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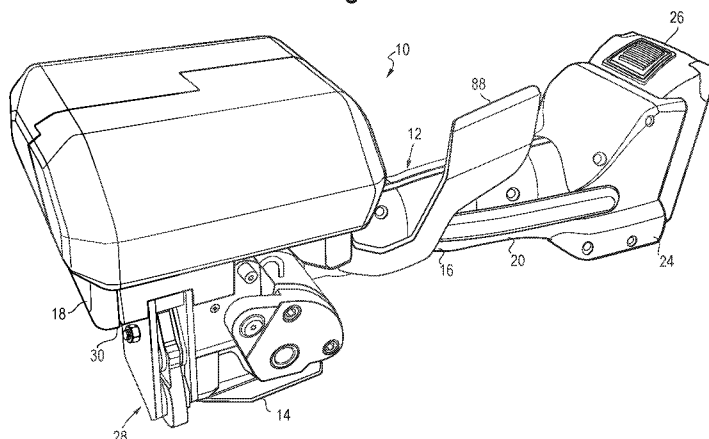
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(54) Title: ELECTRICALLY POWERED COMBINATION HAND-HELD NOTCH-TYPE STRAPPING TOOL

Fig. 1



(57) Abstract: A strapping tool (10) for tensioning overlapping sections of steel strap around a load and forming a notch-type seal in a seal element positioned over the overlapping sections of steel strap includes a body (12) having a foot (14), a tensioning section (16) and a sealing section (18). The tensioning section has a tensioner motor assembly (22) operably mounted to the body. The tensioner motor assembly has an electrically powered tensioner motor (34). A tensioning wheel (40) is operably connected to the tensioner motor. The sealing section has a notcher assembly (28) that includes an electrically powered notcher motor (32) operably mounted to the body. The notcher assembly includes a linkage and at least one pair of jaw elements (54). The linkage is configured to pivot ends of the jaw elements toward one another in a sealing cycle to form the notch-type seal in the seal element. A control system controls operation of the tensioner motor and the notcher motor. The control system is configured to operate the strapping tool in an automatic mode in which the tensioner motor and the notcher motor are sequentially actuated by action of the control system by an operator.



TITLE

ELECTRICALLY POWERED COMBINATION HAND-HELD NOTCH-TYPE STRAPPING
TOOL

CROSS-REFERENCE TO RELATED APPLICATION DATA

This application claims the benefit of and priority to Provisional U.S. Patent Application Serial No. 62/265,202, filed December 9, 2015, the disclosure of which is incorporated herein in its entirety.

BACKGROUND

[0001] Strapping tools or strappers come in a wide variety of types, from fully manual hand tools to automatic, table-top machines. Strapping tools can be designed and intended for use with different types of strap or strapping materials, such as metal strapping or plastic/polymeric strapping. Strappers for metal strapping materials can be automatic table-top or hand-held devices that are configured to seal the strap onto itself. The sealing function can be performed using a sealless configuration by forming interlocking keys in overlapping courses of the strap, or by applying a seal that is positioned over and crimped onto and cut into the overlapping strap courses.

[0002] Known hand-held devices for steel strap include manual tools that require an operator to exert one or more forces to tension the strap and form the seal, pneumatically operated tools that perform the tension and sealing functions by actuation of one or more pneumatic motors and portable, electrically operated tools, such as battery operated tools. The manual tools can be fatiguing to operate for long periods of time and may be difficult to maneuver and manipulate in certain instances, for example when the seal is formed on the side of a package or load. Moreover, manual sealing typically requires multiple tools to tension the strap, form the seal and cut the sealed strap from its source.

[0003] Pneumatic tools, such as that disclosed in Crittenden, US Patent No. 6,079,457, commonly assigned with the present application and incorporated herein in its entirety by reference, function well; however, they require a source of compressed gas, such as air, and thus necessitate the use of hoses, compressed gas fittings and the like for operation. As such, the use of pneumatic tools may be limited in certain applications where, for example, the

strapping operations are carried out at different locations throughout a manufacturing facility. Moreover, pneumatic tools employ pneumatic motors which can be costly, and pneumatic circuits which can be complex and require casting and machining operations in the manufacture of pneumatic circuit modules.

[0004] Electrically operated notch-type tools are known, however, such tools either tension strap or seal strap, but do not perform both functions in a single tool.

[0005] Accordingly, there is a need for a powered notch-type strapping tool that functions to tension strap around a load, form a notch-type seal in the overlapping courses of strap material and cut the sealed strap from its source. Desirably, such a tool is self-contained, is electrically and/or battery powered, and is thus portable and can be used throughout a facility at any location. More desirably still, such a tool can be used in a variety of operating modes.

SUMMARY

[0006] Various embodiments of the present disclosure provide a strapping tool for tensioning and forming a notch-type joint in overlapping sections of steel strap around a load. The tool includes a body having a foot, a tensioning assembly operably mounted to the body and a sealing assembly operably mounted to the body. The tensioning and sealing assemblies have electrically powered motors. A tensioning wheel is operably connected to the tensioner motor.

[0007] The sealing section has a notcher assembly that includes an electrically powered notcher motor. The notcher assembly has a linkage and at least one pair of jaw elements. In an embodiment the notcher assembly has multiple pairs of jaw elements. The linkage is configured to pivot the ends of the jaw elements toward one another in a sealing cycle to form the notch-type seal in the seal element. In an embodiment with multiple pairs of jaw elements, one or more pairs of the jaw elements can be engaged and disengaged so that a desired number of pairs of jaw elements open and close during the sealing cycle.

[0008] A control system controls operation of the tensioner motor and the notcher motor. The control system is configured to operate the strapping tool in an automatic mode in which the tensioner motor and the notcher motor are sequentially actuated by action of the control system by an operator. In an embodiment, such action is a single action, for example, a single depression of an actuation switch or button. In an embodiment, such action is multiple depressions of an actuation switch or button.

[0009] In an embodiment, the tensioner motor assembly is pivotally mounted to the body relative to the foot to permit readily positioning the overlapping course of strap the tool. In such an embodiment, the tensioner motor assembly biased to move the tension wheel toward the foot to retain the strap captured between the tension wheel and the foot.

[0010] In an embodiment, the tool includes an actuation switch for controlling the tool. The actuation switch is operably connected to control system to control operation of the tensioner motor and the notcher motor.

[0011] In one embodiment, the sealing section includes one pair of jaw elements and notch plates positioned on either side of the pair of jaw elements. In another embodiment, the sealing section includes two pairs of jaw elements and notch plates positioned between and on either side of the pairs of jaw elements.

[0012] Other objects, features, and advantages of the disclosure will be apparent from the following description, taken in conjunction with the accompanying sheets of drawings, wherein like numerals refer to like parts, elements, components, steps, and processes.

