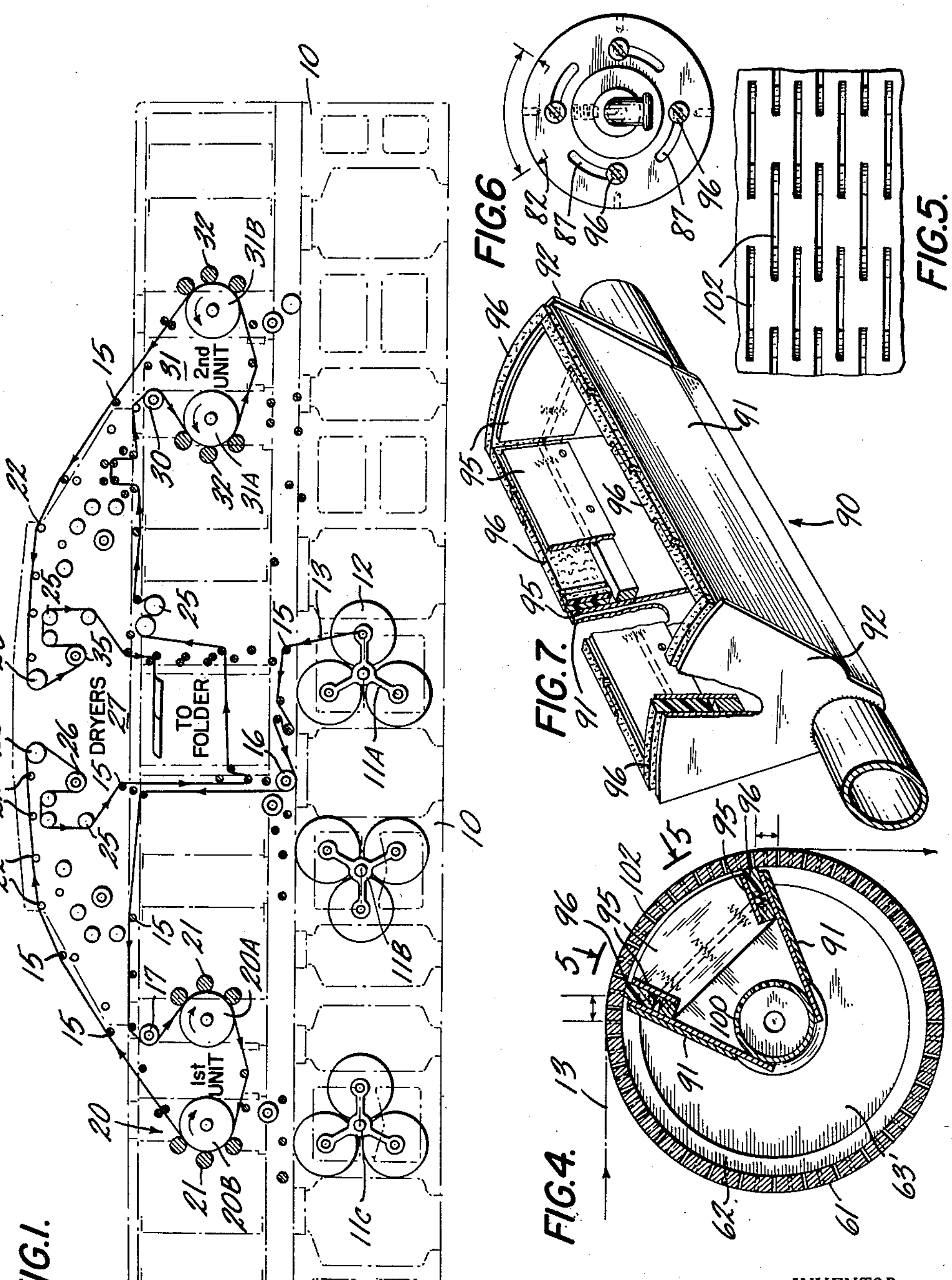
Dec. 19, 1961 H. W. FAEBER 3,013,487

APPARATUS FOR TENSION CONTROL

Filed Jan. 18, 1957 3 Sheets-Sheet 1



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APPARATUS FOR TENSION CONTROL

