

April 16, 1968

P. SINGLETON

3,377,832

METAL TUBE EXTRUSION PRESS WITH MANDREL COOLING DEVICE

Filed Feb. 2, 1965

6 Sheets-Sheet 1

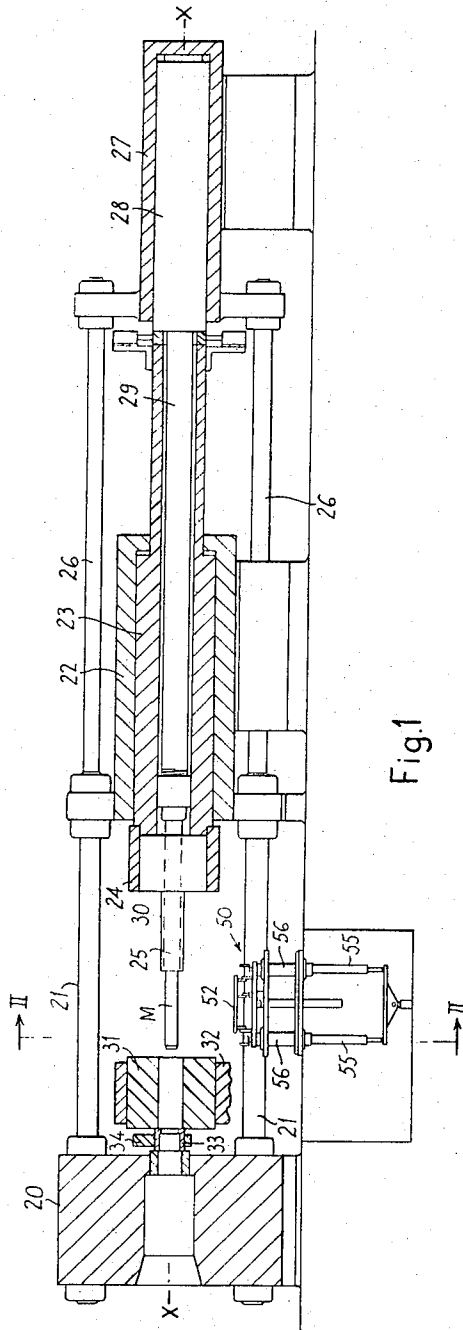


Fig. 1

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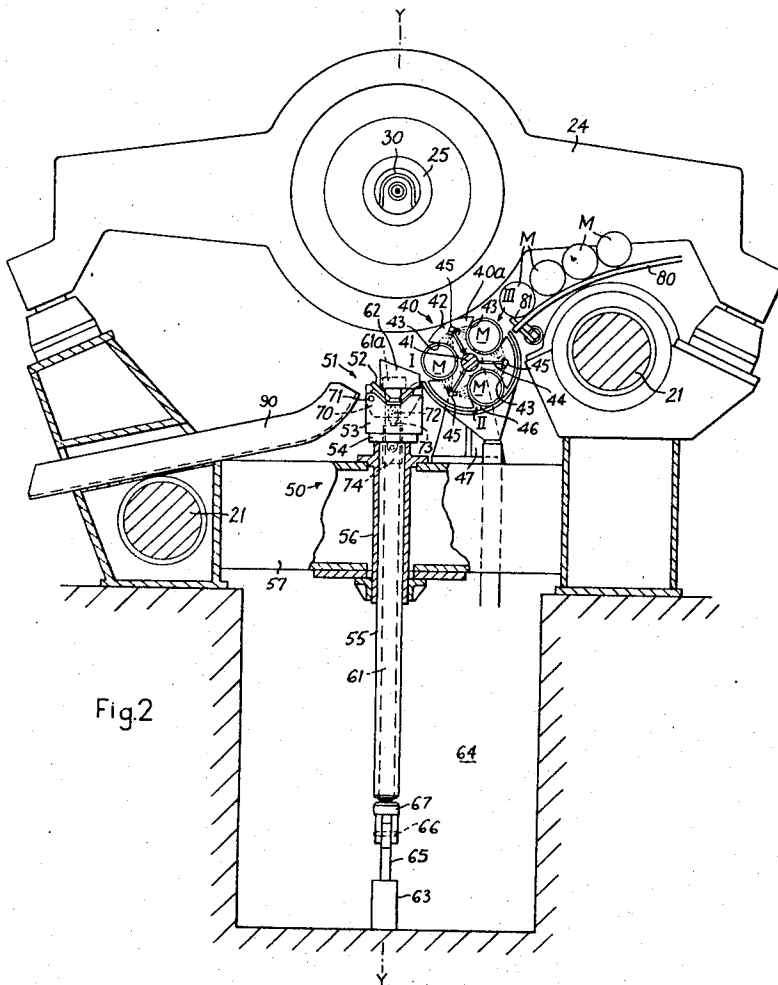
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6 Sheets-Sheet 2



