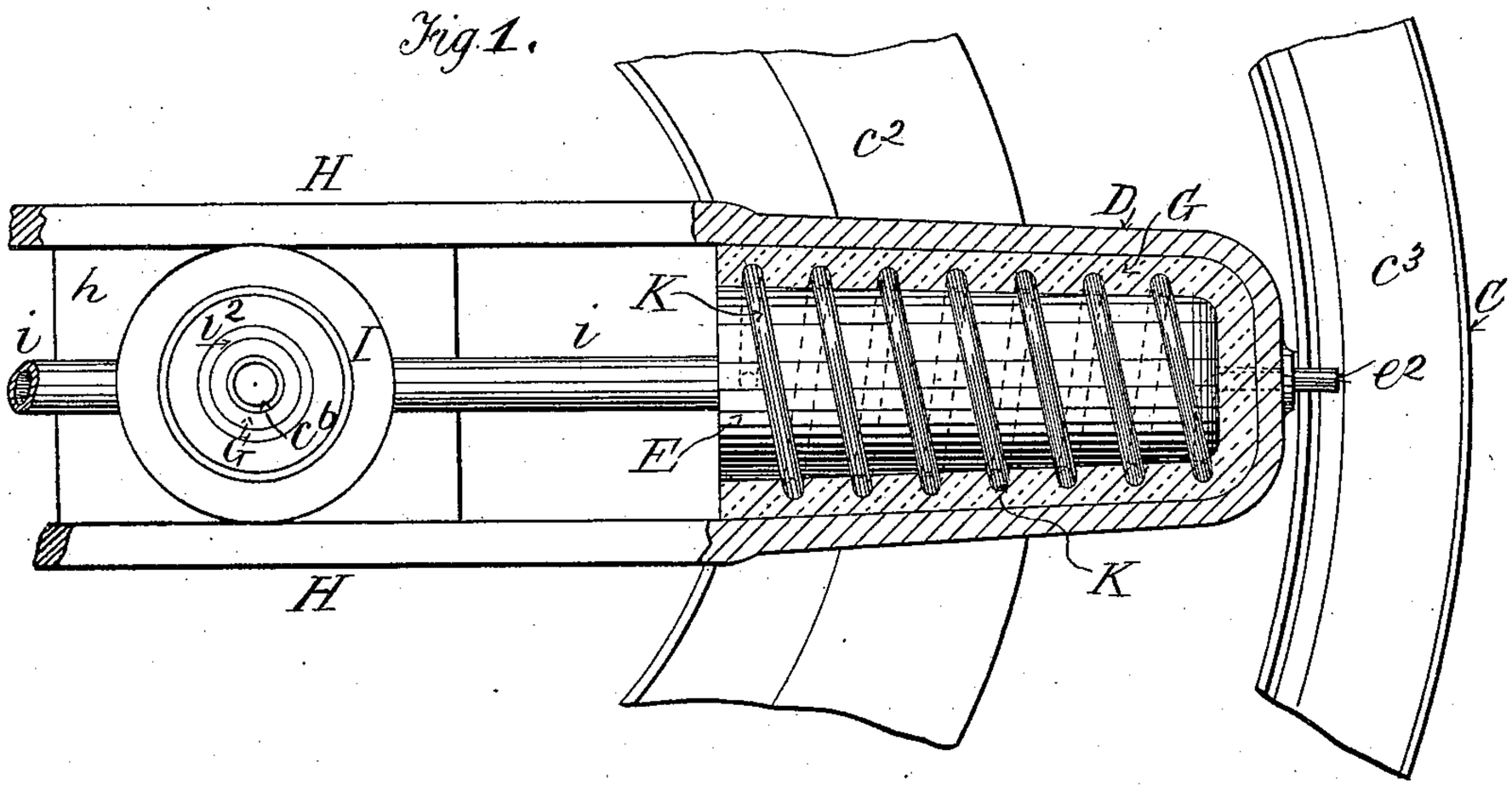
(No Model.) 4 Sheets—Sheet 1.

J. A. MAYS.

APPARATUS FOR REDUCING, SEPARATING, AND REFINING METALS.

No. 574,439. Patented Jan. 5, 1897.

Fig. 1.



