

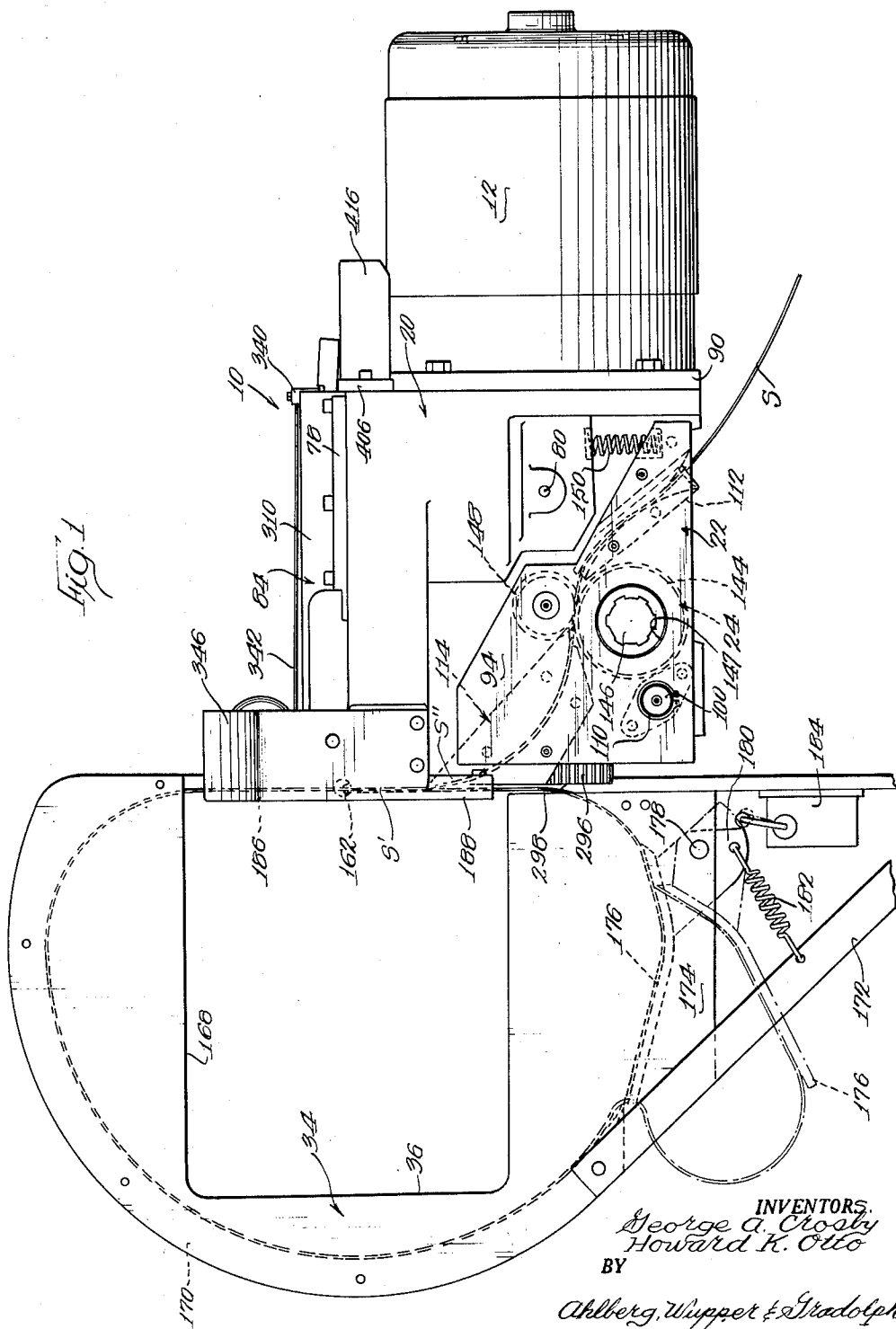
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G. A. CROSBY ET AL
POWER STRAPPING MACHINE

2,915,003

Filed Nov. 13, 1956

8 Sheets-Sheet 1



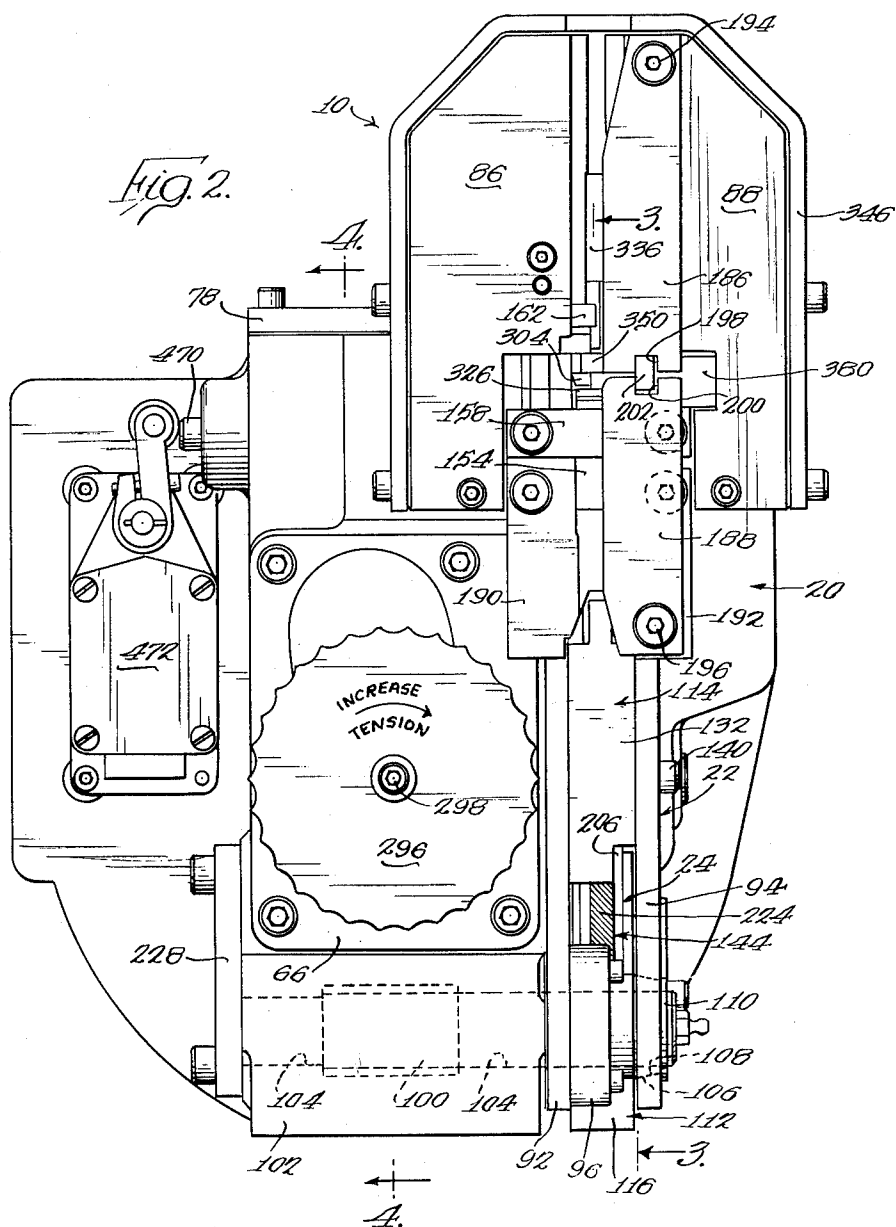
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8 Sheets-Sheet 2



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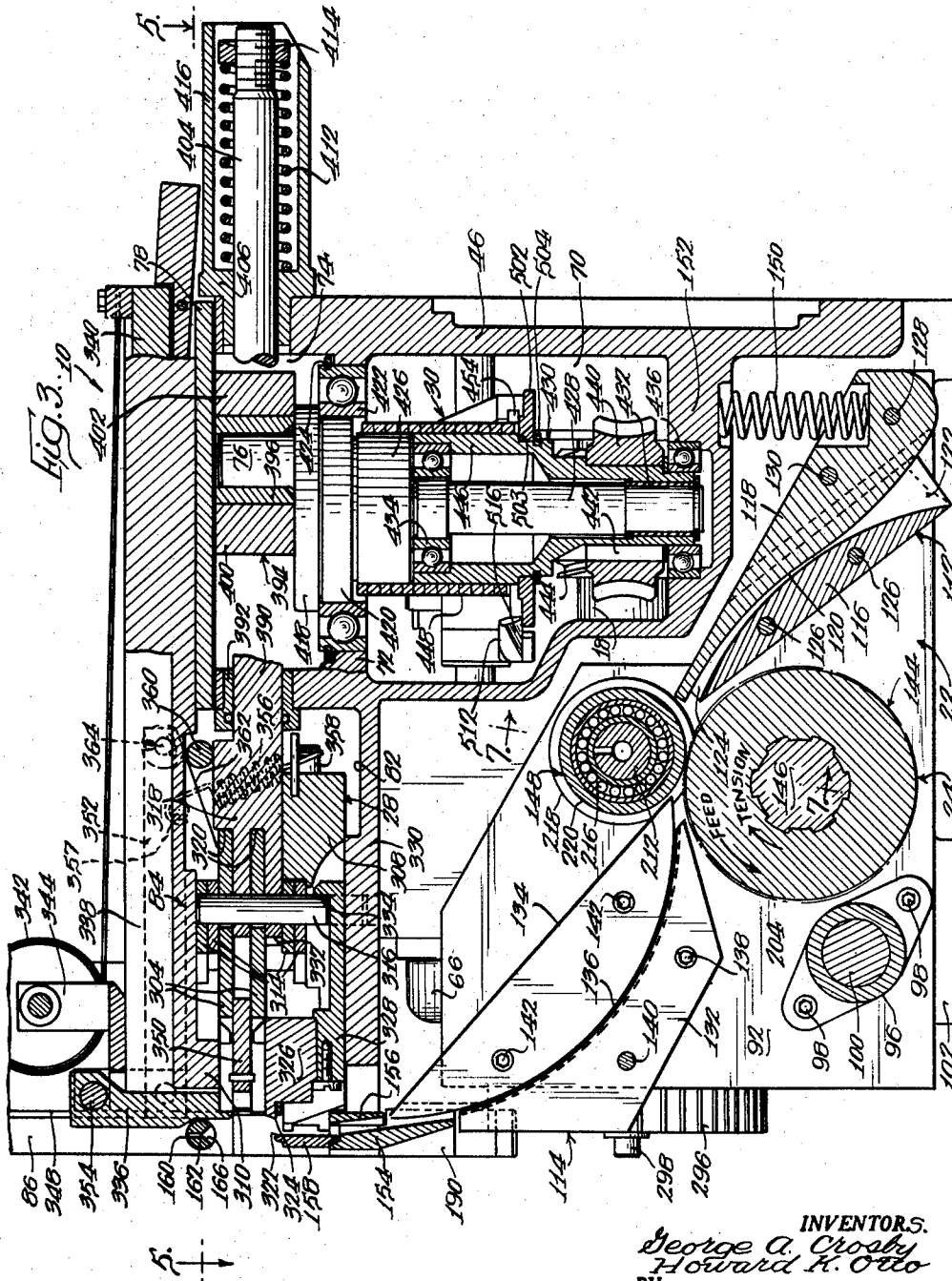
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8 Sheets-Sheet 3



