April 12, 1960 D. A. EDGECOMBE 2,932,390

DISPLACEABLE GUIDING MECHANISM FOR EXTRUSION MANDREL

Filed April 16, 1954 2 Sheets-Sheet 1

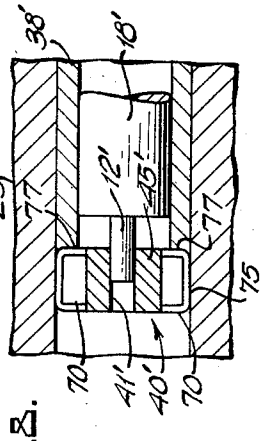
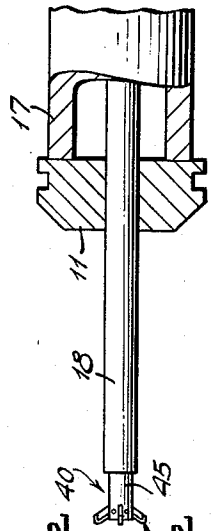


Fig. 8.



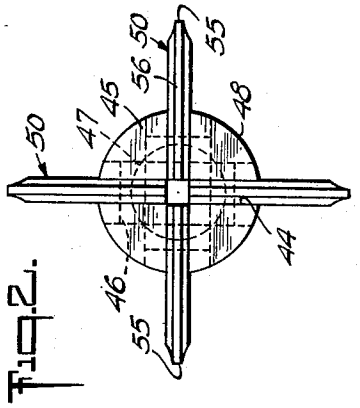


Fig. 2.

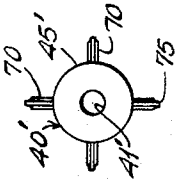


Fig. 7.

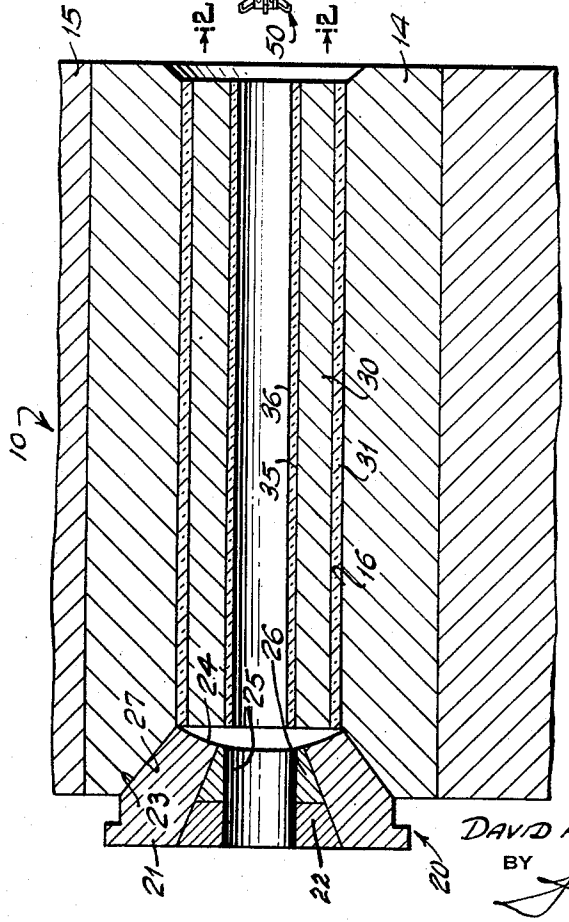


Fig. 1.

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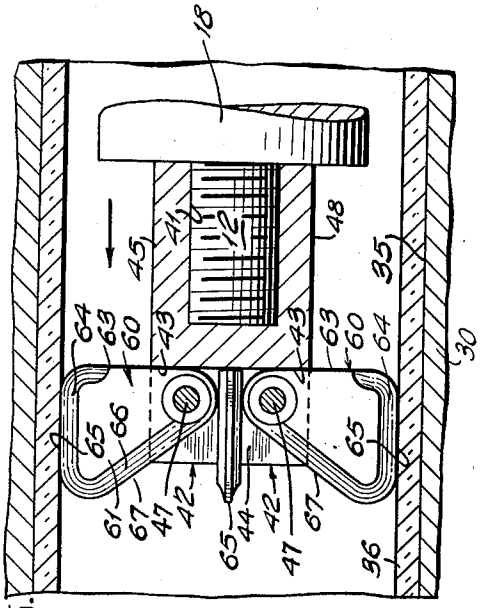


Fig. 5.

