United States Patent [19]

Briles

[11] **3,908,257**

[45] **Sept. 30, 1975**

[54] **GO, NO-GO RIVET GUN**

[76] Inventor: **Franklin S. Briles**, 3600 Catamaran, Corona Del Mar, Calif. 92625

[22] Filed: **Aug. 14, 1974**

[21] Appl. No.: **497,309**

[52] **U.S. Cl.** **29/243.54**; 29/509; 72/19; 72/391; 173/2; 173/133; 227/8

[51] **Int. Cl.**[2] **B23P 11/00**

[58] **Field of Search** 72/19, 391; 227/8; 173/2, 173/133; 29/243, 54, 509

[56] **References Cited**

UNITED STATES PATENTS

657,449	9/1900	Prange	29/243.54
1,014,639	1/1912	Calwell	173/2
3,088,440	5/1963	Wilmer	173/2 X
3,253,440	5/1966	Baker	72/19
3,348,571	10/1967	Henning	227/8
3,559,449	2/1971	Steinmetz	227/8 X
3,581,373	6/1971	Murdoch et al.	29/243.54
3,747,194	7/1973	Christensen	29/243.54

Primary Examiner—Charlie T. Moon
Attorney, Agent, or Firm—William W. Haefliger

[57] **ABSTRACT**

A gun for upsetting the shank terminal of a metallic rivet projecting from work comprises:

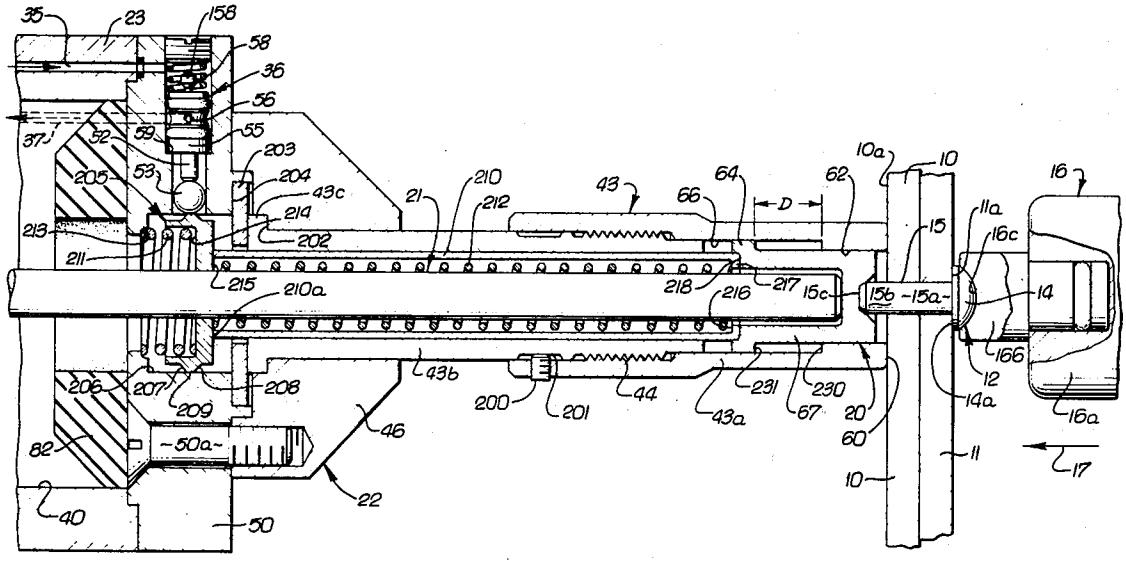
a. a forwardly extending tubular barrel,

b. a plunger tube driven forwardly within the barrel for transmitting upsetting force,

c. an anvil carried by and movable axially relative to the barrel between the plunger and rivet terminal to receive said upsetting force and to deliver same to the rivet terminal,

d. and means responsive to displacement of the anvil relative to the barrel as the barrel is advanced toward the work with the anvil in engagement with the rivet terminal for enabling said forward driving of the plunger when the anvil is within a predetermined axial range of positions relative to the barrel, and for disabling said forward driving of the plunger when the anvil is outside said range of positions.