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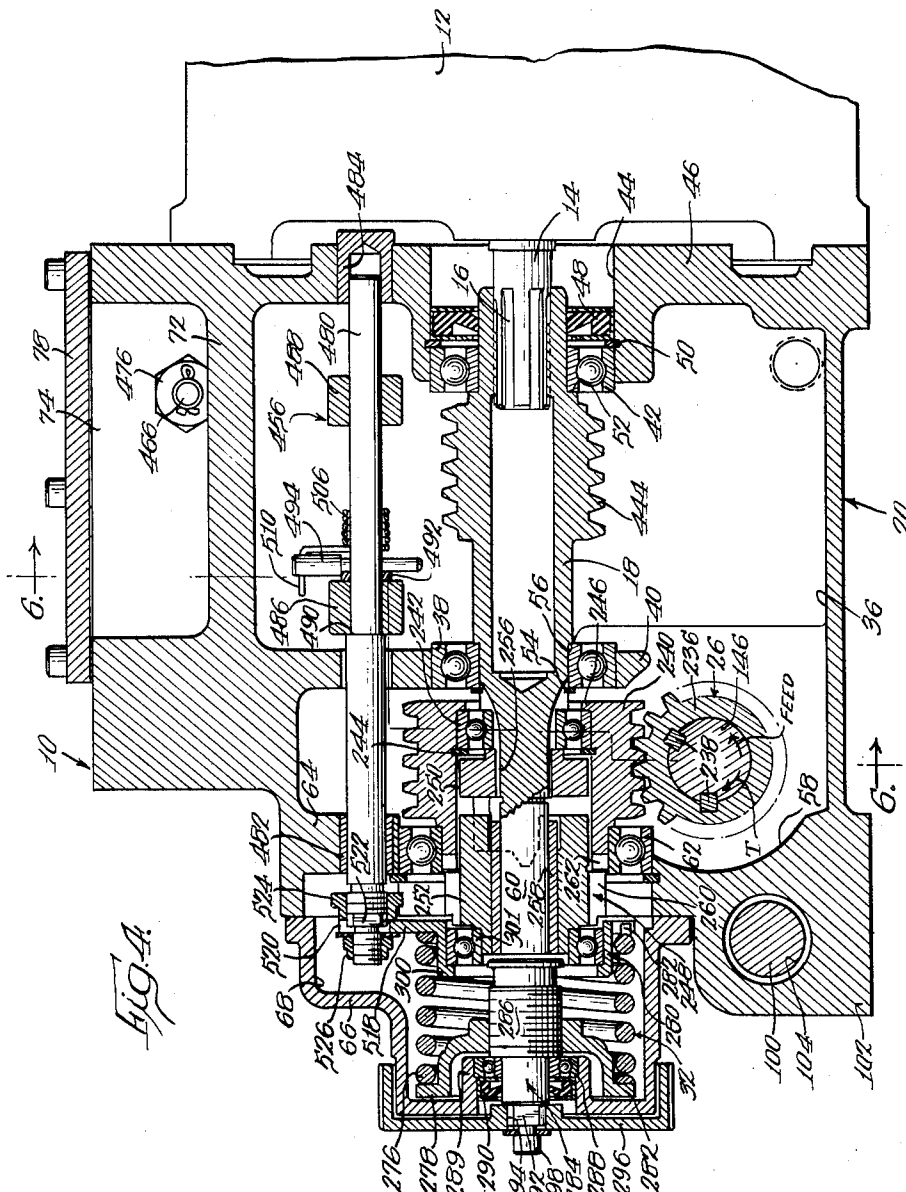


Fig. 4.

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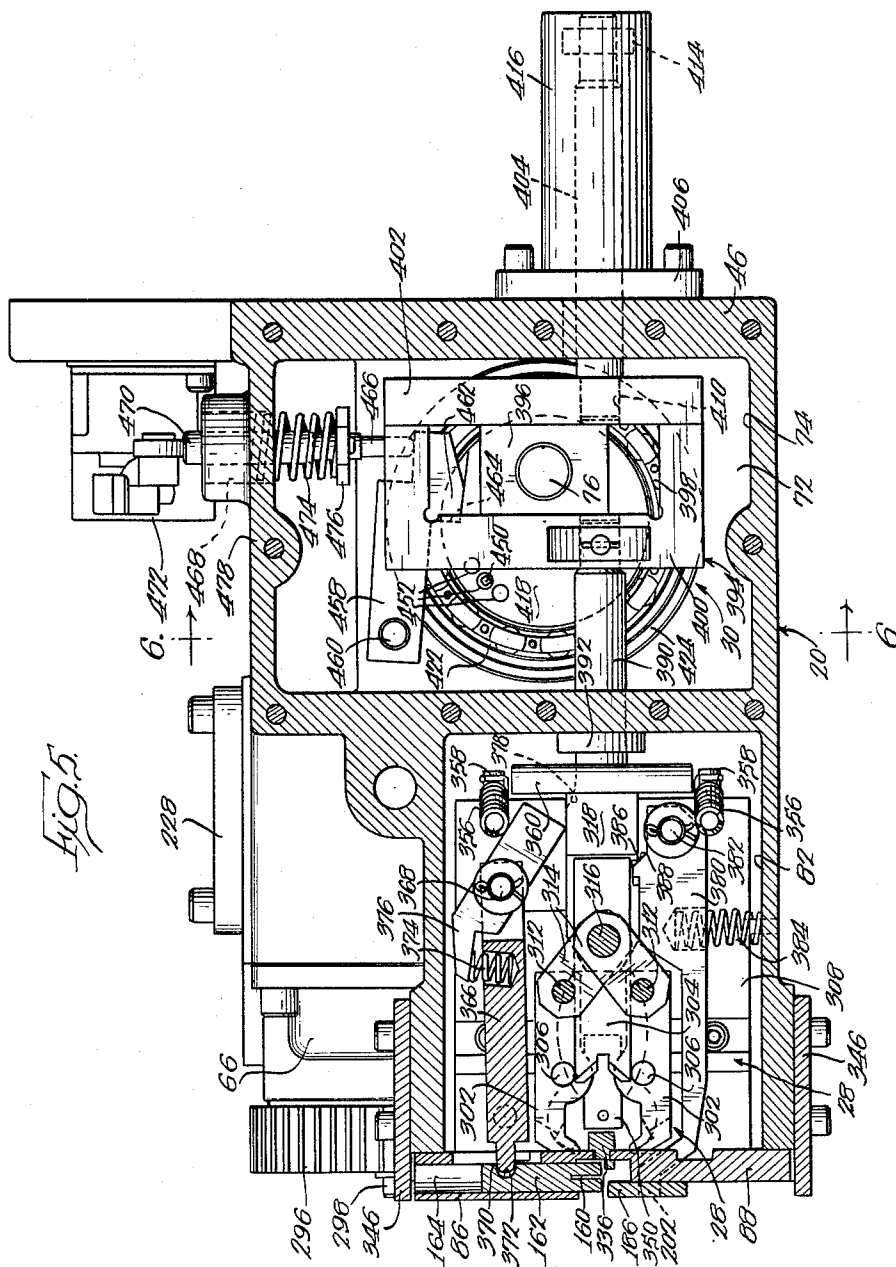
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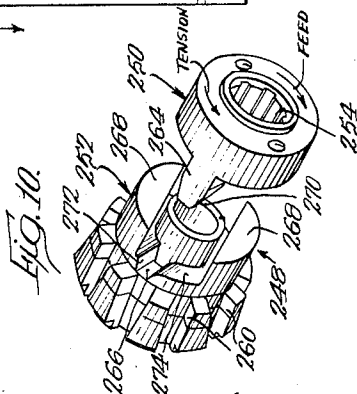
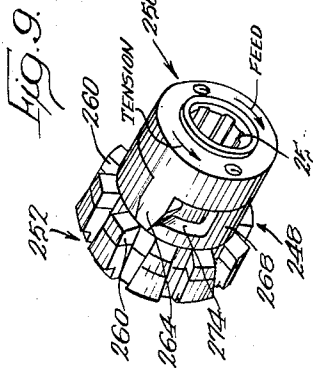
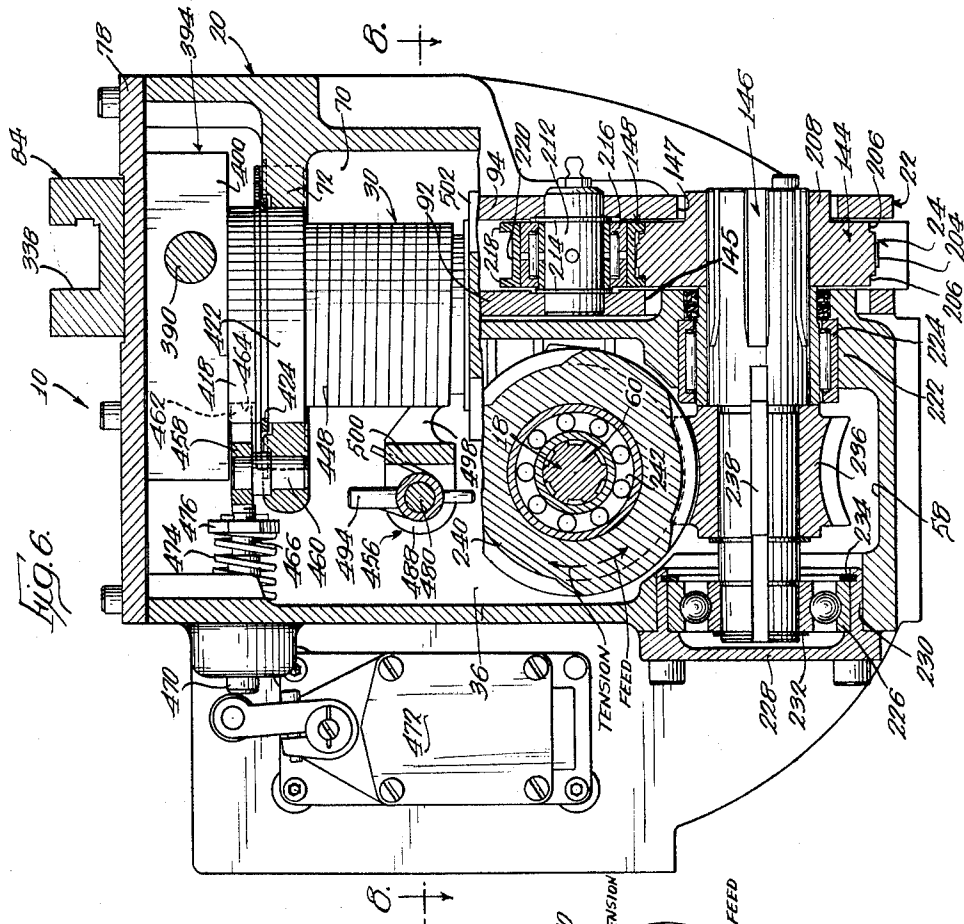
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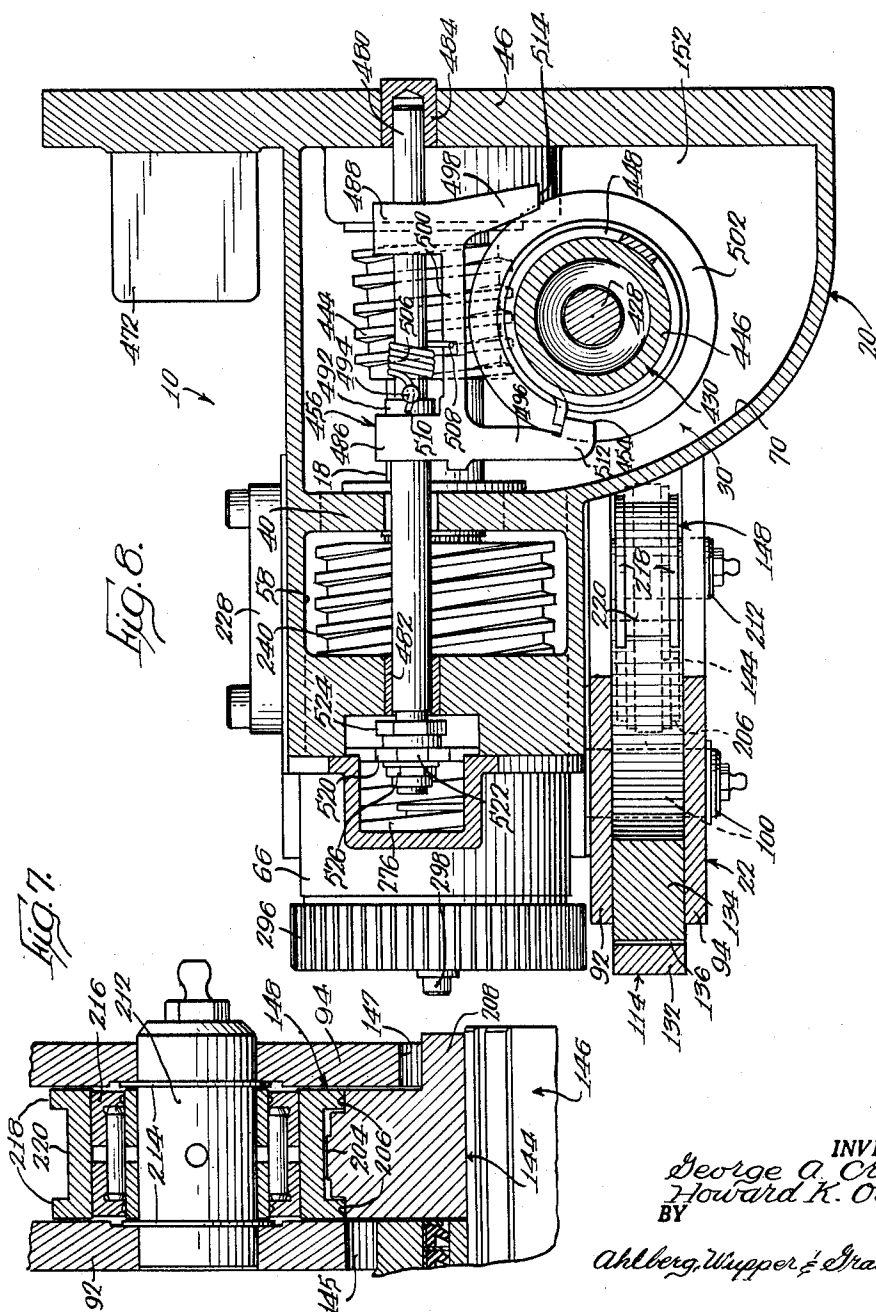
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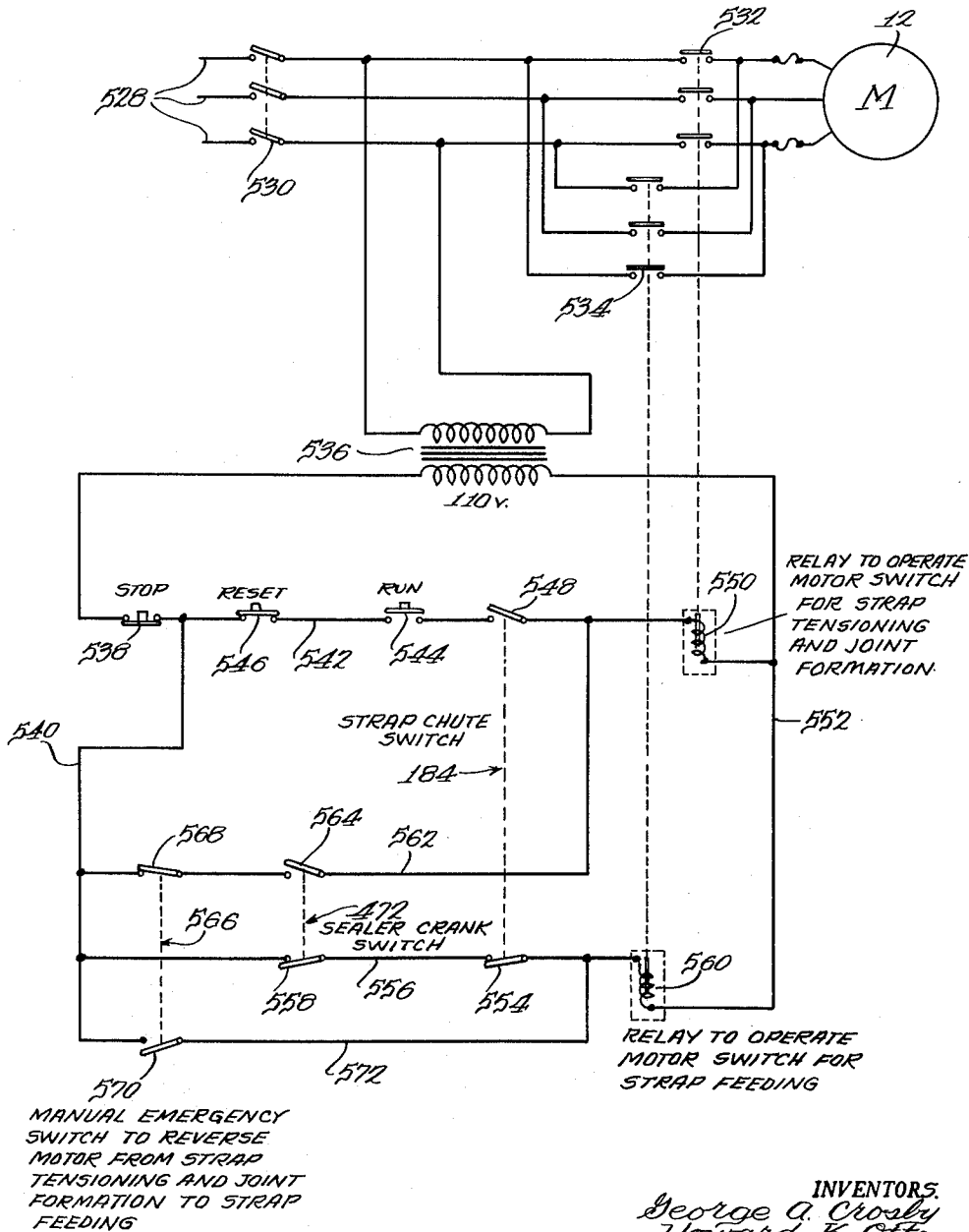
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Fig. 11.



