

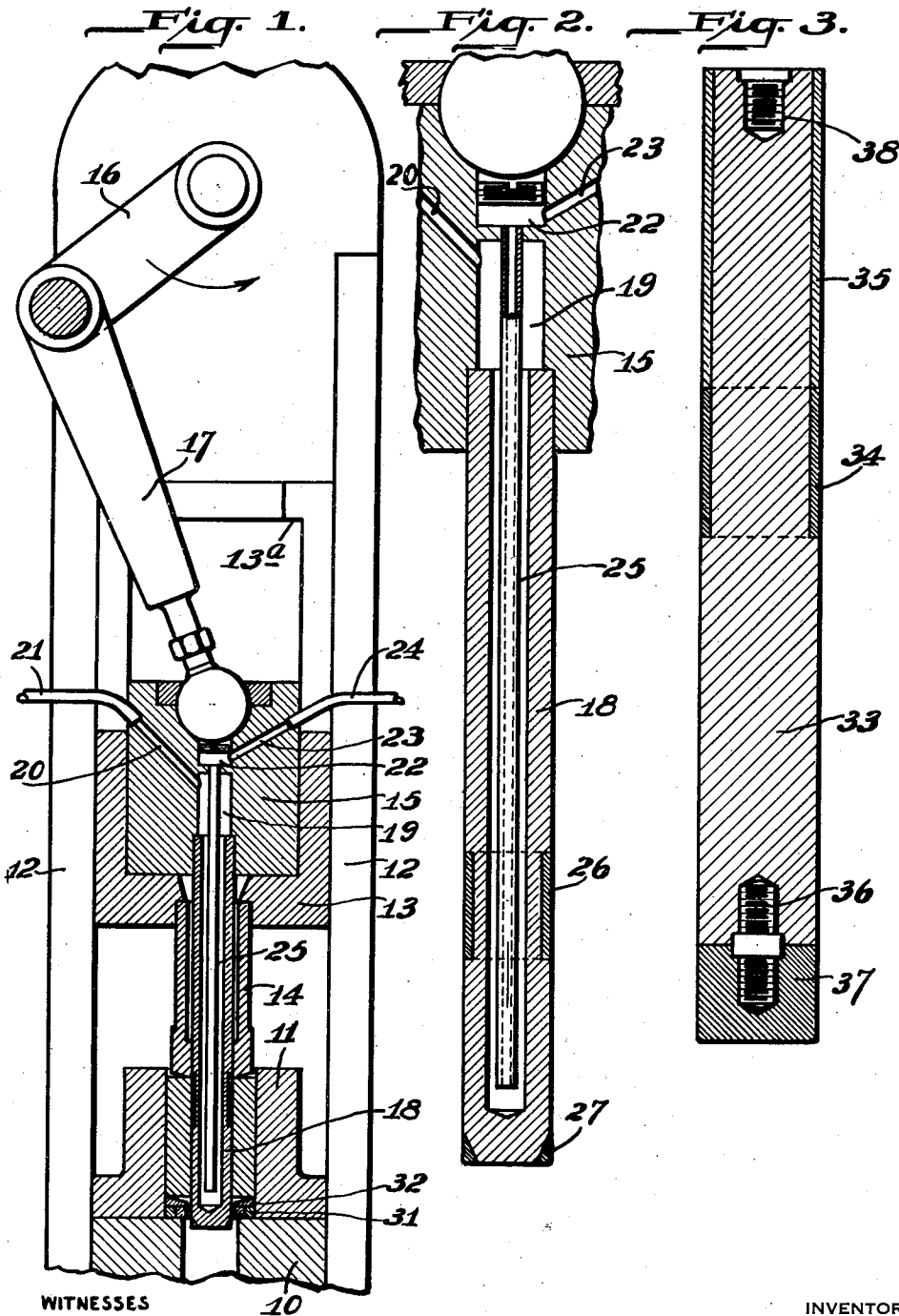
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EXTRUSION APPARATUS

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WITNESSES

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EXTRUSION APPARATUS

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Tubus A. G., Zurich, SwitzerlandApplication March 1, 1933, Serial No. 659,117
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5 Claims. (Cl. 207—19)

My invention pertains to methods of, and apparatus for, extruding in a hot state iron, steel and other metals requiring high extrusion temperatures, particularly in the production of tubes.

