June 22, 1965 P. ANTHONY 3,190,104

AUTOMATIC PULL GUN

Filed Feb. 8, 1962 3 Sheets-Sheet 1

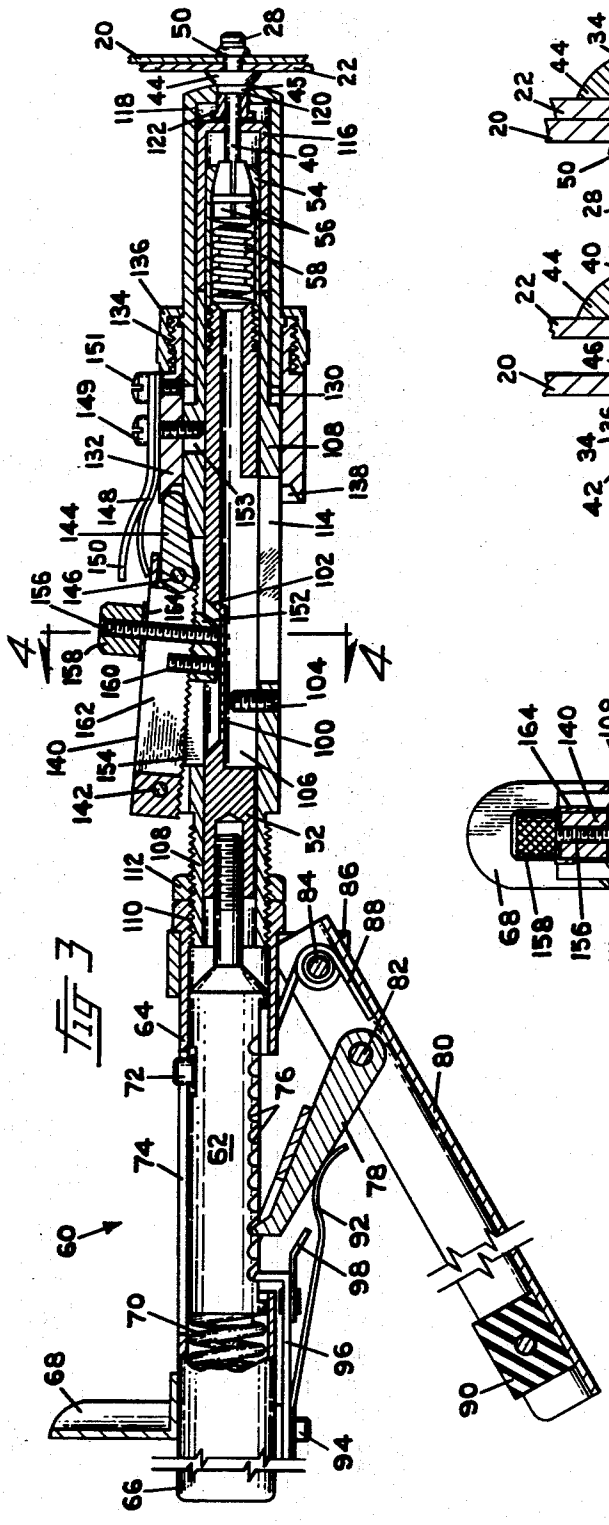


FIG 3

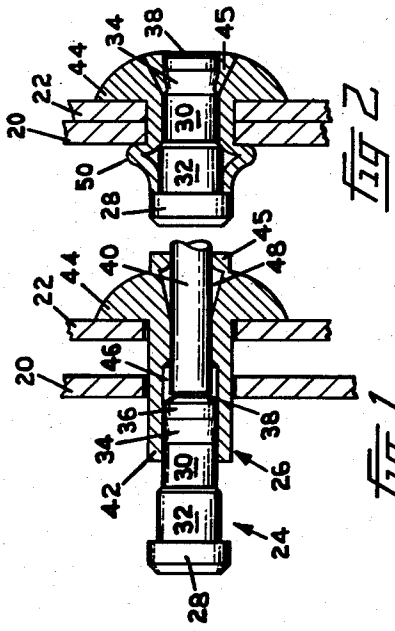


FIG 2

FIG 1

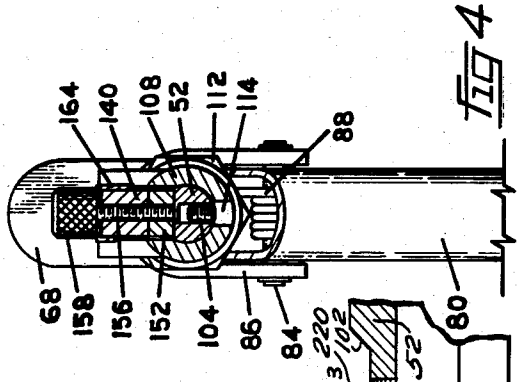


FIG 4

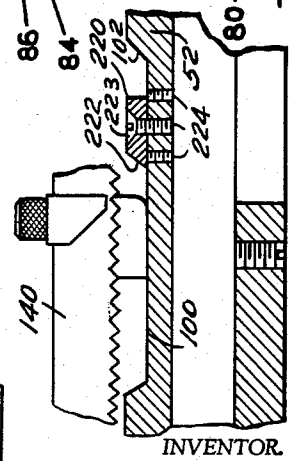


FIG 10

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AUTOMATIC PULL GUN

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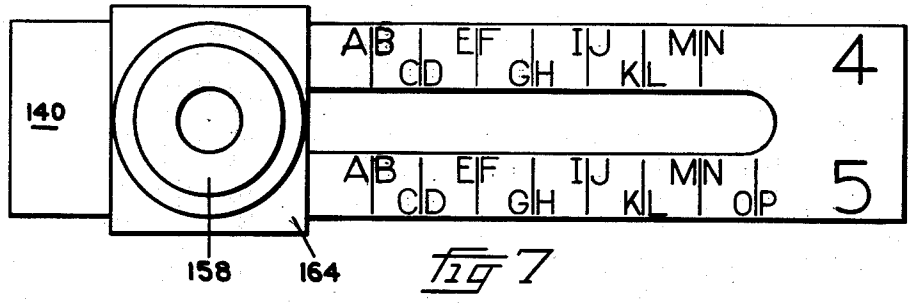


