

SECTION 4, CHAPTER 1

RIVETS AND RIVETING

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COMMON RIVETS

Introduction

1. Rivets are a permanent form of fastening, i.e. a fastening that cannot readily be separated. They are widely used in engineering to secure the various items of components built up from sheet metal, metal sections or metal tubing. Rivets are cheaper, lighter in weight, and more rapidly fastened than bolts, but have the disadvantage of not

facture are steel, nickel alloy, copper, tungum, aluminium and its alloys. Some shapes of rivet heads are shown in Fig. 1.

3. Tubular rivets are used where there is a gap between the parts to be riveted together; in some cases ferrules and in other cases distance pieces may be used with these rivets (Fig. 2). They may also be used with very

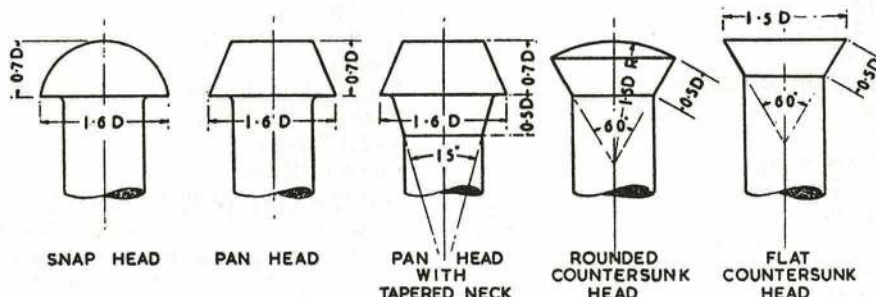


Fig. 1. SOME B.S.I. RIVET HEADS

being suitable for tensile loads, i.e. loads that tend to pull off the heads of rivets. Rivets are supplied with one head already formed, and when they are worked, another head is formed on the other end of the shank (sometimes called the point) by means of hand or power operated tools.

Types of Rivets

2. Rivets are made in a variety of shapes and metals. Metals used in their manu-

thin metal sheets, where there is more risk of the metal tearing than of the rivet breaking. Solid rivets are used to join thick metal sheets, where there is no gap between the parts, or where the work must be liquid or gas tight; if a flush finish is desired, solid countersunk-head rivets are used. The more common types of rivets are shown in Fig. 2 and information regarding special rivets will be found later in this chapter.

Name.	Shape as received.	Shape when closed.	Uses.	Remarks.
Snaphead			Riveting sheets together.	Special tools for forming head and "holding up."
Panhead			As for snaphead.	Can be closed with hammer only if the head shape is not important.
Counter-sunk			As for snaphead, where flush surface is needed.	Formed head either countersunk or "snap."
Tubular			For tubes or where there is not solid metal between the heads. "Ferrules" may be used to increase the surface taking the load.	Heads formed by a "snap," or "spun." Distance piece often used.

Fig. 2. COMMON RIVETS

Identification

4. It is important that rivets used should be of the same material as the work to be riveted unless specially ordered otherwise. Rivets are manufactured from various metals and may be identified by markings, colour, anti-corrosive treatment or magnetic properties. Solid rivet markings are situated on the head or tail of the rivet; tubular rivets are not marked. When in doubt as to the identification of rivets, reference should be made to the label on the carton in which the rivets were contained. Common solid rivets used in the R.A.F. are supplied as A.G.S. parts and may be identified as follows:—

(a) **Aluminium (B.S.L.36).** Non-magnetic. Anodically treated coloured black, and sometimes marked with a dimple or a letter "A".

(b) **Duralumin (B.S.L.37).** Non-magnetic. Natural colour and sometimes marked with a letter "D".

(c) **Hiduminium (B.S.L.57).** Non-magnetic. Anodically treated coloured violet, and sometimes marked with a letter "S".

(d) **Magnesium-Aluminium Alloy, M.G. 5 (B.S.L.58).** Non-magnetic. Anodically coloured green, and sometimes marked with a letter "X" or number "5".

(e) **Mild Steel (B.S.1109).** Magnetic. Cadmium coated.

(f) **Monel Metal (D.T.D.204A).** Non-magnetic. Natural colour, but supplied cadmium coated when used to rivet light alloys; monel metal is a nickel-copper alloy.

(g) **Tungum, Copper and Stainless Steel.** These rivets are supplied in their natural colours. Tungum and copper rivets are non-magnetic, and stainless steel rivets are usually magnetic.

Heat Treatment of Rivets

5. Only duralumin rivets require heat treatment before closing. The purpose of heat treatment is to soften the rivet so that it can be closed without cracks forming in the head. To enable the metal fully to age-harden, the rivets are normalized and not annealed. Normalizing consists of placing the rivets into a wire-mesh basket, suspending the basket in a salt bath at 485°C.—505°C. for fifteen minutes and then quenching in clean, cold water. The rivets must be closed within two hours of being heat treated; if the work is not completed within two hours, the rivets must be re-normalized.

Note.—Owing to a loss in strength caused by re-normalizing, it is recommended that rivets are re-normalized once only; if the work is still incomplete after four hours, unused rivets should be discarded and fresh ones obtained.

Allowance

6. The "allowance" is the length of the shank of the rivet protruding through the plates, which is to be formed into the rivet head; it is stated as a multiple of the rivet diameter (D). The allowance varies according to the shape of the head to be formed, the material from which the rivet is made (the softer the metal, the greater the allowance), and, with tubular rivets for example, on the method adopted for closing the head. The allowances for the common type rivets are given in Table 1.

Clearance

7. The clearance is the difference between the size of the hole and the rivet diameter; rivet holes are normally drilled .003 in. to .012 in. oversize. Clearance is necessary, particularly with light alloys, to prevent puckering of the sheet metal, owing to the metal of the shank spreading during the closing.

TABLE 1

Type of Rivet	Solid		Tubular	
Shape of Head ..	Snap	Countersunk	Hand Closed	Spun
Allowance ..	1.3D to 1.75D	.75D	.5D	.75D

TABLE 2

Diameter of Rivet ..	$\frac{3}{8}$ in.	$\frac{1}{8}$ in.	$\frac{5}{8}$ in.	$\frac{3}{16}$ in.	$\frac{1}{4}$ in.
Drill Size, English ..	0.098 in.	0.1285 in.	0.161 in.	0.191 in.	0.257 in.
Drill Size, Metric ..	2.50 mm.	3.25 mm.	4.10 mm.	4.85 mm.	6.50 mm.

ing process. Table 2 gives the drill sizes which can be used for solid rivets made of mild steel.

Cut Countersinking

8. As stated previously, countersunk rivets are used where a flush finish is required. Cut countersinking consists of drilling the rivet hole and then machining a cone-shaped seating to receive the head of a 90 deg. countersunk rivet, but this process must not be employed on sheet metal of 22 S.W.G. or thinner because it would weaken the material. Countersinking may be done by using a rose bit, a "D" cutter (Fig. 3), or a large drill having a similar cutting angle to the angle of the rivet head. A stop should be used to ensure that the countersink is the correct depth—a short length of tube fitted over the cutting tool (Fig. 3) can be used for this purpose. Do not allow the stop to rotate, otherwise, the metal surrounding the countersink will be damaged.

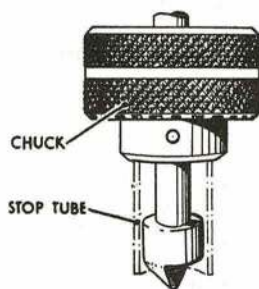


Fig. 3. "D" CUTTER

Forming a Snaphead

9. The riveter will frequently require the assistance of another airman to support (hold-up) the rivet with a tool called a dolly while the actual riveting is being done. To close a snaphead rivet proceed as follows:

- Mark the positions of the rivets, centre punch and drill the holes the correct size.
- Remove any burrs from the holes—a large drill fitted with a wooden handle

will be found useful for this operation—and ensure that there is no foreign matter on the jointing surfaces.

(c) To prevent relative movement between parts when they are being riveted together, they should be service bolted, i.e. temporarily held together with the aid of bolts, spaced one in every fourth hole, the bolts being removed as the riveting progresses.

AL 10

(d) Insert a rivet of correct length. Do not cut and file long rivets to length, if the correct length rivet is available; this is a waste of time and material, and it is almost certain that the size of the rivet heads formed will vary.

(e) Check the dolly and snap for correct size. Support the rivet head in the dolly, and place the set-up over the shank of the rivet (Fig. 4). Lightly tap the set-up with a hammer to bring the plates close together and the rivet head tight up against the face of the part. Remove the set-up and check the allowance.

(f) Give the point of the rivet a few heavy blows with the face of a hammer; this swells the shank of the rivet to fill the hole. Using the snap and a hammer, form the rivet head to the correct shape (Fig. 4).

Riveting Faults

10. The chief causes of faulty riveting (Fig. 5) are as follows:—

- Holes drilled to an incorrect size.
- Shank of rivet not perpendicular to the riveted parts prior to riveting, caused by the hole not being drilled square.
- Holes out of line caused by insufficient service bolting allowing relative movement of the parts.
- Allowance too great or too small.
- Parts not drawn together (perhaps due to burrs.)
- Incorrect clearance causing puckering of sheets.

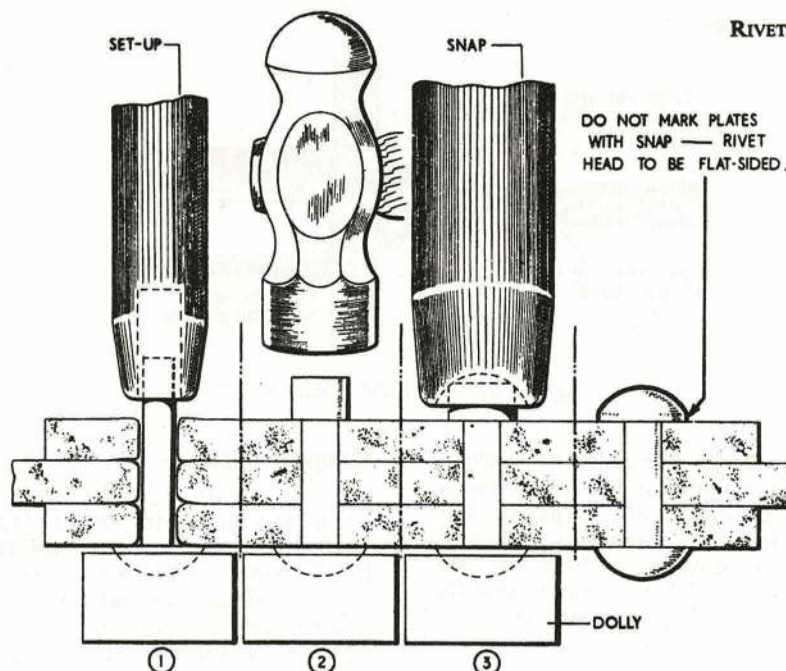


Fig. 4. SNAPHEAD RIVETING Showing Stages of Operation



CORRECT RIVET

RIVET TOO LONG—
DAMAGE TO RIVET AND
PLATE — EXCESSIVE NUM-
BER OF BLOWS.RIVET TOO SHORT—
SNAP CUTTING INTO
PLATE — WEAK HEAD.DOLLY NOT STRAIGHT
— OFFSET HEAD—MARKED
PLATE.SNAP NOT STRUCK
NORMAL TO SURFACE OF
PLATE — DAMAGE TO PLATE
AND WEAK HEAD.HOLE TOO LARGE —
WEAK HEAD AND LEAKAGE.INCORRECT SIZE OF
SNAP IN DOLLY.PLATES NOT HELD
TIGHTLY — DEFORMED
SHANK AND WEAK
JOINT.SPUN HEAD OR UNSUIT-
ABLE SNAP TOOL—HEAD
TOUCHING WORK ON RIM
LINE ONLY.

