Jan. 7, 1958 G. TURRALL ET AL 2,818,568

ROTARY STAPLING MECHANISM

Filed March 14, 1955 4 Sheets-Sheet 1

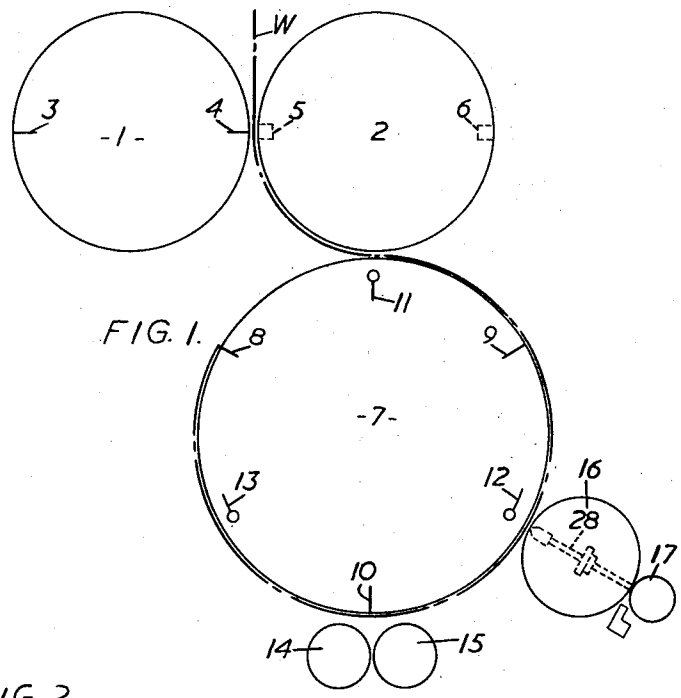
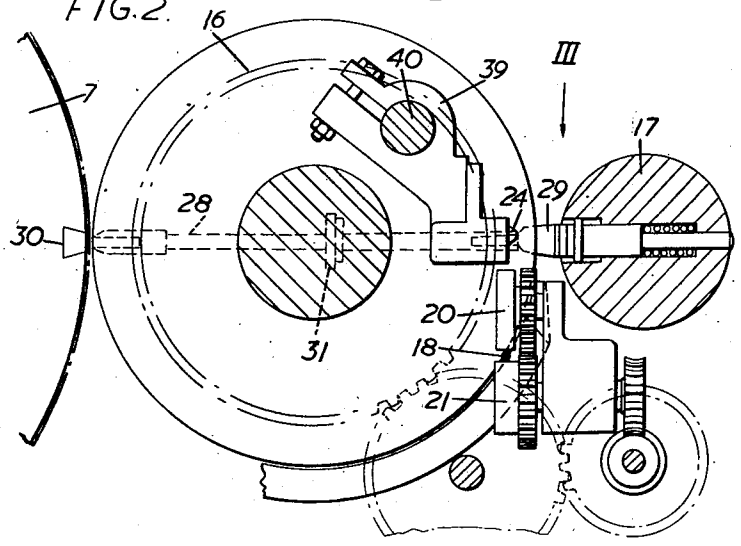


FIG. 1.

FIG. 2.



