

July 9, 1968

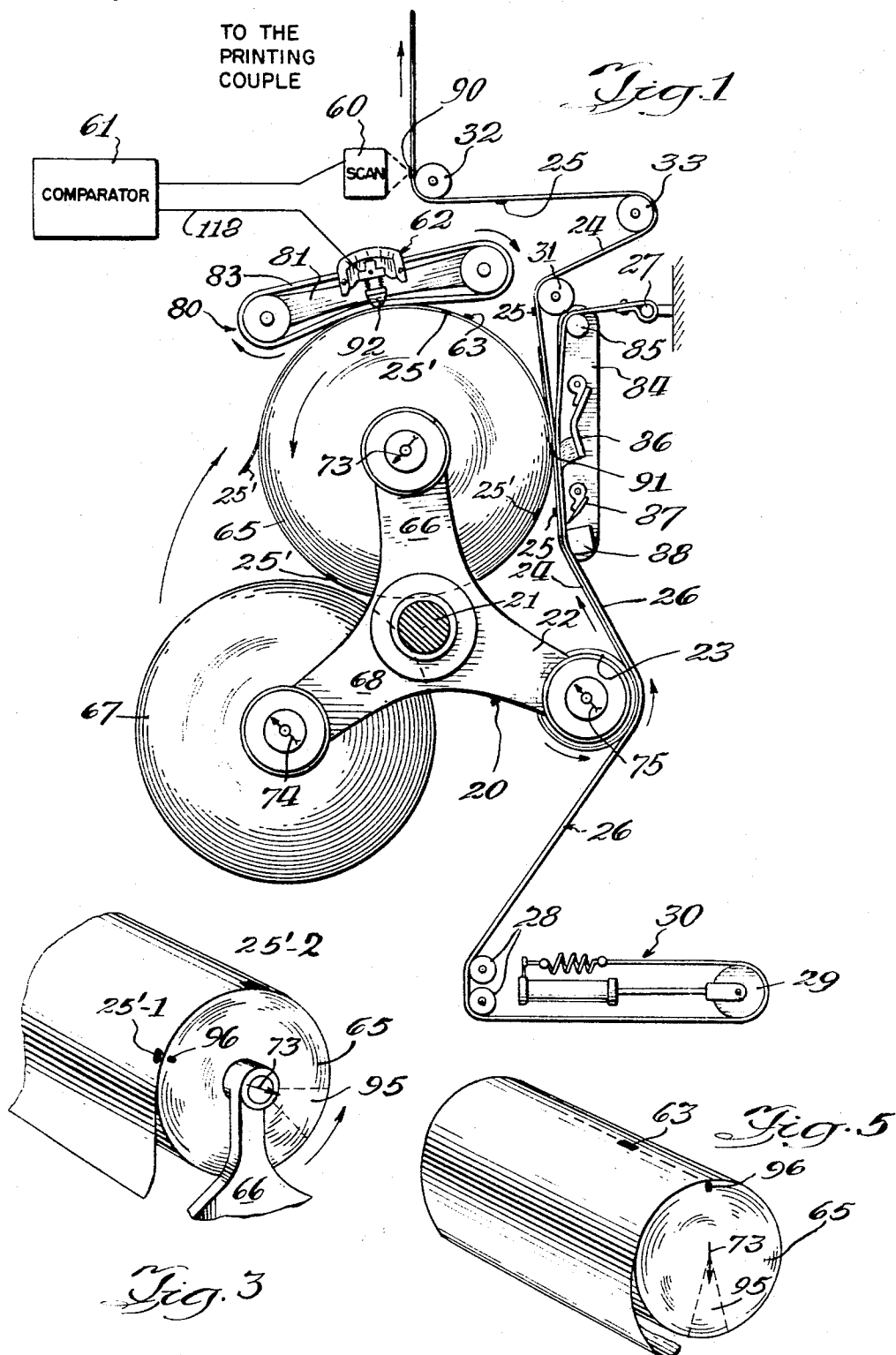
C. H. ANGELL ET AL

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AUTOMATIC PREPRINT PASTER APPARATUS AND METHOD FOR USING SAME

Filed Sept. 28, 1966

3 Sheets-Sheet 1



July 9, 1968

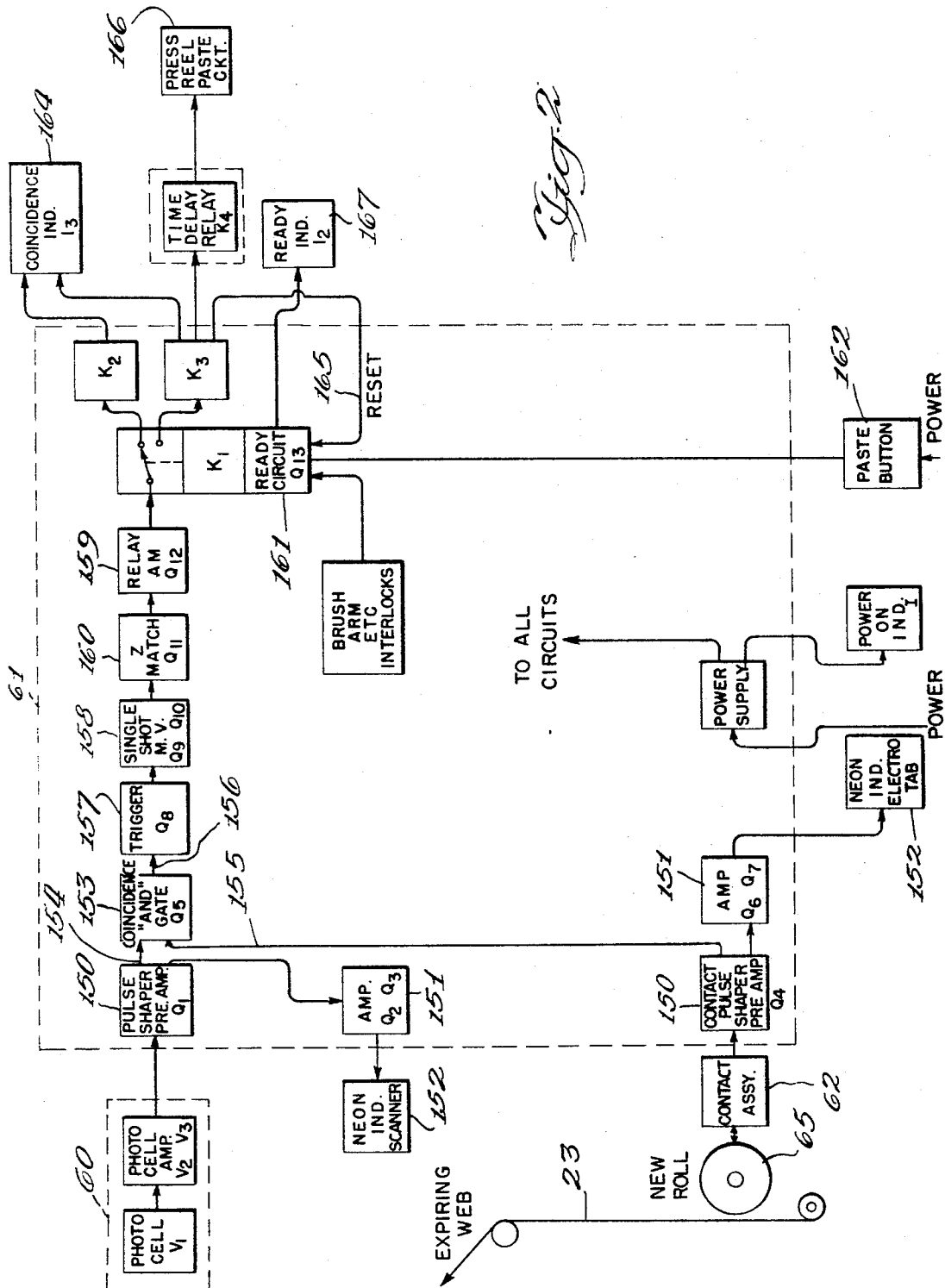
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AUTOMATIC PREPRINT PASTER APPARATUS AND METHOD FOR USING SAME