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POWER STRAPPING MACHINE

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Application November 13, 1956, Serial No. 621,724

17 Claims. (Cl. 100—26)

The present invention relates to a new and improved power strapping machine for binding bundles, packages, coils, and the like, with a loop of flat tensioned strapping with its overlapping ends united into a tension resisting joint.

The machine of the present invention is, like its predecessors, capable of fully automatic or semi-automatic operation, and it operates to pass strap about the bundle so that its free end is placed in overlapping position with the standing portion thereof which is connected to the source of strap supply or a coil of strapping. The strapping is shrunk closely down about the bundle and a proper tension is applied thereto by the machine. When this tension has reached a satisfactory value, the overlapping portions of the strapping and an embracing seal blank are united into a tension resisting joint, and the strapping applied to the bundle is severed from the source of strap supply. The machine of the present invention represents a marked advance over those of the prior art and has the following among its objects:

A primary object is to provide a new and improved power strapping machine which is compact and relatively small in size and yet capable of applying strapping to bundles with a tension usually associated with substantially larger machines.

Another object is to provide a new and improved power strapping machine which may be used in various types of installations and may be oriented so that it operates in various positions such as on its side, and the like.

Another object is to provide a new and improved power strapping machine which is wholly mechanical in its operation and needs no hydraulic or pneumatic pressure sources.

Another object is to provide a new and improved power strapping machine which incorporates novel means for regulating and determining the tension which is applied to the strapping about the bundle.

Another object is to provide a new and improved power strapping machine incorporating novel means for regulating the strap tension which can easily be adjusted by turning a knob on the outside of the machine either to increase or decrease the tension to be applied to the strapping.

Another object is to provide a new and improved power strapping machine incorporating novel means to disconnect the tensioning drive from the motor when the tension in the strapping has reached the desired value.

Another object is to provide a strapping machine incorporating a novel feed wheel and backup roller arrangement whereby the teeth on the feed wheel are protected against damage.

Another object is to provide a new and improved power strapping machine having a novel drive for the joint forming portion of the machine which is so interrelated with the remaining portions of the machine that its operation is initiated at precisely the time the strap tension about the bundle has reached a predetermined value.

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Another object is to provide a new and improved strapping machine which is so arranged that it functions more rapidly than many of the prior art machines with each operation succeeding the previous operation with no delay.

Another object is to provide a new and improved power strapping machine which is rugged in construction and has a relatively long life.

Other objects and advantages will become apparent from the following description taken in conjunction with the accompanying drawings wherein:

Fig. 1 is a side elevational view of the power strapping machine of the present invention showing a part of the strap guiding chute or track in changed position to operate a switch signaling the fact that the strap has traversed the length of the chute;

Fig. 2 is an enlarged front elevational view of the machine with the strap guiding track or chute removed;

Fig. 3 is an enlarged vertical sectional view taken along the line 3—3 of Fig. 2, looking in the direction of the arrows, and showing details of the strap feeding and tensioning mechanism and of the drive for the joint forming mechanism;

Fig. 4 is an enlarged vertical sectional view taken along the line 4—4 of Fig. 2, looking in the direction of the arrows, and showing constructional details of the drive for the strap feeding and tensioning mechanism and of the strap tension regulating mechanism;

Fig. 5 is a horizontal sectional view taken substantially along the line 5—5 of Fig. 3, looking in the direction of the arrows, and showing details of the joint forming mechanism and the drive therefor;

Fig. 6 is a vertical sectional view taken along the irregular line 6—6 of Fig. 4, looking in the direction of the arrows, and showing details of the strap drive and the drive for the joint forming mechanism;

Fig. 7 is an enlarged fragmentary sectional view showing the coaction of the driven feed and tension wheel and the backup or pressure roller, and is taken substantially along the line 7—7 of Fig. 3, looking in the direction of the arrows;

Fig. 8 is a horizontal sectional view taken along the line 8—8 of Fig. 6, looking in the direction of the arrows, and showing details of the shipper shaft and related mechanism for releasing the clutch in the drive for the joint forming mechanism;

Fig. 9 is a perspective view of the cam clutch in the strap tensioning mechanism showing the parts in engaged position;

Fig. 10 is a perspective view of the clutch of Fig. 9 shown with the parts thereof separated; and

Fig. 11 is a diagram of a typical electrical control circuit for this machine.

In the figures, the machine is shown in its normal position wherein the strap guide or track would be vertical and the opening for the package or bundle is oriented so that a bundle is placed therein in a horizontal direction. This disposition is purely arbitrary because it is possible to operate this machine in a variety of positions and, therefore, the orientation used in the following specification is for the purpose of the description only.

General organization

The strapping machine 10 of the present invention is powered by a reversible electric motor 12 which has its motor shaft 14 keyed or splined at 16 to the main drive shaft 18 of the machine. The drive shaft 18 is mounted in a housing 20 which has also houses or supports a strap guiding structure 22, a strap feeding and tensioning mechanism 24, a drive 26 for the strap feeding and tensioning mechanism, a joint forming and strap cutting mechanism 28, a drive 30 for the joint forming and

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strap cutting mechanism, and a strap tension regulating mechanism 32 which is associated with the strap feeding and tensioning mechanism drive 26. Strapping S (Fig. 1) is drawn from a source of supply or reel (not shown) which may be of the type disclosed in the copending application of Robert C. Luth, Serial No. 505,945, filed May 4, 1955, and entitled "Strap Dispenser" and which is assigned to the assignee of the present invention and application. This application issued into Patent No. 2,844,334, dated July 22, 1958. The strap S is drawn from the reel through the guide 22 by the strap feeding and tensioning mechanism 24 and is directed around a closed guide track or chute 34, which has a bundle receiving opening 36 therein, so that the leading end of the strap S' overlaps a standing portion S'' thereof in front of the joint forming mechanism 28.

The strap may be passed through the track or chute at the end of a bundle binding operation, and in such cases the chute 34 may be of the closed or nonopening type, and the machine cycle will begin with the strap tensioning step rather than with the strap feeding operation. On the other hand, the chute 34 may be of the openable type, in which case the strap is fed at the start of a machine cycle rather than at the end thereof. In the present disclosure the chute or track 34 is of the closed type and, for purposes of illustration, the description will indicate that the strap S is fed about the opening 36 and fills the chute as the last step in the machine cycle.

