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Lee

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[54] AUTOMATIC REAR FEEDER FOR BLIND RIVETS

[72] Inventor: William H. Lee, Mount Vernon, N.Y.

[73] Assignee: Josephson, Speiser & Ives, New York, N.Y.

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[51] Int. Cl. B21j 15/06

[58] Field of Search 72/391, 453; 227/114, 117, 227/118

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Primary Examiner—Charles W. Lanham

Assistant Examiner—Gene P. Crosby

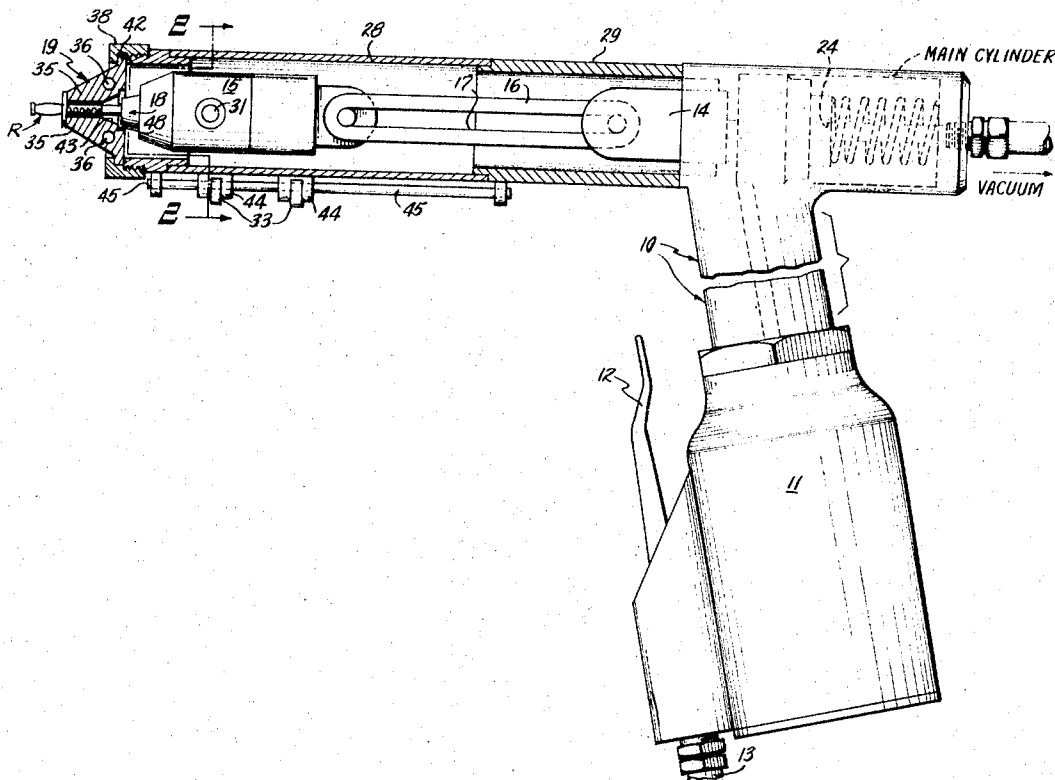
Attorney—Arnold G. Gulko

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ABSTRACT

Blind rivets are automatically fed into a nosepiece of a blind rivet-setting tool by having the nosepiece split into sections which are pivoted so that the rivet can be carried by the pulling jaws and pushed through from the rear. The tool operates with two strokes. In the second stroke an auxiliary air cylinder pulls the jaws back and cams a sleeve to rotate it, to feed a fresh rivet into the space between the jaws and the nosepiece. The jaws pick up the rivet on the forward stroke and push it through the nosepiece sections, these sections closing behind the rivet flange. Vacuum is used to discharge the spent rivet mandrel and to draw the fresh rivet back against the nosepiece ready to be set.

