Sept. 12, 1950 R. C. CORLETT 2,521,691

REGISTRATION CONTROL DEVICE

Filed Nov. 21, 1946 3 Sheets-Sheet 1

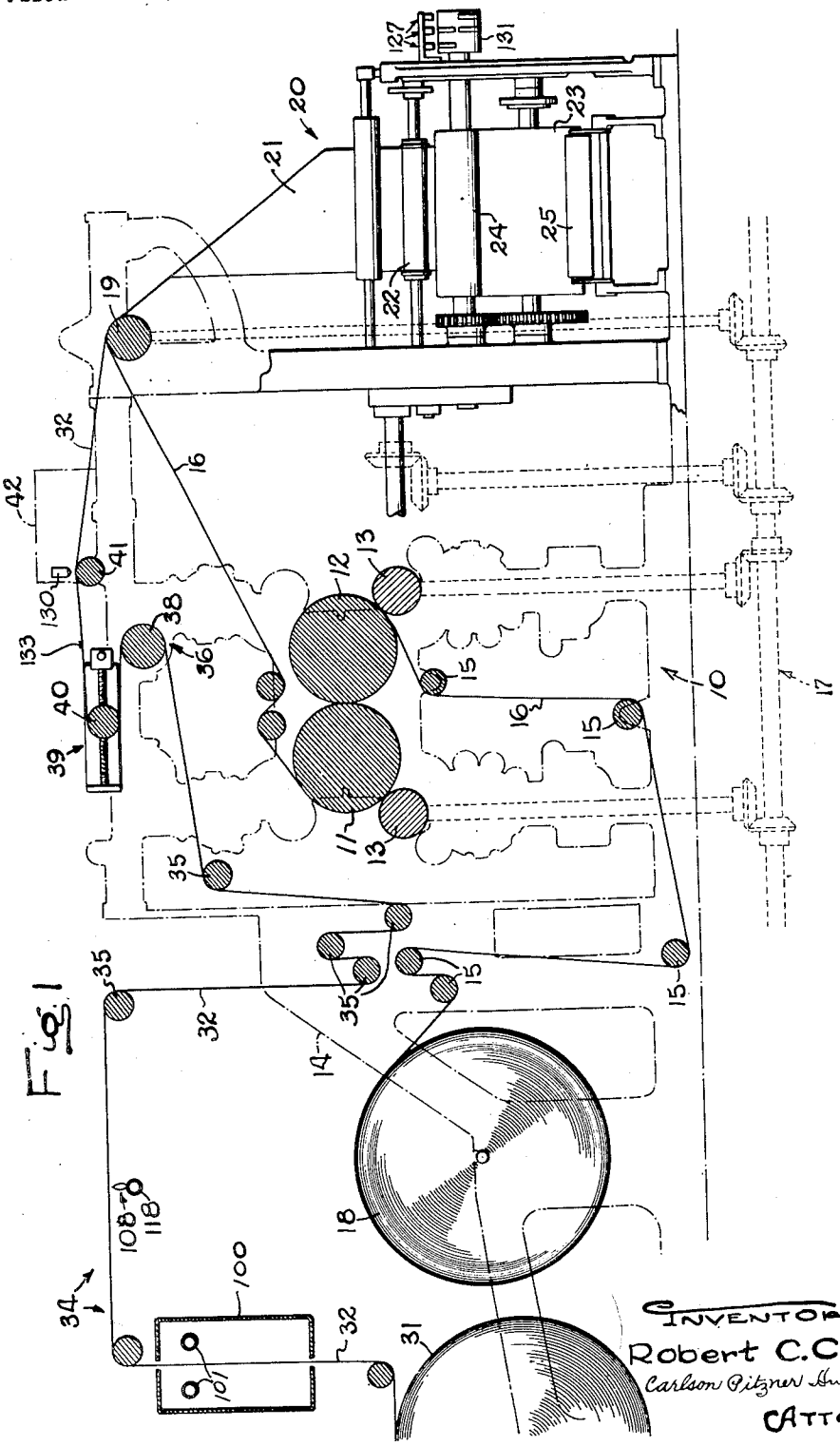


Fig. 1

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REGISTRATION CONTROL DEVICE

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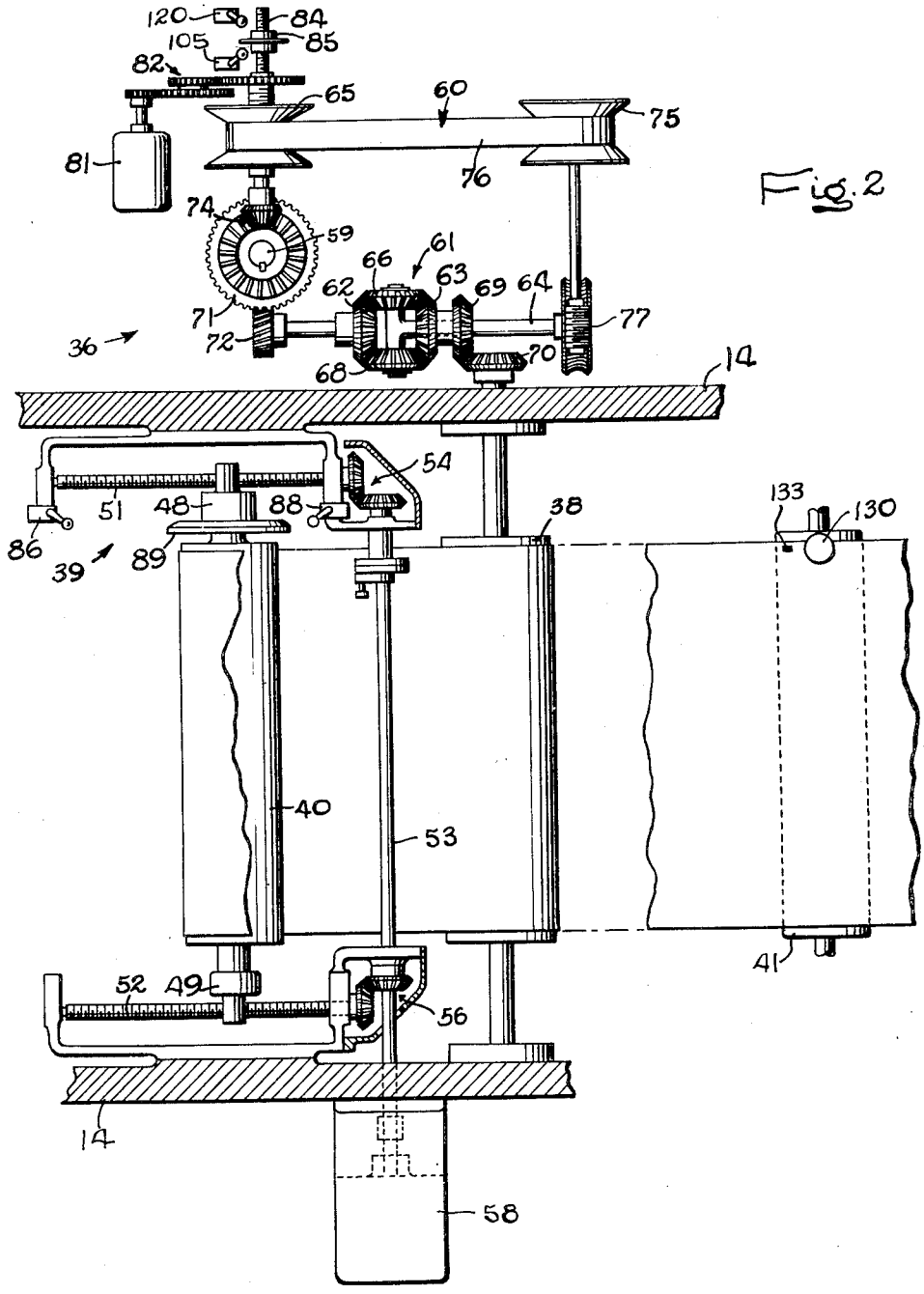


