July 8, 1969 H. S. WELSH 3,454,463

METHODS OF MAKING NEWSPRINT PAPER

Filed July 12, 1966 Sheet 1 of 2

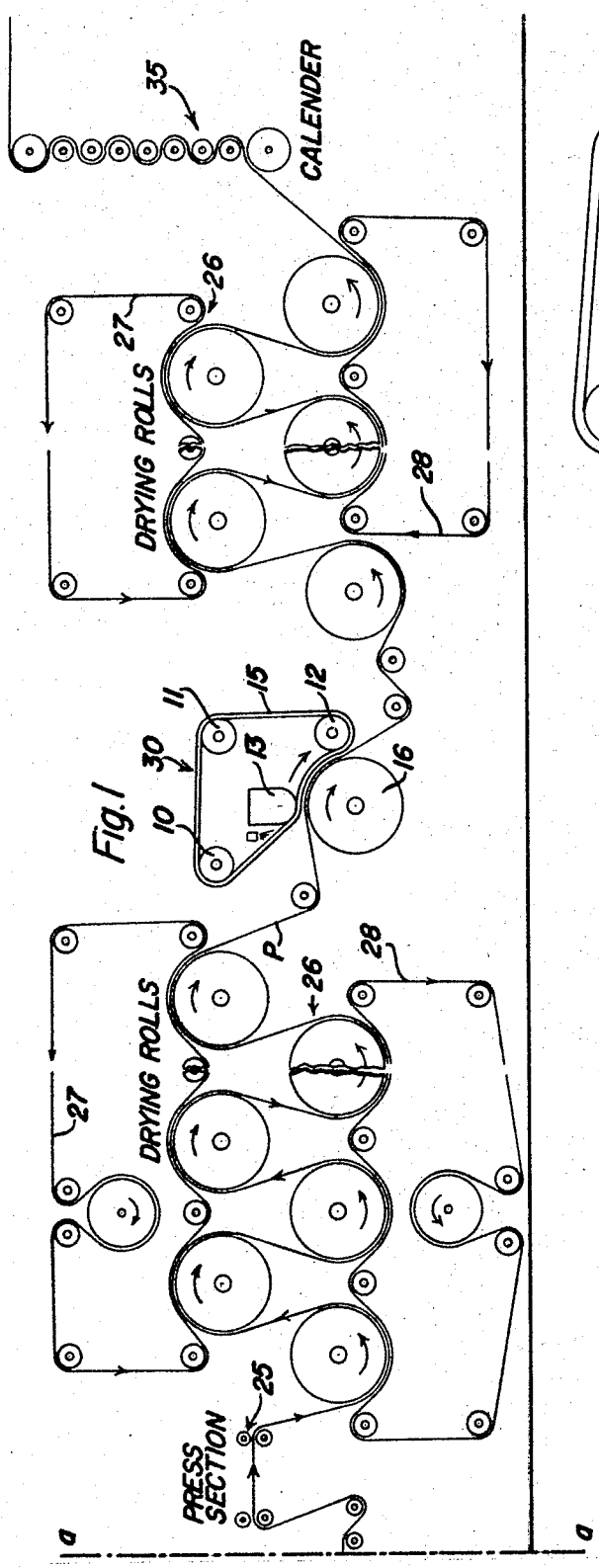

Fig. 1

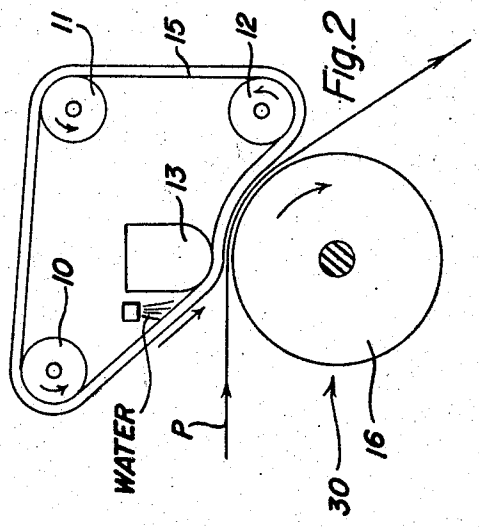

Fig. 2

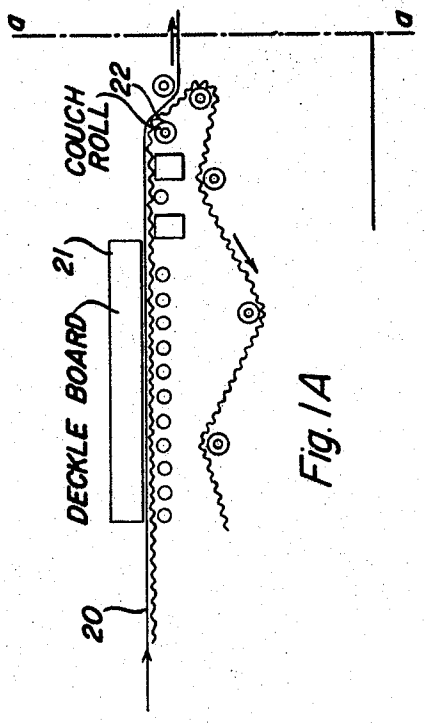

Fig. 1A

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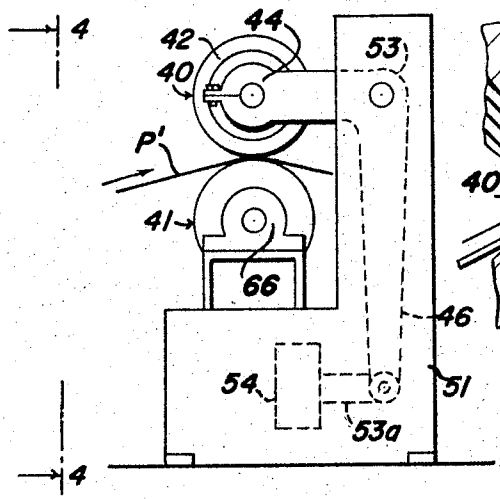

