May 4, 1948. C. W. APGAR ET AL 2,440,839

ROTARY DRUM DRYING APPARATUS HAVING MEANS TO GUIDE WEB OVER DRUM

Filed Sept. 10, 1945 3 Sheets-Sheet 1

Fig. 2.

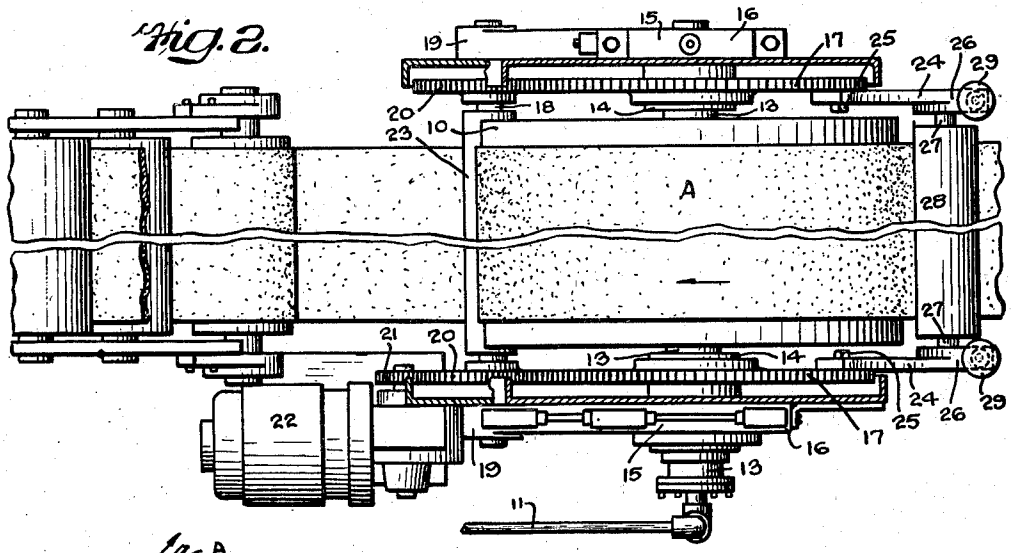


Fig. 1.

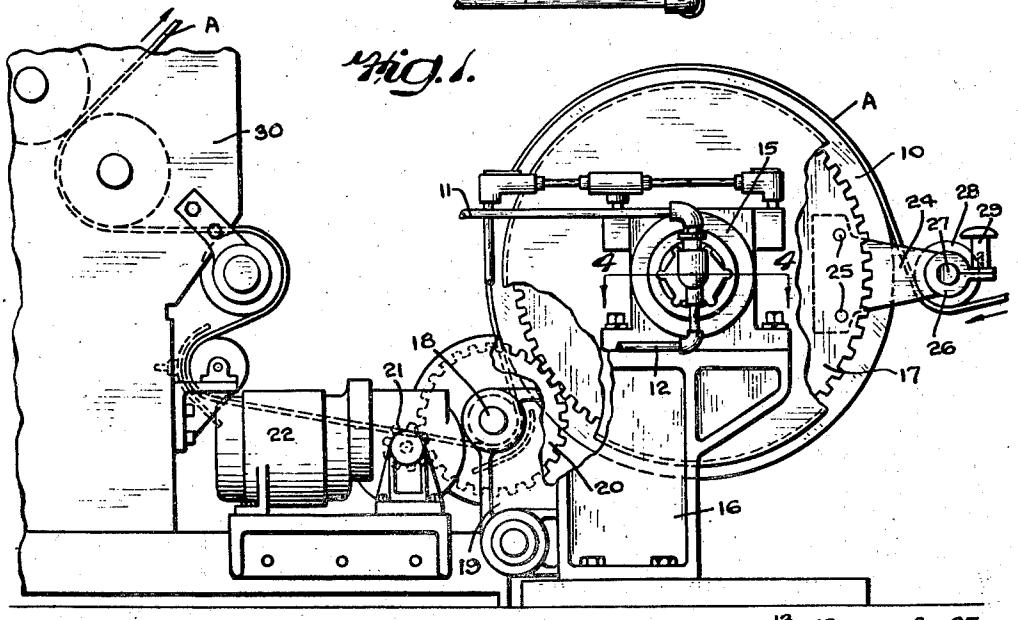
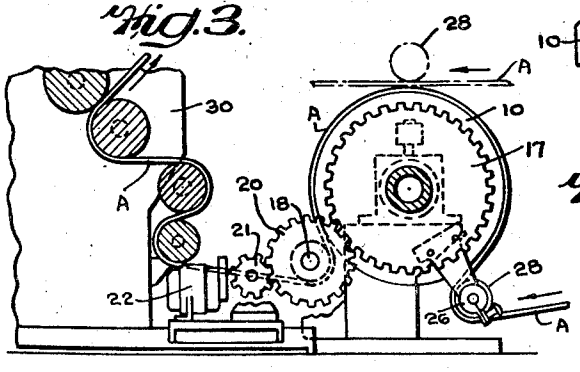


