

(19)



(11)

EP 1 824 738 B1

(12)

EUROPEAN PATENT SPECIFICATION

(45) Date of publication and mention
of the grant of the patent:
23.04.2008 Bulletin 2008/17

(51) Int Cl.:
B65B 13/32 (2006.01)

(21) Application number: **05796290.4**

(86) International application number:
PCT/IB2005/003282

(22) Date of filing: **03.11.2005**

(87) International publication number:
WO 2006/048738 (11.05.2006 Gazette 2006/19)

(54) **WELDING TOOL FOR A STRAPPING APPARATUS**

SCHWEISSWERKZEUG FÜR EINE UMREIFUNGSVORRICHTUNG

OUTIL DE SOUDAGE POUR UN APPAREIL DE CERCLAGE

(84) Designated Contracting States:
CH DE ES FR GR IT LI

• **FINZO, Flavio**
CH-5436 Würenlos (CH)

(30) Priority: **04.11.2004 CH 18172004**

(74) Representative: **Klein, Friedrich Jürgen et al**
Patentanwälte Klein & Klein
Grienbachstrasse 17
6300 Zug (CH)

(43) Date of publication of application:
29.08.2007 Bulletin 2007/35

(73) Proprietor: **Orgapack GmbH**
8953 Dietikon (CH)

(56) References cited:
US-A- 4 050 372 **US-A- 4 096 019**
US-A- 4 300 976 **US-A- 4 313 779**
US-A- 4 450 032

(72) Inventors:
• **AEMISEGGER, Steve**
CH-2000 Neuchatel (CH)

EP 1 824 738 B1

Note: Within nine months from the publication of the mention of the grant of the European patent, any person may give notice to the European Patent Office of opposition to the European patent granted. Notice of opposition shall be filed in a written reasoned statement. It shall not be deemed to have been filed until the opposition fee has been paid. (Art. 99(1) European Patent Convention).

Description

[0001] The present invention relates to a friction welding tool used in conjunction with a strapping machine, said welding tool being fitted with a drive of which the output motion can be converted by a mechanism into an oscillating motion of a welding shoe. Moreover the present invention relates to a strapping apparatus fitted with a friction welding tool.

[0002] Such friction welding tools are widely used in conjunction with mobile strapping apparatus that are used at arbitrary stations to strap items to be packed with a superficially fusing strap. In principle however such friction welding tools also may be used with stationary strapping apparatus. In general such strapping apparatus comprises a tensioner applying sufficient tension to the strap loop placed around the particular item to be packed. Thereupon the strap loop may be affixed by a clamping unit of the strapping apparatus to the item to be packed to prepare it for the ensuing lacing procedure. As regards strapping apparatus of this kind, the lacing procedure can be implemented using a friction welding tool. In such a process the strap is depressed by an oscillating friction shoe in the zone between the two ends of the strap loop, This pressure and the heat generated locally and for a short time by the motion superficially fuse the strap, which typically is made of plastic. As a result a connection between the two superposed plies of strap is formed which is practically permanent and may be undone at best only applying a large force.

[0003] A plurality of such friction welding tools uses a cam or a connecting rod drive to convert a rotary driving motion into the oscillating motion of the welding shoe. It has been found however that the friction welds so made are not wholly satisfactory. In order to attain optimally welded links, a given amount of heat must be applied within a given time window into a locally bounded segment of the two mutually overlapping strap plies. As regards conventional plastic straps, strap temperatures of about 250 °C are required.

[0004] This feature entails given operational rates of the friction welding shoes while simultaneously given frictions must be applied to the strap, where both the said rates and the friction forces may depend on the nature of the strap. Furthermore the operational rate should be as constant as possible. In general problems will be encountered to attain optimal operational rates and friction forces of the welding shoes using the forces and torques generated by a manual lever and the conventional linkrod drive within the required superficial welding time window. This difficulty is enhanced moreover where manually operated friction welding tools are used - of which the weight should be as low as possible - to enjoy good handling of the strapping apparatus. Consequently very long drive levers used to apply large torques, or gear units with many transmission stages, are usually not used because of handling difficulties.

[0005] Even when electric motors are used to deliver

the drive motion as regards welding tools not actuated manually, similar problems do arise. Accordingly to-date tradeoffs had to be accepted between the attainable welding parameters.

[0006] It is therefore the objective of the present invention to create a friction welding tool of the above cited kind that improves welding.

[0007] For a welding tool of the above species used in conjunction with a strapping apparatus, this problem is solved by the invention by means of an approximately polygonal drive element which is configured as seen in the direction of drive transmission between the drive and the welding shoe and which comprises a peripheral surface having at least three zones that are at a larger distance from the axis of rotation than other peripheral zones.

