July 11, 1967 S. T. SANDBERG 3,330,095

FOLDING DEVICE

Filed July 1, 1964 4 Sheets-Sheet 1

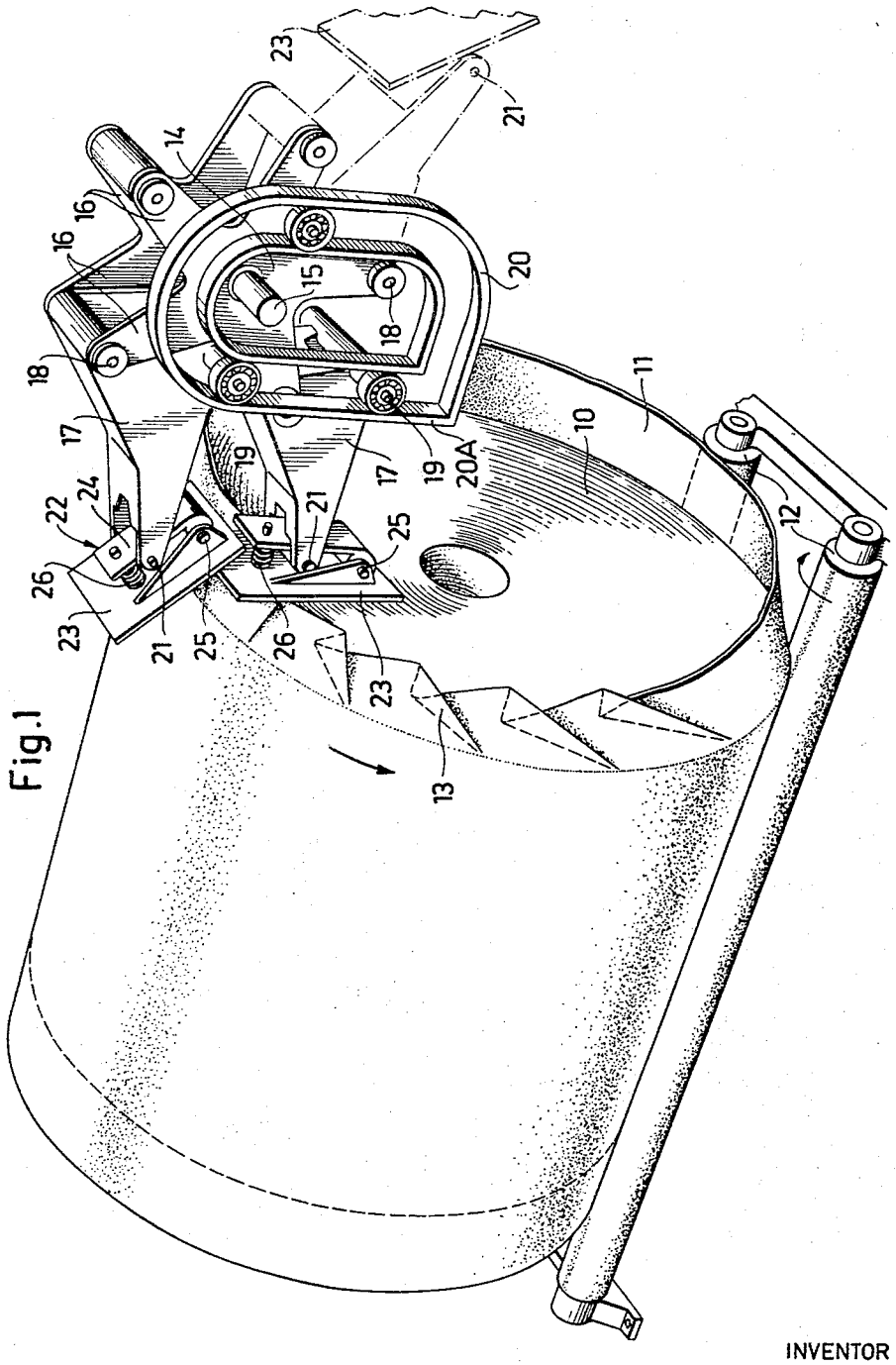


Fig.1

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July 11, 1967 S. T. SANDBERG 3,330,095

