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APPARATUS FOR HANDLING STRIP MATERIAL

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FIG. 1.

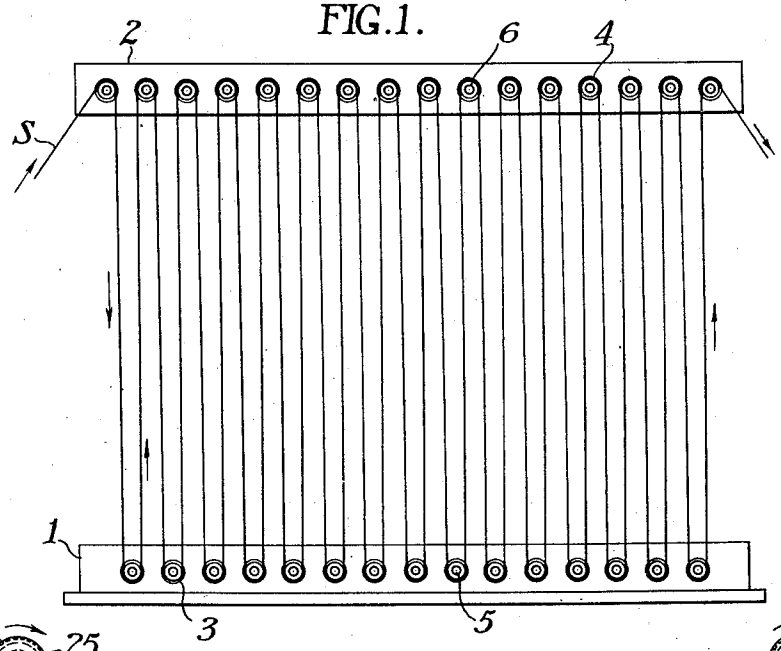
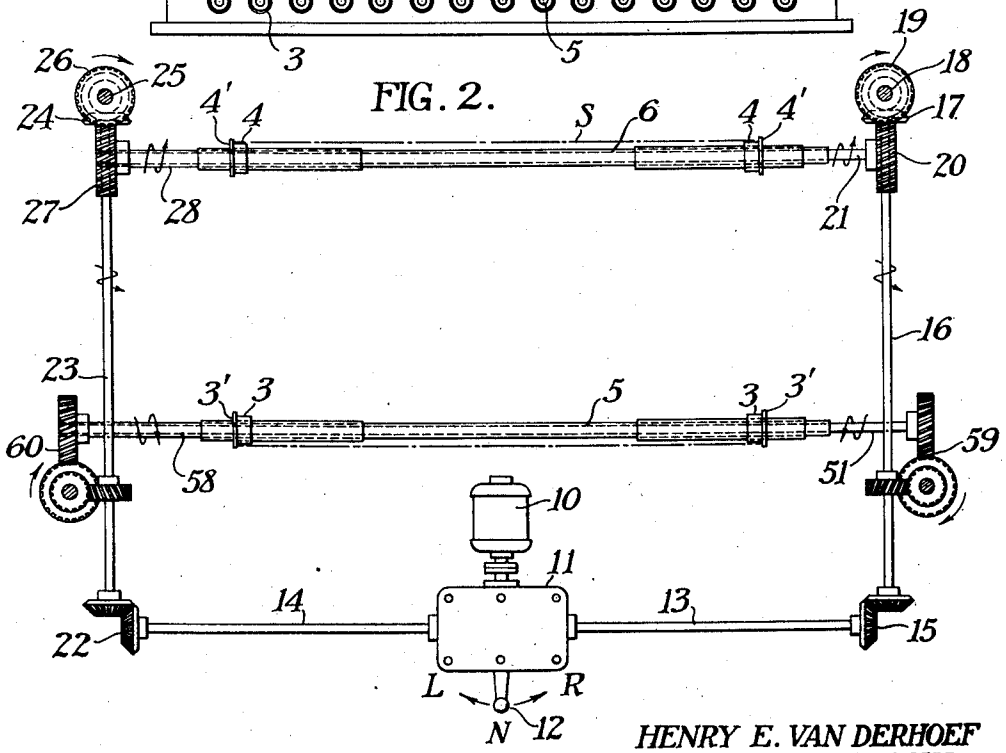


FIG. 2.



