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METHOD OF OPERATING EXTRUDING PRESSES

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This invention relates to improvements in methods of operating extruding presses.

In general, an extruding press accommodating a large charge is more efficient than a press accommodating a small charge. When increasing the capacity of a press it is desirable to increase the length of the cylinder and working stroke of the ram rather than the diameter because when a cylinder bore has too great a diameter it is very difficult to control the temperature of the charge. Furthermore, the length of the working stroke of presses has been in part limited because no means had been provided for securing the cap of the press in relationship to the hydraulic cylinder with sufficient rigidity and accuracy.

A prevalent way of anchoring the columns of the framework to the cap of the press and to the lugs of the hydraulic cylinder, has been either to thread the ends of the columns and anchor them to the cap and lugs by means of large nuts; or the columns are made with an integral bolt-head end and the bolt-head "hooked over" the corner of the cap by inserting the column in a U-shaped aperture in the corner of the cap, this same construction being employed in securing the lower ends of the columns to the cylinder. When employing the first mentioned means it is very difficult to obtain the same tension on each one of the columns due to movement between the nut and the bolt threads. The latter mentioned type is insufficiently rigid, and since the face of the bolt-head of the column is not seated throughout, foreign matter gradually seeps in at the unengaged side between the column and its seat, allowing corrosion and causing an unseating of the seated members.

A method employed in operating extruding presses has been to fill the cylinder of the press with a charge for instance of molten lead, allow the lead to solidify and then to extrude the lead into the form required, for example, cable sheath.

In following this method of extrusion the time required to fill the cylinder and cool the charge is frequently as long or longer than the actual time of extrusion and the press is inactive for one-half or more of the time. Also when employing this process it is necessary to exercise great care to obtain uniform cooling of the metal charge which is essential to preserve the uniformity of the article formed, such as, in the case of lead alloy cable sheath, concentricity. Furthermore, during the time of refilling the extruding cylinder the small portion of metal which is immediately within the die may become marked with an annular ring known as a "press mark" and the region of this annular ring may constitute a weak spot in the article formed.

An object of this invention is to extrude matter in a substantially continuous manner and with reduced periods of inactivity of the extruding mechanism.

Other objects which are secured by this invention will be indicated hereinafter and will be particularly pointed out in the appended claims.

An extruding press may be made to accommodate a greater charge, for instance of lead, by increasing the length of the cylinder. In order to preserve the rigidity of the press and minimize deflection which would result from an extra long ram and cylinder, the framework may be constructed as follows:

Columns are employed having a bolt-head construction, the bolt-head at either end of the column being integral therewith. Apertures in the four corners of the cap and in the lugs on the hydraulic cylinder are slightly larger than the bolt-head of the columns. Each column is extended through one of the four apertures in the cap and the aperture in one of the lugs on the hydraulic cylinder. Split sleeves having a flanged portion are then placed around the ends of the columns, and the columns bearing the split sleeves are drawn back through the apertures in the cap and lugs until the flanged portion of the sleeves seat themselves on the outside faces of the cap and lugs. Split nuts are then inserted around threaded portions of the columns and the two sections of the split nuts being held together by suitable means, the nuts are drawn up tightly against the inside face of the cap and lugs, so as to prevent an unseating of the column from its ground seat on the upper face of the cap and lower face of the lugs on the hydraulic cylinder.

An improved method of operating extruding presses which may be employed efficiently with a press having a long cylinder
and accommodating a larger supply of the material to be extruded is as follows:

The cylinder of a press is entirely filled with a charge for instance, of molten lead.

Time is allowed for the charge to solidify and then a portion only is extruded, part of the solid charge being allowed to remain in the unobstructed portion of the cylinder of the press. The ram is then withdrawn from the cylinder, the cylinder replenished with lead and then the part which had been allowed to remain in the cylinder is extruded while the new charge is still unsoftened. By this method one part of a charge is being extruded while the rest of the charge is cooling.

