United States Patent

[11] **3,581,545**

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[33] **Japan**
[31] **42/9994**

[54] **METAL EXTRUSION PRESS OF TURNTABLE TYPE**
10 Claims, 6 Drawing Figs.

[52] U.S. Cl. **72/263,** 72/270
[51] **Int. Cl.** **B21c 23/00**
[50] **Field of Search** 72/255, 257, 263, 272, 270

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ABSTRACT: A metal extrusion press having a plurality of containers capable of having their positions changed, the containers being secured to a turntable and distributed therearound so that by the intermittent revolving movement of the turntable the individual containers are successively transferred to the extrusion station from stations in which preparatory operations can be performed.

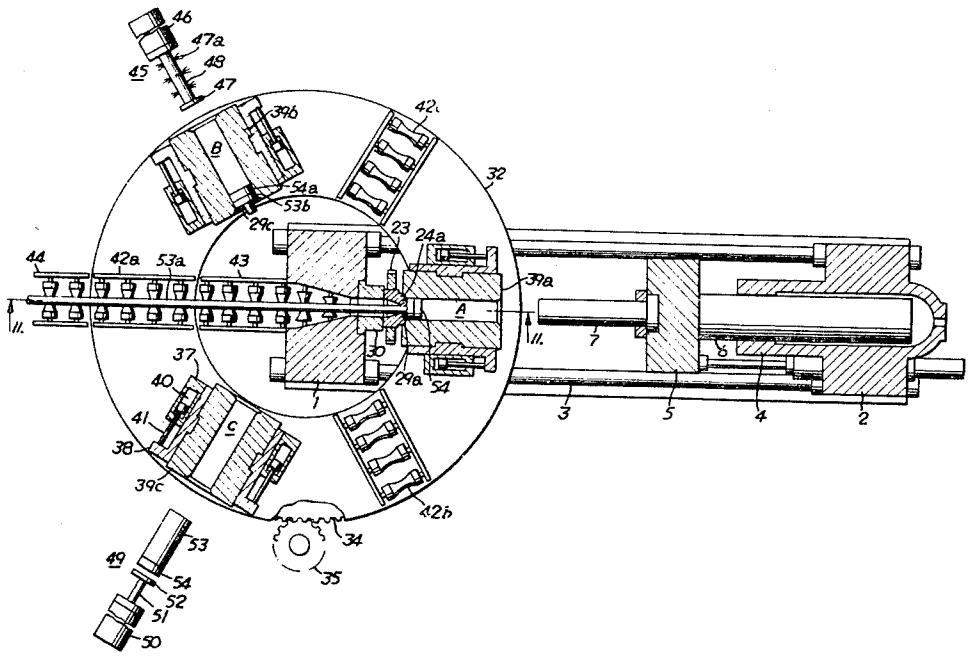

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Fig. 1

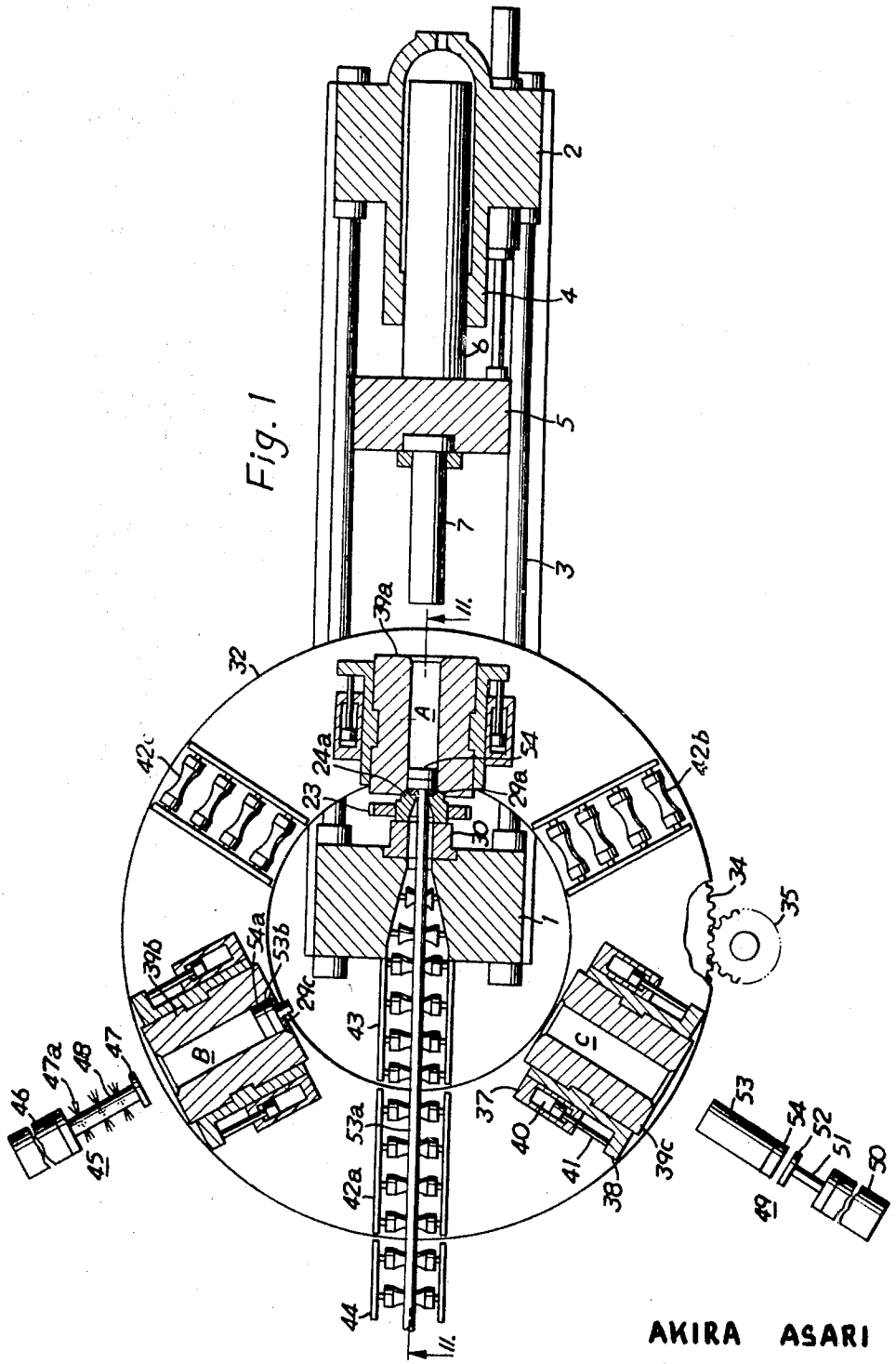

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Fig. 6

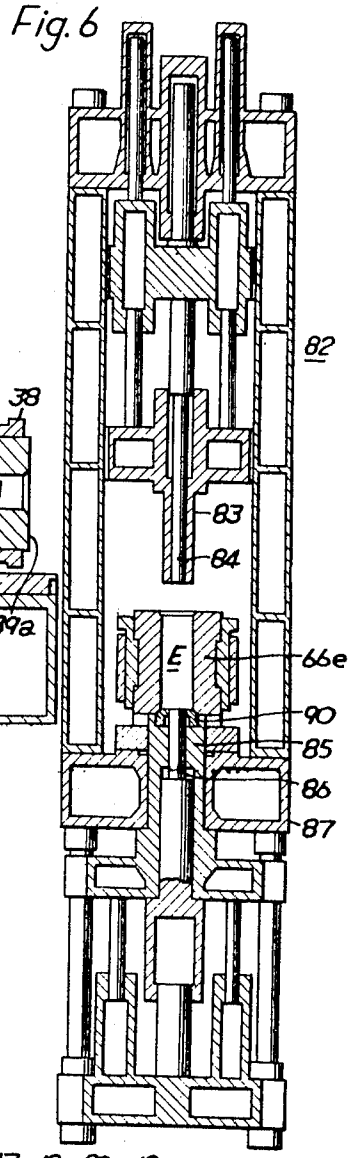

Fig. 2

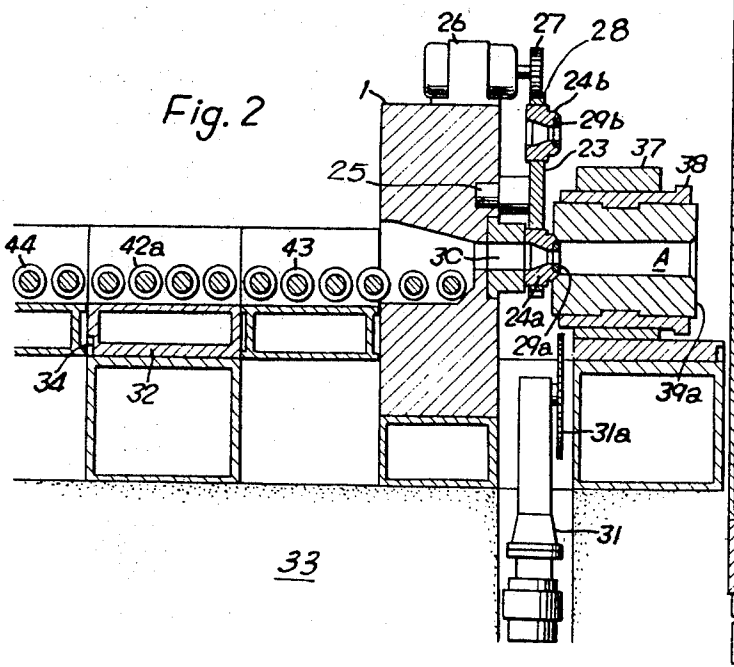

Fig. 3

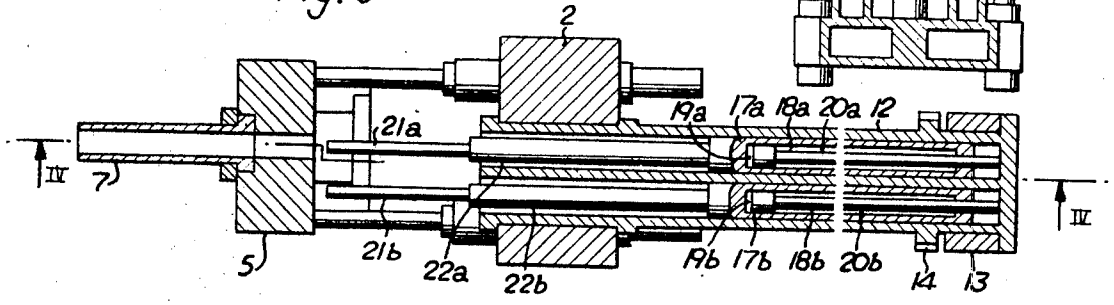

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Fig. 4

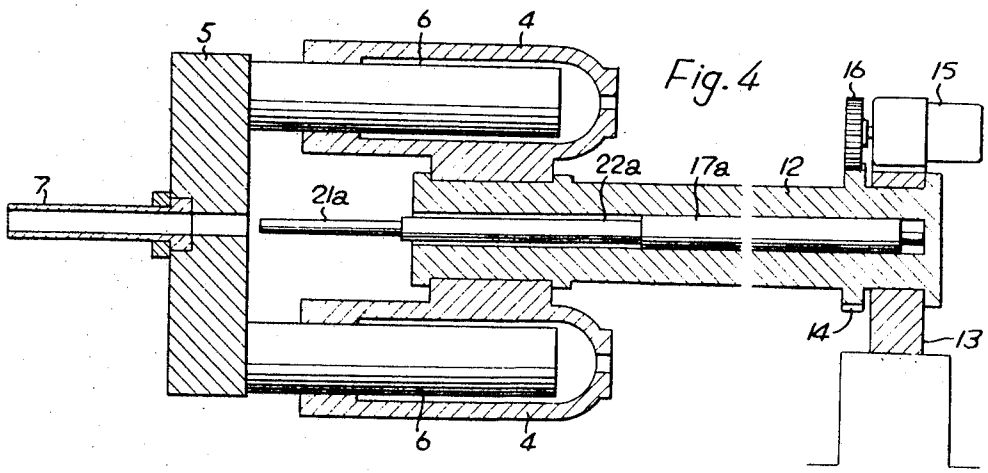
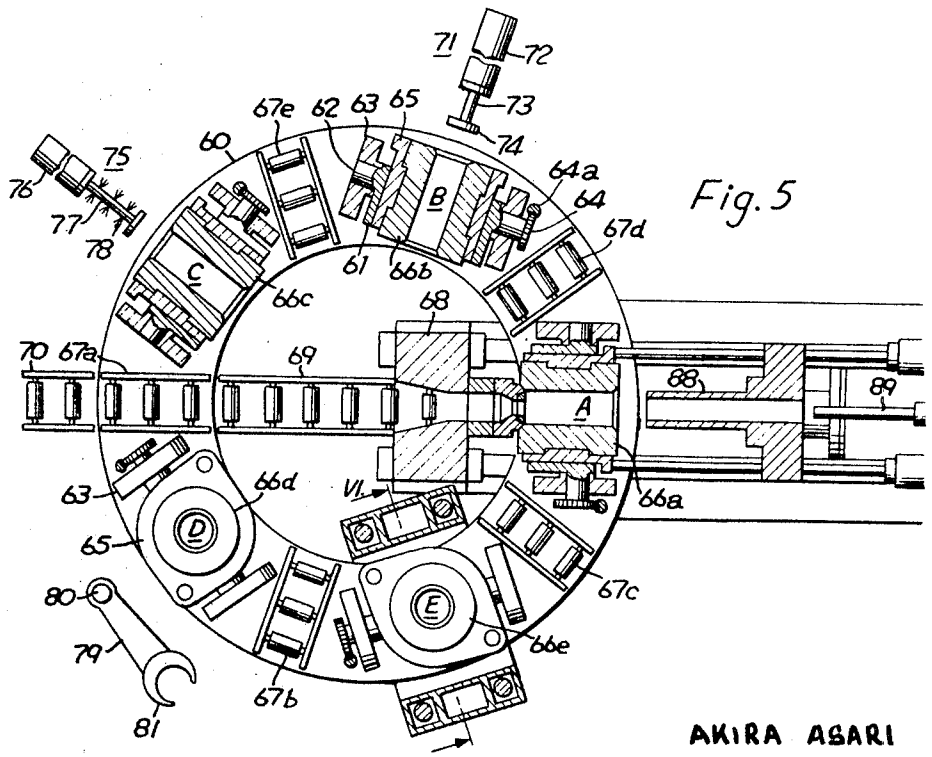


Fig. 5



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METAL EXTRUSION PRESS OF TURNTABLE TYPE

In case a metal billet is received in a container and is extruded from behind by a stem through a front die, since the extrusion residue remains adhering to the die, much time and labor have to be consumed in carrying out various operations such as removal of the extrusion residue, severance of the extruded material from the extrusion residue, cleaning of the inner surface of the container, mounting of a new die, cooling