Fig 7

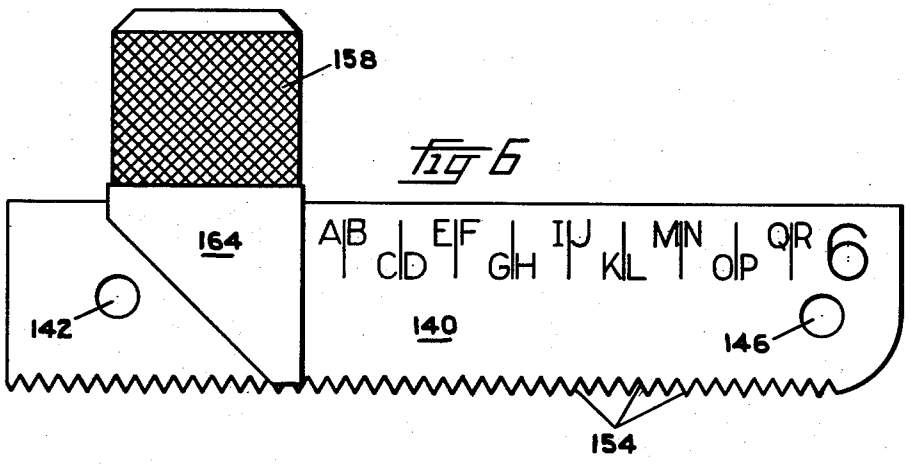


Fig 6

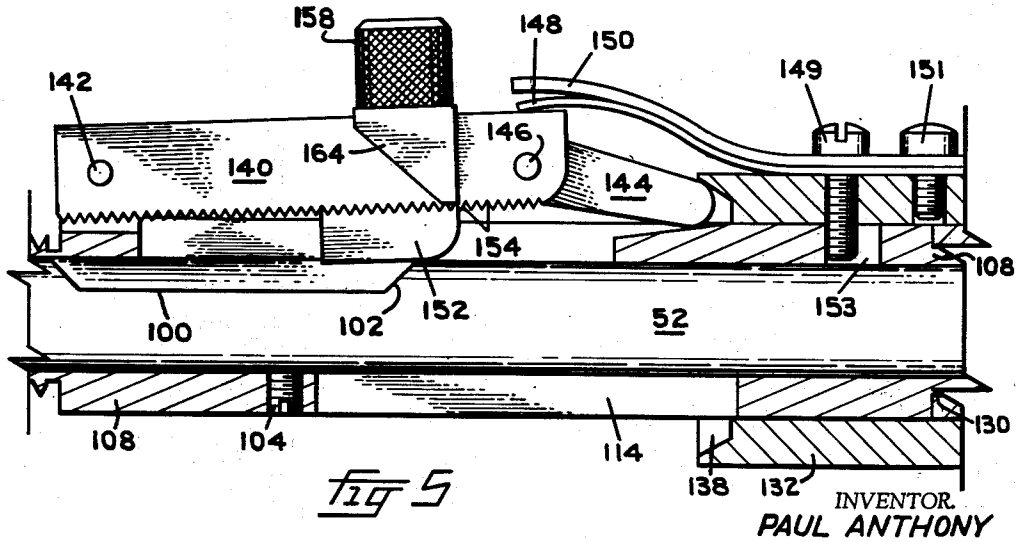


Fig 5

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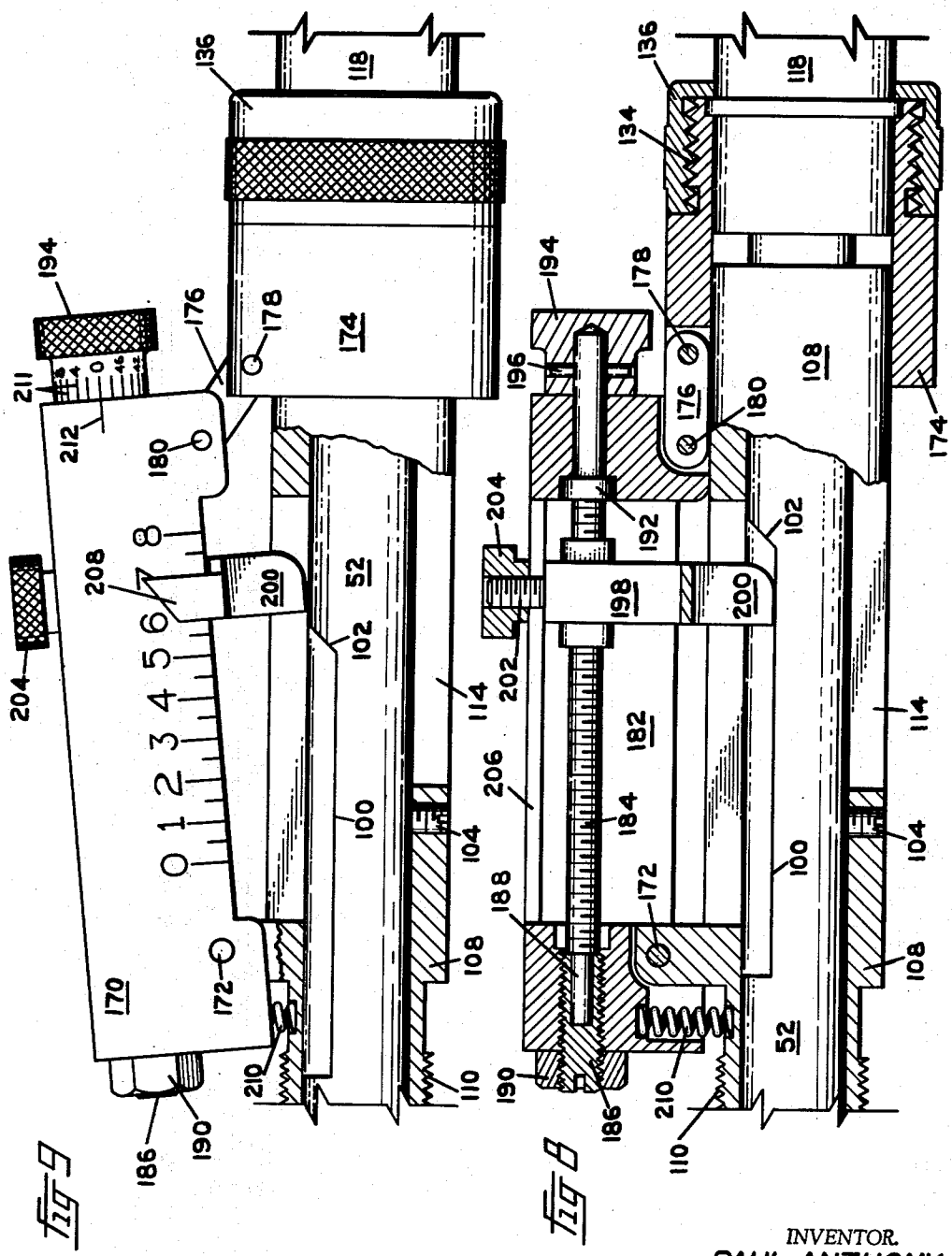
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June 22, 1965 P. ANTHONY 3,190,104

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Filed Feb. 8, 1962 3 Sheets-Sheet 3



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3,190,104

AUTOMATIC PULL GUN

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7 Claims. (Cl. 72—391)

This invention relates to pulling and driving apparatus and, more particularly, to a mechanically actuated tool for first, pulling and folding and second, driving and setting blind rivets and the like.

