This invention relates to devices for setting fasteners and more specifically to a rivet gun device for setting rivets.

An object of this invention is to provide a novel pull type rivet gun device provided with adjustment means to permit pre-setting of the interrelationship of the mandrel gripping collet means and the nose piece whereby the amount of movement of the actuating lever to produce initial gripping of the rivet mandrel during the rivet setting operation may be minimized.

Another object of this invention is to provide a novel and improved pull type rivet gun having a handle and an actuating lever which may have the position of its fulcrum varied to permit adjustment of the length of the lever arm whereby to provide for power strokes during the rivet setting operation.

A more specific object of this invention is to provide for a rivet gun device for use in setting rivets including an elongate actuator member having means for carrying the mandrel gripping collets at the front end thereof, and being arranged and constructed for relative axial movement with respect to the gun body member, and an adjustment member engaging the rear end of the actuating member and being adjustable relative thereto whereby the amount of axial movement required between the actuator and body members during the rivet setting operation may be variously adjusted.

These and other objects and advantages of the invention will more fully appear from the following description made in connection with the accompanying drawings, wherein like character references refer to the same or similar parts throughout the several views, and in which:

FIG. 1 is a side elevational view of one embodiment of my invention;

FIG. 2 is an exploded side elevational view of the embodiment illustrated in FIG. 1;

FIG. 3 is a longitudinal sectional view of the embodiment illustrated in FIG. 1 illustrating the relationship to a fastener to be set;

FIG. 4 is a longitudinal sectional view similar to FIG. 3 in which the setting of the fastener has been partially completed;

FIG. 5 is a side elevational view of a different embodiment;

FIG. 6 is a longitudinal sectional view of the embodiment illustrated in FIG. 5 showing the relationship to a fastener to be set and

FIG. 7 is a sectional view similar to FIG. 6 of the embodiment illustrated in FIG. 5 in which the setting of the fastener has been partially completed.

Referring now to the drawings, and more specifically to FIGS. 1 to 4 it will be seen that one embodiment of the novel rivet gun device, designated generally by the reference number 10, is shown. This rivet gun is of the pull type and is used for expanding rivets of the type illustrated in FIGS. 3 and 4. This gun includes an elongate handle 11 preferably constructed of a suitable rigid metallic material such as steel or the like and having a hand grip cover element 12 covering the lower end portion thereof and formed of a suitable resilient yieldable material such as rubber, plastic or the like for facilitating gripping by a user. A generally rectangular shaped frame or handle block member 13 is integrally formed with the upper end of the handle 11 and is provided with a pair of vertically spaced-apart transversely extending apertures 14 therethrough, the function of which will be more clearly defined hereinafter.

The frame block member 13 has an externally threaded embossed element or nipple 15 integrally formed therewith and projecting forward therefrom. An elongate fore-and-aft bore 16 is formed in the frame block member 13 in the nipple 15, as best seen in FIGS. 3 and 4. It will be noted that the bore 16 is positioned slightly below the lowermost aperture 14 in the frame block member.

The nose assembly of the gun includes an elongate generally tubular body member 17 which is internally threaded at its rear end portion as at 18 for threaded engagement with the nipple 15. The forward end portion of the body member 17 is of frusto-conical configuration, the inner surface of which defines a generally frusto-conical shaped guide surface 19, as best seen in FIGS. 3 and 4. It will be noted that the opening at the forward end of the body member 17 is of reduced size and is internally threaded as at 20 for threaded engagement with the externally threaded portion 22 of the nose piece 21. It will be noted that the nose piece 21 has an axial bore 23 therethrough which is disposed in coaxial relation with respect to the bore 16 of the frame block member 13. It will further be noted that the rear end portion of the nose piece 21 is positioned within the body member 17 and defines a generally rearwardly tapering or conical surface 24, the function of which will be described in detail hereinafter.

An elongate tubular actuating member or sleeve 25 is positioned within the body member 17 and projects rearwardly through the bore 16 in the frame block member and exteriorly thereof. The forward end of the actuating member 25 is enlarged to define a generally hollow tubular cylindrically shaped chamber element 26 the interior of which communicates with and forms a continuation of the bore 27 of the actuating member 25. It will be noted that the forward end portion of the chamber element 26 is externally threaded at 28 for threaded engagement with the internally threaded rear end portion of a collet head element 29.

