United States Patent [19]

Kataoka

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[54] **SHEET REWINDER**

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[52] **U.S. Cl.** ..... **242/56 A,** 242/56.2, 242/64

[51] **Int. Cl.** **B65h 19/26,** B65h 19/06

[58] **Field of Search** ..... 242/56 A, 56 R, 64, 242/56.2

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Assistant Examiner—Edward J. McCarthy
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[57] **ABSTRACT**

In the rewinding of a sheet from a feed roll onto smaller rolls, a bonding agent is applied to the upper surface of the sheet after a predetermined amount of the sheet has been wound to a predetermined tension and the sheet is cut so as to divided the area to which bonding agent has been applied to the front and rear. The front portion serves as a seal for the roll already wound while the rear portion serves to fasten the sheet to a new core.

8 Claims, 8 Drawing Figures

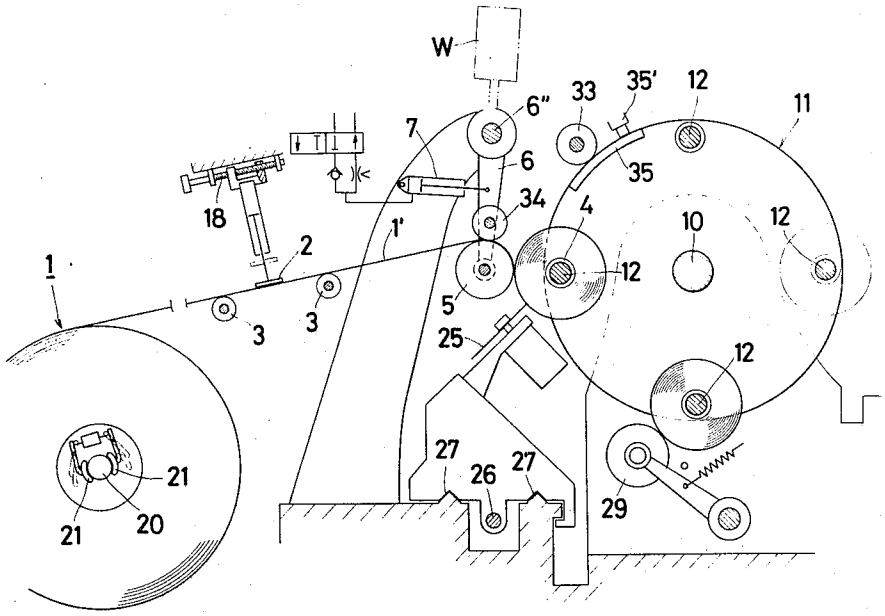


Fig. 1

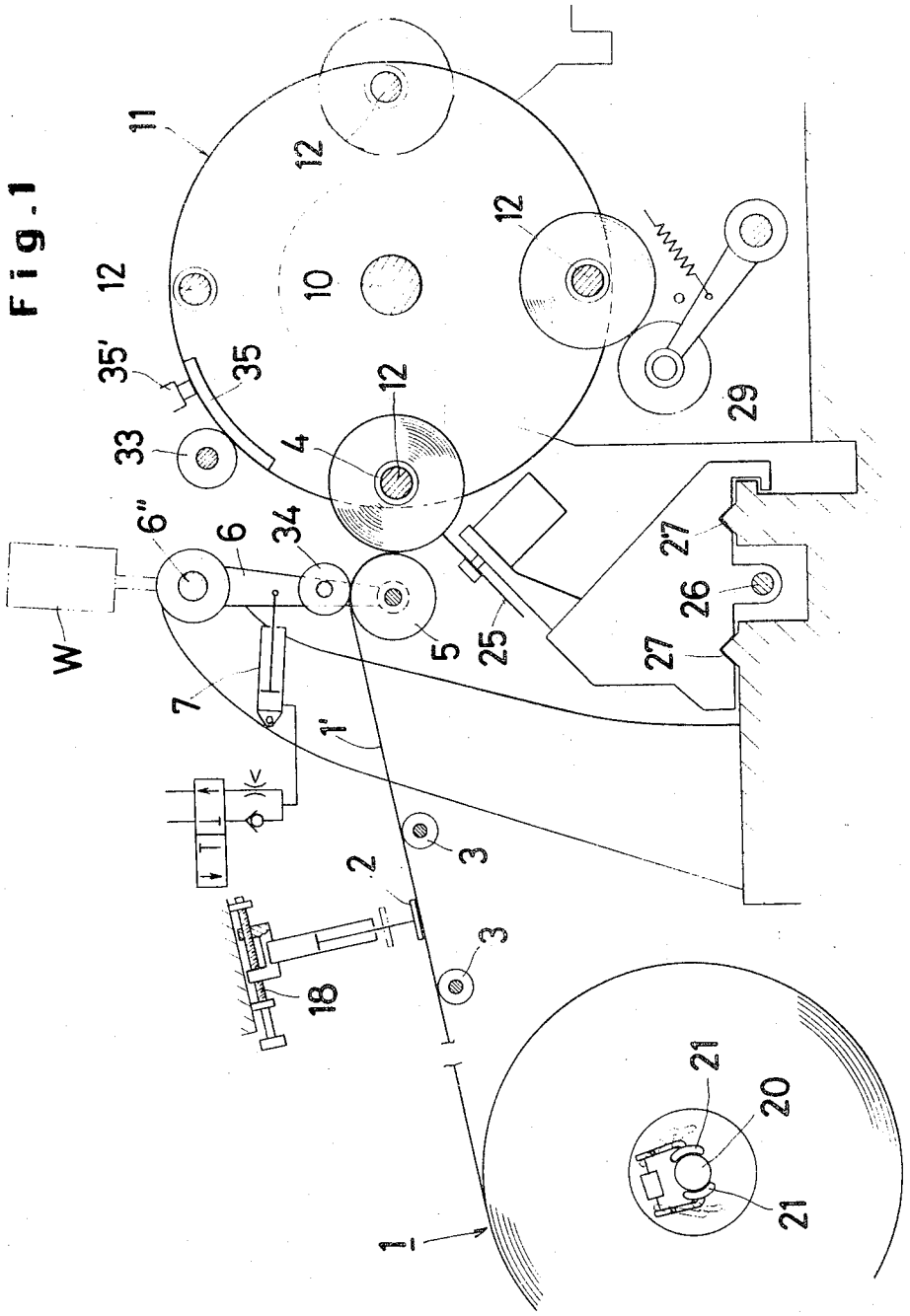


Fig. 2

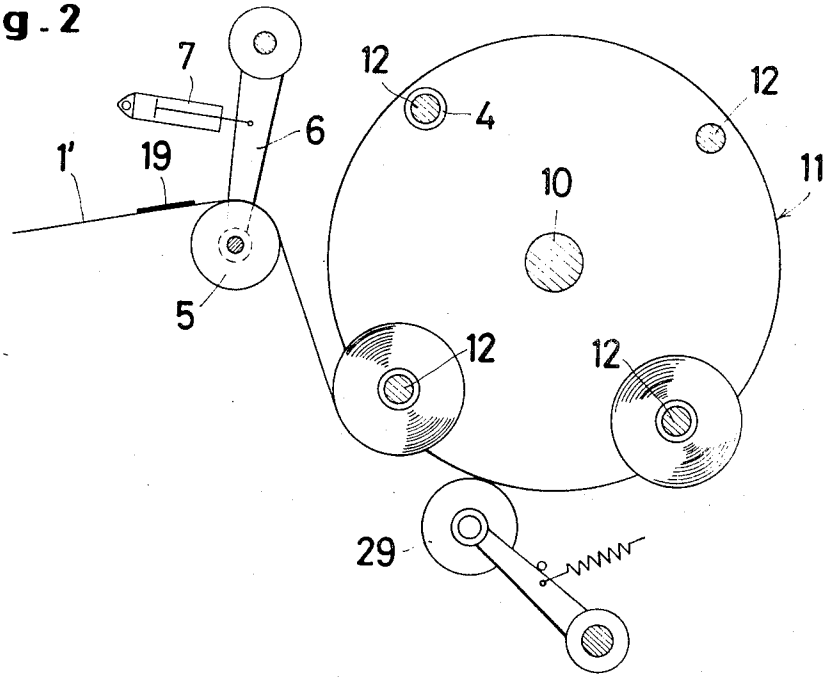


Fig. 3

