July 6, 1926. 1,591,330

C. E. LARSON ET AL

DENTAL CASTING MACHINE

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Fig. 1

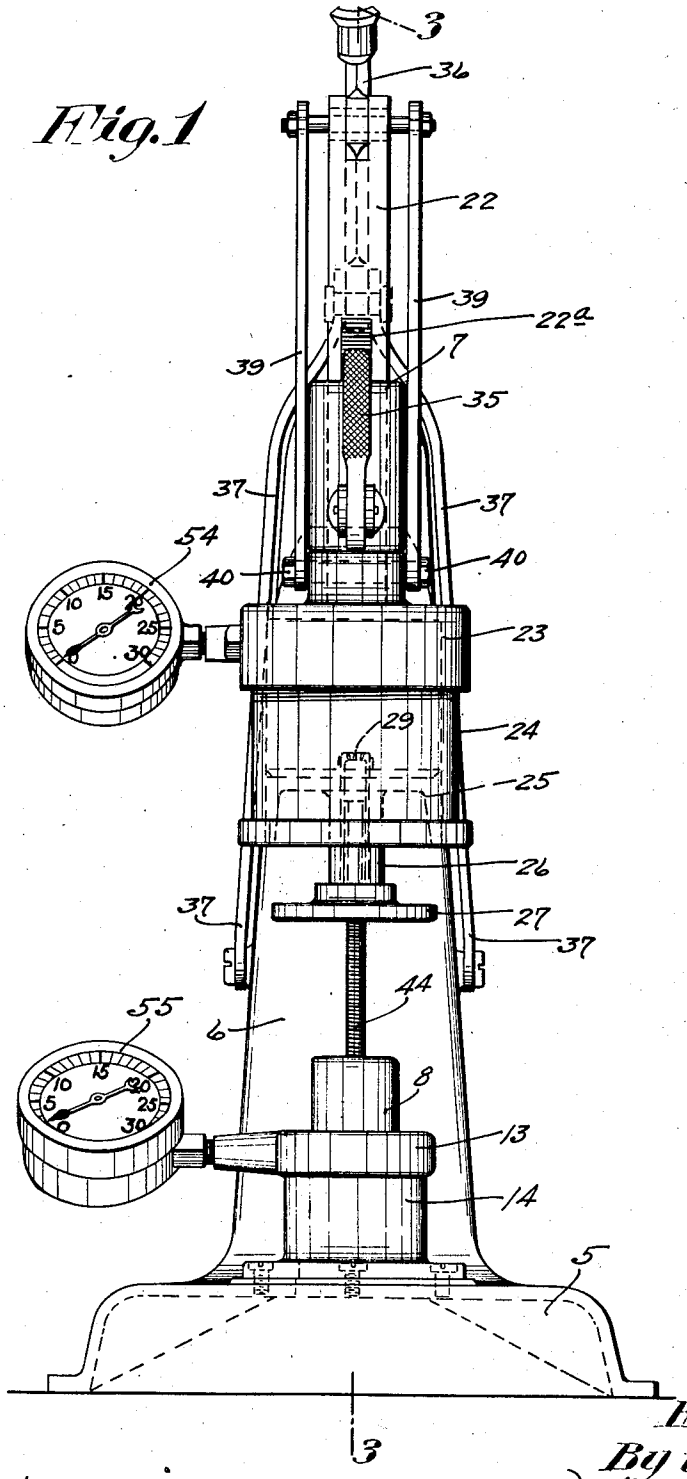

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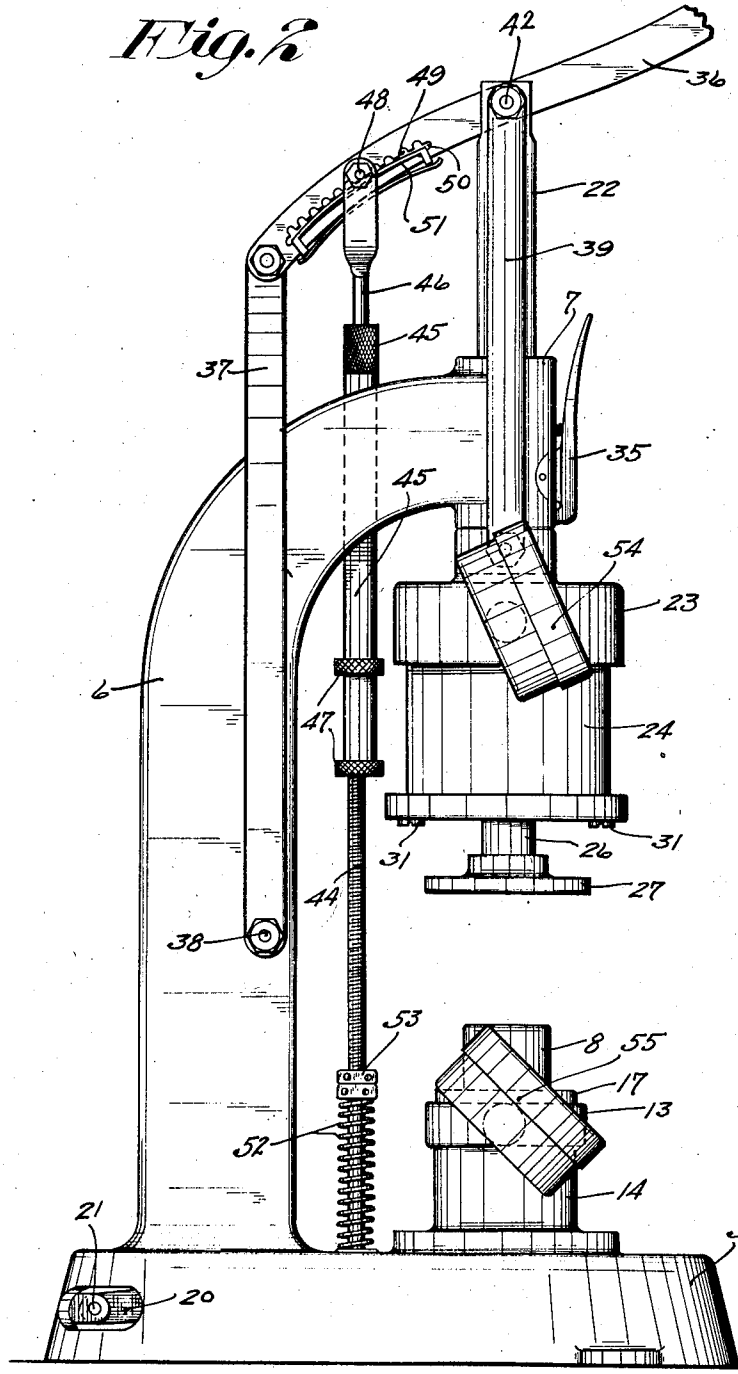
Fig. 2