BRIEF DESCRIPTION OF THE DRAWINGS

[0013] FIG. 1 is an illustration of an embodiment of an electrically powered combination hand-held notch-type strapping tool;

[0014] FIG. 2 is another perspective view of the tool;

[0015] FIG. 3 an illustration of the tool with a portion of the tensioning assembly removed for clarity of illustration;

[0016] FIG. 4 is an enlarged, partial side view of the tool illustrating the tensioning and sealing sections;

[0017] FIG. 5 is a side sectional view similar to FIG. 4;

[0018] FIG. 6 is an enlarged, partial side view of another embodiment of the tool illustrating the tensioning and sealing sections;

[0019] FIG. 7 is a side sectional view of the tool of FIG. 6;

[0020] FIG. 8 is a top sectional view of the tool of FIGS. 4 and 5;

[0021] FIG. 9 illustrates the sealing section linkages;

[0022] FIG. 10 is a bottom perspective view of the sealing section showing the notchers;

- [0023]** FIG. 11 is an illustration of one embodiment of a jaw element; and
[0024] FIG. 12 is an illustration of one embodiment of a notch plate.

DETAILED DESCRIPTION

[0025] While the present disclosure is susceptible of embodiment in various forms, there is shown in the drawings and will hereinafter be described one or more embodiments with the understanding that the present disclosure is to be considered illustrative only and is not intended to limit the disclosure to any specific embodiment described or illustrated.

[0026] Referring now to the figures, an embodiment of the electrically powered combination notch-type strapping tool 10 is shown. The tool 10 is configured to tension steel strap or strapping material around an object or load, crimp a seal element onto the overlapping portions of the strap and cut and bend tabs in the seal element and strap to form a sealed tensioned loop around the load. Generally, the strap includes a feed or supply end and a free end that is fed around the load and reinserted into the tool with the seal element to overlap the supply end. Such a notch-type seal and a tool for forming such seals are disclosed in Figiel, US 9,272,799, and Nasiatka, US patent application Serial No. 14/689,471 (US Publication 2015/0321777), the disclosures of which are incorporated herein in their entirety.

[0027] The tool 10 includes a body 12 having a foot 14, a tensioning section 16 and a sealing section 18. The tensioning section 16 includes a housing 20 and a first or tensioner motor assembly 22 operably mounted within the tensioning section housing 20. A receiver 24 is formed as part of or mounted to the tensioning section housing 20 for receiving a battery 26 or other power source. The sealing section 18 of the tool includes a notcher assembly 28 having a housing 30 and a second or notcher motor assembly 32 mounted within the notcher housing 30.

[0028] Referring to FIGS. 3-8, the tensioning section 16 includes the tensioner motor assembly 22, which has a motor 34, such as a DC motor, and a gear set 36 to convert the motor output drive to a usable speed. The gear set 36 can include a planetary gear set 38 to reduce the output speed and to increase the output power or torque from the motor 34. The gear set 36 includes a final drive (not shown) that meshes with a gear (not shown) on a tension wheel 40. The tension wheel 40 is mounted normal to the final drive. The gear set 36 and final drive

are housed in a gear housing 42 mounted to the tool body 12. A gripping pad 44 can be positioned on the foot 14, opposite the tension wheel 40.

[0029] The tensioner motor assembly 22, gear housing 42 and tension wheel 40 are movably mounted to the body 12 to move the tension wheel 40 toward and away from the foot 14. This permits the tool 10 to be opened to position the strap between the foot 14 and the tension wheel 40. In an embodiment, the tensioner motor assembly 22, gear housing 42 and tension wheel 40 are pivotably mounted to the body 12 to pivot the tension wheel 40 toward and away from the foot 14. The tensioner motor assembly 22, gear housing 42 and tension wheel 40 can be biasedly mounted to the body 12, such as by a spring (not shown), to bias the tension wheel 40 toward the foot 40 and into contact with the strap when the tool 10 is in the closed position.

[0030] FIGS. 4-6 and 9-12 illustrate an embodiment of the sealing section 18. The sealing section 18 includes a notcher assembly 46 having, generally, a drive wheel 48, a first link 50 eccentrically mounted to the drive wheel 48, a pair of jaw 52 links pivotally mounted to the first link 50 and a pair of jaw elements 54 mounted to the jaw links 52.

[0031] The drive wheel 48 is driven by a drive motor 56. In an embodiment, the motor 56 is connected to the drive wheel 48 by a drive belt 58. Those skilled in the art will recognize other configurations of drive train, such as direct gearing that can be used to drive the drive wheel, which other drive trains are within the scope and spirit of the present disclosure. In an embodiment, the drive wheel 48 is an overrun clutch, such as that disclosed in the aforementioned application to Nasiatka.

[0032] The first link 50 is eccentrically mounted to the drive wheel 48 by a first pin 60. The pair of jaw links 52 are pivotally mounted to the first link 50 by a second pin 62. The jaw links 52 extend between the first link 50 and the jaw elements 54. Each jaw element 54 includes a first opening 64, a second opening 66 and a tapered pincer end 68. In an embodiment, as shown in FIGS. 4 and 5, the notcher assembly 46 includes a pair of opposing jaw elements 54. In another embodiment, as illustrated in FIGS. 6 and 7, the tool 10 includes multiple pairs of jaw elements 154a, 154b. Each pair of jaws 54, 154 elements is pivotally mounted to its respective jaw link 52 by a third pin 70.

[0033] The jaw elements 54 are mounted to, and operably connected to each other, by notchers 72, an example of which is shown in FIGS. 9, 10 and 12. The jaw elements

54 are mounted to the notchers 72 by respective fourth pins 74. In this configuration, as the drive wheel 48 rotates, the first link 50 rotates with the wheel 48 which in turn moves a second end of the first link 50 in a generally reciprocating manner. The jaw links 52, which are mounted pivotally to the second end of the first link 50, move in a generally downward and outward arc, which in turn opens and closes the jaw elements 54.

[0034] In an embodiment, the notcher assembly 46 includes side plates 76 that contain the drive wheel 48, the jaw elements 54, the first link 50 and jaw links 52, and the notchers 72. The side plates 76 can also include a slotted 78 opening and the second pin 62 can extend through the opening 78 to guide the second end of the first link 50 and the first ends of the jaw links 52 in a reciprocating path as the tool 10 moves through the sealing cycle.

[0035] In an embodiment the tool 10 is of a single notch type. In such a tool, there is one pair of jaw elements 54 to form the notch in the strap and seal. In another embodiment, as illustrated in FIGS. 6 and 7, the tool 10 includes two pairs of jaws 154a, 154b with the jaws of one pair spaced from the jaws of the other pair by a notch plate 72. In an embodiment with multiple pairs of jaw elements, 154a, 154b, one or more pairs of the jaw elements 154a or 154b can be engaged and disengaged from the drive so that less than all of the pairs of jaw elements open and close during the sealing cycle. For example, in an embodiment with two pairs of jaw elements 154a and 154b, one pair of jaw elements 154a or 154b can be disengaged from the drive by movement of jaw 155. Those skilled in the art will recognize the double notch tool and the two pairs of tabs that are cut into the seal and strap using such a tool.

