

July 11, 1961

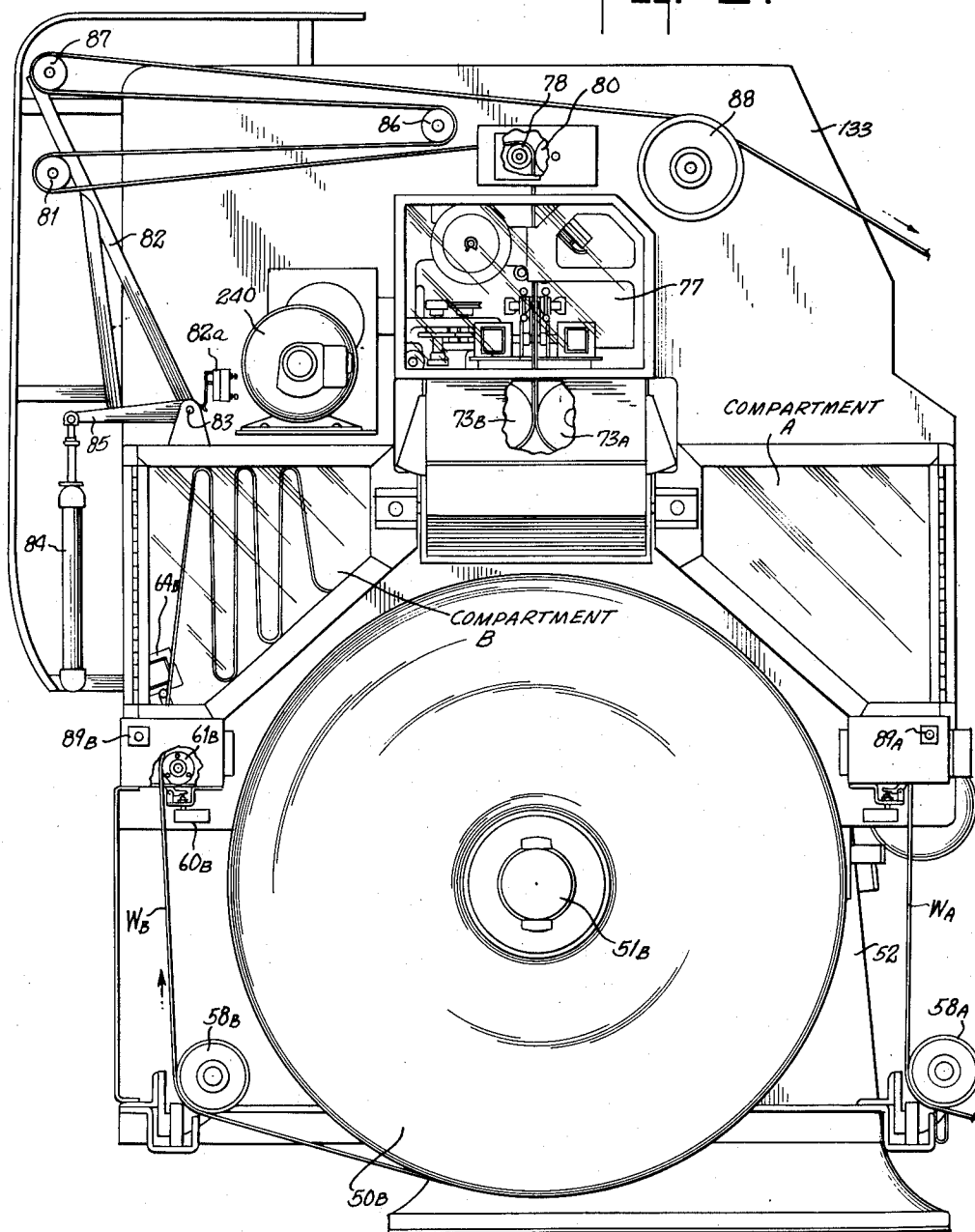
H. A. HENDRICH ET AL
AUTOMATIC WEB SPLICING MACHINE

2,991,827

Filed July 5, 1955

26 Sheets-Sheet 1

Fig. 1.



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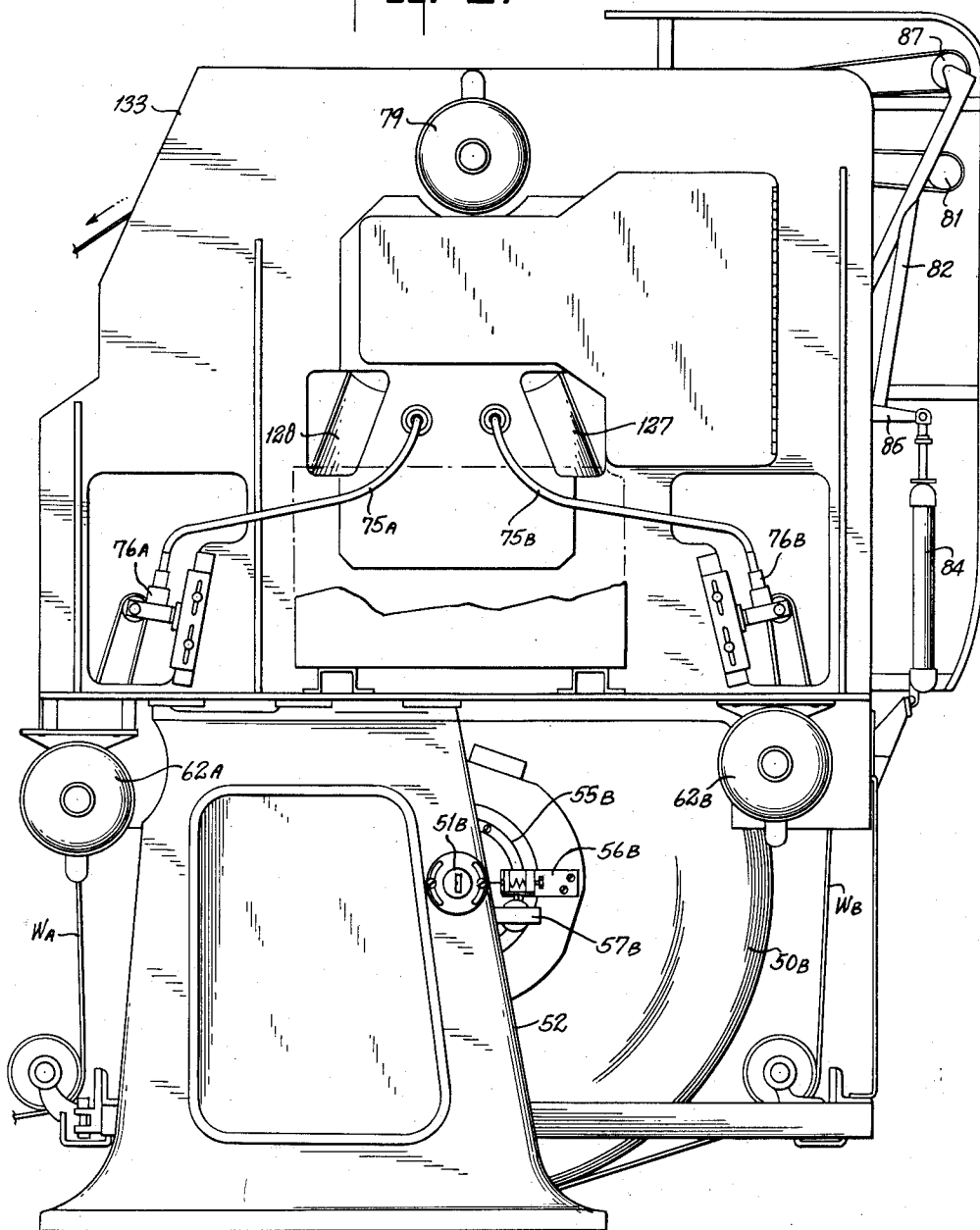
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Fig. 2.



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2,991,827

AUTOMATIC WEB SPLICING MACHINE

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Fig. 3.

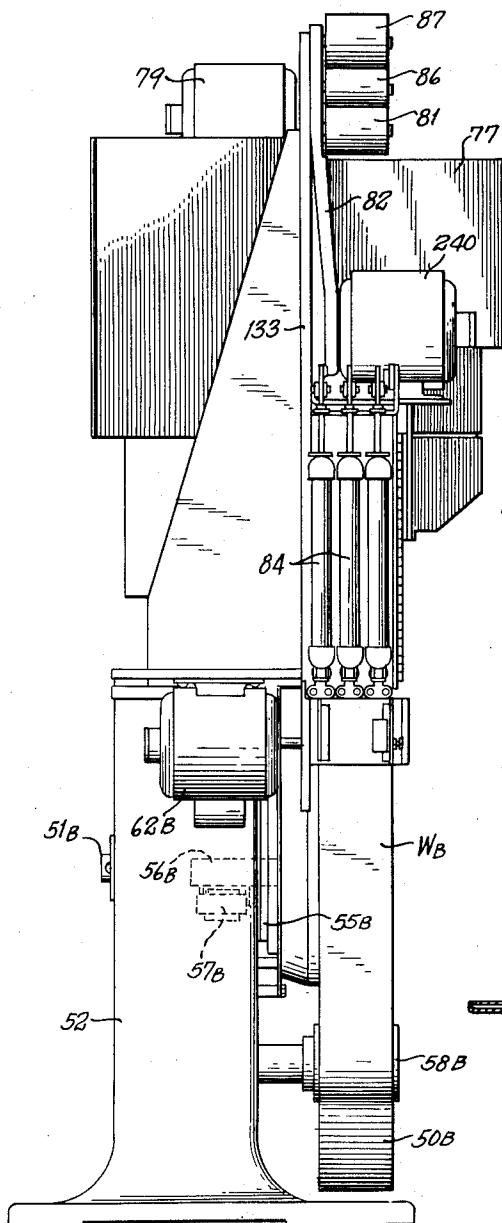


Fig. 6.

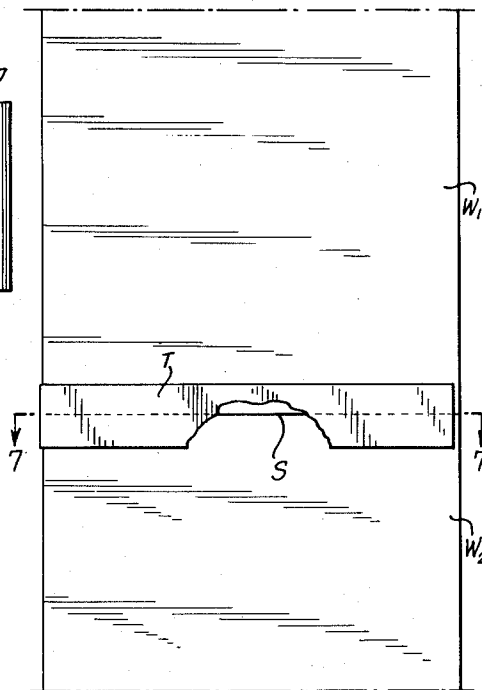
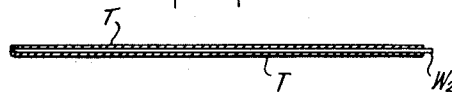


Fig. 7.



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Fig. 3a.

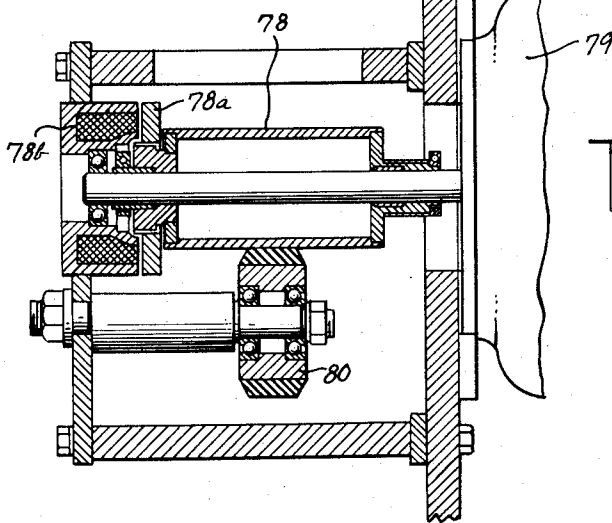
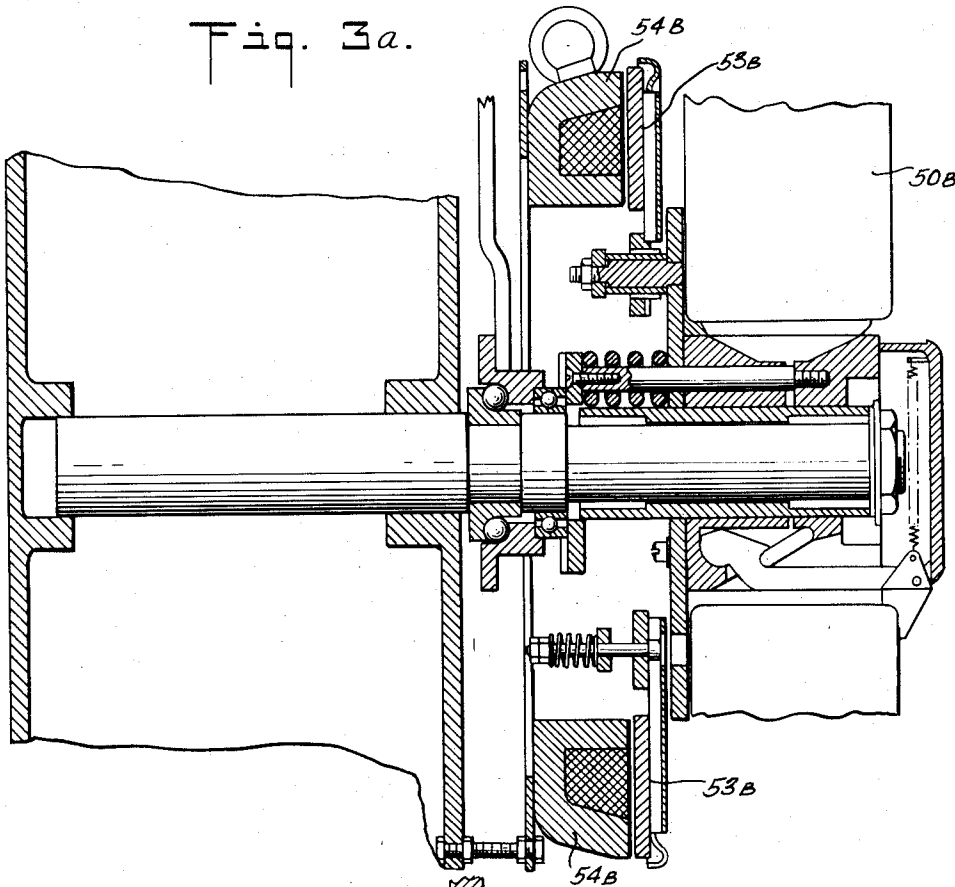


Fig. 3b.

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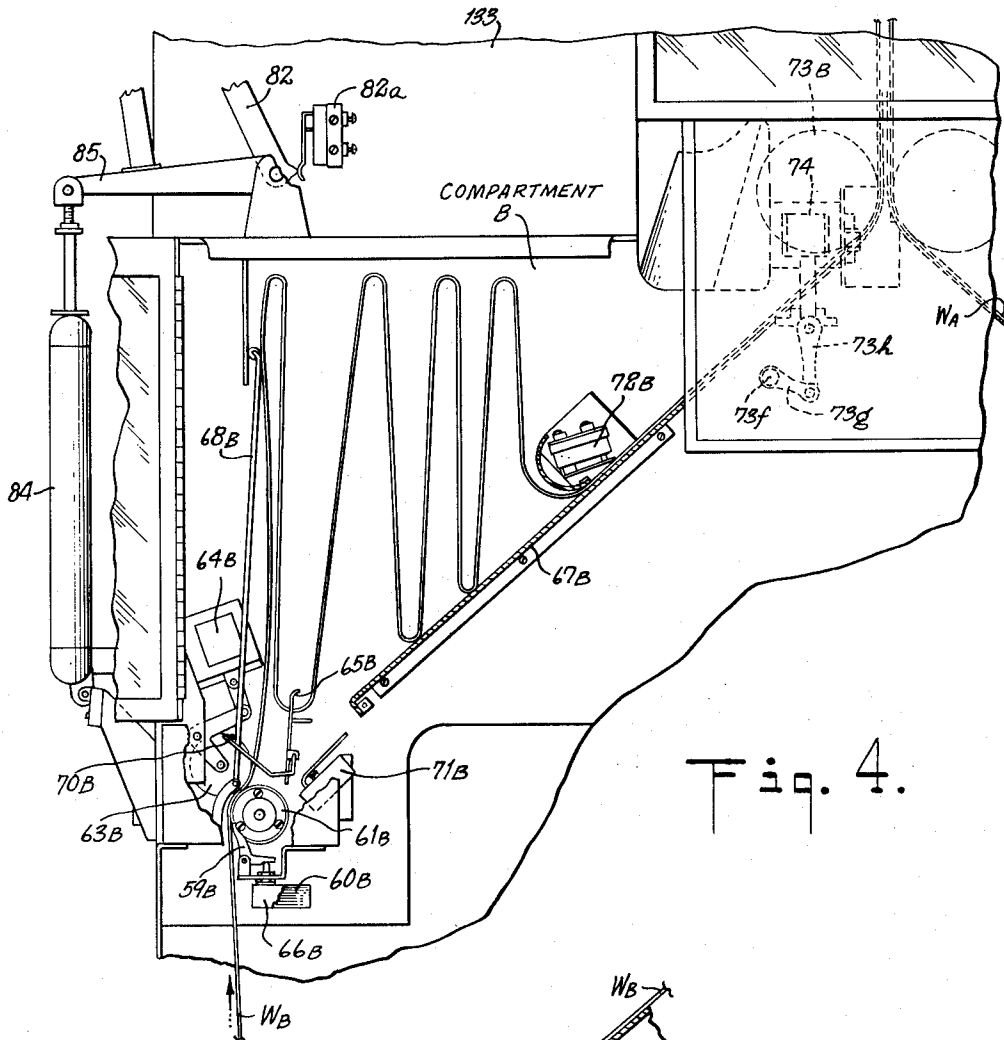


Fig. 4.

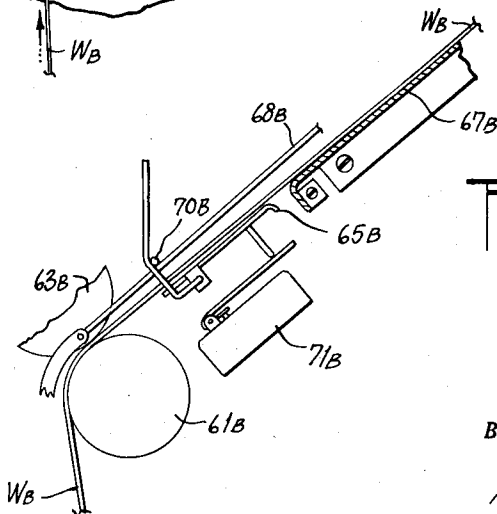


Fig. 4A.