11 Claims, 7 Drawing Figures



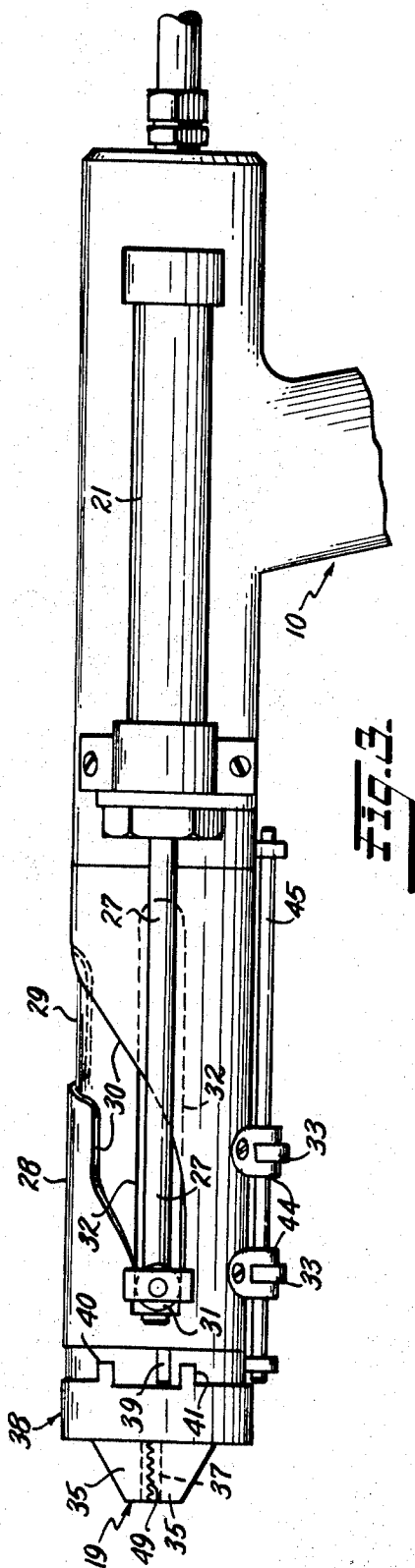


FIG. 3.