Fig. 2

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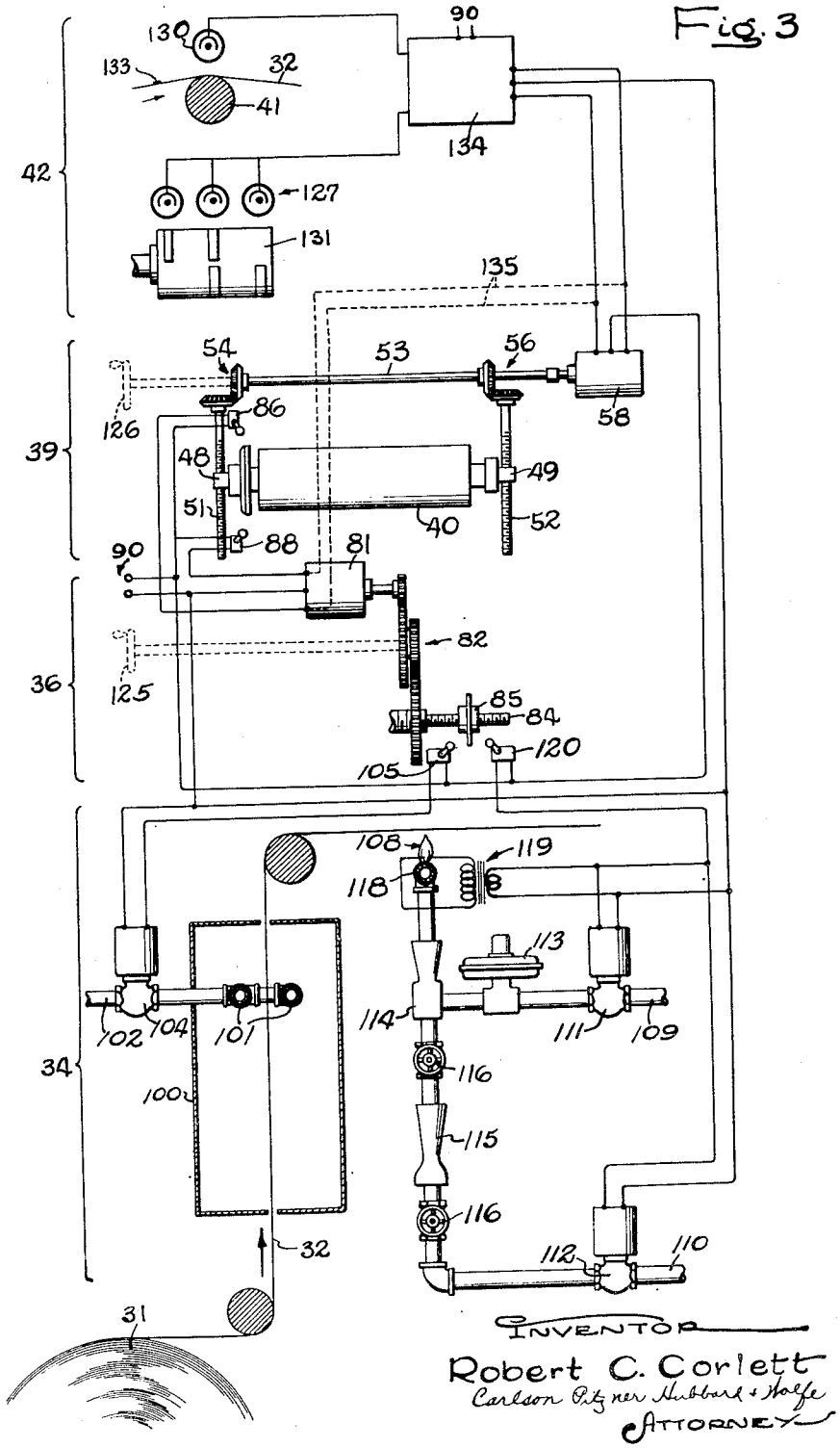
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Sept. 12, 1950 R. C. CORLETT 2,521,691

REGISTRATION CONTROL DEVICE

Filed Nov. 21, 1946 3 Sheets-Sheet 3

Fig. 3



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UNITED STATES PATENT OFFICE

2,521,691

REGISTRATION CONTROL DEVICE

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Application November 21, 1946, Serial No. 711,287

21 Claims. (Cl. 270—5)

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The present invention relates to registration control devices for web feed printing presses. More particularly, the invention relates to means for producing registered insertion of a pre-printed re-rolled web.