Fig. 5. RIVETING FAULTS

(g) Head not central with shank of rivet caused by incorrect use of the snap.

(h) Incorrect size of dolly or snap, causing damage to the plate or forming a bad rivet head.

Removal of Solid Rivets

11. If rivets are defective or for any other reason they have to be removed, care must be taken to avoid damage to the riveted material, particularly if it is thin sheet. To remove a solid rivet proceed as follows:—

(a) File a flat on the original head of the rivet; the original head is more likely to be central than the formed head.

(b) Support the rivet in a suitable dolly, and centre-pop the centre of the flat with a centre punch.

(c) Drill the head to a depth slightly less than the thickness of the rivet head, using a drill of the same diameter as the rivet shank (Fig. 6).

(d) Chip off the drilled head using a sharp chisel, the cut being in the direction of the line of rivets.

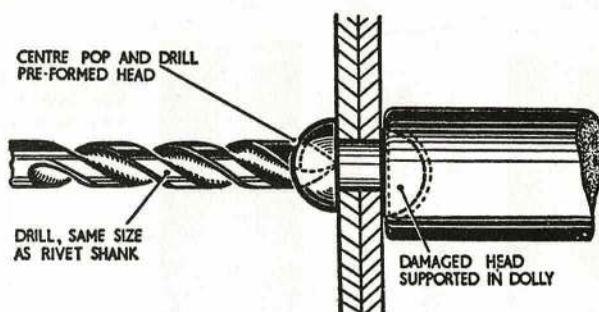


Fig. 6. REMOVAL OF SOLID RIVET

(e) Support the work locally to prevent buckling of the plate—a hardwood block drilled with a hole slightly larger in diameter than the rivet head will be found useful for this purpose. Drive out the rivet using a parallel pin punch slightly smaller in diameter than the rivet shank.

Riveted Joints

12. The position of rivets relative to one another and to the edge of sheet metal or plating is important. The rivets must not be too close together, or the excessive number of holes will weaken the joint. They must not be too far apart, or there will be too few to take the load, and in the case of a liquid-tight joint leakage would occur. The distance apart of rivets from centre to centre is known as the “pitch” and is stated in diameters (D). Rivets must not be too near the edge of the sheet, or they will tear through the metal when the joint is under load; the distance from the centre of the rivet to the edge of the sheet is termed “rivet landing”. These considerations, modified for practical reasons, determine the rivet spacing and pattern. The minimum distances are as follows:—

Pitch	4D
Rivet landing	$1\frac{1}{2}D$ to 2D
Distance apart of centre lines of rivet chains ..	3D to 4D

Note.—“D” is the rivet diameter.

13. Fig. 7 shows three typical methods of lap joint riveting. The single chain lap joint is used on lightly loaded joints, the double chain gives greater strength for more heavily loaded members, and the staggered arrangement is used where the joint must be both strong and liquid or gas tight.

Dimple Riveting

14. To obtain a flush finish on one side when riveting thin sheets (approximately 18 S.W.G. or thinner), solid rivets can be fitted, when authorized, by the dimple countersinking method (Fig. 8). In this process the rivet hole is drilled $\frac{1}{8}$ in. under-size, and a dimpling tool is used to dimple the sheets prior to inserting the rivet. 120 deg. countersunk rivets are inserted from the outside and closed by reaction or normal riveting, or, snaphead rivets may be inserted from the inside and closed by spreading the rivet end to fill the dimple; a rivet allowance of $\frac{3}{4}D$ should be used for this latter method.

Reaction Riveting

15. Solid rivets are closed as described previously (para. 9), or, when authorized, by the reaction method (Fig. 9). The clearances for both methods are the same but the allowance for reaction riveting is reduced to 1D.

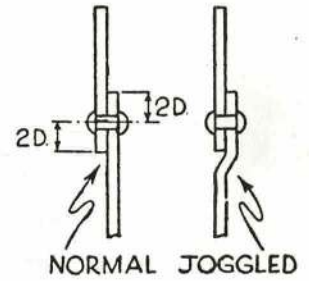
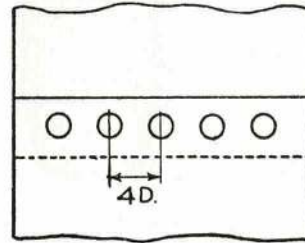
16. In reaction riveting, the pre-formed head of the rivet receives the blows; the snap is struck with a hammer while a metal block is held lightly against the end of the shank of the rivet. The block can be any convenient size or shape, but the face held against the rivet must be smooth and flat. The action of hammering the snap causes the reaction block to rebound, thus forming a flat head on the shank end of the rivet. The depth of the flat head should not be less than $\frac{1}{2}D$. Reaction riveting may also be applied to countersunk rivets, using as a snap a small round bar with a smooth flat end.

Tubular Riveting

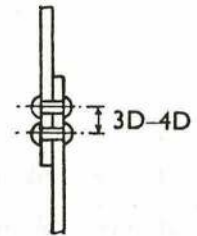
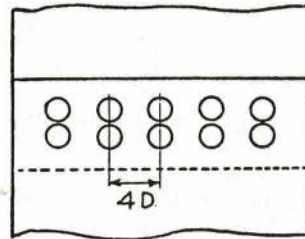
17. As the normal method of closing tubular rivets may buckle the rivet, tubular

Fig. 7.
EXAMPLES OF RIVETED
LAP JOINTS

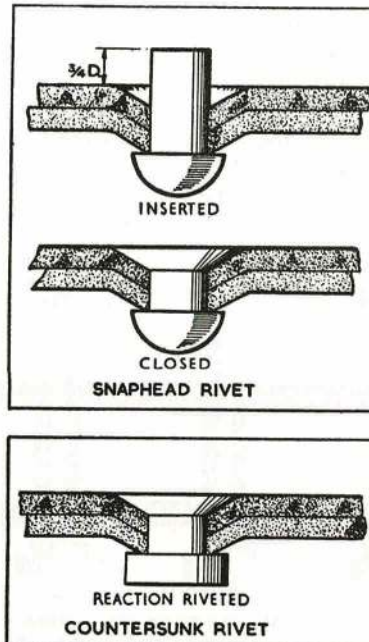
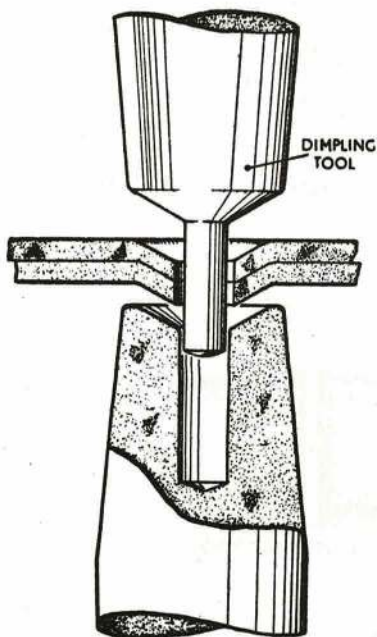
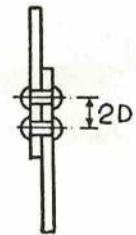
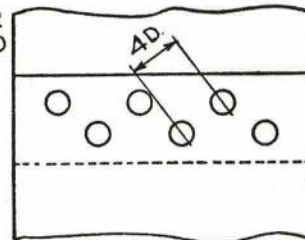
SINGLE
CHAIN



DOUBLE
CHAIN



ZIGZAG OR
STAGGERED



* Fig. 8. DIMPLE RIVETING

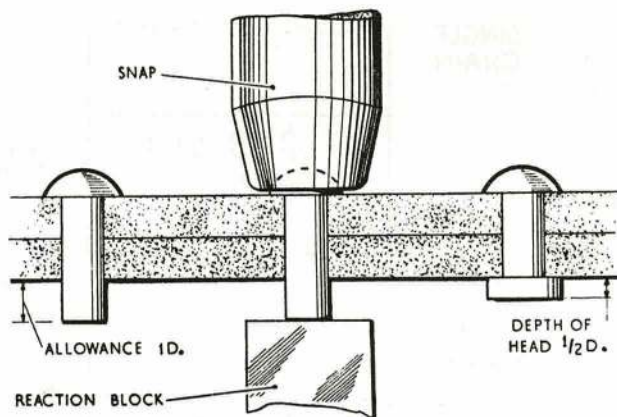


Fig. 9. REACTION RIVETING

rivets of $\frac{1}{8}$ in. diameter and smaller are usually closed by using a spinning tool (Fig. 10) operated in conjunction with a hand brace. Larger sizes of tubular rivets should be fitted as follows:—



Fig. 10. SPINNING TOOL

(a) Drill the hole $\frac{1}{8}$ in. smaller in diameter than that of the tubular rivet, and ream the hole to size.

(b) Using a large drill in a handle, countersink the hole slightly to allow the tubular head to bed. The countersinking removes the sharp edge which might cause the rivet head to crack.