Referring now to the drawings in which like numerals are employed to designate similar members throughout the several views,

Figure 1 is a front elevation of a press showing an improved framework;

Figure 2 is a detail showing a section along the line 2—2 of Figure 1;

Figure 3 is a detail showing a section along the line 3—3 of Figure 2, and

Figure 4 is a cross section along the line 4—4 of Figure 1 and looking in the direction indicated by the arrows.

Referring to the drawings, the invention is disclosed in an extruding press which comprises a hydraulic cylinder 10 and a ram 11, slidably mounted in the hydraulic cylinder. Integral with the cylinder 10 are apertured lugs 12, the function of which will be described more in detail hereinafter. The ram 11 carries a die block 13, and an extruding cylinder 16, said die block having an upper portion 14 and a lower portion 15, respectively. Means (not shown) is provided for raising the ram 11 carrying the cylinder 16 into a position wherein a plunger 17 may enter the cylinder. Continued upward movement of the ram 11 will cause the plunger 17 to displace any matter such as lead which may be contained in the cylinder. The plunger 17 depends from a cap 18 which is secured in spaced relation with respect to the hydraulic cylinder 10 by means of four columns 19, opposite ends of which are attached to the cap 18 and the lugs 12 by means of split flanged sleeves 20, split nuts 21 and collars 22. The manner in which the split sleeve, split nut and collars are employed will be more fully explained hereinafter.

Referring particularly to Figure 4, spiral borings 25 may be employed for introducing heating or cooling matter into the walls of the cylinder 16, the flow of matter theretofore being controlled by intake valves 26 and discharge valves 27. The die block 13 is in direct connection with the cylinder 16 and the two sections 14 and 15 thereof are held firmly together in the usual manner, the die block in general being held in position in respect to the cylinder 16 by means of bolts 28 and nuts 29. Mounted within the die block is a core-tube 30 (Figure 4) spaced and held in position by means of an adjusting nut 31 and a die ring 32 spaced and held in position by means of an adjusting nut 33. Within the die block and in proximity to the core-tube 30 and the die ring 32 is a hollow chamber 35 termed a forming chamber. A press of the type pictured in the drawing may be employed for the purpose of covering a cable core 36 with lead 37. The ram 17 together with the cylinder 16 in order to function efficiently with the method of operating the press, hereinafter described, should be at least 36 inches long. Heretofore it has been considered undesirable to employ a cylinder and ram of these dimensions, but by means of the improved framework shown in the drawings a cylinder and ram of this length may be made to function efficiently.

The columns 19 are of exactly the same length measuring from the two inside faces of the column heads. Four apertures in the cap 18 and corresponding apertures in the lugs 12 are employed with flanged sleeves 20, nuts 21 and collars 22 for anchoring the four columns to the cap 18 and cylinder 10. The flanged sleeves 20 are ground to fit snugly against the inner face of the head of the column 19 and the opposite face of said flange 20 is ground to fit snugly against the outside face of the cap 18 and lug 12. The sleeve portion of the flanged sleeve 20 is provided with a snugly fitting upper section of the column 19 and the walls of the apertures in the cap 18 and lugs 12. There is consequently no play of the column in the apertures in the cap and lugs.

The span of the several columns on account of the positive anchoring method and spacing method may be made exactly the same and the cap 18 consequently may be positioned at exactly right angles to the axis of the hydraulic cylinder. Since adjacent parts are ground to produce a perfect seat the possibility of foreign matter seeping in and unseating the column is very slight, particularly since engaged parts are at all times held in a rigid position. It is possible also when this construction is used to employ shims for the purpose of compensating for irregularities.