Filed Sept. 28, 1966

3 Sheets-Sheet 2



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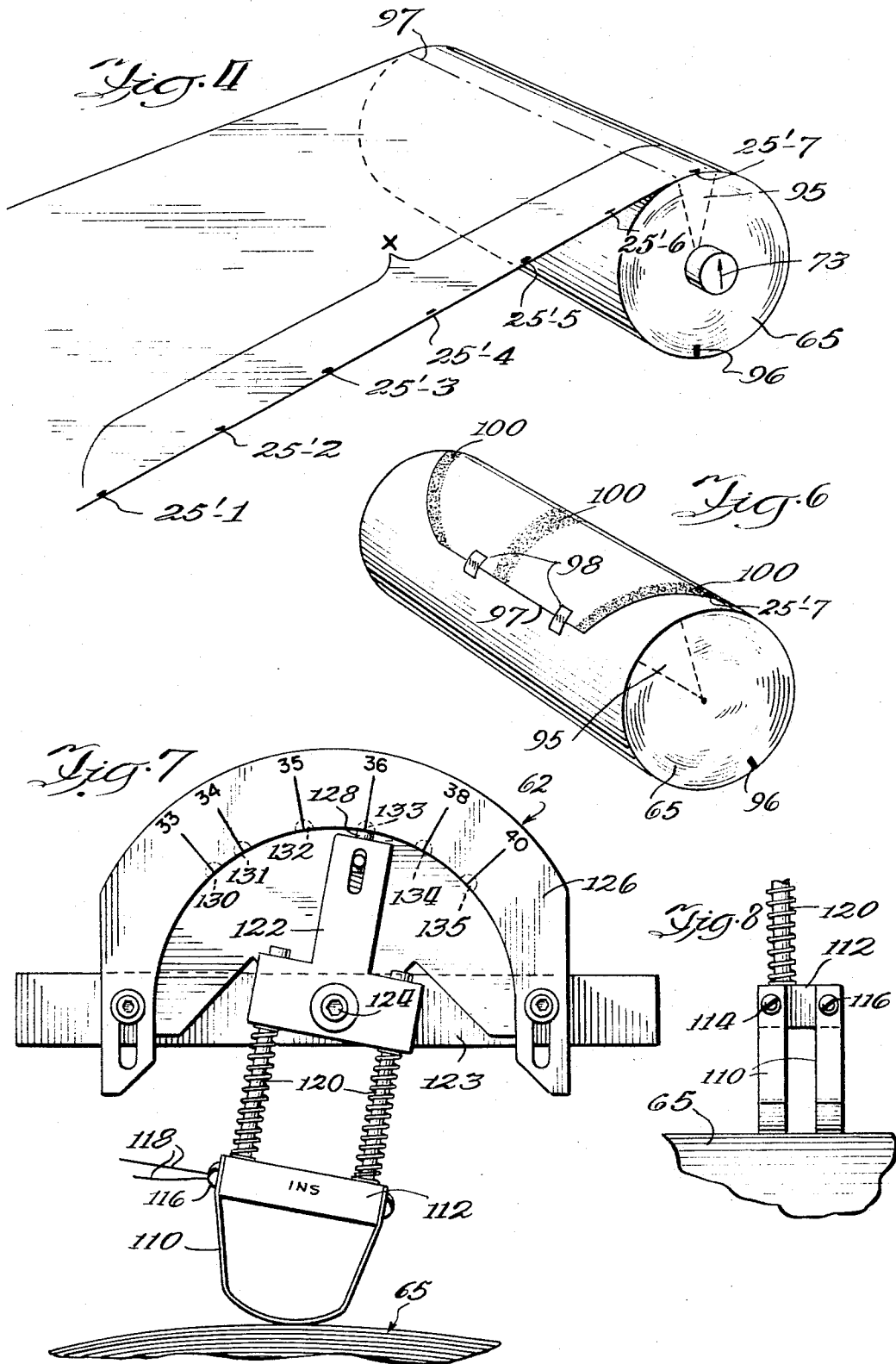
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AUTOMATIC PREPRINT PASTER APPARATUS AND METHOD FOR USING SAME

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AUTOMATIC PREPRINT PASTER APPARATUS AND METHOD FOR USING SAME

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This invention is addressed to those branches of the graphic arts known as printing, packaging, and converting. It is particularly concerned with operations in which a running web of flexible material being fed into a machine from an expiring roll is spliced automatically to a new roll of the same material without interrupting operation of the machine.

More specifically, the invention is directed to operations of the type mentioned wherein the material constituting the wound rolls carries a preapplied, repetitive pattern of work and wherein the machine, to which the web is fed, applies another repetitive pattern in predetermined and substantially fixed relationship to the previously mentioned preapplied pattern.

Still more specifically the invention provides an improved method and means for making a flying paster whereby the running web of an expiring roll is spliced or pasted to the exposed end of the outer ply of material on the new roll in such a manner that the patterns of work on the material of the new roll and on the expiring web are substantially matched at the splice.

Within the scope of the invention, the material constituting the web and the roll may be paper, paperboard, plastic film, metal foil, fabric, and the like, or laminates of any such materials. Either or both of the work performing operations may comprise printing, embossing, slitting, slotting, notching, creasing, laminating, and the like, or any combination thereof.

In addition the last named work performing operation may include sheeting, cutting, perforating, folding, forming, and similar operations.

One good example of an operation wherein the provisions of the invention may be applied to particular advantage is relatively new on the American scene and is known in the industry as "in-register inseting." Therefore an outline of such an operation, as it is generally applied to newspaper production, will be given as background for a subsequent, more explicit description of the invention and used to explain the advantages which the invention affords.

Modern newspaper presses, conventionally, comprise a plurality of printing units, each of which provides at least two impressions, for printing on both sides of the running web of paper fed to each unit. Each impression is formed between a printing or "plate" cylinder and an impression or "blanket" cylinder (sometimes called a "packing" cylinder).

For each printing unit, there is a reel, usually adapted to carry three rolls of paper, each of which usually is from 38" to 40" in diameter, and from about 15" to about 60" or more in width. A web of paper is unwound, successively, from each roll in a particular reel and supplied to the printing unit associated with that reel, wherein the printing is applied at the impressions.

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The printed webs from several units are fed to a folder wherein they are combined in superimposed fashion, folded, and cut in unison to form a complete newspaper or a newspaper section.

Normal production rates may range, for example, from 30,000 up to about 70,000 papers per hour on a "straight run." The speed at which the webs can be threaded through the press, on start-up or after a web has broken, are quite slow, but production web speeds range up to 2,000 feet or more per minute.

In-register inseting varies from conventional operating practice in several respects. Carefully preprinted and wound rolls of paper are placed in at least one reel of the press instead of "white" rolls (i.e., unprinted paper) and the preprinted web is fed to the folder, usually through one or both impressions of a printing unit. Thus, additional printing may be applied to one or both sides of the preprint in the newspaper press. In the folder, the preprinted web is combined with webs from other printing units of the press and is cut and folded with them so that the preprinted page or pages become an integral part of the newspaper or newspaper section delivered from the folder.