Filed Jan. 18, 1957 3 Sheets-Sheet 2

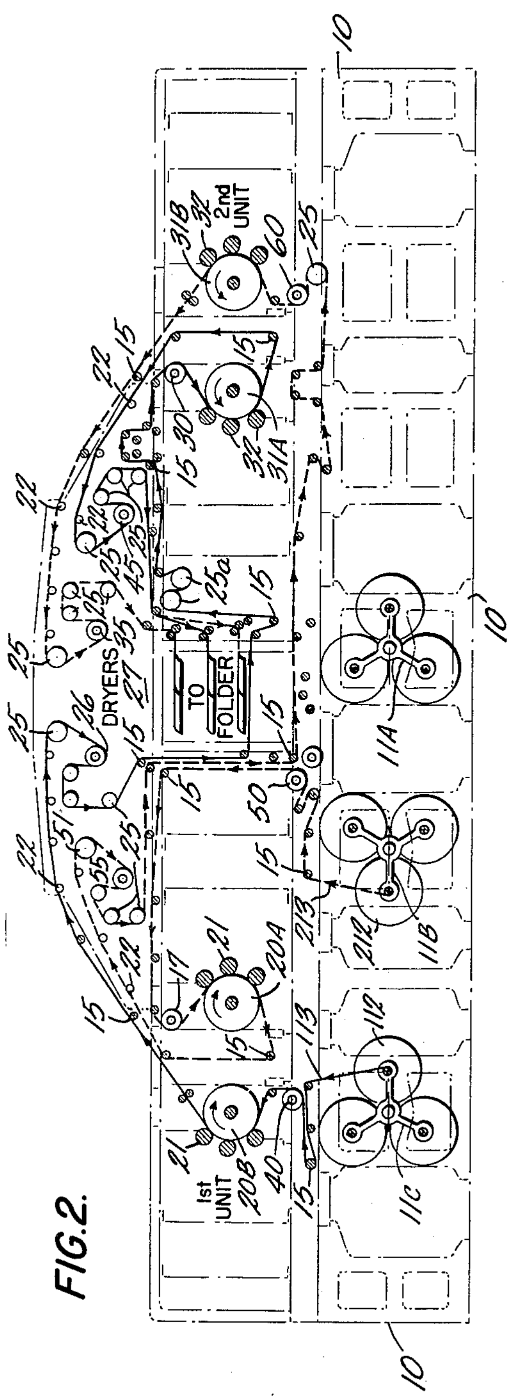

FIG. 2.

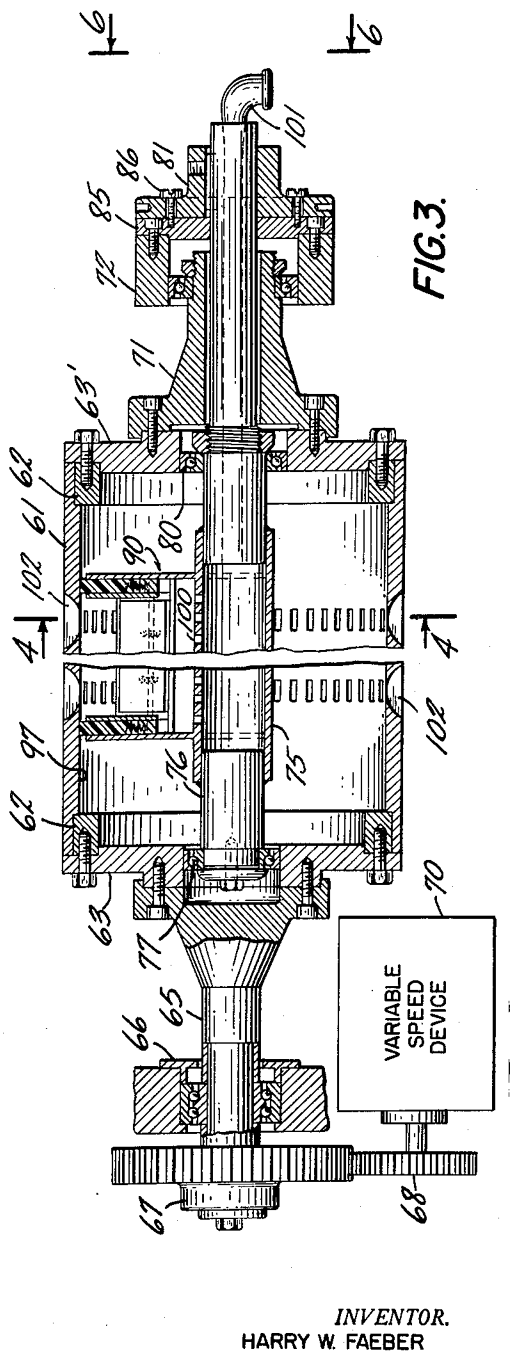

FIG. 3.