12 Claims, 10 Drawing Figures



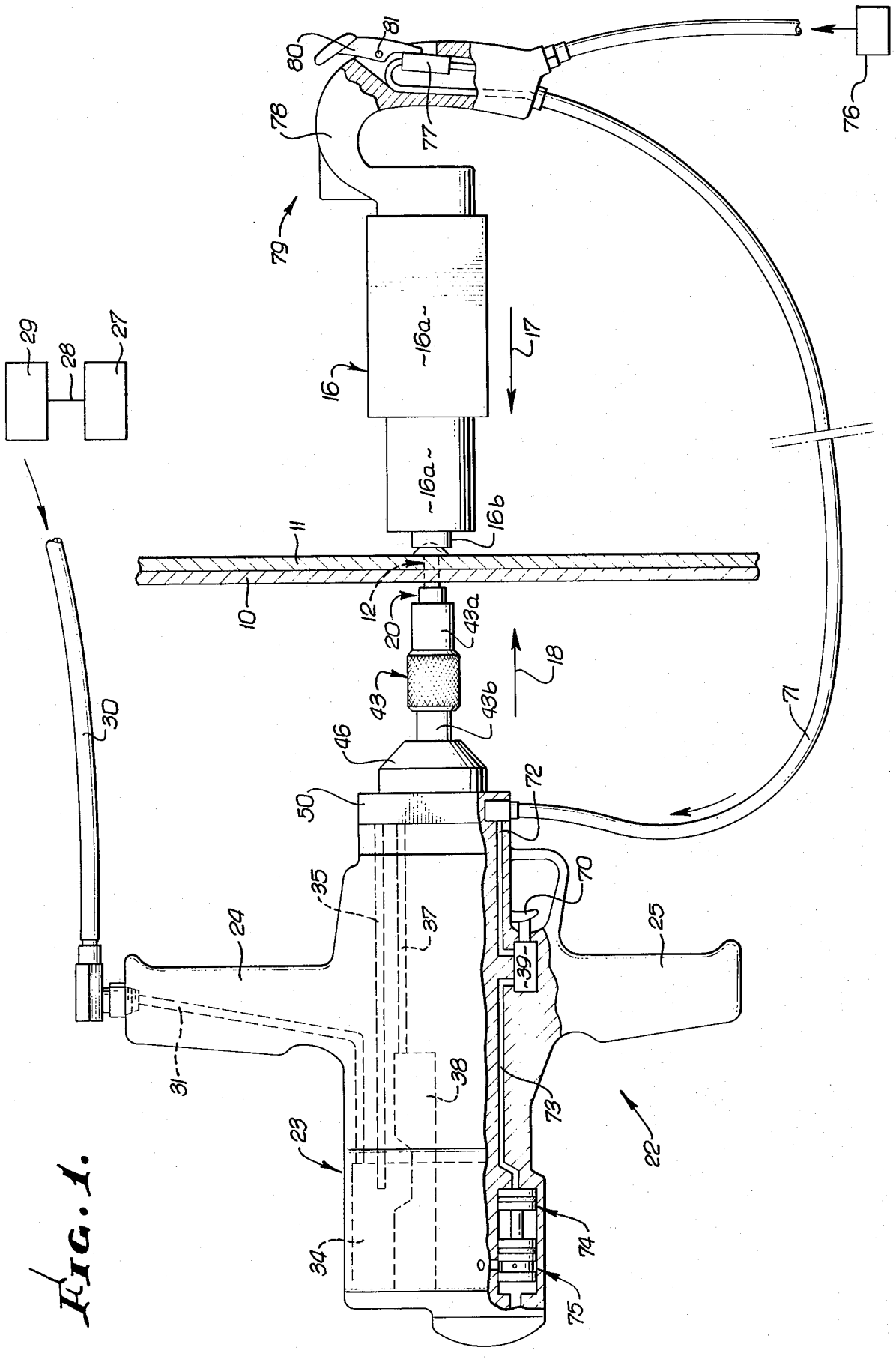

80
81
78
77
76
79
16a
17
16
29
28
27
16a
16b
11
10
12
20
43a
18
43
43b
46
72
50
71
30
35
70
24
37
25
39
31
38
73
23
22
34
74
75

FIG. 1.

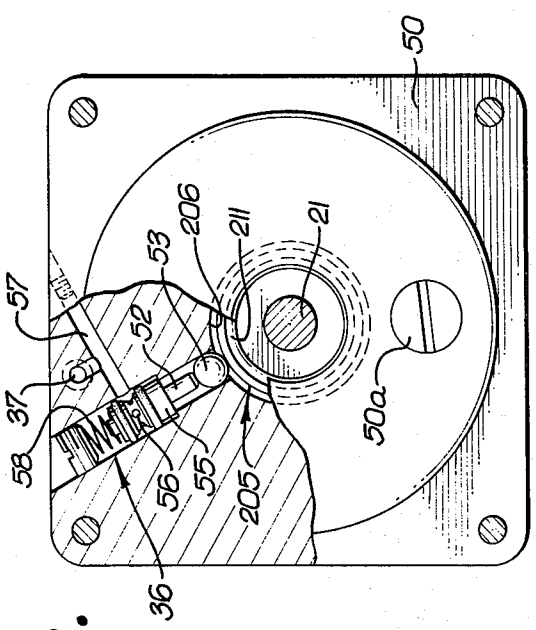

50
57
53
206
211
21
52
37
58
56
55
205
36
50a

FIG. 3.

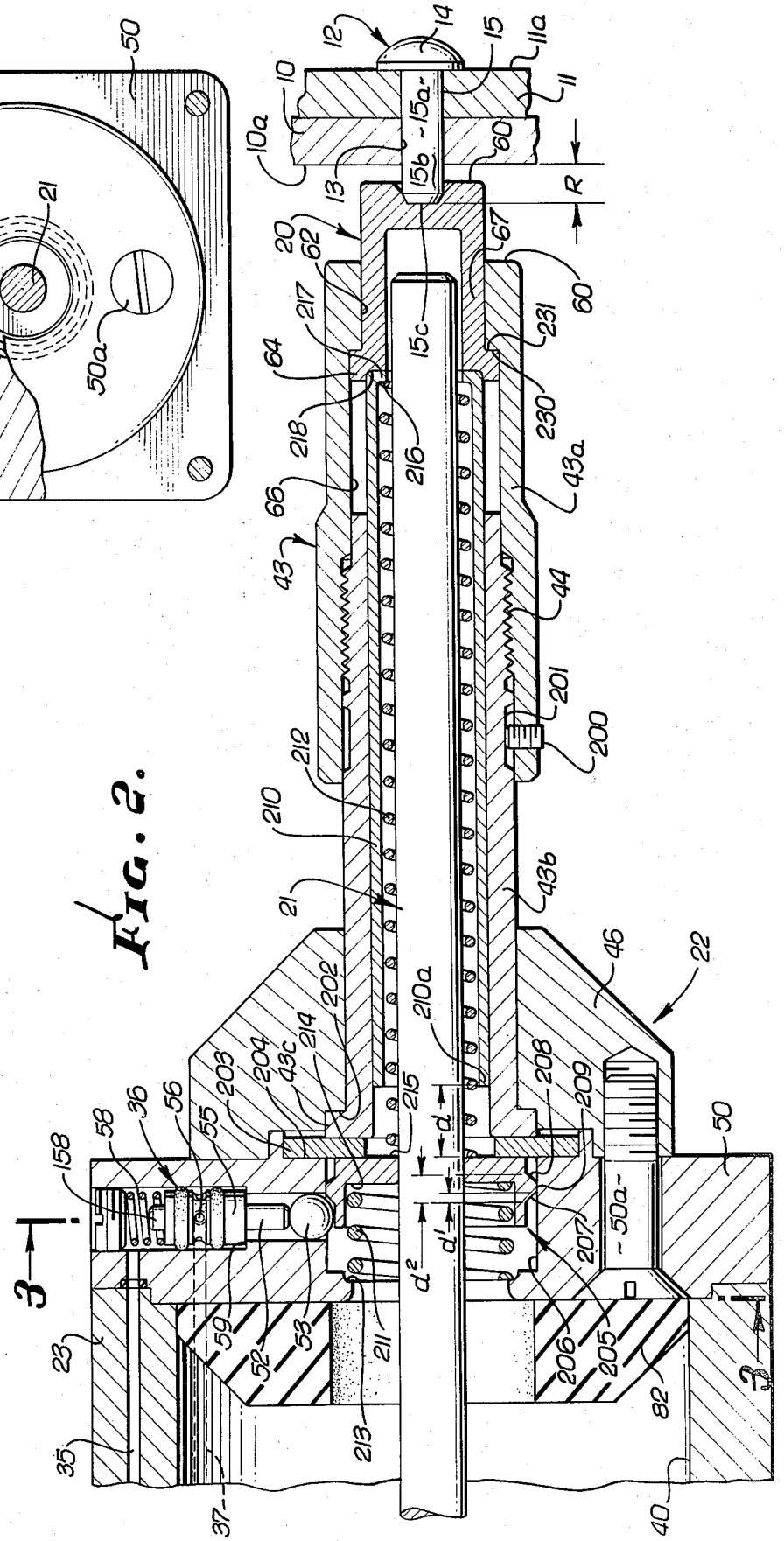

12
14
15
11a
10
11
10a
15a
15b
13
60
R
20
62
67
217
64
15c
231
218
216
230
66
43a
43
44
201
200
212
210
21
436
46
22
202
210a
214
204
43c
203
215
208
209
50
56
55
36
58
158
d
d'
d²
50a
207
59
52
53
211
206
205
213
82
23
35
37
40
3
3

FIG. 2.

FIG. 5.