5 The principal object of my invention is to render the practice of this method more economical, especially as to the operation of the extruding tools employed therein, and to improve upon such tools.

10 In the hot extrusion of tubes of iron, steel or the like, major problems have been encountered in connection with the piercing mandrels, because of the great strains to which the mandrel is subjected as a result of the nature of the process and the temperature at which it is conducted, as well as because of the possibility of the mandrels becoming welded to the metal of the billet being extruded. Mandrels partly or
15 wholly made of special and expensive materials have been employed, and various attempts have been made to overcome the difficulties incident to the heating of the mandrels.

20 So far as the heating of the mandrels is concerned, it has been proposed, in the hot extrusion of the less resistant metals as executed by relatively slow acting hydraulic presses, to cool the mandrels by applying a cooling fluid interiorly thereto. However, the proposal was ineffective, for the reason that during the slow extrusion operation a material amount of heat was absorbed
25 from the billet by the interiorly cooled mandrel, with the result that the cooled billet opposed too great a resistance against the extruding operation. In an effort to avoid this increase of billet resistance, it has been common, in the hot extrusion of iron, steel and the like, to heat the
30 piercing mandrel before use, and, after each operation, to apply mild cooling means to the exterior of the mandrel,—sufficient to avoid increasing heating of the mandrel to such an extent as would injure the metal thereof. Since the application of the cooling means to the outside of the mandrel, especially with mandrels made of steels that react unfavorably to chilling, frequently occasioned trouble,—as, for instance, cracking of
35 the mandrel,—it has been proposed to change the mandrel after each operation, giving time for the mandrels to cool by exposure to the air.

40 Not only were interiorly cooled mandrels, as heretofore proposed, ineffective for the above-stated reason that they cooled the billet to such an extent as to increase the resistance of the billet to extrusion beyond what was practical,—an effect which might have been expected to be the more
45 pronounced in the case of the extrusion of more

highly resistant metals, requiring high extruding temperatures, such as iron and steel,—but for the mandrels to be cooled interiorly they would necessarily have to be hollow, and it could hardly be anticipated that a hollow mandrel could withstand the much higher strains that are encountered in the extrusion of iron and steel as compared with less resistant metals. I have discovered, however (and therein lies one of the features of the present invention,) that by carrying on the
5 extruding operation at a high extruding speed, in excess of an average of three inches of billet length per second, and employing a mandrel which is interiorly cooled, either continuously or intermittently, the loss of heat from the billet to the mandrel is very slight, and the resistance of the
10 billet to extrusion not materially increased. Moreover, I have found that the hollow mandrels are capable of withstanding the strains to which they are subjected during the practice of the process.

By this combining of a high extruding speed with an interior cooling of the mandrel, I have been able greatly to increase the speed at which the process can be practiced, to the extent of doubling, and sometimes trebling, production over that which was obtainable by the above-mentioned method of exteriorly cooling the mandrel between extruding operations. Furthermore,
15 I have made available, as mandrel materials, metals which are of relatively low tensile strength in the heated state and consequently would not otherwise be usable. This last brings about a material economy.

20 So far as the construction of the mandrels is concerned, it has been proposed in the practice of cold and hot drawing processes, to provide the entire outer surface of the mandrel with a welded coat of an alloy of the stellite type, tungsten, or the like. Such a construction was very expensive. Moreover, when mandrels so constructed are applied to the hot extrusion of such metals as iron and steel, there is great danger of cracking of the coating material upon the mandrel encountering the hot billet, because of the great
25 difference between the coefficient of expansion of the coating material and that of the mandrel body. Accordingly, another feature of my invention consists in providing the mandrel with a coating at only a relatively small part thereof,—being the part which is in operation towards the end of the extruding operation. In this manner, great economy in the production of the mandrels is obtained, and, at the same time, the chance
30 of

of the coating cracking is minimized, because of the relatively small length of the coating.

I have shown, by way of example, in the accompanying drawing and described in the following specification, apparatus of my invention by which my improved method can be practiced. I wish it understood, however, that changes may be made in the apparatus, and that the method may be carried out by other apparatus than that described and shown, without exceeding the scope of my invention, as defined in the appended claims.

