# United States Patent [19]

**Annis, Jr.**

[11] **3,718,526**

[45] **Feb. 27, 1973**


## [54] APPARATUS FOR FRICTION FUSING


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[73] Assignee: **Signode Corporation**



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[52] **U.S. Cl.**.....**156/580,** 100/29

[51] **Int. Cl.**.....**B30b 5/00,** B65b 13/24

[58] **Field of Search** .....156/73, 580; 100/29, 30, 25, 100/26



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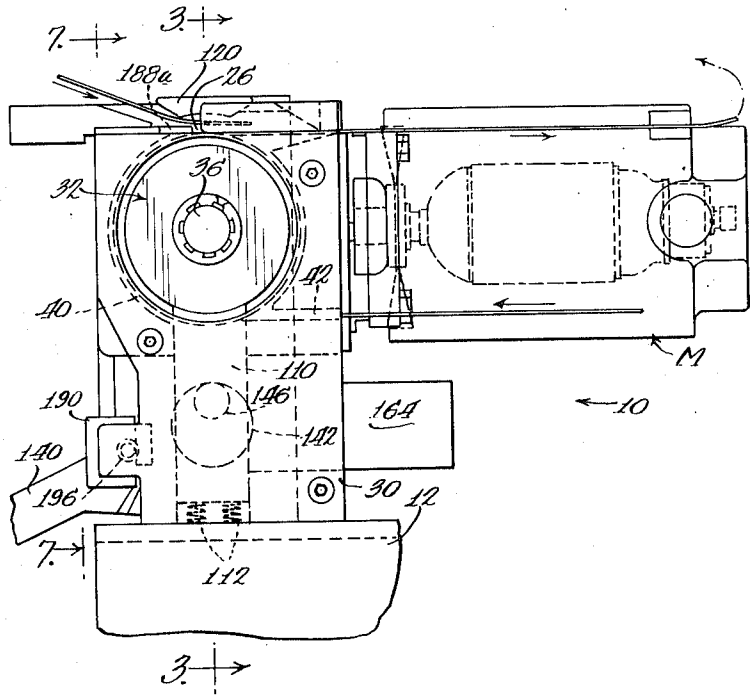
*Attorney*—Dressler, Goldsmith, Clement & Gordon



[57] **ABSTRACT**

A strapping machine for feeding strap from a supply, tensioning a strap loop around an article, friction fusing overlapping end portions of the strap and cutting the loop of strap from the supply. The machine includes a strap engaging wheel, with an anvil and a feed pad supported adjacent the periphery of the wheel and biased towards the wheel to frictionally grip strap between the anvil and wheel or the feed pas and wheel. A unidirectional motor drives the feed wheel, and a drive mechanism between the motor and the wheel is capable of (1) rotating the wheel in one direction while the feed pad forces the strap into engagement with the periphery of the wheel, (2) rotating the wheel in a second direction while the anvil frictionally grips over-lapping portions of the strap to tension the strap loop about an article and (3) automatically converting rotation in the second direction to oscillating movement to friction fuse the overlapping strap portions.


**24 Claims, 11 Drawing Figures**



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SHEET 1 OF 5

Fig. 1.

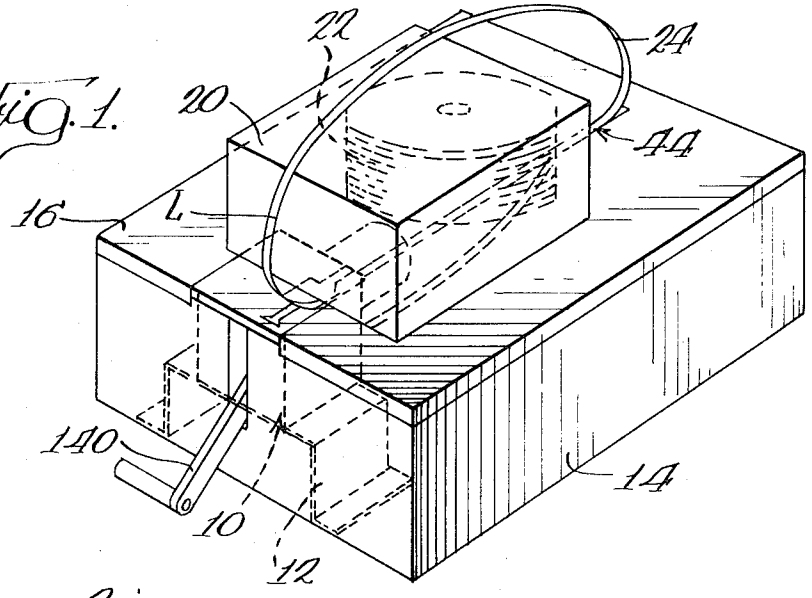
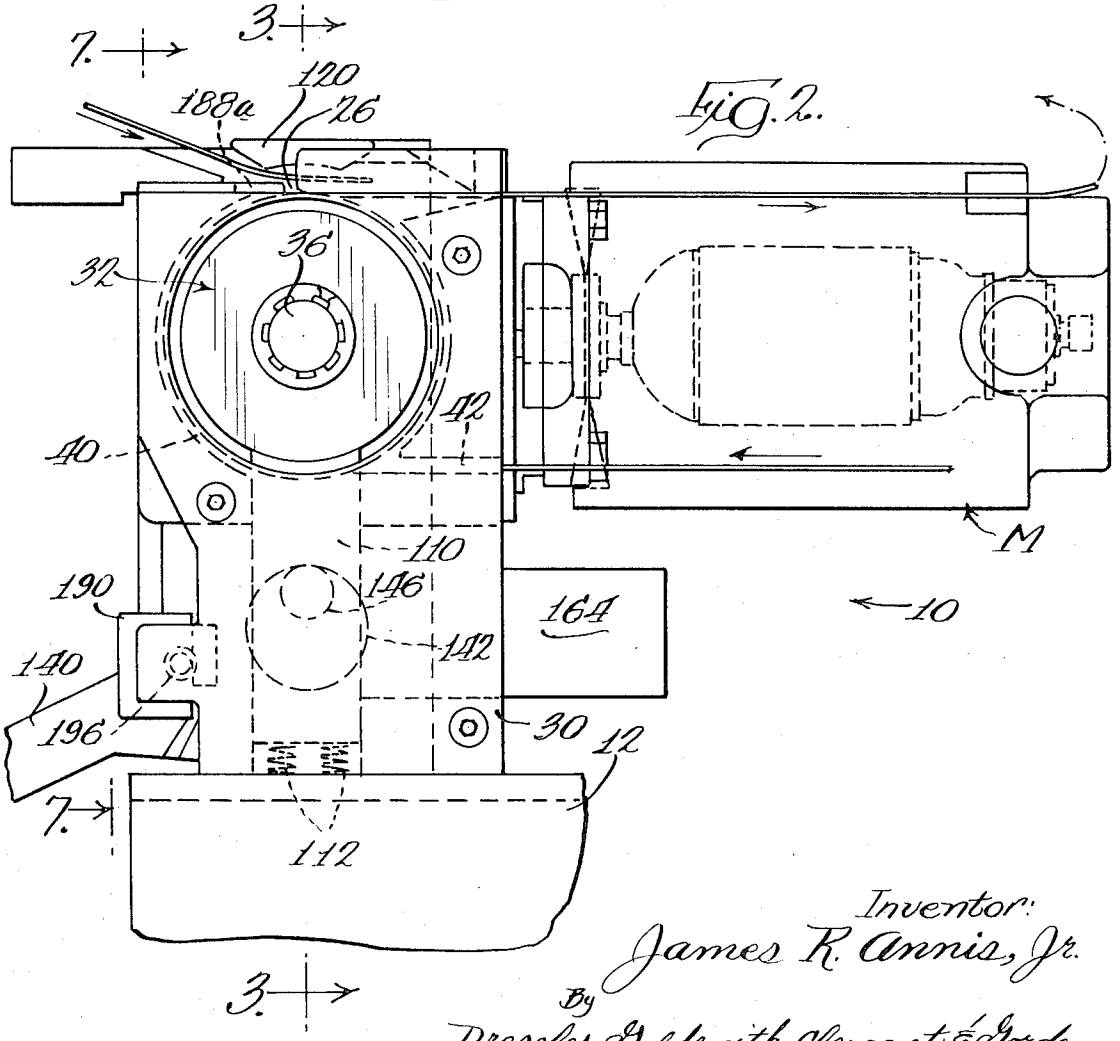