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DENTAL CASTING MACHINE

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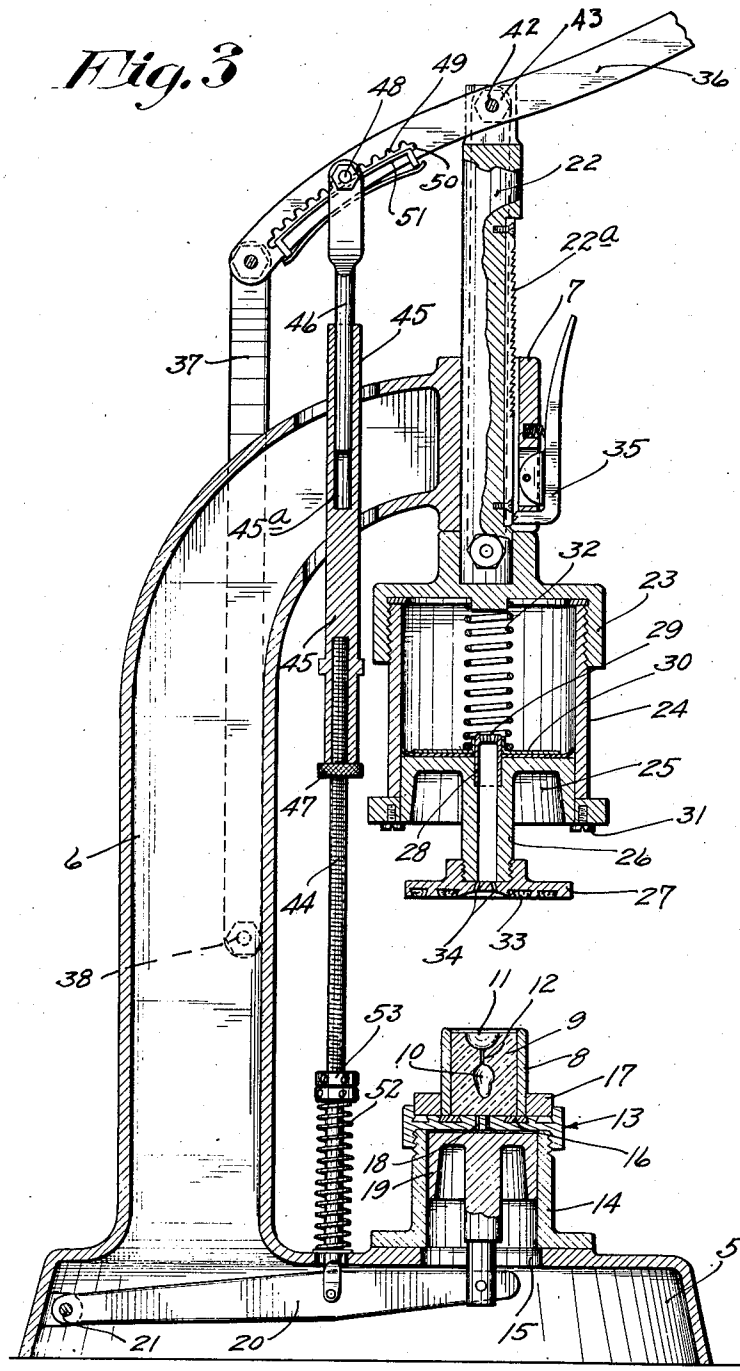
Fig. 3



