

A. M. CRAIG.
 APPARATUS FOR CASTING METALS.
 APPLICATION FILED DEC. 8, 1913.

1,107,904.

Patented Aug. 18, 1914.

3 SHEETS-SHEET 1.

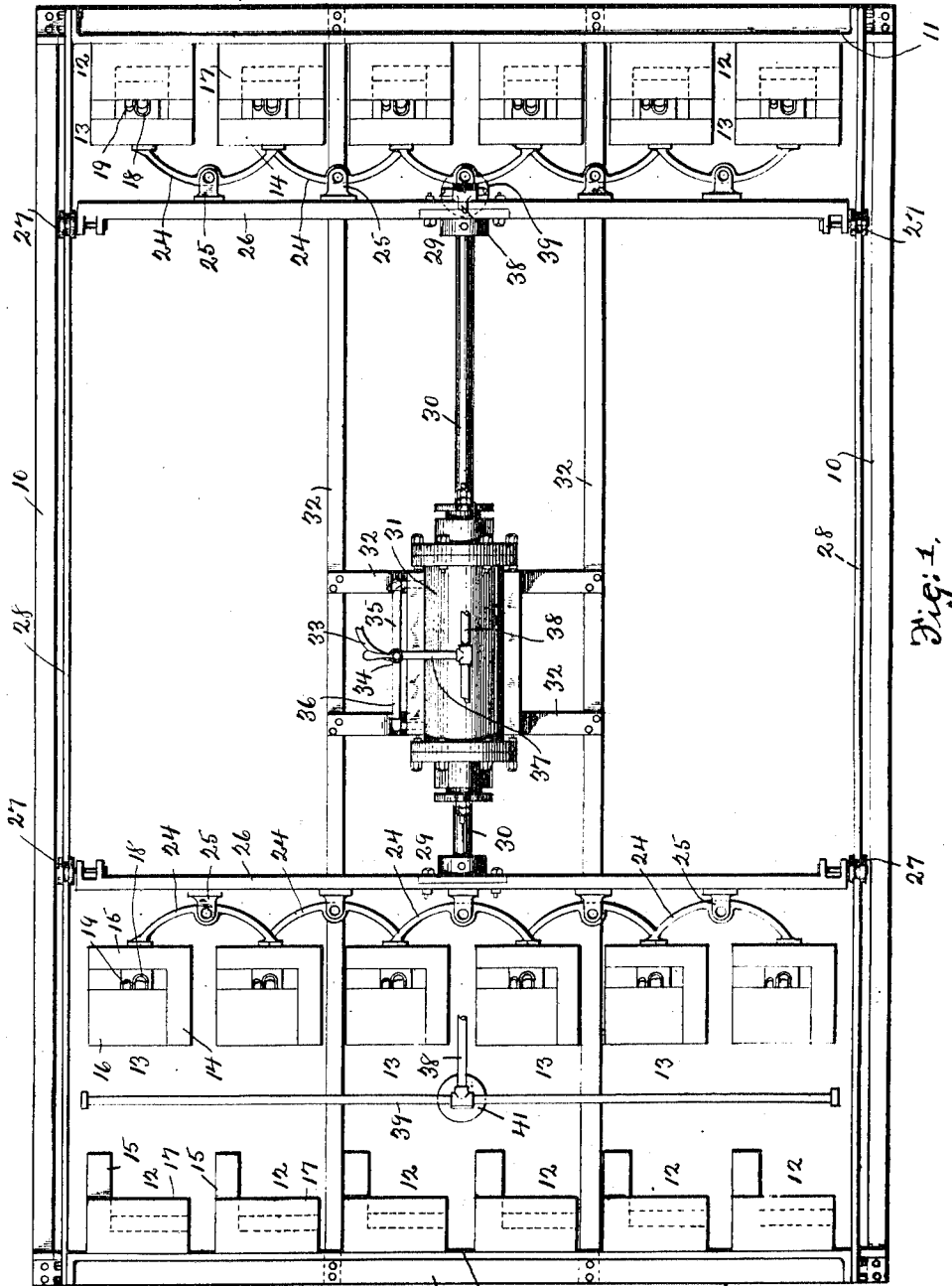


Fig. 1.

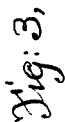
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3 SHEETS-SHEET 2.



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3 SHEETS—SHEET 3.

