Oct. 10, 1967 D. A. EDGECOMBE ETAL 3,345,853

WORK FEEDING METHOD AND APPARATUS FOR PIERCING PRESS

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FIG. 1.

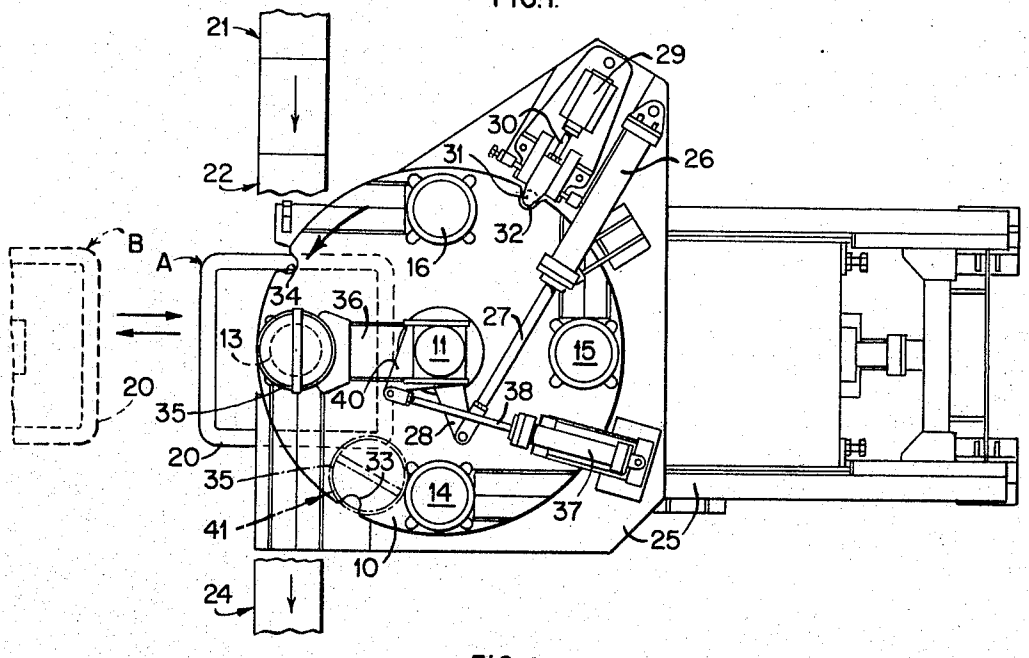

FIG. 2.

