

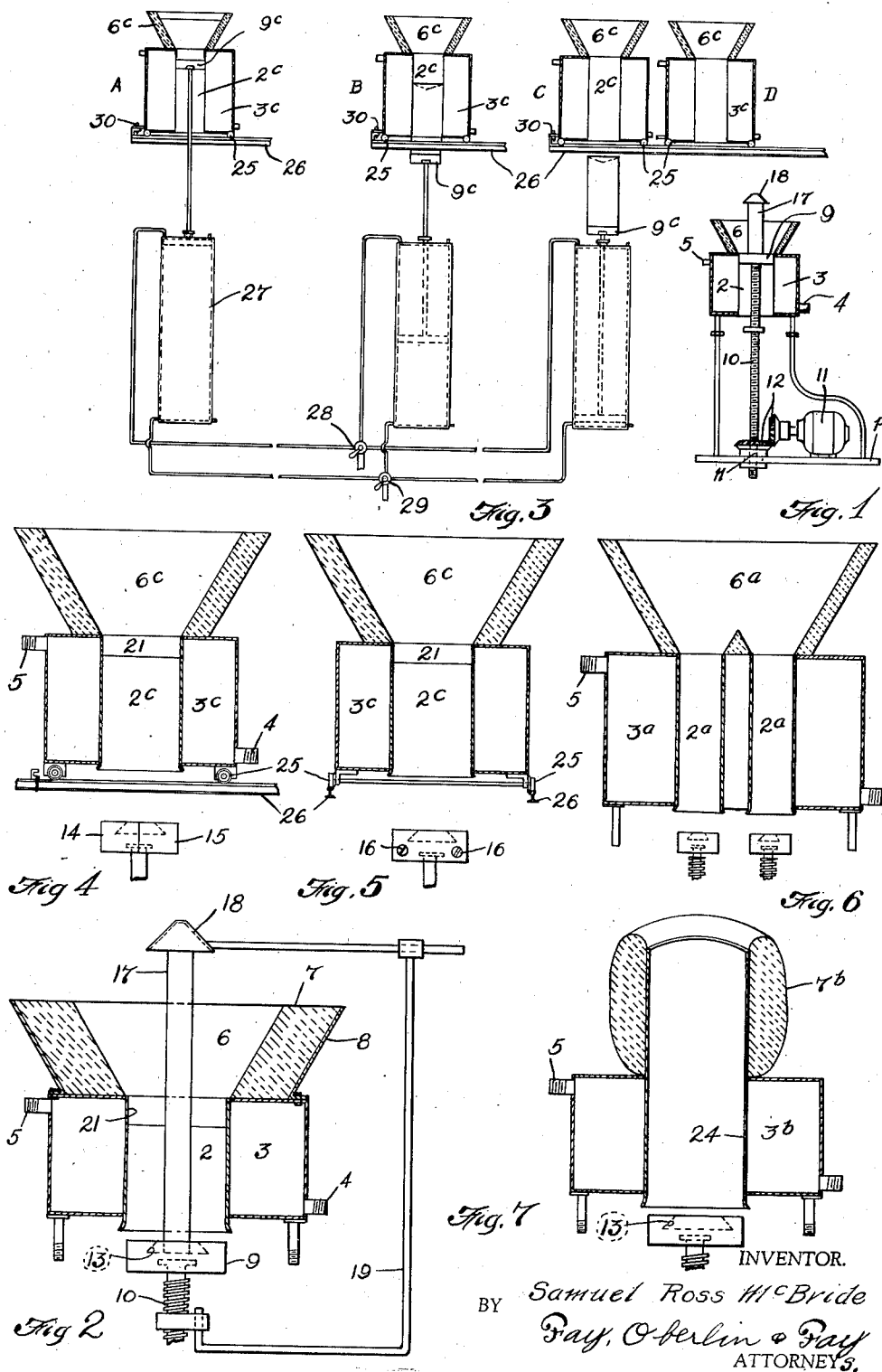
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S. R. McBRIDE

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APPARATUS FOR TREATING METALS

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INVENTOR.
BY Samuel Ross McBride
Pay, Oberlin & Pay
ATTORNEYS.

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APPARATUS FOR TREATING METALS

Samuel Ross McBride, Ravenna, Ohio, assignor
to H. L. F. Company, Los Angeles, Calif., a cor-
poration of California

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In my patent application Serial No. 63,385, filed February 11, 1936, there is set forth the treatment of metals by subjecting the metal to a molecular drawing action progressively by changing it from the liquid to solid state by an advancing front through the metal mass, thus effectuating a compression or drawing action progressively and regularly in situ. In accordance with the present invention, a further extension and modification of this mode of action is had, and with attainment of further features of particular advantage in dealing with certain metals.