Fig: 6,

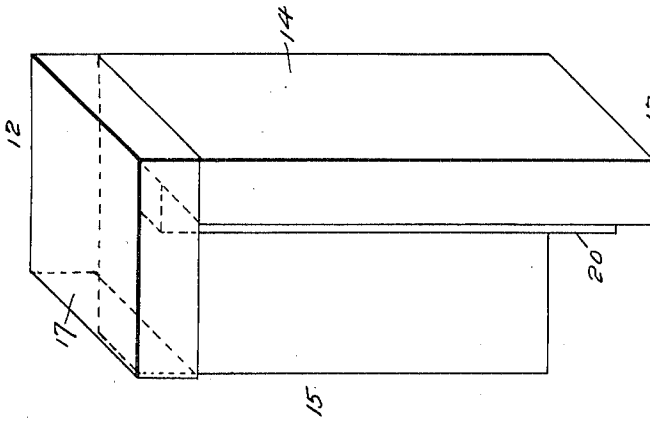
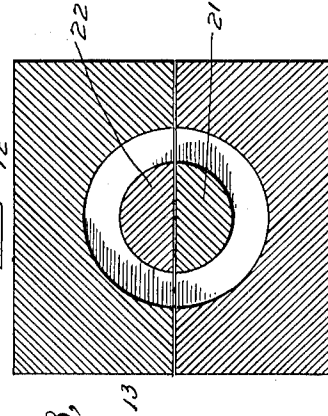


Fig: 8,

Fig: 5,

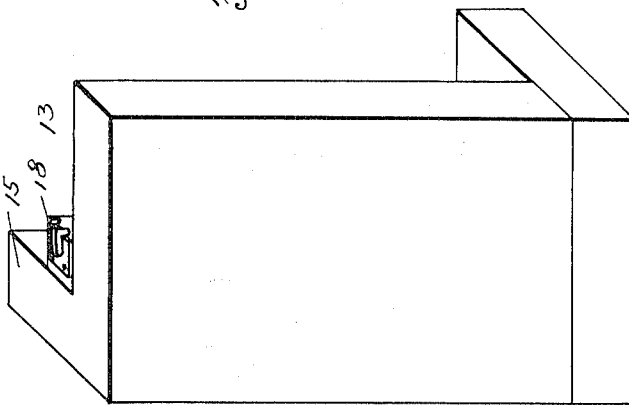
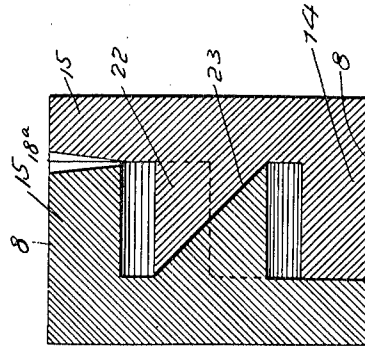


Fig: 7.

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APPARATUS FOR CASTING METALS.

1,107,904.

Specification of Letters Patent.

Patented Aug. 18, 1914.

Application filed December 8, 1913. Serial No. 805,224.

To all whom it may concern:

Be it known that I, ALVIN M. CRAIG, a citizen of the United States, residing at New Haven, New Haven county, Connecticut, have invented a new and useful Improvement in Apparatus for Casting Metals, of which the following is a full, clear, and exact description.

My invention relates to improvements in apparatus for casting metals under pressure.

It is not unusual to cast metals in a non-expandible mold, and to compress the mold by plungers operated by pistons, the plungers pressing against the metal in the mold while the metal is plastic or comparatively soft. It has also been attempted to cast metals in molds in which some part of the mold is under pressure and yields when the mold expands or the metal expands within it under the first heat, but these methods of casting do not meet the requirements of the trade. In making ordinary castings, if the mold is non-expandible, under usual circumstances the swelling of the metal and mold when the metal is first poured, will either break the mold or casting, or distort the latter. Where spring pressure is used the intense heat from the mold will draw the temper from the springs so that this sort of apparatus is only usable when castings are infrequently made.

The object of my invention is to produce a very rapid system of casting in which the casting can be made under as heavy pressure as desired, to the end that the grain may be laid on the casting, the metal greatly condensed, and at the same time use an expandible mold in which the mold sections themselves can yield when the metal is first poured, and in which the mold sections as distinguished from the plunger, are pressed upon the casting by pressure of an elastic fluid, preferably air, so that while the pressure is as great as may be desired, the pressure is an elastic one and will yield or react under the expansion of the mold and its contents, so that no harm is done to either the mold or the casting. In this way I am enabled to make castings under enormous pressure without danger to either casting or mold, and so the metal is very dense and is more suitable for almost any purpose than ordinary castings. This makes the invention valuable in the casting of armor plate.

