previously treated end of the new roll of paper can be conveniently inserted therein at a location relatively far removed from its generally inaccessible operating position in the path of movement of paper through the apparatus.

As a further feature of the instant invention, there is provided a preparing apparatus or subassembly by which the beginning end of the new roll of paper can be simply, easily and quickly prepared for subsequent joining to the trailing end of the exhausted roll of paper. As will be described in greater detail, such preparing subassembly comprises a compact multifunction arrangement of cutting and trimming members which makes it a relatively simple matter for even untrained personnel to properly prepare the beginning end of new rolls of paper.

As a further feature of the instant invention, the apparatus hereof is provided with certain duplicative portions by which an endless number of fresh supply rolls of paper may be automatically joined to the previously exhausted rolls of paper even though exhausting rolls of paper alternately appear at opposite reels of the support stand.

Accordingly, it is an object of the instant invention to provide apparatus for automatically splicing the beginning of one roll of paper on like material onto the approximate end of a second roll of paper or like material without discontinuing the flow of paper to a utilizing device.

Another object of the instant invention is to provide such automatic splicing apparatus which includes festooner means carried by a support stand thereof for establishing an elongated path of travel of paper of the second roll moving through the apparatus and for allowing the utilizing device to feed upon the paper carried by said festooner when the second roll of paper has stopped rotating to permit a new roll of paper to be joined thereto.

Another object of the instant invention is to provide such an automatic splicing apparatus which includes clamping, severing and splicing means operative during the period of time that displaceable rollers of the festooner are shortening said elongated path, for clamping the paper of the second roll at a first position, severing the paper of the second roll at a second position below the first position, and for splicing the previously treated beginning end of the new roll of paper onto a trailing end of the exhausting roll of paper.

Still another object of the instant invention is to provide such an automatic splicing apparatus in which the aforementioned clamping, severing and splicing apparatus is removably supported with respect to the support stand of said apparatus such that the previously treated beginning end of the new supply of paper may be conveniently inserted therein at a position removed from the relatively inaccessible operating position of said clamping, severing and splicing assembly.

Yet another object of the instant invention is to provide preparing apparatus for quickly, simple and easily preparing

the beginning end of a new supply of paper for subsequent joining to the trailing end of an exhausting roll of paper.

These and objects of the instant invention and a better understanding thereof may be had by referring to the following description and drawings in which:

FIG. 1 is a front view of the automatic splicing apparatus of the instant invention;

FIG. 2 is a rear view of the apparatus of FIG. 1;

FIG. 3 is an end view of the apparatus of FIG. 1;

FIGS. 4, 5 and 6 illustrate the paper-preparing apparatus of the instant invention and the consecutive steps that are required to prepare the beginning end of a first roll of paper for subsequent joining to a second or exhausting roll of paper being utilized in conjunction with the splicing apparatus of FIG. 1; and

FIGS. 7-10 illustrate in detail the clamping, severing and splicing assembly of the instant invention and the sequential steps of operation by which the previously treated beginning end of a roll of paper may be automatically joined to the trailing end of an exhausted roll of paper carried by the apparatus shown in FIG. 1.

Turning to the Figures, wherein like numerals are used to designate like elements, and with specific reference to FIG. 1, there is shown the automatic splicing apparatus 10 of the instant invention by which the previously treated beginning end 12 of a new roll of paper 14 may be quickly and automatically joined to the approximate end 16 of a virtually exhausted roll 18 of paper of like material without discontinuing the flow of paper to a utilizing device (not shown) but whose location is depicted by the arrowhead 20 associated with the flow of paper through the apparatus 10. The designation "approximate" end 16 of the exhausted roll of paper 18 is intended to denote the fact that the beginning end 12 of the new roll of paper 14 will be joined to the paper of the exhausted roll 18, not at its actual end thereof, but at the point 16 substantially near the end of the paper on the roll 18.

Broadly speaking, the apparatus 10 includes a support stand 22 provided at its lower extremity with a pair of outstanding bearing axles 24 and 26 respectively by which the rolls of paper 14 and 18 may be rotatably carried by the stand. At its opposite extremity the support stand 22 carries a festooner arrangement broadly designated 24, while at an intermediate location, the support stand 22 carries clamping, severing and splicing means broadly designated 26, and to be described in greater detail.

The festooner, arrangement 24 includes a first set of rollers 28 rotatably carried by a common support bar 30 rigidly secured to a central postlike portion 32 of the support stand 22. The festooner 24 further includes a second set of rollers 34 rotatably carried by a common bar 36 slidably displaceable along the upright post portion 32 of the support stand 22. Although not illustrated in detail, it might be noted that the common bar 36 may be slidably mounted along the central post portion 32 of the support stand 22 by any convenient mounting means such as an enlarged collar circumventing the post portion 32 or by being appropriately retained in a retaining channel or guide provided along the forward surface of the post portion 32. Regardless of the mounting arrangement being utilized, and as will be described in greater detail, the second set of rollers carried by the common bar 36 must be displaceable relative to the first set of rollers 28 as suggested by the phantom showing 36' in FIG. 1.

Thus it will be appreciated that the normal flow of paper through the apparatus 10 is from the exhausting roll 18, through a pair of positioning rollers 38, through the clamping, severing and splicing apparatus 26, around the freely rotating directional roller 40, then around the rollers 28 and 34 in the manner depicted by arrowheads 42, and finally to the utilization device (not shown) whose location is depicted by the arrowhead 20. Although not to be limited hereby, it may be noted that the utilization device may, as indicated previously, be a machine for spirally intertwining the paper passing through the apparatus 10 with electrical cable which machin-

ery is commonly utilized in the production of paper insulated electrical cable.