The framework is assembled by first placing the collars 22 over the heads of the columns 19, inserting one head of each column 19 through an aperture in the cap 18, and the other end of each column through a corresponding aperture in the lugs 12 on the cylinder 10. One of the split sleeves 20 is then placed around each end of the column with the flanged portion thereof adjacent to the column head, and the columns bearing the flanged sleeves are then drawn back.
until the flanged portions of the split sleeves rest upon the outside face of the cap and lugs of the cylinder and the heads of each column rest on the faces of the flanges adjacent to them. The split nuts 21 are then placed in position on threaded portions of the columns 19. The collars 22 are placed over the split nuts 21 and said split nuts bearing the collars 22 drawn up tightly against the inside faces of the cap 18 and lugs 12.

An efficient method of operating an extruding press of this type is as follows:

First, the cylinder 16 is filled with a molten charge, for instance of lead, up to the point A. Time is allowed for the charge to solidify and then about half of the lead charge, down to the point B, is extruded. After extruding the lead down to the point B the press is returned to its original position and the cylinder replenished with a new supply of molten lead up to the point A. As soon as the lead charge has solidified sufficiently to prevent blowing out around the ram the lower part of the charge which was left in the cylinder during replenishing, is extruded.

In this manner the temperature of the new charge is being decreased while the old charge which has already solidified is being extruded. By this means the time which has heretofore been lost while waiting for an entire charge to solidify is partly saved.

In order to explain more in detail the manner in which the above described method may be employed more efficiently than some methods heretofore used, a basis of comparison may be established. A pressure often employed is 54,000 pounds per inch. A type of press heretofore employed for the purpose of extruding this type of cable sheath accommodates 732 pounds of lead. A press embodying an improved construction such as described may have a 36 inch long 10 inch diameter ram and cylinder and will then accommodate about 1,100 pounds of lead. By employing the extruding press and the process described above, beneficial results are obtained which will be described according to the basis of comparison above set out. The temperature of the charge may be presumed to be the same in each case.

1. Active efficiency of the press.

By the active efficiency of a machine is meant the ratio of the actual output to its theoretical greatest possible output, i.e., its rate of output when functioning without a stop.

The rate of extrusion of 2% outside diameter sheath weighing 4,805 lbs. per ft. is 27 ft. per minute, or about 130 lbs. per minute. This would represent theoretical perfect activity of the press employed.

Under a process heretofore employed, a press cylinder accommodating 732 pounds of lead was used. The time required for backing down and filling was 2.7 minutes; the time required for the charge to cool 6.5 minutes, and the extruding time 5.6 minutes, a total of 14.8 minutes for extruding 732 pounds of lead. The rate of extrusion thus averages about 49.5 lbs. per minute and this compared to the theoretical perfect activity output of 130 lbs. per minute gives an efficiency of about 38%.

The process described above, using a 36 inch cylinder accommodating an 1,100 pound charge of lead for extrusion into 2% inch outside diameter sheath is as follows: To start operation the cylinder is entirely filled with molten lead alloy, and this charge is then allowed to cool for 61/2 minutes, after which one-half the charge is extruded.

The cylinder is lowered and filled in two minutes, the new charge is allowed to cool for two minutes, and the lower half of the charge, 550 lbs., is extruded in 4.5 minutes. The actual time to extrude 550 lbs. of lead under this method is—

<table>
<thead>
<tr>
<th>To refill</th>
<th>2</th>
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</thead>
<tbody>
<tr>
<td>To cool</td>
<td>2</td>
</tr>
<tr>
<td>To extrude</td>
<td>4.3</td>
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</tbody>
</table>

Total 8.3

Since 550 lbs. of lead are extruded in 8.3 minutes, the actual lead extruded per minute is 66.3 pounds. Compared to the theoretical perfect activity output of 130 lbs. per minute, the efficiency of this new method is about 51%.

The ratio of increased output by the old method and the new method above described, which constitutes this invention, is as 48.5 pounds per minute to 66.3 pounds per minute, or an increase of about 35% in output.

