Feb. 18, 1969 B. W. HARRISON 3,428,306

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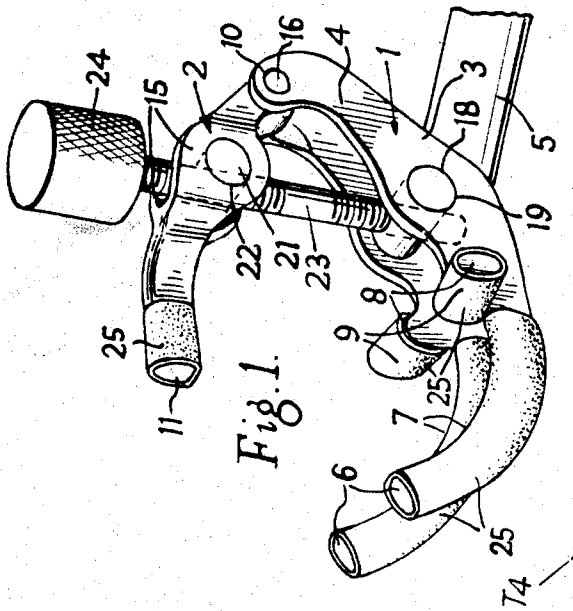


Fig. 1.

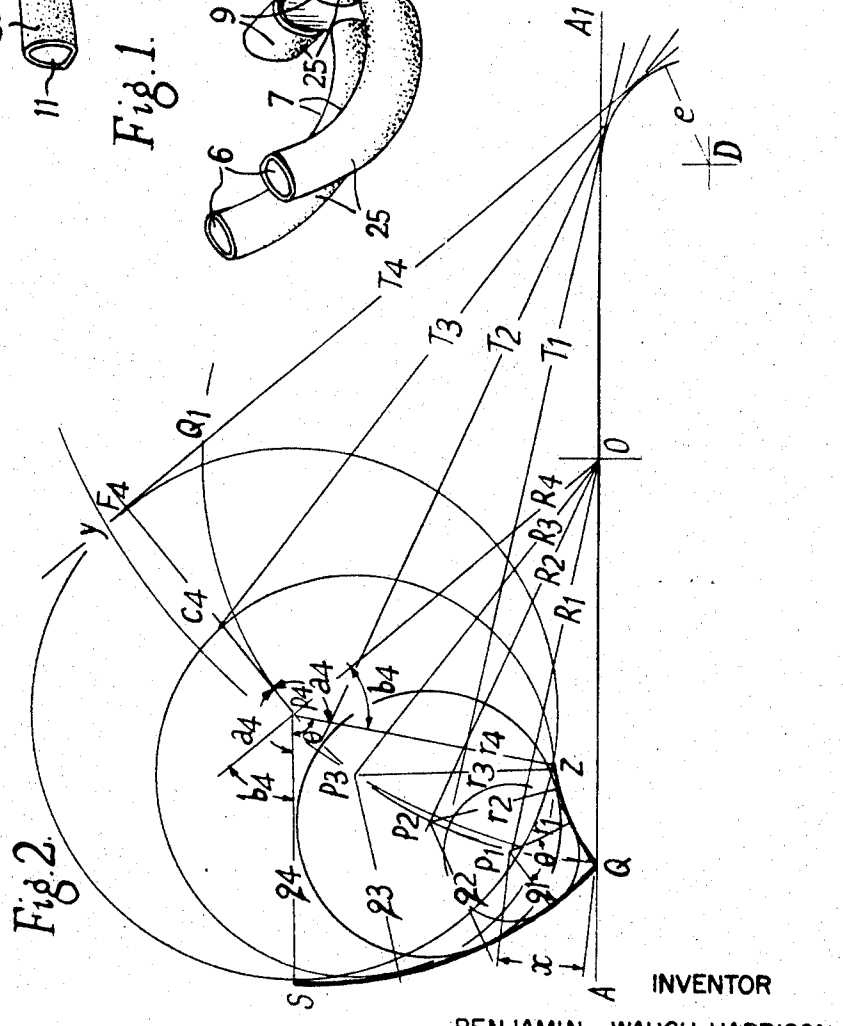


Fig. 2.

INVENTOR

BENJAMIN WAUGH HARRISON

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Benjamin Waugh Harrison, The Garage, Hammers Lane, London, NW. 7, England

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ABSTRACT OF THE DISCLOSURE

There is provided a clamp for generally cylindrical objects and having two jaws, one jaw provided with intersecting concave and convex surfaces. Means are provided for retaining the two jaws in clamping relation. Preferably the second jaw is of concave shape relative to the first jaw.

This invention relates to clamps and, more particularly, to clamps having adjustable jaws for cylindrical or conical surfaced articles hereinafter termed substantially cylindrical articles.