FOLDING DEVICE

Filed July 1, 1964 4 Sheets-Sheet 2

Fig.2

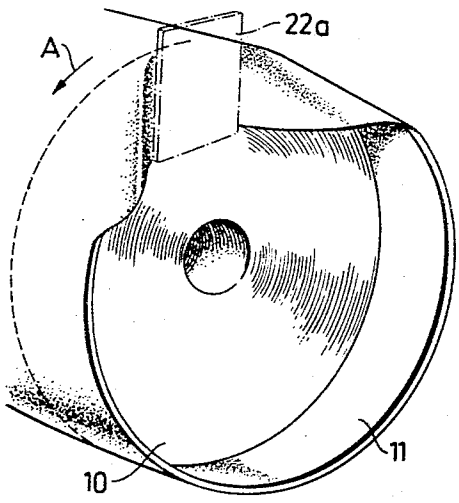


Fig.3

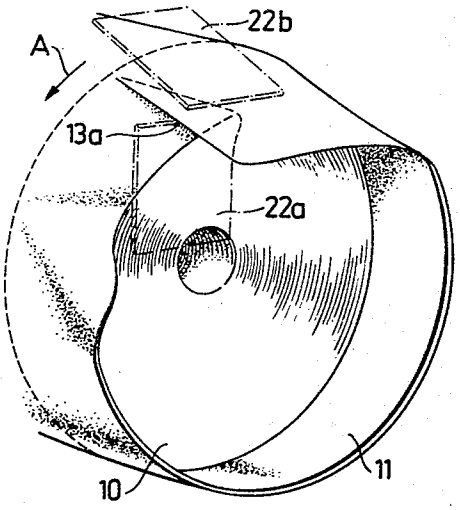


Fig.4

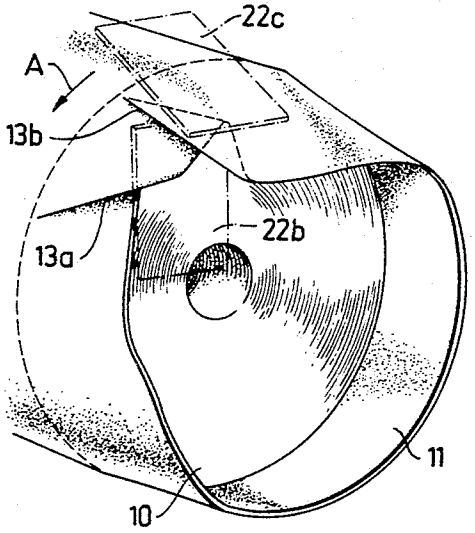
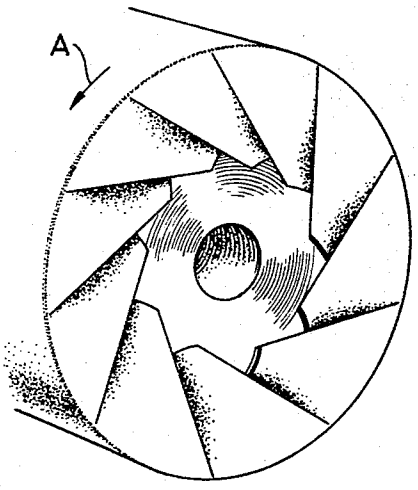