(c) Slightly radius the end of the rivet, insert, and support the head in a dolly. Use a set-up to bring the head of the rivet tight against the tube (Fig. 11), then re-

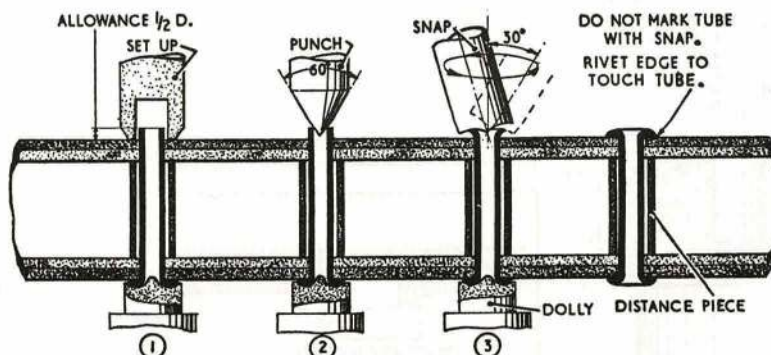
move the set-up and check the allowance ($\frac{1}{2}D$).

(d) With a punch or spreader, ground to 60 degs., open out the end of the rivet; if necessary, the splay of the end can be increased by use of a ball-pein hammer.

(e) Complete the closure with the tubular rivet snap, using a little oil on the snap to help prevent the rivet head cracking.

Distance Pieces

18. Mild steel distance pieces are often fitted to prevent hollow structures from being distorted or crushed when closing tubular rivets or tightening bolts. Distance pieces should be a close fit, and butt squarely against the inside faces of the structure. When fitting new parts care should be taken to replace the distance pieces in their correct positions. When removing rivets or bolts from closed-section members, follow through with lengths of wire to prevent the loss of distance pieces.



Showing Stages of Operation

Fig. 11. CLOSING TUBULAR RIVET

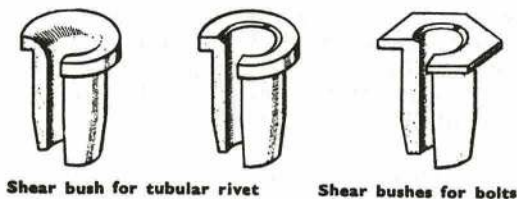
Shear Bushes

19. Shear bushes (Fig. 12), sometimes termed ferrules, are made of high tensile steel or high tensile stainless steel. They are fitted to take the shear load and are used in conjunction with tubular rivets, or bolts. The hole for a shear bush must be reamed to ensure a push fit (shear bush not free to rotate). Shear bushes for tubular rivets can be identified by the rounded portion inside the head, which accommodates the head of the rivet. Shear bushes for bolts are flat across the top of the head, with a slight chamfer at the hole.

SPECIAL RIVETS

Semi-Pierced Rivets

20. Semi-pierced rivets are solid, but have a hole drilled in the shank (Fig. 13) so that a head similar to that of a tubular rivet can be formed. Stainless steel rivets, which are usually brittle and difficult to close without fracture, are often of the semi-pierced type.



Shear bush for tubular rivet Shear bushes for bolts

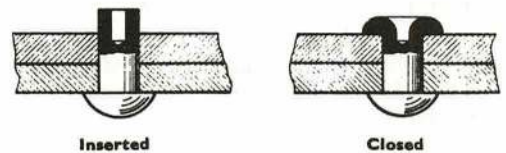
Fig. 12. SHEAR BUSHES

Cox Rivets

21. Cox type rivets are a special type of tubular rivet which are split longitudinally, and they are supplied with either flat or cone-shaped heads. They are cheap to produce and are manufactured from sheet or strip material. Unless otherwise stated, they may be replaced on repair work by ordinary tubular rivets. Flat-head Cox rivets are closed with tools similar to those used for ordinary tubular riveting, and cone-headed rivets are closed with the snap and dolly as shown in Fig. 14.

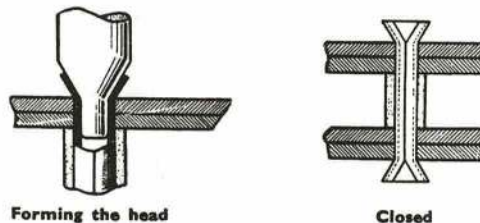
De-Bergue Rivets

22. These rivets are mainly used on the seams of fuel and oil tanks. They are normally closed with the aid of a riveting tool, the head of the rivet being forced into the plating, thus making a dimple which helps the plates to resist shear; a snaphead is formed to close the rivet (Fig. 15). For repairs, leaking rivets may be replaced by special bolts fitted with a Petrolite packing washer under the head.



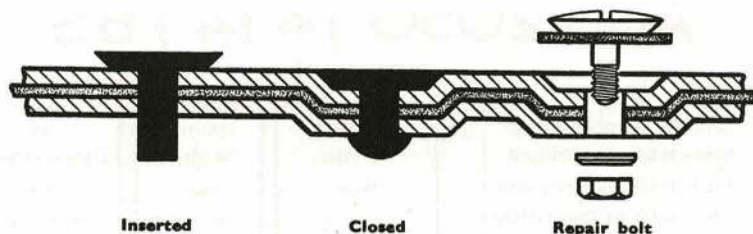
Inserted Closed

Fig. 13. SEMI-PIERCED RIVET



Forming the head Closed

Fig. 14. CONE-HEAD COX RIVET



Inserted Closed Repair bolt

Fig. 15. DE-BERGUE RIVET AND REPAIR BOLT

Rivnuts

23. Rivnuts are hollow rivets, the end being either open or closed (Fig. 16). They are virtually anchor nuts in rivet form, and are used for the attachment of components such as treadways to sheet metal floors. They are inserted and riveted from one side of the plating, the procedure for closing being as follows:—

(a) Drill the correct size hole for the rivnut. Chamfer the edges of the hole slightly to ensure removal of burrs and sharp edges.

(b) Using the special cutting tool provided, cut a keyway in the hole.

(c) Screw the internally threaded rivnut on to the threaded end of the closing tool and insert the rivnut into the hole, ensuring that the projecting key, formed beneath the head during manufacture, engages with the keyway; this prevents the rivnut turning when a screw is screwed into or out of it.

(d) Push the rivnut well home into the hole. Hold the closing tool firmly at right angles to the surface of the work, and operate the handle until a solid resistance is felt; the rivnut will then be closed.

(e) Rotate the small handwheel at the end of the closing tool to remove the threaded spindle from the rivnut.

Note.—When rivnuts are not in use due to the removal of a component, the rivnuts should be blanked-off by means of special screws.

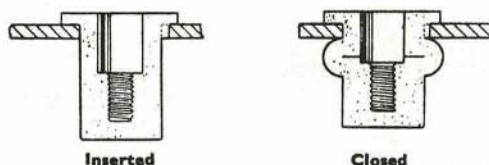


Fig. 16. RIVNUT

AGS. 2050 / 4 14 / BS

A. G. S. 2048 = M.G. 5.- DOMED HEAD - 2049 = M.G. 5.- COUNTERSUNK - 2050 = D.T.D. 10-DOMED HEAD - 2051 = D.T.D. 10-COUNTERSUNK	DIAMETER IN 32nds. INCH i.e. $\frac{1}{8}$ in.	LENGTH IN $\frac{1}{100}$ INCH i.e. 0.14 in.	BS = BREAK-STEM BH = BREAK-HEAD
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Fig. 17. IDENTIFICATION-TUCKER POP RIVETS

Tucker Pop Rivets

24. These rivets are hollow and are supplied mounted on a mandrel. They are used for the riveting of thin gauge metal, and can be utilized in positions where one end only of the rivet is accessible (blind riveting). A riveting tool (lazy tongs, Fig. 18) is provided for closing this type of rivet.

25. Rivets are available made of various metals including aluminium alloy M.G. 5, and monel metal D.T.D. 10. The aluminium alloy rivets are dyed green, and those made from monel metal are cadmium plated; they are either dome, or countersunk (120°) head form. The rivet sizes commonly used are $\frac{1}{8}$ in., $\frac{5}{16}$ in., and $\frac{3}{8}$ in. diameters made of aluminium alloy, and $\frac{1}{8}$ in., $\frac{5}{16}$ in., and $\frac{3}{8}$ in. diameters made of monel metal.

26. The mandrels are made of high tensile steel and are supplied in two forms, break-head (Fig. 19) and break-stem types. The break-stem type has a waisted shank and breaks below the head, thus trapping the broken head portion in the rivet. Rivets with break-head mandrels are used in circumstances where the broken-off portion of the mandrel will not be trapped in the structure; rivets with break-stem mandrels must be used in all other circumstances.

27. **Identification.** Tucker pop rivets are identified by A.G.S. numbers printed on the carton in which the rivets are supplied, e.g. A.G.S. 2050/414/BS. As illustrated (Fig. 17), the numbers indicate the material,

type of head, diameter and length of the rivet; BS indicates that the rivet is closed by use of a break-stem mandrel.

28. Drilling Procedure and Rivet Closing. The drill sizes for varying diameters of rivets are as for Chobert rivets (para. 40). The procedure for closing rivets with the aid of lazy tongs is described in the following paragraph; when a power-operated Pop Riveter Type P.G.O. 3 is used, rivet closing is similar to that described later for Avdel rivets.

29. Using Lazy Tongs. When this type of closing tool (Fig. 18) is used, the operation of closing a Tucker pop rivet (Fig. 19) is as follows:—

(a) Fully extend the lazy tongs and insert the shank of the mandrel into the jaws of the chuck.

(b) Slightly compress the lazy tongs so that the jaws grip the mandrel, then insert the rivet into the hole.

(c) Hold the chuck containing the rivet firmly against and square to the surface being riveted; compress the lazy tongs. This action causes the head of the mandrel to close the rivet and then to break off.

30. Break-head type rivets, when used externally, should be plugged so as to make the structure weatherproof. This can be done by coating rivet interiors with jointing compound and filling them with a mixture of putty and jointing compound. Alternatively, they may be sealed with a wooden plug, e.g. a match-stick dipped in rubber-resin cement, the protruding part of the plug being cut off when the cement has set.