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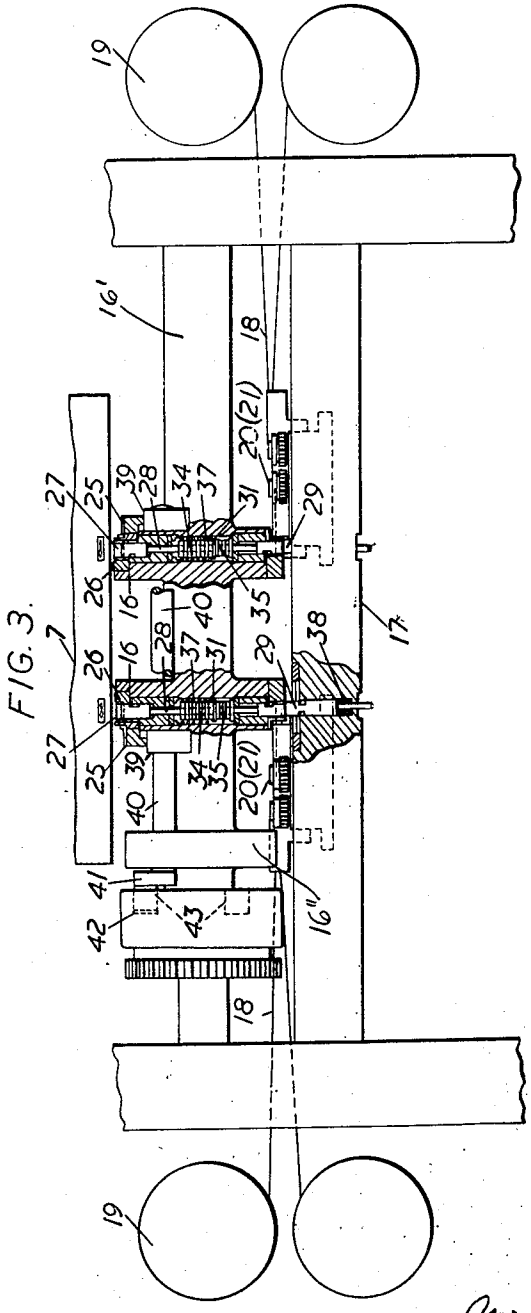


FIG. 3.

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FIG. 4.

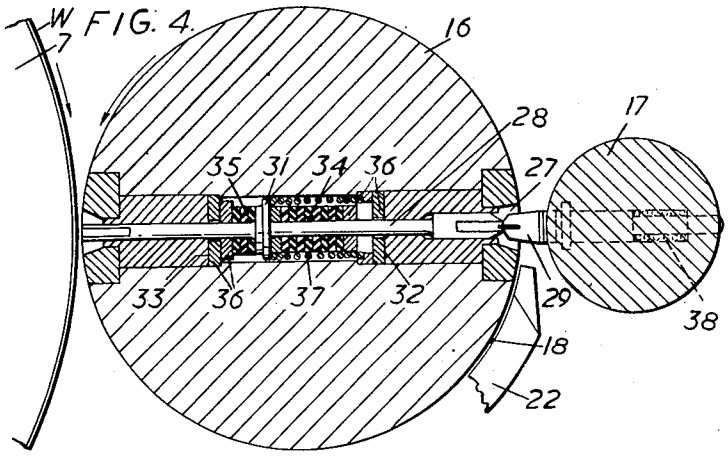
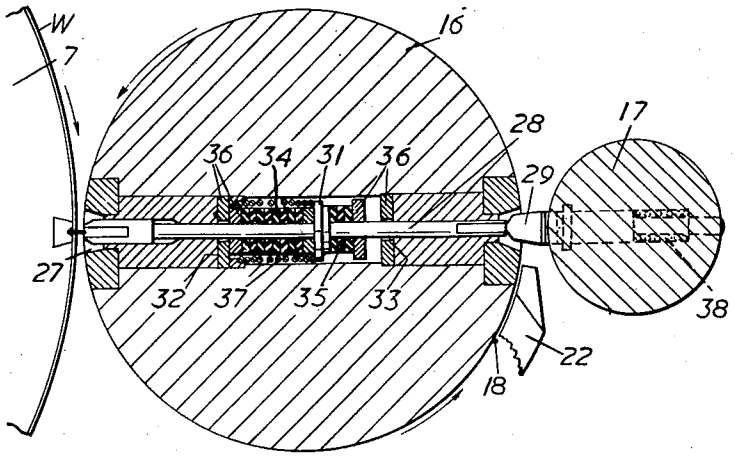


FIG. 5.