To the accomplishment of the foregoing and related ends, the invention, then, comprises the features hereinafter fully described and particularly pointed out in the claims, the following description and annexed drawing setting forth in detail certain illustrative embodiments of the invention, these being indicative however, of but a few of the various ways in which the principle of the invention may be employed.

In said annexed drawing:—

Fig. 1 is a vertical sectional view showing an embodiment of the invention; Fig. 2 is an enlarged sectional detail of the upper portion thereof; Fig. 3 is a vertical sectional view of a modified form of apparatus; Fig. 4 is an enlarged sectional detail taken therefrom; Fig. 5 is a sectional detail at right angles to that shown in Fig. 4; and Figs. 6 and 7 are vertical sectional details of modifications.

As shown in Figs. 1 and 2, there is provided a chamber 2, whose cross-section is dimensioned to correspond to the cross-section of the metal product to be formed. Such chamber is provided with controlled means for cooling, and this may take the form of a jacket 3 with an inlet connection 4 and outlet connection 5 for the cooling fluid. Surmounting the chamber 2 is a supply-member 6 for molten metal, this being of refractory material, or at least refractory lining 7 in the metallic shell 8. The chamber 2, in contrast, is of thin-walled metal, as steel sheet, or high temperature resistant alloys, such as nickel alloys, depending somewhat upon the particular metal to be cast. Fitting as a piston for the chamber 2 is a follower member 9 which is movable through the chamber 2, fitting the same in its bore, whether circular, rectangular or of other desired section, the piston 9 being initially in its upper position at the top of the chamber 2, thereby forming the bottom of the molten-metal container 6 at the time of starting the operation, and being movable up and down in controlled cycle by suitable means, as for instance the screw-threaded stem

10 which carries the piston and being operated by motor 11 through the gearing 12 and connected nut *n* mounted in the platform *p*, the construction being such that the piston can be placed in position and then be retracted from its upper position, thereby moving down through the chamber 2, which is the cooling zone. The piston 9 is provided with means for gripping or holding the metal which solidifies in contact therewith, and an undercut 13 or the like is satisfactory for key-gripping the lower end of the metal mass in its solidification against the piston. By constructing the piston-head in separable portions 14, 15, as shown more clearly in Fig. 4, these portions being held together by screws or the like 16, 15 the formed metal may be released from the piston in due course after the cycle is completed.

Where a core is desired, as in the formation of tubular or hollow metal products, such core 17 may be centered by suitable means, as by the core holder 18 which is supported by the arm 19, this allowing the necessary support irrespective of movement.

Molten metal is provided in the molten metal charger 6, the capacity preferably being such as to exactly supply the molding cavity 2. The piston 9, as above indicated, is at this stage located in its upper position, forming the floor of the molten metal charger 6. The piston 9 is now lowered, while cooling fluid is supplied in the jacket 3. The metal directly contacting the piston 9 solidifies in the keying undercut 13 and as the piston is retracted, the rate of progress depending somewhat upon the particular metal being worked with, the metal passing from the molten metal charger 6 through the metering orifice 21 of the molding chamber 2, receives its cross-sectional contour and begins to solidify, and as the piston descends, it tensions or pulls the mass of metal through the cooling zone, the metal molecules thereby receiving not only the progressive compressional action as effected by the zone of setting up, but the metal molecules are simultaneously tensioned at the time of transition from liquid to solid state, and an adjustment of arrangement and orientation is had, such as to result in properties characterizing the metal product in a peculiar manner, with a remarkable evenness of texture and outstanding toughness. Products superior to metal structure attained by rolling or pressure-extruding are attained. Rolling results in elongation of grain with considerable difference in the results at the exterior as compared with the interior of the section, and compression-extrusion interferes with a free