In carrying out my invention I operate the mold sections by pistons so that continuous casting can be carried on, and this is rendered possible further by the fact that I preferably employ compressed air as a means of actuating the mold sections, thus obtaining the elastic advantage above stated, and I get a further and great advantage for this reason. It is well known that when air confined under great pressure, is allowed to expand quickly, it absorbs the heat from the surrounding atmosphere, so that intense cold is generated, and I use the exhaust from my compression cylinder or cylinders as a blast against the mold and casting when the mold is opened, thus chilling and cooling the mold and casting. This arrangement makes it possible to cast rapidly and use the mold as frequently as possible, and it also tends to harden both the mold and casting, as will be well understood by those familiar with the art. In carrying out my invention I also employ the mold preferably in two parts, in which the mold sections are not spring actuated or jointed, but close firmly against the metal of the casting, while at the same time they can yield in all directions, thus providing for the expansion of the casting and mold when the metal is first poured, while the elastic pressure behind them will close them firmly against the casting as the latter cools, thus producing, as above stated, a dense casting and one having a smooth surface which in most cases will not need machining. This capacity for compensation and expansion in all directions is because in the preferred form the mold is made in two parts overlapping at the sides, top, and bottom, so that when the opposed mold sections are forced against the liquid metal, the latter is compressed laterally, and end compensation also takes place because the end or vertical expansion is against the top and bottom of the mold, which can yield under the pressure as will appear from the description which follows.

Reference is to be had to the accompanying drawings forming a part of this specification, in which similar reference characters indicate corresponding parts in all the views.

Figure 1 is a broken top plan view of an apparatus embodying my invention. Fig. 2 is a side elevation of the apparatus shown in Fig. 1. Fig. 3 is a side elevation of a simple form of the apparatus. Fig. 4 is a side ele-

vation showing a slightly modified form of construction in which a three piece mold is used. Fig. 5 is a perspective view of one-half of a mold forming a part of my invention. Fig. 6 is a perspective view of the opposite half of the mold to that shown in Fig. 5. Fig. 7 is a transverse section of the mold as adapted to make a casting having a core. Fig. 8 is a cross section on the line 8—8 of Fig. 7. Fig. 9 is a detail of the pipe which can be used for discharging a cold air blast upon the mold sections. Fig. 10 is a cross section of a preferred form of the mold, and Fig. 11 is a detail showing how the piston rod can connect with a mold section.

As illustrated in Figs. 1 and 2 the apparatus is provided with a suitable frame 10 of any preferred construction, having preferably at the ends brackets 11 or similar abutments which afford a backing for the mold sections 12. These mold sections are made up in two parts 12 and 13, and the parts 12 are affixed to the abutments 11, while the parts 13 reciprocate back and forth with relation to the parts 12. Obviously the principle would be the same if both parts of the mold moved, but one is sufficient. I prefer to make the mold in two sections as shown in Figs. 1, 5 and 6, so that they can be squeezed together to compress the metal, but will permit expansion in all directions. I do not know that two part molds having these peculiarities have heretofore been made. The interior of the mold can of course be given any configuration, but the mold sections 12 and 13 are arranged so as to fit together compressively and yet provide for a smooth casting and for expansion, as stated. To accomplish this each section is provided with walls 14 and 15 arranged at right angles to each other, while the section 13 has a bottom 16 integral with its sides and adapted to close over the bottom edges of the wings 14 and 15 of the opposite section 12, while the section 12 has a top 17 adapted to close over the wings 14 and 15 of the section 13. Thus it will be seen that the mold sections can be pushed together to any desired extent, and yet they can expand laterally in any direction as well as vertically. The top 17 is a little shorter than the bottom 16, so as to provide conveniently for the pouring cup 18 which is arranged on one of the sections, preferably on the section 13, and beside it is a suitable vent 19. I prefer a raised portion or abutment 20 on the wing 14 of the section 12, which will fit into the corresponding part of the section 13 opposite, so as to abut with the metal in the casting.