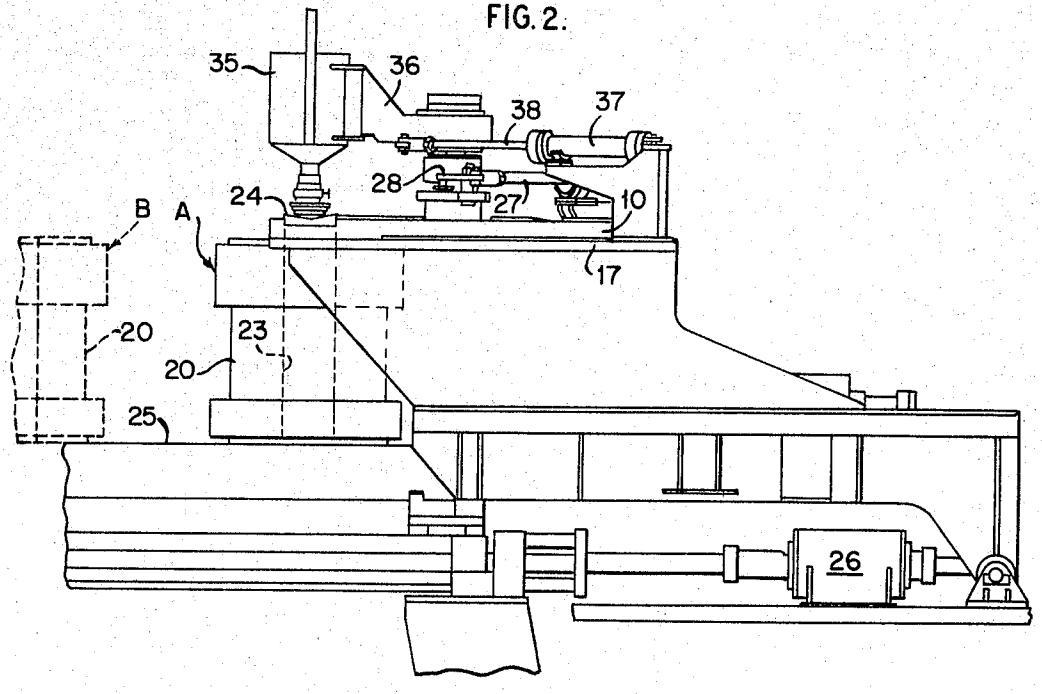

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FIG. 3

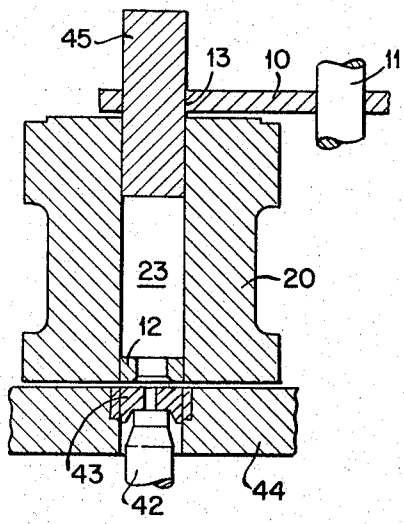


FIG. 4

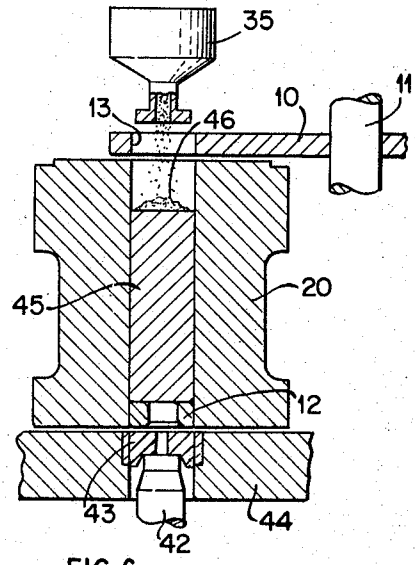


FIG. 5

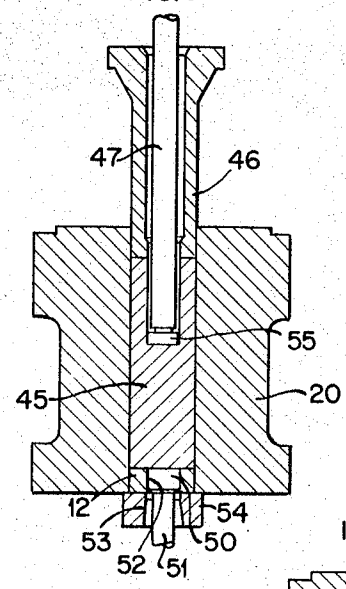


FIG. 6

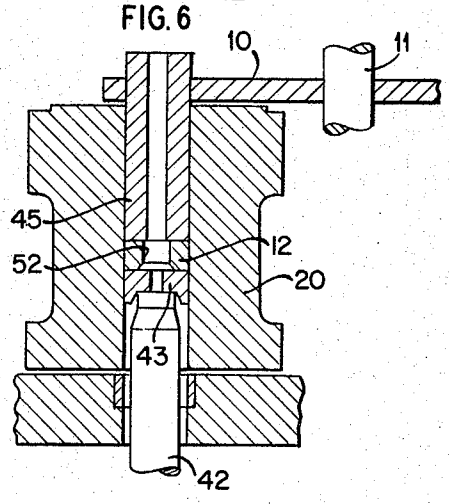
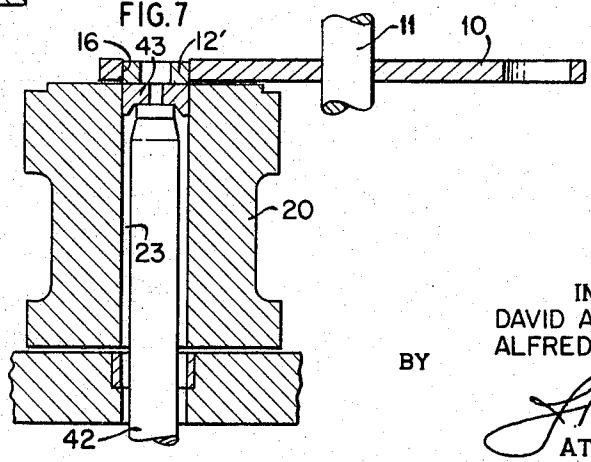


FIG. 7



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WORK FEEDING METHOD AND APPARATUS FOR PIERCING PRESS

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6 Claims. (Cl. 72—263)

The present invention relates to the hot working of metals, and more particularly to the piercing of a billet preparatory to the extrusion of ferrous metal tubes or other hollow articles.

