S. ENOMOTO.

APPARATUS FOR CASTING METAL UNDER PRESSURE.

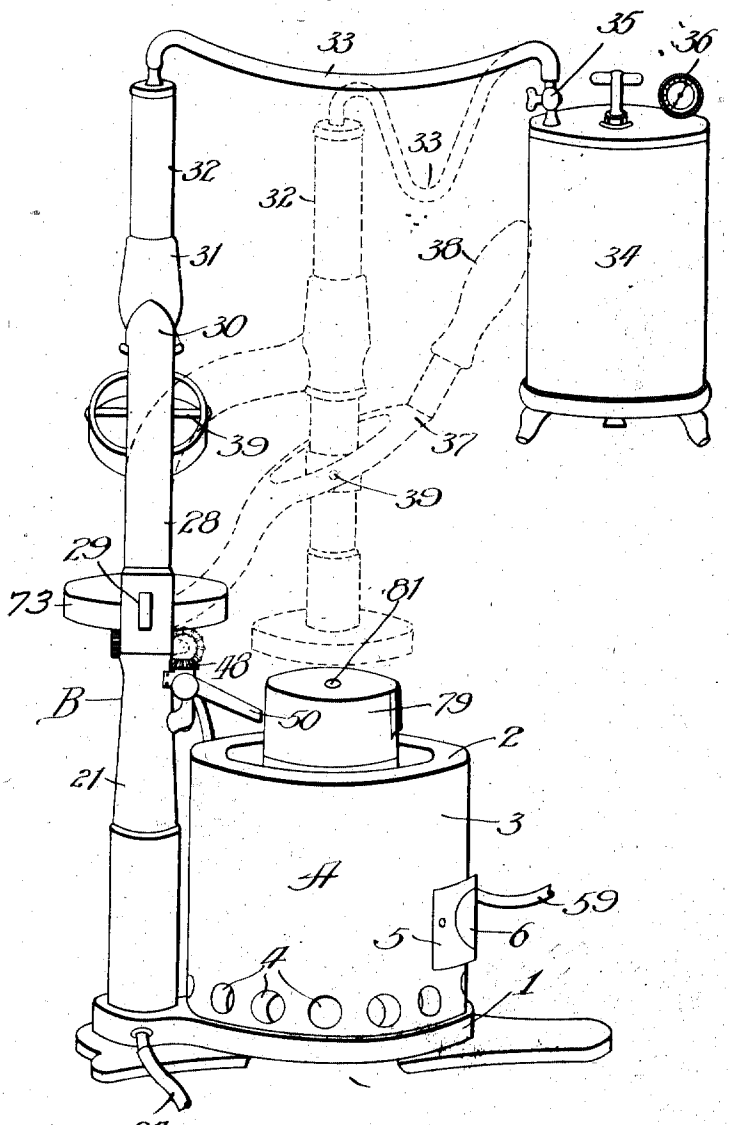
APPLICATION FILED JUNE 11, 1910.

1,001,005.

Patented Aug. 22, 1911.

5 SHEETS—SHEET 1.

Fig. 1.



