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(54) Blind rivet fastening device

(57) [Problem] To provide a blind rivet fastening device that makes it easy to mount a blind rivet in the nose and that keeps the mounted blind rivet from falling out of the nose.

[Solution] When the nose 10 is connected slidably to the tool housing 13 in the axial direction, the nose 11 resists the action of the elastic pushing means 34, 35 and is slid so as to be pulled rearward in the axial direction, and the jaw 11 is pulled rearward in the axial direction in the jaw guide 29. When this has occurred, the inner diameter of the jaw 11 is increased, the mandrel 3 is easily inserted into the jaw 11, the force (arrow 46) pulling the nose 10 rearward in the axial direction is released, the jaw 11 is returned forward axially in the jaw guide 29 by the pushing force of the elastic pushing means 34, 35, and the inner peripheral surface of the jaw 11 is frictionally engaged with the mandrel 3.

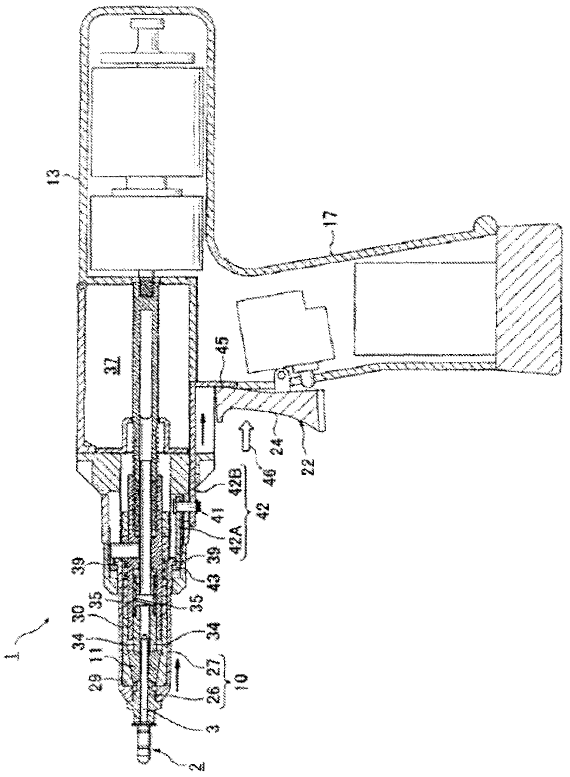

FIG. 2

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Description

Technical Field

[0001] The present invention relates to a blind rivet fastening device and, more specifically, to a blind rivet fastening device that makes it easy to mount a blind rivet in the nose and that keeps the mounted blind rivet from falling out of the nose.

Background of the Invention

[0002] A blind rivet consists of a hollow rivet main body and a mandrel inserted into the rivet main body. The rivet main body consists of a hollow sleeve and a flange at one end of the sleeve. The mandrel passed through the sleeve is forcibly pulled until it becomes ruptured on the flange side. This distorts a portion of the sleeve so that it expands. The expanded sleeve portion and the flange secure the fastened components on both sides and fasten the rivet main body to the fastened components. A blind rivet has the advantage of being able to fasten a fastened component such as a panel from one side. Because the mandrel is forcibly pulled until it ruptures, expanding and deforming a portion of the sleeve, the ruptured mandrel can be stored in a collector.

[0003] In order for the blind rivet fastening device to fasten a blind rivet to fastened components, the mandrel is inserted into the hole in the nose of the fastening device and the rivet main body is mounted so as to protrude from the nose. The fastening device is then positioned so that the rivet main body can be inserted into the mounting hole in the fastened components. The fastening device is then activated, forcibly pulling the mandrel until it ruptures. This expands and distorts the sleeve of the rivet main body, fastening the blind rivet to the fastened components. A blind rivet fastening device is desired that makes it easy to mount a blind rivet in the nose and that keeps the mounted blind rivet from falling out of the nose when the blind rivet is fastened.

Summary of the Invention

Problem Solved by the Invention

[0004] A motor-driven blind rivet fastening device is described in JP 01-177040 U. In this fastening device, a jaw driven by a motor installed pulls back the mandrel of the blind rivet mounted in the nose of the device, fastening the blind rivet to the fastened components. The jaw returned by the motor pulls the mandrel remaining in the nose through the nose and discards it. Thus, the blind rivet fastening device in JP 01-177040 U is not configured in a way that makes it easy to mount a blind rivet in the nose and that keeps the mounted blind rivet from falling out.

[0005] The blind rivet fastening device in JP 06-262290 A has an elastic ring in the nose to keep the blind rivet mounted in the nose from falling out. This elastic ring keeps the blind rivet from falling out but provides resistance when a blind rivet is installed in the nose. As a result, the mounting process is not easy.

[0006] A motor-driven blind rivet fastening device is also disclosed in JP 05-200476 A. This blind rivet fastening device has a recovery container for ruptured mandrels in the rear portion of the device. However, the blind rivet fastening device in JP 05-200476 A is not configured in a way that makes it easy to mount a blind rivet in the nose and that keeps the mounted blind rivet from falling out. Another motor-driven blind rivet fastening device is disclosed in JP 2003-266134 A. This blind rivet fastening device also has a recovery container for ruptured mandrels in the rear portion of the device. However, the blind rivet fastening device in JP 2003-266134 A is not configured in a way that makes it easy to mount a blind rivet in the nose and that keeps the mounted blind rivet from falling out.

[0007] The object of the present invention is to provide a blind rivet fastening device that makes it easy to mount a blind rivet in the nose and that keeps the mounted blind rivet from falling out of the nose.

Means of Solving the Problem

[0008] In order to achieve this object, the present invention is a blind rivet fastening device comprising a hollow nose for receiving the mandrel of a blind rivet consisting of the mandrel and the rivet main body, a tool housing arranged axially to the rear of the nose, a jaw arranged inside the nose to hold the mandrel received by the nose, a jaw guide arranged inside the nose so as to be able to be pulled to the rear axially and engage the outer peripheral surface of the jaw in such a way that the inner diameter of the jaw is reduced when pulled to the rear axially and the reduced inner diameter of the jaw is restored when returned forward axially from the rear axial position, a pulling head connected to the jaw guide for pulling the jaw guide rearward into the tool housing, a drive means arranged in the tool housing and operated to pull the pulling head axially in the rearward direction, and an elastic pushing means for always pushing the jaw forward in the axial direction so that the outer peripheral surface of the jaw engages the inner peripheral surface of the jaw guide, the drive means being operable by a trigger lever installed in a handle formed integrally with the tool housing, and the sleeve of the rivet main body being deformed so as to spread when pulled to the rear by the pulling head, jaw guide and jaw, fastening the rivet main body to the fastened component with the spread deformed sleeve portion and the rivet main body portion, **characterized in that**:

the nose is connected slidably to the tool housing in the axial direction, the nose resists the action of the elastic pushing means and is slid so as to be pulled rearward in the axial direction, and the jaw is pulled

rearward in the axial direction in the jaw guide, increasing the inner diameter of the jaw, allowing the mandrel to be easily inserted into the jaw, releasing the force pulling the nose rearward in the axial direction, returning the jaw forward axially in the jaw guide by means of the pushing force of the elastic pushing means, and frictionally engaging the inner peripheral surface of the jaw with the mandrel inserted in the jaw.

[0009] These characteristics make it easy to mount a blind rivet in the nose and keep the mounted blind rivet from falling out of the nose.

[0010] In this blind rivet fastening device, the trigger lever is connected rotatably to the handle by a pin, the trigger lever comprises an operating portion extending lengthwise from the pin to one side of the handle and a mounted portion extending lengthwise from the pin to the other side of the handle, the operating portion is the trigger lever portion rotating the pin and activating the drive means with a pulling action, and the mounted portion is the trigger lever portion slid by the pulling action of the mounted portion so as to pull the nose rearward in the axial direction. The pulling action of the mounted portion of the trigger lever mounts the blind rivet and keeps it from falling out.