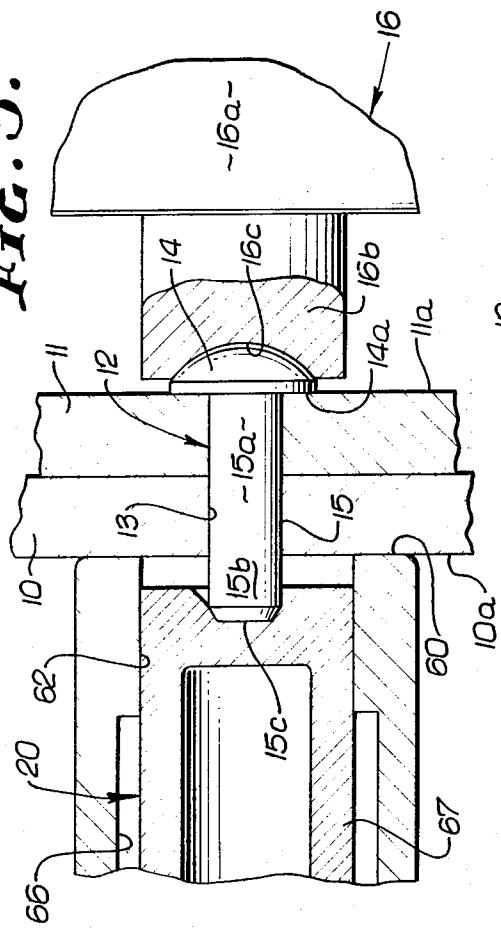
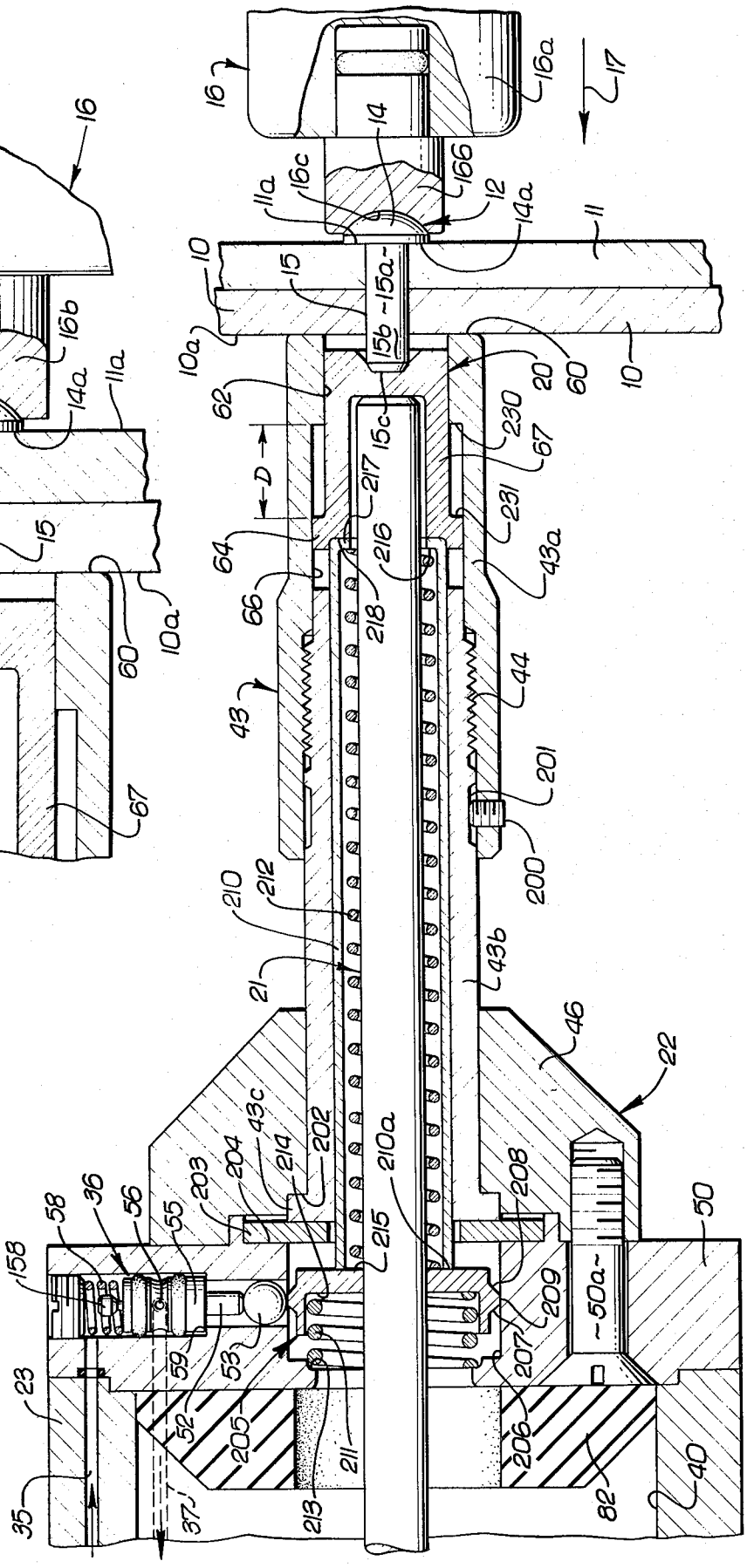

16
16a
14
16c
16b
14a
11a
11
12
15a
13
15
10
15b
10a
60
62
15c
20
66
67

FIG. 4.


16
16a
17
14
166
16c
11a
12
14a
11
10
15
15a
15b
10a
20
60
62
230
67
15c
217
231
D
64
216
43a
66
218
44
43
201
200
212
210
21
43b
46
22
43c
202
214
204
203
210a
208
50
36
56
58
55
158
215
209
50a
53
59
207
52
205
206
23
211
82
40
35
37
213