[0036] The tool 10 is configured to permit operation in a fully automatic mode. To this end, the tool 10 includes a control system, shown generally at 80, to control operation of the tool 10. In an embodiment the tool 10 includes an actuation switch 82 and one or more circuits to control the tensioner motor 34 and the notcher motor 56. Other position switches and/or sensors, such as the illustrated strap sensor shown at 84, sense the presence of strap in the tool 10, the position of the jaws 54 and the like.

[0037] In an embodiment, the tool 10 functions in conjunction with a tool setting management system 102 and method. In such a system, the tool 10 has a stored tool setting, such as the tension to be drawn in the strap. The system 102 enables a user to modify the tool setting using a device 104 wirelessly connected to the tool 10. The tool setting management system allows a user to wirelessly pair the device 104 with the tool 10, for example, by pairing

through a Bluetooth protocol. The tool 10 has at least one modifiable tool setting, for example, the strap tension, that enables the user, once the tool 10 and device 104 are in communication with each other, to input a tool setting modification, such as a change in the desired tension, into the device 102, which change is then transmitted to the paired tool 10. Upon receiving the tool setting modification, the tool controller 80 modifies the stored setting in the tool 10. An example of such a device is a smart phone, a pad or tablet device 104 that is paired with the tool 10. Such a system and method is disclosed in Figiel, US Patent Application Serial No. 62/191,087, the disclosure of which is incorporated herein in its entirety.

[0038] In an embodiment, the tool 10 includes one or more indicators, such as LEDs 86, to provide indication of certain functions and states of the tool 10. The LED indicator 86 can be positioned within or around the actuation switch 82.

[0039] In an embodiment, the tool 10 is configured having a single button actuation control system. In such a system there are no user adjustable settings on the tool. Rather, the tool has a handle 88 for opening and closing the tension wheel 40 on the strap and the button actuation switch 82 to actuate the tool 10. Other modifiable settings, such as tension level, strap size and the like are carried out using the wireless device 104.

[0040] In one operating scenario, the tool 10 is in a home position in which the spring biases the tension wheel into contact with the foot. When the battery is installed, the tool turns on and runs a self-test. An indicator, such as the LED in the actuation switch, can be configured to flash in a predetermined sequence to indicate the operating state of the tool. Once the tool completes the self-test it is in a ready/sleep state. In the ready/sleep state, the tensioner and sealer motors are off (no power to the motors), and the tool is ready for operation.

[0041] To commence a strapping cycle, the tool is opened by urging or pulling the tensioner motor assembly toward the tensioner handle to open a gap between the tension wheel and the foot. A lead or free end of the strap is positioned around the load and a supply end of the strap (from a strap dispenser) is positioned overlapping the free end. A seal is positioned on the overlapping courses of strap at the jaws with the supply end entering from the rear end (the tension wheel end) of the tool.

[0042] In one scenario of operation, depressing and releasing the actuation switch 82 commences the operating cycle. With the overlapping strap S courses positioned between the tension wheel 40 and the foot 14 and with the seal positioned on the overlapping strap courses at

the jaw elements 54, the tension cycle starts, in which the tensioner motor 34 operates to drive the tension wheel 40 to draw tension in the strap. When a predetermined amount of tension is drawn (as set by using the tool setting management system), the tensioner motor 34 stops.

[0043] The sealing cycle then starts, in which the sealing motor 56 operates to drive the sealing section drive wheel 48.

[0044] When power is provided to the motor 56, the output shaft rotates which in turn drives the drive belt 58. The drive belt 58 rotates the drive wheel 48 which moves the first link 50 downward. The jaw links 52 are driven away from the first link 50 which pivots the jaw elements 54 such that the pincer portions 68 move inward, toward the notch plates 72. When the drive wheel 48 has rotated approximately 180 degrees from its starting position, the jaw elements 54 are in the fully closed position, the pincers 68 contact the seal element, which crimps the seal element on the strap and cuts into the seal element and strap to form a notch in the seal element and strap. As drive wheel 48 continues to rotate beyond the 180 degree position and back toward the home position, the first link 50 is driven upward and the jaw links 52 are driven toward each other, which opens the jaw elements 54 to release the sealed strap and to return the tool 10 to the home or ready position.

[0045] In an embodiment, the tool 10 is configured having a single button actuation control system in which the tensioning and sealing cycle is commenced by a single action, for example, a single depression of an actuation switch or button. In another embodiment, such action is multiple depressions of an actuation switch or button.

[0046] In an embodiment, the actuation button 82 can also be used to stop operation of the tool 10 if, for example, the strap or seal are not properly positioned. In one operating scenario, repeated pushes of the button 82 or a single long hold down of the button 82 can stop operation of the tool 10. The button 82 can also be used to reset the tool 10 to the home position.

[0047] In an embodiment the tool can have a pretension cycle in which the tool operates to draw a lesser amount of tension, for example about 200 pounds of tension, prior to entering a full tensioning cycle. The pretension can be used to, for example, moderately tension the strap so that adjustments can be made to the position of the strap or to apply or adjust edge protectors on the load. Once the pretension cycle is complete, the tensioning and sealing cycle can commence or be completed. In an embodiment the actuation button is depressed and the tool

runs through the pretension cycle. Indication can be provided by, for example, a flashing light at the actuation button indicating that the pretension cycle is complete. After the operator carries out any needed adjustment or actions (for example, applying edge protectors), the button can be depressed once again, which continues the operation, e.g., tensioning and sealing cycle, of the tool.

[0048] The tool 10 as disclosed and described is an electrically powered tool that uses a battery; it will however be appreciated that the tool 10 can be configured to operate with a voltage converter (not shown) for example, for use at line voltages (e.g., 120V-240V). In addition, although the tool 10 is described as including a tensioner motor 34 and a sealing motor 56, it is contemplated that a single motor can be used to carry out both the tension and sealing functions with appropriate drives in place.

[0049] It will be appreciated by those skilled in the art that the relative directional terms such as sides, upper, lower, rearward, forward and the like are for explanatory purposes only and are not intended to limit the scope of the disclosure.

[0050] All patents or patent applications referred to herein, are hereby incorporated herein by reference, whether or not specifically done so within the text of this disclosure.

[0051] In the present disclosure, the words “a” or “an” are to be taken to include both the singular and the plural. Conversely, any reference to plural items shall, where appropriate, include the singular.

[0052] It should be understood that various changes and modifications to the presently preferred embodiments disclosed herein will be apparent to those skilled in the art. Such changes and modifications can be made without departing from the spirit and scope of the present disclosure and without diminishing its intended advantages. It is therefore intended that such changes and modifications be covered by the appended claims.

CLAIMS

1. A strapping tool for tensioning overlapping sections of steel strap around a load and forming a notch-type seal in a seal element positioned over the overlapping sections of steel strap, comprising:

- a body having a foot;
- a tensioning section having a tensioner motor assembly operably mounted to the body, the tensioner motor assembly having an electrically powered tensioner motor;
- a tensioning wheel operably connected to the tensioner motor;
- a sealing section, the sealing section having a notcher assembly including an electrically powered notcher motor operably mounted to the body, the notcher assembly including a linkage and at least one pair of jaw elements, the linkage configured to pivot ends of the jaw elements toward one another in a sealing cycle to form the notch-type seal in the seal element; and
- a control system for controlling operation of the tensioner motor and the notcher motor, wherein the control system is configured to operate the strapping tool in an automatic mode in which the tensioner motor and the notcher motor are sequentially actuated by an action of the control system by an operator.