[0011] In this device, the nose comprises a nosepiece and a nose housing integrally connected with the nosepiece and also connected so as to slide axially with respect to the tool housing, a link extending rearward axially along the tool housing and engaging the mounted portion of the trigger lever is connected to the back end of the nose housing, the pulling action of the mounted portion slides the link rearward in the axial direction so as to pull the nose rearward in the axial direction, pull the jaw rearward in the axial direction along the jaw guide and against the pushing of the elastic pushing means, and enlarge the inner diameter of the jaw, the release of the pulling action of the mounted portion causes the force pulling the nose rearward in the axial direction to be released, and the pushing force of the elastic pushing means returns the jaw forward in the axial direction along the jaw guide and reduces the diameter of the jaw. Here, the back end of the jaw guide is connected integrally with the front end of the pulling head, the elastic pushing means comprises a jaw pusher engaging the back end of the jaw and a jaw pusher spring elastically pushing the jaw pusher towards the jaw from the pulling head, a plurality of portions are assembled circumferentially to form a slender tube facing forward, the jaw guide is a hollow tube tapered so as to reduce the inner diameter in the forward direction, and the jaw pusher spring causes the outer peripheral surface of the jaw to elastically and frictionally engage the inner peripheral surface of the jaw guide.

[0012] The drive means encompasses a motor and a drive shaft rotated by the motor, the battery serving as the power source of the motor and a trigger switch for supplying power from the battery to the motor are stored in the handle, the trigger switch has an operating pin pushed by the operating portion of the trigger lever, and the pulling action of the operating portion supplies power to the motor. The drive shaft is formed with male threading or female threading in the front end portion, the hollow section in the rear portion of the pulling head is formed with male threading or female threading to engage the male threading or female threading in the drive shaft, and the rotation of the drive shaft causes the pulling head to move forward or backward axially.

[0013] In this blind rivet fastening device, the hollow cavity between the outer periphery of the drive shaft and the inner periphery of the tool housing forms a mandrel collector for housing the mandrel portion ruptured when the rivet main body is fastened to the fastened component, and the ruptured mandrel portion is placed in the mandrel collector from an axial slit in the drive shaft via the jaw, jaw guide and pulling head. A cover is installed on the mandrel collector that can be opened to remove the ruptured mandrels stored inside. The motor is installed axially in the rear of the tool housing, the pulling head is arranged axially in the front of the tool housing, and the mandrel collector is arranged in the middle of the tool housing between the motor and the pulling head.

Brief Explanation of Drawings

[0014]

FIG 1 is a cross-sectional view of the blind rivet fastening device in the first embodiment of the present invention showing the device in the original position before a blind rivet is mounted.

FIG 2 is a cross-sectional view of the blind rivet fastening device in FIG 1 showing a blind rivet mounted in the nose and the mounted portion in the upper portion of the trigger lever being pulled.

FIG 3 is a cross-sectional view of the blind rivet fastening device in FIG 1 showing the released mounted portion in the upper portion of the trigger lever after a blind rivet is finished being mounted in the nose.

FIG 4 is a cross-sectional view of the blind rivet fastening device in FIG 1 showing the pulled operating portion in the lower portion of the trigger lever immediately after a blind rivet has been fastened to the fastened components.

FIG 5 is a cross-sectional view of the blind rivet fastening device in FIG 1 showing the released operating portion in the lower portion of the trigger lever after the fastening operation with the blind rivet fastening device removed from the fastened component.

FIG 6 is a cross-sectional view of the blind rivet fastening device in FIG 1 showing the next blind rivet being mounted and the ruptured mandrel portion from the previous blind rivet being stored in the mandrel collector.

Best Mode of Embodying the Invention

[0015] The following is an explanation with reference to the figures of the blind rivet fastening device in the first embodiment of the present invention. FIG 1 shows the blind rivet fastening device 1 before a blind rivet 2 has been mounted with the blind rivet fastening device in the original position. The blind rivet fastening device 1 fastens blind rivets 2 to fastened components such as car panels. The blind rivet 2, as shown in FIG 1, consists of a mandrel 3 and a blind rivet main body 5, and the rivet main body 5 consists of a hollow sleeve 6 and a flange 7 on one end. The mandrel 3 consists of a portion passing through the rivet main body 5, extending a long length from the flange 7 and gripped by the blind rivet fastening device 1, and a mandrel head 9 extending from the end of the sleeve 6 on the opposite side of the flange 7 with a diameter larger than the inner diameter of the sleeve. As is well known, a blind rivet 2 is applied by inserting the sleeve of the rivet main body 5 into a mounting hole in the fastened component, bringing the flange 7 into contact with the fastened component, forcibly pulling the mandrel 3 until a predetermined ruptured portion has been ruptured, deforming and widening a portion of the sleeve 6 with the mandrel head 9, and securely interposing the fastened component between the expanded sleeve portion and the flange 7. This fastens the rivet main body 5 to the fastened components. Thus, a blind rivet 2 has the advantage of being able to fasten the fastened components from one side, even when the fastened components are large panels (e.g., car panels). Blind rivets 2 are usually made of a metal material such as steel or aluminum. The ruptured mandrel portion has to be recovered after the blind rivet has been fastened. Before the blind rivet is fastened, the blind rivet 2 should be held by and kept in the blind rivet fastening device 1. After the blind rivet 2 is held by the blind rivet fastening device 2, the fastening device is positioned in the fastening position. At this time, the blind rivet 2 may fall out. This prevents proper fastening from being performed.

[0016] The blind rivet fastening device 1 in FIG 1 comprises a hollow nose 10 for inserting the mandrel 3 of the blind rivet 2, a jaw 11 arranged inside the nose 10 serving as a means for holding the mandrel 3 inserted into the nose, a motor 14 arranged in the tool housing 13 behind the nose 10 serving as the drive means for pulling the jaw 11 gripping the mandrel rearward from the nose, and a transmission 15 for transmitting the drive force (torque) of the motor 14. The transmission 15 is used to decelerate the rotation of the motor 14 and increase the torque in order to obtain enough force to pull and rupture the mandrel 3. Here, the motor 14 and the transmission 15 serve as the drive means. However, a hydraulic piston/cylinder device or a pneumatic piston/cylinder device can be used as the drive means if it is able to forcibly pull the jaw 11 holding the mandrel 3 rearward from the nose 10. The handle 17 in the tool housing 13 is gripped by the operator. The battery 18 serving as the power source for the motor 14 is housed inside the handle 17. A trigger switch 19 is also attached to the handle 17 to supply power to the motor 14. A trigger lever 22 is rotatably attached in the handle 17 on a pin 21 near the trigger switch 19. As shown in FIG 1, the lower portion of the trigger lever 22 is near the operating pin 19A of the trigger switch 19. When the operator rotates the operation portion 23 in the lower portion of the trigger lever 22 towards the handle 17 (counterclockwise around the pin 21 in FIG 1), power from the battery 18 is supplied to the motor 14 and the drive shaft 25 is rotated via the transmission 15. The drive shaft 25 is a portion of the drive means. The trigger lever 22 consists of an operating portion 23 in the lower portion of the pin 21 and a mounted portion 24 in the upper portion of the pin 21. The mounted portion 24 is described below.

[0017] The nose 10 in the blind rivet fastening device 1 encompasses a nosepiece 26 at the front end and a nose housing 27 extending from the back end of the nosepiece 26 towards the tool housing 13 in a tubular shape. The front end of the nose housing 27 is screwed into the rear end of the nosepiece 26 and integrally connected to the nosepiece 26 to form the nose 10.