Of current interest is the use of blind rivets to retain and hold metallic parts together, especially as used in the aircraft fabrication arts. Such rivets are adapted to be applied and set from one side only of the structure being riveted. In use, it appears that there are a multiplicity of various blind rivet sizes and styles, to accommodate various thicknesses of materials to be retained by the rivet plus various strength requirements. Each of these rivets, accordingly, requires various pulling and driving characteristics.

Accordingly, it is a primary object of this invention to provide a pulling and driving tool for blind rivets and the like which overcomes the problems associated in the use of various sizes, types and styles of rivets.

It is another object of this invention to provide an automatic actuated pulling and driving tool for blind rivets and the like which is easily adjustable to accommodate the varying sizes and styles of rivets.

It is another object of this invention to provide a mechanically actuated blind rivet pulling and driving tool which includes visual indicating means for adjustment to the various styles, types and sizes of rivets.

It is another object of this invention to provide an improved pull gun that is economical to manufacture, assemble, and is durable, efficient and reliable in its operation.

These and other objects of this invention will become more apparent upon further reading the specification and claims taken in conjunction with the following illustrations of which:

FIGURES 1 and 2 are partial sectional views of a blind rivet typical of this invention, before and after the pulling and driving operation.

FIGURE 3 is a partial sectional elevational view of an automatic, mechanically actuated pulling and driving tool embodying the present invention, and depicting the first pulling and folding operation.

FIGURE 4 is a sectional view taken along the line 4—4 of FIGURE 3.

FIGURE 5 is an enlarged, partial sectional view of the automatic tripping device embodied within this invention as depicted during the second driving and setting operation.

FIGURE 6 is a side elevational view of typical identification markings for setting the tool to the various sizes and types of blind rivets.

FIGURE 7 is a top elevational view describing additional markings for setting the automatic tripping device with respect to various sizes, types and styles of blind rivet.

FIGURE 8 is a sectional view of an alternate automatic tripping device embodying the principles of this invention and shown in the first operational position.

FIGURE 9 is an enlarged side elevational view of the apparatus of FIGURE 8 in the second operational position.

FIGURE 10 is a sectional view of still another alternate automatic tripping device embodying the principles of this invention and shown in the first operational position.

General operational description

Generally speaking, this invention is concerned with the pulling and driving of blind rivets, the process of which is

generally depicted in FIGURES 1 and 2. As shown therein, work pieces 20 and 22 are to be fastened together by the rivet which includes a pin portion generally indicated by the numeral 24 and a collar portion generally indicated by the numeral 26. The pin 24 includes a head portion 28 and a shank portion 30. Forward and between the shank 30 and the head 28 is an enlarged diameter shoulder portion 32. A forwardly and inwardly shaped groove 34 is immediately behind the shank 30 and terminates with a short cylindrical surface 36. A break-neck 38 extends between the forward portion of the pin and a rearward length of pin 40 which terminates in gripping grooves, not shown. The collar 26 includes a forward sleeve portion 42 and a rearward flange portion 44. The sleeve includes a forward cylindrical recess 46 within which that portion of the rivet, forward of the break-neck 38 is moved. The flange portion of the collar includes a conical recess 48 within which tubular projection 45 is later driven.

In the first operational phase, the rivet assembly is initially inserted into aligned apertures of the work piece 20 and 22 which are to be fastened together. Pin 24 is pulled relative to collar 26 while a forward reaction force is maintained against flange 44. As the shoulder 32 is driven within the recess 46 of sleeve 42, the shank 30 of the rivet pin expands the sleeve portion to fill the apertures in the work pieces 20 and 22 while upsetting or folding the end of the sleeve 42 adjacent head portion 28 to form a blind head 50 of the rivet sleeve.

In the second phase the pin pulling force is substantially increased at this moment such that, by an arrangement of parts, hereinafter described, there is substantially simultaneous or sequential driving or shearing of projection 45 into the space between conical recess 48 and the tapered pin portion 34 forming what is termed a conical keystone lock or set and thereafter shearing of the break-neck portion 38.

Accordingly, in the assembly of the rivet type above described, it can be appreciated that when various thicknesses of work pieces, requiring various types and sizes of blind rivet pins and collars, there must be sequenced coordination of the pulling and driving operations to form a locked assembly such as illustrated in FIGURE 2. A premature shearing of the break-neck or driving of the projection will form an incomplete or unuseable connection.

