July 28, 1959 G. J. AGULE ET AL 2,896,483

DEVICE FOR COLD WELDING EXHAUST TUBULATIONS

Filed June 1, 1954 3 Sheets-Sheet 1

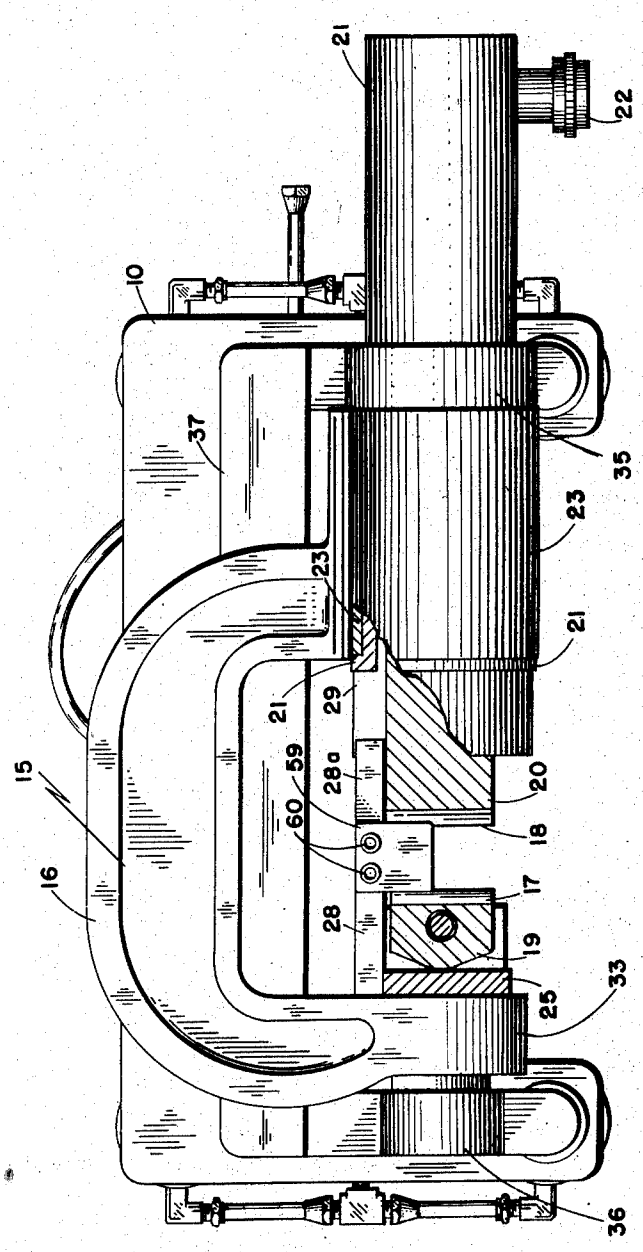



FIG. 1