[0018] In the blind rivet fastening device 1, the rear end of the nose housing 27 is connected slidably in the axial direction to the front end of the hollow tool housing 13. Thus, the nose 10 consisting of the nosepiece 26 and the nose housing 27 is movably connected to the tool housing 13 in the axial direction over a predetermined length.

[0019] The inside of the front portion of the nose housing 27 contains a tube-shaped jaw guide 29 able to slide in the nose housing 27 in the axial direction. The inside of the jaw guide 29 contains a jaw 11 able to slide in the jaw guide 29 in the axial direction. The jaw 11 is arranged so that the front end is near the back end of the nosepiece 26, and the jaw is formed with a shape that is slender in the direction of the nosepiece 26. The jaw 11 is divided into two to four pieces in the circumferential direction inside the tube-shaped jaw guide 29. These pieces are assembled so that they form a tube-shaped body inside the jaw guide 29. The pieces of the jaw 11 have a shape that forms a space inside the assembled tube-shaped body that can receive the mandrel 3 of the blind rivet 2. As described above, the jaw guide 29 is formed with a hollow cavity that is tapered so that the inner diameter becomes smaller in the forward direction (left in FIG 1) and conforms to the slender shape of the jaw 11. The jaw 11 assembled to form a slender tube-shaped body is slidably inserted into the tapered hollow cavity in the axial direction. Therefore, when the jaw guide 29 is forward with respect to the jaw 11 in the axial direction (left in FIG 1), the diameter of the space inside the tube-

shaped body formed by the pieces of the jaw 11 enlarges. This makes it easy to insert the mandrel 3 of the blind rivet 2. When the jaw guide 29 is rearward with respect to the jaw 11 in the axial direction (right in FIG 1), the diameter of the space inside the tube-shaped body formed by the pieces of the jaw 11 narrows. This frictionally holds the mandrel 3 of the blind rivet 2 inserted into the space and securely grasps the entire blind rivet 2.

[0020] A specific gap G is formed at the original position in FIG 1 between the front surface of the jaw guide 11 and the inner wall surface at the front end of the nose housing 27 so that the nose 10 consisting of the nosepiece 26 and the nose housing 27 can move in the tool housing 13 a predetermined length in the axial direction. When this gap G is formed, the inner diameter on the inside of the jaw 11 is smaller than the outer diameter of the mandrel 3.

[0021] The tube-shaped pulling head 30 is screwed into the back of the jaw guide 29 and connected integrally. A slit (not shown) extending axially to receive the pin 31 fixed to the tool housing 13 is formed in the pulling head 30, and the slit and pin 31 are arranged so that the pulling head 30 (and jaw guide 29) can slide axially in the tool housing 13 but not rotate axially. Female threading 30A is formed inside on the back end of the pulling head 30, and the front end of the tube-shaped drive shaft 25 extending forward from the transmission 30 also extends to the female threading portion. Male threading 25A is formed in the front end of the drive shaft 25 that engages the female threading 30A in the back end of the pulling head 30. Because the male threading in the drive shaft 25 is screwed into the female threading of the pulling head 30, the rotational action of the drive shaft 25 not moving axially is converted to retreating action pulling back the pulling head 30 axially or advancing action pushing forward the retreated pulling head 30 axially. The male threading in the drive shaft 25 and the female threading in the pulling head 30 can be switched to female threading in the drive shaft 25 and male threading in the pulling head 30. A sensor switch (not shown) is formed in position 33 of FIG 1 to reverse the rotation of the motor 14. After the pulling head 30 has retreated a certain length (the length required to rupture the mandrel 3), it retreats no further and the pulling head 30 begins to advance.

[0022] A jaw pusher 34 consisting of a hollow tube-shaped body is arranged behind the jaw 11 inside the jaw guide 29 and the pulling head 30 so as to push the jaw 11 forward. In order to apply force so that the jaw pusher 34 pushes the jaw 11 forward, a jaw pusher spring 35 consisting of a coil spring is arranged at the back end of the jaw pusher 34 inside the front portion of the pulling head 30. The jaw pusher spring 35 always applies force to push the jaw pusher 34 forward, and the jaw 11 is pushed forward. This always pushes the jaw 11 in the direction of the nosepiece 26, and the slender-shaped outer surface of the jaw 11 is pushed against the tapered inner surface of the jaw guide 29. When the jaw guide 29 is forward axially with respect to the jaw 11, the diameter of the space inside the tube-shaped body formed by the pieces of the jaw 11 is increased so that the mandrel 3 of the blind rivet 2 can be easily inserted. When the jaw guide 29 is rearward with respect to the jaw 11 in the axial direction, the diameter of the space inside the tube-shaped body formed by the pieces of the jaw 11 narrows. The elasticity of the jaw pusher spring 35 frictionally holds the mandrel 3 of the blind rivet 2 inserted into the space and securely grasps the entire blind rivet 2.

[0023] The drive shaft 25 is formed with a hollow core so that the portion of the mandrel ruptured by the jaw 11 can be sent through the hollow portion of the drive shaft 25 via the hollow portion of the jaw pusher 34 and the jaw pusher spring 35. The drive shaft 25 extends in the tool housing 13 a fixed length forward from the transmission 15. A mandrel collector 37 for storing the ruptured mandrel portions is formed in the large drum-shaped cavity between the outer surface of the drive shaft 25 and the inner surface of the tool housing 13. The ruptured mandrel portion sent to the drive shaft 25 is discharged from the slit 36 extending axially in the drive shaft 25 and is stored in the mandrel collector 37. The ruptured mandrel portions stored and collected in the mandrel collector 37 can be discarded by opening the cover 38. The cover 38 is usually closed. When necessary is can be opened to the position indicated by the dotted lines in FIG 1. In order to mount blind rivets 2 and recover ruptured mandrels after the blind rivet has been fastened, the axial portion of the nosepiece 26, the axial portion of the jaw 11, the axial portion of the jaw pusher 34 and the axial portion of the pulling head 30 are hollow. This allows a mandrel to be held and passed through. The mandrel collector 37 is arranged in the middle portion of the tool housing 13 between the motor 14 and the transmission 15 at the back end of the tool housing 13 and the pulling head 30 at the front end of the tool housing 13. This extends down at an oblique angle from the tool housing 13 in the middle position so that the handle 17 of the blind rivet fastening device 1 is easy to grip. Because the mandrel collector 37 can be arranged in the middle position of the tool housing 13, the mandrel collector does not have to be installed in the back end of the tool housing as in JP 05-200476 A and JP 2003-266134 A, and instability caused by the weight of the collected ruptured mandrels is reduced when the device is held by the operator.

[0024] As described above, the nose 10 consisting of a nosepiece 26 and a nose housing 27 is connected so as to be able to move in the tool housing 13 a predetermined length in the axial direction. The back end of the nose housing 27 constitutes a ring-shaped engagement portion 39 protruding outward radially. The engagement portion 39 engages the engagement portion 43 at the front end of the link 42 extending in the axial direction to the outside of the tool housing 13 from the inside of the tool housing 13 via a connecting pin 41. The link 42 consists of a front link 42A on the inside of the tool housing 13 and a rear link 42B on the outside of the tool housing 13 connected to the front link 42A by the connecting pin

41. The back end of the rear link 42B extends to a position near the handle 17 and extends below the handle to a position near the handle 17 to form an L shape. The back end 45 of the L-shaped rear link 42B extends into the gap between the mounted portion 24 in the upper portion of the trigger lever 22 and the handle 17. The link 42 is connected to the tool housing 13 by the connecting pin 41 and the axial slit (not shown) in the tool housing 13 so that it can slide axially in the tool housing 13.

[0025] As described above, the trigger lever 22 has a mounted portion 25 extending to the upper portion of the pin 21 on the outside of the operating portion 23 in the lower portion of the pin 21. When the operator pulls the operating portion 23 in the lower portion in the direction of the handle 17 using a finger, the trigger lever 22 rotates counterclockwise around the pin 21, pushes the operating pin 19A in the trigger switch 19, and supplies power from the battery 18 to the motor 14.

