



Feb. 26, 1946.

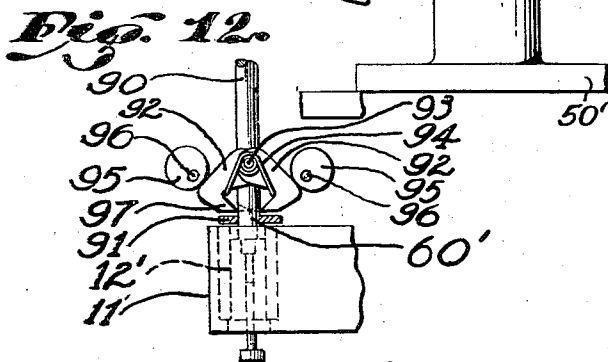
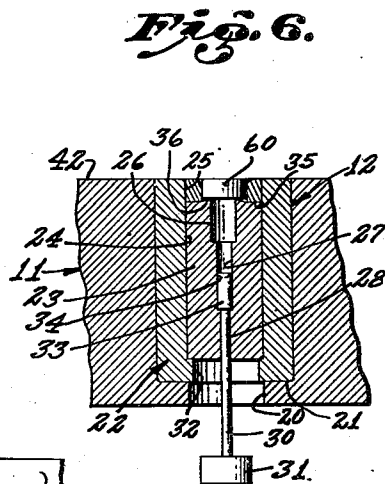
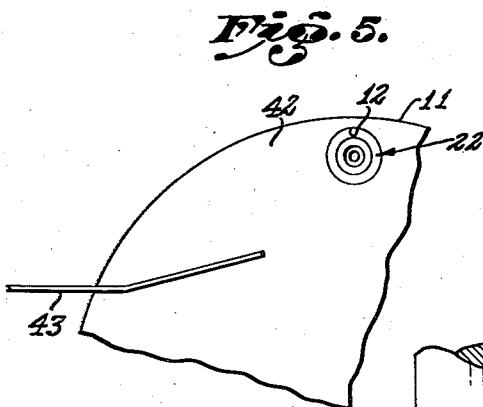
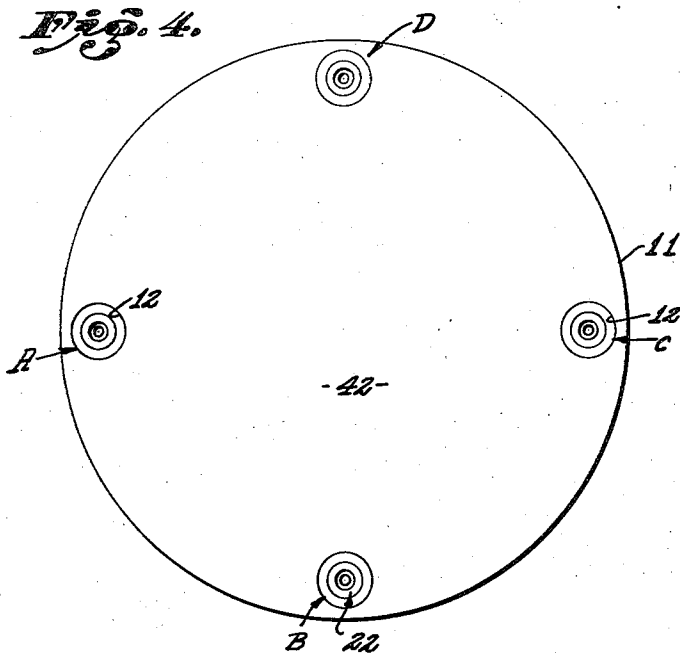
C. R. BUCHET

2,395,722

METHOD OF AND APPARATUS FOR MAKING RIVETS

Filed Nov. 28, 1944

3 Sheets-Sheet 2



C. R. BUCHET,  
INVENTOR.

BY *[Signature]*  
ATTORNEY

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3 Sheets-Sheet 3

Fig. 7.