This collet head member 29 includes a rear cylindrical portion 30 having an external diameter slightly smaller than the internal diameter of the body member 17 for sliding therein. The forward portion of the collet head member 29 is of frusto-conical configuration and defines a generally frusto-conically shaped exterior guide surface 31 for sliding engagement with the guide surface 19 of the body member 17. It will also be noted that the collet head member 29 has an internal generally cylindrically shaped bore 32 wherein which converges forwardly to define a forward internal conical guide surface 33 also clearly illustrated in FIGS. 3 and 4.

The collet head member 29 has a pair of mandrel gripping elements or collets 34 positioned therein each provided with a serrated or toothed inner semi-cylindrical gripping surface 35 which are arranged in mating opposed relationship. The exterior surface of the collets 34 are forwardly tapered as at 36 which engage the inner guide surface 33 of the collet head member 29 so that the collets 34 are retained in predetermined mating relation with respect to each other. The forward end portion of each of the collets is shaped and configured and able to operate with each other to define a conical surface 37 for engagement with the rearwardly convex conical surface 24 of the nose piece 21 when the collets are in a forward position as illustrated in FIG. 3. Thus it will be seen that when the collets 34 are in the forward position as illustrated in FIG. 3, the interrelationship of the collets 34 with respect to the nose piece 23 and the collet head member 29 serve to arrange the collets in predetermined spaced-apart relation with respect to each other. When
in this position, the semi-cylindrical gripping surfaces 35 of the collets define an opening or recess which is disposed in coaxial relation with respect to the bore 23 of the nose piece 21.

Means are also provided for urging the collets forwardly against the conical guide surface 33 of the collet head member 29 for expanding the collets apart. To this end, it will be seen that the rear portion of the collets 34 is shaped and constructed so that each pair of collets defines a concave wedge or tapered chisel-shaped surface or recess 38. A generally cylindrically shaped collet expander element 39 having a convex generally wedge or tapered chisel-shaped forward end portion 40 corresponding therewith to the concave recess of the collets 34 is positioned within the chamber element 26 for axial movement relative thereto. It will be noted that the cylindrical bore 32 of the collet head member 29 is disposed in substantially coaxial relation with respect to the internal diameter of the chamber element 26 whereby the collet expander movement is axially movable in the chamber element 26 and the collet head member 29. The convex forward wedge portion 40 has an axial bore therein communicating with the opening defined by the collets 34 and being disposed in coaxial relation therewith. A relatively light coil spring element 41 has its rearmost end bearing against the rear surface of the chamber element 26 and has its forward end portion extending into the cylindrically shaped collet expander element 39 and normally urging the same into engaging relation with the concave rearwardly facing wedge recess 38 defined by the collets 34. Therefore the cooperative action of the spring element 41 and the collet expander element 39 urge the collets 34 forwardly with respect to the collet head member 29.

Means are also provided for urging the actuator member 25 as well as the collet head member 29 forwardly relative to the body member 17. This means includes a relatively large helical coil spring element 42 having its rearmost end bearing against the forward end of the nipple 15 and having its forward end portion bearing against the rear annular surface of the collet head member 29. It will be noted that the spring 42 is disposed around the chamber element 26 and causes the collets 34 to be urged against the rear conical surface of the nose piece 21. This spreads the collets with respect to each other but upon relative axial shifting movement of the collets and nose piece, the collets will be caused to move towards each other and will grip the mandrel of a rivet fastener as illustrated in FIG. 4.