[0008] It was discovered that the approximately polygonal drive element of the present invention allows multiplying the stroke that would otherwise be available from the linkrod design, provided that the approximately polygonal drive element shall comprise at least three peripheral zones that are a larger distance from said unit's axis of rotation. Every two zones of increased distance may enclose a peripheral zone of which the maximum distance to the axis of rotation is less than the least distance from the peripheral surface in one of the adjoining zones. This geometry may be used to attain more advantageous welding parameters than heretofore. The invention allows significant improvement in the welding tool's efficiency even while simultaneously making possible a more economical welding tool design than heretofore.

[0009] Alternatively the angular speed may be reduced by a factor of three using manual levers in the preferred application, said angular speed being applied to a shaft connected directly or indirectly to the manual lever. Because of the increased number of strokes per rotation of the drive element, it is thus feasible to attain the same welding parameters as heretofore. Such a feature may be exploited as leading to a simpler design of the friction welding tool, making possible in turn a reduction in weight of the strapping apparatus.

[0010] In the present invention, a polygonal or near-polygonal drive element in the preferred application may be construed being a single or multi-element component connected to a rotary shaft and fitted with a peripheral surface deviating from a circular shape. An approximately polygonal drive element is further characterized in that the peripheral surface may comprise as seen in the peripheral direction several mutually adjoining zones that differ in their particular distances from their particular maximum distances from the axis of rotation. The distance between the peripheral surface and the axis of rotation also may vary among the particular zones themselves. Also and as regards their topographies, identical zones may be employed. Illustratively the zones of greater distance to the axis of rotation may be at least approximately congruent. The same design also applies to the

zones of lesser maximum distance from the axis of rotation.

[0011] Basically however the approximately polygonal drive element may comprise a number of zones farther away from the axis of rotation and preferably said number is odd and larger than 3. A zone of lesser distance to the axis of rotation of the approximately polygonal drive element may be configured between every two preferably peripherally sequential zones that are farther away.

[0012] The approximately polygonal drive element may be operationally connected with at least one contacting element in order to transmit to this element a motion resulting from the drive element rotation. Preferably the drive element is configured between two contacting elements and displaces latter to and fro during a stroke in synchronous, translational manner and in the same direction. Said contacting elements are designed to rest against the drive element's peripheral surface. Advantageously too, the contact between the drive element and the two contacting elements shall be as play-free as possible. A preferred joint straight path of the contacting elements may preferably intersect the axis of rotation of the approximately polygonal drive element and be perpendicular to it.

[0013] Sliding friction may exist between the drive element and the minimum of one contacting element. However advantageously the mechanical loading of the minimum of one contacting element and of the drive element shall be in the form of rolling friction. This feature may be implemented for instance by imparting a degree of freedom to the contacting elements in the form of rotation about their bearing axis in addition to their ability to translate.

[0014] Advantageously, regardless of the number of zones, the diameter lines of the approximately polygonal drive element intersecting the axis of rotation at least approximately shall be of the same length. Accordingly the drive element may be a structure of the same thickness or similar.

[0015] Further preferred embodiment modes of the present invention are shown in the claims, the specification and the drawing.

[0016] The present invention is elucidated by the illustrative embodiments shown in purely schematic manner in the Figures.

Fig. 1 is a strapping apparatus integrating a friction welding tool of the invention,

Fig. 2 is a highly schematic representation of part of a friction welding tool of the invention,

Fig. 3 is a friction welding tool of the invention, and

Fig. 4 is a lever mechanism of the friction welding tool of Fig. 3 driven by the rotational motion of an approximately polygonal drive element.

[0017] The exclusively manually operated strapping apparatus 1 of the invention shown in Fig. 1 comprises a base plate 2 of which the lower side is designed to be

configured on an item to be packed. All operating units of the strapping apparatus 1 are mounted on the base plate 2. The various designs of the individual operational units of such strapping apparatus are known in their many ways in the state of the art. Accordingly, following a short discussion of the basic design of said apparatus, the next discussion shall relate only to the welding tool.

[0018] Using the strapping apparatus 1, a loop not shown in further detail in Fig. 1 of a plastic strap (for instance made of polypropylene [PP] or of polyethylene terephthalate [PET], previously deposited on the item to be packed, may be tensioned by said apparatus' tensioner 3. The tensioner comprises a drum 4 holding the strap to be tensioned. In this manner the loop may be sufficiently tensioned for good strapping.

[0019] Next the strap loop shall be affixed by a clamp 5 of the strapping apparatus to this apparatus. For that purpose the clamp comprises two strap jaws 6, 7. Thereupon welding may be carried out, at a site of said loop where two strap plies are superposed, by means of the strapping apparatus' friction welding tool 8. In this manner the strap loop can be closed on itself permanently. For that purpose the friction welding tool 8 is fitted with a welding shoe 9 which, by applying pressure to the strap and by carrying out a simultaneously oscillation motion, does superficially melt the two superposed strap plies onto each other. The plasticized or superficially molten segments flow into each other so that, following strap cooling, a connection has been established between the two strap plies.