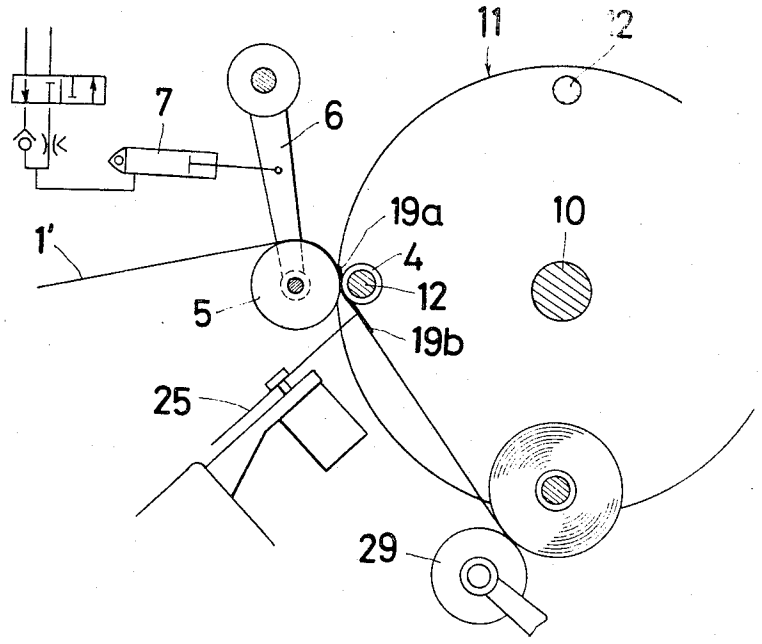


Fig. 4

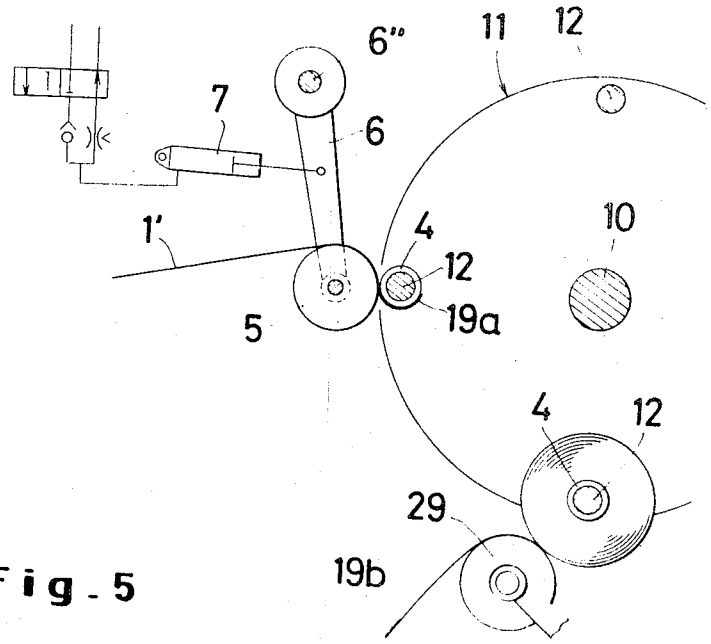


Fig. 5

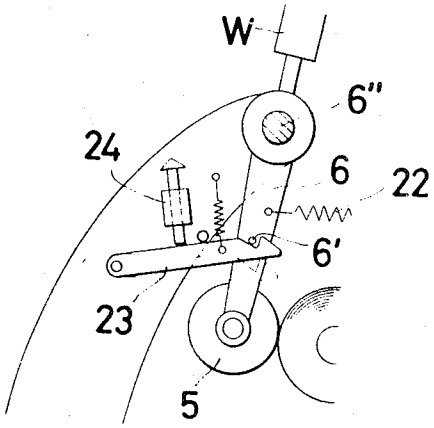


Fig. 6

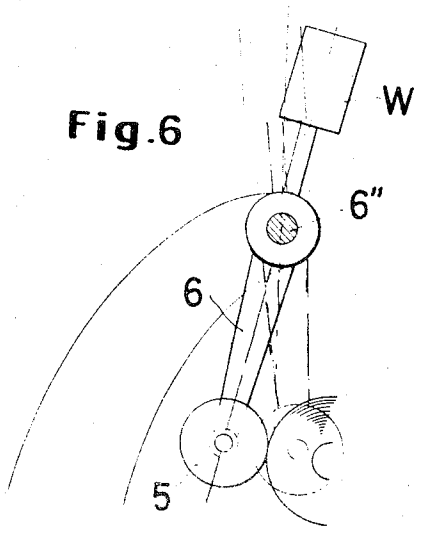


Fig. 7

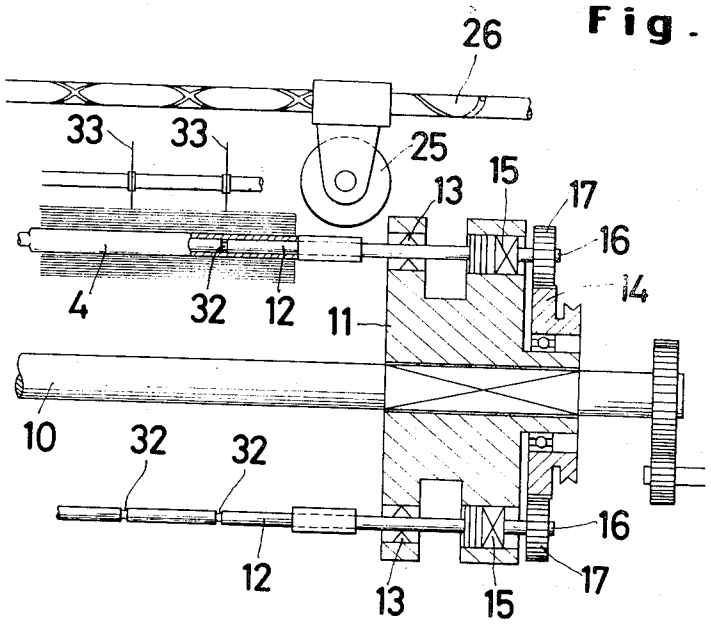
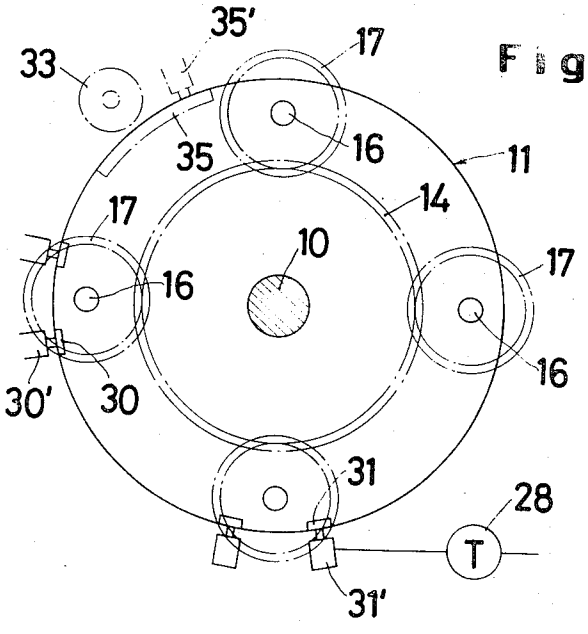


Fig. 8



INVENTOR

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SHEET REWINDER

This invention relates to a rewinder adapted to draw a feed sheet from a large roll of feed sheet and rewind the drawn sheet into small rolls. While the sheet is being wound on a rotating core, the decompressor roll is held down to press the sheet against the outer surface of the roll so as to permit the sheet to be wound around the core with a predetermined amount of tension. Bonding agent is applied to the upper surface of the sheet so that a bonding agent film is formed to a fixed length on the sheet. The sheet is cut so that the bonding agent film is divided into two portions; front and rear portions. The rear portion of the bonding agent film which now falls at the forward end of supply sheet is used to fasten that end of sheet onto a new core to start the