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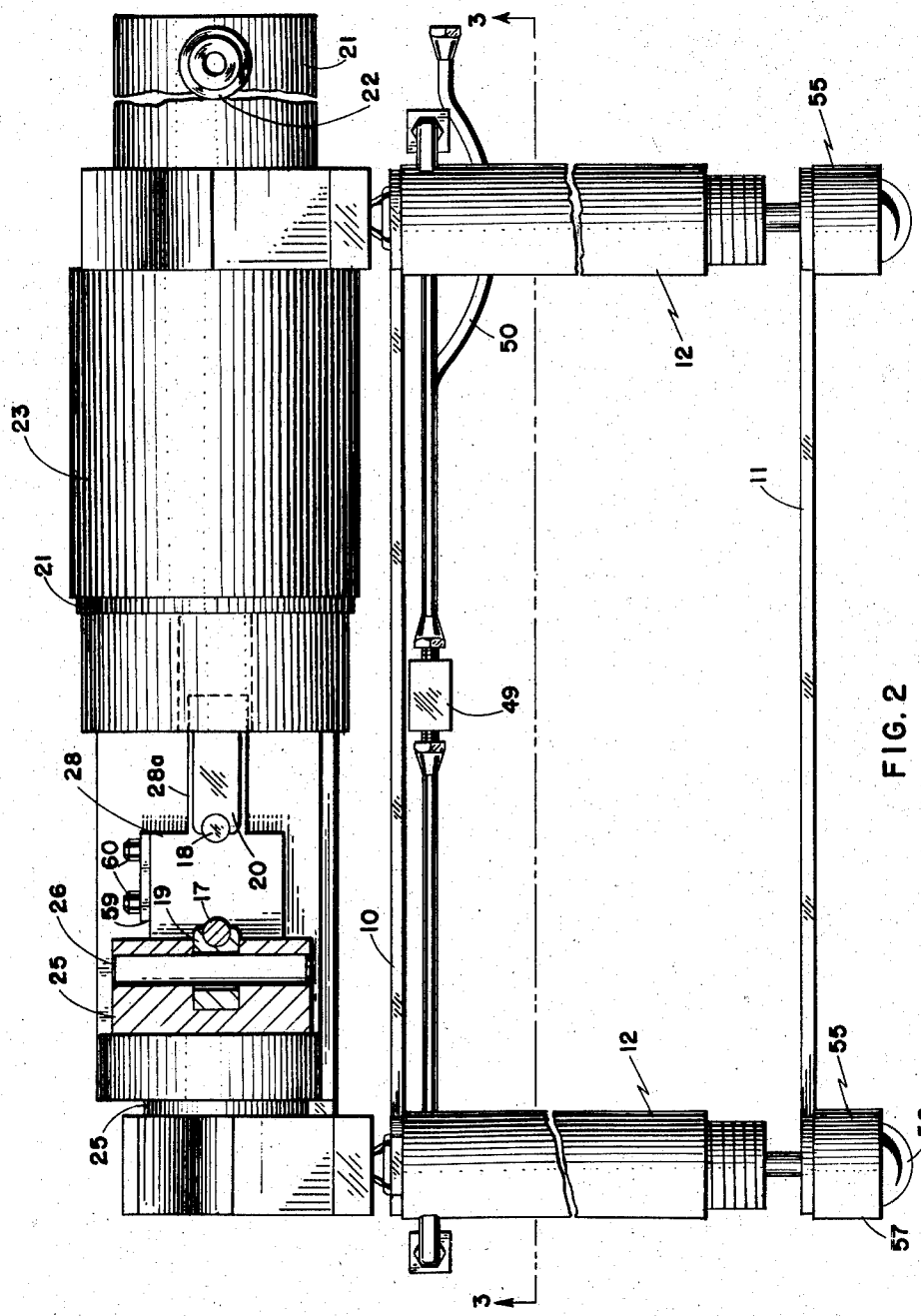



FIG. 2

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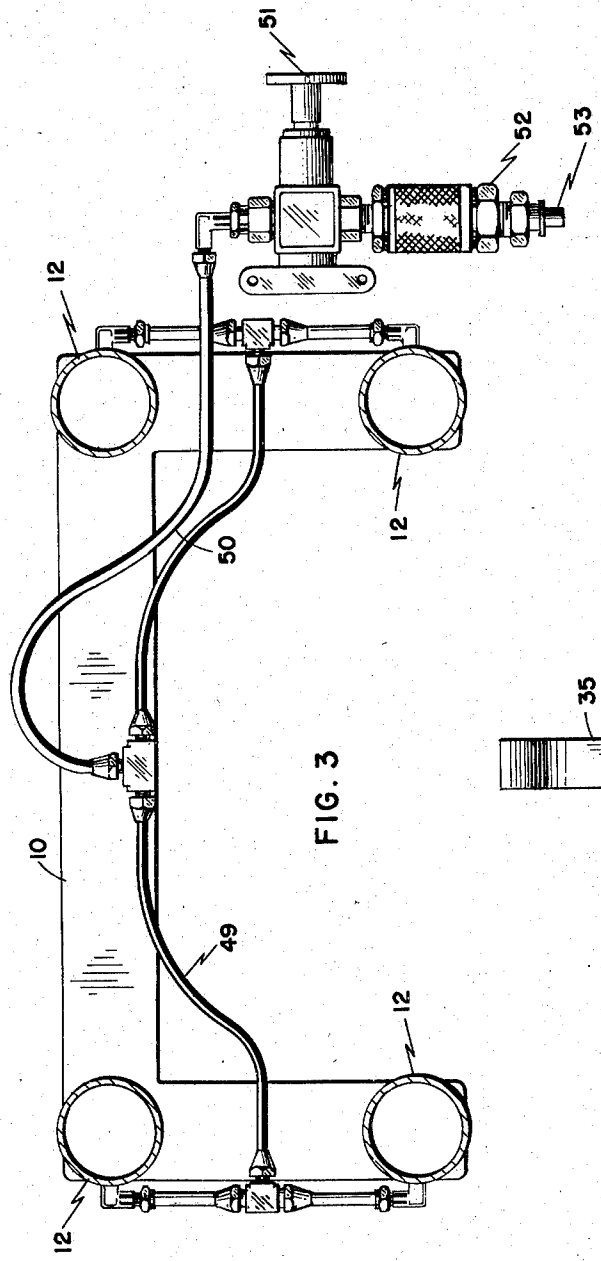