[0026] When the operator pulls the mounted portion 24 in the upper portion in the direction of the handle 17 using a finger, the trigger lever 22 rotates clockwise around the pin 21, the back end of the rear link 42B of the link 42 moves to the rear of the tool housing 13, and the entire link 42 slides to the rear of the tool housing 13. By sliding to the rear of the link 42, the engagement portion 43 of the front link 42A slides the engagement portion 39 at the back end of the nose housing 27 to the rear, and the nose 10 is slid to the rear in its entirety. By sliding the nose 10 to the rear, the jaw 11 is pushed to the rear 11 via contact with the jaw pusher 34 and jaw pusher spring 35 which moves the nosepiece 26. Because the jaw guide 29 engaged with the outer surface of the jaw 11 does not move, the jaw 11 moves to the rear in the axial direction with respect to the jaw guide 29, i.e., it moves in the direction that expands the inner diameter. This increases the diameter of the interior space of the tube-shaped body formed by the pieces of the jaw 11, making it easier to insert the mandrel 3 of the blind rivet 2. Next, when the operator releases the pull on the mounted portion 24 in the upper portion, the jaw pusher 34 and the jaw pusher spring 35 returns the jaw 11 to the forward position through contact which pushes on the nosepiece 26, thereby returning the nose 10 to the forward position. By returning the nose 10 to the forward position, the link 42 slides to the original forward position along with the connecting pin 41. The jaw 11 returned to the forward position by the jaw pusher 34 and the jaw pusher spring 35 moves the jaw guide 29 forward. This reduces the diameter of the interior space inside the tube-shaped body formed by the pieces of the jaw 11, which frictionally retains the mandrel 3 of the blind rivet 2 inserted into the space and secures the entire blind rivet 2.

[0027] The blind rivet 2 mounting operation, fastening operation and ruptured mandrel storing operation performed by a blind rivet fastening device 1 with this configuration will now be explained with reference to FIG 2 through FIG 6. FIG 2 shows a blind rivet 2 mounted in the fastening device 1. A blind rivet 2 is mounted in the blind rivet fastening device 1, as shown in FIG 1, by inserting the mandrel 3 of the blind rivet 2 into a hole in the nosepiece 26 of the nose 10. When inserted, as indicated by arrow 46 in FIG 2, the mounted portion 24 in the upper portion of the trigger lever 22 is pulled in the direction of the handle 17, the trigger lever 22 is rotated clockwise around the pin 21, the back end 45 of the rear link 42B of the link 42 moves to the rear of the tool housing 13, and the entire link 42 is slid to the rear of the tool housing 13. By sliding the link 42 to the rear, the engagement portion 43 of the forward link 42A slides the engagement portion 39 at the back end of the nose housing 27 to the rear, and slides the entire nose 10 to the rear. By sliding the nose 10 to the rear, the jaw pusher 34 and the jaw pusher spring 35 move the jaw 11 in contact with and pushing the nosepiece 26 to the rear. Because the jaw guide 29 engaging the outer surface of the jaw 11 does not move, the jaw 11 moves to the rear axially with respect to the jaw guide 29 by the length of gap G in FIG 1. This increases the inner diameter of the jaw guide in the portion engaged by the jaw 11. The diameter of the tube-shaped interior space formed by the pieces of the jaw 11 in the jaw guide 29 is thereby increased, which makes it easy to insert the mandrel 3 of the blind rivet 2.

[0028] FIG 3 shows the state after the pulled mounted portion 24 in the upper portion of the trigger lever 22 has been released by the operator. When released, the force on the back end 45 of the rear link 42B of the link 42 is eliminated. The spring action of the jaw pusher spring 35 pushing on the nosepiece 26 returns the jaw pusher 34 and the jaw 11 to the forward position which, in turn, returns the nose 10 to the forward position. When the nose 10 has returned to the forward position, the link 42 slides forward along with the connecting pin 41 and returns to the original position shown in FIG 1. The jaw 11 returned to the forward position by the jaw pusher 34 and the jaw pusher spring 35 moves the jaw guide 29 forward, which reduces the diameter of the interior space of the tube-shaped body formed by the pieces of the jaw 11. This frictionally holds the mandrel 3 of the blind rivet 2 inserted into the interior space of the jaw 11 against the inner surface of the jaw 11, and secures the entire blind rivet 2. Because the jaw 11 is always pushed by the spring action of the jaw pusher spring 35, the frictional engagement between the inner surface of the jaw 11 and the outer surface of the mandrel 3 is maintained at a constant strength. This keeps the blind rivet 2 held in the nose 10 from falling out however the blind rivet fastening device 1 is held.

[0029] FIG 4 shows a blind rivet 2 fastening fastened components 47 such as two or three panels. When fastening fastened components 47 with a blind rivet 2, the operator inserts the rivet main body 4 of the blind rivet 2 mounted in the nose 10 into a mounting hole in the fastened component 2 and properly maintains the position of the blind rivet fastening device 1 with respect to the fastened components 47. The operator pulls the operating portion 23 in the lower portion of the trigger lever 22

towards the handle 17 in the direction indicated by arrow 49, which rotates the trigger lever 22 counterclockwise around the pin 21. The operating pin 19A in the trigger switch 19 is pushed by this, and power from the battery 18 is supplied to the motor 14. The motor 14 operates in the forward direction and the drive shaft 25 is rotated axially by the strong torque via the transmission 15. Because the male threading 25A at the front end of the drive shaft 25 is meshed with the female threading 30A formed in the hollow cavity at the back end of the pulling head 30, the rotation of the drive shaft 25 forcibly causes the pulling head 30 to be pulled back. The retreat of the pulling head 30 strongly pulls back the integrally connected jaw guide 29, and the jaw 11 engaging the inner tapered surface of the jaw guide also retreats. Because the mandrel 3 of the blind rivet 2 is held in the jaw 11, the pull back of the jaw 11 ruptures a predetermined portion of the mandrel 3. The mandrel head 9 deforms and enlarges a portion of the sleeve 6, and the fastened components 47 such as two panels are interposed securely between the deformed and enlarged sleeve portion and the flange 7. This fastens the rivet main body 5 to the fastened components 47, e.g., fastening two panels to each other. As shown in FIG 4, a portion of the ruptured mandrel 3 remains held by the jaw 11 inside the fastening device 1.

[0030] When the pulling head 30 moves the jaw 11 to the position at which a predetermined portion of the mandrel 3 is ruptured, a reverse motor switch installed at position 33 in FIG 4 (and FIG 1) is activated. The motor 14 or transmission 15 is controlled by the signal from this switch, and the drive shaft 25 is reversed. The reverse operation causes the threaded drive shaft 25 to move and return the pulling head 30 to the forward position. When the pulling head 30 has been returned to the original position shown in FIG 1, the movement stops. Once it has stopped, the operator releases the pulled operating portion 23 of the trigger lever 22 and the blind rivet fastening device 1 is removed from the fastened components 47. FIG 5 shows this state. The trigger lever 22 is returned to the state in which the operating portion 23 is not pushing on the operating pin 19A of the trigger switch 19. Thus, power from the battery 18 to the motor 14 is being blocked. Because the pulling head 30 and the jaw guide 29 have been returned to their original positions, the jaw 11 and the jaw pusher 34 are returned to their original positions by the jaw pusher spring 35. At this time, the ruptured mandrel 3 is held by the jaw 11 and a portion may protrude from the nose 10.