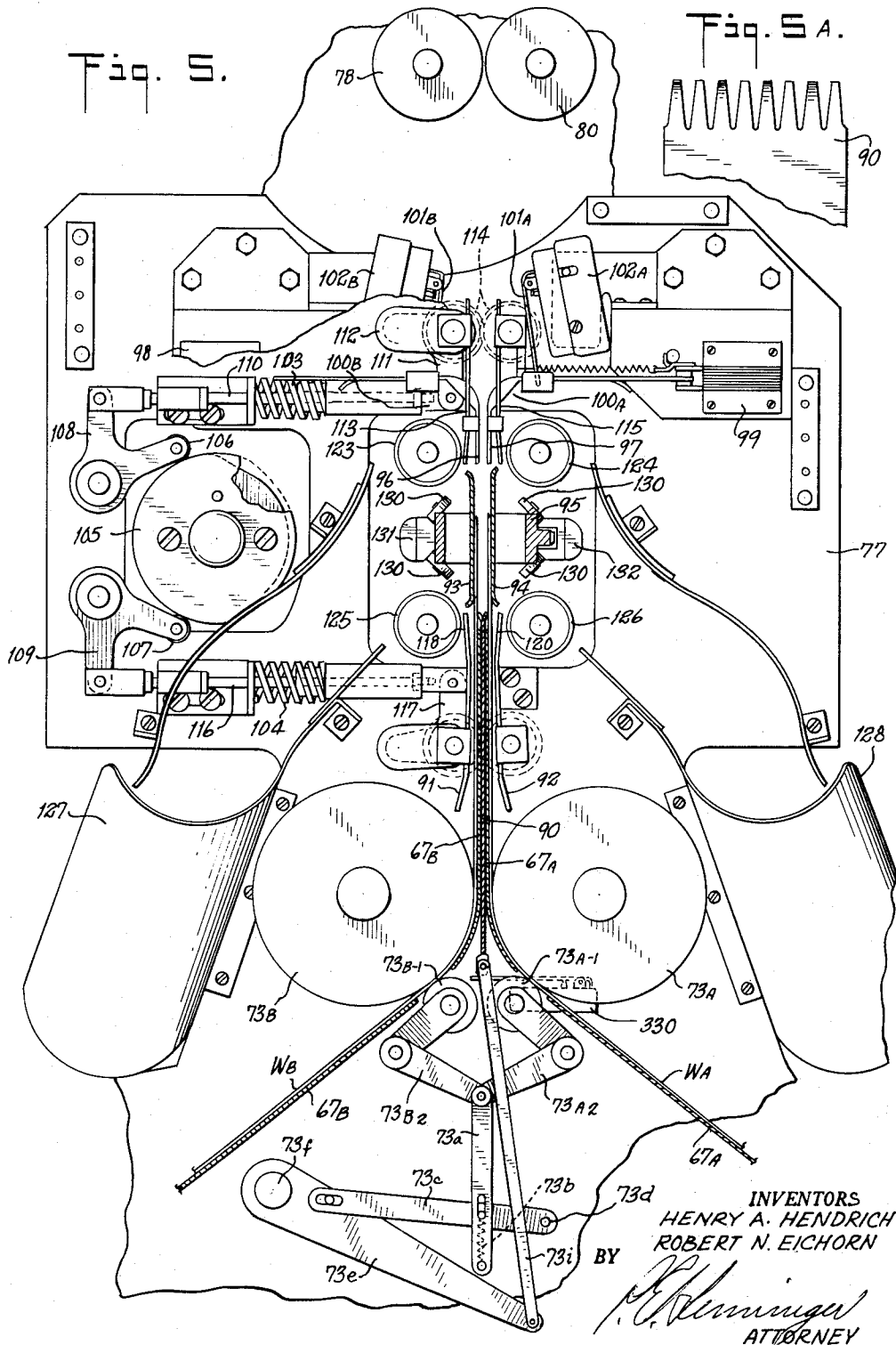
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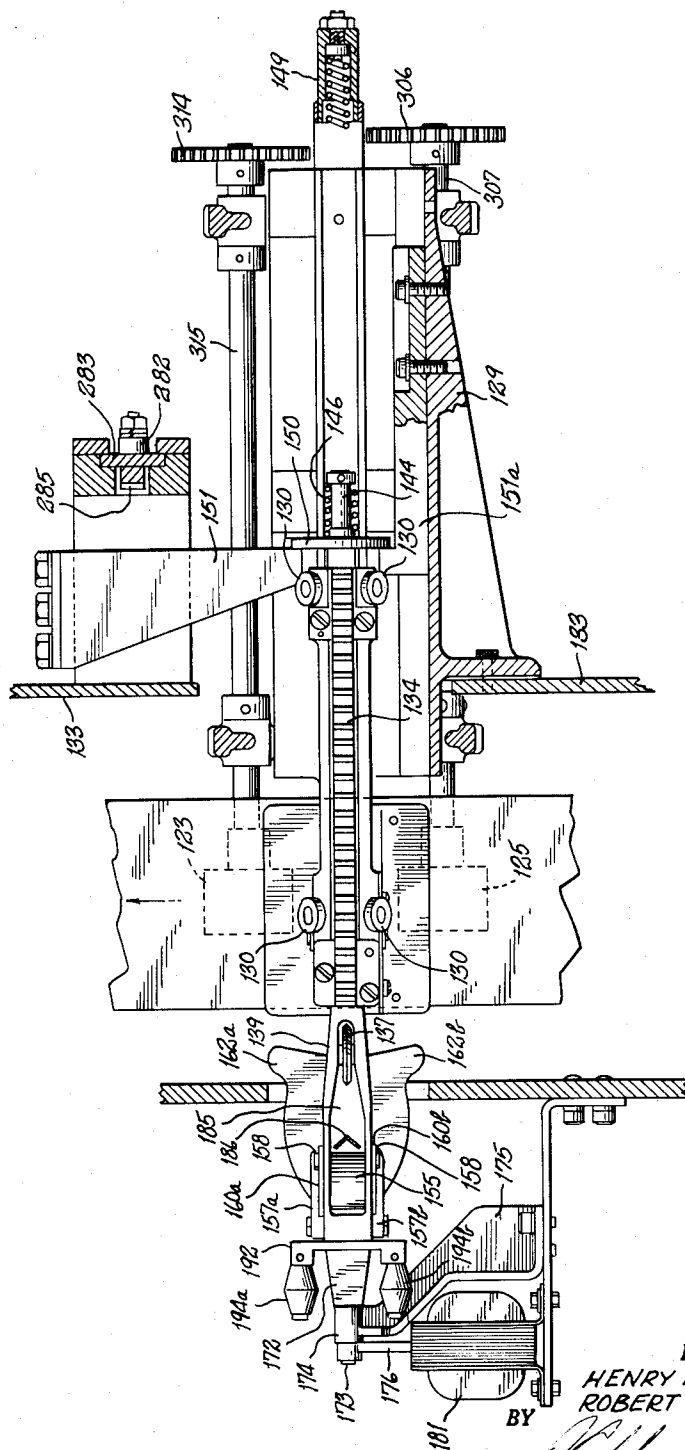
2,991,827

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Fig. 6.



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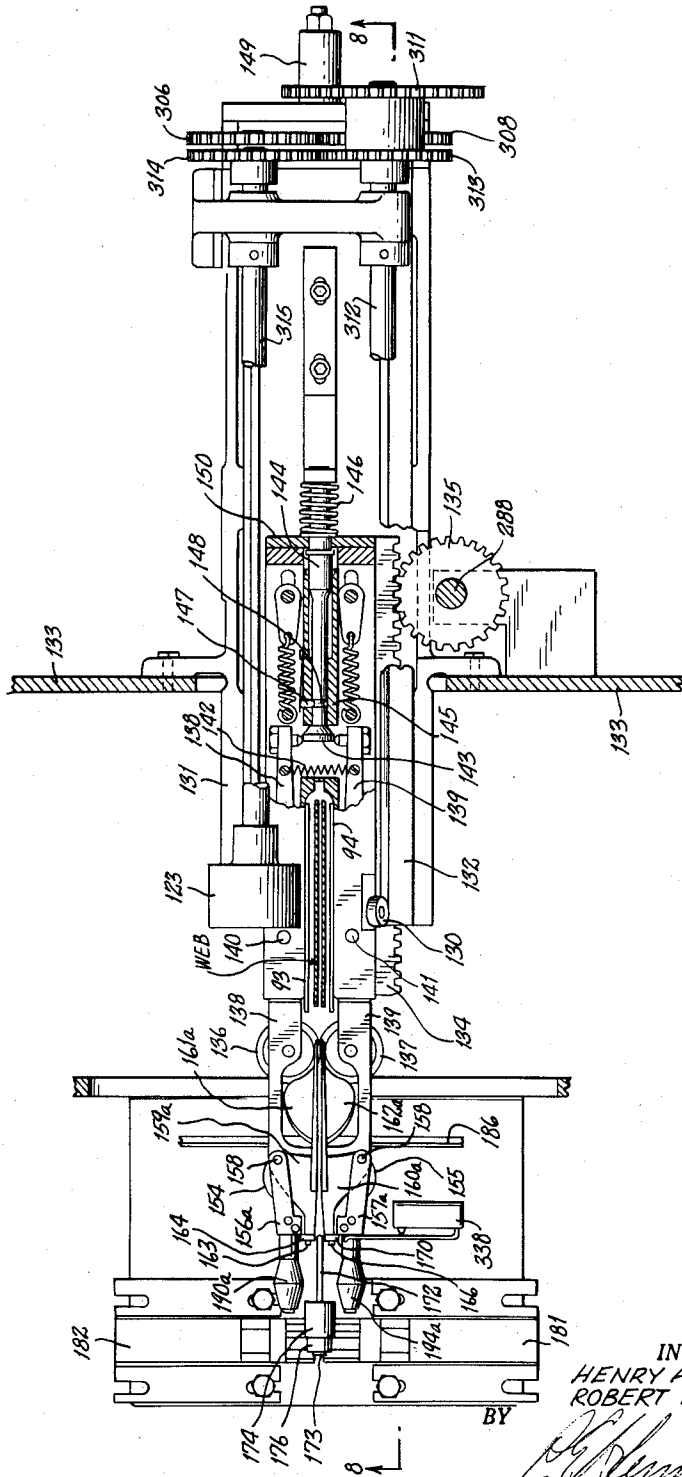
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Fig. 9.



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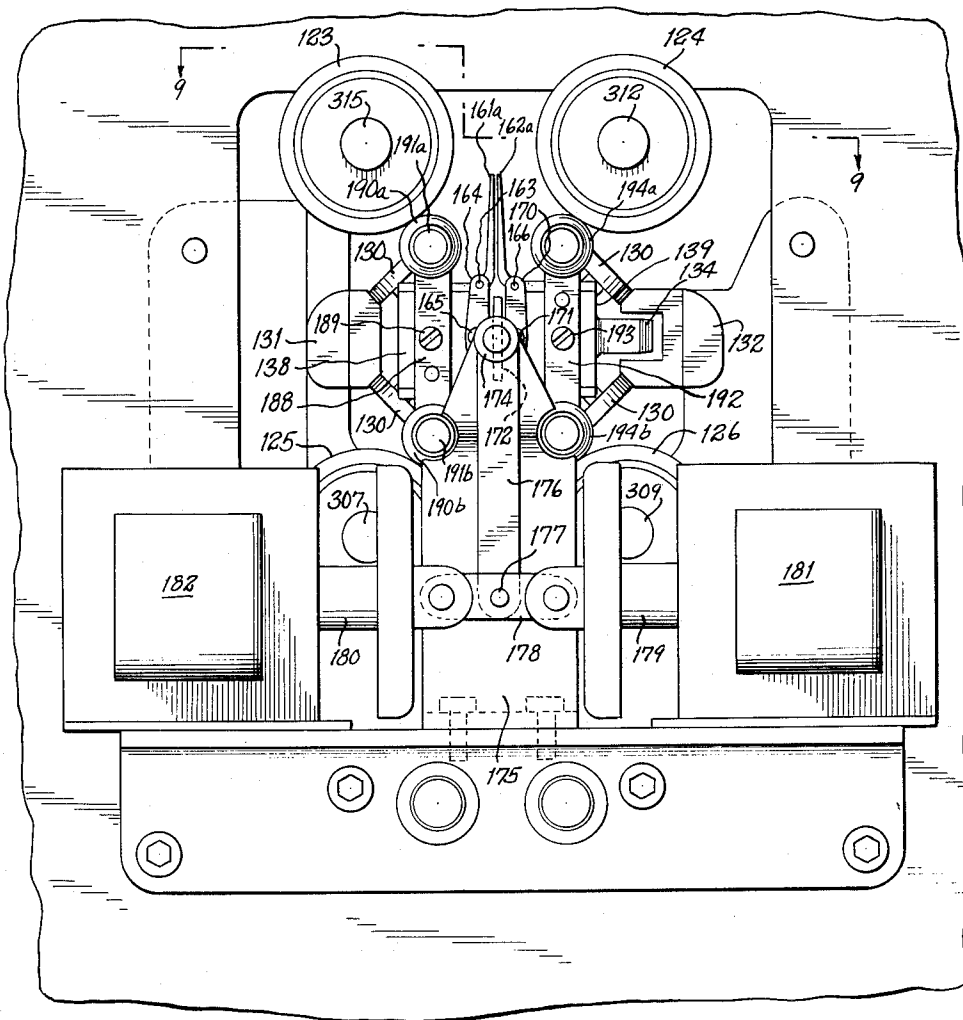


Fig. 10.

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Fig. 11.

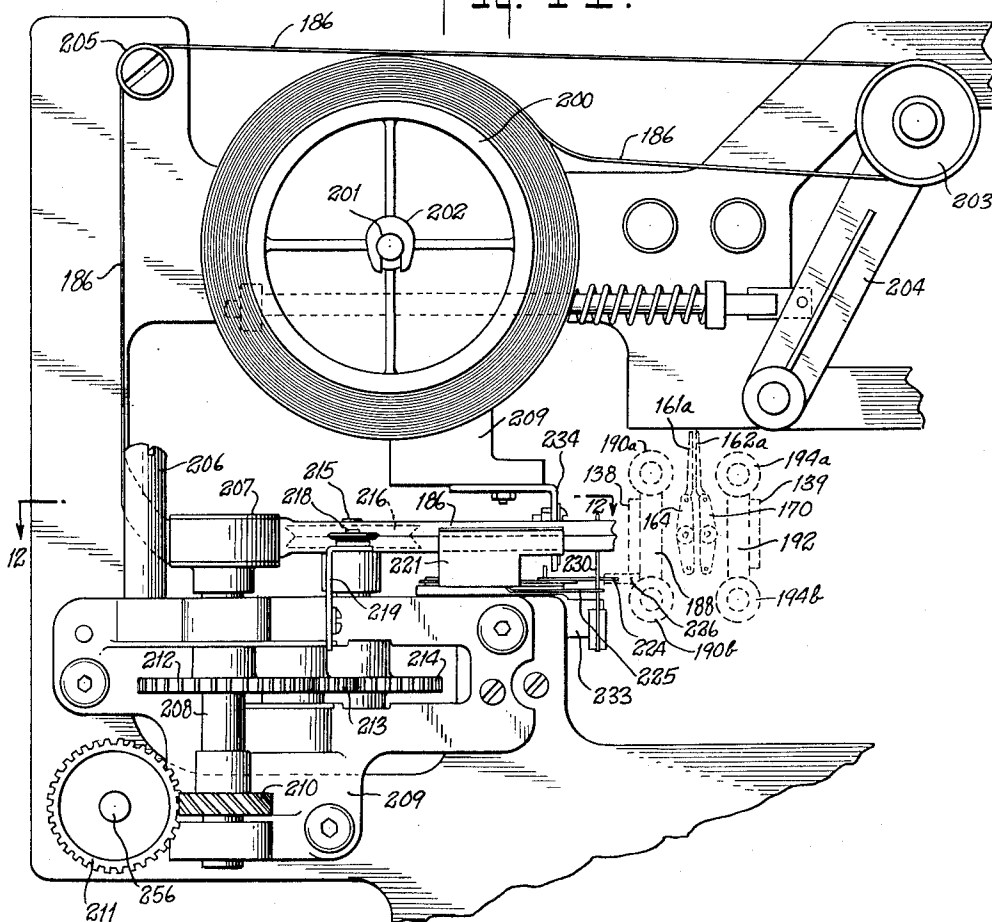
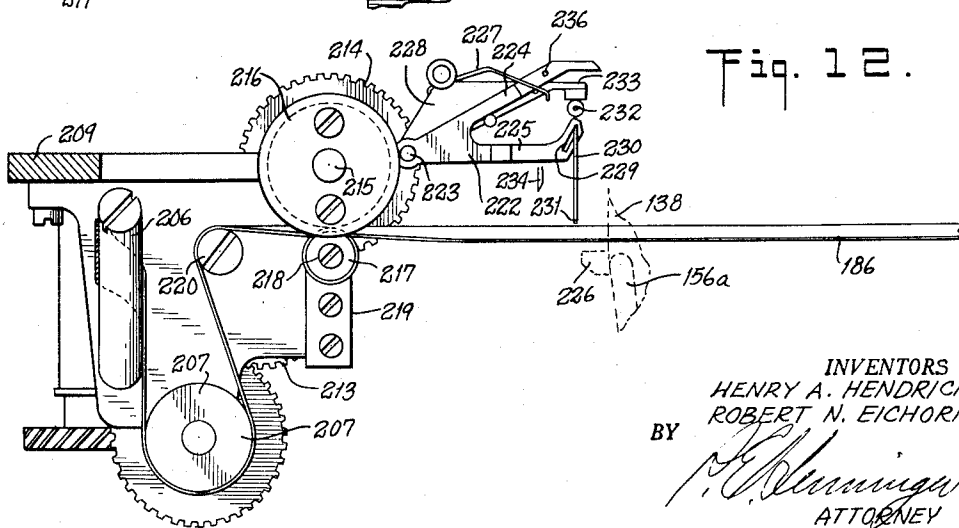


Fig. 12.



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Fig. 15.

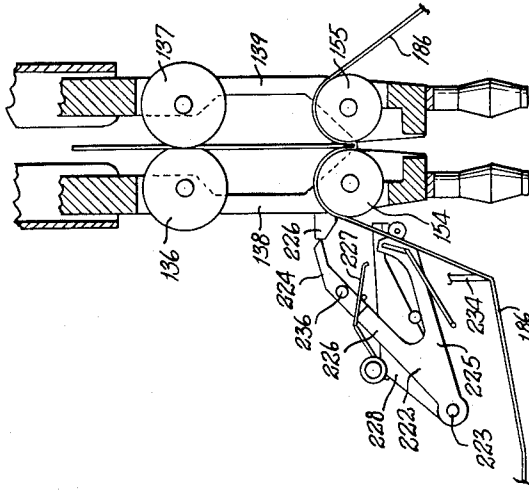


Fig. 14.

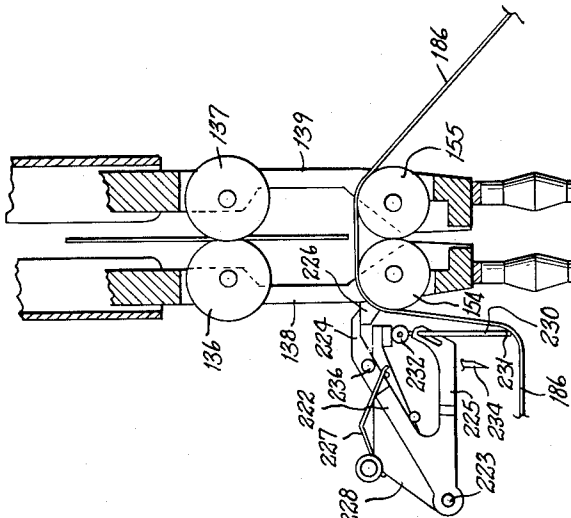


Fig. 13.

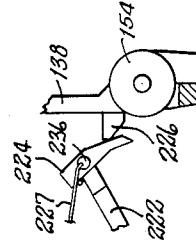
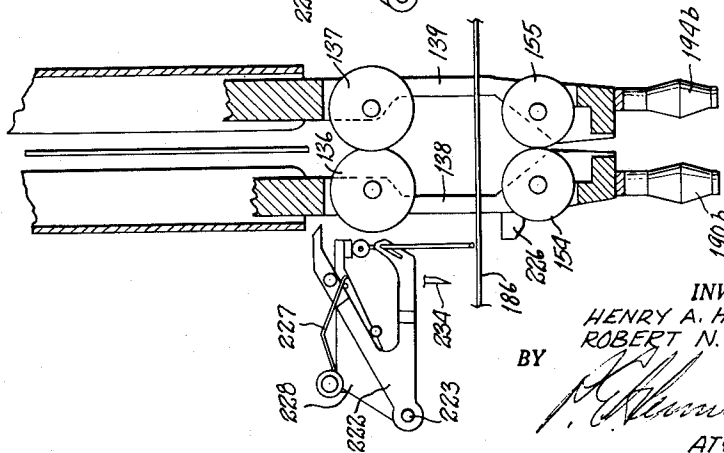


Fig. 15a.

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Fig. 17.

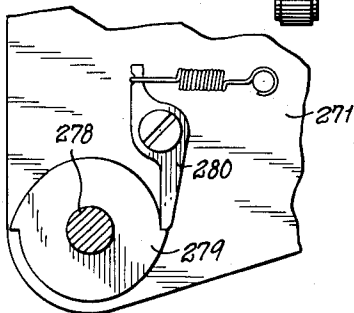
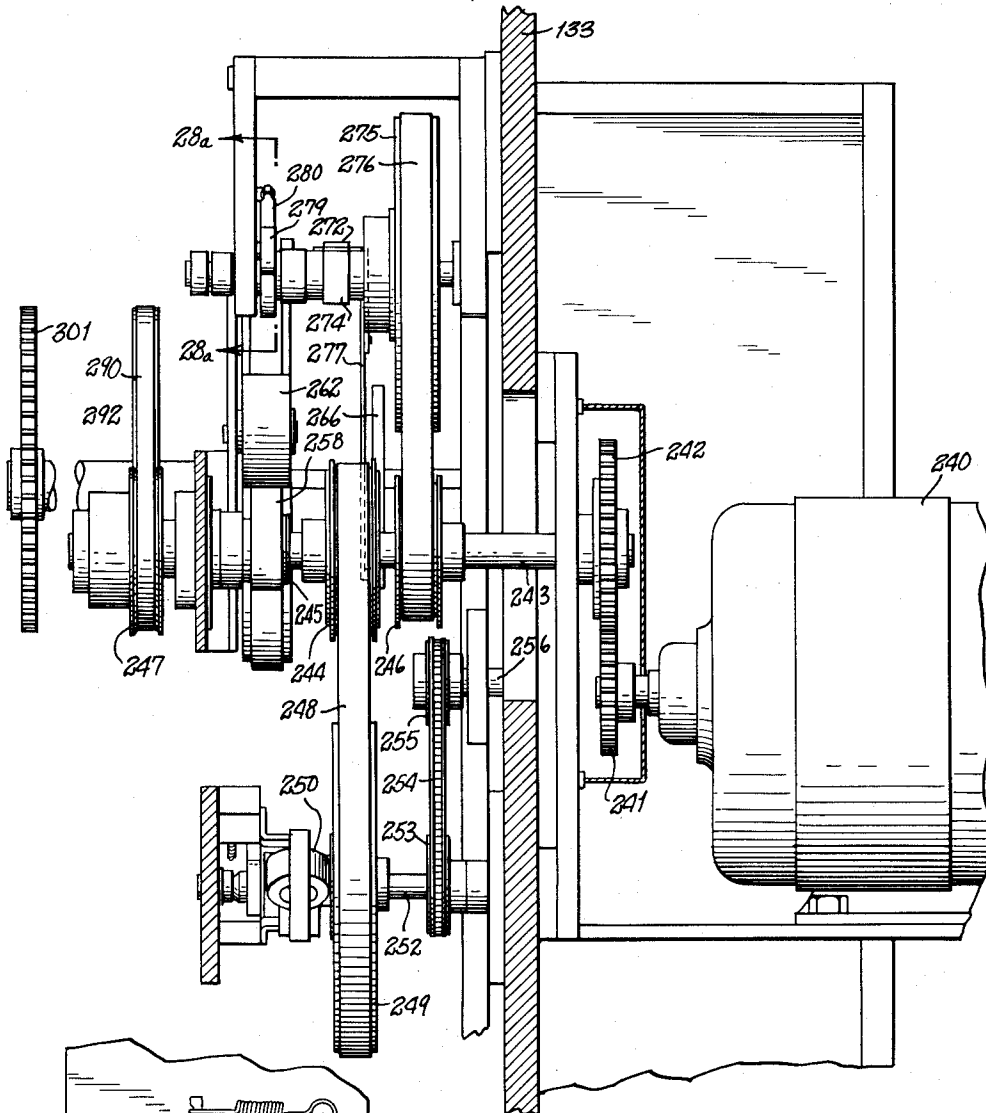


Fig. 22a.