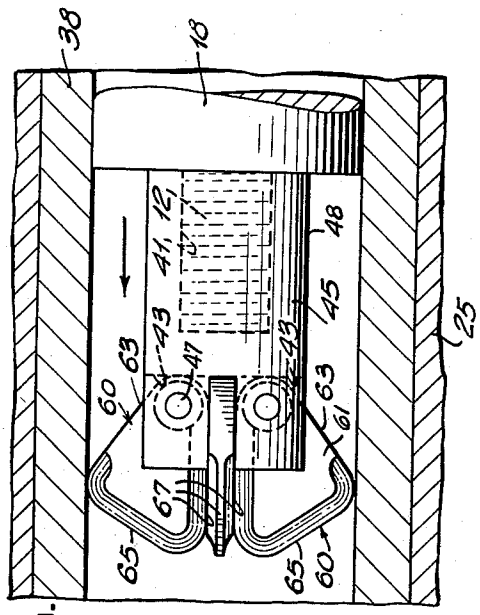


Fig. 6.

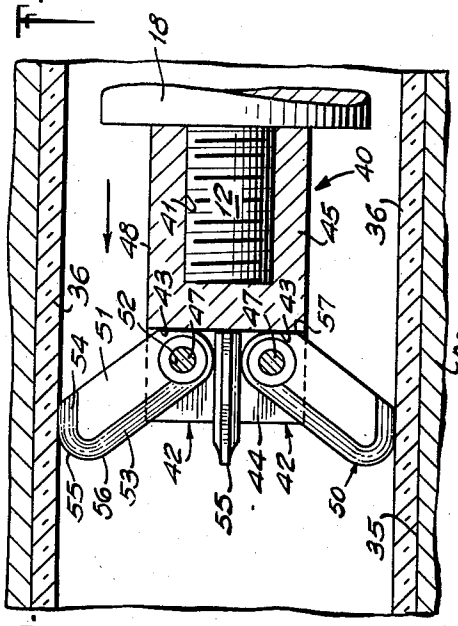


Fig. 3.

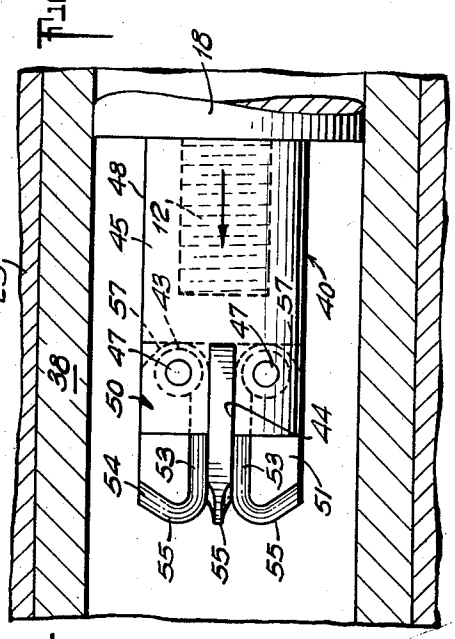


Fig. 4.

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DISPLACEABLE GUIDING MECHANISM FOR EXTRUSION MANDREL

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Application April 16, 1954, Serial No. 423,802

6 Claims. (Cl. 207—19)

This invention relates to the extrusion of tubular metal elements from pierced billets and, more particularly, to novel displaceable guiding mechanism for the free end of the mandrel of an extrusion press.

In the formation of metal shapes by extrusion, a block or billet of metal at an elevated temperature is forced under high pressure to flow through a die having an opening corresponding to the desired cross-sectional shape of the extrusion to be produced. The temperature of the metal may be 2300 F., in the case of steel, by way of example.

To form a tubular extrusion, the billet is usually pierced before insertion in the extrusion press and, before ram pressure is applied to the billet, a mandrel is projected coaxially through the billet and die. When pressure is applied to the billet, the billet metal flows through the die around the mandrel, so that a tube is extruded having dimensions determined by the die and the mandrel. In effect, the die and mandrel cooperate to form an annular die.

In a typical extrusion press, a front and rear platen are held in accurately spaced relation with each other. Between the platens is mounted a billet container for movement toward and away from the forward platen. The rear platen supports a ram arranged to project into the container and force a billet therein to flow through the die. The latter is mounted in a die holder releasably engaged in a die carrier aligned with the container passage. This carrier is mounted for movement into and out of the forward platen to move the die into and out of operative relation with the exit or downstream end of the container. The ram has a mandrel coaxially telescoped therewith for forming tubular extrusions.