During the strap feeding operation the motor 12 drives in a first direction and, when the strap feeding has been completed either through the closed chute 34 or about the bundle, a switch in the electric control circuit is operated either to stop the machine, as at the end of a machine cycle, or to initiate subsequent machine operation. In either event the motor 12 is restarted in the opposite direction to operate the joint forming mechanism 28, first to clamp the free or leading end S' of the strap so as to anchor it against movement, and secondly to fold the wings or flanges of a seal blank about the overlapping strapping portions S' and S'' to preform the seal blank for the final joining operation. This preforming of the blank is not sufficient, however, to prevent movement of the standing portion of the strapping relative to the joint forming mechanism and the anchored end S' of the strapping.

At the same time the feeding and tensioning mechanism 24 is operated in the tensioning direction, first to shrink the loop of strap S about the bundle, and then to apply a tension thereto. The tension regulating mechanism 32 senses the instant at which the tension in the strap about the bundle reaches the desired or optimum value, and it operates to disconnect the drive 26 for the feeding and tensioning mechanism from the drive shaft 18 and to release the joint forming mechanism 28 so that the latter may be further operated by its drive 30 to complete the joint in the overlapping strapping portions and seal, to sever the strap about the bundle from the standing portion S'' thereof, and to withdraw the joint forming mechanism to its start or so-called "zero" position, thereby clearing the front of the machine for a subsequent strap feeding operation. When the joint forming mechanism finishes its operation, the machine either is shut off or operates as previously indicated to feed strap S to fill the strap guide or chute 34 so that the machine is readied for a subsequent bundle binding cycle.

Housing and main drive

The machine housing 20 is shown throughout the several views and reference is particularly made to Figs. 1, 3, 4, 5, 6, and 8. It should also be noted that various openings in the housing are closed with caps, partitions, or cover plates which are secured thereto by conventional machine bolts and, when necessary, are fitted with gaskets to prevent leakage of oil or lubricant from the

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housing and the seepage of dirt thereinto. Therefore, in the ensuing description no reference will be made to these conventional constructional details.

The machine housing 20 is divided into a number of appropriate compartments or chambers for the various parts of the machine which have been briefly described under the heading "General Organization."

The main drive shaft 18 is mounted in a chamber 36 (Fig. 4) and is supported on a front bearing 38 mounted in a depending wall 40 which projects into the chamber 36, and a rear bearing 42 which is mounted in an opening 44 in the rear wall 46 of the housing 20. The opening is sealed by a conventional seal or packing 48 which surrounds the projecting end of the drive shaft 18, and the bearing 42 is secured by a retainer ring 50 in the opening 44 and a shoulder 52 on the drive shaft. The front bearing 38 is similarly retained between a ring 54 and a shoulder 56. Thus, the drive shaft 18 is freely journaled in the ball bearings 38 and 42 for rotation in either driving direction by the motor 12 which has its motor shaft 14 keyed or splined to the drive shaft at 16.

The housing chamber 36 is not regularly shaped and has a forward portion 58 defined in part by the depending wall 40 and which houses the drive 26 for the strap feeding and tensioning mechanism. The drive shaft 18 has a pilot portion 60 projecting into a part of the strap feeding and tensioning mechanism drive 26, namely worm gear 240 which is partially supported on ball bearing 62 mounted in the front wall 64 of the chamber 58.

The tension regulating mechanism 32, which is disposed at the forward end of the strap feeding and tensioning mechanism drive 26 and in the main in front of the wall 64, is enclosed within a housing or cap 66 which is secured to the housing 20 and thereby forms a chamber 68 for the tension adjusting mechanism.

The chamber 36 communicates with a chamber 70 thereabove and to one side, which encloses the drive 30 for the joint forming mechanism, the lower end of which projects down and lies alongside of the drive shaft 18 as will become clear hereinafter. The chamber 70 is generally defined at its upper end by a wall 72 in which a portion of the drive 30 for the joint forming mechanism is journaled, and which has formed thereabove a chamber 74 which houses the crank end 76 of the joint forming mechanism drive. The chamber 74 is closed by a cover plate 78.

The chambers 36, 58, 68, 70 and 74 are in communication with each other, and the lower portion of the chamber 36, and those which communicate with it at that level form a sump for lubricant which is introduced thereinto to the level of an opening 80 in the wall of the housing 20 (Fig. 1). This opening is, of course, closed with the conventional screw plug.

The joint forming mechanism is enclosed within a chamber 82 which is closed in part at its upper side by a seal blank containing magazine 84 and at its forward end by the face plates 86 and 88.

The motor 12 is provided with a flange 90 by means of which it is bolted to the housing 20, and the housing may be provided with tapped openings and the like so that it might be mounted in a permanent installation if desired.

Strap guide and closed guide track

The strap guide 22 and chute 34 are best illustrated in Figs. 1, 2, 3, 6 and 7.

The strap guide 22 is enclosed between a pair of plates 92 and 94 which are spaced apart by guiding elements to be described hereafter, and a bushing 96 which is secured to the plate 92 by bolts 98 and is rotatably mounted upon a pivot pin or shaft 100. The pivot pin is nonrotatably secured in a boss 102 at the lower front of the housing and has a drive fit in a pair of aligned bores 104 therein. The bushing 96 has an outer conical or tapered end 106 which seats in a complementary

tapered opening 108 in the plate 94, and the latter is held by a retaining ring 110 in a suitable groove in the outer end of the pivot pin 100. The guiding means 22 is thus mounted for pivotal movement on the pin 100.

The guiding of the strap between the plates 92 and 94 is accomplished by a lower guide assembly 112 and an upper guide assembly 114, which are mounted between the plates 92 and 94 and are secured thereto. The lower guide assembly 112 comprises a pair of interfitting guiding elements 116 and 118 which define therebetween a strap guiding slot or space 120 which has a flared lower or inlet end 122 and a slightly open upper end 124. The guide element 116 is secured to the plate 92 by a pair of bolts 126, and the guide element 118 is secured to the plate 92 by a bolt 128, and to both plates by a bolt 130 which passes through aligned apertures therein and also assists in holding the plate 94 to the plate 92.

The upper guide assembly 114 comprises a pair of interfitting guide elements 132 and 134 which define therebetween a guiding slot 136 which, it will be observed, is an arcuate slot extending upwardly toward the front of the machine to direct the strap past the front of the joint forming mechanism 28. The guide member 132 is secured to the plate 92 by a bolt 138, and to both plates by a bolt 140 which functions as does the bolt 130. The guide member 134 is secured to the plate 92 by a pair of bolts 142. Thus, the plates 92 and 94 enclose the guiding assemblies 112 and 114 and the bushing 96, and the whole assembly is arranged for limited pivotal movement about the pin 100.

The strapping is drawn from the reel through the inlet 122, the slot 120, and between a feed wheel 144 which is fixed to the outer end of a shaft 146 and a pressure or backup roll 148 which is journaled for rotation between the plates 92 and 94. The axis of rotation of the pressure roll is fixed relative to the plates 92 and 94, and it is urged toward the feed wheel 144 by a biasing spring 150 which acts between a wall 152 of the housing 20 and the guiding element 118, the ends of the spring 150 being held in keeper pockets in the wall 152 and element 118. The biasing spring insures that there will be no slippage of the strap on the feed wheel 144 during the feeding operation.

The strapping is fed by the wheel 144 through the slot 136, between a pair of stationary guiding members 154 and 156 and past the inner face of a stationary clamping and cutter block 158. This assembly of guides 154 and 156 and block 158 is similar to that disclosed in the copending application of George A. Crosby and Robert J. Frey, Serial No. 424,832, filed April 22, 1954, issued as Patent No. 2,801,558, dated August 6, 1957, for an invention entitled "Joint Forming Mechanism" and will not, therefore, be described in greater detail. The strapping is next guided through a slot 160 in a barrier 162 which is reciprocable in a bore 164 in the face plate 86 (Fig. 5). The strapping thereafter passes around the guide chute 34 until its leading end contacts the barrier 162 in the V-shaped notch 166 therein and against the standing portion S' of the strapping, it being understood that the leading portion S' is guided past the outer face of the stationary cutter block and anchoring member 158 by the stationary guides 190 and 192 (Fig. 1). The closed guide chute may comprise a pair of plates 168 secured to a frame 170 and mounted to the front of the machine by suitable means including a bracket 172. The bracket 172 cooperates with a second bracket 174 in supporting the strap track 34.

The guiding chute includes a dropout jaw 176 which is pivoted at 178 to the bracket 174 by a plate 180 which is connected to the underside of the jaw 176 and through which the pivot pin 178 extends. A tension coil spring 182 extends between the plate 180 below the pivot 178 and the diagonal bracket 172 normally to hold the jaw 176 in strap guiding position. When the leading

end S' of the strap contacts with the barrier 162 it stops, but the strap feed continues with the excess strap ballooning outwardly to depress the jaw 176, as shown in the dot-dash lines of Fig. 1. This movement of the jaw 176 rotates the plate 180 and the latter operates a switch 184 to terminate the strap feeding operation and shut off the motor 12 or reverse its direction, depending upon the type of machine cycle being used.

The guiding structure at the front of the machine, and in front of the joint forming and strap cutting mechanism 28 also includes a pair of strap guiding plates 186 and 188 which, in guiding position, overlie about one-half of the strap pathway between the face plates 86 and 88 and the pair of side guides 190 and 192. The plates 186 and 188 are pivoted at their upper and lower ends, respectively, on pivot pins or bolts 194 and 196, and have their lower and upper ends, respectively, notched at 198 and 200 to accommodate the tip 202 of an actuating lever 380 (Figs. 2 and 5) which moves the adjacent ends of these plates to the right or out of strap guiding position, to permit the joint forming mechanism to advance during its operation and to permit the bundle to be withdrawn when the joint is completed.

The face plates 86 and 88, the guides 190 and 192, and the movable guide plates 186 and 188 insure that, when the strap is being fed, it will faithfully traverse the closed guide chute or track 34 and that its leading end S' will contact the barrier 162, so that the loop of strap will balloon outwardly and depress the jaw 176 to actuate the switch 184 in the control circuit. Actuation of the switch 184 starts or conditions the machine for the succeeding cycle which is that of shrinking the straps about the bundle and applying the requisite tension thereto.

Feeding and tensioning mechanism and drive therefor

The strap feeding and tensioning mechanism 24, the drive 26 therefor, and its connection to the main drive shaft 18 of the machine are best shown in Figs. 3, 4, 6, 7, and 8.

Referring first to Figs. 3, 6 and 7, it will be observed that the strap feed wheel 144 is fixed to the outer end of the feed and tensioning shaft 146 and projects through oversize openings 145 and 147 in the plates 92 and 94, respectively, so that these plates may rock on the pin 100 and relative to the feed wheel 144 thereby to accommodate the strap S. The feed wheel 144 has a peripheral surface 204 which is serrated or formed with a great multiplicity of tiny truncated pyramid-shaped strap gripping elements which are relatively harder than the strap used in binding bundles. At either side of this toothed periphery 204 the feed wheel 144 is formed with annular shoulders 206 which are of smaller diameter than the diameter of the toothed periphery 204, and the feed wheel 144 is formed with a boss 208 which projects through the oversize opening 147 in the plate 94.

The pressure roll 148 is journaled on a shaft 212 which is carried in the plates 92 and 94 and restrained against axial movement by a pair of retaining rings 214 (Fig. 7). The roller 148 is journaled on the shaft 212 by a needle or roller bearing 216. The pressure roll 148 has a pair of annular rims 218 which are adapted to ride upon the shoulders 206 of the feed wheel with the tread 220 between the rims forming the backup surface, and the rims 218 and shoulders 206 being so dimensioned that the hardened tread surface 220 does not contact the toothed periphery 204 of the feed wheel 144 when no strapping lies between the feed wheel 144 and the pressure roller 148. Thus, the hardened teeth are protected against accidental and inadvertent damage by careless adjustment of the machine or by failure to make certain that there is always strapping between the feed wheel and the backup roll when the feed wheel is being driven.