HENRY E. VAN DERHOEF
ALFRED E. BROOKS
INVENTORS

BY Newton M. Parrish
Ronald H. Stewart
ATTORNEYS

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FIG. 3.

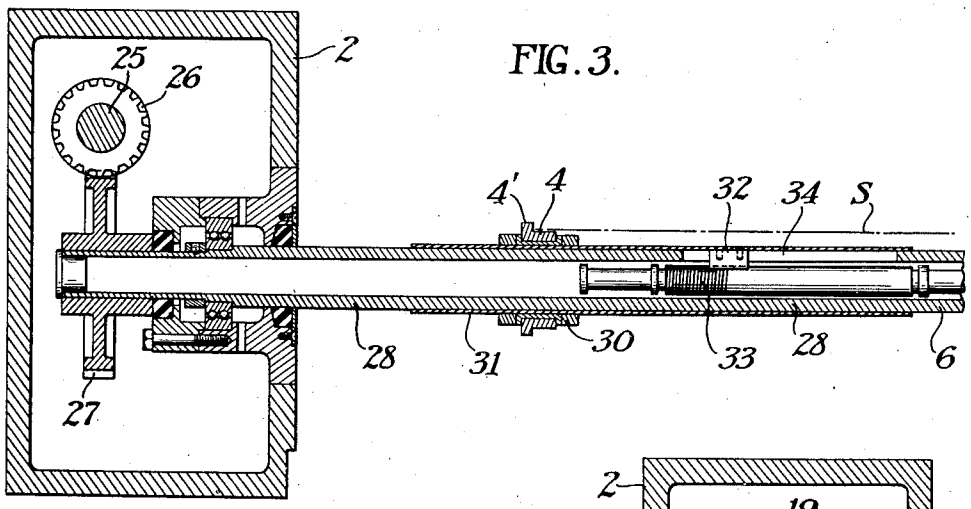


FIG. 4.

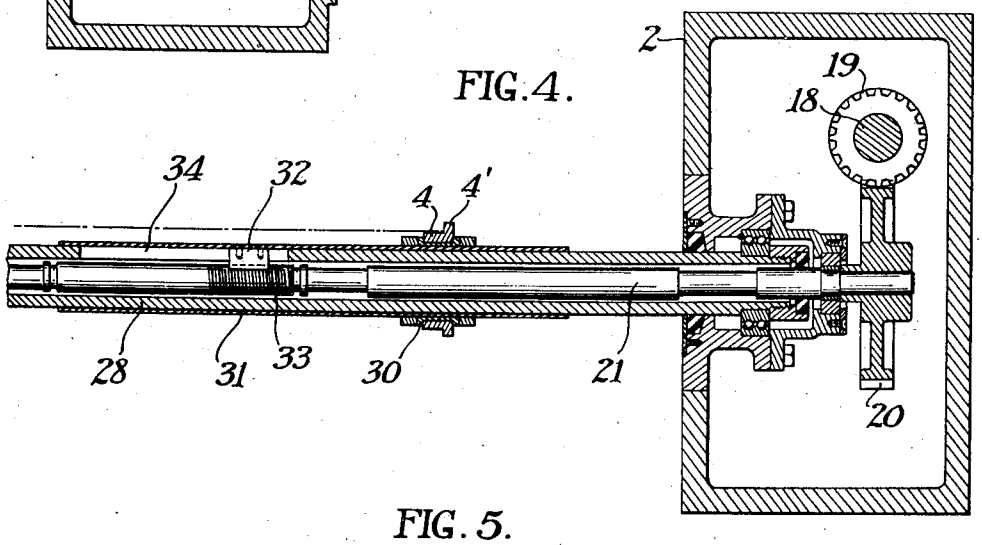
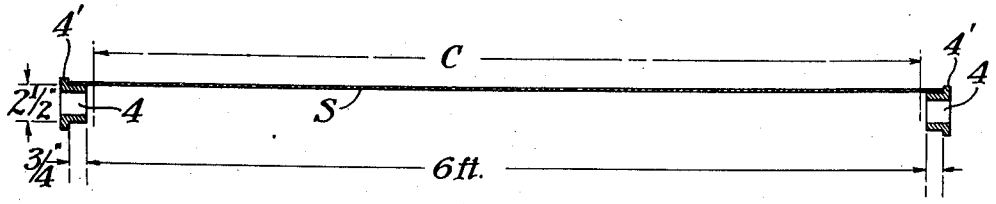


