May 29, 1945. R. HAAS 2,376,915

APPARATUS FOR THE LONGITUDINAL CREPING OF WEBS OF PAPER OR OTHER SHEET MATERIAL

Filed Dec. 31, 1940 3 Sheets-Sheet 1

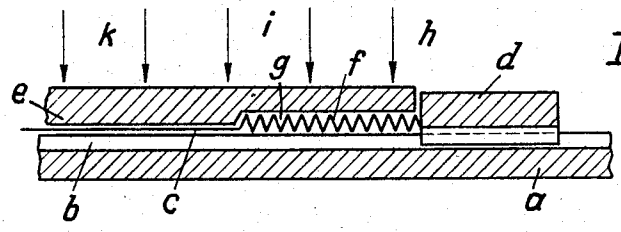


Fig.1

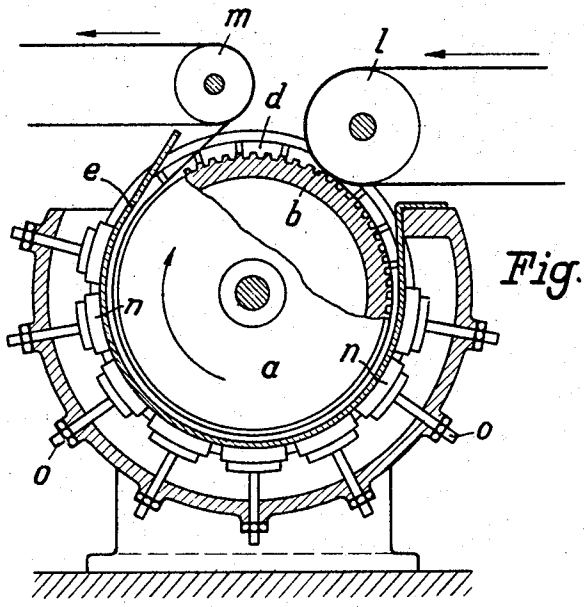


Fig.2

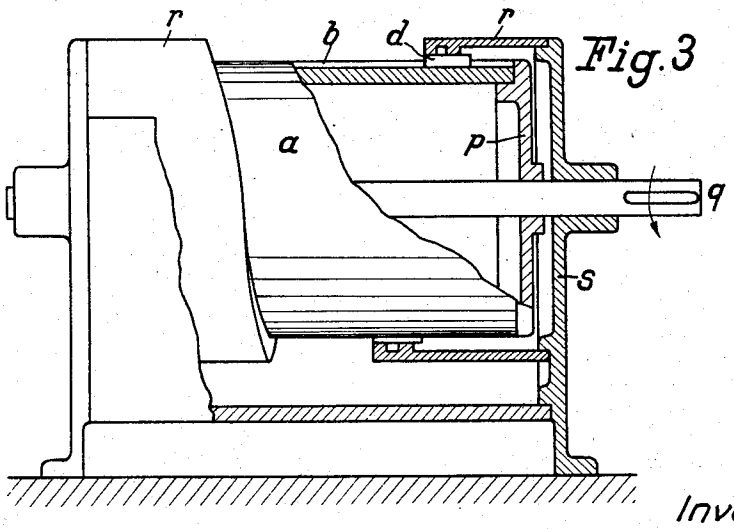
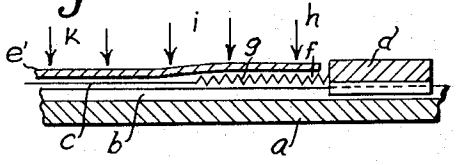


Fig.3

Fig. 1A



Inventor:
RUDOLF HAAS,

BY Bailey & Parson

ATTORNEYS

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Filed Dec. 31, 1940 3 Sheets-Sheet 2

