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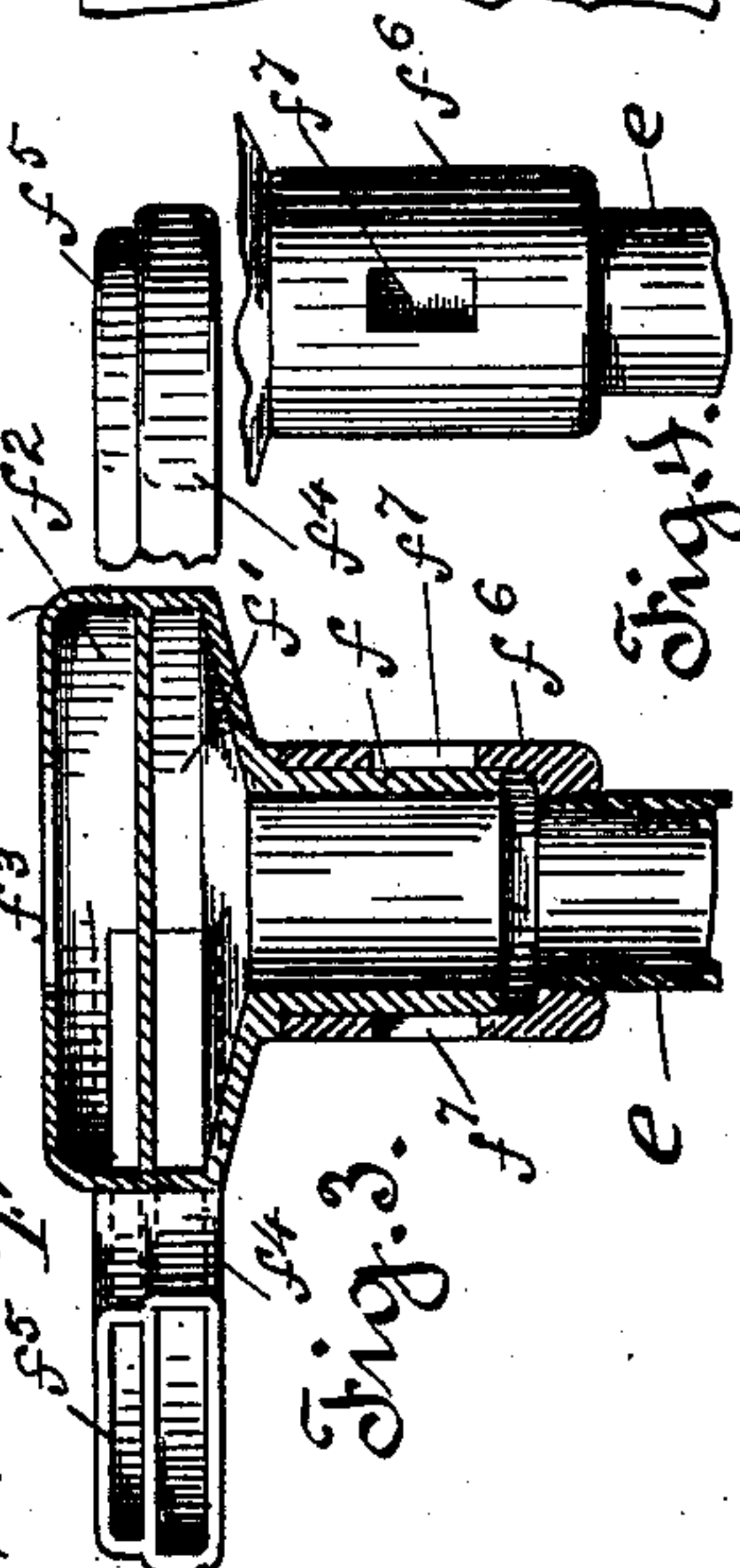