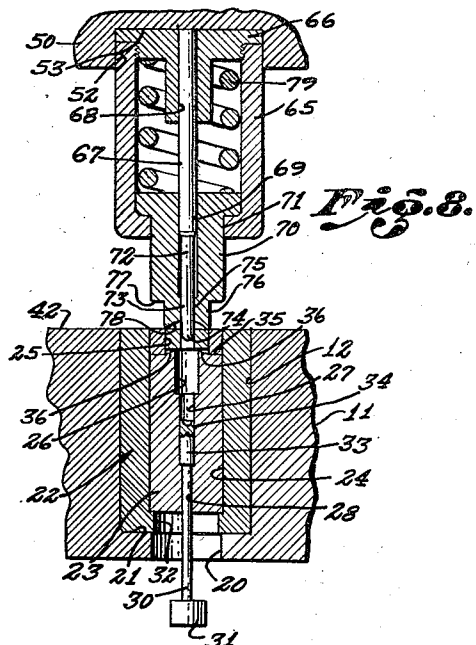
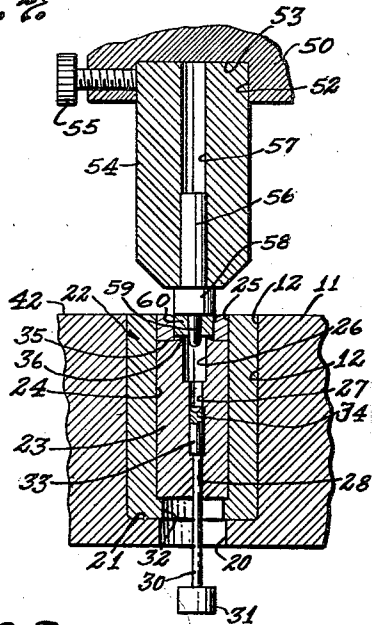


Fig. 9.

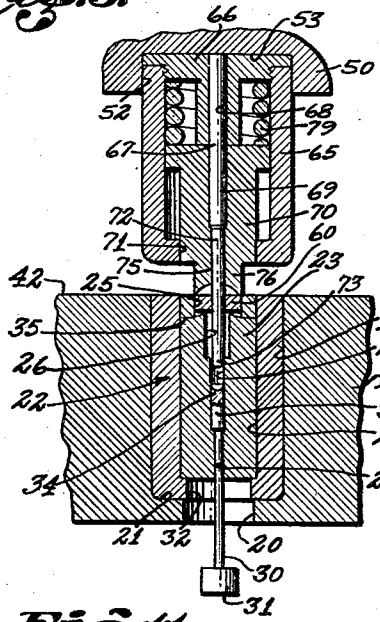


Fig. 10.

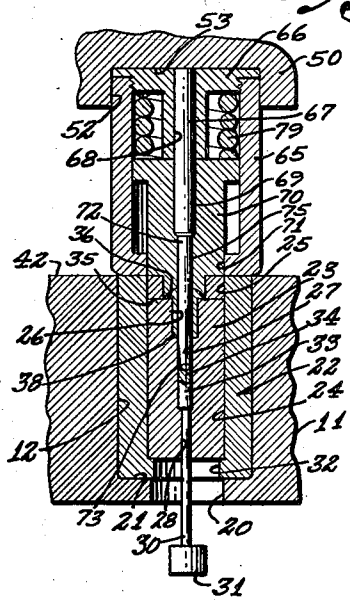
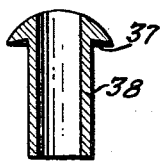


Fig. 11.



C. R. BUCHET,  
INVENTOR.

BY *[Signature]*  
ATTORNEY

# UNITED STATES PATENT OFFICE

2,395,722

## METHOD OF AND APPARATUS FOR MAKING RIVETS

Conrad R. Buchet, Pasadena, Calif., assignor of one-half to Milton H. Lees, Jr.

Application November 28, 1944, Serial No. 565,493

18 Claims. (Cl. 10—11)

This invention relates to a method of and apparatus for making rivets.

A general object of the invention is to provide a novel apparatus for forming rivets, particularly rivets of the tubular type.

Another general object of the invention is to provide a novel method of making rivets, particularly tubular rivets.

A more specific object of the invention is to provide a rivet making apparatus including a novel die member.

A further object of the invention is to provide a rivet making apparatus including novel punch members.

A further object of the invention is to provide a rivet forming apparatus wherein a tubular rivet is made from a flat blank by combined punch and die members which operate to form the rivet by causing the blank to move along a die member while a punch moves into the die member to form the hollow portion.