Fig.5



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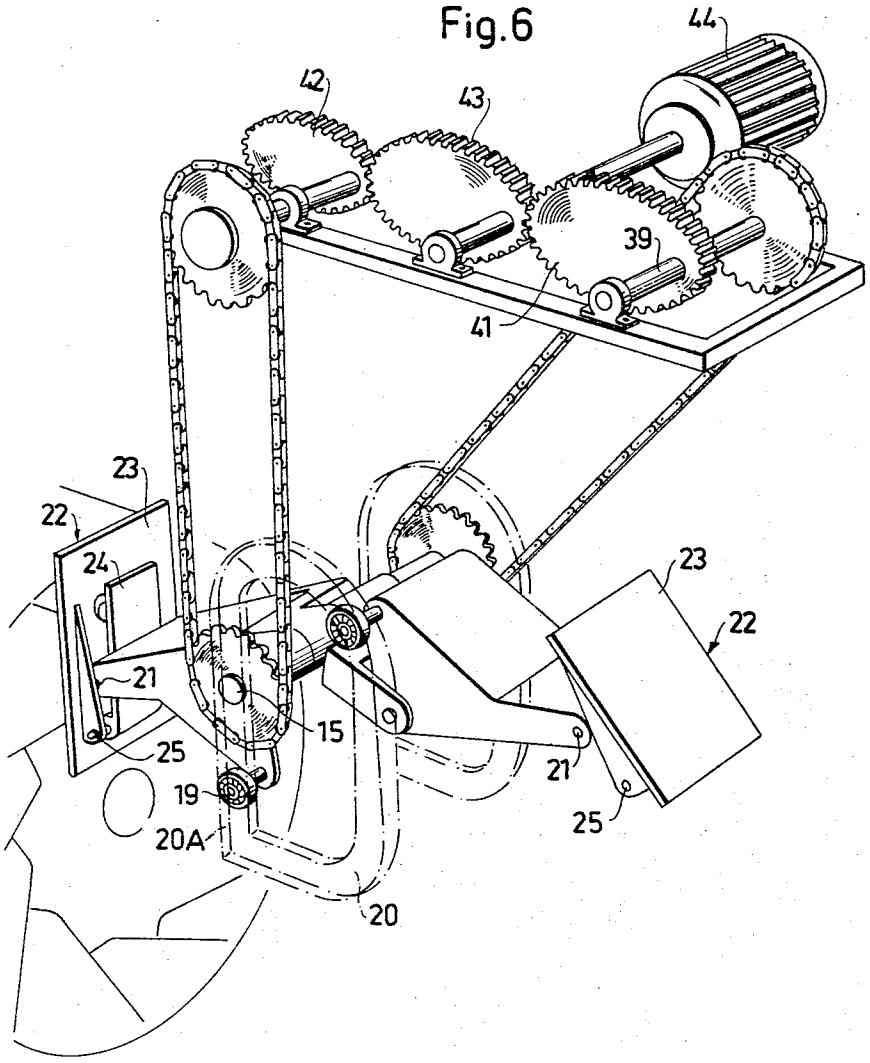
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July 11, 1967 S. T. SANDBERG 3,330,095

FOLDING DEVICE

Filed July 1, 1964 4 Sheets-Sheet 3

Fig.6



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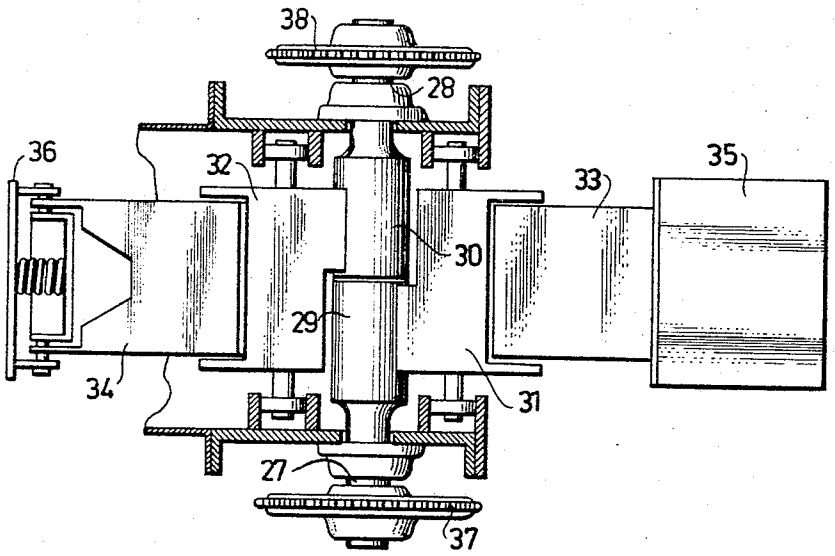
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July 11, 1967 S. T. SANDBERG 3,330,095