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Filed Jan. 18, 1957 3 Sheets-Sheet 3

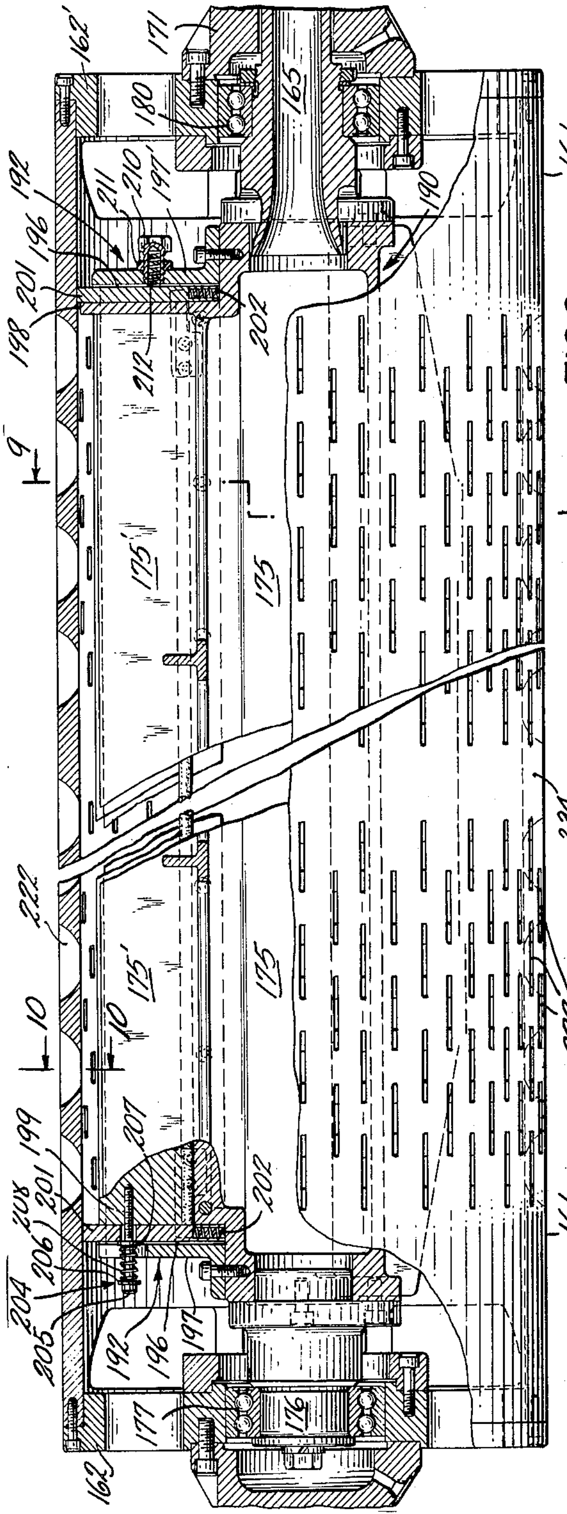

FIG.8.

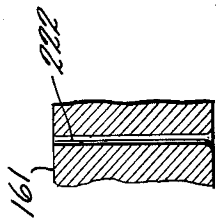

FIG.10.

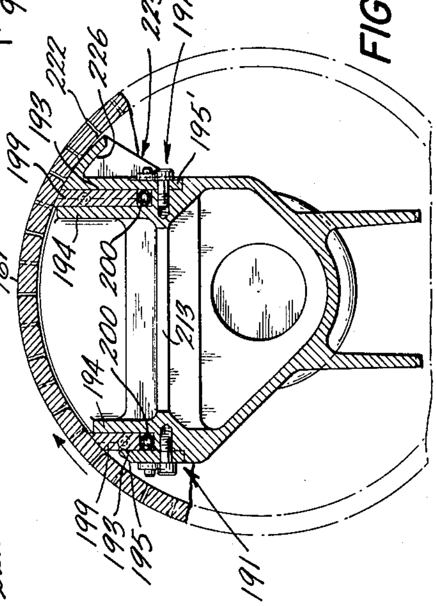

FIG.9.

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APPARATUS FOR TENSION CONTROL

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6 Claims. (Cl. 101—181)

This invention relates to a web tension control device or system to be used in printing presses and similar types of apparatus which continuously treat elongated sheets of material and also require accurate registration between the sheet and the various moving parts of such apparatus.

In a multi-roll machine for processing a continuous sheet or web, such as a printing machine, the web is stored on a supply roll or reel from which it is withdrawn continuously and thereafter passes over guide rolls and through one or more impression units. The control of the web tension is necessary in order to assure that the various impression units will come in contact with the web at the right place with relation to the zone of contact of the other impression units with the web. Attempts have been made in this type of apparatus to control the tension on the web by controlling the reel tension. One of the disadvantages of reel tension control is that every time the supply roll is changed and a "paster" is made, there is an inevitable temporary variation of the web tension at the reel, thereby throwing the press out of register.

Another disadvantage of relying on reel tension control stems from the great length of the web in modern presses: an adjustment of tension at the reel is felt only belatedly near the middle of the web lead, and hardly at all near the opposite end of the press. Still another disadvantage of depending solely on reel tension control is the absence of any means to adjust the tension to different values in various parts of the press, or to compensate for varying degrees of shrinkage in the dryers.

One object of the present invention is to provide apparatus that will permit of more accurate tension control in a machine which processes an elongated sheet of material in a multiplicity of impression units so as to maintain accurate registry between the impression units.