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DENTAL CASTING MACHINE

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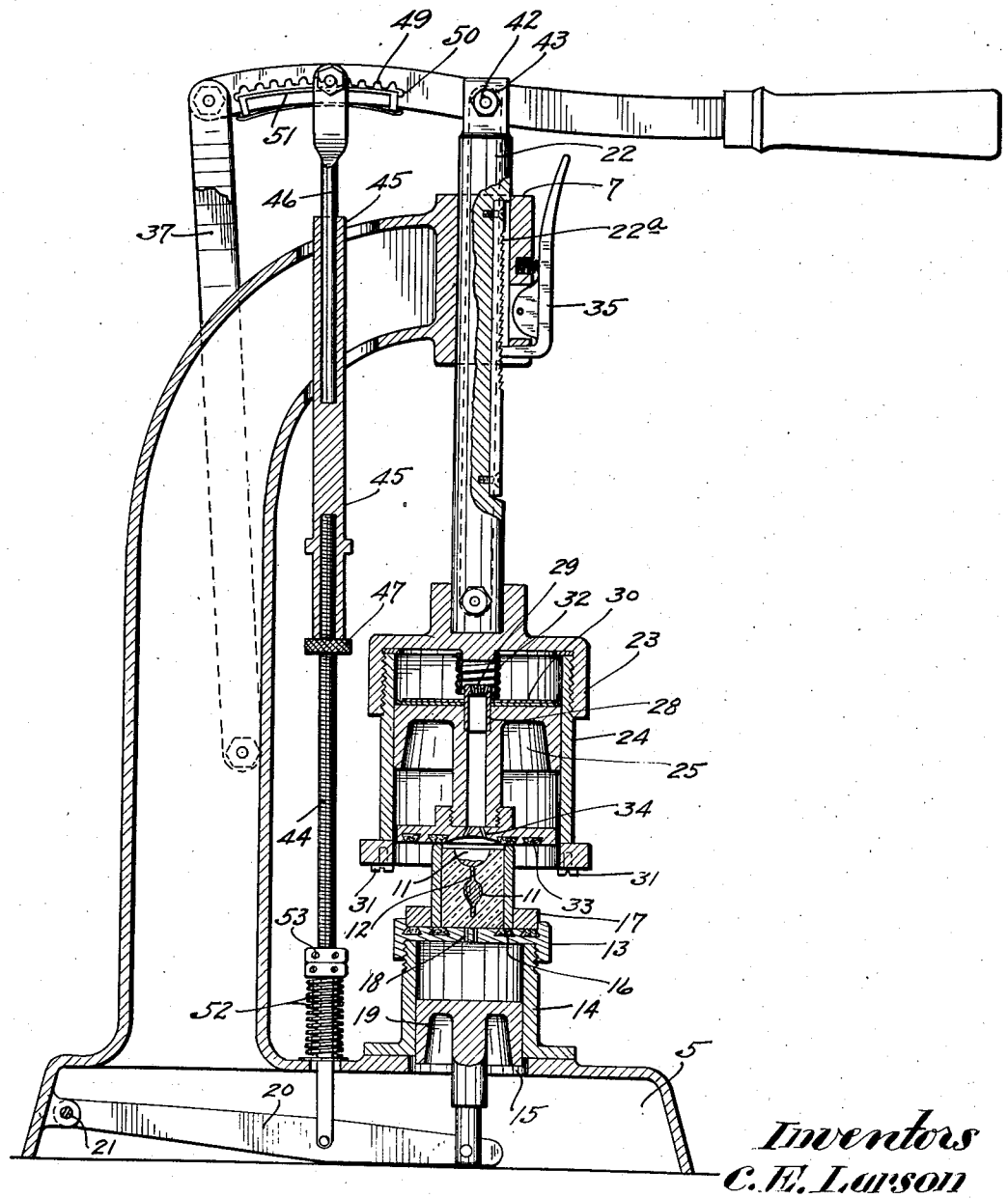
Fig. 4