Fig.3

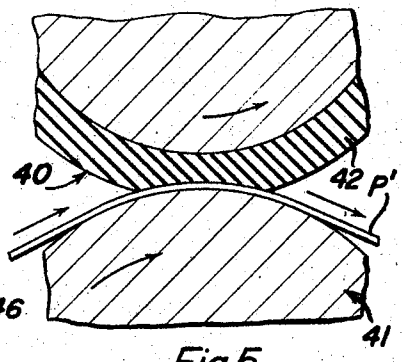

Fig.5

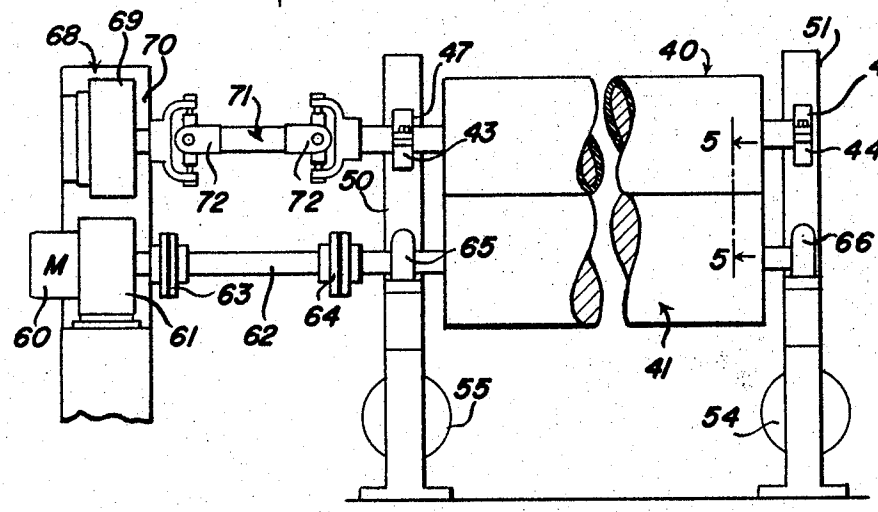

Fig.4

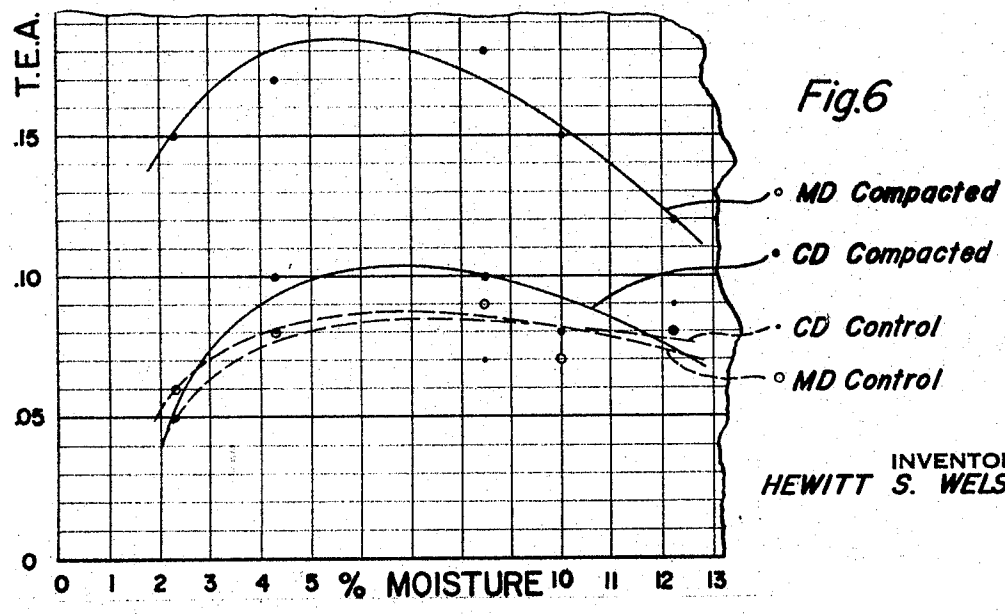

Fig.6

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METHODS OF MAKING NEWSPRINT PAPER

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Int. Cl. D21f 11/00, 11/02
U.S. Cl. 162—206 4 Claims

ABSTRACT OF THE DISCLOSURE

The method of subjecting high groundwood content newsprint paper to controlled compressive shrinking while the newsprint web is in the range of approximately 30 to 50% moisture by weight, including the features of passing the wire side of the web in contact with the moving, smooth surface of a mechanical compactor and shrinking the newsprint web to a value substantially above the desired value and then stretching the web to the desired value.

The present invention relates to an improved newsprint paper and to methods of making same. While the term newsprint in general denotes the type of paper upon which newspapers are printed, in a more technical sense it may be defined as the paper used for this purpose characterized by containing mostly groundwood derived as a rule from long fibred trees. For the purpose of the present application it may be considered to contain a minimum of 65% groundwood, with the rest composed of so-called chemical pulp, as for example, unbleached sulfite or the equivalent. A typical furnish of newsprint, which will vary with the type of printing machine to be employed, may contain from 70 to 80% groundwood with the rest chemical fibre. Normally the newsprint sheet is unfilled, although in some instances a filler such as clay is added in percentages up to 5 to 6%. The current definition of newsprint stemming from that originally contained in section 1772 of "United Tariff Act of 1930" now calls for not less than 70% of groundwood—30% bleached sulfate to 80% groundwood—20% bleached sulfate. According to this definition mixtures of sulfate and sulfite pulps can be used but not above 25% of the total furnish.

In general, the speeds of the newspaper printing machines have been increased gradually whereby at present speeds of 1000 feet per minute are not uncommon. However, the higher the speed of the printing machine, the greater is the likelihood of web breakage, with the consequent loss of printing time, failure to meet deadlines for regular editions, etc. Such breaks are therefore highly expensive, and much effort has been expended in improving the newsprint web so that such breaks may be kept at a minimum.

For the purpose of strengthening the web it has been proposed to increase the amount of chemical fibre in the furnish, as for example, sulfite pulp derived from spruce or other soft wood, in proportion to the amount of groundwood present. Since, in general, the cost of chemical pulp is approximately twice that of groundwood, and since the presence of an increased proportion of chemical fibre does not improve the printing qualities of the paper but may even impair such qualities, the expedient of increasing the chemical pulp content is not favored.