In conventional types of rotary printing presses it is customary to feed a number of webs of plain paper through the printing couples simultaneously and to adjust them into register before the final association, folding, and cutting. Local adjustment to secure register during the passage of any of these webs through the machine is commonly hand operated. Since all of the plate cylinders are driven by a common or synchronized driving means, there is little or no tendency for the webs to get out of register once they have been adjusted.

In present day newspaper practice, however, it is often desirable to insert a pre-printed web prior to association, folding, and cutting of the webs; for example, it may be desirable to pre-print a web of four-color work in a rotogravure unit and to store it in re-rolled form for later insertion. There are numerous difficulties involved in the insertion of a pre-printed web. In the first place, as a practical matter, it is not possible to cause the impressions on a rotogravure web to be spaced at exactly the same distance apart as the impressions on the main web with which it is to be associated. For example, if the rotogravure cylinders differed from a predetermined diameter by only one-thousandth of an inch, the error in registration of the printed matter on the webs, being rapidly cumulative without corrective control, would amount to a total of several inches for one thousand sheets. A contributing factor is the wear and embossing of the newspaper press blankets with normal usage which reduces their circumference and therefore the length of the printed impression. Moreover, shrinkage or expansion due to atmospheric conditions and stretching of the web from mechanical causes all may tend to produce improper registration.

In an attempt to overcome the above difficulties, some presses have been operated with the rotogravure unit lined up with the letter press unit and the webs printed simultaneously. This scheme is of extremely limited application, however, primarily because of the greatly reduced speed at which the unit as a whole must be driven. This results from the fact that four-color presses have generally not been operated at a rate in excess of 36,000 papers per hour, whereas letter press printing is frequently done

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at 48,000 to 50,000 papers per hour. Furthermore, this arrangement practically doubles the size of the press required in addition to requiring a large number of pressmen having different skills. Then, too, the fumes from the special ink used in the rotogravure process are objectionable and require special precautions because of fire and explosion hazards. In the event of accident much more time is required to produce a replacement rotogravure cylinder so that shutdowns are likely to be longer and more costly.

The problem therefore resolves itself to providing means for keeping a pre-printed web in registration with a main or cooperating web in spite of the previously mentioned causes giving rise to misregistration. A device for controlling registration and having many advantages over prior art devices as shown in copending application for United States Letters Patent, Serial No. 699,897 of Curtis S. Crafts, filed September 27, 1946.

As disclosed therein, registration is accomplished by the use of a roller for controlling the in-feed speed of the pre-printed web with respect to the speed of the combined webs and by the use of a bodily shiftable compensator roller which engages the pre-printed web prior to its association with the remainder of the webs. Means are provided for detecting misregistration and for causing an appropriate change in the setting of the compensator roller, the latter being effective upon reaching one of its limit positions to cause a corrective change in the rate of in-feed. Such a scheme has been found extremely effective in avoiding difficulties caused by cumulative error, due to short printing and the like, provided that the error, expressed as a percentage of length, is not unduly great. If the percentage of error is excessive, however, it may be necessary for the pre-printed web to be tensioned to the point where there is danger of breakage. Under some circumstances of severe mismatching, it may be impossible to stretch the web sufficiently to obtain continuous registered feeding and cut-off of the webs.

While extreme discrepancies in cyclic length are not frequently encountered, it is nevertheless of paramount importance that a registration device operate efficiently under such circumstances and it is likewise important that the stress applied to the web to produce registration be at all times kept within safe limits. It is further desirable that a registration device be of the utmost simplicity both to increase reliability and to reduce maintenance costs to a minimum.

It is therefore a primary object of the invention to enable registration of two or more webs in spite of large discrepancies in the cyclic length of the impressions and without danger of breaking the web because of the stresses set up therein during registration adjustment.

Another object of the present invention is to provide an improved registration device in which accurate registration may be accomplished even at the highest letter press speeds and without recourse to complicated or expensive mechanisms. It is a related object to provide a registration device which may be quickly and easily adapted for use with a standard letter press.

It is a further object of the invention to provide means for regulating in-feed speed over relatively wide limits and which may be controlled either manually or by phase detection apparatus of the photoelectric type.

More specifically, it is an object to provide, in combination with mechanism for adjusting web tension speed, means for changing the physical characteristics, particularly the stress-strain characteristics of an inserted web to enable registration under conditions of appreciable cyclic mismatch between the webs. In accordance with a more detailed aspect of the invention, the length and stress-strain characteristics of the web are varied by changing the moisture content of the web.

Further objects and advantages of the invention will become apparent as the following description proceeds, taken in connection with the accompanying drawings, in which:

Figure 1 is a partially schematic view in elevation of means for accomplishing registered insertion of a pre-printed web in accordance with my invention and as applied to a letter press of conventional construction.

Fig. 2 is a fragmentary plan view of a portion of the press illustrated in Fig. 1 showing the compensating roller and the in-feed driving roller together with means for accomplishing the adjustment of each.

Fig. 3 is a simplified schematic diagram of the registration control arrangement and showing the detector, compensator assembly, in-feed control assembly, and moisture content control assembly.

While the invention is susceptible of various modifications and alternative constructions and uses, I have shown in the drawings and will herein describe in detail the preferred embodiment of the invention. It is to be understood, however, that I do not intend to limit the invention by such disclosure but intend to cover all modifications and alternative constructions falling within the spirit and scope of the invention as expressed in the appended claims.

Referring more particularly to the drawings, Fig. 1 shows the end portion of a newspaper press including a final perfecting type press unit 10 having impression cylinders 11, 12 which cooperate with plate cylinders 13. The press unit 10 is mounted in a frame 14 carrying rollers 15 for guiding a main or printing web 16 from a storage roll 18 into the press unit. After the web 16 leaves the press unit 10 it passes over a main draw roller 19 and into a conventional type of folder unit 20 for folding and cutting the associated webs. The latter is accomplished by means of a former 21, nipping rollers 22, a folding roller 23 and a cutting cylinder 24. The folded and cut webs are given a second fold by means of a tucker blade (not shown) and finally delivered on a delivery belt 25.