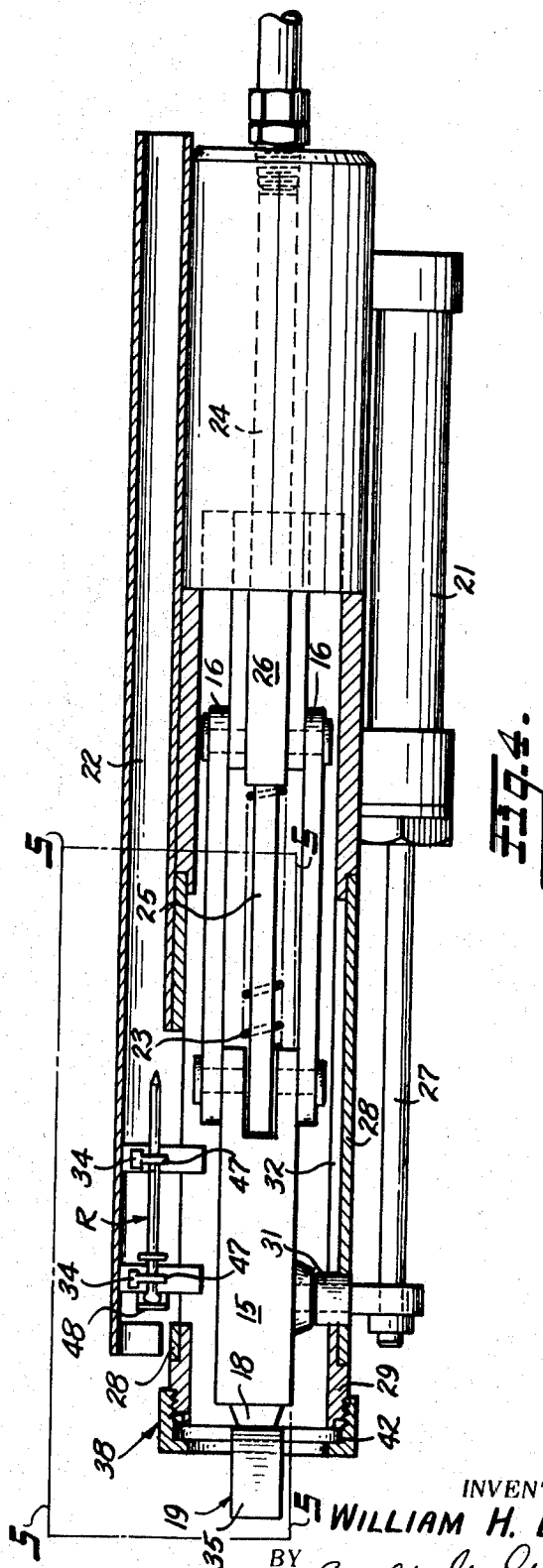
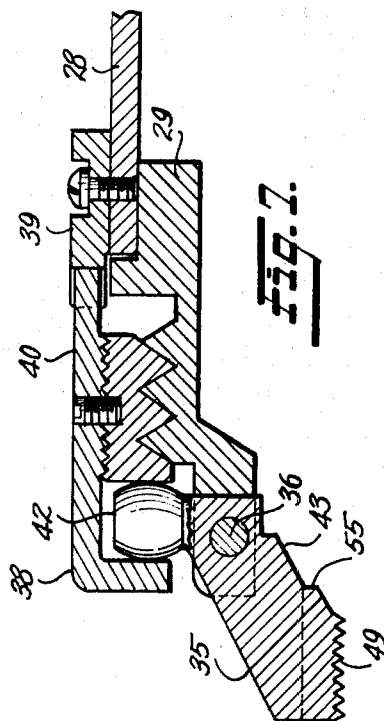
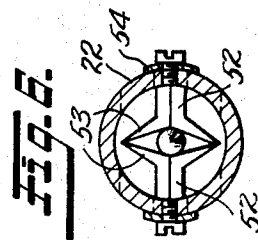
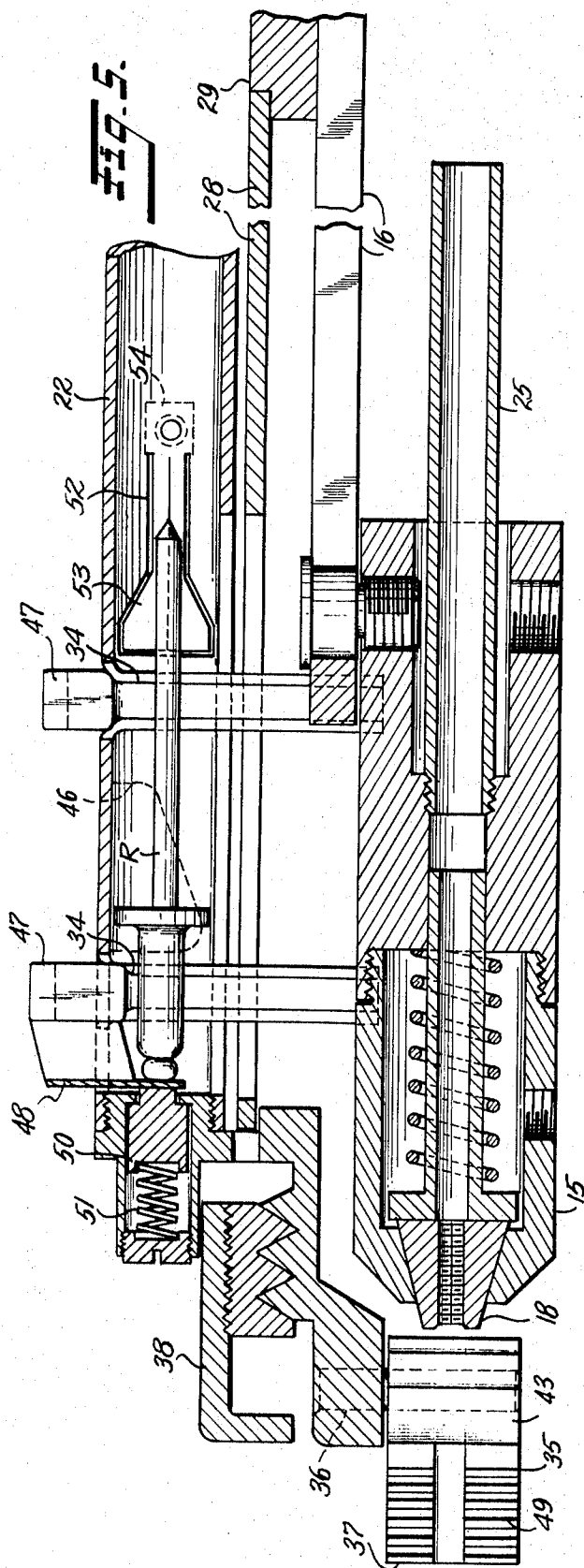


FIG. 4.

INVENTOR.
WILLIAM H. LEE
BY *Arnold G. Gulko*

ATTORNEY



INVENTOR
WILLIAM H. LEE
BY *Arnold G. Gulko*
ATTORNEY

AUTOMATIC REAR FEEDER FOR BLIND RIVETS

The present application is a continuation-in-part of my prior copending application Ser. No. 60,813, filed Aug. 4, 1970, now abandoned.

The present invention relates to the automatic feeding of blind rivets and especially to apparatus in which the blind rivet is thrust through the mandrel-receiving orifice of the nosepiece from the rear thereof.