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ROTARY STAPLING MECHANISM

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FIG. 6.

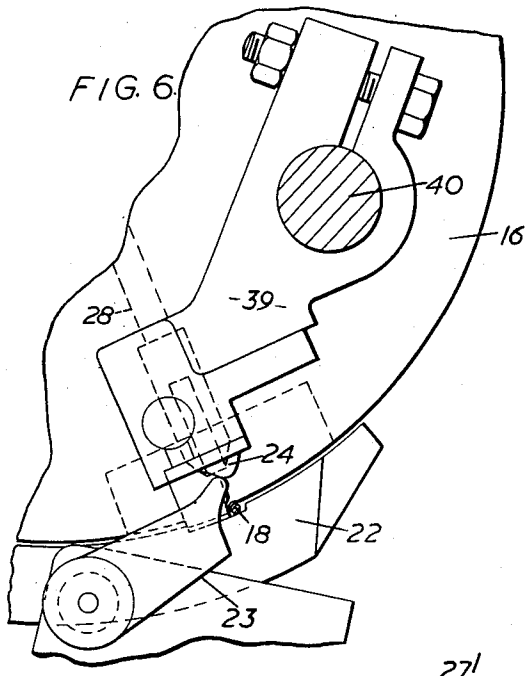
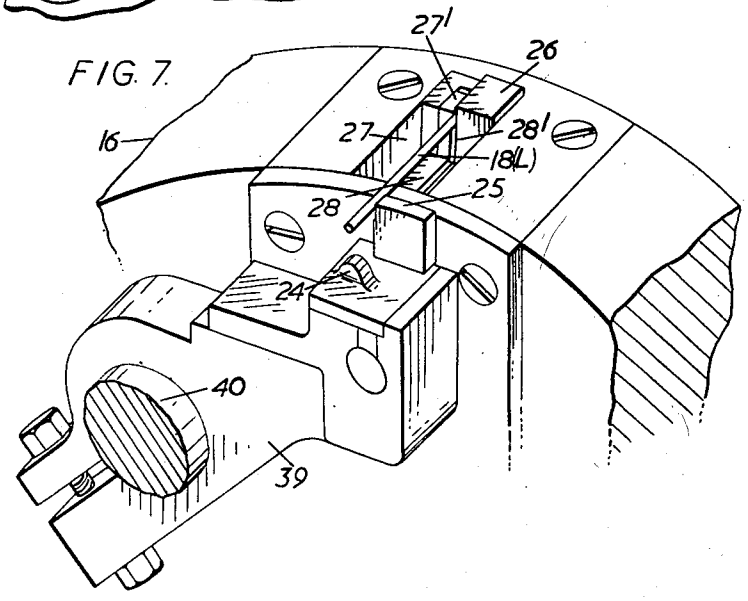


FIG. 7.



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ROTARY STAPLING MECHANISM

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Application March 14, 1955, Serial No. 494,078

Claims priority, application Great Britain August 16, 1954

9 Claims. (Cl. 1—7)

This invention relates to rotary stapling mechanism to be employed to staple together webs (or sheets) such as those issuing from a printing machine.

The invention is concerned more especially with stapling mechanism comprising a punch cylinder having a punch which as the cylinder rotates forces a length of staple forming wire into a staple forming die in a rotating die cylinder, the staple being carried in the die to a stapling position at which it is ejected and forced through the webs to be stapled; the staple is clenched by an anvil on a third rotating cylinder between which and the die cylinder pass the webs to be stapled.

Now according to one feature of this invention, the die cylinder is fitted with a staple driving component which is diametrally displaceable in the cylinder between limit stops and presents at least one of its ends to the punch so that the component is displaced by it to eject and drive by its other end a staple which was formed by the punch in an earlier part of the rotation of the die cylinder, and in addition, shock absorbing buffers are interposed between the component and its stops to absorb the shock of impact.