Rotative power is supplied to the printing mechanism, to the main draw roller 19 and to the folding, cutting and delivery mechanisms by a common drive mechanism shown dotted at 17 so that the rotating elements are locked at all times for movement in unison. Consequently, the angular position of the cutting cylinder 24 is an accurate indication of the positioning of the inked impression on the web 16, which fact, as will later be seen, is useful in maintaining registration of an inserted pre-printed web. The foregoing structure is merely illustrative of one newspaper press with which my registration control may be used and of itself forms no part of the present invention. As a matter of fact, the mechanism to be described is equally applicable to other types of presses, for example a magazine press, and for use with other types of folding and cut-off mechanisms. For the sake of simplicity, only a single press unit 10 and a single web 16 have been shown. It will be apparent, however, that additional mechanically coupled press units 10 could be used, the webs therefrom being combined with the web 16 at the main draw roller 19.

In the present embodiment a pre-printed or inserted web indicated at 32 is supplied from a storage roll 31 and is associated with the main web 16 just prior to engaging the main draw roller 19 referred to. After leaving the storage roll 31 the pre-printed web 32 is passed through a web treating device indicated generally at 34, thence over auxiliary and tension regulating rollers 35 and into the compensating and speed controlling portion of my device mounted at the top of the press frame. In the present instance, the in-feed speed of the web 32 is determined by an in-feed control assembly designated as 36 which includes an in-feed roller 38. Compensation is provided by a compensator assembly 39 which includes a bodily movable compensator roller 40. After leaving the compensator 39, the web 32 passes over an idler roller 41 thence to the main draw roller 19 where it is combined with the main web 16.

Where it is desired to maintain registration completely automatically, the pre-printed web 32 may be passed through a detector 42 preferably utilizing a photocell just prior to the association of the webs.

The use of a detector, compensator assembly and in-feed control assembly of the type disclosed herein is described in some detail in the copending application referred to. In brief, the compensator assembly 39 serves as a means for forming an adjustable loop in the inserted web 32 prior to feeding such web to the main draw roller 19. By laterally shifting the compensator roller 40, it is possible to correct immediately for large amounts of misregistration caused, for example, by splicing. The compensator assembly also serves as a means for transiently changing the tension in the inserted web, the temporary nature of the change being caused by the fact that a small amount of relative movement or creep takes place between the tensioned web and the power driven rollers 38, 19 and 22.

In order to maintain the inserted web 32 under a condition of steady-state tension, means are provided for varying the speed of the in-feed roller 38. With the roller 38 rotating at a somewhat slower peripheral speed than the main draw roller 19, it will be apparent that the portion of the web which has already passed the in-feed

roller 38 will be tensioned an amount which depends upon the difference in peripheral speed. In this way the inserted web 32 may be stretched prior to the association of the webs by an amount which just compensates for the discrepancy between the cyclic length of the impressions on the webs.

Although the means for accomplishing such transient and steady-state tensioning of the inserted web are shown generally in the above-mentioned copending application, it will be helpful to review the specific structure of the compensator assembly 39 and the in-feed control assembly 36 as disclosed in Fig. 2. Reference will first be made to the compensator assembly 39 which is shown in the lower portion of Fig. 2 and which includes the shiftable compensator roller 40 to which reference has already been made.

The compensator roller is arranged for sidewise bodily adjustment by being mounted on internally threaded supports 48 and 49 which engage horizontal lead screws 51 and 52 respectively. The latter are rotated simultaneously from a common adjusting drive shaft 53 through pairs of bevel gears 54 and 56. The adjusting shaft 53 is, in turn, driven by means of a compensator adjusting motor 58. By causing the motor 58 to rotate in one direction, it will be apparent that the length of the partial loop of the web 32 passing over the compensator roller 40 may be lengthened to compensate for the condition where the pre-printed web is leading while causing rotation of the motor 58 in the opposite direction will shorten the loop as necessary to compensate for a lagging web. Because of creep, the correction brought about by the compensator roller is only temporary and persistence of the tendency of the pre-printed web to lead or lag will make it necessary for the compensator roller soon to be moved to one extreme or the other of the range of its adjustment. By means to be described, the approach of the compensator roller to an extreme position is utilized in controlling the in-feed speed control assembly.

Referring now to the in-feed control assembly 36 shown at the upper portion of Fig. 2, it will be seen that the in-feed roller 38 is driven by an infinitely variable drive which receives its driving power through a shaft 59, it being understood that the latter is coupled to the main press drive 17. Although various types of infinitely variable drives may be used without departing from my invention, the exemplary embodiment includes an adjustable belt drive 60, commonly known as a PIV drive and a differential 61. The differential is of a conventional type having an input element consisting of a bevel gear 62, a speed changing element 64, and an output element consisting of a bevel gear 63. Freely rotatable on the speed change element 64 are intermediate bevel gears 66 and 68, the latter turning about an axis which is at 90° to the axis of rotation of the element 64. A pair of bevel gears 69 and 70 serve to couple the differential to the in-feed roller 38.

Input power to the differential 61 is obtained from two sources. The first source includes a direct connection to the vertical drive shaft 59 by means of the meshed gears 71, 72. The second source of power is the adjustable belt (PIV) drive 60 which is powered through a pair of bevel gears 74, rotating the speed changing element 64 through gears 77 at a very low speed. The belt drive 60 includes an adjustable sheave 65 and a sheave 75, the latter being drivingly interconnected by a belt 76.

As is well known in differential practice, the speed of the output element 63 is equal to the speed of the input element 62 arithmetically modified by twice the speed of the speed changing element 64. Since the speed of the element 64 may be made relatively low, adjustment of the belt (PIV) drive enables very fine control of the top speed to be achieved, on the order of a fraction of an R. P. M. In the present embodiment, adjustment is effected by varying the distance between the tapered sides of the adjustable sheave 65. The latter may be gradually separated or brought closer together by any desired sheave adjusting means which here include a PIV adjusting motor 81 and associated gearing 82. The motor 81 is reversible and may be energized by means to be described to change the driving ratio of adjustable belt drive 60, and thus the in-feed speed of the pre-printed web 32. Included in the in-feed assembly 36 are means responsive to the upper and lower limits of in-feed speed. Here this is accomplished by a threaded shaft 84 rotatable with the adjusting motor 81 and which engages a traveling nut 85 for a purpose which will appear.