FIG. 3

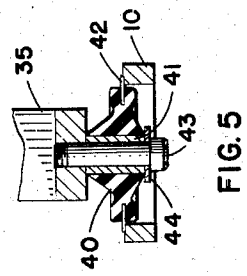



FIG. 5

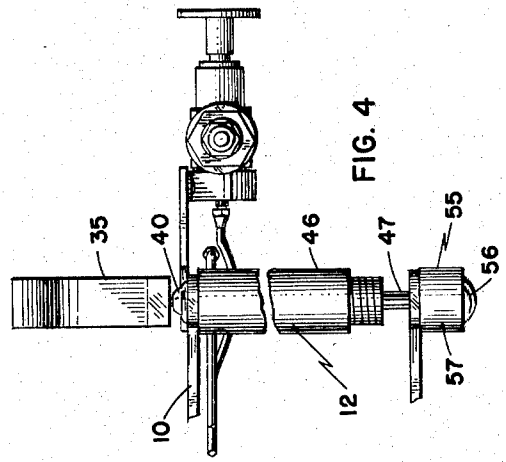



FIG. 4

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2,896,483

# DEVICE FOR COLD WELDING EXHAUST TUBULATIONS

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Application June 1, 1954, Serial No. 433,607

1 Claim. (Cl. 78—82)

This invention concerns a novel pinch-off device for exhaust tubulations such as are used on electron tubes in order to permit them to be connected to an exhaust pump. More specifically, this invention consists of a pinch-off device which will properly position itself relative to the exhaust tubulation which is to be pinched-off so that no mechanical damage can be caused the exhaust tubulation or the envelope to which it is attached.

It has become common in the electron tube industry and elsewhere where vacuum-tight or gas-tight sealing off is required to employ a metallic exhaust tubulation which may be sealed vacuum-tight or gas-tight by mechanically pinching together its side walls into a cold weld. Such an exhaust tubulation is advantageously composed of copper and is pinched-off by using a pair of rounded jaw pinchers as described in U.S. Patent No. 2,427,597, the invention of Garner. This method of sealing off tubulations has proved extremely useful and has accomplished great savings in both time and money.

One problem which has been encountered with manually operated pinch-off devices of the sort suggested by Garner has been the tendency for the operator to twist the pliers or apply uneven forces to the pliers. As a consequence the tubulation may break or the tube structure may be damaged due to these undesirable forces applied to it while pinching it off. However, to date only hand pinchers or pliers have been employed and these tools depend upon the care and skill of the operator in order to obtain uniform careful handling. Even a skilled operator may on occasion tend to twist the pliers or pull them away from the normal plane so that there is opportunity for damage to the exhaust tubulation or the envelope to which it is attached.

The present invention is intended to avoid breakage of the tubulation or damage to the structure to which it is attached by the use of a self-adjusting fixture which may be used to automatically pinch-off exhaust tubulations. This fixture has the advantage of being self-adjusting and will shift into such position that it applies equal pressure on both sides of the tubulation without any twisting. Once positioned normal to the tubulation to be pinched, it remains normal and its position is self-adjusting in response to various applied forces so that the pressure applied to the opposite sides of the tubulation during pinch-off will remain equal.