2. The strapping tool of claim 1 wherein the action of the control system by the operator is a single actuation of a single switch on the tool.

3. The strapping tool of claim 1 wherein the action of the control system by the operator is multiple actuations of a single switch on the tool.

4. The strapping tool of claim 1 wherein the tensioner motor assembly is movably mounted to the body relative to the foot.

5. The strapping tool of claim 4 wherein the tensioner motor assembly is pivotally mounted to the body and wherein the tensioner motor assembly is biased to move the tension wheel toward the foot.

6. The strapping tool of claim 1 including an actuation switch for controlling the tool, the actuation switch operably connected to the tensioner motor and the notcher motor.

7. The strapping tool of claim 1 wherein the sealer includes one pair of jaw elements and including notch plates positioned on either side of the pair of jaw elements.

8. The strapping tool of claim 1 wherein the sealer includes at least two pairs of jaw elements and including notch plates positioned between and on either side of the pairs of jaw elements.

9. The strapping tool of claim 8 wherein one or more of the pairs of jaw elements is engageable with and disengageable from the notcher motor such that less than all of the pairs of jaw elements move through a sealing cycle.

10. The strapping tool of claim 1 wherein the sealer includes a drive wheel operably connected to the linkage.

11. The strapping tool of claim 10 wherein the drive wheel includes an over run clutch.

Fig. 1

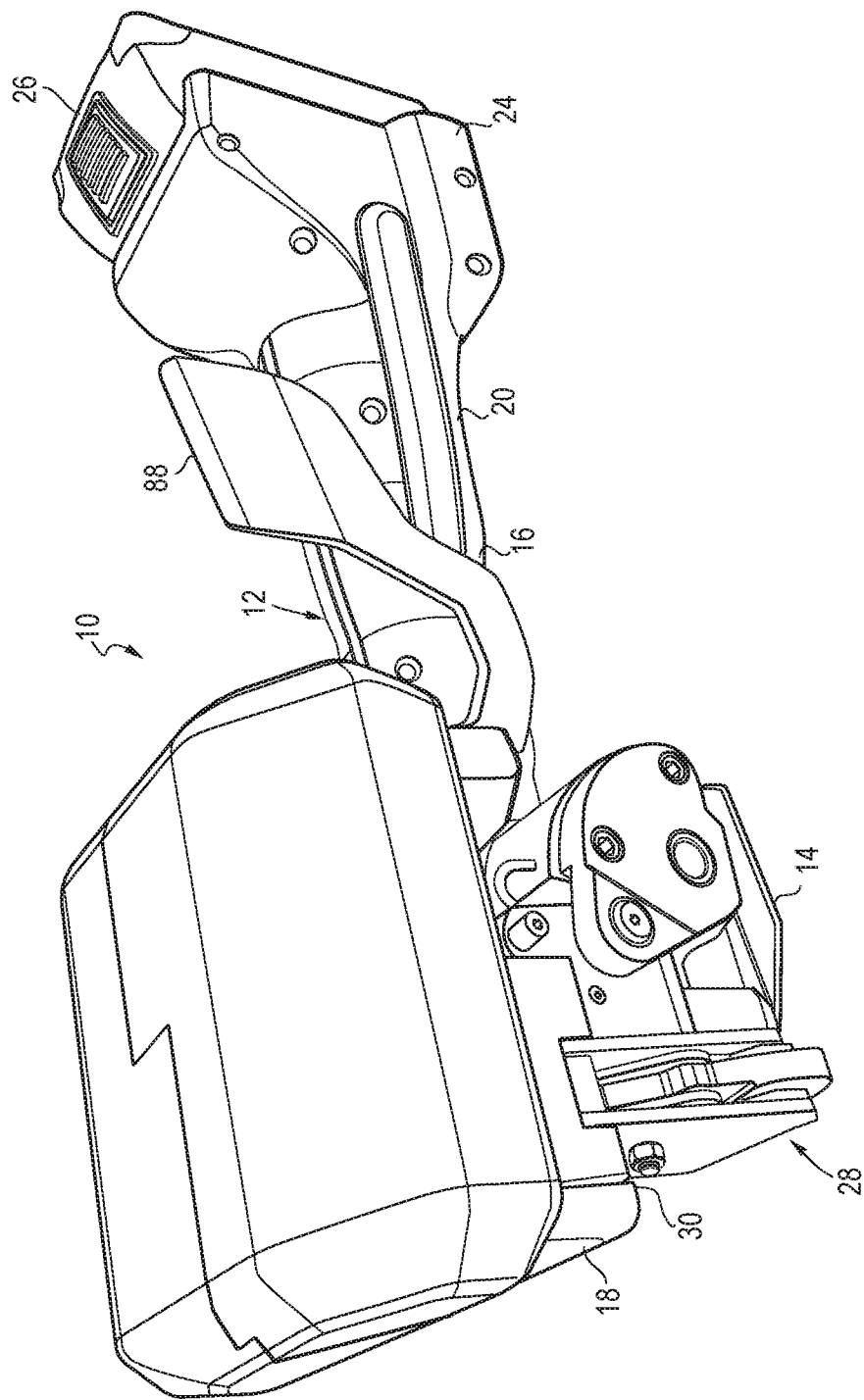


Fig. 2

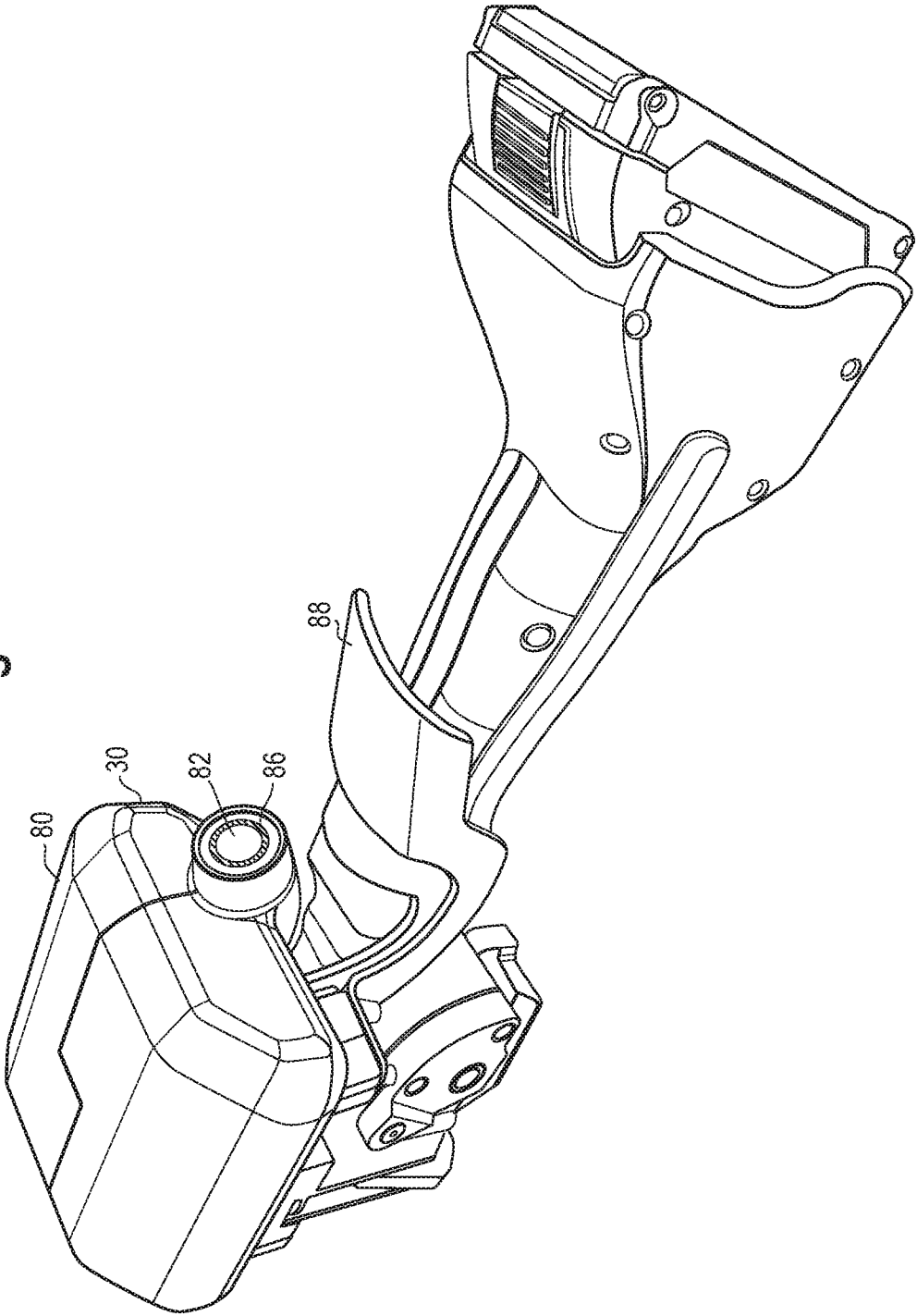
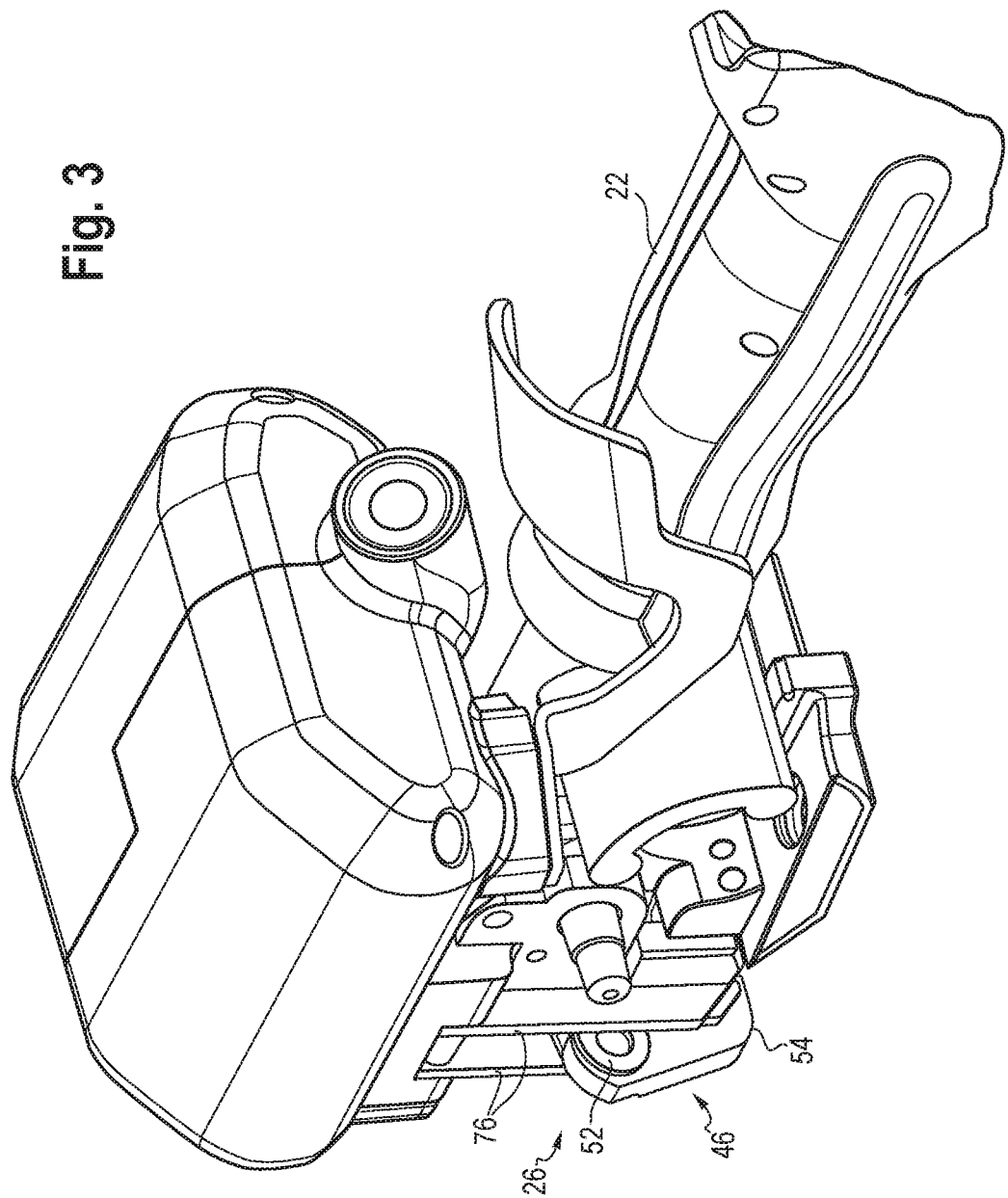