winding of sheet thereon. The front portion of the bonding agent film which now falls at the tail end of the cutoff portion of the sheet is used to fasten that end of sheet onto the underlying portion of sheet already wound on the core to complete the sheet winding. It is an object of the present invention to cause the front portion of the bonding agent film to be moved farther from the point of contact so as to keep that portion from coming into contact with the core before the aforesaid depressor roll is brought into contact with the outer surface of the core, thereafter bring the depressor roll into contact with the core and subsequently rotating the two cores so as to effect the said fastening of the two ends of bonding agent film.

This invention is described hereinafter with reference to the illustrated embodiments.

FIG. **1** is a schematic side view of the entire rewinder in the state following completion of the core's winding motion,

FIG. **2** is a side view of a part of the rewinder in the state in which a turret is in the process of making an angular rotation subsequent to completion of the core's winding motion,

FIG. **3** is a side view of a part of the rewinder in the state in which the angular rotation of the turret has already been completed and the sheet is being cut by a cutting device,

FIG. **4** is a side view of a part of the rewinder in the state in which the sheet cutting has been completed and the core's winding motion has been resumed,

FIG. **5** and FIG. **6** are side views of depressor rolls which differ in design from the depressor rolls illustrated in FIG. **1** through FIG. **4**;

FIG. **7** is a plan view showing a part of the turret in section, and

FIG. **8** is a side view of the turret as seen in a direction different from that of FIG. **1**.

The supply sheet wound in a roll **1** is mounted rotatably on a suitable support. The sheet **1'** paid off the roll is passed under a bonding agent applying means **2** and over a pair of rolls **3** and **3**. It is then passed over a depressor roll **5** which is held in contact with a core **4**. By the counterclockwise rotation of the core **4**, the sheet **1'** is wound up around the core, with the upper surface of sheet facing toward the core.