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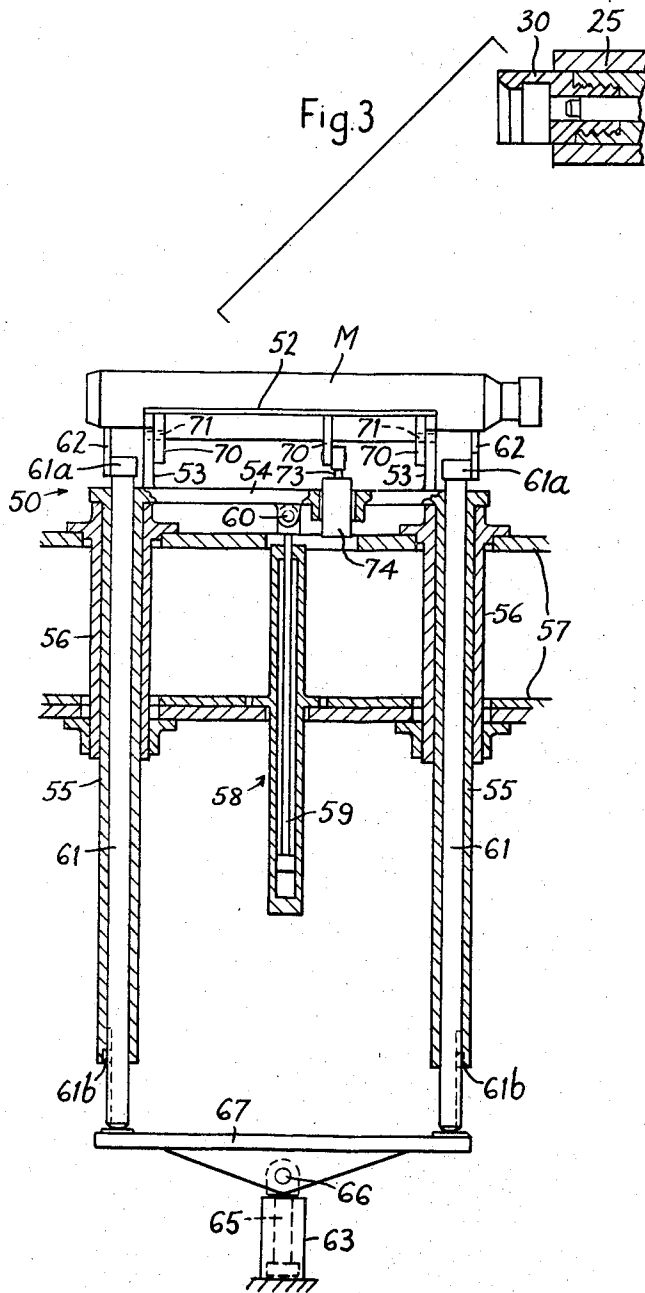
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METAL TUBE EXTRUSION PRESS WITH MANDREL COOLING DEVICE

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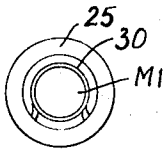