In-register inseting is accomplished at normal press speeds and is characterized in that the preprinted copy is held in the desired and substantially fixed position on the newspaper page (i.e., in "page register" with any and all additional printing applied to either or both sides of the preprinted web in the newspaper press and in substantially fixed relation to the cut line of the page in the folder).

There is another method of inseting preprinted copy in the newspaper, which may be termed "random inseting." It is similar to in-register inseting except that no provision is made for holding the preprinted copy in predetermined and substantially fixed position on the newspaper page. It utilizes a type of art work and page layout known as a "wallpaper pattern," in which identical copy is repeated within the length of the newspaper page. This type of repetitive pattern permits cutting at random in the newspaper folder while still leaving one complete pattern and, of necessity, part of another repetitive pattern on the newspaper page. However, this imposes severe restrictions upon the art work and page layout which may be used. Also, it gives the advertiser less than a full page of non-repetitive copy at the price of a full page. Partial pages of preprinted copy can only be run in the form of continuous columns of full-page length, because additional printing cannot be applied to the preprint in the newspaper press in longitudinal register with the preprinted copy. In-register inseting obviates each of these disadvantages and limitations by making provision for holding the preprinted copy in register on the newspaper page.

The preprint used for in-register inseting has come to be widely known throughout the printing industry and by advertisers and their agencies as "SpectaColor." Although special care and special equipment are required in its preparation and special control equipment (usually automatic) is used in the inseting operation, most of the problems and difficulties which attended its early production and use have been overcome.

One of the few and probably the greatest of the remaining deterrents to continuing, rapid growth of this medium

has been the necessity for periodically interrupting operation of the entire newspaper press when an expiring web is pasted to a new roll of preprint. This is made necessary to avoid the waste of paper which occurs when flying pasters are made on the preprint in the same manner as they conventionally are made on white rolls. A new white roll can be successfully pasted to a rapidly traveling web from a practically depleted white roll, with little or no printed waste. However, when this is done with preprinted rolls, the preprinted patterns may fail to match at the splice by as much as half a page, in either direction, and any significant mismatching involves waste.

When the splicing or pasting is not done with the preprinted copy substantially matched at the splice, the copy from the new roll is displaced on the cut and folded newspaper page by a like amount and remains displaced until corrective action is taken and completed by the inseting control equipment. This action involves stretching or elongating the running web by the application of tension or stress. The amount of stress which the web will withstand, without breakage, is limited, particularly under the dynamic conditions encountered in press operation. Therefore, the rate at which corrective action can be accomplished is limited. For example, a stretch of about .040" per page approaches the safe limit even with paper of good tensile strength and stretchability. Thus, if the preprinted patterns are mismatched at a splice by, say, 2", 5" or 10", for example, and the rate of correction employed is limited to .040" per page, some 50, 125, or 250 newspapers will have been printed before the preprinted copy is brought back to proper position on the newspaper page. Each newspaper or newspaper section in which this out-of-register preprint appears may consist of from 8 to over 100 pages, and the entire product should be discarded since it is not profitable and, often, not possible to substitute a good page or sheet for the one which is out of register.

It will be apparent that an excessive amount of printed waste can be accumulated by out-of-register pasting. Indeed, such waste becomes rather phenomenal on press runs which last for several hours, all day, or all night at speeds up to and exceeding 60,000 papers per hour. The average roll of preprint will contain some 15,000 to 16,000 usable pages and will become depleted, necessitating a paster, in from 15 to 20 minutes.

To avoid such waste it has been common practice to decelerate and stop the press when a roll of preprint nears expiration, hand paste the expiring web to a new roll of preprint, taking care to match the patterns at the splice, start the press at slow speed and accelerate the new web up to normal running speed. But this practice involves lost production time, which is both troublesome and costly, particularly when long runs are made and the press is capable, as is usually the case, of sustained high-speed operation.

To successfully accomplish its objective, any system of making in-register, flying pasters must operate as intended nearly 100% of the time. If it results in a web break once in ten attempts, for example, more production time may be lost in rethreading the web through the press than would have resulted from making all ten pasters by hand. Also, if the preprinted patterns are not matched at the splice within about one inch or less, on the average, there will still be a substantial loss of printed copy. Therefore, the problems presented do not lend themselves to ready solution.

Most high speed newspaper presses today are equipped with automatic pasting equipment whereby the press is not stopped, and in many cases, not even slowed down, to effect the splice between rolls of blank newsprint as the new roll is fed into the press. The details of such apparatus vary according to the different manufacturers, but basically are similar. The apparatus usually employed and herein illustrated includes a reel which carries three rolls of paper between radial arms and chucks, the arms

being rotatable in unison, about a central axis to index the respective rolls to the desired position. The roll from which a web of paper is being fed into the press is herein termed the expiring roll, the roll positioned back of the expiring roll (i.e., in a direction opposite that of the reel rotation), and which is prepared for splicing thereto, is termed the new roll, the third roll, which is positioned ahead of the expiring roll and in the direction of reel rotation is termed the depleted roll or butt and is replaced by a fresh roll of paper before the reel moves the preceding new roll into splicing position.

Tension is normally maintained on the expiring roll by automatically operated friction belts which are brought to bear against each roll shortly after it becomes the expiring roll. Before the expiring roll is fully depleted, the new roll is prepared for pasting by shaping the leading end thereof into a suitable V or W contour, applying adhesive to the areas adjacent the shaped ends and providing a weakened connection or "tear tab" between the point of each V and the underlying ply of the roll. When the expiring roll is nearly depleted, the new roll is mechanically rotated about its own center or core by a predrive mechanism which is adjusted to bring the new roll up to a peripheral speed closely approximating the linear speed of the expiring web. Thereafter the splicing operation is initiated either by the pressman or automatically, when the expiring roll is depleted to a predetermined diameter. A paster carriage then moves into position and brings a set of brushes and a set of spring loaded knives into close proximity to the expiring web. The brushes and knives are cam operated and are electrically coordinated with the rotational position of the V contours on the new roll, to which adhesive has been applied. At the proper time, preferably just after the adhesively coated area has completely passed the brushes, the brushes are actuated to press the expiring web against the surface of the new roll, which, as mentioned previously, has a peripheral speed approximating the linear speed of the web. As the new roll completes a revolution, the adhesively coated area will engage and be spliced to the expiring web. Immediately after the splice is effected, the knives are actuated to sever the expiring web, the brushes and knives retract and the paster carriage returns to its inoperative position. During the retraction of the paster carriage, the chucks carrying the depleted or butt roll are dynamically braked to prevent unravelling of the web remaining thereon. At this point it must be realized that the new roll (which has now become the expiring roll) maintains the same position that it did at the time of splicing. Shortly thereafter the reel is rotated to bring the new roll into proper position and engagement with the friction belts, and index the depleted or butt roll into position for removal and the loading of a new roll in its place. The above discussed operation of making a splice between the expiring web and a new roll without stopping the press is more colorfully termed by the pressroom personnel as "making a flying paster."

It has been obvious from the inception of the technique of inseting preprint copy into a newspaper that it would be ideal to use the flying paster apparatus for splicing, but no apparatus or method was available for properly matching a repetitive pattern on the expiring web with a pattern on the periphery of the new roll while making a flying paster. The automatic paster equipment used on present day presses splices the new roll to the expiring web without provision for matching preprinted patterns at the splice.