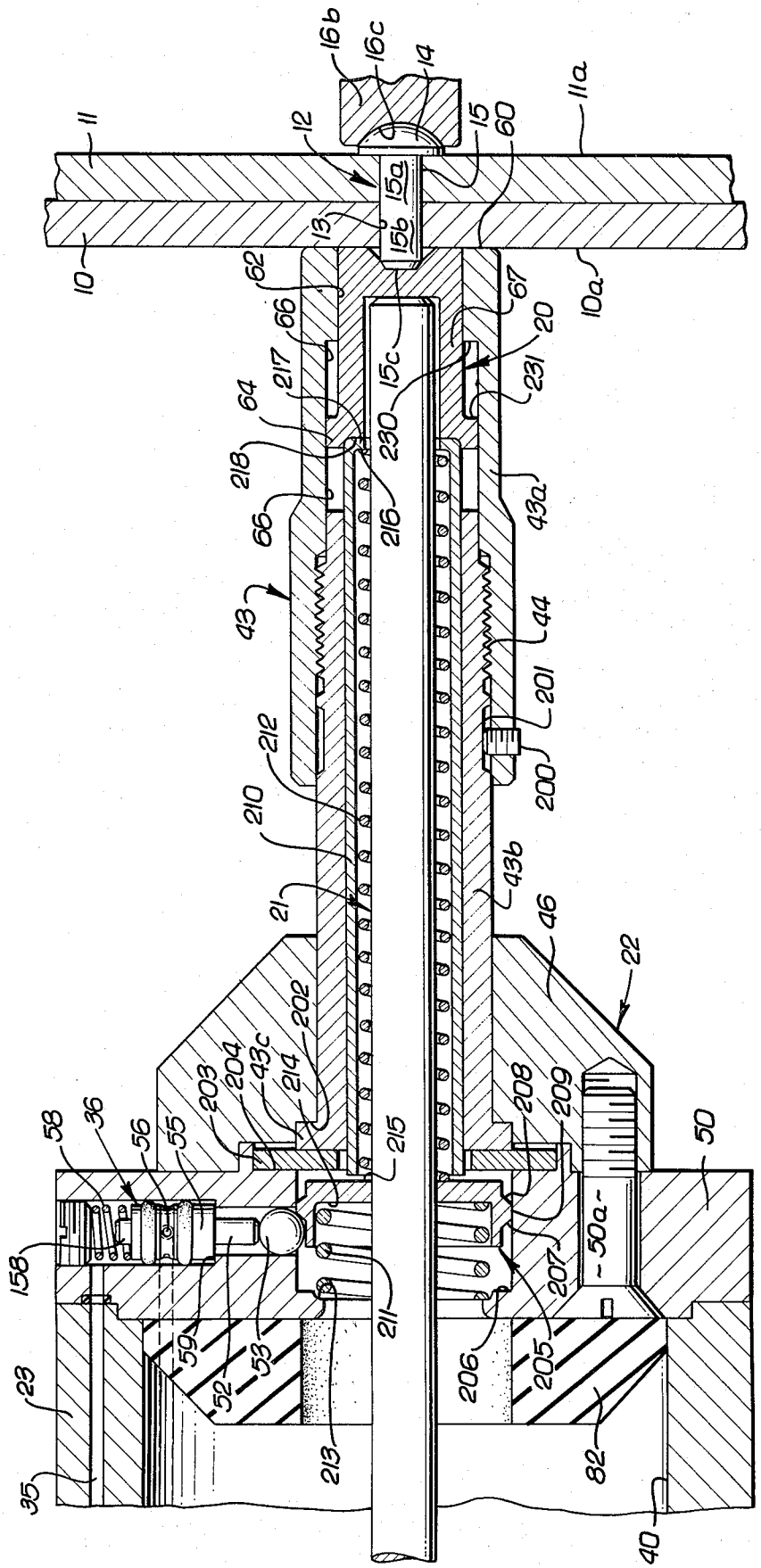

16b
16c
14
11a
11
12
15
60
15a
15b
13
10
62
67
10a
66
20
15c
231
217
64
230
218
216
43a
66
43
44
201
212
200
210
436
21
46
22
202
204
43c
214
203
208
209
50
58
36
56
55
215
50a
158
207
211
206
205
59
53
52
23
213
82
35
40

FIG. 6.

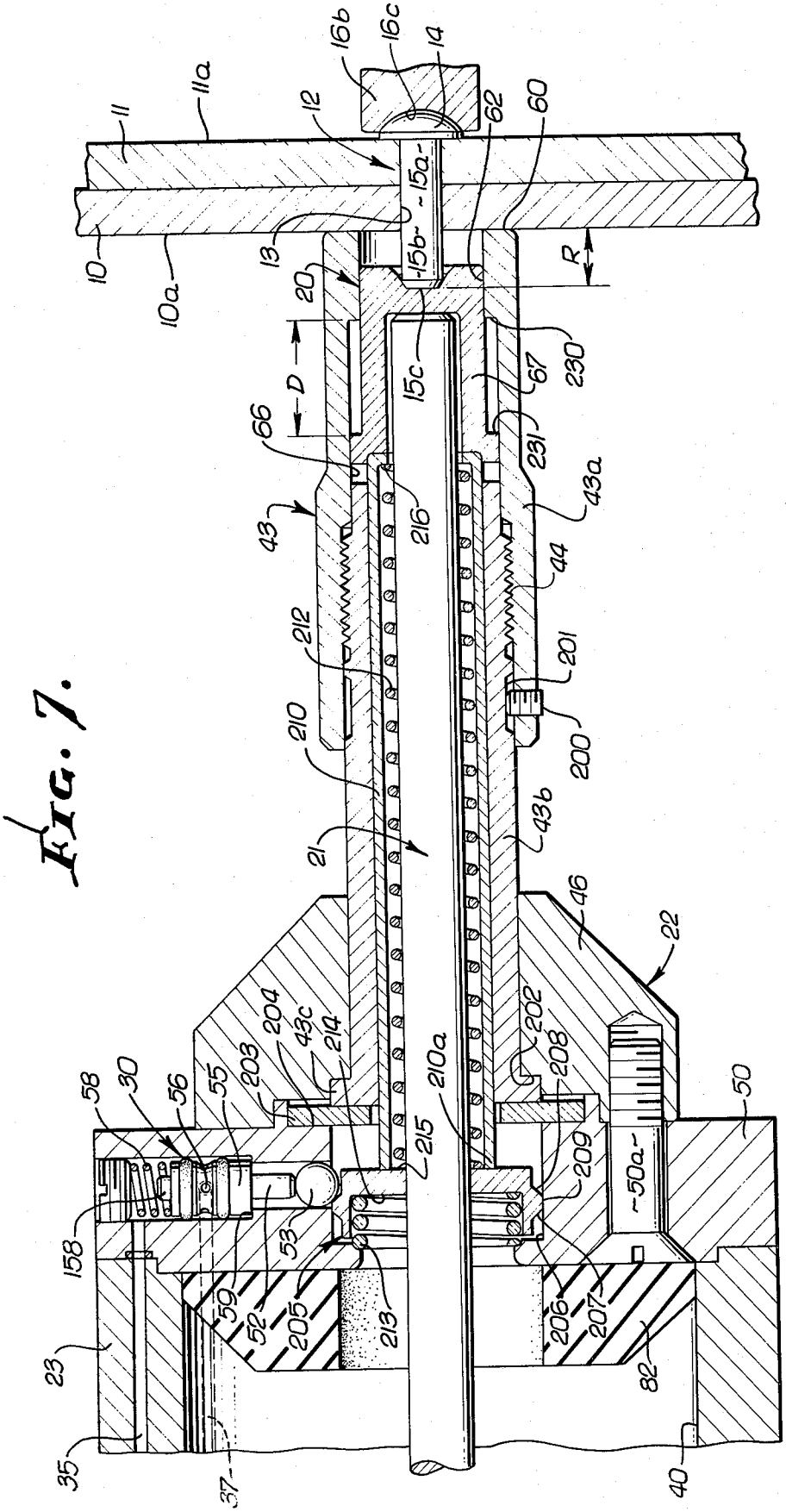

16b
16c
14
11
11a
12
62
60
15a
15b
13
10
10a
20
R
D
66
15c
67
230
231
43a
43
216
44
212
201
210
200
21
43b
46
22
204
43c
214
202
208
210a
58
30
56
55
203
215
209
50a
50
158
53
59
52
205
213
206
207
82
23
35
37
40

FIG. 7.