According to the present invention, there is provided a clamp having two jaws, one jaw providing a clamping surface of concave-convex shape and the other jaw providing a clamping surface, and means for retaining the other jaw in clamping relation with the clamping surface of the said one jaw.

Preferably, the other jaw provides for a substantially cylindrical article to be held in the clamp, a point of contact and a perpendicular extending from a tangent plane at the point of contact bisects an angle between the tangent planes made by the points of contact the one jaw makes with the article. The jaws may be pivotally interconnected.

Preferably, the one jaw comprises two arcuately extending arms of the same curvature which are arranged in side by side relation and two laterally projecting arms, the surfaces of the two arms and the surfaces of the projecting members provide the concave-convex clamping surface of the clamp. The two arcuately extending arms may diverge from the jaw. The retaining means may comprise a threaded rod which passes through threaded trunnions mounted in each of the jaws or the jaws may be interconnected so that they are biased towards one another.

The invention will now be described by way of example with reference to the accompanying drawing:

FIGURE 1 is a perspective view showing a clamp, and FIGURE 2 is a diagrammatic drawing showing the formation of a clamp jaw according to the present invention.

In FIGURE 1 of the accompanying drawing, there is shown a clamp having two jaws hereinafter termed a stationary jaw or part **1** and a moveable jaw or part **2**. The stationary part **1** has a base member **3** and two side members **4**. A boss (not shown) projects from the base member **3** and is externally threaded for engagement with a correspondingly threaded surface (not shown) provided in a handle or support arm **5**. The handle or support arm **5** may form part of a bracket or may be attached to any suitable mounting. Two curved or arcuately shaped arms **6** of the same shape extend in spaced relation to diverge from one end of the stationary part **1** and provide an internal concave surface **7**. Located adjacent to that end of the base member **3** from which the arms **6** extend are two laterally projecting curved surfaced members **8** which present a convex surface **9**. At the opposite end of the base member **3** to the arms **6** the side members **4** are formed with co-axial apertures **10**.

The movable part **2** has a clamping surface or arm **11** at one end an an aperture (not shown) at the opposite end. Intermediate the two ends is a passage provided by two spaced wall members **15**. The moveable part is connected to the stationary part **1** by a pivot pin **16** passing through the apertures **10** in the side members **4** and the aperture in the moveable part **2**.

A threaded trunnion **18** is mounted in co-axial apertures **19** provided in the side members **4** of the stationary port **1** and a similar trunnion **21** is mounted in apertures **22** in the wall members **15** of moveable part **2**. A threaded rod **23** is in threaded engagement with the trunnions **18** and **21** and the pitch of the thread of the rod **23** passing through the trunnion **18** in the stationary part **1** is of opposite pitch to the thread of the rod **23** passing through the trunnion **21** in the movable part **2** so that on rotation of the rod **23** the moveable part **2** is moved to or away from the stationary part **1**. To facilitate the rotation of the rod **23**, a knurled head **24** is provided at one end of the rod **23**. The knurled head **24** may be replaced by a suitably fixed nut, a bolt head or an Allen key aperture and both ends of the threaded rod **23** may have such a fitting.

The arms **6**, the members **8** and the arm **11** provide the jaws of the clamp and may have a covering of resilient material **25**, for example, synthetic plastics material, to provide a protective covering and thus prevent damaging articles held by the jaws of the clamp.

In use an article such as a cylinder, or another cylindrical or conical surfaced article, is placed between the clamp jaws and, on rotation of the head **24**, the arm **11** of the moveable part **2** moves towards the arms **6** and the members **8** of the stationary part **1** and grips the article in the jaws of the clamp. The shape or curvature of the arms **6**, the members **8** and the arm **8** ensures that the article makes point contact therewith and not continuous contact thus providing a good gripping action. At the same time, due to the divergence and inclination of the arms **6** and members **8** respectively, the points of contact on small diameter articles, are closer together axially than for articles of larger diameter thus reducing the risk of damage to small diameter articles caused by axial bending.

In an alternative construction (not shown) the jaws may be biassed to a clamping position by a spring or by a cam acting on one of the jaws thus dispensing with the rod and trunnions. In a still further construction (not shown) the two jaws may be interconnected in the form of a clip with the interconnecting part tending to bias the jaws into clamping relation with an article placed between the jaws.

Either of the jaws may be attached to a support or bracket and it is not essential for this to be on the stationary jaw and, where the jaws are to pivot while clamping an article, they may be pivotally connected to a support instead of being stationary as previously described.