As disclosed in the Crafts copending application, the in-feed speed is varied in response to the approach of the compensator roller 40 to one or the other of its limit positions. Referring now to Fig. 2 and the central portion 39, 36 of Fig. 3, it will be seen that limit switches 86 and 88 are provided which are operated by a limit switch cam 89 mounted to move bodily with the compensator roller support 48. With the limit switches 86, 88 each connected in series with a source of electrical power 90, it will be apparent that the PIV adjusting motor 81 will be caused to rotate either in one direction or the other as the compensator roller approaches one of its alternate limit positions.

Moisture content control assembly

In accordance with one aspect of the invention, means are included for changing the percentage moisture content of the inserted web in response to the approach of the in-feed speed adjustment to one or the other of its limit positions. Prior to a discussion of the specific means here used for changing the moisture content of the web, it will be helpful to observe in general the effect of adding moisture to a paper web. It has been observed that the effect reflected both in a change in length and in a very striking change in the stress-strain characteristics. Specifically, it has been found that when the moisture content of a pre-printed web is substantially increased above normal by means of a water spray, steam bath, or the like, the paper fibers tend to swell, thereby increasing the untensioned length of a single impression. In addition, the increased moisture greatly increases the ease with which the web may be stretched or strained by application of a given stress thereto. For purposes of convenience, the increased ease of stretching may be referred to as increased "elasticity," recognizing that the term is here used in a sense which is somewhat different from the normal definition usually applied to this term in the field of mechanics. It has also been observed that an increase in the moisture content of a paper web to a certain extent also increases the breaking strength, which fact is very advantageous in the registration control disclosed herein.

Referring now to the lower portion of Fig. 3 and the left-hand portion of Fig. 1, it will be

seen that the inserted web 32 after leaving the storage roll 31 is passed through a moisture spraying chamber 100 including spray nozzles 101 which spray moisture in the form of steam or fine droplets on both sides of the web, such moisture being supplied through a supply line 102. In accordance with one aspect of the invention, provision is made for controlling the flow of water by means of a valve 104 which may be electrically operated and turned on as an incident to the in-feed speed adjustment reaching a predetermined minimum speed position. In the present instance, this is accomplished by a limit switch 105 which is operated by the traveling nut 85 on the shaft 84 of the in-feed speed control and valve 104 of the quick acting solenoid type. Current to operate the valve 104 is supplied from any convenient source 90.

To understand the manner in which the moisture content control acts to correct misregistration, it will be assumed that an inserted web 32 is used having a length per impression which is, on the average, shorter than the cyclic length of the main web 16. Under such conditions, the speed of the in-feed roller 38 is reduced by rotation of the PIV-adjusting means in the proper direction, the means for effecting such rotation being either automatic or manually controlled. As slowing down of the roller 38 takes place, the web 32 will be increasingly tensioned until the cyclic length of the impressions thereon is such as to correspond to those on the main web. If the discrepancy between the impressions on the webs is great, it will be necessary to slow down the in-feed rollers 38 to the point where the tension produced in the web in the section thereof preceding the main draw roller 19 reaches a magnitude which may cause breakage of the web. In order to prevent such tension from reaching a dangerous value, the limit switch 105 is so arranged with respect to the nut 85 (see Fig. 3) that any further reduction of in-feed speed beyond a predetermined point causes the switch 105 to be operated and the moisture spray device 101 to be turned on.

Since webs of paper, and particularly newsprint, are both thin and water absorbent, the steam or finely divided droplets of water are taken up by the web almost immediately. In order to increase the amount of time during which such absorption may take place, however, the moisture chamber 100 may be made quite long and additional spraying nozzles added. It will be understood, of course, that the paper should not be excessively wetted, since addition of moisture beyond a certain point greatly reduces the breaking strength and causes the web to wrinkle. A moderate application of moisture to an extent readily determined by a trial and adjustment procedure, has the effect of increasing the normal length of the web (in the unstressed condition) and also of making the web more readily stretched by application of a given magnitude of tension. Since these effects are additive, both tending to produce a longer web, the effects of short printing may be completely compensated with only moderate tensioning of the web. In the practical case, the cyclic length of the inserted web may be increased in this manner by an amount sufficient to overcompensate for the short printing and to cause misregistration to occur in the opposite sense. The latter, however, can be readily taken care of either manually or automatically by the detector disclosed herein merely by increasing the speed of the in-feed roller 38. It will be apparent in any event that by using the moisture treatment, a given amount of corrective elongation in the short web may be achieved with a much lower value of tensile stress than would be necessary if no moisture were applied.

In the foregoing discussion it has been assumed that the cyclic length of the inserted web was too short and that elongation of the same was required. It is possible, on the other hand, that the pre-printed web may have a cumulative error in the opposite direction; in other words, the inserted web may be "long" printed instead of "short" printed relative to the printing web 16. If such is the case, it is necessary to increase the speed of the in-feed roller 38. If the discrepancy is very great, however, a point will be reached in which the in-feed roller 38 is feeding the web 32 at a speed which is excessively fast as compared to the speed of the main printing web so that there is danger of loosening the pre-printed web which may result in wrinkling and complete loss of control. In accordance with one aspect of the invention, therefore, means are provided for correctively varying the moisture content to cause a shrinkage or shortening of the web. This is accomplished in the present instance by the controlled application of a gas flame to the web, the same being indicated at 108 in Figs. 1 and 3. The combustible mixture is obtained from a gas line 109 and an air line 110 respectively controlled by solenoid type valves 111 and 112. As is conventional in gas burner practice, a regulator 113 is used to regulate the pressure at which gas is supplied to a proportional mixer 114. An inspirator 115 for drawing in atmospheric air together with control valves 116 may be used in the air line if desired. The mixture is finally supplied to a manifold type burner 118 which extends the width of the web 32. An ignition transformer 119 connected in parallel with the solenoid valves 111, 112, may be used to light the flame with an electric spark whenever the valves are open. In the practice of the invention and in a manner completely analogous to the water spray, the gas burner is turned on or off by means of a limit switch 120 which is actuated by the traveling nut 85 at the opposite limit of travel corresponding to maximum in-feed speed.