[0031] FIG 6 shows the next blind rivet 2. Here, the next blind rivet 2A is mounted in the blind rivet fastening device 1, and a portion of the previous ruptured mandrel is stored in the mandrel collector. The following is an explanation with reference to FIG 2 of the operation performed to mount the next blind rivet 2A in the fastening device 1. In other words, as indicated by arrow 46 in FIG 6 (and FIG 2), the operator pulls the mounted portion 24 in the upper portion of the trigger lever 22 towards the handle 17. The trigger lever 22 is rotated clockwise around the pin 21, and the back end 45 of the rear link 42B of the link 42 is moved toward the rear end of the tool housing 13, and the entire link 42 is slid to the rear of the tool housing 13. The engaged portion 43 of the front link 42A slides the engaged portion 39 at the back end of the nose housing 27 rearward, the entire nose 10 slides to the rear, and the jaw 11 moves to the rear. Because the jaw guide 29 engaging the outer surface of the jaw 11 does not move, the jaw 11 moves axially to the rear in the jaw guide 29, and the inner diameter of the portion of the jaw guide engaging the jaw 11 is enlarged. This enlarges the diameter of the tube-shaped inner space formed by the plurality of jaws 11 in the jaw guide 29, allowing the blind rivet 2 to be easily accepted by the mandrel 3. The mandrel 3A for the next blind rivet 2A moves the remaining ruptured mandrel 3 to the rear but only by the length inserted in the jaw 11, which releases the hold of the jaw 11. When the blind rivet 2A is fastened to the fastened component, the mandrel 3A ruptures. At the moment of rupture, the remaining ruptured mandrel 3 is struck, and the ruptured mandrel 3 is suddenly sent into the drive shaft 25 by means of the pulling head 30 as indicated by arrow 50. The ruptured mandrel 3 in the drive shaft 25 passes through the axial slit 36 in the drive shaft 25 and is stored in the mandrel collector 37. When a certain quantity of ruptured mandrels 3 is stored in the mandrel collector 37, the cover 38 is opened in the direction of the arrow 51 and the spent material is removed.

Claims

1. A blind rivet fastening device (1) comprising a hollow nose (10) for receiving the mandrel (3) of a blind rivet (2) consisting of the mandrel and the rivet main body, a tool housing (13) arranged axially to the rear of the nose (10), a jaw (11) arranged inside the nose (10) to hold the mandrel (2) received by the nose (10), a jaw guide (29) arranged inside the nose (10) so as to be able to be pulled to the rear axially and engage the outer peripheral surface of the jaw (11) in such a way that the inner diameter of the jaw (11) is reduced when pulled to the rear axially and the reduced inner diameter of the jaw (11) is restored when returned forward axially from the rear axial position, a pulling head (30) connected to the jaw guide (29) or pulling the jaw guide (29) rearward into the tool housing (13), a drive means arranged in the tool housing (13) and operated to pull the pulling head (30) axially in the rearward direction, and an elastic pushing means (34, 35) for always pushing the jaw (11) forward in the axial direction so that the outer peripheral surface of the jaw (11) engages the inner peripheral surface of the jaw guide (29), the drive means being operable by a trigger lever (22) installed in a handle (17) formed integrally with the tool housing (13), and the sleeve of the rivet main body (5) being deformed so as to spread when pulled to the rear by the pulling

head (30), jaw guide (29) and jaw (11), fastening the rivet main body (5) to the fastened component with the spread deformed sleeve portion and the rivet main body portion (5), **characterized in that** the nose (10) is connected slidably to the tool housing (13) in the axial direction, the nose (10) resists the action of the elastic pushing means (34, 35) and can be slid so as to be pulled rearward in the axial direction by a force, thereby causing the jaw (11) to be pulled rearward in the axial direction in the jaw guide (29), increasing the inner diameter of the jaw (11), and allowing the mandrel (3) to be easily inserted into the jaw (11), by releasing the force pulling the nose (10) rearward in the axial direction, the jaw (11) is caused to return forward axially in the jaw guide (29) by means of the pushing force of the elastic pushing means (34, 35), and to frictionally engage the inner peripheral surface of the jaw (11) with the mandrel inserted in the jaw (11).

2. The device (1) according to claim 1, wherein the trigger lever (22) is connected rotatably to the handle (17) by a pin (21), wherein the trigger lever (22) comprises an operating portion (23) extending lengthwise from the pin (21) to one side of the handle (17) and a mounted portion (24) extending lengthwise from the pin (21) to the other side of the handle (17), wherein the operating portion (23) is the trigger lever portion rotating the pin (21) and activating the drive means with a pulling action, and wherein the mounted portion (24) is the trigger lever portion slid by the pulling action of the mounted portion (24) so as to pull the nose (10) rearward in the axial direction.

3. The device (1) according to claim 2, wherein the nose (10) comprises a nosepiece (26) and a nose housing (27) integrally connected with the nosepiece (26) and also connected so as to slide axially with respect to the tool housing (13), wherein a link extending rearward axially along the tool housing (13) and engaging the mounted portion (24) of the trigger lever (22) is connected to the back end of the nose housing (27), wherein the pulling action of the mounted portion (24) slides the link rearward in the axial direction so as to pull the nose (10) rearward in the axial direction, pull the jaw (11) rearward in the axial direction along the jaw guide (29) and against the pushing of the elastic pushing means (34, 35), and enlarge the inner diameter of the jaw (11), wherein the release of the pulling action of the mounted portion (24) causes the force pulling the nose (10) rearward in the axial direction to be released, and wherein the pushing force of the elastic pushing means (34, 35) returns the jaw (11) forward in the axial direction along the jaw guide (29) and reduces the diameter of the jaw (11).

4. The device (1) according to any one of claims 1 to 3, wherein the back end of the jaw guide (29) is connected integrally with the front end of the pulling head (30), wherein the elastic pushing means (34, 35) comprises a jaw pusher (34) engaging the back end of the jaw (11) and a jaw pusher spring (35) elastically pushing the jaw pusher (34) towards the jaw (11) from the pulling head (30), wherein a plurality of portions are assembled circumferentially to form a slender tube facing forward, wherein the jaw guide (29) is a hollow tube tapered so as to reduce the inner diameter in the forward direction, and wherein the jaw pusher spring (35) causes the outer peripheral surface of the jaw (11) to elastically and frictionally engage the inner peripheral surface of the jaw guide (29).

5. The device (1) according to any one of claims 1 to 4, wherein the drive means encompasses a motor (14) and a drive shaft (25) rotated by the motor (14), wherein the battery (18) serving as the power source of the motor (14) and a trigger switch (19) for supplying power from the battery (18) to the motor (14) are stored in the handle (17), wherein the trigger switch (19) has an operating pin (19A) pushed by the operating portion (23) of the trigger lever (22), and wherein the pulling action of the operating portion (23) supplies power to the motor (14).

6. The device (1) according to any one of claims 1 to 5, wherein the drive shaft (25) is formed with male threading or female threading in the front end portion, the hollow section in the rear portion of the pulling head (30) is formed with male threading or female threading to engage the male threading or female threading in the drive shaft (25), and wherein the rotation of the drive shaft (25) causes the pulling head (30) to move forward or backward axially.

7. The device (1) according to claim 5 or claim 6, wherein the hollow cavity between the outer periphery of the drive shaft (25) and the inner periphery of the tool housing (13) forms a mandrel collector (37) for housing the mandrel portion ruptured when the rivet main body (5) is fastened to the fastened component, and wherein the ruptured mandrel portion is placed in the mandrel collector (37) from an axial slit in the drive shaft (25) via the jaw (11), jaw guide (29) and pulling head (30).

8. The device (1) according to claim 7, wherein a cover (38) is installed on the mandrel collector (37) that can be opened to remove the ruptured mandrels stored therein.

9. The device (1) according to claim 7 or claim 8, wherein the motor (14) is installed axially in the rear of the tool housing (13), wherein the pulling head (30) is arranged axially in the front of the tool housing (13),

and wherein the mandrel collector (37) is arranged in the middle of the tool housing (13) between the motor (14) and the pulling head (30).