In FIGURE 2 of the accompanying drawing, there is shown diagrammatically the formation of the clamp jaw and to determine the shape of a clamp jaw according to the present invention it is first necessary to draw a base line A, A_1. To determine the actual shape and location of the arms **6** and members **8** of the stationary part, it is necessary to draw the curve Q, Q_1 with a radius R_1. For any required angle mark points P_1 to P_4 on the curve Q, Q_1 so that the chordal distance between each adjacent point is equal to a distance X.

It can be shown that:

$$x = r_1 / \cos \frac{\phi}{2}$$

This is true for small values of X and the smaller the value of X the more accurate will be the result. Any

number of points P can be constructed but for convenience only four are shown. Next, circles with centres P_1 to P_4 with radii r_1 to r_4 are drawn with each radius being larger than the previous by the value of r_1. Then there are constructed the radii R_1 to R_4 from points P_1 to P_4 through the point O and the radii r_1 to r_4 and q_1 to q_4 so that angle $b_4=b_4$, as shown by the angle made for R_4 and the radii r_4 and q_4. The curve SQZ is then drawn through the points where the radii r_1 to r_4 and q_1 to q_4 cross the respective peripheries of their circles.

The curve SQZ provided by the circles corresponding to the centres P_4, P_3, P_2 and P_1 now represents the profile presented by the arms **6** and the members **8** of the stationary part **1** of the clamp jaw.

To determine the pivot joint for the moveable part **2**, it is necessary to take the circle with the centre P_4 and then construct the line C_4 so that it bisects the angle ϕ and passes through the point P_4 to a point F_4 at the circumference of the circle. A tangent T_4 is drawn to the circle with centre P_4 through the point F_4 and extended so as to cross the base line A, A_1. This process is repeated for each of the other circles with centres P_1, P_2 and P_3 and the tangents T_1 to T_3 are drawn so that they extend to cross the base line A, A_1. The tangents T_1 to T_4 after crossing the base line A, A_1 provide points of a curve which is approximately equivalent to a circular curve with a radius E extending from a centre D. The centre D corresponds to the pivot point for the pivot pin **10** connecting the moveable part **2** to the stationary part **1**. The clamping surface or arm **11** of the moveable part **2** corresponds to the tangents T_1 to T_4 with the curve QY representing the locus of the point of contact between arm **11** and an article held within the jaw of the clamp. This applies for any size of article which may be located within the jaws of the clamp.

I claim:

1. A clamp having two pivotally connected jaws, one jaw providing a first clamping surface of elongated arcuate concave shape and a second clamping surface of elongated arcuate convex shape intersecting said first surface and the other jaw providing an elongated concave clamping surface relative to the first jaw, and means for retaining the other jaw in clamping relation with the clamping surfaces of the said one jaw.

2. A clamp for a substantially cylindrical article comprising two jaws, one jaw providing a first arcuate clamping surface of concave shape and a second arcuate clamping surface of convex shape and the other jaw providing a clamping surface, means for retaining the other jaw in clamping relation with the clamping surfaces of the said one jaw, each of said jaws defining contact points adapted for engagement with an article, tangent planes extending through each of said contact points, perpendicular planes extending from said tangent planes through said contact points, said perpendicular plane extending from said tangent plane of said contact point on said other jaw bisecting an angle made by the perpendicular planes extending from the tangent planes through said contact points of said one jaw.

3. A clamp as set forth in claim **2**, in which said one jaw comprises two arcuate extending arms of the same curve arranged in side by side relation and two laterally projecting members, surfaces of the first arms defining said concave shape and surfaces of the members defining said convex shape.

4. A clamp having two jaws, one jaw providing a first clamping surface of concave shape and a second clamping surface of convex shape and the other jaw providing a clamping surface, pivot means for interconnecting said jaws, two arcuate arms extending in the same curve in side by side relation from said one jaw defining said concave surface, two lateral members projecting from said one jaw defining said convex surface, and means for retaining said other jaw in clamping relation with said clamping surfaces of said one jaw.

5. A clamp as set forth in claim **1**, in which said retaining means comprises a threaded rod and a threaded trunnion in each of said jaws, opposite ends of said rod engaging said trunnions.

6. A clamp as set forth in claim **5**, in which the thread of that part of said rod engaging one trunnion is of reverse pitch to the thread of that part of the rod engaging the other trunnion.

7. A clamp as set forth in claim **6**, comprising a head for adjustment of said rod.

8. A clamp having two jaws, one jaw providing a first clamping surface of concave shape and a second clamping surface of convex shape intersecting said first surface and the other jaw providing a clamping surface concave relative to said one jaw, said one jaw comprising two arcuate extending arms of the same curve arranged in side by side relation and two laterally projecting members, surfaces of the first arms defining said concave shape and surfaces of the members defining said convex shape.

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ROBERT C. RIORDON, *Primary Examiner.*

JAMES F. McKEOWN, *Assistant Examiner.*

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