It can be appreciated thus far in the description, that the tortuous path defined by the rollers 28 and 34 of the festooner arrangement 24 establishes an elongated path of travel for the paper and in so doing, makes a considerable amount of paper available above the clamping, severing and splicing apparatus 26. Thus, and as will be further described, when the roll 18 has been just about exhausted, such that it is necessary to halt its rotation and initiate the changeover operation; by virtue of the downward displacement of the second set of rollers 34, this amount of paper carried in the festooner will become available for continuous supply to the utilizing device. During this displacement, the clamping, severing and splicing assembly 26 will join the beginning end 12 of the roll 14 to the approximate end 16 of the exhausted roll of paper 18. Thus and in accordance with the basic concept of this invention, the new supply of paper on the roll 14 will be quickly moving through the apparatus 10 and be supplied to the utilizing device without any interruption having taken place during the changeover.

Turning to the details of the festooner arrangement 24 and with specific reference to FIGS. 1 through 3, the upper displaceable bar 36 thereof has connected thereto, at a point generally designated 44 in FIG. 3, one end 46 of a chain or other suitable connecting member 48 which passes over a guide pulley 50, and into the hollowed-out central portion 32 of the stand 22 where its opposite end 52 (see FIG. 2) is connected to one end of a piston 54 which resides within a cylinder 56. The cylinder 56 includes an inlet port 58 provided with a conventional one-way check valve 60 and an outlet port 62 similarly provided with a conventional one-way check valve 64.

In operation, compressed air is supplied from a source broadly designated 66 in FIG. 3 through the inlet port 58 and against the enlarged piston head 68 of the piston 54. The pressure is maintained at a sufficient magnitude to just counterbalance the upward force on the piston 54 generated by the weight of the common bar 36 with the rollers 34 thereon and the tension force downwardly applied to the common bar 36 by virtue of the pull applied by the utilizing device on the paper passing through the apparatus. It will be appreciated that the one-way check valve 60 permits the entry of air under pressure into the cylinder 56 but prevents a reverse flow, while the one-way check valve 64 performs a similar function with respect to the exhausting of air from the cylinder 56 and in addition is so constructed to permit the buildup of sufficient counterbalancing air pressure against the piston head 68.

It will thus be appreciated that during normal operation of the apparatus 10, that is with the paper from roll 18 passing therethrough, the displaceable rollers 34 will be maintained in the solid line position illustrated in FIG. 1. However, and as is about to be described, when the roll of paper 18 is virtually exhausted, such that it is necessary to halt its rotation to initiate the changeover operation, there is a substantially greater downward force applied on the rollers 34. This increased downward force is, of course, generated by virtue of the fact that the exhausting roll of paper 18 has now stopped rotating, while the pull on the paper passing through the festooner arrangement 24 remains substantially the same. As a result, the upward forces applied to the piston 54 (FIG. 2) exceeds the counterbalancing force applied by the pressure from the source 66 whereby the piston 54 begins to rise (and cylinder 54 is exhausted through the one-way check valve 64 and exit port 62). In this manner, as the utilizing device continues to pull on the paper carried by the festooner, the displaceable rollers 34 are free to approach the stationery rollers 28. It is during this downward displacement of the rollers 34, that the extra length of paper which was established by the tortuous path over the rollers 28 and 36, becomes available for feeding the utilizing device while the changeover operation, takes place.

To initiate the above-described process, there is provided on the support stand 22 adjacent the axles 24 and 26 at a predetermined diametric distance therefrom, a pair of sensing switches 118 and 120 (See FIG. 2). Each of the switches include a sensing finger 122 and 124 respectively, which is normally biased to engage the rear surface of the roll of paper positioned therebefore. Thus, when the roll of paper 18 is virtually exhausted, and its diameter becomes sufficiently small to no longer restrain the sensing finger 122, the normally open circuit established thereby (not shown) will close to energize appropriate braking means (not shown in detail but suggested at 123 and 125 respectively) to halt the rotation of the roll 18. As indicated previously, when the roll 18 is halted; the continued pull indicated by the arrowhead 20 will, with the "permission" of the exhausting cylinder 56 of FIG. 2, begin to move the rollers 34 toward the rollers 28, thereby providing a continuous flow of paper to the utilizing device during the changeover operation about to be described.

As best seen in FIGS. 7 through 10, the clamping, severing and splicing assembly 26 includes a backing plate 70 rigidly secured at opposite ends 72 and 74 thereof to a pair of support blocks 76 and 78 respectively. As will be explained in greater detail, blocks 76 and 78 are provided with elongated central passageways 80 and 82 respectively by which the major portion of the clamping, severing and splicing apparatus 26 may be removably secured to the support stand 22 by virtue of the appropriately shaped outstanding support bars 84 and 86 thereof.

