Feb. 11, 1941. H. HILL 2,231,761

PRESS FOR THE EXTRUSION OF METALS

Filed June 15, 1939

2 Sheets-Sheet 1

Fig. 1.

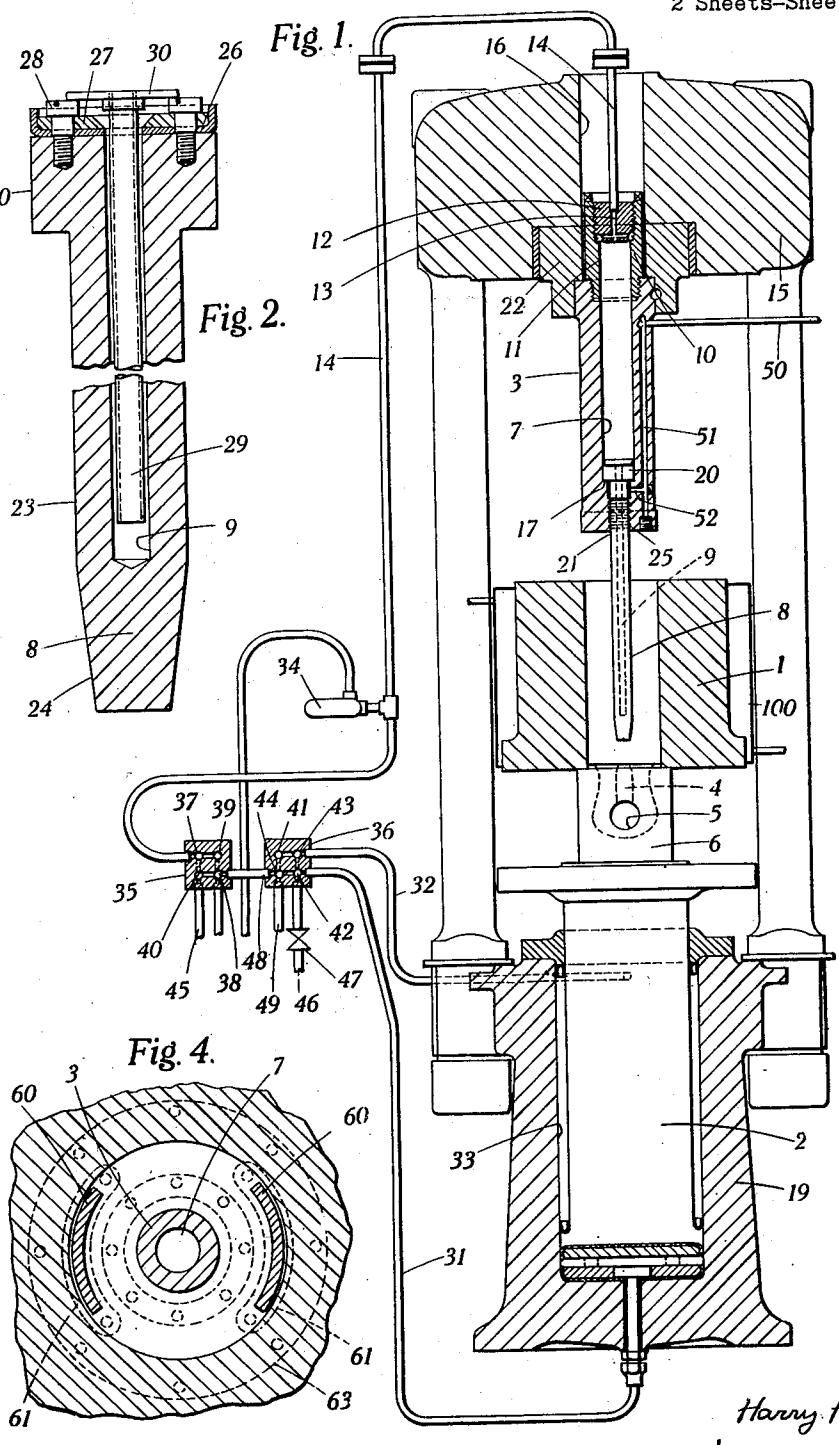


Fig. 2.

Fig. 4.