Blind rivets are used extensively in industry for securing together diverse products and especially sheets of metal having aligned openings therein. In order to accomplish this, the blind rivet is held by a tool capable of pulling the mandrel of the rivet. The head of the rivet is inserted into the aligned openings and the trigger of the pulling tool is depressed to operate the tool. The tool functions to grasp the mandrel of the rivet and pulls it away from the work until the mandrel snaps off, leaving the rivet in its final securing position and releasing the tool from the work. The blind rivets which are used are of diverse construction as are the tools which pull them, but they are all well known and have in common the use of a blind rivet having a forward head terminating in an outstanding flange and a rearwardly extending rivet mandrel the forward end of which reaches through the flange to terminate at the forward end of the head. This mandrel has a weakened portion near its forward end which enables the rivet mandrel to be snapped off at the end of the pulling operation.

The tools which pull or set the rivets have in common the presence of rivet pulling jaws which are operated by a collet which reciprocates within a collet housing and which grasp the rivet mandrel at the rear of a nosepiece. The nosepiece holds the rivet and enables it to be guided into the aligned openings in the work piece. The pulling jaws grasp the rivet mandrel and move rearwardly away from the work to pull the rivet mandrel rearwardly through the nosepiece until it is snapped off.

At present a workman using the pulling tool supplied blind rivets, one at a time, by hand. Each rivet is inserted individually into the nosepiece from the front of the tool. After one rivet is set by pulling its mandrel rearwardly through the nosepiece, the workman moves the tool away from the workpiece, another blind rivet is inserted into the nosepiece from the front of the tool, and the tool is ready for reuse.

I have previously designed a blind rivet pulling device which includes automatic rivet feeding means in which the forward end of the rivet is grasped and the rivet is moved to a position in advance of the nosepiece, then laterally to align the mandrel of the rivet with the axis of the nosepiece orifice, and then rearwardly to insert the rivet mandrel in the nosepiece orifice. The details of this blind rivet pulling device are more fully set forth in my prior application Ser. No. 25,371, filed 4/3/70, which is hereby incorporated by reference.

However, front loading mechanisms are subject to certain inherent disadvantages as follows:

1. the feed mechanism extending beyond the forward end of the riveting gun causes difficulty in close quarters since the gun must be drawn back away from the work to permit the feeder to operate;
2. in some rivets, the ferrule is formed loose on the mandrel, and this causes misalignment of the mandrel with the nosepiece orifice resulting in a failure of the feeder to load the gun; and
3. a spring detent partially obstructing the nosepiece orifice was previously needed to keep the supplied rivet from falling out of the nosepiece, and this makes loading less certain and reliable.

The present invention is directed to overcoming these and related defects of front loading devices and to providing an efficient automatic loading device for blind rivet setting tools.

In accordance with the present invention, apparatus for setting blind rivets is provided in which the nosepiece of the tool is divided longitudinally into sections and these sections are separated, as by pivotal movement, to permit the ferrule and flange of a blind rivet to be pushed through from the rear. The sections are closed behind the rivet flange so that the supplied rivet can be set by the operation of a main cylinder.

After a first rivet is set by the action of the main cylinder which retracts and projects the pulling jaws, an auxiliary cylinder is used to reciprocate the pulling jaw assembly independent of the main cylinder. When the jaws are retracted, a fresh rivet is fed from the side to a position between the retracted jaws and the nosepiece with its mandrel pointing to the rear. As the jaws are moved toward the nosepiece, the rivet mandrel is inserted in the jaws, the fresh rivet feed means is withdrawn and the jaws push the rivet through the space between the pivoted nosepiece sections and the nosepiece closes behind the rivet flange.

Vacuum means are employed to remove the spent mandrel rearwardly and to retract the fresh rivet within the assembled nosepiece, ready to be set when desired. To this end, the jaws are advanced until they contact the rear of the nosepiece, this contact releasing the rivet mandrel which is otherwise grasped by the jaws. Telescoping tubes are employed to enable the vacuum to communicate between the rear of the tool and the reciprocating jaws.

Means are provided during the elongated stroke of the auxiliary cylinder to feed the fresh rivet when the jaws are retracted and to pivot the nosepiece sections so that these are separated when the jaws are projected to push the rivet through, and closed near the end of the stroke, after the rivet is pushed through. For this purpose, the rivet setting or pulling stroke is a short stroke which does not actuate the sleeve rotation relied on herein for rivet feeding and nosepiece opening and closing. However, the auxiliary cylinder has a long stroke so that there will be space for insertion of a fresh rivet and, with the rivet grasped by the end of its mandrel by the jaws, for the nosepiece to be closed after the rivet flange has passed through.