Secured to a longitudinal edge 88 of the backing plate 70 is a pair of axle-bearing blocks 90 and 92 which include apertures within which is freely rotated an elongated axle 94. The lower portion of the axle 94 passes freely through a pair of arms 96 and 98 which are secured at their inner extremity to a baseplate 100. By virtue of this arrangement, it will be appreciated that the base plate 100 is freely rotatable about the axis 94 from the position indicated in FIG. 7 to a position which lies in the same plane as the backing plate 70. In fact, and as will be further described, the coplanar mounting arrangement is utilized to effectuate a severing operation in the sense that an upper edge 102 of the base plate 100 coacts with a lower edge 104 of the backing plate 70 to sever the paper of the exhausting roll as the baseplate 100 rotates into the plane of the backing plate 70. A small return spring 106, one end of which is secured to a locknut 108 and the opposite end of which is secured to the arm 98, continually biases the baseplate 100 toward the position shown in FIG. 7. Pivotaly secured along a longitudinal edge 110 of the baseplate 100 is a gripping plate 112 the purpose of which is to grip the previously treated beginning end 12 of the new roll of paper 14 between itself and the baseplate 100. The gripping plate 112 is preferably mounted on the baseplate 100 by means of a spring biased togglelike overcenter linkage (not shown) by which the plate 112 can be selectively positioned in either the open position illustrated in FIG. 7 or its gripping position in which the plate 112 lies in intimate abutting contact with the upper surface of the baseplate 100. It will also be apparent from FIG. 7, and for purposes to be further discussed, that an upper portion 116 of the gripper plate 112 extends beyond the upper edge 102 of the baseplate 100 and actually overlaps a portion of the backing plate 70.

As suggested in FIG. 7, when the gripping plate is rotated to its open position, the beginning end 12 of the new roll of paper 14 may be inserted between the gripping plate and base plate 100. Passing over for the moment, the manner in which the beginning end 12 is prepared, it is sufficient to note at this point that the beginning end is provided with a length of adhesive material (only the underside of which is adhesive) such as cellophane tape 126 which includes a forward portion 128 extending beyond the forwardmost edge 12' of the paper. In placement, and as will be further described, the beginning end 12 is inserted between the gripping plate 112 and baseplate 100 such that the forwardmost edge 130 of the forward portion 128 of the tape 126 coincides with the leading edge 116 of the

gripper plate 112 when the gripper plate is rotated from its open position of FIG. 7 to its grasping position illustrated in FIG. 8. In this manner, the exposed adhesive undersurface of the forward portion 128 of the tape segment 126 will extend beyond the upper edge 102 of the baseplate 100 and will thereby be available for engagement with the trailing end 16 of the exhausting roll of paper 18 when, as will be described, the baseplate 100 with the gripper plate 112 carried thereby are rotated as a single unit from the position of FIG. 8 to the severing and splicing position of FIG. 9.

In FIG. 8, wherein the assembly comprising the backing plate 70, baseplate 100, and gripping plate 112 has been positioned on the support bars 84 and 86 of the support stand 22, there is illustrated the remainder of the clamping, severing and splicing mechanism 26. Specifically, the clamping, severing, and splicing mechanism 26 further includes a clamp 132 carried at one end of a piston 134 driven by a piston head 136 positioned within a conventional double-acting pneumatic cylinder 138. Secured on the opposite side of the piston head 136 is an actuating rod 140 the outer end of which carries a disclike actuating plate 142 the function of which is to engage a microswitch 144 when the clamp 132 is moved from the nonclamping position of FIG. 8 to the clamping position of FIG. 9.

Also shown in FIG. 8 is the driving mechanism for rotating the baseplate 100 and gripper plate 112 from the position of FIG. 8 to the severing and splicing position of FIG. 9. Specifically, the driving mechanism includes a double-acting pneumatic cylinder 146 the piston stem 150 of which is connected to a generally U-shaped actuating member 152 which is slidably movable on the support stand 22 between the positions illustrated in FIG. 8 and FIG. 9. The U-shaped member 152 includes the outstanding arms 154 and 156 which rotate the baseplate 100 and the gripper plate 112 from the position of FIG. 8 to the position of FIG. 9. It will be understood that in the embodiment illustrated in the present drawings, it is the arm 154 which is functional whereas, and as will be further explained, it would be the arm 156 which would be functional were the apparatus being used to replace an exhausting roll of paper 14 in FIG. 1 with a new roll of paper 18.

Illustrated in FIG. 10 is the driving mechanism for rotating the gripper plate 112 from its position of FIG. 9 to its open position of FIG. 10. Such driving mechanism includes a bell-crank-type lever member 158 pivotally secured about a fulcrum point 160. One end of the lever 158 is provided with a hooklike termination 162 which engages the undersurface of the handle 164 of the gripper plate 112 to rotate same to its open position when the opposite end 166 of the lever 158 is rotated in the direction of the arrow 168 by a pull on the operating member 170 generated by an electromagnet 172.

To control, in proper sequence, the various mechanisms which have been described with respect to FIGS. 7 through 10, there is provided on the displacable common bar 36 (See FIG. 3), an extending actuating finger 174 which will sequentially engage microswitches 176 and 178 carried by a stationery block 180 as the displacable bar 136 moves from the solid line of FIG. 1 toward its phantom showing 36'. By conventional electrical and pneumatic circuits, the closing of microswitch 176 of FIG. 3, will result in a supply of actuating fluid to the left side of doubled-ended cylinder 138 of FIG. 8 such that the clamp 132 will be moved from its nonclamping position of FIG. 8 to its clamping position of FIG. 9.