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Patented July 6, 1926. 1,591,330

UNITED STATES PATENT OFFICE.

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DENTAL CASTING MACHINE.

Application filed January 28, 1925. Serial No. 5,373.

Our present invention relates to machines generally adapted for casting of metal bodies into molds, but, more particularly, to machines for casting small articles from the precious metals. More specifically considered, the machine is especially adapted for use in the dental profession to cast inlays, crowns, bridges, and the like, and for the casting of jewelry. In the casting of dental inlays, for example, great accuracy and uniformity is required in the molding operation.

It is the general practice to form the molds for dental inlays and the like in a special investment material of such fine porosity that metal will not enter the pores thereof but air under pressure will pass quite slowly through such investment material. In practice, it has been found that, by the use solely of air under pressure, the best casting results cannot be accomplished because air pockets are liable to be formed in the mold cavity, and if too great pressure is used or the pressure is too suddenly applied, the investment material is liable to be fractured. We have found, however, that by subjecting the investing material, during overlapping intervals of time, to the action of partial vacuum, tending to draw the molten metal toward the bottom of the bowl, and to the action of air under pressure, tending to force the molten metal down into the mold, substantially perfect inlays or the like may be produced.

For accomplishing the above results, we provide an air compressor, preferably in the form of a cylinder and piston, and a vacuum-producing device, also preferably in the form of a cylinder and piston, and in connection therewith, provide an operating device, preferably in the form of a lever, by means of which the functions above stated may be produced.

A commercial form of this improved casting machine is illustrated in the accompanying drawings, wherein like characters indicate like parts throughout the several views.

Referring to the drawings:

Fig. 1 is a front elevation of the improved machine;

Fig. 2 is a left side elevation of the machine;

Fig. 3 is a vertical section taken on the line 3—3 of Fig. 1; and

Fig. 4 is a view corresponding to Fig. 3, but showing the machine operative to simultaneously produce air compression and partial vacuum and to render the same effective on the mold within the flask, as above outlined.

The frame of the machine is preferably a hollow casting involving a base 5 and a pedestal 6, the upper end of which latter is forwardly curved and terminated in a vertical bearing sleeve 7.