To the above purpose, the invention employs a rotatable sleeve which is rotated in response to the movement of the jaws beyond the limited movement needed for rivet setting. Thus, on the long retraction stroke, the sleeve is rotated in one direction causing a fresh rivet to be supplied and a cap rotated to open the nosepiece sections. On the long projection stroke, the sleeve is rotated in the opposite direction. The cam connection with the sleeve now causes the rivet feed to be retracted after the mandrel end has been inserted appropriately in the jaws and the cap is rotated near the end of the stroke to close the nosepiece behind the fresh rivet flange.

The invention will be more fully understood from the description which follows, taken in conjunction with the accompanying drawings which show an illustrative hand tool constructed in accordance with the invention. In the drawings:

FIG. 1 is a side elevation, with parts broken away and partly in section, showing a blind rivet-pulling tool (commonly termed a "gun") including means for automatically feeding blind rivets thereto;

FIG. 2 is a cross-section taken approximately on the line 2—2 of FIG. 1 and showing the barrel and sleeve construction, the feed mechanism and the auxiliary cylinder operation;

FIG. 3 is another side elevation, but without parts broken away to show the auxiliary cylinder and the cam-rotated sleeve construction and the manner in which the sleeve controls the cap-operated nosepiece sections;

FIG. 4 is a top view, again with parts broken away and partly in section to further show the inter-relation of the parts;

FIG. 5 is a two and a half times enlarged top view of a portion of FIG. 4, the portion being outlined in phantom at 5—5—5;

FIG. 6 is a cross section of the feed tube showing the spring fingers which center the rivet mandrel; and

FIG. 7 shows some of the details of the mounting of the nosepiece sections and the cap which pivots them.

In this invention, two separate operations follow one another in close sequence. First, the rivet is set or pulled. Second, a fresh blind rivet is supplied to the nosepiece of the gun, ready to be set or pulled when desired.

Referring to FIG. 1, there is shown an air operated rivet-setting tool or gun 10 which includes means for automatically supplying a fresh blind rivet immediately after the previous

rivet has been set or pulled. The gun 10 includes a body 11 which carries a trigger 12 which, when depressed, allows air to enter the body 11 from air supply line 13 to power the various actions of the tool. Most immediately, air under pressure operates a main cylinder positioned at the rear of the gun within the body 11 which functions to pull the clevis 14 to the rear of the gun. This pulling motion is transmitted to collet housing 15 by means of draw bars 16 which are slotted as shown at 17 for a purpose to be described.

At the forward end of collet housing 15 are pulling jaws 18 which are shown in FIG. 1 positioned about the mandrel of a blind rivet which is shown mounted at the forward end of the nosepiece 19 constituted by nosepiece sections (described hereinafter) with the flange of the rivet bearing against the nosepiece. As is well known, when the jaws 18 are pulled rearwardly, the rivet mandrel is pulled to the rear while the rivet flange is held by the nosepiece so that the rivet is set. The rivet mandrel breaks away from the ferrule and, in this invention, is ejected to the rear of the gun.

Accordingly, and with a previously supplied rivet in the jaws 18, and with the rivet ready to be set in the nosepiece 19, the collet housing 15, on being pulled rearwardly by the action of the main cylinder, will pull the rivet mandrel, setting the rivet in the work and breaking off the mandrel which is gripped in the jaws 18 of the collet.

When the main cylinder completes its pulling stroke, a finger is moved to cock a valve which ultimately actuates air cylinder 21 which is positioned at one side of the main cylinder as shown in FIG. 4. At about this same time, a signal is transmitted to a feed hopper and a rivet is blown by air from the feed hopper into a feeding position in tube 22 (see FIG. 3) ready for the operation of the feed mechanism.

The manner in which signals are generated to initiate the rivet feeding operation which includes the operation of air cylinder 21 and the transfer of a rivet from a feed hopper containing the same into a feeding position at the forward end of tube 22 is not a prime feature of this invention. Indeed, the gun 10 may carry manually operable buttons at any convenient location which can be depressed by the operator in order to actuate the air cylinder 21 and then to transfer another rivet from a hopper or other supply to the forward end of tube 22. It is preferred, however, to adapt the structure used to the specific type of rivet pulling gun which is selected and to make the operation more automatic.