As seen in Fig. 7, where there is no strapping between the feed wheel 144 and the pressure roll 148, the two

are almost in tangential contact. However, when strapping is fed into the machine through the guide slot 120 and between the feed wheel 144 and pressure roll 148, the latter moves upwardly (Fig. 3) and the pressure which it exerts on the strapping during the feeding operation is that which is supplied by the biasing spring 150, otherwise, there would be insufficient pressure exerted by the pressure roller 148 to insure a proper feeding of the strap.

When the wheel 144 drives in the strap tensioning or clockwise direction (Fig. 3), the guiding means 22 is self energized to urge the pressure roll 148 slightly against the strap S which is between it and the feed wheel 144. After the strap has been shrunk closely about the bundle and the excess returned toward the supply source through the slot 120, the wheel 144 in cooperation with the pressure roll 148 imparts tension to the loop about the bundle, and during the tensioning operation considerable pressure should be used to hold the strap S in driving contact with the wheel periphery 204 to prevent slippage. As the slot guide 136 curves downwardly from its end 221 toward the nip between the wheel 144 and roll 148, an increase in strap tension causes the strap to resist its curved guide path in the slot 136 and to push against the guiding element 134. This action of the strap tends to rock the guiding assembly 22 about the pivot 100 in the clockwise direction thereby increasing the pressure of the roll 148 on the strap. Thus, as the strap tension and chance of strap slippage on the feed wheel increases, the pressure exerted by the roll 148 on the strap increases to overcome the likelihood of slippage. It should be noted that the positions of the feed wheel 144 and pressure roll 148 with respect to the pivot 100 are such as to move the roll 148 toward the wheel 144 if the guide assembly 22 rotates in the clockwise direction.

The feed wheel shaft 146 is journaled in the wall 222 of the housing 20 on a roller bearing 224, and at its opposite end it is journaled by a ball bearing 226 in a cap 228 which closes an opening 230 in the housing. A retaining ring 232 holds the shaft 146 against axial movement relative to the bearing 226 which is also anchored by a retaining ring 234 in the cap or cover 228.

Between the bearings 224 and 226 a worm gear 236 is mounted on the shaft 146 and secured thereto for rotation therewith by keys 238.

The worm gear 236 is in constant mesh with a worm 240 (Fig. 4) which is journaled on the pilot end 60 of the main drive shaft 18 by a bearing 242 which is held between a retaining ring 244 and shoulder 246. At its opposite end the worm 240 is journaled in the wall 64 of the housing 20 by the bearing 62.

The worm 240 is not directly keyed to the shaft 18 but is operatively and selectively connected thereto by a cam clutch 248 which is shown most clearly in Figs. 9 and 10. The cam clutch includes a driving element 250 and a driven element 252, and the latter is adapted to be engaged with and disengaged from the worm 240. The two elements are biased to engaged position (Fig. 9) by the tension regulating mechanism 32.

The driving element 250 is keyed to the pilot end 60 of the shaft 18 by cooperating splines 254 on the driving element and 256 on the drive shaft 18. Thus, the driving element 250 is constantly rotated in one direction or the other, depending upon the direction of rotation of the drive shaft 18 as it is operated by the motor 12.

The driven element 252 includes a bearing sleeve 258 in which the pilot end 60 of the shaft 18 may rotate relative to the driven element. This driven element includes a plurality of circumferentially disposed, axially directed teeth 260 which are adapted to engage with complementarily shaped and similarly disposed teeth 262 on the worm 240 when the clutch elements are in engaged position for driving the worm. The teeth 262 on the worm are provided with sloped crowns so that, when they are out of driving engagement, the driven member can ro-

tate relative to the worm 240 without driving it and also without damaging the teeth on the two parts.

The driving clutch element 250 has a pair of projecting driving lugs 264 which are adapted to engage in slots 266 formed between wall parts 268 on the driven element 252. It will be observed that the outer ends of the driving lugs 264 are tapered at 270 and that the sides of the slots 266 are complementarily tapered at 272.

When the shaft 18 drives in the direction to rotate the driving cam member 250 in the counterclockwise or strap tensioning direction, as indicated in Figs. 9 and 10, the lugs 264 drive the clutch member 252 until such time as the resistance to the drive becomes too great, as sensed by the strap tension regulating mechanism 32. This resistance, created by the strap tension, acts to stall the worm 240 and the tapered sides 272 of the slots 266 slide on the tapered surfaces of the driving lugs 264, and the ends of the lugs 264 bear against shelves 274 on the element 252 to move the latter in such direction as to disengage the teeth 260 from the teeth 262, permitting the shaft 18 to continue rotation in the tensioning direction but without imparting drive to the worm 240. The pressure exerted by the strap tension regulating mechanism 32 on the driven clutch member 252 to keep it in engagement with the driving clutch member 250 is determinative of the amount of tension which will be imparted to the strap.

The lugs 264 will remain on the shelves 274 until the motor feed is reversed, at which time the lugs 264 will rotate in the opposite or clockwise direction, as seen in Figs. 9 and 10, and will move off the shelves toward the walls 268 at the opposite sides of the slots 266. This reversal of drive may be sudden and, to prevent cracking or breaking of the parts, the angles between the walls 268 and shelves 274 are provided with small fillets to reduce the likelihood of damage to the driven element 252. The lugs 264 reengage in the slots 266 under the force exerted by the tension regulating mechanism 32, thereby permitting the teeth 260 to reengage the teeth 262 of the worm 240 and the latter to drive the worm gear 236 in the strap feeding direction.

Strap tension regulating mechanism

The strap tension regulating mechanism 32 is best seen in Fig. 4 and is located within the cap 66 at the front of the machine.

The tension regulating mechanism 32 includes a relatively heavy spring 276 which acts between a tension ring 278 and a keeper 280 which is also a shifting arm for purposes which will be hereinafter explained. At its ends the spring 276 is provided with lugs 282 that fit in suitable apertures in the ring 278 and keeper 280 to prevent the spring from rotating relative to these members when its compressive force is being changed.

The ring 278 is mounted upon a tension adjustment screw 284 which has a threaded end 286 screwed through a central tapped aperture in the ring 278 so that it may be moved toward and away from the keeper or arm 280, thereby imparting greater or less compression to the spring which then will exert a greater or less pressure on the keeper 280.

The adjustment screw 284 is journaled in a bearing 288 mounted in a boss 289 in the cap or cover 66 and is fitted with a packing gland 290 to prevent loss of lubricant. The adjustment screw 284 is provided with a projecting end 292 which is flatted to key with a complementarily shaped opening 294 in a tension adjustment knob 296 which fits over the outer projecting end of the housing 66. A bolt and washer combination 298 secures the tension adjustment knob 296 to the outer end of the adjusting screw 284.

When it is desired to increase the tension which the tensioning mechanism 24 will apply to the strapping, the knob 296 is turned in the clockwise direction (Fig. 2)

and, when it is desired to decrease the tension, it is turned in the counterclockwise direction.

The keeper arm 280 has a cup-shaped portion 300 which encloses a bearing 301 in which the outer end of the driven member 252 of the clutch assembly is journaled. Through the keeper 280 and bearing 301, the pressure which is exerted by the strap tension spring 276 is applied to the driven clutch member 252 and thereby to the worm 240 to the driving clutch member 250 and the cooperating teeth 260 and 262. When a predetermined tension has been applied to the strapping, the worm 240 tends to stall and the tapered sides 272 of the slots 266 slide on the driving lugs 264 and the latter move onto the shelves 274 to push the driven member 252 away from the driving member 250 against the force exerted by the spring 276 to disengage the teeth 260 and 262, terminating the strap tensioning operation.

It is, therefore, readily apparent that the force exerted by the strap tension spring 276, in resisting disengagement of the teeth 260 and 262, is the determining factor in the amount of tension which is applied to the strapping.

Joint forming mechanism and strap cutoff

The joint forming mechanism and strap cutoff 28 are best shown in Figs. 3 and 5 and are of the type disclosed in the previously mentioned copending application of George A. Crosby and Robert J. Frey, Serial No. 424,832, issued as Patent No. 2,801,588.

Essentially the mechanism comprises a pair of jaws 302 which have the fourfold functions of anchoring the end S' of the strap against the block 158, folding the seal blank about the overlapping strapping portions, providing shoulders across which movable notchers 304 operate to deform the strap and seal into a tension resisting joint, and holding the completed joint during the severing of the strap about the bundle from the standing portion S'' thereof. The jaws 302 are mounted for rectilinear and pivotal movement on a pair of pins 306 which are guided for movement toward and away from joint forming position by a lower guide block 308 and the underside of the seal magazine mounting 310, the guide block 308 and magazine block 310 being secured to the housing 20 by suitable means.

At their rear ends the jaws 302 are fitted with intermediate connecting pins 312 which are guided for forward and outward movement relative to the path of movement of the jaw assembly by slots in the guide block 308 and the magazine block 310. These pins are connected by links 314 and a common pin 316 to a yoke 318 which is provided with shoulders 320 in engagement with the inner ends of the notcher plates 304 to push the latter outwardly and relative to the jaws 302 in their advanced and holding position in order to form the joint between the overlapping strapping portions S' and S'' and the folded seal blank. The yoke 318 is connected to the drive 30 for the joint forming mechanism, as will be described immediately hereinafter.

After the joint has been formed, the standing portion S'' of the strap is severed to separate the strapping about the bundle from the source of strap supply. It was previously described herein that the standing portion S'' passes to the right or the inner face of the stationary anchoring and cutter block 158 (Fig. 3). This block has a cutting edge 322 which cooperates with the cutting edge 324 of a movable cutter 326, which is guided in a slot formed in the guide block 308 and is mounted in a rectilinearly movable bar 328 which is slidable on a wall 330 of the housing 20. The rear face of the cutter 326 is contacted by the forward edge 332 of the yoke 318 to move it through the cutting stroke and to sever the standing strapping portion S'' which is confined between the inner face of the stationary cutter block 158 and the movable cutter 326. The cutter block 326 is mounted so that it is immovable relative to the cutter bar 328, and the lower end of the pin 316 engages a shoulder 334

thereon so that during the retraction of the joint forming mechanism to the "zero" or start position the cutter 326 is withdrawn for a subsequent cutting operation.

The seal blanks used in forming the joint may be of the type shown in George A. Crosby Patent No. 2,710,435, dated June 14, 1955. They are fed from the seal storage magazine 84 one at a time by vertically reciprocable ejector 336 which moves in front of the storage slot 338 in the magazine. The seal blanks are urged toward the exit end and the ejector 336 by a follower 340 connected to a "Negator" coil spring 342 which has the characteristic of putting a constant pressure on the follower 340 regardless of its position. The coil spring is mounted on a bracket 344 above the exit end of the magazine and within a U-shaped housing 346 covering the front of the machine, as shown best in Fig. 2.

The ejector 336 is guided in vertical ways 348 in the face plates 86 and 88 and moves to strip the seals one at a time from the stack of nested seals in the magazine storage space 338 and delivers them between the jaws 302 when the latter are in their retracted and open position, and therefore, in front of an anvil 350 which is movable with the jaws and supports the back of the seal blank during the folding of the flanges thereof about the strapping and the formation of the joint between the overlapping strapping portions and the seal blank.

In Fig. 3 the ejector is shown in its lowermost position at the end of a seal feeding stroke. The ejector is raised out of this position by a pair of arms 352 connected to the ejector by a pin 354, the arms being biased toward feeding position by a pair of springs 356 connected to lugs 357 projecting from the outer faces of the ejector arms and pins 358 at the rear of the lower guide block 308. The arms 352 are raised by a cross bar 360 carried on the top of the yoke 318 and underlying and in contact with the diagonal undersurfaces 362 of the arms 352. As the yoke moves forwardly through the joint forming operation, the arms 352 are pivoted about their pivotal mounts 364 in the sides of the magazine block 310 to raise the ejector 336 out of the way of the forward movement of the joint forming jaws 302 and the notcher plates 304, and to permit the ejector 336 to engage the outermost seal in magazine 84. When the jaws are retracted after the formation of the joint, the arms 352 snap the ejector 336 downwardly to bring another seal into position in front of the anvil 350 and in the outer hooked ends of the jaws 302, as more fully described in the previously referred to copending application of George A. Crosby and Robert J. Frey, Serial No. 424,832, issued as Patent No. 2,801,588.