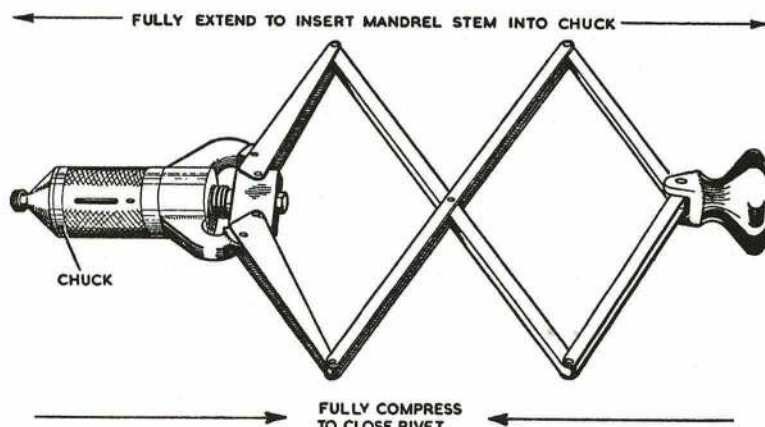


Fig. 18. TUCKER POP RIVETING TOOL (LAZY TONGS)

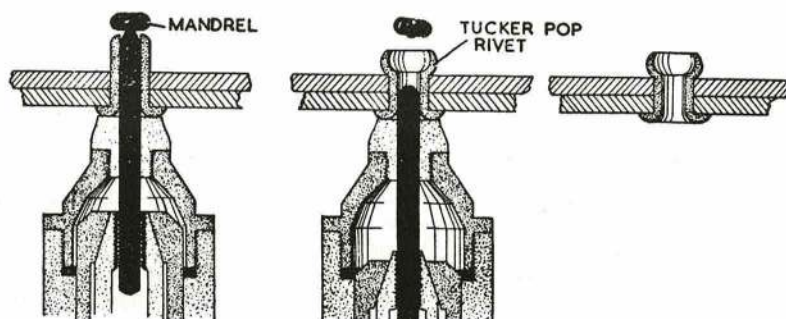


Fig. 19. CLOSING TUCKER POP RIVET—BREAK-HEAD TYPE

Tucker Cup Rivets

31. Tucker cup rivets are similar to Tucker pop rivets, but the shank end is not open (Fig. 20). They are used for riveting thin gauge material where both ends of the rivet are accessible. To close a Tucker cup rivet a "squeeze" type of riveting tool is used.

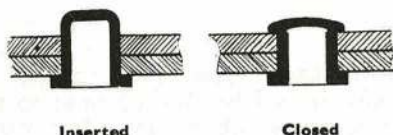


Fig. 20. TUCKER CUP RIVET

Avdel Rivets

32. Avdel rivets are hollow and similar to break-stem pop rivets. The rivets and mandrels are supplied as complete assemblies, the mandrel being housed in the rivet. The rivet sizes commonly used are $\frac{1}{8}$ in., $\frac{5}{32}$ in., and $\frac{3}{16}$ in. diameters, and are available in aluminium alloy, L.69 (hiduminium), with either snap or countersunk (120°) head form. The light alloy mandrel is pulled through the rivet by the riveting tool causing the shank to expand, but owing to its shape and that of the mandrel, the rivet shank curls and secures the mandrel head before the mandrel shank breaks. The rivets and mandrels are greased before packing, and should not be greased further in any way, as excessive lubrication may result in too low mandrel push-out values.

33. **Identification.** Avdel rivets are identified by code numbers on the carton in which they are supplied, e.g. 402/405, 422/510, etc. As illustrated (Fig. 21), the numbers 402/405 indicate Avdel self-sealing snap-head, L.69 rivet, $\frac{4}{32}$ in. ($\frac{1}{8}$ in.) diameter, and $\frac{5}{32}$ in. long

34. **Drilling Procedure.** To obtain the strongest joint the expanded rivet when placed must completely fill the hole, therefore, it is advisable that holes are pilot drilled and then opened out to final hole size with the correct drill. Holes for dimple riveting should be pilot drilled, dimpled and then opened out by drilling, or by the use of a dimpling punch of the same diameter as the recommended drill size.

Note.—Sheets should be tightly clamped together whilst drilling to prevent swarf collecting between them, and all burrs should be removed from the holes before riveting.

35. **Avdel Sheet Grippers.** To ensure that the sheets are pulled tightly together when drilling, and to prevent relative movement of the sheets when riveting, the sheets should be service bolted with grippers (Fig. 22), spaced one in every fourth hole. To fit the gripper, spin the locknut to unscrew, and push the centre spindle forward. Insert the spindles into the hole and pull the threaded spindle against the sheets; spin the locknut to tighten as required.

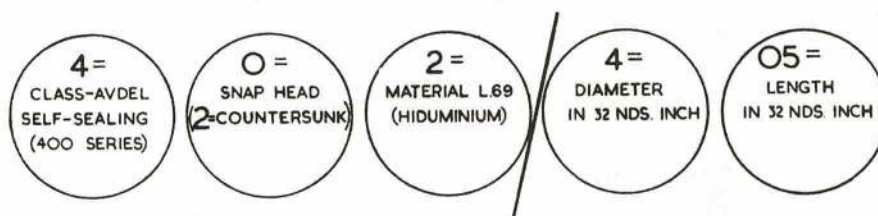


Fig. 21. IDENTIFICATION-AVDEL RIVETS

Diam. of Rivet	Pilot Drill	Final Drill	Permissible Limits on Drilled Holes
$\frac{1}{8}$ in.	2.5 mm.	3.2 mm.	.128—.131 in.
$\frac{5}{32}$ in.	3.2 mm.	4.0 mm.	.160—.163 in.
$\frac{3}{16}$ in.	4.0 mm.	4.75 mm.	.190—.193 in.

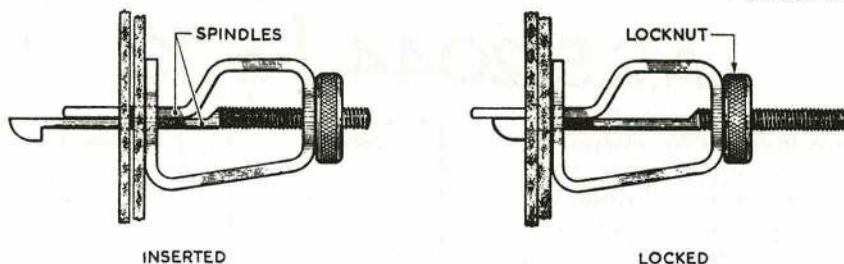


Fig. 22. AVDEL SHEET GRIPPER

36. **Rivet Closing (Type F Riveter).** Check the riveter for correct operation by pressing the push-button and holding it momentarily before releasing; the barrel should have extended a full $\frac{7}{8}$ in. and fully retracted during this test. Do not test the riveter by closing a rivet out of the sheets; without the resistance offered by the sheets, the mandrel will be drawn through the rivet and will jam itself into the cone tip before breaking. Having checked the riveter for serviceability, proceed as follows:—

(a) Fit the correct size of front cone—cones are marked with the diameter of rivet for which they are intended. The rivet assemblies can either be inserted into the drilled hole and the riveter subsequently applied to the mandrel stem, or, the assembly can be loaded to the riveter first, and then applied to the drilled hole.

(b) The riveter should be held firmly against and normal to the sheet, the push-button being operated until the mandrel stem breaks, when the button should be released. This action expands the rivet shank into the hole, forms a tulip head at the tail of the rivet, and failure of the mandrel at the breaker groove leaves a short length of stem standing proud above the rivet (Fig. 23).

(c) This part of the mandrel stem is then trimmed off flush with the rivet head with

the aid of suitable end nippers or side-cutters, preferably of the flush-cutting type. To obtain an absolutely flush finish to countersunk rivet heads, the remaining mandrel pip should be removed by the use of a rivet milling tool (para. 82).

Chobert Rivets

37. Chobert rivets are similar to Tucker pop rivets except that the hole is tapered. They are used where one end only of the rivet is accessible. The rivet sizes commonly used are $\frac{1}{8}$ in., $\frac{5}{16}$ in., and $\frac{3}{8}$ in. diameters, and they are available made of aluminium alloy, L.69 (hiduminium), L.37 (duralumin), and D.T.D. 821 (steel); duralumin rivets must be normalized before closing. The rivets are either snap or countersunk (120°) head form, and the mandrel is made of high tensile steel. In Chobert riveting, the head of the mandrel is pulled through the rivet but is not broken off. The rivets are closed by a special riveting tool, similar in principle to the lazy tongs; a magazine type of riveting tool is also available which carries a number of rivets on the mandrel, thus avoiding a waste of time in threading rivets individually after each closing.

38. **Identification.** Chobert rivets are identified by A.G.S. numbers printed on the carton

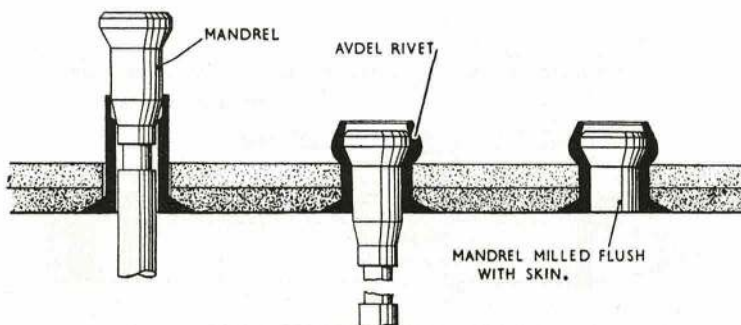


Fig. 23. CLOSING AVDEL RIVET

A.G.S. 2044 / 5 10

A.G.S. 2040=D.T.D. 720-SNAPHEAD 2041=D.T.D. 720-COUNTERSUNK 2043=L.37-SNAPHEAD 2044=L.37-COUNTERSUNK 2045=L.69-SNAPHEAD 2046=L.69-COUNTERSUNK	DIAMETER IN 32nds. INCH i.e. $\frac{5}{32}$ in.	LENGTH IN 32nds. INCH i.e. $\frac{5}{16}$ in.
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Fig. 24. IDENTIFICATION-CHOBERT RIVETS

in which the rivets are supplied, e.g. A.G.S. 2044/510. As illustrated (Fig. 24), the numbers indicate the material, type of head, diameter and length of the rivet.

39. Sealing Pins. Where additional strength or water-tightness is required, the rivets after they have been closed are plugged with sealing pins. Those used with L.37 and L.69 rivets are made to specification L.1 or D.T.D.423, while steel pins made to specification S.1 are used with the steel rivets. Sealing pins are provided to suit all sizes of Chobert rivet, but steel pins must be used only with steel rivets. The method of identifying the material, diameter and length of sealing pin is by A.G.S. number, e.g. A.G.S. 2042/404 is a mild steel sealing pin of $\frac{1}{8}$ in. diameter and $\frac{5}{8}$ in. long, while A.G.S. 2047/404 is a sealing pin of the same size but made of aluminium alloy. Sealing pins are driven into position by the use of a light hammer or pneumatic sealing pin driver; to seal countersunk rivets, the next shorter-sized pin can be used if desired.