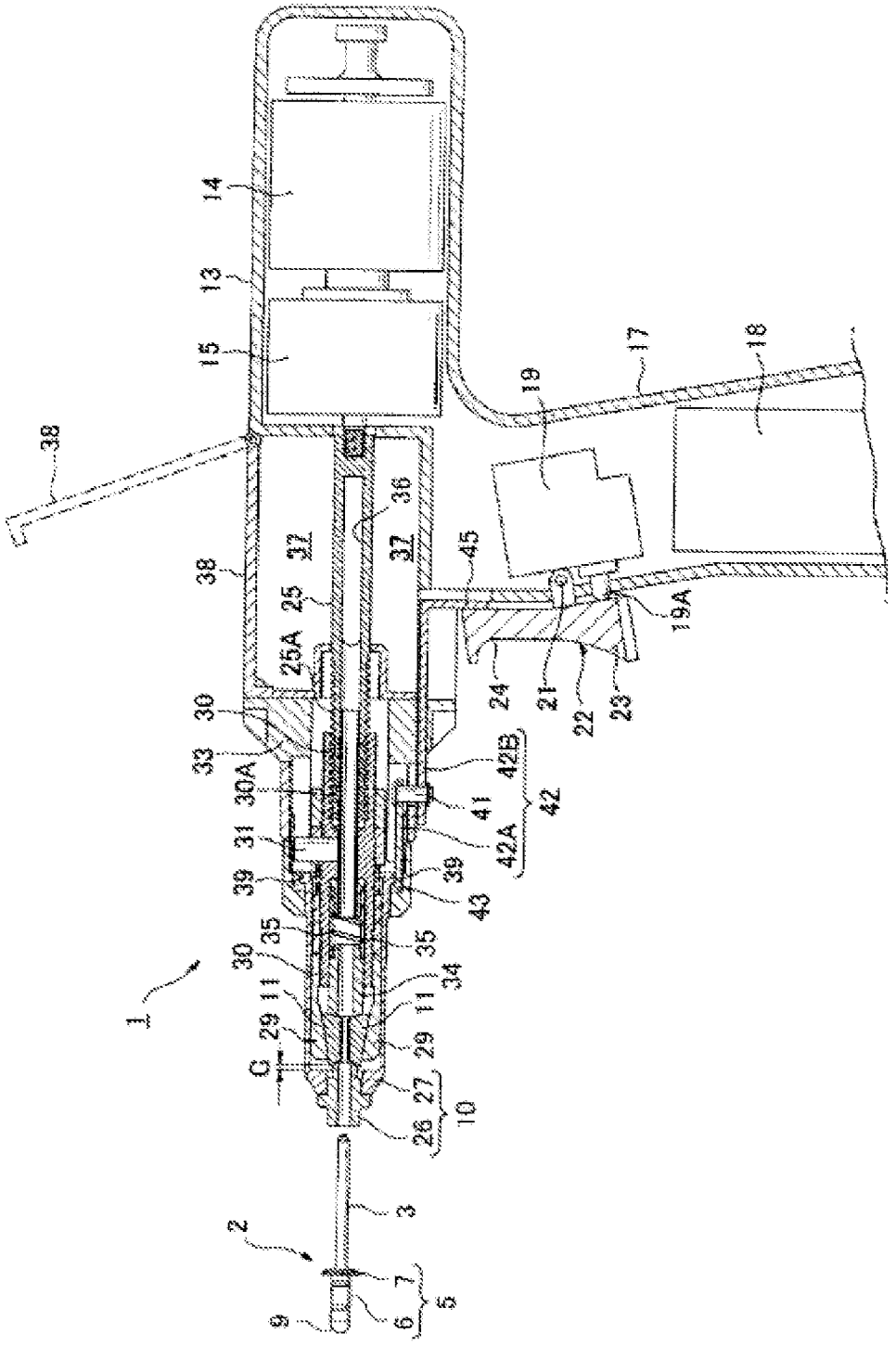
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FIG. 1

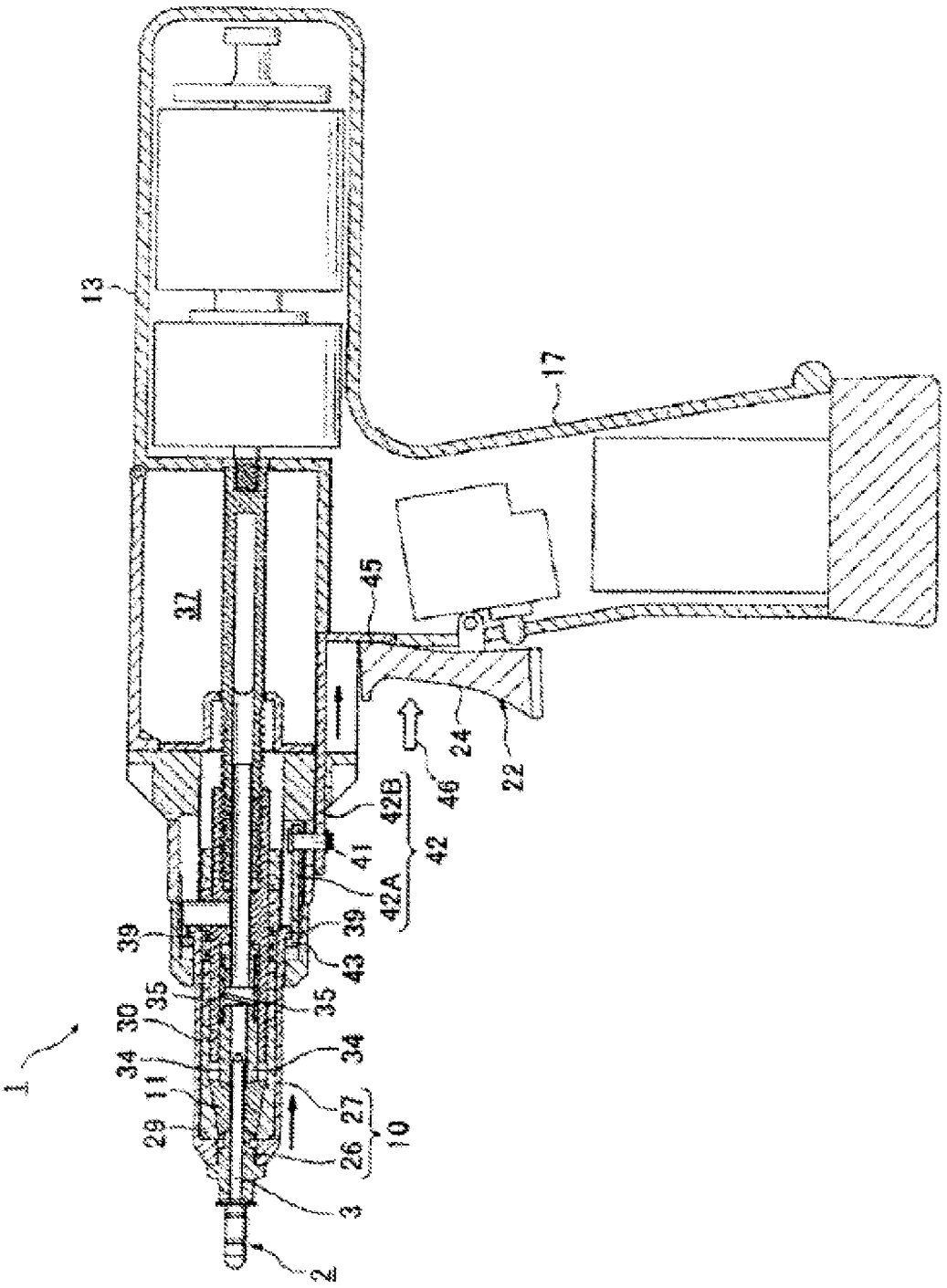
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FIG. 2