Specific description

The embodiments of this invention may be more clearly understood by reference to FIGURES 3, 4 and 5. The device includes an interior actuating shaft 52 which extends longitudinally of the device. At the forward end a collet retaining sleeve 54 is threadably attached thereto. Within the sleeve are a multiplicity of collet members 56 whose interior includes griper edges for interlocking engagement with gripper teeth not shown, at the rear end of rivet pin 40. A spring element 58 normally biases the collet members forward into such interlocking engagement, yet will permit the collet members 56 to be forced rearwardly and thereby open to permit insertion of the gripping elements on the next rivet pin 40 and force the remaining pin rearwardly out. The rear most end of longitudinal actuating shaft 52 is attached to a pulling mechanism designated generally by the numeral 60. An actuating piston 62 is threadably attached to the longitudinal shaft 52 and is reciprocably movable within cylindrical housing 64. The housing 64 terminates its rearward end with a handle portion 66 which is that portion beyond stop guide 68. A spring 70 within the housing normally biases the piston member 62, and hence the shaft 52, forward. A guide element 72 maintains the piston 62 in the position shown and is movable within

longitudinal guide slot 74 within the outer cylindrical housing 64. At the lower end of piston 62 are a multiplicity of ratchet teeth 76 within which the pivotal pawl member 78 fits to cause rearward actuation and pulling movement of piston 62, shaft 52 and rivet pin 40. The pawl 78 is pivotal on a handle member 80 about shaft 82. The handle itself is pivotal about shaft 84 which is fixed upon a support member 86 formed as a part of housing 64. Coil spring 88 biases the handle normally outwardly and away from the longitudinal axis of the gun. A resilient shock member 90 is adapted as a part of the handle to engage the body and housing of the gun during operation. Flat spring member 92 is attached to the cylindrical housing 64 by a locking bolt 94. This spring tends to maintain or force the movable pawl into the matching slots 76. A fixed pawl member 96 is spring biased inward to maintain the piston 62 in a given position during that period when the movable pawl is being actuated to another slot 76. A thumb release lever 98 is attached thereto in that instance it is desired to release the piston 62 and permit it to travel forward under the force of spring 70 to the forward most position.

Intermediate the actuator shaft 52 along one side is a recess 100 which terminates its forwardmost end with a tapered shoulder 102. A guide pin 104 is adapted to maintain the shaft in longitudinal alignment upon the movement of guide opening 106 with respect thereto. The guide pin 104 is threaded through a longitudinal thrust housing 108 which is fixed to the cylindrical housing 64 by threaded attachment 110 and lock nut 112. A slot 114 permits sheared rivet pins 40 to be removed from the apparatus as they are pushed rearwardly by insertion of a new pin within the collet members 56. The thrust housing 108 terminates its forwardmost end with an abutting thrust bushing 116.

An outer anvil 118 is coaxially mounted with respect to thrust housing 108 and bushing 116. An inner anvil 122 is movable within the forward axial opening 120 of outer anvil 118 and in the space between thrust bushing 116 and outer anvil 118. The outer anvil 118 is movable with respect to the longitudinal thrust housing 108 along the outer surface 130 and is attached to a cylindrical sleeve 132 which is coaxially about the thrust housing 108. Attachment between the sleeve 132 and outer anvil 118 is made by a threaded connection 134 using a threaded collar 136. The rearward opening of sleeve 132 includes a bevelled recess face 138.

Between the sleeve 132 and the longitudinal thrust housing 108 is thrust actuator 140, the first rearward link of which is pivotal about pin 142 which is attached to the thrust housing 108. The forward portion of the thrust actuator link 140 includes a pivoted link 144 which is adapted to be insertably retained within the bevelled retaining surface 138 of outer sleeve 132 and is forwardly pivotal about shaft 146 attached to the thrust actuator first link 140. Spring retaining elements 148 and 150 are adapted to normally bias and retain the thrust actuator 140 in the position shown in FIGURE 3, which is the first operating position. A follower member 152 is adapted to be interlocked with the transverse grooves 154 formed along the bottom surface of first thrust actuator link 140. The follower 152 is retained within the grooves by a threaded shaft 156 which is locked with respect to the thrust actuator body 140 by lock nut 158. A guide pin 160 is slideable within a longitudinal slot 162 of the thrust actuator. A guide yoke and washer 164 is adapted to provide visual means for setting the follower member 152 according to a coded rivet.