Fig. 2.




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Fig. 3.

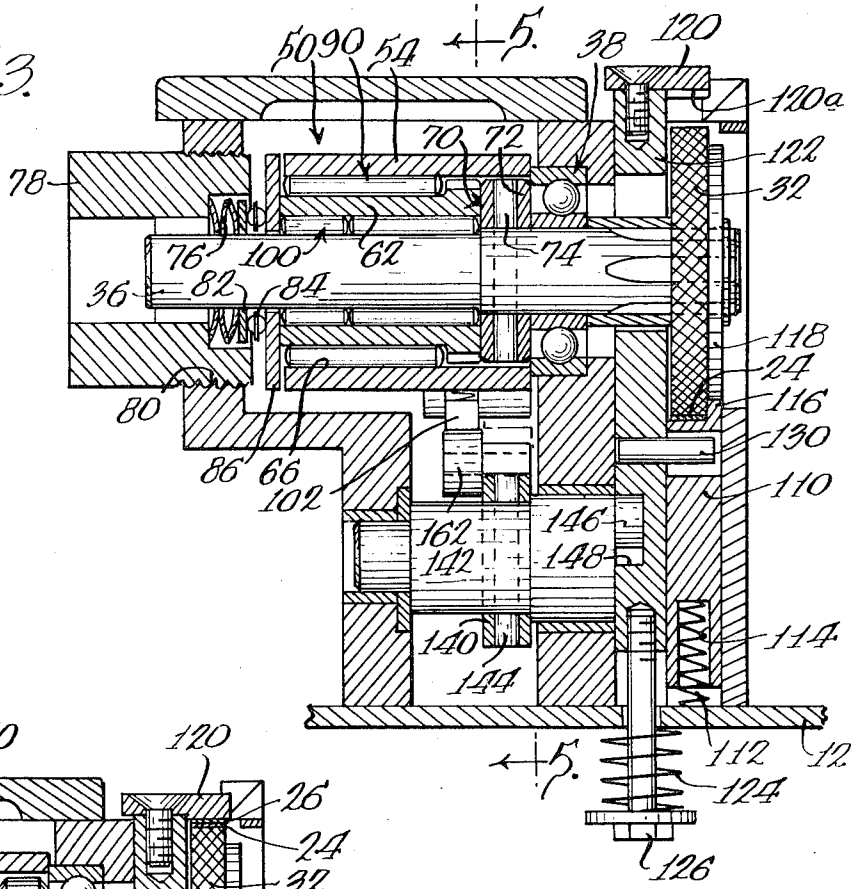
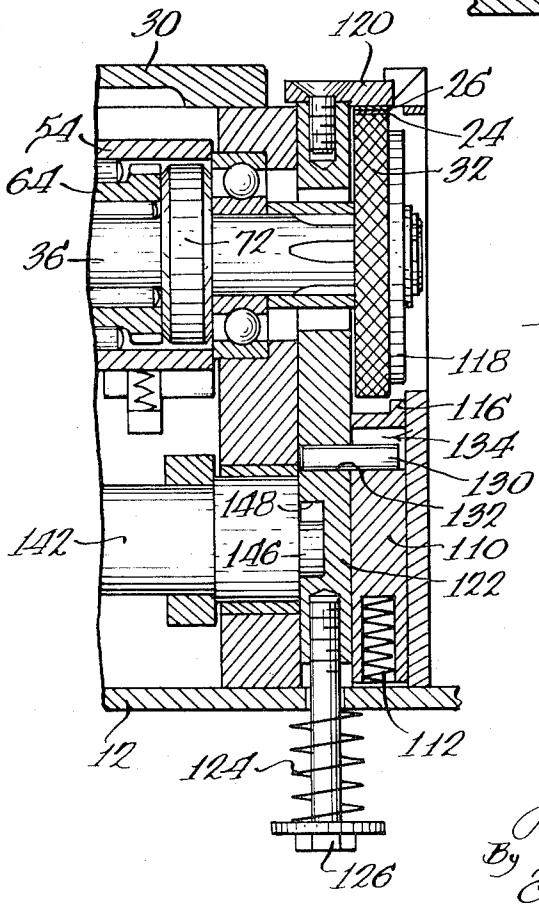



Fig. 4.