Another object of the invention is to provide an apparatus for permitting the control of the registry between the various impression units without depending upon the tension exerted on the web by the retarding force applied to the supply reel.

Still another object of the invention is to provide apparatus for adjusting the web tension to different degrees in various sections of the press.

Yet another object of the invention is to provide apparatus to compensate for web shrinkage in the dryers.

The invention provides an apparatus for processing a continuous sheet of material, such as a printing press, having a multiplicity of impression units which exert a processing action on the web, and comprising at least one rotatable vacuum roll which is adapted to contact the sheet or web over a substantial portion of its periphery during the travel of the sheet through the machine. The vacuum applied to the vacuum roll tends to hold the sheet against said peripheral portion of the roll. The operation of the vacuum roll then is controlled according to the procedure and using means hereafter described in more detail with relation to the speeds of the impression units of the machine which exert the processing action on the web, thereby to control the tension of the web during at least a part of its travel through the machine and, in turn, maintain the desired registration between the various impression units. The invention may be readily understood from the following description, considered together with the attached drawings.

FIGURE 1 is a schematic elevation view of a multi-

unit printing press provided, according to the invention, with improved means for controlling the tension on the sheet and threaded with a single web of paper.

FIGURE 2 is also a schematic side elevation view of a printing press constructed according to the invention threaded with two webs rather than a single web.

FIGURE 3 is a cross-sectional view of one of the vacuum rolls taken on the plane of the axis of the roll.

FIGURE 4 is a cross-sectional view of the roll taken on a plane indicated by a line 4—4 shown in FIGURE 3 and looking in the direction of the arrows.

FIGURE 5 is a developed view of the periphery of the roll, the portion of the periphery shown being that indicated by a line 5—5 appearing in FIGURE 4, and looking in the direction of the arrows.

FIGURE 6 is an end view of the roll as seen from a plane indicated by the line 6—6 in FIGURE 3 and looking in the direction of the arrows.

FIGURE 7 illustrates in an isometric view the vacuum chest which is mounted inside the drum shown in FIGURES 3 and 4.

FIGURE 8 is a longitudinal sectional view of another type of vacuum roll.

FIGURE 9 is a section taken on a plane designated by the line 9—9 in FIGURE 8 and looking in the direction of the arrows.

FIGURE 10 is an enlarged sectional view taken on a plane designated by the line 10—10 in FIGURE 8 and looking in the direction of the arrows.

Referring first to FIGURE 1, the machine frame **10** supports a series of 3-arm rotatable reels **11A**, **11B** and **11C**, each of which is adapted to support rotatably three rolls of paper or similar sheet material **12**. After leaving the roll **12**, the paper passes over a series of guide rolls **15**, after which it comes into contact with the first vacuum roll **16**. The structure and performance of the vacuum rolls will be described in greater detail hereinafter. After leaving the vacuum roll **16**, the web passes over other guide rolls **15** and comes in contact with a second vacuum roll **17**. Thereafter it passes to the first impression or printing unit **20**, which is composed of a first impression cylinder **20A** and a second impression cylinder **20B**. Each impression cylinder is provided with a series of plate or printing cylinders **21**, which print the web **13**. Another series of guide rolls **15** convey the web to a series of water-cooled guide rolls **22** inside the dryer **27**. The web then passes around a large water-cooled roll **25** and hence to a third vacuum roll **26** all of which are located in the dryer **27**. The dryer **27** serves the purpose of drying the ink applied to the sheet by the first impression unit. Another series of water-cooled guide rolls **25** and other rolls **15** convey the web to the large water-cooled rolls **25A** and the web thereafter meets the surface of the fourth vacuum roll **30**. After passing around this roll **30**, the web approaches the second printing unit **31**, which is composed of two impression cylinders **31A** and **31B**, each having its own series of plate cylinders **32**. The web from the second printing unit passes over the guide rolls **15** and small, water-cooled rolls **22** on its way again toward the dryer **27**, where it meets the fifth vacuum roll **35**. After passing over the large water-cooled guide rolls **25**, the web is turned by a bar mounted at an angle to the path of the web, so that it then assumes a path which is at an angle of about 90° from its original path, and it passes over a sixth and final vacuum roll which is not shown in FIGURE 1. The dried web is finally processed in a folder, wherein it is cut and folded to produce signatures.