[0020] To the extent required, the strap loop may severed from a strap roll by a cutter 10 of the strapping apparatus 1.

[0021] The tensioner 3, the clamp 5, the friction welding tool 8 and the cutter 10 are actuated by manually powered actuation elements of the strapping apparatus. The strapping apparatus of Fig. 1 does not receive external, additional power such as electricity for instance. However such might be the case for other strapping apparatus of the invention (omitted). In the embodiment mode shown, the said actuation elements include at least one manual lever 15 rotatable about a pivot axis 14 that, by means of omitted connections and/or freewheeling elements, can act on the various operational units.

[0022] In the welding unit of the invention, the manual lever 15 may be actuated several times to move the welding shoe 9 until welding is complete. The pivoting motion of the manual lever 9 in this process is transmitted in a manner not shown in detail to a planetary gear 16 (Fig. 3). The planetary gear 16 converts the motion of the shaft of the manual lever 15. The drive motion so converted then will rotate a planetary gear output shaft 18. An approximately polygonal drive element 20 is shown in Fig. 2, of which the rotational motion is transmitted by a further mechanism 21 to the welding shoe, is mounted on said output shaft. This mechanism 21 is shown in highly schematic manner in Fig. 2 by a rectangle and it may in principle be designed in very many ways.

[0023] An applicable embodiment of said mechanism is shown in Figs. 3 and 4. As may be inferred from these Figures, the approximately polygonal drive element 20 is situated between two contact elements designed as radially cylindrical roller bearings 22, 23 (hereafter roller bearings). The two roller bearings 22, 23 rest at a mutual offset of about 180° against a peripheral surface 24 of the approximately polygonal drive element 20. Said roller bearings are configured in a manner that their axes of rotations run parallel to the axis of rotation 18a of the approximately polygonal drive element. All three axes of rotation intersect a straight displacement path 25 along which the roller bearings 22, 23 may translate. The roller bearings 22, 23 are mounted respectively by their inner rings on bolts 27, 28, the two bolts resting in a fork-shaped guide bracket 29. Both the roller bearings 22, 23 and the drive element 20 are situated within the fork subtended by the guide bracket.

[0024] The translations of the roller bearings 22, 23 are determined by a given geometry of the peripheral surface 24 of the approximately polygonal drive element 20, namely said drive element comprises three zones 30a, 30b, 30c at its peripheral surface that are farther away from its axis of rotation. These three zones are apart by 120° from each other. A zone 31a, 31b, 31c of the peripheral surface 24 is situated in each case between two of those zones 30a, 30b, 30c at comparatively smaller radial distances from the drive element's axis of rotation 18a. The zones 31a, 31b, 31c situated at lesser radial distances also are equidistant by about 120°.

[0025] The contact sites between a particular roller bearing and the drive element may shift in relation to the translational path and they may be situated on the displacement path 25 as well as above or below. In this manner tangential contact may be attained at the particular contact site, that is a contact site at which a common tangent exists for both contacting partners. This constraint should affect the shaping of the individual zones of the approximately polygonal drive element.

[0026] The fork-shaped guide bracket 29 is linked at its left end, as seen in Fig. 3, by means of a rotatably supported connecting lever 33 to an upper lever 34. A welding shoe lever 35 is linked to the right end of the guide bracket 29 and also by its upper end to the upper lever 34. The upper lever 34 rests on the base plate 2 at the linkage site 36 of the connecting lever 33 in a manner not shown in further detail in Fig. 3.

[0027] The welding shoe 9 is linked in tipping manner to the lower end of the welding shoe lever 35. The guide bracket 29, the connection lever 33, the upper lever 34 and the welding shoe lever 34 constitute a parallelogram. An omitted tension spring affixed both to the upper lever 34 and in the region of the base plate 2 forces the upper lever 34 and hence the welding shoe 9 toward the base plate 2.

[0028] In order to arrive at an optimal length of stroke of the welding shoe 9 in relation to operational rate and compression, advantageously the distance from the link-

age site 41 of the guide bracket 29 at the welding shoe lever 35 to the linkage site 41 of the guide bracket 29 and the linkage site 43 of the welding shoe 9. In this manner the linkage site 41 of the guide bracket 29 divides the welding shoe lever 35 into segments which are 1/3 to 2/3 the lever's length.