of the mandrel and clamping of the container. These preparatory operations as opposed to the extruding operation usually take a much longer period of time than does the extruding operation itself (usually they take at least twice the extrusion period). Therefore, in the press system, i.e. the so-called series process system wherein the preparatory operations are carried out at the same place as that for the extruding operation, since the extruding operation and preparatory operations must of necessity be alternately carried out, the press cycle is determined in terms of the sum of the periods of time required for both sort of operations. Thus the present situation is that the press cycle is regarded as being destined to be much longer than the extrusion period.

An extrusion press has already been suggested wherein the system, in which the sum of the periods of time required for the extruding and preparatory operations is reckoned as the press cycle, is abolished, by remodeling the series process system of alternately carrying out such extruding and preparatory operations at one and the same station into a new system of concurrently carrying them out at separate stations and wherein in view of the fact that the period of time required for the preparatory operations is usually longer than that for the extruding operation, the period of time required for the preparatory operations is reckoned as the press cycle. French Pat. Nos. 1,302,560, 1,374,400 and 1,349,514 disclose some examples of such extrusion press. These extrusion presses are usually called multicontainer type presses wherein some containers for billets are carried by a container holder arm, so that either by revolving the holder arm around an axis parallel to the direction of extrusion or by reciprocating it in one axial direction, the individual containers are caused to move between an extrusion station and a preparatory operation station.

However, these multicontainer type presses still have the following disadvantages:

1. In case a container holder arm for holding containers is adapted to be revolvable around the axis of a support rod interconnecting an opposed frame and a cylinder frame, the procedure of aligning the centerline of the container with the extrusion centerline (the centerlines of the stem, mandrel, die, etc.), which has to be operated at the time of installation of the extrusion press, involves much difficulty.
2. Since the extrusion press usually handles heated billets and, in some cases, the containers are electrically or otherwise heated, the container holder arm and the containers are affected to such an extent as to be expanded, resulting in misalignment between the centerline of the container and the extrusion centerline. Particularly in the known type in which the container holder arm is installed around a support rod, the container centerline necessarily extends laterally (radially) with respect to said support rod, so that it becomes necessary to provide a special adjusting mechanism in the attaching part between the container holder arm and the containers in order to cope with said thermal influence.
3. Further, in the extrusion press, there are generally provided a plurality of support rods (mostly three or four), and in the aforementioned known press, a considerably large-size container holder arm has to be revolved, so that special attention must be paid to the arrangement of other support rods than the one for supporting the container holder arm and it is necessary to increase the distance between the support rods.