Accordingly, the primary object of the invention is to provide auxiliary apparatus and a method whereby the equipment commonly used to make an ordinary flying paster may also be used with rolls of preprinted material, in such fashion that the pattern of a new roll and the pattern of an expiring web are closely matched at the splice. The apparatus and method herein provided enable

5 flying pasters or splices to be made without excessive waste of printed copy and without stopping the press.

Generally the invention is characterized as to its apparatus and method by the provision of means for anticipating the coincidence of control marks on the expiring web and control marks on the periphery of the new roll at the point about the surface of the new roll and in the path of travel of the expiring web where the splice is to be made, and for effecting the splice at the instant of such coincidence or as close thereto as possible. The automatic splicing equipment of a given press is augmented by detecting apparatus and electronic circuitry to determine when the desired coincidence will exist. Said apparatus is effective because of the geometrical relationship between the following points of reference: (1) the point along the path of travel of the web and about the periphery of the new roll at which the splice is made and which is hereinafter called the "splicing point." This point for a roll of given diameter and on any specific type of reel, for all practical purposes, is fixed; (2) the point along the path of travel of the web at which the control marks or reference indicia are detected. This is hereinafter termed the "mark detection point." It is selected to be a predetermined distance from the splicing point, the distance preferably, but not necessarily, being equal to an integral number of repeat lengths of the repetitive pattern; (3) the direction and amount of angular displacement at which the electro- 10 tab or other detection element on the new roll is placed relative to the end of the outer ply of the new roll which has been prepared for pasting. This is hereinafter termed the "pasted area index point." Its location varies with the type of automatic pasting apparatus used and the overall geometry of the system; and (4) the point along the path of rotation of the new roll at which the electro- 15 tab or other suitable indicium on the new roll is detected. This is hereinafter termed the "index detection point." Its location is determined by the overall geometry of the system, but preferably it is so selected that its angular distance, in the direction of roll rotation, from the splicing point (1) represents some integer of the repeat length of the preprinted pattern.

One more consideration must be taken into account. Prior to initiation of the pasting cycle, the new roll is brought up to a peripheral speed which approximately corresponds and is preferably quite close the linear speed of the expiring web. This synchronization of speed is an important factor in the timing of the splicing operation, and the various makes of automatic splicing apparatus in use today provide means for achieving reasonable syn- 20 chronization at any given uniform web speed, but not at varying web speeds.

Previous attempts have been made by others to accomplish in-register flying pasters on preprinted rolls during inseting operations. These attempts have not met with the measure or frequency of successful completion required to avoid excessive waste of printed copy and lost production time. We attribute the primary reason for failure of these attempts to the misconception that it is necessary to hasten coincidence of the marks at the pasting point by varying the speed of the new roll during the pasting cycle. We have found in actual practice that better matching of the patterns at the splice is obtained and fewer web breaks are encountered when the ratio between the linear speed of the expiring web and the peripheral speed of the new roll is held constant during the pasting cycle. This is especially important during the critical period between the time when anticipated coincidence of the patterns at the pasting point is detected and the time at which the splice is made. During this period any variation of even a minor nature in the ratio between the linear speed of the expiring web and the peripheral speed of the new roll will negate the anticipated coincidence.

If a change in the speed of either the new roll or the expiring web occurs during the critical period mentioned

and an attempt is made to make the paster, the patterns will fail to match at the splice by an excessive amount. In addition, the danger of breaking the web is great if the peripheral speed of the new roll exceeds the linear speed of the web by even a slight amount.

We have established by tests that the ratio above mentioned, for best results, should be quite close to 1:1 and preferably should not exceed about 1:1.03, with the new roll running only slightly faster and never slower than the web speed.

For the reasons above mentioned, an important feature of the method of pasting herein provided resides in maintaining a ratio close to unity between the linear speed of the expiring web and the peripheral speed of the new roll during the pasting cycle, and particularly during the afore- 25 said critical period.

It must be understood that there are various constructions of automatic splicing equipment in use today and the selection of the four previously described points of reference (see col. 5) will vary with the specific design of the automatic paster apparatus. Obviously, means other than that as briefly discussed above and as more fully discussed below may be used to provide the proper timing of the splicing operation. Further, it is also evident that when any one of the four reference points above mentioned has been fixed, for a particular run of preprinted material and a particular reel, the geometrical relationships of the system having been determined, any two of the remaining three reference points also may be fixed and the third may be varied to accommodate variations in the diameter of the rolls. Thus, the term "fixed" as used, is in no way intended to infer permanent fixation, but rather adjustable fixation depending upon the geometrical arrangement of the reel employed and the repeat length of the preprinted copy to be run through the press.

The following is a detailed description of one embodiment of the invention wherein point 1 (the splicing point) is fixed, and points 2 and 3 (the mark detection point and the pasted area index point, respectively) have been precalculated and adjustably fixed with respect to the particular preprinted material being run through the press and the geometry of the reel. Point 4 (the index detection point) remains adjustable to accommodate variations in the diameter of the rolls of preprinted material. As above stated this is merely one embodiment and is in no way intended to limit the scope of the invention.

In the drawings:

FIG. 1 is a schematic illustration of an automatic splicing system embodying the present invention, with the scanner and comparator shown in block diagram form.

FIG. 2 is a block diagram of the various electrical components used in conjunction with the present invention.

FIGS. 3-6 are perspective views of the new roll of pre-print material, illustrating the steps required to prepare said roll for splicing to the running web.

FIG. 7 is a front elevational view of the detector used in conjunction with the new roll of preprinted material, which is shown broken away.

FIG. 8 is a side view of the detector illustrated in FIG. 7, showing the new roll of preprinted material broken away.

Considering now the details of the apparatus, in FIG. 1 a reel 20, with arms of generally Y-shaped configuration, is mounted for rotation on an axis 21 and may be rotated about this axis by a suitable electric motor (not shown) to index the respective rolls held by the reel in a clockwise direction in the view shown. In the condition shown in FIG. 1 the automatic splice is being made. The arms 22 (one at each side of the reel) carry the expiring roll 23, from which web 24 extends upwardly, as shown, passing various portions of the reel and the press. Web 24 carries printed matter which has been applied by a prior process, and each preprinted pattern includes a register mark of suitable form and size, indicated at 25. These marks are shown as black dashes on the web 24 repeated

along its length in FIG. 1. These marks are designated 25 and are capable of being "seen" by and their occurrence detected when they arrive at photoresponsive scanners (not shown) of the automatic inseting control as well as at scanner 60 of the automatic splicing control.

The tension applied to the expiring web 24 at the reel is maintained by flexible belts indicated at 26 and usually of light gauge metal or leather. The belts engage the expiring roll in an arc about its surface and are anchored at 27. The bottom ends of the belts 26 are passed over rollers 28 and 29 whose distance apart is controlled by suitable mechanism 30, operated by the normal tensioning and automatic splicing equipment and not unique to this invention. The distance between respective rollers 28 and 29 is directly related to the amount of drag or tension placed on the expiring roll by the control belt 26. The web 24 passes over other various idler rollers and the like illustrated at 31, 32 and 33 and into a printing couple (not shown), which is provided with some form of automatic inseting control means.

In accordance with the present invention it will be noted that there is a scanner 60 located to view the control marks 25 on the web 24 at the roller 32. This scanner 60 is normally fixed for any given set of conditions but, preferably, is adjustable along the length of the web to accommodate the web length between the pasting point and the point of scanning for the particular web lead employed. Such adjustment may also be used, when desired, to accommodate rolls of preprint of different diameters. Upon each occurrence of a mark 25 at the scanner 60, the latter produces an abrupt electrical output signal which is compared in a comparator 61 with another signal derived from the detector 62.