Fig. 3.



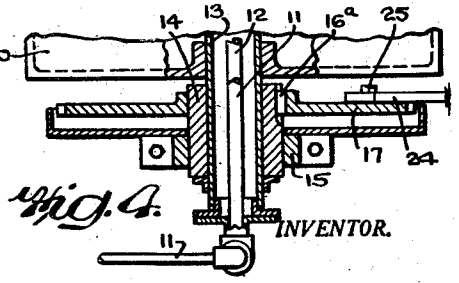


Fig. 4.

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May 4, 1948. C. W. APGAR ET AL 2,440,839

ROTARY DRUM DRYING APPARATUS HAVING MEANS TO GUIDE WEB OVER DRUM

Filed Sept. 10, 1945 3 Sheets-Sheet 2

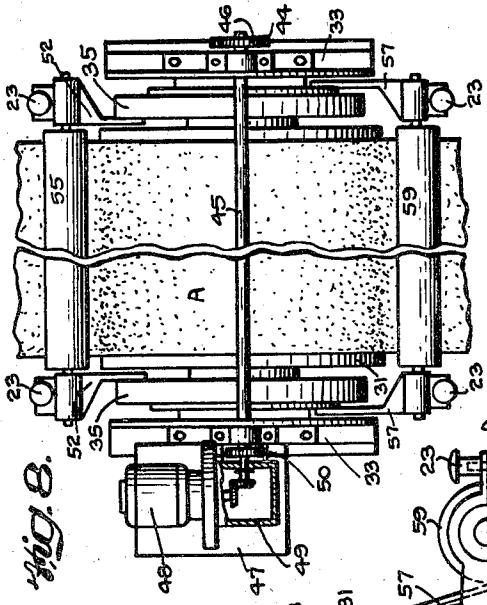

Fig. 8.

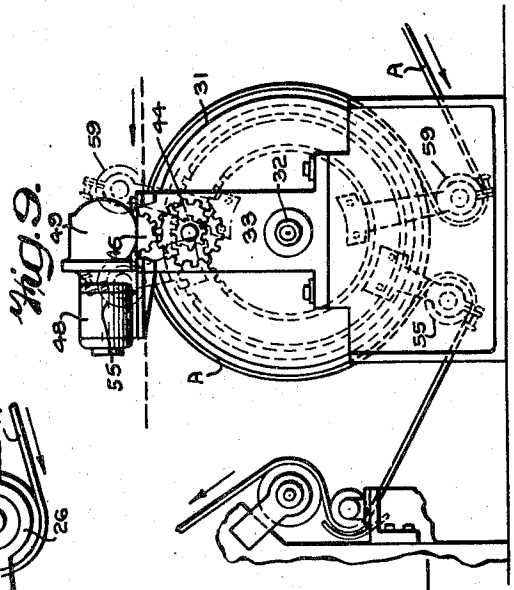

Fig. 9.