Referring now to FIGURE 5, the thrust actuator is shown in its pivoted position, wherein the effective distance between pivot pin 142 on thrust housing 108, and the bevelled surface 138 of sleeve 132 is effectively shortened permitting relative movement. This occurs when follower member 152 is forced upwardly by the bevelled shoulder 102 as actuating shaft 52 is pulled rearwardly.

Threaded members 149 and 151 act to retain the spring biasing elements 148 and 150 against the thrust actuator link 140 shown. Spring 150 limits the pivotal movement of link 140 whereas spring 148 of lesser spring force merely biases the link downward such that the links will normally tend to return to the first operating position when shaft 52 is returned forward. Bolt 149 is further adapted as a guide member with respect to thrust housing 108 being operative within the recess guide 153.

Referring now to FIGURES 6 and 7, it is to be noted that transverse grooves 154 within which the follower element 152 and its matching groove are retained are of pitch of approximately 1/32 inch. The markings upon the thrust actuator 140, that is numerical scales 4, 5 and 6, are rivet code markings for 1/8 CKL, 5/32 CKL and 3/16 CKL blind rivets respectively. Each letter for each rivet size corresponds with the markings found upon the rivet being used and generally relates to the thickness of the work pieces which are to be fastened. For example, indicia "4—A" corresponds to a 1/8 CKL rivet which is adapted to fasten work pieces of grip range or thickness ranging from .020" to .036". The forward line of indicator 164 is moved, after loosening nut 158 and permitting follower 152 to drop out of engagement with grooves 154, to the corresponding indicia marker on link 140. The nut is tightened to fix the follower to the link.

FIGURES 8 and 9 describe an alternate embodiment of this invention particularly corresponding to the thrust actuating device. Like numerals for like or substantially similar parts heretofore described will be used. In this embodiment a thrust actuator link 170 is pivotally mounted on shaft 172 which is affixed to longitudinal thrust housing 108. The forward portion of the thrust actuator link is pivotally attached to sleeve 174 through a second pivotal link 176 which is pivotally attached at its forward end to the sleeve at shaft 178 and rearwardly to the thrust actuator link 170 at shaft 180. A longitudinal guide slot 182 extends from the forward end to the rearward end of thrust actuator 170. Within this slot is threaded shaft 184 which is rotatingly supported rearwardly within a threadably adjustable bushing 186 which supports the cylindrical bearing surface 188 therein. Set screw 186 is locked by nut 190. The forward end of the threaded shaft 184 is retained against the forward wall of slot 182 by a flange 192. The shaft extends outward of the thrust actuator 170 to which is attached a vernier adjustment knob 194 using interlocking pin 196. Longitudinally movable along the threaded shaft as it is rotated is a follower nut 198 which terminates at its lower end with a follower portion 200. The upper end of the nut includes a threaded guide shaft 202 to which a locking nut 204 is attached. The threaded guide shaft 202 is longitudinally movable, after loosening follower nut 198, within guide slot 206. As shown in FIGURE 9, the follower nut includes an indicator guide 208 movable therewith with respect to the indicia stamped along the outside of thrust actuator link 170 as shown in FIGURE 9. A spring member 210 located at the rearward portion of thrust actuator 170 normally biases the actuator into the position shown in FIGURE 8. Vernier scale markings 211 are impressioned about the periphery of vernier knob 194 for rotation with respect to impressioned marker 212 visibly indicated on the body of the thrust actuator 170 and adjacent the vernier markings.

Operation

As heretofore described, the purpose of the apparatus of this invention is to first pull and fold and second, drive and set blind rivets of the CKL type as heretofore described with reference to FIGURES 1 and 2. In actual operation using a thrust actuating device of FIGURES 3, 4, 5, 6 and 7 the thicknesses of the work pieces 20 and 22 are determined. After determining the manufacturer's recommended size and type of rivet, the nut 158 is loosened, permitting follower 152 to drop out of engage-

ment with the grooves 154 of thrust actuator 140 and hence movement of the indicator, and follower, to the predetermined letter code for the given rivet diameter. The lock nut 158 is then tightened forcing the follower into the matching grooves and hence fixed relationship with respect to the thrust actuator 140. The gripping portion of a rivet of appropriate pin diameter and gripping code letter is inserted through the coaxial opening of the inner anvil 122 of outer anvil 118 and forward thrust bushing 116 into interlocking engagement with the collet members 56. The forward sleeve of the rivet 42 is inserted within the opening of the work pieces. A slight press forward is given to the setting tool by grasping the handle portion 66 such that the thumb is on one side of stop shield 68 and the fingers extending on the other side so as to grasp pivotal handle 80. Upon squeezing the handle towards the cylindrical housing 64 piston 62 is caused to be moved rearwardly against spring 70 and in turn begins the first operational phase of pulling the attached actuating shaft 52. This movement folds sleeve 42 to form the blind upset 50 as heretofore described.

