United States Patent

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[54] **PACKAGE STRAPPING TOOLS**

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[51] **Int. Cl.**.....**B21f 9/02**

[58] **Field of Search**.....140/93.2, 93.4, 123.6

[56] **References Cited**

UNITED STATES PATENTS

3,032,075	5/1962	Hall et al.	140/93.4
3,396,760	8/1968	Kirsinas et al.	140/93.4
3,384,131	5/1968	Sansum	140/93.2

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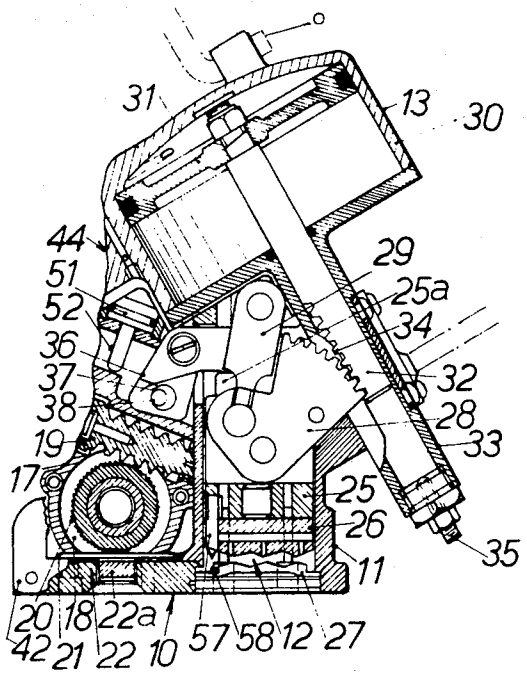
[57] **ABSTRACT**

A strapping tool by means of which the overlapped ends of a loop of strapping are secured together after that loop has been arranged and tightened around a package. A fluid pressure operated ram is coupled to a rack in mesh with an angularly movable toothed member connected by a toggle linkage to a linearly movable element of the jointing means.