Fig. 4

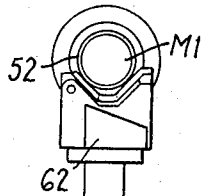
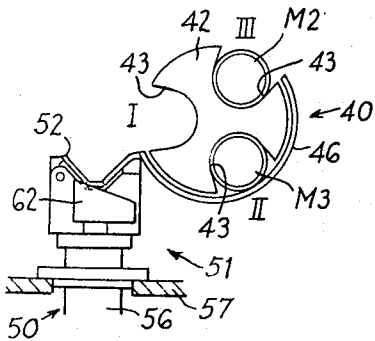


Fig. 5

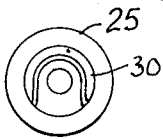


Fig. 6

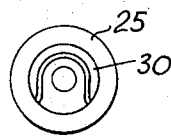
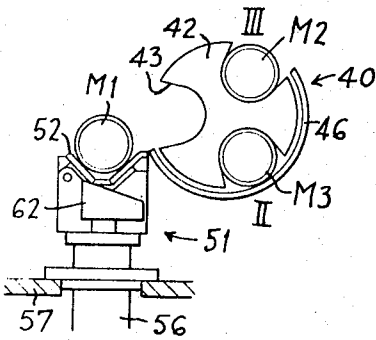
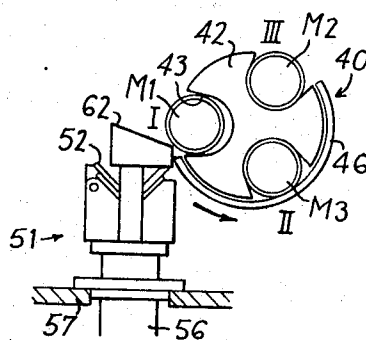


Fig. 7



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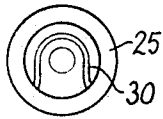


Fig. 8

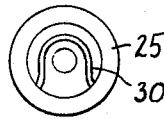
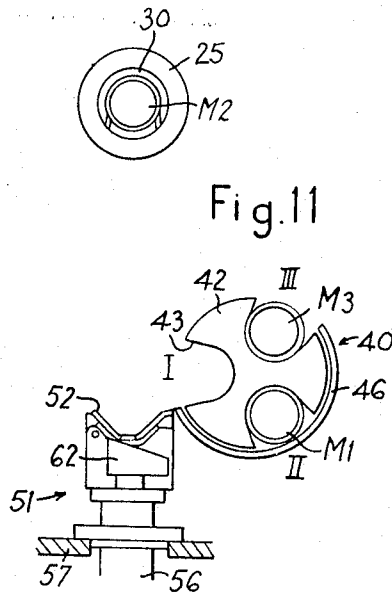
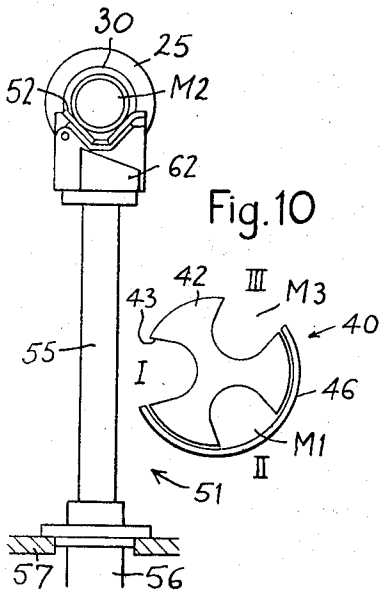
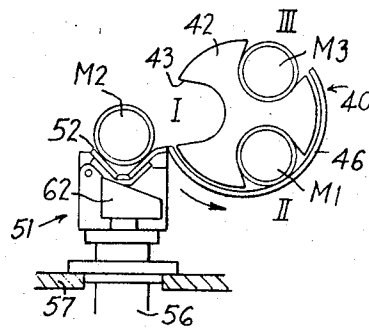
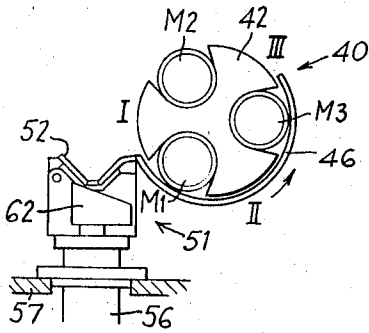