In the drawing:

Fig. 1 is a schematic sectional view of an extrusion press adapted for use in practicing my improved method, said press being provided with a piercing mandrel constructed in accordance with my invention;

Fig. 2 is a fragmentary sectional view, on an enlarged scale, of the mandrel and associated parts shown in Fig. 1;

Fig. 3 shows a modified form of mandrel embodying my invention.

The form of extrusion press schematically shown in Fig. 1 is but one of several that might be employed for producing by hot extrusion, tubes of iron, steel and the like, provided, however, that the plunger-actuating mechanism be such as to produce, during the actual extruding operation, an average plunger speed of at least three inches per second. The press chosen for illustration includes a base 10 upon which is mounted a billet container 11 having at its lower end a matrix die through which the metal is extruded around a mandrel. Upwardly extending from the base is a suitable frame, shown as including standards 12, in which is mounted, for vertical movement, the plunger head 13 from which there extends downwardly the hollow extruding plunger 14. Mounted in the plunger head, for vertical movement therein, is a mandrel head 15, the movement of the mandrel head with respect to the plunger head being limited, in a downward direction, by the lower end of the plunger head, and in an upward direction by a shoulder 13a of the latter. Rotatably mounted in the upper part of the frame is a crank 16, the pitman 17 of which is connected with the mandrel head. The result of this construction,—details of which have been omitted for the reason that they are fully disclosed in patents which I have heretofore obtained, for instance, Patent No. 1,773,464,—is that as the crank 16 rotates the mandrel head 15 descends so that a mandrel carried thereby and extending through the hollow plunger 14 pierces a billet which has been placed in the container 11, while at the same time the plunger head descends until the lower end of the plunger rests upon the top of the billet. After the billet has been pierced, the lower end of the mandrel head 15 comes into engagement with the bottom of the plunger head (Fig. 1,) so that further movement of the crank forces the plunger downward and the billet is extruded around the mandrel.

The mandrel 18 is made hollow and is mounted in a socket of the mandrel head so that the interior of the mandrel is in communication with a cavity 19 formed centrally in the latter and from which cavity there extends an outlet passage 20 which may terminate in a flexible hose such as 21. Above the cavity 19 the mandrel head is formed with a second cavity 22 from which extends an inlet passage 23 terminating in a flexible hose 24. Secured in the mandrel head so as to communicate with the cavity 22

and extend longitudinally of the hollow mandrel down to a point adjacent the lower end thereof is a tube 25. A coolant, fluid or gaseous, is supplied either continuously or intermittently through the hose 24 to the inlet passage 23 so as to circulate through the mandrel and find an outlet through the passage 20 and hose 21.

As has been stated, the press, however constructed, is made to operate at a billet-extruding speed of in excess of an average of three inches of billet length per second. By employing this high press speed and at the same time interiorly cooling the mandrel, as described, I find that the absorption of heat from the billet is very small and that a noticeable increase of billet resistance does not occur. In addition, practical operation shows that the mandrels, although hollow, are capable of withstanding the heavy strains to which they are subjected. Consequently, I am able to avoid difficulties, arising from mandrel heating and welding of the mandrel to the billet material, that have heretofore accompanied the practice of the hot extrusion process in the production of tubes from iron and steel and other resistant metals requiring high extrusion temperatures. At the same time, I find that the mandrels perform their work satisfactorily when constructed of steels which possess comparatively low tensile strength in the heated state and are consequently very cheap. This effects an economy which is highly important, since one of the important problems that has heretofore been encountered in the commercial practice of the hot extrusion process as applied to iron, steel and the like has been the high original and replacement cost of the extruding tools employed.

To increase the resistance of the mandrel to wear and tear, while still permitting the body thereof to be made of a relatively inexpensive metal, as well as to decrease further the likelihood of welding occurring between the mandrel and the metal of the billet, I provide upon the mandrel a relatively short annular coating 26 of what I may term "hard alloy metal," that is to say, a metal having great tensile and compressive strength at high temperatures, having great resistance to wear and tear, and not liable to weld with the metal of the billet being extruded. Alloys of the stellite type, tungsten carbides and the like may be employed for the coating, but are very expensive. I have discovered that the requisite properties of the mandrel may be obtained by employing for the coating alloyed chill castings or steels which show an eutectic in the cast state. As an example, a carbon-chromium steel of this type containing 1.2 to 2.5% carbon and 10 to 13% chromium, such as is commonly used for making cutting punches, is well adapted for the mandrel coating and is relatively inexpensive. Such steels are sometimes designated "Ledeburit steels".