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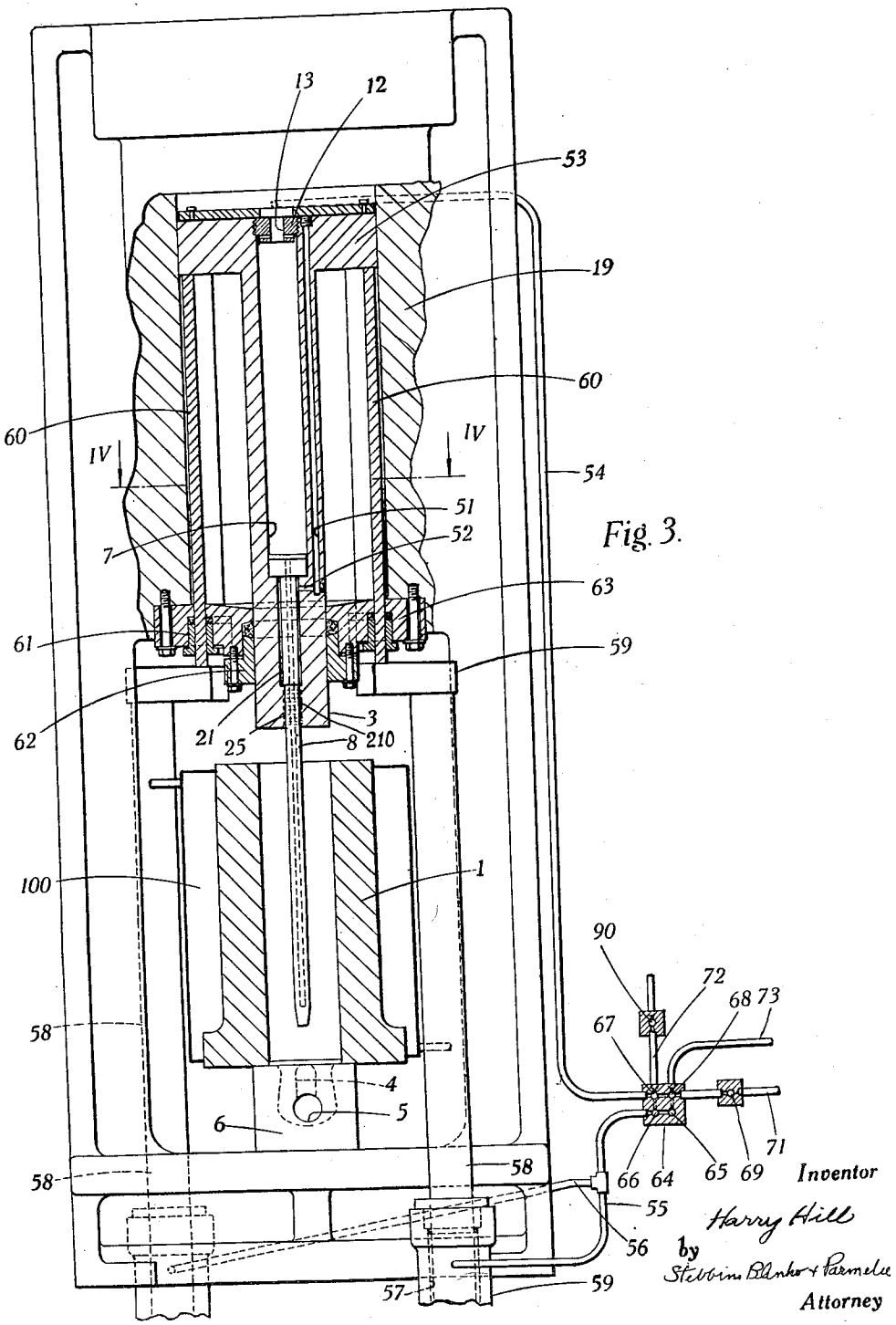


Fig. 3.

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PRESS FOR THE EXTRUSION OF METALS

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8 Claims. (Cl. 207—16)

This invention relates to presses for the extrusion of metals of the kind in which a container is supplied with molten metal which is allowed to cool to bring it to the plastic condition and is then extruded from the container by relative movement of the container and a ram. In the larger sizes of press a correspondingly large mass of molten metal requires to be brought to the plastic condition before extrusion can take place and a considerable period is necessary for the metal to cool down to the appropriate extrusion temperature. This period, for example, may be as long as twenty minutes. By the present invention we provide means whereby this period required for cooling may be reduced by a substantial amount.