Fig. 3



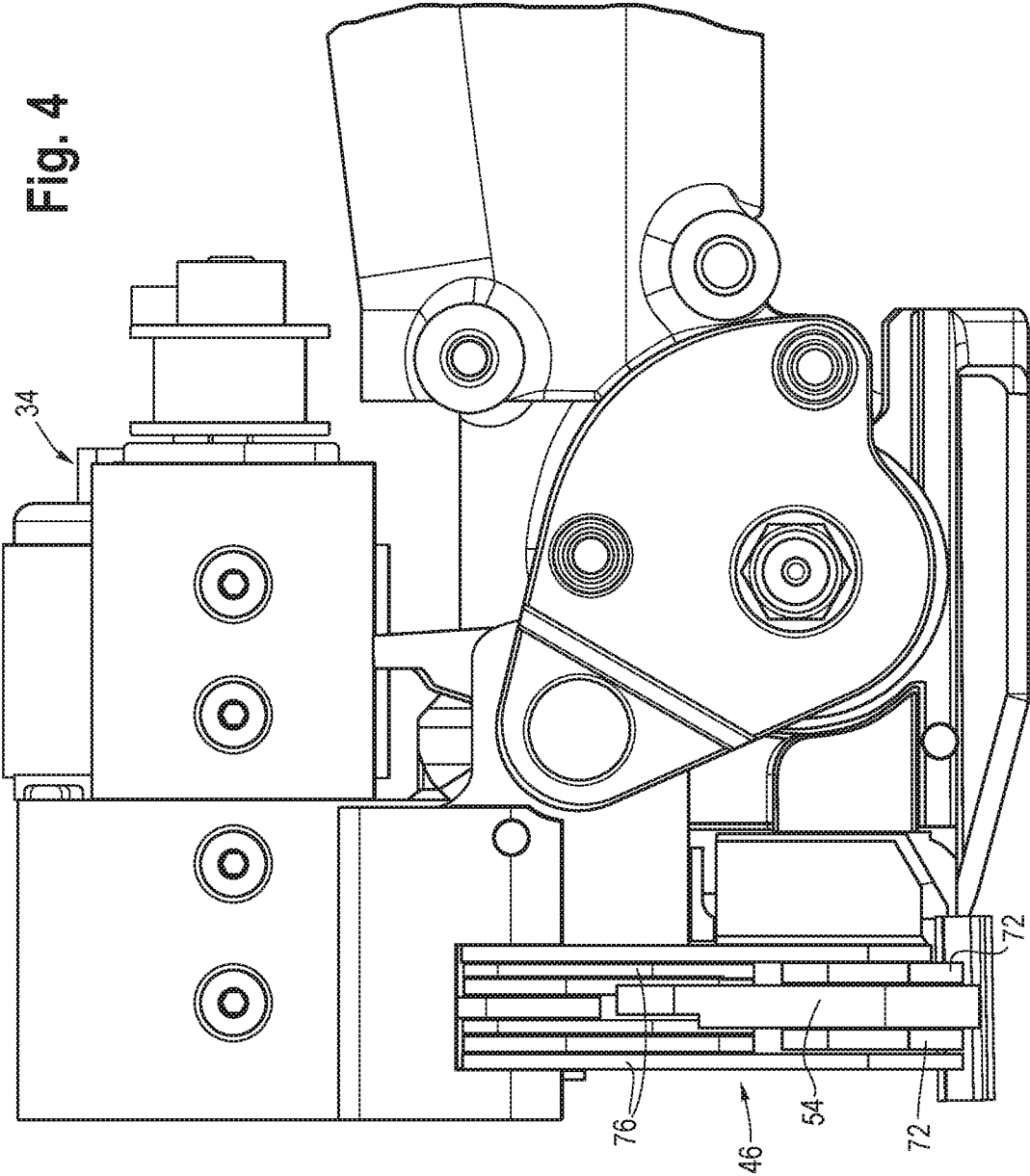


Fig. 5

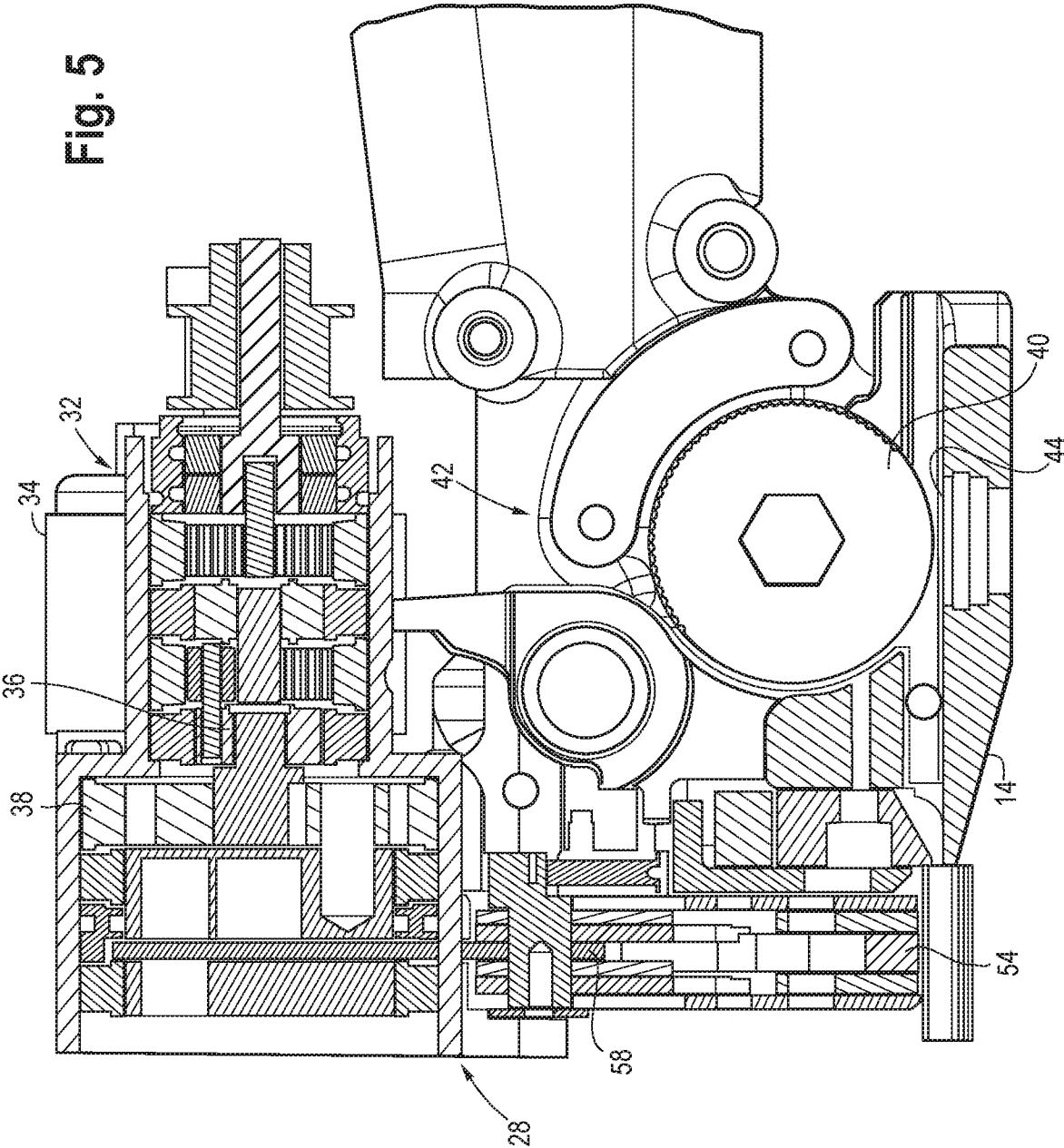


Fig. 6

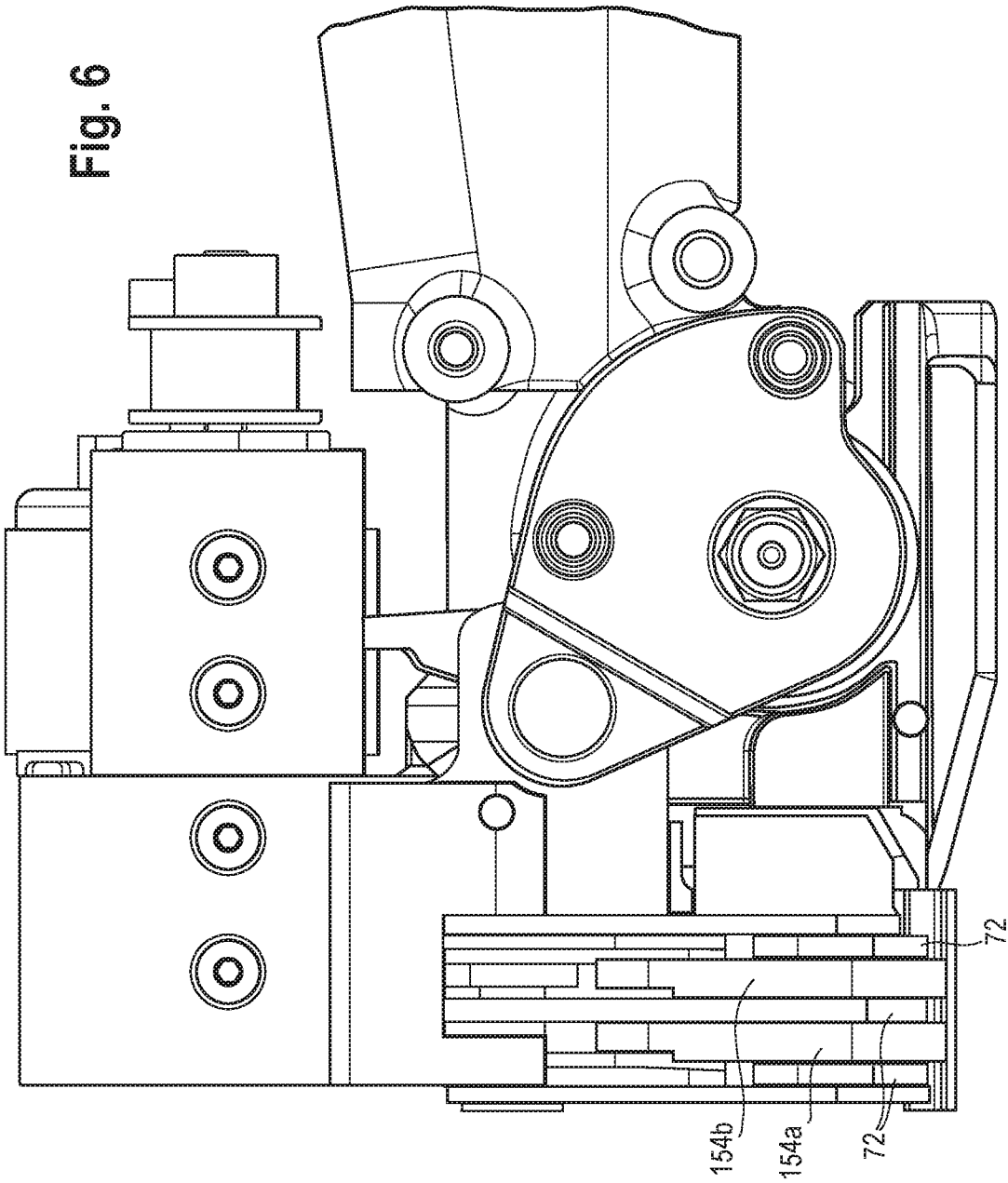


Fig. 7

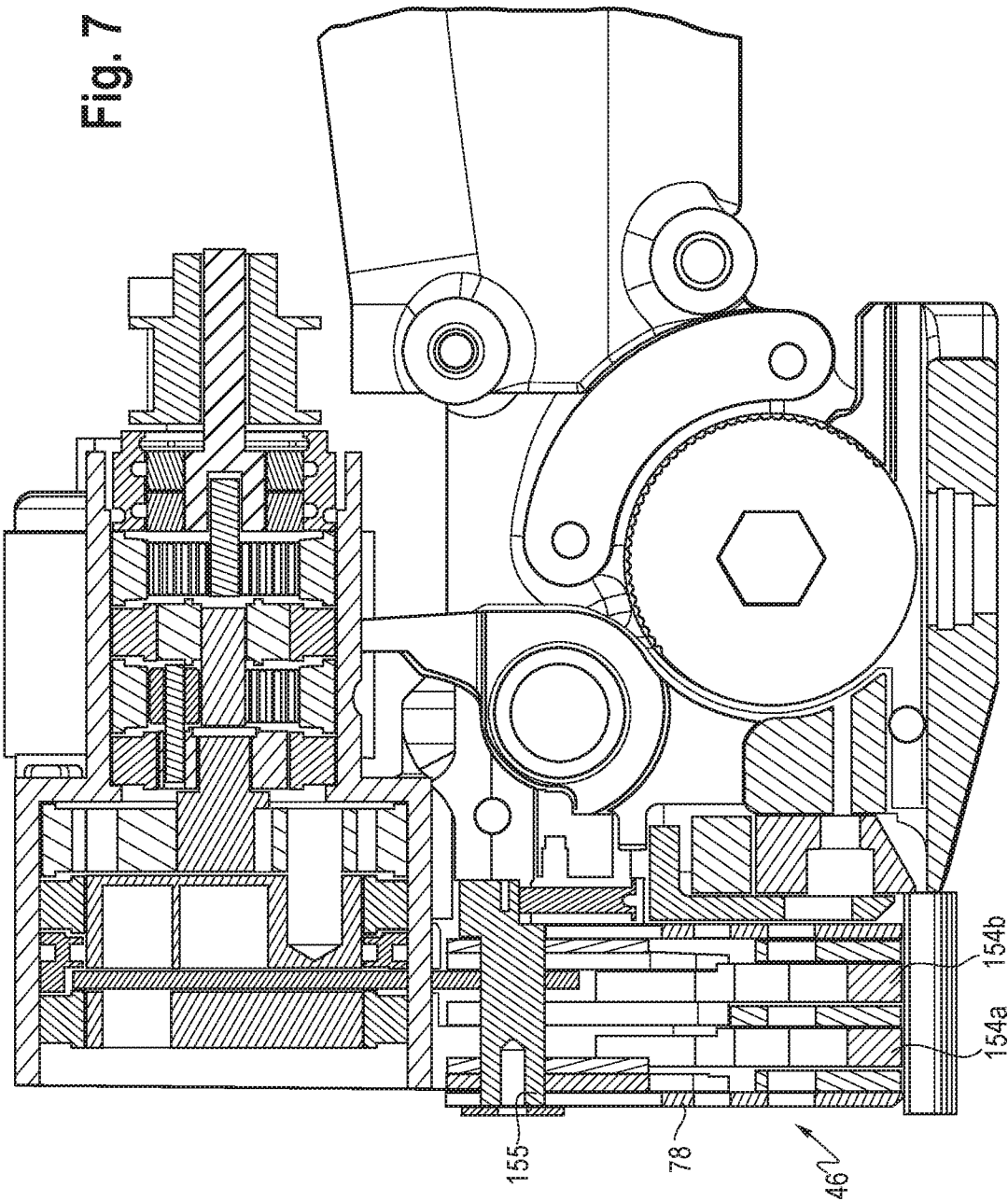
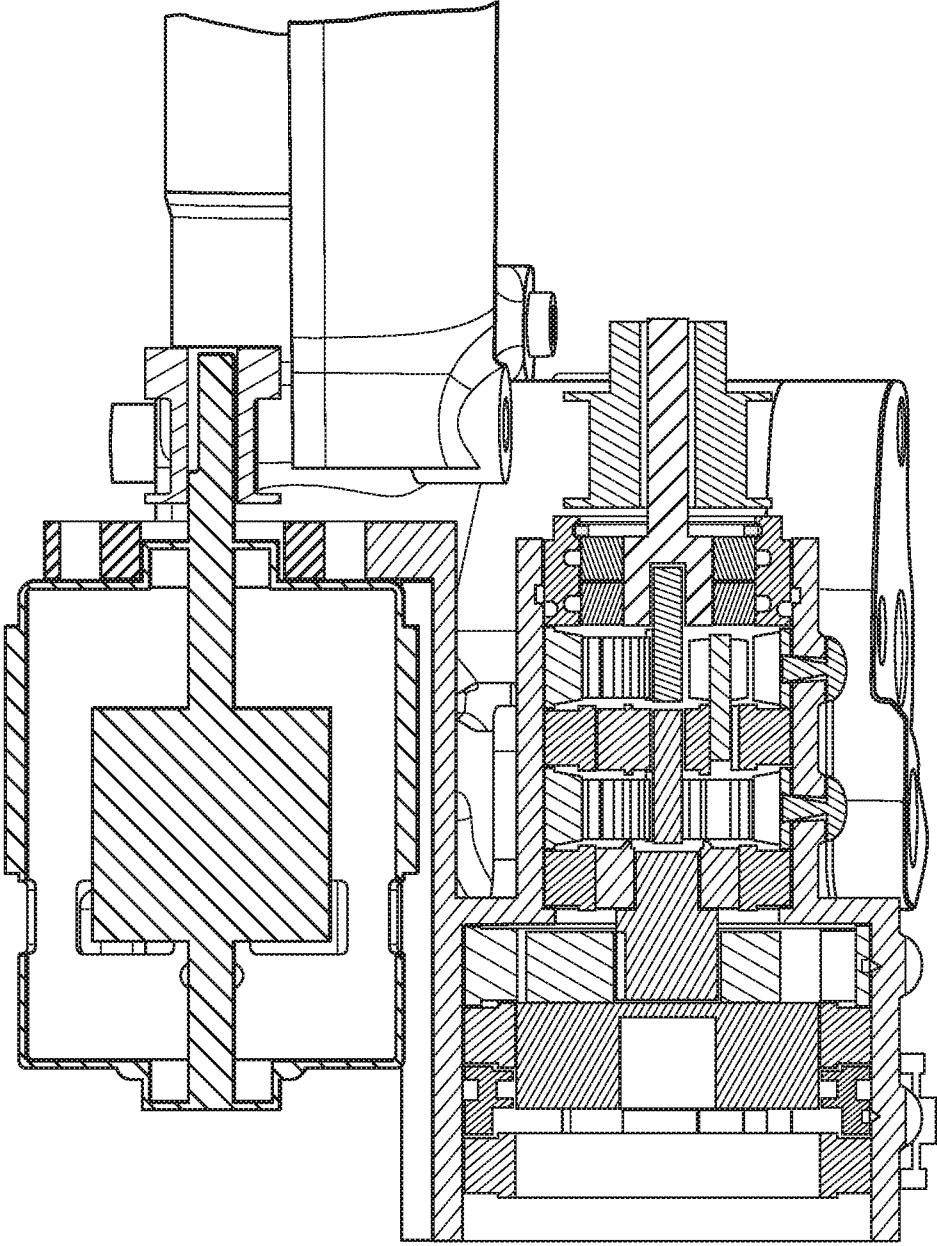
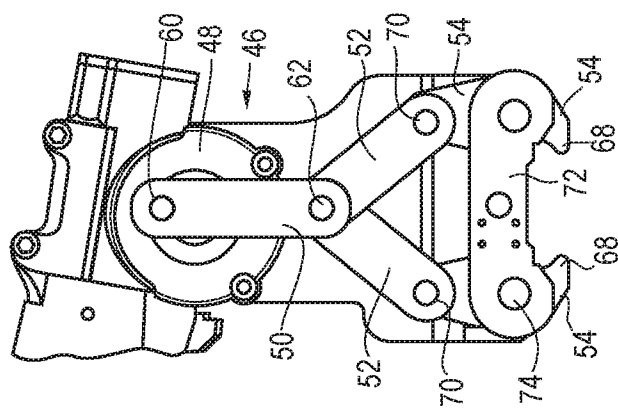


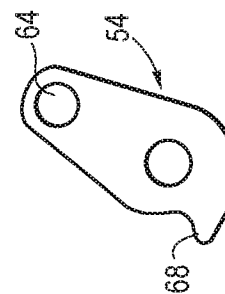
Fig. 8



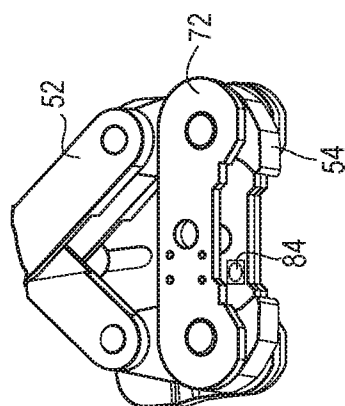






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Fg. 12 72



INTERNATIONAL SEARCH REPORT

International application No
PCT/US2016/065128

A. CLASSIFICATION OF SUBJECT MATTER

INV. B65B13/34 B65B13/22 B65B57/02 B65B57/00
ADD.

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
B65B

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

EPO-Internal, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 3 103 955 A (ERICSSON ARVID I ET AL) 17 September 1963 (1963-09-17)	1,4,5,7, 8
Y	figures 1, 2, 11-13 column 2, lines 18-21 column 2, line 71 - column 3, line 4 page 4, lines 3-68 page 6, lines 33-39 page 9, lines 15-30	2,3,6, 10,11
Y	----- WO 2014/179895 A2 (ORGAPACK GMBH [CH]) 13 November 2014 (2014-11-13) figures 3, 10, 11 page 11, lines 1-7, 16-30 ----- -/-	2,3,6



Further documents are listed in the continuation of Box C.



See patent family annex.

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INTERNATIONAL SEARCH REPORT

International application No
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