2. Uniform temperature maintained at the die block.

When employing the old method of extruding lead alloy cable sheath, (referring to the attached drawings) the cylinder 16 was filled with molten lead up to the point A, and extruded into sheath down to the point C. The ram 17 was then withdrawn and the cylinder 16 replenished. This method has a tendency to cause unequal cooling of the lead alloy in the die block, and may cause eccentricity in the sheath. This unequal cooling may be caused as follows:

When lead alloy is extruded according to this method, the small charge of lead which remains in the die block on refilling
may be chilled below the average temperature of the charge, and the last part of the charge is cooler than the first part of the new charge, on account of the longer period of radiation and conduction. This loss of heat is augmented by the water in the circulatory system around the cylinder, and no means can readily be provided for reheating the charge, once cooled. Cable extruded according to this method may have a tendency to show eccentric form.

The reason why unequal cooling causes eccentric cable sheath is believed to be as follows: Lead alloys are more plastic at high temperatures than at low temperatures. A more plastic mass bends more easily than a more viscous one. When the lead is colder it has a tendency to move in a straight line and compress at the lower section of the forming chamber, and "bunches up" at the lower section of the forming chamber. This causes a stress on the adjacent section of the core-tube causing it to flex so as to admit an undue thickness of lead at the lower side of the sheath. When the first part of the new charge reaches the die block it is more plastic than the lower part of the charge and bunches up on the upper part of the sheath. As soon as all the old charge has been extruded, the sheath is perfectly concentric. In practice it is known that when the lead is cooled unequally, the cold part of the charge causes a heavy sheath on the bottom of the cable, and the hotter part of the charge tends to cause a heavy sheath on the top side of the cable.

In the new method above described, the lead is extruded up to the point B, and the cylinder then refilled. Extrusion then takes place in the forming chamber before the upper charge between A and B has entirely solidified. The lead in the die block does not cool too greatly during refilling because it has the mass of hot lead above it from which it receives heat by conduction. The last of the old charge if cooled too greatly is again reheated by coming in contact with the new charge near the point B. There is less "bunch up" in the forming chamber and the sheath so extruded approaches perfect concentricity.

3. Quality of the article at the press mark.

The cause of the so-called press mark is the annealing of an article, for instance lead alloy cable sheath, at the die ring during refilling of the cylinder and cooling of the new charge. The time required during the old method is 9.2 minutes, and during this time the sheath is being annealed.

Tests seem to show that the annealing effect reaches its maximum in about 9.5, or that the weakness at the press mark in the old method almost reaches the maximum at the existing temperature.

According to the new method of extruding described, the time of refilling and cooling is 4 minutes. The annealing action is therefore decreased by more than half, and tests show that lead annealed 4 minutes has greater tensile strength and hardness than lead annealed 9.5, temperature being uniform in both cases.

This process is not limited to the extrusion of lead but may be employed in handling any matter which is extruded.

The improved framework above described is not limited to use in extruding presses, as it may be employed wherever a heavy strong framework is required.

What is claimed is:

1. A process for producing lead alloy cable sheath which consists in filling a cylinder of an extruding press with a charge of molten lead alloy, extruding part of said charge around a cable core, replenishing said cylinder with lead alloy and then beginning the extrusion of the remaining part of said charge around said cable core before the new charge has solidified.

2. A process for producing lead alloy cable sheath, which consists in filling the cylinder of an extruding press with a charge of molten lead alloy, allowing the molten charge to solidify, extruding half of the solid charge around the cable core, replenishing the cylinder with molten lead alloy and then beginning the extrusion of the remaining half of the solid charge of lead alloy before the added half of the charge has solidified.

3. A method of extruding lead which consists in extruding part of a charge of solid lead from a container, allowing a portion of the charge to remain in the container, replenishing the container with liquid lead, and then extruding the remaining part of said charge, the part of the charge allowed to remain in the container being large enough so that if immediately after replenishing the container with liquid lead, the old charge be extruded at a normal, uniform rate, the added liquid charge will have solidified by the time all of the old charge has been extruded.

In witness whereof, I hereunto subscribe my name this 24 day of March, A. D. 1924.

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