When the casting is to be made with a core, the internal form of the mold can be changed as in Figs. 7 and 8. Here the part 14 of one mold is provided with a raised

portion 21 forming half the core, while on the opposite section the part 15 is provided with a raised portion 22 forming the opposite part of the core, and these parts 22 and 21 meet on an inclined line 23 (see Fig. 7) so that notwithstanding the fact that the mold is provided with a core, it can be compressed or permitted to expand just the same, as the meeting parts 21 and 22 will have a sliding action along the line 23. This mold has an ingate 18^a at the joint. While these molds can be used singly, I prefer to use them in groups as shown in Figs. 1 and 2, and arrange them at opposite ends of the casting apparatus, so that one set of molds will be closed while the other set is open, and also provide means for equalizing the pressure on the several molds. This equalization is preferably accomplished as shown in Fig. 1, where the section 13 has its back secured to a yoke or link 24 which is also rigidly connected to the back of the next mold section 13 and is centrally pivoted to the bracket 25 mounted on the cross head 26. Thus it will be seen that when the mold sections 13 are squeezed against the mold sections 12, if for any reason there should be a little more metal in one section than in the other, or there should be more expansion in one than in the other, the reaction of one section 13 will cause a correspondingly forward action of the next adjacent section, and so the mold sections will act with equal pressure on the metal of their respective molds. Obviously the pivotal connection can be changed, but I claim any lever action in which the above result is attained. Each cross head 26 reciprocates back and forth in the frame 10, and it can be mounted in any workmanlike manner. I have shown a simple means in which the cross head 26 has at the ends rollers 27 running on rails 28 which are supported on the brackets 11, and each cross head has a pivotal connection as at 29 with a piston rod 30 which enters a pressure cylinder 31 and connects with a piston in the usual manner. Any suitable loose connection can be made with the piston rod 30, as for instance as shown in Fig. 11, where the piston rod enters the casing 29^a on the back of the cross head 26 as illustrated in Fig. 2, or of the mold section 13 as illustrated in Fig. 4, and a pin 29^b extends through the casing 29^a and through the piston rod 30. The cylinder 31 and its contained piston I have not shown in detail, as it is the usual air engine, and it can be mounted in any convenient manner, preferably on a suitable framework 32, so that it will be in proper relation to the cross heads 26. The flexible pipe 33 connecting with a source of compressed air supply, is connected with a three-way cock 34, and this connects by means of the pipes 35 and 36 with the cylinder 31, so that the inlet and

exhaust can be controlled in a manner common to such cylinders, and which I have not here shown. The exhaust from the cylinder also comes through the cock 34 in the customary manner, and I have shown the exhaust connected with the pipe 37 leading into a pipe 38 arranged longitudinally of the cylinder 31, and this connects with transverse pipes 39 which are arranged as shown in Figs. 1 and 2 above the mold sections 12 and 13, the pipe being broken away at one end of Fig. 1, as shown. The pipe 39 has jet openings 40 on the under side (see Fig. 9) which are directed so that when the molds are open as at the left hand in Fig. 1, the exhaust air will be discharged upon the mold sections 12 and 13, thus chilling them quickly and also having a tendency to chill the metal which may be in one of the mold sections.

I wish it distinctly understood that I do not confine the invention to the particular arrangement of air pipes, as I claim to be the first to utilize the exhaust from a compressed air cylinder to chill a mold in the manner described.

From the foregoing description it will be seen that with the apparatus above described castings can be very rapidly made, and the casting operation continued, because of the peculiar means for working and chilling the mold, and in practice the cock 34 is actuated so as to close one set of molds, as at the right hand in Fig. 1, when the metal is poured into these closed molds, and then additional pressure can be applied so as to compress the metal in the molds to the desired extent, and it will be seen that at the first pouring when the molds and metal expand, the yielding pressure behind the molds will permit of expansion against such pressure, while the overlapping arrangement of the mold ends will permit endwise expansion. When the casting is completed and the compression finished, the piston in the cylinder 31 is moved in the opposite direction, thus closing the molds at the left hand of the machine and opening the molds at the right hand, while the exhaust is delivered upon the molds just opened in the manner already indicated.

In Fig. 3 I have shown a very simple form of machine in which, however, the principle is the same as already described. In this form the machine has a single mold formed of the sections 12 and 13, and the section 13 is reciprocated by the piston in the cylinder 31. The mold section is supported and guided as already described, but as stated there is simply one mold, and consequently the equalizing arrangement above referred to is not necessary. The exhaust pipe 38 is arranged over the mold and connects with a short pipe 39 having jet pipes 40^a delivering to the mold sections when the mold is

open. This makes a very simple construction which can be readily loaded and the casting made and discharged.