40. Drilling Procedure. To obtain the strongest joint, and for rivets which are to be

pinned, it is absolutely essential to have the correct size hole and a mandrel that is not worn. The following table gives the correct sizes of holes and drills for the various rivet diameters.

Diam of Rivet	Drill Size	Diam. of Hole
$\frac{1}{8}$ in.	3.2 mm.	.129 in.
$\frac{5}{32}$ in.	4.0 mm.	.161 in.
$\frac{3}{16}$ in.	4.75 mm.	.191 in.

41. Hand-Operated Riveting. The operation of closing a Chobert rivet using a hand-operated riveter (Fig. 25) is as follows:—

(a) Ensure there is no swarf on the mandrel head, then smear the head with grease XG-275.

(b) Place the rivet on the mandrel, and work up and down to ensure that the rivet bore is lubricated.

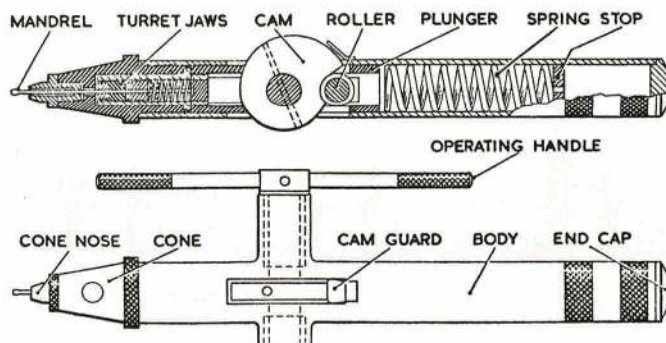


Fig. 25. SINGLE-ACTING CHOBERT RIVETING TOOL

(c) Turn the riveting tool operating handle in an anti-clockwise direction as far as it will go, to ensure that the turret jaws are open. In this position the handle is in line with the body of the tool.

(d) Insert the mandrel, and push until the head of the rivet rests on the nose of the riveting tool.

(e) Place the rivet into the hole and push well home, holding the riveting tool firmly at right angles to the surface of the work.

(f) Steady the riveting tool against the body, if possible, and turn the operating handle in a clockwise direction to pull the mandrel through the rivet; when resistance ceases, the rivet is secured (Fig. 26).

42. Owing to the method of fitting Chobert rivets, the correct allowance and size of rivet hole to drill is of great importance. This information is given in the instructions issued with the riveting tool and in the Vol. 6; the cutting of a Chobert rivet to length is prohibited.

43. **Rivet Closing (Type D Riveter).** Check the riveter barrel for correct operation by pressing the push-button, and holding it momentarily before releasing. The barrel should extend 1 in. and then fully retract again during this test. If the test is satisfactory, proceed as follows:—

(a) Fit the correct size front jaw assembly to suit the size of rivet to be closed. Select the correct size of mandrel and lubricate with grease, XG-275. Load the mandrel with rivets, shank-end foremost, and fit the mandrel spring; with $\frac{1}{8}$ in. diameter rivets, fit the small end of the spring against the head of the rear-most rivet. Slide the rivets up and down the mandrel to ensure that their bores are thoroughly lubricated.

(b) To load the riveter slacken off the tail jaw assembly, and slide the loaded mandrel into the front jaws as far as it will go. Support the riveter on the bench and, holding the front jaw (spring loaded) with one hand, slightly raise the jaws with the other hand and use the mandrel gently as a lever to open the jaws. Push the loaded mandrel down into the riveter until just one rivet is left projecting beyond the front jaws; adjust the mandrel until the gap between the head of the rivet and the front jaws is $\frac{1}{8}$ in. Hand tighten the tail jaw assembly.

(c) Before riveting, ensure that the faying surfaces are held rigidly in contact by sheet grippers, that swarf is not trapped between the sheets, and that the rivet holes are free from burrs. The riveter should be held firmly against and normal to the sheet, then the push-button should be depressed to close the rivet. When the push-button is released, the next rivet will feed forward outside the rivet jaws, ready for the procedure to be repeated.

(d) When the stack of rivets on the mandrel is exhausted, the front end of the mandrel spring will project through the front jaw assembly. To remove the mandrel, slacken off the tail jaw assembly and, use the fingers to withdraw the mandrel from the front jaws. If the mandrel is gripped by either the tail jaws or the cursor assembly, push or lightly tap the mandrel back into the riveter to free it from the grip of the jaws or steel balls, and withdraw the mandrel.

(e) To reduce the speed and power of the riveter, which may be necessary when riveting thin sheets or closing small diameter rivets, slacken off the adjuster nut on the push-button by a fraction of a turn. This will pull the push-button plunger forward, so that when the push-button is depressed, only part of the waisted

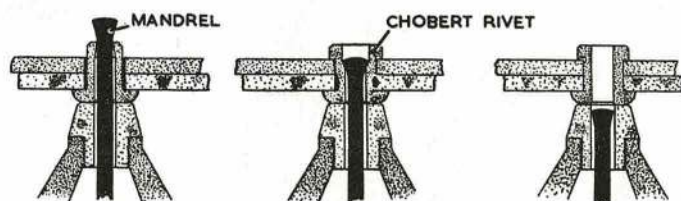


Fig. 26. CLOSING CHOBERT RIVET

portion of the plunger will register with the rear passage, thus restricting the supply of compressed air to the riveter.

POWER-OPERATED TOOLS

Avdel Riveter and Intensifier, Type F

44. This equipment (Fig. 27) is used for closing Avdel rivets and, by fitting a different front assembly to the riveter, may be used to close Chobert rivets, etc. The riveter is hydraulically operated; the intensifier, which is supplied with compressed air, enables an intensified hydraulic pressure to be applied to the riveter. To suit the size of rivet to be closed, various sizes of interchangeable front cones are supplied with the riveter, the rivet sizes commonly used being $\frac{1}{8}$ in., $\frac{5}{32}$ in., and $\frac{3}{16}$ in. diameters.

45. The riveter is connected to the intensifier by a hydraulic hose which retains the hydraulic fluid under pressure between the riveter piston and the intensifier oil piston. An

air release pipe from the riveter, containing an air release valve operated by the riveter push-button, is connected to the front of the shuttle valve body of the intensifier; the compressed air inlet is situated at the rear of the shuttle valve body.

46. Hydraulic fluid is contained in a small reservoir on the intensifier, the contents of which can be checked through the sight glass—the level should be maintained above half-way up the glass, topping-up being done after removal of the filler plug. The riveter will operate at pressures of from 20 lb. to 60 lb. per sq. in., but the pressure should never exceed 80 lb. per sq. in.—too high pressures result in excessive speed of riveter operation with consequent reactive kick. The speed of the tool is controlled by adjusting the air restrictor screw on the shuttle valve body, and operating pressure should be maintained at slightly more than that necessary to close the rivet. The initial pressure setting is made by adjustment of

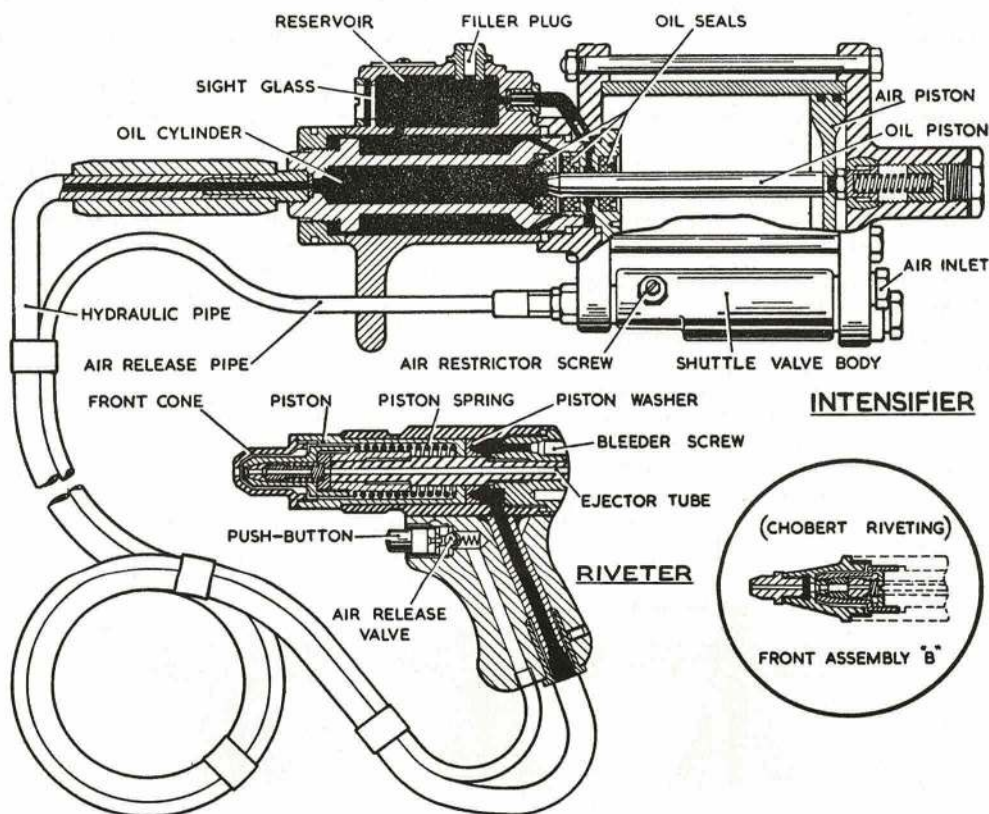


Fig. 27. AVDEL RIVETER AND INTENSIFIER, TYPE F

an air control unit on the intensifier (not illustrated).

47. An oil piston in the intensifier is secured to a large air piston upon which compressed air is directed. The oil piston is of small diameter and slides in the oil seals of the intensifier oil cylinder. Because of the difference between the cross-sectional areas of the oil and air pistons, the pressure generated within the oil cylinder is considerably greater than that applied to the air piston.

48. When the riveter operating push-button is depressed (Fig. 28), the air release valve opens and allows air from the intensifier shuttle valve body to escape to atmosphere. This disturbs the balance of air pressure on the shuttle valve and pellet, which move forward and permit the compressed air to act on the rear face of the air piston. At the same time, the shuttle valve allows air from the front of the air piston to escape to atmosphere through an exhaust port in the shuttle valve body. This action causes the air piston to move the oil piston into the oil cylinder and supply oil under pressure to the riveter via the hydraulic pipe.