As noted previously, during the movement of the clamp 132, the rear disclike plate 142 will engage the microswitch 144. When switch 144 is closed, conventional electrical and pneumatic circuits will direct supply fluid to the left side of double-acting cylinder 146 which in turn will pull the U-shaped actuating member 152 from its position shown in FIG. 8 to the position shown in FIG. 9 during which movement the baseplate 100 and gripping plate 112 will be rotated to the position shown in FIG. 9.

Finally, when the actuating finger 174 of FIG. 3 reaches the second microswitch 178, an appropriate circuit will be closed

to energize the electromagnet 172 which in turn will rotate the bellcrank-type lever 158 such that its projecting end 162 will rotate the gripper plate 112 from the position of FIG. 9 to its open position illustrated in FIG. 10. Simultaneously, the closing of the second microswitch 178 of FIG. 3 will, by appropriate pneumatic circuits supply actuating fluid to the opposite side of the double-acting cylinder 138 of FIG. 7 to pull the clamp 132 away from the backing plate 70 and back to the position illustrated in FIGS. 8 and 10.

OPERATION

Having identified the basic components of the apparatus 10 of the instant invention, an overall description of operation will now be presented. It is assumed for the purposes of this immediate description that by virtue of the preparing subassembly 184 of FIGS. 4 through 6, the beginning end 12 of the new roll of paper 14 has been properly prepared and provided with the previously mentioned adhesive tape section 126 the undersurface of the forward portion of which extends beyond the most forward edge 12' of the beginning end 12 of the new roll of paper. Thus, during the flow of paper from the roll of paper 18 through the apparatus 10 of FIG. 1, the previously prepared beginning end 12 of the new roll of paper is inserted between the gripper plate 112 and the baseplate 100 (FIG. 7). As a particular advantage of the instant invention, and by virtue of the fact that the assembly including the backing plate 70, baseplate 100 and gripping plate 112 is removable from the support stand, the insertion of the beginning end 12 between members 100 and 112 may take place at any convenient location relatively removed from their generally inaccessible operating position.

As noted, the placement of the beginning end 12 between the members 100 and 112 is such that the forward leading edge 130 of the forward tape portion 128 is intended to coincide with the leading edge 116 of the gripper plate 112. Leading edge 116 is, as noted previously, forward of the leading edge 102 of the baseplate 100 and in effect overlaps a portion of the backing plate 70. When the beginning end 12 is properly placed, the gripper plate 112 is rotated to securely grasp the beginning end 12 between itself and the baseplate 100. (See FIGS. 7 and 8).

Next, the subassembly including the backing plate 70, the baseplate 100 and the gripper plate 112 is placed in operating position on the support stand 22 by being slid onto the support bars 84 and 86 respectively. It will be appreciated that in the operating position (perhaps best illustrated in FIG. 1), the paper of the exhausting roll 18 flows up from the directing rollers 38 and through the V-like arrangement illustrated in FIG. 8 and defined by the backing plate 70 and the baseplate 100. As illustrated in FIG. 1, the exhausting paper then continues on around the directing roller 40, around the rollers 28 and 34 of the festooner 24 and on to the utilizing device.

Let it be assumed now that the roll 18 of FIG. 1 is becoming exhausted such that it is desired to introduce a new roll of paper 14 without discontinuing the flow of paper to the utilizing device. When the exhausting roll of paper 18 dwindles down to a diameter less than the diametric location of the microswitch 118, the sensing finger 122 thereof is freed to establish the necessary circuit to energize the braking device 125 of FIG. 2 to halt the rotation of the roll of paper 18. As previously described, once the rotation of roll 18 is halted, the continued pull of the utilizing device on the paper, exerts a substantially greater downward force on the rollers 34 whereby the common bar 36 begins its downward displacement toward the stationary rollers 28. During such downward displacement, and while the changeover operation takes place, the additional paper carried by the festooner 24 new becomes available for utilization in the manufacturing process.

As the common bar 36 descends, and with reference to FIG. 3, the extending finger 174 initially contacts the microswitch 176. The circuit made thereby, directs actuating fluid into the

double-ended cylinder 138 to drive the clamp 132 from its position of FIG. 8 to its clamping position of FIG. 9 in which it clamps the approximate end 16 of the exhausting roll of paper 18 between itself and the backing plate 70. Therefore, when the very tail end of the approximate end 16 of the exhausting roll of paper 18 is severed in the manner to be immediately described, the clamp 132 will still maintain the end 16 firmly in place.

As noted previously, as the clamp 132 is moving toward its clamping position, the rearwardly disposed disclike plate 142 engages the microswitch 144 to energize appropriate circuitry to direct actuating fluid into the double-acting cylinder 146 to which draws the U-shaped actuating member 152 from the position shown in FIG. 8 toward the position illustrated in FIG. 9. During its movement, the outstanding leg 154 thereof engages the baseplate 100 to rotate both the gripper plate 112 and the baseplate 100 from the position shown in FIG. 8 to the severing and splicing position illustrated in FIG. 9. The severing is accomplished when the baseplate 100 enters the plane of the backing plate 70 during which the upper edge 102 of the baseplate 100 and the lower edge 104 of the backing plate 70 coact to define a shearing arrangement which cuts the approximate end 16 of the paper of the roll 18 from the supply which is left on the bearing roller 26 of FIG. 1 (it being appreciated that the clamp 132 maintains the end 16 against the plate 70).