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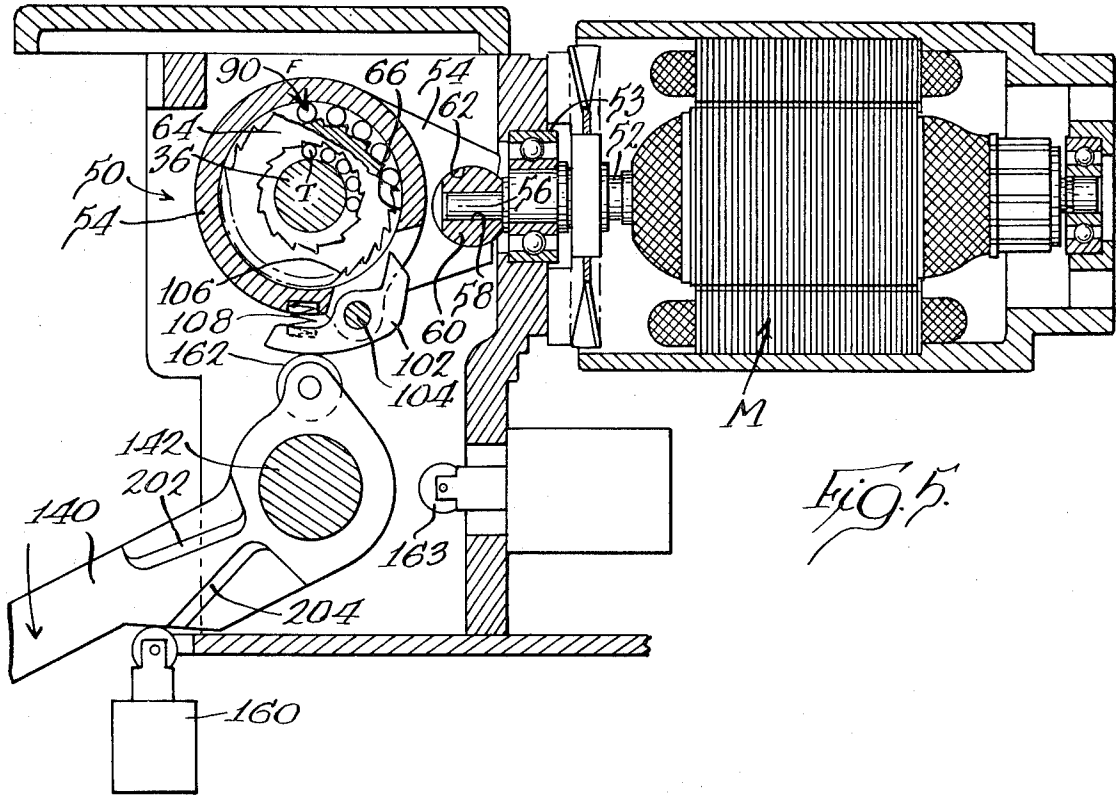



Fig. 5.

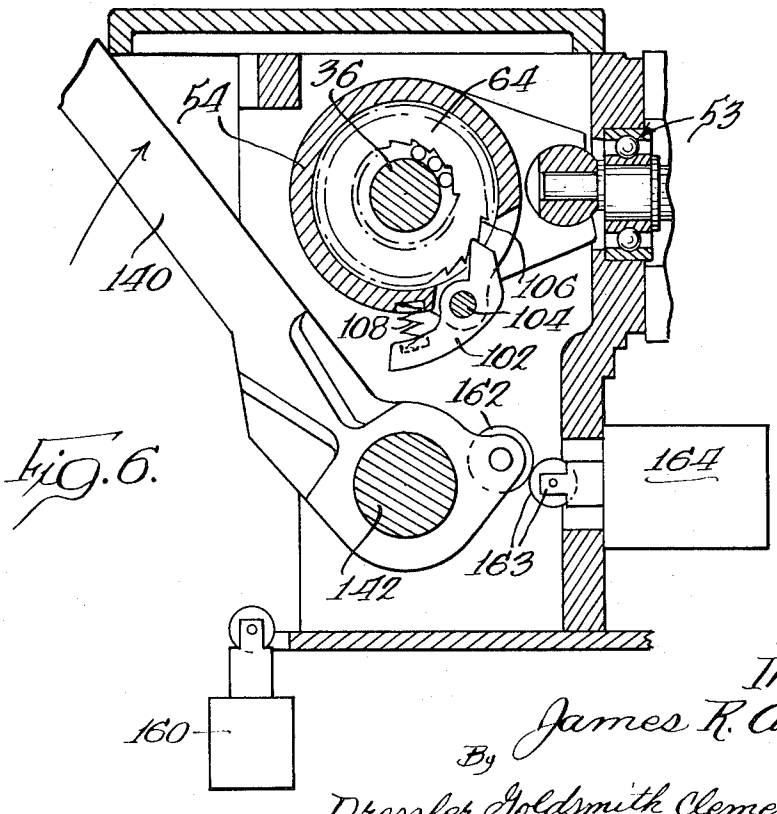



Fig. 6.

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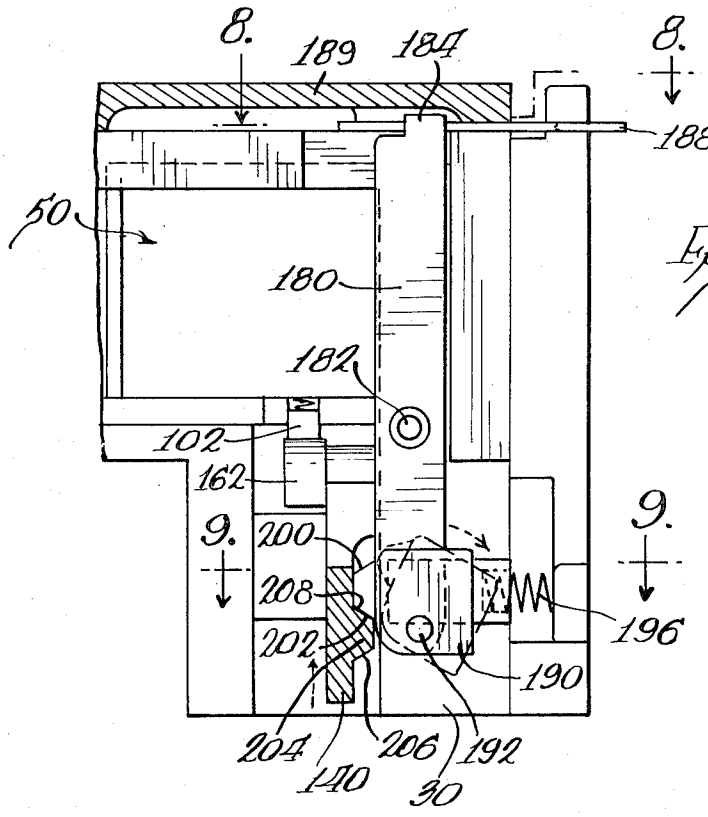



Fig. 7.

Fig. 9.

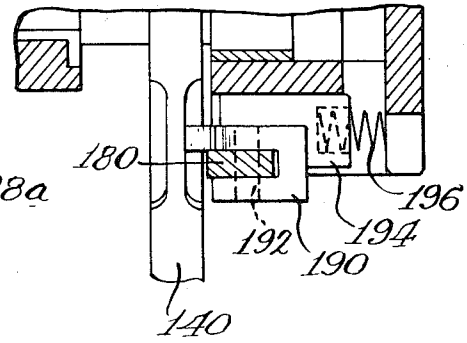
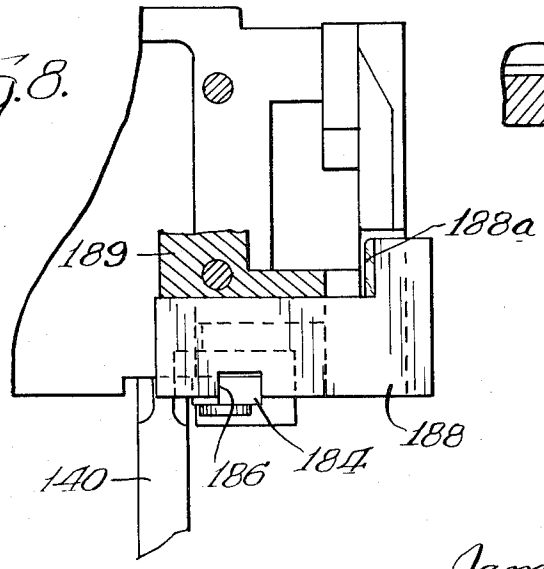



Fig. 8.