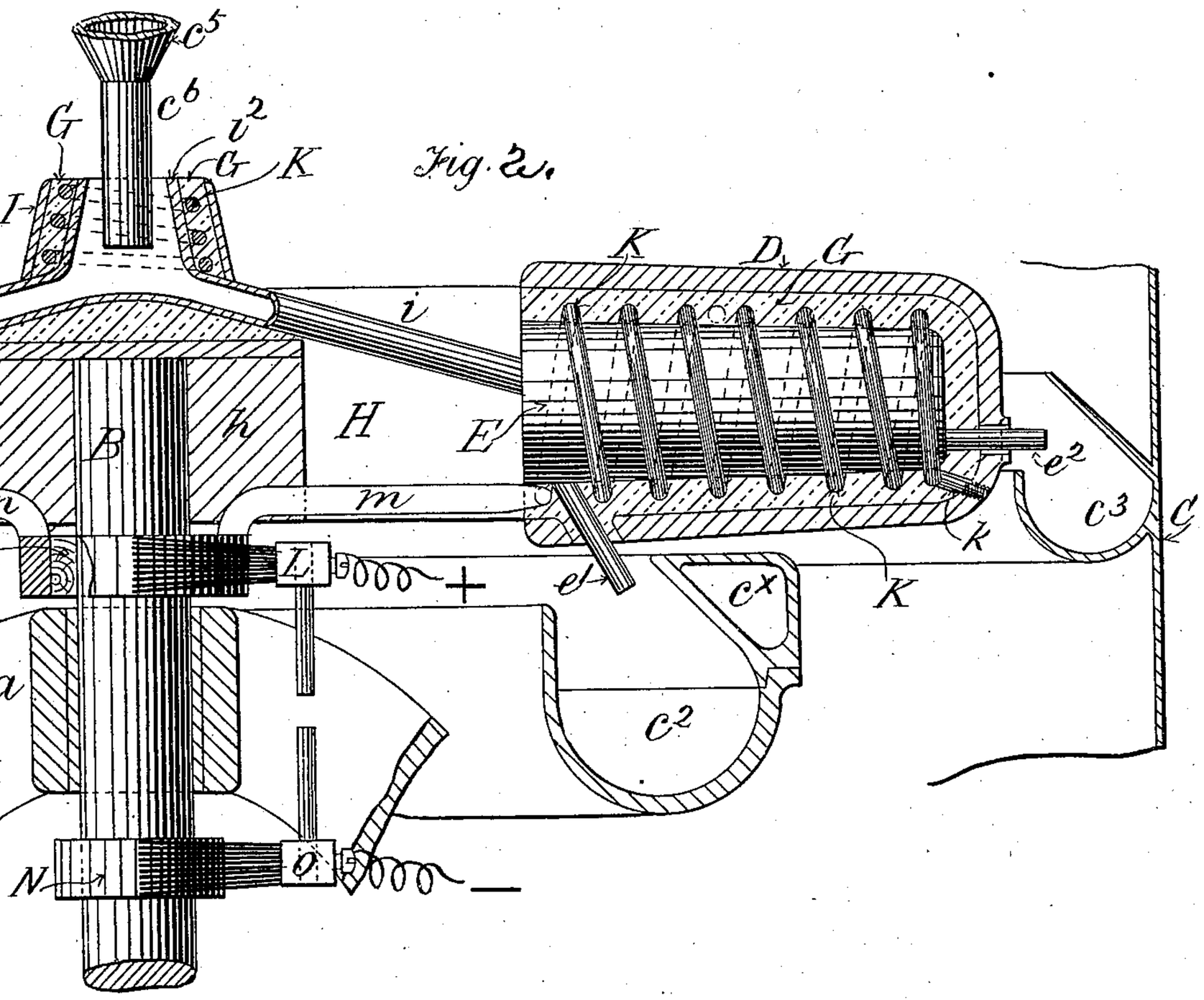


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Fig. 3.