With the above structure in mind, it will be apparent that increasing the speed of the in-feed roller 38 beyond a predetermined magnitude in an attempt to produce registered insertion of web 32 will cause the traveling nut 85 to reach right-hand or maximum speed position thereby operating limit switch 120 and turning on the gas flame 108. The latter results in shrinkage of the web 32 which correctively reduces its cyclic length. The latter may actually result in sufficient shrinkage so that the discrepancy is overcompensated. If this occurs, however, it is merely necessary, by manual or automatic means, to reduce the speed of the in-feed roller 38, the latter being accompanied by a leftward movement of the traveling nut 85 and consequently the shutting off of the gas flame 108. While this aspect of the invention has been described in connection with a gas burner and a control valve therefor, it will be apparent that heating may be accomplished in other ways without departing from the invention. For example, radiant electrical heating

coils or steam heated drums controlled by the limit switch 120 may be used.

Using the scheme outlined above, it will be apparent that a water spray and gas flame will only be turned on during the time that the in-feed speed adjustment is in one or the other of its extreme positions. However, where the discrepancy in the cyclic lengths of the webs is less severe, it will not be necessary for the in-feed speed adjustment to vary widely from the median position illustrated in Fig. 3. Normally, then, it will only be necessary for the water spray or gas flame to be turned on occasionally which is advantageous where it is desired to save fuel or where, for some reason, the continuous moisture spray may be objectionable.

If desired, and without departing from the invention, the control for the application of moisture or heat need not be of the "on-off" type but may also be of a "proportional" type in which the degree of opening of the inlet valves 104, 111, 112 is proportional to the degree of departure of the in-feed speed from a median condition. To accomplish this it would merely be sufficient to cause the traveling nut 85 to open and close such valves progressively as it travels toward one or the other of its respective limit positions. Such arrangement would, however, have the disadvantage that moisture or heat would have to be applied for a greater portion of the total time.

In those cases where the presence of moisture is objectionable or where different stress-strain characteristics are desired than can be obtained by the use of water, it is contemplated that many other types of liquids or solutions may be used in place of water. The particular liquid to be used may be determined by the process of trial and error merely by noting the change in physical characteristics brought about by the application of such liquid to a sample strip of paper.

Detection of lag or lead

In practicing the invention, it is desirable to use an automatic means for detecting misregistration between the webs and to produce automatic compensation therefore. The use of automatic detecting means is not essential, however, since the major advantages of my registration control may be obtained even where manual adjustment is used. In a simple embodiment manual adjustment may be used in connection with the PIV drive and the amount of correction determined simply by observing the papers emerging from the folding and cut-off unit. Such manual adjustment may be accomplished by providing a hand wheel 125 (Fig. 3) in direct engagement with the gearing 82 and thereby enabling the PIV adjusting motor 81 to be dispensed with. Alternatively, manual adjustment of the compensator roller 40 may be used. To accomplish this, it is merely necessary to provide a hand wheel 126 coupled directly to the drive shaft 53 thereby eliminating the necessity for compensator adjusting motor 58. This arrangement has the advantage that large amounts of misregistration due, for example, to splicing may be easily and quickly corrected. Using the latter scheme, no change in the in-feed speed would occur until the compensator roller had been moved to one of its alternate limiting positions resulting in the actuation of one of the limit switches 86, 88, controlling the PIV adjusting motor 81 and furthermore no change in the moisture content of the web would occur until the in-feed speed reached a predetermined upper or limit switches 105 or 120.

The use of manual registration control is accompanied by a number of serious disadvantages, the more important of which are the constant attention required and the large number of wasted copies produced before registration is finally achieved. As more completely discussed in the copending Crafts application, it is desirable to detect misregistration by photoelectric means. This can be done by employing a detecting photocell 130 to scan the inserted web 32 and in alinement with registering markings 133 thereon. Similarly, the instantaneous position of the main web 16 may be determined, for purposes of phase comparison, by the use of photocells 127 cooperating with a scanning cylinder 131 which may be coupled to the main press drive at any desired point and preferably at the cut-off cylinders 24. With the webs properly registered, the passage of a registering mark 133 will be registered by the detecting photocell 130 when the scanning cylinder 131 is in a predetermined angular "null" position. On the other hand, the passage of a mark on the web 32 when the scanning cylinder is either advanced or retarded with respect to its "null" position may, by an appropriate amplifier and relay arrangement 134, be utilized to energize the compensator adjusting motor 58 in a direction to make the appropriate correction. Although the amplifier and relay arrangement 134 is merely schematically illustrated, it will be understood that the circuit may be the same as in the Crafts application or any equivalent phase detector which will appear to one skilled in the art.

As illustrated in Fig. 3, the photocell controlled device 134 is caused to energize the compensator adjusting motor 58 and no change in in-feed speed occurs until the compensator roller 40 reaches one or the other of its limit positions, whereupon the PIV adjusting motor 81 is correctively energized. If desired, and without departing from my invention, the amplifier and relay device 134 may be associated directly with the PIV adjusting motor 81 by means of leads shown dotted at 135. With the leads 135 connected to the PIV adjusting motor 81, any tendency toward misregistration will be immediately reflected in rotation of the PIV adjusting motor 81 in such a direction as to maintain registration. Just as in the preferred embodiment, the moisture content control 34 will be operated whenever the speed of the in-feed roller 38 reaches a predetermined limiting value. Even where such direct control of in-feed speed by device 134 is used, large amounts of misregistration caused, for example, by splicing may be corrected by initial manual adjustment of the compensator roller through the use of the hand wheel 126.

Constant high moisture content

As stated above, one of the primary advantages resulting from the use of increased moisture content is the fact that the web becomes more "elastic" and can be elongated by tensile forces which are considerably less than would be necessary where the web is in the normal dry state. I have found, therefore, that the use of moisture continuously added to the web greatly increases the effectiveness of the compensator roller and in-feed speed control in producing registration. Stated in other words, a given degree of misregistration may be corrected by applying tensile forces to the short web which are of considerably lower magnitude than the forces normally re-

quired, and the danger of breakage of the web during the adjustment process may be substantially eliminated.