[0029] Because of the topography of the peripheral surface 24 and the substantially playless rest of the roller bearings 22, 23 against said peripheral surface, the two roller bearings 22, 23 both resting in the fork-like guide bracket 29 synchronously and jointly carry out three complete double strokes (along the double arrow 44) of identical lengths along the translation displacement path 25 for one revolution of the drive element 20.

[0030] The translations of the roller bearings 22, 23 are transmitted by their support bolts 27, 28 to the guide bracket 29. The site 41 linking the welding shoe lever 35 to the guide bracket 29 then entails a swivel motion of the welding shoe lever 35 of which the motion furthermore is further determined by the linkage of the welding shoe lever 35 at the upper lever 34. In turn the motion of the upper lever 34 is determined by the linkage of the guide bracket 29 via the connection lever 33 to the upper lever 34 and also by the tipping support of the upper lever about the axis of the linkage site 36. Moreover the motion of said lever 34 is affected by the force exerted on it by the omitted tension spring.

[0031] The rotary motion of the drive element 20 is transmitted in this manner by means of the translating stroke of the roller bearings 22, 23 to the lever mechanism beyond the drive element, resulting in a reciprocating, pure translating motion of the welding shoe 9 on a plastic strap configured underneath it.

[0032] Compared to the already known linkrod drives, the above shown embodiment of the drive element allows carrying out, differently from conventional designs, not one double stroke, but instead a total of three double strokes of the welding shoe in the direction of the double arrow 11 for each drive shaft rotation. Assuming that the shaft of the drive element 18 runs at the same angular speed as in known designs, then the invention offers a tripling of the rate at which the welding shoe is reciprocating. This feature considerably increases the efficiency of the welding tool of the invention compared to conventional welding tools used in strapping apparatus.

Claims

1. A friction welding tool for a strapping apparatus, said tool being fitted with a drive of which the output motion is convertible by a gear unit into an oscillatory motion of a welding shoe, **characterized by** an approximately polygonal drive element (20) which is configured, as seen in the direction of transmission of the drive motion, between the drive and the welding shoe (9) and which is fitted with a peripheral sur-

- face (24) that comprises at least three zones (30a, 30b, 30c) which are configured about an axis of rotation (18a) and which are at a greater distance to the axis of rotation (18a) than other zones (31a, 31b, 31c) of said peripheral surface (24).
2. Friction welding tool as claimed in claim 1, **characterized in that** the drive element (2) comprises an odd number of zones (30a, 30b, 30c) being at a greater distance from the axis of rotation (18a).
 3. Friction welding tool as claimed in one or both of the above claims, **characterized in that** at least one contacting element rests against the drive element (20), said contacting element itself carrying out a motion caused by the rotary motion of the drive element (20).
 4. Friction welding element as claimed in claim 3, **characterized in that** the contacting element is operationally connected to a mechanism driven by the contacting elements, a translating reciprocating motion thereby being transmissible from the mechanism to the welding shoe (9).
 5. Friction welding tool as claimed in claim 4, **characterized in that** the mechanism is a lever mechanism.
 6. Friction welding tool as claimed in claim 5, **characterized in that** the compliant lever mechanism comprises parallelogrammatic lever linkages.
 7. Friction welding tool as claimed in claim 6, **characterized in that** the minimum of one contacting element is mounted to a guide bracket (29) that is part of the parallelogrammatic linkage system.
 8. Friction welding tool as claimed in at least one of the above claims, **characterized in that** the drive element (20) is configured between two contacting elements each of which is in contact with the peripheral surface (24) of the drive element (20).
 9. Friction welding tool as claimed in claim 8, **characterized in that** the two contacting elements preferably are always moved synchronously by the drive element (20).
 10. Friction welding tool as claimed in at least one of the above claims 8 and 9, **characterized in that** the distance between the two contacting elements is substantially constant during a rotation of the drive element (20).
 11. Friction welding tool as claimed in at least one of claims 2 through 10, **characterized in that** at least one contacting element is displaceable along a straight path of displacement (25).
 12. Friction welding tool as claimed in claim 11, **characterized in that** the minimum of one contacting element is displaceable along a path of translation,
 13. Friction welding tool as claimed in at least one of the above claims, **characterized in that** a zone of larger distance from the axis of rotation always is diametrically opposite a zone of lesser distance from said axis of rotation.
 14. Friction welding tool as claimed in at least one of the above claims, **characterized in that** a drive motion for the welding shoe may be generated manually.
 15. Strapping apparatus, in particular a portable strapping apparatus, to strap an item to be packed with a plastic strap, comprising
 - a tensioner to apply sufficient tension to a strap loop,
 - a clamp allowing clamping the tensioned strap, and
 - a friction welding tool to generate a weld connection at two mutually overlapping strap plies,**characterized by** a friction welding tool as claimed in at least one of the above claims 1 through 14.