A press for the extrusion of metals, according to the present invention, comprises a cooling member adapted to be moved into the press ram before filling the press container and to be moved out of the ram into a body of molten metal in the container for the purpose of increasing the normal rate of cooling of the molten metal to bring it to the required degree of plasticity for extrusion. The cooling member, preferably, is arranged to enter the container centrally so that it is brought into contact with the metal located at the greatest distance from the container wall. The cooling member, for example, may have the form of a solid metal rod or it may be a hollow metal member closed at its outer end. The cooling member will be at a temperature considerably less than that of the molten metal in the container and will have an appropriate heat absorbing and removing capacity. When the cooling member is placed in the molten metal, heat is abstracted from the molten metal by the cooling member so as to increase the normal rate of cooling of the molten metal to bring it to the plastic condition, the heat being transmitted from the cooling member to the ram.

The cooling member is arranged to slide within the press ram and pressure means will be provided to force the cooling member out of the ram into the molten metal in the container and to hold it in the container, while the ram is exerting pressure upon the plastic metal to extrude it.

Two forms of construction, in accordance with the invention, are illustrated as examples in the accompanying drawings, wherein:

Figure 1 shows one form of press in sectional elevation,

Figure 2 is a sectional elevation of a part of the press drawn to a larger scale,

Figure 3 shows another form of press, also in sectional elevation, and

Figure 4 is a plan on the line IV—IV of Figure 3 and looking in the direction of the arrows.

The press shown in Figure 1 is of the kind in which the container is movable and the ram is fixed, while the press shown in Figure 3 is of the kind in which the ram is movable and the container is fixed.

Referring first of all to Figures 1 and 2, the press comprises a container 1 for receiving the molten metal and a ram 3 for extruding the metal, after it has been brought to the plastic state, from the lower end of the container. At the lower end of the container 1 is placed a die box 6 having a bridge 4 and an orifice 5 through which latter the plastic metal is extruded.

If the press is extruding a lead sheath over an electric cable, for example, the general operation of the press will be carried out as follows: The container 1 is filled with molten lead and moved upwards with the die box 6 to bring the ram 3 into contact with the surface of the molten metal to exert pressure thereon. The latter is cooled by water in a water-jacket 100 to bring it to the required degree of plasticity for extrusion and the container 1 and die box 6 are then raised again so that the container is entered by the ram and the plastic metal forced out of the opening 5 in the form of a tube over the cable. After extrusion the container and die box are lowered and the container again filled with molten metal ready for another extrusion operation. The movements of the container 1 are effected by a hydraulic ram 2 placed beneath the die box 6 and working in a hydraulic cylinder 19. The cable to be covered passes through the press in a horizontal direction.

In order to reduce the period of cooling normally required for the molten metal to be brought to the plastic state before it can be extruded, the ram 3 is provided with a cooling member 8 which is adapted to be thrust down through the ram into the molten metal in the container 1 immediately after the latter has been filled. For this purpose the ram 3 is formed as a tubular member so that it may receive and guide the cooling member 8. The ram has three centrally disposed communicating passages 7, 21 and 210 (Figure 3) of different diameters, the uppermost passage 7 being of larger diameter than the intermediate passage 21, so that a shoulder 17 is formed between those two passages. At the

upper end of the ram 3 is a sleeve 10 which is screwed into the ram and has a passage 11 coaxial with the passage 7 and of the same diameter. The upper end of the sleeve is closed by a plug 12 provided with a passage 13 of small bore communicating with a pipe 14. The ram 3 is secured to a ring 22 which is fixed in a cross head 15. The latter has a passage 16 to provide for the entry of the pipe 14 and the reception of the sleeve 10.