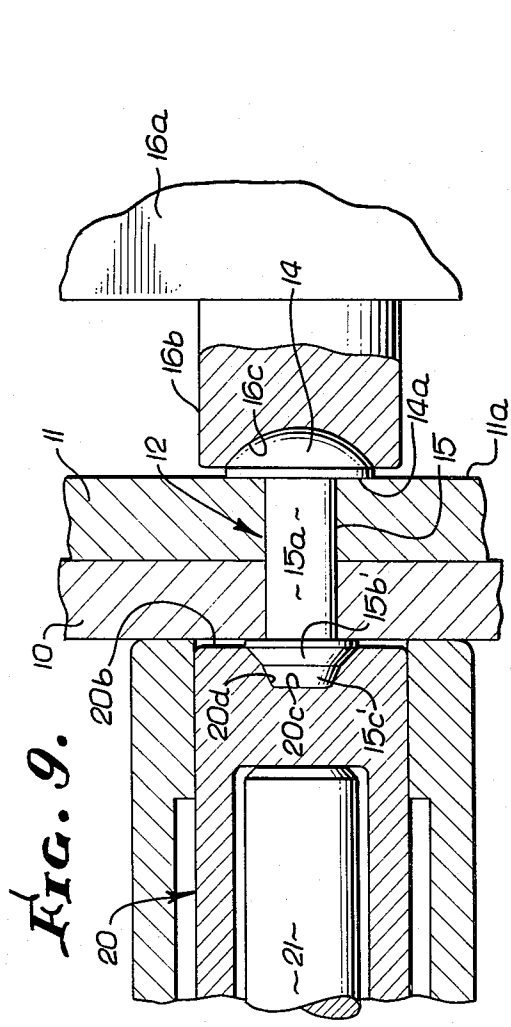

16a
16b
16c
14
14a
11
12
15
11a
15a
15b'
10
20b
20d
20c
15c'
20
21

FIG. 9.

17
11a
12
14a
14
15
11a
11
10
15a
13
10a
19
15b'
60
67
62
20a
231
230
64
20
15c'
43a
218
217
216
18
43
44
212
201
200
210
21
436
46
22
202
43c
204
214
203
55
56
36
58
208
209
215
50
50a
207
205
158
59
52
53
21a
206
23
35
41
82
37
42
40

FIG. 8.

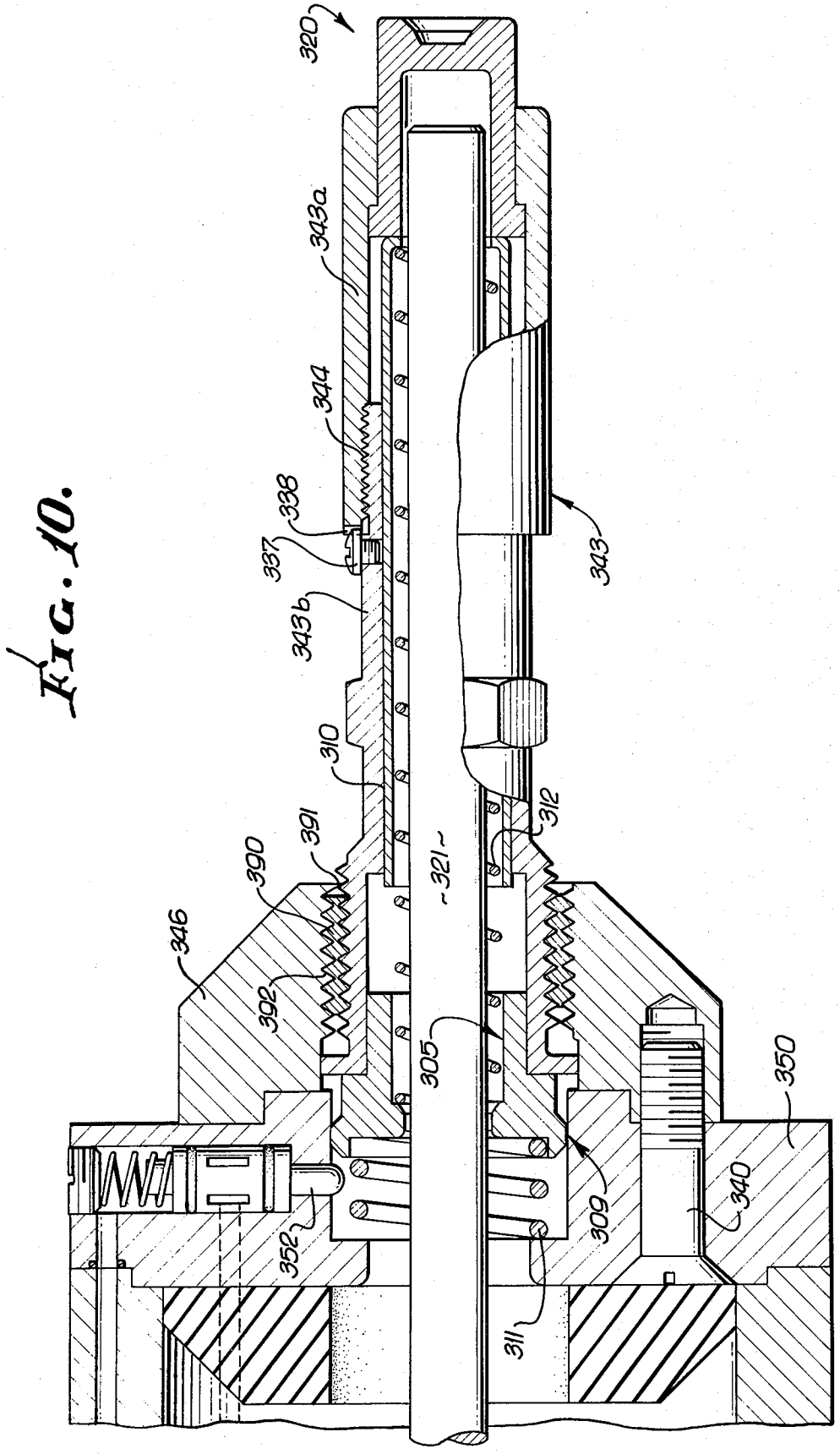

320
343a
344
338
337
343b
343
310
312
391
390
321
346
392
305
350
309
340
352
311

FIG. 10.

GO, NO-GO RIVET GUN

BACKGROUND OF THE INVENTION

This invention relates generally to riveting apparatus and systems, and more particularly concerns riveting equipment facilitating more rapid and efficient riveting with associated substantial reduction in noise levels.

At the present time there are many problems involved in the riveting of panels, as for example in aircraft fabrication. Among these are the requirements for selection and use of rivets of desired length; removal from the work of upset rivets which are too long or too short, which substantially slows down productivity; and the delivery by a rivet gun of a large number of blows or impacts to the rivet head, in order to gradually upset the rivet shank terminal, a so-called heavy mass or "bucking bar" being held against that terminal to form the upset. Not only is this latter procedure extremely noisy, but it also produces rapid oscillation of the rivet back and forth in the panel bore during the riveting process, which tends to gall the bore and remove anodizing on the rivet shank due to back and forth frictional contact of the shank with the bore. Further, the impact shock loading or hammering is repeatedly delivered via the rivet head to the work panels, tending to separate them slightly at their interface, and resulting in an undesirably loose riveted connection and/or buckling of one or both panels, in many instances. Additional problems include unwanted flattening and cracking of rivet heads, marring of the panels, so-called clinching of the upset and tipping or cutting of the driven head.