49. Immediately fluid pressure is applied to the riveter piston washer, the piston moves forward. As the mandrel is held static by the jaw assembly, the front cone to which the piston is attached forces the

rivet over the tapered head of the mandrel, thus swelling the shank and closing the rivet. When the rivet head is correctly formed on the blind side, the joint becomes solid and the mandrel stem breaks.

50. When the riveter operating push-button is released (Fig. 29), the air release valve closes and pressure is built up in the air hose. This pressure causes the intensifier shuttle valve and pellet to move rearward and uncover drillings through which air is directed to the front of the intensifier air piston; the movement of the shuttle valve also uncovers the port in the shuttle valve body, thus permitting air behind the piston to escape. The compressed air acting on the front of the air piston drives the piston back to the starting position, in readiness for closing the next rivet.

51. When the oil pressure in the riveter drops the spring returns the riveter piston to its rearward position and, at the same time, the riveter jaws release the broken-off portion of the mandrel stem. The spent mandrel stem is automatically ejected through the ejector tube at the rear of the riveter barrel as the next rivet is inserted.

52. **Bleeding.** The full stroke of the barrel containing the riveter piston washer should be $\frac{7}{8}$ in., and any loss of stroke is caused by air in the system which must be eliminated

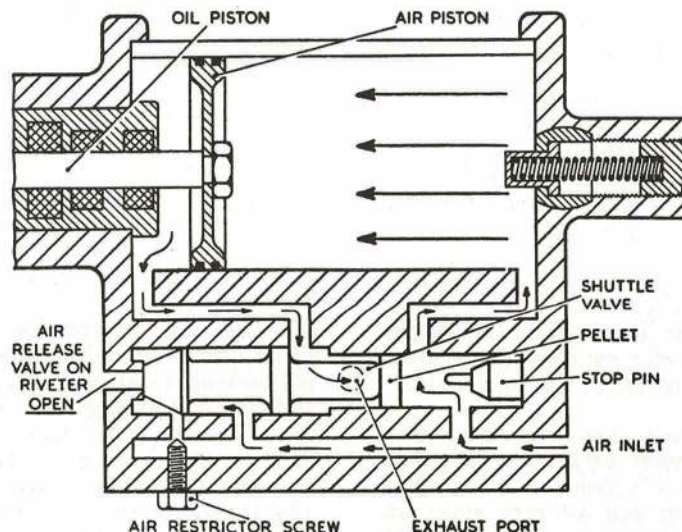


Fig. 28. PUSH-BUTTON DEPRESSED

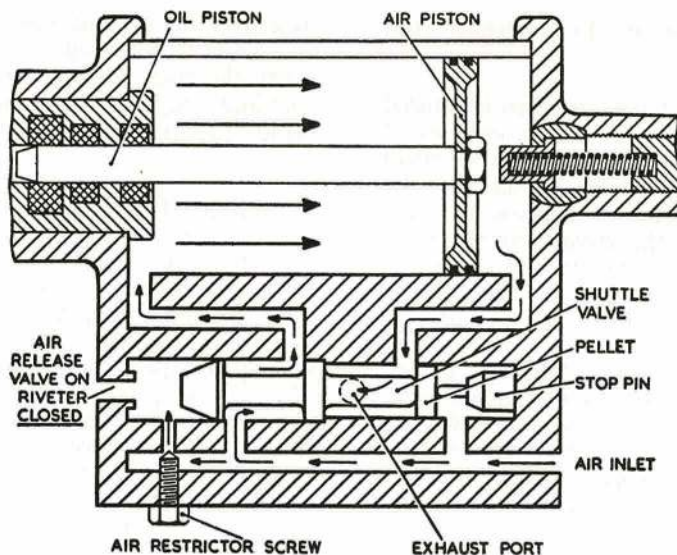


Fig. 29. PUSH-BUTTON RELEASED

and replaced with fluid from the reservoir. When this happens, place the intensifier on the bench and operate the riveter at floor level. By this method priming is automatic and the full stroke should soon be regained, provided an adequate supply of hydraulic fluid is maintained in the intensifier reservoir. When priming, keep the hose free from sharp bends to ensure an easy flow, and tap the hose to assist clearance of the air bubbles. If full stroke is not recovered, or when the system is empty, place the intensifier on the floor, and lightly clamp the riveter handle in a vice on the bench, the bleeder screw at the rear of the riveter to be set at its highest point. Ensure there is ample fluid in the reservoir and, with the operating push-button depressed, loosen the bleeder screw not more than one-eighth of a turn. On completion of the forward stroke, close the bleeder valve and release the push-button, allowing the barrel to return to its normal position. Repeat this sequence of operations until the fluid flowing from the bleeder screw is free from bubbles, then tighten the bleeder screw. The intensifier requires no attention other than maintenance of the fluid level.

53. Caution. When handling or transporting the intensifier care must be taken to keep it upright, otherwise, fluid will leak from the vent plug and air may enter the system. When priming, it should not be necessary to remove the bleeder valve screw. If for any reason it is removed, care must be

taken to see that the $\frac{1}{8}$ in. ball seal under the screw is not blown out or lost. Only the approved hydraulic fluid (OM-15) must be used when recharging or priming the intensifier; if vegetable fluid is used it will harm the composition glands and hose.

Notes. 1. For riveting in positions not otherwise accessible, the front assembly may be removed and fitted to a right-angled head extension, which is then screwed into the front of the riveter.

2. A pin tester is provided for checking the minimum mandrel push-out value of closed rivets; this value should not be less than 15 lb.

3. The operation of the intensifiers of the Chobert repetition riveter, Type C, and the Pop riveter, Type P.G.O.3, is similar in principle to the intensifier of the Avdel riveter, Type F.

Chobert Repetition Riveter, Type D

54. This riveter (Fig. 30) is pneumatically operated and is used for closing Chobert rivets. It is provided with interchangeable self-locking front jaw assemblies, mandrels and mandrel springs to suit rivets of $\frac{1}{8}$ in., $\frac{5}{16}$ in., and $\frac{3}{8}$ in. diameters. The riveter incorporates an automatic feed which accommodates a number of rivets, not exceeding $12\frac{1}{2}$ in. along the mandrel; the maximum number that may be loaded depends on the length of rivet used, e.g. 50 rivets, if their length is $\frac{1}{4}$ in.

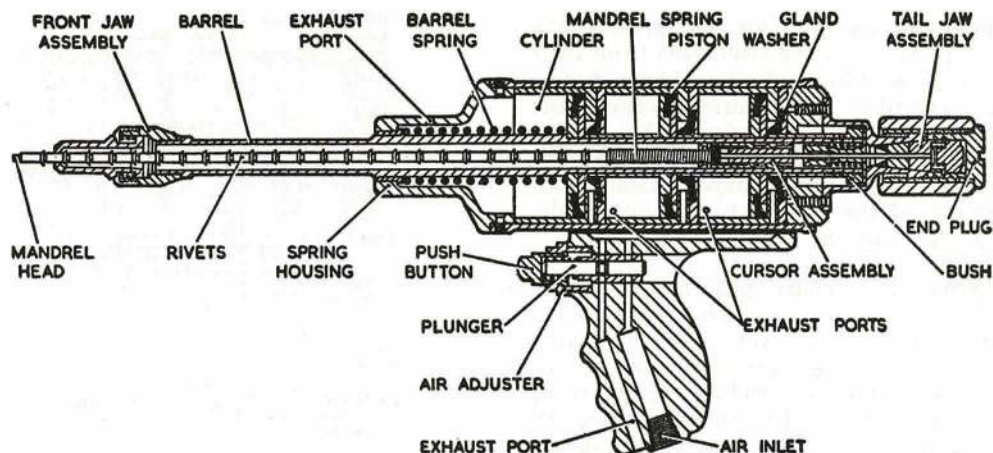


Fig. 30. CHOBERT REPETITION RIVETER, TYPE D

55. The riveter consists of a cylinder containing a multi-piston which moves a sliding barrel. A long mandrel, on which the rivets are threaded, passes down the centre of the barrel and is held in the jaws of a chuck in the tail end of the tool. On the front of the barrel is secured the front jaw assembly which, when the tool is operated, forces the rivet over the tapered head of the mandrel, thus closing the rivet. The automatic feed is provided by a cursor assembly inside the barrel. A push-button on the handle assembly is used to operate the tool, and suitable drillings allow the compressed air to move the multi-piston forward. Air trapped behind the multi-piston escapes to atmosphere through various exhaust ports drilled in the cylinder casing. A spring is used to move the multi-piston to the rear.

The air pressure required to operate the riveter is 60-80 lb. per sq. in.

56. When the riveter push-button is depressed (Fig. 31), the push-button plunger moves to the rear so that its waisted portion lines up with the rear drilling in the handle, thus admitting compressed air through various drillings to the cylinder. This air pressure forces the multi-piston and barrel forward until the bush at the rear end of the barrel contacts the face of the counter-bore. Air in the spaces in front of the piston washers is forced out to atmosphere through exhaust ports in the casing and spring housing.

57. As the mandrel is held static by the tail jaw assembly, the noses of the jaws of the front jaw assembly force the rivet over the tapered head of the mandrel, thus swelling the shank and closing the rivet. During this action (Fig. 32), the cursor ring gripping the barrel moves the cursor shell with the barrel, while momentarily the cursor plunger

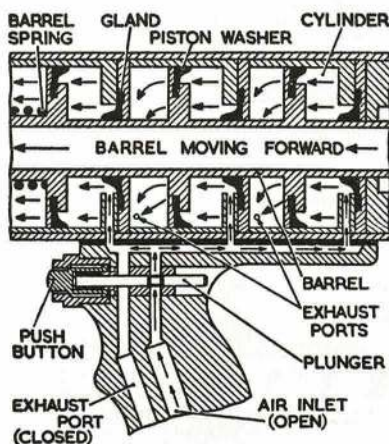


Fig. 31. PUSH-BUTTON DEPRESSED

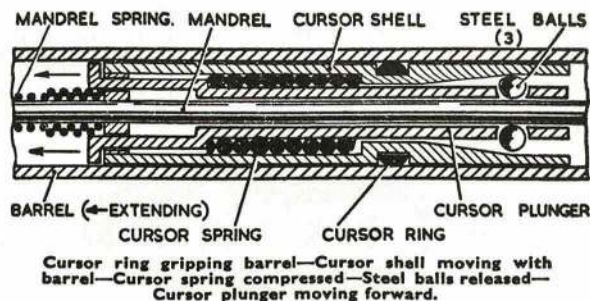


Fig. 32. BARREL EXTENDING

remains stationary. This compresses the cursor spring, frees the steel balls from their grip on the mandrel and makes the complete cursor assembly move forward along the mandrel. Thus, the cursor assembly applies pressure to the mandrel spring and the stack of rivets, forcing them to move forward until the shank of the second rivet contacts the tapered head of the mandrel.