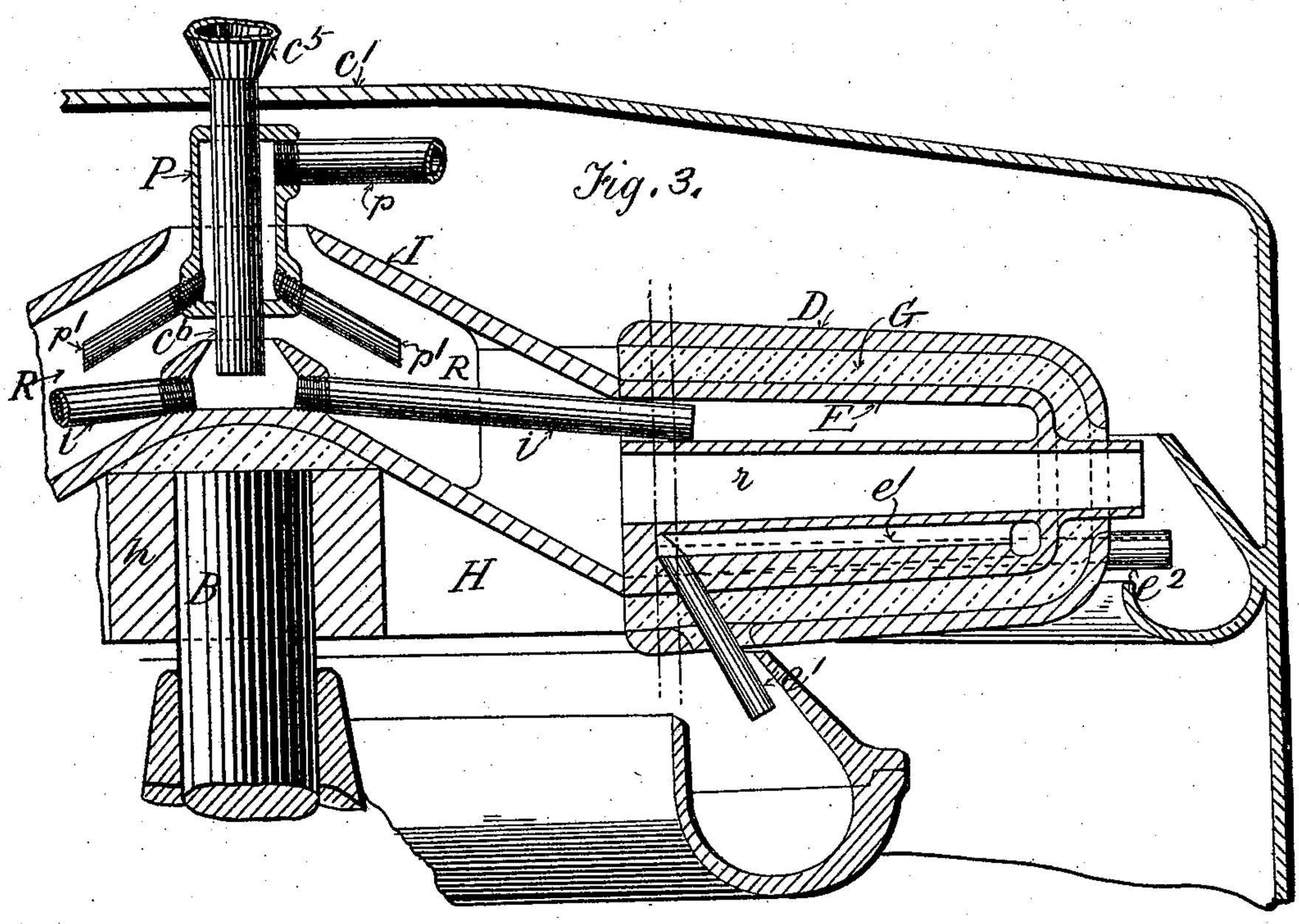

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Fig. 4.