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Fig. 10.

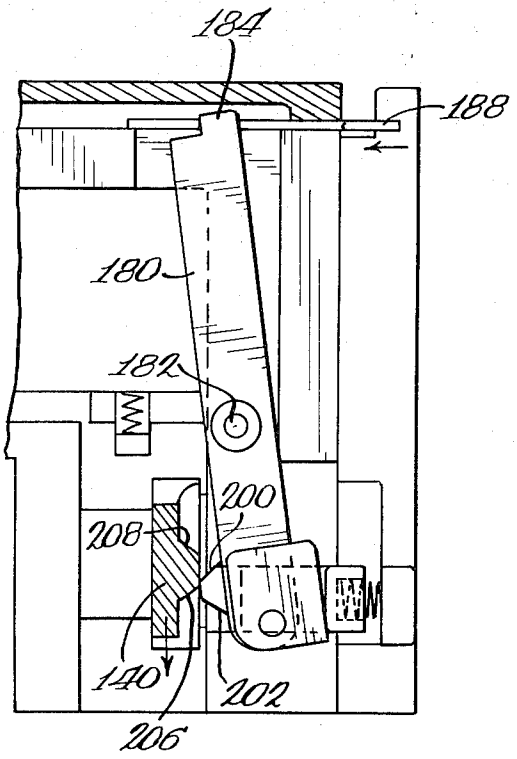
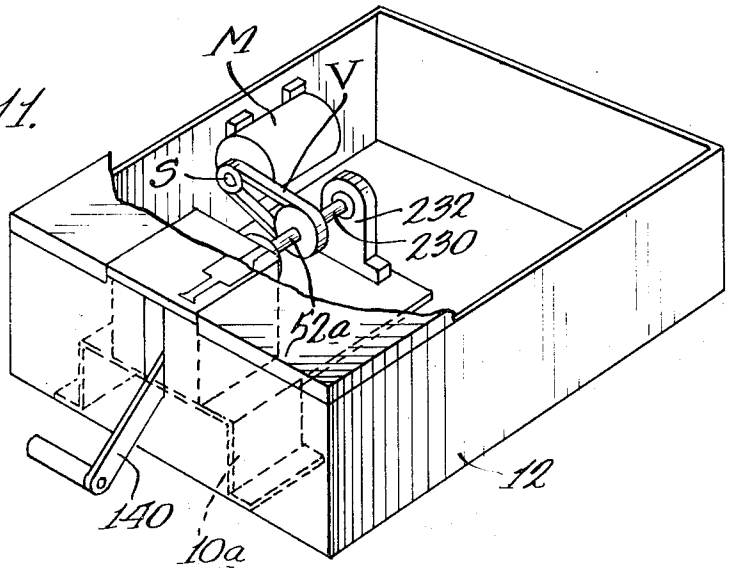



Fig. 11.




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# APPARATUS FOR FRICTION FUSING

## BACKGROUND OF THE INVENTION

The present invention relates generally to strapping machines and more particularly to strapping machines of the type disclosed in U. S. Pat. Nos. 3,442,203 and 3,548,740.

In recent years the use of thermoplastic strapping for packaging articles has found a remarkable degree of commercial success. In the packaging of articles, it is customary to place a strap or ligature in constricting relation around the article and tension the strap before joining overlapping portions.

The assignee of the entire interest to the present application has developed several machines to automatically feed a strap loop from a supply around an article and place the leading end in overlapping relation to the main body of strap, tensioning the strap loop around the article and friction-fusing the overlapping portions of the strap. Examples of these machines are disclosed in the above mentioned patents.

In addition, applicant's assignee has developed several hand tools that are capable of tensioning a strap loop that has been applied to an article and subsequently friction-fusing overlapping portions of the strap loop. Examples of these tools are disclosed in U.S. Pat. Nos. 3,442,732; 3,442,733; 3,442,734; and 3,442,735, as well as application Ser. No. 801,133 filed Feb. 20, 1969 now U.S. Pat. No. 3,586,572, and application Ser. No. 46,591 filed June 16, 1970.

Applicant's assignee has generally referred to the hand carried apparatus as tools while referring the larger apparatus of a more permanent nature as machines. However both types of equipment are considered in the field of strapping apparatus.

While the various apparatuses disclosed in the above patents have found a remarkable degree of commercial success, applicant's assignee is continually striving to produce improved and simplified apparatuses that are capable of forming operations described in these patents in a more expeditious manner.

## SUMMARY OF THE INVENTION

The present invention contemplates a strapping machine that is of the semi-automatic type and is capable of feeding strap from a supply to allow the formation of a loop around the article, compressing overlapping ends of the strap, tensioning the strap and automatically friction-fusing the strap after a a predetermined tension has been applied to the loop. All of the above is accomplished by a single rotating element that is driven by a unidirectional motor through a drive mechanism that utilizes conventional clutches. Furthermore, the machine incorporates cutting means that are capable of being actuated by the single control lever that controls the movement of the single moving element.

In the illustrated embodiment, the strapping machine includes a strap-engaging wheel or element having an anvil and a feed pad cooperating therewith, with a drive mechanism connected to the element that is capable of (1) rotating the feed wheel in one direction to feed strap from a supply, (2) rotate the wheel in the opposite direction to tension the strap and (3) automatically convert rotary motion in the opposite direction to oscillating motion of the strap-engaging wheel to friction-fuse overlapping end portions after a predetermined tension has been applied to the loop. All of this is accomplished with a minimum number of moving parts that cooperate with each other and can be adjusted to vary the tension on the loop.



The drive mechanism for feeding strap from a source, tensioning the strap about an article and friction-fusion sealing the overlapping portions of the strap includes an input member having rocking or reciprocating means cooperating therewith to rock the member between extreme positions, a gripping or output member adapted to engage the strap with first means between the input and output members to intermittently rotate the output member in response to rocking movement of the input member. The drive mechanism further includes second means between the input and output members for intermittently rotating the output member in an opposite direction to tension the strap about an article and automatically convert the rotary motion in the opposite direction to an oscillating motion when a preselected amount of tension has been drawn in the loop to cause interface melting between the frictionally engaged overlapping portions of the strap.

## BRIEF DESCRIPTION OF SEVERAL VIEWS OF DRAWINGS

FIG. 1 is a perspective view of the strapping machine enclosed in a supporting structure with a strap loop encompassing an article and ready for tensioning and friction-fusion sealing;

FIG. 2 is a fragmentary end view of the functioning portion of the machine, as viewed along the end having the wheel supported thereon;

FIG. 3 is a vertical section taken generally along line 3—3 of FIG. 2 showing the various parts of the mechanism in a strap-feeding position;

FIG. 4 is a fragmentary view similar to FIG. 3 showing the various parts in a tensioning and fusing position;

FIG. 5 is a section view taken generally along line 5—5 of FIG. 3;

FIG. 6 is a fragmentary view similar to FIG. 5, showing the drive mechanism in a second operative position for tensioning and friction-fusing;

FIG. 7 is a section view taken generally along line 7—7 of FIG. 2;

FIG. 8 is a section view taken generally along line 8—8 of FIG. 7;

FIG. 9 is a section view taken generally along line 9—9 of FIG. 7;

FIG. 10 is a fragmentary view similar to FIG. 7 showing the cutting mechanism in its actuated position; and

FIG. 11 is a fragmentary perspective view similar to FIG. 1, showing a slightly modified form of drive motor.