Fig. 9



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Fig.13

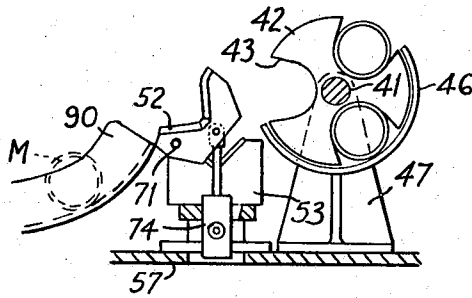
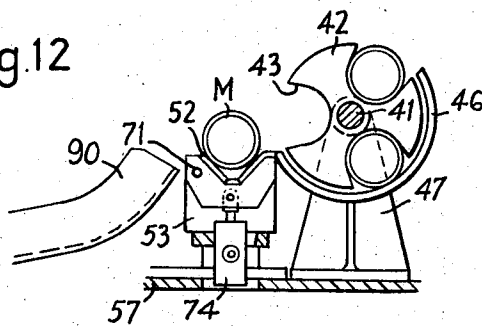


Fig.12



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METAL TUBE EXTRUSION PRESS WITH MANDREL COOLING DEVICE

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5,349/64

9 Claims. (Cl. 72-263)

ABSTRACT OF THE DISCLOSURE

A horizontal metal tube extrusion press having a mandrel and provided with a cooling device for a plurality of mandrels.

This invention relates to an extrusion press in which tubes are produced from metal billets with the aid of a mandrel. If the extrusion temperature is relatively high, as is the case, for instance, with steel and nickel billets, the mandrel must be cooled at frequent intervals, and, if practicable, after each operation. Mandrels subjected to intense heat must also be frequently exchanged.

It is an object of the present invention to provide a metal tube extrusion press having mandrel-transport means which are capable of effecting a quick exchange of a hot mandrel for a cool one.

It is a further object of the invention to provide in a metal tube extrusion press a mandrel-cooling device, built into the press, and mandrel-transport means adapted to carry hot or cool mandrels back and forth between the press and the cooling device.

It is a still further object of the invention to provide in a metal tube extrusion press into which a mandrel-holder is built, transport means which present a new mandrel to this holder for ready attachment thereon, and which can receive a used mandrel immediately after detachment from the holder.

It is a still further object of the invention to provide a metal tube extrusion press having mandrel-transport means and a built-in mandrel-cooling device capable of handling a plurality of mandrels at the same time and of transferring fresh mandrels from outside the press to the transport means.

It is a still further object of the invention to provide a metal tube extrusion press having mandrel-transport means which can be utilised for the discharge from the press of mandrels unfit for further use, in addition to the conveying of mandrels between the press and a built-in cooling device.

It is finally an object of the invention to provide a metal tube extrusion press having mandrel-transport means and a built-in mandrel-cooling device which are both so arranged in the press as not to increase its overall dimensions.

The present invention is particularly adapted to be used in metal tube extrusion presses of the horizontal type, and an embodiment of the invention will now be described by way of example with reference to the accompanying drawings, in which:

FIG. 1 is a sectional side elevation representing a general view of a horizontal metal tube extrusion press into which the invention is incorporated.

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FIG. 2 is a transverse section along line II—II of FIG. 1 showing a mandrel-transporter in association with feeding means, evacuating means, and cooling means for mandrels.

FIG. 3 is a longitudinal section through the transporter of FIG. 2.

FIGS. 4 to 11 show diagrammatically various steps through which the mandrel-transporter shown in FIGS. 2 and 3 passes during a cycle of operations in which the mandrel is taken from the press to the cooling means and back.

FIGS. 12 and 13 show two stages through which the mandrel-transporter of FIGS. 2 and 3 passes during a mandrel-evacuating operation.