The device of the present invention employs rounded jaws, preferably composed of a hard material like tungsten carbide, as taught by Garner. At least one of these jaws is mounted upon a movable ram. A frame for supporting the jaws opposite one another is provided so that the ram will drive one jaw against the other. The tubulation to be pinched-off is positioned between the jaws. Finally, the frame is provided with means which will permit free movement of the frame while maintaining the plane of the jaws. This is movement relative to the supporting table or reference plane above which the tubulation is pinched-off.

In addition to being self-adjusting, the device of the present invention is preferably hydraulically actuated so that it will be capable of pinching-off tubulations of great size. This is particularly advantageous because heretofore in pinching-off tubulations of great size, the additional amount of force required caused the operator to use much more strength. Such additional tax on the strength of the operator might lessen his control and when misapplied could more readily cause damage to the tubulation or the envelope to which it is attached than would be the case were the relatively small amounts of force used with small tubulations misapplied. The hydraulic unit is capable of pinching-off tubulations of any size with essentially the same ease with which it will pinch-off the smallest tubulation.

A small degree of self-adjustment of one of the jaws may be provided in the structure of the present invention so that the jaws may adjust to remain essentially parallel to one another throughout the pinching operation. If the jaws become sufficiently out of parallel, a satisfactory cold weld is not obtained all the way across the tubulation. Because it is the nature of the preferred construction of the present invention to lend support at one side of the jaws, if the forces become sufficient, the support may yield so that fixed jaws will not be exactly parallel. If provision is made for self-adjustment, however, the jaws will tend to maintain parallelism because the tendency to distribute forces evenly over the supporting opposed surfaces will produce such a result. Thus, it is possible to insure complete seal off each time by use of the self-adjusting jaws.

The device of the present invention may be made quite flexible by providing for its elevation to different heights so that the jaws may be at the desired level for pinching-off. A preferred way to produce this elevation is to employ legs for the frame which are pneumantically actuated cylinders wherein additional air pressure will cause an increase in the length of the leg.

Another feature of the present invention which adds to its flexibility and usefulness is the flexible mounting device whereby the support for the jaws is coupled by flexible yieldable mounting members to the frame so that a small amount of vertical adjustment is possible. Such vertical adjustment prevents damage to the tube structure as the tubulation is pinched-off due to forces which occur in the axial direction due to elongation of the tubulation.

For a better understanding of the present invention reference is made to the following drawings:

Fig. 1 illustrates a plan view from above of the pinch-off device;

Fig. 2 illustrates a front elevational view of the device showing the jaw support members in partial section.

Fig. 3 is a sectional view taken along line 3—3 in Fig. 2 showing in plan the pneumatic system for actuating the legs to raise or lower the height of the pinching jaws relative to the supporting reference plane.

Fig. 4 illustrates one of the legs showing the flexible coupling between the frame and the support for the jaws.

Fig. 5 illustrates in partial section a flexible coupling between the support and the frame permitting some vertical yield in the structure.

Referring to the drawings, and in particular to Figs. 1 and 2, it may be seen that the primary frame members **10** and **11** are of C-shape. The two C-shaped members define a rectangular frame wherein one long side of the rectangle is removed. These C-shaped members should have sufficient thickness to be relatively rigid. Said C-shaped members are connected by four vertical columns generally designated **12** of identical construction at the four corners of the rectangle.

Actual support for the jaws is provided by a support

member generally designated **15** which is advantageously adapted to accept a hydraulic ram to form a structure sometimes called a hydraulic C-clamp. This support has a webbed C-shaped connection piece **16** which interconnects two vise-like jaws **17** and **18**. These jaws are rounded and are advantageously composed of tungsten carbide rod mounted so that rounded surfaces of the two members will abut one another when the jaws are closed. These jaws may, in turn, be embedded in steel block **19** and piston **20** of the hydraulic ram. Block **19** and piston **20** advantageously embrace more than half the circumference of the cylindrical jaws **17** and **18**, respectively, and so hold them fast, leaving the exposed areas of the jaws for pinching.