## DETAILED DESCRIPTION

While this invention is susceptible of embodiment in many different forms, there is shown in the drawings and will herein be described in detail one specific embodiment and a modification thereof with the understanding that the present disclosure is to be considered as an exemplification of the principles of the invention and is not intended to limit the invention to the embodiments illustrated.

FIGS. 1 and 2 of the drawings generally disclose a strapping machine 10 supported on a base or platform 12 within a container 14 that has a cover 16 adapted to support an article 20 which is in a position to have a loop of strap constricted around the article. The container 14 encloses a large supply or roll of strap 22 that is capable of being fed by the strapping tool 10 in sufficient quantity to produce a loop L of strap 24 about the article with the leading end portion 26 overlapping the main body of strap adjacent the strapping machine 10. Container 14 may be carried by a castered frame, so that the machine can easily be transported to different locations, if and when desired.

Referring particularly to FIG. 3, the strapping machine 10 includes a casting or housing 30 supporting all of the elements necessary for automatically feeding a supply of strap from the source 22 in sufficient quantity to produce a loop L, tensioning the strap loop about the article 20 and automatically friction-fusing the overlapping portions of the strap when a predetermined tension level has been reached on the strap. The feeding, tensioning and sealing of overlapping portions is accomplished by a single element or strap-engaging wheel 32 splined to a shaft 36 that is rotatably supported by a bearing 38 in the housing 30. The housing or casting 30 and the wheel 32 cooperate to define a path 40 (FIG. 2) for the strap 24 along the peripheral surface of the wheel with the opening or strap feeding path 40 having an extension 42 terminating adjacent one surface of the housing. The opposite end of the arcuate path 40 is in alignment with an elongated slot 44 (FIG. 1) defined in the container cover 16 which acts as a continuation of the strap feeding path so that the strap may be fed under the lower surface of the article 20.

The drive means for the strap-engaging wheel or member 32 is more clearly shown in FIGS. 3 and 5 and includes a unidirectional motor M having its output shaft 52 supported by bearings 53. A drive mechanism, generally designated by the reference numeral 50, is located between the motor shaft 52 and output shaft 36 and is capable of converting unidirectional rotation of the motor shaft 52 to intermittent rotary movement of the wheel 32 in either direction or alternatively oscillating movement of the wheel. For this purpose, the drive mechanism 50 includes an input member 54 adapted to be oscillated or rocked between extreme positions in response to rotation of the motor shaft 52. The oscillating or rocking means (FIG. 5) includes an eccentric pin 56 secured to the shaft 52 and received in an opening 58 of an element 60 supported for movement in a recess 62 defined in the input member 54. Thus, as is explained in more detail in the above mentioned copending Ericsson application Ser. No. 801,133, rotation of the motor shaft 52 will rock the input member 54 between extreme positions.

The drive mechanism of the invention includes first means between the input member and the strap-gripping element, consisting of wheel 32 and shaft 36, for intermittently rotating the element in one direction to feed strap from the source 22 in sufficient quantity to encompass the article and have a free or leading end in overlapping relation with a portion of the strap engaged by the element to form a strap loop. This means is more clearly shown in FIGS. 3 and 5 and includes an intermediate member 64 surrounding the shaft 36 and located within an opening 66 in the input member 54.

The intermediate member 64 is connected to the element or output member 32,36 through a friction clutch 70 (FIG. 3) consisting partially of a friction disc 72 connected to shaft 36 through a pin 74. The other element of the friction clutch 70 includes the end surface of the intermediate member 64 that is biased into engagement with the surface of the disc 72 by biasing means including a spring 76 having one end in engagement with a cap 78 threaded into an opening 80 in the housing 30. The opposite end of the spring 76 is in contacting engagement with an annular disc 82 and forces the intermediate member 64 towards the disc 72 through bearing means 84 and a further disc 86. The biasing means including spring 76 and cap 78 is capable of varying the frictional engagement between the two elements of the friction clutch 70 by adjustment of the cap 78 relative to the housing 30, for a purpose which will be described later.

The drive mechanism for rotating the strap-gripping wheel 32 in a feed direction further includes a one-way clutch 90 between the input member 54 and the intermediate member 64. The one-way clutch or unidirectional clutch means 90 (FIG. 5) is capable of rotating the shaft 36 and the wheel 32 in a clockwise direction to feed strap from the source 22 in a manner which will be described in more detail later.

The drive mechanism 50 further includes a second unidirectional clutch 100 interposed between the intermediate member 64 and the output member for rotating the wheel 32 in a counterclockwise direction as viewed in FIG. 5, to tension the strap loop about the article. The means for tensioning the strap loop further includes a pawl 102 (FIG. 5) pivoted by a pin 104 on the input member 54 and having one end biased toward engagement with ratchet teeth 106 on the intermediate member 64, with the biasing means being in the form of a spring 108 between the input member and the opposite end of the pawl.

The means for feeding strap from a source 22 further includes a feed pad cooperating with the peripheral surface of the wheel 32 to produce friction engagement between the wheel and the strap so that rotation of the wheel will feed strap from the source 22 when the drive mechanism 50 is conditioned for the feeding operation. The feed pad is shown in a first or operative position in FIG. 3 wherein the pad is in strap-gripping relation with the wheel to produce frictional engagement between the strap 24 and the periphery of the wheel. For this purpose, the feed pad 110 is biased upwardly toward the wheel 32 by springs 112 received in recesses or openings 114 and having their free ends engaging the platform 12. The upper or engaging end of the feed pad has a laterally offset flange 116 having an end surface that cooperates with a reduced diameter portion 118 on the wheel 32 such that the gripping surface of the wheel, which preferably is knurled or otherwise roughened to increase frictional engagement with the strap, is not directly contacted by the feed pad at any time. The feed pad 110 has a second position, shown in FIG. 4, wherein the adjacent surface of the pad is spaced a sufficient distance from the periphery of the wheel 32 to allow unrestricted movement of the strap between the two surfaces. The mechanism for moving

and holding the feed pad in a second position will be described in more detail hereinafter.

The tensioning and friction-fusion sealing of the overlapping portions of the strap loop are accomplished by producing frictional engagement between the overlapping portions of the strap through a mechanism which will now be described. The mechanism for producing the frictional engagement between overlapping portions of the strap includes an anvil **120** having a knurled surface **120***a* cooperating with the peripheral surface of the gripping wheel **32** and normally biased to a position where the surface **120***a* on the anvil is urged towards the surface of the wheel to frictionally compress the overlapping portions of the strap between the wheel and the anvil. For this purpose, the anvil **120** includes an extension **122** guided for movement along a path defined by a recess in the housing. The biasing means is in the form of a spring **124** that is interposed between the supporting base **12** and a screw **126** threaded into an opening in the extension **122**.