10 Claims, 9 Drawing Figures



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SHEET 1 OF 4

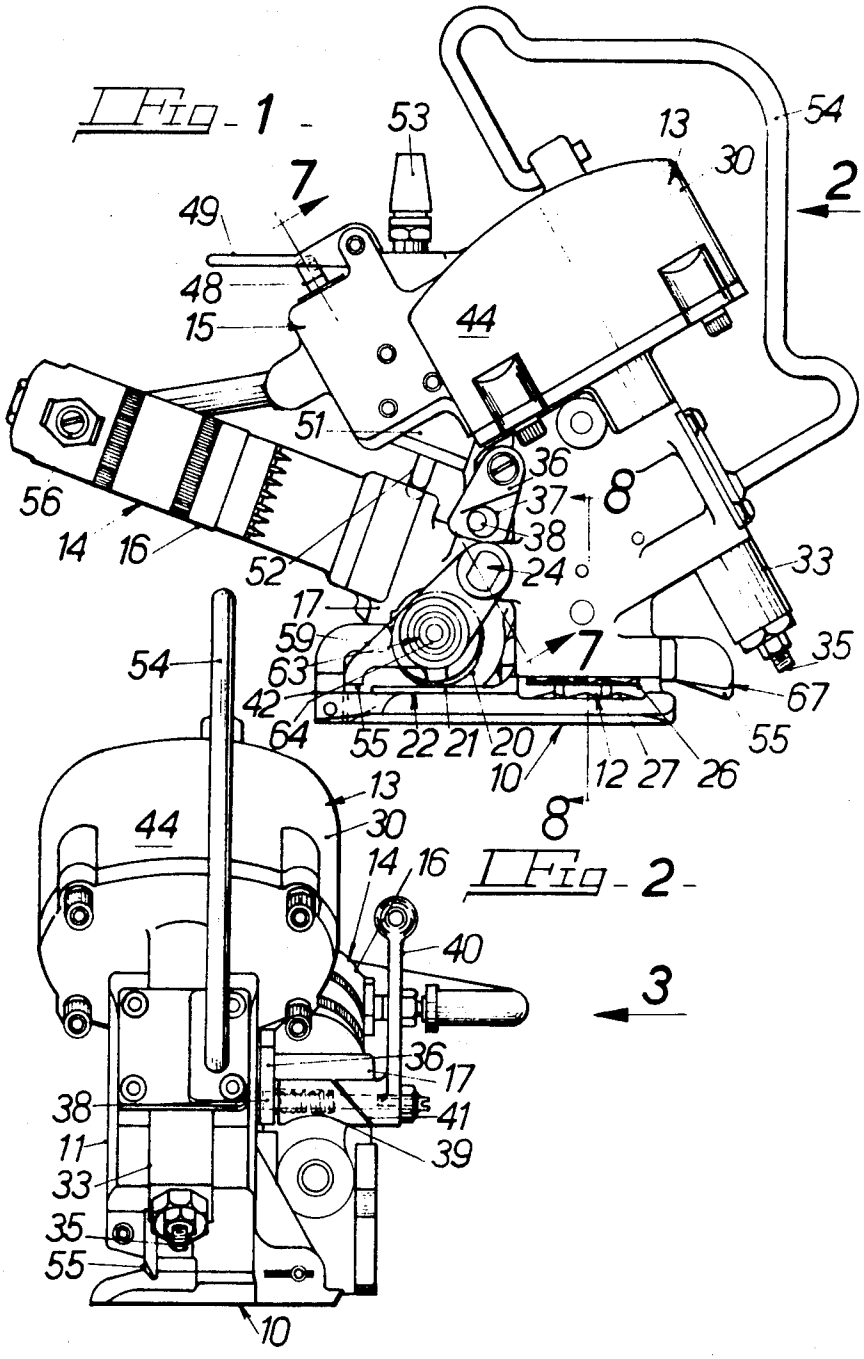

FIG - 1 -

FIG - 2 -

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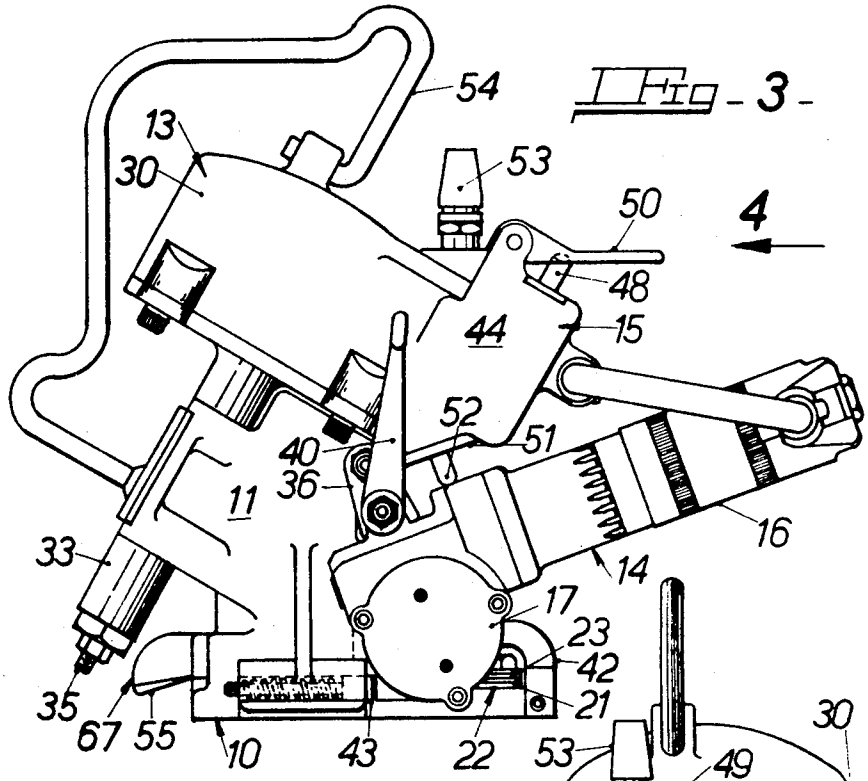