When an extrusion is to be made, the container is moved forwardly to seat against the rear face of the forward platen. A die holder and die assembly is meanwhile mounted on the rear face of the carrier and the latter is moved rearwardly into the forward platen to engage the die in a recess in the forward end of the container and coaxial with the container passage. The carrier is then locked to the forward platen. After a heated billet has been loaded into the container, the mandrel is projected through the pierced billet into the die. The ram, carrying a dummy block on its outer end, is then moved forwardly under very high pressure to force the billet outwardly through the die. The extrusion is then severed and conveyed away from the press.

The formation of metal shapes by extrusion has been successfully applied to non-ferrous metals for some time. However, it is only recently that plain and alloy steels have been extruded using glass as a lubricant. This has been due to the relative difficulties and problems involved in the extrusion of steels and alloys as compared to the difficulties and problems of extruding non-ferrous metals such as aluminum, brass, and copper. For example, the use of lubricants having a carbon base for the extrusion of some alloy steels may require an excessive amount of refinishing of the extruded shape due to the carbon pickup in the hot metal. These extra finishing operations have prevented the extrusion process from attaining a competitive position with respect to other metal working processes.

This picture has been changed radically by the introduction of a new steel extrusion process in which relatively refractory materials, such as glass, have been used as lubricants. These refractory materials have the advantage that they do not contain any significant amounts of carbon as a constituent element, coupled with a further advantage that the glass has the property of melting in successive layers or films as it is contacted by the hot metal. Thus, only the surface or contacting layer of the glass is initially melted as the billet moves therealong, and as this film is destroyed, successive underlying layers or films are melted sequentially, thus providing a continuous lubricant film between the extrusion and the die through which the extrusion is being forced under very high pressures.

In the aforementioned typical extrusion press, plugs of glass fiber or similar material are placed in the container passage before the billet is loaded into the container. Charging of the billet into the container pushes these plugs up against the upstream or entry surface of the die. In addition, a layer of glass lubricant is applied to the external surface of the hot billet as the latter is being fed to the extrusion press. This is presently effected by rolling the hot billet over powdered or particle form glass spread on a transfer surface over which the hot billet moves to the extrusion press. The glass adheres to and forms a thin layer on the external surface of the billet.

As described in the copending application of A. B. Capron et al., Serial No. 413,766, filed March 3, 1954, the surface of the internal passage in the pierced billet is lubricated by depositing a measured quantity of powdered glass in such passage for distribution over the surface thereof as a film or layer as the billet rolls over the transfer surface.

The application of lubricant to the billet surfaces in the form of powdered glass provides thin glass films of uniform depth on these surfaces. The resulting thin films permit the clearances between the billet and container, and between the mandrel and billet, to be greatly reduced as compared to the clearances required when the glass lubricant is applied in the form of blankets or sleeves of glass fiber. This, in turn, greatly improves the concentricity of the extrusion.

However, the close clearance between the mandrel and the internal surface of the billet introduces a problem in projecting the mandrel through the billet. Any deflection of the free or unsupported end of the mandrel causes the mandrel to engage the glass layer and scrape it off the billet internal passage. This is particularly true in the case of mandrels having a high ratio of length to diameter.

To avoid this difficulty, the present invention is directed to novel displaceable guiding mechanism for the free end of a mandrel. This guiding mechanism comprises a spider including a body mounted on the free end of the mandrel, and having a diameter somewhat less than that of the mandrel, and means movably mounted on the spider body for projection perpendicularly from the mandrel surface to engage the billet internal passage to center the mandrel through the billet and in the die. These means are displaceable out of the path of the extrusion by the latter as the ram forces the billet through the die around the mandrel.

More specifically, the spider body has circumferentially spaced radial slots therein in each of which is

pivotally mounted a blade or runner. When the mandrel is projected into the billet passage, these runners are swung backwardly and outwardly to project from the spider to ride along the glass layer or surface of the billet to center the mandrel in its movement through the billet and into the die. While the runners may scrape some glass from the billet internal surface, the amount removed is inconsequential as the guiding surfaces of the runners are narrowed to attain substantially line contact with the engaged surface. Backward movement, and thus projection, of the runners is limited to a pre-set value by engagement of surfaces of the runners and slot.