To produce a constant high moisture content using the apparatus disclosed, it is sufficient merely to substitute a manually settable water valve for the automatically controlled valve 104, the valve being adjusted well below the point of excessive wetting and consequent weakening of the web. It is recognized that such a simplified arrangement has a number of disadvantages as compared to the automatic "on-off" control discussed, one of the latter being that the moisture spray must run continuously. Furthermore, where the inserted web has for any reason been "long-printed" the moistening may cause the web to expand to a cyclic length which is too great to enable mechanical correction by reduction of tension in the web. This alternate scheme does, nevertheless offer a simple means for substantially increasing the elongation, under tension, which may be effected by the mechanical portion of the registration control. While its use is somewhat limited in the case of "long-printed" webs, this can be readily taken care of by printing the pre-printed web so that the cumulative error, if any, therein is "short" as compared to the main web.

I claim as my invention:

1. In a web feed printing press, means for combining a first web in registry with a second web, an in-feed roller for supplying said first web, variable speed drive mechanism for driving said in-feed roller adjustable between upper and lower limiting speeds, a compensator roller over which said first web is led prior to its association with said second web, means for effecting transverse bodily adjustment of said compensator roller between two extreme positions, means responsive to the approach of said compensator roller to one of its alternate extreme positions for correctively varying the speed of said variable speed drive mechanism, means for correctively adjusting the moisture content of said first web, and means actuated as an incident to said variable speed drive mechanism reaching one of its alternate limiting speeds for correctively varying the moisture content in said first web.

2. In a device for maintaining registry between a first web and a second web, a draw roller for said webs, means associated with said first web for varying the in-feed speed thereof relative to that of the draw roller, means for adjusting said speed varying means in a direction to produce registry of said webs, and means actuated as an incident to a decrease in the in-feed speed of the first web for increasing the moisture content of said first web and thereby to increase the maximum corrective effect upon registration which may be produced by decreasing said in-feed speed.

3. In a device for maintaining registry between a first web and a second web, means associated with said first web for varying the in-feed speed thereof relative to the second web, means including a detector responsive to variations and relative positional phasing of the webs for adjusting said speed varying means in a direction to produce registry of said webs, and means actuated in response to a decrease in the in-feed speed of the first web to a predetermined limit of adjustment for increasing the moisture content of said first web.

4. In a web feed printing press, means for combining a first web in registry with a second web, said means comprising, in combination, an in-feed roller for supplying said first web, variable speed drive mechanism for driving said in-feed roller, means for correctively adjusting said variable feed drive mechanism in a direction to produce registration, and means actuated as incident to a predetermined reduction in in-feed speed for increasing the moisture content of said first web considerably above the normal value thereof in order to increase the maximum rate at which misregistration may be corrected by the in-feed speed adjustment

5. In a web feed printing press, the combination comprising means including a draw roller for combining a first web having spaced registering markings thereon with a second web having printed impressions thereon, an in-feed roller for supplying said first web to said combining means and spaced from the latter, variable speed drive mechanism for driving said in-feed roller, means operable in response to variations in the relative positional phase of successive marks on said first web and of the impressions on said second web for correctively adjusting the peripheral speed of said in-feed roller with respect to the speed of the combined webs, and means actuated by said adjusting means upon the latter's reaching a predetermined low speed setting for increasing the moisture content of said first web considerably above the normal value thereof in order to increase the maximum reduction in in-feed speed which may be tolerated without danger of breakage of said first web.

6. In a web feed printing press, the combination of a folder having a rotary cut-off device, means for leading a web from a printing unit to said folder, means including an in-feed roller driven by a variable speed drive mechanism for supplying a pre-printed re-rolled web having spaced marks thereon to associate with the first mentioned web preparatory to entering said folder, means operable in response to variations in relative positional phase of the marks on said pre-printed web and of said rotary cut-off device for correctively adjusting said variable speed drive mechanism, and means actuated by said adjusting means upon the latter's reaching a predetermined low speed setting for adding moisture to the pre-printed web in order to increase the elasticity thereof and thus increase the corrective effect upon registration which may be obtained by varying the speed of said in-feed roller.

7. In a device for combining first and second traveling webs in a condition of registry, means associated with said first web for varying the tension therein prior to the combining of the webs, means for correctively adjusting said tension varying means in a direction to produce registry of said webs, and means actuated by said adjusting means as an incident to an increase in tension for substantially increasing the moisture content of said first web thereby to increase the effectiveness of said tension varying means in producing registration.

8. In a device for combining first and second traveling webs in a condition of registry, means associated with said first web for varying the tension therein immediately prior to the combining of the webs, detecting means responsive to variations in relative positional phasing of said webs, means actuated by said detecting means for correctively adjusting said tension varying means in a direction to produce registry of

said webs, and means for increasing the moisture content of said first web as an incident to the approach of a maximum tension condition thereby to increase the effectiveness of said tension varying means in producing registration.

9. In a device for combining first and second traveling webs in a condition of registry, a draw roller, means associated with said first web for varying the tension therein prior to the combining of the webs at said draw roller, means for correctively adjusting said tension varying means in a direction to produce registry of said webs, means including a moisture chamber having a water spray therein for increasing the moisture content of said first web thereby increasing the percentage of elongation which may be effected by said tension varying means without danger of breaking the pre-printed web, means actuated automatically as an incident to increasing the tension in the first web beyond a safe value for turning on said water spray, and valve means for by-passing said automatic means for causing said spray to operate continuously during the registration of normal and short-printed webs.

10. In a device for combining first and second traveling webs, means associated with said first web for varying the tension therein prior to the combining of the webs, detecting means responsive to variations in relative positional phasing of said webs, means actuated by said detecting means for correctively adjusting said tension varying means in a direction to produce registry of said webs, means including a moisture chamber having a water spray therein for increasing the moisture content of said first web thereby increasing the percentage of elongation which may be effected by said tension varying means without danger of breaking the web, means actuated automatically as an incident to increasing the tension in the first web beyond a safe value for turning on said water spray, and valve means for by-passing said automatic means for causing said spray to operate continuously during the registration of normal and short-printed webs.

11. In a web feed printing press, the combination of a folder having a rotary cut-off device, means for leading a web from a printing unit to said folder, means including an in-feed roller driven by a variable speed drive mechanism for supplying a pre-printed re-rolled web to associate with the first mentioned web preparatory to entering said folder, means for correctively adjusting the speed of said variable speed drive mechanism so that the webs are associated in registry, said speed adjusting means having alternate limit positions of adjustment, and means responsive to the approach of said speed adjusting means to one of its alternate limit positions for correctively varying the moisture content of at least one of said webs.