FIG. 5.



HENRY E. VAN DERHOEF
ALFRED E. BROOKS
INVENTORS

BY Newton W. Perrine
Francis H. Garrett
ATTORNEYS

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APPARATUS FOR HANDLING STRIP MATERIAL

Henry E. Van Derhoef and Alfred E. Brooks, Rochester, N. Y., assignors to Eastman Kodak Company, Rochester, N. Y., a corporation of New Jersey

Application November 9, 1938, Serial No. 239,688

16 Claims. (Cl. 271—2.3)

This invention relates to machines for handling long strips of material passing it through a path preferably consisting of a plurality of loops so that the material may be coated on one or both sides and may be dried or subjected to other treatments, or so that said material and/or coatings or treatments may be completely or partially dried. Sheeting of all kinds may be processed providing they have sufficient flexibility and rigidity to be adapted for our method and apparatus. Examples of such sheeting are fibrous sheeting such as paper and the like and nonfibrous sheeting such as that comprising principally cellulose esters (cellulose nitrate, cellulose acetate, cellulose acetate propionate, cellulose butyrate and the like) cellulose ether (ethyl cellulose, benzyl cellulose and the like) or resins (vinyl resins, acetal resins, and the like), as well as are other material capable of being collodized and cast into flexible sheets.

An object of our invention is to provide a method of and apparatus for handling such sheeting or web materials passing them through a path preferably consisting of a plurality of loops and propelling the material by a large number of tendency driven members each having a very small contact with the material so as to expose a very large area of both sides of the material for drying or treatment operations. Another object of our invention is to provide a machine in which the wide strip of sheeting has only a minimum contact with the machine. Another object of our invention is to drive the sheet by means of a large number of tendency driven rollers each having only a small surface contact with the sheet, preferably with a looped area of the sheet. Another object is to provide a method of handling a sheet which may have become slightly deformed before processing or which may change in form as in width or length, shrinking and/or swelling because of drying or processing, and to drive the sheet in such a manner as to compensate for such changes. Another object is to provide tendency drive roller members each of which may independently vary in speed to care for stretching, shrinking, or variations in the lengths of the edges of the strip material due to these or any other causes. Still another object of our invention is to provide a machine in which small areas of the edges of the sheet are driven through the machine by tendency driven rollers the speeds of which are at least partially controlled by the sheeting itself. Other objects will appear from the following specification, the novel features being particularly pointed out in the claims at the end thereof.

In the past it has been somewhat difficult to handle long or continuous strips of cellulosic sheeting which may be approximately .003" to .010" thousandth of an inch in thickness in such a manner that the long sheet will pass smoothly through a machine for drying, coating, tinting, toning or other operations because it usually happens in such long strips of sheeting that one edge or the other or both edges may be wrinkled, stretched or otherwise slightly deformed so that a positive driving mechanism does not function satisfactorily. Moreover, under these conditions it is difficult to guide a sheet by the edges through a looped path, because where the edges of a sheet are somewhat irregular, at points where the sheet is looped it is liable to cause a breakdown of the arch of the sheet due to a variation of tension in the sheet. Another difficulty in the past has been to satisfactorily care for expansion and for shrinkage of the strip material without undue tension. Still another difficulty has been to properly guide the material through its looped path.