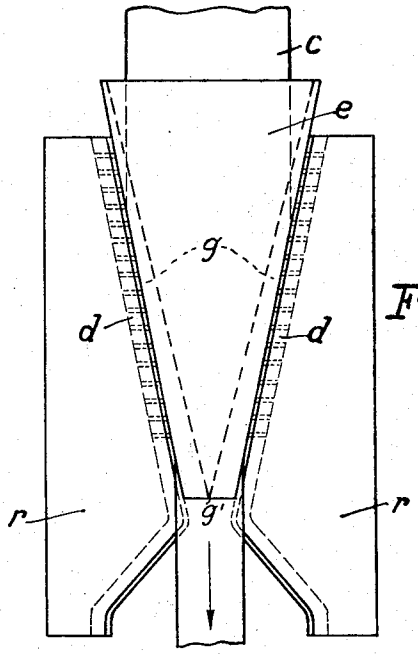


Fig. 4

Fig. 5

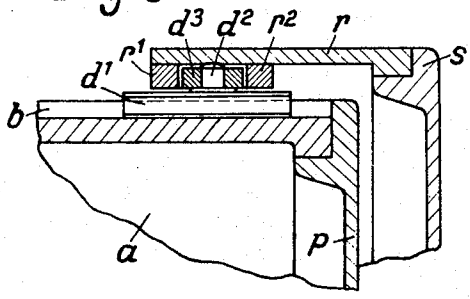


Fig. 6

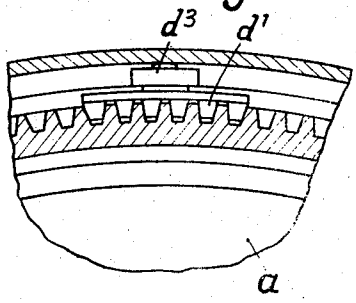
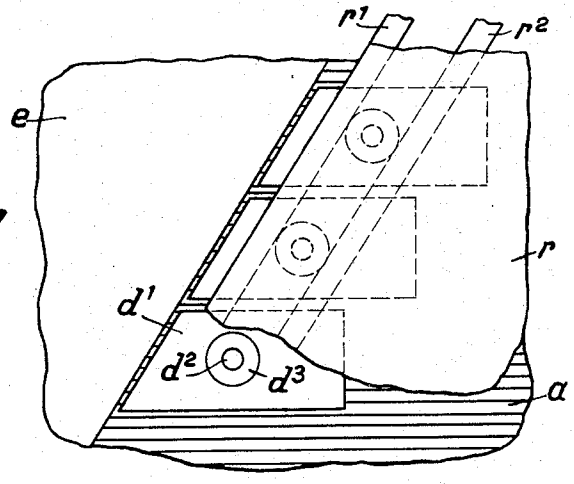


Fig. 7



Inventor:
RUDOLF HAAS,
Bailey & Harson
BY
ATTORNEYS

May 29, 1945. R. HAAS 2,376,915

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Filed Dec. 31, 1940 3 Sheets-Sheet 3