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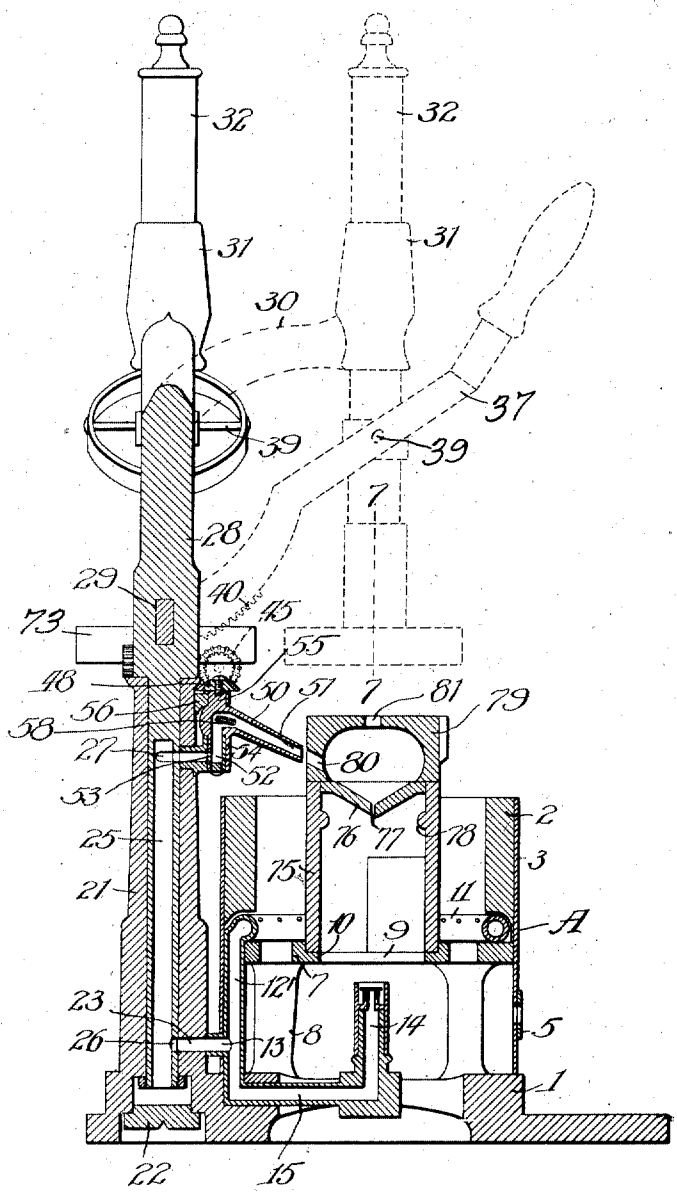
5 SHEETS—SHEET 2.

Fig. 2.



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5 SHEETS—SHEET 3.

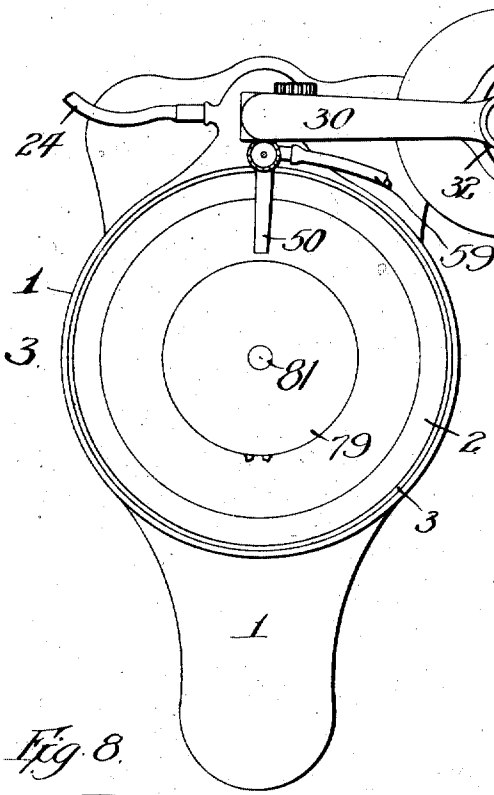


Fig. 3.

Fig. 15.

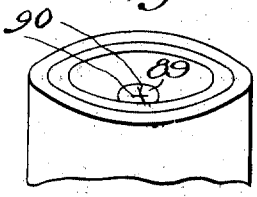


Fig. 14.

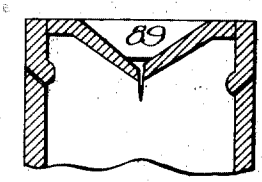
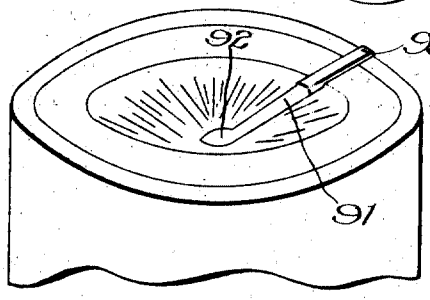


Fig. 8.