The spider may take either one or two forms. In one form, the spider body is fixedly secured to the free end of the mandrel, and the runners are of such dimension as to be folded or collapsed within their slots by the extrusion as the latter flows over the mandrel and spider. In the other form, the spider body is merely set on the end of the mandrel to guide it through the billet. In this form, the runners do not collapse and the spider is carried out of the press in front of the extrusion as the latter is formed.

For an understanding of the invention principles, reference is made to the following description of typical embodiments thereof as illustrated in the accompanying drawings.

In the drawings:

Fig. 1 is a longitudinal sectional view through an extrusion press die, loaded container and ram, showing a mandrel equipped with the guiding means of the invention;

Fig. 2 is a front elevation view of the spider, taken on the line 2—2 of Fig. 1;

Fig. 3 is an enlarged logitudinal sectional view of a pierced billet showing a mandrel with a completely collapsible form of spider being projected therethrough;

Fig. 4 is a similar view of a die and extrustion, showing the collapsible spider as an extrusion flows thereover;

Figs. 5 and 6 are views, respectively similar to Figs. 3 and 4, illustrating a modified form of runner;

Fig. 7 is a front elevation view of a non-collapsible spider; and

Fig. 8 is a view, similar to Figs. 4 and 6, of the spider of Fig. 7 being displaced from a mandrel by an extrusion.

Referring to Fig. 1, an extrusion press **10** is illustrated as including a die assembly **20**, a container **15**, a ram **17**, and a mandrel **18** mounted coaxially of ram **17** and projectable therefrom. Die assembly **20** is held against the exit or downstream end of a passage **16** in a container liner **14** by a suitable die carrier (not shown), and includes a mounting ring **21** in which is mounted a frusto-conical die **25** and a frusto-conical backing ring **22**. Mounting ring **21** has a frusto-conical surface **23** engaging a frusto-conical seat **27** in liner **14**, and an annular concave upstream surface **24** forming a continuation of the upstream or entry surface **26** of die **25**.

Mandrel **18** extends through and supports replaceable "dummy block" **11** on ram **17**. In accordance with the invention, the free end of mandrel **18** carries a spider **40** described more fully hereinafter.

As described in the copending application of Sidley O. Evans, Serial No. 328,688, filed December 30, 1952, now Patent No. 2,739,799 billets intended for the extrusion of tubular products are preferably initially heated to a piercing temperature and then pierced with an I.D. somewhat larger than that of the extruded tubular products. The initial heating means, the piercing press, and associated conveyors, and handling devices have not been shown as they form no part of the present invention.

The pierced billets are then heated to a high temperature, such as 2300 F. in the case of steel, in a suitable heating means. The billets are charged into the heating means and extracted therefrom by suitable billet handling device. This device deposits the heated billets onto a transfer means which transfers the billets into alignment with passage **16** of container liner **14** and ejects them into this passage.

While being transferred from the heating means for injection into container **15**, the pierced billet **30** has thin layers of glass, uniform in depth, applied to its outer surface and to the surface of the pierced passage **35**. These layers are indicated at **31** and **36**, respectively. Layer **31** is applied by rolling the heated billet over particulate glass spread on a surface of the transfer means. Layer **36** is applied by depositing a measured quantity of particulate glass into passage **35**. As the hot billet rolls along the transfer surface, the particulate glass is spread over and adheres to the billet cylindrical surfaces forming the thin glass films **31** and **36** of a predetermined small depth on these surfaces.

Mandrel **18** with spider **40** is first extended through passage **35** and into die **25**. Ram **17** is then projected into passage **16** to engage the billet and force it, under high pressure, to flow through die **25** around mandrel **18**, thus forming a tubular extrusion. Mandrel **18** is withdrawn into ram **17** at the end of the extrusion stroke, and ram **17** and mandrel **18** are then conjointly withdrawn and container **15** moved rearwardly a short distance away from the front platen of the press. The extrusion is then severed between the container and front platen, after which container **15** is moved forwardly and the extrusion withdrawn by a runout table and conveyor. Ram **17** is then moved into container **15** to eject the severed end, or discard, of the extrusion, this discard moving into the front platen and falling into a suitable receptacle.

Before the billet **30** is charged into the passage **16** of container liner **14**, one or more cylindrical plugs of glass fiber (not shown) are placed in the passage **16** so that loading of the billet thereinto will result in the plugs being interposed between the billet and the upstream face of the die assembly. The die assembly is shown and described more particularly in the copending application of David A. Edgecombe, Serial No. 334,211, filed January 30, 1953, for "Die Charging Arrangement for Metal Working Apparatus," now Patent No. 2,731,123.