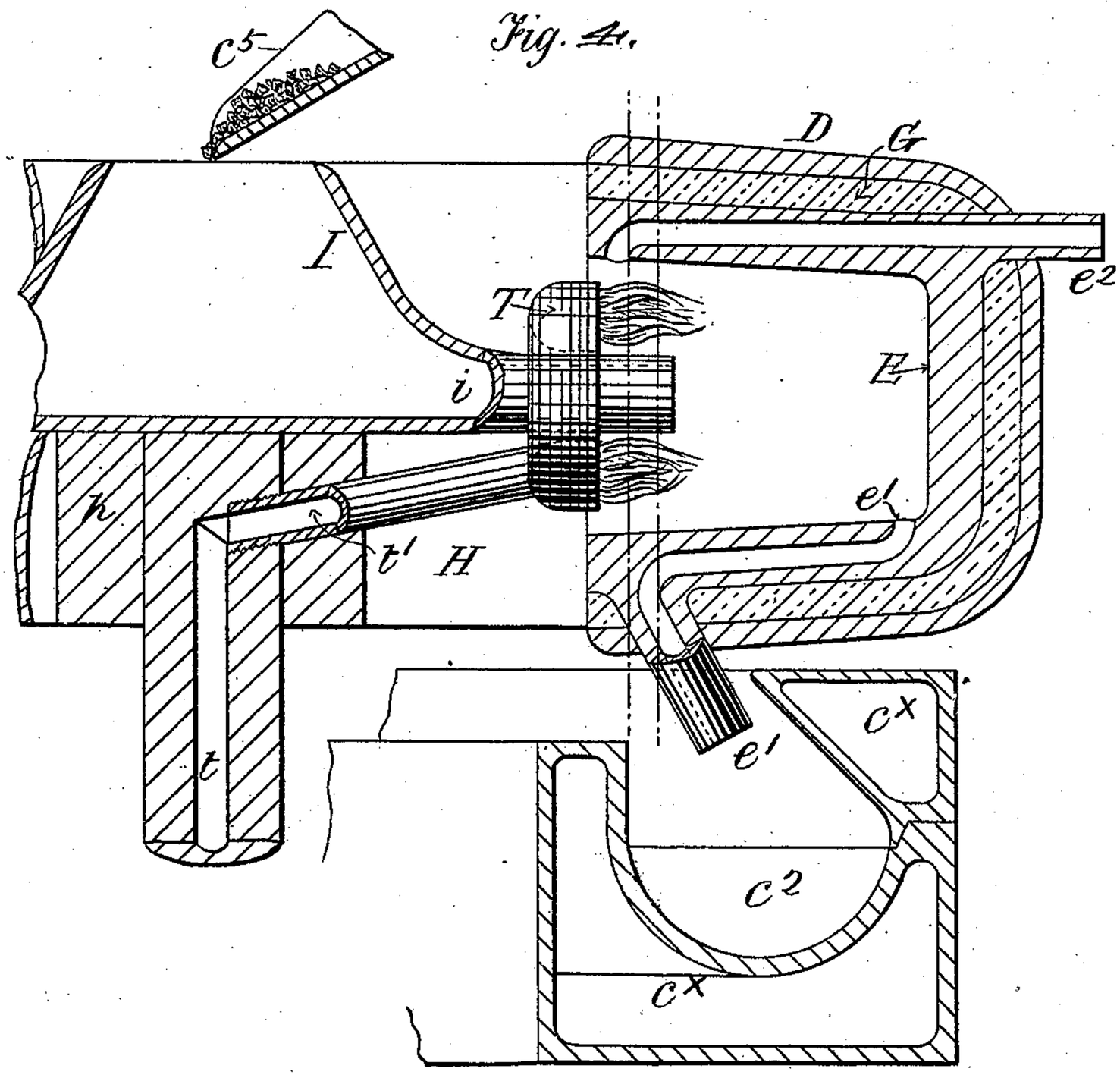

Fig. 5.