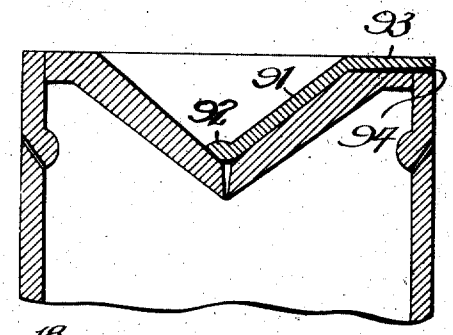


Fig. 9.

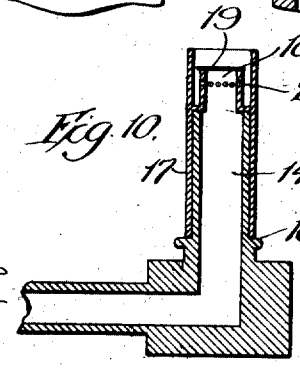


Fig. 10.

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5 SHEETS—SHEET 4.

Fig. 7.

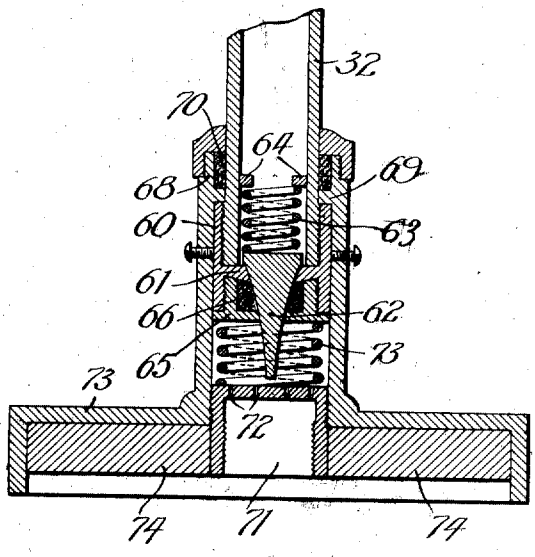


Fig. 4.

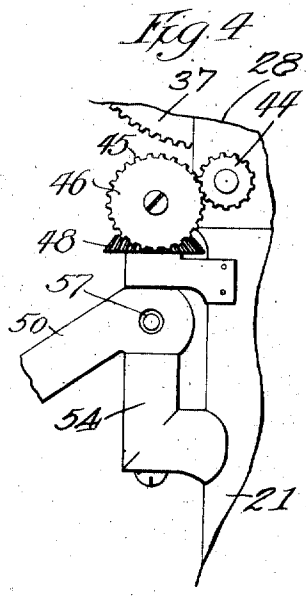
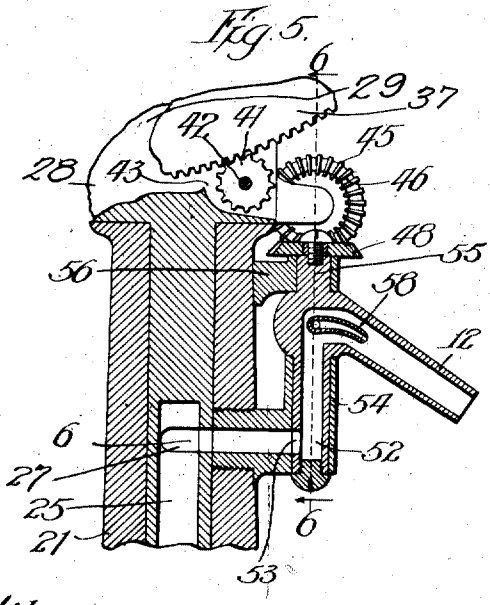


Fig. 5.



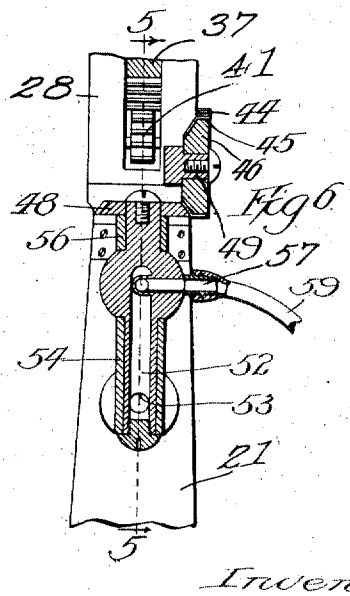


Fig 6.