The machine arrangement shown in FIGURE 2 is similar to that described and shown in connection with FIGURE 1 except that FIGURE 2 provides for the two-color printing of each of two webs of paper. The first web

113 is withdrawn from the roll 112 which is supported on the 3-arm reel 11C. After passing over the guide roll 15, the web meets the first vacuum roll 40, which is just ahead of the first impression cylinder 20B. After leaving the first impression cylinder 20B, the paper is conveyed toward the dryer 27 over a series of rolls 15 and 22, the latter being water-cooled rolls located in the dryer. In the dryer, the web comes into contact with the vacuum roll 26 which is the second vacuum roll in its path of travel through the machine. The guide rolls 15 then convey the web to the large water-cooled rolls 25A located below the dryers 27, as seen in FIGURE 2. The additional guide rollers 15 convey the web to the vacuum roll 30, which is a third vacuum roll that the web has encountered to this point in its travel through the machine. In the second printing unit, the web is processed by the impression cylinder 31A, which cooperates with the back-up or pressure rolls 32. After leaving the roll 31A, the web passes over additional guide rolls 15 and then meets the small water-cooled rolls 22 and the large water-cooled roll 25 in its travel through the dryer 27. In the dryer 27 the web now meets the vacuum roll 45 and thereafter the additional large water-cooled rolls 25. After this, the web is guided by a bar disposed at an angle to the path of travel so that it then changes its path by an angle of about 90° and passes over a fifth and final vacuum roll not shown in the drawing. From the final vacuum roll, the sheet passes to a conventional folder which cuts the web and folds it into signatures.

The second web 213 is withdrawn from the supply roll 212 and after passing over the preliminary guide rolls 15 meets the vacuum roll 50. The guide rolls 15 then carry the web to the vacuum roll 17, which is the second vacuum roll in the path of travel of this web. In the first printing unit, the web 213 is processed by the impression cylinder 20A and the plate cylinders 21 in a manner similar to that described in connection with FIGURE 1. Thereafter the web passes around the additional guide rolls 15 and enters the dryer 27 where the small water-cooled rolls 22 convey it to a first large water-cooled roll 51. After passing over the roll 51, the web meets the third vacuum roll 55. The large water-cooled rolls 25 then convey the web out of the dryer 27, whereafter the guide rolls 15 lead to a large water-cooled roll 25 and thence to the fourth vacuum roll 60. In the second printing unit the web 213 is processed between the impression cylinder 31B and the plate cylinders 32, following which the small guide rolls 15 convey the web to the dryer 27 and the small water-cooled rolls 22 and the large water-cooled roll 25 carry the web to the vacuum roll 35, which is mounted in the dryer 27 and is the fifth vacuum roll in the path of travel of the web. The web is conveyed out of the dryer 27 over the large water-cooled roll 25 and thence to a turning bar disposed at an angle to the path of the web so as to change the path of the web by about 90°. Thereafter, the web meets the sixth and final vacuum roll not shown in FIGURE 2, which conveys the web to a cutter and folder of conventional design of the type heretofore described.

The details of the vacuum rolls are shown in FIGURES 3, 4, 5, 6 and 7. The cylindrical shell 61 is provided with and secured to the end rings 62 which are bolted to the end flanges 63 and 63′. Supported near one end in a bearing 66 and bolted at the other end to the flange 63 is drive journal 65. The remote end of the journal shaft 65 is secured to a gear 67, which is driven by a pinion 68 which in turn is connected to a variable speed device 70. At the opposite end of the shell 61 a hollow journal 71 is bolted to the flange 63′, which in turn is supported in an anti-friction bearing shown generally at 72.

A center pipe 75 extends axially through the hollow journal 71 and the cylindrical shell 61. The remote end of the pipe 75 is closed by a plug 76 and is supported in an anti-friction bearing 77 which is mounted in the rotating flange 63. Near the center portion of the pipe it is supported in a bearing 80, which is mounted in the rotating flange 63′. The opposite end of the pipe 75 carries a keyed disc 81 adjacent the stationary mounting of the bearing 72. The disc 81 has indicating marks 82 shown in FIGURE 6, which show the location of the vacuum chamber (to be described in detail hereinafter) which is mounted inside the cylindrical shell 61. The disc 81 is clamped to the stationary cap 85 of the bearing 72, by means of the screws 86. Morevore, the disc 81 is provided with slots 87, also shown in FIGURE 6, through which the bolts 86 pass and which permit the angular adjustment of the stationary center pipe 75 and its associated vacuum chamber.

The vacuum chamber enclosure 90, shown isometrically in FIGURE 7, consists of two side walls 91 and two end walls 92, all of which are welded to the center pipe 75 as shown in the drawings. At the outer edges of the vacuum chamber enclosure, there is provided a channel 95 in which there is mounted an assembly of segmented sealing members 96 which are resiliently biased outwardly from the bottom of the channel 95 toward the inner surface 97 of the cylindrical shell 61. The sealing members 96 overlap each other as shown in FIGURE 7, thereby better to seal the vacuum chamber, which is enclosed by the side and end walls of the housing and the surface of the cylindrical shell 61 from the outside atmosphere. The vacuum chamber is connected to the center of the pipe 75 by the holes 100 through the pipe wall and negative pressure is maintained therein by its connection to a vacuum source not shown in the drawing, through the pipe 75 and the connecting pipe elbow 101.