SUMMARY OF THE INVENTION

It is a major object of the invention to provide solutions to the above problems, through method and apparatus to be described.

Basically, the method of riveting contemplated by the invention concerns operating a rivet gun to discriminate between rivets which are of acceptable length or lengths, and rivets which are not of acceptable length, the steps of the method including:

a. applying a rivet to a work piece so that one end portion of the rivet protrudes from the work piece,

b. applying a rivet gun to said end portion of the rivet, and advancing the gun toward the work, and

c. operating the gun to impact the rivet only if the protruding end portion of the rivet is of acceptable length as determined by the extent of said advancement of the gun toward the work relative to the rivet end portion.

Accordingly, rivets which are of unacceptable length, and as determined by the gun, can therefore be quickly removed from the work to facilitate replacement by rivets of acceptable lengths. This eliminates the problem of removing unacceptable rivets from the work after deformation, as when an inspector might discern that a rivet upset is too large or too small. Further, the method contemplates adjustment of the gun to adjust the acceptable length range of the rivets to be "length gauged" by the gun, prior to the riveting operation.

The apparatus contemplated by the invention includes a gun for upsetting a rivet shank terminal, and comprises:

a. a forwardly extending tubular barrel,

b. a plunger to be driven forwardly within the barrel for transmitting upsetting force,

c. an anvil carried by and movable axially relative to the barrel between the plunger and rivet terminal to receive said upsetting force and to deliver same to the rivet terminal,

d. and means responsive to displacement of the anvil relative to the barrel as the barrel is advanced toward the work with the anvil in engagement with the rivet terminal for enabling said forward driving of the plunger when the anvil is within a predetermined axial range of positions relative to the barrel, and for disabling said forward driving of the plunger when the anvil is outside said range of positions.

As will be seen, the means for disabling the forward driving of the plunger may include a safety valve openable to pass fluid pressure when the anvil is within the predetermined range of positions, and a cam member movable to operate the safety valve in response to axial movement of the anvil relative to the barrel as the barrel is advanced toward (and preferably engages) the work, with anvil in engagement with the rivet terminal. A sleeve typically couples movement of the anvil to the cam member, with lost motion coupling so as to displace the cam member only after predetermined axial "rivet length gauging" movement of the anvil rearwardly relative to the barrel; further, the cam member has first and second risers spaced so as to determine the acceptable length range of the rivets to be upset, as will be seen. In addition, the barrel length is adjustable so as to adjust said acceptable length range.

These and other objects and advantages of the invention, as well as the details of an illustrative embodiment, will be more fully understood from the following description and drawings, in which:

DRAWING DESCRIPTION

FIG. **1** is a side elevation showing a riveting system incorporating the invention;

FIG. **2** is an enlarged fragmentary elevation, taken in section of the forward portion of the riveting gun shown in FIG. **1**, and prior to deformation of a fastener inserted into a work bore;

FIG. **3** is a section taken on lines **3**—**3** of FIG. **2**, and partially broken away to show interior details;

FIG. **4** is an enlarged vertical section showing application of the FIG. **1** system components to a rivet inserted into a work bore;

FIG. **5** is an enlarged elevation like that of FIG. **2**, showing the gun components during force application to the rivet;

FIG. **6** is an enlarged fragmentary elevation showing system components in relation to a rivet which is too short, prior to riveting;

FIG. **7** is a view like FIG. **6** showing system components in relation to a rivet which is too long, and prior to riveting;

FIG. **8** is a view like FIG. **4** showing system components applied to an acceptable rivet, and after upset formation,

FIG. **9** is an enlarged section showing upset formation, as in FIG. **8**, and

FIG. **10** is a view like FIG. **2** showing another form of the invention.

DETAILED DESCRIPTION

In FIGS. **1 4, 5** and **8** of the drawings, the work is shown in the form of two panels or skins **10** and **11** to be interconnected as by a rivet or rivets **12**; however,

the work may take other forms. The rivet is shown as inserted into a bore **13** that extends through both panels, with the rivet head **14** at one side of the work. The shank **15** includes a portion **15***a* within the bore, a terminal portion **15***b* protruding from the bore at the opposite side of the work, and a tip at **15***c*. The rivet may have loose fit, push fit or other fit in the bore as desired.

In this environment, a system for securing the rivet to the work includes first means at one (right) side of the work applying back-up force to the rivet head tending to urge the head toward the work. Such first means may for example include a so called bucking bar **16,** having heavy metallic mass or body portions **16***a* and a terminal **16***b* that may be concavely recessed at **16***c* to fit the domed curvature of the rivet head. Force exerted via the bucking bar, as indicated by arrow **17,** is transmitted to the head **14,** and then to the work panel **11** tending to keep the inner face **14***a* of the head engaged with side **11***a* of that panel. Such steady force may, for example, be less than 50 pounds.

The system also includes second means at the opposite (left) side of the work for delivering an impact to the rivet shank terminal **15***b* in a longitudinal axial direction (indicated by arrow **18**) tending to urge that terminal toward bore **13,** and with sufficient impact velocity as to radially expand and axially shorten the bulk of the terminal, thereby to form an upset (as at **15***b*′ in FIG. **8**) engaging the opposite side of the work (as at **19** in FIG. **8**) while the head **14** extends or remains closely adjacent the one side of the work, as at surface **11***a*. The upset is preferably formed in response primarily to only a single impact, as described, so that the rivet does not oscillate in bore **13,** and the time required to form the upset is minimized. Also, impact force is utilized to form the upset rather than being substantially dissipated by transmission via the rivet head to the work, as in the past. Note that the head surface **14***a* remains engaged against the work surface **11***a* during completion of upset formation, whereby a tight rivet connection to the work is always assured. These conditions may be met when the velocity of impact exceeds about 800 to 1,000 feet per second. Merely as illustrative, the materials of the rivet and panels may be selected from the group consisting of aluminum, aluminum alloys, titanium and titanium alloys, and other ferrous and non-ferrous metals and alloys.