The horizontal metal tube extrusion press shown in FIG. 1 has a main longitudinal axis X—X in which the main extrusion tools and their drives are arranged. The press comprises the main platen 20 which is tied by columns 21 to a main hydraulic cylinder 22. Displaceable in the latter is a main ram 23 on to which a moving cross-head 24 is mounted. The latter carries the pressing stem 25. Arranged behind the main cylinder 22 and connected to it by rods 26 is a piercer cylinder 27 in which a piercer ram 28 is displaceable. Attached to the latter is a mandrel shaft 29 which extends into a mandrel-holder 30.

A mandrel M can be detachably secured to the holder 30. One way of attachment is described in our co-pending U.S. patent application Ser. No. 423,773, filed Jan. 6, 1965, now Patent No. 3,345,851, to which reference is made. According to this proposal, the front of the mandrel-holder 30 has a short slot through which a mandrel can be inserted from below. This slot forms part of a recess into which the mandrel head can enter. The head is formed with a collar which can be held in engagement with an in-turned end of the mandrel-holder. This engagement is effected by a spring-loaded rod passing axially through the mandrel-holder. When the rod is retracted, the mandrel can be easily detached from the holder. It is to be understood that this mode of attachment is primarily suitable in those cases where the mandrel is merely used for defining an annular gap in the die, and not for piercing billets. The above-described mode of attachment or detachment has the advantage that the mandrel need not be axially displaced or turned about its axis.

Arranged in front of the platen 20 so as to face the pressing stem 25 and the mandrel M is a billet-container 31 on a rotary carrier 32. An extrusion die 33 is arranged on a rotary carrier 34 between container and platen. More than one container 31 may be provided on the carrier 32 and more than one die 33 on carrier 34. The containers and dies mounted on the carriers 32 and 34 respectively can therefore be moved from a working station in the press axis to a station outside that axis and back. Furthermore, the two carriers 32 and 34 can be displaced by means not shown in the direction of the main longitudinal axis X—X of the press. Container, die and their rotary carriers are only diagrammatically indicated in the drawings, as their design is not essential to the present invention. It is pointed out, however, that the rotary container 32 makes it possible to load the container 31 with a billet at a station outside the press axis X—X. It is, further, not necessary for the billet-loading gear to enter the space in the press axis between pressing stem 25 and container 31. This space can thus be entered

by the means for transporting a mandrel to and from a position in the press axis next to the mandrel-holder 30, while a billet is loaded into a container outside the press axis.

The press described here is operated for the extrusion of a tube in the well-known manner. A hollow billet is first placed into the container 31 at an outside station, and the container is subsequently moved by rotation of the carrier 32 into the press axis X—X. The mandrel M which has been previously attached to the mandrel-holder 30 as described, is advanced by a ram through the billet into the die 33 and the pressing stem 25 is subsequently advanced by the ram 23 into the container 31 extruding the billet into a tube through the annular gap between mandrel and die.

During a series of operations, the mandrels are apt to reach temperatures which are so high that they impair the mechanical strength of the mandrels and thus render them unfit for use in a press. This occurs particularly if the extrusion operations follow each other in quick succession and if the temperatures of the billets which are extruded, and with which the mandrels are in contact, are in the order of 1,000° C. or more, which is the case, for instance, when the billets are made of steel or nickel. The mandrels have then to be cooled at frequency intervals, and with some presses it is preferred to apply coolant to a mandrel after each extrusion operation.

To this end, a mandrel-cooling device 40 is provided within the confines of the press. This device consists essentially of a rotating rack 40a which can receive simultaneously a number of mandrels. The rack 40a comprises a rotating shaft 41, driven by means not shown, and recessed plates 42 mounted on the shaft at an axial distance somewhat shorter than the length of the mandrels. The recesses 43 in the plates 42 are substantially U-shaped; their semi-circular bottom parts have a radius slightly larger than that of the mandrels, so that the recesses are large enough to hold one mandrel each.