4. Further, in the aforementioned known type of presses, repair or replacement of containers has to be made in a small space in the vicinity of the opposed frame, and moreover, this operation is difficult.
5. In the aforementioned type of presses, preparatory operating means such as billet supplying means, extrusion residue removing means, and inner container surface cleaning means are provided in the vicinity of the extrusion press proper, and that by utilization of support rod. As a result, visibility is so poor that the preparatory operations including supply of billets, removal of the extrusion residue and cleaning of containers cannot be conveniently carried out concurrently with the extruding operation. Moreover, since they must be operated in a limited space, these operations are difficult. There are various disadvantages including the fact that the preparatory operating means are installed in the vicinity of the extrusion press proper, that the space available for them is small, and that the repair of these preparatory operating means is difficult.
6. Since said preparatory operations are carried out concurrently with the extruding operation, as mentioned above, the influences produced by the preparatory operations act directly on the extrusion press proper, which, coupled with the factor mentioned in the preceding Paragraph (2), puts restrictions on the improvement of the precision of extrusion of the extrusion press.

An object of this invention is to provide a multicontainer type metal extrusion press free from the above-mentioned disadvantages.

More specifically, objects of the invention are to provide a metal extrusion press having a greatly decreased press cycle; to provide a multicontainer type press in which alignment or centering of individual containers can be independently effected; to provide a press in which there is no need of especially increasing the distance between press support rods; to provide a multicontainer type press in which repair and replacement of containers can be conveniently effected; to provide a press having a large space allowing the preparatory operations to be effected with good visibility; to provide a press in which mechanical vibrations accompanying the preparatory operations are hardly transmitted to the press proper; to provide a press having no restrictions on the design and installation of the preparatory operating means; and to provide a multicontainer type press which is very advantageous to the concomitant installation of piercing press for extruding pipes.

According to this invention there is provided a turntable type metal extrusion press characterized by comprising a revolvable turntable located forwardly of an extrusion stem and having a plurality of containers distributively secured thereto in such a manner that as the turntable is intermittently revolved the containers are brought to an extrusion station one by one; preparatory operation stations positioned adjacent the outer periphery of the turntable correspondingly to the stop position of the individual containers, whereby the extruding and preparatory operations are carried out at the extrusion station and preparatory operation stations with respect to the separate containers.

Distributively installed at the preparatory operation stations are extrusion residue removing means, means for cleaning the inner surface of the container used for extrusion, means for charging the container, whose inner wall has been cleaned, with a billet to be extruded, and means for charging a new die. These preparatory operating means each have their respective functions, which will be applied to containers which have arrived at the preparatory operation stations at which said means are installed.

For a press for extrusion-shaping of pipes, a piercing press is installed at a preparatory operation station, whereby prior to extrusion a billet is pierced to provide a hollow billet.

Usually the turntable is a horizontal one adapted to revolve around the axis of a vertical shaft, but it may be an inclined

one adapted to revolve around the axis of a shaft forming an acute angle with the vertical. The axes of the containers secured to the turntable are radially directed toward the center of revolution of the turntable. But it is not absolutely necessary to fix the containers to the turntable and the direction in which the containers are secured may be variable. Particularly, when a piercing press is concomitantly installed, it is desirable that the containers be so secured as to be revolvable around their own axes. As to the driving mechanism for revolving the containers, a system in which a gear type transmission mechanism is incorporated is usually useful, but other systems may be employed.

The driving mechanism for the extrusion stem may be a hydraulically operated one as in the usual press. A mandrel necessary to a press for extrusion-shaping pipes is used jointly with the hollow extrusion stem. This mandrel is usually hydraulically driven. As in the usual pipe extrusion press, this mandrel is a rodlike one adapted to be moved back and forth, but it is possible to use a set of two or more mandrels in order to ensure a perfect cooling effect. In that case, by using such mandrels alternately one at a time, a mandrel which has been used may be fully cooled until its next use.

Conveniently, the die charging means is such as uses a revolvable frame as in the usual extrusion press, but other types may be utilized.

The invention will be explained in more details by referring to the accompanying drawings wherein:

FIG. 1 is a plan view, in cross section, of an example of a turntable type metal extrusion press according to this invention;

FIG. 2 is a section taken along the line II–II of FIG. 1;

FIG. 3 is a plan view, in cross section, of a multimandrel mechanism;

FIG. 4 is a partial section taken along the line IV–IV of FIG. 3;

FIG. 5 is a plan view, in cross section, of an example of a pipe extrusion press; and

FIG. 6 is a section taken along the line VI–VI of FIG. 5.

An extrusion press using no mandrels is shown by way of example in FIGS. 1 and 2. An opposed frame 1 on the left-hand side and a cylinder frame 2 are interconnected by support rods 3, said cylinder frame 2 being provided with a main cylinder 4 in which is slidably fitted a ram 6 to which a cross-head 5 is secured, thus constituting drive means for a stem 7, to be later described. That is, this stem 7 is secured to said cross-head 5 in such a manner as to face front. In case a mandrel is additionally used to provide for a press for extrusion-shaping pipes, the stem 7 may be hollowed to allow the mandrel to pass therethrough, as is known in the art. Further, the cylinder frame 2 is provided with a mandrel-returning cylinder (not shown) slidably receiving a piston (not shown) connected to said cross-head 5, it thus being so arranged that after the completion of extrusion work the stem 7 may be returned.

When it is desired to make additional use of mandrels to provide for a pipe extrusion-shaping press, it is possible to use two (or more) mandrels, instead of only a single mandrel as before. Such multimandrel means is shown by way of example in FIGS. 3 and 4. Thus, a mandrel-revolving cylindrical body 12 is rotatably supported in an eccentric position in said cylinder frame 2. The rear end of the revolving cylindrical body 12 is revolvably supported in the base by a support block 13. Further, the mandrel-revolving cylindrical body 12 is peripherally provided with a gear wheel 14 meshing with a gear wheel 16 secured to the end of a shaft extending from an electric motor 15, so that the mandrel-revolving cylindrical body 12 can be revolved by driving the electric motor 15.