The hydraulic ram is composed of a cylinder **21** in which the piston **20** rides. The part of piston **20** which accepts jaw **18** may be either an integral part of the piston or an adapter joined to the piston. In either event, fluid is fed into cylinder **21** through coupling **22** in order to urge the piston out of the cylinder. Cylinder **21** of the hydraulic ram is supported by the C-support member **15** within its tubular flange **23** which closely engages the side walls of said cylinder.

Block **19** which supports jaw **17** is supported in fixed anvil-like member **25** by means of pin **26** which is snugly accepted by member **25**, but loosely engages block **19**. Block **19** has a rounded back edge. As may be seen in Fig. 1, in order to preserve the alignment of the jaws, block **19** is free to shift its position in a sort of swivel motion within the plane of the jaws, as will be described later. Member **25** is cylindrical in shape and has a shoulder between larger and smaller diameters. The smaller diameter is accepted by tubular flange of C-support member **15** which flange snugly engages the smaller diameter portion of anvil member **25** so that its shoulder is opposed by the tubular flange **33**.

Because piston **20** may have a tendency to rotate in its cylinder, thereby misaligning the jaws, it is usually a wise precaution to supply some interconnecting means **28** to prevent rotation of the jaws. This interconnecting means may consist of a bar which is affixed to member **25** by bolts or other appropriate means. Bar **28**, in turn, bears a guide **28***a* which is engaged by slot **29** in piston **20**. It will be noted that piston **20** is generally cylindrical in cross-section except for that part of piston **20** which directly engages jaw **18**, which part is rectangular in section. The cylindrical portions vary in diameter, the part which is always outside the cylinder having a diameter larger than the diameter of the cylinder and having groove **29** therein.

C-shaped support **15** is advantageously mounted on frame **10** using mounting brackets **35** and **36** which may be joined together by cross-link **37**. Mounting bracket **35** is advantageously provided with a cylindrical hole which snugly engages the outside diameter of the cylinder **21** of the hydraulic ram. Bracket **36** is provided with a cylindrical hole which snugly engages the cylindrical surface of anvil member **25**.

The mounting brackets may be supported on the frame through special flexible mounting members, four of which are employed at distributed points. As may be seen in Figs. 4 and 5, it is possible that the mounting members may extend between the legs **12** and the mounting brackets or between the actual frame portion **10** and the mounting bracket. Each of the mounting members consists of an annular flexible pad **40** of rubber or similar material at whose inside diameter the thickness may be increased to engage sleeve **41** over its entire length. At its outside periphery and embedded in the edge thereof to extend radially is planar annular member **42**. The resilient structure formed thereby is supported by passing a bolt **43** through the sleeve and engaging it in a threaded hole in annular bracket **35**. The bolt may be held in place by washer **44** which



prevents the head of the bolt from pressing directly on sleeve **41**. Annular ring **42** rests atop frame member **10** or leg **12** over an aperture therein so that only the ring **42** touches the frame member. The ring **42** may be fixed in place by welding or in any other suitable manner. This construction because of the resilient web between the ring **42** and the sleeve **41** permits the vertical adjustment of the structure. Such adjustment may be necessary when the tubulation is effectively elongated as it is pinched-off in order to permit the jaws to maintain their position.

The legs of this structure are advantageously cylinders **46** which contain a piston member **47** and a pneumatic connection through a manifold line generally designated **49**. Air pressure may be fed to this manifold through tubing **50** which is connected to a control valve **51** beyond a speed control valve **52**. The various valves and couplings employed in this pneumatic system are well known in the art and, hence, will not be described in detail. Connection with a compressor or a compressed air system may be made at coupling **53**.

In order to afford versatility in motion, the bottoms of legs **12** are terminated in caster members **55** which advantageously consist of a ball **56** and a socket **57**. These casters will permit the unit to freely adjust itself in response to various pressures within the system.

