Oct. 13, 1942. E. A. KEY ET AL 2,298,703

EXPANDING AND FLARING TOOL

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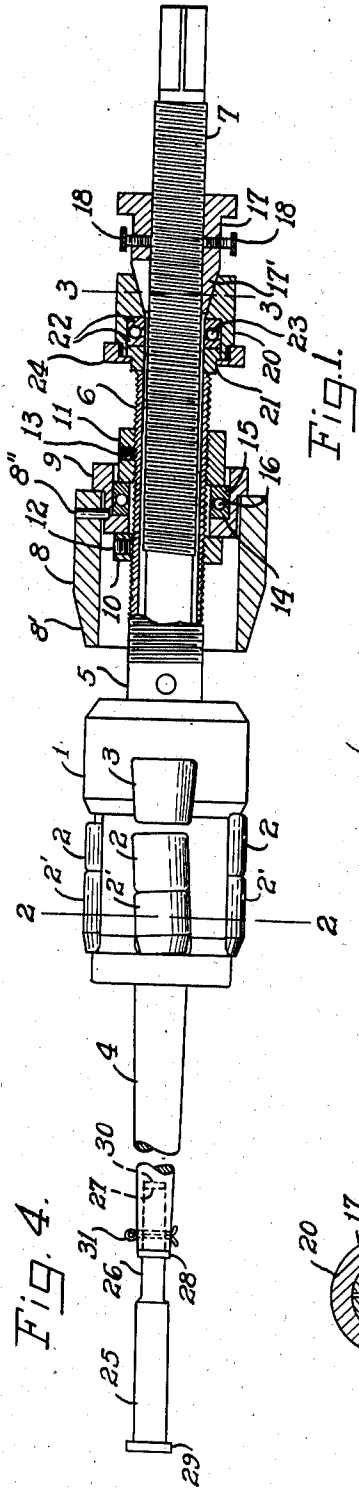

Fig. 1.

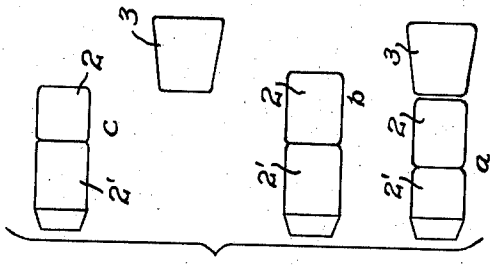

Fig. 5.

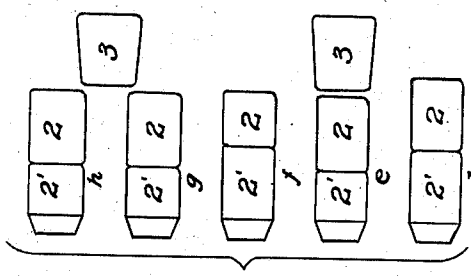

Fig. 6.

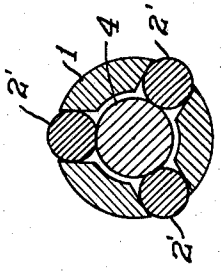

Fig. 2.

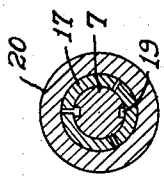

Fig. 3.

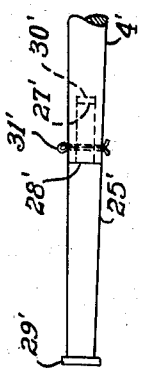

Fig. 4.

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EXPANDING AND FLARING TOOL

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2 Claims. (Cl. 153—82)

This invention relates to a tube expander and flarer of the type which employs expanding and flaring rolls, and a tapered rotatable mandrel for controlling the rolls, with the rolls arranged to effect a self feed of the rolls and mandrel into the tube during the expanding and flaring operation; the invention relating more particularly to a means for ironing out and smoothing the interior of the tube after the desired expansion and flaring of the tube has been effected.

The object of the invention is to provide means for effectively arresting both the feeding-in action of the rolls and of the mandrel at a predetermined point so that continued rotation of the mandrel merely irons out and smooths the interior of the tube without any further expansion or flaring of the tube; a more specific object being to provide effective means to prevent any further feeding-in of the mandrel after the feed-in of the parts has been arrested.

In the accompanying drawing:

Fig. 1 is a view partly in elevation and partly in longitudinal section of a device embodying the improvements.

Fig. 2 is a section on the line 2—2 of Fig. 1.

Fig. 3 is a section on the line 3—3 of Fig. 1.