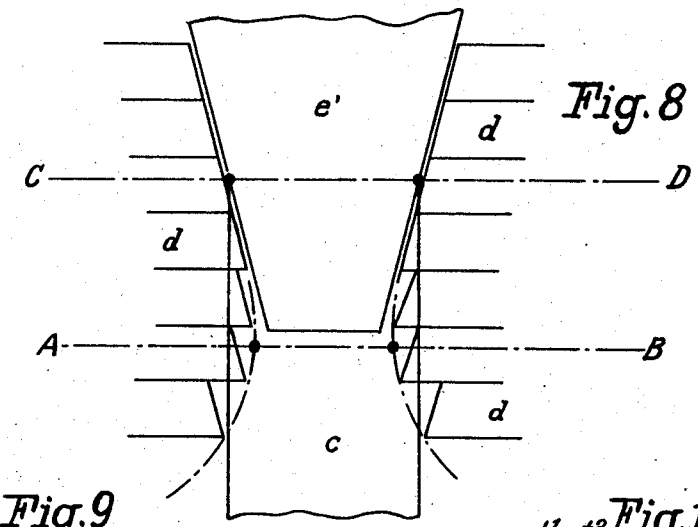


Fig. 8

Fig. 9

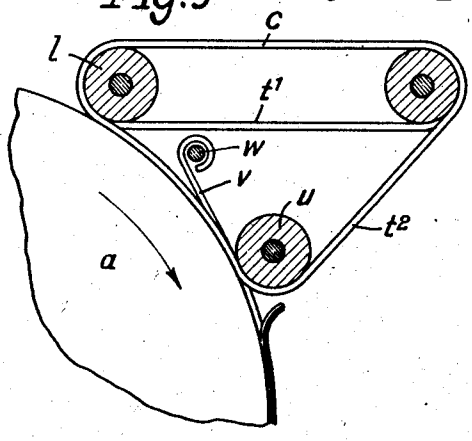


Fig. 10

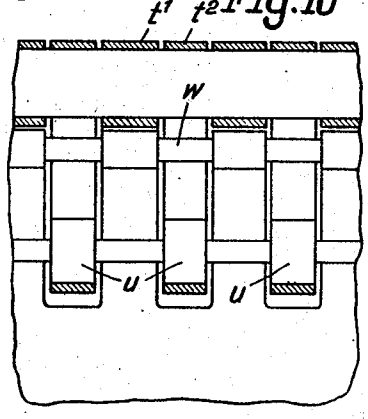
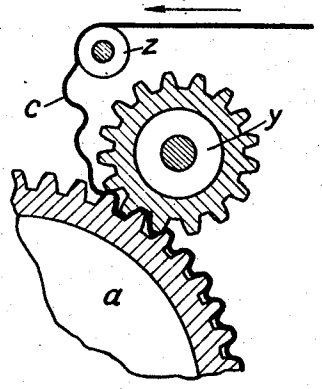


Fig. 11



Inventor:
RUDOLF HAAS,

BY Bailey & Parson

ATTORNEYS

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2,376,915

UNITED STATES PATENT OFFICE

2,376,915

APPARATUS FOR THE LONGITUDINAL CREPING OF WEBS OF PAPER OR OTHER SHEET MATERIAL

Rudolf Haas, Berlin-Zehlendorf, Germany; vested in the Alien Property Custodian

Application December 31, 1940, Serial No. 372,674
In Germany November 2, 1938

11 Claims. (Cl. 154—30)

This invention relates to apparatus for the longitudinal creping of webs of paper or other sheet material.

The continuous longitudinal creping of webs of paper and other sheet material has heretofore been carried out by enclosing the web within two surfaces and by applying creping tools moving forward on one or both sides of the web along an oblique inwardly directed line, whereby the web will be gradually shoved together.

Practically, this procedure is accomplished in the following manner. The web is carried through a rotating cylinder which, for instance, consists of a grate and a ribbon moving with said cylinder, said ribbon being of a width corresponding to the width of the web at its place of entrance into the creping apparatus, while the creping tools are working through the slots of the grate to grip the web, inward and outward motion of said tools being controlled by fixed cams provided in the interior of said cylinder.

This process, although it has been used with some success in the manufacture of creped paper, is connected with certain disadvantages, which are avoided by my present invention.

However, when using this process, the creping tools, which are working through the slots of the grate by gripping the web on either side thereof and shoving it together, can only be prevented from damaging the surface of the ribbon moving with the web, if a moderate pressure is applied to the ribbon. In consequence of this, the web will tend to form only relatively coarse longitudinal creases, unless it is subjected to creping in very moist condition. However, creping in moist condition is not permissible, because the web must be shifted relatively to the ribbon moving with the cylinder, such shifting creating the danger, that in case of an excessively moist web the surface and fibrous structure of the latter will be damaged. With the known process, accordingly, there can be attained only a longitudinal creping which is of considerably greater coarseness than the transverse creping, as a rule preceding the former. This is not desirable for many purposes of application.

In order to prevent damage to the ribbon moving with the cylinder, it had also been tried to cover up the creping tools which exert a pressure on the ribbon by the margins of the web at the place of entrance into the creping apparatus, thus avoiding any direct contact between the ribbon and the creping tools. This, however, results in the disadvantage that a part of the width of the web does not participate in the process of longitudinal creping, so that there will be undesirable losses of paper or the like at the margins of the web. These losses are especially of importance in case of creping webs of bituminous paper, because the margins of the web which are soaked with the bitumen cannot be subsequently supplied to the paper machine or dressing plant.