A further problem has to do with maintaining registry of the sheet, which is accentuated by the increasing use of color pages in newspapers. Normally the web is first colorprinted on a separate printing machine. It is then run through the main machine where the reverse side is printed. It is obvious that the registry of the printed matter on the side of the sheet reverse from the color printing must be exact, since the error in registry in each page is cumulative. In general, such registry problem would be facilitated if the web has sufficient strength and stretchability to permit it to be stretched a necessary amount.

A further drawback is that newsprint, in common with other water laid papers, is characterized by what is termed two-sidedness, i.e., the side of the paper formed next to the Fourdrinier wire is less smooth than the reverse or so-called felt side.

It is the principal object of my invention to produce a newsprint paper which shall be free of the foregoing drawbacks while possessing still other advantages as mentioned below.

My invention is predicated upon my discovery that by subjecting the newsprint web preferably during its manufacture and while the web is comparatively wet, to the step of controlled compressive shrinking, a newsprint paper will be produced having an increased tensile energy absorption (T.E.A.) such as to eliminate the above mentioned drawbacks and which will impart to the sheet other superior qualities as will be apparent hereinafter. While the idea broadly of subjecting certain papers to compressive shrinkage is not new per se, in view of the Cluett Patent No. 2,624,245 of Jan. 6, 1953, several factors were considered to militate against this approach to the problems affecting newsprint: (1) newsprint paper because of the poor bond existing between its fibres was not thought to lend itself satisfactorily to compressive shrinking at all—regard being had for the fact that the web preparatory to compressive shrinking must have a substantial moisture content, i.e. 30% or more and in such state was thought not to be able to withstand the action of compressive shrinking, especially at speeds at which newsprint paper is made, namely, 2,000 feet per minute or higher; (2) experience with compressive shrinking to date has been in connection with papers having a high content of chemical fibres and a compressive shrinking of at least 10% and it was not known whether newsprint would hold a compressive shrinking or compaction on the order of 5% or less; (3) it was not known whether or not a compressive shrinking of say 4%, assuming it would be retained, would render the sheet too limp and hence unsuited for the manufacture of newspapers; and (4) the behavior of the compressed newsprint at the calender stack was also an unknown quantity and it was feared such added stretchability would give rise to creases and folds at the calender stack.

However, careful experiments on the application of controlled compressive shrinking to newsprint unexpectedly revealed that this approach was sound. Thus, compressing the sheet in this manner so as to give it an added stretch i.e. stretchability, on the order of 4% or less above the pre-existing or primitive stretch already present was found to effect improvements in various respects whereby the sheet could be run on the high speed printing machine with a minimum of breakage and would have improved printability including the substantial elimination of two-sidedness.

A further and salient feature of the invention is that it enables the paper maker to furnish paper to the printer at a substantially less moisture content than is frequently the case since the paper maker no longer needs to rely upon a high moisture content to bolster the T.E.A. value. This relationship between moisture and T.E.A. will be apparent from FIG. 6 to be subsequently referred to.

It is a further and alternative feature of the invention to subject the newspaper web to compressive shrinkage in excess of the optimum in the final sheet and then to stretch the web so as to remove a portion of such shrinkage and leave in it the desired amount of stretch, as for example, the added approximately 4% or less already mentioned. Thereby a greater polishing action may be given the wire side.

Standard newsprint paper as a rule cannot be satisfactorily printed by offset because of linting, so much so that it is often required that paper for offset be safe to No. 11 wax on the Dennison scale. Because of the action of the compactor it is considered that the treated paper will have less tendency to "pick" and may be used in offset printing presses for which the untreated paper would not be suited, or the improved method may be utilized to bring up to specification newsprint paper which has a reduced content of chemical fibre and which otherwise would not be suitable. Thereby further advantage may be taken of the favorable properties of groundwood as respects printability.

A still further advantage resides in the fact that because of the substantial elimination of two-sidedness, less calendering action will be necessary, whereby much less risk will be run of so-called extruding or elongating of the web in the calendar. If the action of the first portion of the calendar rolls does result in elongating the web, and hence the production of a slack, a fold is likely to be created which will cut the paper as it passes between the subsequent calendar rolls.