A simple actuating device for the rivet feeding operation would be a small microswitch mounted on the release side of the trigger 12. When the operator desires to pull a rivet, he depresses the trigger 12 whereupon a power stroke is executed and the rivet is pulled. The operator would then release the trigger to close the microswitch and thereby power the cylinder 21 to operate rod 27 to cause a fresh rivet stored in tube 22 to be shifted over to the collet 15 which then carries this rivet through the open nosepiece sections 35.

As the rod 27 completes its forward stroke thrusting the fresh rivet through the nosepiece sections 35, it contacts another microswitch which actuates a blower to deliver another rivet, the rivet passing through the feed tube 22 to a forward position where it is caught to be shifted over to the collet 15 on a subsequent operation of the gun. Similarly, the microswitch which actuates the blower can be engaged by any movement near the end of the rivet insertion stroke.

To summarize operation, when trigger 12 is depressed a first rivet is pulled. When the rivet pulling operation is completed, the trigger 12 is released to contact a first microswitch actuating air cylinder 21. Air cylinder 21 moves rod 27 which causes a second rivet to be shifted from the forward end of tube 22 into the path of the collet 15 which receives the second rivet and carries it into position to be pulled in a subsequent operation. Near the end of its forward stroke, rod 27 contacts a second microswitch which causes a third rivet to be blown through tube 22 to the position previously occupied by the second rivet.

To prevent any problem, a safety switch is provided to sense the presence of a rivet in the forward end of feed tube 22. When a rivet is present, the safety switch prevents the blower from operating to deliver another rivet.

If desired, one can pull the trigger 12 and hold the trigger in its depressed position. This will cause the rivet in the nosepiece to be pulled, but no further rivet will be supplied while the trigger is held depressed. This enables one to perform servicing operations, e.g., to clear the gun of rivets, to clean the gun, or to remove a jammed rivet mandrel.

When the piston in the main cylinder is forced back to its starting point (there is an internal spring in the main cylinder the action of which is helped by spring 23 shown in FIG. 4) the jaws 18 return to their forwardmost position where they release the spent mandrel. As best seen in FIG. 4 and since the system is maintained under vacuum (via a hose connected to tube 24 which connects to the collet housing 15 through sliding telescoped tubes 25 and 26) the spent mandrel, as soon as it is released, is sucked through the collet housing and then through the telescoped tubes 25 and 26 and the tube 24 which extends through the center of the main cylinder 20. From here, the spent mandrel is conveyed by the vacuum to a waste collection bottle in advance of the suction pump which supplies the vacuum.

As the collet housing 15 reaches its forward most position and the jaws 18 have released the spent mandrel, the cocked air valve is actuated operating air cylinder 21, and piston rod 27 is drawn into the cylinder (moved rearwardly).

The air cylinder 21 performs two functions. First, the collet housing 15 is moved rearwardly, sliding in the slots 17 of draw bars 16. Second, a sleeve 28 surrounds the main barrel 29 of the gun. This sleeve 28 is formed with a cam opening 30. A roller 31 carried by collet housing 15 extends through a straight slot 32 in the barrel 29 and through the cam opening 30 in sleeve 28. Thus, when cylinder 21 moves piston rod 27, to move the collet housing, roller 31 (which is held in a straight line by slot 32) bears against the cam opening 30 to rotate sleeve 28.

Two swivel lever connections 44 are made to the cam sleeve 28 and these connections 44 support two levers 33 which are connected to two feed levers 34. The levers 34 pivot on bearings 45 carried by barrel 29. As cam sleeve 28 is rotated, the feed levers 34 move from a position in tube 22 shown in FIG. 2 (where they have picked up a blind rivet R delivered by air from a feed hopper through feed tube 22) to a central position in line with the nosepiece orifice and the axis of the jaws 18. As the feed levers 34 pivot, they swing through the sleeve 28 and the barrel 29, cut outs being provided in both the sleeve and the barrel so that the feed levers 34 and the rivet carried thereby can move through.

After rod 27 has been retracted within cylinder 21, the action of the cylinder is reversed projecting the rod 27 and forcing the collet housing 15 forwardly so that the jaws thereof advance toward the now centrally positioned rivet which is still supported by the feed levers 34. Thus, as the jaws 18 are moved forwardly, the mandrel of the rivet is forced into the jaws. As should now be evident, the cam opening 30 is shaped so that on contact with the forwardly moving roller 31, the sleeve 28 will remain stationary for a period and then counter-rotate to force the feed levers 34 to release the rivet mandrel and return to their original position within the tube 22, ready to receive the next rivet which is blown in.