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APPLICATION FILED JUNE 11, 1910.

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5 SHEETS—SHEET 5.

Fig. 11

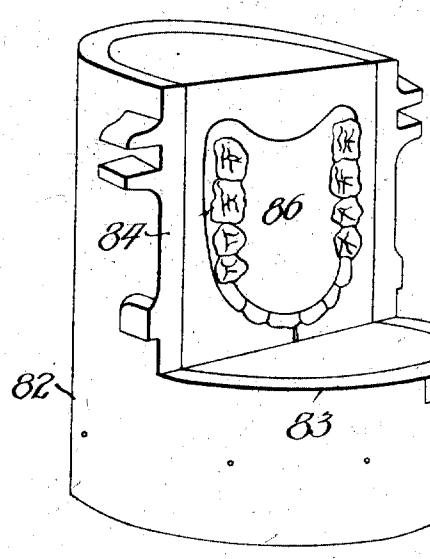


Fig. 12

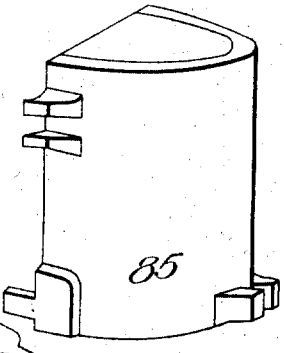
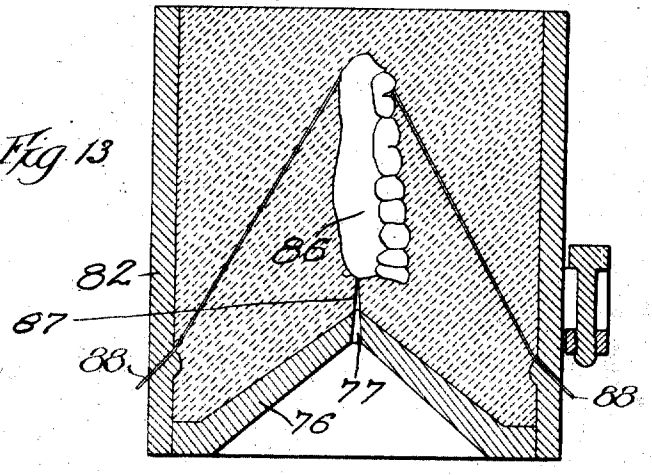


Fig. 13



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UNITED STATES PATENT OFFICE.

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APPARATUS FOR CASTING METAL UNDER PRESSURE.

1,001,005. Specification of Letters Patent. Patented Aug. 22, 1911.

Application filed June 11, 1910. Serial No. 566,400.

To all whom it may concern:

Be it known that I, SEKIICHI ENOMOTO, a subject of the Emperor of Japan, residing at No. 11 Imairi-Cho Shibaku, Tokyo, Japan, have invented a certain new and useful Improvement in Apparatus for Casting Metal Under Pressure, of which the following is a specification.

This invention relates to apparatus for casting precious and light metals such as gold, silver, or aluminum, and is particularly designed for small work and where accuracy and high finish are desired.

One of the objects of my invention is to provide an apparatus whereby the molten metal is forced into the mold cavity under pressure.

The invention will be more fully described in connection with the accompanying drawings and will be more particularly pointed out and ascertained in and by the appended claims.

In the drawings:—Figure 1 is a view in side elevation of an apparatus embodying one form of my invention. Fig. 2 is a similar view with lower parts thereof in section. Fig 3 is a plan view. Fig 4 is a fragmentary side elevation of a portion of a blow pipe and the actuating means therefor. Fig. 5 is a sectional view on line 5—5 of Fig. 6. Fig. 6 is a sectional view on line 6—6 of Fig. 5. Fig. 7 is a vertical sectional view on line 7—7 of Fig. 2. Fig. 8 is a perspective view of a portion of one form of flask. Fig. 9 is a vertical sectional view thereof. Fig. 10 is an enlarged sectional view of one of the burners in the furnace. Fig. 11 is a perspective view of one form of flask with a portion thereof removed. Fig. 12 is a perspective view of the removed portion. Fig. 13 is a vertical sectional view of the flask with the pattern therein. Fig. 14 is a sectional view of the flask with the gate closed by mica or like material. Fig. 15 is a perspective view of the flask showing the mica slit in the form of a cross.