The depressor roll **5** is supported at the free end of a swing arm **6**. The swing arm **6** is pushed out as by the piston of a piston type actuator **7** to confer energy for bringing the depressor roll **5** into contact with the outer surface of the core **4**. As the winding of sheet around the core progresses and the diameter of the roll of sheet increases gradually, the depressor roll **5** is pushed back

proportionally and the piston of the actuator **7** retracts by forcing the fluid (such as, for example, air) out of the cylinder through a throttle, causing the swing arm **6** to swing in the direction opposite that of energy exertion. The fact that the core has wound up a predetermined amount of feed sheet (a full core) is determined by using, as a parameter, the position to which the swing arm **6** has been swung back in the direction opposite that of energy exertion, the total diameter of the roll of sheet or the total length of feed sheet paid off the roll **1**. When this fact is sensed through such parameter, the rotation of the core **4** for sheet winding is stopped in the manner described hereinafter.

In order to draw the supply sheet from the roll **1** and wind up the drawn sheet, the core **4** rotates itself counterclockwise. It is held in position indirectly by an angularly rotatable main shaft **10** which is disposed lateral thereto. It, therefore, can be revolved around the main shaft in consequence of the rotation of the main shaft.

In the illustrated embodiment, the main shaft **10** is adapted so as to produce an angular rotation, 90° at a time. At one end thereof is fastened a disk **11**. On the circumference of the disk **11**, four spindles **12** are disposed parallel to the main shaft, spaced equally by intervals of 90° and supported in position each by a bearing provided with a one-way clutch **13** which is rotatable only in the counterclockwise direction and not rotatable in the clockwise direction. The aforementioned core **4** is inserted around the said spindle **12**.

When the main shaft is brought to a stop after an angular rotation, the first spindle assumes the first position at which a new core is set in position on the spindle, the second spindle assumes the second position at which the core set thereon winds up the feed sheet while it is kept in contact with the depressor roll **5**, the third spindle assumes the third position at which the tail end of the sheet wound on the core is fastened, and the fourth spindle assumes the fourth position at which the roll of sheet already wound on the core is removed from the spindle.

Setting of a new core on the spindle at the first position and removal of a full core from the spindle at the fourth position may be effected either manually or automatically with a mechanical means. The spindle **12** can be that which has an equiangular hexagonal section, so that it may be inserted fast in the inner hollow of the core and rotated in conjunction with the core.

At the protruding end of the main shaft **10** which penetrates through the disk **11**, a large toothed wheel **14** may be mounted freely so as to be rotated relatively to the main shaft **10**. This toothed wheel is continuously rotated by motive power.

Each spindle **12** is interlocked with a shaft **6** via an electromagnetic on-off clutch **15**. The shaft **16** has a small toothed wheel **17** fitted thereon and, by the agency thereof, is meshed with the said large toothed wheel **14**. The said shaft **16** may also be supported opposite the disk. This disk **11** may be substituted by a set of radially arranged spokes.

Consequently, the winding of feed sheet by the counterclockwise rotation of the core **4** at the second position is effected so long as the on-off clutch **15** of the spindle **12** holding the said core **4** in position remains in the interlocked position (ON status). From this, it is clear that the said on-off clutch **15** has only to be switched to its disconnected position (OFF status) in order that the core **4** may cease its rotation the moment

the aforesaid status of full core is sensed as mentioned previously.

When the core at the second position has wound up the predetermined amount of sheet thereon and, as a consequence, ceases its rotation, the bonding agent applying means **2** descends to a point intervening between the rolls **3** and **3**, applies bonding agent **19** sideways onto the upper surface of the sheet **1'**, and ascends back to its former position. In the place of the bonding agent applying means, there may be used a means adapted to attach a piece of two-face adhesive tape to the upper surface of the sheet **1'**. When the application of bonding agent is completed, the main shaft **10** rotates one quarter of a circle, causing the core held at the second position to be advanced to the third position and the core held at the first position to the second position respectively.

In this case, the core which is being advanced from the second position to the third position by the 90° rotation of the main shaft tends to rotate clockwise because of a pull given by the sheet wound thereon. Since the spindle **12** is supported in position, as mentioned previously, by a bearing which is provided with a one-way clutch **13**, however, the core is prevented from being rotated clockwise. As a consequence, the core draws the last portion of sheet out of the roll to a length corresponding to the distance travelled by the core because of the 90° rotation of the main shaft. The sheet **1'** is passed over half of the circumference of the depressor roll **5** and is pulled by the core which is in motion from the second position to the third position. Even if the core, while in transit from the second position to the third position after having wound up the predetermined amount of sheet at the second position, passes the point at which the depressor roll **5** will afterward come into contact therewith, the component of the said tension keeps the depressor roll **5** in a state pushed away in the direction opposite that of energy exertion. This condition lasts until the core has completed its travel from the second position to the third position. In the meantime, the core at the first position can be advanced to the second position without coming into contact with the upper surface of the sheet **1'**.