Mounted on the shaft 41 and radially extending therefrom are tubes 44 which take cooling fluid from one or more ducts, not shown, in the shaft to external tubes 45 whose axes are parallel to that of shaft 41 and whose length is at least equal to that of a mandrel. The tubes 45 have a series of holes over their length, so that cooling fluid can be sprayed from them on to a mandrel. It will be seen from FIG. 2 that a mandrel which is in a recess 43 can be sprayed simultaneously with cooling fluid issuing from two tubes 45, each of them acting on one circular half of the lateral surface. Hence, the entire surface of the mandrel will be exposed to cooling fluid, and an intensive cooling effect be obtained in a relatively short period. A stationary semi-circular shield 46 covers the lower part of the rack 40a. This shield collects cooling fluid and also protects the parts of the press underneath the rack from being flooded. Means, not shown, may be provided to drain the hollow of the shield. The bearings of the shaft 41, which are not shown here, and the shield 46 are mounted on parts 47 supported on the press frame.

The rotary rack 40a can be moved step-by-step in a counter-clockwise direction, as seen in FIG. 2, through three stations I, II and III. At station I, mandrels are received in succession from the press and returned to it, and cooling of a mandrel is begun; mandrels can also be removed from the rack at this station. Station II is an intermediate station where cooling is continued. At station III, cooling is further continued and, if necessary, new mandrels are received by the rack from a separate feeding device presently to be described.

The cooling device 40 is arranged entirely within the confines of the press and in immediate proximity to the vertical median axial plane Y—Y of the press. This makes it possible to utilise, for the transport of mandrels between that cooling device and a position in the press axis X—X at which mandrels can be attached to or detached from the mandrel-holder 30 as described above,

a mandrel transporter 50, which consists essentially of a lifting gear 51 which is movable in the vertical plane Y—Y and substantially tangential with regard to the rotary movement of the rack 40a.

The mandrel-transporter will now be described in detail:

The mandrel-lifting gear 51 is so arranged as to be reciprocable in the plane Y—Y, and comprises a cradle 52 for the reception of a mandrel M (FIG. 2). The cradle is mounted on two upright arms 53 (FIG. 3) of a horizontal crossbar 54. The latter is joined at its ends to two downwardly extending sleeves which are guided for vertical movement in stationary tubes 56 secured to a horizontal crossbeam 57 of the press frame.

Arranged midway between the tubes 56 is a long-stroke piston-and-cylinder unit 58 which is mounted on beam 57 and whose piston rod 59 has a swivelling connection 60 to crossbar 54. Slidable within the sleeves 55 are rods 61 having enlarged heads 61a to which blades 62 with sloping or slanting edges are attached. These blades are adapted to lift a mandrel clear of the cradle 52. A short-stroke cylinder-and-piston unit 63 is mounted at the bottom of a pit 64 in the foundation of the press, and has a piston rod 65 which in turn has a swivelling connection 66 to a second horizontal crossbar 67. Rods 61 rest on the crossbar 67—without being secured thereto—so that when the rod 65 is lifted the rods 61 and the blades 62 are raised as well. Rotation of the rods 61 in their sleeves 55 is prevented by keys 61b. For the sake of clarity, the blades 62 are shown in FIG. 2 in their lifted positions.

When the cradle 52 is raised by unit 58, the crossbar 54 engages from below the enlarged heads 61a of the rods 61, and these rods, with the blades 62, will also be lifted; the crossbar 67, however, remains in its place, as unit 63 acts on the rods 61 only when the unit 58 is in its lowermost position.

Cradle 52 has at its ends and in its middle depending ribs 70. These are pivoted at their ends by pins 71 to the arms 53. The rib in the middle of the cradle has a swivelling connection 72 to a rod 73 of another short-stroke piston-and-cylinder unit mounted on crossbar 54.

A sloping runway 80 is so arranged in the lower part of the press that the lower end of the former is next to the station III of the cooling device 40. This runway can be loaded with mandrels M taken from a magazine outside the press. The mandrels are held back on the runway 80 by a retractable latch 81 and can be delivered one by one to the rack 40a after retraction of the latch.

A chute 90 is also arranged in the lower part of the press so that its upper end is substantially level with the cradle 52 when the latter is positioned next to the station I of the cooling device 40. This chute serves the purpose of evacuating mandrels which are no longer usable from the press, and extends to a point outside the press where the mandrels can be taken away for reconditioning.