FOLDING DEVICE

Filed July 1, 1964 4 Sheets-Sheet 4

Fig.7



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United States Patent Office 3,330,095 Patented July 11, 1967

3,330,095

FOLDING DEVICE

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Filed July 1, 1964, Ser. No. 379,767
Claims priority, application Sweden, June 28, 1963, 7,214/63
12 Claims. (Cl. 53—380)

The present invention relates to a device to fold the portions (so-called folding cornet) projecting from the ends of a cylindrical object, especially newsprint rolls or the like and formed by a wrapping paper wound one or more turns around the roll, against each end while the roll is rotated around its longitudinal axis in such a way that at each end there are formed self-locking folds tightened over the roll-edge.

The object of the present invention is to obtain a folding device which is comparatively simple and cheap but the function of which is nevertheless rapid and safe so that in all respects a satisfactory folding is ensured.

A feature of this invention is a device including a spider mounted on a horizontal driving shaft which is perpendicular to the roll axis and supports a number of substantially radially projecting and equally spaced pair of arms. A like number of substantially triangular levers is provided each of which levers at its one base corner is pivotally mounted between the ends of the respective pair of arms and which lever at its other base corner by means of a guide-wheel or the like is guided in a fixed guide-way during the rotation of the driving shaft. Each of said levers supports at its free apex end a freely pivotally mounted folding member. The pivoting shaft of each such member as well as the mounting shaft of the triangular lever associated therewith is parallel to the driving shaft. The guide-way of said levers is so shaped that the pivoting shaft of each folding member during that portion of each revolution of the driving shaft when said folding member reaches the end of the roll, moves from the periphery toward the centre thereof in a direction substantially parallel to the surface of said end, so that the folding member on account of its pressing against the edge and the end of the roll folds the folding cornet over the edge of the roll and against the end and simultaneously it presses that fold which has been formed by the preceding folding member seen in the direction of rotation. This last mentioned folding member when during its movement inwardly approaches the innermost position remains substantially stationary when the mounting shaft of the lever associated therewith passes an imaginary connecting line between the pivoting shaft of the folding member and the driving shaft, i.e. these two folding members are closer to each other during this portion of their movement than during the remaining portion of one revolution of the driving shaft.

The invention will be further described in connection to the following drawings:

FIG. 1 is a perspective view of an embodiment of a folding device according to the invention.

FIGS. 2–5 show four steps of the folding operation.

FIG. 6 shows in perspective a somewhat modified embodiment of the folding device.

FIG. 7 is a plan view of a part of the folding device according to FIG. 6.

The folding device according to FIG. 1 is intended for folding the projecting ends, i.e. the so-called folding cornet **11**, of a wrapping paper wound around a newsprint roll **10** against each end of the roll. During this operation the roll is rotated around its longitudinal axis by resting on a roll-support **12** continuously driven by a motor. By folding the folding cornet while the roll is simultaneously rotated around its longitudinal axis there are obtained

self-locking folds **13** tightened over the roll edge at each end of the roll.

The folding device comprises a schematically shown spider **14** fixed to a horizontal driving shaft **15** arranged perpendicularly to the roll axis, said shaft being driven in a suitable way (not shown). The spider supports a number of substantially radially projecting symmetrically spaced pair of arms **16**, viz, in the present case five such pairs of arms **16**.

Each of said pairs of arms **16** supports a substantially triangular lever **17** which at one of its base corners is pivotally mounted between the free ends of the pair of arms by means of a shaft **18**. At its other base corner each lever **17** by means of a guide-roll **19** is guided during the turning of the driving shaft **15** in a stationary guide-way **20**. In FIG. 1 it is shown a guide-way **20** only at one side of the assembly of pair of arms and lever with associated members, but of course it is also possible to provide corresponding guide means also at the other side of said assembly.