In the use of the device illustrated, the jaws **17** and **18** are first raised to the level of the desired pinch-off on the exhaust tubulation. Raising or lowering the level of the jaws is accomplished through the introduction or release of air within the legs of the structure. The legs may alternatively be adjustable manually or by some means other than pneumatic, hydraulic or other fluid means. The convenience of the pneumatic or a fluid system is immediately apparent, however. Introduction of the air into the hollow cylindrical legs **46** will cause the piston **47** therein to be driven out of the chamber and hence will effectively lengthen the leg. The speed control valve **52** will assure that the lengthening process will not occur abruptly, but rather will occur with smoothness and ease. The control valve serves merely to open or close the pneumatic system.

When the jaws **17** and **18** are at the desired level, the device is moved into position so that the tubulation lies between the jaws **17** and **18**. Stop member **59** held in place by bolts **60** to the frame or the guide **28** serves to center the tubulation between the jaws **17** and **18** opposite pin **26**. Thereafter, the hydraulic ram is actuated by the introduction of fluid into the cylinder to drive the ram forward toward the anvil. As the ram moves forward, the device moves on its casters **55** and readjusts its position until the tubulation is squarely between the jaws. Then as the tubulation is squeezed and deformed between the jaws **17** and **18**, the position of the frame of the structure is still able to shift to relieve any stresses which might otherwise be imposed upon the exhaust tubulation or the structure to which it is connected.

As the jaws are brought together, jaw **17** may tend to move out of parallel with jaw **18**, and it is permitted to do so beacuse of its loose connection with pin **31**. However, as the jaws are completely closed, the jaws tend to move into parallelism with one another in order to distribute the force applied evenly across the jaws. Jaw **17** can shift because its mounting block **19** is permitted to shift around pin **26** as an axis. The clearance between block **19** and pin **26** permits block **19** to bear against anvil **25** no matter what position it ultimately assumes in maintaining parallelism between the jaws. Without the ability of this mounting block to move, there would be a tendency for the jaws to spread at one end and contact at the other in response to the heavy forces applied. The centering of the tubulation opposite pin **26** by stop **59**

assures proper adjustment of the jaws into parallel position.

Many modifications of the structure described will occur to those skilled in the art. All such modifications of said structure within the scope of the claim are intended to be within the scope and spirit of the present invention.

We claim:

A device for cold welding and severing exhaust tubulations of electron tubes, comprising a base having a pair of spaced jaw supports thereon, pinching and severing jaws carried by the respective jaw supports, one of the jaws being movable in a plane in a direction toward the second jaw to position the jaws in severing engagement with a tubulation therebetween, means for applying pressure to said movable jaw of an amount sufficient to pinch the tubulation and to consequently elongate the tubulation in a direction normal to the plane of movement of the movable jaw, and resilient means connecting the jaw supports to the base whereby said jaw supports and jaws thereon are simultaneously movable in response to elongation of the tubulation by said jaws in the direction of said elongation and normal to the plane of movement of the movable jaw.



**References Cited** in the file of this patent

UNITED STATES PATENTS

| | | |
|---|---|---|
| 672,552 | Harrington | Apr. 23, 1901 |
| 676,292 | Wigtel | June 11, 1901 |
| 851,398 | Broadbooks | Apr. 23, 1907 |
| 1,021,501 | Bettendorf | Mar. 26, 1912 |
| 1,165,174 | Holmes | Dec. 21, 1915 |
| 1,308,593 | Kendall | July 1, 1919 |
| 1,343,946 | Warner | June 22, 1920 |
| 1,556,735 | Tiffany | Oct. 13, 1925 |
| 2,243,013 | Morey et al. | May 20, 1941 |
| 2,421,716 | Rose | June 3, 1947 |
| 2,427,597 | Garner et al. | Sept. 16, 1947 |
| 2,456,125 | Johndrew | Dec. 14, 1948 |
| 2,555,421 | Ronan | June 5, 1951 |
| 2,556,000 | Temple | Aug. 28, 1951 |
| 2,675,202 | Kaemmerling | Apr. 13, 1954 |
| 2,776,473 | Dailey et al. | Jan. 8, 1957 |

OTHER REFERENCES

"Means of Connecting Aluminum Conductors" (Barnes), published by McGraw Hill, May 1954.

Publication: "Shear Type Mountings" of Lord Manufacturing Co., Erie, Pa. (Bulletin 100).