FIG - 3 -

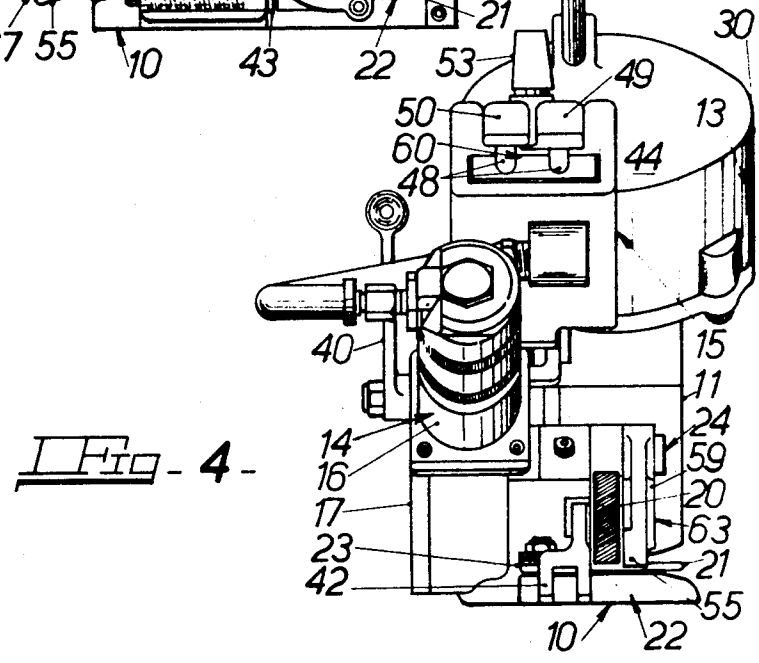

FIG - 4 -

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Fig - 5 -

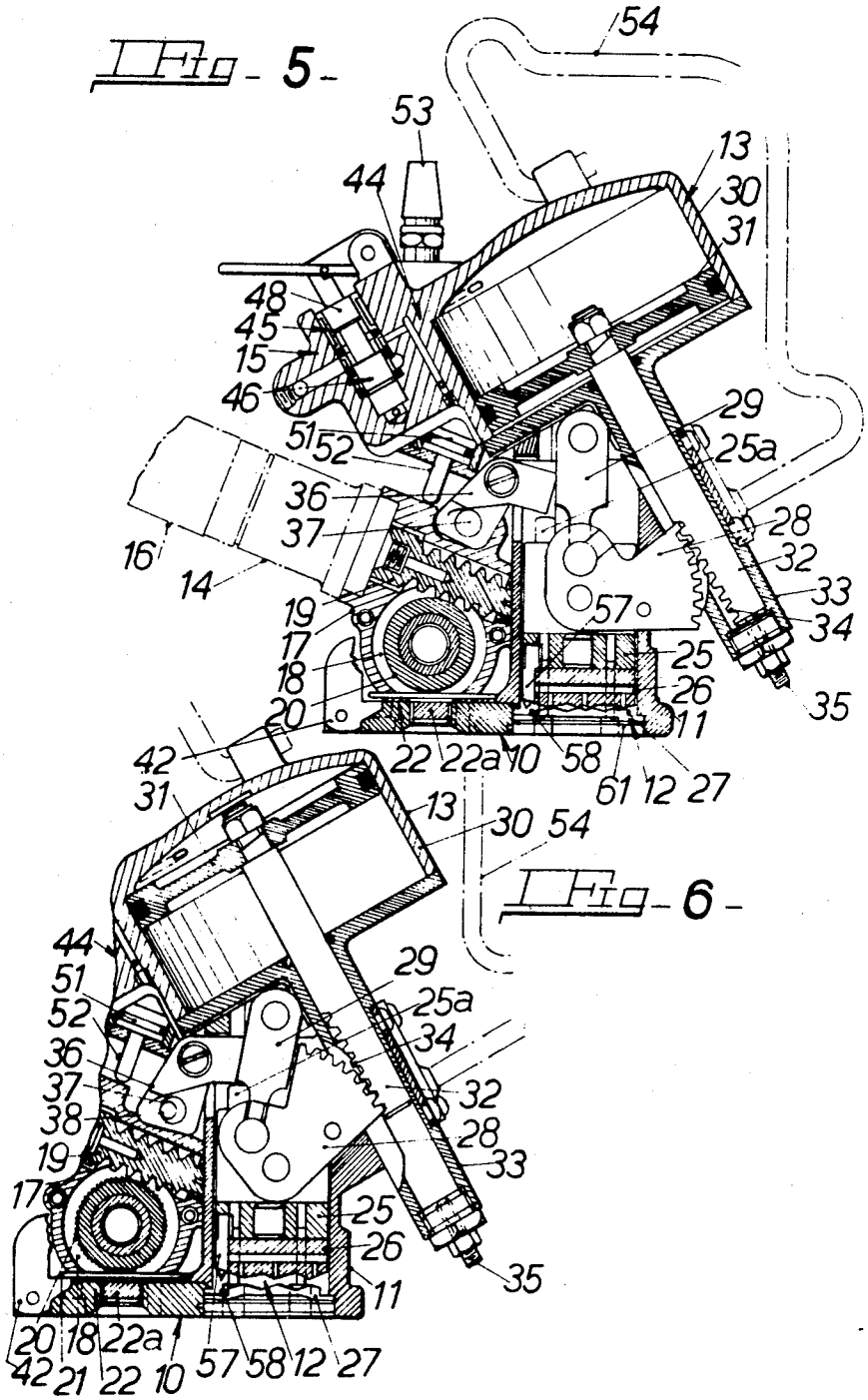

Fig - 6 -

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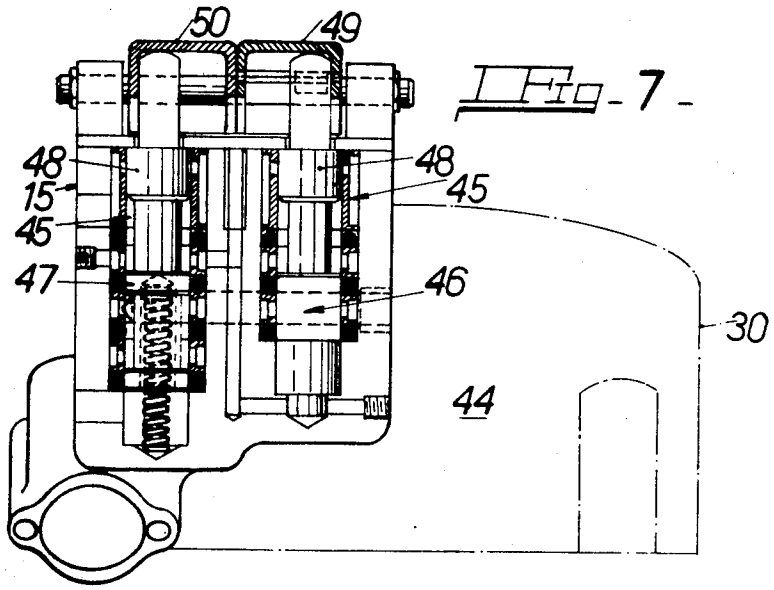

FIG - 7 -

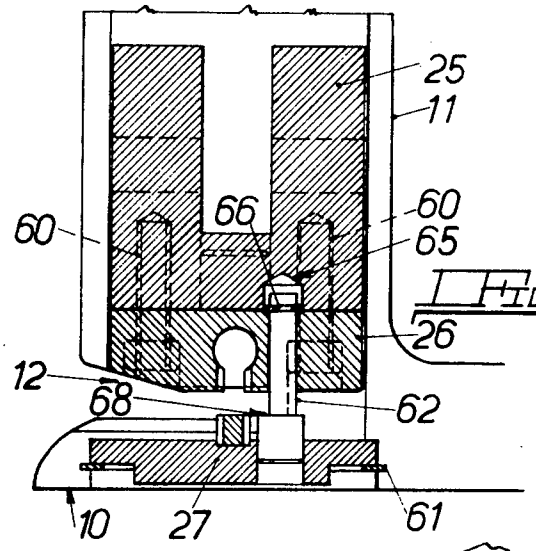

FIG - 8 -

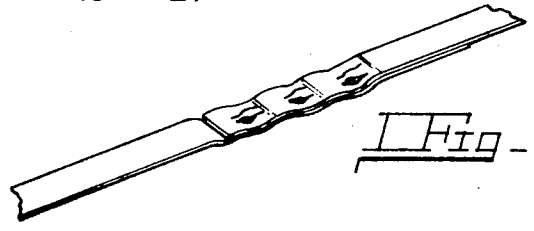

FIG - 9 -

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PACKAGE STRAPPING TOOLS

This invention relates to strapping tools for securing together by fluid-pressure operated jointing means the overlapping ends of a loop of strapping which has been tightened around a package. Such strapping tools will hereinafter be described as being "of the kind described."

The present invention consists in a strapping tool of the kind described comprising a fluid pressure operated ram coupled to a rack in mesh with an angularly movable toothed member which is connected to the jointing means by a linkage capable of converting angular motion into linear motion.

The angularly movable toothed member may conveniently be a quadrant as, in such a form, maximum radius, and therefore mechanical advantage, can be provided in the minimum space if the travel of the rack is not too great.

The linkage may be a toggle linkage of which the angularly movable toothed member forms one link. The mechanical advantage of the toggle linkage can be made to increase progressively as the operation of the jointing means proceeds by arranging that the toggle elements approach the in-line position during this operation.

The angularly movable toothed member may be pivotally mounted on a linearly movable element of the jointing means, for example on the movable element of a punch and die set. The free end of the toggle link completing the toggle linkage is then pivoted to a fixed part of the tool. This enables the mechanism to be arranged very compactly with the toggle linkage alongside the rack and the fixed pivot of the toggle link close to the ram and remote from the jointing means.

A combination of all these features provides a mechanism which occupies only a small space and enables the jointing means to be actuated with considerable mechanical advantage so that the size of the pressure-operated ram can be kept to a minimum.