To permit the jaws 302 to move outwardly, the front of the machine must be cleared of the strap guiding means, including the slotted barrier 162 and the movable guide plates 186 and 188. The barrier 162 is slidable in the face plate 86 and is movable out of the path of the strapping and away from the jaws 302 by a lever 366 which is pivoted on a pin 368 mounted in the lower guide block 308 (Fig. 5). The lever has a projecting tip 370 at its outer end engaging a notch 372 in the barrier so that, as the lever moves outwardly, the barrier is removed from blocking position. The lever 366 is pivoted outwardly by the jaws 302, as their rear ends pivot outwardly, and against the force of a spring 374 which acts against a short lever 376 also mounted on the pivot pin 368, and which is restrained against movement by the yoke 318 until the latter clears an arcuate surface 378 past the inner end of the short lever 376.

The movable guide plates 186 and 188 are pivoted out of the way by the lever 380 which is pivoted on the pin 382 mounted in the lower guide block 308. The lever 380 is urged toward guiding position by a spring 384 which acts between a wall of the chamber 82 and the lever 380. At its outer end the lever 380 carries the finger 202 which engages in the notches 198 and 200 in the plates 186 and 188, respectively, and in normal position holds

these plates in the position shown in Fig. 2. However, when the yoke 318 moves forwardly to operate the jaws 302 and notchers 304 to form the joint, yoke corner 386 contacts diagonal cam surface 388 on the lever 380 to swing the latter outwardly against the spring 384 which pivots the plates 186 and 188 outwardly from in front of the jaws 302. As the jaws are retracted, the spring 384 returns the plates 186 and 188 to the strap guiding position.

The drive for joint forming mechanism

The drive for the joint forming mechanism is best illustrated in Figs. 3, 4, 5, 6 and 8 which also illustrate the triggering arrangement for initiating operation of the latter from the drive shaft.

The yoke 318 of the joint forming mechanism 28 is integral with a push rod or shaft 390 which projects through a bushing 392 in the wall separating the chamber 82 from the chamber 74 and prevents the escape of lubricant into the chamber 82. The rear end of the push rod is connected to a rectangular crosshead guide 394 in which a crosshead 396 is reciprocable, the guide having a generally rectangular opening 398 formed between a U-shaped front part 400 and a back plate 402 which are suitably connected together by bolts and welds.

The crosshead guide is prevented from cocking relative to the push rod 390 by a tail guide 404 which is coaxial with the push rod and extends through a tail guide bushing 406 mounted in the rear wall 46 of the housing 20. The tail guide 404 is secured to the rectangular crosshead guide in an opening 410. The tail guide 404 and the assembly connected thereto are urged rearwardly by a spring 412 which acts between the bushing 406 and a washer or nut 414 threaded onto the outer end of the tail guide 404 and locked in position. The tail guide 404 and spring 412 are enclosed in a generally tubular tail guide housing 416 connected to the bushing 406.

The crosshead 396 is rotatably connected to the crank pin 76 which in turn is mounted in the head of a crank 418 of circular form which has a cylindrical bearing portion 420 seated within a bearing 422 held by a retainer 424 in the wall 72. The sealer crank head 418 is somewhat larger than the circular portion 420 within the bearing 422 and the bearing, therefore, acts as an end thrust bearing and assists in supporting the crank assembly.

Below the cylindrical bearing portion 420 is a drum portion 426 formed integrally therewith, from which depends a pilot shaft 428 for guiding the crank assembly properly rotatably in the machine housing 20.

The pilot shaft 428 projects into a sealer clutch race 430 and particularly into the lower portion thereof in which it is sleeved at 432 for rotation. The sealer clutch race is fitted with an internal ball bearing 434 at its upper end and in which the upper end of the pilot shaft 428 is journaled. At its lower end the sealer clutch race 430 is journaled into a ball bearing 436 which is held in a suitable guide opening in the wall 152 of the housing and, therefore, the assembly of the crank 418 and its pilot shaft 428 and the sealer clutch race 430 are properly supported and guided for rotation about a common vertical axis in the housing 20.

Immediately above the lower bearing 436 the sealer clutch race is fitted with a worm gear 440 which is keyed thereto at 442. The worm gear 440 is in constant mesh with a worm 444 which is formed on the drive shaft 18, as seen most clearly in Fig. 4. Whenever the drive shaft 18 is being rotated, the worm 444 drives in one direction or the other to drive the worm gear 440 and consequently the sealer clutch race 430.

The sealer clutch race 430 includes a driving drum 446 which is of the same diameter as the crank drum 426 and about which a clutch spring 448 is encircled with an interference fit. The clutch spring is formed of rectangular spring wire so as to provide the maximum amount of

frictional bearing surface against the outer face of the drum 446 during a driving operation. At its upper end, the clutch spring 448 has an upwardly extending projecting finger 450 which is inserted into one of a plurality of holes 452 through the crank drum 420 and crank 418, the selection of the holes governing the position of the crank 418 and crank pin 76 relative to the sealer mechanism release in order to provide the niceties of adjustment which are desirable in this machine. At its lower end the spring 448 has an axially outwardly projecting end 454 adapted to engage or be engaged by a shipper 456, the positioning of which is under the control of the keeper arm 280, thereby to determine the engagement or release of the sealer driving clutch spring 448 with the drum 446.

The clutch spring 448, drum 446 and crank 418 are so arranged that when the worm gear 440 rotates this assembly in the counterclockwise direction, as seen in Fig. 5, there is a positive driving engagement between the drum 446 and the clutch spring 448 which is transmitted to the crank 418 and, therefore, to the crank pin 76 to drive the crosshead 396 and the push shaft 390 to operate the joint forming mechanism and strap cutoff 28. When, however, the worm gear 440 is driven in the clockwise direction, the frictional contact of the clutch spring 448 on the drum 446 is insufficient to operate the joint forming mechanism in the reverse direction against any great resistance. This clockwise drive is timed to take place only when the crank 418 is restrained against clockwise movement by crank stop arm 458 which is pivoted at 460 on the shelf or partition 72. The stop arm 458 has a projecting stop lug 462 engageable in a notch 464 in the crank 418 to prevent the latter from rotating in the clockwise direction beyond a certain point which is the "zero" position for the joint forming mechanism.

The sealer crank stop arm 458 is biased against the crank 418 by a plunger 466 which projects from the housing through a bushing 468 and has an end 470 to operate a switch 472 in the control circuit for the motor to effect motor operation in such direction as to impart tension to the strapping and at the proper time to drive the joint forming mechanism 28 to form the joint between the overlapping strapping ends. The plunger 466 is held in engagement with the stop arm 458 by a spring 474 confined between a nut 476 on the threaded portion of the plunger and a wall 478 of the housing 20. This biasing spring insures that the arm 458 remains in contact with the circumferential edge of the crank 418.

The shipper 456, as seen in Fig. 8, has a general H shape in plan and is mounted upon a shaft 480 which is slidably mounted in bearings 482 and 484 in the end walls 64 and 46 of the housing 20. The shipper 456 has a pair of bearings 486 and 488 by means of which it is journaled on the shaft 480. The bearing 486 is held against a shaft shoulder 490 by a retaining collar 492 and a pin 494 pressed into a hole in the shaft 480. Opposite the bearings 486 and 488 the shipper is formed with a pair of arms 496 and 498 which are interconnected by a cross bar 500. The arms 496 and 498 extend on either side of the spring clutch 448 and bear against a shipper shelf 502 which is carried between a shoulder 503 and a ring 504 seated in a circumferential groove at the lower end of the drum 446. The arms 496 and 498 are biased toward the shipper shelf 502 by a spring 506 which has an end 508 bearing on the cross bar 500 and another end 510 retained by the pin 494.

The arm 496 has a hooked outer end 512 against the inner face of which the end 454 of the clutch spring 448 engages when the joint forming mechanism 28 has been advanced to bring the pivot pins 306 toward their forward position and to rock the jaws 302 thereabout to fold the flanges of the seal blank about the strapping and to anchor the free end S' of the strapping on the stationary anchor block 158. When the spring end 454 is held by the arm hook 512, the spring loosens its frictional grip on the drum 446 and the latter may rotate in the counter-

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clockwise direction and not drive the crank 418 and the joint forming mechanism 28.

At the end of the strap tensioning operation the shipper shaft 480 is moved toward the front of the machine, thereby moving the shipper 456 in the same direction and releasing the end of the clutch spring 454 so that the spring 448 closely grips the drum 446 to provide the driving connection between the drum and the crank 418 to rotate the latter an angular distance such that the end 454 of the spring engages tip 514 of the shipper arm 498. In this position of the crank 418 the joint forming mechanism 28 will be in its "zero" position. During this partial revolution, therefore, the joint forming mechanism 28 is operated to form the joint between the overlapping strapping ends and seal blank, to sever the standing portion of the strapping about the bundle, and to withdraw the mechanism to the "zero" position so that the seal ejector 336 can strip a seal from the magazine 84 and move it into position within the hooked outer ends of the jaws 302.

The hooked end 512 of the arm 496 has a cam-shaped or angular face 516 at its underside, so that, should it be necessary at any time to reverse the operation of the machine (if the strap breaks or the jaws become jammed with an improperly fed or formed seal blank, or for some other cause), the machine can be backed up. Under these circumstances the machine will be operated in the reverse to normal direction and, if the tip 454 of the clutch spring 448 is counterclockwise of the hooked shipper arm 512, it will be necessary that the spring end 454 pass beneath the shipper arm 496. Therefore, as the spring end 454 moves in the clockwise direction, it engages the cam surface 516 and rocks the shipper on its bearings 486 and 488 about the shaft 480 and against the force of the biasing spring 506 to lift it slightly from the shipper shelf 502 to permit the spring to pass thereunder.

The shipper 456 is operated by the cam clutch 248 and, upon separation of the clutch elements 250 and 252, the shipper shaft 480 is moved to the left, and upon their reengagement, it is moved to the right, as seen in the respective vertical and horizontal sectional views, such as Fig. 4 and Fig. 8. The keeper 280 has an upwardly extending arm 518 (Fig. 4) with a bifurcated end 520 which fits over a flatted extension 522 on the forward end of the shipper shaft 480, the distance between the flat faces being only slightly less than the opening between the bifurcations 520 on the arm 518 so that the shipper shaft has a snug fit therewith and is prevented from rotation. The bifurcated end 520 is secured in place between a pair of lock nuts 524 and 526 which are threaded onto the end of the shipper shaft. In this manner the shipper shaft is firmly locked to the keeper 280 and its extension arm 518 and is, therefore, moved in accordance with the movement of the driven element 252 of the cam clutch, and the clutch spring 448 is, therefore, not released to provide the driving connection to the joint forming mechanism 28 for the final joint formation until the strap about the bundle has been properly tensioned.

Control circuit

A simplified control circuit for the strapping machine 10 is shown in Fig. 11 and is used for the machine when the operating cycle begins with a full strap chute or track 34 and the first operation to be carried out is the withdrawal of the excess strap S from the chute 34 and the tensioning of the strap about the bundle.

The motor 12 is of the three-phase direction-reversing type and obtains its power from a three-phase source 528 through a master three element gang switch 530. The control circuit, which includes the operating switches 184 and 472 and the relays for operating motor switches 532 and 534, obtains its power through a step-down trans-

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former 536, the primary of which is connected across the outside taps of the current source 528.

The secondary of the transformer 536 has one terminal connected through a master stop switch 538 to a conductor 540 and to a conductor 542. A manually operated run or operating switch 544 and a normally closed manually operable reset switch 546 are in the conductor 542 as well as switch element 548 of the multiple contact chute switch 184. This switch 548 is normally open, and is closed when the strap chute has been filled and the jaw 176 been depressed, as shown in Fig. 1. The conductor 542 is connected to one tap of a relay 550, the other tap of which is connected to a conductor 552 which leads back to the second terminal of the transformer secondary to complete the circuit. The relay 550 operates the motor gang switch 532 and, when energized, closes the latter so that the motor operates to rotate the drive shaft 18 in such direction as to operate the feeding and tensioning mechanism 24 to shrink the strap loop about the bundle and to apply a tension thereto.