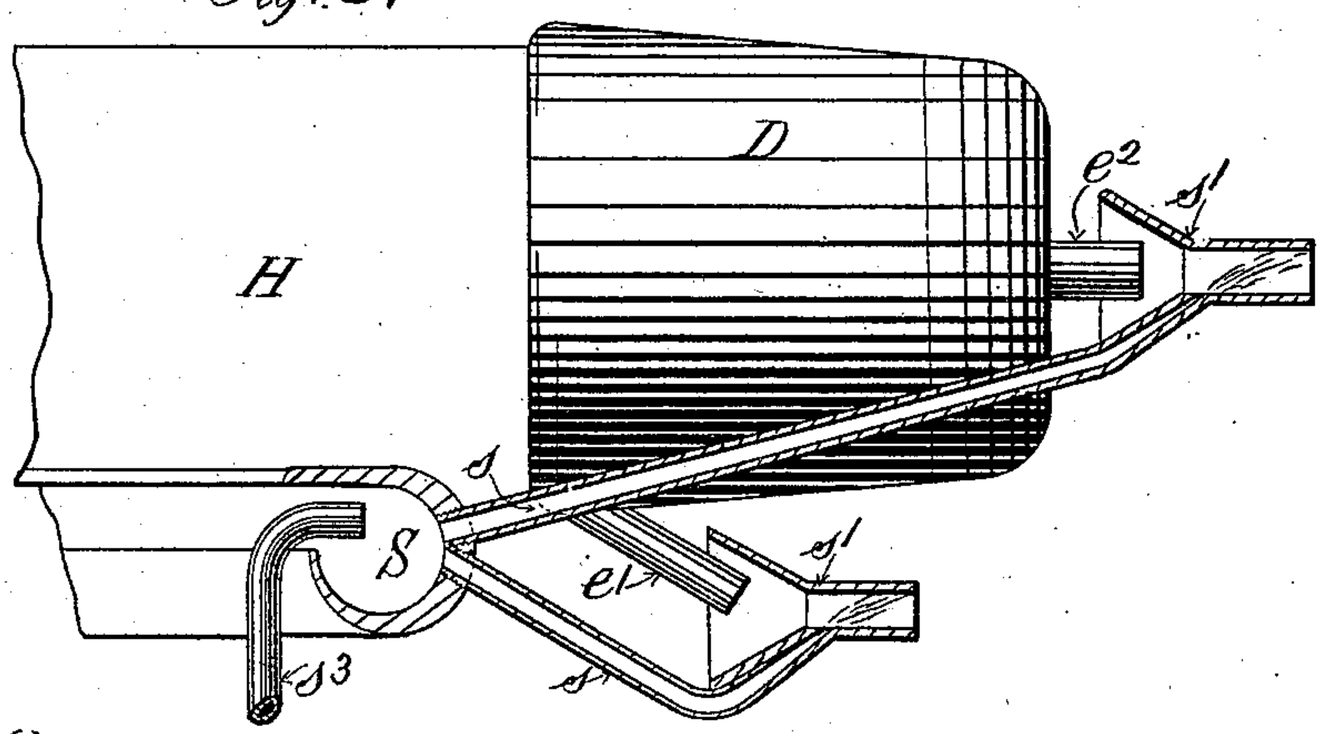

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Fig. 6.