The ram could be hydraulically actuated but because of the large mechanical advantage available with the mechanism described a pneumatic ram operated by compressed air at the pressures normal in factory compressed air services may be used to operate jointing means requiring quite a large operating force.

The linearly movable element of the jointing means may include a crosshead to which the movable element of a punch and die set may be releasably connected. The crosshead may be slidable in a guide formed in the body of the tool. The guide may open through the base of the tool and, in the mouth of the guide, means may be provided for locating and securing the fixed element of the punch and die set. The locating and securing means may take the form of an enlargement of the mouth of the guide forming a recess affording location and provided with a spring clip engaging a groove in the wall of the recess to secure the fixed element in position. The fixed element can be readily taken out after the spring clip has been removed. The movable element is then exposed and if this is secured to the crosshead by for example screws accessible at the parting surface of the punch and die set, this element too can be easily taken out.

The body of the tool including the base plate is preferably all formed in one piece, for example, by

casting. This reduces deflection of the base plate during sealing and avoids the need for screws and dowels for securing a separate base plate which are liable to be stretched during the jointing operation and then to work loose.

An embodiment of the invention will now be described by way of example, with reference to the accompanying drawings, in which:

FIG. 1 is a side view of a strapping tool according to the invention;

FIG. 2 is an end view of the tool in the direction of arrow '2' shown in FIG. 1;

FIG. 3 is a side view of the tool in the direction of arrow '3' shown in FIG. 2;

FIG. 4 is an end view of the tool in the direction of arrow '4' shown in FIG. 3;

FIG. 5 is a sectional side view of the tool as shown in FIG. 1 in an operated condition;

FIG. 6 is a sectional side view of a part of the tool similar to FIG. 5, but with the tool in an unoperated condition;

FIG. 7 is a sectional scrap-view on the line 7—7 in FIG. 1 of the tool;

FIG. 8 is a scrap sectional view on the line 8—8 in FIG. 1; and

FIG. 9 is a diagrammatic perspective view of a jointed part of a strap.

The strapping tool generally comprises a base plate **10** formed integrally with a housing **11** in which jointing means in the form of a punch and die assembly **12** is housed, a pneumatic ram assembly **13** for operating the punch and die assembly **12**, an air motor assembly **14** for tensioning a strap (not shown) to be fastened around a package (not shown), and a control valve assembly **15** by which the operation of the strapping tool is controlled.

The air motor assembly **14** comprises an air motor **16** and a gear box **17** to which the motor **16** is attached and which contains a gear wheel **18** in engagement with a worm gear **19** driven by motor **16**. The gear wheel **18** is mounted on and drives a shaft **64** which in turn drives a knurled wheel or rotary dog **20**. The rotary dog **20** is disposed over a pressure plate **21** which is secured to and lies over a foot portion **22** of the base plate **10** against which it is urged by spring cup washers **23**.

The air motor assembly **14** is pivotally connected to the housing **11** of the base plate **10** at **24** so that the rotary dog **20** is movable towards and away from the pressure plate **21**. An outrigger arm **59** is also pivoted at **24** and has a bearing at **63** in which the shaft **64** of rotary dog **20** and gear wheel **18** is journalled. The outrigger arm **59** is extended to provide a strap guide **55**.

Slidably mounted in the housing **11** is a cross-head **25** carrying a die **26**, the movable element, of the assembly **12** which is secured to the crosshead **25** by screws **60**. A punch **27**, the fixed element, of assembly **12** is secured in a recess in the foot portion **22** by a spring clip **61** locating in a groove formed in the wall of the recess. On removal of the clip **61** the punch **27** can be withdrawn from the recess thereby giving access to the screws **60** securing the die **26** to the crosshead. The die **26** is then removable through the recess in the foot portion **22**. Alignment pins **62** each extend through a hole in die **26** and project into a recess **65** formed in the crosshead **25** where the pin **62** is secured by a spring

clip 66 engaged in a circumferential groove in the pin 62. The end portion of each pin 62 remote from the die 26 is of enlarged diameter and engages in a clearance hole in the punch 27 to ensure the alignment of punch 27 and die 26. Each of the alignment pins 62 is disposed so that the periphery of the smaller diameter portion is at a distance from the longitudinal center line of the punch and die set equal to half the width of the strap to be fastened and thus they act as strap guides. Shoulders 68 formed by the enlarged diameter portions of pins 62 function as extractors in that when a joint has been formed in a strap as will be described hereinafter the extractors lift the jointed portion of the strap clear of the punch to facilitate its removal from the tool. To this end the length of the enlarged diameter portion is such that when the die 26 is at or towards its greatest distance from the punch 27 the shoulders 68 are at or adjacent the level of the top of the punch 27.