Patentansprüche

1. Reibschweisseinrichtung für eine Umreifungsvorrichtung, die mit einem Antrieb versehen ist, dessen Antriebsbewegung über ein Getriebe in eine oszillierende Bewegung eines Schweisschuhs transformierbar ist, **gekennzeichnet durch** ein polygonartiges Antriebselement (20), das in Übertragungsrichtung der Antriebsbewegung zwischen dem Antrieb und dem Schweissschuh (9) angeordnet ist und das mit einer Umfangsfläche (24) versehen ist, die mit zumindest drei Zonen (30a, 30b, 30c) versehen ist, die in Bezug auf eine Rotationsachse (18a) angeordnet sind und die in Umfangsrichtung und im Vergleich zu anderen Zonen (31a, 31b, 31c) der Umfangsfläche (24) einen erhöhten Abstand zur Rotationsachse (18a) aufweisen.
2. Reibschweisseinrichtung nach Anspruch 1, **dadurch gekennzeichnet, dass** das Antriebselement (20) mit einer ungeraden Anzahl an Zonen (30a, 30b, 30c) mit erhöhtem Abstand zur Rotationsachse (18a) versehen ist.

3. Reibschweisseinrichtung nach einem oder beiden der vorhergehenden Ansprüche, **dadurch gekennzeichnet, dass** gegen das Antriebselement (20) zumindest ein Kontaktelement anliegt, das aufgrund der rotativen Bewegung des Antriebselements (20) selbst eine Bewegung ausführt. 5
4. Reibschweisseinrichtung nach Anspruch 3, **dadurch gekennzeichnet, dass** das Kontaktelement mit einem Getriebe in Wirkverbindung steht, das von dem Kontaktelement angetrieben wird, wobei mit dem Getriebe auf den Schweissschuh (9) eine translatorische Hin- und Herbewegung übertragbar ist. 10
5. Reibschweisseinrichtung nach Anspruch 4, **dadurch gekennzeichnet, dass** das Getriebe als Hebelgetriebe ausgebildet ist. 15
6. Reibschweisseinrichtung nach Anspruch 5, **dadurch gekennzeichnet, dass** das normgerechte Hebelgetriebe eine parallelogrammartige Anlenkung von Hebeln umfasst. 20
7. Reibschweisseinrichtung nach Anspruch 6, **dadurch gekennzeichnet, dass** das zumindest eine Kontaktelement an einer Führungsstange (29) angeordnet ist, die Teil der parallelogrammartigen Anlenkung ist. 25
8. Reibschweisseinrichtung nach zumindest einem der vorhergehenden Ansprüche, **dadurch gekennzeichnet, dass** das Antriebselement (20) zwischen zwei Kontaktelementen angeordnet ist, die beide mit der Umfangsfläche (24) des Antriebselements (20) in Kontakt stehen. 30 35
9. Reibschweisseinrichtung nach Anspruch 8, **dadurch gekennzeichnet, dass** durch das Antriebselement (20) die beiden Kontaktelemente vorzugsweise stets synchron bewegt werden. 40
10. Reibschweisseinrichtung nach zumindest einem der vorhergehenden Ansprüche 8 und 9, **dadurch gekennzeichnet, dass** der Abstand der beiden Kontaktelemente zueinander bei einer Drehbewegung des Antriebselements (20) im Wesentlichen konstant ist. 45
11. Reibschweisseinrichtung nach zumindest einem der Ansprüche 2 bis 10, **dadurch gekennzeichnet, dass** das zumindest eine Kontaktelement entlang einer Bewegungsachse (25) beweglich ist. 50
12. Reibschweisseinrichtung nach Anspruch 11, **dadurch gekennzeichnet, dass** das zumindest eine Kontaktelement entlang einer translatorischen Bewegungsachse beweglich ist. 55

13. Reibschweisseinrichtung nach zumindest einem der vorhergehenden Ansprüche, **dadurch gekennzeichnet, dass** eine Zone mit erhöhtem Abstand zur Rotationsachse stets einer Zone mit geringerem Abstand zur Rotationsachse diametral gegenüber liegt.
14. Reibschweisseinrichtung nach zumindest einem der vorhergehenden Ansprüche, **dadurch gekennzeichnet, dass** eine Antriebsbewegung für den Schweissschuh manuell erzeugbar ist.
15. Umreifungsvorrichtung, insbesondere tragbares Umreifungsgerät, zur Umreifung von Packgut mit einem Kunststoffband, umfassend eine Spanneinrichtung zur Aufbringung einer ausreichenden Spannung auf eine Bandschlaufe, eine Klemmeinrichtung, mit der das mit der Spannung versehene Band klemmbar ist, sowie eine Reibschweisseinrichtung, mit der an zwei sich überlappenden Bandlagen eine Schweissverbindung erzeugbar ist, **gekennzeichnet durch** eine Reibschweissverbindung nach zumindest einem der vorhergehenden Ansprüche 1 bis 14.