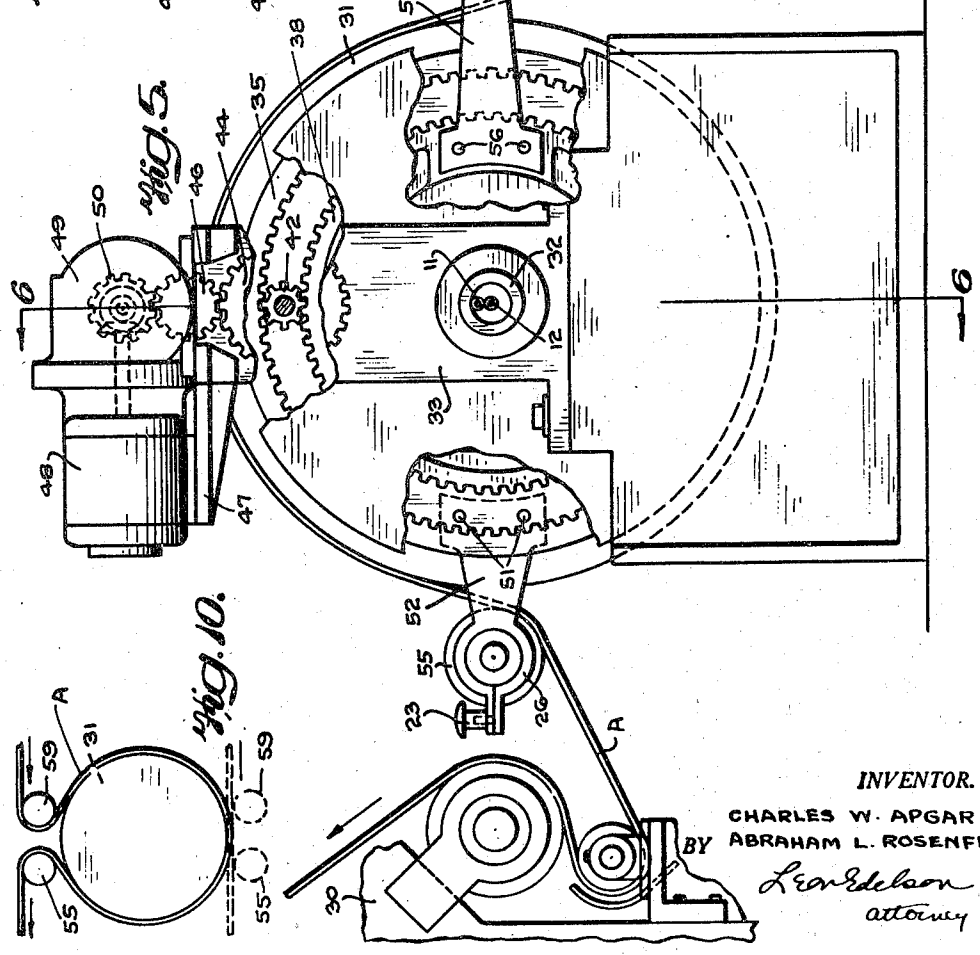

Fig. 5.

Fig. 10.

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May 4, 1948. C. W. APGAR ET AL 2,440,839

ROTARY DRUM DRYING APPARATUS HAVING MEANS TO GUIDE WEB OVER DRUM

Filed Sept. 10, 1945 3 Sheets-Sheet 3

Fig. 7.