Referring more particularly to Figs. 2, 3 and 4, the spider **40** illustrated is completely collapsible by the extrusion, and includes a body **45** carrying radially projectable, circumferentially spaced runners **50**. A tapped axial recess **41** at the body rear end receives a threaded axial mounting pin or stud **12** on the free end of mandrel **18**. The forward end of body **45** is formed with circumferentially spaced radially and axially extending slots **42** which open through the front of the body and have radial rear walls **43** and parallel flat side walls **44**. Preferably four (4) slots **42** are provided, although a different number of radial slots may be used.

At equal, pre-set distances from the axis of body **45**, the side walls **44** of each slot are formed with coaxial drilled passages **46** extending perpendicularly to the side walls to receive driven pins **47** having a length such as to terminate inwardly of the outer surface **48** of body **45**. These pins pivotally support the runners **50**, each of which is mounted in a slot **42**.

Runners **50** have the general shape of an isosceles trapezoid with the base corners rounded. The main body portion **51** has a thickness substantially equal to the width of a slot **42**, for guiding contact with slot side walls **44**. A transverse aperture **52** adjacent one base corner receives pin **47**. The base **53** and outer sloping side **54** of the runner are bevelled on each side surface to provide narrow edges **55**, **56**.

Short, narrow edges **55** engage the glass film **36**, when mandrel **18** is projected into passage **35**, to guide and center the mandrel in passage **35** and die **25**. When mandrel **18** is thus to be projected, runners **50** are swung backwardly and outwardly until runner surfaces **57** engage slot rear walls **43**, limiting the runner projection to a pre-set amount just sufficient for guiding contact with

glass layer 36. The runners may remove narrow strips of layer 36, but the amount removed is inconsequential due to the narrowness of edge 55. The spider projects beyond passage 35 before billet 30 is compressed and extruded.

When the ram 17 is forced into passage 16 to compress and extrude billet 30, the extrusion 38 flows through die 25 over mandrel 18 and spider 40. The extrusion 38 collapses runners 50 into slots 42, as shown in Fig. 4. It should be noted that the configuration of runners 50 is such that the dimensional spread of the runners, when collapsed, is less than the I.D. of extrusion 38, so as not to obstruct the latter.

The circular rounding of the pivot corner of each runner assures that the distance of the edge of this corner from its pivot cannot increase as the runner folds, and can, at the most, remain constant. This prevents damage to the inside of the extrusion by the folded runners.

Figs. 5 and 6 illustrate an alternative form of runner which is not completely collapsible into the spider body.

Runners 60 are triangular in shape, with rounded corners, and have body portions 61 whose thickness is equal to the width of slots 42 for guiding engagement with slot side walls 44. A transverse aperture at the inner corner of each runner receives a pin 47. Extending from this corner is a rectilinear surface 63 arranged to engage slot rear wall 43 to limit backward and outward movement of the runner. The other two edges 64 and 66 are doubly bevelled to provide narrow surfaces 65 and 67, respectively. Surface 65 has guiding engagement with glass film or layer 36 when runners 60 are extended during projection of mandrel 18 and spider 40 through passage 35.

When ram 17 forces billet 30 through die 25 around mandrel 18 and spider 40 to form extrusion 38, the extrusion folds runners 60 forwardly and inwardly until the diametric projection of the runners is less than the internal diameter of the extrusion. The extrusion then flows over the partially retracted or collapsed runners 60.

In operation of the forms of the invention illustrated in Figs. 1 through 6, runners 50 or 60 are first moved outwardly of the slots to their limit of movement, being retained in this position in a suitable manner such as by tight contact between the wall surfaces 44 of the slots and the side surfaces of the runners. Mandrel 18 is then projected through the billet passage and into die 25, runners 50 and 60 remaining fully extended during this movement. Ram 17 is then advanced to extrude the billet, and the extruded tube first folds the runners 50 or 60 inwardly of the slots and then passes over the folded or collapsed runners.

Figs. 7 and 8 show a non-collapsible form of spider used in certain instances. Referring to these figures, the spider 40′ has a body 45′ which is simply a short piece of relatively thick tubing which slips over the smooth or threaded pin 12′ of mandrel 18′. Welded to the outer surface of tubular body 45′ are fins 70, four fins being illustrated, although a different number may be used. These fins have a height sufficient to provide the necessary guiding function for mandrel 18′, the outer edges of the fins having narrow guiding surfaces 75 corresponding to the guiding surfaces 55 and 65 of the other embodiments.