Moreover, such covering up of the creping tools by the margins of the web in case of variation from one to another width will require a change of the position of the place of entrance of the ribbon which rotates with the cylinder, and in addition proper readjusting of the position of the ribbon. Such readjusting, however, is a waste of time and labor. There will be similar difficulties at the place of exit, a varying width and thickness of the web also necessitating a varying width of the creped web at the place of exit.

By my present invention, now, I have devised an improved apparatus for the longitudinal creping of webs of paper and the like. My new apparatus is distinguished not only by its simplicity in a technical respect, but also avoids the aforementioned disadvantages inherent to known apparatus or processes of this kind.

My invention consists essentially therein, that the web of paper or the like to be creped is pressed against the periphery of the grooved cylinder by means of a fixed mantle tapering in the direction of motion of the web, and that the creping tools are arranged to move inwardly along or underneath the longitudinal edges of said mantle.

Accordingly, my invention is not limited to the replacing of the heretofore used ribbon moving with the cylinder by a fixed mantle. In addition to this, according to my invention this fixed mantle is of proper conformation tapering in the direction of motion of the web, and furthermore the creping tools are guided during their inward motion along or underneath the longitudinal edges of said mantle.

This tapering conformation of the fixed mantle and the guiding of the creping tools along or underneath the longitudinal edges of said mantle, which edges form a closed space for the margins of the web to be creped, will permit the arrangement of the creping tools in such a manner, that they will come into action onto the web in lateral direction and that, in spite of this, there will be avoided in the first place a direct or indirect contact between said tools and the web, and in the second place, any pressure exerted by said tools against said mantle which keeps the web in depressed condition. In consequence of this, said mantle can be pressed with such a force against

the rotating cylinder that sufficiently fine longitudinal creases will be formed on the web, without, however, requiring an excessive moistening of the latter for increasing its ability of being formed. In this way the aforementioned disadvantages connected with such moistening are successfully avoided.

The action of the creping tools onto the web in direction from the margin of the latter has the further advantage of avoiding any losses of paper, as the longitudinal creping is caused to extend as far as to the edges of the web.

For the same reason by my invention also the necessity of providing any kind of readjustment at the place of entrance of the paper during variation from one to another width of the web will be dispensed with. More particularly, according to my invention any width of the web—within the maximum width defined by the size of the creping apparatus—will come at the proper time into the range of action of the creping tools at the point of intersection with the path of motion of the latter.

An especial further advantage of the apparatus forming part of my present invention consists therein that there is a considerably greater liberty with regard to the selection of the material for the mantle and the means for pressing the same against the web, as compared with the use of a rotating web.

In the figures of the drawings I have diagrammatically represented an example of an apparatus constructed according to the principles of my present invention and, in addition, some details of the construction.

Fig. 1 is an explanatory diagrammatic section of the aforementioned procedure employing a fixed mandrel having its marginal edges recessed, Fig. 1A is a view similar to Fig. 1 but showing a fixed mandrel formed from thin sheet metal, Fig. 2 a longitudinal section through the apparatus, Fig. 3 a partial transverse section thereof, Fig. 4 shows the tapering surface of the mantle developed out in a plane and in the path of motion of the creping tools, Fig. 5 is a transverse section through an example of a construction of the creping tools and of the guide means therefor, as well as of the part of the rotating cylinder appertaining thereto, Fig. 6 a longitudinal section through the construction according to Fig. 5, Fig. 7 a plan-view of an example of a construction of a plurality of successive creping tools with parts of the guide means and the cylinder appertaining thereto, Fig. 8 a plan-view of the place of exit of the web subsequent to the operation of creping, Fig. 9 a longitudinal section through a special construction of the apparatus at the place of entrance of the web, Fig. 10 a plan-view on Fig. 9 taken in direction of the web entering the apparatus and Fig. 11 a longitudinal section through a special construction of the apparatus at the place of entrance of the web.