While the main shaft **10** is rotating one quarter of a circle, the shaft **20** around which the feed roll **1** is mounted actuates brakes **21** to control its free rotation. The rotation of the feed roll is so regulated that the sheet may not be broken by the tension which builds up in the sheet in consequence of the 90° rotation of the main shaft.

The aforesaid one-way clutch **13** serves the purpose of preventing the spindle **12** from being rotated clockwise while the core at the second position is being advanced to the third position in consequence of the 90° rotation of the main shaft. Therefore, it may be utilized as a substitute for a braking means.

When the 90° rotation of the main shaft is completed, the brakes **21** are released to render the shaft **20** freely rotatable. Consequently, the tension which has kept the depressor roll **5** in a retracted condition is relieved and the depressor roll **5** is returned, by the energy exerted thereon, to where it is brought into contact with the outer surface of the core which has recently assumed the second position. Thus, it presses the sheet **1'** against the core, causing the rear portion **19a** of the bonding agent **19** applied to the upper surface of the sheet **1'** to adhere to the core which is now held at the second position.

When the sheet **1'** is drawn out of the core while the core is being advanced from the second position to the third position in consequence of the 90° rotation of the main shaft, the bonding agent **19** applied to the sheet **1'** by the bonding agent applying means **2** is essentially required to be moved to a position such that the front portion **19*b*** and the rear portion **19*a*** thereof fall on both sides of the point at which the depressor roll **5** comes into contact with the core which has just assumed the second position. For this purpose, the position at which the bonding agent is applied to the sheet by the bonding agent applying means must be fixed in accordance with the diameter of the roll of sheet to be wound on the core. Denoted by **18** is a regulator adapted to move the bonding agent applying means **2** in the direction of the length of sheet **1'** so as to adjust the position of bonding agent application for the purpose mentioned above. The said regulator **18** may be omitted, of course, where the sheet rewinder of this invention is used for rewinding a feed sheet having a fixed thickness into rolls each containing a fixed length of sheet without exception.

The component of the tension which builds up in the sheet **1'** while the sheet **1'** is being drawn out of roll in consequence of the 90° rotation of the main shaft keeps the depressor roll **5** in a retracted position. While the depressor roll **5** is kept in that position, the front portion **19*b*** of the bonding agent **19** is allowed to pass the point of contact without being brought into contact, on its upper surface, with the core which is being advanced to the second position.

While the angular rotation of the main shaft is in process, the depressor roll **5** must be safely retained in its retracted position and the front portion **19*b*** of the bonding agent must be allowed, with absolute certainty, to pass the said point of contact without being brought into contact with the core which is in transit to the second position. For this purpose, there may be incorporated a device which serves to temporarily immobilize the depressor roll in its retracted position into which the roll has been driven back by the increasing diameter of the roll of sheet wound on the core at the second position.

Where the energy exerted on the depressor roll **5** originates in the piston type actuator **7**, the port formed for the passage of the fluid (such as, for example, air) into and out of the cylinder may be blocked by an electromagnetic valve while the angular rotation of the main shaft is in process. As a result, the piston is restricted from moving in either of the forward and backward directions. After the angular rotation of the main shaft has been completed, the valve may be switched so as to permit the piston to move forward. In the case of the embodiment of FIG. **5** in which the energy to be exerted originates in the traction which is produced by a spring **22**, a claw member **23** is required to engage with a projection **6'** on the swing arm **6** after the depressor roll has been brought to its retracted position. In this case, the claw member **23** should be so adapted as to be movable along a circular locus described around the fulcrum **6''** of the swing arm as the center, so that the required engagement with the projection **6'** may be obtained at a fixed position which is determined by the desired diameter of the roll of sheet wound on the core. At the same time, it is necessary to provide a release

means **24** (such as, for example, a solenoid) which, on completion of the angular rotation of the main shaft, pushes the claw member **23** against the energy being exerted thereto so as to release the engagement thereof with the projection **6'**.