The mandrel-revolving cylindrical body 12 is longitudinally bored with two parallelly spaced holes in which are slidably fitted mandrel-driving cylinders 17*a* and 17*b*, respectively, in which, in turn, mandrel pistons 18*a* and 18*b* are fitted, respectively, one end of each mandrel piston is secured to said revolving cylindrical body 12, and the mandrel pistons 18*a*, 18*b* and the mandrel-driving cylinders 17*a*, 17*b* constitute front chambers 19*a*, 19*b* and rear chambers 20*a*, 20*b*, respectively, said front chambers 19*a* and 19*b* being pressurized to advance mandrels 21*a* and 21*b* to be later described toward the opposed frame 1, said rear chambers 20*a*, and 20*b* being pressurized to retract the mandrels 21*a* and 21*b*. These two mandrels 21*a* and 21*b* are respectively connected to the front portions of said mandrel cylinders 17*a* and 17*b* through mandrel holders 22*a* and 22*b*. The axes of the respective sets of mandrels 21*a*, 21*b*, mandrel holders 22*a*, 22*b*, and mandrel-driving cylinders 17*a*, 17*b* are aligned with each other. Thus, by revolvably installing the revolving cylindrical body 12 in laterally eccentric relation to the extrusion centerline in this manner, the revolving cylindrical body 12 is revolved as mentioned above so that when one set comprising said three different members is moved toward the extrusion centerline, the axes of these members will be aligned with the extrusion centerline.

References will now be given to an arrangement near the opposed frame constituting part of extruding means. The reference numeral 23 designates a disclike die-revolving plate which has a centerline located above the extrusion centerline and which is revolvably supported by a pin 25 on the side of the opposed frame 1 nearer to the stem 7. The die-revolving plate 23 has a gear 28 provided on the outer periphery thereof meshing with a gear 27 secured to the end of a shaft extending from an electric motor 26 so that by driving the electric motor 26 the die-revolving plate 23 may be revolved. Secured to the die-revolving plate 23 are two die holders 24*a* and 24*b* having dies 29*a* and 29*b* removably secured thereto, respectively. As mentioned above when the die-revolving plate 23 is revolved to move one of the die holders 24*a*, 24*b*, the axis of the die holder thus moved comes into alignment with the extrusion centerline and the rear part of said plate is supported by the opposed frame 1 through a receiving disc 30 secured to the side of the opposed frame 1 nearer to the stem 7. Disposed below the side of the opposed frame 1 nearer to the stem 7 is cutting saw drive means 31 having a cutting saw 31*a* attached thereto, said cutting saw drive means being adapted to be advanced and retracted at right angles to the extrusion centerline.

A turntable to which contained holders are secured will now be described.

A circular platelike centrally cutout turntable 32 is installed around the opposed frame 1 so as to be supported at its lower surface by a bed 33. The outer periphery of the turntable is provided with a gear 34 meshing with a gear 35 driven by an electric motor (not shown) so that by driving the latter the turntable 32 may be revolved. In this embodiment, the center of revolution of turntable 32 is on the side of the opposed frame 1 opposite the stem 7 and is at right angles to the extrusion centerline.

Three suitable container holders 38 are secured to the upper surface of the turntable 32 so as to extend radially with an angle of 120° between adjacent container holders by means of outside holders 37. Each holder 38 is axially slidable with respect to the associated outside holder 37. Further, each outside holder 37 is provided with container driving cylinders 40 extending in parallel to the axial direction. Fitted in each container driving cylinder 40 is a piston 41 having one end thereof connected to the flange of said container holder 38, so that when the container driving cylinders 40 are driven the container holders may be axially moved. Containers 39*a*, 39*b* and 39*c* are rigidly fitted in the respective container holders 38. Further, three movable conveyors 42*a*, 42*b* and 42*c* are secured to the upper surface of the turntable 32 in equispaced relation, each extending radially between adjacent containers. Further, on the side of the opposed frame 1 opposite the stem 7, a fixed conveyor 43 is so provided to be positioned below an extension of the extrusion centerline. A fixed taking-out conveyor 44 is provided in front of the turntable 32 so as to be positioned below said extension of the extrusion centerline.

When one container 39*a* is in a position where it is aligned with the extrusion centerline, the movable conveyor 42*a*,

which corresponds to that container 39*a* and is on the side opposite the latter, is aligned with the fixed conveyors 43 and 44, thereby constituting a straight row of conveyors. This is also true of the other containers 39*b*, 39*c* and movable conveyors 42*b*, 42*c*.

The position of the container 39*a* which is on the extrusion centerline is an extrusion station A and the positions of the other two containers are preparatory operation stations B and C. At the first preparatory operation station B, there is provided extrusion residue removing and cleaning means 45 positioned outside the turntable 32. As will later be described, this extrusion residue removing and cleaning means 45 serves to remove extrusion residues, dies and pusher discs and clean the inner walls of containers. This means 45 is driven by a cylinder mechanism 46 having a piston rod 48 which is provided with an extrusion residue removing plate 47 secured to the front end thereof and a brush 47*a*. The extrusion residue removing plate 47, brush 47*a* and piston rod 48 are free to move into and away from the container 39*b* (it being noted that such container is changed once for each extrusion). The extrusion residue removing and cleaning means is usually so installed as to extend radially through the center of the turntable, but when it is desired to render containers revolvable around their own axes, it may, for example, be so installed as to extend parallel to the extrusion centerline.

At the second preparatory operation station *C*, there is provided billet charging means 49 positioned outside the turntable 32. As will later be described, the means 49 serves to charge a billet and a pusher disc to the container 39*c*. The billet charging means is driven by a cylinder mechanism 50 receiving a piston rod 51 having an inserter plate 52 secured to the front end thereof, said inserter plate 52 and piston rod 51 being free to move toward and away from the container 39*c* positioned in front of the billet charging means 49. While the billet charging means 49 also is so installed as to extend radially of the turntable 32, it may be modified so that it extends in other direction.