Each lever **17** carries at its free apex-end a folding member **22** freely pivotally mounted on a shaft **21** and it is to be noted that the shaft **21** as well as the shaft **18** are parallel to the driving shaft **15**.

The guide-way **20** of the levers **17** is provided with a portion **20A** which is substantially parallel to the surface of the end of the roll. By this it is obtained that the pivoting shaft **21** of each folding member during a portion of each revolution of the driving shaft **15** when said folding member reaches the roll end, moves from the periphery of the roll **10** towards its centre in a direction substantially parallel to the surface of the end of the roll.

As best seen in FIGS. 2–5 and as will be further described in the following the folding members **22** fold the folding cornet over the edge of the roll and against the end thereof during the last mentioned movement due to the pressing action against the end side of the roll and simultaneously that fold **13** which was formed by the preceding folding member seen in the direction of movement of the driving shaft is subjected to a pressure. It is to be noted that this last mentioned folding member **22** remains substantially stationary when during its movement inwardly it approaches its innermost position. The reason for this is that the pivoting shaft **18** carries out a circular motion around the driving shaft **15** while said base corner of the lever provided with the guide-roll **19** is guided along said straight portion **20A** of the guide-way **20**. Thus when the pivoting shaft of the lever **17** in the pair of arms **16** passes an imaginary connecting line between the pivoting shaft **21** of the folding member and the driving shaft **15** the inward movement of the folding member is stopped. Thus during the whole folding operation each two adjacent folding members are closer to each other during the now described portion of their movement than during the remaining portion of a revolution of the driving shaft. On account of this it is obtained that a previous folding member **22** holds its fold **13** while the following folding member **22** is forming a new fold **13** which later after it has been completed holds the previously formed fold so that the preceding folding member can be returned to its initial position.

The mode of operation of the now described folding device is explained in the following with reference to FIGS. 2–5.

In FIG. 2 a first folding member **22***a* has been moved against the folding cornet **11** so that a portion of this has been pressed against the end of the roll **10** while the roll is continuously turned around its longitudinal axis in the direction indicated by the arrow A.

In FIG. 3 the folding member **22***a* has moved inwardly towards the centre of the end of the roll so that a first fold **13***a* has been formed. On account of the described

construction of the folding device and especially on account of the construction of the guide-way **20** the movement of the folding member **22***a* is retarded while the folding member **22***b* is moved towards the end of the roll with "normal" speed. This second folding member **22***b* forms in FIG. 3 the beginning of a new fold which in its turn shall hold the completed fold **13***a* and enable the folding member **22***a* to be moved away.

In FIG. 4 the folding member **22***b* has completed the fold **13***b* which holds the first fold **13***a*. The folding member **22***a* has been moved away and the folding member **22***b* has moved to its innermost position. A further folding member **22***c* has just started to form a further fold for holding the preceding fold **13***b*.

The now described process is then repeated continuously so that the completely folded cornet obtains the shape shown in FIG. 5.

In the above described embodiment the driving shaft **15** is intended to be rotated with a constant speed which of course is so chosen in respect of the turning speed of the roll **10** and the dimensions of the roll and the folding cornet that the formed folds obtain the intended inclination relatively to imaginary radial lines through the axis of the roll **10** and so that the last fold becomes substantially equal to the preceding folds, i.e. an even spacing is obtained. This can of course also be achieved by providing the driving means for the turning of the roll with a variable speed gearing of any known construction.

It is however also possible to provide between the driving motor and driving shaft **15** a gearing with non-cylindrical, preferably elliptical gears which gearing is situated nearest to the motor and a second gearing between the output shaft of said first gearing and the driving shaft and provided with cylindrical gears and with a gear ratio of $1:x$, where x is the number of pairs of arms. By this arrangement the gradient of the angular velocity of the driving shaft **15** can be so chosen that of the total time that each folding member **22** cooperates with the folding cornet of the roll, that time during which said folding member **22** is substantially stationary is extended or shortened. It is clear that the inclination of the folds is getting more tangential by an extension of said time and more radial by a shortening of said time, provided that the turning velocity of the roll **10** remains unchanged.