During the first phase pulling movement, follower 152 is retained downwardly within the recess 100 and is retained therein with respect to the movement of the pulling shaft 52 until engagement of shoulder 102 is made with follower 152. This instance of contact is so positioned to be substantially simultaneously with the termination of the first phase pulling operation which forms the blind upset 50. Prior to engagement the position of the thrust actuator as shown in FIGURE 3 prevents any relative movement of sleeve 132, and hence attached outer anvil 118 which is attached thereto by threaded sleeve 136, with respect to thrust housing 108. Engagement of tapered shoulder 102 with follower 152, however, now forces the thrust actuator upwardly. This begins the second operational phase which effectively shortens the heretofore fixed distance between thrust housing 108 with respect to sleeve 132 and hence permits relative movement of the outer anvil 118 with respect to the inner anvil 122 and thrust bushing 116, such that upon further pulling by pivotal movement of handle 80 now substantially simultaneously shears the break-neck 38 and forces thrust bushing 116 to act with respect to the outer anvil 118 and hence force the inner anvil 122 forward shearing the rivet collar or flange portion 45 into the conical recess 48, which in turn fills that space between the conical opening and the tapered recess 34 forming a keystone lock. In that instance the thickness of the work pieces 20 and 22 should change with respect to the next pulling and driving operation, the indicator 164 is thusly changed to the desired code letter, corresponding to the given rivet diameter and the operation is repeated.

The embodiment of FIGURES 8 and 9 operates similarly to the thrust actuating device of FIGURES 3, 4, 5, 6 and 7, except that means are provided for setting the desired follower 200 position with respect to tapered cam surface 102 by the use of a vernier knob 194 having scale markings 211 spaced to correspond to $\frac{1}{1000}$ths of an inch (.001").

For example where it is desired to fasten materials .032" in thickness, it is recommended by the manufacturer that a ⅛" rivet diameter and a type A code letter rivet be used. According to a prepared chart for that type of rivet, .025" is added to the material thickness giving a resultant code number of .057. Nut 204 is loosened and vernier knob 194 turned until marker 208 is aligned along the indicia scale of thrust actuator 170 at a reading 57, corresponding to code number .057. Lock nut 204 is then tightened and the rivet is ready to pull and drive.

Although this invention has been described with reference to preferred and specific embodiments, this is not to be held as limiting. For example, other means of actuating the pull rod 52 may include hydraulic or pneumatic force means. Further, in one embodiment there may be provided means to adjust the shoulder of the actuating shaft with respect to a fixed follower on the thrust actuator according to various rivet sizes. As is shown in the drawing, an adjusting element 220 having a beveled shoulder 222 is longitudinally adjustably attached in the recess 100 in actuator shaft 52 by means of set screw 223. A plurality of longitudinally spaced internally threaded holes 224 are provided in the bottom of recess 100 to receive set screw 123. The spacing of holes 224 is selected such that element 220 can be positioned appropriately to cause actuation of the thrust actuator in setting any sized rivet. Accordingly, it is apparent that other modifications may be made by those skilled in the art without departing from the scope of the appended claims.

What is claimed:

1. Apparatus for operationally first, pulling and folding and second driving and setting blind rivets and the like, the combination comprising,
an axially movable actuating shaft having axial means at a forward end to removably retain said rivet,
a coaxial thrust housing within which said shaft is movable,
manually actuatable means on said housing and engaging said shaft at the rearward end to actuate said shaft,
an outer anvil substantially adjacent said forward end and coaxially movable about said housing,
an inner anvil coaxially positioned and axially movable upon relative movement of said housing and said outer anvil to cause said second operation,
axially aligned openings in said housing, and said outer and inner anvils to permit insertion of said rivet, and retention on said shaft, and
a thrust actuator positioned between said thrust housing and said outer anvil and pivotal form a first operational position maintaining said outer anvil and said thrust housing apart, to a second operational position permitting relative movement between said outer anvil and said thrust housing.