Pivotally secured to the crosshead 25 is a toothed drive quadrant 28 which also serves as one link of a toggle linkage. The toggle linkage is completed by a toggle link 29 one end of which is pivotally connected eccentrically to the quadrant 28, the other end being pivotally connected to the housing 11.

The pneumatic ram assembly 13 is disposed at and is supported on the opposite end of the housing 11 to the base plate 10 and comprises a cylinder 30 in which a piston 31 is reciprocably slidable. A rod 32 projects from the piston 31 and is slidable in a guide tube 33. The rod 32 is formed with a toothed rack 34 which is in engagement with the toothed drive quadrant 28. An adjustable stop screw 35 is provided at the end of the guide tube 33 to limit the movement of the piston 31 and rack 34 in the direction in which the die 26 approaches the punch 27, clearance between punch and die being thus adjusted.

A bell crank lever 36 constituting a member of releasable retaining means is pivotally mounted at its elbow on the housing 11 and has one arm passing through an aperture in the wall of the housing 11 and arranged to be engaged at its end by a stud 25*a* on the crosshead 25 when the crosshead 25 is adjacent, or at, its position remote from the foot portion 22. Adjacent the end of the other arm of the lever 36 an aperture 37 is formed in the arm. Engageable in the aperture 37 is a peg 38 constituting a component of releasable retaining means mounted on and slidable relative to the gear box 17 of the motor assembly 14. The peg 38 is urged by coil spring 39 to the engaged position, but is withdrawable from that position by a lever 40 through a cam arrangement 41. The arrangement is such that when the bell crank lever 36 has its one arm engaged by the stud 25*a* and the peg 38 is engaged in aperture 37 the air motor assembly 14 is held in a position such that the rotary dog 20 is away from the pressure plate 21. When the motor assembly 14 is thus supported with the rotary dog 20 away from the pressure plate 21, the pressure plate 21 is held away from the foot portion 22 by a bell crank lever 42 the elbow of which is pivotally connected to the foot portion 22. One arm of lever 42 is arranged to engage the face of the plate 21 adjacent the foot portion and the other arm is bent so that its end is engaged by part of the gear box 17. This other arm of lever 42 includes a portion acting as a strap guide. The pressure plate 21 is held sufficiently away from the foot portion 22 to enable the free end of the strap to be fastened to be inserted between the pressure plate 21 and the foot portion 22.

When the motor assembly 14 is released by operation of the lever 40 to disengage the peg 38 from aperture 37 it drops to such a position that support of the pressure plate 21 by the lever 42 ceases and the strap is gripped between the plate 21 and the foot portion 22 which is provided with an insert 22*a* the surface of which adjacent the pressure plate 21 is serrated to assist the gripping of the strap. The position to which the motor assembly 14 drops when released by lever 40 is such that the rotary dog 20 is still sufficiently away from the pressure plate 21 to allow the insertion of another part of the strap to be accomplished between the dog 20 and the pressure plate 21. The assembly 14 is resiliently supported in that position by a spring loaded push rod 43 engaging the gear box 17.

The cylinder 30 of the ram assembly 13 is formed as part of a body 44 in which the ported chambers 45 of two control valves 46, 47 are formed. Spools 48 of the valves 46, 47 are slidably movable in the chambers 45 by means of levers 49, 50.

Control valve 46 operable by lever 49 controls the operation of the air motor 16 and an auxiliary ram 51 a piston rod 52 of which is arranged to engage the gear box 17. When the ram 51 is pressurized the air motor assembly 14 is forced to pivot about its pivoted connection to the housing 11 towards the foot portion so that the rotary dog 20 is forced towards engagement with the pressure plate 21.

Control valve 47 operable by lever 50 controls the operation of the ram assembly 13. The air supply to the strapping tool is connected to port 53.

A universal carrying handle and hanging attachment 54 is secured to the strapping tool and is so formed that the tool can hang with the base plate 10 disposed vertically or horizontally.

At the end of the strapping tool remote from the strap guide 55 provided on outrigger arm 59 a further strap guide 55 is provided in the form of a plate secured to a lug formation 67 projecting from the housing 11 of the strapping tool.

In operation, the air supply is connected to the tool at port 53. Ram control valve 47 in the unoperated condition allows air to flow to the underside of piston 31 of the ram assembly 13 to support the die 26 away from punch 27, and stud 25*a* engaging the arm of bell crank lever 26 to hold the air motor assembly 14 with the dog 20 away from pressure plate 21.