The flask 8, which, as shown, is a cylindrical ring, frequently designated as an investment ring, is filled with the investment material 9 formed with a mold cavity 10 and fusing cavity 11, said mold cavity and fusing cavity being connected in the customary way by a hollow passage, usually designated as a sprue 12. In the construction illustrated, the flask 8 is seated on a combined cylinder head and flask base 13 that is screwed onto the upper end of a lower cylinder 14, which, in turn, is bolted or otherwise rigidly secured to the base 5 with its open lower end aligned with a clearance passage 15 formed in the latter. As an important feature, the lower end of the flask 8 is directly seated on a packing ring 16, preferably of braided steam packing tightly pressed into a dove-tailed annular groove formed in the head 13. Preferably also, the head 13 is formed with several of the dove-tailed annular grooves filled with packing material and arranged, one packing ring for each size of flask to be used. The head 13 has an upstanding annular flange within which is seated a centering ring 17 that fits closely around the flask or ring 8 and properly centers the same. For each flask of varying diameter there would be provided a spacing ring 17 fitting around the same by fitting within the flange of the head 13.

One or more, preferably several, small air ports 18 are formed in the head 13 to connect the upper end of the cylinder 14 to the lower inner portion of the flask 8. Working within the cylinder 14 is a piston 19, the stem of which depends through the clearance passage 15 and, as shown, is connected to one end of a lever 20, the other end of which is pivoted at 21 to a lug on the interior of the base 5. As will presently appear, the cylinder 14 and piston 19 constitute the vacuum-producing device, that is, the device for producing partial vacuum.

Working vertically through the bearing sleeve 7, in axial alignment with the cylinder 14 and flask 8, is a plunger 22, the lower end

of which is rigidly secured to the head 23 of an upper cylinder 24. Working within the cylinder 24 is a piston 25, which, as shown, has a depending tubular stem 26 to which is rigidly secured a disk-like flask cover 27. As shown, a thin metal thimble 28 is pressed into the bore of the upper portion of the stem 26 and is provided at its upper end with one or more, preferably several, small air ports 29. The upper end of the thimble 28 terminates above a leather packing disk 30 carried by the top of the piston 25. The piston 25 is normally held at the lower end of the cylinder 24 and against stop screws 31, partly by the action of gravity and partly by the action of a coiled spring 32.

The flask cover 27, preferably and as shown, is made as an element separable from the piston 25 and it is provided with concentric packing rings 33 set into annular dove-tailed grooves and corresponding in their diameter and general purpose to the packing rings 16, before described, except that the said packing rings 33 are engageable with the upper ends of the flask to form air-tight joints therewith. One or more, preferably several, small air ports 34 are formed in the central portion of the cover 27 and are arranged to deliver air under compression from the cylinder 24 to the upper portion of the flask in the casting operation hereinafter described.

For holding the plunger 22 and the parts carried thereby in depressed positions for reasons that will fully appear in the description of the operation, there is provided a pawl and ratchet latch. This latch, as shown, comprises a ratchet-toothed steel bar 22^a set into and rigidly secured to the plunger 22, and a spring-pressed latch dog 35 pivoted to the sleeve 7 with its beveled end working through a notch in the latter and engageable with the teeth of the bar 22^a.

The operating device shown is in the form of a lever 36 pivotally connected at one end to the upper ends of a pair of links 37, extended one on each side of the pedestal 6 and at their lower ends pivotally anchored thereto at 38.

The intermediate portion of the lever 36 is connected to the plunger 22, and this may be done in different ways but, preferably, it is accomplished through laterally spaced links 39. These links 39, at their lower ends, are pivoted on a nut-equipped bolt 40 that is passed through the hub of the cylinder head 23 and the lower end of the plunger 22 and performs the additional function of securing said cylinder head to said plunger. The upper ends of the links 39 are secured by nuts or otherwise to the ends of a cross rod 42. The upper end of the plunger 22 is bifurcated so that it embraces the lever 36. The lever 36 is pivoted on the central portion of the cross rod 42 and said cross rod is passed with a large amount of clearance through holes 43 formed in the prongs at the upper end of the plunger 22. With this arrangement, the lever 36 does not directly act upon the plunger 22 but indirectly acts thereon through the links 39 and applies its downward pressure thereto at the lower end of said plunger and at a point below the bearing sleeve 7.