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Fig. 19.

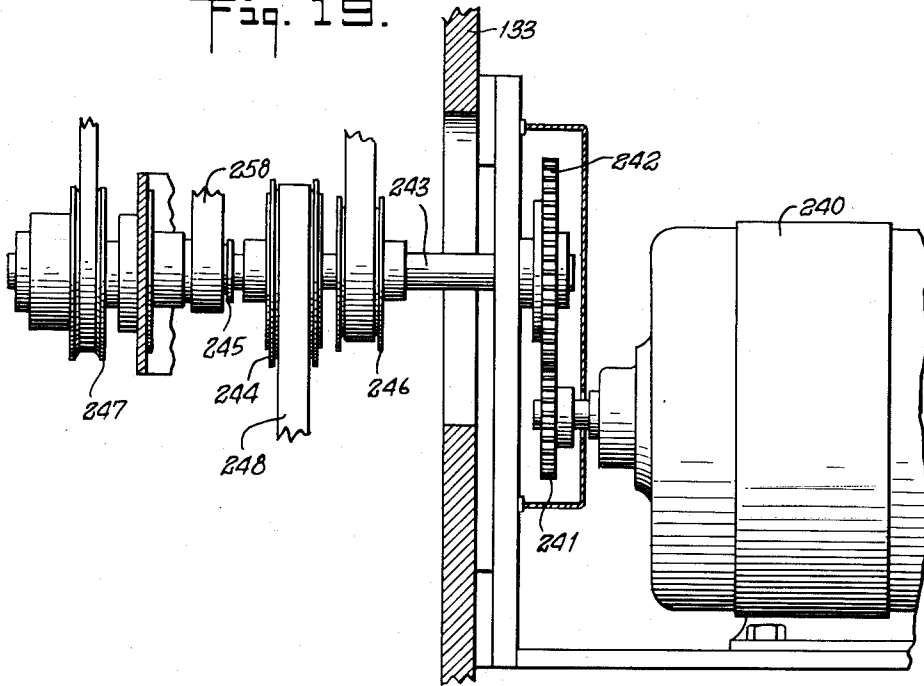
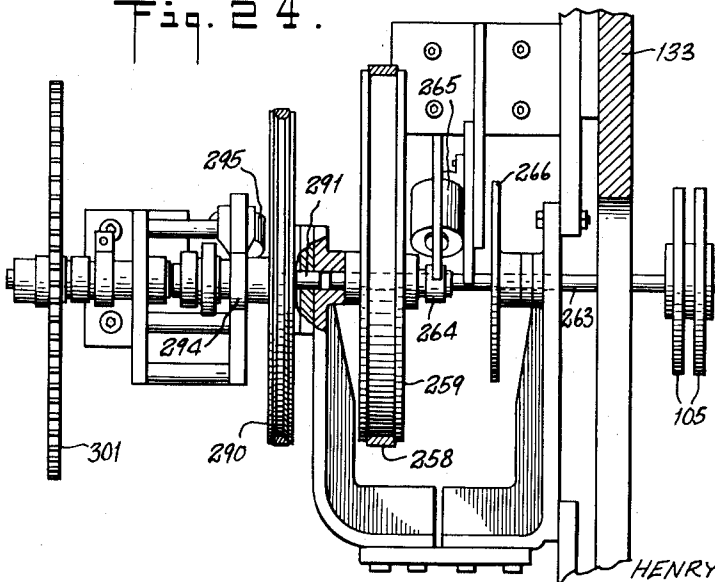


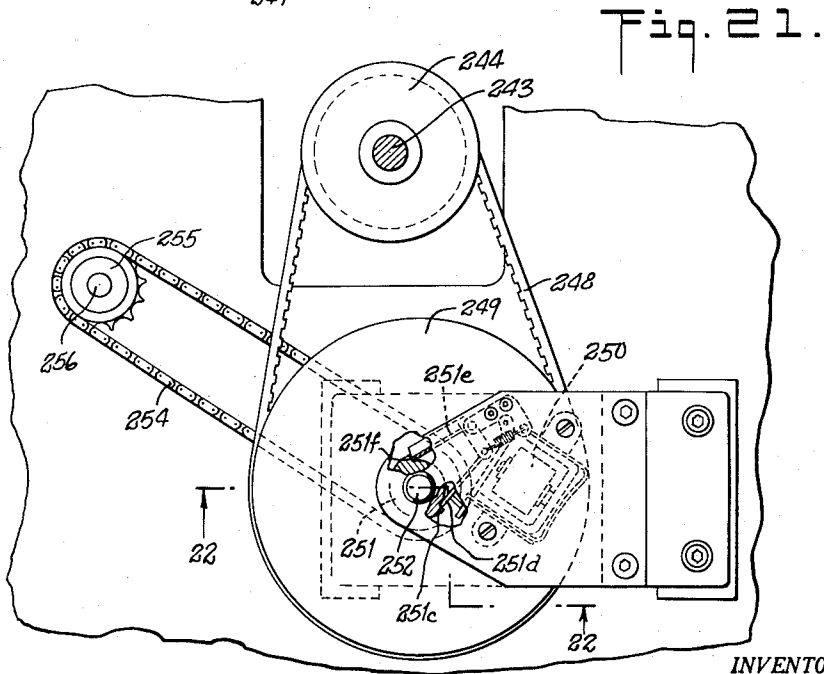
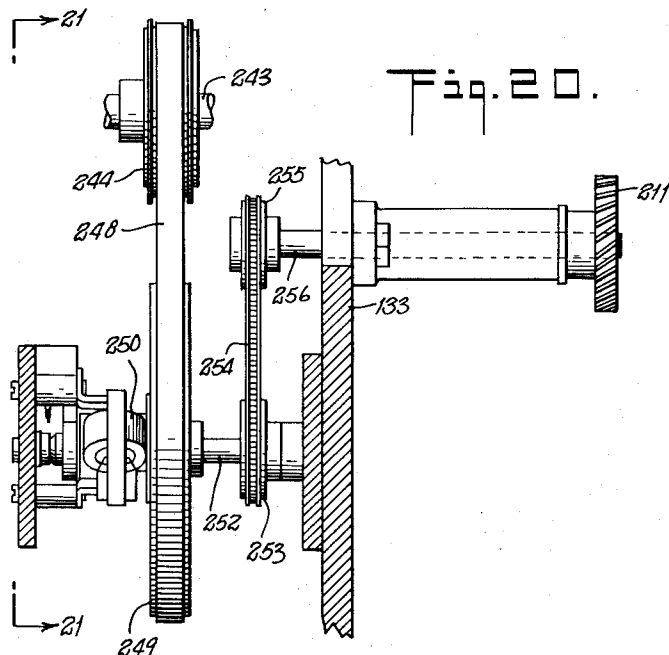
Fig. 24.



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AUTOMATIC WEB SPLICING MACHINE

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Fig. 25.

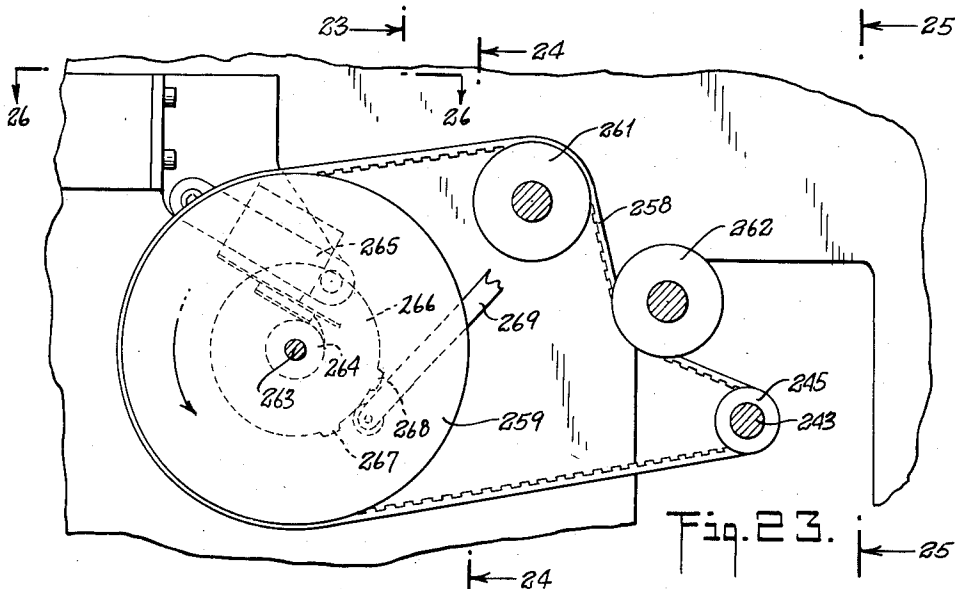
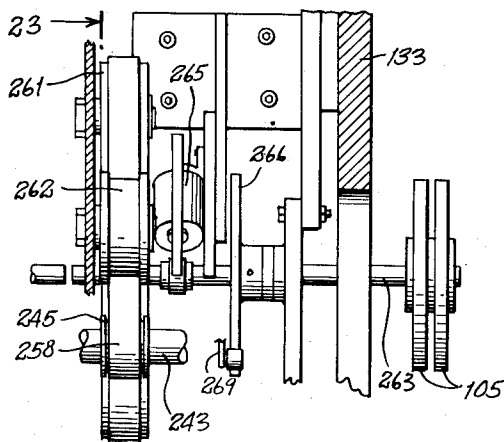


Fig. 23.

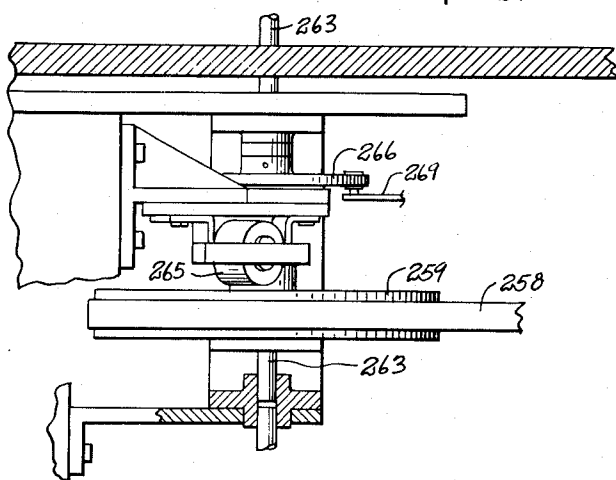


Fig. 26.

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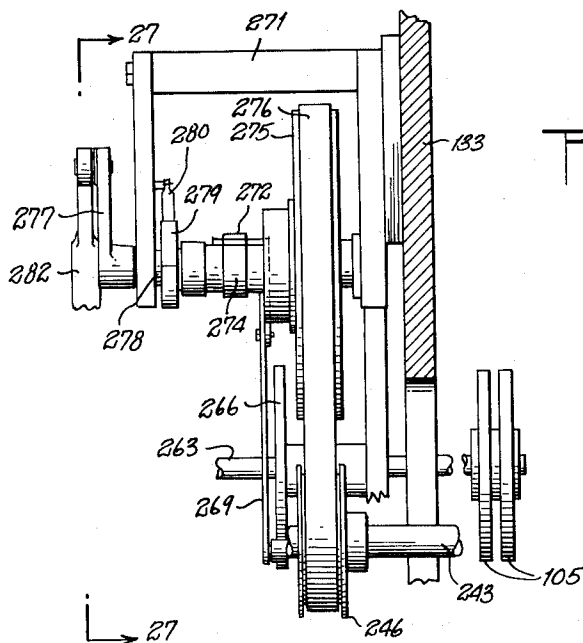
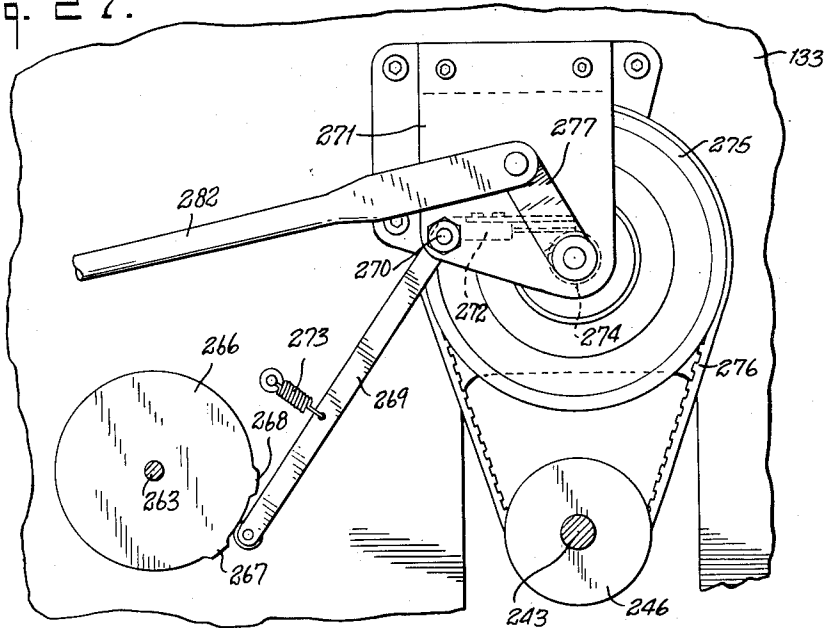


Fig. 28.

Fig. 27.



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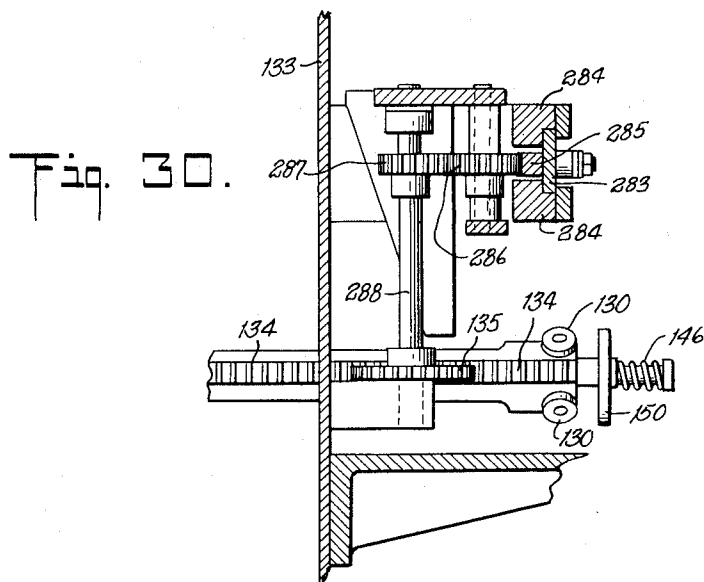
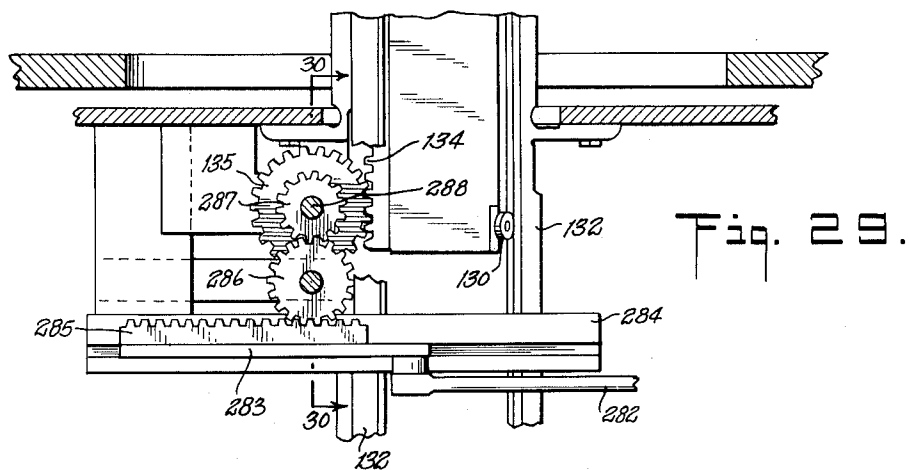
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AUTOMATIC WEB SPLICING MACHINE

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Fig. 33.

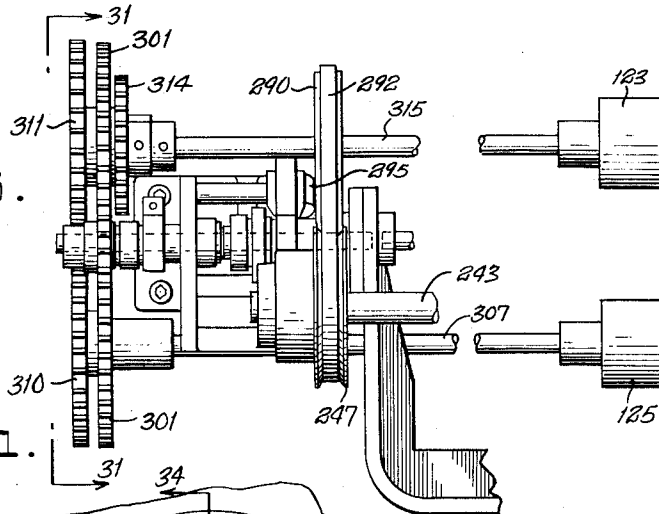


Fig. 31.

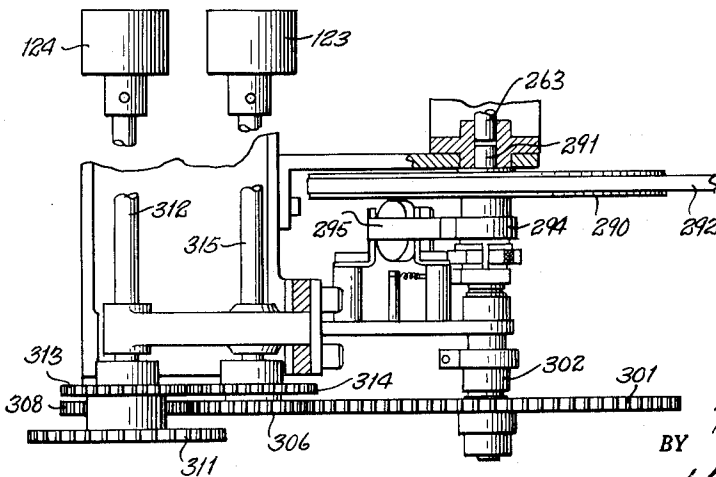
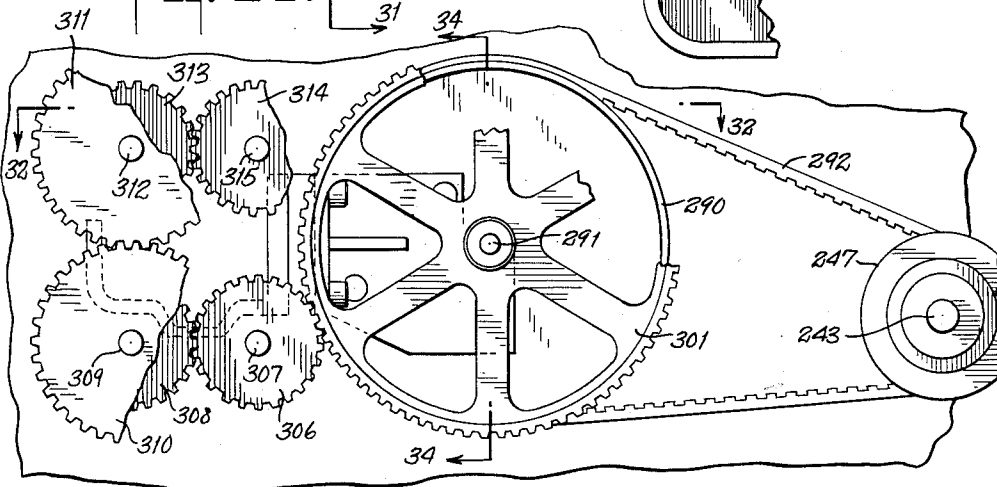


Fig. 32.

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Fig. 34.

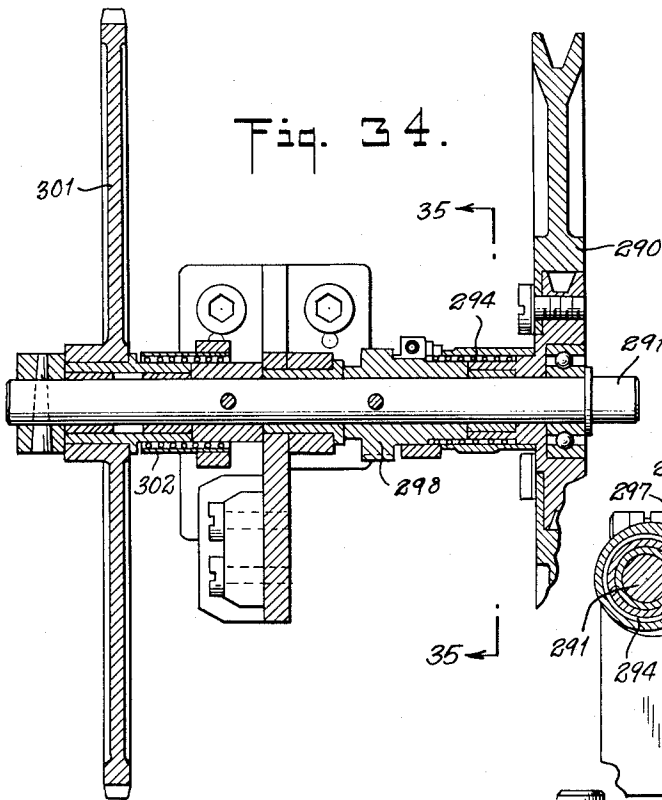


Fig. 35.