In Fig. 4 I have shown an arrangement like that in Fig. 3, except that the mold has a separable bottom 42 which fits up into the cavity of the mold, and thus makes the mold a three part one. The bottom 42 is mounted on a piston rod 43 which extends into the cylinder 44, and the piston in the cylinder can be worked as already described so that the casting can be compressed from three or more sides instead of two, but in practice I find that the arrangement previously described is entirely satisfactory. As shown in Fig. 4, the bottom 42 is shaped to enter the cavity between the two mold sections 12 and 13, so as to form a bottom to the mold when the latter is closed, and after the metal is poured in the mold and the two sections forced together, the piston rod 43 is forced up from the pressure in the cylinder 44 so that the metal is squeezed endwise between the bottom 42 and the top of the mold.

From the foregoing description it will be seen that I have provided a very simple means of casting metal under a very heavy pressure, that I have provided an elastic pressure which permits of the expansion of the mold, that the mold is a simple solid structure in which the parts themselves yield bodily against the elastic pressure, and that I am enabled to get unusually dense smooth castings and to produce them very rapidly.

I claim:—

1. An apparatus for the purpose described, comprising a separable mold having overlapping parts at the sides and ends arranged to provide for compression and expansion in all directions, and means actuated by an elastic pressure for forcing the mold sections together.

2. In a structure such as described, a two part mold shaped to form a closed chamber between the parts, one section of the mold having a top overlapping the sides of the opposed section, and the second section of the mold having the bottom overlapping the under sides of the first section, whereby the two sections can be moved freely together.

3. In an apparatus of the kind described, a two part mold comprising opposed sections, the first section forming two sides of the mold and having a fixed top overlapping the sides of the second section, and the second section forming two sides of the mold and having a fixed bottom overlapping the sides of the first section, whereby the sections can be moved freely together and can expand in all directions.

4. An apparatus for the purpose described, comprising a fixed mold section, a reciprocating mold section arranged opposite its fixed section, the said sections being arranged to overlap at the top, bottom, and

sides, and a piston and cylinder for actuating one of the mold sections.

5. In an apparatus such as described, the combination of opposed mold sections movable back and forth in relation to each other overlapping at the sides and ends and arranged when closed to expand in different directions, a guided support for one of the sections, and a piston and cylinder for actuating one of the mold sections.

6. An apparatus for the purpose described, comprising a plurality of molds spaced apart with relation to each other, each mold having an outer fixed mold section and an inner movable mold section, a cylinder and piston arranged between the opposed molds, and piston rods actuated from the piston of the cylinder and connected with the opposed movable mold sections, whereby said mold sections will move simultaneously to open one mold and close the other mold.

7. An apparatus for the purpose described comprising opposed molds, each mold having a fixed and a movable section, a cylinder and piston arranged between the two movable mold sections, and an operative connection between the cylinder piston and the mold sections by which one mold is opened and the other is closed.

8. An apparatus of the kind described comprising a series of fixed mold sections, a series of movable and complementary mold sections movable back and forth with relation to the fixed sections, and an equalizing device connecting adjacent movable mold sections, whereby an excess pressure on one section will be transmitted to the next connected section.

9. An apparatus such as described comprising a plurality of molds formed of opposed sections movable back and forth with relation to each other, and a lever connection between adjacent movable sections whereby a movement of one section against the lever will be transmitted to the next section, and the pressure on the two equalized.

10. An apparatus of the kind described comprising a series of fixed mold sections, a series of movable mold sections reciprocating back and forth with relation to the fixed sections, a cross head, a piston and cylinder for actuating the cross head, and a pivotal connection between the cross head and the adjacent mold sections whereby the pressure on adjacent molds is equalized.

11. An apparatus such as described comprising a series of fixed mold sections, a series of complementary movable mold sections, a sliding cross head, and tilting members mounted on the cross head and connecting adjacent movable mold sections.

12. An apparatus such as described comprising a series of fixed mold sections, each series being spaced apart from each other, plural series of movable mold sections complementary to and sliding back and forth with relation to the fixed mold sections, sliding cross heads arranged behind each series of movable mold sections, supports connecting the movable mold sections with the respective cross heads, a piston and cylinder located between the two cross heads, and an operative connection between the cylinder piston and the cross heads, whereby the two cross heads will be simultaneously but oppositely moved.

13. An apparatus of the kind described comprising opposed mold sections movable with relation to each other, an air engine for actuating the mold sections, and means for discharging the exhaust from the air engine upon the mold sections to cool the latter.

14. In an apparatus such as described, a two-part mold having overlapping sides, a top carried by one of the mold sections and overlapping the sides of the opposed mold section, and a bottom rigid on the second section and overlapping the bottom ends of the first section.

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