2. Apparatus for operationally first, pulling and folding and second driving and setting blind rivets and the like, the combination comprising,
an axially movable actuating shaft having axial means at a forward end to removably retain said rivet,
a coaxial thrust housing within which said shaft is movable,
manually actuatable means on said housing and engaging said shaft at the rearward end to actuate said shaft,
an outer anvil substantially adjacent said forward end and coaxially movable about said housing,
an inner anvil coaxially positioned and axially movable upon relative movement of said housing and said outer anvil to cause said second operation,
axially aligned openings in said housing, and said outer and inner anvils to permit insertion of said rivet, and retention on said shaft,
a thrust actuator positioned between said thrust housing and said outer anvil and pivotal from a first operational position maintaining said outer anvil and said thrust housing apart, to a second operational position permitting relative movement between said outer anvil and said thrust housing,
a recess and shoulder on said shaft, and
a follower member adjustably fixed to said thrust actuator according to the size of a given rivet,
said follower member contiguous with said recess during said first operational position and engageable with said shoulder to pivot said thrust actuator to said second operational position.

3. Apparatus for operationally first, pulling and folding and second driving and setting blind rivets and the like, the combination comprising,
an axially movable actuating shaft having axial means at a forward end to removably retain said rivet,

a coaxial thrust housing within which said shaft is movable,

manually actuable means on said housing and engaging said shaft at the rearward end to actuate said shaft,

an outer anvil substantially adjacent said forward end and coaxiially movable about said housing,

an inner anvil coaxially positioned and axially movable upon relative movement of said housing and said outer anvil to cause said second operation,

axially aligned openings in said housing, and said outer and inner anvils to permit insertion of said rivet, and retention on said shaft,

a thrust actuator positioned between said thrust housing and said outer anvil and pivotal from a first operational position maintaining said outer anvil and said thrust housing apart, to a second operational position permitting relative movement between said outer anvil and said thrust housing,

a recess and shoulder on said shaft, and

a follower member adjustably fixed to said thrust actuator, indicator means associated with said follower for setting said follower according to the size of a given rivet,

said follower member contiguous with said recess during said first operational position and engageable with said shoulder to pivot said thrust actuator to said second position.

4. Apparatus for operationally first, pulling and folding and second driving and setting blind rivets and the like, the combination comprising,

an axially movable actuating shaft having axial means at a forward end to removably retain said rivet,

a coaxial thrust housing within which said shaft is movable,

manually actuatable means on said housing and engaging said shaft at the rearward end to actuate said shaft,

an outer anvil substantially adjacent said forward end and coaxially movable about said housing,

an inner anvil coaxially positioned and axially moveable upon relative movement of said housing and said outer anvil to cause said second operation;

axially aligned openings in said housing, and said outer and inner anvils to permit insertion of said rivet, and retention on said shaft,

a thrust actuator positioned between said thrust housing and said outer anvil and pivotal from a first operational position maintaining said outer anvil and said thrust housing apart, to a second operational position permitting relative movement between said outer anvil and said thrust housing, and

means to pivot said thrust actuator from said first position to said second position upon actuation of said shaft.

5. Apparatus according to claim **4** wherein said means to pivot is adjustable according to the size of said rivet.

6. Apparatus for operationally first, pulling and folding and second driving and setting blind rivets and the like, the combination comprising,

an axially movable actuating shaft having axial means at a forward end to removably retain said rivet,

a coaxial thrust housing within which said shaft is movable,

manually actuatable means on said housing and engaging said shaft at the rearward end to actuate said shaft,

an outer anvil substantially adjacent said forward end and coaxially movable about said housing,

an inner anvil coaxially positioned and axially movable upon relative movement of said housing and said outer anvil to cause said second operation,

axially aligned openings in said housing and said outer and inner anvils to permit insertion of said rivet, and retention on said shaft,

a thrust actuator positioned between said thrust housing and said outer anvil and pivotal from a first operational position maintaining said outer anvil and said thrust housing apart, to a second operational position permitting relative movement between said outer anvil and said thrust housing said thrust actuator including a first length portion pivotally attached to said thrust housing at one end and to which said follower is adjustably fixed and a second link pivotally attached to the other end of said link, said second link contactable with said outer anvil, and wherein spring means attached to said outer anvil normally biases against said first link into said first operational position,

a recess and shoulder on said shaft, and

a follower member adjustably fixed to said thrust actuator, indicator means associated with said follower for setting said follower according to the size of a given rivet, said follower member contiguous with said recess during said first operational position and engageable with said shoulder to pivot said thrust actuator to said second position.

7. Apparatus according to claim **6** wherein said second link is pivotally attached to said outer anvil.

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GRANVILLE Y. CUSTER, *Primary Examiner.*