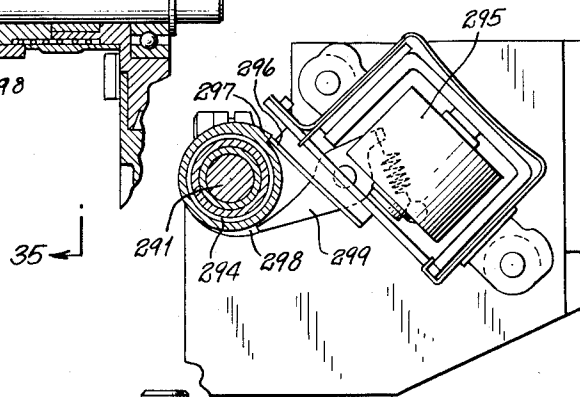
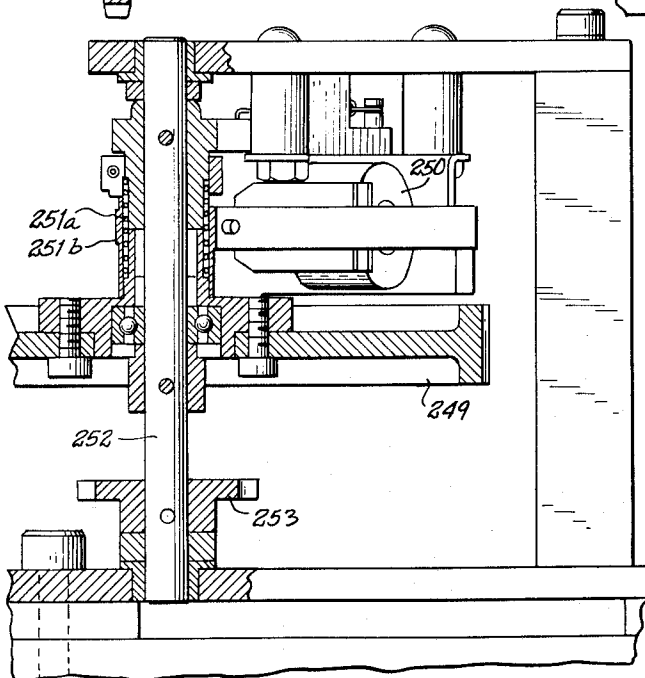


Fig. 22.



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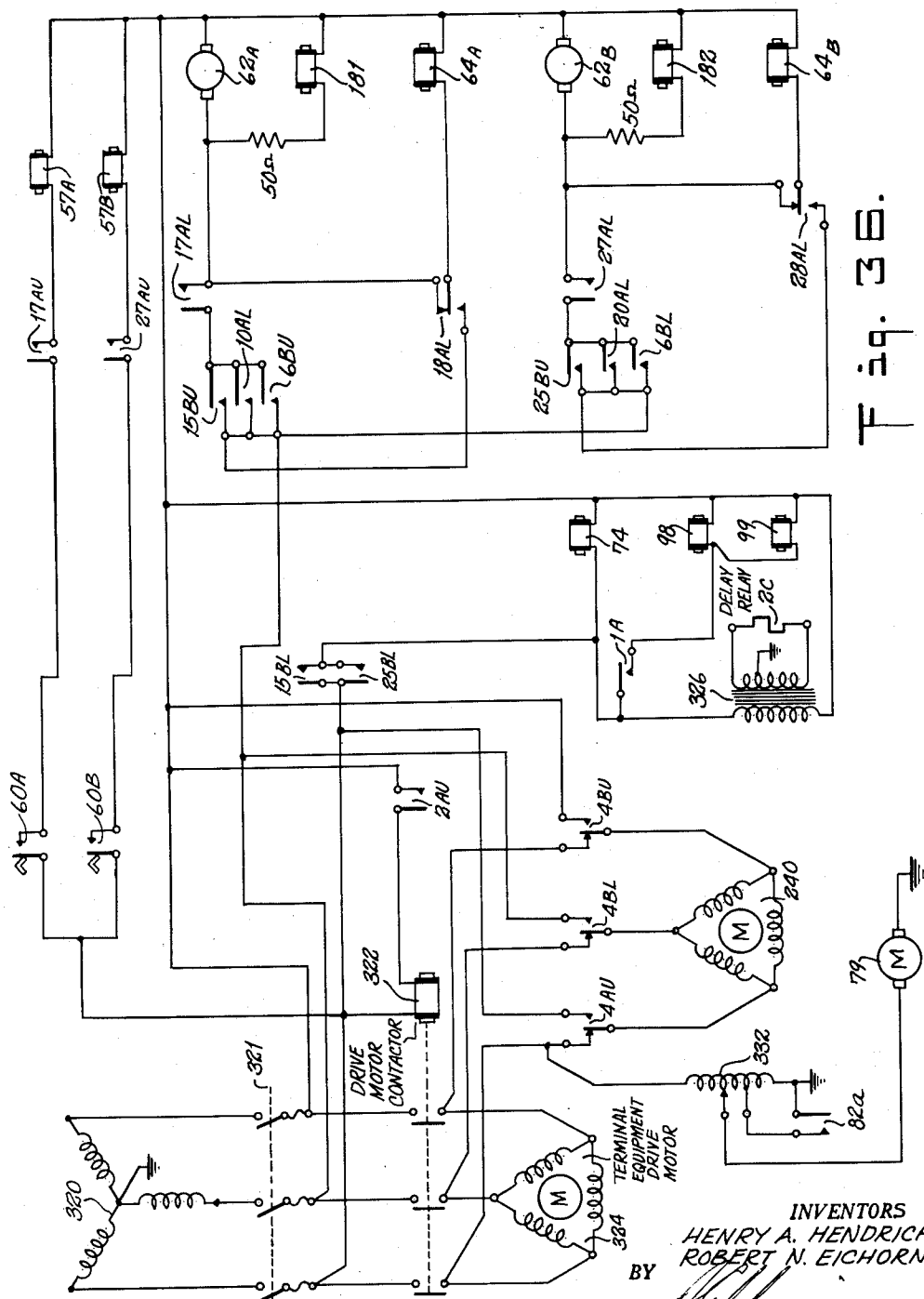
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2,991,827

AUTOMATIC WEB SPLICING MACHINE

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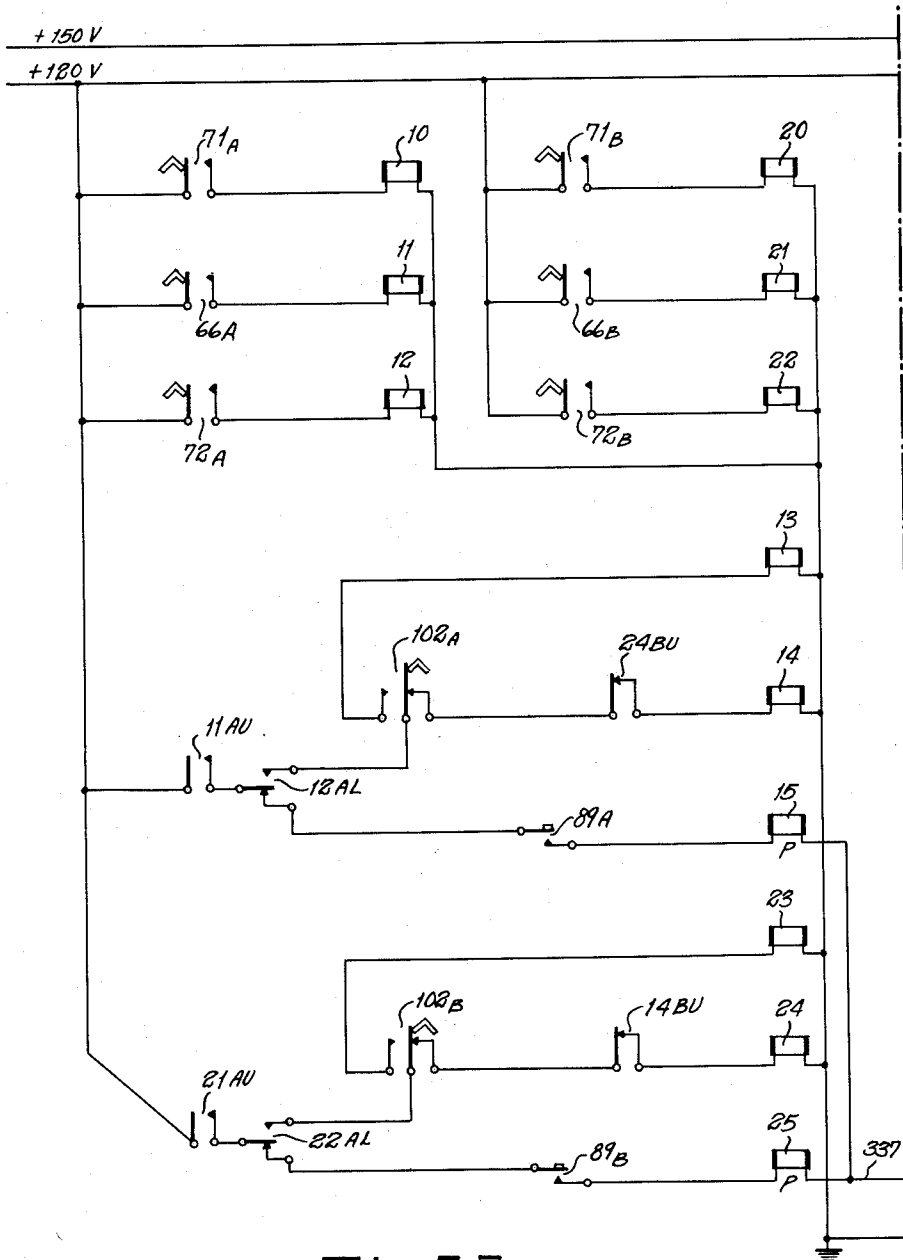


Fig. 37.

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AUTOMATIC WEB SPLICING MACHINE

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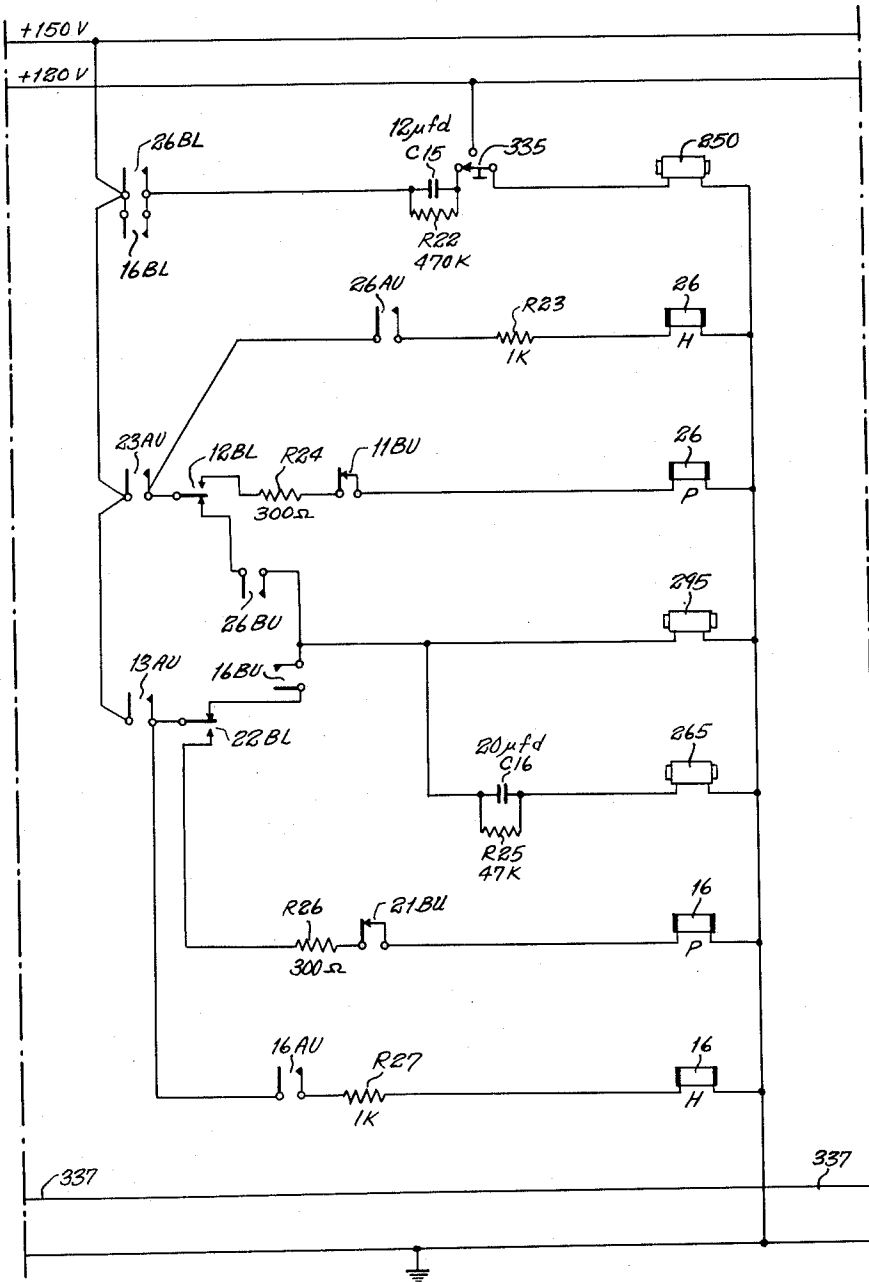


Fig. 3B.

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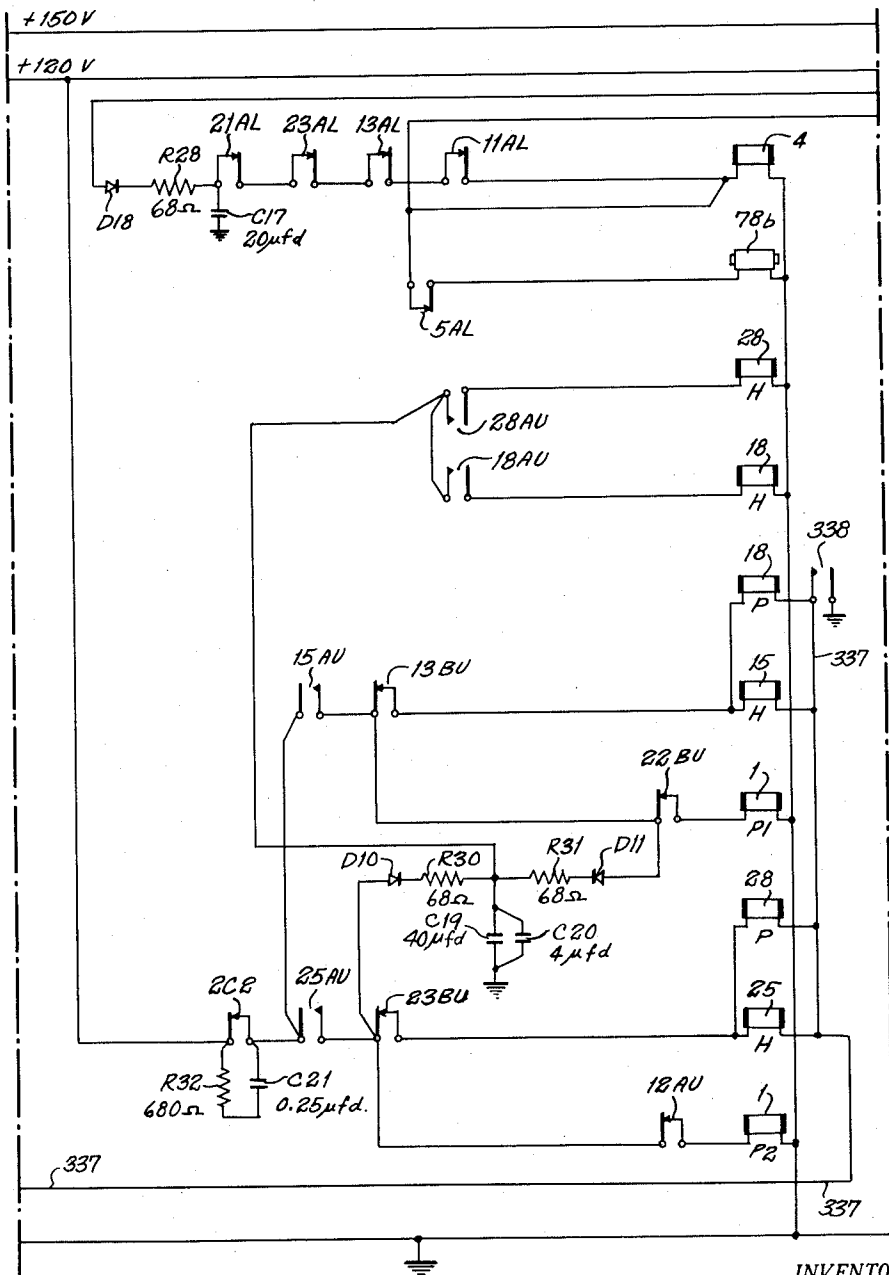


Fig. 39.

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AUTOMATIC WEB SPLICING MACHINE

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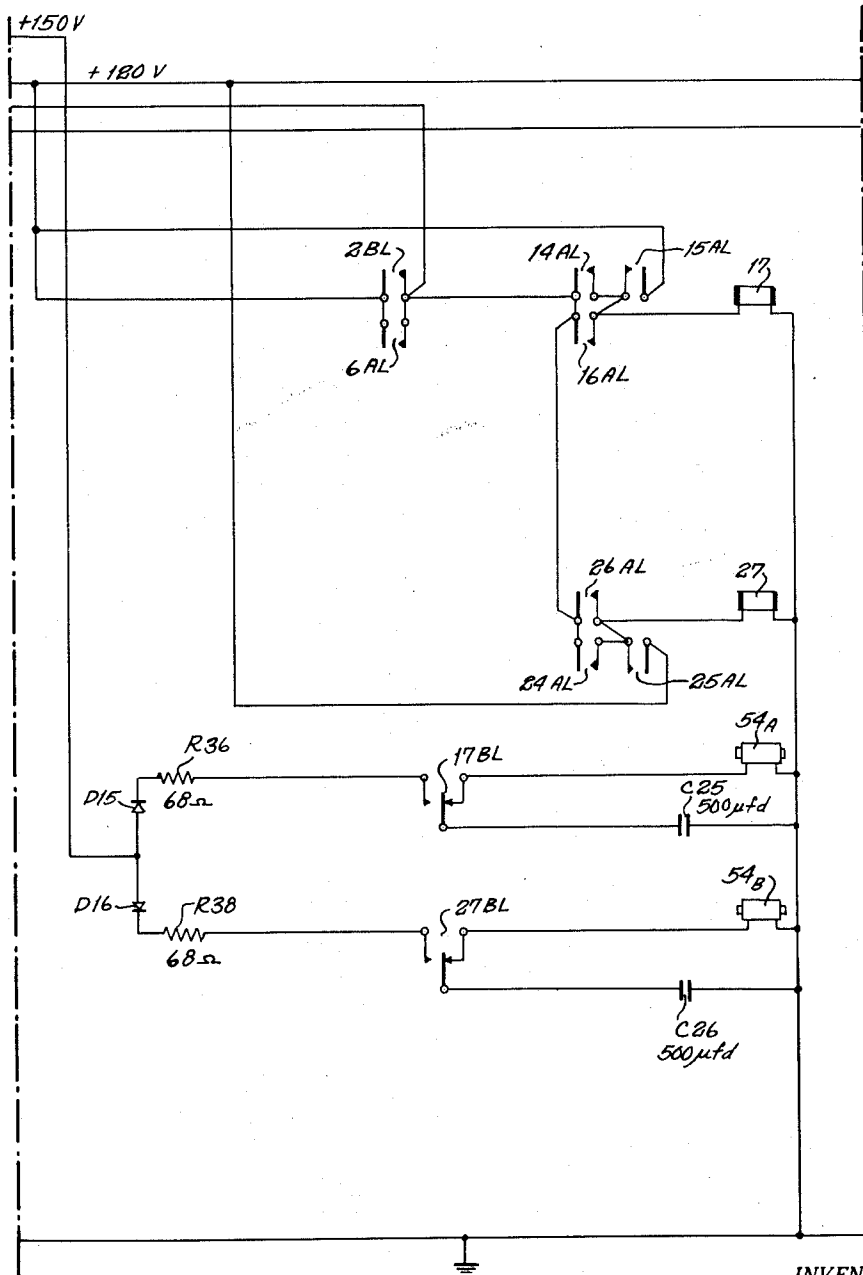


Fig. 40.