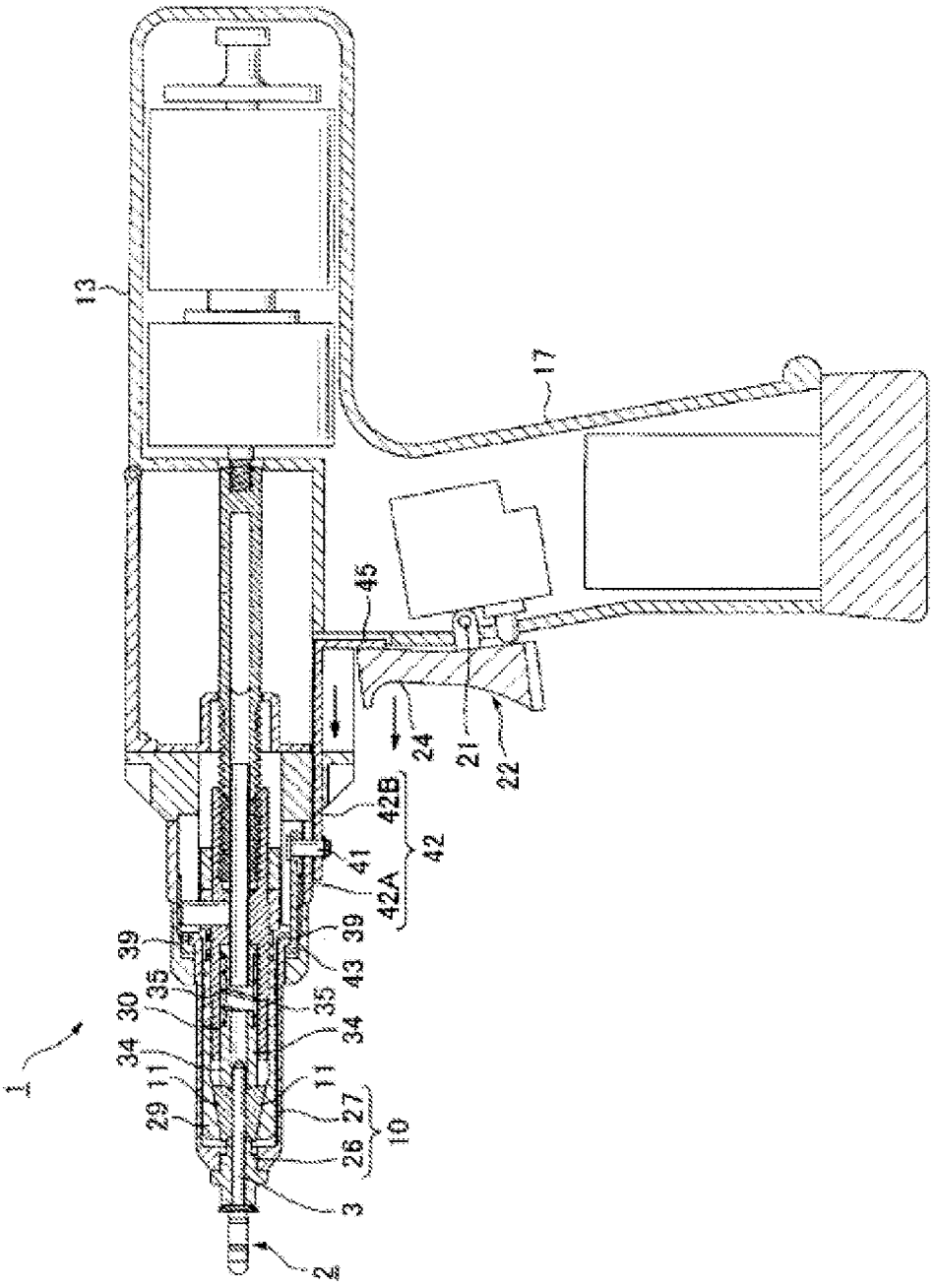
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FIG. 3

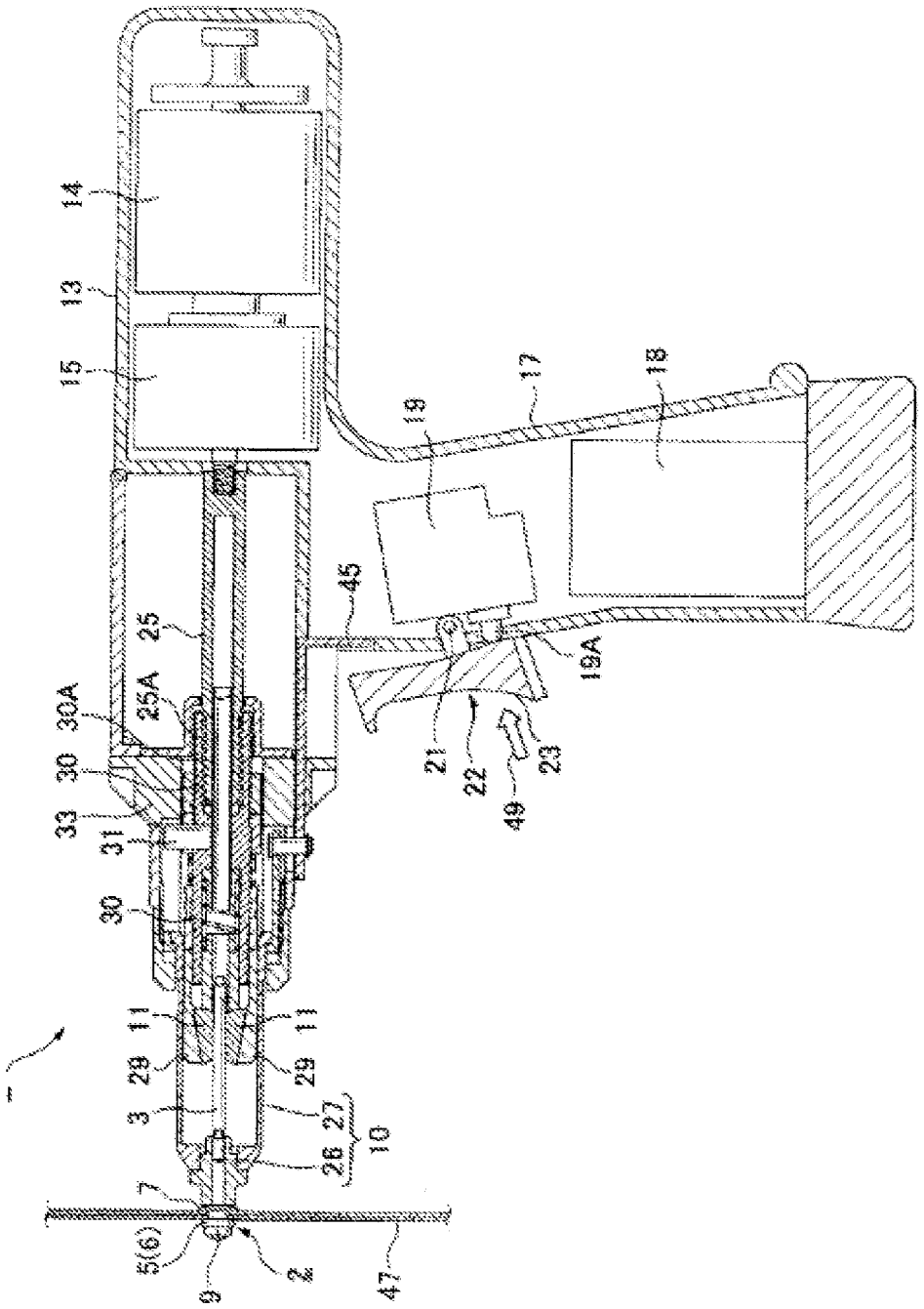
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FIG. 4