The runway 80 and the tube 90 are arranged at opposite sides of the vertical median plane Y—Y, and are substantially in alignment with each other. It will be seen from FIG. 2 that the two bottom columns 21 of the press are staggered relative to each other in the vertical direction, with the runway passing over the upper column 21, and the chute 90 over the lower column 21. The exit end of the runway 80 and the entry end of the chute 90 are spaced-apart from each other, with the cooling device 40 and the mandrel-lifting gear 51 being movable within that space.

A cycle of operations of the apparatus described above will now be described with reference to FIGS. 4 to 11. This cycle includes the transfer of a hot mandrel, after its release from the mandrel-holder 30, to the cooling device 40, and the transfer of a cooled mandrel from that device back to the mandrel-holder.

In FIG. 4, the mandrel-lifting gear 51 is shown in its retracted position in which the cradle 52 is at the same

level as and next to the station I of the cooling device 40. A mandrel M1 is attached to the mandrel-holder and two further mandrels M2 and M3 are located in the recesses 43 or rack 40a at stations II and III respectively where they are subjected to the cooling fluid sprayed from the tubes 45; the recess 43 at station I is empty.

In the next step, FIG. 5, mandrel M1 has been detached from the mandrel-holder 30 after the cradle 52 has been lifted by unit 58, so that the cradle is ready to receive the detached mandrel M1. The cooling device 40 is still in the same position as in FIG. 4.

In FIG. 6, the cradle 52 with mandrel M1 has been lowered so as to be next to the empty recess 43 at station I. The blades 62 are now raised by unit 63 through the intermediary of the crossbar 67 and the rods 61, whereby the mandrel M1 is lifted out of the cradle 52 and made to roll off the blades and into the empty recess 43 (FIG. 7).

The cooling device 40 is now rotated in a counter-clockwise direction by one step (FIG. 8), whereby the three mandrels M1, M2 and M3 are each moved from one of the stations I, II and III respectively to the next. Rotation of the cooling device 40 by one step has thus advanced mandrel M2 from station III to station I. When at that station, the mandrel M2 rolls out of its recess and into the cradle 52 (FIG. 9), inasmuch as this recess will have a slightly downward slope when at station I.

The cradle 52 with mandrel M2 in it is then raised again and takes this mandrel to a position where it can be readily attached to mandrel-holder 30 (FIG. 10). The cooling device remains stationary during this time.

After the mandrel M2 has been attached to the holder 30, the cradle 52 is lowered, as shown in FIG. 11. All the parts of the mandrel-lifting gear 51 are therefore again in the positions which they occupied before and which are shown in FIG. 4. A complete cycle has been carried out during which a hot mandrel M1 has been taken from the mandrel-holder to the cooling device, and a cooled mandrel M2 thereafter taken from that device to the mandrel-holder. This cycle can be completed in a relatively short time, especially when the various movements described here are initiated automatically by limit switches or the like. While the mandrel is being exchanged in the manner described, other auxiliary operations can be carried out on the press, such as the movement of the billet-carriers and die-carriers, by which containers and dies respectively change their places relative to the axis X—X.

If it is desired to feed one of the mandrels stored on the runway into the press, one of the recesses 43 of the rack 40a has to be cleared first and then moved to station III. After retraction of the latch 81, the foremost mandrel on runway 80 will roll off into the empty recess and by rotation of rack 40a by one step be taken to station I from where this mandrel is transferred to cradle 52. The new mandrel is then ready to be taken to the mandrel-holder 30. The latch 81 is returned to its blocking position as soon as one mandrel has left the runway 80, so that only one mandrel can leave this runway at a time.

When a mandrel has become unfit for further use, due to wear or for other reasons, the mandrel, after its detachment from mandrel-holder 30, is first transferred to cradle 52 and then lowered to a position next to the cooling device, as shown in FIG. 1. In this position, the mandrel is next to the entry end of the chute 90. Cradle 52 is now tilted, by means of unit 74, about a pin 71 in the counter-clockwise direction of FIGS. 12 and 13, whereby the mandrel in the cradle 52 is caused to roll off towards the chute 90 and on to that chute.