Such a stapling mechanism is required to operate at the high speeds of modern rotary printing machines; the rate of vibration of the component would therefore be very great and the component would be liable to destruction by fatigue due to reversing shock impacts at high frequency; it has however been found that the buffers protect the component from damage on that account.

The arrangement of the component can be such as to form and drive two staples in each rotation of the die cylinder which requires that the two ends of the component are engaged in succession by the punch to form a staple at the one end and to drive the preformed staple at the other end; in such a case the punch alone moves the component first in one direction and then in the other.

In other cases it would be sufficient to form and drive one staple in each rotation of the die cylinder: in this case also the component could be displaced in both directions by the punch operating first to form a staple against one end of the component and then later against the other end to drive that staple; it is, however, preferred that the staple-driving displacement of the component shall be effected against the action of a return spring arrangement: in such a case, the component could be limited by the return motion stop so that the appropriate end is not engaged by the punch but sits flush with the base of the staple when it is formed by the punch in the recess.

The staple forming die in the die cylinder is conveniently formed between cheek blocks having radial grooves into which the die forces or bends a length of wire to the required U shape with the limbs of the U lying in the grooves.

The frictional engagement between the legs of the staple and the die can be relied upon to hold the staple in position (after the punch has withdrawn from the die) while the staple is being carried round to ejecting position: however it is preferred to provide the die with a spring finger

which is deflected when the punch enters the die in the staple forming operation and reacts as the punch recedes from the die to exert sufficient drag to hold the staple in the die.

The punch can be fixed to its cylinder: however, as the staple driving component is of fixed length and its ends are successively presented to the webs which pass between the die and anvil cylinders, the radial position of that end of the component which is presented to the punch will depend upon the thickness of the webs and that thickness can vary from one product to another. Again, in the staple driving operation, webs of different runs may resist to different degrees the compressive action of the punch.

According to a further feature of this invention, the punch is mounted in the punch cylinder to have a limited reciprocatory movement in it so that the punch is enabled to accommodate itself to the position of the end of the compartment which it is engaging: the punch may be subjected to a light spring action biasing it to a normal position.

The punch is enabled to accommodate itself automatically or "give way" to the position occupied by the end of the component as the two move in their circular orbits into cooperation. This avoids the necessity for careful radial setting of the punch which would otherwise be necessary. In addition, the arrangement of this invention ensures that a tightly formed staple will result without the danger of over-compression of the parts involved and consequent risk of breakage.

The punch and die can be arranged to form staples with their base limb in alignment longitudinally of the die cylinder for effecting transverse stapling, or transversely of the cylinder to effect longitudinal stapling. Moreover, the mechanism can be arranged to staple what are termed "collect" and "non-collect" products.

The accompanying drawings illustrate a machine which incorporates both features of the invention. In these drawings,

Figure 1 is a diagrammatic view of the output end of a printing machine equipped with the stapling mechanism of this invention,

Figure 2 is a local end elevation to a larger scale of the stapling mechanism,

Figure 3 is a sectional plan view looking approximately in the direction of the arrow III in Figure 2,

Figures 4 and 5 are sectional views showing the parts in different positions,

Figure 6 is a local end elevation of the staple wire cutting mechanism, and

Figure 7 is a perspective view showing the staple forming die and the arrangement to enable "collect" and "non-collect" products to be stapled.

Reference firstly to Figure 1, this illustrates a well known form of the output or delivery end of a printing machine: it comprises two cylinders **1**, **2** between which pass associated webs W to be stapled, the cylinder **1** having cutting knives 3, 4 and the cylinder 2 cutting blocks 5, 6, the knives and the blocks serving to cut the webs into product lengths. The webs are taken to a collecting cylinder **7** having taking devices **8**, **9**, **10** and folding blades **11**, **12**, **13** which operate to fold the sheet lengths now cut from the webs W into folding rollers **14**, **15**. In what is known as a "non-collect" run, the sheet lengths pass straight through to the folding rollers: in the case of a collect run, the taking devices **8**, **9**, **10** are operated so that every other sheet length cut from the associated web is taken around with the collecting cylinder **7** and assembled with further sheet lengths to form a collected product which then passes to the folding rollers.