The passage 7 in the ram 3, in conjunction with the passage 11 in the sleeve 10, forms a working cylinder for the cooling member 8. The latter is of cylindrical cross-section and, as will be seen from Figure 2, has a head 20, and a stem 23 terminating in a lower tapering portion 24. The head is of larger diameter than the stem 23 and operates as a piston within the cylinder formed by the passages 7 and 11 in the ram 3, the shoulder 17 limiting the downward movement of the cooling member 8 when it is forced out at the lower end of the ram 3, the plug 12 limiting the upward movement of the cooling member upon the return stroke of the latter. The cylindrical stem 23 makes a sliding fit in the lower part of the ram 3, and the passage 21a in that part of the ram is provided with grooves 25 forming a seal of the labyrinth type.

The construction of the cooling member is shown in Figure 2. The head 20 is provided with a flexible leather washer or similar sealing member 26 to prevent the escape of water past the head of the cooling member in a downward direction, the washer being held in position by a ring 27 and screws 28. The cooling member has a centrally disposed passage 9 which receives a tube 29 supported away from the bottom of the passage by a ring 30 fixed to the upper end of the tube. The diameter of the tube 29 is such as to leave between it and the wall of the passage 9 a substantial clearance space to provide for the circulation of water in a downward direction through the tube 29 and upwards through the space between the tube and the wall of the passage 9. The tube 29 is supported clear of the bottom of the passage 9 by the ring 30 resting upon the screws 28.

The upward movement of the hydraulic ram 2 is effected by water flowing through a pipe 31 into the lower end of the cylinder 19. Downward movement of the hydraulic ram is effected by water flowing through a pipe 32 into an annular space 33 provided between the hydraulic ram 2 and the cylinder 19.

If it be assumed that the cooling member 8 is at the upper end of its stroke and the container 1 is in its lowermost position, the lower end of the cooling member will be approximately flush with the lower end of the ram 3 and the container is ready to receive a new charge of molten metal. As soon as possible after the container 1 has been charged, the cooling member 8 is forced down into the molten metal in the container and the normal rate of cooling of the metal thereby substantially increased. The cooling member is forced into the molten metal by water entering above the cooling member through the pipe 14 and passage 13 in the plug 12. The cooling member enters the molten metal centrally thereof and heat is abstracted from the metal and transmitted through the cooling member to the water therein and also to the ram 3 from which it is radiated to the surrounding atmosphere. Some heat will also be transmitted to and radiated from the cross-head 15.

As soon as the cooling member has been forced down into the molten metal, the container 1 is raised to bring the lower end of the ram 3 into contact with the surface of the molten metal and the ram then exerts pressure upon the metal while the latter is being cooled. This pressure will be comparatively small as compared with the extrusion pressure. The container 1 is raised by water entering beneath the hydraulic ram 2 through pipe 31 into the hydraulic cylinder 19. During this upward movement of the container 1, the lower end of the cooling member 8 makes contact with the remainder of the old charge in the container and it will also make contact with the bridge 4 of the die box 6, so that the upward movement of the container will also cause a certain amount of upward movement of the cooling member 8 and water flows out of the ram 3 through the pipe 14 into the pipe 31 to the underside of the hydraulic ram 2.

After the metal in the container 1 has been brought to the required degree of plasticity, the container is again raised and the extrusion pressure exerted upon the plastic metal to force the latter out of the orifice 5 in the form of a tube around the cable being sheathed. While extrusion is taking place cooling member 8 is forced upwards by contact of the bottom of the cooling member with the bridge 4 of the die box 6 and during this movement the water is locked behind the cooling member but increase of pressure is avoided by the escape of water from the pipe 14 through a relief valve 34. After the extrusion operation has been completed, the cooling member 8 will have been pushed upwards into the ram 3 when it will occupy its original position in the ram. The container 1 and die box 6 are returned to their original positions by water entering the annular space 33 between the hydraulic ram 2 and the wall of the hydraulic cylinder 19. Upon return of the container 1 it is ready to receive another charge of molten metal.

The control of the water supply for operating the cooling member 8 and the hydraulic ram 2 may be conveniently effected by the valve apparatus shown at the left of Figure 1 and consisting of two valve boxes 35 and 36 each containing four valves operating in pairs. In the valve box 35, valves 37 and 38 open and close together and the valves 39 and 40 open and close together. In the valve box 36, valves 41 and 42 open and close together and the valves 43 and 44 open and close together.