According to one aspect of the invention, the feed pad **110** and the anvil **120** have cooperating means for maintaining the anvil spaced from the surface of the wheel while the strap is frictionally gripped between the surface and the feed pad and alternatively maintaining the pad spaced from the wheel surface while the anvil is frictionally gripping the overlapping portions of the strap. This is accomplished by a pin **130** (FIG. 4) press fitted into an opening **132** in the anvil extension **122** with a portion of the pin received in an elongated opening **134** in the feed pad.

The strapping machine **10** further includes manual means or a lever **140** for moving the anvil and feed pad between their first and second respective positions and conditioning the drive mechanism for feeding or tensioning and fusing. The lever **140** is pivotally supported on the housing by a stub shaft **142** secured to the lever by a pin **144** (FIG. 3). The stub shaft **142** has an eccentric pin **146** fixedly secured to the end thereof and received in a recess **148** defined in the anvil, more specifically the anvil extension **122**. The lever **140** is normally held in a detented position shown in FIGS. **1** and **2** by a mechanism that will be described later. In the detented position the eccentric **146** overcomes the biasing means **124** for the anvil and holds the anvil in a second inoperative position where the anvil surface **120***a* (FIG. 3) is spaced from the periphery of the wheel to allow unobstructed movement of strap between the peripheral surface of the wheel **32** and the gripping surface **120***a* of the anvil. In this position, the pin **130** is located between the upper and lower extremities of the elongated opening **134** so that the biasing means **112** will force the feed pad **110** into frictional-gripping relation with the periphery of the feed wheel **32**.

The second position for the feed pad and anvil is shown in FIG. 4 wherein the anvil is biased into engagement with overlapping portions of the strap to produce frictional engagement between the overlapping portion **26** and the main body of the strap **24**. In this position, the pin **130** is in engagement with the lower surface of the elongated opening **134** and overcomes the biasing means **112** to positively hold the feed pad in a second position wherein the gripping surface is spaced from the wheel a sufficient distance to allow unobstructed movement of the strap along the path **40**.

The pivoted lever **140** performs the dual function of moving the anvil and feed pad between their respective first and second positions and also conditioning the drive mechanism **50** for either a strap-feeding operation, or loop-constricting, strap-tensioning and friction-fusing operation. For this purpose, a normally open switch **160** is disposed in the path of the lever **140** and is adapted to be actuated upon counterclockwise pivotal movement of the lever from the neutral detented position which will be described later. In the actuated position shown in FIG. **5**, the lever has been pivoted counterclockwise sufficient to close the normally open switch **160** which is connected in a suitable circuit to the motor to thereby actuate the motor and rotate the motor shaft **52** in one direction.

The lever **140** or manual means is also adapted to be moved in a clockwise direction form its detented position to condition the drive mechanism for tensioning and friction-fusion sealing and to actuate the motor for rotation and subsequent oscillation of the strap-gripping wheel **32**. To perform this function, the lever **140** has a roller **162** (FIGS. **5** and **6**) rotatably supported on an extension thereon and located in alignment with one end of the pawl **104** and an actuating member **163** for a second switch **164**.

According to another aspect of the invention, the strapping tool of the present invention further includes cutting means cooperating with the anvil and actuated in response to movement of the lever **140** from a tensioning and friction-fusing position to the neutral detented position. The cutting means or mechanism is illustrated in FIGS. **7–10** and includes a link **180** pivoted intermediate its ends at **182** on the housing or casting **30**. One end of the link **180** has a projection **184** received in a recess **186** defined in a cutting element **188** having a cutting edge **188***a* that is guided for reciprocal movement within the housing **30** by a cover **189**. The opposite end of the link **180** has a U-shaped actuating member **190** pivotally supported by a pin **192**. The actuating member **190** is normally held in a first position by a block **194** slidably supported in a recess in the housing **30** and biased to the solid line position shown in FIGS. **7** and **9** by a spring **196**. The actuating member **190** further includes a pair of inclined camming surfaces **200** and **202** that are disposed in the path of a projection **204** on the lever **140** with the projection having similar camming surfaces **206** and **208**. The arrangement of the biasing means and the actuating member allows the lever to be pivoted clockwise without moving the cutting element **188**. Also, the actuating member **190** and its associated biasing means **196** cooperate with the biasing spring **108** for pawl **102** to define the detented position for the lever **140**.

## OPERATION

For a more complete understanding of the present invention, a sequence of operation will now be described. The free end of the endless supply of strap is fed through the extension **42** of the path **40** to be located between the adjacent surfaces of the gripping wheel **32** and the feed pad **110**. The lever **140** is then moved from its detented neutral position shown in FIG.

1 to the position of FIG. 5 during which the switch **160** is actuated and the motor M is energized to begin rocking of the input member **54**. An inspection of FIG. 5 shows that in this position, the pawl **102** is held in a spaced position from the ratchet teeth **106** on the intermediate member or ratchet sleeve **64** while the anvil **120** is held at a spaced location from the periphery of the wheel **32** and the feed pad **110** is biased into engagement with the strap to frictionally grip the strap between the feed wheel and the adjacent surface of the pad **116**. The rocking motion of the input member **54** is transmitted through the first unidirectional clutch means **90** and friction clutch means **70** to cause an intermittent clockwise rotation of the shaft **36** and the gripping wheel **32** to feed the strap **24** along its path **40**. The unidirectional clutch **90** will allow substantially unrestricted movement of the input member **54** in a counterclockwise direction while the gripping wheel **32** is prevented from rotating in the counterclockwise direction by the force of the spring **112**.

When a sufficient amount of strap has been fed from the source **22** to allow the strap to form a strap loop around the article and have the free end portion **26** placed in overlapping relation with the main body of the strap adjacent the anvil **120**, the feeding operation is terminated. This is accomplished by merely releasing the handle and the spring force from the biasing means or spring **124** cooperating with the anvil will be sufficient to move the lever to its neutral detented position.

The free end portion **26** is then manually located in overlapping relation to the main body of the strap **24** and thereafter, the lever is pivoted clockwise from the position shown in FIG. **5** to that shown in FIG. **6** and is manually held in that position by the operator for performing the tensioning and friction-fusion sealing operation. During this movement of the lever, the actuating member **190** for the cutting element **188** is pivoted to the dotted line position of FIG. **7** and then is returned to the solid line position while the link remains stationary. In order to eliminate the need for the operator to maintain a manual contact between the roller **162** and the actuating member **163** for switch **164**, it is preferable that the switch **164** also incorporates a timing mechanism which will cause the motor to be operated for a predetermined period to time sufficient to perform the tensioning and friction-fusion melting of overlapping portions of the strap. The timing mechanism may be of the type disclosed and claimed in the above mentioned Frey application Ser. No. 46,591.