In all figures of the drawings, including Fig. 1, like reference characters indicate like parts of the apparatus.

In order to explain the invention, attention may be called to the course of the process of creping. This process commences at the margins of the web where it is creased and simultaneously therewith upset at the place of the creases. The length of the crease thus produced and therefore the size of the creping will be the smaller, the greater is the pressure for a given rigidity of the paper, this pressure being exerted by a surface acting on a rotating cylinder, or in other words, the smaller the gap available for the paper while it is being upset between a mantle and a cylinder. If now a certain number of creases has been formed, the paper mass accumulated in these creases will then also be more and more upset in direction of its height, thus enlarging the original distance between the mantle and the cylinder. Accordingly, the creases now adjoining the former creases will be of greater size, because the space available for these creases had been increased. From this explanation it may be seen that a fine and uniform longitudinal creping can only be attained, if the pressure, with which the mantle is pressed against the rotating cylinder during the course of the operation of creping, is exerted in such a manner that immediately in the rear of the continuously increasing width and thickness of the bead the distance between mantle and cylinder is not essentially greater than it had been at the margin of the web at the beginning of the operation of creping.

This part of the operation of creping is represented diagrammatically in Fig. 1 of the drawings. In Fig. 1, *a* designates a part of the cross-section of a rotating cylinder forming part of a creping apparatus. This cylinder is provided with grooves *b* which serve not only to move the web *c* with the cylinder, but also to move the creping tools *d*. The mantle, which does not participate in the rotation of the cylinder, is indicated at *e*. The operation of creping beginning from the margin of the web is supposed to have already proceeded so far that a greater number of crepe creases has been formed, which taken together will result in a beaded or thickened part of the web. This beaded or thickened part of the web will cause the mantle *e* to be lifted somewhat from the cylinder *a*, which process cannot be avoided without applying impermissibly large mechanical forces. The place where at any time the new crepe creases adjoining the former creases are formed is at *g*. It is of importance that at this place, as Fig. 1 shows, the distance between the mantle *e* and the cylinder *a* should not become excessive and, accordingly, care must be taken to maintain at every place of the mantle *e* the proper distance between the latter and the cylinder *a*. This is accomplished according to my invention by giving the mantle *e* a proper conformation and especially by properly constructing the device which presses the mantle against the cylinder, this device being indicated in Fig. 1 by arrows *h*, *i* and *k*. In the case of a rotating ribbon this condition can be fulfilled in known processes only by making the ribbon of yielding material, for instance rubber, and by using only a small pressure for the above stated reasons. This small pressure is all the more necessary in view of the fact that in case of a rotating ribbon the position of the bead will be steadily moving from the outside towards the inside which will cause a permanent change of the shape of the ribbon.

On the other hand, in the case of using the fixed mantle according to my invention, the two beads which are produced of increasing width in a direction from right to left during the operation of creping, will always remain at the same place with respect to the mantle. Accordingly, besides elastic materials, even hard metallic materials and, therefore, materials with an especially smooth surface may be used, if care is taken that the conformation of the mantle is in

conformity with the bead produced underneath the web when moving underneath the mantle.

The latter condition can be fulfilled either by making the mantle from thin sheet metal, in which case the mantle will adjust itself to the form required by the paper during a short time of operation of the creping apparatus, or by shaping the mantle from the start in such a manner that the marginal surfaces are at a greater distance from the cylinder than the intermediate surface, and that these marginal surfaces forming a sort of step are of increasing width in the direction of motion of the web, until they finally merge into each other at the end of the mantle.

Furthermore, the pressure with which the mantle is pressed against the cylinder may be different at every place in accordance with the requirements of the process of creping be carried out at any time. For instance, there may be used a greater number of springs arranged independently of each other at distances *h*, *i* and *k*, as indicated in Fig. 1, which springs may be tensioned at every place as desired. Preferably, the mantle is pressed against the web with a greater pressure at the margins of the latter than at the middle parts which have not yet been subjected to the process of creping. By properly adjusting this pressure it will be possible to reduce to a minimum the amount of power required for the rotation of the cylinder for any desired fineness of the crepe creases to be produced on the web.