The improved method will be best understood by reference to the following detailed description taken with the accompanying drawings in which—

FIGURES 1 and 1A are diagrammatic views in side elevation of a machine of known construction for making newsprint paper which includes a compactor for carrying out the compressive shrinking;

FIGURE 2 is an enlarged view of the compactor used;

FIGURE 3 is a view of a second form of compacting apparatus likewise heretofore known;

FIGURE 4 is a view in elevation as seen from the left of FIGURE 3;

FIGURE 5 is an enlarged view taken on line **5**—**5** of FIGURE 4; and

FIGURE 6 consists of graphs obtained by plotting values of T.E.A. measured both in the machine direction (MD) and in the cross machine direction (CD) both for compacted and uncompacted newsprint.

Referring now to FIGURE 2 showing the first mentioned form of the compactor unit, per se, **10**, **11** and **12** respectively denote the three idler rolls which together with a bar **13** hold a thick belt **15** of rubber against heated drum **16** for a portion of the periphery thereof, said bar having a convex surface, as shown, in contact with said belt. The bar **13** and associated devices i.e. belt **15** and rolls **10**–**12** are held so as to be adjustably movable toward and away from drum **16** by means not shown, and means are also provided permitting sideways movement of bar **13** in respect to the drum **16**. Thereby the degree of wrap of the belt with respect to the drum **16**, as well as the force with which it presses web P against said drum may be suitably varied. It will be understood that as the belt **15** undergoes reversal in curvature in passing beneath the bar **13** the inner surface of the belt opposite the drum will be shortened and will move more slowly than the surface of the drum, such action serving to compress the fibres of the web P in a longitudinal direction and bring about a shrinking of the web without causing it to crepe. Drum **16** is heated by means not shown, as by steam fed to the interior of said drum. The heated drum causes additional heating of the web, while the thus heated water in the web causes a softening and increased flexibility of the fibres thereof. The coefficient of friction between the wet web and the heated drum **16** is relatively low at drum temperatures of about 212° F., or above, and especially so as compared to the coefficient of friction between the web and the surface of the belt **15** in contact therewith. It will be noted that belt **15** is not independently driven but receives its movement from contact with web P. Therefore, the pressure between the belt **15** and roll **16** must be such as to enable the belt to be driven. The arc of contact of the belt **15** and the roll **16** will also depend upon the amount of shrinkage to be undergone; for the present purposes such arc of around 20° to 60° has been found satisfactory.

To be strongest, the paper undergoing treatment should be freshly laid without having been dried to a greater degree than the optimum value for compressive shrinking. The application of compresive shrinkage to the newsprint web in such condition is illustrated in FIG. 1. In this figure part only of the so-called wet or Fourdrinier section is shown including among other conventional elements the wire **20**, deckle board **21** and couch roll **22**. Also shown diagrammatically is the press section **25**, following which is the customary drier stack **26** with which is associated upper felt belt **27** and lower felt belt **28**. Normally the moisture content of the web as it leaves the press section is in the neighborhood of 66%, or greater, which is too high for passing through the compactor. The latter previously described and now denoted **30** is, therefore, disposed in the drier stack **26** at a point where the moisture content of the web is from 30 to 50% (preferably 32 to 38%). After passing through the compactor **30**, the paper is further dried to the desired value e.g. 4 to 10% (preferably 5 to 7%) moisture for the finished paper by the means shown consisting of drier rolls and felts, the same as those to the left of compactor **30** already described. The dried paper is then passed to the machine calendar **35**.

It will be apparent from FIG. 1 that the wire side of the web is that which is held in contact with the drum **16**, the ironing and smoothing action of which in combination with the shrinking action of the belt **15** is effective to reduce and even substantially eliminate the quality of two-sidedness normally possessed by newsprint paper. To this end and for the proper shrinkage of the web, the following conditions are recommended: the surface of the drum **16** should be smooth chromium, cast iron, etc., the rubber belt **15** have a Durometer hardness of 60 and the nip pressure thereof against belt **15** range from 50 to 200 pounds per linear inch; the tension of the belt be held at 40 pounds per linear inch. The drum **16** is maintained at a temperature of approximately 230 to 250° F. at the exterior surface thereof. The felt side of the paper also receives some polishing but not as much as the wire side in the arrangement above described. By so operating, a controlled amount of longitudinal compressive shrinkage is imparted to the paper web. For the purpose of this disclosure, it may be assumed that the amount of imparted shrinkage will increase the stretch by substantially the same amount. For example, if the amount of primitive stretch of the paper is 1% and the web is compressively shrunk or compacted 4%, the amount that the paper can be stretched before rupture will be about 5%. In general, I contemplate that after the compressive shrinkage step, the web will have a total stretch of substantially from 2 to 5% in the machine direction or slightly higher.

