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F. SINGER

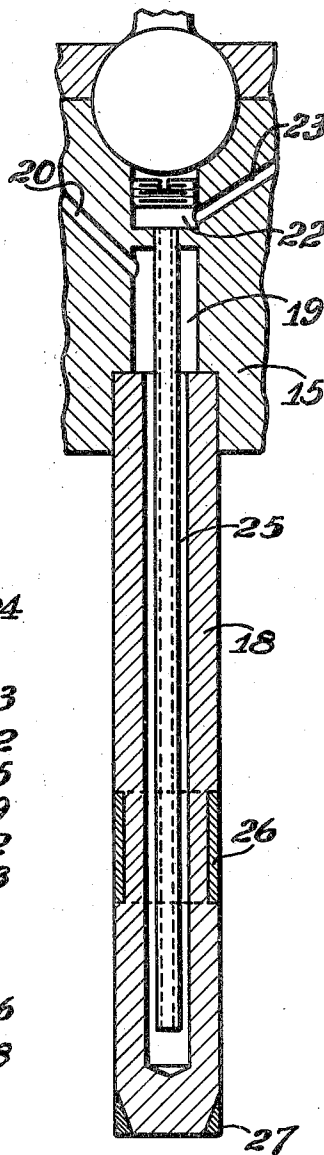
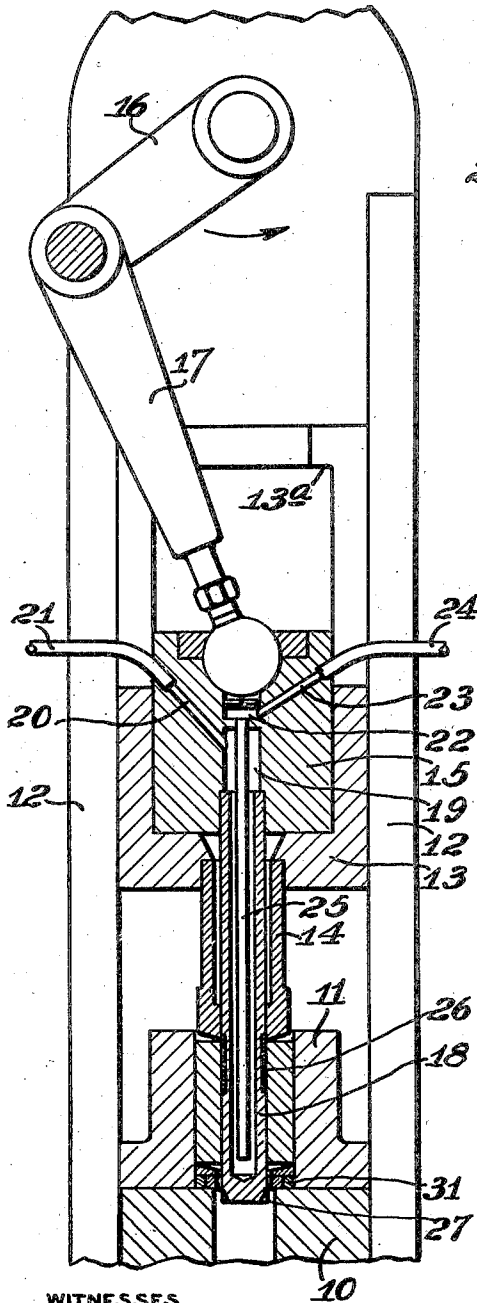
2,036,182

EXTRUSION METHOD

Original Filed March 1, 1933

Fig. 1.

Fig. 2.



WITNESSES
A. B. Wallace.
J. B. Flier

INVENTOR
Fritz Singer
by Brown, Critchlow & Flier
his attorneys.

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EXTRUSION METHOD

Fritz Singer, Nuremberg, Germany, assignor to
Tubus A.-G., Zurich, Switzerland

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659,117. Divided and this application April 14,
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29, 1931

1 Claim. (Cl. 207—10)

This invention pertains to methods of extruding in a hot state iron, steel and other metals requiring high extrusion temperatures, particularly in the production of tubes, and this application is a division of my compending application Serial No. 659,117, filed March 1, 1933.

The principal object of my invention is to render the practice of this method more economical, especially as to the operations of the extruding tools employed therein.

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 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.

So far as the heating of the mandrels is concerned, it has been proposed, in the hot extrusion of the less resistant non-ferrous 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 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 non-ferrous metals, to heat the 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 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.

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 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 it is upon this that the present invention is predicated in part, that by carrying on the extruding operation at a high extruding speed, in excess of an average of three inches of billet length per second, and by cooling the mandrel interiorly, even with intensely acting cooling means, as for instance cold water either continuously or intermittently, the loss of heat from the billet to the mandrel is very slight, and the resistance of the 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, 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.

I have shown, by way of example, in the accompanying drawing and described in the following specification, apparatus by which my improved method can be practiced. It is to be understood, however, 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 claim. In the drawing Fig. 1 is a schematic sectional view of an extrusion press adapted for use in practicing my improved method and provided with a piercing mandrel constructed in accordance with my invention; and Fig. 2 a fragmentary sectional view, on an enlarged scale, of the mandrel and associated parts shown in Fig. 1.

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 31 through which the metal is extruded around a mandrel. Extending upwardly 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 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 high resistance 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 en-

countered 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 chilled castings, or steels of the Ledeburite type, such as those containing chromium. "Ledeburite" steels is the term applied to steels of various compositions and properties which show a eutectic in the cast state. As an example, a carbon-chromium steel of the Ledeburite 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.

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 27, Fig. 2, of a hard alloy which may be the same as that employed for the coating 16.

According to the provisions of the patent statutes, I have explained the principle and construction of my invention and have illustrated and described what I now consider to represent its best embodiment. However, I desire to have it understood that, within the scope of the appended claim, the invention may be practiced otherwise than as specifically illustrated and described.

I claim:

That improvement in methods of extruding seamless tubes from heated billets of iron, steel or other metals having high melting points, which comprises placing a heated billet of such metal in a container having an apertured die therein, inserting a hollow mandrel through the billet into the aperture of the die, applying a coolant to the interior of the mandrel, and extruding the billet around the mandrel and through the aperture at an average speed in excess of three inches of billet length per second.

FRITZ SINGER.