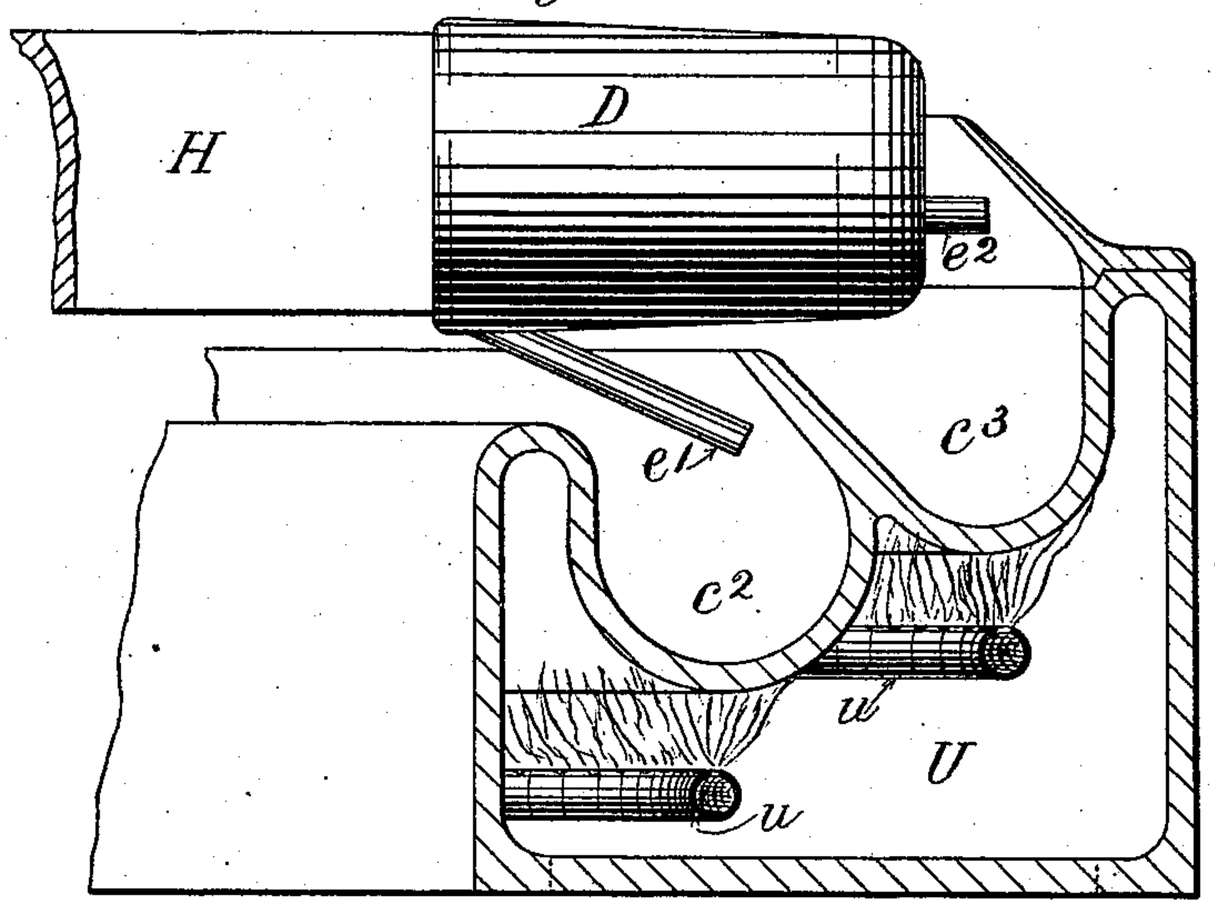
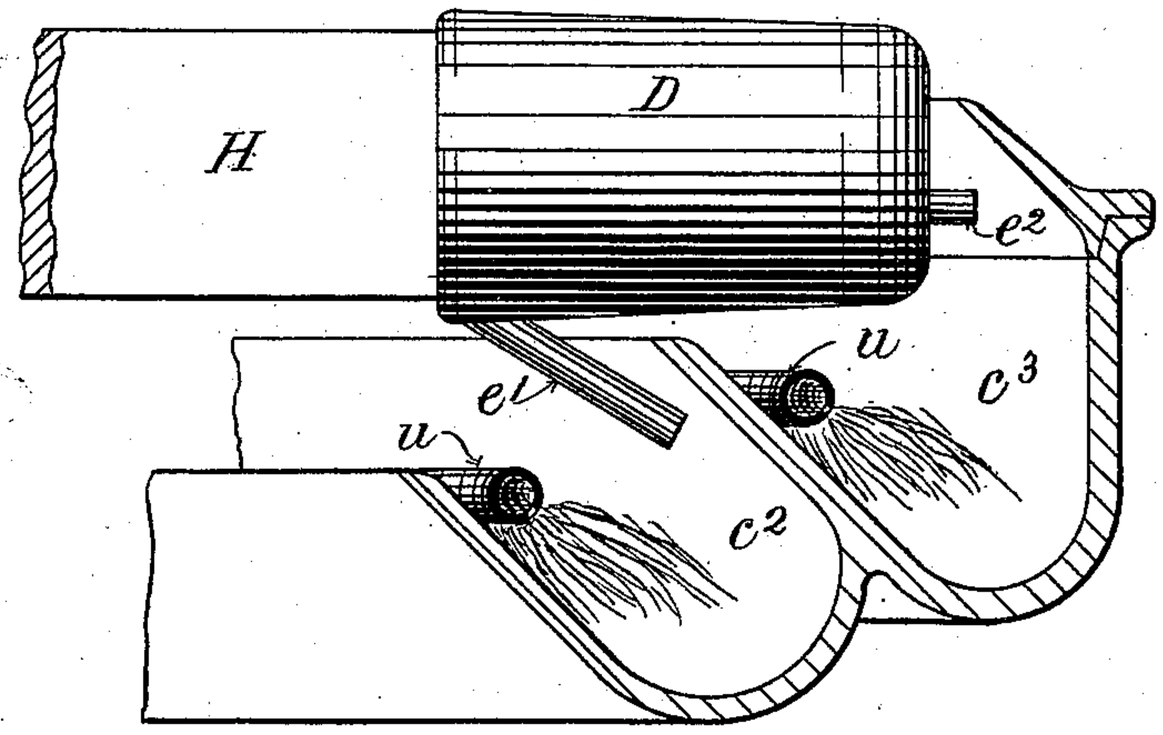


Fig. 7.



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UNITED STATES PATENT OFFICE.

JONATHAN A. MAYS, OF LONDON, ENGLAND.