When the strap chute switch 184 has been operated to close the switch element 548, it opens switch element 554 which is in a conductor 556 which includes a normally closed switch element 558 forming a part of the switch 472 which is operated by the sealer crank latch 458. The conductor 556 is connected to the conductor 540 and to one terminal of a relay 560 which has its other terminal connected to the conductor 552. The relay 560, when energized, closes the gang switch 534 to operate the motor 12 in the strap feeding direction.

The sealer crank switch 472 has a second switch element 564 in a conductor 562 which is in parallel with the conductor 542 in so far as the latter includes the switches 544, 546, and 548 and, therefore, when the switch element 564 is closed, the relay 550 will remain energized even though the switch element 548 has been opened, as will be the case as soon as the dropout jaw 176 returns to its normal chute closing and strap guiding position. When, however, the switch element 564 is closed, the switch element 558 is open and, therefore, the relays 560 and 550 may not be energized at the same time.

A manually operated emergency switch 566, having switch elements 568 and 570, is provided for motor reversal from the strap tensioning and joint forming condition to the strap feed condition and is used in case of an improper seal feed or strap feed malfunction in order to operate the machine to the "zero" position so that the malfunctioning may be corrected without running the machine through a complete cycle with the possibility of damage to the machine elements, particularly the jaws 302. The normally closed switch element 568 is in the conductor 562 and, therefore, is in series with the switch element 564, and switch element 570 is in a conductor 572 which has one end connected to the conductor 540 and the other end connected to the conductor 556 ahead of the relay 560 and, therefore, in parallel with the switch elements 558 and 554 which are normally closed but one of which would be open during the malfunctioning of the machine and, therefore, it is necessary that the open switch be bypassed.

Operation

The operation of the machine will be described beginning with the withdrawal of the strap from the chute 34 and shrinking it about the bundle. Thus, the described cycle starts with the strap S filling the strap chute 34 and loosely encircling the bundle, and the leading end S' of the strap engaged in the notch 166 of the barrier 162 and overlapping the standing portion S'' thereof.

Under these circumstances the motor control circuit will have the switch element 548 closed and the switch element 554 open so that the circuits to both relays, 550 and 560, are deenergized. The crank latch 458 will be

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in engagement with the notch 464, and the switch 472, therefore, will be in the position shown in Fig. 11.

The run button 544 is closed and the relay 550 is energized to close the gang switch 532 to the motor to operate it to rotate the drive shaft 18 in the counterclockwise direction (Fig. 6) to drive the feed wheel 144 in the clockwise direction (Fig. 3). At the same time the crank 418 will be driven in the counterclockwise direction (Fig. 5) from the "zero" position to advance the joint forming mechanism 28 to bring the jaws 302 to their forward positions and to rock them sufficiently about their pivot pins 306 to clamp the free end S' of the strapping between the hooked ends of the jaws and the anchor block 158, and to fold the seal flanges loosely about the overlapping strapping portions S' and S''. The joint forming mechanism drive 30 is operated sufficiently to bring the end 454 of the clutch spring 448 against the hooked end 512 of the shipper arm 496, at which time the spring 448 is loosened on the drum 446 and the frictional driving connection therebetween is broken. The tensioning continues with the strap being drawn by the feed wheel 144 between it and the pressure roll 148 until the indicated tension has been applied to the strap. As previously explained, the pressure with which the roll 148 holds the strap S against the toothed periphery 204 of the feed wheel is self-energized so that there is always a positive drive on the strap in the tensioning direction.

When the desired maximum strap tension has been reached, the resistance to rotation of the feed wheel 144 will be sensed through the worm gear 236 and worm 240 and the latter tends to stall. Under these circumstances, the force exerted by the motor through the drive shaft 18 causes the lugs 264 of the cam element 250 to ride out of the slots 266 and to push the driven element 252 away from the driving element 250. The cam lugs 264 thereafter rest on the shelves 274 and rotate the driven member in an idling condition. This movement of the driven member 252 away from the driving member 250 separates the driving teeth 260 on the cam element 252 from the correspondingly shaped teeth 262 on the worm 240, thereby disconnecting the worm from the drive shaft 18 and terminating its driving effect. The feed wheel ceases to rotate and tensioning of the strapping has been completed.

When the cam member 252 moves away from the driving member 250, the shipper operating arm 518 is moved to the left, thereby moving the shipper to the left (Figs. 4 and 8). This leftward movement of the shipper releases the spring clutch 448 so that the latter resumes its frictional engagement with the drum 446 to connect the latter with the crank 418. The crank resumes rotation in the counterclockwise direction (Fig. 5) to complete the rocking of the jaws about the pivot pins 306 in the advanced position and to advance the notchers 304, thereby forming the joint between the overlapping strapping portions and seal. The movable cutter 326 severs the standing portion S'' of the strapping, which lies between the movable cutter and the block 158, between the cutting edges 322 and 324.

The crank 418 continues to operate in the counterclockwise direction until the end 454 of the clutch spring contacts with the face 514 of the shipper arm 498. At this time the crank 418 will be in such position as to permit the latch arm 458 to engage its lug 462 in the notch 464, thereby permitting the switch 472 to open the switch element 564 and close the element 558. This re-establishes the circuit through the conductor 556 and switch 554 and breaks the circuit through the conductor 562 to the relay 550 to deenergize the latter and open the motor contacts 532.

Closing the circuit through the conductor 556 to the relay 560 energizes that relay to close the contacts 534 and reverse the direction of motor operation. The feed wheel 144 is driven in the counterclockwise direction (Fig. 3) to feed strapping between it and the pressure

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roll 148, the pressure of which is now determined by the effect of the biasing spring 150. The strap feed continues until the free end of the strap S' strikes the barrier 162 when it tends to balloon out of the chute 34 and, since the only direction in which it can bulge is through the opening created by the dropout jaw 176, the latter falls away and operates the switch 184 to close the contact 548 in the now open circuit 542 because the run button 544 is open, and to open the contacts 554 to the relay 560. This relay deenergizes, opening the gang switch 534 to stop the motor and the machine is conditioned for another operating cycle.

Should at any time after the motor has been energized through the switches 532 and the motor is in the strap tensioning and joint forming portion of its cycle, the machine should jam due to an improperly fed seal blank, breaking of the strap, or for some other reason, the circuit can be deenergized by opening the stop switch 538. The reason for the malfunctioning of the machine is corrected and the switch 566 manually actuated to open the switch element 568, which is in the holding circuit for the relay 550, and to close the switch element 570 which is in the bypass or parallel circuit to the relay 560. The machine is operated in the reverse direction to withdraw the joint forming mechanism from joint forming to "zero" position and to feed strapping for another cycle which proceeds in the normal manner.

It will be readily appreciated from the foregoing description that the objectives which were claimed for this novel machine are fully attained, as well as others which were not specifically set forth.

While a preferred embodiment of the power strapping machine constituting this invention has been shown and described, it will be apparent that numerous modifications and variations thereof may be made without departing from the underlying principles of the invention. It is, therefore, desired by the following claims to include within the scope of the invention all such variations and modifications by which substantially the results of this invention may be obtained through the use of substantially the same or equivalent means.

What is claimed as new and desired to be secured by United States Letters Patent is:

1. A machine for binding bundles and the like with a band of tensioned strapping, comprising in combination, means for guiding the strapping from a supply source and about the bundle so that a free end portion of the strapping overlaps a standing portion of the strapping, means for anchoring the free end portion of the strapping, reversible means including a feed wheel rotatable on a fixed axis and a pressure roll between which the strapping passes for feeding strapping through said guiding means, for shrinking the strapping closely about the bundle, and for applying a tension thereto, means movably mounting a portion of said strapping guiding means on the machine and mounting said pressure roll for movement toward and away from said feed wheel, said guiding means portion being contacted by one face of the strapping during the tensioning thereof about the bundle to move said mounting means and to urge said pressure roll toward said feed wheel, means connected to said feeding and tensioning means for regulating the amount of tension applied to the strapping, means for forming a tension resisting joint in the overlapping strapping portions, and means interconnecting said tension regulating means and said joint forming means to initiate operation of the latter to deform the overlapping strapping portions into the joint only when the desired amount of tension has been applied to the strapping.

2. A machine as claimed in claim 1, wherein said guiding means portion has a curved surface contacted by the strapping, and said mounting means comprises a pair of spaced side guide plates rockably mounted on the machine, said plates mounting said guiding means portion and said pressure roll therebetween.

3. A machine as claimed in claim 1, wherein said feed wheel has a toothed periphery to engage the strapping, said periphery being bounded by a pair of circumferential shoulders of smaller diameter than said toothed periphery, and said pressure roll has a strapping engaging tread bounded by a pair of rims adapted to ride on said feed wheel shoulders to space said pressure roll tread a distance from said feed wheel periphery less than strapping thickness when there is no strapping between said feed wheel and said pressure roll.

4. A machine as claimed in claim 1, wherein said feed wheel has a toothed periphery to engage the strapping, said pressure roll has a tread engageable with the strapping to hold the latter against said feed wheel periphery, and said feed wheel and said pressure roll having cooperating shoulders and rims to space said toothed periphery a distance from said tread less than strapping thickness when no strapping is between said feed wheel and said pressure roll.

5. A machine for binding bundles and the like with a band of tensioned strapping, comprising in combination, means for guiding the strapping from a supply source and about the bundle so that a free end portion of the strapping overlaps a standing portion of the strapping, means for anchoring the free end portion of the strapping, reversible means transiently gripping the strapping for feeding strapping through said guiding means, for shrinking the strapping closely about the bundle, and for applying a tension thereto, said strapping guiding means including a movable portion contacted by one face of the strapping during the tensioning thereof about the bundle, said reversible strap gripping means having a bodily movable part movable toward and away from another part thereof and connected to said movable strap guiding portion so that the strapping when being tensioned engages said movable guide portion to urge said movable strap gripping part toward said other part to increase the gripping pressure of said reversible gripping means on the strapping during the tensioning thereof, means sensitive to the tension in the strapping and connected to said feeding and tensioning means for regulating the amount of tension applied to the strapping, means for forming a tension resisting joint in the overlapping strapping portions, and mechanical means interconnecting said tension regulating means and said joint forming means to initiate operation of the latter to deform the overlapping strapping portions into the joint only when the desired amount of tension has been applied to the strapping.

6. A machine for binding bundles and the like with a band of tensioned strapping, comprising in combination, reversible power means, means for guiding the strapping from a supply source and about the bundle so that a free end portion of the strapping overlaps a standing portion of the strapping, means for anchoring the free end portion of the strapping, reversible means for feeding strapping through said guiding means, for shrinking the strapping closely about the bundle, and for applying a tension thereto, clutch means connecting said strapping feeding and tensioning means to said power means, means connected to said clutch means for regulating the amount of tension applied to the strapping, means for forming a tension resisting joint in the overlapping strapping portions, second clutch means connecting said joint forming means to said power means, and means interconnecting said tension regulating means and said second clutch means to engage said second clutch thereby to initiate operation of the latter to deform the overlapping strapping portions into the joint only when the desired amount of tension has been applied to the strapping.

7. A machine for binding bundles and the like with a band of tensioned strapping, comprising in combination, means for guiding the strapping from a supply source and about the bundle so that a free end portion of the strapping overlaps a standing portion of the strapping,

means for anchoring the free end portion of the strapping, a drive shaft, reversible power means connected to said drive shaft for rotating the latter, reversible means for feeding strapping through said guide means, for shrinking the strapping closely about the bundle, and for applying a tension thereto, means selectively connecting said feeding and tensioning means to said drive shaft, means associated with said connecting means for regulating the amount of tension applied to the strapping, means for forming a tension resisting joint between the overlapping strapping portions, means including a spring clutch selectively connecting said joint forming means to said drive shaft, and means including a shipper interconnecting said spring clutch and said tension regulating means to initiate operation of said joint forming means to deform the overlapping strapping portions into the joint only when the desired amount of tension has been applied to the strapping.