Revendications

1. Outil de soudage par friction pour un appareil de cerclage, ledit outil étant équipé d'une commande dont le déplacement produit peut être converti par une unité d'engrenage en un mouvement oscillant d'une semelle de soudage, **caractérisé par** un élément d'entraînement de forme approximativement polygonale (20) qui est configuré, lorsque l'on regarde dans la direction de transmission du mouvement d'entraînement, entre la commande et la semelle de soudage (9) et qui présente une surface périphérique (24) qui comprend au moins trois zones (30a, 30b, 30c) qui sont configurées autour d'un axe de rotation (18a) et qui sont situées à une plus grande distance de l'axe de rotation (18a) que d'autres zones (31a, 31b, 31c) de ladite surface périphérique (24).
2. Outil de soudage par friction selon la revendication 1, **caractérisé en ce que** l'élément d'entraînement (2) comprend un nombre impair de zones (30a, 30b, 30c) situées à une plus grande distance de l'axe de rotation (18a).
3. Outil de soudage par friction selon une ou les deux revendication(s) précédente(s), **caractérisé en ce qu'**au moins un élément de contact s'appuie contre l'élément d'entraînement (20), ledit élément de contact exécutant lui-même un mouvement provoqué par le déplacement rotatif de l'élément d'entraînement (20).

4. Outil de soudage par friction selon la revendication 3, **caractérisé en ce que** l'élément de contact est connecté de façon opérationnelle à un mécanisme entraîné par les éléments de contact, un mouvement alternatif de translation pouvant ainsi être transmis du mécanisme à la semelle de soudage (9).
5. Outil de soudage par friction selon la revendication 4, **caractérisé en ce que** le mécanisme est un mécanisme à levier.
6. Outil de soudage par friction selon la revendication 5, **caractérisé en ce que** le mécanisme à levier adaptable comprend des bielles de levier en forme de parallélogramme.
7. Outil de soudage par friction selon la revendication 6, **caractérisé en ce qu'**au minimum un élément de contact est monté sur une console de guidage (29) qui fait partie du système de bielles en forme de parallélogramme.
8. Outil de soudage par friction selon au moins l'une des revendications précédentes, **caractérisé en ce que** l'élément d'entraînement (20) est configuré entre deux éléments de contact, chacun d'eux étant en contact avec la surface périphérique (24) de l'élément d'entraînement (20).
9. Outil de soudage par friction selon la revendication 8, **caractérisé en ce que** les deux éléments de contact sont de préférence toujours déplacés de façon synchronisée par l'élément d'entraînement (20).
10. Outil de soudage par friction selon au moins l'une des revendications 8 et 9 précédentes, **caractérisé en ce que** la distance entre les deux éléments de contact est essentiellement constante pendant une rotation de l'élément d'entraînement (20).
11. Outil de soudage par friction selon au moins l'une des revendications 2 à 10, **caractérisé en ce qu'**au moins un élément de contact peut être déplacé le long d'un chemin de déplacement droit (25).
12. Outil de soudage par friction selon la revendication 11, **caractérisé en ce que** ledit au minimum un élément de contact peut être déplacé le long d'un chemin de translation.
13. Outil de soudage par friction selon au moins l'une des revendications précédentes, **caractérisé en ce qu'**une zone située à une plus grande distance de l'axe de rotation est toujours diamétralement opposée à une zone située à une plus petite distance dudit axe de rotation.
14. Outil de soudage par friction selon au moins l'une des revendications précédentes, **caractérisé en ce qu'**un mouvement d'entraînement de la semelle de soudage peut être produit manuellement.
15. Appareil de cerclage, en particulier appareil de cerclage portable, pour cercler un article à emballer avec une bande de plastique, comprenant:
- un dispositif de mise sous tension pour appliquer une tension suffisante à une boucle de cerclage;
 - une pince qui permet de serrer la bande tendue; et
 - un outil de soudage par friction pour réaliser une connexion soudée à l'endroit où deux couches de la bande se chevauchent mutuellement;
- caractérisé par** un outil de soudage par friction selon au moins l'une des revendications 1 à 14 précédentes.