An outline of the operation of the aforementioned press will now be given.

The container 39*a*, which has already undergone cleaning of the inner surface thereof and has been charged with a billet 53 and a dummy block 54, is positioned at the extrusion station *A*. On the other hand, one die holder 24*a* secured to the die-revolving holder 23, and the die 29*a* have been positioned on the extrusion centerline. Then, the container driving cylinders 40 are driven to move the container 39*a* toward the opposed frame 1 until the front surface of the container 39*a* abuts against the die holder 24*a*, while the main cylinder 4 is pressurized to advance the stem 7 to apply pressure to the end face of the billet 53 through the dummy block 54, thereby extruding the material 53*a*. The thus extruded material 53*a* is supported by the fixed conveyor 43, movable conveyor 42*a* and fixed conveyor 44 positioned in front of the opposed frame 1.

When it is desired to extrusion-shape pipes, hollow billets are used along with mandrels. When the multimandrel shown in FIGS. 3 and 4 is used, prior to driving the stem 7 the front chamber of the aforementioned mandrel driving cylinder 17*a* to advance the mandrel 21*a* to pass through the holes in the pusher disc 54 and billet 53 to insert the front end of the mandrel 21*a* into the die 29*a*. And, in this condition, extrusion may be operated.

When a first run of extrusion is completed, the container driving cylinders 40 are driven to retract the container 39*a* toward the side opposite the opposed frame 1. At this time, the extruded material 53*a*, without being pulled out from the container 39*a* by reason of the friction between the inner surface of the container 39*a* and the extrusion residue 53*b*, moves as the container is moving, with part of the rear end of the extrusion material 53*a* exposed to the outside between the front surface of the die holder 24*a* and the rear surface of the container 39*a*. Thereupon, the cutting saw-driving means 31 is advanced so that the extrusion residue 53*b* and the extruded material 53*a* are separated from each by being cut with the cutting saw 31*a*.

In addition, it is to be noted that when the container 39*a* is retracted as mentioned above, the die 29*a* is pulled toward the side opposite the die holder 24*a* owing to the friction between the inner surface of said die 29*a* and the outer surface of the extrusion residue 53*b* so that the die 29*a* and the die holder 24*a* are separated from each other, with the die 29*a* moving as the container 39*a* is moving; after all, as a result of the aforementioned cutting operation, the extrusion residue 53*b*, die 29*a* and dummy block 54 are left in the container 39*a*.

In addition, in case the multimandrel shown in FIGS. 3 and 4 is used, when a first run of extrusion is completed, the rear chamber of the mandrel driving cylinder 17*a* is pressurized to pull out the mandrel 21*a* from the extrusion residue 53*b*, and after the cylinder is retracted to its rearmost position the stem 7 is retracted.

Concurrently with the aforementioned extruding operation at the extrusion station *A*, removal of the extrusion residue produced in the preceding extrusion and clearing of the container are operated at the first preparatory operation station *B*. That is, the container 39*b* used in the preceding operation has arrived at this station B and the extrusion residue 53*b*, die 29*c* and dummy block 54*a* remain in said container adhering to the inside wall of the latter. Thus, the cylinder mechanism 46 of the extrusion residue removing and cleaning means 45 is driven to advance the piston rod 48 into the container 39*b* to push out the extrusion residue 53*b*, die 29*c* and dummy block 54*a* remaining in the container and also to clean the inner surface of the container. Thereafter, the piston rod 48 is retracted.

Further, concurrently with the extruding operation, removal of the extrusion residue and cleaning of the container, there is effected supply of a billet at the second preparatory operation station *C* to provide for the subsequent extrusion. That is, at the second preparatory operation station *C*, a billet 53 fresh from the heating furnace and a new dummy block 54 have already been supplied to the billet charging means 49 so as to be positioned in front of the inserter plate 52, and by driving the cylinder means 50, the inserter plate 52 is advanced to insert the billet 53 and dummy block 54 into the container 39*c* positioned forwardly thereof.

In addition, it is so arranged that at the extrusion station *A* after completion of a first run of extrusion followed by retraction of the container 39*a* and cutting of the extrusion residue, the electric motor 26 is driven to revolve the die revolving plate 23 so as to move the die holder 24*b* having a new die 29*b* mounted thereon into alignment with the extrusion centerline.

As mentioned above, the extrusion operation and the first and second preparatory operations are concurrently carried out in one cycle. And, after one cycle is completed and the extruded material on said taking-out conveyor group is taken out onto the fixed conveyor 44, the gear 35 is driven to revolve the turntable counterclockwise through 120°. By this revolving movement, the three containers 39*a*, 39*b*, 39*c* that were at the respective stations *A*, *B*, *C* have now been moved to the respective next stations *B*, *C*, *A*, where the respective operations in the next cycle are carried out. That is, the container 39*a* that was at the extrusion station *A* is moved while carrying with it the extrusion residue, etc. remaining therein to the second preparatory operation station B, where removal of the extrusion residue, etc. and cleaning of the inner surface are operated. The container 39*b* that was at the first preparatory operation station *B* is moved to the second preparatory operation station *C*, where charging of a billet 53 is operated. The container that was at the second preparatory operation station *C* is moved while containing a new billet to the extrusion station A, where extrusion is operated. Thus, in the metal extrusion press in this embodiment, three runs of extrusion are effected per revolution of the turntable 32.

Further, in the aforementioned embodiment, the extrusion residue removing and cleaning means 45 and the billet charging means 49 are installed at separate stations, but they may

be installed at a common station in opposed or parallel relation to each other.

Further, in the above description of the operation, removal of the extrusion residue is effected by the extrusion residue removing and cleaning means **45**; however, it may be effected by causing the stem **7** to push out the extrusion residue from the container **39***a* immediately after completion of cutting of the extrusion residue, while the extrusion residue removing and cleaning means may be used solely to clear the inner surface of the container **39***a*.