Fig. 4 is a view showing a modification in the form of the reduced portion of the mandrel.

Fig. 5 is a diagrammatic view of the arrangement of the rolls when three pairs of expanding rolls are employed.

Fig. 6 is a diagrammatic view of the arrangement of the rolls when five pairs of expanding rolls are employed.

Referring to the drawing, 1 represents a cage having openings to receive a series of expanding rollers 2 and 2' arranged in a series of pairs, and a pair of flaring rollers 3.

The expanding and flaring rolls are so disposed as to more effectively eliminate seams or ridges in the metal of the tube which is being expanded and flared and to that end the pairs of expanding rolls are of different lengths. Referring to Fig. 5 in which three pairs of expanding rolls are employed, the pair of expanding rolls indicated at *a* is the shortest in length, the pair of expanding rolls indicated at *b* is the longest in length and the pair of expanding rolls *c* is of a length greater than the pair of rolls *a* but shorter in length than the pair of rolls *b*. The flaring rolls 3 are of a length to overlap the expanding rolls 2 of the pair of rolls *b* but do not lap the rolls 2 of either of the pair of rolls *a* or *c*. By this arrangement the ridges formed by the rolls are of comparatively shallow depth and can be readily ironed out by the rolls during the ironing operation to be described. The same arrangement is illustrated in Fig. 6 in which five pairs of expanding rolls are employed indicated at *d*, *e*, *f*, *g* and *h*. In this case each pair of expanding rolls *e*, *g* and *h* are of the same length, the pair of rolls *d* of greater length and the pair of rolls *f* of shorter length than the pair of rolls *d*, but longer than the pairs of rolls *e*, *g* and *h*. The flaring rolls 3 overlap the expanding roll 2 of the pair of rolls *d* but do not overlap any of the other expanding rolls.

A tapered mandrel is indicated at 4, the cage with its rollers and the tapered mandrel being old in the art. The cage has a rearwardly extending hollow stem 5 secured thereto in any well known way, this stem being externally screw-threaded with right-hand threads 6. The rear end of the mandrel is provided with left-hand threads 7 and the mandrel extends through the hollow stem 5 and through the cage so that the tapered portion thereof will engage the rolls and force them outwardly against the interior of the tube as the mandrel is rotated clockwise in any well known way. The expanding rollers are arranged with their axes at an angle to the longitudinal axes of the cage and mandrel so that a self-feeding action of the cage and mandrel will be had during the expanding and flaring operation.

In order to effect an ironing out of the interior of the tube to present a smooth surface after the expanding and flaring action has taken place means are provided for arresting any further feeding-in action of the cage and mandrel during continued rotation of the mandrel. To arrest the feeding action of the cage there is provided a stop in the form of a ring 8 having a forward tapered end 8' which is carried by the stem 5, this ring 8 being adapted to enter the flared end of the tube after a predetermined feeding action and thereby arrest any further feeding-in of the cage. This stop ring 8 is adjustably mounted upon the threaded stem 5 and also rotatably mounted thereon and to that end the ring 8 is mounted upon a thrust collar 9 which loosely surrounds the stem 6 and is held in different positions of adjustment on the stem by threaded nuts 10 and 11, the nuts being secured to the threaded stem 5 by set screws 12 and 13. Interposed between the nut 11 and a shouldered portion of the collar 9 is an anti-friction thrust bearing consisting of two bearing rings 14 and 15 with interposed balls 16 which permits the stem 5 to rotate within the collar 9 for ironing out purposes. The ring 8 is removably secured to the collar 9 by the

pin 8'' which enters apertures in the ring and collar so that a new ring of different shape may be substituted at any time to accommodate itself to the particular form of tube which is being expanded and flared.

In order to arrest the forward movement of the mandrel in an effective way there is adjustably mounted upon the threaded portion of the mandrel a stop in the form of a nut 17 which is adapted to be locked to the mandrel in different positions of adjustment by thumb screws 18, the ends of which enter longitudinally extending slots 19 in the threaded portion 7 of the mandrel. The end of the cage extension 5 cooperates with the nut 17 to arrest the forward feeding movement of the mandrel, but in view of the fact that the mandrel will rotate faster than the cage 8 there is interposed between the nut and the end of the stem an anti-friction thrust bearing. The nut has a split tapered forward end 17' which is adapted to enter a tapered socket in a chambered ring 20 which loosely surrounds the threaded portion of the mandrel. A thrust ring 21 also loosely surrounds the threaded portion of the mandrel and interposed between the rings 20 and 21 is an anti-friction thrust bearing consisting of the bearing rings 22 and interposed balls 23. A cap 24 is threaded upon the forward end of the ring 20 and engages with a shouldered portion of the ring 21 so as to hold the parts in assembled condition.