12. In a web feed printing press, the combination of a folder having a rotary cut-off device, means for leading a web from a printing unit to said folder, means including an in-feed roller driven by a variable speed drive mechanism for supplying a pre-printed re-rolled web having spaced marks thereon to associate with the first mentioned web preparatory to entering said folder, means operable in response to variations in relative positional phase of the marks on said pre-printed web and of said rotary cut-off device for correctively adjusting the speed of said variable speed drive mechanism so that the webs are associated in registry, said speed adjusting means having alternate limit positions of adjustment, and means responsive to the approach of said speed adjusting means to one of its alternate limit positions for correctively varying the moisture content of at least one of said webs.

13. In a device for maintaining registry between first and second traveling webs, means associated with at least one of said webs for correctively varying the tensioning thereof to bring said webs into registry and having alternate limits of adjustment, means actuated by said tension adjusting means as an incident to the latter's approaching one of its alternate limits of adjustment for causing a change in the moisture content of one of said webs which is sufficient in magnitude and of the proper sense to enable movement of said tension adjusting means away from the said one of its limits of adjustment and toward said other limit of adjustment.

14. In a device for maintaining registry between first and second traveling webs, means associated with at least one of said webs for varying the in-feed speed thereof relative to the remaining web, means for correctively adjusting said speed varying means in a direction to produce registry of said webs, and means controlled by said speed adjusting means for varying the moisture content of one of said webs in a direction to supplement the effect of said adjusting means.

15. In a device for maintaining registry between first and second traveling webs, means associated with at least one of said webs for adjustably varying the tension thereof and having upper and lower limits of adjustment, means for varying the moisture content of one of the webs, detecting means responsive to variations in relative positional phasing of the webs, means actuated by said detecting means for correctively adjusting said tension varying means in a direction to produce registry of said webs, and means controlled by said tension varying means for correctively adjusting the moisture content varying means as an incident to said tension varying means approaching one of its alternate limits of adjustment.

16. In a web feed printing press the combination of a folder having a rotary cut-off device, means for leading a web from a printing unit to said folder, means including an in-feed roller driven by a variable speed drive mechanism for supplying a pre-printed re-rolled web to associate with the first mentioned web preparatory to entering said folder, means including a source of moisture and a source of heat for changing the moisture content of said pre-printed web, means for correctively adjusting the speed of said in-feed rollers between limits corresponding to maximum and minimum tension, and means including limit switches operated as an incident to the approach of said speed adjusting means to its limits of speed adjustment corresponding to maximum and minimum tension for effecting the application of moisture or heat respectively to said pre-printed web.

17. In a web feed printing press the combination of a folder having a rotary cut-off device, means for leading a web from a printing unit to said folder, means including an in-feed roller driven by a variable speed drive mechanism for supplying a pre-printed re-rolled web having spaced marks thereon to associate with the first mentioned web preparatory to entering said folder, means for applying a source of moisture and

a source of heat to said pre-printed web, means operable in response to variations in relative positional phase of the marks on said pre-printed web and of said rotary cut-off device for correctively adjusting the speed of said in-feed rollers between upper and lower limits, and means operated as an incident to the approach of said speed adjusting means to its lower limit to cause application of moisture to said web and operated as an incident to approach of speed adjusting means to its upper limit to cause application of heat to said pre-printed web.

18. In a web feed printing press the combination of a folder having a rotary cut-off device, means for leading a web from a printing unit to said folder, means including an in-feed roller driven by a variable speed drive mechanism for supplying a pre-printed re-rolled web having spaced marks thereon to associate with the first mentioned web preparatory to entering said folder, means including a water spray device for treating said pre-printed web, means operable in response to variations in relative positional phase of the marks on said pre-printed web and of said rotary cut-off device for correctively adjusting said variable speed drive mechanism between high and low speed limits, and means responsive to the approach of said speed adjusting means to the low speed limit of adjustment for actuating said water spray device.

19. In a web feed printing press, means for combining a first web having spaced registering markings thereon with a second web in a position of registry with successive impressions on the latter, said means comprising an in-feed roller for supplying said first web, variable speed drive mechanism for driving said in-feed roller and variable between high speed and low speed limits of adjustment, a compensator roller over which said first web is led prior to its association with said second web, means for effecting transverse bodily adjustment of said compensator roller between two limit positions, means operable in response to variations in the relative positional phase of successive marks on said first web and of the impressions on said second web for correctively adjusting said compensator roller, means responsive to the approach of said compensator roller to one of its alternate limit positions for correctively adjusting the speed of said variable speed drive mechanism, and means responsive to the variable speed drive mechanism reaching its minimum and maximum speed limits for increasing and decreasing respectively the moisture content in the first web.

20. In a web feed printing press the combination of a folder having a rotary cut-off device, means for leading a web from a printing unit to said folder, means including an in-feed roller driven by a variable speed drive mechanism for supplying a pre-printed re-rolled web having spaced marks thereon to associate with the first mentioned web preparatory to entering said folder, a compensator roller over which the pre-printed web is led prior to its association with said first mentioned web, means supporting said compensator roller for bodily adjustment between alternate limit positions, means operable in response to variations in relative positional phase of the marks on said pre-printed web and of said rotary cut-off device for correctively adjusting the position of said compensator roller, means responsive to the approach of said compensator roller to one of its alternate limit positions for correctively adjusting the speed of said variable speed drive mechanism for said in-feed roller, and means responsive to said speed varying means reaching a predetermined low speed limit of adjustment for increasing the moisture content of said pre-printed web.

21. In a web feed printing press the combination of a web combining station, means for leading a web from a printing unit to said combining station, means including an in-feed roller for supplying a pre-printed web to associate with the first-mentioned web at said combining station, said in-feed roller and said combining station being spaced apart to define a loop of web, means for lengthening said loop of web and thereby transiently tensioning said pre-printed web to correct for misregistration between said webs, means for applying an adjustable sustained tension to said loop of pre-printed web to correct for misregistration between said webs, means controlled by said loop lengthening means upon the latter's reaching its limits of movement for correctively adjusting said sustained tensioning means, means for varying the moisture content of said pre-printed web, and means controlled by said sustained tensioning means for actuating said moisture content changing means in a direction tending to bring about registration.

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