It will thus be evident that, when using a fixed and tapering mantle, the conditions warranting a proper and sufficiently uniform longitudinal creping may be fulfilled much more easily than when using a rotating ribbon. This advantage, it is true, may be attained at the expense of a somewhat greater power for the operation of the apparatus, as the motion of the web relatively to the mantle in order to overcome the sliding friction against the latter takes place as a whole along a greater path than with a rotating ribbon, in which latter case this motion corresponds only to the length of the creping. The requirement of greater power, however, can be efficiently compensated by selecting a proper material for the mantle, especially one that results in greater smoothness of its surface and therewith in reduced friction between the mantle and the web.

The use of a fixed tapering mantle for pressing the web to be creped against the rotating cylinder further has the considerable advantage of improving the construction by making the creping tools representing the lateral closure of the space available for the web of very small height with a view to avoiding any tilting forces acting on said tools. In this manner it is no longer necessary to pass the creping tools from the inside through the grate of the cylinder. Accordingly, the creping tools can be made of a shape independent of the height of the bars of said grate, this height being quite considerable in view of the bending forces acting thereon, especially in the case of a web of great width. In view of this it will furthermore be possible to attend more easily to the creping tools which reciprocate slidingly on the outside of the cylinder.

In Fig. 2, *a* represents the rotating cylinder which is shown partly in a side-view and partly in a longitudinal section, said cylinder being provided with grooves *b* on its periphery. The creeping tools *d*, which are described more fully further below, are mounted to reciprocate within said grooves in lateral direction and participate in the rotation of the cylinder due to the engagement of said tools with said grooves. The mantle *e* is fixed and does not participate in the rotation of the cylinder, so that the web entering and leaving the apparatus at *l* and *m*, respectively, will be drawn through the apparatus between the cylinder *a* and the mantle *e*. In the present case rubber pads *n* are distributed over the periphery of the mantle and adjusting screws *o* serve for resiliently pressing said rubber pads against the several places of the mantle at a proper pressure necessary for every place of the latter. However, the pressure with which the mantle *e* is pressed against the cylinder may be produced also by any other means, for instance by imparting a tension in tangential direction to the mantle or by hydraulic means or by a weight or the like.

In Fig. 3 the cylinder *a* provided with grooves *b* over its periphery, is again shown partly in section and partly in elevation. The lateral walls *p* of the cylinder are mounted on the shaft *q* which is rotated in the direction indicated by arrow. Fixed guides *r* extend from either side over the cylinder *a*, said guides serving to properly guide the rotating creping tools *d* in lateral direction, in such a manner that the web will be shoved together. The guides *r* are preferably fixed to both bearing shields *s* of the apparatus. In Fig. 3 the fixed tapering mantle *e* as well as the guide means *l*, *m* for the web are supposed to be taken away for the sake of clearness.

In Fig. 4 the surface of the mantle *e* is shown as being developed out in a plane. This surface in the most simple case is of the form of a trapezoid bounded by straight lines. The surface of the mantle, however, may also be bounded by curved instead of straight lines. Said surface, moreover, is positioned within the space between the two guides *r*. The creping tools *d* which are indicated diagrammatically in this figure, move alongside the longitudinal edges of the surface of the mantle *e* as far as a point at which they are in closest proximity to each other, whereupon said tools again return into their outermost initial position. During the process of creping said tools form a lateral closure of the space *g* available for the motion of the web. The latter may be of any desired width, while the longitudinal creping will begin at the place where the two edges of the web intersect the path of motion of the creping tools. The web leaves the apparatus at the point at which the mantle *e* ceases to be in contact with the rotating cylinder.