58. When the riveter push-button is released (Fig. 33), the compressed air to the riveter is shut off, and the air in the spaces between the piston washers of the multi-piston passes through drillings to the front passage of the handle, thus escaping to atmosphere. This allows the barrel spring to retract the barrel.

59. As the barrel retracts (Fig. 34), the cursor ring tends to move the cursor shell with the barrel, but the tapered rear portion of the shell forces the steel balls to grip the mandrel and lock the cursor assembly, while the mandrel spring and the stack of rivets, while the mandrel spring maintains end pressure on the rivets.

60. The jaws of the front jaw assembly (Fig. 35) are spring-loaded, and as the barrel continues to retract, the jaws contact the shank and then the underside of the head of the next rivet. The jaws are now pulled forward against their spring and are separated by the head of the rivet and, after riding over

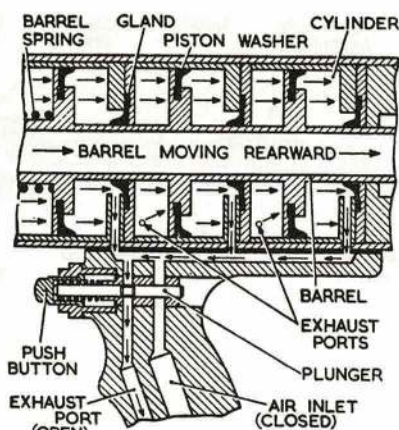


Fig. 33. PUSH-BUTTON RELEASED

the head of the rivet they close around the following rivet shank, ready for the rivet insertion and closing operation to be repeated.

61. **Adjustment.** The amount of compressed air consumed by the riveter at full pressure is approximately $\frac{1}{2}$ cu. ft. of free air per actuation, but this may be reduced, when the smaller-diameter rivets are being used, by decreasing the air pressure required to operate the riveter. Similarly, if the broaching action of the riveter is too abrupt and causes swarfed heads, the speed of operation of the riveter can be retarded (as necessary). To reduce the consumption of air, or to

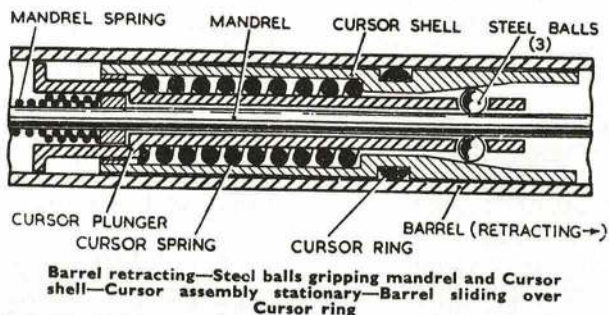


Fig. 34. BARREL RETRACTING

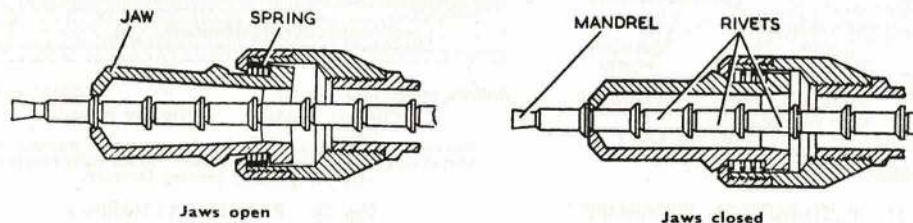


Fig. 35. FRONT JAW ASSEMBLY

regulate the operating speed of the riveter, slacken the adjuster on the boss of the push-button control valve by a fraction of a turn at a time until the desired setting is obtained.

62. The riveter must be kept clean and well lubricated. To prevent the glands and piston washers from becoming dry, a few drops of light machine oil (OM-21) should be put into the casing and spring housing exhaust ports at weekly intervals, or oftener if the riveter is in constant use.

63. The mandrel should frequently be polished with metal polish, as it is liable to become badly scored or worn while in use. The head of the mandrel must not be reduced by more than .002 in.: a monthly check is to be made for serviceability, the head being measured with a micrometer. Undersized mandrels must be rejected, because if they are used the expansion of the rivets by the riveter will be insufficient.

64. Using a soft cloth, all swarf must be wiped away from a mandrel before it is loaded with rivets. If there is any left, the mandrel should be set up in the chuck of a drill and, during rotation, cleaned and polished with the aid of a folded piece of fine emery cloth. Swarf usually accumulates about half-way up the mandrel head, so it should not be necessary to carry the emery cloth over the head; care must, however, be taken not to reduce the diameter of the head of a mandrel below the limit given, i.e.—.002 in.

Note.—During the rotation of the drill the mandrel should be supported about half-way with the left-hand, otherwise, it may cause injury by whipping.

65. Incorrect operation of the automatic feed may be caused by insufficient clearance between the jaws of the front jaw assembly and the head of the first rivet, by tightness of the rivet on the mandrel, by use of the wrong front jaw assembly, by a defective cursor assembly, or by mandrel slip. If the rivet feed is unsatisfactory, slacken the tail jaw assembly, pull the mandrel forward until the front jaws expose $\frac{1}{8}$ in. of the shank of the second rivet, and then tighten the tail jaw assembly.

66. Tightness of the rivets on the mandrel may be caused by lack of lubrication; use

grease XG-275 on rivets and mandrel. Other causes may be a bent mandrel, an accumulation of swarf on the mandrel, or the use of the wrong size of mandrel or rivets; rectify accordingly. Front jaw assemblies are clearly marked to denote their size.

67. To remove the cursor assembly, slacken the tail jaw assembly, remove the mandrel and its spring from the front jaws, unscrew the front jaw assembly and pull the cursor assembly out of the barrel. Wash the cursor assembly in clean kerosine, mount the assembly on a mandrel and test the operation of the plunger by hand. Unsatisfactory movement of the plunger may be caused by a broken or weak spring, defective steel balls, internal corrosion of the assembly, or a combination of these faults. Before inserting the cursor assembly, wipe it dry and lubricate the plunger with light machine oil (OM-21).

68. Mandrel slip may be caused by worn jaws in the tail jaw assembly. To change the jaws, unscrew the end plug (the knurled casing must not be removed) and shake out the spring, jaws and turret. Fit the new jaws into the turret (small end to small end) and, inverting the riveter, place the turret and jaws into the tapered bore. Replace the spring and end plug.

69. **Caution.** The use of pliers to remove a tight mandrel is prohibited; if the mandrel cannot be removed by the fingers, the riveter must be dismantled. The tail jaw assembly must be tightened only by hand as the use of tools or a vice may cause damage.

Note.—The operation of the automatic feed of the Chobert repetition riveters Types C and R is similar in principle to that of the Type D.

Pneumatic Riveting Hammers, Types H and J

70. These power-operated riveters are used for closing solid rivets of $\frac{3}{8}$ in., $\frac{1}{2}$ in., and $\frac{5}{8}$ in. diameter. The barrel of the Type J riveter (Fig. 36) is 1 in. longer than that of the Type H, otherwise the riveters are identical and are similar in operation.

71. **Description.** The riveting hammers consist of an assembly of barrel parts enclosing a plunger, screwed to a handle assembly. A

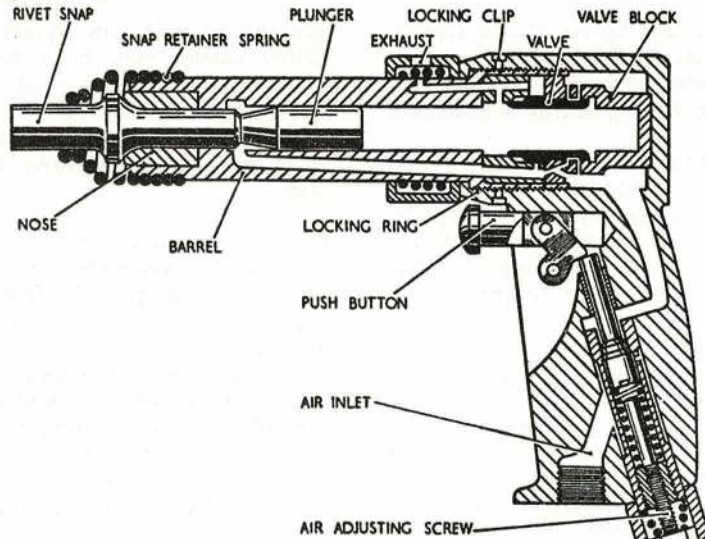


Fig. 36. PNEUMATIC RIVETING HAMMER, TYPE J

sliding tubular valve, housed in a valve block, is incorporated at the rear end of the barrel. The handle assembly is provided with an adapter for connection of the air supply hose, and a push-button throttle for controlling the tool. Adjacent to the air hose adapter is an air adjusting screw, which enables the speed and power to be reduced when riveting thin sheets or when closing small diameter rivets. The air pressure required to operate the hammers is 80 lb. per sq. in.