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AUTOMATIC WEB SPLICING MACHINE

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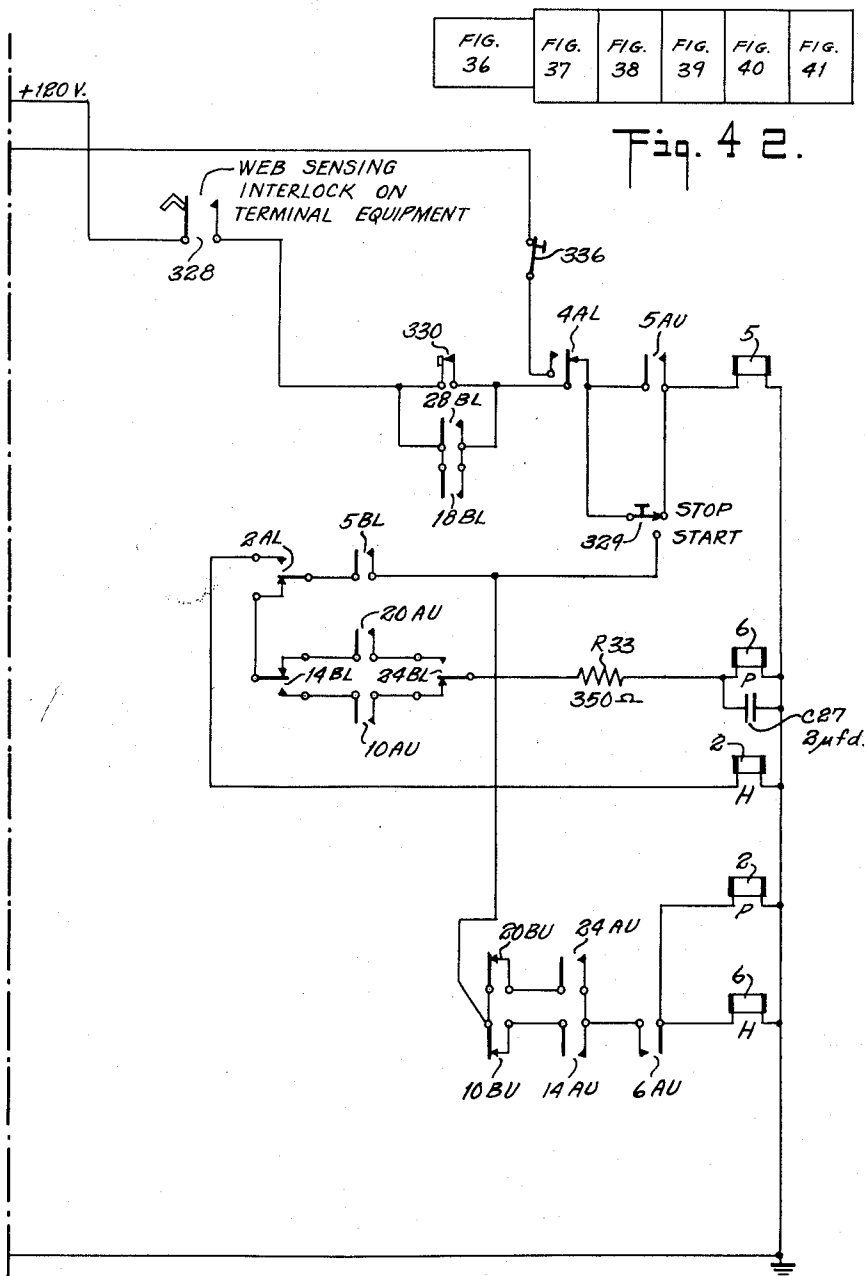


Fig. 41.

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2,991,827

AUTOMATIC WEB SPLICING MACHINE

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Filed July 5, 1955, Ser. No. 519,909
29 Claims. (Cl. 154—42.3)

The present invention relates to web splicing mechanisms and, particularly, to such mechanisms in which the terminal end of a web from one source of supply is automatically spliced to the leading edge of a web from a second source of supply. While the invention has general application, it is particularly suited for splicing card stock web such as used in fabricating data storage cards employed in connection with modern business machines and will be described in that connection.

Data storage cards used in many forms of present-day business machines are fabricated from card stock of preselected width supplied in reels each containing several thousand feet of web. This web is fed into the card fabricating machine at the rate of approximately thirteen feet per second, and it is highly desirable that when the end of a running web is reached, due either to web breakage or to exhaustion of the source, it be immediately spliced to the leading edge of a new web from a new supply reel without the necessity of stopping or even slowing down the card fabricating machine during the interval required to accomplish the web splice. It has heretofore been conventional to stop the card fabrication completely by letting the web end run on through the fabricating machine. This is undesirable since it not only appreciably reduces the hourly rate of card fabrication regardless of operator diligence, but in addition results in paper spoilage at the beginning and end of each reel. The fabrication rate is sufficiently high that it is not so practicable merely to slow down the fabrication machine as is common practice where manual splicing is employed.

To avoid the disadvantages of hand splicing, it has been proposed that web splicing be performed in a semi-automatic manner accomplished sufficiently rapidly that the use of a large take-up tower or similar arrangement enables mere slowing down of the fabrication machine during the splicing interval. To this end, the leading edge of a new web supply is manually positioned and maintained in splicing relation with a running web. As the end of the running web becomes imminent as determined by visual inspection, actuation of a splicing operation is manually initiated. The running web is halted, cutter knives are moved diagonally across the old and new webs positioned in juxtaposed relation, the remnant ends of the cut webs are plowed out of the way, and adhesive tapes are then rolled one on each side of the webs in overlapping relation with their two pieces of abutting ends. During this operation, a relatively large take-up tower is used as a temporary source of web supply for the fabricating machine operating at reduced production rate.

The proposed arrangement last described has not only the disadvantage that it necessitates reduction of production rate during the splicing interval, but also requires either appreciable height above the splice area occupied by the take-up tower or equivalent appreciable floor area for accommodation of a similar form of dancer-roll construction. There is the further disadvantage that the splicing operation is at best only semi-automatic, requiring visual inspection that a web supply is near exhaustion and manual initiation and termination of the actual splicing operation. Human error in inaccurately judging the imminence of web exhaustion may, by virtue of the high web velocity usually employed, result

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in failure to accomplish web splicing prior to actual web exhaustion. This necessitates the expenditure of considerable time and labor to rethread the web through the splicing and fabricating machines, which must in this event be brought to a complete stop.

It is an object of the present invention to provide a new and improved web splicing machine which automatically senses the termination of a traveling web, whether the termination is due to normal exhaustion of the web source of supply or is due to web breakage, and accomplishes in a fully automatic manner a web splice to the leading end of a new web supply.

It is an additional object of the invention to provide a novel automatic web splicing machine which accomplishes a web splice in an exceptionally rapid manner, involving so short an interval as not to require any slow down of the production rate of the machine to which the web is supplied, and one which is of relatively compact construction involving minimum floor space and overhead height.

It is an additional object of the invention to provide a new automatic web splicing machine which automatically and rapidly produces a transverse butt splice having symmetry of cross-section and minimum thickness at the splice with immediate full strength, and thus a splice more satisfactory to the operation of metering device rolls and for passage through areas of severe restriction as in web straightening devices.

It is yet another object of the invention to provide an improved automatic web splicing machine which operates with two sources of web supply and accomplishes the web splice in a fully automatic manner alternately and successively as between the source and with minimum remnant waste at the splice.

It is a further object of the invention to provide an automatic web splicing machine which automatically senses that a web from a new source is available and properly positioned in the machine in readiness for immediate splicing to a web running through the machine, and in response to such sensing automatically completes the splice at the termination of the web in use; or otherwise, automatically shuts itself and related equipment down until such time as a new web supplied to the machine is automatically fed by it into proper splicing position.

It is an additional object of the invention to provide a novel automatic web splicing machine in which it is merely necessary manually to insert a new web into a vacant throat of the machine whereupon the latter automatically moves the new web into proper splicing position and maintains it there awaiting the splicing operation.

It is yet a further object of the invention to provide a new and improved automatic web splicing machine in which there is no time relationship between threading a new web supply into the machine and the automatic splicing operation of the latter so that threading may be done entirely at the operator's convenience any time prior to exhaustion of a running web supply.

An automatic web splicing machine embodying the invention includes means for guiding a moving web through a splicing region, and means for receiving and guiding the end of a web from an alternate web supply source into position in the splicing region where it is retained in stationary generally parallel splicing relation to the moving web. The machine also includes means responsive to the approach toward the splicing region of the terminating end of the moving web for automatically stopping the latter, and means actuated in timed relation to actuation of the last mentioned means for cutting both stationary webs in a common transverse plane, plowing the remnant ends out of the way, abutting the opposing ends of the cut webs, wrapping and adhering a piece of

splicing tape in overlapping relation to the abutting web ends and on both sides of the web stock, removing the remnant ends of the cut webs from the splicing area, and releasing the spliced web for continued movement out of the splicing region. A relatively small and compact dancer-roll construction is employed to furnish a temporary output web supply during the very short interval required for the web splicing to be automatically performed.

Other objects and advantages of the invention will appear as the detailed description proceeds in the light of the drawings forming a part of this application, and in which:

FIG. 1 illustrates in front elevational view an automatic web splicing machine embodying the present invention in a particular form;

FIGS. 2 and 3 illustrate respective back and side views of the FIG. 1 machine, and FIGS. 3a and 3b illustrate reel and web brake constructions employed therein;

FIG. 4 is an enlarged view illustrating more clearly certain constructional features embodied in one of two identical web storage compartments of the machine, and FIG. 4a is an enlarged fragmentary view of one contactor operating mechanism shown in FIG. 4;

FIG. 5 is an enlarged view illustrating constructional details in the splicing region of the machine, and FIG. 5a is an enlarged fragmentary view of a shutter shown in the FIG. 5 construction;

FIGS. 6 and 7 illustrate respective plan and cross-sectional views of a web splice accomplished by the machine of the present invention;

FIGS. 8, 9, and 10 illustrate respective side, top and end views, partly in cross-section, of the novel splicing carriage embodied in the machine;

FIGS. 11 and 12 illustrate the construction of the novel splicing tape eject mechanism of the machine;

FIGS. 13, 14, 15, and 15a are fragmentary views of a portion of the splicing carriage and are used as an aid in explaining its operation;

FIGS. 16, 17, and 18 illustrate respective front elevational, side and top views of the mechanical drive for the splicing components of the machine;

FIG. 19 is a fragmentary view illustrating the main drive shaft arrangement for the splicer components;

FIGS. 20, 21 and 22 illustrate the detailed drive for the splicing tape eject mechanism;

FIGS. 23, 24, 25 and 26 illustrate the drive for the web brakes employed in the splicing region and the synchronized timing control for the splicing carriage drive;

FIGS. 27, 28, 28a, 29 and 30 illustrate the reciprocating drive for the splicer carriage;

FIGS. 31, 32, 33, 34 and 35 illustrate the remnant-end eject drive structure; and

FIGS. 36-42 represent the electrical control circuit employed in the described embodiment of a splicing machine embodying the present invention.

GENERAL ORGANIZATION AND OPERATION

The general purpose and function of the machine is to perform in a fully automatic manner a transverse butt splice between the terminal and leading ends of two card stock webs supplied through the machine for use by a terminal utilizing equipment, not shown, such as a card printing and fabricating machine. The card supply is taken alternately and successively from two web reels positioned on or adjacent to the splicing machine. Either supply reel may at a given time be the active running web source, and the other reel then constitutes an alternate source. As the running source is exhausted of web, or in the event the web should break at a point between the splicing machine and the supply reel, the splicing machine automatically splices the end of the moving web entering it with the stationary end of the alternate web supply. The web supplied at the output of the machine thus flows continuously and in uninterrupted manner even

though a large number of reels have alternately and successively been supplied through the machine during any given period of its operation.

In performing a splicing operation, the running web is halted a short interval while it is being spliced to the alternate web, and the output web is obtained during this brief interval from a temporary web storage provided by a dancer-roll structure. Immediately after the splice has been completed and the web again moves through the splicing region of the machine, the dancer-roll structure accelerates the moving web from the web in storage to higher than normal velocity quickly to restore in the dancer-roll system the quantity of web which was played out during the splicing operation.

The machine receives the end of an alternate web and automatically moves the web into the splicing region where it is retained in proper position ready for splicing to the running web. This is true for either web source considered as the alternate web, it merely being necessary for the end of the web to be manually inserted a short distance into the inlet throat of the appropriate one of two web storage compartments. Excess web stock is automatically stored in the latter for ready withdrawal during a short interval required to accelerate the web reel substantially to its normal angular velocity prior to the moment when the web is pulled directly from the reel by the terminal utilizing equipment. Web stored in the storage compartment is also available for use by the operator in initially threading the dancer-rolls of the splicing machine and for initially threading the terminal utilizing equipment. The quantity of stored web is sufficient for this purpose without the necessity of pulling web off of the supply reel. In an initial loading operation where no web from either source has been inserted into the splicing machine, the machine as before automatically moves the inserted end of the web from the throat location through and beyond the splicing region to a point where the end of the web is conveniently positioned to be grasped by the operator in completing the threading operation mentioned.

The terminal utilizing equipment may accelerate from rest to full speed without motor speed control by virtue of the fact that the web is readily drawn with little effort from the quantity of web automatically stored in the web storage compartment. In this event, however, web again is stored in the storage area but at less than the output supply rate so that by the time the web is finally exhausted from storage the supply reel has been accelerated almost to its normal angular velocity. Thereafter the terminal utilizing equipment pulls the web directly from the supply reel, the dancer-rolls acting as a shock absorber while the terminal equipment is accelerating the supply reel through the last increment needed to bring the latter up to full speed.

Upon de-energization of the terminal utilizing equipment, a brake automatically brakes the running reel to standstill, web tension being maintained through the dancer-rolls. Immediately after the terminal equipment is at rest, the reel brake is automatically released allowing the dancer-rolls to return to normal position at which they store their normal quantity of web stock material.

The detailed construction of the splicing machine will now be considered by reference to FIGS. 1, 2, 3, 3a, 3b, 4, and 4a. As will be evident from the drawings, there are two web-supply feeds to the splicing region located in the upper central portion of the machine. These feeds have essentially duplicate constructions, and corresponding components of the two feeds are identified by the same reference numerals with distinguishing "A" and "B" subscripts. In the following machine description, certain assumptions are made from time to time that a described operation is in relation the "A" or "B" side of the machine. Such operation applies equally well for the opposite assumption if there be substituted reference to corresponding side A and B components.

One web W_B is fed from a web supply reel 50_B supported on a spindle 51_B freely journaled in the base 52 of the splicing machine. Another web W_A is fed from a similar web reel, not shown, similarly supported at a position to the right of the machine in FIG. 1. As shown in the enlarged fragmentary view of FIG. 3a, there is provided on and relating with the spindle 51_B of each such reel an axially displaceable brake disc 53_B which engages the forward face of a fixedly mounted brake solenoid housing 54_B to brake a running web reel to rest during certain times as will hereinafter be explained. The spindle 51_B also supports a brake ring 55_B which is engaged by the brake shoes of a tension control structure 56_B actuated by a tension solenoid 57_B and operating to maintain proper web tension as the web is pulled off of the web reel and thus prevent overrunning such as might be caused, for example, by the reducing diameter of the web reel as web is drawn from it. To this end, a web tension sensing arm 59_B is positioned and spring biased to measure the web tension and to control a switch 60_B which in turn controls the energization of the tension solenoid 57_B .

The webs W_A and W_B enter the splicing machine at the throat of a respective web storage compartment A or B. Positioned at the throat entrance is a lower feed roll 61_B which is mechanically connected to be driven by a feed-roll motor 62_B . The web passes over this roll and is pressed into engagement with it during periods of web feed by a lower pressure roll 63_B actuated by a pressure roll solenoid 64_B . The lower lever arm 59_B is moved clockwise in FIG. 4 by the web W_B to or beyond an intermediate position, at which it closes the contacts of a lower paper lever switch 66_B which makes quickly and has appreciable overtravel by the mere presence of the web entering the storage compartment throat entrance. Application of a tension to the web will cause the arm 59_B to be moved beyond the intermediate position last mentioned, the amount of overtravel being a function of the magnitude of the tension. When a predetermined minimum tension is exceeded, the arm 59_B operates the tension switch 60_B as earlier mentioned.

The web is constrained to move up the sloping floor 67_B of the storage compartment by a guide wire 68_B pivoted near the compartment throat at 69_B and having a cross-bar 70_B which engages and actuates a pivoted lever 65_B . The latter permits the contacts of a switch 71_B to open whenever the storage compartment begins to fill with buckled paper web as illustrated in the drawing. As the web passes up the sloping floor 67_B of the storage compartment, it passes under the arm of an upper paper lever contact 72_B having contacts which are maintained open by passage of a web under the contact lever. The paper web continues to an upper feed-roll 73_B , which is shown in greater detail in FIG. 5, having an associated pressure roll 73_{B1} supported on a crank arm 73_{B2} and actuated through a linkage mechanism. This linkage mechanism includes a reciprocal link 73_a having a pin and slot connection (with spring 73_b interconnection) with an actuating arm 73_c pivoted at 73_d and in turn having a pin and slot connection to an actuating arm 73_e supported on a shaft 73_f . The latter is connected by a crank arm 73_g and a link 73_h to an operating solenoid 74 . The feed-roll 73_B is rotatably supported on, and mechanically connected through an overrunning clutch to, a shaft driven through a flexible cable 75_B (FIG. 2) and reducing gears 76_B by belt drive from the motor 62_B . The overrunning clutch permits the web, if running, to turn the roll 73_B at web speed but otherwise the roll drives the web.

The solenoid 74 is also mechanically connected through the actuating arm 73_e and a link 73_i to actuate a shutter 90 which moves up into the splicing region during a web loading operation to separate the running web from an alternate web entering the splicing region. The lower end of the shutter is constrained by side pins and slotted guides, not shown, for reciprocal motion in a vertical

direction and its upper end moves in floating relation between the extended ends of the storage compartment floors 67_A and 67_B . As shown in FIG. 5a, the upper tip portion of the shutter is serrated to provide spring fingers so formed that alternate fingers are curved to one side of the plane of the shutter and intervening fingers to the other. A shutter interlock switch 330 closes its contacts whenever the shutter is fully withdrawn to its lowermost position. As will become apparent during later consideration of the electrical control system, it is the purpose of the shutter interlock switch 330 to prevent movement of the splicing carriage except when the shutter is in its lowermost position.

The splicing region is indicated in FIG. 1 by the numeral 77 , and it is here that the splicing operation is performed. The detailed construction and operation at the splicing region will be considered hereinafter, but for the moment suffice it to say that a running paper web moves through the splicing region and over a tension control roll 78 mechanically connected to a tension motor 79 . Web tensioning is effected by the motor 79 , acting as a dynamic web brake, by being driven over-speed by the running web during normal operation. To this end, the motor 79 is of the induction type and thus resists any attempt to drive it above synchronous speed. The resisting force provided by the motor is proportional both to the power supplied to its field and the rate of overdrive, as is well known, so the diameter of the tension-roll 78 and strength of field energization of the motor 79 are selected and adjusted to provide the desired web tension during normal conditions of web utilization by the terminal equipment. The mechanical connection between the motor 79 and tension-roll 78 includes an overrunning clutch, not shown, so oriented that the web can drive the motor but the latter cannot pull the web. Pressure of the web on the tension roll 78 is maintained by a pressure roll 80 . Also included in the tension-roll construction is a web brake, shown in FIG. 3b, comprised by a brake disc 78_a splined to the roll 78 and movable axially of the roll to engage the forward face of the housing of a brake solenoid 78_b fixed to the machine frame. There is sufficient grip between the tension-roll 78 and the pressure roll 80 that the web is held against full tension developed by a dancer-roll system, presently to be described, if the web brake is applied. As will presently be explained more fully, it is the purpose of this web brake to stop and hold the running web whenever the splicing machine and associated equipment are automatically stopped by absence of alternate web at the time a splicing operation is called for. This braking action is sufficiently rapid that the end of the running web stops within the storage compartment so that a normal splice operation may proceed when an alternate web is thereafter threaded into the other side of the machine, thus avoiding any requirement for re-threading the web through the splicing machine and associated terminal equipment.

The web moves from the tension roll 78 to a first idler roll 81 provided on a dancer-roll assembly 82 which is pivoted to the machine at 83 and is spring biased to a reset position (counterclockwise in FIG. 1) by enclosed springs 84 connecting to the dancer-roll assembly through a lever arm 85 . The spring assembly 84 also includes a conventional dashpot construction which cushions any tendency of the dancer-roll assembly 82 to move too rapidly toward rest position. The web after passing over the idler roll 81 extends over an idler roll 86 on the machine, over a second idler roll 87 on the dancer-roll assembly, and thereafter passes over an idler guide roll 88 on the machine to the terminal utilizing equipment, not shown. A contact 82_a , actuated by the dancer-roll assembly, reduces the energization of the tension motor 79 to permit more rapid web movement from the splicing machine immediately after completion of a splicing operation and while the dancer-roll assembly is restoring

the quantity of web which it played out during the splicing interval.

A web is initially loaded into one side of the machine, and assume for the moment that the other side of the machine is empty, by inserting the end of the web into the throat of one of the storage compartments as, for example, the compartment B. The lower paper lever contact 66_B is closed by the web insertion, and upon manual actuation of a push button 89_B (positioned conveniently on the front of the machine as illustrated in FIG. 1) the storage input drive motor 62_B is energized. The pressure roll solenoid 64_B is likewise energized and actuates the pressure roll 63_B to press the web firmly into engagement with the lower drive roll 61_B which is now driven by the motor 62_B and moves the web up the sloping floor 67_B of the storage compartment. The web is constrained to move along the sloping floor 67_B by the guide wire 68_B which at this is positioned generally parallel to the floor 67_B. The web moves under the upper lever contact 72_B, which performs no function during the web loading interval, and into engagement with the upper feed roll 73_B and its cooperating pressure roll 73_{B1}. The latter was actuated into engagement with the feed roll 73_B by the solenoid 74 which was energized concurrently with the solenoid 64_B. The upper feed-roll 73_B, driven through the flexible shaft 75_B and gearing 76_B from the lower feed-roll motor 62_B as earlier explained, operates at approximately $\frac{1}{15}$ the linear speed of the lower feed roll so a buckle of the paper web is developed in the storage compartment 61_B which raises the guide wire 68_B about its pivot 69_B.

Referring at this point to FIG. 5, which is an enlarged view illustrating more clearly the details of construction of the splicing region 77, the shutter 90 upon actuation by the solenoid 74 moves up into the splicing region. The web which at this time is being fed into the splicing region by the upper feed-rolls 73_B, 73_{B1} moves in engagement with the extended end of the storage compartment floor 67_B and between lower brake shoes 91, 92 and through guides 93, 94 positioned on a splicing carriage 95 described in detail hereinafter. Immediately above the guides 93, 94 are deflector guides 96 and 97 which, due to the fact that under the assumed conditions this is the initial web feed into the machine, are deflected to each side of the path of the entering web by respective solenoids 98 and 99 which are energized at this time. The entering web accordingly passes between the deflector guides 96, 97 and an electrical time delay device is set to de-energize the machine at this time. This stops the web feed motor 62_B, energizes for a short interval the reel-brake solenoid 54_B, and de-energizes the deflector guide solenoids 98 and 99 and the pressure roll solenoid 74. The pressure roll solenoid 64_B remains energized a short interval longer to prevent over-run of the web while the reel 50_B is braked to a halt. The web stops with its leading edge projecting just above the splicing region and available to the operator for easy withdrawal from the web stored in the storage compartment 61_B. The web is then manually threaded through the dancer-roll assembly 82 and over the output idler roll 88 to the terminal utilizing equipment.