A further object of my invention is to provide a rivet making apparatus including novel means for cutting a rivet blank from a rod.

Other objects and the advantages of my invention will be apparent from the following description taken in connection with the accompanying drawings, wherein:

Fig. 1 is a side elevation, partly in section, showing an apparatus embodying the features of my invention;

Fig. 2 is a view similar to Fig. 1 looking in the direction of the line of arrows 2—2, Fig. 1;

Fig. 3 is a fragmentary side elevation looking in the direction of arrows 3—3, Fig. 2;

Fig. 4 is a section taken on line 4—4, Fig. 1;

Fig. 5 is a fragmentary top plan view taken on line 5—5, Fig. 2;

Fig. 6 is a fragmentary sectional view showing details of the die members;

Fig. 7 is a fragmentary sectional view showing the die and the first punch member;

Figs. 8, 9 and 10 are fragmentary sectional views showing the die and the second punch member in three different positions;

Fig. 11 is a central sectional view showing one type of rivet made according to my improved method and apparatus, and

Fig. 12 is a fragmentary view similar to Fig. 2, showing a modification.

Referring to the drawings by reference characters, I have shown my invention as embodied in a rivet making apparatus which is indicated generally at 10.

As shown the apparatus includes a table 11

which is provided with a plurality of die recesses 12. The table is mounted for step-by-step rotary motion. Various types of step-by-step dial feeds are in use and the particular type of drive means employed forms no part of the present invention. In the disclosure the table is adapted to be driven from a gear 13 by means of a gear 14 on a shaft 15 which is driven in any suitable manner. The drive includes a supporting plate 16 in which the table shaft 17 is journaled. This plate may be fastened to existing structures of well known machines of the type used in the operation of punch type dies in any suitable manner or as by a weld as shown at 18 in Fig. 2.

In the present disclosure I show four of the die recesses 12 although it may be understood that this number may be varied if desired. In the disclosure each of the die recesses includes a reduced lower bore 20 which forms a shoulder 21. In each recess 12 I arrange a removable die member 22 which has a forced fit in the recess 12. Each die member receives a die 23. The dies 23 are alike and have drive fits in the bore 24 in the members 22.

Each die includes an upper enlarged cavity 25 which communicates with a lower reduced cavity 26. The cavity 26, in turn, communicates with a further reduced cavity 27 and the cavity 27 communicates with a further reduced cavity 28. All the cavities are coaxial. Extending through the cavity 28 I show a rivet forming and removing stem 30 which has operating head 31 on the lower end thereof. The stem 30 extends through a hole 32 in the member 22 and through the hole 20 previously mentioned. The upper end of the stem 30 has an enlarged portion 33 which slides in the bore 27 and which has a cupped upper end 34.

The upper face of each die 23 is planar as at 35 adjacent to its periphery while the inner portion adjacent to the cavity 26 flares upwardly as at 36. This flaring portion provides a shoulder 37 (Fig. 11) on the rivet 38 which the apparatus is adapted to make.

At one interval during rotation of the table 11 the head 31 on each stem will engage a cam member 39 mounted on a suitable support 40. The cam member 39 has a cam face 41 thereon which causes the head 31 to be raised, thus pushing the stem 30 upwardly so that the formed rivet extends above the top 42 of the table and into the path of a guide member 43 which removes the rivet from the table.

The punch device includes a base 50, mounted

on column 51. The column 51 is made to reciprocate vertically in any desired manner.

The base 50 is provided with a plurality of recesses 52 which open downwardly and are closed at the upper ends 53. In each recess I arrange a punch holder 54. The punch holders are held in place by set screws 55.

In the disclosure I provide two types of punch members. The punch member shown in Fig. 7 includes a stem 56, arranged in a bore 57 in the punch holder 54 and held therein by a drive fit. The punch includes a depending, enlarged portion 58 from which a slightly tapered punch stem 59 depends.

My apparatus is intended to produce rivets from blanks or pellets 60 as shown in Fig. 6 which may be made of aluminum or other metal or alloys. In operation a suitable pellet is fed down a chute 61, Fig. 1, which has a discharge portion 62 disposed just above the top 42 of the table so that as each recess 25 passes beneath the chute a disc is free to drop into the cavity 25. This operation occurs at station A as shown in Fig. 4 and there is no punch above the station A.