Referring to FIG. 1 of the drawings a strap dispenser (not shown) is disposed to the left of the tool as shown in FIG. 1. A loop of strap is formed around the package to be strapped, the free end portion of the strap being inserted sideways into the tool. The strap is manipulated past the strap guides 55 and into the tool between the punch 27 and die 26 and between the foot portion 22 and the pressure plate 21 which is held away from foot portion 22 by bell crank lever 42, the strap lying over serrated insert 22*a*.

When the free end of the strap is aligned in the tool, lever 40 is operated to withdraw peg 38 from aperture 37 in the arm of bell crank lever 36 so that the motor assembly 14 is allowed to drop to the position where it is resiliently supported by push rod 43. Pressure plate

21 is then unsupported by lever 42 and is urged by spring cup washers 23 to clamp the strap sufficiently to prevent the free end portion of strap from being pulled out of the tool when the loop of strap is initially arranged and pulled close around the package.

The other end of the loop of strap is inserted sideways into the tool being manipulated past the strap guides 55 and into the tool between the punch 27 and die 26 where it lies over the free end of strap and between the pressure plate 21 and the rotary dog 20 which is still supported away from the plate 21 by the action of push rod 43 on motor assembly 14. As well as strap guides 55 the guides provided by alignment pins 62 and the arm of lever 42 assist in the alignment of strap.

The use of the auxiliary ram 51 instead of a conventional spring to urge the rotary dog 20 into contact with the strap makes this provision possible. It avoids the inconvenient operation of manually separating the rotary dog from the pressure plate against the action of such a spring to insert the second end of the loop of strap.

When the loop of strap is satisfactorily aligned in the tool, lever 49 is pressed to move the spool 48 of valve 46 along its chamber 45 to allow air to flow to auxiliary ram 51 so that its piston rod 52 engages gear box 17 and forces rotary dog 20 to clamp the strap against pressure plate 21 which in turn clamps the free end of strap against foot portion 22. Simultaneously air is also allowed to flow to air motor 16 to drive rotary dog and apply tension to the strap. The tension applied to the strap depends on the stall torque of air motor 16 and this is adjusted to suit the application of the tool by means of a throttle screw 56.

When the air motor 16 stalls, lever 50 is pressed to start the jointing operations. The lever 50 has a projection 60 (FIG. 4) engaging lever 49 so that tension on the strap is fully maintained by the motor 16 while the joint is made and until the strap is severed. This is an improvement on the ratchet and pawl tension retaining arrangement commonly employed which inevitibly allows some loss of tension due to roll-back of the ratchet wheel before the pawl takes the load.

Pressing lever 50 moves spool 48 of valve 47 along its chamber 45 closing off the port leading to the underside of piston 31 and allowing air to flow to the upperside of piston 31 to operate the punch and die assembly 12 through rack 34 and drive quadrant 28 which is rotated towards a position where the pivotal connections of connecting rod and quadrant 28 are aligned with the pivotal connection of toggle link 29 to housing 11. It can thus be seen that as that position is approached mechanical advantage of the arrangement approaches infinity.

The punch 27 and die 26 when operated form a well known "seal-less" type of joint for inter-connecting the overlapped portions of the strap. As shown in FIG. 3, three pairs of zig-zag incisions are made in each of the overlapped portions of the strap to form between these incisions an "endless tongue." The mid-section between the incisions is displaced, perpendicularly to the plane of the strap and relatively to the laterally adjacent sections outside the incisions to form a shouldered crown and leave beneath the tongue a correspondingly shouldered opening. The crown at the tongue of one overlapped portion of strap projects through the opening of the other and the shoulders of the tongue are able to inter-engage with the oppositely directed shoulder parts of the opening when relative longitudinal movement is allowed to occur by the parting of the punch 27 and die 26. The pairs of zig-zag incisions are closer together than usual, the ends of adjacent incisions being separated by a distance approximately equal to their length. The punch and die set is therefore shorter and the overall length of the base plate is reduced. The joint itself is stiffer and, as a result, the extent of the relative longitudinal movement occupying between its parts when the punch 27 and die 26 are parted is reduced. This is valuable when non-compressible packages are being strapped.

The die 26 also comprises a chisel shaped cutter 57 arranged to sever the portion of the strap which is under tension after the joint has been made. The punch 27 is provided with a staple 58 in the form of circular cross-section wire which is disposed between the joint forming parts of the punch 27 and die 26 and the cutter 57 and which supports the strap in such a way that, prior to severing, the cutter 57 bends the overlapped portions of the strap to form a shallow corrugation. When the cutter 57 severs the one overlapped portion its cut end remains in the position to which it was previously bent that is in the shallow corrugation. In this way a clear flat joint is produced. During the operation of punch and die assembly 12 stud 25*a* is disengaged from bell crank lever 36 which rotates so that peg 38 can reengage aperture 37.