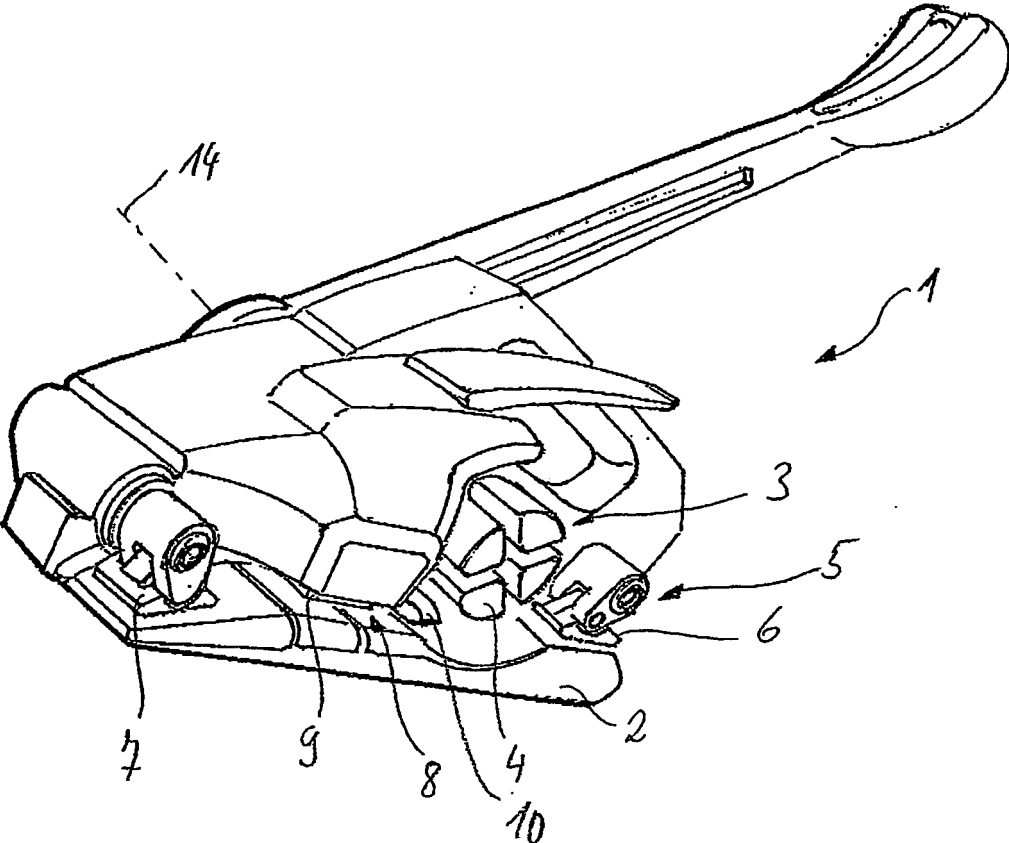
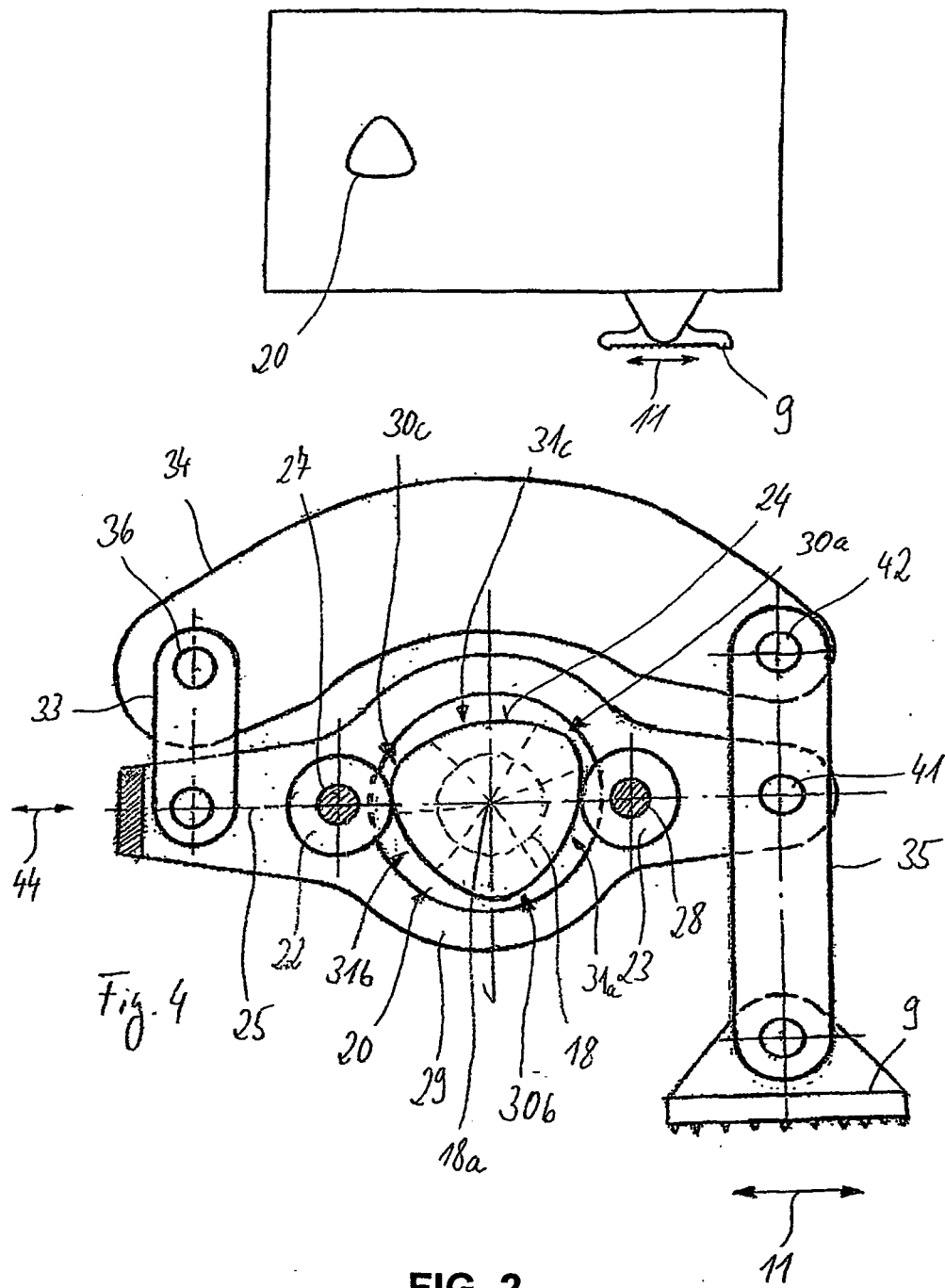