Detector 62, in the case illustrated, is mounted on the predrive apparatus 80 of the automatic splicing equipment and its purpose is to detect the presence of an electrically conductive, adhesive backed marker, commonly termed an electrotab 63, which is placed on the circumference of the new roll in accordance with the procedure hereinafter described. When coincidence of the signals from scanner 60 and detector 62 occurs the flying paster is automatically initiated, the timing of the apparatus being such that an in register paster will be effected when the pasted area on the surface of the new roll next passes the pasting point after the aforesaid coincidence.

The reel in FIG. 1 has the new roll 65 supported by arms 66, and the newly placed roll 67 supported by arm 68. A hollow core upon which each of the rolls is wound is held between tapered rotatable chucks, not visible in the drawing, but located at the outer ends of the arms of the reel. On each of the arms at one end of the reel a suitable marker, here shown as arrows 73, 74 and 75, is provided to indicate at what point on the circumference of the roll the splice will occur, taking into account the geometry of the system and the built-in timing mechanism. As can be recalled from the prior discussion of the splicing operation, the paster brushes 86 and knives 87 are cam operated and their operation is electrically coordinated with each other and with the rotation of the chucks which carry the new roll. The coordination and timing is such that a splice is effected at the point on the circumference of the new roll indicated by the arrow.

It must be understood that the timing and method of placing the electrotab 63 on the new roll will vary depending upon the construction of the apparatus. But irrespective of the construction, the timing mechanism is such that it is always possible to ascertain the approximate point on the circumference of the new roll at which the splice will occur.

In FIG. 1 the predrive is indicated generally at 80 and includes a frame or carriage 81 to which there are secured rollers, a motor and the like for driving one or more belts 83 in the direction indicated by the arrows. When it is desired to bring the new roll 65 up to speed, the carriage 81 is moved to bring the belt or belts 83 into

firm engagement with the periphery of the roll 65. The detector 62, in the case illustrated, is secured to the frame 81 and moves therewith so that as soon as the predrive mechanism is moved into roll driving position the detector is likewise moved into the proper position with respect to the new roll 65. The illustrated predrive assembly is of known construction and, all current makes of automatic splicing equipment are provided with this or a similar type of predrive apparatus. The various known types of predrive systems as well as the illustrated system are provided with means (not shown) whereby the speed of the predrive belt is a direct function of the web speed so that it is possible to maintain the peripheral speed of the new roll close to and, preferably, slightly greater than the speed of the expiring web.

The automatic splicing apparatus, diagrammatically illustrated in FIG. 1, includes a so-called paster carriage 84 pivoted at 85. The carriage 84 carries brushes, shown diagrammatically at 86, and a knife, or knives illustrated at 87, with deflecting means 88 to deflect the expiring web of roll 23 after the splice has been made and the expiring web has been severed behind the splice. This is known as "cutting the tail" of the expiring web.

In conventional automatic splicing equipment, the flying paster or splice is made when the circumferential speed of the new roll 65 is approximately equal to the linear speed of the expiring web 24. The respective speeds of the web and the new roll, as mentioned above, are monitored and regulated by suitable apparatus not shown. When the new roll has been brought up to and stabilized at the desired speed, the paster carriage is actuated and the timing mechanism of the apparatus automatically effects completion of the splice and cuts the tail of the expiring web. The splice, with respect to the joined webs, is at any random point with respect to printing subsequently applied to the webs in the newspaper press. Obviously, in the case of splicing preprinted material, this random pasting makes no provision for matching the preprinted patterns at the splice.

With the use of preprinted material, it is first necessary to anticipate by approximately one to one and one-half revolutions of the new roll, the point in time at which the register marks 25 will coincide at the splicing point with a register mark adjacent the end of the outer ply on the new roll 65. For purposes of differentiating between these different marks in FIG. 1, the register mark at or near the end of the outer ply on the roll 65 is designated 25'. In order to assure proper coincidence of the marks at the splicing point, designated at 91 in FIG. 1, the distance along the path of the expiring web 24 from this point to the mark detection point 90, where the web is viewed by the scanner 60 in the example to which this description applies, is an integer of the repeat length of the preprinted copy. However, it is also possible, within the scope of the invention to move scanner 60, and thus elongate or shorten the distance along the web 24 between points 90 and 91, to accommodate new rolls of different diameters. In case scanner 60 is moved, for the purpose mentioned, the counter-clockwise circumferential distance from the index detection point 92, at which the detector 62 engages the surface roll 65, is an integer of the repeat length of the preprinted material. However, in the embodiment of the invention here illustrated the detector 62 is moved, as will be later explained, to accommodate new rolls of different diameter, thus adjusting the position of the index detection point 92, and the mark detection point 90 remains fixed.

Briefly, the basic theory behind the operation of the apparatus illustrated is as follows. First, the electrotab 63 is placed at a point on the circumferential surface of the new roll which corresponds to an initial control mark shown at 96 in FIG. 3 and explained in later reference thereto. The circumferential distance from the electrotab to the pasted area, be it 360° or more, is chosen to represent the length of the web that will pass the splicing point

during the time elapsed between the initiation of the paster cycle and the actual pasting, taking into account the circumferential spacing of the detector 62 from point 91. Thus, when the signals of the detector 62 and the scanner 60 occur simultaneously, this indicates that the initial control mark 96 (FIG. 4) as well as the register marks on the stripped off and discarded web (also shown in FIG. 4) would have coincided with the register marks 25 on the expiring web if this discarded strip were theoretically moving adjacent the expiring web. The pasting cycle being initiated by the simultaneous occurrence of the signals from detector 62 and scanner 60, the paster will be made as the register mark on the web of the new roll adjacent to the shaped and adhesively coated end portion of the outer ply of the new roll coincides with a control 25 on the expiring web 24 at the pasting point 91.

It is apparent from the above that the circumferential distance along the new roll from point 91 to point 92 is an important factor in achieving the proper timing of a splice. Also it is quite obvious that the distance will vary with the diameter of the new roll, thus, there must be some provision in the system to compensate for this variable. This could be done a number of ways, by moving the scanner 60, by adjusting the position of the detector 62, or by adjusting the placement of the electrotab, or, for that matter, any combination of the three. With existing automatic pasting systems it is desirable to maintain the scanner 60 in a relatively fixed position, but to provide for its adjustment to the desired "fixed" position to accommodate whatever lengths of repetitive pattern is employed and the configuration of the particular reel employed and the web lead from the reel into the press. Thus, compensation for various diameter rolls is preferably provided for by the positioning of the detector 62 and/or the positioning of the electrotab 63. For purposes of the following explanation directed to the preparation of the new roll 65 the position of the detector 62 will be varied while the placement of the electrotab 63 will be the same for all diameter rolls.