The cylindrical shell 61 is provided with a system of slots 102 covering substantially its entire circumference. The length of the slotted area as shown in FIGURE 3 is somewhat less than the length of the vacuum chamber. Moreover, it will be noted that since the vacuum chamber covers only a small sector of the entire cylindrical shell 61, only that portion of the slotted circumference of the shell that is in line with the vacuum chamber is under vacuum at any one time, while the remaining slots are at atmospheric pressure.

Referrng to FIGURE 4, it will be noted that the web 13 has a 90° wrap over the roll and that the vacuum chamber is so designed as to have its side walls a finite distance away from the point of tangency with the web so as to insure against any vacuum leakage. The wrap, of course, could be more than 90° or, the dimensions of the vacuum chamber permitting, even less than 90° if desired.

Another type of vacuum roll assembly is illustrated in FIGURES 8 and 9, the general structure being similar to that shown and described in FIGURES 3 to 7, inclusive. The cylindrical shell 161 is secured to the end rings or plates 162 and 162′ by the threaded bolts shown in FIGURE 8. A drive journal and variable speed device not shown in the drawings are provided to the left of the drum, similar to the driving and connecting members 65, 66, 67, 68 and 70 in FIGURE 3. At the opposite end of the shell 161, the hollow journal 171 is connected with an anti-friction bearing not illustrated, and through the central pipe 165, to a vacuum source similar to the comparable mechanisms illustrated in FIGURE 3.

The center pipe 165 extends axially into a vacuum chamber enclosure indicated generally at 190, having vacuum chamber 175 therein, all being enclosed within the cylindrical shell 161. The remote end of the vacuum chamber 175 is closed by a plug 176, and is supported in an anti-friction bearing 177, which is mounted in the rotating end piece 162. Near the center portion of the pipe 165, it is supported in a bearing 180 which is mounted in the rotating end piece 162′.

The vacuum chamber enclosure 190 consists of two side walls 191 and two end walls 192. The channels 193 are formed by the upstanding flanges 194, that are integral with the enclosure 190, and by the auxiliary plates 195 and 195' that are bolted to the enclosure as shown in FIGURE 9.

The channels 196 at the outer extremities of the end walls 192, are formed by the upstanding plates 197 and 197' that are bolted to the vacuum chamber housing 190 as shown in FIGURE 8, and by the upstanding flanges 198 that are integral with the vacuum chamber housing 190.

The longitudinal sealing members 199 are mounted in the channels 193 and are biased outwardly against, and in frictional engagement with the inside surface of the cylindrical shell 161 by the resilient tubes 200 that are mounted in the bottom of the respective channels. These tubes are preferably formed of an age-resistant elastomeric material such as silicone rubber, and if desired may be inflated to produce the desired pressure for the sealing members against the cylindrical shell. However, if a tubing of the proper size and thickness is selected it is not necessary to inflate them.

The lateral or transverse sealing members 201 are mounted in the end wall channels 196 and are urged upwardly against the inside surface of the cylindrical shell 161 by the helical springs 202.

The longitudinal sealing members 199 and the transverse sealing members 201 are maintained in relatively air-tight contact with each other by the adjustable spring screw units (2 in number at each end of the chamber) 204. These consist each of a threaded bolt 205 having a flanged head 206. The bolt passes through a washer 207, the plate 197 and the sealing element 201 without engaging these elements. Between the washer 207 and the head 206 there is a helical spring 208. The force of the spring 208 bearing against the washer 207 and the head 206 tends to pull the longitudinal sealing members 199 in an axial direction toward the lateral sealing member 201.

Shown at the opposite end of the vacuum chamber in FIGURE 8 there is provided a bolt 210 which is threaded in the end plate 197' and provided with a lock nut 211. The bolt 210 has a hollow cylindrical center, housing a helical spring 212 which presses against the lateral sealing member 201, thereby tending to maintain it in airtight engagement with the end wall 198. There are several such bolts at both ends of the vacuum chamber.

The vacuum chamber 175 has an upper section 175' which communicates with the central portion thereof through the apertures 213 shown most clearly in FIGURE 9. Negative pressure is maintained in the upper portion 175' by its communication with the lower portion thereof which in turn is connected through the centrally disposed pipe 165 to a vacuum source. This negative pressure, which is transmitted to the slots 222 in the shell 161, tends to hold the paper web against the outer surface of the shell 161 in the manner and with the objects described heretofore.

The grooves 222 in the shell 161 and preferably also the grooves 102 in the shell 61 shown in FIGURE 3 have an arcuate shape shown most clearly in the sectional portions of FIGURES 3 and 8 and in the detailed sectional view of FIGURE 10. The grooves can be milled in the wall of the cylinder by means of a 0.028" thick milling cutter resulting in a groove width of 0.030" to 0.031". It has been found that a groove substantially wider than this may allow the vacuum to pull the paper inwardly and leave a mark on the paper. However, for processing heavy papers wider grooves may be used and, conversely, for lighter papers narrower grooves may be desirable. The groove cutter may suitably have a diameter of 2.75" resulting in the formation of grooves that are approximately 2⅜" long on the outside of the wall 61 and 161, but only 1" long on the inside of the wall. Thus the long slot opening on the outside of the periphery provides a secure grip on the paper by the cylinder surface, while the smaller inside dimensions of the groove opening permit of more efficient sealing of the internal vacuum chamber by the sealing elements.