The operation of the machine in thereafter automatically threading a web into the other side of the machine is the same as last described except in two respects. The newly entering web, upon entering the splicing region 77, is maintained by the shutter 90 out of engagement with the web running through the splicing region from the other side of the machine. The newly entering web is fed as before through the guides 93 and 94 but the deflecting-guide solenoids 98 and 99 are not energized at this time and the entering web accordingly is deflected by the curved fingered end of the shutter 90 and by an appropriate one of the deflecting guides 96 or 97 into a free zone 100_A or 100_B where it engages an arm 101_A or 101_B of a respective lever contact 102_A or 102_B. The actuated lever

contact de-energizes the storage input motor 62_A or 62_B, the associated pressure roll solenoid 64_A or 64_B, and energizes the brake solenoid (such as the solenoid 54_B) of the supply reel from which the entering web was taken. The pressure roll solenoid 64_A or 64_B as before remains energized for approximately $\frac{1}{4}$ second to prevent slack developing in the web during the interval required to brake the supply reel to standstill. The shutter and upper pressure roll solenoid 74 also is de-energized at this time, thus dropping the shutter out of the splicing region. Thus the newly entered web is automatically fed into the splicing region 77, where it is maintained in position ready for splicing to the web which at this time is running through the splicing region.

A splicing cycle of operation is initiated automatically through the sensing of a lack of web when the end of a running web, either by exhaustion of the supply reel or web breakage, passes the lower paper lever contact 66_A or 66_B. In the following description, assume that web has been running through the B side of the machine and the end of the web is sensed by the lower paper lever contact 66_B. This contact upon opening causes, in a manner to be described presently in greater detail, a measured length of splicing tape to be ejected into the splicer carriage 95 and also positions web remnant plows on the splicer carriage to suit the "hand" of the splice (i.e., under the assumed condition, that the running web is on the B side and the stationary web at this moment is on the A side). The lower lever contact 66_B also causes energization of the lower feed-roll motor 62_A and the associated pressure roll solenoid 64_A. The lower feed-roll thereupon places more web in the storage compartment 61_A and the alternate web reel is brought up to speed by thus withdrawing web from it.

As the end of the running web passes the upper lever contact 72_B, this contact closes and energizes a brake clutch (described hereinafter) which initiates drive of two brake cams 105. The cams 105 are engaged by cam followers 106 and 107 which actuate respective crank arms 108 and 109. The crank arm 108 is connected by a rod 110 to a second crank arm 111 which is spring-loaded by a spring 103 and is pivoted at 112. The cam 105 and cam follower 106 permit the crank arm 111 to move under actuation of the spring 103 and in moving it applies a brake shoe 113, and through meshed gears 114 an opposing brake shoe 115, to the running web to bring it to a halt. The crank arm 109 similarly is connected by a rod 116 and crank arm 117, spring loaded by a spring 104, to a lower brake shoe 118 and through meshed gears 119 to an opposing brake shoe 120. The cam 105 in moving accordingly effects application of the upper brake shoes 113 and 115 and lower brake shoes 118 and 120 against the running web at both ends of the splicing region. In doing so, however, the relative contours of the cams 105 are so selected that the lower brake shoes 118, 120 are applied a few milliseconds before the upper brake shoes 113, 115 are applied and the upper shoes likewise release a few milliseconds before the lower shoes.

In a manner which will presently be described in detail, the splicing carriage 95 is thereupon actuated to move transversely of the now stationary webs. This carriage supports opposing paper cutting rolls followed by a pair of plows which together cut the remnant ends of the webs and lift them away to permit the splicing tape previously ejected into position extending through the carriage as mentioned above, to be applied by two pressure rolls which follow the plows. The splice is thus completed in one pass of the splicing carriage 95 transversely across the webs, whereupon the brakes 113, 115 and then the brakes 118, 120 are released by further movement of the cams 105 and the spliced web thereupon begins to move out of the splicing region. As will shortly be explained more fully, the opposing cutting rolls, plows, and pressure rolls of the carriage 95

are moved apart at the end of the carriage splicing movement. The carriage includes four idler rolls which are thereupon moved into engagement with respective ones of four driven remnant eject rolls 123, 124, 125, and 126 which engage the remnant ends of the cut webs and eject them into discharge troughs 127 and 128. Thereafter the carriage 95 returns in spread condition back across the now running web to its initial position where its splicing elements return to their closed relation in readiness for the next splicing cycle of operation.

FIGS. 6 and 7 illustrate in elevation and cross-section a web spliced in the manner described. It will be seen that the webs W_1 and W_2 are joined by a transverse butt splice S, and that the splicing tape T uniformly overlaps both sides of the web juncture. The tape extends around one edge of the spliced webs and is placed on both sides thereof with its ends terminating a short distance from the opposite edge of the webs.

As the running web is brought to a halt at the initiation of the splicing operation as last described, the dancer-roll assembly 82 rotates clockwise as shown in FIG. 1 and supplies the terminal utilizing equipment with web throughout the interval while the running web is stopped for splicing. It was pointed out above that an overrunning clutch is provided between tension motor 79 and the tension-roll 78 so oriented that the web can drive the tension motor but the latter cannot pull the web. When the splice is completed and the web brakes 113, 115 and 118, 120 are released, the dancer-roll springs 84 return the dancer-roll assembly 82 towards its normal running position. In so doing, the dancer-roll assembly restores the quantity of web which it played out during the splicing interval and the tension motor 79 is accordingly driven by the web at a rate which is greater than normal as established by the normal demands of the terminal utilizing equipment. The tension motor 79 thus provides greater braking torque until the dancer-roll assembly 82 ultimately returns to its normal position.

In a particular embodiment of the splicing machine described, the terminal utilizing equipment required a web supply at the rate of 15.4 feet of web per second, and the input feed roll 61_A or 61_B fed web into its associated storage compartment 61_A or 61_B at the rate of 12½ feet per second so that there was a net loss of web from storage of approximately three feet per second. In this case, storage is exhausted from the storage compartment in about five seconds after the splicing operation is completed, and thereafter paper is withdrawn directly from the supply reel with the speed-up of the latter from 12½ feet per second to 15.4 feet per second being compensated by increased tension and absorption of shock in the dancer-roll assembly 82.

SPLICER CARRIAGE

Turning now to the detailed construction and operation of the splicer carriage 95 earlier mentioned, and illustrated in FIGS. 8, 9, and 10, it will be seen that the carriage is movably supported and guided by a plurality of carriage rolls 130 engaging stationary V-ways 131 and 132 provided on a casting 129 secured to a plate 133 extending across the upper portion of the splicing machine. One side of the carriage is provided with a rack 134 which meshes with a driven pinion gear 135 imparting reciprocal motion to the carriage during a splicing operation. The carriage includes a pair of opposed cutting rolls 136 and 137 which are carried by respective arms 138, 139 pivoted at respective points 140, 141 and biased by a spring 142 toward open position where the cutting rolls 136 and 137 are in disengaged spaced relation.

In the initial position of the carriage in readiness for a splicing operation, the arms 138 and 139 are maintained in closed position by the flared end 143 of a latch bar

144 which is guided for reciprocal motion longitudinally of the carriage by a sleeve 145. The latch bar 144 is biased by a spring 146 to latched position and is held in latched position by engagement of a detent 147 carried by the sleeve 145 with a groove 148 provided on the detent bar. The splicing carriage moves to the right in FIGS. 8 and 9 during a splicing operation, and near the end of its movement the end of the latch bar 144 engages a stop 149 whereby continued movement of the carriage forces the latch bar 144 to move to the left in the carriage and thus disengage its flared end 143 from the ends of the levers 138 and 139. The latter thereupon are moved by the spring 142 to open position with the cutting rolls 136 and 137 spaced apart.

After completing the splicing operation the carriage moves to the left, and near the end of its movement a flange 150 through which the latch bar 144 extends engages a stop 151 secured to the plate 133 and a stop 151_a on the casting 129. Continued movement of the carriage to its normal position of rest causes the flange 150 to act through the spring 146 and restore the latch bar 144 to engaged position with the ends of the arms 138 and 139, thus to move the latter to closed position.

The forward ends of the arms 138 and 139 carry (on shafts, not shown) respective pressure rolls 154 and 155 which engage the splicing tape 186 and roll it under pressure onto both sides of the abutting webs to complete the splice. Each arm 138 and 139 is also provided at its forward end with respective upper bridge supports 156_a, 157_a and similarly positioned respective lower bridge supports 156_b, 157_b. These are fixedly secured at their forward end to the carriage arms, and carry at their rear ends pivots 158 which pivotally retain on the top and bottom sides of the arms respective yokes 159_a, 160_a and 159_b, 160_b. The top yokes 159_a and 160_a have integrally affixed thereto upper split-plow members 161_a and 162_a, respectively. The bottom yokes 159_b and 160_b similarly support integral lower split-plow members 161_b and 162_b, respectively.

The forward ends of the plow yokes 159_a and 159_b are provided with pins 163 which engage apertures in a yoke 164 pivoted at 165 to the end of the arm 138. The yokes 160_a and 160_b similarly are provided at their forward ends with pins 166 which engage apertures in a yoke 170 pivoted at 171 to the forward end of the arm 139. The yokes 164 and 170 are arranged to be engaged by a vane 172 supported on a shaft 173 journaled at 174 in the upper end of a bracket 175. The shaft 173 has secured thereto an arm 176 which is pivotally connected at 177 to a yoke 178 having its opposite ends pivotally connected to the movable armatures 179 and 180 of respective solenoids 181 and 182. The latter when selectively energized set the "hand" of the plows 161_a—162_b depending upon whether the stationary alternate web positioned in the splicing region is on the left hand or right hand side of the running web as viewed in FIG. 10.

Thus, energization of the solenoid 181 moves its armature 179 to the right rotating the arm 176, shaft 173 and vane 172 counterclockwise. The vane 172 engages the upper end of the yoke 164 above its pivot 165 to rotate its counterclockwise, and engages the lower end of the yoke 170 below its pivot 171 similarly to rotate this yoke counterclockwise. The yokes 164 and 170 through the pins 163 and 166 move the upper yokes 159_a and 160_a clockwise about their pivots 158 as seen in FIG. 9, and this so deflects their respective split-plow members 161_a and 162_a that member 161_a moves in between the webs (and member 162_a moves outside of the webs) when the splicing carriage 95 moves to the right in FIG. 9 during a splicing operation. Conversely, the yokes 164 and 170 through their mechanical connection with the lower yokes 159_b and 160_b so deflect the lower plow members 161_b and 162_b that the member 162_b enters between the webs (and member 161_b moves outside the webs) during movement of the splicing carriage to initiate a splicing operation. Thus the plow members 161_a and 162_b are used

for one "hand" setting, and members 161_b and 162_a for the other. The positioning of the plow members will be in opposite direction of deflection to that described whenever the solenoid 182 is energized, as will now be evident without further explanation.

In thus positioning the plow members, the upper member 161_a and lower member 162_b (or 161_b and 162_a) will deflect the remnant ends of the alternate and running webs away from the splice area after the webs have been cut by the cutting rolls 136 and 137, which move ahead of the plow members with movement of the splicing carriage 95 in performing a splicing operation.

Each of the carriage arms 138 and 139 includes an elongated longitudinal aperture 185. The cutting rolls 136 and 137 are positioned in the rear end of this aperture, and the pressure rolls 154 and 155 in the front. In a manner presently to be explained in detail, a self-supporting length of splicing tape 186 is projected into position extending through the aperture 185 to be transported by the pressure rolls 154 and 155 into engagement with the webs to be spliced.

As shown more clearly in FIG. 10, the carriage arm 138 is provided at its extreme forward end with a yoke 188 pivoted at 189 to the arm and supporting at its opposite ends pressure rolls 190_a and 190_b, which rotate freely on respective shafts 191_a and 191_b affixed to the ends of the yoke. The carriage arm 139 similarly is provided at its forward end with a yoke 192 pivoted at 193 and carrying upper and lower pressure rolls 194_a and 194_b. The pressure rolls 190_a, 190_b, 194_a and 194_b move with the splicing carriage into engagement with corresponding ones of the power driven eject rolls 123-126 for remnant-end ejection.

A carriage interlock switch 338 is positioned to have its contacts closed by the splicing carriage in the "home" position. This interlock is used to prevent energization of the shutter solenoid 74 except when the splicing carriage is in the "home" position. This interlock action will become more clear when the electrical control system is later described.

Consider now a summary explanation of the more detailed operation of the splicing carriage, and assume for purposes of the explanation that the running web is positioned on the A side of the machine with the stationary alternate web positioned on the B side. Prior to the initiation of the splicing operation, the splicing carriage is positioned as shown in FIGS. 8 and 9 with the carriage arms 138 and 139 maintained in closed position by the detent bar 144. As the end of the running web passes the lower paper lever contact 66_A, the contacts of the latter close to start the input 62_B and cause a length of the splicing tape 186 to be ejected by an ejecting mechanism (presently to be described) into position within the aperture 185 of the carriage arms 138 and 139. The remnant plow elements 161_a-162_b are positioned by appropriate energization of the solenoid 181 at the time the input motor 62_B is energized to start movement of web into the storage compartment 61_B. Under the assumed conditions, the plow positioning is one such that the plow elements 161_a and 162_b would be deflected to the center gap between the webs and the plow elements 161_b and 162_a deflected to either side of the webs.

As soon as the web brakes halt the running web as earlier explained, the splicing carriage is driven by the pinion 135 and rack 134 to the right (as shown in FIGS. 8 and 9) and the cutting rolls 136 and 137 cut the two webs in a common transverse plane normal to the web axis. The plow elements 161_a and 162_b follow and lift the cut remnant ends away to permit the splicing tape 186 to be applied by the pressure rolls 154 and 155 on opposite sides of the abutting ends of the cut webs. Upon movement of the splicing carriage to its extreme right-hand position as shown in FIGS. 8 and 9, the splice is completed, the web brakes are automatical-

ly released, and the alternate web on the "B" side of the machine moves out of the splicing region and becomes the running web. At the end of the carriage movement, the latch bar 144 engages the stop 149 to unlatch the carriage arms 138 and 139. The latter move under actuation of the spring 142 to their open position at which the cutting roll 136, the plow elements 161_a and 162_b and the pressure roll 154 all carried by the arm 138 are spaced from the cutting roll 137, the plow elements 162_a and 162_b, and the pressure roll 155 which are carried by the arm 139. The remnant eject pressure rolls 190_a, 190_b, 194_a and 194_b thereupon are moved to engage the power driven remnant eject rolls 123-126. The remnant ends are thus caught between the pressure and eject rolls, which eject the remnant ends into the remnant chutes as earlier described. The web brakes release and the splicing carriage dwells until the completion of remnant ejection after which it is returned across the spliced (and now running) web without interference because of the spaced apart position of the carriage arms 138 and 139. As the splicing carriage completes this return movement, the latch stop members 151 and 151_A engage the latch flange 150 and move the latch bar 144 to latch the carriage arms 138 and 139 in closed position in readiness for a subsequent splicing operation.

SPLICING TAPE FEED MECHANISM

The splicing tape eject mechanism is illustrated in FIGS. 11 and 12. The splicing tape 186 is of the type having a pressure sensitive adhesive on one surface, such as that marketed under the trade-mark "Scotch" tape. This tape is supplied in reels, and such a reel 200 is freely rotatably supported upon a shaft 201 and is retained in position by a "C" washer 202 engaging a circumferential groove near the end of the shaft. The tape 186 is supplied from the reel 200 over a guide roll 203 of a dancer-roll assembly 204 and over an idler roll 205 and a turning post 206 to a knurled tape drive roll 207. The latter is supported for rotation on the end of a shaft 208 journaled in a frame casting 209 and carrying on its lower end a spiral gear 210 which meshes with a pinion drive gear 211.

As mentioned earlier, the splicing tape is extended through the splicing carriage just prior to the splicing operation, thus minimizing sagging or damage to the unsupported end of the tape where it projects through and beyond the splicing carriage. Accordingly the drive gear 211 is driven in a manner explained more fully hereinafter, through one complete revolution and rotates the shaft 208 and knurled tape drive roll 207 one and one-half revolutions thereby pulling a length of tape (for example approximately six inches in a particular application) from the tape reel 200. The tape dancer-roll assembly 204 provides stable pull-off conditions at this time, while the idler 205 and turning post 206 guide the tape to the drive roll 207. Mounted intermediate the ends of the shaft 208 is a pinion gear 212 which drives through an idler gear 213 a gear 214 affixed to the lower end of a shaft 215 journaled in the frame 209. The upper end of the shaft 215 has affixed thereto a tape crease roll 216 having a V-shape grooved rim as indicated. A tape crease wheel 217 is supported for free rotation about a stud 218 affixed to the end of an arm 219 mounted on the frame 209, the crease wheel 217 being positioned within and closely spaced from the apex of the peripheral V-groove of the crease roll 216. The tape crease roll 216 is turned at a slightly greater peripheral speed than the tape drive roll 207 to cause a slight stretch in the intervening length of tape. This small amount of stretch has been found to produce better retention, after forming, of the desired tape V cross-section. The tape after passing around the drive roll 207 and an idler guide roll 220 is forced between the tape crease roll 216 and the tape crease wheel 217 to

form the tape into a V cross-sectional shape for purposes of stiffening it. A fixed guide 221 on the frame 209 thereafter guides the formed tape into position projecting through the splicing carriage. In a particular embodiment of the invention, by way of example, the extension of the splicing tape requires approximately 120 milliseconds and occurs just before the splicing carriage begins to move at the initiation of a splicing operation.

Also supported on the frame 209 of the tape eject mechanism is a looper assembly comprised by V-shaped swivel arm assembly 222 pivoted at 223 to the frame and including two arms 224 and 225. The arm 224 projects into the path of a projection 226 on the arm 138 of the splicer carriage so that movement of the latter turns the assembly 222 counterclockwise, as shown in FIG. 12, against the restoring force of a spring 227 supported on a triangular shaped plate 228 affixed to the frame 209. The arm 225 includes a slot 229 through which extends a looper wire 230 having one end 231 adjacent the tape 186 in its projected position through the splicing carriage and having its opposite end pivoted at 232 to end 233 of the triangular plate 228.

A tape cutting knife 234, preferably having a serrated knife edge, is supported on the frame 209 and projects into spaced opposed relation to the tape as indicated in FIGS. 11 and 12.

Consider now the operation of the tape eject mechanism described, and refer to FIGS. 13, 14, 15, and 15a which illustrate successive steps in the process of applying the splicing tape during a splicing operation. The carriage is shown at rest in FIG. 13, and its forward movement at the initiation of a splicing operation brings the pressure rollers 154 and 155 into contact with the splicing tape 186 and thereby forces it toward the near edge of the web. The tape as it is moved forward partially withdraws from the splicer carriage and begins to bend around the end 231 of the looper wire 230 as illustrated in FIG. 14. This wire maintains its position until the tape is within approximately one-eighth inch of the edge of the web at which time the projection 226 on the carriage arm 138 comes into contact with the end 224 of the arm 222 and begins to pivot the latter about the pivot point 223. This movement carries with it the arm 225. Since the looper wire 230 is pivoted at 232, the movement of the arms 224 and 225 causes the looper wire to pivot about the pivot point 232 and thereby allow the splicing tape to become slack and temporarily independent of the splicing carriage movement. This "free" tape is then available to be drawn into the area between the tape pressure rollers 154 and 155 and be anchored firmly for a short distance on both sides of the web without pulling the tape to the left, as illustrated in FIG. 15. Further motion of the splicing carriage brings the splicing tape taut against the tape cutting knife 234, at which time the tape and the edge of the web are securely held by the tape pressure rolls 154 and 155 so that the tape is readily cut by the knife 234.

As the splicing carriage continues its forward motion, the projection 226 passes beyond the end 224 of the swivel arm 222 and the spring 227 restores the looper assembly 222, 225 and 230 to the rest position shown in FIG. 13. The pressure rolls 154 and 155 continue to press the cut length of tape along the line of the splice of the two web ends, as earlier explained, in completion of the splicing operation. As the looper wire 230 returns to its rest position, it restores the cut end of the tape 186 to a location suitable for the next tape projection operation at the initiation of a subsequent splicing operation.

When the carriage arms 138 and 139 return in open relation during return movement of the splicing carriage to its initial position, as described above in connection with FIGS. 8-10, the projection 226 on the carriage arm 138 strikes the rear end portion 224 of the arm 222 and pivots it about a pivot point 236 on the arm

226 as indicated by the fragmentary view of FIG. 15a. This permits the projection 226 to pass by the looper wire assembly to its position shown in FIG. 13. After movement of the projection 226 past the end 224 of the arm 222, the end 224 is restored to position by the spring 227.

MECHANICAL DRIVE

The drive mechanism for all of the components in the splicing region is shown in FIGS. 16 through 35. Referring particularly to FIGS. 16, 17, 18, and 19, a continuously running motor 240 is connected through gears 241 and 242 to a drive shaft 243 upon which are mounted three "timing" belt pulleys 244, 245, and 246 and a V belt pulley 247. These "timing" belts have equally spaced and transverse cleats or bars integrally molded into the inner surface of the belt. The cleats engage cooperating slots on the pulley surface and thereby prevent belt slippage on the pulley. The drive pulleys last mentioned actuate the following drives:

- a. Pulley 244—tape eject drive;
- b. Pulley 245—primary clutch drive;
- c. Pulley 246—secondary clutch drive;
- d. Pulley 247—remnant eject drive.