In FIGS. **5** and **6**, there is shown an example of a pipe extrusion press having additional provision of a piercing press, according to this invention. In this example, there are provided one extrusion station and four preparatory operation stations, with five containers secured to a turntable. Here, for purposes of brevity of description, the turntable arrangement only will be described.

On the upper surface of a turntable **60** installed to revolve in a horizontal plane, five outer container holders **61** are radially arranged equidistantly (with an angular distance of 72° with respect to the center of revolution). The opposed ends of each outer container are provided with shafts **62** each fitted in a support plate **63** vertically secured to the upper surface of the turntable **60**. One of each pair of shafts **62** is provided with a gear **64** secured thereto and meshing with a rack **64***a* driven by a hydraulic cylinder (not shown). Each outer holder **61** has a container holder **65** slidably fitted therein. These container holders have containers **66***a*, **66***b*, **66***c*, **66***d* and **66***e*, respectively, rigidly fitted therein.

Five movable conveyors **67***a*, **67***b*, **67***c*, **67***d* and **67***e* are equidistantly arranged on and secured to the upper surface of the turntable **60**, each placed between adjacent containers. A fixed conveyor **69** is provided below an extension of the extrusion centerline and on the side opposite the stem. A fixed conveyor **70** is provided in front of the turntable **60** so as to be positioned below said extension of the extrusion centerline.

A single extrusion station *A*, and four preparatory operation stations *B*, *C*, *D* and *E* are established around the turntable **60** correspondingly to the positions in which the respective containers are to be stopped. The extrusion station *A* is, of course, on the extrusion centerline. At the first preparatory operation station *B* there is provided extrusion residue removal means **71** adapted to be driven by a cylinder mechanism **72** whose piston rod **73** has an extrusion residue removing plate **74** secured to the front end thereof. The extrusion residue removing plate **74** and piston rod **73** are free to move into and away from the container **66***b* positioned in front of the extrusion residue removing means **71** (it being noted that such container is changed one for each extrusion).

At the second preparatory operation station *C*, there is provided a container cleaning means **75** adapted to be driven by a cylinder mechanism **76** whose piston rod **77** has a brush **78** attached thereto. The brush **78** and piston rod **77** are free to move into and away from the container **66***c* positioned in front of the container cleaning means **75**.

At the third preparatory operation station *D*, there is provided billet changing means **79** free to revolve around the axis of a pivot shaft **80** and is adapted to hold a billet by means of a manipulator **81** provided at the front end thereof.

At the fourth preparatory operation station *E*, there is provided a piercing press **82** across the turntable **60**. The piercing press **82** is of the vertical type, comprising an upset stem **83** positioned above the container **66***e*, a mandrel **84** extending through said upset stem, a container backup bar **85** and a backup stem **86** extending through said container backup bar **85**. These members are supported by a frame **87** and vertically driven by actuation of a hydraulic cylinder.

The pipe extrusion press described above has an extrusion stem **88** and a mandrel **89** extending centrally through said stem **88**. The turntable **60** is intermittently revolved in the same manner as in the preceding embodiment. As a result, the five containers **66***a*—**66***e* are intermittently moved by turns from the extrusion operation station *A* to the preparatory operation stations *B*—*E*. Each time the turntable **66** stops, the predetermined operations are carried out at the respective stations *A*—*E*. At the extrusion operation station *A*, the extrusion stem **88** and mandrel **89** are advanced so that the billet is extrusion-shaped into the form of a pipe. The extruded pipe is then guided by the fixed conveyor **69**, movable conveyor **67***a* and fixed conveyor **70**.

At the first preparatory operation station *B*, the extrusion residue is removed from the container by the advancing movement of the removing plate **74** of the extrusion residue removing means **71**. At the second preparatory operation station C, the inner surface of the container is cleaned by the advancing movement of the brush **78** of the container cleaning means **75**.

At the extrusion station *A* and the first and second preparatory operation stations *B* and *C*, the containers **66***a*—**66***e* are subjected to their respective predetermined operations while they are in their horizontal positions. Billet charging and piercing operations at the third and fourth operation stations *D* and *E*, however, are carried out while the containers are held in their erected positions. To this end, the hydraulic cylinder for the rack **64***a* is driven during the revolving movement of the turntable **60** to erect the particular container. When the container **66***d* reaches the billet charging position as at **79**, this container is caused to stand erect. At this time, a new solid billet fresh from the heating furnace has already been charged to the billet charging means **79** (it being noted that a billet having a narrow central hole may sometimes be employed, as will later be described). The billet is held by the manipulator **81** and the billet charging means **79** is revolved around the axis of the shaft **80** to move the billet to a position just above the container **66***e* to which it is then charged.

When the container containing the new solid billet therein is moved correctly to the center of the fourth preparatory operation station *E*, the container backup bar **85** is driven to bring a piercing die **90** into abutment against the lower surface of the container **66***e* standing erect. Subsequently, the upper surface of the backup stem **86** is exposed to the lower surface of the container **66***e* to close the lower side of the container, while the upset stem **83** is lowered to downwardly press its lower surface against the upper surface of the billet contained in the container **66***e*, thereby upsetting the same. Thereafter, the mandrel **84** is lowered to press the piercing tool secured to the lower end of said mandrel against the billet and the piercing tool is further lowered to make a hole in the billet.

When an expansion operation in which a predetermined hole is made in a billet having a narrow hole extending centrally and longitudinally thereof, the operation thereof is substantially the same as that mentioned above. In that case, an expansion tool may be used as a tool to be attached to the lower end of the mandrel **84**.

The billet pierced in the manner mentioned above is then moved to the extrusion station *A*, where it is extruded into a pipe as mentioned above.

All of what is described above is given only by way of example and different types of embodiments may, of course, be thought of in the scope which does not depart from the spirit of this invention.

The effects of the present invention will now be described.