The folding members can be constructed in many different ways. It has however been found especially preferable to make them in the way shown on the drawings, i.e. each folding member has the shape of a plate **23**, pivotally connected to its associated lever by means of a link **24**. This link is in its turn pivotally connected to the lever **17** by means of the already mentioned shaft **21** and the plate **23** pivotally mounted on one end of the link **24** by means of a shaft **25**. Between the other ends of the plate **23** and the link **24** there is provided a compression spring **26**.

To facilitate the passage of the folding plate **23** through the folds **13** it may be preferable to provide the plate with a rotatable circular disc (not shown) at the trailing edge of the plate. Although not shown, it may be preferable to supplement each folding plate with a cylindrical folding roll.

It may be mentioned that in special cases it is also possible to replace the above described folding member by a cylindrical folding roll mounted in the lever **17** or the link **24** and possibly tapering towards its ends. It is also possible to make each folding member in the shape of a freely rotatable plate.

The above described device may for obtaining the desired distance between the driving shaft and the end of the roll be provided with a spacing roller or the like which is in contact with the roll end and moves along a circle lying between the working area of the folding members and the folding cornet when folded in against the end of the roll.

The device can also be provided with a stationary press-plate or press-roller adapted to further flatten the folds formed by the folding members. Of course this press-plate or press-roll cannot be moved to its working position until the first fold is formed. The above described folding members as well as any press-plate can be heated by electrical elements in a manner known per se.

The modification shown in FIGS. 6 and 7 is somewhat more simplified than the above described device so that the number of constructive details can be reduced. This modified device contains two coaxial and independently mounted shafts **27, 28** each having a spider **29** and **30** respectively with a substantially radially projecting pair of arms **31** and **32** respectively which are provided with levers **33, 34** and folding members **35, 36**.

In the present case the two shafts **27, 28** are driven by chain drives **37, 38** from a driving shaft **39** and **40** respectively. Each of these shafts is provided with a non-cylindrical, viz. in this case an elliptical gear **41** and **42** respectively which two gears cooperate with a correspondingly shaped intermediate driving gear **43** driven by the motor **44**. The gearing consisting of the non-cylindrical gears **41, 42, 43** is so dimensioned that the gradient of the angular velocity of the pair of arms carrying the two folding members is so chosen that that folding member which has reached the substantially stationary inner radial position is moved round to the new folding position with such a velocity that this new folding position is reached before the other folding member which during this time has moved inwardly from the outer to the inner folding position, has passed this inner folding position.

I claim:

1. Apparatus for the folding over of the extending margin of a sheet material which is wrapped around a cylindrical object while this cylindrical object is rotated about its longitudinal axis, comprising: a spider mounted on a drive shaft which is perpendicular to said longitudinal axis of said cylindrical object; said spider having a plurality of substantially radially projecting and equally spaced apart pairs of arms; a plurality of substantially triangular levers, each of which, respectively, at one of its base corners is pivotally mounted to and between the distal ends of a respective one of said pairs of arms of said spider by a pivot shaft; a stationary guide way; each of said levers respectively, at the other of its base corners, having a guide follower which is engaged with and guided by said stationary guide way during the rotation of said spider; each of said levers, respectively, at its distal apex and having a folding member freely and pivotally mounted thereto by a pivot shaft; the axes of said spider drive shaft, each of said lever pivot shafts, and each of said folding member pivot shafts being parallel; said stationary guide way being so constructed and arranged to guide each respective guide follower so that during a respective portion of each revolution of said spider drive shaft the respective folding member of a respective said lever reaches the end of said cylindrical object and is moved along a path from the periphery of said object toward the center of said object in a direction substantially parallel to the surface of said end of said object, whereby each such folding member in turn initially presses against said extending margin of the sheet material to fold a portion of such margin over the peripheral edge and against the end of the object, and simultaneously presses that fold which has been formed by the immediately preceding folding member seen in the direction of rotation of said spider; each of said folding members having a minimum velocity when the respective pivot shaft of its respective lever intersects an imaginary connecting line extending between the respective pivot shaft of such folding member and said spider driving shaft, each of said folding members having said minimum velocity as it travels along a radially inner portion of said path while the immediately succeed-

ing folding member is traveling along a radially outer portion of said path.