To force the cooling member 8 into the molten metal, low pressure water is admitted through a pipe 45 to valve 37 which is open, water then flowing through pipe 14 to the ram 3, and into the cooling member 8. Valves 39 and 40 will then be closed. The valves 37 and 38 are now closed and high pressure water is admitted to the valve box 36 through a pipe 46 by opening an isolating valve 47, water then flowing to the hydraulic cylinder 19 beneath the hydraulic ram 2 through valve 42 and pipe 31. The pressure of the water is now increased to produce the extrusion pressure and when the extrusion operation is completed valves 43 and 44 are opened and valves 41 and 42 closed, when high pressure water flows through pipe 32 into the annular space 33 to return the container 1 to its original position. When the container is given its initial upward movement water flowing out of the ram 3 passes through pipe 14, valves 37 and 38, a pipe 48, valve 42 to the pipe 31. When the hydraulic ram 2 is moving upwards, water flows out of

the annular space 33 through pipe 32, valves 43 and 44 to a return pipe 49.

The grooves 25 in the lower part of the ram 3 are provided to prevent the passage of metal along the surface of the cooling member to the upper end thereof.

It will be seen from Figure 1 that a pipe 50 communicates with a longitudinally extending passage 51 in the ram 3, the passage 51 communicating with a short lateral passage 52. The latter is in communication with a clearance space provided between the cooling member and the passage 21 in the ram. The pipe 50 and passages 51 and 52 provide for the escape of steam or water should there be any leakage of water past the head 20 of the cooling member 8.

Referring now to Figures 3 and 4, the press in that case has a movable ram 3 and a fixed container 1. The ram as in the previous construction is a hollow member having passages 7 and 21 and 210 to receive the cooling member 8, the passage 210 having sealing grooves 25. The upper end of the ram 3 has an enlarged head 53 serving as a piston in a hydraulic cylinder 19 and water is admitted through a pipe 54 to the passage 7 to force the cooling member 8 downwards into the molten metal in the container 1 and also for forcing the ram 3 downwards into the container. The upward movement of the cooling member is limited by a plug 12 having a passage 13 to permit the entry of water to the upper side of the cooling member. The upward movement of the ram 3 and of the cooling member 8 is effected by the admission of water to pipes 55 and 56. The water enters annular spaces 57 and exerts pressure upon the lower ends of piston rods 58 working in cylinders 59 and connected to the ram 3.

The piston rods 58 are connected at their upper ends to appropriately shaped members 59 to which are fixed arcuate longitudinally extending members 60 which are secured at their upper ends to the head 53 of the ram 3. The ram 3, arcuate members 60, and members 59 and piston rods 58 thus move up and down together. The arcuate members pass through glands 61 and the ram 3 through a gland 62, the glands being mounted in a ring 63 bolted to the lower end of the hydraulic cylinder 19. The cooling member 8 is of the same construction as that shown in Figure 2, but is made longer than that shown in Figure 1. The glands are provided with packing members.

The control of the water supply is conveniently effected by the valve apparatus shown to the right of Figure 3. It comprises a valve box 64 having valves 65, 66, 67 and 68, a valve 69 in a low pressure supply pipe 71 and a valve 70 in a high pressure supply pipe 72.

When the cooling member 8 is in its uppermost position, the container 1 is ready for filling. After filling, low pressure water is admitted to the pipe 71 from which it flows through valve 67 to pipe 54 and to the passage 7 in the ram 3, forcing the cooling member downwards into the molten metal. High pressure water is then admitted to the upper side of the head 53 of the ram 3 through valve 70 and valve 67, valve 69 being closed. This brings the ram 3 into contact with the surface of the molten metal in the container 1. When the metal is ready for extrusion, the water pressure is increased and the ram 3 slides over the cooling member 8 as it is forced into the container. During the downward movement of the ram 3, water is expelled from beneath the piston rods 58 through pipe 55 and valves 66, 65 and 68 to a return pipe 73. The ram 3 is returned to its original position by high pressure water flowing through valves 70 and 66 to beneath the piston rods 58, water then flowing from above the cooling member 8 and the head 53 of the ram 3 through pipe 54, valves 67 and 68 to the pipe 73. When the cooling member 8 and ram 3 enter the container 1, molten metal flows into the grooves and ultimately solidifies to form a temporary joint between those parts so that when the ram 3 is moved upwards after extrusion, the cooling member 8 is carried with it.