The coating 26 extends only over that portion of the mandrel which will be in operation during the latter part of the extruding operation, and, being thus of relatively small length, is not liable to become cracked owing to differences which may obtain between its coefficient of expansion and that of the body of the mandrel. By making the body of the mandrel, as has been described, of steel of low cost, and the short coating of the cheap chromium-carbon steel, a mandrel is obtained which is at once inexpensive and extraordinarily resistant against wear and tear and against welding with the billet metal.

Since the operative edge of the extremity of the mandrel is subjected to extremely heavy wear and tear, I may provide the mandrel with an edge coating, designated 27 in Fig. 2, of a hard alloy which may be the same as that employed for the coating 16, or I may provide the mandrel with a special end-piece, as later described with reference to Fig. 3.

In Fig. 3 I have shown a modified form of mandrel, in this case a solid mandrel. According to this modification, the mandrel, 33, has shrunk thereon a sleeve 34 of the requisite length, and so placed, as to be in contact with the billet metal during the latter part of the extruding operation. The materials of the mandrel and the sleeve, respectively, may be the same as those mentioned above, with respect to the mandrel and coating, in reference to the form of mandrel shown in Figs. 1 and 2. The sleeve 34 is further secured in position by a retaining sleeve 35 which is mounted on the mandrel and may be of the same material as the latter. To the end of the mandrel is secured, as by a screw 36, an end piece 37 which may be of the same material as the sleeve 34. The end piece serves the same purpose as the edge coating 27 referred to in connection with Figs. 1 and 2, and is readily replaceable upon becoming worn. The mandrel may be formed with a threaded bore 38 for use in attaching it to the mandrel head.

No claim is made herein to the extrusion method disclosed hereinabove, this method being the subject matter of claims presented in an application copending herewith.

I claim:

1. A mandrel for employment in the hot extrusion of tubes from metals requiring high extrusion temperatures, said mandrel comprising a body portion, an annular protecting portion of hard alloy metal applied to said body portion and of relatively short length and placed intermediate the ends of said body portion to adapt it to encounter the metal of the billet during part of the operation of actually extruding the billet, and an end-piece of hard alloy metal removably secured to said body portion, to permit replacement.

2. A mandrel for the hot extrusion of tubes from metals requiring high extrusion temperatures, said mandrel comprising a body portion of steel normally subject to rapid wear when used for such extrusion, said body portion having at only the extremity and at an intermediate portion thereof which encounters the billet material during the latter part of the actual extrusion operation, a coating of another alloy metal which is resistant to wear at the extrusion temperature, and being thereby of materially increased life.

3. A mandrel for the hot extrusion of tubes from metals requiring high extrusion temperatures, said mandrel comprising a body portion of steel normally subject to rapid wear when used for such extrusion, said body portion having a comparatively short length at that portion thereof which is in contact with the billet during the latter part of the actual extrusion operation provided with a coating of ledeburitic chromium-carbon alloy exhibiting an eutectic in the cast state and which is resistant to wear at the extrusion temperature, and being thereby of materially increased life.

4. A mandrel for the hot extrusion of tubes from metals requiring high extrusion temperatures, said mandrel comprising a body portion, and an annular coating of hard alloy material applied to said body portion, said coating being of relatively short length and positioned intermediate the ends of said body portion to be in contact with the metal of the billet during the latter part of the actual extrusion operation.

5. A mandrel for the hot extrusion of tubes from metals requiring high extrusion temperatures, said mandrel comprising a body portion, an annular coating of hard alloy material applied to said body portion, said coating being of relatively short length and positioned intermediate the ends of said body portion to be in contact with the metal of the billet during the latter part of the actual extrusion operation, and an edge coating of hard alloy material adherently applied to the operative edge of the extremity of the mandrel.

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