Like characters of reference designate similar parts throughout the different figures of the drawings.

As shown the invention includes a casting furnace indicated as a whole at A. A supply regulating device is indicated as a whole at B.

In the further description of the invention reference will first be had to the furnace A, exclusive of the flask and its appurtenances, and secondly to the supply controlling apparatus B. Thirdly the flask and its appurtenances will be described to show the relation of the combination of mechanism.

Referring to Fig. 2, the furnace A is mounted upon a base 1 and is provided with a wall 2, of suitable material, and an outer casing 3, which is preferably of metal. The casing 3 is provided with a plurality of air inlet holes or openings 4 and also with a door 5 having a suitable observation opening 6 closed by mica or the like. Within the furnace there is provided a suitable flask support 7 resting upon uprights 8 which latter project upwardly from the base 1. The flask support 7 is provided with an opening 9 and a suitably recessed portion 10 upon which latter the flask may be mounted. Suitable burners are provided in the furnace, and in the construction shown, a burner ring 11 is mounted upon the support 7 and extends about the furnace. A supply pipe 12′, for the ring 11, extends downwardly therefrom and connects with an extension 13. The burner ring 11 is arranged to heat the exterior of the flask and an additional burner 14 is arranged below the support 7 and the flask and delivers upwardly and centrally toward the flask. The burner 14 is connected with a pipe 15 which likewise terminates at the extension 13. As shown in Fig. 10 the burner 14 comprises an inner tube provided with a shoulder 16. An outer burner portion 17 fits over the inner portion and is provided with an inclosed burner proper, 18, disposed below the upper end of the outer member 17. A cap 19 prevents material from falling into the inner portion of the burner 14. Suitable outlets 20 provide egress for the flame.

The supply controlling apparatus or device comprises an upright 21 extending upwardly from the base 1 and provided with a bore which may be closed at its lower end by a plug 22. Said upright is provided with a passage 23 forming a communication between the bore and the extension 13. A suitable source of supply of gas or other combustible material is conveyed to the upright 21 by a pipe or hose 24. The regulating apparatus includes a rotatable member comprising a lower tubular portion 25, rotatively mounted in the bore of the upright 21 and provided with an opening 26 for automatically closing and opening the passage 23 to control the supply to the burners 11

and 14. Near the upper end of the lower hollow portion 25 there is provided an opening 27, preferably elongated, to afford a supply of fuel to a blow-pipe, now about to be described. The upper portion 28 of the controlling device is provided with an opening 29 for an operating lever and a bracket 30 provided with a tubular guide 31 in which an air pipe 32 is slidably mounted. The air pipe 32 communicates by a flexible connection 33 with a source of supply of air or other pressure mediums in the reservoir 34. A suitable valve 35 may be provided for controlling egress of the pressure medium from the reservoir 34. A gage 36 is provided on the reservoir to indicate the pressure therein. An operating lever 37 is provided with a handle portion 38 and is pivotally mounted at 39 to the air or other pressure pipes 32. The free end of said lever 37 is provided with teeth 40 and is slidably mounted in the opening 29. The teeth 40 engage with a pinion 41 mounted upon a shaft 42, the pinion being disposed in a recess 43 in the upper portion 28. On the outer end of the shaft 42 is mounted a pinion 44 which meshes with spur teeth 45 on a pinion 46. The pinion 46 also has bevel teeth 47 which mesh with a bevel pinion or gear 48. The gear wheel 46 is mounted upon a stud shaft 49 secured in any desirable manner to the upper part 28.