One of the problems has been to drive the sheet because where the edges may differ throughout their length at various different places due to stretching, shrinkage, swelling, or other deformations, it is impossible to satisfactorily drive the sheet by constantly driven members since to take care of the usual variations in such material, the drive of one side should at times rotate faster than the drive on the other side in order to take care of the irregularities of the sheet material. This change in speed may be extremely slight, but is nevertheless quite important.

In accordance with our invention we have provided a method and apparatus for driving such sheet material in which a large number of driving spools are employed, each driving spool having comparatively small surface contact with the sheet. Each spool is driven by a tendency drive—that is a drive which resiliently tends to turn the spool but which permits the spool to be readily held back or pulled ahead by the sheet material through its small surface contact therewith. The tendency drive is a light drive and with our preferred form of invention the driving torque of any one spool is insufficient to move the sheet, but where a series of spools all tend to move the sheet at one time, the sheet will be moved. The speed of all these spools may there-

fore vary to take care of irregularities in the edges of the sheet and this is accomplished automatically. Moreover, with our plurality of tendency driven spools an extremely large portion of the total area of the sheet material is exposed to the air, gases, coating material or other treatment mediums.

Coming now to the drawings wherein like reference characters denote like parts throughout;

Fig. 1 is a schematic side elevation of a machine for handling sheet material illustrating our invention.

Fig. 2 is a diagrammatic view of a preferred form of driving mechanism for the tendency driven elements.

Figs. 3 and 4 are sectional views showing in detail the tendency drive mechanism, Fig. 3 relating to the left hand side of the machine and Fig. 4 relating to the right hand side of the machine.

Fig. 5 is a schematic showing illustrating the extremely small contact between the tendency driven members and the sheet material.

As indicated in Fig. 1, our means of handling sheet material may be embodied in a machine which comprises a lower support 1 and an upper support 2, these supports carrying a plurality of spools, spools 3 being arranged on the support 1 and spools 4 being arranged on the upper support.

Both sets of spools 3 and 4 are similarly mounted. Spools 4 are all mounted on a shaft designated broadly as 6, and spools 3 on shafts designated broadly as 5 both shafts being driven as will be hereinafter more fully described, the spools having a tendency drive or friction connection only with the driven shafts, so that while the shafts 5 and 6 tend to turn the spools 3 and 4 at a constant speed, the spools may nevertheless be driven readily at various different speeds depending on the speed of the strip material.

The sheeting S may be of any of the materials above mentioned. The supports 1 and 2 may be enclosed in any type of housing desired and may consist of one or more units. It is only necessary, however, in order to illustrate our invention, to show the drive for a single pair of spools, since this drive is applied preferably to all of the spools carried by the shafts 5 and 6 on the upper and lower supports 1 and 2.

In Fig. 2, the spool members 4 are shown as being flanged at 4', these flanges being designed to guide the edges of the strip material S with the cylindrical portions of the spools 4 being adapted to engage small areas of the strip material S at the edges only. Spools 3 are similarly flanged at 3'.

As illustrative of a preferred form of our invention and in order to indicate the proportions of the sheet S which are in frictional contact with the driving spools, reference may be had to Fig. 5. The strip material S may conveniently be from three feet to six feet wide (the spools being adjustable as will be hereinafter more fully described) and the width of the cylindrical portion of the spools 4, which support the strip material may be ¾ of an inch wide. The diameter of the cylindrical portion may be approximately two and one-half inches. Thus it will be seen that only a very small area of the strip material S is in contact with the spool members so that a comparatively large area of the sheet indicated at C may be coated, tinted, toned or the like, preferably by apparatus which leaves a small strip—say an inch wide—on each edge of the sheet free from coating material.