8. A machine for binding bundles and the like with a band of tensioned strapping, comprising in combination, means for guiding the strapping from a supply source and about the bundle so that a free end portion of the strapping overlaps a standing portion of the strapping, means for anchoring the free end portion of the strapping, a drive shaft, reversible power means connected to said drive shaft for rotating the latter, a reversible feed wheel for feeding strapping through said guide means, for shrinking the strapping closely about the bundle, and for applying a tension thereto, clutch means selectively connecting said feed wheel to said drive shaft so as to operate said feed wheel, means acting on said clutch means for limiting the amount of tension applied to the strapping, means for forming a tension resisting joint between the overlapping strapping portions, including a normally engaged spring clutch for selectively connecting said joint forming means to said drive shaft when the latter is driven to operate said joint forming means in the joint forming direction, and means including a shipper interconnecting said spring clutch and said tension regulating means to disengage said clutch during tensioning of the strapping and to release said clutch when the desired amount of tension has been applied to the strapping so that said joint forming means may deform the overlapping strapping portions into the joint.

9. In a machine for binding bundles and the like with a band of tensioned strapping, the combination comprising, a drive shaft, reversible power means connected to said drive shaft for rotating the latter, reversible means engageable with the strapping for feeding strapping and for withdrawing strapping to shrink it closely about the bundle and to apply a tension thereto, means for anchoring a free end of the strapping looped about the bundle, a worm gear mounted for free rotation on said drive shaft, a worm driven by said worm gear and connected to said reversible means for feeding and withdrawing strapping, a driving clutch element connected to and driven by said drive shaft, a driven clutch element, complementary engageable means on said driven clutch element and said worm gear, and said clutch elements having complementary engageable driving parts which are disengaged upon excessive resistance to driving said driven clutch element, a spring acting on and urging said driven clutch element into engagement with said driving clutch element and said worm gear, and adjustable means for adjusting the force exerted by said spring, whereby the strapping when tensioned to a predetermined amount resists the driving of said feeding and withdrawing means to hold said worm gear and said driven clutch element against rotation and to cause said driving clutch element to move said driven clutch element against the force of said spring to disengage it from driving connection with said worm gear and said driving clutch element.

10. In a machine for binding bundles and the like with a band of tensioned strapping, the combination comprising, a drive shaft, reversible power means connected

to said drive shaft for rotating the latter, reversible means engageable with the strapping for feeding strapping and for withdrawing strapping to shrink it closely about the bundle and to apply a tension thereto, means for anchoring a free end of the strapping looped about the bundle, means selectively connecting said feeding and withdrawing means to said drive shaft, said means including a worm gear mounted for free rotation on said drive shaft, a worm driven by said worm gear and connected to said reversible means for feeding and withdrawing strapping, a driving clutch element, a driven clutch element, complementary engageable means on said driven clutch element and said worm gear, and said clutch elements having complementary engageable driving parts which are disengaged upon excessive resistance to driving said driven clutch element, and adjustable means associated with said connecting means for regulating the amount of tension to be applied to the strapping and for urging said driven clutch element into engagement with said driving clutch element and said worm gear, whereby the strapping when tensioned to a predetermined amount resists the driving of said feeding and withdrawing means to hold said worm gear and said driven clutch element against rotation and to cause said driving clutch element to move said driven clutch element against the force of said adjustable means to disengage it from driving connection with said worm gear and said driving clutch element.

11. In a machine for binding bundles and the like with an encircling band of tensioned strapping, the combination comprising, a powered drive shaft, reversible means for feeding strapping and for withdrawing strapping to shrink it closely about the bundle and to apply a tension thereto, means for anchoring a free end of the strapping encircling the bundle and remote from said reversible means, means sensing the tension applied to the strapping by said reversible means for regulating the amount of tension applied to the strapping, means for forming a tension resisting joint between the overlapping strapping portions and an embracing seal, a crank connected to said joint forming means, a driving element connected to and driven by said drive shaft, friction means having a part fixed to said crank and another part releasably frictionally engaging said driving element, a release element on said friction means opposite said part fixed to said crank, and a pair of stops movable between two positions by said tension regulating means and engageable with said release element to release said friction means from frictional engagement with said driving element, whereby said crank is selectively connected to and disengaged from driving connection with said drive shaft so that said joint forming means forms the joint in the overlapping strapping portions after the strapping has been properly tensioned.

12. In a machine for binding bundles and the like with an encircling band of tensioned strapping, the combination comprising, a powered drive shaft, reversible means for feeding strapping and for withdrawing strapping to shrink it closely about the bundle and to apply a tension thereto, means for anchoring a free end of the strapping encircling the bundle and remote from said reversible means, means sensing the tension applied to the strapping by said reversible means for regulating the amount of tension applied to the strapping, means for forming a tension resisting joint between the overlapping strapping portions and an embracing seal, a crank connected to said joint forming means, a driving drum connected to and driven by said drive shaft, a spring clutch having one end fixed to said crank and its major portion frictionally engaging said drum, a projecting end on said spring clutch opposite said end fixed to said crank, a shipper movable between two positions and having stops engaging said projecting spring end to release said spring from frictional engagement with said drum, and movable means connecting said shipper with said tension regulating means, whereby said shipper in a first position releases

said spring clutch from engagement with said drum after said joint forming means has been partially operated, and said shipper is moved to a second position to permit said spring clutch to reengage said drum after the strapping has been properly tensioned so as to permit the joint forming means to complete the joint in the overlapping strapping portions and embracing seal.

13. In a machine for binding bundles and the like with a band of tensioned strapping, the combination comprising, an encircling powered drive shaft, reversible means for feeding strapping and for withdrawing strapping to shrink it closely about the bundle and to apply a tension thereto, means for anchoring a free end of the strapping encircling the bundle and remote from said reversible means, means sensing the tension applied to the strapping by said feeding and withdrawing means for regulating the amount of tension applied to the strapping, said tension regulating means having a movable arm, means for forming a tension resisting joint between the overlapping strapping portions and an embracing seal, a crank connected to said joint forming means, a driving drum connected to and driven by said drive shaft, a spring clutch having one end fixed to said crank and its major portion frictionally engaging said drum, a projecting end on said spring clutch opposite said end fixed to said crank, a shipper movable between two positions and having stops engaging said projecting spring end to release said spring from frictional engagement with said drum, a longitudinally shiftable shaft connecting said shipper with said movable arm, whereby said shipper in a first position releases said spring clutch from engagement with said drum after said joint forming means has been partially operated, and said shipper is moved to a second position to permit said spring clutch to reengage said drum after the strapping has been properly tensioned so as to permit the joint forming means to complete the joint in the overlapping strapping portions and embracing seal.

14. A machine for binding bundles and the like with a band of tensioned strapping, comprising in combination, reversible power means, means for guiding the strapping from a supply source and about the bundle so that a free end portion of the strapping overlaps a standing portion of the strapping, means for anchoring the free end portion of the strapping, reversible means for feeding strapping through said guiding means and for withdrawing the strapping to shrink it closely about the bundle and to apply a tension thereto, clutch means connecting said strap feeding and withdrawing means to said power means, means connected to said clutch means for regulating the amount of tension applied to the strapping, means for forming a tension resisting joint in the overlapping strapping portions, drive means including a second clutch means connecting said joint forming means to said power means, means interconnecting said tension regulating means and said second clutch means to engage said second clutch means thereby to initiate operation of said joint forming means to deform the overlapping strapping portions into the joint only when the desired tension has been applied to the strapping, and control means for said power means operated by a part of said drive means at the conclusion of the operation of said joint forming means to reverse the direction of operation of said reversible power means.

15. A machine for binding bundles and the like with a band of tensioned strapping, comprising in combination, a drive shaft, reversible power means connected to said drive shaft for rotating the latter, reversible means for feeding strapping so that a free end portion of the strapping overlaps a standing portion thereof and for withdrawing the strapping to shrink it closely about the bundle and to apply a tension thereto, means for anchoring the free end portion of the strapping during the shrinking and tensioning of the strapping about the bundle, clutch means selectively connecting said feeding and tensioning means to said drive shaft, means acting on and resisting disengagement of said clutch means

for regulating the amount of tension applied to the strapping, means for forming a tension resisting joint between the overlapping strapping portions, drive means including second clutch means selectively connecting said joint forming means to said drive shaft, movable means interconnecting said second clutch means and said tension regulating means to initiate operation of said joint forming means to deform the overlapping strapping portions into the joint only when the desired tension has been applied to the strapping and said first clutch means has been disengaged, and control means for said power means operated by a part of said drive means at the conclusion of the operation of said joint forming means to reverse the direction of operation of said reversible power means thereby to reverse the rotation of said drive shaft to reengage said first clutch means, and to move said interconnecting means for a subsequent machine cycle.

16. A machine for binding bundles and the like with a band of tensioned strapping, comprising in combination, a drive shaft, reversible power means connected to said drive shaft for rotating the latter, reversible means for feeding strapping so that a free end portion of the strapping overlaps a standing portion thereof and for withdrawing the strapping to shrink it closely about the bundle and to apply a tension thereto, means for anchoring the free end of the strapping during the shrinking and tensioning of the strapping about the bundle, clutch means selectively connecting said feeding and withdrawing means to said drive shaft, said clutch means being disengaged by resistance to driving said feeding and tensioning means in the strapping withdrawal direction, means acting on and resisting disengagement of said clutch means for regulating the amount of tension applied to the strapping, means for forming a tension resisting joint between the overlapping strapping portions, drive means including a driving drum and a spring clutch normally engaged with said drum for selectively connecting said joint forming means to said drive shaft when the latter is driven to operate said joint forming means in the joint forming direction means including a movable shipper interconnecting said spring clutch and said tension regulating means to disengage said spring clutch from said drum during tensioning of the strapping and to release said spring clutch for engagement with said drum when the desired amount of tension has been applied to the strapping and said first named clutch means has been disengaged so that said joint forming means may deform the overlapping strapping portions into the joint, and control means for said power means operated by a part of said drive means at the conclusion of the operation of said joint forming means to reverse the direction of operation of said reversible power means thereby to reverse the rotation of said drive shaft, to reengage said first named clutch means, and to move said shipper into position for a subsequent machine cycle.

17. A machine for binding bundles and the like with a band of tensioned strapping, comprising in combination, a drive shaft, reversible power means connected to said drive shaft for rotating the latter, reversible means for feeding strapping so that a free end portion

of the strapping overlaps a standing portion thereof and for withdrawing strapping to shrink it closely about the bundle and to apply a tension thereto, means for anchoring the free end portion of the strapping during the shrinking and tensioning of the strapping about the bundle, drive means including clutch means selectively connecting said feeding and withdrawing means to said drive shaft, said clutch means including a driving clutch element connected to and driven by said drive shaft, an axially movable driven clutch element engageable with and disengageable from another element in said drive means, and said clutch elements having complementarily formed engageable driving parts which are disengaged upon excessive resistance to driving said driven element by axial movement of the latter which also disengages said driven element from other drive means element, means acting on and resisting disengagement of said clutch elements for regulating the amount of tension applied to the strapping, means for forming a tension resisting joint between the overlapping strapping portions, means selectively connecting said joint forming means to said drive shaft, said last named means including a crank connected to said joint forming means, a driving drum connected to and driven by said drive shaft, a spring clutch having one end fixed to said crank and its major portion frictionally engaging said drum, a projecting end on said spring clutch opposite said end fixed to said crank, a shipper movable between two positions and having stops engaging said projecting spring end to release said spring from frictional engagement with said drum, movable means connecting said shipper with said tension regulating means, whereby said shipper in its first position releases said spring clutch after said joint forming means has been partially operated and said shipper is moved to its second position upon axial disengaging movement of said driven clutch element to release said spring clutch after the strapping has been properly tensioned so as to permit the joint forming means to complete the joint in the overlapping strapping portions, and control means for said reversible power means operated by said crank at the end of the operation of said joint forming means to reverse operational direction of said power means thereby to reverse the rotation of said drive shaft, to reengage said driven clutch element with said driving clutch element and said other drive means element, and to move said shipper into its said first position.

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