In FIGURE 10 it will be noted that the sharp corner at the edge of the groove on the inside of the walls 61 and 161 are rounded off or chamfered in order to prevent damage to the sealing members 96 and 199. However, the edge of the groove on the outside of the periphery remains sharp as machined, which assists in maintaining a firm hold on the paper. Moreover, the grooves in adjacent axial rows are overlapped in order to obtain continuous coverage of the area of contact between the paper and the cylindrical surface.

As shown in FIGURE 8, the rows of grooves across the roll are interrupted in the marginal locations 224. The purpose of this interruption of the grooves is as follows. In certain operations some of the vacuum rolls will carry only a partial web, that is a web less than the full width of the roll 61 or 161. The unused portion of the roll must be wrapped with paper or taped with adhesive tape in order to seal the grooves, which otherwise would be exposed to the atmosphere and thus would cause excessive vacuum leakage. On other vacuum rolls two one-half webs may be run side by side separated by a gap, and the interruption of the grooves in the marginal portion 224 coincides with the gap, thus preventing vacuum leakage in the gap.

The noise which originates from the successive sudden exposure of the evacuated slots 102 and 222 to the atmospheric air, as these slots emerge from the trailing edge of the vacuum chamber 175', can be very annoying. The rolls rotate very often at a high rate of speed and the frequency of exposure of the evacuated slots of the atmosphere is such that a high pitched whine may be produced. One feature of the invention is the provision of a mechanism, indicated generally at 225 in FIGURE 9, for reducing the noise produced by the release of vacuum. As shown in the drawings, the longitudinal plate 195' extends upwardly almost to the inner surface of the cylindrical shell 161. At this point the plate is provided with a skirt 226 that gradually tapers away from the inner cylindrical surface, moving in the direction of rotation of the shell. A wedge-like space is thereby formed between the skirt 226 and the cylindrical shell 161, with the smallest clearance near the edge of the vacuum chamber. The structure described provides for the gradual refilling of the evacuated slots rather than a sudden refilling, with a consequent substantial reduction or even complete elimination of the noise.

The tension on the web passing over the vacuum roll may be controlled in one of two ways: (1) the vacuum may be maintained at a uniform level but the surface speed of the roll may be increased or decreased as desired by means of the variable speed device 70; or (2) the surface speed of the vacuum roll may be constant. The first alternative (the control of the speed of the vacuum roll with constant vacuum) is preferred. In the second alternative (control of the vacuum), reducing the vacuum would reduce surface friction between the roll and the web, thus reducing the tension (in the case where the vacuum roll is located at the pulling side of the web) or increasing the surface friction (in case the roll is located in advance of the mechanism exerting the pull on the web). Increasing the vacuum would have an effect opposite to that just described.

Referring again to FIGURE 1, the tension in the web 13 between the supply roll 12 and the first vacuum roll 16 may vary depending upon any of many factors, some of which have been referred to hereinbefore. However, the speed of the vacuum roll 16 or the vacuum therein, preferably the speed, is controlled so as to maintain a predetermined tension in the web between the roll 16 and the first printing unit 20. For example, the speed of the rolls 16 and 17 may be regulated to a small fraction less than the web speed, thereby to provide a small drag on the web which in turn produces the desired tension.

This allows tension control of the web as it enters the press, independent of the tension at the roll 12. Thus, the only function that the roll tension has to fulfill is to keep the web taut between the supply roll and the first vacuum roll 16, preventing any sag in this area. However, no accurate tension control is required between the roll 12 and the first vacuum roll 16.

The third vacuum roll 26, which is mounted in the dryer 27 and following the first printing unit 20, generally will be adjusted to run slightly faster than web speed, e.g., 0.1% above web speed, in order to maintain the desired tension in the web through the first printing unit 20 thereby maintaining proper registration between the web and the printing surfaces of the plate cylinders 21. In the absence of such tension control, the web may shift on the impression cylinder between successive contacts with the plate cylinders, which causes mis-register. The ratio between the surface speed of any particular vacuum roll and the web, once set, is maintained as a fixed quantity as the press is speeded up or slowed down, and the desired tension in the web at that locality is thereby preserved regardless of press speed.