In order to take care of different widths of strip material, the spools 3 and 4 are adjustably mounted so that they may move to and from each other and this may be accomplished in the manner shown in Fig. 2. In this figure, the driving motor 10 is attached to a known type of speed change 11 which may be controlled by a handle 12 to cause the shafts 13 and 14 to move differentially or together. That is, when the handle is swung towards R the speed of shaft 13 accelerates with respect to the speed of shaft 14 and when the handle is swung towards L the speed of shaft 14 accelerates with respect to shaft 13. When the handle is placed in position N shafts 13 and 14 turn at exactly the same speed. Shaft 13 is connected through bevel gears 15, a shaft 16 and bevel gears 17 to turn a shaft 18 which, through a gear 19 and worm 20 drives shaft 21.

Shaft 14, through bevel gears 22, shaft 23 and bevel gears 24, drives shaft 25 which in turn, through gear 26 and worm wheel 27, drives the sleeve 28.

The drive of shaft 5 is exactly like shaft 6. That is shaft 5 is composed of a shaft 51 and a sleeve shaft 58 similar to shafts 21 and 28 and through gearing 59 and 60 these shafts turn at the same relative speeds as shafts 21 and 28 but in an opposite direction.

During the time that the handle 12 is at position N, shafts 21 and 51 and sleeve shafts 28 and 58 turning at the same speed, tend to turn the spools 3 and 4 at the same speed. The tendency drive in the present instance, consists of providing the spools 3 and 4 with a smooth inner surface adapted to engage a smooth surface on a friction member 30 affixed to a sleeve 31 which is, in the case of Fig. 4, adjustable upon the sleeve shaft 28 through the nut 32, engaging the screw 33 which turns with the shaft 21. The nut 32 projects through an aperture 34 in the sleeve shaft 28 so that when shaft 21 moves at a different speed from the sleeve shaft 28, the nut by riding on the screw, moves the sleeves 31 axially of the shaft. Since the construction of the spools 3 and 4 on the right and left hand end of the shafts are identical, they need not be separately described. It is sufficient to say that by swinging the handle 12 toward R, the spools will be brought together and by swinging the handle towards L the spools will move apart and by leaving the handle in position N, the spools will be tendency driven at exactly the same speed. Thus it is a simple matter to adjust the driving spools to take care of the width of the sheet which is to be treated.

Our invention may be applied to many forms of machines and the tendency driven spools may be multiplied if necessary to take care of the machines of various different lengths, it being understood that the only requirements are that a sufficient number of tendency driven spools be provided to actually move the sheet and that the friction or tendency drive be so adjusted that the individual spools do not have sufficient power to move a sheet without the assistance of other tendency driven spools.

We have found that if the spools are positively driven, it is quite impossible to keep a long sheet moving through a comparatively straight course and this difficulty increases in cases where the strip material is of such nature that the edges are not substantially smooth, parallel and of ex-

actly the same length. Consequently with normal variations in the strip, the arch of the material passing over positively driven spools will break down. We have found that a machine constructed in accordance with our invention in which the edge spools are tendency driven as above described, can successfully handle long strips of material in which the edges may vary quite extensively in length and shape at various different points throughout their length. With our machine it frequently happens that one spool 4 over which the strip material is passing, will accelerate momentarily as a stretched edge passes over it, even though its companion roller 4 coaxially mounted therewith may move at a different speed. Thus, the tendency drive is an important part of our invention and the tendency drive is the feature which propels long strips of material through a fixed path and at the same time guides the material through the flanges on the spools. Very little and substantially light tension may then be exerted upon the sheet. This tension on a six foot width of material may for instance be only one or two pounds, so it will be seen very little strain on the strip material occurs as it is moved through our machine.

Where the term "vertically" is used in the specification and claims we mean the term to be used broadly and to include a film path running up and down in at least an approximately vertical path. However the loops may not be exactly parallel and the angle of the film runs may actually vary quite widely from the true vertical.