The several drives are effective by selective solenoid-operated clutch control in the sequence as listed above.

a. Splicing tape eject drive

Considering first the splicing tape eject drive, illustrated in FIGS. 20, 21 and 22, the pulley 244 is coupled by a belt 248 to a driven pulley 249. As the end of the running web passes the lower paper lever contact 66_A or 66_B (FIGS. 1-4), the contact energizes a tape clutch solenoid 250 (FIGS. 20 and 21) with an electrical pulse. Energizing this solenoid permits a tape clutch 251 in the hub of the pulley 249 to engage for one revolution, the clutch being of the well known helical spring type having a spring 251_a enclosed within a housing 251_b having a stop notch 251_c engaged by the extended armature 251_d of the solenoid 250 upon clutch disengagement. A pivoted keeper arm 251_e engages a notched member 251_f secured to a driven shaft 252. Engagement of the clutch 251 mechanically couples the pulley 249 to the driven shaft 252, which is coupled by a sprocket wheel 253 and a chain 254 to a sprocket wheel 255 mounted upon the end of a shaft 256. The latter drives the pinion gear 211 (FIG. 11) of the tape dispensing mechanism, causing the latter to present a measured amount of splicing tape to the splicing carriage in the manner described above.

b. Primary clutch drive

It is the purpose of the primary clutch drive to apply the web brakes (113, 115, 118, and 120 of FIG. 5) to stop the running web just prior to a splicing operation and also to initiate the operation of a secondary clutch drive which will be described shortly. The primary clutch drive is illustrated in FIGS. 23-26. The main drive pulley 245 is coupled by a belt 258 to a pulley 259, the belt extending over idler pulleys 261 and 262. The pulley 259 rotates a primary clutch shaft 263 through one revolution when a primary clutch 264, of the helical spring type, is released by energization of a primary clutch magnet 265 with an electrical pulse of current as the end of the traveling web passes the upper paper lever contact 72_A or 72_B (FIGS. 1 and 4). The shaft 263 carries on its end the cams 105, shown in FIG. 5, which in moving apply the web brakes. The shaft 263 also rotates a double lobed cam 266, the lobes 267 and 268 of which actuate a control arm 269 of a secondary clutch now to be described.

c. Secondary clutch drive

The secondary clutch drive is illustrated in FIGS. 27, 28 and 28a. Referring particularly to FIG. 27, the control arm 269 is pivoted at 270 in a frame 271 and in-

cludes an arm 272 which is biased by a spring 273 into engaging relationship with a clutch 274 of the helical spring type. The clutch 274 encloses the projected hub of a pulley 275 which is driven by a belt 276 from the drive pulley 246 on the main drive shaft 243. Accordingly, when the control arm 269 is moved by the cam lobe 267 and its arm 272 disengages the clutch 274, the latter permits the driven pulley 275 to complete a driving engagement to a crank arm 277 positioned on the end of a shaft 278. Also positioned on the latter is a toothed member 279, shown more clearly in FIG. 28a, which is engaged by a keeper 280 mounted on the frame 271 and serves to maintain the shaft 278 locked-up when the arm 272 engages the clutch 274.

The crank arm 277 is driven through 180° of rotation before the control arm 272 again engages a tooth of the clutch 274, and subsequently moves through an additional 180° when the other cam lobe 268 engages and moves the control arm 269 during the full 360° movement of the cam 266. For the position of the cam lobes 267 and 268 as shown in FIG. 27, the proper position of the crank arm 277 is a horizontal one pointing to the left as shown in FIGS. 16 and 17, but it has here been shown partially rotated to clarify the illustration. The crank arm 277 is connected through a connecting rod 282 to a cross slide 283 constrained for reciprocal movement within a frame 284. As shown in FIGS. 29 and 30, the cross slide 283 is provided with a rack 285 which engages an idler pinion gear 286 positioned in meshing engagement with a pinion gear 287 fixed on a shaft 288. The latter carries the pinion gear 135 which engages the rack 134 of the splicing carriage as shown in FIGS. 8, 9, and 10.

It will be apparent that the secondary clutch drive under control of the cam 266 thus actuates the cross slide 283 in opposite directions between its limits of travel and in doing so drives the splicing carriage in opposite directions between its limits of travel.

d. Remnant eject drive

The remnant eject drive is illustrated in FIGS. 31-35 and includes a pulley 290 which is supported on a shaft 291 and is driven through a V-belt 292 from the pulley 247 on the main drive shaft 243. As shown more clearly in FIGS. 34 and 35, the pulley 290 is coupled through a helical spring clutch 294 to the shaft 291 under control of an electromagnet 295 having an armature actuated pall 296 positioned normally to engage a notch 297 of the clutch housing. A spring biased pivoted keeper arm 299 engages a notched member 298 affixed to the driven shaft 291. The shaft 291 supports at its end a gear 301 which is mechanically coupled to the shaft through an overrunning spring clutch 302 oriented to drive the gear 301 from the shaft 291 but permitting the former to override the shaft when the latter comes to rest.

The gear 301 meshes with a pinion gear 306 secured to the end of a shaft 307 which carries on its opposite end the eject roll 125. The gear 306 in turn drives a pinion gear 308 which is secured on the end of a shaft 309 having the eject roll 126 supported on its opposite end. A gear 310 is also affixed to the shaft 309 and engages a gear 311 secured on a shaft 312 which carries at its opposite end the eject roll 124. Also affixed to the shaft 312 is a gear 313 which engages a gear 314 affixed to a shaft 315 carrying at its opposite end the eject roll 123.

It will be apparent from the foregoing description that the eject rolls 123-126 are gear driven from the gear 301 which is actuated through the overrunning clutch 302 and the solenoid actuated clutch 294 from the pulley 290 driven through the pulley 247 from the main drive shaft 243.

ELECTRICAL CONTROL CIRCUIT

The electrical control circuit for the automatic web splicing machine hereinbefore described is shown in FIGS. 36-41 which should be considered in the relationship shown in FIG. 42. FIG. 36 shows the main energization from a three phase alternating current transformer of which only the secondary winding 320 is shown through a manually operated disconnect switch 321 and a solenoid operated power contactor 322 which completes energization of the terminal equipment drive motor 324. This alternating current energization is also supplied to a rectifier system, not shown, from which are derived the 150 volt and 120 volt direct current energizations employed in the control circuit of FIGS. 37-41.

The arrangement and operation of the overall electrical control circuit will be considered in relation to several types of operation of the web splicing machine.

In the following described operations, assumptions are made with regard to the A or B sides of the splicing machine. The described operation is the same for the opposite assumption if there be substituted reference to corresponding side A and side B components, contacts, and the following correspondence of electrical circuit control relays:

CORRESPONDING RELAYS

Side A	Side B
10	20
11	21
12	22
13	23
14	24
15	25
16	26
17	27
18	28
1P1	1P2

1. Initial web loading

Assuming that initial web loading takes place on side A of the machine, the end of the web from the reel is inserted into the entrance of the storage compartment. This operates lower paper lever contact 66_A which thereupon closes its contacts to energize relay 11. The relay pull-in winding 15P of relay 15 may now be energized through relay contacts 11AU and normally closed relay contacts 12AL by manually depressing push button 89_A. Relay contacts 15AU thereupon close to energize the holding winding 15H of relay 15 and the pull-in winding 18P of relay 18 through normally closed relay contacts 13BU, normally closed contacts 2C2 of a time delay relay 2C, and a circuit 337 grounded through contacts 338 positioned on the splicing carriage and closed whenever the latter is properly positioned in readiness to initiate a splicing cycle of operation. Relay 1-P1 is also energized at this time through normally closed relay contacts 22BU, and the hold winding 18H of relay 18 is now energized through relay contacts 18AU. A charge is also placed in condensers C19 and C20 through resistor R31, rectifier D11, relay contacts 15AU, and the normally closed relay contacts 2C2 from the 120 volt supply line. Of the latter mentioned relays, relay 1-P1, and relay windings 15H and 18P are de-energized in approximately two seconds by the time delay relay contacts 2C2. The time delay relay is shown in FIG. 36 and includes a thermal element 2C energized through a transformer 326 and relay contacts 15BL from the alternating current supply source.

Since the operation under consideration is an initial web loading operation, initial load solenoids 98 and 99 (which are connected to the deflecting guides 96 and 97, FIG. 5) are now energized through relay contacts 15BL and relay contact 1A. The shutter solenoid 74 (which also actuates the upper feed roll 73_{A-1}, 73_{B-1}) is also energized at this time through relay contacts 15BL.

Relay 17 (FIG. 40) is energized through relay con-

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tacts 15AL. Relay contacts 17BL thereupon close to charge condenser C25 through a resistor R36 and a rectifier D15 from the 150 volt supply line. Relay contacts 17AU energize the tension brake solenoid 57_A through relay contacts 7AL and the tension contacts 60_A.

Input motor 62_A (FIG. 36) and the plow setting solenoid 181 are now energized through relay contacts 17AL and relay contacts 15BU, and input pressure roll solenoid 64_A is energized through normally closed relay contacts 18AL. As the web is driven through the exit of the A storage compartment, the upper paper lever contact 72_A is actuated to close its contacts and thereupon energize relay 12 (FIG. 37). Relay 14 is now energized through normally closed relay contacts 24BU, the normally closed contacts of the load stop contact 102_A, relay contacts 12AL, and relay contacts 11AU.

As soon as the time delay relay contacts 2C2 open after approximately two seconds delay, relay 15 is de-energized and its contacts 15AL and 15BL open to de-energize relay 17 and the shutter solenoid 74. This energizes the reel brake 54_A for approximately one second by closure of relay contacts 17BL to discharge the condenser C25 through the brake solenoid 54_A. The drop out of relay 18 is delayed for approximately one-quarter second, after the time delay relay contacts 2C2 open, by virtue of the charge which has been stored in the condensers C19 and C20 and which maintain the relay hold winding 18H energized through relay contacts 18AU. This permits the pressure roll solenoid 64_A to remain energized through relay contacts 18AL for a short time after input motor 62_A becomes de-energized by the opening of relay contacts 15BU, and prevents slack web from forming between the web reel and the entrance to the storage compartment.

The web is thereby loaded through the A side of the machine, and is pulled from above the exit of the splicing region for threading through the dancer-roll and into the terminal utilizing equipment in the manner earlier explained.

2. The web start and run operation

Assume that a web has been inserted into the A side of the splicing machine as last described and has been threaded through the machine and into the terminal equipment. The threading operation will have exhausted the web stored in the A storage compartment. This results in closure of the storage contact switch 71_A with resultant energization of the relay 10 to close its contacts 10AU. Energization of the latter is necessary to permit energization first of relay winding 6P and thereafter of the terminal equipment drive motor 324 through energization of relay 2 which controls energization of the drive motor contactor 322. This insures that web accumulation in the storage compartment is more uniform as to quantity since accumulation always starts from the condition where web is flat or almost flat on the floor 67_A or 67_B of the storage compartment. Relay 10 upon being thus required to be initially energized delays starting the terminal equipment while the stationary A-side reel is being accelerated and a new supply of web is being accumulated in the A storage compartment (sufficient stored web opens storage contacts 71_A to de-energize relay 10) to provide a low-tension source of web to the terminal equipment. Accordingly, the splicing machine is in condition to start and run with relays 10, 11, 12, and 14 energized. Further, a web sensing interlock 328 (FIG. 41) provided on the terminal utilizing equipment is closed to indicate that the terminal equipment is threaded with web.

The splicing machine is provided with a start-stop manually operable switch 329 (FIG. 41). If this switch happens to be in the start position at this time, it is moved to its stop position to energize relay 5 through the start-stop switch 329, the normally closed relay contacts 4AL, the contacts 330 provided on the shutter and operated to

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closed position when the shutter is dropped out of the splicing region, and the web sensing interlock contacts 328. Relay contacts 5AU close when the relay 5 is energized and maintain energization of the latter when the start-stop switch 329 is moved to its start position. The latter operation places 120 volt energization on the pull-in winding 6P of relay 6 through the resistor R83, relay contacts 24BL, 10AU, 14BL, 2AL, and 5BL. Energization of relay 6 in turn energizes relay 17 (FIG. 40) through relay contacts 14AL and 6AL. Relay 17 upon becoming energized closes its contact 17BL to connect the condenser C25 through the resistor R36 and the diode rectifier D15 to the 150 volt supply line. The charge of condenser C25 is later used to energize the web supply reel brake 54_A should the web be stopped for any reason.

Energization of the relay 17 also energizes the input motor 62_A through relay contacts 17AL and 6BU paralleled at this time by relay contacts 10AL. The plow setting solenoid 181 is energized concurrently with the input motor 62_A, and the input pressure roll solenoid 64_A is likewise energized with the input motor 62_A through normally closed relay contacts 18AL. This accelerates the web reel A and puts excess web in storage in the A storage compartment. When the latter compartment starts filling with stored web, the storage contact 71_A is opened through the action of arm 68_A, thereby opening the energizing circuit of relay 10 which drops out to de-energize the pull-in winding 6P of relay 6 and complete an energizing circuit to the hold winding 6H of this relay and the pull-in winding 2P of relay 2. This energizing circuit is traced through relay contacts 6AU, 14AU, normally closed relay contacts 10BU, the stop-start switch 329, relay contacts 4AL, the shutter contacts 330, and the web sensing interlock contacts 328 to the 120 volt supply line. The condenser C27 connected across relay winding 6P prevents drop out of relay 6 until the holding winding 6H of relay 6 is energized.

Energization of relay 17 also causes energization of the tension brake solenoid 57_A, through relay contacts 7AL, whenever the contacts of the tension switch 60_A close.

With the pull-in winding 2P of relay 2 energized as last mentioned, the hold winding 2H of this relay is energized through relay contacts 2AL and 5BL, the start-stop switch 329, relay contacts 4AL, the shutter contacts 330, and the web sensing interlock contacts 328 from the 120 volt supply line. The drive motor contactor 322 (FIG. 36) is now energized through relay contacts 2AU from the alternating current supply line. Alternating current energization is thereupon supplied to the terminal equipment drive motor 324, the splicer motor 240 and the tension motor 79 which is energized through an adjustable auto-transformer 332. The dancer-roll contact 82_A operates to provide full tension-motor energization (and thus maximum web tension) when the dancer-roll is at rest position but reduced tension-motor energization when the dancer-roll is moved to a high tension position for any reason.

The relay hold winding 6H of relay 6 will continue to be energized as long as there is web in the storage compartment, but is de-energized upon opening of relay contacts 10BU when relay 10 is again energized by closure of full storage contacts 71_B. The pull-in winding 6P of relay 6 does not become again energized upon closure of relay contacts 10AU since its energizing circuit is opened by relay contacts 2AL, relay 2 being energized at this time. When relay 6 thus becomes de-energized, the input motor 62_A, plow solenoid 181, and input pressure roll solenoid 64_A become de-energized by opening of relay contacts 6BU. It may be noted that relay 17 continues to be energized after relay 6 drops out due to the previous energization of relay 2 to close its contacts 2BL which are connected parallel with the relay contacts 6AL.

The web now moves through the splicing machine, and relays 2, 5, 10, 11, 12, 14, and 17 remain energized. It may be noted that relay 20 is also energized at this time

if it be assumed that no web is loaded in the B side of the machine and accordingly that the full storage contacts 71_B of the B storage compartment are closed by the absence of stored web in this compartment.

3. Normal load of the alternate web

Assume now that the A side of the splicing machine is loaded with web, and that it is desired to load web into the B side.

When the end of the web is inserted into the entrance to the B storage compartment, the lower paper lever contact 66_B closes its contacts and thereupon energizes relay 21. The pull-in winding 25P of relay 25 is now energized, upon closure of the manually operated push button 89_B, through normally closed relay contacts 22AL and relay contacts 21AU. The holding winding 25H of relay 25 and the pull-in winding 28P of relay 28 are now energized through the normally closed relay contacts 23BU, relay contacts 25AU, and normally closed time delay relay contacts 2C2. Relay contacts 25AU upon closing also place a charge in condensers C19 and C20 through resistor R30 and diode rectifier D10. Relay 1P2 will not be energized at this time because relay contacts 12AU are open due to energization of relay 12 through upper paper lever contact 72_A which is closed by the presence of web in the A side of the machine.

Relay 27 (FIG. 40) is now energized through relay contacts 25AL, and this in turn places a charge in condenser C26 through relay contacts 27BL, the resistor R38, and the diode rectifier D16. It also completes the energizing circuit of the tension brake solenoid through relay contacts 27AU, 7BL and the tension contact switch 60_B. The shutter and upper feed-roll solenoid 74 and time delay relay 2C (FIG. 36) are energized through relay contacts 25BL from the alternating current supply source. Input motor 62_B and the plow solenoid 182 are also energized through relay contacts 27AL and 25BU. The input pressure roll solenoid 64_B is energized through the relay contacts 28AL, relay 28 having its holding winding 28H energized through relay contacts 28AU from the potential developed across the condensers C19 and C20.

As the newly entering web is driven through the exit of the B storage compartment the upper paper lever contact 72_B closes to energize relay 22. Since the web deflecting solenoids 98 and 99 are de-energized at this time (relay 1P2 being de-energized) the web passes through the splicing region and the end of the web is deflected into engagement with the stop contact 102_B. The latter in closing its contacts energizes relay 23 through the contacts 102_B, the relay contacts 22AL, and the relay contacts 21AU. Energization of relay 23 causes de-energization of the holding winding 25H of relay 25 and pull-in winding 28P of relay 28 due to the opening of relay contacts 23BU. It may be noted at this point that should the stop contacts 102_B fail to energize the relay 23, the relay windings 25H and 28P are nevertheless de-energized at the end of about two seconds by opening of the time delay relay contacts 2C2. Relay 27 is de-energized due to the opening of relay contacts 25AL, and its contacts 27AL thereupon open to de-energize the input motor 62_B and the plow setting solenoid 182. The reel brake solenoid 54_B is now energized through the relay contacts 27BL by the charge stored in the condenser C26. The holding winding 28H of relay 28 remains energized for approximately one-quarter second by the charge stored in the condensers C19 and C20, and this accordingly maintains the input pressure roll solenoid 64_B energized for a short time after the input motor 62_B has become de-energized and prevents slack web from developing between the supply reel and the entrance to the B storage compartment. The time delay relay 2C and the shutter and upper pressure roll solenoid 74 are de-energized with the opening up of relay contacts 25BL.

It may be noted that normally a full quantity of web will have been stored in the B storage compartment at

the time the end of the web engages the stop contact 102_B to energize relay 23 and thereby de-energize relays 25 and 28.

The web is now loaded into the B side of the splicing machine ready for a splicing operation. Relays 2, 5, 10, 11, 12, 14, 17, 21, 22, and 23 remain energized at this time.

4. Web transfer by web splicing operation

Assume that the web on the A side of the machine is running in normal manner and that an alternate web has been loaded into the B side of the machine, in readiness for splicing, as last described. Now as the end of the web on the A side of the machine passes the lower paper lever contact 66_A, the contacts of the latter open and relay 11 is de-energized. Relay 14 is likewise de-energized by the opening of contacts 11AU. The pull-in winding 26P of relay 26 is now energized through relay contacts 11BU, 12BL, and 23AU. Its holding winding 26H is thereupon energized through relay contacts 26AU and contacts 23AU.

Energization of relay 26 initiates a cycle of operation of the splicing tape eject mechanism by energizing the tape clutch magnet 250 (FIG. 38) through relay contacts 26BL, the condenser C15 shunted by the resistor R22 and a manually operable switch 335 (used for manual tape ejection). The period of energization of the magnet 250 is limited to one cycle of operation of the tape eject mechanism by the time constant of the condenser C15 and the impedance of this magnet. Relay 17 is de-energized due to the opening of contacts 14AL, and the reel brake solenoid 54_A is thereupon energized through relay contacts 17BL by the charge stored in the condenser C25 thus braking to a halt the supply reel of the A web. Relay 27 is now energized through relay contacts 26AL and relay contacts 2BL. Operation of relay 27 energizes the input motor 62_B, input pressure roll solenoid 64_B, and the plow setting solenoid 182 through relay contacts 27AL and 20AL.

As the end of the web on the A side of the machine passes the upper paper lever contact 72_A relay 12 is de-energized.

The splice clutch magnet 265 and the eject magnet 295 (FIG. 38) are now energized through relay contacts 23AU, normally closed contacts 12BL and relay contacts 26BU. The splice clutch magnet 265 receives its energization through the condenser C16 and parallel-connected resistor R25, and the splice clutch operation is accordingly limited to one cycle by the time constant of the condenser C16 and the impedance of the magnet 265. During this cycle of operation, the running web is halted by application of the web brakes, the splicing carriage traverses a complete cycle of operation, and the four remnant eject rolls are drivingly rotated as explained above in the description of the splicing operation. After the remnant ends are ejected, the stop contact 102_B will return to its normally closed position, and relay 24 is thereupon energized through relay contacts 14BU, contacts 102_B, 22AL, and 21AU. Relay 23 is de-energized by the transfer of stop contact 102_B, and relay holding winding 26H of relay 26 is accordingly de-energized by opening of relay contacts 23AU. Relay contacts 24AL close a short time before relay contacts 26AL open so that relay 27 (FIG. 40) is not de-energized and condenser C26 accordingly remains connected to the 150 volt supply line through relay contacts 27BL, resistor R38, and diode rectifier D16.

When the web is exhausted from storage in the B storage compartment relay 20 is energized by closure of the full storage contact 71_B to de-energize the input motor 62_B and input pressure roll solenoid 64_B by opening of relay contacts 20AL.

The web on the side B of the machine is now running, and side A is empty. Relays 2, 5, 10, 20, 21, 22, 24, and 27 remain energized at this time.

5. Normal stopping operation

The terminal utilizing equipment and the splicing machine may be stopped by manually depressing the stop-start push button 329 once to its stop position. This de-energizes relay 2 but allows relay 5 to remain energized. De-energization of relay 2 opens the power supply circuit contactor 322 and thereby de-energizes the terminal equipment drive motor 324, the tension motor 79, and the splicer motor 240.