Means are provided for retraction of the actuator member 25 along with the collet head member and collets carried thereby. To this end, it will be seen that the rear end portion of the actuator member 25 is externally threaded as at 43 and that an adjustment member or nut 44 threadedly engages the same. It will be seen in the embodiment illustrated that a forward surface 45 of the adjustment nut 44 of the adjustment nut 44 is planar and engages the rear surface of the actuator member 43 when the actuator member is in the forward or inoperative position. By adjusting the adjustment nut 44 relative to the actuator member 25, the relationship of the collets 34 with respect to the nose piece may be pre-set. Therefore if the adjustment nut 44 is adjusted relative to the actuator member 25 so that the collets 34 are retracted rearwardly from the position illustrated in FIG. 3, then the spaced-apart relation of the collets with respect to each other will be slightly lessened when the collets are in their forwardmost position. With this particular arrangement, the mandrel of a fastener may be inserted through the nose piece and through the opening defined by the collets 34 and the adjustment nut 44 may thereafter be adjusted so that the collets actually define an opening which barely receives the mandrel of the fastener therethrough. The initial retractive movement of the collets relative to the nose piece results in the collets immediately gripping the mandrel during the rivet setting operation. When the collets are shifted out of engagement with the nose piece the collets move towards each other and the mandrel and further movement in an axial direction results in pulling the mandrel relative to the sleeve.

The means for producing retractive movement of the actuator member and collets comprises an elongate actuating lever 46 which is of channel shaped metallic construction and which is relieved at its upper end to define a pair of bifurcations or arms 47 disposed on opposite sides of the frame block member 13. These arms 47 are provided with a pair of vertically spaced-apart apertures 48 therein, these apertures 48 being disposed in substantially the center of the recesses therein. The frame block member 13 is adapted to be fastened to the frame 10 and is of such a size that these apertures 48 are positioned on the center line of the frame block member 13 to permit the insertion of a pivot pin 49 selectively through either the upper or lower apertures so that the pivotal axis of the lever 46 may be varied with respect to the frame block member 13. The rear surfaces or edges of the bifurcated arms 47 define camming or bearing surfaces for cooperatively engaging the bearing surface 45 of the adjustment nut 44. Therefore when the lever 46 is pivoted relative to the frame block member 13, the adjustment nut 44 will be urged rearwardly along the actuator member and the collets 34.

It will be noted that the distance from the center of the pivot pin 49 to the bearing or camming surface 50 which engages the adjustment nut 44 during pivoting of the lever 46 actually defines the resistance arm of the second class lever which the actuating lever 46 comprises. Thus by changing the location of the fulcrum or pivot point, the resistance arm as well as the effort arm of the lever can be variously adjusted thus changing the mechanical advantage of the lever and thus permitting the production of a power stroke.

During operation of the rivet gun device 10, the mandrel of the rivet fastener will be inserted in the nose piece and between the collets 34 which will be disposed in their forwardmost position. It is pointed out that the rivet fastener to be used in conjunction with the rivet gun 10 is of the type comprising an elongate pointed mandrel M having a head H at one end and also having a weakened zone adjacent the head and accommodating a sleeve type fastener S thereon. This sleeve type fastener has a disc or flange D integral with the rearmost end thereof so that when the sleeve S is inserted through apertures in a pair of structures or members to be connected, the rivet may be set by the rivet gun 10. It will be noted that during this rivet setting operation, the disc D is placed against one of the work pieces and the forward surface of the nose piece 21 is also urged against the disc whereby upon pulling or retractive action of the mandrel M, the head thereof will engage and expand the forward end of the sleeve fastener S so that the fastener will become set. The weakened portion of the mandrel adjacent the head H may be broken and the mandrel may slip through the bore 27 of the actuator member 25 and the sleeve 26 is ejected.

In order to obtain efficient functioning of the rivet gun 10, it is desirable that the mandrel be gripped by the collets during initial movement of the actuating lever 46 thereby minimizing the amount of movement of the collets before the mandrel is gripped. This immediate gripping action of the collets may be effected by first inserting the mandrel M through the nose piece and collets 34 and thereafter tightening the adjustment nut 44 until the mandrel is firmly gripped by the collets and thereafter turning the adjustment nut to render the passage defined by the collets only slightly larger than the external diameter of the mandrel. Thereafter when the actuating lever 46 is pivoted by an operator, the mandrel will be immediately gripped and thereby facilitate quick setting of the fastener.