The punch 56 is disposed at station B and when the die is beneath this punch the latter descends and the stem 59 strikes and pierces the blank 60 as shown in Fig. 7. This causes the blank to be flattened slightly to more or less fill the cavity 25. When the punch 56 ascends the slightly tapered stem 59 moves from the hole in the blank and the latter is ready to be moved to station C for operation by a second punch, shown in Figs. 8, 9 and 10.

The punch shown in Figs. 8, 9 and 10 includes a housing 65 which has a closure 66 threadedly engaging the upper end thereof. The housing 65 is held in its recess 52 by a set screw. The closure 66 has a depending stem 67 which is secured in a bore 68 in the closure. The stem 67 is arranged in a bore 69 on a forming member 70 which slides in a hole 71 in the lower end of the housing 65. The punch 69 includes a reduced lower portion 72 which is slightly tapered at its lower portion 73 and the end is rounded as at 74. The lower end of the recess 69 is reduced at 75 to guide the portion 73 of the punch. The forming member 70 has a reduced lower portion 76 forming a shoulder 77. The lower face of the portion 76 is arcuately recessed as at 78 to form the head portion of the rivet. A spring 79 normally urges the member 70 downwardly in the housing 65.

In making a rivet according to my invention, blanks are placed in the chute 61 and feed from there into the recess which happens to be at station A. When the table moves to the next station, namely, B, the punch member shown in Fig. 7 will operate, causing the stem 56 thereon to descend so that the stem 59 will pierce the blank. When the punch member rises the stem 59 will be withdrawn from the blank. The next operation takes place at station C where the other punch member operates upon the pierced blank. As this member moves downwardly the punch 69 passes through the pierced blank and the reduced portion 76 on the forming member 70 moves into the recess 25 and the lower face of this member which is cupped as at 78 engages the pierced blank and forces the material of the blank downwardly. The material flows into the cavity 26 and as the punch 73 descends the material flows about the punch forming a hollow, cylindrical shank. Thus it will be seen that as a portion of the

metal forms the head another portion of the blank will move along the recess 26 and along the punch 73 to form the rivet shank. After the rivet is formed the blank moves to station D and the end 31 on the stem 30 engages the cam surface 41, causing the stem to eject the rivet which is swept away by the member 43.

The material of the rivet is tightly squeezed into the cavity 26 so that when the punch 73 moves upwardly the formed rivet remains in the cavity 26. When the punch 73 is withdrawn the bore of the rivet contracts a small amount but sufficient to be engaged and ejected by the cupped end 34 of the ejector.

In the modification shown in Fig. 12 the table 11' is provided with die recesses 12' in which dies similar to those previously described are arranged.

In the modification the blanks 60' are cut from a cylindrical rod 90 which passes through a guide member 91 arranged at station A and aligned with the die recesses 12'. Adjacent to the rod 90 I pivot a pair of opposed shear arms 92 arranged on the pivots 93 and normally urged outwardly by a spring 94. Opposed cams 95, mounted on shafts 96 and operated in any desired manner, engage and move the jaws together.

The jaws 97 of the shear arms are offset from the arms so that they are in position to engage the rod 90 and cut off a blank 60'. When the shear members 92 move inwardly they cut off the blank 60' and hold the rod 90 momentarily while the table 11' is advanced, whereupon the arms 92 spread apart, allowing the rod 90 to drop so that its lower surface rests on the table and is in a position to pass into another recess 12' when the latter becomes aligned with the rod 90.

From the foregoing description it will be apparent that I have invented a novel method of and apparatus for making rivets which is extremely simple and highly efficient for its intended purpose.

Having thus described my invention, I claim:

1. A rivet making apparatus including a table, a punch member movable relative to said table, said table having a die thereon, said die having an upper cavity, the die having a second, reduced cavity below and communicating with the upper cavity, the cavities being coaxial, said punch member including a housing having a reciprocating forming member therein, means normally advancing said forming member, said forming member having a lower face adapted to form a rivet head, and a stem movable with said punch member and having a lower portion normally protruding through the lower face of the forming member, said stem being smaller than the reduced cavity in the die to provide a metal receiving space.