The referenced second means may, with unusual advantage, include a gun **22** having structure such as anvil **20** for engaging the tip **15***c* of the rivet shank terminal and a plunger **21** to deliver the high velocity impact to the anvil at inner surface **20***a* thereof for impact transfer to the rivet head. The illustrated gun **22** also includes a body **23** and a pair of handles **24** and **25** enabling it to be held by a worker, using both hands. Pneumatic means including a piston is provided to drive the plunger or striker forwardly, such means including for example a compressed air source **27** seen in FIG. **1** as supplying air via line **28,** air pressure regulator, cleaner and lubricator **29,** and line **30** to the gun **22** via handle **24.** Within the latter, air flows via duct **31** to air reservoir **34.** From that reservoir, air passes via duct **35** to a poppet type safety valve generally indicated at **36,** in FIG. **2,** and which, when opened, passes air pressure to a trapped air chamber **38** via duct **37.** A trigger controlled valve, indicated at **39** in FIG. **1,** controls sudden release of pressurized air from chamber **38** to the main cylinder or bore **40** to drive piston **41** therein forwardly. The elongated striker or plunger **21** has an enlarged section **21***a* connected via screw **42** to the center of the piston as seen in FIG. **8.**

The gun also includes an outer barrel **43** carried by nose section **46** of the body **23.** Section **46** may be connected to body **23** via adapter block **50,** as shown, a fastener **50***a* retaining the nose section to the block. The barrel may advantageously include sections **43***a* and **43***b* which have axially threaded interconnection at **44.** Relative axial adjustment of the barrel length is achieved by rotating section **43***a* relative to section **43***b*, followed by tightening of set screw **200** (carried by section **43***a*) against a cylindrical shoulder or land **201** on section **43***b*. This operation adjusts the range of acceptable rivet lengths, as will be seen. Note that section **43***b* has fixed position relative to body **23** and nose section **46,** as facilitated by retention of a flange **43***c* on section **43***b* between shoulder **202** and washer **203.** The latter is retained by shoulder **204** on block **50.**

In accordance with an important aspect of the invention, means is provided to be responsive to displacement of the anvil relative to the barrel as the barrel is advanced toward the work, with the anvil in engagement with the rivet terminal, for enabling forward driving of the plunger **21** when the anvil is within a predetermined axial range of positions relative to the barrel, and for disabling such forward driving of the plunger when the anvil is outside said range of positions. Such means may typically include a cam member movable in the body (for example in block **50**) to effect operation of the safety valve in response to axial movement of the anvil **20** relative to the barrel **43** as the barrel is advanced toward the work with the anvil in engagement with the rivet terminal.

More specifically, the cam member may comprise an annulus **205** received about the plunger **21** and movable axially within a bore **206** in block **50.** Member **205** has axially spaced cam risers, the first **207** of which is frusto-conical and angled forwardly and radially outwardly to transmit opening movement to the safety valve in response to first predetermined rearward movement of the cam member relative to the barrel. The second riser **208** is also frusto-conical and angled rearwardly and radially outwardly to transmit closing movement to the safety valve in response to second predetermined rearward movement of the cam member relative to the barrel. The cam member also has a plateau **209** located to maintain the safety valve open when the cam member is within the predetermined axial range of positions, i.e., between the positions seen in FIGS. **2** and **7,** with the plateau **209** urging the safety valve ball **53** upwardly as seen in FIG. **4.** In this regard, ball **53** couples between plunger **52** and the plateau **209.** The poppet valve plunger **52** (downwardly pressure urged) works within a cylinder **55** to open and close communication between ducts **35** and **37,** as via a side duct **56** in valve cylinder **55,** and auxiliary duct **57** in block **50,** as seen in FIG. **3.** Cylinder **55** is resiliently urged at **58** against stop **59,** and air pressure exerted on the poppet head **158** normally urges the plunger **52** against ball **53.** When the forward end **60** of barrel section **43***a* is urged against the work surface **10***a*, and the anvil **20** has been sufficiently displaced rearwardly relative to the barrel, cam member **205** displaces ball **53** radially outwardly to also move plunger **52** outwardly, opening the safety valve by unseating the poppet head **158.** Accordingly, working air pressure

cam flow to chamber **38** only after the gun has been applied to the work, and cam member **205** has been sufficiently rearwardly displaced by the anvil **20.**

Coupling between anvil **20** and cam member **205** is provided by a sleeve **210** axially movable within the barrel. The sleeve typically and advantageously has lost motion coupling with the cam member so that the latter will only be displaced relatively rearwardly after predetermined axial movement of the anvil rearwardly relative to the barrel. Further, yieldable means is provided to urge the sleeve, anvil and cam member axially forwardly relative to the barrel, such yieldable means for example including a first coil spring **211** at the rearward side of the cam member urging the latter forwardly, and a second coil spring **212** at the forward side of the cam member and urging the sleeve and anvil relatively forwardly. Note the confinement of spring **211** between block shoulder **213** and inwardly recessed shoulder **214** in the cam member, and the confinement of spring **212** between right face **215** of the cam member and the sleeve internal shoulder **216.** The latter is provided on a flange **217** which seats against recessed shoulder **218** on the anvil. Sleeve **210** slides within barrel bore **219,** and spring **212** is received lengthwise within the sleeve, providing a very compact and unusually efficient assembly. Barrel shoulder **230** limits spring urged rightward travel of anvil shoulder **231.**

A typical lost-motion coupling between the sleeve and cam member is provided by operative engagement of the left end **210***a* of the sleeve with the cam member surface **215** only after predetermined leftward displacement of the sleeve by the anvil through a distanst *d*. Further, the anvil, sleeve and cam member must then be displaced leftwardly by the additional distance d_1 corresponding to the axial length of the cam riser **207,** in order to open the safety valve. Accordingly, the protruding length R of the rivet must be sufficient (i.e., the rivet must be of sufficient length) that anvil **20** is displaced a distance D to the left of at least about $d + d_1$, before the barrel tip **60** engages the work, to enable forward driving of the plunger **21,** as in response to opening of the safety valve and trigger released pressure application against the main piston. Note the axial distance d_2, equal to the axial distance from near the bottom of riser **207** to near the bottom of riser **208.**

If the protruding length R of the rivet (as in FIG. 7) is such that *D* is greater than about $d + d_2$, then the gun will be disabled, whereby the protruding length R of the rivet, for the gun design shown, must be such that *D* lies approximately between two limits, identified as follows, for the gun to be operable:

$$d + d_2 \geq D \geq d + d_1$$

The acceptable length R of the rivet is controlled by adjusting the barrel length, as for example rotating barrel section **43***a* forward or barckward on section **43***b*. Note in FIG. **8** that anvil **20,** sleeve **21** and cam member **205** move slightly to the right upon formation of upset **15***b'*.

In operation, the riveting method is carried out so as to discriminate between rivets which are of acceptable length and rivets which are not of acceptable length, and involves the steps:

a. applying a rivet to a work piece so that one end portion of the rivet protrudes from the work piece,

b. applying a rivet gun to said end portion of the rivet, and advancing the gun toward the work, and

c. operating the gun to impact the rivet only if the protruding end portion of the rivet is of acceptable length as determined by the extent of said advancement of the gun toward the work relative to the rivet end portion.

Further, the gun is operated only if the protruding end portion of the rivet falls within a predetermined length range; and the gun is disabled if the protruding end portion falls outside that range. Also, the barrel length is adjusted to control the rivet acceptable length, as previously stated.