What we claim is:

1. A support for relatively wide sheets of material comprising a pair of spaced flanged spools the diameter of said spools being approximately $\frac{1}{15}$ to $\frac{1}{40}$ of the distance between the spools and including a film bearing surface of not more than approximately $\frac{1}{15}$th the total width of the sheet supported thereby, said film bearing surface having a cylindrical surface making relatively small contact with the film.

2. In a processing machine for strip material the combination with a support, of a plurality of oppositely disposed, single flange rollers rotatably mounted thereon, said rollers being mounted in coaxially arranged pairs spaced apart to support a film band by its edges only, means for flexibly and individually driving a coaxially arranged pair of flanged rollers including a source of power and each driven flanged roller including a tendency drive operably connected with the source of power, whereby the edges of a sheet which may vary in length may be smoothly driven, said rollers being engaged by the edges of said strip material looped about the rollers.

3. In a processing machine for strip material, the combination with a support, of a plurality of flanged rollers rotatably mounted thereon for supporting the strip material in a plurality of loops, said rollers being mounted in coaxially arranged pairs spaced apart to support a strip of material by its edges only at looped portions of said strip material, means for separately driving pairs of flanged rollers including a source of power and a tendency drive connecting each roller with the source of power.

4. In a machine for handling long bands of strip material, the combination with a support, of a plurality of shafts carried thereby, a plurality of single flange spools frictionally mounted thereon, each shaft supporting a coaxially arranged spaced pair of spools with said flanges spaced outwardly of the spools, the pairs of spools including mounts so spaced that a long film band may be passed through a series of vertical runs back and forth, each spool including a narrow cylindrical portion forming the sole support for said film band by contact with only the extreme edges of the film band at the points where the band of material is bent for the vertical back and forth runs.

5. In a machine for handling long bands of strip material, the combination with a support, of a plurality of shafts carried thereby, a plurality of flanged spools frictionally mounted thereon, each shaft supporting a coaxially arranged pair of spools, the pairs of spools providing guides so spaced that a long film band may be passed through a series of vertical runs back and forth, each spool including a narrow cylindrical portion forming the sole support for said film band by contact with only the extreme edges of the strip material, and means for driving the spools separately or together through said friction mounts, said friction in said mounts being insufficient for one spool alone to drive the strip material but sufficient for a plurality of said frictionally driven spools to move said strip material, whereby the long strip material may be driven by spaced tendency driven spools contacting with said film at intervals along the edges thereof.

6. In a machine for handling long lengths of cellulosic material in strip form, the combination with a support, of a plurality of spools, a plurality of tendency drives cooperating with said spools, a plurality of shafts for driving said spools through said tendency drives, means for guiding the strip material through a path including said spools, and means for altering the spacing between the spools to care for various widths of strip material.

7. In a machine for handling long lengths of cellulosic material in strip form, the combination with a support, of a plurality of spools, a plurality of tendency drives cooperating with said spools, a plurality of shafts for driving said spools through said tendency drives, each shaft slidably connected to and supporting a tendency driven spool, means for guiding strip material into frictional contact with the spool including flanges on the spools, and means for moving the tendency driven rollers axially of the shaft.

8. In a machine for handling long lengths of cellulosic material in strip form, the combination with a support, of a plurality of spaced spools, a plurality of tendency drives cooperating with said spools, a plurality of shafts for driving said spools through said tendency drives, each shaft slidably connected to and supporting a tendency driven spool, means for guiding strip material into frictional contact with the spool including a single flange on each of the spools, and means for moving the tendency driven rollers axially of the shaft, said means simultaneously moving all of said spools axially and to the same extent.