The steps in preparing the new roll of preprinted material 65 for use in the automatic splicing apparatus of the type illustrated, are shown in FIGS. 3-6. It must be kept in mind that this is a preprinted roll of paper having register marks 25' printed thereon during the preprinting operation. FIG. 3 is a perspective view illustrating a new roll 65 mounted on the arm 66. First the paste or splice zone 95 is located. In the apparatus illustrated, this zone 95 is indicated by the arrow 73 and designated by the dotted lines. Next, one of the control marks 25' closest to the tail end of the arrow 73 is located. This mark is designated 25'-1 and represents the initial reference control mark. If the location of the control marks 25' are such that the tail end of the arrow is approximately midway between two marks, the control mark closest to the leading edge of the pasting zone should be chosen as the initial reference control mark. A mark 96 is then made on the side of the roll to indicate the circumferential position of this original reference control mark. Referring now to FIG. 4, starting at the selected control mark 25'-1 the preprinted roll is unwound one or more full turns, the amount of material being unwound is designated X and has been precalculated to represent the amount of web that will pass the splice point during the time differential between initiation of the paster cycle and the actual effecting of the paste or splice, taking into account the circumferential distance between the detector 62 at point 92 and point 91. In the illustrated form of splicing apparatus this amount will be approximately 1½ complete wraps or plies of material. When this amount of web has been removed, once around the roll and then to the pasting area indicated by the head of arrow 73, the web is severed on a line 97 which corresponds to the leading edge of the pasting area 95. It cannot be too strongly emphasized that this discussion is in regard to a system wherein the detecting points have been placed as pre-

viously discussed. If the detecting points vary from those as discussed, or the timing mechanism of the pasting apparatus varies, as it does for various makes of reels, the method of selecting of the original reference control mark, and the amount of web material stripped off will be different. But, since the overall geometry of each system can be determined, these factors can be adjusted accordingly.

In rolls of normal diameter (36 to 40") and with a nominal preprint repeat length of 22¾" to 23⅞" there will be five and a fraction repeat lengths around the roll and from five to eight repeat lengths will be stripped off and discarded depending upon the distance about the roll circumference, between the splicing point (91 in FIG. 1) and the index detection point (92 in FIG. 1). For purposes of illustration, the register or control marks 25' on the discarded portion, have been designated 25'-1 through 25'-6. Since this portion is discarded, in the following description the aforementioned marks will be referred to as hypothetical control marks. The control mark 25'-7 remaining on the web of the new roll will be the actual mark which should coincide with a mark 25 of the expiring web at the instant of pasting.

In FIGS. 5 and 6 the roll is shown prepared for splicing. The mark 96 designates the circumferential position of the initial control mark 25'-1, and at this point an electrotab 63 (FIG. 5) is adhered to the periphery of the new roll, this electrotab being conductive and being placed in the same circumferential path about the roll as that occupied by detector 62. When the detector 62 passes over the electrotab 63, it will close a circuit and thereby transmit a signal to the comparator 61.

In preparing the remaining end 97 of the new roll for the pasting operation, the edges are trimmed off to form a truncated V shape, in the case illustrated, and several areas thereon are coated with an adhesive, as shown at 100, care being taken to prevent areas where the pre-drive belt touches from being so covered. Further, the tear tab 98 is affixed between the end 97 of the adhesive coated area and the main body of the roll to prevent unravelling while the roll 65 is being brought up to speed. Obviously, this tear tab 98 is weakened, in a well known manner, sufficiently to cause it to sever along line 97 upon adhesion of prepared area of the new roll to the expiring web. The methods of so attaching the tab 98 to the remainder of the roll 65 are numerous and well known in the art.

The detailed operation of the illustrated apparatus is as follows. After a new roll 65 has been prepared and the electrotab 63 attached thereto and prior to the depletion of the expiring roll 23, the operator alerts the apparatus by closing a suitable circuit to energize the comparator 61 and to bring the predrive apparatus 80 into engagement with the new roll 65 to bring it up to speed. Electrical bridging fingers of the detector 62 will engage the surface of the new roll 65, and each time the electrotab 63 passes beneath these fingers, there will be a signal produced representing the occurrence of one of the hypothetical control marks 25' at the splice point 91. At the same time the scanner 60 is viewing the expiring web and produces a signal each time one of the register marks 25 on the web 24 passes point 90. Due to the selection of the distance on the web path from point 90 to 91 as an integer of the repeat length of the preprint pattern, this signal represents a control mark 25 passing the splice point 91. Signals from detector 62 and from the scanner 60 are electronically compared by the comparator 61. The presence of signals from the scanner 60 and the detector 62 may be visually ascertained by the pressman by the use of flashing lights. During or shortly after indicated coincidence of the signals, the reel tender may press the automatic paster button to alert the control equipment for a paster. Then, upon the next succeeding coincidence the electrical output signal from comparator 61 closes a relay to initiate the pasting operation and the

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brush 86 (FIG. 1) is automatically actuated. Since the predrive apparatus is maintaining the circumferential speed of the new roll at very close to the linear speed of the web and since the aforementioned discarded portion of the web stripped from the new roll represents the time lag between initiation of the pasting operation and the actual pasting, the respective register marks 25 and 25'-7 will coincide within a reasonable tolerance when the splice occurs. Due to minor human errors in preparation of the new roll and other slight discrepancies the patterns, represented by the register marks, may fail to exactly coincide by a slight amount. However, in most cases, the patterns will be matched at the splice within about 1/2" or less.

The above description is complete with two exceptions. One is a description of the detector 62 as to its detail, and the other is a description of the circuitry by means of which the apparatus is rendered automatic in operation. The portion of the apparatus which operates with the previously existing equipment to bring brushes 86 and knives 87 into play is not new but is adopted by the invention to the operation thereof. Turning now to FIGS. 7 and 8, detector 62 is shown here in more detail than in FIG. 1. A pair of metallic contact fingers 110 are mounted to an insulating block 112, the fingers being connected to terminals 114 and 116 respectively, so that engagement of the electrotab 63 with the fingers 110 will close the circuit between the terminals 114 and 116. Two wires connected to the terminals represent the connection 118 extending to the comparator 61. The fingers 110 and insulating block 112 are mounted on spring pressed support rods 120 which are secured to adjustable supporting block 122. Supporting block 122 is pivotally mounted at 124 to a supporting member 123. Supporting member 123 is affixed to the carriage 81 of the predrive apparatus 80 (FIG. 1) and is adjustably positioned thereon so that the contact fingers 110 will engage the periphery of the new roll at a point, previously referred to as point 92, which is spaced circumferentially from the splicing point 91 a predetermined distance.

Also mounted on a supporting member 123 is a crescent-shaped member 126. Member 126 has a series of apertures, 130 to 135, for a purpose that will be clarified hereinafter. Spring press pin 128 is mounted in the supporting block 122 and is adapted to be engaged in the apertures 130 to 135. By pulling the pin 128 downward, as shown in FIG. 7, one may pivot the supporting block and spring-biased rod assembly, including the fingers 110, about the point 124 to vary the circumferential and radial positioning of the contact fingers 110. The numbers 33, 34, 35, 36 and 38 and 40 mark the location of the detents 130-135 which have been precalculated to provide a proper circumferential positioning of the control fingers when preprinted rolls of diameters corresponding to the aforementioned numbers are being used. It will be appreciated that, assuming the predetermined movement of the predrive mechanism 80, if the detector 62 is mounted to framework 81, it will touch the surface of roll 65 at a distance from point 91 which is determined by the diameter of the roll 65. This detector compensates for roll diameter changes by providing for the adjustment of the contact fingers 110 such that the circumferential distance from point 91 to point 92 will remain the same irrespective of the diameter of the roll. For example, as shown in FIG. 7, the pin 128 is engaged in detent 133 which has been precalculated to correspond to a 36 inch diameter roll. In this position the control fingers 110 are disposed along a radial line, with respect to the pivot point 124, such that when a 36 inch diameter roll is used, the circumferential difference from the point where the fingers 110 contact the roll to the splicing point 91 is equal to the aforementioned predetermined distance.