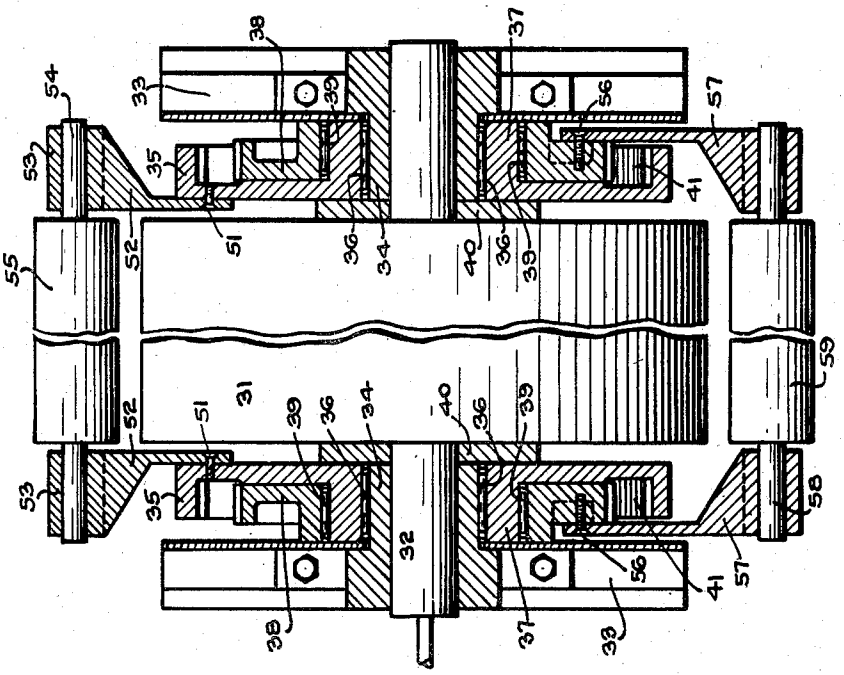
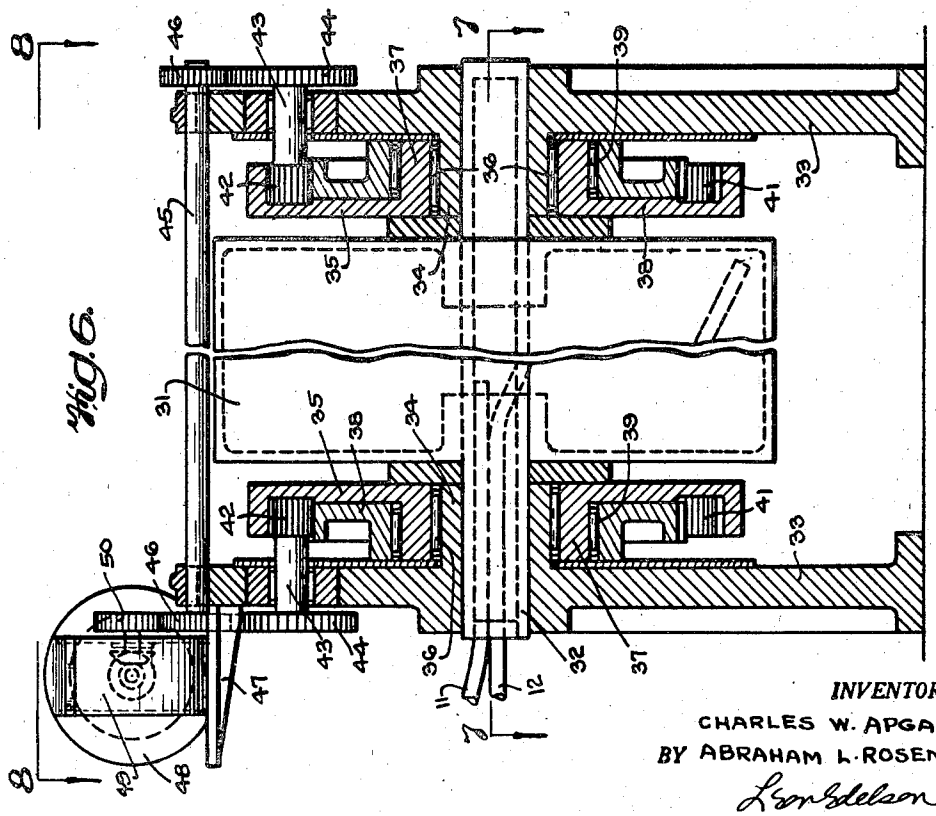


Fig. 6.



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Patented May 4, 1948 2,440,839

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2,440,839

ROTARY DRUM DRYING APPARATUS HAVING MEANS TO GUIDE WEB OVER DRUM

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Application September 10, 1945, Serial No. 615,324

4 Claims. (Cl. 34—110)

1

This invention relates generally to apparatus for preheating the liner webs employed in the fabrication of corrugated paper board and the like, and more particularly to an improved construction of preheater drum for preheating the adhesive face of the liner as it is delivered to the board-making apparatus in the form of a continuous web wound off from a supply roll.

Among the principal objects of the present invention is to provide a revoluble heating drum which is free to rotate with the paper web as it travels from the supply roll to the main apparatus, the drum being characterised by the fact that it is of such substantial diameter as to prolong the period of contact between the moving web and the drum and so subject a maximum expanse of the liner to the drying heat of the drum for a time interval considerably greater than has heretofore been customary in the art.

A further object of the present invention is to provide the heater drum with one or more operatively associated idler rolls which are adapted to be so angularly adjusted about the axis of rotation of the drum as to vary, as desired, the extent to which the web is wrapped around the peripheral surface of the drum as it is delivered from the supply roll to the paper receiving unit of the main apparatus, which unit, in the case of a machine for making corrugated paper board, may be either a single facer or double facer.