As the severing is taking place, and at virtually the same time, the overlapped extending portion 116 of the gripper plate 112 will urge the adhesive undersurface of the forward portion 128 of the tape segment 126 into adhesive contact with the trailing edge of the approximate end 16 of the previous roll of paper (See FIG. 10). Thus, the beginning end of the new roll 14 is spliced onto the trailing end of the old roll 18. Both the severing and splicing operation takes place in FIG. 9 of the drawings.

Finally, with the splicing complete, the extending actuating finger 174 of FIG. 3 reaches the second microswitch 178 carried by the stationary block 180 to close the necessary circuit to energize the solenoid 172. As illustrated in FIG. 10, with the solenoid 172 energized, the pivoting lever 158 is rotated clockwise about the fulcrum 160 whereby its forward hook-shaped portion 162 kicks only the gripper plate 112 back to its open position illustrated therein. Simultaneously the closing of microswitch 178 energizes appropriate circuitry to direct operating fluid into the right side of double-ended cylinder 138 to withdraw the clamp 132 such that the trailing end of the old roll of paper and the beginning end of the new roll of paper, spliced thereto, can continue flowing through the apparatus. It will be appreciated, that with paper flowing through the apparatus once again, the net downward force on the displaceable rollers 34 is reduced such that the common bar 36, under the influence of the fluid in the cylinder 54 of FIG. 2, will slowly return to its solid line position of FIG. 1.

The flow of paper from the roll 14 continues through the apparatus 10 until it is nearly exhausted at which time the release of the sensing finger 124 of the microswitch 120 (FIG. 2) will initiate a new changeover operation in which the beginning end of a brand new roll of paper placed on the bearing axle 26 of FIG. 1 will be automatically joined to the approximate end of the now old roll of paper 14. The new changeover operation is essentially the same as the old. The only difference is that a new clamping, splicing and severing apparatus (not shown) which is the mirror image of the apparatus illustrated in FIG. 7, will be situated on the duplicative support bars 84' and 86' illustrated in FIG. 1. Similarly, the numbers 132' and 172' indicate the additional duplicative parts which are required to perform the clamping, severing and splicing operation when it is the roll of paper on the bearing 24 which is exhausting and it is the roll of paper on the bearing axle 26 which is to be spliced thereto.

Thus, by alternately using identical, but mirror image apparatus of the type illustrated in FIG. 7, in conjunction with certain duplicative parts illustrated in FIG. 1, it is possible to

continuously splice the beginning end of one roll of paper to the trailing end of an exhausting roll of paper without interrupting the flow of paper to a utilizing device.

Turning to FIGS. 4, 5, and 6 there is illustrated the apparatus for preparing the beginning end of one roll of paper for subsequent joining to the trailing end of an exhausting roll of paper. This apparatus is broadly designated 184 in FIGS. 4 through 6 and as seen in FIG. 1, is preferably secured to the support stand 22 by means of a support bracket 186.

The preparing apparatus includes a support plate 188 along the upper surface 190 of which may be laid the beginning end 12 which is to be prepared for subsequent joining. Pivotally secured along one longitudinal edge 192 of the upper surface 190 of the support plate 188 is a grasping plate 194 which is pivotally rotatable from the open position of FIG. 4 to the grasping position of FIG. 5 in which the beginning end 12 is firmly held against the upper surface 190 of the support plate 188.

Pivotally secured along a transverse edge 196 of the gripper plate 194 is an edge preparing plate member 198 which may be rotated from the nonoperative position of FIG. 4 to the operative position of FIG. 5 in which a straight edge 200 is available for guiding a knife or razor whereby a clean edge 202 (See FIG. 6) can be provided and the excess paper 204 can be easily removed.

After the cut has been made, the edge-preparing plate member is rotated back to its nonoperative position (FIG. 6) and a length of tape 206 is drawn from a tape-dispensing means 208 across the end 202 of the beginning end 12 of the paper. Finally, a pivoting bifurcated trimming member 210 is rotated about an axis 212 such that its two leading edges 214 and 216 coact with two upstanding edges 218 and 220 respectively (FIG. 5) to trim the tape 206 such that it corresponds in width to the paper 12. When this is completed, the grasping plate 194 is lifted up and the prepared end of the paper (now bearing the tape section identified as 126 in FIG. 7) may be inserted into the clamping, severing and grasping apparatus illustrated therein. It will be appreciated that the preparing apparatus 184 illustrated in FIGS. 4 through 6 makes it a relatively simple matter for even unskilled personnel to prepare the beginning end of a new roll of paper.

Thus there has been described novel, automatic splicing apparatus for joining the beginning end of a new roll of paper to the trailing end of an exhausting roll of paper without discontinuing the flow of the paper to an alternate utilizing device. Although this invention has been described with respect to its preferred embodiments, it should be understood that many variations and modifications will now be obvious to those skilled in the art, and it is preferred, therefore, that the scope of the invention be limited, not by the specific disclosure herein, only by the appended claims.