FIG. **6** illustrates a depressor roll **5** which is constructed so as to be gravitationally brought into contact with the core. The embodiment illustrated here is not provided with any means which serves the purpose of retaining the depressor roll **5** in its retracted position into which the roll has been pushed back by the increasing diameter of the roll of sheet wound on the core. The arm **6** for suspending the depressor roll **5** is extended beyond the fulcrum **6''**. On the said extension of the arm, there is fixed a balance weight "*w*" which lessens the gravity of the depressor roll **5**, so that the force with which the roll comes into contact with the surface of the core may be decreased to produce a mild impact between the two surfaces at the time of contact. Consequently, the component of the tension which builds up on the sheet **1'** in consequence of the angular rotation of the main shaft suffices for the purpose of keeping the depressed roll securely in its retracted position. By using the balance weight "*w*" of the type shown in FIG. **1** through FIG. **4**, incl., or of the type shown in FIG. **5**, it is made possible to lessen the gravity of the depressor roll **5**, lower the pressure requirement for the actuator **7**, or decrease the resilience of the spring **22**.

After the main shaft **10** has completed its angular rotation and the depressor roll **5** has been brought into contact with the outer surface of the core at the second position, the cutter blade **25** cuts the sheet **1'** in the direction of its width at a point anterior to the point of contact between the depressor roll **5** and the core and at a position at which the front portion **19***b* of the bonding agent **19** is fastened to the sheet **1'**.

The said cutter blade **25** is supported in position by means of the screwed lever **26** and the guide **27** which are disposed parallel with each other below the sheet **1'** in the direction of the sheet's width. The cutting of the sheet is effected by rotating the screw lever **26** so as to move the cutter blade across the sheet from outside one edge of the sheet to outside the other edge. The subsequent round of cutting may be effected by reversing the direction of the movement of the cutter blade. When the screwed lever **26** is provided with a reciprocating screw thread, the direction of the lever rotation need not be reversed in making the cutter blade travel back and forth alternately on the screwed lever **26**.

After the cutter blade **25** has cut the sheet **1'**, the clutches at the second and the third position are switched to their interlocked position respectively. Consequently, the cores held at these positions begin to rotate counterclockwise. Since the core at the third position need not be rotated any longer after the cut of sheet has been wound up on the roll, the clutch **15** at this position may be so adapted as to be switched back to its disconnected position thereafter. For this purpose, a timer **28** may be inserted in the circuit which is feeding electric current to the clutch **15** at the third position. This timer **28** has only to be set so that the supply of electric current to the clutch will be discontinued upon lapse of the time which is required for completely winding the cut end of sheet.

Along the outside of the third position, a roller **29** may be disposed in such condition that the roller will come into contact with the outer surface of the sheet wound on the core at the third position. Then, the roller **29** enables the bonding agent **19** placed at the tail end of sheet to be fastened safely to the underlying sheet, completing the roll end sealing of sheet.

From the spindle which has been advanced to the fourth position, a small roll of sheet having a sealed end is removed together with the core. An empty core is set in position on the spindle which has been returned to the first position.

Referring to the drawings, **30** and **30'** denote slip-type current collector and brush which are used for feeding electric current to the clutch **15** at the second position so as to rotate the core placed at that position. Similarly, **31** and **31'** denote slip-type current collector and brush which serve to feed electric current to the clutch **15** at the third position so as to rotate the core placed at that position.

According to this invention, therefore, the sheet rewinding operation can be continued fully automatically until the feed sheet **1** is used up, if a device for removing the core together with the roll of sheet wound thereon from the spindle at the fourth position and a device for mounting an empty core on the spindle at the first position are additionally installed and they are operated respectively for the purposes mentioned each time the main shaft completes its 90° rotation.

Grooves **32** may be formed annularly at fixed intervals on the outside of each spindle. While the core is being advanced from the first position to the second position, the core is made to rotate and pass under blades **33** which are regularly spaced. Then, the core while on the spindle can be cut crosswise by lowering these blades **33** until their edges protrude into the said grooves **32**. At a position anterior to the bonding agent applying means **2**, blades **34** for cutting the sheet **1'** may be disposed so as to fall in the same planes as the said blades **33**, whereby the sheet **1'** can be divided into parallel strips. The strips of sheet, thereafter, are wound on the corresponding divided portions of the core. In this case, annular blade grooves may be formed on the depressor roll **5** at the same intervals as the blades **34** so as to receive the protruding edges of these blades **34**. Consequently, the blades and the corresponding blade grooves provide means for cutting the sheet into strips.

Denoted by **35** and **35'** are current collector and brush which are installed for the purpose of cutting the core crosswise.