Movement of the lever from the position shown in FIG. **5** to that shown in FIG. **6** initially allows the spring **108** to bias the pawl **102** into engagement with the ratchet teeth **106**, as is shown in FIG. **6**. As the lever is moved between these positions, the anvil and feed pad are moved from the position shown in FIG. **3** to that shown in FIG. **4**. In the second position shown in FIG. **4**, the feed pad is positively held in spaced relation from the periphery of the wheel by the pin **130** and the biasing means **124**. At the same time, the spring or biasing means **124** also frictionally grips the overlapping portions of the strap loop between the peripheral surface of the wheel **32** and the gripping surface **120***a* of the anvil. It will be appreciated that in order to accomplish this, the biasing force or spring **124** must be of sufficient magnitude to overcome the action of the springs **112** and also to apply a predetermined frictional force between the overlapping portions of the strap.

It should be noted that movement of the lever from the first position to the second position will not actuate the cutter mechanism. This is because the actuating member **190** is pivoted in a clockwise direction against the action of the spring **196** while the arm **180** remains stationary.

In the second position, the pawl will act as a latch means and cooperate with the unidirectional clutch means **90** to cause the intermediate member **64** to oscillate in response to oscillation of the input member. Thus, the input member and the intermediate member may be considered to be a single element during the tensioning and friction-fusing portion of the cycle.

Oscillating motion of the intermediate member is converted to unidirectional rotation of the wheel **32** in the opposite or tension direction by the second unidirectional clutch means **100** cooperating with the connecting means or friction clutch **70** and the frictional force between the overlapping portions of the strap. Thus, when the tensioning operation is initiated, the unidirectional clutch means **100** will cause the shaft **36** and wheel **32** to intermittently rotate in a counterclockwise direction in response to counterclockwise rotation of the intermediate member. However, the clockwise oscillating or rocking movement of the intermediate and input members **64** and **54** will not be transmitted to the wheel **32**. This results from the fact that the gripping force supplied by the anvil **120** to the overlapping portions of the strap with the wheel **32** acting as a reaction member will produce sufficient forces on the wheel to overcome the frictional forces between the friction clutch **70** and allow the intermediate and input members to be moved in a clockwise direction while the wheel **32** is held in a fixed position. Thus, the frictional forces applied to the wheel from the anvil **120** through the overlapping strap portions will cooperate with the friction clutch **70** to allow clockwise movement of the intermediate member while the friction wheel **32** is held in a stationary position. The result is that the rocking movement of the input and intermediate members **54** and **64** will be converted to intermittent rotary movement in a counterclockwise direction to tension the strap loop around the article **20**.

When the tension in the strap loop reaches a predetermined level, the intermittent rotary motion of the wheel in a counterclockwise direction is automatically converted to an oscillating motion to cause relative movement between the overlapping portions of the strap to produce interface melting which subsequently solidifies to form a joint. An inspection of FIG. **2** shows that the tension on the strap loop L will produce a clockwise torque onto the wheel **32** while the gripping force produced by the anvil **120** will tend to hold the wheel in a stationary position. When the tension on the strap, combined with the frictional force between the cooperating portions of the friction drive **70**, is sufficient to overcome the frictional force between the adjacent surfaces of the overlapping portions of the strap, the intermittent counterclockwise rotary motion will automatically be converted to an oscillating motion. This will be accomplished by operatively interconnecting the input member, the intermediate member, and

the output member through the unidirectional clutch means **100** and the frictional clutch **70**. Thus, when the tension on the strap reaches a predetermined level, the wheel **32** will automatically begin to oscillate and carry with it the main portion of the strap while the free end portion **26** is held in gripping relation with the anvil to thereby cause the main body of the strap to produce multidirectional movement of the strap **24** to the free end portion **26**. After the overlapping portions of the strap have been friction-fusion sealed, the duration of which is determined by the timer forming part of switch **164**, the motor is stopped.

The amount of tension applied to the loop may be varied by adjusting the spring force of either of the springs **76** or **124** by the threaded members or adjustable means **78** and **126**.

After the friction-fusion sealing operation has been completed, the lever **140** is moved from the position shown in FIG. **6** to its neutral detented position shown in FIG. **2**. During this movement, the cutter means (FIGS. **7–10**) is automatically moved from its inactive position shown in FIG. **7** to the second position shown in FIG. **10** to sever the strap loop from the main body of the strap. In the normal position shown in FIG. **7**, the cutting edge **188***a* will be located adjacent the edge of the strap that is adjacent the outer edge of the wheel **32**. When the anvil **120** begins its upward movement, by counterclockwise pivotal movement of the lever **140**, the tension in the strap loop will cause the loop as well as the main body of the strap adjacent the friction-fusion joint to move upwardly with the anvil. In its uppermost position shown in FIG. **2**, the anvil will be spaced sufficiently from the periphery of the wheel to place the main body of the strap in alignment with the cutting edge **188***a*. During the latter portion of counterclockwise movement of the lever towards the neutral detented position, the camming surface **206** causes a counterclockwise pivotal movement of the link **180**. This necessarily results since the U-shaped configuration of the actuating member **190** will prevent counterclockwise pivotal movement of the actuating member relative to the lever beyond the solid line position shown in FIG. **7**. The counterclockwise rotational movement of the link **180** about its pivot axis **182** will move the cutter element **188** to the left as viewed in FIGS. **7** and **10** from the position shown in FIG. **7** and the position shown in FIG. **10** during which the friction-fused loop will be severed from the main body of the strap. After the strap has been severed, the link **180**, the actuating mechanism **190** and the block **194** will again be moved to the neutral position shown by the solid lines of FIG. **7**.

From the above description it will be appreciated that the present invention provides a simple and inexpensive strapping machine which is capable of initially feeding a length of strap from a source, tensioning a strap loop about an article, and forming a friction-fusion joint overlapping the portions to produce a tensioned strap loop about an article. The loop is subsequently severed from the main body of the strap. All of this is accomplished by a cutting means and a single wheel which may be rotated in either direction and oscillated by a unidirectional motor with a simple drive mechanism incorporating conventional drive elements located between the drive motor and the strap-gripping element.

A slightly modified form of the invention is shown in FIG. **11**. In the modified form of the motor M is supported on the container **12** and has its shaft S connected to the input shaft **52***a* through a conventional belt V. The shaft **52***a* has an eccentric **56** on one end thereof (not shown in FIG. **11** but shown in FIG. **5**) while the opposite end of the shaft is supported by a bearing **230** and a support bracket **232** carried by the support **10***a*. The modified form of the invention allows for the use of a lighter weight housing since it is no longer necessary to support the entire weight of the motor directly on the housing as is required in the embodiment illustrated in FIGS. **1–10**.

In both embodiments the inside of the container may be insulated to reduce the noise level of the machine resulting from the rocking or oscillation of the various components. In addition the housing **30** could be isolated from the container and support or base through the use of suitable shock absorbers or equivalent devices.

I claim:

**1**. Apparatus for use in providing a strap about an article and for friction-fusion sealing of overlapping portions of the strap, comprising a source of strap; an element engaging said strap; a drive means cooperating with said element; first means between said drive means and said element for intermittently rotating said element in one direction to feed strap from said source in sufficient quantity to encompass said article with a free end in overlapping relation with a portion of said strap engaged by said element; and second means between said drive means and said element for reciprocating said element to friction-fuse overlapping portions of said strap.