In the piercing of hot billets it is known to insert a preheated billet into a metal container and to thereafter subject the billet to a piercing operation to produce a hollow billet. In the usual procedure a preheated billet, at a suitable temperature, is delivered to a container which has a liner ring or shear ring positioned at the bottom of the container cavity to cooperate in the piercing operation so as to permit the ejection of a slug of the metal from the container in piercing the billet. Necessarily the shear ring is heated by both conduction from the hot billet and by reason of the work performed. The container with the hot billet therein is moved to a piercing position wherein the piercing operation actually occurs. After the billet is pierced the container is returned to its previous position and the billet ejected from the container for transportation to the next stage of an extrusion process.

The container, after the ejection of the pierced billet is then ordinarily ready to receive a succeeding billet to be pierced. In the usual procedure the shear ring must be replaced in the container after a series of billet piercing operations, where shear ring replacement becomes necessary due to the accumulated high temperature in the shear ring particularly at the shearing edge, causing breakdown of this edge and shortening the life of the ring so that it must be discarded prematurely.

In the present invention we provide an automatic indexing or shear ring positioning apparatus whereby the shear ring is ejected from the billet container after each piercing operation. Immediately prior to the insertion of a succeeding hot billet into the container, a cooled shear ring is positioned in the container. With our invention each shear ring is subjected to billet heat and billet working during only one cycle and the life thereof is greatly extended. The shear ring is automatically removed from the container and passed through a cooling stage whereby each shear ring is in an optimum condition during each piercing cycle. Advantageously the life of each shear ring is greatly extended and since the placement of shear rings in the billet container is automatic, the indexing table or shear ring positioning apparatus eliminates a considerable amount of labor in the overall operation of the billet piercing procedure.

The various features of novelty which characterize our invention are pointed out with particularity in the claims annexed to and forming a part of this specification. For a better understanding of the invention, its operating advantages and specific objects attained by its use, reference should be had to the accompanying drawings and descriptive matter in which we have illustrated and described a preferred embodiment of the invention. Of the drawings:

FIG. 1 is a plan view of a shear ring indexing table constructed and arranged in accordance with the present invention;

FIG. 2 is an elevation of the apparatus shown in FIG. 1; and

FIGS. 3–7, inclusive, diagrammatically illustrate successive stage in the piercing of a billet between the insertion of a hot billet to be pierced into the container and the ejection of the shear ring from the billet container when the pierced billet is ejected.

As shown in FIGS. 1 and 2 the present invention includes a horizontally disposed plate or table **10** constructed for rotation about a vertical axis formed by an upright shaft **11**. The table is positioned for movement in a horizontal plane about the axis of rotation. The table is formed with a thickness substantially equal to the thickness of a shear ring **12** (see FIG. 7) and is provided with four equally spaced openings **13**, **14**, **15**, and **16**, circumferentially arranged adjacent the outside periphery of the table **10**. Each opening is provided with an insert sized to accommodate a particular size of shear ring **12**. The table rotates above the horizontally disposed plate **17** which is arranged to close the bottom of each opening during rotation of the table, except when the opening is positioned above its shear ring discharge position immediately above a billet receiving container.

A suitably heated billet approaches the indexing table **10** and the container **20** on a conveyor **21** and is tilted in a known mechanism indicated generally at **22** for discharge through one of the aligned openings **13**, **14**, **15**, and **16** into the cavity **23** of the container **20**. As hereinafter described a cooled shear ring **12** is supplied for each successive billet discharged by the conveyor **21** and tilting mechanism into the container **20**.

With the billet in the container **20** at the billet receiving position A, the container is moved transversely to a position B associated with a billet piercing press (not shown) where the billet is pierced. Both the container **20** and the pierced billet are then returned to position A, the billet ejected from the container by a hydraulic piston, and transferred away from the container by a conveyor **24**.

As shown in FIG. 1 and 2 the billet container **20** is mounted on a base structure **25** so as to be movable in a horizontal direction, by action of the hydraulic cylinder **26**. The base structure also supports the indexing table **10**, the shaft **11** and the operating mechanism for the table.