The lever 36 has a connection for operating the piston 19 through the lever 20. This connection performs not only the major function indicated but also highly important minor functions and, as designed to carry out all of these functions, comprises as follows: a connecting link made up of three main elements 44, 45 and 46. The element 44 is a screw-threaded rod, which, at its lower end, works through a passage in the top of the base 5 and is pivotally connected to the intermediate portion of the lever 20. The upper end of the rod 44 is screwed into the lower end of the intermediate section 45 and is adjustably secured by a lock nut 47. The upper section 46 is telescoped into an axial bore 45^a formed in the upper portion of the section 45, so that said section 46 acts as a plunger. The upper end of the plunger 46 is bifurcated so that it embraces the lever 36 and its bifurcated end is provided with a sort of wrist pin 48 that is engageable with any one of several notches 49 formed in the upper side of the long slot 50 provided in said lever adjacent to its pivoted end. A leaf spring 51 is secured to the lever 36 and follows the slot 50, so that it yieldingly holds the wrist pin 48 engaged with the notch 49 in which it is positioned. By a slight depression of the spring 51, the wrist pin 49 may be readily shifted into engagement with any one of the said notches 49.

The numeral 52 indicates a coiled spring that surrounds the lower portion of the rod 44 and is compressed between the base 5 and lock nuts 53 on said rod. This spring 52 normally holds the piston 19 raised to the position shown in Fig. 3, but it also performs another important function, which will appear in the description of the operation.

The numeral 54 indicates a pressure gauge connected to the cylinder 24, and the numeral 55 indicates a vacuum gauge that is connected to the cylinder 14.

Operation.

The operation of this machine for casting is substantially as follows:

Normally, the parts all stand as shown in Fig. 3. The metal, by means of a blowpipe or otherwise, will be melted within the fusing cavity 11, but under the action of gravity, no part of this molten metal will run

into the mold 10 through the small sprue 12. The metal being properly fused within the cavity 11, the operator moves the lever 36 downward, thereby producing the following actions, preferably in the order of sequence just to be stated.

Downward movement of the lever 36, of course, carries the cylinder 25, the piston 24 and the flask cover 27 toward the flask 8. Slightly before the cover 27 engages the top of the flask 8, the plunger 46 will strike the bottom of the bowl 45ª and thereby cause the entire link 44—45—46 to move downward as a unit and thereby impart a downward movement to the piston 19. This initial downward movement of the piston 19 will produce a partial vacuum in the upper portion of the cylinder 14 and, hence, commence the downward drawing action on the molten metal before the air pressure is applied to the top of the flask, and this draws from the flask certain gases as well as the air from the mold 10. Immediately following this initial suction or partial vacuum-producing action, the flask cover 27, under continued downward movement of the lever 36, will tightly seal itself against the top of the flask, thereby stopping further downward movement of the piston 25, so that continued downward movement of the cylinder 24 will produce air pressure which will be delivered through the tubular stem 26 and ports 34 directly against the upper portion of the investment material 9 and against the upper portion of the molten metal in the fusing cavity 11. It will thus be seen that the action of partial vacuum and air pressure are then brought into action on the investment material and the molten metal, the former tending to suck or draw the molten metal down into the mold and the latter tending to press the same downward into the mold. The extent to which the above actions will take place will be regulated by the extent to which the lever 36 is forced downward. The operator watching the gauges 54 and 55 can readily determine when the proper pressure and vacuum have been produced, and will then stop further pressure on the lever, at which point the dog 35, engaging the ratchet bar 22ª, will lock the plunger 22, cylinder 24 and flask cover 27 in their lowered operative positions shown in Fig. 4. The above action does not produce a sudden shock or high pressure within the flask, but there will be a comparatively slow but continued flow of the compressed air from the cylinder 24 downward through the investment material until the pressures in the pressure cylinder 24 and vacuum cylinder 14 have been equalized. During the time that the equalization of pressure is taking place, the metal will be forced into the mold, caused to completely fill the mold and to solidify. The suction action produced by the partial vacuum removes the gases and air from the investment material and mold and effectually eliminates all air pockets and resulting flaws in the casting, and for that reason, as we have found in practice, it is advisable to render the partial vacuum or suction action slightly in advance of the delivery of compressed air onto the molten metal. Of course, the time interval between the two actions noted is very short and, moreover, it may be varied by adjustments of the link sections 44 and 45, the one in respect to the other. By the latch dog 34, the depressed elements may be held down as long as desired and until it is certain that the casting has properly crystallized or set. If, at any time during the setting operation above described, the gauges should indicate a drop in the air pressure, additional pressure may be instantly applied by giving the lever 36 a slightly farther downward movement.