It is desirable that the so-called moisture profile, i.e., the variation in moisture of the web across the width thereof be maintained within comparatively narrow limits, i.e., plus or minus 3 to 5%, inasmuch as variation in moisture content will cause the amount of compression imparted to the sheet to vary. The means of maintaining

the moisture profile within the stated limits is, however, well known and need not be described here.

By thus operating upon a groundwood web, its properties may be modified as indicated in the following table:

TABLE

Moisture content (percent)		2.3	4.3	8.45	10.0	12.2
	Compacted samples:					
1	Tensile, MD	9.2	10.1	10.2	9.0	8.7
2	Lb./in., CD	5.0	5.0	5.4	4.3	4.5
3	Stretch, MD	3.0 (1.9)	3.2 (1.85)	3.3 (2.0)	3.0 (1.7)	2.6 (1.1)
4	Percent, CD	2.4 (0.6)	2.5 (0.8)	2.4 (0.4)	3.0 (0.4)	3.0 (0.1)
5	T.E.A., MD	0.15	0.17	0.18	0.15	0.12
6	In. lb./in.^{2}, CD	0.05	0.10	0.10	0.08	0.08
	Control samples:					
7	Tensile, MD	11.2	12.0	12.3	9.7	9.7
8	Lb./in., CD	5.8	5.9	5.7	5.2	4.9
9	Stretch, MD	1.1	1.35	1.3	1.3	1.5
10	Percent, CD	1.8	1.7	2.0	2.6	2.9
11	T.E.A., MD	0.06	0.08	0.09	0.07	0.08
12	In. lb./in.^{2}, CD	0.05	0.08	0.07	0.08	0.09

MD—Machine direction. CD—Cross machine direction. T.E.A.—Tensile energy absorption.
NOTE.—Lines 3,4—The figures in parenthesis give the difference between total stretch and so-called primitive stretch.

The foregoing table taken with the curves of FIG. 6 which are based thereon (only the T.E.A.—machine direction and the T.E.A.—cross direction data are plotted) shows that the amount of stretch imparted to the newsprint which is the difference between the values of stretch called for under the heading "Compacted Samples" and those under the heading "Control Samples" i.e. the so-called primitive stretch. These differences are indicated in the figures in parenthesis in lines 3 and 4. In general, the added MD stretch shown is around 2 except at high moisture values which normally are not employed in finished paper. It will also be noted that increasing the stretch in the machine direction results in an increase of the stretch in the cross direction, which is an advantage, particularly in resisting tear.

The space between the curve "MD Compacted" and the curve "MD Control" indicates the substantial increase in T.E.A. obtained. The curves also bring out the fact that the user of the compacted paper does not need to rely upon high moisture content for the purpose of obtaining high T.E.A.

For the purposes of this invention the added stretch imparted to the newsprint web will vary as above stated from approximately 2%, or slightly under, to approximately 4% and the T.E.A. value of the finished paper will vary from about 0.15 to about 0.35 inch pounds per square inch.

As above mentioned, in lieu of imparting a stretch to the web of an added approximately 4%, the compactor **30** may be operated to produce a somewhat greater shrinkage of the web, as for example, 15% which is thereupon stretched by the controlled drawing action of the drying rolls subsequent to the compactor, so that the final paper shrinkage is approximately the same amount as previously indicated. In this way the wire side of the web is given an increased polishing action.