The barrel **43** may be considered as an element of tubular means carried by the body to project forwardly, such tubular means also including the anvil **20** for receiving the plunger or **21** striker. The anvil has slidable reception within the bore **62** of the barrel forward section **43***a*. Means is also provided to confine the tip **15***c* of the rivet terminal against radial expansion while the bulk of the terminal **15***b* undergoes such expansion to form the upset, thereby to form a centering indicator at the tip of the rivet. See in this regard the example of such an indicator in **15***c'* in FIG. **8.** An inspector can very quickly ascertain, by viewing such an indicator **15***c'*, whether it is concentric as related to the expanded upset **15***b'*. If the latter is concentric, the upset is correctly formed, whereas if it is not concentric, (as for example oval shaped) the existence of an out-of-round condition of the upset and its azimuthal bulge direction, are immediately evident, in relation to the location of the indicator **15***c'* which always remains centered.

For the above purpose, the anvil end wall **20***b* typically forms a centered recess **20***c* shaped to receive and confine the rivet tip **15***c* during the impact delivery, via that tip, to the rivet terminal portion **15***b* subjected to radial expansion and axial compression. Annular tapered wall **20***d* of the recess blocks radial expansion of the tip during the formation of the upset.

Maintenance of the recess **20***c* in centered and centering engagement with the tip **15***c* may be achieved, in unusually advantageous and simple manner as described below. Firstly, preliminary interfitting of the anvil and rivet shank tip, as described, as aided by compression spring **212,** urges the anvil toward the rivet. Note that the anvil flange **64** is guided by a counterbore wall **66** in tubular part of barrel **43***a* for axial movement; also, the anvil skirt **67** may have axial guided engagement with bore wall **62** in the part **43***a* for centering purposes. Initially, therefore, the anvil recess **20***c* receives the rivet tip **15***c* and the barrel **43** is thereby centered in relation to the rivet as the barrel terminal **60** is pushed into forcible engagement with the work surface **10***a*. Such engagement is thereafter forcibly maintained during formation of the upset **15***b'* and the force transmitted between barrel terminal **60** and wall **10***a* develops frictional force resisting lateral displacement of the barrel, anvil and rivet terminal during upset formation, further facilitating the maintenance of the centered conditions as described. Accordingly, problems of malformation of the upset are eliminated or minimized.

Control means is provided to effect application against the piston **41** of fluid pressure sufficient to drive the plunger **21** forwardly in one stroke to substantially fully upset the rivet shank terminal. Such control means includes a trigger **70** operable to open valve **39** to pass control air pressure from line **71** and duct **72** in

body **23** to duct **73** in that body. Such pressure shifts spool valve elements **74** and **75** to the left, thereby unblocking the passage of pneumatic pressure from chamber **38** to the main cylinder or bore **40** for driving the piston **41** forwardly. Pressure delivery to line **71**, as from source **76**, may be valve controlled at **77** at the side of the work panels opposite the gun **22** and plunger **21**, so that the worker who applies the bucking bar **16** can control application of impact force to the rivet, preventing inadvertent impact delivery to the rivet prior to his application of the bar **16** to the rivet head; otherwise, such impact delivery could "shoot" the rivet from the work and possibly injure personnel. Valve **77** may be carried in the handle **78** of a bucking tool **79**, and to which the bar **66** is attached, as shown. A thumb trigger **80** pivotally attached to the handle **78** at **81**, controls the valve **77**. Cusion **82** arrests the forwardly moving piston **41**.

Typical rivet materials include aluminum, Monel, stainless steel, copper and brass.

In that form of the invention seen in FIG. **10**, the outer barrel **343** is adjustably carried by nose section **346** of the body. Section **346** is connected to body via adapter block **350**, a fastener **340** retaining the nose section to the block. The barrel includes sections **343***a* and **343***b*, which have axially threaded interconnection at **344**. A fastener **337** thread connected to section **343***b* interfits a notch **338** in section **343***a* and blocks relative rotation of the sections. Relative axial adjustment of barrel length, so as to adjust the range of acceptable rivet lengths, is achieved by forcible rotation of the barrel section **343***b* relative to nose section **346**. Note that these two have adjustable interconnection, as provided by the helical metallic insert **390** which interfits both external thread **391** on the barrel and the internal thread **392** on the nose section. The insert allows such rotary axial adjustment of the barrel, and also provides frictional resistance to same, so that the barrel will not inadvertently rotate.

Structural components corresponding to those previously described include anvil **320**, sleeve **310**, cam member **305**, springs **311** and **312**, and plunger **321**. The cam member plateau **309** is directly engageable with the tip of plunger **352** rather than an intermediate ball, as previously described.

I claim:

1. In a gun for upsetting the shank terminal of a metallic rivet projecting from work, the combination comprising

a. a forwardly extending tubular barrel,

b. a plunger tube driven forwardly within the barrel for transmitting upsetting force,

c. an anvil carried by and movable axially relative to the barrel between the plunger and rivet terminal to receive said upsetting force and to deliver same to the rivet terminal,

d. and means responsive to displacement of the anvil relative to the barrel as the barrel is advanced toward the work with the anvil in engagement with the rivet terminal for enabling said forward driving of the plunger when the anvil is within a predetermined axial range of positions relative to the barrel, and for disabling said forward driving of the plunger when the anvil is outside said range of positions.

2. The combination of claim **1** including a body carrying the barrel, and said means includes a safety valve operable to pass plunger operating pneumatic pressure when the anvil is within said range of positions.

3. The combination of claim **1** wherein the barrel includes sections which are axially adjustably interconnected, whereby said range may be adjusted by adjusting the axial interconnection of said sections.

4. The combination of claim **3** including a body carrying one of said sections in fixed position relative to the body, the other of said barrel sections having threaded connection to said one section to provide said axially adjustable interconnection.

5. The combination of claim **2** wherein said means comprises a cam member movable in said body to effect operation of said safety valve in response to axial movement of the anvil relative to the barrel as the barrel is advanced toward the work with the anvil in engagement with the rivet terminal.

6. The combination of claim **5** wherein said means also includes a sleeve axially movable within the barrel to transmit said relative axial movement of the anvil to said cam member.

7. The combination of claim **6** wherein said sleeve has lost motion coupling with the cam member to displace the cam member axially of the barrel only after predetermined axial movement of the anvil rearwardly relative to the barrel.

8. The combination of claim **7** including yieldable means urging the sleeve, anvil and cam member axially forwardly relative to the barrel.

9. The combination of claim **8** wherein said yieldable means includes a first spring at the rearward side of the cam member urging the cam member relatively forwardly, and a second spring at the forward side of the cam member and urging the sleeve and anvil relatively forwardly.

10. The combination of claim **5** wherein the cam member is axially movable in said body and has axially spaced cam risers, the first of which is angled to transmit opening motion to the safety valve in response to first predetermined rearward movement of the cam member relative to the barrel, and the second of which is angled to transmit closing motion to the safety valve in response to second predetermined rearward movement of the cam member relative to the barrel.

11. The combination of claim **10** wherein said cam member also has a plateau located to maintain the safety valve open when the cam member is within said predetermined axial range of positions, said plateau located axially substantially between said risers.

12. The combination of claim **1** wherein the gun includes a body having a nose section, and the barrel has axially adjustable interconnection with said nose section, whereby the said range may be adjusted by adjusting the axial interconnection of the barrel and said nose section.

* * * * *