2. Apparatus according to claim 1, further comprising: a motor; gear means coupling said motor to said spider drive shaft; said gear means including a first gear assembly of non-cylindrical gears coupled to the output shaft of said motor and a second gear assembly of cylindrical gears coupled to the output shaft of said first gear assembly and having a gear ratio of $1:x$, where x is the number of pairs of said arms, whereby the gradient of the annular velocity of said spider driving shaft is such that of the total interval each folding member is disposed at the end of the object, the subinterval during which such folding member has a minimum velocity either is extended to provide a more tangential inclination of the wrapper fold, or is shortened to provide a more radial inclination of the wrapper fold.

3. Apparatus according to claim 1 wherein each folding member includes a plate, a link pivotally connected at one end thereof to said plate, at the other end thereof is biased away from said plate, and intermediate said ends is pivotally connected to the distal end of the respective lever.

4. Apparatus according to claim 3 wherein a respective rotatable circular disc is coupled to the trailing edge of each folding plate.

5. Apparatus according to claim 3 wherein a respective cylindrical folding roller is coupled to the trailing edge of each folding plate.

6. Apparatus according to claim 1 wherein each folding member compresses a cylindrical folding roller mounted to a respective one of said levers.

7. Apparatus according to claim 1 further including a spacer roller coupled to said spider drive shaft and abuting the end of the object for spacing said spider drive shaft a predetermined working distance from the end of the roller, said spacer roller contacting the end of the object radially inwardly of said path of said folding members.

8. Apparatus according to claim 1 further including a stationary pressing member for overlying the folds formed by said folding members, and support means therefore for disposing said pressing member between an inactive position and an active position, whereby said pressing member may be brought to its active position after the first fold has been formed.

9. Apparatus according to claim 1 further including heating means for heating each of said folding members.

10. Apparatus according to claim 1 wherein each of said folding members is a freely rotatable plate.

11. Apparatus according to claim 6 wherein each of said folding rollers tapers towards its ends.

12. Apparatus for the folding over of the extending margin of a sheet material which is wrapped around a cylindrical object while this cylindrical object is rotated about its longitudinal axis comprising: two spiders, each mounted on a respective one of two coaxial and independently rotatable drive shafts; each spider respectively having a substantially radially projecting pair of arms; a pair of arms respectively having a triangular lever, each of which, respectively, at one of its base corners is pivotally mounted to and between the distal ends of said pair of arms by a pivot shaft; a stationary guide way; each of said levers, respectively, at the other of its base corners, having a guide follower which is engaged with and guided by said stationary guide way during the rotation of the respective spider; each of said levers, respectively, at its distal apex end having a folding member freely and pivotally mounted thereto by a pivot shaft; the axes of said spider drive shaft, each of said lever pivot shafts, and each of said folding member pivot shafts being parallel; said stationary guide way being so constructed and arranged to guide each respective guide follower so that during a respective portion of each revolution of said spider drive shaft the respective folding member of a respective said lever reaches the end of said cylindrical object and is moved along a path from the periphery of said object towards the center of said object in a direction substantially parallel to the surface of said end of said object, whereby each such folding member in turn initially presses against said extending margin of the sheet material to fold a portion of such margin over the peripheral edge and against the end of the object, and simultaneously presses that fold which has been formed by the immediately preceding folding member seen in the direction of rotation of said spider; a drive motor; each of said spider drive shafts being coupled to said drive motor by a transmission including a non-cylindrical gear assembly such that a gradient of the angular velocity of the pairs of arms carrying the folding members is provided such that that folding member which has reached the minimum velocity position is moved around to the new folding position with such a velocity that this new folding position is reached before the other folding member, which during this time has moved inwardly from the outer to the inner folding position, has passed this inner folding position.

No references cited.

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