It will be observed that, unlike a conventional unitary nosepiece of a conventional rivet setting tool, the nosepiece used in this invention is split longitudinally into two sections with each section being mounted for pivotal movement and configured to permit the flange of the rivet to be passed through the nosepiece sections when these sections are appropriately pivoted. After the rivet flange has been pushed beyond the forward end of the nosepiece sections (jaws 18 holding the rivet mandrel intermediate its length for this purpose) the nosepiece sections pivot inwardly to close behind the rivet flange reconstituting the assembled nosepiece behind the same.

More particularly, the nosedpiece sections are identified at 35, each section 35 pivoting at 36. When the sections 35 are pivoted to the closed position shown in FIG. 1, they define between them an assembled nosedpiece 19 which includes an axial mandrel-receiving orifice 37. Each nosedpiece section 35 is formed with interlocking serrated teeth 49 on their inner mating faces to rigidify the composite nosedpiece 19 when the rivet is pulled.

The nosedpiece sections 35 are pivoted by the turning of a coarse threaded cap 38 which rotates in one direction to open the sections 35 when finger 39 carried by sleeve 28 engages detent 40 to rotate cap 38 in a threading direction. This occurs at the end of the collet retraction stroke when the sleeve 28 is completing its rotation in a first direction.

On the return stroke, after the gripped rivet has been thrust through the pivoted nosedpiece sections 35, the sleeve 28 will be completing its counter-rotation, where the finger 39 can engage a second detent 41 to rotate cap 38 in an unthreading direction. As will be apparent from FIG. 1, as the cap 38 moves back and forth, it grasps flange 42 on the nosedpiece sections 35 to cause these sections to pivot. The inner rear of each section 35 is formed with an enlarged bore portion 43 to facilitate passage of the rivet flange through the pivoted sections.

When jaws 18 reach their forwardmost position at the end of the rivet-feeding stroke, they engage the rear of the assembled nosedpiece (see ledge 55) forcing the jaws to open slightly and thereby release the rivet mandrel. The vacuum in the system discussed hereinbefore pulls the rivet rearwardly to seat the flange of the rivet on the front end of the nosedpiece as shown in FIG. 1, ready to be pulled or set.

Referring more particularly to the manner in which fresh rivet R is handled, the rivet is shown in FIGS. 4 and 5 after it has been blown in through the tube 22 from a hopper, now shown.

Referring more particularly to FIG. 5, which shows the rivet handling structure of FIG. 4 in greater detail and on an enlarged scale, there is shown structure to increase the accuracy with which the blown rivet R is stopped and positioned. This increases the certainty that the supplied rivet will be properly picked up by the claws 47 of the rivet transfer mechanism.

As can be seen in FIG. 2, the flange of the blown rivet R engages a leaf spring 46, the position of which is shown in dotted lines in FIG. 5. Thus, as the rivet R completes its traverse through tube 22, the flange part of the rivet engages the spring 46 to hold the blind rivet lightly against the far side of the tube 22, the opposite side of the tube being cut away as shown in FIG. 4 to permit the rivet to be carried laterally out of the tube 22. This spring 46 thus acts as a retainer to hold the rivet as it is grasped by the claws 47, the spring 46 being made out of thin spring steel fastened to the outside of the feed tube 22 as pictured in FIG. 2. FIG. 2 also shows the forward end of the spring 46 extending into the tube 22 (through an appropriate slit in the tube) so as to be in position to engage the rivet flange.

The moving rivet R is stopped by the stop 48 which is desirably backed up by a block 50 which helps to absorb the shock of impact. The block 50 is backed up by a spring 51.

It is also desirable to slow the speed of the blown rivet R and to hold the free end of the rivet mandrel as the claws 47 move against the rivet R to engage the same for subsequent shifting movement into line with the advancing collet 15. A structure for accomplishing this is shown in FIGS. 5 and 6 which show centering fingers 52 made of thin spring steel. The free ends 53 of the fingers 52 are formed to the shape of shallow V's pictured in FIG. 6 and the trailing ends of the fingers 52 are secured to the walls of the tube 22 as shown at 54.

As the rivet passes spring fingers 52, the flange of the rivet spreads the fingers apart, slowing the speed of the rivet. After the rivet flange passes, the free ends 53 of the spring fingers 52 come together to form a guide to hold and center the rivet mandrel. The rivet is thus held by the leaf spring 46 and the spring fingers 52 so as to be grasped by the claws 47. It will be appreciated that the use of spring fingers 52 makes the posi-

tioning of the rivet more accurate than is possible when the spring 46 is used alone.