The preceding description of the operation of the apparatus and the preparation of a new roll of preprinted material has been presented under the assumption that the

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detector 62 and the corresponding point of detection 92 is adjustable. It is apparent that if the detector 62 is fixed, to compensate for the various diameter rolls, it is merely necessary to correspondingly adjust the positioning of the electrotab 63 with regard to the reference mark 96 placed on the side of the roll.

The function of the detector 62 is to monitor the occurrence of the initial, hypothetical reference control mark 25'-1 at a predetermined circumferential distance from the splicing point. 91. Therefore, if the system and placement of the electrotab 63 immediately over the mark 96 are designed to accommodate a 36 inch diameter roll, for rolls of varying diameters the electrotab need only be moved with respect to the mark 96 to compensate for the change in diameter. For example, with rolls of a diameter larger than 36 inches the distance from point 91 to point 92, when said point 92 is fixed, will be slightly greater than the desired predetermined distance for a 36 inch diameter roll. To compensate for this it is merely necessary to displace the electrotab 63 from mark 96, in the direction opposite to the direction of rotation of the new roll and by a distance precalculated to suit the given change in roll diameter and circumference. Similarly, for rolls having a diameter less than 36 inches the electrotabs 63 will be moved a corresponding amount in the opposite direction.

With respect to the electronic circuitry of the apparatus, this is shown in block form in FIG. 2.

In FIG. 2 a comparator 61 is represented by the large block outlined by dotted lines in the right-hand portion of FIG. 2 while the scanner 60 is shown at the upper left. The detector 62 is referred to as the contact assembly and is shown at the lower left-hand portion of FIG. 2. As the signals are produced respectively by the scanner 60 and the detector 62, they are shaped by the pulse shapers 150 and amplified by the amplifiers 151 and cause flashing of the neon tubes 152. These indicator tubes 152 are side by side on the control panel and, being suitably identified, will indicate visually to the reel tender that signals are being received from the scanner 60 and detector 62. It will be appreciated that since the circumference of the roll 65 is rarely an integral number of repeat lengths, there will be recurrent intervals of coincidence between the scanner and detector signals.

The signals from scanner 60 and the detector 62 are fed into a single "AND" gate which is represented by block 153. The "AND" gate 153 will not produce an output unless the simultaneous signals occur at both of its inputs 154 and 155 which are attached to the scanner 60 and the detector 62, respectively. When a simultaneous signal occurs there will be an output at 156 which produces a signal from the trigger 157 to operate a single shot multivibrator 158. The square wave output from the single shot multivibrator 158, is applied to a relay amplifier 159 through an impedance matching network 160, and this will energize either relay K2 or relay K3. Whichever of these relays is energized depends upon the condition of relay K1 in the READY circuit.

Reference is made to block 161 which is designated the READY circuit. In the use of the apparatus, the operator watches the roll. When the roll has reached a size which will allow ample paper for a coincidence to occur without excessive waste, he presses the paste button 162. This will energize the relay K1 switching the output of the amplifier 159 to energize the relay K3 upon occurrence of the next coincidence. Prior to the pressing of the paste button 162, the relay K2 is energized by the output of amplifier 159 to show the number of coincidence pulses received by the flashing of the coincidence indicator 164.

The first set of coincidence pulses after the pressing of the paste button 162 will then operate the automatic splicing apparatus. The pulse from relay K3 will energize time delay relay K4 which is connected to the previously discussed timing mechanism of the respective spindles to insure that the splice will occur at a given point on the cir-

cumference of the roll attached thereto. The time relay K4 will energize the paster circuit 166 at the proper time to give an in-register splice. As soon as the relay K3 is energized, it resets the READY circuit 161 through the line 165.

It is obvious that the circuitry to accomplish the above discussed function is simple and straightforward, and that one skilled in the art could well devise other arrangements to accomplish the same functions. The above discussed elements are by way of example only and are in no way intended to limit the invention.

Further, as was emphasized throughout the specification, the drawings and detailed description of the invention have been presented, for illustrative purposes only, in regard to but one specific make of automatic pasting apparatus. Today, there are various makes of automatic pasting apparatus in use, and it is intended that the invention can be used to adapt any of these systems to provide for in register splicing.

Modifications of the specific apparatus and method of operation herein used by way of illustration and example will be readily apparent to those skilled in the art and such modifications are intended to be within the scope of the appended claims. For example, instead of using an electrotab and contacts such as described for detecting occurrence of an electrotab, it is entirely within the scope of the invention to employ an initial index mark made by a crayon or other suitable means on one end of the new roll, preferably adjacent to its periphery, instead of an electrotab on the peripheral surface of the roll, and to detect its occurrence at the desired angular position in the path of rotation of the roll by a photoelectric scanner of similar photosensitive device. Another suitable but non-equivalent alternative is to use a proximity switch for detection of the electrotab or a similar element having magnetic or electrical capacitive properties, in place of the electrotab detector shown and described.

What we claim as new and desire to secure by Letters Patent of the United States is:

1. In an operation wherein a running web of flexible material being drawn from an expiring roll thereof is spliced to the adhesively coated terminus of the web of a new roll of such material at a specific point along the path of travel of the expiring web, the material of said rolls having a repetitive pattern, including register marks, preprinted thereon, the improved method of effecting a splice between the two webs with their respective patterns substantially matched at the splice, comprising the steps of, placing a detectable point of reference on the outer periphery of the new roll at a predetermined point with respect to said adhesively coated terminus, driving the new roll at a peripheral speed that is substantially equal to that of the expiring web, detecting the occurrence of the register marks on the expiring web as they pass the splicing point, detecting the occurrence of said point of reference on the outer periphery of a new roll as it passes a predetermined point in the path of rotation of the roll, then as the expiring roll nears depletion, comparing the time of occurrence of the reference point on the new roll and the register marks on the expiring web at their respective points of detection and upon their simultaneous occurrence rapidly bringing the running web and the surface of the new roll into contact, whereby an in register splice is effected when the adhesively coated terminus of the web of the new roll contacts the expiring web.

2. The method defined in claim 1 wherein the step of detecting the occurrence of the register marks on the expiring web comprises the placement of detecting means therefor at a predetermined point along the path of the expiring web in relation to the point of splicing.

3. The method defined in claim 1 wherein the step of driving the new roll at a speed substantially equal to that of the expiring web includes the step of maintaining the peripheral speed of said roll at least as great as and not

more than slightly greater than the linear speed of the expiring web.

4. The method of splicing a running web of flexible material to the adhesively coated terminus of the web of a roll of such material, the respective webs having a repetitive pattern, including register marks, preprinted thereon, said method comprising the steps of, detecting the point along the path of the running web at which the splice will occur, determining the occurrence of the register marks on the running web at said splicing point and deriving a signal therefrom, driving the new roll of pre-printed material at a peripheral speed substantially equal to that of the expiring web, placing a detectable reference element on the new roll at a predetermined angular distance from said adhesively coated end, said distance being measured therefrom in the direction of rotation, detecting the occurrence of said detectable element at a specific point along the path of rotation of said new roll and deriving a signal therefrom, comparing said signals so derived such that their simultaneous occurrence will produce a command signal, using said command signal to actuate connecting apparatus which forces the running web into contact with the new roll such that said adhesively coated terminus is spliced to the running web with their respective preprinted patterns substantially matched.