The actuating lever 46 has a pair of threaded recesses therein for accommodating additional nose pieces 21 which will have various size openings therein. Differ-
ent size nose pieces are used for different size rivets and the adjustability of the interrelationship of the collets with respect to the nose piece when the collets are in the forward position, also permit quick and effective gripping of the mandrel by the collets even when such nose pieces are changed. Further the adjustability of the lever fulcrum permits the length of the resistance arm of the lever as well as the effort arm to be adjusted for providing for a power stroke and/or a greater lever amount of movement of the collets during the rivet setting operation. With this arrangement the number of strokes necessary to set a rivet fastener will be minimized.

Referring now to FIGS. 5 through 7, it will be seen that a different embodiment of my rivet gun device, designated generally by the reference numeral 10a, is there shown. The rivet gun device 10a also includes a handle 11a having a cover element 12a covering the lower end portion thereof to facilitate gripping thereof by a user. A handle or frame block member 13a is provided but is constructed separately from the handle 11a. This frame block member 13a is of generally rectangular construction and is also provided with a pair of vertically spaced-apart apertures 14a therein. The frame block member is further provided with a pair of vertically spaced-apart apertures 15a therein which are positioned rearwardly of the apertures 14a.

The handle 11a which is of generally channel shaped construction is relieved at its upper end to define a pair of arms or bifurcations 11b provided with a pair of spaced-apart vertical apertures arranged in registering relation with the apertures 14a in the frame block member 13a and secured thereto by a suitable fastener 14c in the form of a bolt. Another bolt type retaining element 14d extends through the upper aperture in the handle and threadedly engages the upper aperture 14b in the block member 13a.

The frame block member 13a also has a forwardly opening longitudinally extending recess 15a therein which receives the rear end portion of an elongate guide pin 15b therein. An elongate fore-and-aft longitudinally extending bore 16a is formed in the frame block member 13a as best seen in FIGS. 6 and 7 and is positioned below the recess 15a therein.

The nose assembly of the embodiment of the gun device 10a includes an elongate generally tubular body member or sleeve 17a which is internally threaded at its rear end portion as at 18a for threaded engagement with an externally threaded nut 18b. This threaded nut also has a rearwardly facing longitudinally extending recess 18c therein for receiving the front or forward end of the guide pin 15b therein. The forward end portion of the body member 17a is of frusto-conical configuration having an inner surface which defines a generally frusto-conically shaped guide surface 19a. The opening at the front end of the body member 17a is of reduced size and is internally threaded as at 20a for threaded engagement with the externally threaded portion 22a of the nose piece 21a. The bore 23a of the nose piece 21a is disposed in coaxial relation with respect to the bore 16a of the frame block member 13a and the rear end portion of the nose piece 21a is positioned within the body member 17a and defines a generally rearwardly tapering or wedge shaped surface 24a.

An elongate tubular actuating member 25a is positioned within the body member 17a and projects rearwardly through the bore 16a and exteriorly of the frame block member 13a. The forward end portion of the actuating member is also enlarged to define a generally hollow tubular cylindrically shaped chamber element 26a the interior of which comprises two apertures 27a and forms a continuation of the bore 27a of the actuating member 25a. The forward end portion of the chamber element 26a is externally threaded for threaded engagement with the internally threaded rear end portion of the collet head member 29a. The collet head member 29a includes a rear cylindrical portion 30a having an external diameter slightly smaller than the internal diameter of the body member 17a for sliding therein, and having an internal diameter corresponding in size to the size of the internal convex rear of the chamber element 26a. The forward portion of the collet head member 29a is also of frusto-conical configuration and defines a frusto-conically shaped exterior guide surface 31a for sliding engagement with the guide surface 19a of the body member 17a. The collet head member 29a has an internally generally cylindrically shaped bore therein which converges forwardly to define a forward internal conical guide surface 33a which receives and engages the collets 34a therein.

The collets 34a are of substantially identical construction to the collets 34 of the embodiment of FIGS. 1 to 4 and are provided with serrated toothed inner semi-cylindrically gripping surfaces which are arranged in mating opposed relation. The exterior surfaces of the collets 34a are forwardly tapered and engage the inner conical guide surface 33a of the collet head member 29a so that the collets 34a are retained in a predetermined relation with respect to each other. The respective forward and rear end portions of the mating collets 34a are shaped and contoured to define wedge-shaped concave recesses, the forward concave recess engaging the rear conical convex surface 24a of the nose piece 21a.