Still another object is to provide the preheater drum with one or more idler rolls motor driven to impart thereto an epicyclic movement with reference to the revoluble drum whereby the idlers may be positionally adjusted about the periphery of the drum not only to increase the area of contact between the web and the drum but also expedite the initial threading of the web between the idlers and the drum with which they are associated.

A still further object is to provide a preheating unit for a continuous web of sheet material which is readily and expeditiously adjustable to vary the extent of wrap of the web about the drum to thereby obtain varying degrees of exposure of the sheet material to the heat of the drum as the web travels thereabout, thus insuring proper and adequate drying of the sheet material without any attending reduction in the feeding speed of the material to the main apparatus.

Other objects and advantages of the present invention will appear more fully hereinafter, it being understood that the present invention consists substantially in the combination, construction, location and relative arrangement of parts

2

as will be described in detail hereinafter, as is shown in the accompanying drawings, and as will be pointed out in the appended claims. In the accompanying drawings which illustrate certain preferred embodiments of the present invention;

Figure 1 is a side elevational view of a preheating unit constructed in accordance with the present invention in which a single idler roll is employed in association with the main preheating drum;

Figure 2 is a top plan view of the apparatus shown in Figure 1;

Figure 3 is a schematic view corresponding to Figure 1 showing the idler roll in adjusted position to increase the extent of wrap of the web about the heating drum;

Figure 4 is a detail sectional view taken on the line 4—4 of Figure 1;

Figure 5 is a side elevational view of a modified construction of the apparatus of the present invention in which a pair of idler rolls are employed in association with the main preheating drum;

Figure 6 is a vertical sectional view taken on the line 6—6 of Figure 5;

Figure 7 is a horizontal sectional view taken on the line 7—7 of Figure 6;

Figure 8 is a top plan view, partially in section, of the apparatus as viewed from the line 8—8 of Figure 6;

Figure 9 is a side elevational view corresponding to Figure 5 showing the idler rolls in adjusted position to provide for maximum wrap of the web about the drum; and

Figure 10 is a schematic view to illustrate a further adjusted position of the idler rolls with the web passing around the bottom of the drum instead of about the top, as in Figures 5 to 9.

While the invention as shown in the drawings is in the form of a preheating apparatus particularly adapted for use in heating the adhesive face of liners employed in the fabrication of corrugated paper board, it will be understood that the apparatus of the present invention is not at all limited to such particular application, but instead may be employed to heat and so condition as to its moisture content any sheet material which is delivered in continuous web form from a supply roll to a processing machine.

Referring now to the drawings and more particularly to Figures 1 to 4 thereof, it will be observed that the apparatus of the present invention is characterised by the provision of a heating drum 10 of a diameter considerably greater than those heretofore conventionally employed in the art to which the present invention relates. This

drum 10 is of hollow construction having closed opposite ends into the interior of which is suitably delivered a h ating medium, such as steam, the heating medium entering the drum by way of a conduit 11 and being delivered therefrom by way of a discharge conduit 12. The arrangement of these conduits in relation to the drum and the means for permitting free rotation of the drum without interfering with the circulation of the heating medium into and out of the drum are conventional and well known in the art and form no part of the present invention. The details of such conduit arrangement are therefore not shown or described herein.

Extending axially through the drum 10 is a hollow stationary shaft 13, the opposite extremities of which project freely beyond the drum ends and are respectively fitted with rotatable sleeves 14—14. These sleeves 14—14 are in turn journalled for rotation within suitable bearings 15—15 formed in the upper ends of a pair of vertically extending supports or standards 16—16 disposed at opposite ends of the drum 10. The conduits 11 and 12 are preferably arranged within one end of the hollow shaft 13 (see Figure 4) with their inner open ends disposed within and in free communication with the interior of the drum, suitable provision being made to permit free rotation of the drum about its supporting shaft 13 without escape of the heating medium from the drum except by way of the discharge conduit 12. Splined to each of the sleeves 14—14, as at 16^a, is a gear 17 of a diameter only somewhat less than that of the drum 10, the general arrangement being such that while the drum 10 is freely revoluble about its supporting shaft 13 under the friction pull of the sheet material passing about the cylindrical surface of the drum, the gears 17—17 may be rotated into angularly adjusted position relatively to the drum for the purposes and by the means presently to be described.