According to this invention, the bonding agent applying means applies the bonding agent **19** on the upper surface of the sheet after the core stationed and rotated at the second position has wound up the predetermined amount of sheet. Then, while the core at the second position is being advanced without rotation to the next position and the core at the first position is simultaneously being advanced to the second position, the depressor roll which tends to come into contact with the outer surface of the core at the second position is kept out of the point of contact. While the depressor roll is kept in its retracted position, the bonding agent **19** applied on the sheet is moved so that it may straddle the said point of contact. Thereafter, the depressor roll is brought into contact with the outer surface of the core at the second position and the sheet is cut at a point an-

terior to the said point of contact so that the bonding agent is divided into the front and the rear position. Subsequently, the cores are rotated to permit the forward end of sheet and the tail end of sheet to be sealed respectively. Thus, the rewinding of a large feed roll of sheet into small rolls of sheet can be accomplished with high efficiency.

What is claimed is:

1. In a sheet rewinder wherein a core is rotated to draw out a sheet from a feed roll, the rotation of the core being stopped after the core has wound up a predetermined amount of sheet, said sheet rewinder comprising in combination, a means for applying a bonding agent to the sheet at a point intervening between the feed roll and the core while the core's rotation is suspended; a depressor roll disposed relative a core winding location and adapted to apply force against the sheet and towards contact with the outer surface of the core at a point intervening between the said bonding agent applying means and the core, said depressor roll disposed for retracting movement by the increasing diameter of the roll of sheet on the core; means for winding sheet material on the core; an angular rotating means for advancing the core having a predetermined amount of sheet wound thereon to a position free from contact with the depressor roll and subsequent to the application of the bonding agent by the bonding agent applying means; means for simultaneously advancing a new core to the core winding location at a position opposite the depressor roll; means for restricting the supply roll rotation and means for keeping said depressor roll in retracted position during the angular rotation of the angular rotating means; and a means for cutting the sheet in the direction of its width at a point immediately anterior to the said point of contact and within the area of applied bonding agent, the bonding agent applied to the sheet being moved to the cutting means location by means that the sheet is paid out in consequence of the angular rotation of the angular rotating means while rotation of the supply roll is restricted, the applied bonding agent being disposed opposite the sheet cutting means and being severed thereby.

2. The sheet rewinder of claim **1** wherein a sheet from the feed roll is severed into a plurality of strips by cutting blades disposed relative the depressor roll and in cooperation therewith.

3. The sheet rewinder of claim **1** wherein a core is severed into a plurality of cores by blades disposed relative the angular rotating means at a location prior to advancing a new core to core winding location.

4. The sheet rewinder of claim **1** wherein a roller is disposed relative the angular rotating means at a location for placing the tail end of a severed sheet containing bonding agent into fastening position onto an underlying sheet of a sheet wound core.

5. In a sheet rewinder wherein a core is rotated to draw out a sheet from a feed roll, the rotation of the core being stopped after the core has wound up a predetermined amount of sheet, said sheet rewinder comprising in combination, a means for applying a bonding agent to the sheet at a point intervening between the feed roll and the core while the core's rotation is suspended; a depressor roll disposed relative a core winding location and adapted to apply force against the sheet and towards contact with the outer surface of the core at a point intervening between the said bonding agent applying means and the core; said depressor roll disposed for retracting movement by the increasing diameter of the roll of sheet on the core; means for winding sheet material on the core; an angular rotating means for advancing the core having a predetermined amount of sheet wound thereon to a position free from contact with the depressor roll and subsequent to the application of the bonding agent by the bonding agent applying means; means for simultaneously advancing a new core to the core winding location at a position opposite the depressor roll; a means for restricting the supply roll rotation during angular rotation of the angular rotating means; means for holding the depressor roll securely in retracted position during aforesaid angular rotation; means for releasing the hold of the depressor roll by said means after completion of rotation of the angular rotating means; and a means for cutting the sheet in the direction of its width and within the area of applied bonding agent, the bonding agent applied to the sheet being moved to the cutting means location by means that the sheet is paid out in consequence of the angular rotation of the angular rotating means while rotation of the supply roll is restricted, the applied bonding agent being disposed opposite the sheet cutting means and being severed thereby.

6. The sheet rewinder of claim **5** wherein a sheet from the feed roll is severed into a plurality of strips by cutting blades disposed relative the depressor roll and in cooperation therewith.

7. The sheet rewinder of claim **5** wherein a core is severed into a plurality of cores by blades disposed relative the angular rotating means at a location prior to advancing a new core to core winding location.

8. The sheet rewinder of claim **5** wherein a roller is disposed relative the angular rotating means at a location for placing the tail end of a severed sheet containing bonding agent into fastening position onto an underlying sheet of a sheet wound core.

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