It will be seen from the foregoing that the mandrel-transporter 50 can be used for several purposes. It serves not only for the transport of mandrels between mandrel-holder and cooling device, but also for feeding new mandrels from the storage rack to the mandrel-holder and for taking to a discharge chute from the mandrel-holder unusable mandrels.

The mandrel-transporter according to the invention has the advantage of requiring little floor space and being accommodated within the confines of the press and in its lower part. In the example shown, most of the mandrel-transporter and the entire cooling device can be accommodated in the space between the two lower columns 21 of the press, leaving the upper part of the press free for the installation and movement of other auxiliary equipment.

The invention can be carried out in various ways and is not limited to the embodiments shown in the drawings. It is, for instance, possible to utilise the blades 62 for the discharge of mandrels from the cradle 52 into the chute 90, in which case, of course, the slope of the blades must be in the opposite direction from that shown in FIG. 2. In this case, transfer of the mandrels from the cradle to the cooling device is effected by tilting the cradle about the pins 71 which then have to be arranged at the other side of the ribs 70, as in FIG. 2.

While the invention has been described here with reference to a press having a rotary container-carrier, and in which, therefore, the loading of the billet into the container takes place outside the axis X—X, the invention can also be used on a press having a single container, in which the loading of the billet takes place in the press axis. This is possible because there is a clear space left for the lateral movement of any billet-loading gear into the press axis after retraction of the mandrel-lifting gear 51.

I claim:

1. A horizontal metal extrusion press having a mandrel, a holder for positioning said mandrel in the extrusion axis of the press, a cooling device for a plurality of mandrels, said cooling device being arranged inside the press and below its horizontal axial plane and comprising a rotatable rack having a plurality of U-shaped recesses for receiving one mandrel each, means for directing a cooling spray into each recess, a mandrel transporter having a vertically reciprocable cradle adapted to take a mandrel after its detachment from said holder to said cooling device and back, and separate means for discharging a mandrel by gravity from said cradle into said cooling device and from said cooling device into said cradle when said cradle has been retracted into a position next to said cooling device.

2. A horizontal metal tube extrusion press according to claim 1, having a runway for discharging a mandrel into said cooling device, said rotatable rack being adapted to receive, at different points of its rotary path, a mandrel from said cradle and another mandrel from said runway.

3. A horizontal metal tube extrusion press according to claim 1, having a chute for receiving direct a mandrel from said cradle and for discharging said mandrel from the press.

4. A horizontal metal tube extrusion press according to claim 3, in which means are provided for discharging by gravity a mandrel from said cradle on to said chute.

5. A horizontal metal tube extrusion press according to claim 1, in which the means for discharging a mandrel from said cradle into said cooling device consist of retractable blades arranged on said cradle and having edges sloping towards said cooling device, said blades being adapted to lift a mandrel out of said cradle.

6. A horizontal metal tube extrusion press according to claim 4, in which said cradle is tiltable about its horizontal axis towards said chute.

7. A horizontal metal tube extrusion press according to claim 1, in which said cradle is tiltable about its longitudinal axis towards said cooling device.

8. A horizontal metal tube extrusion press according to claim 4, in which the means for discharging a mandrel from said cradle on to said chute consist of retractable blades arranged on said cradle and having edges sloping towards said chute, said blades being adapted to lift a mandrel out of said cradle.

9. A horizontal metal tube extrusion press having a mandrel, a holder for positioning said mandrel in the

extrusion axis of the press, a cooling device for a plurality of mandrels arranged in the lower part of the press, and a vertically retractable mandrel-transporter adapted to take a mandrel after its detachment from said holder to said cooling device, a cradle in said transporter for receiving a mandrel, and a mandrel-discharge chute, said mandrel transporter, when in its retracted position, being situated between said chute and said cooling device, and said cradle being adapted to discharge by gravity a mandrel into either said cooling device or said chute when said mandrel transporter is in its lowered position.

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