As heretofore stated the marginal surfaces of the mantle are recessed at *g* in order to compensate for the increased thickness of the marginal edges of the web *c* while being creped. These recesses are provided by cutting a step in the marginal mantle surfaces adjacent the periphery of cylinder *a*. In Figure 4 it is seen that the recesses *g* are of increasing width in the direction of motion of the web *c* until they finally merge with each other at *g'* at the end of the mantle. Therefore, the increasing width of the creped beads in the direction of travel of the web will be accommodated by the increasing widths of the recesses *g*. In Figure 1A, the mantle *e'* is made from thin sheet metal so that the marginal edges of the mantle will adjust themselves to the form required by the paper beads. Likewise, a number of pressure springs are arranged

independently of each other at distances *h*, *i* and *k*.

In this manner the marginal edges of mantle *e'* may be adjusted at *o* to press against the web *c* with a greater pressure than the intermediate portions in accordance with the requirements.

Figs. 5 and 6 which are co-ordinated sections in transverse and longitudinal direction, respectively, show a simple form of construction of the creping tools *d*. According to these figures the creping tools consist of a toothed plate d_1 with a pivot d_2 attached thereto and a roller d_3 carried by said pivot. The roller d_3 moves between the rails r_1 and r_2 which form part of the guides *r*. Said two rails r_1 and r_2 are mounted parallel to and at a distance from each other, this distance being equal to the diameters of said roller d_3. the teeth of said plate d_1 do not need to exactly correspond to the profile of the grooves *b* on the periphery of the cylinder *a*, it being sufficient if said teeth engage with said grooves only as far as a certain depth of the latter.

As may be seen from Fig. 4, the web *c* to be creped will be subjected to the operation of creping only along the converging part but not along the diverging part of said guides *r* nor at the two reversing points. The creping tools, accordingly, may be constructed in such a manner with oblique ends acting on the web that they will closely adjoin each other to form a continuous oblique line along which an uninterrupted shoving action may be exerted on the web to be creped. This is represented in Fig. 7 in which *a* designates the grooved rotating cylinder, *r* the guide with its two rails r_1 and r_2, *e* the fixed tapering mantle and d_1, d_2 and d_3 the several parts of the creping tools.

As stated above, the web to be creped may be of any desired width, when entering the apparatus, see Fig. 4.

At the place of exit the conditions are different and care should be taken that the width of the web at this place must correspond to the width of the web in upset condition, that is to the width which the web assumes in accordance with the fineness of the creping, the width of the web at the place of entrance and the thickness of the web. Fig. 8 shows how these conditions may be met with by my invention in a very simple manner. The converging and again diverging creping tools are shown at *d*, the fixed tapering mantle at *e'* and the web at its point of exit at *c*. The place at which the creping tools are nearest to each other is at A—B. For the reasons stated in connection with the description given for Fig. 7, the creped web is preferably discharged from the apparatus at some earlier time, that is about at the line C—D. If the end of the mantle *e'* is constructed in the form of a movable tongue which may be more or less lifted, the line C—D may be displaced as desired to a narrower or wider place, so that the web may be discharged from the creping apparatus just at that point where it is in sufficiently creped condition but not yet under excessive pressure. Obviously, the creped beads formed on the opposite marginal edges of the web *c* will preferably merge with one another at the discharging line C—D, and accordingly the spring pressure on the mantle *e'* must be adjusted in the manner previously described to cause this merger to be effected at the proper place. On the other hand, if a recessed mantle *e* is employed as shown in Fig. 1, the recesses *g* will preferably merge at line C—D.

Experience has shown that the web underneath the fixed mantle, even if the web had previously been creped in transverse direction and contains a certain amount of moisture, may enter the apparatus without any difficulty and will be properly carried with the rotating cylinder. However, for the sake of safety it is preferable to slightly press the entering web against the grooved cylinder, as had been indicated in Fig. 2 by the fact that the guide roller *l* for the web is in contact with the surface of the cylinder *a*. A form of construction which is still more perfect, as far as positive motion is concerned, is shown in Figs. 9 and 10. As shown in these figures, alternately shorter and longer ribbons t_1 and t_2 are wound around the guide roller *l* for the web, the longer ribbons serving to firmly press the entering web for some distance against the rotating cylinder *a*, this distance extending from the roller *l* as far as to the narrower rollers *u*. These latter rollers *u* are positioned within the recessed portions of the fixed mantle *e*, the tongues *v* between these recessed portions being, for instance, fixed to a common rod *w* mounted in transverse direction. This arrangement permits to press the web by means of the ribbon t_2 and the roller *u* against the cylinder *a*, until the web has arrived underneath the tongues *v*.