The following is a brief description of the type of compactor shown in FIGS. 3 and 4;

Here a pair of rolls **40, 41** are mounted so as to receive web P' in the nip between them. Upper roll **40** has a relatively soft outer layer **42** of rubbery material, whereas lower roll **41** has a polished metal surface similar to roll **16**. Rolls **40, 41** are so mounted as to afford a nip pressure which may be varied as desired. To effect this, upper roll **40** is journalled in bearings **43, 44** in the respective upper ends of bell crank levers **46, 47** held in uprights **50, 51** on pivots, one of which **53** is shown in FIG. 3. The lower end of bell crank **46** is pivotally attached to a link **53***a* which in turn is attached to a piston, not shown, in cylinder **54** held in upright **51**. Similarly the lower end of bell crank **47** is linked to a piston in cylinder **55** on upright **50**. Thus, by operation of the pistons in cylinders **54, 55** in response to air or other fluid under pressure admitted to said cylinders, the nip pressure between rolls **40, 41** may be suitably varied.

For driving the lower roll **41**, an electric motor **60** is provided operating through a reduction gear box **61** and shaft **62** equipped with flexible couplings **63, 64** of conventional type. Said shaft **62** is journalled at **65** which together with bearing **66** supports roll **41** as shown.

Preferably roll **40** is driven by the action of roll **41** acting through the web P'. It is a feature of this type of apparatus that the upper relatively soft surfaced roll **40** turns at a somewhat slower surface speed than the lower roll **41** and to vary this speed differential between the rolls a brake **68** is provided operating on a drum **69** which is held in an upright **70**. To allow for the slight to and fro movement of the upper roll **40** toward and away from the lower roll **41**, the brake drum **69** is connected to the roll **40** by means of shaft **71** provided with universal joints **72, 73** of conventional type.

As shown in FIG. 5 the lower hard roll **41** engages the upper roll with sufficient force so as to bite into the rubbery layer **42** with the consequent deformation thereof so as to engage the web over a relatively large area of contact. By reason of the fact that the friction between the layer **42** and the upper surface of the web is greater than the friction between the lower surface of the web and the surface of the lower roll **41**, and of the slower surface speed of the roll **40** as respects roll **41** the web is compressively shrunk aided by the factors of the moisture content of the web and if desired the elevated temperature thereof. The latter may be effected by pre-heating the web, for example, on the drying rolls and additionally the lower roll **41** may be equipped with internal heating means not shown. Thereafter the web having undergone compressive shrinking is dried in conventional manner, as for example, as is the case of the web P above described.

I claim:

1. The method of making a newsprint paper web with enhanced properties of T.E.A. and stretch on a Fourdrinier paper machine comprising: taking a paper furnish containing a minimum of 65% groundwood; removing a part of the moisture from the paper furnish until it has a moisture content in the range of approximately 30 to 50% by weight to form a coherent paper web; mechanically pushing and crowding the fibers of said coherent paper web together between the faces of the web while the web is in a plastic condition to shrink the web substantially above the desired value which is on the order of 2 to 4%, the shrinking being carried out by confining the coherent paper web under pressure between a rigid, moving, smooth surface of a rotating element and a resilient non-porous surface which moves at a somewhat less linear speed than that of the smooth surface, the wire side of the coherent paper web passing in contact with the smooth surface; and thereafter stretching the web to the desired value which is on the order of 2 to 4%; and completing the drying of the web.

2. The method according to claim 1 in which said rotating element is maintained at a temperatlure above 212° F. during the shrinking operation.

3. The method of making a newsprint paper web with enhanced properties of T.E.A. and stretch on a Fourdrinier paper machine comprising: taking a paper furnish containing substantially 80% groundwood; removing a part of the moisture from the paper furnish until it has a moisture content in the range of approximately 30 to 50% by weight to form a coherent paper web; mechanically pushing and crowding the fibers of the coherent paper web together between the faces of the web while thet web is in a plastic condition to shrink the web substantially above the desired value which is on the order of from 2 to 4%, the shrinking being carried out by confining the web under pressure between a rigid, moving, smooth surface of a rotating element and a resilient nonporous surface which moves at a somewhat less linear speed than that of the smooth surface, the wire side of the paper passing in contact with the smooth surface; and

thereafter stretching the web to the desired value which is on the order of 2 to 4%; and completing the drying of the web.

4. The method according to claim 3 in which said rotating element is maintained at a temperature above 212° F. during the shrinking operation.

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U.S. Cl. X.R.

162—111, 113, 142, 150