It will also be seen that for the rivet to be engaged by the spring claws 47 (carried at the forward ends of levers 34), it is necessary for the feed levers 34 and the claws 47 to be retracted beyond the path of the incoming rivet in the feed tube. After the incoming rivet is moved or blown into receiving position in the feed tube 22 (where it is held by stationary spring 46 and the spring fingers 52) only then will the feed mechanism become operative to swing the feed levers 34 to carry the spring claws 47 in an arc which picks up the rivet from its receiving position and forces it past the retaining spring 46 and out from between the spring fingers 52 to swing the rivet into line with the collet jaws 18.

When collet housing 15 moves forwardly (which eases the compressive force on the jaws 18) the jaws 18 engage the rivet mandrel, but the rivet cannot move forward because the rivet flange cannot move past the forwardmost claw 47 because this claw includes the previously noted stop 48 (see FIGS. 4 and 5). After the free end of the mandrel is firmly anchored in the jaws 18, the feed levers 34 are moved rapidly away so that the rivet can be carried forward with its flange spaced ahead of the jaws 18.

FIG. 5 also includes details of the collet 15 showing the manner in which the jaws 18 are held to engage the rivet mandrel, while releasing the rivet mandrel when the jaws 18 encounter an abutment such as the rear of the nosedpiece sections 35 (note particularly the ledge 55 shown in FIG. 1 and in greater detail in FIG. 7). The collet structure is conventional and will not be described in detail.

Lastly, FIG. 7 presents in greater detail the manner in which the nosedpiece section 35 is pivotally mounted at the forward end of the main barrel 29 and it also shows the details of constructions of the cap 38 and its mounting at the forward end of the sleeve 28.

The invention is defined in the claims which follow.

I claim:

1. Apparatus for setting blind rivets comprising, a nosedpiece divided longitudinally into sections defining a mandrel-receiving orifice, means to separate said sections to permit the ferule and flange of a blind rivet to be pushed through the space between said sections from the rear of said nosedpiece, and means to move said sections together behind the flange of said rivet to reconstitute said nosedpiece, means including jaws movable toward and away from said nosedpiece along the axis of said orifice to grasp the mandrel of said rivet for setting said rivet, and means to supply a fresh rivet with its mandrel pointing to the rear to said jaws when said jaws are moved toward said nosedpiece, so that the rivet will be pushed through the space between said nosedpiece sections by said jaws.

2. Apparatus as recited in claim 1 in which said fresh rivet is supplied to said jaws by means to feed said fresh rivet from the side to a position between the retracted jaws and said nosedpiece so that the rivet mandrel is inserted in said jaws as said jaws are moved toward said nosedpiece.

3. Apparatus as recited in claim 2 in which said means to feed said rivet from the side is withdrawn from the path of said jaws after said jaws engage said mandrel, but before said jaws reach said nosedpiece.

4. Apparatus as recited in claim 1 in which said jaws are formed to release said mandrel when said jaws engage the rear of the nosedpiece, and vacuum means are provided for sucking the rivet mandrel rearwardly through said jaws.

5. Apparatus as recited in claim 4 in which a main cylinder is provided for reciprocating said jaws to set said rivet and an auxiliary cylinder is provided for reciprocating said jaws after said rivet has been set and released so that a fresh rivet can be supplied when said jaws are retracted by said auxiliary cylinder.

6. Apparatus as recited in claim 5 in which said main cylinder is connected to said jaws by means of slotted bars and said auxiliary cylinder moves said jaws in the slots of said bars.

7. Apparatus as recited in claim 4 in which telescoped tubes communicate with said jaws to carry the vacuum thereto regardless of the reciprocation of said jaws.

8. Apparatus as recited in claim 1 in which said nosepiece sections are each pivotally mounted and the inner rear portion of said sections are bored so that, when said sections are pivoted to separate the same, the flange of said rivet can be pushed through the space between said sections.

9. Apparatus as recited in claim 8 in which said nosepiece sections are formed with an outwardly extending flange which is engaged by a cap at the forward end of the apparatus, said cap being movable forward and back to act on said flange and pivot said sections.

10. Apparatus as recited in claim 9 in which said cap is threaded on said apparatus and is formed with spaced detents which can be engaged to rotate said cap on way or another to move said cap forward and back.

11. Apparatus as recited in claim 5 in which said auxiliary cylinder reciprocates an element with said jaws, said element bearing against a cam slot in a sleeve surrounding said jaws, whereby said sleeve is rotated in time relation to the reciprocation of said auxiliary cylinder, and the rotation of said sleeve is employed to supply said fresh rivet and to pivot said nosepiece.

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