**2**. Apparatus as defined in claim **1**, further including third means for rotating said element in an opposite direction to tension said strap.

**3**. Apparatus as defined in claim **1**, in which first means includes a feed pad; biasing means biasing said feed pad toward a surface of said element with said strap interposed between said surface and pad to frictionally grip said strap and feed said strap while said element is rotating in said one direction.

**4**. Apparatus as defined in claim **3**, in which said second means includes an anvil; second biasing means biasing said anvil toward said surface to frictionally grip the overlapping portions of said strap and cause relative movement between said overlapping portions in response to oscillation of said element, and cooperating means between said anvil and said pad for (1) maintaining said anvil spaced from said surface while said strap is frictionally gripped between said surface and said pad and (2) maintaining said pad spaced from said surface while said anvil is frictionally gripping said overlapping portions.

**5**. Apparatus as defined in claim **4**, in which said second means includes means for initially rotating said element in an opposite direction while said anvil is frictionally gripping said overlapping portions to tension said strap about a package.

**6**. Apparatus as defined in claim **5**, further including cutter means adjacent said anvil; a lever having a first position for feeding strap and a second position for tensioning and sealing said strap; and means interposed between said cutter means and said lever for actuating said cutter means when lever is moved from said second to said first position.

7. Apparatus as defined in claim 1, in which said second means includes means for initially rotating said element in an opposite direction to tension said strap.

8. Apparatus as defined in claim 7, in which said first means includes an oscillating member; an intermediate member between said oscillating member and said element; connecting means between said intermediate member and said element; and clutch means between said oscillating member and said intermediate member for converting oscillating motion of said oscillating member to unidirectional intermittent rotary motion of said intermediate member and said element in said one direction.

9. Apparatus as defined in claim 8, in which said second means includes positive unidirectional drive means between said oscillating member and said intermediate member and clutch means between said intermediate member and said element; and said connecting means includes a friction drive between said element and said intermediate member, further including means for producing a frictional force between said strap and said element whereby said frictional force prevents rotation of said element in said one direction until a predetermined level of tension is produced in said strap and said element is oscillated to fuse overlapping portions of said strap when said strap is tensioned to said predetermined level.

10. Apparatus as defined in claim 9, further including first adjustable means for varying the frictional force of said friction drive and second adjustable means for varying the frictional force between said strap and said element.

11. Apparatus as defined in claim 9, in which said means for producing a frictional force between said strap and said element includes an anvil and in which said first means includes a feed pad for engaging said strap and forcing said strap into engagement with said element, the further improvement of manual means for simultaneously moving said anvil and feed pad between (1) a first position in which said anvil is spaced from said strap and said feed pad is in engagement with said strap and (2) a second position in which said anvil is in engagement with said strap and said feed wheel is spaced from said strap.

12. Apparatus as defined in claim 11, further including cutter means adjacent said anvil; and means actuating said cutter means to cut said strap when said anvil and feed pad are moved from said second to said first position.

13. Apparatus as defined in claim 9, in which said drive means includes a unidirectional motor having a rotating output shaft and means between said shaft and oscillating member for converting rotary motion of said shaft to oscillating motion of said oscillating member.

14. In a strapping machine having a strap engaging wheel and an anvil adjacent said wheel cooperating with each other for tensioning a strap loop about an article and oscillating overlapping strap portions relative to each other to effect interface melting, the improvement of a feed pad cooperating with said wheel to produce frictional engagement between the wheel and strap so that rotation of said wheel will feed strap from a source for encompassing said article.

15. A friction-fusion machine as defined in claim 14, further including a lever for moving said anvil and feed pad between (1) a first position in which said feed pad is in strap gripping relation with said wheel and said anvil is spaced from said wheel and (2) a second position in which said feed pad is spaced from said wheel and said anvil is in strap gripping relation with said wheel.

16. A strapping machine as defined in claim 15, further including cutter means cooperating with said anvil and means on said lever for actuating said cutter means when said feed pad and anvil are moved from said second to said first position.

17. A strapping machine as defined in claim 15, further including means for (1) rotating said wheel in one direction when said feed pad is in strap gripping relation with said wheel, (2) rotating said wheel in an opposite direction when said anvil is in strap gripping relation with said wheel and (3) automatically converting rotating motion in said opposite direction to oscillating motion when a predetermined level of tension has been applied to the strap loop.

18. A strapping machine as defined in claim 17, in which said last means includes an input member; means for oscillating said input member; an intermediate member; first unidirectional clutch means between said intermediate member and said input member for intermittently rotating said intermediate member in said one direction in response to oscillation of said input member; and drive means between said intermediate member and said wheel for intermittently rotating said wheel in response to intermittent rotation of said intermediate member.

19. A strapping machine as defined in claim 18, in which said last means further includes latch means between said intermediate member and said input member and cooperating with said first clutch means for oscillating said intermediate member in response to oscillation of said input member; and second clutch means for intermittently rotating said wheel in said opposite direction in response to oscillation of said intermediate member.

20. A strapping machine as defined in claim 19, in which said drive means between said intermediate member and said wheel includes a friction clutch, said friction clutch accommodating relative rotation in said one direction when the tension in said loop is below said predetermined tension and providing a drive connection between said intermediate member and said wheel when the tension in the loop reaches said predetermined level.

21. A strapping machine as defined in claim 20, in which said lever is pivoted about a fixed pivot axis further including cooperating means between said lever and anvil for moving said anvil between first and second positions; and means between said anvil and said feed pad for moving said feed pad between first and second positions in response to movement of said anvil between first and second positions.

22. A drive mechanism for use in a machine for feeding strap from a source, tensioning the strap about an article and friction-fusion sealing of overlapping portions of the strap, comprising an input member; reciprocating means to reciprocate said input member between extreme positions; an output member adapted to engage the strap; first means between said input and output members for intermittently rotating said output member in one direction to feed strap from a source;

second means between said input and output members for intermittently rotating said output member in an opposite direction for tensioning the strap about an article; and third means for reciprocating said output member by said input member for effecting relative motion between overlapping portions of the strap.

23. Apparatus for automatically tensioning a thermoplastic strap loop about an article and friction-fusion sealing overlapping portions of the strap comprising a wheel; an anvil; biasing means biasing said anvil into strap comprising relationship with said wheel to produce a frictional force between overlapping portions of the strap; a driven member oscillated between extreme positions; unidirectional clutch means between said member and said wheel for intermittently rotating said wheel in one direction in response to oscillation of said member; and friction drive means accommodating relative movement between said member and said wheel when the tension on said loop is below a predetermined level, said friction drive means cooperating with said unidirectional clutch means to oscillate said wheel when the tension in said loop reaches said predetermined level.

24. Apparatus as defined in claim 23, in which said biasing means includes adjustable means for varying the frictional force between overlapping portions of the strap and said friction drive means includes adjustable means for varying friction force between said member and said wheel.

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