As the ram forces the billet to flow around the mandrel to form extrusion 38, this extrusion engages the rear edges 77 of fins or runners 70, forcing spider 40′ outwardly through die 25, separating the spider from mandrel 18′. The ejected spider is recovered and reused.

While a specific embodiment of the invention has been shown and described in detail to illustrate the application of the invention principles, it will be understood that the invention may be embodied otherwise without departing from such principles.

What is claimed is:

1. A guiding mechanism for the free end of a mandrel comprising a spider including a body detachably mounted on the free end of said mandrel and having a diameter less than the mandrel diameter; said body having peripherally spaced, longitudinally extending, radial slots therein; and runners pivotally mounted in said slots for movement into positions projecting from the body surface into substantially knife edged guiding engagement with the billet internal surface as the mandrel is projected through the billet to center the mandrel through the billet; said runners being displaceable out of an extended billet engaging position into a collapsed non-billet-engaging position by force which pivots said runners toward the mandrel axis extending beyond the free end of said mandrel; outward movement of said runners being limited, by engagement between coacting surfaces on the runners and slots, to positions in which the runners have only guiding contact with the billet internal surface.

2. A guiding mechanism for the free end of an extrusion press mandrel comprising a spider including a body mounted on the free end of said mandrel and having lateral dimensions not greater than those of the mandrel; said body having at least one normally vertical, longitudinally extending slot therein; and a runner, having a relatively narrow guiding edge, pivotally mounted in said slot for movement into a position projecting from the body surface into guiding engagement with the internal surface of a tubular billet as the mandrel is projected through the billet to center the mandrel through the billet; said runner being displaceable out of an extended billet engaging position into a collapsed non-billet-engaging position by force which pivots said runner toward the mandrel axis extending beyond the free end of said mandrel; outward movement of said runner being limited, by engagement between coacting surfaces on the runner and slot, to a position in which the runner has only guiding contact with the billet internal surface.

3. A guiding mechanism for the free end of a mandrel comprising a spider including a body mounted on the free end of said mandrel and having a diameter not greater than the mandrel diameter; said body having at least one longitudinally extending radial slot therein; and a runner having a relatively narrow guiding edge, pivotally mounted in said slot for movement into a position projecting from the body surface into guiding engagement with the internal surface of a tubular billet as the mandrel is projected through the billet to center the mandrel through the billet; said runner being displaceable out of an extended billet engaging position into a collapsed non-billet-engaging position by force which pivots said runner toward the mandrel axis extending beyond the free end of said mandrel; outward movement of said runner being limited, by engagement between coacting surfaces on the runner and slot, to a position in which the runner has only guiding contact with the billet internal surface.

4. A guiding mechanism for the free end of a mandrel comprising a spider including a body mounted on the free end of said mandrel and having a diameter not greater than the mandrel diameter; said body having peripherally spaced, longitudinally extending, radial slots therein; and runners, having a relatively narrow guiding edge, pivotally mounted in said slots for movement into a position projecting from the body surface into guiding engagement with the internal surface of a tubular billet as the mandrel is projected through the billet to center the mandrel through the billet; said runners being displaceable out of an extended billet engaging position into a collapsed non-billet-engaging position by force which pivots said runners toward the mandrel axis extending beyond the free end of said mandrel; outward movement of said runners being limited, by engagement between coacting surfaces on the runners and slots, to a position in which the runners have only guiding contact with the billet internal surface.

5. Mandrel guiding mechanism as claimed in claim 2

in which said guiding edge is convexly curved in the direction of mandrel movement.

6. Mandrel guiding mechanism as claimed in claim 1 in which the knife edge is convexly curved in the direction of mandrel movement.

References Cited in the file of this patent

UNITED STATES PATENTS

91,815	Bailey	June 29, 1869
180,169	Tasker	July 25, 1876
294,537	Waring	Mar. 4, 1884
361,569	Adams	Apr. 19, 1887
658,882	Thust	Oct. 2, 1900
1,166,040	Burlington	Dec. 28, 1915
2,320,071	Frothingham	May 25, 1943
2,732,938	Albers	July 31, 1956

FOREIGN PATENTS

406,455	Great Britain	Mar. 1, 1934