The present invention is concerned with mechanism by which the associated sheet lengths (whether collected or non-collected) are stapled together. This mechanism

comprises a cylinder 16 which is in the form of a disc and which will be termed the die cylinder and a cylinder 17 which will be termed the punch cylinder, the disc being mounted on a shaft 16'.

To the die cylinder is fed a length of staple forming wire 18 which is drawn from a supply reel 19 by feed rollers 20, 21. This wire is advanced continuously between the cylinder 16 and a control plate 22 and past a cutter 23 which as the cylinder rotates is actuated by a striker 24 on the cylinder to sever a staple forming length of wire from the leading end of the wire 18.

The die cylinder 16 is also provided with wire taking beaks 25, 26 disposed at each side of a staple forming recess 27 having side walls formed with wire-receiving recesses 28'. As will be seen from Figure 7, the length of wire L when taken by the beaks 25, 26 is positioned to span the recess 27, this occurring when the beaks pass the wire feed line.

The punch cylinder 17 has a punch 29 and as the cylinder continuously rotates the punch rolls in the manner of intermeshing gear teeth into the recess 27. In so doing, the punch forces the length L of wire into the recess to form the familiar U-shaped staple.

Slidably mounted in a diametrally extending passage or opening in the die cylinder 16 is a double ended component or plunger 28. One end of this component in one position of the latter forms a base wall of the recess 27 at the time the punch 29 forces the wire into the recess. The formed staple is carried round by the rotation of the die cylinder 16 until the end of the component registers with a clenching die 30 on the collecting cylinder 7. The punch cylinder 17 rotates at twice the angular speed of the die cylinder 16 and therefore when the component 28 registers at one end with the clenching die the other end registers with the punch 29. In the result, the punch displaces the component 28 so that the staple carrying end is substantially flush with the surface of the cylinder and ejects the previously formed staple and forces its legs through the webs, the legs being turned over by the clenching die 30 to complete the stapling operation.

Reference will now be made especially to Figures 4 and 5 which show the double-ended component 28. The diametral movement of the component is necessarily limited in the die cylinder 16 and this is achieved in the construction shown by forming the component with a limit stop, enlargement, or flange 31 and by forming the cylinder with two preferably annular limit or stop members 32, 33 projecting laterally inwardly of the passage in the path of the flange and through which the component 28 extends, the limiting means or stops 32—33 being spaced from the limiting means or flange 31 in the direction of movement of the component 28. If the flange were allowed to engage the stops direct, the component would be liable to destruction by shock fatigue, but this is avoided by interposing between the flange 31 and the two stops 32, 33 shock absorbing buffers 34, 35 which are deformable in the direction of movement of the component 28 and can be formed by blocks or as shown by rings of rubber threaded on to the component. The distance between the stops can be slightly greater than the overall length of the buffers and the flange 31 so that the component 28 is permitted a small unbuffered movement in both directions.

The stops 32, 33 are formed by the end walls of bushes in the die cylinder 16 and in order still further to reduce the impact shock, these ends can be faced with a fabric reinforced plastic applied in the form of washers 36.

In the particular construction shown, a single staple is formed and driven by the punch in each rotation of the die cylinder 16. In this case only one end of the component 28 requires to be impacted by the punch 29, the other end, while forming the base of the staple forming recess, just touching the cross limb of the U-shaped staple when formed by the punch. This requires that the stop 33 shall be appropriately positioned to hold the component as is shown in Figure 4, which shows the parts at the end of the staple forming position; it also requires that, as the punch moves the component 28 in only one direction to the limit imposed by the stop 32, provision must be made to return the component 28 in readiness for the next staple forming and driving operation. This is effected in the construction shown by a return spring 37; this spring is preferably more closely wound at its ends than at its intermediate part.