A collet expander element 39a having a generally wedge-shaped forward end portion corresponding in shape to fit within the concave rear recess of the collets 34a is positioned within the chamber element 26a for axial movement relative thereto. The collet expander element is normally urged axially forwardly by a relatively light coil spring element 41a which has its rearmost ends urging against the rear surface of the chamber element 26a. Thus the collets 34a are urged forwardly with respect to the collet head member 29a by the cooperative action of the collet expander elements 39a and the spring element 41a.

A relatively large helical coil spring 42a normally urges the collet head member 29a forwardly so that relative axial movement between the body member 17a and the collet head member which is attached to the actuator member is yieldably resisted by this coil spring 42a. It will therefore be seen that the coil spring 42a cooperates with the spring 41a and collet expander element 39a to urge the collets forwardly and against the nose piece in the manner of the embodiment of FIGS. 1 to 4.

The means for producing relative axial movement between the actuator member 25a which carries the collets and the body member 17a comprises an elongate actuating lever 46a which is of channel shape metallic construction and which is relieved at its upper end to define a pair of bifurcations or arms 47a disposed on opposite sides of the frame block member 13a. These arms 47a are also provided with a pair of apertures 48a therein, the apertures being disposed in registering relation with respect to the apertures 14a in the frame block member 13a to permit insertion of a pivot pin 49a selectively through either the upper or lower apertures therein.

Thus the pivotal axis of the lever 46a may also be varied with respect to the frame block member 13a. The forward surfaces or edges of the arms 47a define camming or bearing surfaces 50a for cooperatively engaging the rear surface of the nut 18b which is affixed to the body member 17a.

The rear end portion of the actuator member 25a is externally threaded as at 43a and an adjustment member or nut 44a threadedly engages the same. By adjusting the adjustment nut 44a relative to the actuator member 25a, the relationship of the collets 34a may be varied and, in turn, the resiliently urged back of the nose piece. It will be seen that when the lever 46a is moved or swung about the pivot pin 49a towards the handle 11a, the bearing surfaces 48a thereof will progressively urge the body member 17a.
as this occurs, the nose piece 21a will be moved out of engaging relation with respect to the forward recessed portion of the collets 34a and the collets will grip the mandrel of the rivet fastener in the manner of the embodiment of FIGS. 1 to 4. Again it will be noted that the initial relationship of the collets with respect to the nose piece may be readily adjusted by adjustment of the adjustment nut 44a so that the amount of movement necessary by the actuating lever 46a to produce a gripping effect of the rivet fastener mandrel by the collets may be variously adjusted.

The bifurcated arms 11b of the handle 11a are also provided with camming surfaces or edges 11d. Therefore by removing the adjustment nut 44a, the block member 13a with the handle and lever attached may be turned through 180° so that the handle 11a is disposed forwardly and the lever 46a is disposed rearwardly. Thereafter the retaining element 14d may be removed and reinserted in the uppermost registering apertures in the lever and block member 13a. The lever 46a will then serve as the handle and the handle 11a will function as a lever. The adjustment nut is then applied to the end of the actuating member. Because of the differences of the camming surfaces, the effort and resistance arms of the actuating lever may be substantially altered. By reversing the relative position of the handle 11a and actuating lever 46a from the respective positions thereof, illustrated in FIG. 5, the length of the stroke of the collet with respect to the nose piece 21a may be changed which is particularly advantageous when the mandrels are of small diameter and strength. It is further pointed out that the handle 11a is also provided with a suitable threaded aperture for attachment thereto of an additional or extra nose piece 21a as best seen in FIG. 5.

From the foregoing it will be seen that I have provided a novel rivet gun device for use in applying or setting rivets of the type comprising a mandrel having a sleeve mounted thereon. It will be noted that my novel rivet gun device is provided with means for effectively adjusting the relationship of the nose piece with respect to the mandrel gripping collets and also has provision for changing the respective lengths of the effort and resistance arms of the actuating lever by a relatively simple operation. These various adjustments permit an operator to set rivets with a minimum of lost motion or play of the actuating lever and also allow an operator to vary the magnitude or mechanical advantage of the power stroke during the rivet setting operation. Further the various adjustments of my rivet gun device permit setting of rivets in a minimum number of strokes if this is desired by an operator.