As hereinafter described, a shear ring **12** is retained in each of the four openings **13**, **14**, **15** and **16** for successive use in the piercing of each hot billet. After each piercing cycle, and upon delivery of the pierced billet to the conveyor **24**, the table **10** is rotated through an angle of 90° to thereby position a cooled shear ring **12** above the container **20**. The rotation of the table **10** is effected by a power piston **26** action through a piston rod **27** and a linkage arm **28** on a ratchet device attached to the shaft **11**. The exact vertical alignment between successive openings **13**, **14**, **15** and **16**, in the table **10** with the cavity **23** of the container **20** is established by a table locking piston **29** attached to the supporting structure **25**. A piston rod **30** having an enlarged rounded end **31** is advanced by the piston **29** to engage in notches, such as **32**, **33**, and **34** which are suitably positioned 90° apart about the outer circumference of the table. Thus, when end **31** engages the notch **32** the opening **13** in table **10** will be in exact coaxial alignment with the cavity **23** of the container **20**. In a similar manner notches **33** and **34**, when engaged by the rounded end **31**, will align openings **15** and **14**, respectively, with the cavity **23** of the container. A similar notch (not shown) will also insure alignment of the opening **16** with the cavity **23** when the piston **26** ratchet drive combination rotates the table 90° in a counter clockwise direction from the position shown in FIG. 1.

After the billet has been deposited in the container **20**, a hopper **35**, containing lubricating material, mounted on the end of a supporting arm **36** pivotally attached to the shaft **11** is moved through an arc into alignment with the container cavity **23** for the delivery of lubricating ma-

terial, such as powdered glass or the like, on the top of the hot billet. The arm 36 supporting the hopper is moved through the arc by the operation of a hydraulic or pneumatic piston 37 pivotally attached to the arm 36 through a piston rod 38 and a bracket 40. When the lubricating material has been deposited on the billet the piston 37 is actuated to rotate the hopper to a position at one side of and out of alignment with the cavity 23 of the container such as shown at 41. The hopper thus does not interfere either with the introduction of the hot billet into the container or the ejection of the pierced billet from the container.

The operation of the invention is illustrated in FIGS. 3–7, inclusive. As shown in FIG. 3 the container 20 is located in its receiving position A beneath the indexing table 10. As shown, the liner ring 12 has been dropped into the bottom of the container and is held in position by an ejector stem 42 supporting an ejector ring 43 which is located with its upper surface flush with the surface of a beam 44 forming part of the support structure 25. The ejector ring is provided with a shoulder to limit its downward movement relative to the beam 44. The billet 45 delivered to the conveyor 21 is upended, with the billet axis in a substantially vertical position so that the billet is dropped into the cavity 23 of the container 20.

As shown in FIG. 4 the billet has its lower end abutting the upper surface of the shear ring 12 and the hopper 35 containing lubricating material, such as powdered glass, is positioned above the opening 13. A pre-selected quantity of powdered glass 46 is discharged from the hopper 35 to the uper surface of the hot billet 45.

As shown in FIG. 5 the container 20 with the billet 45 and shear ring 12 therein has been transferred by means of the hydraulic piston 26 (see FIG. 2) to the position B and the piercing step initiated. In this position the container 20 is in alignment with the ram 46 and mandrel 47 of the piercing machine. As shown in the drawing the ram 46 has exerted a downward pressure against the upper surface of the hot billet 45 to press the billet into conformity with the confining walls of the cavity 23 in container 20. Immediately following the action of the ram 46, the piercing mandrel 47 is pushed downwardly into the hot billet 45 with the metal of the billet being back extruded so as to lengthen the billet 45 in an upward direction. The mandrel 47 continues its downward movement through the billet to a position adjacent the shear ring. Thereafter, while the mandrel continues its downward movement, the end portion 50 of the hydraulic piston rod 51 projecting through the aperture 52 in the shear ring 12 is withdrawn downwardly so that a "slug" of hot metal is extruded through the aperture of the shear ring and the opening 53 of the backup ring 54. The head 55 on the lower end of the piercing mandrel 47 is pushed through the aperture 52 and opening 53 with the projecting head 55 then removed from the mandrel 47 with the "slug" of metal for separate handling and reuse of the head 55. Immediately thereafter the piercing mandrel and the ram are moved upwardly out of the container, and the container is returned to the position A.

As shown in FIG. 6 the ejector stem 42 of the hydraulic mechanism beneath the container is actuated in an upwardly direction to push the pierced billet, the shear ring 12 and the ejector ring 43 upwardly through the opening 13 of the indexing table 10. The ejector stem 42 continues its upward movement until the billet 45 clears the upper surface of the indexing table 10 and the billet is deposited on the conveyor 24 for removal to the next stage in the extrusion of a tubular product. As the billet is removed from the container the shear ring 12 is pushed up into the opening 13 and is held in this location by the stem 42 and ejector ring 43 during initial rotation of the indexing table 10. The shear ring 12 is retained in its opening 13 during rotation of the table 10 to the position indicated by the numeral 14. Simultaneously the opening 16, with a replacement, cooled shear ring 12' therein

is moved into vertical alignment with the cavity 23 of the container 20 and locked in position by operation of the piston 29 (see FIG. 1). This is shown in FIG. 7 where the shear ring 12', in a cooled condition, is located in vertical alignment with the cavity 23 of the container 20. Immediately thereafter the ejector stem 42 is moved downwardly with the shear ring 12' and the ejector ring 43 entering the cavity by gravity, or under the influence of the next hot billet delivered to the apparatus by the conveyor 21. The cycle is again started by the introduction of a succeeding hot billet as illustrated in FIG. 3.