In the case where two staples are formed and driven in each rotation, the component 28 would have both of its ends displaced by the punch 29 which simultaneously forms the staple against one end which is displaced so that the other end drives the staple which was previously formed by the punch. In this case, the component requires no return spring 37 as it is moved first in one direction and then in the other by the punch.

The position of the driving end of the component 28 (i. e. the left hand end as seen in the driving position shown in Figure 5) will depend in some degree on the thickness of the webs and on the resistance of the paper to the staple insertion: the component 28 being of fixed length, its other end to be engaged by the punch 29 will consequently vary in position of presentation to the punch.

To enable the punch to accommodate itself to such variation so avoiding close adjustment of the parts, the punch may as shown be mounted in the punch cylinder 17 for limited free radial movement preferably against the action of a light biasing spring 38. The extent of movement of the punch could be of the order of about 0.06", this having been found adequate for the purpose.

In the arrangement shown, the side wall or walls of the die or recess 27 can incorporate a spring finger 27' as is shown for one wall in Figure 7, the finger serving to hold the formed staple in the recess as the punch 29 recedes.

As has been stated, the mechanism can be arranged to staple collected and non-collected products. This is provided by arranging firstly that the rate of feed of the wire 18 shall be variable, being at one speed for a collect run and at twice that speed for a non-collect run: for this purpose the wire feed rollers 20, 21 are arranged to be driven by a variable speed gearing driven from the shafts of the cylinders 7 or 16.

Secondly the wire taking beaks 25, 26 are controlled so that a length of wire is taken either in every other rotation of the die cylinder 16 (for stapling a collected product) or in every rotation of the cylinder (for a non-collected product), and the cutter 23 is operated similarly to cut a staple-forming length of wire once in every other rotation of the die cylinder or in every rotation.

To effect this, one of the two beaks, i. e. the beak 25 and the striker 24 which operates the cutter 23, are both carried by an arm 39 which is mounted on a shaft 40 pivoted in the die cylinder 16: the shaft 40 has a second arm 41 fitted with a roller 42 controlled by a cam 43. This cam can either be rotated (by gearing not shown) from the die cylinder to rotate at one half the speed of the cylinder or it can be locked to the cylinder.

When the cam rotates, it rocks the arm 39 inwardly in one rotation of the die cylinder and outwardly in the next rotation: this moves the striker 24 clear of the cutter 23 and the beak 25 clear of the wire 18 in one rotation of the die cylinder so that the wire length is not cut and the wire length is not taken by the beak: in the next rotation of the die cylinder, the slower rotating cam rocks the arm 39 to move the striker and the beak outwardly so that the cutter 23 is operated to cut a length of wire and the beak 25 is operated to take the cut length and to carry it round to the staple forming position in register with the punch 29.

When the cam 42 is locked to the die cylinder 16 the arm 39 is held at its outward position so that the striker 24 operates the cutter in every rotation of the die cylinder and the beak 25 is held in position to take

the cut length of wire also in every rotation of the die cylinder.

The construction shown in the drawings is intended to insert two staples in alignment across the webs to be stapled; for this purpose, the mechanism described is duplicated by the provision of an additional disc **16** on the shaft **16'** as is shown in Figure 3, there being however only a single cam **43** to operate a single shaft **40** having mounted on it two arms **39** one for each mechanism. The shaft **40** extends through both discs **16** and rotates therewith in an orbit about the shaft **16'**. The shaft **40** also extends through a supporting disc **16''** which is mounted fast on the shaft **16'**.

The mechanism for controlling the operation of the mechanism to enable a collect and a non-collect run to be dealt with is more fully described in co-pending application Serial No. 328,578 filed December 30, 1952, now Patent No. 2,709,808 dated June 7, 1955 so that further description in this application is believed to be unnecessary.