A blow pipe is indicated at 50 and is preferably in the form of an elbow having a discharge end 51 and an intake end 52. The intake end is provided with an opening 53 for admitting the fuel thereto and is mounted in a tubular bearing 54 secured to the standard 21. The bearing 54 extends into the standard 21 and forms a communication between the opening 27 and the opening 53. The upper end of the blow pipe is provided with a journal 55 mounted in a bearing 56 which latter is secured to the upright 21. The bevel 48 is secured to the journal 55 to rotate the same. An air supply is provided for the blow pipe and as shown the same is in the form of an extension 57 projecting laterally from the blow pipe between the bearings thereof. The extension 57 is provided with a discharge end 58 located within the blow pipe and discharging in the direction of discharge of the gases from the blow pipe.

It will be seen from the foregoing that the controlling device may be rotated in the upright 21 without cutting off the supply from the blow pipe although rotation serves to cut off the supply to the burners 11 and 14. When the lever 37 is operated the gearing, just described, serves not only to rotate the blow pipe but cut off the supply of fuel thereto. To effect proper combustion in the blow pipe a suitable supply of air may be supplied through a flexible connection 59.

I will next describe an automatic form of nozzle for admitting pressure during the casting operation and reference will be had to Fig. 7.

In the form shown a sleeve 60 is threaded on to the lower end of the pipe 32 and is provided with an annulus 61 through which a tapering valve 62 projects. The head of the valve seats on top of the annulus 61 and the opening of the latter forms one of the seats for the valve. The valve 62 is maintained in a closed position upon its seat by a spring 63 interposed therebetween and the lugs 64 on the pipe 32. A cap 65 has threaded engagement with the sleeve 60 and is provided with an opening through which the valve 62 projects. A suitable packing 66 is inclosed by the cap 65 and surrounds the valve 62. The nozzle 67 is provided with a sleeve 68 which extends upwardly about the parts just described, and which is provided with an inwardly projecting shoulder 69 adapted for engagement with the upper end of the sleeve 60 to limit downward movement of the nozzle with respect to the pipe 32. A packing flange 70 forms an air-tight joint between the pipe 32 and the sleeve 68. A thimble 71 is threaded into the lower end of the nozzle and is provided with a plurality of openings 72. In order to maintain the parts in the position shown and to provide for yielding movement of the nozzle upwardly with respect to the pipe 32 a spring 73 is interposed between the cap 65 and the upper ends of the thimble 71. An imperforate part of the upper wall of the thimble 71 is arranged for engagement with the lower end of the valve 62. The lower end of the nozzle is preferably enlarged as at 73 and may be provided with suitable packings, as at 74, for obtaining an air tight juncture with the part to which pressure is to be supplied.

A flask 75 is mounted upon the support 7 and is provided with a removable gate 76. The gate 76 is provided with an opening 77 and a flask is also provided with an annular shoulder 78 for retaining the investment material. Superimposed upon the flask 75 and the gate 76 is a hinged reflection cap 79 provided with an opening 80 shown disposed abreast of and in receiving relation to the blow pipe discharge 51. An air hole 81 is arranged in the top of the cap 79 and in the side thereof is a grooved portion 82 for reception of a suitable handle for removing the cap 79. When the lever 37 is moved downwardly the packing 74 engages the cap 79 and arrests movement of the nozzle so that upon continuous movement of the pipe 32 the valve 62 is brought into engagement with the imperforate part of the thimble 71. This action, against the resistance of spring 73, unseats the valve 62 against the action of the spring 63 and allows the

pressure to flow through the opening 81 into the cap 79. Downward movement of the levers 37 through the gearing hereinbefore described also turns the blow-pipe in its bearing so that the supply of fuel thereto is cut off. I will next describe the construction of the flask and the manner in which the mold is prepared for casting, reference being first had to Figs. 12 to 14.

In the form of flask herein illustrated one side thereof, 82, is divided on a horizontal line at 83 and on a vertical line at 84. The separable part is indicated at 85. Suitable means may be provided for securing the parts 82 and 85 together. The cask is inverted as shown in Fig. 14, and the part 82 is filled with a suitable investment material, as illustrated, and a pattern indicated at 86, is set in the soft material in the desired position. The gate 77 is joined to the pattern by wax, as indicated at 87. The part 82 is provided with a plurality of air discharge openings 88 and waxed threads or other suitable combustible material, is disposed from the openings 88 to the pattern 86 and extended through the investment material, as shown in Fig. 14. The part 85 is next secured to the part 82, as shown in Fig. 14, and the part 85 is filled with investment material from its uppermost end.