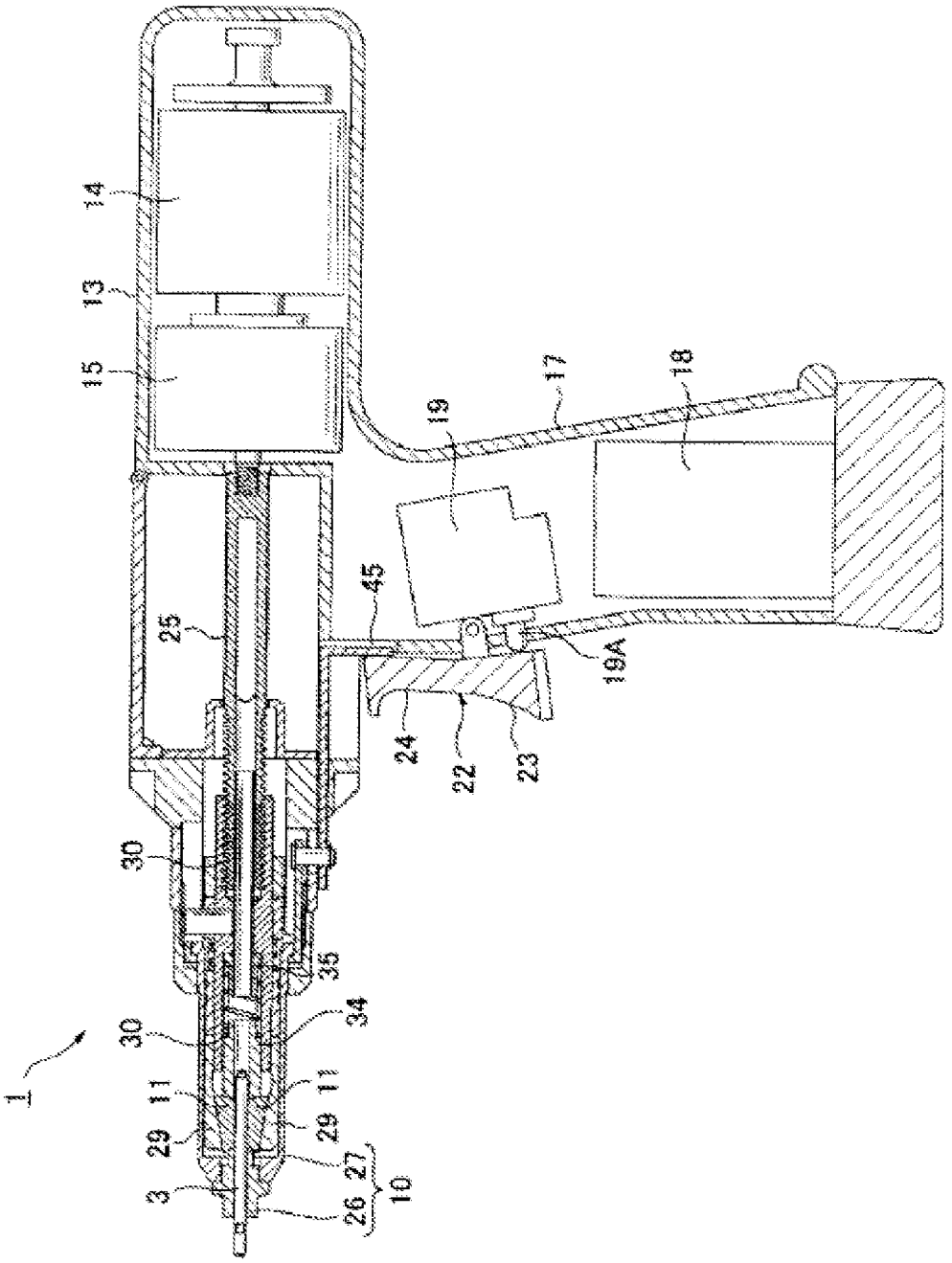

FIG. 5

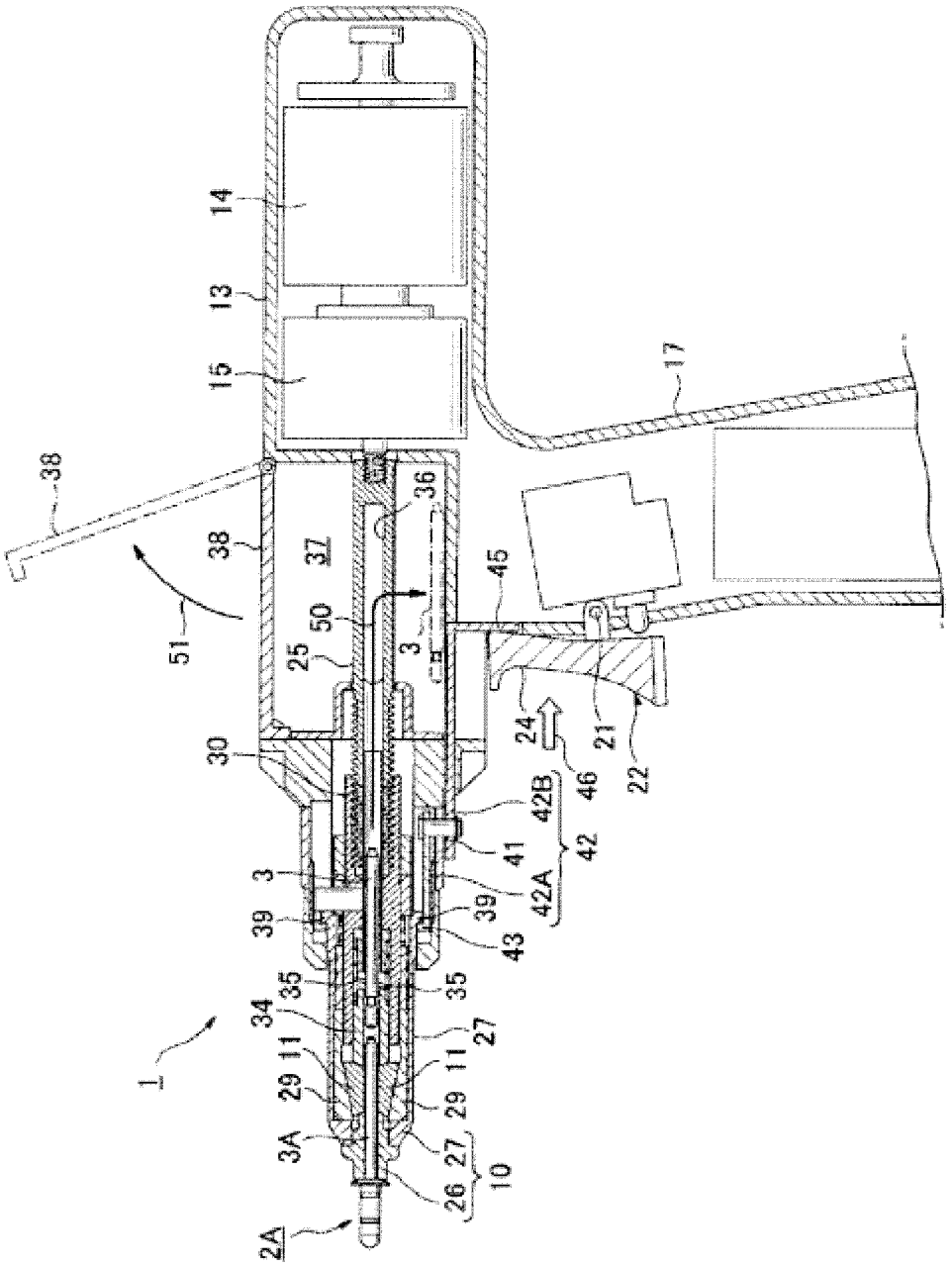
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FIG. 6

REFERENCES CITED IN THE DESCRIPTION

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