It will be noted in the illustrated embodiment of the invention that there are four (4) shear rings positioned in the indexing table 10. Each hot billet is used with one of the shear rings with shear rings used successively so that each ring may be cooled before it is reused in the piercing process. Advantageously, the shear rings will each be cooled by water jets when in the position indicated by the opening 16, shown in FIG. 1. The described sequence of the operation may be manually actuated or may be automatically controlled.

While in accordance with the provisions of the statutes we have illustrated and described herein the best form and mode of operation of the invention now known to us, those skilled in the art will understand that changes may be made in the form of the apparatus disclosed without departing from the spirit of the invention covered by our claims, and that certain features of our invention may sometimes be used to advantage without a corresponding use of other features.

What is claimed is:

1. In combination with a billet piercing apparatus comprising a billet piercing press, a container, a billet receiving and discharging position transversely spaced from said piercing press, means for moving said container between said billet piercing press and said billet receiving and discharge position, an indexing table rotatable about an upright axis spaced from said billet receiving and discharge position, said indexing table having a plurality of circumferentially equally spaced openings positioned adjacent the periphery of and extending therethrough, means for supporting a liner ring in each of said openings, means for rotating said indexing table to align an opening and the liner ring therein with said container when the latter is in a billet receiving position, and means for inserting said liner ring in said container before inserting the billet.

2. In combination with a billet piercing apparatus comprising a billet piercing press, a container, a billet receiving and discharged position transversely spaced from said piercing press, means for depositing a hot billet in said container at said hot billet receiving position, means for discharging a pierced billet from said container at said billet discharge position, means for moving said container between said billet piercing press and said billet receiving and discharge position, and indexing table rotatable about an upright axis spaced from said billet receiving and discharge position, said indexing table having a plurality of circumferentially equally spaced openings positioned adjacent the periphery of and extending therethrough, means for supporting a liner ring in each of said openings, means for rotating said indexing table to align an opening and the liner ring therein with said container when the latter is in a billet receiving position, and means for inserting said liner ring in said container before inserting the billet.

3. In a billet piercing apparatus wherein a billet container is moved between a billet piercing position and a billet charging and billet discharging position, the combination which comprises means for inserting a liner ring and a hot billet in said container in the order named, means for moving said container with the liner ring and the hot billet therein to said billet piercing position, means for piercing said billet with some of the billet metal ejected from said container through said liner ring, means

for moving said container with the pierced billet and the liner ring therein to said billet discharge position, means for ejecting the billet and said liner ring from said container in the order named, and means for inserting a cooled liner ring in said container before inserting the succeeding hot billet in said container to repeat said billet piercing operation.

4. In a billet piercing apparatus wherein a billet container is moved between a billet piercing position and a billet charging and billet discharging position, the method of operation which comprises inserting a liner ring and a hot billet in said container in the order named, moving said container with the liner ring and the hot billet therein to said billet piercing position, piercing said billet with some of the billet metal ejected from said container through said liner ring, moving said container with pierced billet and the liner ring therein to said billet discharge position, ejecting the billet and said liner ring from said container in the order named, and inserting a cooled liner ring in said container before inserting the succeeding hot billet in said container to repeat said billet piercing operation.

5. In a billet piercing apparatus wherein a billet container is moved between a billet piercing position and a billet charging and billet discharging position, the method of operation which comprises inserting a liner ring and a hot billet in said container in the order named, depositing lubricating material on the top of said billet moving said container with the liner ring and the hot billet therein to said billet piercing position, piercing said billet with

some of the billet metal ejected from said container through said liner ring, moving said container with the pierced billet and the liner ring therein to said billet discharge position, ejecting the billet and said liner ring from said container in the order named, and inserting a cooled liner ring in said container before inserting the succeeding hot billet in said container to repeat said billet piercing operation.

6. In combination with a billet piercing press, a container, a billet receiving and discharging position transversely spaced from said billet piercing press, means for moving said container between said billet piercing press and said billet receiving and discharge position, means for inserting a cooled liner ring in said container at said billet receiving position prior to insertion of said billet into the container, and means for discharging said pierced billet and said liner ring from said container.

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