Extending longitudinally of the drum 10 to one side thereof and in parallel relation to the drum axis is a shaft 18, the opposite ends of which are bearingly supported between lateral extensions 19—19 of the main supports or standards 12—12, this shaft being fitted at its opposite ends with a pair of gears 20—20 respectively in mesh with the gears 17—17. The gears 20—20 are each keyed to their shaft 18 for common rotation, one of them being in mesh with a pinion gear 21 driven by an electric motor 22 suitably mounted upon the supporting bed of the apparatus. This motor is of the reversible type and is equipped with suitable controls and limit switches for instantly starting and stopping it and for controlling its direction of rotation, all of which are conventional, form no part of the present invention and so are neither shown nor described herein. Rotatably carried upon the shaft 18 between the gears 20—20 is an idler roll 23, the cylindrical surface of which is spaced from the proximate cylindrical surface of the drum 10.

The gears 17—17 immediately associated with the drum 10 are respectively provided with radially extending brackets 24—24, each bracket being secured to its associated gear 17 by screws 25. These brackets are provided at their outer ends with split bearing elements 26—26 within which are journalled the opposite ends 27—27 of an idler roll 28, the bearing elements being equipped with screw means 29 for adjusting the frictional grip of the bearing elements upon the journalled ends of the idler roll 28, whereby to permit the latter to rotate more or less freely, as desired.

It will be noted that the idler roll 28 parallels the axis of the drum 10 and is supported in such spaced relation to the external surface of the drum that upon rotation of the gears 17—17 the idler roll 28 may be variously positioned about the circumference of the drum, as from the dotted line position shown in Figure 3 into the full line position shown therein or into any intermediate position, as in Figure 1.

The sheet material to be preheated and thus conditioned as to its moisture content is designated in the drawings by the reference character A, it being delivered in continuous web form from a supply roll (not shown) to and about the heating drum 10 and thence to the fabricating unit designated generally by the reference numeral 30, which unit may be either a single facer or double facer, both of which are well known in the corrugated paper board industry.

In the use of the pre-heating apparatus shown in Figures 1 to 4, the idler roll 28 is initially located, by means of the motor-driven entrained gears 21, 20 and 17, in the dotted line position at the top of the drum 10, in which position the leading end of the sheet material delivered from its supply roll is readily threaded across the top of the drum and between it and idler 28, thence between the drum and the fixed idler roll 23, and finally between the several rolls of the processing unit 30. Thereupon, by suitable controlled operation of the motor 22, the idler roll 28 is rotated about the peripheral surface of the drum to provide for any desired extent of wrap of the sheet material about the surface of the heated drum, the maximum wrap-around being when the idler roll 28 is in the full line position shown in Figure 3. Due to the relatively large diameter of the drum, a substantial length of the web is at all times in surface contact with the drum. This, in addition to the fact that the drum is freely revoluble and rotates at the same linear speed as the sheet material, insures maximum heating of the material as it travels about the drum with consequent maximum extraction of moisture therefrom. By varying the position of the idler roll 28 with relation to the drum, the length of the web in surface contact with the drum may be correspondingly varied, the apparatus of the present invention thus providing a quick, efficient and easily controlled means for conditioning sheet material of varying moisture content.

Figures 5 to 9 illustrate a modified embodiment of the present invention wherein a pair of positionally adjustable idler rolls are provided in association with the main heating drum. In this form of the apparatus, the heating drum 31 is journalled for free rotation about the hollow shaft 32, the opposite ends of the latter being supported by a pair of vertically extending standards 33—33. These standards 33—33 are of the construction most clearly shown in Figures 6 and 7, each standard being provided with a central hub element 34 forming a bearing for an internal gear 35. Suitable roller bearings 36 are interposed between each gear 35 and its support 34. Each internal gear 35 is in turn provided with an annular central hub element 37 forming a bearing for an external gear 38 concentrically arranged with respect to the internal gear 35, roller bearings 39 being also interposed between each gear 38 and its support 37. Suitable spacers 40—40 are disposed respectively between the opposite ends of the drum 31 and the concentric gears 35 and 38.