When the investment material hardens to some extent the inverted cask is disposed upon the support 7, as shown in Fig. 2 with the gate 77 disposed downwardly as indicated in Fig. 14. With the regulating device in the position shown in Fig. 2 in full lines the opening 26 permits a flow of fuel to the burners and the cask and its contents are slowly heated. The wax pattern melts as the result of the high temperature, and runs out of the gate 77. The waxed threads extending out of the openings 88 also melt thereby leaving air vents connecting the mold cavity with the exterior of the flask. Any wax that fails to run out will of course be entirely eliminated as the temperature rises.

After the pattern has been melted and eliminated so that a mold cavity is formed in the flask the latter, is inverted, with the gate 77 in the position shown in Fig. 2. The gate 76 now forms a cavity or crucible for receiving the metal. Preferably immediately above the gate opening 77 I place a sheet of mica 89 as shown in Figs. 14 and 15. The mica is provided with a plurality of slits 90, which may as shown be crossed, and the metal is disposed upon the mica. The heat reflection cap 79 is placed in position as shown in Fig. 2 with the opening 80 in alinement with the blow pipe 50. The lever 37 is in an upper position and also in the full line position as shown in Fig. 2 thereby leaving the blow pipe in communication with a hollow lower extension 25. The blow pipe is now lighted and supplied with fuel and air and the flame is directed upon the metal supported upon the mica 89. During this operation the burners 11 and 14 are also heating the flask.

When the metal reaches a sufficiently molten state, or is in a condition of fluid to properly flow, the lever 37 is swung about to the dotted line position which operation serves to cut off the burners 11 and 14, by turning the opening 26 out of register with the passage 23. However the blow pipe continues in operation because of the elongated opening 27. As the lever 37 is lowered the gearing swings the blow pipe laterally thereby cutting off the same from its source of supply of fuel. The continuous movement of the lever 37 brings the packing 74 of the nozzle into engagement with the top of the reflection cap 79. When movement of the nozzle is arrested by such engagement further downward movement of the lever brings the valve 62 into engagement with the upper wall of the nipple 71 thereby unseating the valve and allowing pressure to flow through the opening 81 and opening 72 into the cap 79 and upon the molten metal thereby forcing the same through the gate 77 and into the cavity, the slitted portion of the mica yielding to permit the metal to flow through the gate 77.

In place of the mica 89 a ladle 91 may be disposed in the gate, as shown in Figs. 8 and 9. The lower end 92 covers the gate 77 and the other end 93 is disposed in an inclined position in a recess 94. Upon downward movement of the nozzle the packing engages the inclined portion 93 and lifts the part 92 so as to permit the metal to flow through the gate 77.

I claim:

1. An apparatus for casting light and precious metals comprising in combination, a flask containing a mold cavity and having a top wall portion on which the metal is supported, the top wall extending laterally from the point of support of the metal to expose the top and sides of the same, and a cap covering the metal and said top wall portion and provided with an interior arched heat reflecting surface acting upon the exposed portions of the metal, and means for projecting a flame into said cap to fuse the metal.

2. An apparatus for casting light and precious metals comprising in combination, a flask containing a mold cavity and having a top wall portion on which the metal is supported, the top wall portion diverging widely laterally from the point of support of the metal to expose the top and sides of the same, and a cap covering the metal and the top wall portion and provided with an interior heat reflecting surface acting upon the exposed portions of the metal, and means

for projecting a flame into said cap to fuse the metal.

3. An apparatus for casting light and precious metals comprising in combination, a flask containing a mold cavity and having a top wall portion on which the metal is supported, the top wall being conical and inclined laterally at a relatively great angle from the point of support of the metal to expose the top and sides of the same, and a cap covering the metal and top wall portion and provided with a semi-spherical interior heat reflecting surface acting upon the exposed portions of the metal, and means for projecting a flame into said cap to fuse the metal.