5. The method of splicing a running web of material to the adhesively coated terminus of the web of like material wound in the form of a roll, the respective webs having a repetitive pattern, including control marks, preprinted thereon, said method comprising the steps of, terminating the outer ply of said roll within a predetermined area on the circumference thereof, applying adhesive material to a limited area on the surface of said outer ply, adjacent to said terminus, placing a detectable reference element on the new roll at a predetermined angular distance from said terminus, rotating the roll at a constant peripheral speed substantially equal to the linear speed of the running web, detecting the occurrence of said reference element at a predetermined point in the path of rotation of said roll, detecting the occurrence of the control marks on the running web as they pass the splice point, comparing the time of occurrence of the reference element at its point of detection with the occurrence of the control marks on the running web at the splice point, then upon their simultaneous occurrence bringing the running web into contact with the roll whereby an in register splice will be effected as the adhesively coated area on the outer ply of the roll contacts the running web and severing the running web subsequent to effecting said splice.

6. The method defined in claim 5 wherein said predetermined angular distance from the terminus of the outer ply at which the detectable element is placed is at least 360°.

7. The method defined in claim 6 wherein said predetermined angular distance, the point of pasting and said predetermined point of detection of the reference element are so inter-related that the running web is brought in to contact with the new roll shortly after the adhesively coated areas thereof passes the splicing point, whereby full area contact between said adhesively coated area and said running web is assured.

8. The method of splicing a running web of material to the adhesively coated outer terminus of the web in a roll of like material, the respective webs having a repetitive pattern, including control marks, preprinted thereon, comprising the steps of, driving the new roll at a speed approximating that of the expiring web, deriving separate signals directly related to the positioning of the control marks on the expiring web and on the web of the roll with respect to a predetermined splicing point and using said signals to time the splicing apparatus such that the adhesively coated end of the web of the roll engages the expiring web when the respective pre-applied patterns are substantially matched at the splicing point.

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9. The method defined in claim 8 wherein the derivation of the signal related to the positioning of the control marks on the new roll comprises the steps of placing a detectable element on the outer periphery of the new roll at a predetermined point with respect to the adhesively coated terminal end of the outer ply, and monitoring the occurrence of said element at a selected point along the path of rotation of said new roll to acquire a timing signal.

10. The method defined in claim 9 wherein the circumferential distance from the monitoring point to the splice point is equal to the length of an integral number of the repetitive preprinted patterns.

11. The method defined in claim 8 wherein the peripheral speed of the roll is maintained at a value not less than and only slightly greater than the linear speed of the expiring web.

12. Apparatus for automatically splicing a running web of material to the adhesively coated outer terminus of the web in a roll of like material at a predetermined point along the path of the running web, said webs having a repetitive pattern, including control marks, preprinted thereon and said patterns being substantially matched at the splice, said apparatus comprising means to drive the roll of preprinted material at a peripheral speed approximating that of the running web, means for determining when the repetitive patterns on the running web will be in registration with the pattern at said terminus of the web in the roll, connecting means responsive to said determination of registration of the respective patterns for bringing the running length of preprinted web into contact with the rotating roll of preprinted material, whereby said adhesively coated terminus will engage and be spliced to said running web with their respective patterns substantially matched at the splice.

13. The apparatus as defined in claim 12 wherein said means to determine registration comprises detecting means placed along the path of travel of the running web to monitor the occurrence of control marks at the splicing point and to produce a signal thereupon, means associated with the roll and responsive to the angular position about its path of rotation of a detectable indicium near the outer terminus of the web in the roll for producing a signal when said indicium is at a predetermined angular distance from the splicing point, means receiving the respective signals and, upon simultaneous occurrence thereof, producing a command signal which actuates said connecting means to bring the running web and the new roll into engagement.

14. Apparatus for automatically splicing a running web of material to the adhesively coated terminal end of the web of a roll of like material at a predetermined point along the path of the running web, said webs having a repetitive pattern, including control marks, preprinted thereon and said patterns being in registration at the splice point, said apparatus comprising connection means for forcing the running web into contact with adhesively coated surface of the roll to effect the splice, means for driving the new roll at a peripheral speed substantially equal to the linear speed of the running web, detecting means placed along the path of the running web for determining when the control marks thereon pass the splicing point, a second detecting means positioned along the path of rotation of said new roll for determining the occurrence of the control mark adjacent the terminal end of the web thereof at a point spaced at a predetermined angular distance from the splicing point, said first and second detecting means being provided with means to produce signals upon the detection of their respective control marks, comparator means receiving said signals and, upon the simultaneous occurrence thereof, producing a command signal which actuates said connecting means to effect the splice as said control mark on the adhesively coated terminus of the web of the new roll coin-

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cides with a control mark on the running web at the splicing point.

15. The apparatus as defined in claim 14 wherein said predetermined angular distance from the splicing point is equivalent to the length of running web passing the splicing point during the time interval between actuation of the connecting means and effecting of the splice.

16. The apparatus as defined in claim 15 wherein said predetermined distance is so calculated that the connecting means forces the running web against the roll shortly after the adhesively coated area on the latter has passed the splicing point.

17. The apparatus for automatically splicing a running web of material to the adhesively coated terminal end of the web of a new roll of like material at a predetermined point along the path of the running web, said webs having a repetitive pattern, including control marks, preprinted thereon and said patterns being substantially matched at the splice, said apparatus including connecting means for forcing the running web into contact with the roll to effect a splice, means for driving the roll at a peripheral speed substantially equal to the linear speed of the expiring web, registration timing apparatus comprising detecting means to monitor the expiring web and to produce a signal as the control marks thereon pass the splicing point, a detectable element associated with the roll and placed thereon at a predetermined circumferential location, second detecting means associated with said roll to monitor said detectable element and produce a signal when said element is at a predetermined circumferential distance from the splicing point, and comparator means receiving the signals from the respective detecting means and upon their simultaneous occurrence producing a command signal which actuates said connecting means to effect a splice with the repetitive patterns of the respective webs substantially matched.

18. The apparatus as defined in claim 17 wherein the connecting means is provided with means to sever the running web immediately after the splice is effected.

19. A detecting device adapted for use with automatic splicing apparatus to engage a rotating roll of printing stock for detecting the position of an electrotab placed on the circumference thereof, said device comprising a supporting member adapted to be positioned above the rotating roll, a contact element supporting block pivotally secured to said member, a pair of contact elements carried by said block and spring-biased in a direction toward the rotating roll such that they are adapted to be contacted by the electrotab, means associated with said supporting member and said block for positioning said block and the contact elements in a plurality of preselected circumferential positions.

20. The detecting device as defined in claim 19 wherein said means to position said contact element supporting block comprises a spring-biased detent associated with said block, a series of apertures provided in said supporting member and adapted to selectively receive said spring-biased detents to maintain the relative positioning of said contact fingers.

21. A method of splicing an expiring web of material, having a repetitive pattern preprinted thereon, to the adhesively coated terminus of the web of a new roll of like material to effect an in-register splice of said webs, said method comprising the steps of; driving the new roll at a speed closely approximating that of the expiring web; anticipating instances of registration of the pattern adjacent the terminus of the new roll with the patterns on the expiring web at the point where the splice is to take place, and using said anticipation to time the actuation of splicing apparatus such that a splice is effected at one of the instances of registration without reducing the speed of the expiring web.

22. A method as defined in claim 21 wherein said step of anticipating instances of registration includes deriving a pair of separate and distinct signals one of

which being related to the position of the pattern adjacent the terminus of the new web with respect to a predetermined point, the other being related to the position of the patterns on the expiring web with respect to said predetermined point, the simultaneous occurrence of said signals indicating an approaching instance of registration.

23. A method as defined in claim 22 further including, feeding said separate signals into a comparator, deriving a command signal from said comparator upon the simultaneous occurrence of said signals, using said command

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signal to actuate the splicing apparatus as the expiring web nears depletion.

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