Disposed in the annular space 41 formed between each pair of the concentric gears 35 and 38 for common entrainment therewith is a pinion gear 42, the shaft 43 of which is bearingly supported in the upper end of the standard 33. The shafts 43—43 of the pinion gears 42—42 project outwardly of their supports and are each fitted at its outer end with a splined gear 44.

Also supported by the standards 33—33 is a shaft 45 extending in parallel relation to the axis of the drum and disposed preferably just above the top of the drum, this shaft 45 having keyed or otherwise secured to each of its opposite ends a pinion gear 46. These pinion gears 46—46 are external of the standards 33—33 and respectively in constant mesh with the gears 44—44 also arranged externally of the standards 33—33.

Suitably mounted upon a support 47 carried by one of the pedestals or standards 33—33 is a motor 48 having a reduction gear box 49 for driving at suitably reduced speed a gear 50 in mesh with one of the pinion gears 46—46. As in the case of the apparatus shown in Figures 1 to 4, the motor 48 is of the reversing type and is suitably provided with conventional controls and limit switches (not shown) operative to start and stop and reverse the direction of rotation of the motor, as desired.

Secured to each of the gears 35—35, as by the screws 51, is a radially extending arm 52, these arms 52—52 extending outwardly beyond the circumference of the drum 31 and terminating in supports 53 for the opposite ends of an idler roll shaft 54. An idler roll 55 is fitted upon the shaft 54 in spaced relation with respect to the cylindrical surface of the drum 31.

Similarly secured to each of the gears 38—38, as by the screws 56, is a radially extending arm 57, these arms 57—57 being also extended outwardly beyond the circumference of the drum to support therebetween the shaft 58 for a second idler roll 59 also disposed in spaced relation to the cylindrical surface of the drum 31. The two idler rolls 55 and 59 are not only freely revoluble between their respective supporting arms 52—52 and 57—57, but also are adapted to be angularly adjusted about the cylindrical surface of the drum to vary, as desired, the extent of wrap of the sheet material A about the drum, the rolls 55 and 59 being simultaneously shiftable in opposite directions by means of the motor-driven gear drive for said rolls.

In operation of the apparatus just described, it may be assumed that the gear drive is so arranged as to present the idler rolls 55 and 59 in the upper dotted line positions shown in Figure 9, in which position said rolls are disposed to either side of the pinion gear shaft 45 and in such close relation thereto that the sheet material as delivered from its supply roll may be threaded between both rolls and the proximate surface of the drum along a flat plane substantially tangential to the drum surface. Upon operation of the motor 48 in the proper direction, the pinion gears 46—46 are commonly driven by the motor gear 50 and in turn commonly drive the gears 44—44 and the pinion gears 42—42. The latter gears, being each in entrainment with each concentric pair of the main gears 35 and 38, cause the latter to rotate in opposite directions and so effect angular adjustment about the drum of the idler rolls respectively associated with the gears 35—35 and the gears 38—38. These idler rolls may thus be shifted into their lower dotted line positions

shown in Figure 9 for maximum wrap of the sheet material about the drum, or into any intermediate position, as shown in Figure 5, for obtaining any desired degree of wrap-around of the material on the drum. Inasmuch as the speed of rotation of the gears 35—35 is somewhat greater than that of the gears 38—38, the angular displacement of the idler rolls 55 and 59 with reference to the fixed shaft 45 extending along the top of the drum is not the same, and accordingly the idler rolls in their position for maximum wrap are not symmetrically disposed with respect to the vertical diametric plane of the drum. This, however, is not material, but if such symmetrical disposition of the idler rolls is desired for their final position, it may be readily obtained by the simple expedient of so locating the rolls at their starting point that they are asymmetrically positioned with respect to the vertical diametric plane of the drum and so gradually approach symmetrical disposition as they are shifted in opposite directions about the surface of the drum.