APPARATUS FOR REDUCING, SEPARATING, AND REFINING METALS.

SPECIFICATION forming part of Letters Patent No. 574,439, dated January 5, 1897.

Application filed June 19, 1893. Serial No. 478,138. (No model.) Patented in England February 7, 1893, No. 2,639.

To all whom it may concern:

Be it known that I, JONATHAN ALDOUS MAYS, a subject of the Queen of Great Britain, residing at 1 Belsize Terrace, Hampstead, London, England, have invented certain new and useful Apparatus for Reducing, Separating, and Refining Metals, of which the following is a specification.

This invention has been patented in Great Britain February 7, 1893, No. 2,639.

This invention relates to applying or employing centrifugal force in connection with the reduction, separation, and purification of metals and such like molten substances.

In the case of compound fluids having different specific gravities or of fluids carrying finely-divided foreign matters in suspension, that is to say, of fluids which do not readily or completely separate from each other or become clarified, as the case may be, under the influence or action of gravity alone, it is well known that they may be readily and completely separated from each other or that they may be clarified under the action of centrifugal force. Typical cases of such operations are seen in the centrifugal separation of cream from milk and in the centrifugal removal of impurities from syrup or sugar. Now in this invention I propose to apply or utilize centrifugal force in a similar way with the view to either effecting the separation of metals from each other or of relieving or purifying molten metals of or from the impurities they may carry or contain.

Some of the apparatus I employ in carrying out this invention is applicable to the treatment of other materials than molten metals, as, for instance, molten slag. I am thus enabled to separate metals from each other or to remove impurities from metals by mechanical means, and where the impurities in metals are required to be reduced I find that they can more readily be brought to the surface and exposed by the aid of centrifugal force than is the case under the action of gravity.

The apparatus I employ is so designed as to effect the operations referred to continuously.

The apparatus necessary to the carrying out of this process consists, essentially, of a revolving vessel or frame formed integral with or rigidly attached to an axially-disposed spindle, around and with which the vessel or equivalent frame rotates.

In mixtures of molten metals where there are substantial differences in the specific gravities of the metals forming the mixture the various metals separate from each other comparatively readily under the influence or action of gravity alone, while in mixtures where there are but slight differences of specific gravity the separation is much more sluggish, and I find that by subjecting such molten metals to centrifugal force and thereby increasing for the time being the relative densities of the concomitants of the molten body it is possible to multiply almost at will the differences between the specific gravities of such concomitants, and thus facilitate and accelerate their separation to an extent which may be described as proportionate or relative to the centrifugal multiplication of the respective densities.

In the accompanying drawings, in which like letters refer to like parts or to parts fulfilling the same functions, Figure 1 is a part plan, and Fig. 2 is a part vertical section of a machine, showing an electrical device for heating the pots. Fig. 3 is a part vertical section of a device for heating the pots, in which gaseous fuel is used. Fig. 4 is a part vertical section of a melting and separating machine. Fig. 5 is a vertical section of a device for cooling the metals or slags as they are emitted from the vessel. Fig. 6 is a vertical section of apparatus for heating the collectors. Fig. 7 is a vertical section of apparatus for heating the molten material in the collectors.

The standing parts of the machine are sectioned from the top left to the bottom right corner of the drawings, while those parts which rotate are sectioned from the top right to the bottom left corners. I use the words "top" and "bottom" or "upward" and "downward" in this specification as meaning, respectively, the parts of the molten material which are situate nearer to and farther from the axis of rotation.

A revolving spindle B is rigidly attached to the casing or its equivalent pots or vessels D. An outer casing C has formed integral with or attached to or supported by it the collectors and their deflectors c^2 c^3, and the

cover c' in its turn supports the feed-funnel c^5 and tube c^6. The vertical spindle B has fixed to it in any convenient position a pulley upon which runs a belt by means of which rotatory motion is given to the spindle B and the vessel or vessels D.

The interior of the vessel D in the cases where only a low temperature is required may form also the pot for containing the molten material; but in cases in which high temperature is necessary an inner vessel or pot E is used, either of metal or of any suitable refractory material, as may be required in each particular case, and between this pot and the outer vessel is interposed a layer G of material of some kind which is a non-conductor of heat or which conducts it very imfectly, such as fire-clay, asbestos, magnesia, or lime.