Preferably, the spring 52 is of such tension that it will hold the piston 19 raised at any time the machine is not in use and, in fact, would hold said piston against downward movement even if an adjustment should be made wherein the air pressure was delivered to the flask in advance of the partial vacuum and until the lever 20 is given a positive downward movement through the mechanical connections described. It is further highly important to note that, in this machine, the vacuum-producing device made up of the cylinder 14 and piston 19, is located immediately below and adjacent to the flask and that, in the normal position of the parts, there is practically no air-containing space between the piston 19 and the flask and from this, it follows that the initial downward movement of the piston 19 will instantly produce or start suction or partial vacuum in the flask, and from this, it also follows that very slight movement of the piston 19 is required to produce the desired partial vacuum or suction. It is further important to note that this machine, by the manipulation of a simple operating device or lever, is caused to produce its own air pressure and partial vacuum. Otherwise stated, this machine is a self-contained machine that requires no connections to or association with an air storage tank or other source of air supply. Moreover, the machine is capable of being easily manipulated to accurately produce any desired pressure. A person using the machine will soon be able to predetermine or know approximately the pressure that will be required to best produce any particular kind of casting and the gauges will indicate when such predetermined or desired pressures have been produced.

As already indicated, adjustments of the link sections 44 and 45 will determine the

relative times of bringing the vacuum-producing and air-compressing devices into action, and it has also been noted that the said air-compressing and vacuum-producing devices will be continued in action during overlapping intervals of time, and during which time the casting will be formed and caused to crystallize or set. The amount of vacuum that will be produced for a predetermined downward movement of the lever or operating device 36 may be varied by adjustments of the wrist pin 48 in the notches 49 of the lever 36, and it may be further stated that the closer the pin 48 is set to the pivot 37, the less will be the partial vacuum produced and, conversely, the farther the pin 48 is set from the pivot 37, the greater will be the partial vacuum produced. Of course, adjustments of the pivotal connection between the plunger 46 and the lever 36 will require re-adjustments of the sections 44 and 45 to set the vacuum-producing and air-compressing devices, the former for action in advance of the latter.

It will be noted that in this machine, the air compressor afforded by the described cylinder and piston is a complete or self-contained expansible and contractible air compressor having its own and enclosed air-containing chamber. Moreover, it will be noted that this air compressor is located immediately above the flask, so that the heat applied to melt the metal in the mold will rise and preheat the air in the said chamber. This preheating of the air is important because, when the air-compressing action takes place, hot dry air will be forced against the metal in the mold.

What we claim is:

1. A casting machine comprising a complete or self-contained air compressor and a vacuum producer in opposing arrangement and adapted to engage and close an interposed flask containing an investment material in which a mold is formed and an operating device having a connection for throwing said air compressor and vacuum producer into action during overlapping intervals of time.

2. A casting machine comprising a complete or self-contained air compressor and a vacuum producer in opposing arrangement and adapted to engage and close an interposed flask containing an investment material in which a mold is formed, and an operating device having a connection for throwing said air compressor and vacuum producer into action during overlapping intervals of time, but with the action of the latter started ahead of the former.

3. The structure defined in claim 1 in further combination with a latch operative to hold said air compressor and vacuum producer set for predetermined actions.

4. The structure defined in claim 2 in further combination with a latch operative to hold said air compressor and vacuum producer set for predetermined actions.