4. An apparatus for casting precious and light metals comprising in combination, a flask containing a mold and its cavity and provided with a heat structure connected with the cavity and arranged to receive and act as a crucible for the metal, a heat reflecting cap covering the metal and the heat structure and provided with an interior heat reflecting surface, means projecting a flame through the cap to fuse the metal, and projecting fluid pressure through the cap to force the molten metal into said cavity.

5. An apparatus for casting precious and light metals comprising in combination, a flask containing a mold cavity, a support for the metal communicating with said cavity, a device for covering the opening or communication between said support and cavity, and serving to support the metal, means for melting the metal on said device, and fluid pressure means acting to move said device to permit the molten metal to flow into said cavity and serving to force the molten metal into said cavity.

6. An apparatus for casting precious and light metals comprising in combination, a flask containing a mold and its cavity, burners for heating said flask, means for heating the metal, and movable fluid pressure means for forcing the molten metal into said cavity and controlling the passage of fuel to said burners.

7. An apparatus for casting precious and light metals comprising in combination, a flask in which a mold and cavity are contained, a support for the metal normally closing ingress to the cavity, means for heating the metal on said support and means acting to move said support to provide ingress of the molten metal to the cavity.

8. An apparatus for casting precious and light metals comprising in combination, a furnace provided with heating means, a flask support therein, a flask containing a mold and cavity with a pattern in the cavity adapted to be melted, said flask having openings for the pattern to discharge therethrough, said flask and support being formed and arranged to permit the flask to be placed thereon in either of reverse positions, a gate structure for the flask communicating with the mold cavity therein adapted to act as a crucible for the metal, means for heating the metal in said crucible, and fluid pressure means for forcing the molten metal into said cavity.

9. An apparatus for casting precious and light metals comprising in combination, a furnace provided with a plurality of burners, a flask support in said furnace, a flask containing a mold with a pattern in the cavity of the mold adapted to be melted, a gate for said flask communicating with said cavity, said flask and support being arranged to permit the flask to be inverted thereon, and one of said burners being disposed so as to direct its flame against the gate of the inverted flask.

10. An apparatus for casting precious and light metals comprising in combination, a flask in which the mold and cavity are contained, a support for the metal normally closing ingress to the cavity, means for heating the metal on said support, a means acting to move said support to permit ingress of the molten metal to the cavity and forcing said molten metal into said cavity.

11. An apparatus for casting precious and light metals comprising in combination, a flask containing a mold and a cavity, a gate for supporting the metal and adapted to act as a crucible therefor and communicating with the cavity, means for heating the metal in said crucible, and rotatable and longitudinally movable fluid pressure mechanism for controlling passage of fuel to said means, and forcing the molten metal in said crucible into said cavity.

12. An apparatus for casting precious and light metals comprising in combination, a flask in which the mold and cavity are contained, a support for the metal normally closing ingress of the metal to the cavity and adapted for movement after the metal is melted to permit ingress thereof to the cavity, and means for heating the metal on said support.

13. An apparatus for casting precious and light metals comprising in combination, a furnace provided with heating means, a flask support therein, said flask containing a mold and cavity with a pattern in the cavity adapted to be melted, said flask having opening for the pattern to discharge thereto and the flask and support being formed and arranged to permit the flask to be placed thereon in either of reverse positions.

14. An apparatus for casting precious and light metals comprising in combination, a furnace provided with heating means, a flask support in said furnace, a flask containing a mold with a pattern in the cavity of mold adapted to be melted, said mold having a gate opening to the pattern, and

said flask and support being arranged to permit the flask to be inverted thereon to permit said heating means to melt the pattern.

15. An apparatus for casting light and precious metals comprising in combination, a flask having a metal supporting portion with widely diverging metal supporting walls arranged to expose the top and sides of the metal thereon, and a cap covering the metal and provided with an interior heat reflecting surface acting upon the exposed portions of the metal, and means for projecting a flame into said cap to fuse the metal, substantially as described.

In testimony whereof I affix my signature in presence of two witnesses.

SEKIICHI ENOMOTO.

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