I claim:

1. Apparatus for automatically splicing the beginning of one roll of paper or the like onto the approximate end of a second roll of paper or the like without discontinuing the flow of paper to a utilizing device;

said apparatus comprising:

a support stand, said stand having means for supporting said one roll of paper and said second roll of paper in rotatable relationship therewith;

festooner means carried by said support stand for establishing an elongated path of travel for paper of said second roll moving through said apparatus and for allowing said utilizing device to "feed" upon the paper carried by said festooner means when the second roll of paper has stopped rotating;

first sensing means for stopping the rotation of said second roll when a preselected amount of paper remains on said roll;

clamping, severing and splicing means responsive to the halt of said second roll for clamping the paper of said second roll at a first predetermined location, severing the paper of said second roll at a second predetermined location,

below said first predetermined location, and for joining the beginning of said one roll to the severed end of said second roll; and

releasing means responsive to the passage of a preselected time after said second roll has stopped rotating for resetting said clamping, severing and splicing means;

whereby said utilizing device will begin "feeding" on the paper of said one roll of paper; wherein said festooner means comprises:

a first set of rollers secured to said support stand in freely rotatable relation therewith;

a second set of freely rotatable rollers, said second set of rollers being freely displaceable relative to said first set of rollers when said second set of rollers approaches said first set of rollers;

said paper of said second roll alternately passing over rollers of said first and second sets to establish said elongated path;

operating means for maintaining said second set of rollers at a predetermined distance from said first set of rollers when said second roll of paper is rotating and feeding paper through said rollers of said first and second sets to said utilizing device, said operating means including means for permitting said second set of rollers to approach said first set of rollers in response to predetermined tension created on said paper by said utilizing device to thereby shorten said elongated path of travel and allow said utilizing device to "feed" upon the paper of said second roll which is supported by and between the rollers of said first and second sets when said second roll has stopped rotating.

2. The apparatus of claim 1 wherein said operating means includes:

pneumatic cylinder means;

piston means movable within said cylinder means;

one end of said piston means extending out of said cylinder means and being operatively connected to said second set of rollers;

pressure supply means for supplying a first predetermined fluid pressure against said piston means, said first predetermined pressure being sufficient to maintain said second set of rollers at said predetermined distance when said second roll of paper is rotating and feeding paper;

and pressure exhaust means for relieving the pressure in said cylinder means and allowing said second set of rollers to approach said first set of rollers when the pressure in said cylinder means exceeds a second predetermined fluid pressure due to the force applied to said second set of rollers when said second roll of paper stops rotating.

3. The apparatus of claim 1 wherein said clamping, severing and splicing means is operated in response to said second set of rollers traversing a first distance toward said first set of rollers.

4. The apparatus of claim 3 wherein said releasing means is operated in response to said second set of rollers traversing a second distance toward said first set of rollers.

5. The apparatus of claim 1 wherein said operating means includes:

pneumatic cylinder means;

piston means movable within said cylinder means;

one end of said piston means extending out of said cylinder means and being operatively connected to said second set of rollers;

pressure supply means for supplying a first predetermined fluid pressure against said piston means, said first predetermined pressure being sufficient to maintain said second set of rollers at said predetermined distance when said second roll of paper is rotating and feeding paper;

and pressure exhaust means for relieving the pressure in said cylinder means and allowing said second set of rollers to approach said first set of rollers when the pressure in said cylinder means exceeds a second predetermined fluid pressure due to the force applied to said second set of rollers when said second roll of paper stops rotating;

wherein said clamping, severing and splicing means is operated in response to said second set of rollers traversing a first distance toward said first set of rollers; and

wherein said releasing means is operated in response to said second set of rollers traversing a second distance toward said first set of rollers.

6. The apparatus of claim 1 wherein said clamping, severing and splicing means includes clamping means responsive to the halt of said second roll for clamping the paper of said second roll at said first predetermined location.

7. Apparatus for automatically splicing the beginning of one roll of paper or the like onto the approximate end of a second roll of paper or the like without discontinuing the flow of paper to a utilizing device;

said apparatus comprising:

a support stand, said stand having means for supporting said one roll of paper and said second roll of paper in rotatable relationship therewith;

festooner means carried by said support stand for establishing an elongated path of travel for paper of said second roll moving through said apparatus and for allowing said utilizing device to "feed" upon the paper carried by said festooner means when the second roll of paper has stopped rotating;

first sensing means for stopping the rotation of said second roll when a preselected amount of paper remains on said roll;

clamping severing and splicing means responsive to the halt of said second roll for clamping the paper of said second roll at a first predetermined location, severing the paper of said second roll at a second predetermined location, below said first predetermined location, and for joining the beginning of said one roll to the severed end of said second roll;

releasing means responsive to the passage of a preselected time after said second roll has stopped rotating for resetting said clamping, severing and splicing means; whereby said utilizing device will begin "feeding" on the paper of said one roll of paper;

wherein said clamping, severing and splicing means includes clamping means responsive to the halt of said second roll for clamping the paper of said second roll at said first predetermined location;

wherein said clamping means includes a backing plate positioned on the opposite side of said paper of said second roll; and

a power-driven clamp which grasps the paper of said second roll between itself and said backing plate.

8. The apparatus of claim 7 wherein said clamp is driven by pneumatic pressure.

9. The apparatus of claim 6 wherein said clamping, severing and splicing means includes severing means responsive to the operation of said clamping means for severing the paper of said second roll at said second predetermined location below said first predetermined location.

10. The apparatus of claim 7 wherein said clamping, severing and splicing means includes severing means responsive to the operation of said clamping means for severing the paper of said second roll at said second predetermined location below said first predetermined location; and

said severing means comprising a baseplate an upper edge of which coacts with a lower edge of said backing plate to sever the paper of said second roll as the plane of said baseplate enters the plane of said backing plate.

11. The apparatus of claim 10 wherein said baseplate is pivotally rotatable between a first position out of the plane of said backing plate and a second cutting position in the same plane as said backing plate.