2. A rivet making apparatus including a table, a punch member movable relative to said table, said table having a die thereon, said die having an upper cavity, the die having a second reduced cavity below and communicating with the upper cavity, the cavities being coaxial, a rivet removing member having an end slidable into said second cavity, said punch member including a housing having a reciprocating forming member therein, means normally advancing said forming member, said forming member having a lower face adapted to form a rivet head, and a stem fixed relative to said punch member and having a lower portion normally protruding through the lower face of the forming member, said fixed

stem being smaller than the reduced cavity in the die to provide a metal receiving space.

3. A rivet making apparatus including a table mounted to rotate, a punch member movable relative to said table, said table having a plurality of dies thereon, each die having an upper cavity, each die having a second reduced cavity below and communicating with the upper cavity, the cavities being coaxial, a rivet removing member having an end slidable into each second cavity, means to limit the downward movement of the removing member, said punch member including a housing having a reciprocating forming member therein, means normally advancing said forming member, said forming member having a lower face adapted to form a rivet head, and a stem fixed relative to said punch member and having a lower portion normally protruding through the lower face of the associated forming member, said fixed stem being smaller than the reduced cavity in the die to provide a metal receiving space.

4. A rivet making apparatus including a table mounted to rotate, a punch member movable relative to said table, said table having a plurality of dies thereon, each die having an upper cavity, each die having a second reduced cavity below and communicating with the upper cavity, the cavities being coaxial, a rivet removing member having an end slidable into each second cavity, means to limit the downward movement of the removing member, means to shift said removing member, said punch member having a plurality of punches thereon, one of said punches having a stem adapted to pierce a blank in the die, the other punch member including a housing having a reciprocating forming member therein, means normally advancing said forming member, said forming member having a portion movable into the upper cavity of each die and having a recessed lower face adapted to form a rivet head, said forming member having a bore, and a stem in the bore fixed relative to said other punch member and having a lower portion normally protruding through the recessed face of the associated forming member, said fixed stem being smaller than the reduced cavity in the die to provide a metal receiving space.

5. A rivet making apparatus including a table, a punch member adjacent to said table, said table having a recess therein, a die in said recess, said die comprising a lower portion and an upper portion, the lower portion having an upper face the peripheral portion of which is flat and the inner portion of which tapers upwardly, the upper portion of the die having a cylindrical bore, the lower portion having a reduced cavity communicating with the upper portion bore and having a further reduced lower cavity communicating with the first reduced cavity, all of the cavities and the bore being coaxial, said punch member having a plurality of punches thereon, one of said punches having a tapered stem adapted to pierce a blank in the die below, the other punch member including a housing having a reciprocating forming member therein and protruding therefrom, means normally urging said forming member to protruding position, said forming member having a reduced portion movable into the cylindrical bore in the upper portion of each die and having a lower face adapted to form a rivet head, said forming member having a bore extending therethrough, and a stem in said forming member bore and fixed relative to said punch member and having a

lower tapered portion normally protruding through the lower face of the forming member, said fixed stem being smaller than the first reduced cavity in the lower die member to provide a metal receiving space.

6. A rivet making apparatus including a table, a punch member adjacent to said table, said table having a recess therein, a die in said recess, said die comprising a lower portion and an upper portion, the upper portion of the die having a cylindrical bore, the lower portion having a reduced cavity communicating with the upper portion bore and having a further reduced lower cavity communicating with the first reduced cavity, all of the cavities and the bore being coaxial, said punch member including a housing having a reciprocating forming member therein and protruding therefrom, said forming member having a portion movable into the cylindrical bore in the upper portion of each die and having a lower face adapted to form a rivet head, said forming member having a bore extending therethrough, and a stem in said forming member bore and fixed relative to said punch member and having a lower portion protruding through the lower face of the associated forming member, said fixed stem being smaller than the first reduced cavity in the lower die member to provide a metal receiving space.