The web *c* entering the apparatus may furthermore be pressed into the grooves of the cylinder *a* by means of a toothed roller *y*, as shown in Fig. 11. In this way there may be effected a so-called double creping consisting of combined transverse and longitudinal corrugations producing a web which is extensible in both directions. In order to facilitate the pressing of the web into the grooves of the cylinder *a* without exerting an excessive pull, it is only necessary to introduce the web into the apparatus by means of a suitable device, for instance the guide roller *z*, at such a velocity that an excessive length of the web necessary for the transverse creping will always be available between this roller and the cylinder.

I claim:

1. Apparatus for the longitudinal creping of webs of paper or other material capable of being creped, said apparatus comprising in combination: a rotatable grooved cylinder; creping tools adapted to move in the direction of travel of the web laterally to the latter along an oblique inwardly directed line; a fixed mantle surrounding said cylinder for pressing the web against the periphery of the cylinder, said mantle having edges tapering in the direction of travel of the web; and said creping tools adapted to move alongside the tapering edges of said mantle.

2. The combination as specified by claim 1, including means for pressing said fixed mantle against the web to be creped with a greater force at the places of the web which are at a time subject to longitudinal creping and with a smaller force at the places which at a time are not yet subject to longitudinal creping.

3. The combination as specified by claim 1, in which said fixed mantle is of such conformation on its surface facing said cylinder, that the marginal portions of said mantle are at a greater distance from the periphery of said cylinder than the surfaces of said mantle between said marginal portions, and that the latter are of a width diverging in the direction of travel of the web and converging at the end of said mantle.

4. The combination as specified by claim 1, in which said mantle consists of a material able to be yieldingly pressed against said cylinder at a varying distance, said mantle being of such conformation on its surface facing said cylinder, that the marginal portions of said mantle are at a greater distance from the periphery of said cylinder than the surfaces of said mantle between said marginal portions, and that the latter are of a width diverging in the direction of travel of the web and converging at the end of said mantle.

5. The combination as specified by claim 1, including guide means for said creping tools, said guide means overlapping the periphery of said grooved cylinder.

6. The combination as specified by claim 1, including means for pressing said mantle against the web with a greater force at the places at a time subject to longitudinal creping and with a smaller force at the places at a time not yet subject to longitudinal creping.

7. The combination as specified by claim 1, in which the creping tools are of oblique conformation at their surfaces acting on the web, permitting said creping tools to adjoin each other along a substantially continuous surface on their portion which is subject to the operation of creping.

8. The combination as specified by claim 1, in which said mantle consists of yielding material, said combination including means for pressing said mantle against the web with a greater force at the places of the web which at a time are subject to longitudinal creping and with a smaller force at the places which at a time are not yet subject to longitudinal creping, said creping tools being of oblique conformation at their surfaces acting on the web, permitting said creping tools to form a substantially continuous surface during the operation of creping.

9. The combinaiton as specified by claim 1, including a roller for pressing the web to be creped, before entering between said cylinder and said mantle, into the grooves of said cylinder, said grooves being adapted to serve as guide means for said creping tools.

10. The combination as specified by claim 1, in which said mantle consists of yielding material, said combination including means for pressing said mantle against the web with a greater force at the places at a time subject to longitudinal creping and with a smaller force at the places at a time not yet subject to longitudinal creping; and a roller for pressing the web before entering the apparatus into the grooves of said cylinder, said grooves adapted to serve as a guide means for said creping tools.

11. The combination as specified by claim 1, in which said mantle consists of yielding material able to be pressed against said cylinder, permitting a variation of the distance between said mantle and said cylinder at every point of the web, when travelling at increasing thickness through the apparatus, said combination including a roller for pressing the web before entering the apparatus into the grooves of said cylinder, said grooves being adapted to serve as a guide means for said creping tools.

RUDOLF HAAS.