The wire feed mechanism comprising the rollers **20, 21** is preferably, as is shown, that described and claimed in co-pending application Serial No. 386,888 filed October 19, 1953, now Patent No. 2,754,958 dated July 17, 1956.

We claim:

1. In a rotary stapling mechanism having a continuously rotating staple-forming die cylinder provided with a diametral passage therethrough; a component movable in said passage to and from a first position, in which one end of said component forms the base of a staple-forming recess in said die cylinder, from and to a second position in which said one end of said component is substantially flush with the surface of said die cylinder; means for moving staple wire across said recess; a continuously rotating cylinder adjacent to said die cylinder and having means operable in one rotated position of said die cylinder for forcing a length of wire into said recess to form a staple and operable in another rotated position of said die cylinder to engage the other end of said component to move the latter to said second position to eject the formed staple: the combination of limiting means respectively on said die cylinder and said component spaced from each other in the direction of movement of said component and being cooperable to limit movement of said component towards at least one of said positions, and shock absorber means interposed between said limiting means and being deformable in the direction of movement of said component for absorbing shocks incident to movement of said component.

2. A construction as set forth in claim 1 including spring means interposed between said limit means for moving said component from said second position to said first position.

3. A construction as set forth in claim 1 in which said limit means comprise an enlargement on said component intermediate its ends and a member on said die cylinder projecting radially inwardly of said passage in the path of said enlargement.

4. A construction as set forth in claim 3 in which said enlargement comprises a flange extending circumferentially about said component and in which said member comprises an annular part through which said component extends.

5. A construction as set forth in claim 4 in which said shock absorber means comprises a rubber-like element surrounding said component between said flange and said member.

6. A construction as set forth in claim 1 in which the means on said adjacent rotary cylinder is operable in said one rotated position of said die cylinder to engage said one end of said component to move said component to its said first position.

7. A construction as set forth in claim 5 in which the space between said members is greater than the combined lengths of said rubber-like elements and said flange so as to enable said component to have limited free movement in said passage.

8. In a rotary stapling mechanism having a continuously rotating staple-forming die cylinder provided with a diametral passage therethrough; a component movable in said passage to and from a first position, in which one end of said component forms the base of a staple-forming recess in said die cylinder, from and to a second position in which said one end of said component is substantially flush with the surface of said die cylinder; means for moving staple wire across said recess; a continuously rotating punch cylinder adjacent to said die cylinder and having a punch operable in one rotated position of said die cylinder for forcing a length of wire into said recess to form a staple and operable in another rotated position of said die cylinder to engage the other end of said component to move the latter to said second position to eject the formed staple: the combination of limiting means on said die cylinder and said component cooperable to limit movement of said component towards at least one of said positions, shock absorber means interposed between said limiting means for absorbing shocks incident to movement of said component, and means resiliently urging the punch radially outwardly of the punch cylinder to enable the punch to accommodate itself to varying positions of the ends of the component.

9. In a rotary stapling mechanism having a continuously rotating staple-forming die cylinder provided with a diametral passage therethrough; a component movable in said passage to and from a first position in which one end of said component forms the base of a staple-forming recess, from and to a second position in which said one end of said component is substantially flush with the surface of said die cylinder; means for moving staple wire across said recess; a continuously rotating punch cylinder adjacent to said die cylinder and having a punch operable in one rotated position of said die cylinder for forcing a length of wire into said recess to form a staple and operable in another rotated position of said die cylinder to engage the other end of said component to move the latter to said second position to eject the formed staple: the combination of limiting means on said die cylinder and said component cooperable to limit movement of said component towards each of said positions, shock absorber means interposed between said limiting means for absorbing shocks incident to movement of said component, and means resiliently urging the punch radially outwardly of the punch cylinder to enable the punch to accommodate itself to varying positions of the ends of the component.

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