12. The apparatus of claim 11 wherein said severing means includes pneumatic operating means responsive to the operation of said clamping means for rotating said baseplate between its first and second position.

13. The apparatus of claim 9 wherein said clamping, severing and splicing means includes splicing means responsive to the operation of said severing means for joining the previously prepared beginning end of said one roll of paper to the severed end of said second roll of paper.

14. The apparatus of claim 10 wherein said clamping, severing and slicing means includes splicing means responsive to the operation of said severing means for joining the previously prepared beginning end of said one roll of paper to the severed end of said second roll of paper;

said splicing means comprising a gripping plate carried by and movable with said baseplate for gripping the previously prepared beginning end of said one roll between said gripping plate and said baseplate;

said gripping plate including a portion which overlaps a portion of said backing plate to urge the previously treated beginning end of said one roll of paper into adhesive contact with the severed end of said second roll of paper as said baseplate enters the plane of said backing plate.

15. The apparatus of claim 14 wherein said gripping plate is pivotally rotatable on said baseplate between a first, open, position in which said previously treated end of said one roll can be inserted between said gripping plate and said baseplate, and a second gripping position in which said previously treated end of said one roll is frictionally maintained between said gripping plate and said baseplate.

16. The apparatus of claim 14 wherein said baseplate is pivotally rotatable between a first position out of the plane of said backing plate and a second cutting position in the same plane as said backing plate; and

wherein the axis of rotation of said baseplate is secured to said backing plate;

whereby said backing plate, baseplate, and gripping plate carried thereby together define a clamp, sever and splice assembly which together with said power-driven clamp constitutes said clamping, severing and splicing means.

17. The apparatus of claim 16 wherein said gripping plate is pivotally rotatable on said baseplate between a first, open, position in which said previously treated end of said one roll can be inserted between said gripping plate and said baseplate, and a second gripping position in which said previously treated end of said one roll is frictionally maintained between said gripping plate and said baseplate; and

wherein said support stand includes means for removably supporting said clamp, sever, and splice assembly in predetermined position with respect to the path of movement of said paper of said second roll of paper;

whereby said clamp, sever, and splice assembly can be removed from its predetermined position when it is desired to rotate said gripping plate to its first position and insert said previously treated beginning end of said one roll between said gripping plate and said baseplate.

18. The apparatus of claim 15 wherein said releasing means includes operating means for rotating said gripping plate between its gripping position and its open position after said previously treated beginning end of said one roll of paper has joined in adhesive contact with the severed end of said second roll of paper.

19. Apparatus for automatically splicing the beginning of one roll of paper or the like onto the approximate end of a second roll of paper or the like without discontinuing the flow of paper to a utilizing device;

said apparatus comprising:

a support stand, said stand having means for supporting said one roll of paper and said second roll of paper in rotatable relationship therewith;

festooner means carried by said support stand for establishing an elongated path of travel for paper of said second roll moving through said apparatus and for allowing said utilizing device to "feed" upon the paper carried by said festooner means when the second roll of paper has stopped rotating;

first sensing means for stopping the rotation of said second roll when a preselected amount of paper remains on said roll;

clamping severing and splicing means responsive to the halt of said second roll for clamping the paper of said second roll at a first predetermined location, severing the paper of said second roll at a second predetermined location, below said first predetermined location, and for joining the beginning of said one roll to the severed end of said second roll;

releasing means responsive to the passage of a preselected time after said second roll has stopped rotating for resetting said clamping, severing and splicing means; whereby said utilizing device will begin "feeding" on the paper of said one roll of paper;

wherein said festooner means comprises:

a first set of rollers secured to said support stand in freely rotatable relationship therewith;

a second set of freely rotatable rollers, said second set of rollers being displaceable relative to said first set of rollers;

said paper of said second roll alternately passing over rollers of said first and second sets to establish said elongated path;

operating means for maintaining said second set of rollers at a predetermined distance from said first set of rollers when said second roll of paper is rotating and feeding paper through said rollers of said first and second sets to said utilizing device, and for permitting said second set of rollers to approach said first set of rollers to thereby shorten said elongated path of travel and allow said utilizing device to "feed" upon the paper of said second roll which is supported by and between the rollers of said first and second sets when said second roll has stopped rotating;

wherein said clamping, severing and splicing means is operated in response to said second set of rollers traversing a first distance toward said first set of rollers; and

wherein said support stand carries first normally open switch means positioned in the path of movement of said second set of rollers at said first distance therefrom;

movement of said second set of rollers for said first distance closing said first normally open switch means to initiate operation of said clamping, severing and splicing means.

20. The apparatus of claim 19 wherein said clamping, severing and splicing means includes clamping means responsive to the closing of said first normally open switch means for clamping the paper of said second roll at said first predetermined location.

21. The apparatus of claim 19 wherein said clamping means includes a power-driven clamp which grasps the paper of said second roll between itself and a backing plate positioned on the opposite side of said paper of said second roll.

22. The apparatus of claim 21 wherein said clamping, severing and splicing means includes severing means responsive to the operation of said power-driven clamp for severing the paper of said second roll at said second predetermined location below said first predetermined location;

said severing means including a baseplate an upper edge of which coacts with a lower edge of said backing plate to sever the paper of said second roll as the plane of said baseplate enters the plane of said backing plate, and sever and drive-operating means responsive to the operation of said power-driven clamp for rotating said baseplate into the plane of said backing plate.