Since a plurality of containers are distributively attached to a turntable in such a manner that at the container which is positioned at the extrusion station, a container advancing operation, a container clamping operation, an extruding operation and an extrusion residue cutting operation are carried out, and concurrently therewith, at the containers positioned at the preparatory operation stations, an extrusion residue removing operation, container cooling and cleaning operations, a billet charging operation and, in some cases, a billet piercing operation are carried out, the following effects are attained:

1. The press cycle can greatly be reduced as compared with the conventional series process type extrusion press. Particularly, as mentioned above, by employing a multimandrel mechanism, the benefits thereof are great.

2. Since the preparatory operations are carried out concurrently with the extruding operation during the stoppage of the turntable, sufficient time can be allotted to the preparatory operations to carry out, for example, cleaning of the inner surface of the container, setting of the die, charging of the billet and, in some cases, a piercing operation sufficiently and carefully.

3. Since the billet charging operation, which is dangerous work, is carried out in a place remote from the extrusion station (heretofore, between the container and the extruding means), and that outside the turntable, this operation can be carried out in a place of large working area and without any danger, and the billet charging means can be simplified and, moreover, the stroke of the main ram and also of the piercing mandrel can greatly be reduced.

4. Since the extruding means exists independently at one container position and is adapted to be employed only during the extruding operation, it is not necessary for the extrusion stem to concurrently serve for removal of the extrusion residue and consequently there is no need of changing the stroke of the main ram to provide for the extruding operation on one hand and removal of the extrusion residue on the other. Further, there is no need of providing a stroke restricting plate. Further, since use is not made of the extrusion stem for removal of the extrusion residue, an increase in the stroke otherwise necessary for removal of the extrusion residue is dispensed with and the length of the main ram can be made correspondingly shorter.

5. Since the plurality of containers are made capable of changing in position by attaching them to the turntable, there is no need of carrying out a special operation for moving the die with the extrusion residue attached thereto away from the extrusion centerline and hence no means therefor is required.

6. Since the individual containers are attached to the turntable independently of each other, it is possible to effect the centering of the mandrels independently one by one after the centering of the container, die holder, stem, mandrel, etc. is completed at the time of installation of the extrusion press. The centering operation is easy.

7. Since the containers are supported by the turntable and moved to (or from) the side of the extrusion press proper in such a manner as to describe a large curve with respect to the extrusion centerline, there is no need of increasing the distance between adjacent support rods as compared with the known press in which such containers are revolved around the axis of the support rod. There is no need of paying special attention to the arrangement of the support rods.

8. Since the repair or replacement of containers can be operated in a position remote from the extrusion press proper, such operation is easy.

9. The preparatory operations are carried out in a large space with good visibility, so that safety is ensured.

10. Since vibrations due to the preparatory operations are not transmitted to the extrusion press proper (particularly the extruding means), there is no possibility of detracting from the precision of the extrusion press.

11. Since the preparatory operating means can be installed in a large space remote from the extrusion press proper, the design thereof can be made most reasonably without being limited by space. Further, inspection and repair thereof are easy. Further, in case that this invention is applied to extrusion of pipes, since the piercing of a billet is operated at the corresponding preparatory operation station, the following effects are attained:

12. There is no need of separate heating for piercing and extrusion and therefore only a single heating means for billets suffices, and since the elements which determine the press cycle are thus decreased in number, it is possible to prevent the press cycle from increasing.

13. Since billet removing means for the piercing press is unnecessary and billet charging means for the extrusion press also is unnecessary, accessory devices for each press are decreased in number and less expensive.

14. Since transfer of billets between the piercing press and the extrusion press is carried out by the turntable, there is no need of additionally providing a separate transfer device, so that the entire apparatus is simple.

What I claim is:

1. A metal extrusion press comprising a turntable, a plurality of billet containers equally spaced around and secured to said turntable and said containers having their longitudinal axes horizontally disposed on said turntable such that by intermittent rotation of said turntable, said containers are transferred successively between an extrusion station and preparatory operation stations, the axis of rotation of said turntable being perpendicular to the extrusion centerline of said extrusion station, the longitudinal axis of each of said containers extending radially through said axis of rotation of said turntable.

2. A metal extrusion press as claimed in claim 1 wherein a plurality of container holders are secured to said turntable, each of said containers being respectively held by one of said container holders in such a manner as to be longitudinally axially movable with respect thereto.

3. A metal extrusion press as claimed in claim 1 wherein said plurality of containers and a plurality of movable conveyors are secured to said turntable in such a manner as to be alternately arranged thereon.

4. A metal extrusion press as claimed in claim 1, further comprising a die holder mounted at said extrusion station, a die held by said die holder, an extrusion stem mounted at said extrusion station on the side of said container opposite from said die, means for cutting extruded material positioned between said die holder and said container and means positioned at said preparatory operation stations for removing extrusion residue, cleaning said containers and recharging said containers.

5. A metal extrusion press as claimed in claim 1, further comprising a hollow extrusion stem and a mandrel adapted to pass through said stem positioned at said extrusion station.

6. A metal extrusion press as claimed in claim 5, wherein a plurality of mandrels are positioned at said extrusion station, each of said mandrels adapted to be successively transferred to align with said extrusion centerline.

7. A metal extrusion press as claimed in claim 1 further comprising a die, a hollow extrusion stem, a mandrel adapted to pass through said stem positioned at said extrusion station; and installed at said preparatory operation stations are extrusion residue means, container cleaning means, billet charging means and billet piercing means.

8. A metal extrusion press as claimed in claim 1 wherein each of said containers is adapted to rotate about a transverse axis.

9. A metal extrusion press as claimed in claim 8, further comprising vertically operable billet piercing means positioned at one of said preparatory operation stations, and means to rotate each of said containers about said vertical axis to bring said container into vertical alignment with said billet piercing means.

10. A metal extrusion press as claimed in claim 1, further comprising a gear formed on the outer periphery of said turntable, and a drive gear positioned to engage said gear and rotate said turntable.