5. A casting machine comprising a flask for containing the investment material in which a mold is formed, an expansible and contractible pressure-producing device and a vacuum-producing device, the former arranged to deliver compressed air to said flask and the latter arranged for drawing air from said flask, and an operating device having connections for operating said two devices with an overlapping interval of action, whereby metal in the flask will be simultaneously subjected to air pressure on one side and to vacuum on the other side.

6. A casting machine comprising a flask for containing the investment material in which a mold is formed, a pressure-producing device comprising a cylinder and piston, a vacuum-producing device comprising a cylinder and piston, the piston of said pressure-producing device having a flask cover and an air port for delivering air pressure into the flask, and the cylinder of said vacuum-producing device having a portion affording a flask base and provided with an air port for drawing air from the flask, and an operating device having connections for moving the cylinder of said pressure-producing device and the piston of said vacuum-producing device, whereby the metal in said mold will, during an overlappng interval, be subjected to air pressure on one side and vacuum on the other side.

7. The structure defined in claim 5 in further combination with means for throwing said pressure-producing device and vacuum-producing device into action and for setting the same in action, the one under predetermined air pressure and the other under predetermined vacuum pressure.

8. A casting machine comprising means for supporting a flask that is open at both ends and contains a porous mold-forming investment material, a complete self-contained air compressor and a vacuum producer in opposing arrangement and adapted to engage and close the opposite ends of said flask, and means for operating said air compressor and vacuum producer and for renderng the same active on the investment material in said flask during overlapping intervals of time.

9. In a casting machine, a supporting frame, a vacuum-producing cylinder and piston, the former being anchored to the base of said frame and provided with a head affording a flask base, a flask seated on said base and containing an investment material in which a mold is formed, said cylinder head having a port connecting said cylinder to the lower portion of said flask, a plunger mounted to move through the upper portion of said frame in substantial align-

ment with said lower cylinder, a pressure-producing cylinder and piston, the former being secured to the lower end of said plunger and the latter having a flask cover and a port for delivering air from said latter noted cylinder into the upper portion of said flask, and a lever having connections for moving said lower piston, to produce partial vacuum and for moving said plunger, upper cylinder and piston, to produce a compression of air to be delivered into said flask when said flask cover is seated on said flask.

10. The structure defined in claim 9 in combination with means for latching said plunger, upper cylinder and piston in a depressed position to thereby maintain the air pressure in the upper cylinder and the partial vacuum in the lower cylinder during an overlapping interval of time.

11. The structure defined in claim 1 in which said operating connection is adjustable to vary the relative tension of throwing said air compressor and vacuum producer into action.

12. The structure defined in claim 1 in which said operating connection is adjustably attached to said operating device for varying the extent of partial vacuum produced by said vacuum producer.

13. The structure defined in claim 1 in which said operating connection includes a lever and several telescoped elements, one of which telescoped elements has a limited sliding movement, the other part of said connection being spring-retracted.

14. In a casting machine, the combination with a frame including a base and pedestal, of a vacuum-producing device comprising a cylinder and piston, the former being secured to said base and having a head affording a flask-supporting base, said head having an air passage, a lever connected to said base and to said piston, a plunger working through the upper portion of said pedestal substantially in axial alignment with said cylinder, an air compressor comprising a cylinder and piston, the former being secured to the lower end of said plunger and the latter having an air discharge passage and a flask cover, an operating lever connected to said pedestal and plunger and operative to vertically move said plunger and parts carried thereby, and a link connecting said operating lever to said lower lever for operating the piston of said vacuum device.

15. The structure defined in claim 14 in which said plunger is provided with ratchet teeth, and in further combination with a latch dog mounted on the upper portion of said pedestal and operative on said ratchet teeth to hold said air compressor and vacuum producer set.

16. The structure defined in claim 14 in which said link is longitudinally adjustable and has a loose plunger section capable of a limited downward movement before it is brought into action.

17. The structure defined in claim 14 in which the upper end of said link is adjustably connected to said operating lever at points varying in distance from the lever pivot.

In testimony whereof we affix our signatures.

CHARLES E. LARSON.
ERICK ROSENDAHL.