9. In a machine for handling long lengths of cellulosic material in strip form, the combination with a support, of a plurality of spools, a plurality of tendency drives cooperating with said spools, a plurality of shafts for driving said spools through said tendency drives, each shaft slidably connected to and supporting a pair of tendency driven rollers, and means carried by the shafts for moving the spools relative to each other to position the tendency driven rollers for various widths of strip material, said means including right and left hand screws and nuts cooperating

to simultaneously move the spools together or apart.

10. In a machine for handling long lengths of strip material in strip form, the combination with a support, of a plurality of spools mounted on upper and lower shafts, a plurality of tendency drives cooperating with said spools, a plurality of upper shafts for driving said spools through said tendency drives, a lower shaft for driving spools mounted on the lower shaft through said tendency drives, said strip material being looped about the tendency driven spools, passing through a path, a single flange on each of said spools for guiding the material through said path, the tendency drives including only sufficient friction for the shaft to transmit movement to the strip material when in driving contact with a large proportion of the tendency driven spools whereby the speed of the individual tendency spools may be at least partially controlled by the strip material.

11. In a processing machine for strip material, the combination with a support, of a plurality of rollers rotatably mounted thereon for supporting the strip material in a plurality of loops, said rollers being mounted in coaxially arranged pairs spaced apart to support a strip of material by its edges only at looped portions of said strip material, and a tendency drive separately connecting each roller of the pair with a source of power, whereby the two edges of a strip passing over the two rollers of a pair may be differentially driven.

12. In a processing machine for strip material, the combination with a support, of a plurality of shafts carried by the support, a pair of spaced rollers rotatably carried on each shaft, a tendency drive separately connecting each roller of the pair of rollers with a source of power, a tendency drive between each roller and said source of power, whereby a portion of the edges of the strip material may be supported on the pairs of rollers and may be differentially driven by each roller as said strip material passes over said pairs of rollers in a series of loops.

13. A driving support for long bands of wide sheet material comprising oppositely disposed pairs of coaxially arranged rollers, one of each pair of rollers positioned to simultaneously engage one edge only of a single reach of a sheet, and means tending to drive each of the rollers at the same speed including a source of power, whereby the roller supporting one edge of the sheet material may move at a different speed from the coaxially arranged roller supporting the opposite edge of the sheet.

14. A driving support for long bands of wide sheet material comprising oppositely disposed pairs of coaxially arranged rollers, one of each pair of rollers positioned to simultaneously engage one edge only of a single reach of a sheet, a power-driven shaft, a slip connection between each of the rollers and the power-driven shaft tending to turn each roller at the same speed, said slip connection permitting different speeds between a pair of coaxially arranged rollers, whereby one edge of the wide sheet may move faster than the opposite edge thereof.

15. In a machine for handling strip material, the combination with a support, of a plurality of oppositely disposed, single flange rollers, shafts for supporting the rollers carried by the support, one roller positioned for engaging one edge of a reach of the wide strip of material and the other roller positioned to simultaneously engage the other edge in the same reach thereof, two flanged rollers being coaxially and independently mounted on each shaft, and means included in the individual coaxial mounts for each of said rollers and operably connected thereto tending to drive said rollers at the same speed and permitting rotation at different speeds, each operable connection including a friction clutch whereby one coaxially mounted roller supporting one edge of the strip material may turn at a different speed from the other coaxially mounted roller supporting the opposite edge of the same reach of the strip material.

16. In a machine for handling strip material, the combination with a support, of a plurality of oppositely disposed, single flanged rollers arranged in coaxial right and left-hand pairs, each roller having a cylindrical surface and adapted to engage only the extreme edge of a long strip of material, one of said coaxially arranged pairs of rollers engaging one edge of a reach of the wide strip of material and the other of said coaxially arranged pairs of rollers simultaneously engaging the opposite edge of the same reach of the wide strip of material, each of said rollers being independently interconnected with a power drive through a light friction connection between said rollers and power drive of such magnitude that a relatively large number of said rollers are necessary to move said strip of cellulosic material.

HENRY E. VAN DERHOEF.
ALFRED E. BROOKS.