In certain operations, it is desirous that the sheet material be taken off of the drum from the top thereof (as in Figure 10) instead of from the bottom thereof (as in Figure 9), and in such case the apparatus is initially adjusted to position the idler rolls 55 and 59 at the bottom of the drum, i. e. in their dotted line positions shown in Figure 10. With the idler rolls in this initial position, the sheet material is then readily threaded between them and the drum by movement thereof in a plane substantially tangential to the drum surface. Thereupon, the idler rolls are angularly adjusted in opposite directions upwardly about the cylindrical surface of the drum toward their full line positions shown in Figure 10, the sheet material being carried therewith for wrapping about the drum surface to the extent determined by the final angularly adjusted positions of the idler rolls. The operation is thus identical with that employed in the case of the operation illustrated in Figure 9 except that the web of sheet material is wrapped about the bottom instead of about the top surface of the drum.

In all material respects, the apparatus of Figures 5 to 10 functions as does that of Figures 1 to 4, although providing for somewhat greater overlap of the web about the drum and facilitating materially initial application of the web to the drum in cases where it would be otherwise awkward and sometimes impossible to do.

While it is desirable that the heating drum be mounted for rotation about its axis in order to provide for utilization of all of its cylindrical heating surface, as well as to provide that said surface travels at the same linear speed as the sheet material, in certain instances it may be preferred to lock the drum stationary against rotation and so utilize only a portion of its heating surface. By so locking the drum against rotation, it subjects the sheet material to greater friction where such additional friction is necessary for ironing out or otherwise mechanically conditioning the sheet. Of course, any suitable locking mechanism may be employed for this purpose, and if desired, the apparatus may be originally constructed with the drum nonrotatably mounted between its supporting standards. Of course, whether or not the drum is rotatable about its own axis, one or both of the idler rolls operatively associated therewith as hereinbefore described is angularly adjustable about the circumference of the drum to vary the displacement between the idler rolls and so determine

the extent or length of the sheet material which is wrapped around the cylindrical heating surface of the drum.

It will be understood, of course, that the present invention is susceptible of various changes and modifications which may be made from time to time without departing from the general principles and real spirit thereof, and it is accordingly intended to claim the same broadly, as well as specifically, as indicated by the appended claims.

What is claimed as new and useful is:

1. In an apparatus for drying sheet material continuously fed in web form, a rotatable drum having a large diameter cylindrical heating surface for accepting in surface contact therewith a substantial length of the sheet material, said drum being rotatable by the traction pull of the sheet material in surface contact therewith, a pair of concentric internal and external gears arranged at opposite ends of the drum, means for driving said internal gears oppositely with respect to said external gears, and a pair of idler rolls disposed externally of the drum and in parallel relation to the drum axis, said idler rolls being respectively operatively supported by said internal and external gears for arcuate movement about the drum axis relatively to the drum.

2. In an apparatus for drying sheet material continuously fed in web form, a drum having a large diameter cylindrical heating surface for contact with a substantial length of the sheet material, a pair of idler rolls disposed externally of the drum and in parallel relation to the drum axis for maintaining the sheet material in intimate surface contact with the drum, at least one of said idler rolls being mounted for movement along an orbital path uniformly distant from the cylindrical surface of the drum, and motor driven gear means for positionally adjusting said last mentioned idler roll to vary the effective degree of wrap of the sheet material about the drum surface, said gear means including a pair of gears respectively arranged at opposite ends of said drum for coaxial rotation relatively to said drum, said gears being interconnected by said positionally adjustable idler roll.

3. In an apparatus for drying sheet material continuously fed in web form, a drum having a large diameter cylindrical heating surface for accepting in surface contact therewith a substantial length of the sheet material, a pair of concentric internal and external gears arranged at opposite ends of the drum, means for driving said internal gears oppositely with respect to said external gears, and a pair of idler rolls disposed externally of the drum and in parallel relation to the drum axis, said idler rolls being respectively operatively supported by said internal and external gears for arcuate movement about the drum axis relatively to the drum.

4. In an apparatus of the class described, a cylindrical heating drum over which is adapted to pass a continuous web of sheet material to be heated by surface contact with the drum and an idler roll disposed externally of the drum and positionally adjustable about the circumference of the drum to vary the extent of wrap of the web about said drum, a pair of gears respectively arranged at opposite ends of the drum for coaxial rotation relatively to said drum, means for rotatably supporting said idler roll between said gears whereby both gears are rotatable in unison to maintain said idler roll in parallel relation with respect to said drum, and motor driven means for effecting rotational adjustment of said gears to vary the position of said idler roll about the circumference of said drum.

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