23. The apparatus of claim 22 wherein said clamping, severing and splicing means include splicing means responsive to the operation of said sever and splice operating means for joining the previously prepared beginning end of said one roll of paper to the severed end of said second roll of paper;

said splicing means comprising a gripping plate carried by and movable with said baseplate for gripping the previously prepared beginning end of said one roll between said gripping plate and said baseplate;

said gripping plate including a portion which overlaps a portion of said backing plate to urge the previously treated beginning end of said one roll of paper into adhesive contact with the severed end of said second roll of paper as said baseplate enters the plane of said backing plate.

24. The apparatus of claim 23 wherein said baseplate is pivotally rotatable by said sever and splice operating means between a first position out of the plane of said backing plate and a second cutting position in the same plane as said backing plate; and

wherein the axis of rotation of said baseplate is secured to said backing plate;

whereby said backing plate, baseplate, and gripping plate carried thereby together define a clamp, sever and splice assembly which together with said power-driven clamp constitutes said clamping, severing and splicing means.

25. The apparatus of claim 24 wherein said gripping plate is pivotally rotatable on said baseplate between a first, open position in which said previously treated end of said one roll can be inserted between said gripping plate and said baseplate, and a second gripping position in which said previously treated end of said one roll is frictionally maintained between said gripping plate and said baseplate; and

wherein said support stand includes means for removably supporting said clamp, sever, and splice assembly in predetermined position with respect to the path of movement of said paper of said second roll of paper;

whereby said clamp, sever, and splice assembly can be removed from its predetermined position when it is desired to rotate said gripping plate to its first position and insert said previously treated beginning end of said one roll between said gripping plate and said baseplate.

26. The apparatus of claim 25 wherein said releasing means includes operating means for rotating said gripping plate between its gripping position and its open position after said previously treated beginning end of said one roll of paper has joined in adhesive contact with the severed end of said second roll of paper.

27. The apparatus of claim 26 wherein said releasing means includes operating means for rotating said gripping plate between its gripping position and its open position after said previously treated beginning end of said one roll of paper has joined in adhesive contact with the severed end of said second roll of paper;

said operating means of said release means being operated when said second set of rollers traverses said second distance toward said first set of rollers to close second normally open switch means.

28. Preparing apparatus for preparing the beginning end of one roll of paper for subsequent joining to the end of a second roll of paper; said preparing apparatus comprising:

a support plate for supporting the paper of said one roll;

a grasping plate operatively secured to said support plate for grasping the paper of said one roll against said support plate, said grasping plate being movable between an open position in which said paper may be inserted between said grasping plate and said support plate and its grasping position;

an edge-preparing plate member pivotally secured along one edge thereof to said grasping plate and rotatable between a first nonoperative position and a second, operative position in which a second edge thereof engages said paper to facilitate the trimming of the end thereof;

tape-dispensing means secured to said support plate and oriented with respect thereto to permit tape to be drawn across said paper with a portion of said tape overlying the end of said paper; and

tape-trimming means operatively secured to said support plate and movable between a first, nonoperative position and a second operative position for cutting said tape in a manner such that the width of said cut portion of tape corresponds to the width of said paper.

29. The preparing apparatus of claim 28 wherein said grasping plate is pivotally secured along a longitudinal edge thereof to a longitudinal edge of said support plate, and wherein said edge-preparing plate is pivotally secured to an edge of said grasping plate which is transverse to the said longitudinal edge of said grasping plating.

30. Apparatus for automatically splicing the beginning of one roll of paper or the like onto the approximate end of a second roll of paper or the like without discontinuing the flow of paper to a utilizing device;

said apparatus comprising:
a support stand, said stand having means for supporting said one roll of paper and said second roll of paper in rotatable relationship therewith;

festooner means carried by said support stand for establishing an elongated path of travel for paper of said second roll moving through said apparatus and for allowing said utilizing device to "feed" upon the paper carried by said festooner means when the second roll of paper has stopped rotating;

first sensing means for stopping the rotation of said second roll when a preselected amount of paper remains on said roll;

clamping, severing and splicing means responsive to the halt of said second roll for clamping the paper of said second roll at a first predetermined location, severing the paper of said second roll at a second predetermined location, below said first predetermined location, and for joining the beginning of said one roll to the severed end of said second roll;

releasing means responsive to the passage of a preselected time after said second roll has stopped rotating for

resetting said clamping, severing and splicing means; whereby said utilizing device will begin "feeding" on the paper of said one roll of paper;

further including preparing apparatus secured to said support stand for preparing the beginning end of said one roll of paper for subsequent joining to the approximate end of said second roll of paper, said preparing apparatus comprising:

a support plate for supporting the paper of said one roll; a grasping plate operatively secured to said support plate for grasping the paper of said one roll against said support plate, said grasping plate being movable between an open position in which said paper may be inserted between said grasping plate and said support plate and its grasping position;

an edge-preparing plate member pivotally secured along one edge thereof to said grasping plate and rotatable between a first nonoperative position and a second, operative position in which a second edge thereof engages said paper to facilitate the trimming of the end thereof;

tape-dispensing means secured to said support plate and oriented with respect thereto to permit tape to be drawn across said paper with a portion of said tape overlying the end of said paper; and

tape-trimming means operatively secured to said support plate and movable between a first nonoperative position and a second operative position for cutting said tape in a manner such that the width of said cut portion of tape corresponds to the width of said paper.

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