Thus it will be seen that I have provided a novel and improved rivet gun device which is not only of simple and inexpensive construction but one which functions in a more efficient manner than any heretofore known comparable devices.

It will, of course, be understood that various changes may be made in the form, details, arrangement and proportions of the various parts without departing from the scope of my invention.

What is claimed is:

1. A rivet gun device for setting fasteners of the type having an elongated mandrel and a sleeve thereon to be set relative thereto, said device comprising a handle, a rigid frame fixedly attached to one end of said handle, a tubular body member mounted on said frame and having a nose piece at the front end thereof, said nose piece having an axial opening therein for receiving the mandrel of the fastener to be set therein, said body member being disposed in coaxial alignment with the bore of said frame, a hollow collet receiving head mounted within said tubular body member for axial movement relative thereto, a pair of mandrel gripping collets positioned within said collet receiving head rearwardly of said nose piece and having opposing gripping jaws, said collets being disposed in engaging relation with said nose piece when in a forward release position and being axially retractive with said collet receiving head and relative to the nose piece in a mandrel gripping direction for gripping the inserted end of the mandrel between the jaws thereof, an elongate actuator member positioned within said body member and being connected at its forward end with said collet receiving head and being axially shiftable relative to said body member, an actuating lever, cooperating means on one end of said lever and said frame pivotally mounting on said lever and the frame for relative pivotal movement therebetween and upon pivoting movement producing retractive movement engaging said actuator member and collet receiving head and the collets carried thereby, said lever being capable of ready detachment from said frame and being capable of ready re-attachment thereto to define a differently positioned pivotal axis to thereby allow the relative sizes of the respective effort and resistance arms of the lever to be varied, yieldable means interposed between said body member and said collet receiving head for yieldably resisting retractive movement of the latter, and an adjustment member provided for shiftably engaging said actuator member rearwardly.

2. The rivet gun device as defined in claim 1 wherein said actuator member has a threaded rear end portion which projects through said bore in said frame, and said adjustment member threadedly engages said rear end portion of the actuator member, a camming surface on said lever engaging said adjustment member for shifting said actuator member rearwardly.

3. A rivet gun device for setting fasteners of the type having an elongated mandrel and a sleeve thereon to be set relative thereto, said device comprising a handle, an elongate tubular body member adjacent said handle for axial shifting movement relative thereto and having a nose piece at the front end thereof, said nose piece having an axial opening therein for receiving the mandrel of the fastener to be set therein, a hollow collet receiving head positioned within said tubular body member adjacent the front end thereof, a pair of mandrel gripping collets positioned within said collet receiving head rearwardly of said nose piece and having opposing gripping jaws, said collets being disposed in engaging relation with said nose piece and cooperating with the latter when in a released position to permit the end of a mandrel to be inserted therethrough, and gripping the inserted end of the mandrel between the jaws thereof upon axial forward shifting movement of the nose piece, means for producing relatively axial forward shifting movement of said tubular body member and said near piece relative to said collets, said means comprising an elongate actuator member positioned within said body member and connected to said collet receiving head, an actuating lever pivotally mounted adjacent said handle for shifting said body member axially forward, yieldable means interposed between said body member and said collet receiving head and yieldably resisting forward shifting movement of said body member,
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and an adjustment member connected with the rear portion of said actuator member and being adjustable relative thereto to variously pre-set the axial position of said collets with respect to said nose piece when said collets are in the released position.

4. The rivet gun device as defined in claim 3 and a rigid frame member fixedly attached to one end of said handle, said frame member having a bore therethrough, cooperating attachment elements on said lever and said frame to permit the lever to be readily disengaged from the frame and re-attached thereto to have a differently positioned pivotal axis to thereby allow the relative sizes of the respective effort and resistance arms of the lever to be varied.

5. The rivet gun device as defined in claim 3 wherein said actuating lever has a camming surface thereon engaging said body member for shifting said body member forwardly.

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CHARLES W. LANHAM, Primary Examiner.
G. P. CROSBY, Assistant Examiner.