72. Operation. The cycle of operations (Fig. 37) is continuous during the depression

of the push-button. When the push-button is pressed, compressed air passes to the barrel assembly. Assuming that the plunger is forward and the tubular valve rearward, compressed air enters a drilling parallel to the barrel and moves the plunger rearward. This causes air behind the plunger to be swept out through the exhaust port, and the plunger engages into the close fit of the tubular valve. Because of the plunger's momentum the air trapped in the valve block is compressed; this causes the tubular valve to move forward to cut off the air supply to the front of the barrel, and uncover two ports. One port allows air to enter at the rear end

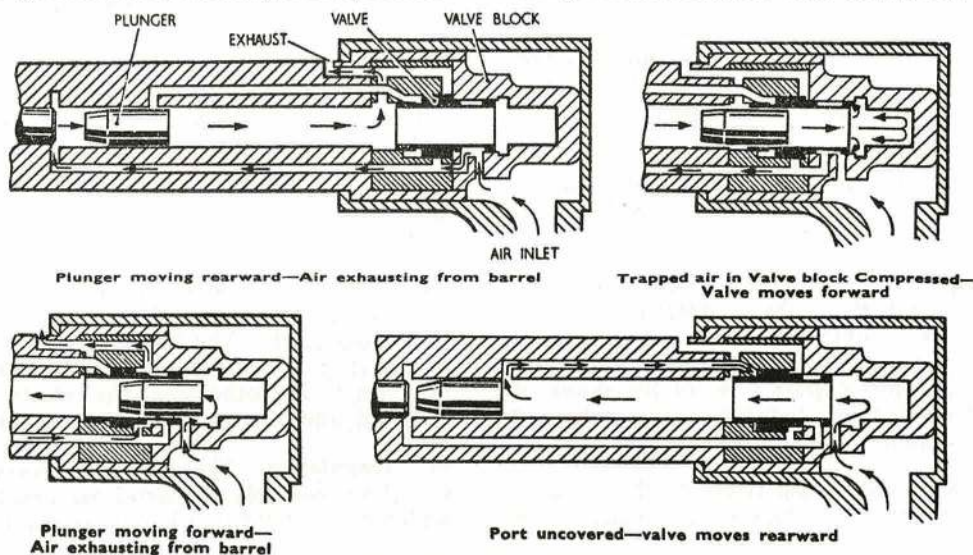


Fig. 37. CYCLE OF OPERATIONS

of the barrel and force the plunger forward, while the other port allows air in front of the plunger to be exhausted. Just before the plunger strikes the snap, its rear end uncovers a port in the barrel. Air passes through this port to an area of the valve not otherwise reached from the barrel, causing the valve to move back. As previously stated, if the push-button is kept depressed, the cycle of operations is continuously repeated.

73. Rivet Snaps. Rivet snaps are available for use with each riveting hammer, the size being clearly marked on the stem of each, and only the correct snap should be used for each rivet size. If a snap is chipped, distorted or in any way defective, it must not be used.

74. Servicing. The riveter must be kept clean and well lubricated. As with all pneumatic tools, lubrication is essential to prevent seizure of moving parts, especially the plunger. A few drops of light machine oil (OM-21) introduced into the air hose adapter, or the end of the barrel, several times a day, will help to keep the riveter serviceable. As the air stream through the tool quickly sweeps away the lubricant, it is better to lubricate many times each day by small injections than to lubricate the tool thoroughly once a week.

75. Caution. The tool must not be operated without first positioning the snap against a solid surface, otherwise, damage or seizure

of the snap will occur. When closing a rivet the push-button should be squeezed gradually, so that the rivet head is formed progressively without damaging the sheet metal, using the minimum number of blows. If the clearance between the snap and the tool nose bore becomes more than .015 in., or the clearance between the plunger and the barrel is more than .003 in., the riveting hammer should be returned to the Equipment Section for repair.

76. Dismantling. To dismantle a riveting hammer, disengage the locking clip and unscrew the barrel from the handle. Do not remove the locking ring which is screwed onto the barrel. Examine the barrel, tubular valve, valve block and the plunger for damage or wear. Before assembly, see that all parts of the riveting hammer are clean, and are coated with a thin film of oil; ensure also that the air passages are not obstructed.

Note.—The operation of riveting hammers Types G and K is similar in principle to Types H and J. The former types are suitable for the larger size rivets, Type G for $\frac{1}{4}$ in. and $\frac{5}{16}$ in., and Type K for $\frac{3}{8}$ in. and $\frac{1}{2}$ in. diameter rivets.

General Purpose Drill, Type M.1 (Mighty Atom)

77. This portable tool (Fig. 38) is suitable for twist drills up to $\frac{3}{8}$ in. diameter, and is operated by compressed air at 80–100 lb. per sq. in. The speed of rotation is 2,500 r.p.m. The complete tool weighs only 1 $\frac{1}{4}$ lb.

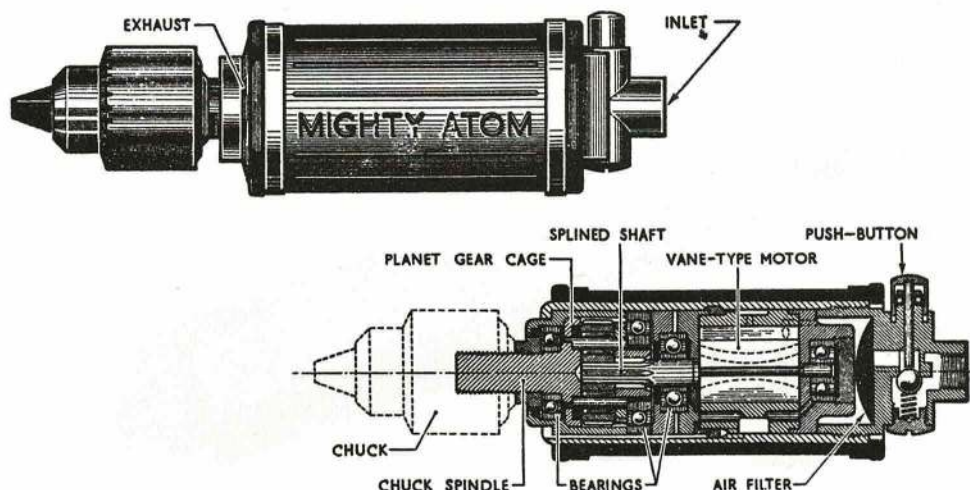


Fig. 38. GENERAL PURPOSE DRILL, TYPE M.1

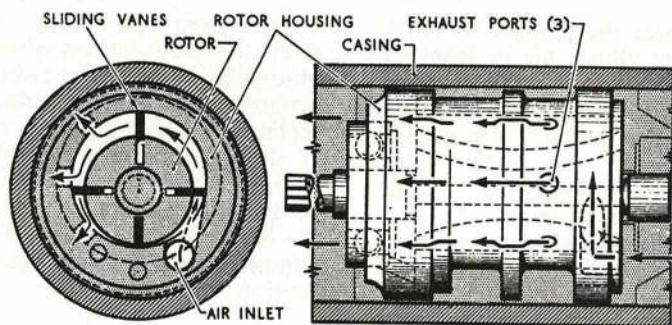


Fig. 39. PRINCIPLE OF VANE-TYPE MOTOR

78. Description. The casing houses a vane-type motor, supported on ball bearings, which drives a splined shaft engaging two planet gears. The rear of the chuck spindle is provided with the planet gear cage, in which the planet gears are meshed. This method of gearing (epicyclic) reduces the speed of rotation of the chuck spindle to 8 : 1. That portion of the tool containing the gearing is packed with grease and sealed from the motor chamber. The vane-type motor consists of a rotor containing four equally spaced radial slots, in each of which are fitted sliding vanes made of composition material.

79. Operation. When the push-button is depressed, the compressed air enters the motor and rotates the rotor by acting on the vanes (Fig. 39). Owing to the high speed of rotation, centrifugal action maintains the vanes in contact with the bore of the rotor housing. As the rotor revolves, the spaces between the vanes, the rotor and the rotor housing increase in volume, so

that the compressed air expands and cools the tool. The air from the exhaust ports flows down the tool through slots provided between the casing and bearings, to escape to atmosphere from around the chuck spindle.

Corner Drill, Type M.2

80. This tool (Fig. 40) is similar in operation to the General Purpose Drill, Type M.1, but its design enables holes to be drilled to within $\frac{5}{16}$ in. of the inside face of a right angle. This is achieved by an extension spindle fitted with a bevel gear engaging a collet spindle. Collet chucks are available in sizes from $\frac{1}{8}$ in. to $\frac{3}{8}$ in. diameters, rising by $\frac{1}{16}$ in. steps to suit various diameters of twist drill.

81. To change a collet and drill, remove the old collet with the aid of a spanner. Insert the new drill into the correct size collet, ensuring that the shank of the drill enters the full depth of the collet. Screw the collet

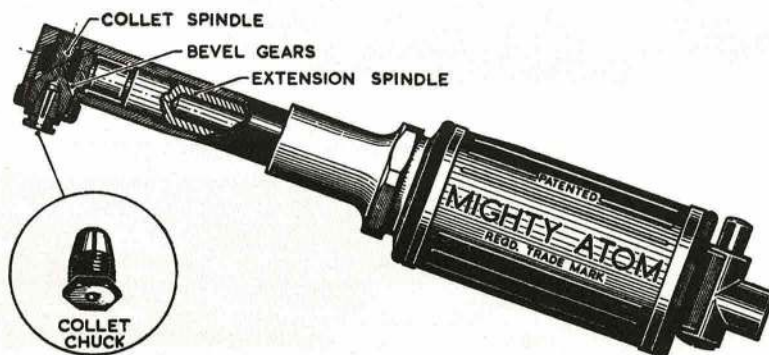


Fig. 40. CORNER DRILL, TYPE M.2

into the spindle and tighten lightly with a spanner.

Rivet Miller, Type P.56

82. This tool (Fig. 41) is used for rapid and accurate removal of the protruding portion of the mandrels of Avdel rivets, or the heads of protruding solid counter-sunk rivets, leaving them perfectly flush with the surrounding surface. The operation of the rivet miller is similar to the General Purpose Drill, Type M.1, but instead of a

drill, a cutter is held in a collet-type chuck surrounded by a shroud which forms a depth stop. Some rivet millers are fitted with a micrometer adjustment, which enables the depth of the cutter to be altered by increments of $.00025$ in. To give stability and prevent movement when milling, the tool is fitted with spring-loaded telescopic legs provided with rubber friction pads. The speed of rotation of the cutter is 18,000 r.p.m. The complete tool weighs $2\frac{1}{8}$ lb.

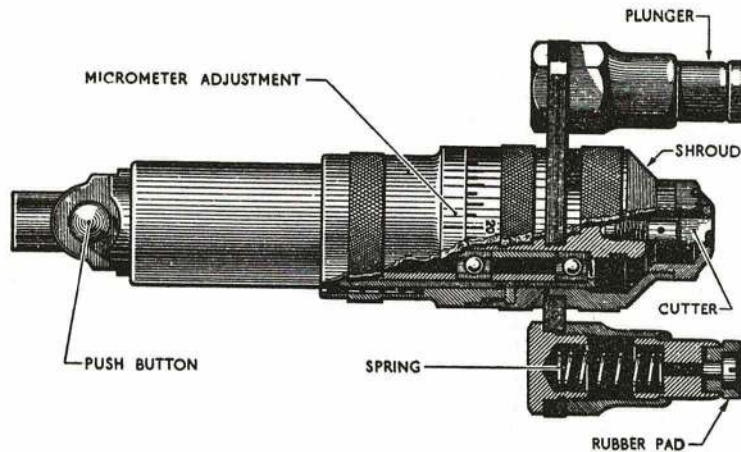


Fig. 41. RIVET MILLER, TYPE P.56

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