It will be understood that in cases where both an outer and inner vessel are used the outer is kept cool by the non-conductor G preventing the heat produced in the inside vessel E passing to the vessel D. This enables the whole strength of the material composing the outer vessel to be utilized to resist the centrifugal strain.

Throughout the drawings the radial levels are shown as governed by siphon-shaped traps; but it will be understood that the levels may be maintained by a proper proportion between the sizes of feed and emission tubes or by other devices.

The molten metal being poured into the standing funnel c^5 and tube c^6 falls into the rotating distributer and upon touching either its sides or bottom acquires sufficient centrifugal force to cause it to pass through one or other of the delivery-tubes i into the pot E, where it is subjected to centrifugal force, as before, and upon separation taking place the heavier material passes off through the trap-tube e' into the collector c^2, while the lighter portion comes to the top or inner surface of the pot.

To keep the distributer or pot, or both, heated is effected in various ways. In Figs. 1 and 2 is shown a method of heating by means of electrical resistances K, shown helically wound around and electrically insulated from the exterior of the pot or vessel E and from the inside distributer i^2, it being embedded in the non-conducting material G in both cases. Sufficient current is carried from any available outside source through the brush L, commutator M, leads m to the resistance-coils K, whence it passes by the end k to the outside vessel D, straps H, block h, shaft B, and ring N to a second brush O, and so returns to the dynamo or other source of supply. The ring or commutator M is insulated from the spindle B by the material m^3. In Fig. 2 is shown a water-jacket $c^\times$ for keeping the deflector or collector c^2 cool by means of a stream of water passing through it.

In Fig. 3 is shown a means of heating the pot by means of the combustion of gas, the supply of which is derived from an outside source and led by the pipe p to the annular gas-chamber P, surrounding the metal-feed pipe c^6, from which gas-chamber it issues from jets p', burning with the air in the combustion-chambers R, the heated products of combustion passing through the flue r out into the atmosphere. The flue is here shown as passing through the inside of the pot or vessel E, but it may equally well be formed to pass on the outside of such pot. The interior arrangement of the pots and passages is otherwise the same as before.

In Fig. 5 the cooling is effected by direct contact of the molten material with water in the form of a jet. S is the annular water-vessel, and s^3 the standing supply-pipe, $s\,s$ the supply-tubes, and $s'\ s'$ the funnel-shaped chamber in which the molten material and water come into direct contact and from which they pass into their collectors.

In the preceding figures the material has been shown as supplied to the vessels in a molten condition, but in Fig. 4 it is supplied in a raw or solid state from a chute c^5 to the distributer I and passed through delivery-pipes i to the pot or vessel E. A reducing-flame from the annular gas-burner T, which is supplied with gas from an outside source through the passage t and pipe t', plays upon the surface of the pot. The heat generated is sufficient to insure the melting of the ore when deposited upon the surface of the already molten material. Separation is effected as soon as the melting is complete, as before. This gas-burner is also sometimes used where molten material is supplied to the machine for the purpose of burning off or reducing the impurities which come to the upper surface in the pot or vessel. In Fig. 4 a water-jacket $c^\times$ is shown around the collector c^2.

In Fig. 6 is shown a method of keeping the collector into which the molten metal or other materials are discharged heated, so as to enable them to flow off to the ingot or other molds or to be at once subjected to additional treatment. In this case a flue or combustion-chamber U surrounds both collectors c^2 and c^3, maintaining therein such a temperature as to insure the contents remaining liquid. These flues may be heated either by the combustion of solid or of gaseous fuel. In some cases the flues are occupied by a ring of gas-burners u, for effecting the same purpose.

In Fig. 7 the liquid contents of the collectors c^2 and c^3 are kept molten by means of rings of inverted gas-burners, the flames of which impinge upon and heat the liquid contents. Two such rings are shown, and they may be supplied with gas from the same outside source.

Having thus fully described my invention, I claim as new and desire to secure by Letters Patent—

1. In an apparatus for separating molten metals, the combination of a revoluble receiving vessel, means for rotating the same, an eduction-tube, or eduction-tubes at different

levels discharging from the said vessel, one or more collectors for receiving the separated substances and a heating-chamber inside the receiving vessel, substantially as described.

2. In combination with a revoluble receiving vessel, a combustion-space a gas jet or burner and an inlet for the metal passing through the combustion-space into the receiving vessel, substantially as described.

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