The ram 3 is provided with passages 51 and 52 to provide for the escape of water or steam as in the construction shown in Figure 1.

In both constructions the cooling member 8 is supported within the ram 3 by friction prior to filling of the container 1 with the molten metal.

In the construction shown in Fig. 1, there will be a tendency for the cooling member to be forced upwards out of the container when pressure is exerted by the ram 3 upon the surface of the metal in the container both before and during extrusion. This tendency for the cooling member to rise is independent of the positive movement imparted to the cooling member by the rising of the container 1. In the construction shown in Figure 3, there will be a tendency for the cooling member 8 to rise when the ram 1 is forced down into contact with the surface of the metal in the container before extrusion, and also while extrusion is taking place. By selecting appropriate dimensions for the pressure surfaces of the cooling member 8, that is to say, the cross-sectional areas of the piston head 20 and of the stem portion of the cooling member, the pressures acting above and below the cooling member can be balanced for a given set of pressure conditions and, in the case of Figure 1, size of press ram 3 and hydraulic ram 2, and in the case of Figure 3, size of press ram 3 and of the head 53 of the press ram 3.

The cooling member 8 and ram 3 will be made of sufficient length such that the latter will serve as an effective guide for the cooling member and hold it in position in the container 1 during the cooling operation. The cooling member may be forced into the metal in the container by liquid or gas pressure and gas or liquid may be introduced into the cooling member as a cooling medium.

In Figures 1 and 3 there is shown a bridge 4 placed at the lower end of the container 1. This bridge serves to divide the plastic metal into two separate streams as it approaches the orifice 5 through which it is extruded. By arranging for the cooling member 8 to be introduced centrally of the container 1, the cooling of the molten metal is carried out in the most efficient manner and the passage of the plastic metal past the bridge 4 to the extrusion orifice 5 is facilitated.

Although the introduction of the cooling member 8 into the container 1 reduces the capacity of the latter, this reduction in capacity may be made small and the disadvantage of the reduction be more than counterbalanced by the advantage obtained by decreasing the length of the cooling period required to bring the molten metal into the plastic state. This cooling period, for example, may be reduced from twenty minutes to as little as five minutes.

What I claim as my invention is:

1. An extrusion press for metals comprising a relatively movable press ram and container, the ram having coaxially disposed communicating

bores of different cross-sectional areas, a plug having a passage therethrough, at one end of the larger bore, a piston within that bore and a member secured to the piston slidable within the smaller bore, means for exerting pressure upon the piston to force the member secured thereto out of the ram into the container, and means for returning the said member out of the container back into the ram.

2. An extrusion press for metals comprising a container, a movable ram, a cooling member within the ram, means for forcing the cooling member out of the ram into the container, means for forcing the ram over the cooling member into the container and means for withdrawing the ram and the cooling member together from the container and means for retaining the cooling member within the ram.

3. An extrusion press for metals comprising a movable container, a ram, a cooling member within the ram, means for forcing the cooling member out of the ram into the container, the movement of the latter serving to return the cooling member into the ram during extrusion, and means for retaining the cooling member within the ram.

4. An extrusion press for metals comprising a relatively movable press ram and container, a cooling member slidable within the ram and movable relative to the container, means for projecting the cooling member out of the ram into the container and means for returning the cooling member to the ram from the container.

5. An extrusion press for metals comprising a fixed press ram and a movable container, a cooling member slidable within the ram, and movable relative to the container, means for projecting the said cooling member out of the ram into the container and means for returning the cooling member into the ram from the container.

6. An extrusion press for metals comprising a press ram and a movable container, a cooling member slidable within the ram, and movable relative to the container, means for projecting the said cooling member out of the ram into the container, the latter returning the cooling member to the ram during extrusion.

7. An extrusion press for metals comprising a movable press ram and a fixed container, a cooling member, slidable within the ram, means for projecting the cooling member out of the ram into the container and means for returning the said cooling member from the container into the ram.

8. An extrusion press for metals comprising a movable press ram and a fixed container, a cooling member slidable within the ram, means for projecting the cooling member out of the ram into the container, means for forcing the ram into the container over the cooling member, and means for withdrawing together the cooling member and the ram out of the container.

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