When the joint has been made and the strap severed the lever 50 is released and is spring returned to its initial position returning the spool 48 of valve 47 to its initial position. Lever 49 also returns to its initial position as does the spool 48 of the valve 46 it operates. This is effected by air admitted beneath that spool 48 by valve 47 when that was operated. On the return of valve 46 to its initial position air motor 16 stops and the flow of air to auxiliary ram 51 ceases. Piston 31 returns to its initial position moving the die 26 away from the punch 27. Stud 25*a* re-engages the arm of bell crank lever 36 and rotates it about its pivotal connection thus rotating air motor assembly 14 to its initial position which in turn lifts pressure plate 21 away from foot portion 22.

While the jointing of strap is being effected by punch and die the shoulders 68 of the enlarged diameter end portions of alignment pins 62 are below the lowest level to which the strap is deformed, but when the die moves away from the punch it draws the shoulders 68 with it. The shoulders engage the underside of the jointed portion of the loop of strap and lift it clear of the punch to facilitate its removal from the tool.

When the tool is removed from the jointed loop of strap it is in a condition ready for use again.

The gearing of the gear wheel 18 and worm gear 19 is reversible that is to say that, if for any reason, for example misalignment of strap and tool it becomes necessary to re-adjust the strap, air motor 16 can be stopped by lifting the lever 49 to return valve 46 to its initial position and the dog 20 will rotate in the opposite direction to release strap tension, the gear wheel 18 back-driving the worm gear 19.

An advantage gained by this tool in which alignment pins 62 function as strap guides over tools where a surface on the body of the tool forms a strap guide is that

the tool can be readily modified to accept different widths of strap without changing the body. All that is necessary is replace punch **27**, die **26** together with the alignments pins **62**, outrigger arm **59**, lever **42** and the strap guide plate **55** secured to lug formation **67**.

I claim:

1. A strapping tool comprising a body, fluid pressure operated jointing means for securing together the overlapping ends of a loop of strapping which has been tightened around a package, said jointing means having a linearly movable element and a fixed element, a fluid pressure operated ram, a toothed rack coupled to said ram, a toothed quadrant pivotally mounted on said linearly movable element and in mesh with said toothed rack, a toggle linkage of which the quadrant forms a first link and having a second link pivotally connected at one end to said body and at the other end to said first link.

2. A strapping tool according to claim **1** wherein said linearly movable element of said jointing means includes a crosshead and said body of said tool defines a guide in which said crosshead is slidable.

3. A strapping tool according to claim **2** wherein said jointing means includes a punch and die set, said movable element of said jointing means being releasably secured to said crosshead.

4. A strapping tool according to claim **3** wherein said tool includes a base, said guide opening through said base to form a mouth, means being provided in said mouth for releasably securing said fixed element of said jointing means.

5. A strapping tool according to claim **4** wherein said means for securing said fixed element comprises a spring clip, said mouth being formed with a recess in which said fixed element of said jointing means is received and located, said recess having a wall formed with a groove in which said spring clip is releasably engaged to retain said fixed element in said recess.

6. A strapping tool according to claim **4** wherein said mouth of said guide is so large and means by which said movable element of said jointing means is releasably secured to said crosshead is so arranged that when said fixed element of said jointing means has been removed from said tool said movable element of said jointing means can be released from said crosshead and removed from said tool through said mouth of said guide.

7. A strapping tool according to claim **6** wherein said body and said base of said tool are formed in one piece.

8. A strapping tool according to claim **6** wherein an alignment pin is carried by said movable element of said jointing means, said fixed element of said jointing means defining a hole in which said alignment pin engages.

9. A strapping tool according to claim **8** wherein the distance between a portion of the periphery of said alignment pin and the longitudinal center line of said jointing means is equal to half the width dimension of a strap to be fastened whereby said alignment pin is able to act as a guide for said strap.

10. A strapping tool according to claim **9** wherein a shoulder is provided on said alignment pin, the distance between said shoulder and said movable element of said jointing means being substantially equal to the maximum clearance between said movable and said fixed elements of said jointing means whereby, in use, said shoulder is capable of engaging the underside of a jointed portion of strap to lift said portion clear of said fixed element when said movable element moves away from said fixed element on the completion of a joint forming operation.

* * * * *