7. A rivet making apparatus including a table mounted to rotate, a punch member movable relative to said table, said table having a plurality of dies thereon, each die having a cylindrical bore, the die having an upper reduced cavity smaller than the bore, the die having a second reduced cavity below and communicating with the upper cavity, the cavities and the bore being coaxial, a rivet removing stem member having an enlarged cupped end slidable in said second cavity and having a stem thereon, means to limit the downward movement of the stem, means to raise said stem during one portion of the movement of the the table, said punch member having a plurality of punches thereon, one of said punches having a stem adapted to pierce a blank in the die below, the other punch member including a housing having a reciprocating forming member therein, means normally advancing said forming member, said forming member having a portion movable into the cylindrical bore in the upper portion of each die and having a recessed lower face adapted to form a rivet head, said forming member having a bore and a stem in the forming member bore and fixed relative to said other punch member and having a lower portion normally protruding through the recessed face of the associated forming member, said fixed stem being smaller than the upper reduced cavity in the die to provide a metal receiving space.

8. A rivet making apparatus including a table mounted to rotate, a punch member movable relative to the table, a plurality of dies on said table, each die having a cylindrical bore and having its upper face flush with the top of the table, each die having an upper cavity smaller than the bore, the die having a reduced intermediate cavity communicating with the upper cavity and having a further reduced lower cavity communicating with the intermediate cavity, all of the cavities and the bore being coaxial, a rivet removing stem having an enlarged cupped end slidable in said intermediate cavity and having a stem thereon projecting through the

lower reduced cavity, means to limit the downward movement of the stem, means to reciprocate said stems during one portion of the movement of the table, said punch member having a plurality of punches thereon, one of said punches having a stem adapted to pierce a blank in the die below, the other punch member including a housing having a reciprocating forming member therein, means normally advancing said forming member, said forming member having a portion movable into the cylindrical bore in the upper portion of each die and having a recessed lower face adapted to form a rivet head, said forming member having a bore extending therethrough, and a stem in the forming member bore and fixed relative to said other punch member and having a lower tapered portion normally protruding through the recessed face of the associated forming member, said fixed stem being smaller than the upper cavity in the die to provide a metal receiving space.

9. A rivet making apparatus including a table, a punch member adjacent to said table, said table having a recess therein, a die in said recess, said die comprising a lower portion and an upper portion, the lower portion having an upper face, the peripheral portion of which is flat and the inner portion of which tapers upwardly, the upper portion of the die having a cylindrical bore, the lower portion having an upper cavity and having a reduced intermediate cavity communicating with the upper cavity and having a further reduced lower cavity communicating with the intermediate cavity, all of the cavities and the bore being coaxial, a rivet removing stem having an enlarged cupped end slidable in said intermediate cavity and having a stem thereon projecting through the lower reduced cavity, means to limit the downward movement of the stem, means to lift the stem, said punch member having a plurality of punches thereon, one of said punches having a tapered stem adapted to pierce a blank in the die below, the other punch member including a housing having a reciprocating forming member therein and protruding therefrom, spring means normally urging said forming member to protruding position, said forming member having a reduced portion movable into the cylindrical bore in the upper portion of each die and having a lower face adapted to form a rivet head, said forming member having a bore extending therethrough, a stem in said forming member bore and fixed relative to said punch member and having a lower tapered portion normally protruding through the lower face of the associated forming member, said fixed stem being smaller than the upper cavity in the lower die member to provide a metal receiving space, and means to mount the table and punch member for relative movement to permit the punches to work on a blank in the die.

10. A rivet making apparatus including a table mounted to rotate a reciprocating punch member adjacent to said table, said table having a plurality of upwardly opening recesses therein, a die member in each recess, each die member having a recess therein, a die in each die member recess, each die having a cylindrical bore and having its upper face flush with the top of the table, the die having an upper cavity smaller than the bore, the die having a reduced intermediate cavity communicating with the upper cavity and having a further reduced lower cavity com-

municating with the intermediate cavity, all of the cavities and the bore being coaxial, a rivet removing stem having an enlarged cupped end slidable in said intermediate cavity and having a stem thereon projecting through the lower reduced cavity, means to limit the downward movement of the stem, means to reciprocate said stems during one portion of the movement of the table, said punch member having a plurality of punches thereon, one of said punches having a stem adapted to pierce a blank in the die below, the other punch member including a housing having a reciprocating forming member therein and protruding means normally urging said forming member to protruding position, said forming member having a portion movable into the cylindrical bore in the upper portion of each die and having a recessed lower face adapted to form a rivet head, said forming member having a bore extending therethrough, and a stem in the forming member bore and fixed relative to said other punch member and having a lower tapered portion normally protruding through the recessed face of the associated forming member, said fixed stem being smaller than the upper cavity in the die to provide a metal receiving space.