Assuming that web is running through the A side of the machine at this time, relay 17 is de-energized due to the opening of the relay contacts 2BL. The reel brake solenoid 54_A is energized through relay contacts 17BL by the charge stored in the condenser C25 to brake the A supply reel to a halt. Opening of relay contacts 17AL will de-energize the input motor 62_A, input pressure roll solenoid 64_A, and plow setting solenoid 181 if they happen to be energized at this time.

The equipment may also be stopped by the opening of the web sensing interlock 328 as would be caused by breakage of the web between the splicing machine and the terminal equipment. In this instance, stopping of the equipment occurs in the same manner as last described for stopping with the stop-start switch 329 with the exception that relay 5 is also de-energized in this type of stop.

Assuming that web has been running through side A of the splicing machine and that side B is loaded, relays 5, 10, 11, 12, 14, 21, and 22 remain energized in a normal stopping operation. If the equipment stops due to web breakage and opening of the web sensing interlock 328, all of the relays last mentioned with the exception of relay 5 remain energized.

6. Normal restarting operation

To restart the splicing machine and terminal utilizing equipment after it has been stopped by manual actuation of the start-stop switch 329, the latter need be depressed only once to start position since relay 5 remained energized by the previous normal stopping operation. Upon actuation of the stop-start switch 329 to the start position, relay pull-in winding 6P of relay 6 is energized through relay contacts 5BL, 2AL, 14BL, 10AU, and 24BL. Assuming that web has been running through the A side of the machine with side B loaded with web, relay 17 is energized through relay contacts 14AL and 6AL. Input motor 62_A and plow solenoid 181 are now energized through relay contacts 17AL and 6BU, and input pressure roll solenoid 64_A is energized through 18AL, 17AL, and 6BU. This places web in storage in the A storage compartment and de-energizes relay 10 upon opening of the storage contact 71_A.

Pull-in winding 2P of relay 2 and holding winding 6H of relay 6 are now energized through relay contacts 6AU, 14AU, 10BU, and the start-stop switch 329. The holding winding 2H of relay 2 is energized through relay contacts 2AL, 5BL, and start-stop switch 329. The remainder of the starting operation is that previously described under the heading "The Web Start and Run Operation" following energization of relay 6.

To start the equipment after it has been stopped by the opening of the web sensing interlock 328, which de-energizes relay 5, the start-stop switch 329 must be manually actuated to the stop position first to energize relay 5 after which manual actuation of this switch to the start position effects the sequence of relay operations last described.

7. Web breakage

A. BREAKAGE BETWEEN THE SPLICING MACHINE AND THE SUPPLY REEL

If the web breaks between the entrance to the storage compartment 61_A or 61_B and the other side of the machine has web in the ready-to-splice position, a normal splice

cycle occurs and the web automatically transfers from the running web to the stationary web.

If the web breaks between the supply reel and the entrance to the A or B storage compartments and there is no alternate web in the ready-to-splice position on the other side of the machine, the running web and terminal utilizing equipment are automatically stopped. Assuming that the web breakage occurs while web is running through side A of the splicing machine, lower paper lever contact 66_A opens its contacts and de-energizes relay 11. Relay 14 is thereupon de-energized by opening of relay contacts 11AU. This de-energizes relay 17 due to the opening of relay contacts 14AL. The reel brake solenoid 54_A is energized through relay contacts 17BL by the energy stored in the condenser C25. Relay 4 is energized through relay contacts 11AL, 13AL, 23AL, 21AL, the resistor R28, the diode rectifier D18, and relay contacts 2BL. The splicer motor 240 is thereupon transferred to the line side of the drive motor contactor 322 by operation of relay contacts 4AU, 4BL, and 4BU. Relays 5 and 2 are de-energized by opening of contact 4AL and the web is stopped by the web brake 78_b, which is energized through 5AL, 11AL, 13AL, etc. Condenser C17 (FIG. 39) provides an extended period of energization for the relay 4 after the relay contacts 2BL open. The web brake 78_b is energized through 5AL and 4AL to stop the traveling web.

After the splicing machine and terminal equipment have been stopped in the manner last described, normal operation is resumed after side B of the machine has been loaded by means of a normal load cycle in the manner explained above. Relays 20, 21, 22, and 23 remain energized with side B thus loaded. The pull-in winding 26P of relay 26 becomes energized through relay contacts 11BU, 12BL, and 23AU when web is loaded into the B side of the machine, and the hold winding 26H is energized through relay contacts 26AU and 23AU. A length of splicing tape is automatically ejected due to the energization of the tape clutch solenoid 250 through the condenser C15 and relay contacts 26BL.

The web breakage caused the equipment to stop with the stop-start switch 329 in the start position. Manual operation of the stop-start switch 329 to the stop position now energizes relay 5, and the web brake solenoid 78_b is de-energized by the opening of relay contacts 5AL. This allows the dancer-roll 82 to return to its rest position. In doing so, it pulls the end of the web through the side A of the machine and past the upper paper lever contact 72_A which thereupon opens its contacts and de-energizes relay 12. The drop out of the latter causes relay contacts 12BL to close and energize the splice clutch solenoid 265 and the eject clutch solenoid 295 through relay contacts 26BU, 12BL, and 23AU. A normal splice operation now occurs in the manner explained above. Manual operation of switch 336 de-energizes relay 4. The stop-start switch 329 is manually operated to its start position, and a normal web start operation as described above follows.

B. BREAKAGE BETWEEN EITHER STORAGE COMPARTMENT AND THE TERMINAL UTILIZING EQUIPMENT

Should the web break between either of the storage compartments and the terminal equipment, the web sensing interlock 328 opens when the end of the web reaches the terminal equipment. The latter and the splicing machine thereupon automatically stop in the manner described above. If the web break should be above the splicing region, the end of the web is simply re-threaded through the splicing machine and the terminal equipment and a normal start operation then follows. If the web break is between either of the storage compartments and the splicing region, an initial load operation must follow.

8. Power failure

Both the splicing machine and the terminal utilizing equipment will stop upon power failure. The reel brake solenoid 54_A or 54_B on the running side is energized through respective relay contacts 17BL or 27BL from the charge stored in the respective condensers C25 or C26. When power returns, the equipment is restarted in normal procedure as above described.

9. Failure of splice shutter to drop out

It may be noted that relay contacts 18BL or 28BL (during the period of energization of relay 18 or 28 and for approximately one-quarter second thereafter) bypass the shutter interlock contacts 330 during a normal load operation when the splice shutter is required to be positioned within the splicing region. After a web loading operation, the splice shutter should have returned to its normal position out of the splicing region before it is time for a web splicing operation to begin. If it does not do so, the splicing machine and terminal equipment are automatically shut down because the shutter interlock contacts 330 remain open and relays 2 and 5 are de-energized.

What is claimed is:

1. An automatic web splicing machine comprising, a splicing section in which an alternate web is stationarily positioned in splicing relation to a running web, braking means included in said section and responsive to termination of said running web for automatically applying clamping forces to said webs during a predetermined splicing interval to halt said running web during said interval, and splicing means included in said section and having a movement across said webs initiated in timed relation to the operation of said braking means for automatically cutting and taping together the abutting cut ends of said webs during said splicing interval.

2. An automatic web splicing machine comprising, means for guiding a moving web from either of two supply sources through a splicing region, means for receiving the end of a web from the other of said supply sources and for automatically moving said other web into position in said splicing region in splicing relation to said moving web while maintaining physical separation of said webs during said movement, and means positioned beyond said splicing region and engaged by the end of said other web at the completion of said positioning movement for effecting de-energization of said positioning means.

3. An automatic web splicing machine comprising, means for guiding a moving web from either of two supply sources through a splicing region, means for receiving the end of a web from the other of said supply sources as an alternate web and for automatically moving said alternate web out of contact with said moving web into position in said splicing region in splicing relation to said moving web and on a side thereof dependent upon which of said sources constitutes the alternate source at any time, means positioned beyond said splicing region and on each side thereof for deflecting the end of said alternate web into a control region, and means responsive to the presence of said web in said control region for effecting de-energization of said positioning means.

4. An automatic web splicing machine comprising, means for retaining an alternate web positioned in splicing relation to a running web, braking means responsive to the termination of said running web for automatically applying clamping forces to said webs to halt said running web for a splicing interval, and splicing means having a movement initiated in timed relation to the operation of said braking means for automatically cutting and taping together the abutting cut ends of said webs during said splicing interval.

5. An automatic web splicing machine comprising, means for retaining an alternate web positioned in splic-

ing relation to a running web, means responsive to termination of said running web for automatically engaging and halting said running web for a predetermined time interval, and means moving in timed relation to said last mentioned means for cutting and thereafter applying splicing tape across the cut ends of said webs during said interval and after said interval for removing the remnant cut ends of said webs.

6. An automatic web splicing machine comprising, a splicing section in which an alternate web is stationarily positioned in splicing relation to a running web, braking means included in said section and responsive to termination of said running web for automatically applying clamping forces to said webs during a predetermined splicing interval to halt said running web during said interval, and splicing means operating subsequent to actuation of said braking means for moving in one direction across said webs to cut and tape together the abutting ends of said webs during said splicing interval.

7. An automatic web splicing machine comprising, a splicing section in which an alternate web is stationarily positioned in splicing relation to a running web, braking means included in said section and responsive to termination of said running web for automatically applying clamping forces to said webs during a predetermined splicing interval to halt said running web during said interval, splicing means operating in timed relation to said braking means for moving in one direction across said webs to cut and tape together the abutting ends of said webs during said splicing interval, and means for causing said splicing means to effect removal of the remnant cut ends of said webs after said interval and before returning out of contact with the spliced web to complete a cycle of splicing operation.

8. An automatic web splicing machine comprising, a splicing section in which an alternate web is stationarily positioned in splicing relation to a running web, braking means included in said section and responsive to termination of said running web for automatically applying clamping forces to said webs during a predetermined splicing interval to halt said running web during said interval, splicing means operating in timed relation to actuation of said braking means for moving in one direction across said webs to cut and tape together the abutting ends of said webs during said splicing interval, and means responsive to the completion of movement of said splicing means in said one direction for causing said splicing means to effect removal of the remnant cut ends of said webs.

9. An automatic web splicing machine comprising, means for retaining an alternate web positioned in splicing relation to a running web, braking means responsive to the termination of said running web for automatically applying clamping forces to said webs to halt said running web for a splicing interval, and splicing means automatically operating subsequent to actuation of said braking means and during said interval for making a pass across said webs transversely to cut said webs along a common plane and thereafter to apply and pressure roll splicing tape into position overlapping the cut abutting ends of said webs.

10. An automatic web splicing machine comprising, means for retaining an alternate web positioned in splicing relation to a running web, braking means responsive to the termination of said running web for automatically applying clamping forces to said webs to halt said running web for a splicing interval, and splicing means automatically operating subsequent to operation of said braking means and during said interval for making a pass across said webs transversely to cut said webs while moving aside the remnant cut ends thereof and thereafter to tape together the abutting cut ends of said webs.

11. An automatic web splicing machine comprising, means for retaining an alternate web positioned in splicing relation to a running web, braking means responsive

to the termination of said running web for automatically applying clamping forces to said webs to halt said running web for a splicing interval, and splicing means automatically operating subsequent to actuation of said braking means and during said interval for making a pass across said webs transversely to cut said webs along a common plane while moving aside the remnant cut ends thereof and for thereafter applying and pressure rolling splicing tape into position overlapping the cut abutting ends of said webs.

12. An automatic web splicing machine comprising: a splicing section in which an alternate web may be retained positioned in splicing relation to a running web and selectably on either side thereof; splicing means having successively positioned web cutters, web remnant-end plows, and splicing tape applicators; means sensing the side of said running web on which said alternate web is positioned at any given time for presetting said plows to remnant-end engaging positions; braking means responsive to the termination of said running web for automatically applying clamping forces to said webs to halt said running web for a splicing interval; and means operating in timed relation to actuation of said braking means for moving said splicing means across said web to effect splicing thereof during said interval.

13. An automatic web splicing machine comprising: a splicing section in which an alternate web may be retained positioned in splicing relation to a running web and selectably on either side thereof; splicing means having members movable between open and closed positions and individually supporting in successive positions therealong opposed web cutting elements and opposed splicing tape applicator members; braking means responsive to the termination of said running web for automatically applying clamping forces to said webs to halt said running web for a splicing interval; and means operating in timed relation to actuation of said braking means for moving said splicing means in one direction across said webs with said members in closed position to effect web splicing during said interval and for thereafter returning said splicing means in reverse direction across the spliced web with said members in open position.

14. An automatic web splicing machine comprising: a splicing section in which an alternate web may be retained positioned in splicing relation to a running web; splicing means having elongated members normally latched in closed position but movable to unlatched open position and individually supporting in successive positions therealong opposed web cutting elements and opposed splicing tape applicator members; braking means responsive to the termination of said running web for automatically applying clamping forces to said webs to halt said running web for a splicing interval; and means operative in timed relation to actuation of said braking means for moving said splicing means in one direction across said webs with said members in latched position to effect a web splice during said interval and for thereafter returning said splicing means in reverse direction across the spliced web with said members in unlatched open position.

15. An automatic web splicing machine comprising: a splicing section in which an alternate web may be retained positioned in splicing relation to a running web and selectably on either side thereof; splicing means having members normally latched in closed position but movable to unlatched open position and individually supporting in successive positions thereon opposed web cutting elements and opposed splicing tape applicator members; braking means responsive to the termination of said running web for automatically applying clamping forces to said webs to halt said running web for a splicing interval; means operating in timed relation to actuation of said brake means for moving said splicing means in one direction across said webs with said members in latched position to effect web splicing during said interval; means for unlatching said members at the completion of said move-

ment in said one direction; and means responsive to movement of said members to unlatched open position for effecting removal from said splicing section of the remnant cut ends of said webs.

16. An automatic web splicing machine comprising: a splicing section in which an alternate web may be retained positioned in splicing relation to a running web and selectably on either side thereof; splicing means having members normally latched in closed position but movable to unlatched open position and individually supporting in successive positions thereon opposed web cutting elements and opposed splicing tape applicator members; braking means responsive to the termination of said running web for automatically applying clamping forces to said webs to halt said running web for a splicing interval; means operating in timed relation to actuation of said braking means for moving said splicing means in one direction across said webs with said members in latched position to effect web splicing during said interval; means for unlatching said members at the completion of said movement in said one direction; driven eject rolls; and pressure rolls carried by members and effective in the unlatched open position thereof to engage the remnant cut ends of said webs against said driven eject rolls to effect removal of said remnant-ends from said splicing section.

17. An automatic web splicing machine comprising: means for guiding a moving web from a first supply source through a splicing region; means for retaining the end of a web from an alternate supply source positioned in said splicing region in splicing relation to said moving web; means responsive to the passage at a point preceding said splicing region of the terminating end of said first web for initiating a splicing operation; and means responsive to said last-mentioned means for automatically stopping the movement of said first web, cutting both stationary webs in a common transverse plane, applying splicing tape in overlapping relation to the abutting web ends, and releasing the spliced web for continued movement out of said splicing region.

18. An automatic web splicing machine comprising: means for guiding a moving web from a first supply source through a splicing region; means for receiving and automatically moving the leading end of a web from an alternate supply source into said splicing region and for positioning and retaining said web in splicing relation to said moving web; means responsive to the passage at a point preceding said splicing region of the terminating end of said first web for initiating a splicing operation; and means responsive to said last-mentioned means for automatically stopping the movement of said first web, cutting both stationary webs in a common transverse plane, applying splicing tape in overlapping relation to the abutting web ends, and releasing the spliced web for continued movement out of said splicing region.

19. An automatic web splicing machine comprising: means for guiding a moving web from a first supply source through a splicing region; means for receiving and automatically storing a quantity of web from an alternate supply source while moving the leading end of said alternate web into said splicing region and for positioning and retaining said web in said splicing region in splicing relation to said moving web; means responsive to the passage at a point preceding said splicing region of the terminating end of said first web for initiating a splicing operation; and means responsive to said last-mentioned means for automatically stopping the movement of said first web, cutting both stationary webs in a common transverse plane, applying splicing tape in overlapping relation to the abutting web ends, and releasing the spliced web for continued movement out of said splicing region.

20. An automatic web splicing machine comprising: means for guiding a moving web from a first supply source through a splicing region; positioning means for receiving and automatically storing a quantity of web

from an alternate supply source while moving the leading end of said alternate web into said splicing region and for positioning and retaining said leading end in splicing relation to said moving web; means responsive to the passage at a point preceding said splicing region of the terminating end of said first web for initiating a splicing operation; and means responsive to said last-mentioned means for automatically stopping the movement of said first web, cutting both stationary webs in a common transverse plane, applying splicing tape in overlapping relation to the abutting web ends, and releasing the spliced web for continued movement out of said splicing region; said positioning means being responsive to the actuation of said last-mentioned means for accumulating an additional quantity of said alternate web during the splicing interval and until the spliced web feeds from said alternate source at normal web velocity.

21. An automatic web splicing machine comprising: means for guiding a moving web from a first supply source through a splicing region; means for retaining the end of a web from an alternate supply source positioned in said splicing region in splicing relation to said moving web; means responsive to the passage at a point preceding said splicing region of the terminating end of said first web for initiating a splicing operation; and means responsive to said last mentioned means for automatically stopping the movement of said first web, moving a splicing mechanism in one direction transversely across said stationary webs to cut both webs in a common transverse plane and apply splicing tape to the abutting cut ends thereof, releasing the spliced web for continued movement out of said splicing region, and returning the splicing mechanism in opposite direction across the running web with the cutters and tape applicator members thereof spaced from said running web.

22. An automatic web splicing machine comprising, means for retaining an alternate web positioned in splicing relation to a running web, braking means responsive to the termination of said running web for automatically applying clamping forces to said webs to halt said running web for a splicing interval, splicing means having a movement initiated in timed relation to the operation of said braking means for automatically cutting and taping together the abutting cut ends of said webs during said splicing interval, and output tensioning means responsive to running web velocity in excess of a preselectable value for developing a restraining force of value varying with the magnitude of said excess velocity.

23. An automatic web splicing machine comprising, means for retaining an alternate web positioned in splicing relation to a running web, braking means responsive to the termination of said running web for automatically applying clamping forces to said webs to halt said running web for a splicing interval, splicing means having a movement initiated in timed relation to the operation of said braking means for automatically cutting and taping together the abutting cut ends of said webs during said splicing interval, and output tensioning means operatively responsive to running web velocity for freely permitting web movement below a preselectable value of web velocity while exerting a restraining force tending to reduce web velocity for values thereof in excess of said preselectable value.

24. An automatic web splicing machine comprising, means for retaining an alternate web positioned in splicing relation to a running web, braking means responsive to the termination of said running web for automatically applying clamping forces to said webs to halt said running web for a splicing interval, splicing means having a movement initiated in timed relation to the operation of said braking means for automatically cutting and taping together the abutting cut ends of said webs during said splicing interval, output means for storing a predetermined quantity of running web prior to said splicing interval and for playing out said stored web during said

interval, output tensioning means responsive to running web velocity in excess of a preselectable value for developing a restraining force of value varying with said excess velocity, and means controlled by said storing means for reducing said restraining force of said tensioning means whenever said storing means does not store at least said predetermined quantity of web.

25. An automatic web splicing machine comprising, means for retaining an alternate web positioned in splicing relation to a running web, braking means responsive to the termination of said running web for automatically applying clamping forces to said webs to halt said running web for a splicing interval, splicing means having a movement initiated in timed relation to the operation of said braking means for automatically cutting and taping together the abutting cut ends of said webs during said splicing interval, a dancer-roll assembly for storing a predetermined quantity of output running web prior to said splicing interval and for playing out said stored web during said interval, output tensioning means including an electric motor coupled through an over-running clutch to a web roll for freely permitting web movement below a preselectable value of web velocity while exerting a restraining force tending to reduce web velocity for values thereof in excess of said preselectable value, and motor energization control means controlled by movement of said dancer-roll assembly for reducing the energization of said motor whenever said assembly does not store at least said predetermined quantity of web thereby to permit more rapid restoration of said quantity of web in said assembly.

26. An automatic web splicing machine comprising, means for retaining an alternate web positioned in splicing relation to a running web, braking means responsive to the termination of said running web for automatically applying clamping forces to said webs at points above and below a splicing region to halt said running web for a splicing interval, and splicing means having a movement initiated in timed relation to the operation of said braking means for automatically cutting and taping together the abutting cut ends of said webs during said splicing interval, said braking means operating to apply said clamping force at the web input to said region before said clamping force is applied at the output of said region and to release the output clamping force before release of the input clamping force.

27. An automatic web splicing machine comprising, means for retaining an alternate web positioned in splicing relation to a running web, braking means responsive to the termination of said running web for automatically applying clamping forces to said webs at points above and below a splicing region to halt said running web for a splicing interval, splicing means having a movement initiated in timed relation to the operation of said braking means for automatically cutting and taping together the abutting cut ends of said webs during said splicing interval, and means included in said braking means for timing the application of said clamping force at the web input to said region to precede the clamping force applied at the output of said region and for timing the release of the output clamping force to precede the release of the input clamping force.

28. An automatic web splicing machine comprising, means for receiving the end of a web from a first web source and for automatically feeding said web end into a splicing region, means for receiving the end of a web from a second web source and for automatically feeding said last mentioned web end into said splicing region, and means responsive to an initial entry of web in either one of said means and the absence of web in the other for directing the newly entered web through said splicing region to the output thereof but responsive to the presence of web in said other means for terminating the web feed by said one means when the end of the web fed thereby reaches the end of said splicing region.

29. An automatic web splicing machine comprising, means for receiving and automatically storing a quantity of web from a first web source while automatically feeding the end of said web into a splicing region, means for receiving and automatically storing a quantity of web from a second web source while automatically feeding the web end into said splicing region, means responsive to absence of web in either one of said means for directing the web fed by the other of said means through said splicing region to the output of said machine, and means responsive to the presence of web in either one of said first-mentioned means for terminating the web feed by the other of said means when the end of the web fed thereby reaches the end of said splicing region.

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