The tension in other segments of the web, i.e., between the third vacuum roll 26 and the fourth vacuum roll 30 and between the fourth vacuum roll 30 and the second printing unit 31, and between the second printing unit 31 and the fifth vacuum roll 35, and between the latter vacuum roll and the sixth vacuum roll not shown in the drawing, and between the sixth and final vacuum roll and the folder, also may be controlled by controlling the ratio between the surface speed of the web and the particular vacuum roll, thereby to maintain the desired registration between the mechanism which is operating on the web, whether it be printing unit or folder. The operation and function of the several vacuum rolls shown in FIGURE 2 is similar to that described in connection with FIGURE 1, with the exception that FIGURE 2 is concerned with the simultaneous processing of two webs rather than a single web, and hence the machine is threaded in a different manner.

Although specific embodiments of the invention have been described in the foregoing presentation, it will be apparent that there are many modifications and equivalents within the scope of the teaching presented in this specification. For example, any of a variety of means known in the art may be utilized for controlling and adjusting the speed of the vacuum rolls. Accordingly, it is intended that all modifications and equivalents be included within the scope of the appended claims.

I claim:

1. In a machine for processing a continuous sheet of material comprising guide rollers, means for continuously moving said sheet at processing speed and at least one impression roll unit for exerting processing action on said sheet, the improvement which comprises at least one rotatable vacuum roll in said machine adapted to contact said sheet at a portion of its periphery during the travel of the sheet through the machine and having vacuum means tending to hold the sheet against said portion, means for continuously rotating said vacuum roll at a given sheet processing speed, and means to vary the peripheral speed of said vacuum roll relative to said impression roll unit and at speeds above and below the speed of said sheet in a direction to maintain registry, thereby to control the tension of the sheet between said vacuum roll and said impression unit, so as to provide for the control of registration between the surface of the impression unit and the area of the sheet to be treated.

2. In a printing machine comprising guide rollers, means for continuously moving said sheet at processing speed and at least one impression roll unit for exerting processing action on said sheet, the improvement which comprises at least one rotatable vacuum roll in said machine adapted to contact said sheet at a portion of its periphery during the travel of the sheet through the machine and having vacuum means tending to hold the sheet against said portion, means for continuously rotating said vacuum roll at a given sheet processing speed, and means to vary the peripheral speed of said vacuum roll relative to said impression roll unit and at speeds above and below the speed of said sheet in a direction to maintain registry, thereby to control the tension of the sheet between said vacuum roll and said impression unit, so as to provide for the control of registration between the surface of the impression unit and the area of the sheet to be printed.

3. A printing machine as described in claim 2 having two such vacuum rolls, one each on opposite sides of said impression unit, so as to provide for the control of registration through the impression unit.

4. In a machine for processing a continuous sheet of material comprising guide rollers, means for continuously moving said sheet at processing speed and at least two impression roll units for exerting processing action on said sheet, the area in which the action is to be exerted by one of said units requiring registration with the area in which the action is to be exerted by another of said units, the improvement which comprises at least one rotatable vacuum roll in said machine adapted to contact said sheet at a portion of its periphery during the travel of the sheet through the machine and having vacuum means tending to hold the sheet against said portion, means for continuously rotating said vacuum roll at a given sheet processing speed, and means to vary the peripheral speed of said vacuum roll relative to said impression roll units and at speeds above and below the speed of said sheet in a direction to maintain registry, thereby to control the tension of the sheet between said vacuum roll and at least one of said impression roll units, so as to provide for the control of registration between the surface of the impression roll units and the area of the sheet to be treated.

5. In a printing machine comprising guide rollers, means for continuously moving said sheet at processing speed and at least two printing rolls, the area in which one printing roll prints on the sheet of material requiring registration with the area in which another roll prints, the improvement which comprises at least one rotatable vacuum roll in said machine adapted to contact said sheet at a portion of its periphery during the travel of the sheet through the machine and having vacuum means tending to hold the sheet against said portion, means for continuously rotating said vacuum roll at a given sheet processing speed, and means to vary the peripheral speed of said vacuum roll relative to said printing rolls and at speeds above and below the speed of said sheet in a direction to maintain registry, thereby to control the tension of the sheet between said vacuum roll and at least one of the impression roll units, so as to provide for the control of registration between the surface of the impression units and the area of the sheet to be printed.

6. In a printing machine comprising guide rollers, means for continuously moving said sheet at processing speed, means for rotatably mounting a supply roll of sheet material, and at least two printing rolls, the area in which one printing roll prints on the sheet requiring registration with the area in which another roll prints, the improvement which comprises a rotatable vacuum roll in said machine adapted to contact said sheet at a portion of its periphery during the travel of the sheet from the supply roll to the first printing roll, and having vacuum means tending to hold the sheet against said portion, means for continuously rotating said vacuum roll at a given sheet processing speed, and means to vary the peripheral speed of said vacuum roll relative to said printing rolls and at speeds above and below the speed of said sheet in a direction to maintain registry, thereby to control the tension of the sheet between said vacuum roll and said first printing roll so as to provide for the

control of registration between the surface of the printing rolls and the area of the sheet to be printed.

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