orientation of molecules, and occasions considerable deformation of texture in the transverse direction. The molecular action in accordance with the present operation thus is capable of yielding results of peculiar character with metals generally which are adaptable to treatment in transition from molten to solid state, including non-ferrous and ferrous alloys. Ingots of ferrous or non-ferrous metal can be produced with grain size controlled as desired. As illustrative of novel results attainable, whereas tin-copper-high lead alloys cannot be rolled at all on account of damaging the poorly held lead, the present treatment gives a structure with these alloys which is superior to and more uniform than a typical rolled texture, and bearing alloys for instance, as of lead 22-24 per cent, copper 69-71 per cent, tin 7-8 per cent, yield a uniform texture together with a Brinell hardness of around 70, which is surprising for a metal of such sort. Nickel as herein treated, yields anodes of outstanding character. As well known, nickel as subjected to corroding action in a plating bath is particularly prone to reveal its weaknesses in structural texture. Cast anodes, which are of coarse and quite uneven texture at best, have given much trouble in the past by their tendency to corrode very unevenly in the plating bath and flake off and break down into quite large pieces which interfere with proper deposition on the cathode and also occasion loss in sludge. Attempts to obviate this difficulty by rolling or by hammering, have given anode structures with somewhat better grain and better behavior in the plating bath, but the best attainable by these methods have still been very deficient in that the texture has been irregular and the corrosion and action generally more erratic than desirable. Nickel anodes however, as prepared by the present process are of striking evenness in texture, coupled with great density, and in the plating bath the corrosion is outstandingly regular and with a minimum of loss in sludge.

Where products of rather small diameter are to be formed, it is of advantage to provide the mold cavities in multiple, as illustrated in Fig. 6, in which mold cavities or chambers 2a are arranged to be fed from a common molten metal charger 6a, and a cooling jacket 3a in common surrounds them.

As seen, the wall of the chamber 2 is of thin metal. Conveniently, and particularly where relatively high melting alloys are to be treated, such metal shell may be in the form of a tube 24, Fig. 7, of some special steel, such as nickel chromium alloy having its upper end or charging end surrounded by a heat-insulating cover 7b, thereby forming a continuous conduit, the upper portion of which serves as the molten metal charger, and therebelow is the cooling zone surrounded by the cooling jacket 3b.

Desirably, a battery or combination of units is associated, such that each unit may be undergoing a separate stage of operation, and thereby forming a complete operating circuit. For this, there may be a series of chambers 2c, each with its cooling packet 3c (see Fig. 3), and its molten metal charger 6c, the chambers being mounted on wheels 25, in truck-like mounting, movable on rails 26. The latter preferably are arranged in circular form, such that the units may be moved

in circuit from point of operation to point of discharge, and thence back, the drawing here showing the front side of the circuit only, on account of exigencies of space. As indicated, the units A, B, C are rolled into position each over a piston 9c, which is operated by a fluid-pressure cylinder 27, and conveniently the respective pistons are controlled by control valves 28, 29, and are timed such that when unit A is in condition just beginning to receive its charge of molten metal, unit B has pulled its charge down through the cooling zone to a considerable degree, and the unit C is completely discharged. The unit D is ready for return to charging position. Each unit as in place over its piston is locked against movement by suitable means, as for instance a locking pin 30 which engages a lug on the unit and a lug close alongside the track. Such pin may be quickly inserted when the lugs are aligned, and may be quickly removed when the unit is to be moved. As arranged in accordance with Fig. 3, three units are simultaneously thus undergoing successive stages of operation, and may then be replaced by empty units D, etc. in circuit.

Other modes of applying the principle of my invention may be employed instead of the one explained, change being made as regards the details disclosed, provided the features stated by any of the following claims or the equivalent or such stated features be employed.

I therefore particularly point out and distinctly claim as my invention:—

1. Apparatus for treating metals, which comprises a series of chambers adapted to receive molten metal, a cooling jacket for each chamber, a molten metal charger on each chamber, a truck-mounting for each chamber, a trackway therefor, a series of pistons operable in the chambers and having means for keying to the metal, including an undercut and separable piston-sections, means for operating each piston, and locking means for holding each chamber in position over its piston.

2. Apparatus for treating metals, which comprises a series of chambers adapted to receive molten metal, a cooling jacket for each chamber, a molten metal charger on each chamber, a truck-mounting for each chamber, a trackway therefor, a series of pistons operable in the chambers and having means for keying to the metal including an undercut and separable piston-sections, fluid-operated means for moving each piston, and locking means for holding each chamber in position over its piston.

3. Apparatus for treating metals, which comprises a series of chambers to receive molten metal, a cooling jacket for each chamber, a molten metal charger on each chamber, a piston operable in each chamber and having means for keying to the metal, means for operating each piston, a truck-mounting for each chamber, a trackway therefor, and locking means for holding each chamber in position over its piston.

4. In casting apparatus having a chamber adapted to receive molten metal and a cooling jacket about said chamber and a piston slidable in the chamber, means for keying the solidifying metal to the piston, said means comprising separable piston-sections presenting an under-cut against the metal.

SAMUEL ROSS McBRIDE.