FIG. 1



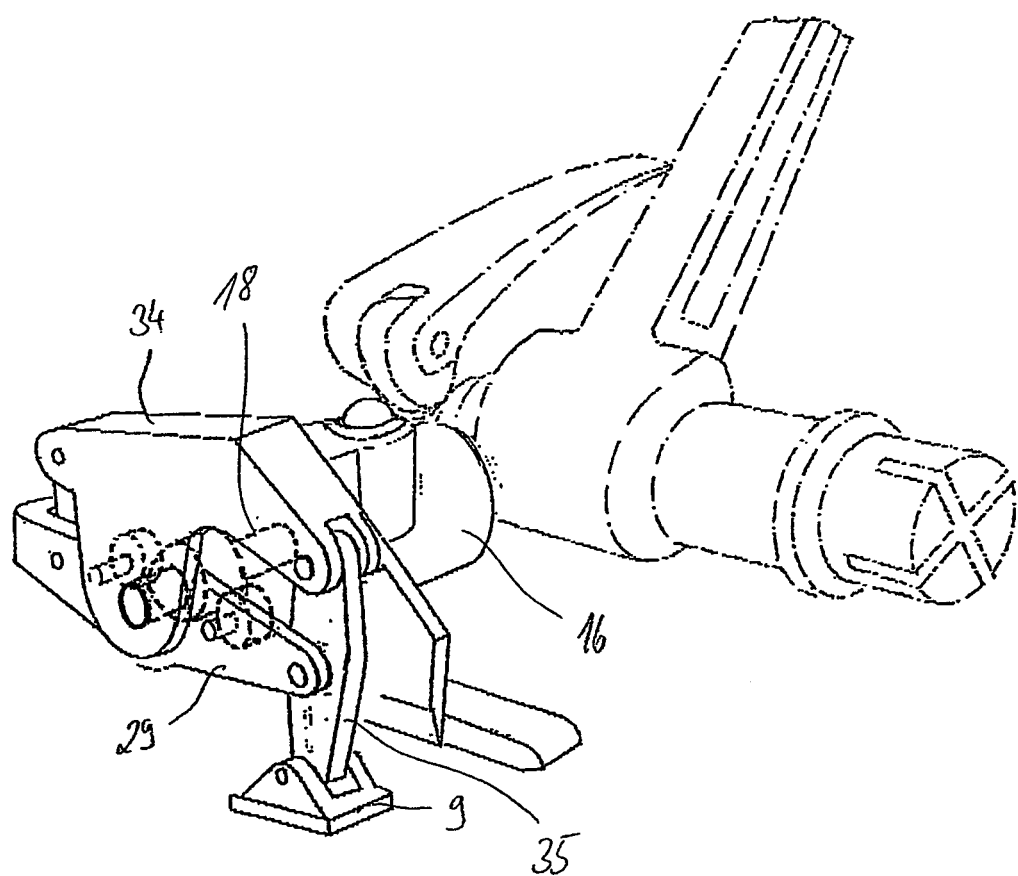


FIG. 3