11. A rivet making apparatus including a support, a table mounted to rotate step-by-step on said support, a reciprocating punch member adjacent to said table, said table having a plurality of upwardly opening recesses therein, a die member in each recess, each die member having a recess therein, a die in each die member recess, each die comprising a lower portion and an upper portion, the lower portion having an upper face, the peripheral portion of which is flat and the inner portion of which tapers upwardly, the upper portion of each die having a cylindrical bore and having its upper face flush with the top of the table, the lower portion having an upper cavity smaller than the bore in the upper die portion, the lower die portion having a reduced intermediate cavity communicating with the upper cavity and having a further reduced lower cavity communicating with the intermediate cavity, all of the cavities and the bore being coaxial, a rivet removing stem having an enlarged cupped end slidable in said intermediate cavity and having a stem thereon projecting through the lower reduced cavity and below the table, means to limit the downward movement of the stem, means in the path of said stems to cause the latter to reciprocate during one portion of the movement of the table, said punch member having a plurality of punches thereon, one of said punches having a tapered stem adapted to pierce a blank in the die below, the other punch member including a housing having a reciprocating forming member therein and protruding therefrom, spring means normally urging said forming member to protruding position, said forming member having a reduced portion movable into the cylindrical bore in the upper portion of each die and having an arcuately recessed lower face adapted to form a rivet head, said forming member having a bore extending therethrough, a stem in the forming member bore and movable relative to said other punch member and having a lower tapered portion normally protruding through the arcuately recessed face of the associated forming member, said fixed stem being smaller than the upper cavity in the lower die member to provide a metal receiving space, means to feed blanks to said

recesses and means to remove rivets from said table.

12. A rivet forming punch including a housing having a reciprocating forming member therein and protruding therefrom, said forming member 5 having an end portion adapted to move into a die and having a lower face adapted to form a rivet head, and a stem fixed relative to said housing and having an end portion normally protruding through the lower face of the forming member, said fixed stem being smaller than the 10 lower end of the forming member.

13. A rivet forming punch including a housing having a reciprocating forming member therein and protruding therefrom, spring means normally urging said forming member to protruding position, said forming member having a reduced portion adapted to move into a die and having a lower face adapted to form a rivet head, said forming member having a bore extending therethrough, and a stem in said bore and fixed relative to said housing and having an end portion normally protruding through the lower face of the forming member, said stem being smaller than the lower end of the forming member. 20

14. A die member including a body having a recess therein, a die in the recess, the die comprising a lower portion and an upper portion, the upper portion of each die having a bore, the lower portion having a reduced intermediate cavity communicating with the upper cavity and having a further reduced lower cavity communicating with the intermediate cavity, all of the cavities and the bore being coaxial, a rivet removing stem having an end slidable in said intermediate cavity and having a stem thereon projecting through the lower reduced cavity, and means to limit the downward movement of the stem. 25

15. A rivet making apparatus including a table, a punch member movable relative to said table, said table having a die thereon, said die having an upper cavity, means above the table to support a rod, means to cut a rivet blank from the rod, and to feed the cut blank to the upper die cavity, the die having a second, reduced cavity below and communicating with the upper cavity, the cavities being coaxial, said punch member including a housing having a reciprocating forming member therein, means normally advancing said forming member, said forming member having a lower face adapted to form a rivet head, and a stem movable with said punch member and having a lower portion normally protruding through the lower face of the forming member, said fixed stem being smaller than the lower cavity in the die to provide a metal receiving space. 30

16. The method of making a rivet comprising taking a blank, piercing the blank, forming a portion of the pierced blank into a rivet head while simultaneously advancing the remainder of the blank away from the head while confining the advancing portion to form a rivet shank. 35

17. The method of making a rivet comprising taking a cylindrical blank, piercing the blank, removing the piercing member from the blank and then forming part of the blank into a head portion with a hole therethrough while forming the remainder of the blank into a tubular portion coaxial with the head portion. 40

18. The method of making a rivet comprising taking a blank, running a member through the blank and forming a portion of the blank into a rivet head surrounding the member while simultaneously running the remainder of the blank along the member while confining the material to form a rivet shank. 45

CONRAD R. BUCHHEI.