In Fig. 1 the parts are shown in the position which they have assumed after the forward feeding action of the cage and mandrel has taken place, the stop ring 8 having entered into the end of the tube (not shown) and arrested the forward feeding action of the cage and its rolls and the tapered portion of the nut 17 having entered the thrust bearing assembly so as to cause the ring 21 to engage with the rear end of the stem 5 to arrest the forward feeding movement of the mandrel.

The tool is then in a position for the ironing out operation and in order to prevent the mandrel from feeding into the cage any further during this ironing out operation due to slippage of the thumb screws 7 in the grooves 19 because of the considerable strain which is brought upon the parts by the continued rotation of the mandrel in a clockwise direction, the threads on the mandrel, as before stated, are of a left-hand character so that any further feeding-in of the mandrel through the cage and hence further expansion of the tube by the expanding rollers is effectively prevented, it being understood that if these threads were of a right-hand character the mandrel would have a tendency to continue to feed forwardly and expand the expanding rollers, because of the strain upon the parts which would result in slippage of the thumb screws 18.

This is due to the fact that as the mandrel is rotated in a clockwise direction for the purpose of rotating the cage and rollers the nut 17 merely turns with it instead of allowing the mandrel to feed through the nut as would be the case if the threads were of a right-hand character.

In order to permit the expanding and flaring rolls to recede into the cage to permit the insertion and withdrawal of the tool from the tube, the mandrel is provided with a removable part which has a reduced portion 25 for the expanding roller, a second and greater reduced portion 26 for the flaring rollers, a stem 27, an annular flange 28 between the reduced portion 26 and the stem 27, and an outer flange 29. The stem 27 is insertable in a socket 30 in the small end of the tapered portion of the mandrel and the stem and tapered portion of the mandrel are perforated to receive a cotter pin 31 to hold the parts together, with the flange 28 abutting the end of the tapered portion of the mandrel. The outer flange 29 is for the purpose of engaging the opening through the cage to prevent the entire withdrawal of the mandrel. In the case of breakage of the mandrel this breakage invariably occurs at the small reduced portion 26 and by having this small reduced portion together with the reduced portion 25 as a separate part from the tapered portion of the mandrel, in case of breakage, these reduced portions may be readily removed and replaced.

In Fig. 4 there is shown a modification in the form of the reduced portion of the mandrel in which the reduced portion is tapered to provide a removable tapered extension 25' of the mandrel proper which is indicated at 4', the taper being a uniform continuation of the taper of the main portion of the mandrel. This tapered extension is provided with a stop collar 29' and also with the stem 27' which enters a socket 30' in the end of the mandrel part 4'. It also has a shoulder 28' to abut the end of the part 4' of the mandrel and a cotter pin 31' extending through apertures in the stem and mandrel secures the stem in position in a way which will permit the ready removal of the extension in case of breakage.

Having thus described our invention, we claim:

1. In a tube expander and flarer, a cage, expanding and flaring rolls carried thereby, said expanding rolls having their longitudinal axes at an angle to the longitudinal axis of said cage, a tapered rotatable mandrel extending through said cage, an adjustable stop for said cage carried thereby to arrest forward feed of said cage in said tube, an adjustable stop on said mandrel cooperating with said cage to arrest forward feed of said mandrel in said cage, at least one set-screw to secure said stop to said mandrel while said mandrel stop is being moved toward said cage, additional means to positively prevent forward feed of said mandrel after said mandrel has been arrested by said cage, said last mentioned means comprising left-hand threads on said mandrel upon which said mandrel stop is threaded and means whereby said stop will rotate with said mandrel when the forward feed of said mandrel is arrested by said stop.

2. In a tube expander and flarer, a cage, expanding and flaring rolls carried thereby, said expanding rolls having their longitudinal axes at an angle to the longitudinal axis of said cage, a tapered rotatable mandrel extending through said cage, an adjustable stop for said cage carried thereby to arrest forward feed of said cage in said tube, an adjustable stop on said mandrel cooperating with said cage to arrest forward feed of said mandrel in said cage, at least one set-screw to secure said stop to said mandrel while said mandrel stop is being moved toward said cage, and additional means to positively prevent forward feed of said mandrel after said mandrel has been arrested by said cage, said lastmentioned means consisting of left hand threads on said mandrel upon which said mandrel stop is threaded and an anti-friction thrust bearing between said mandrel stop and said cage.

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