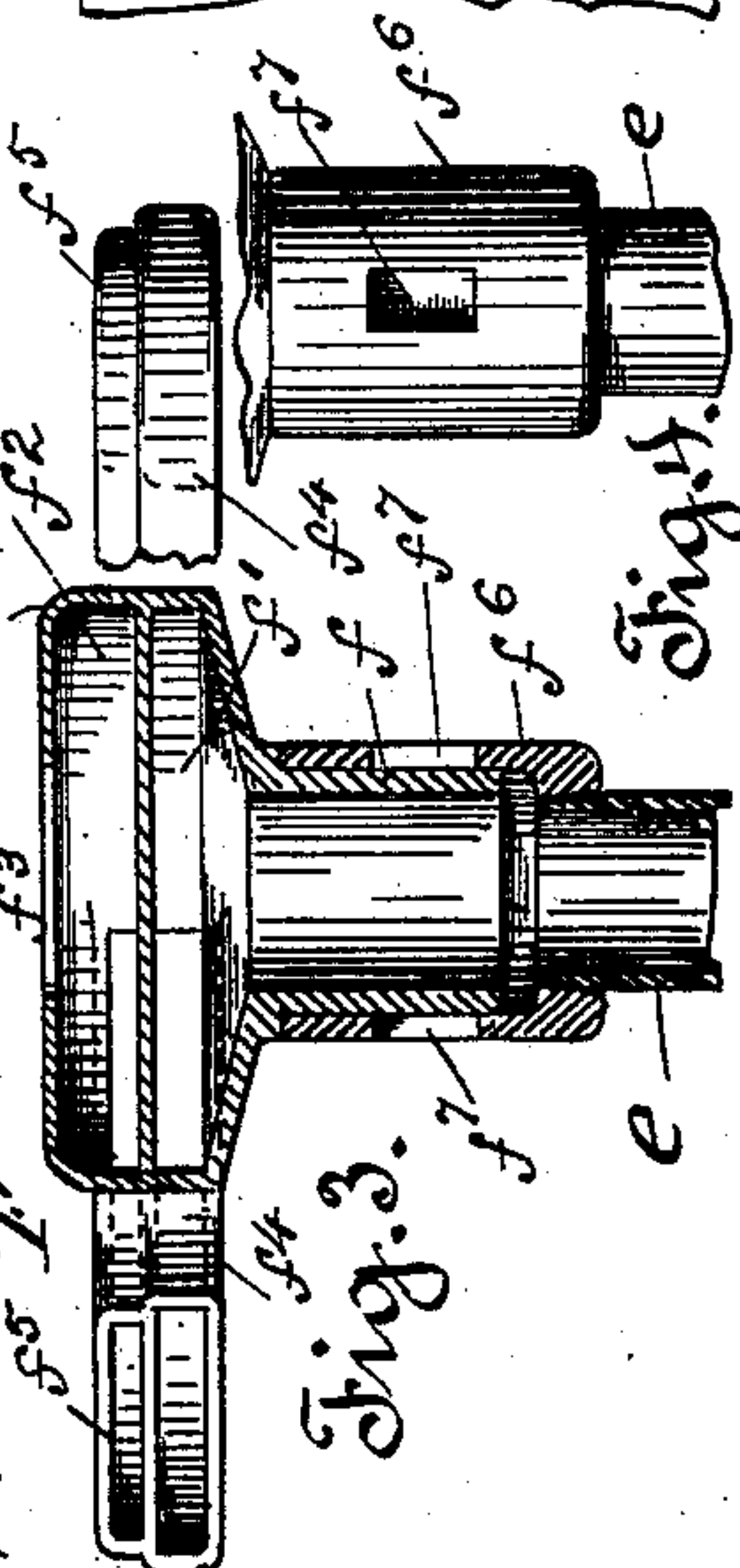
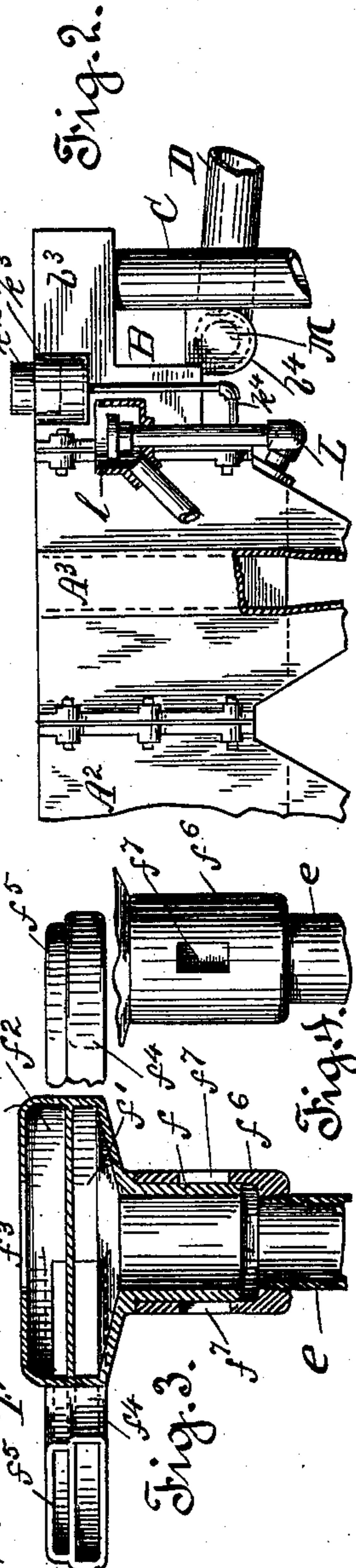
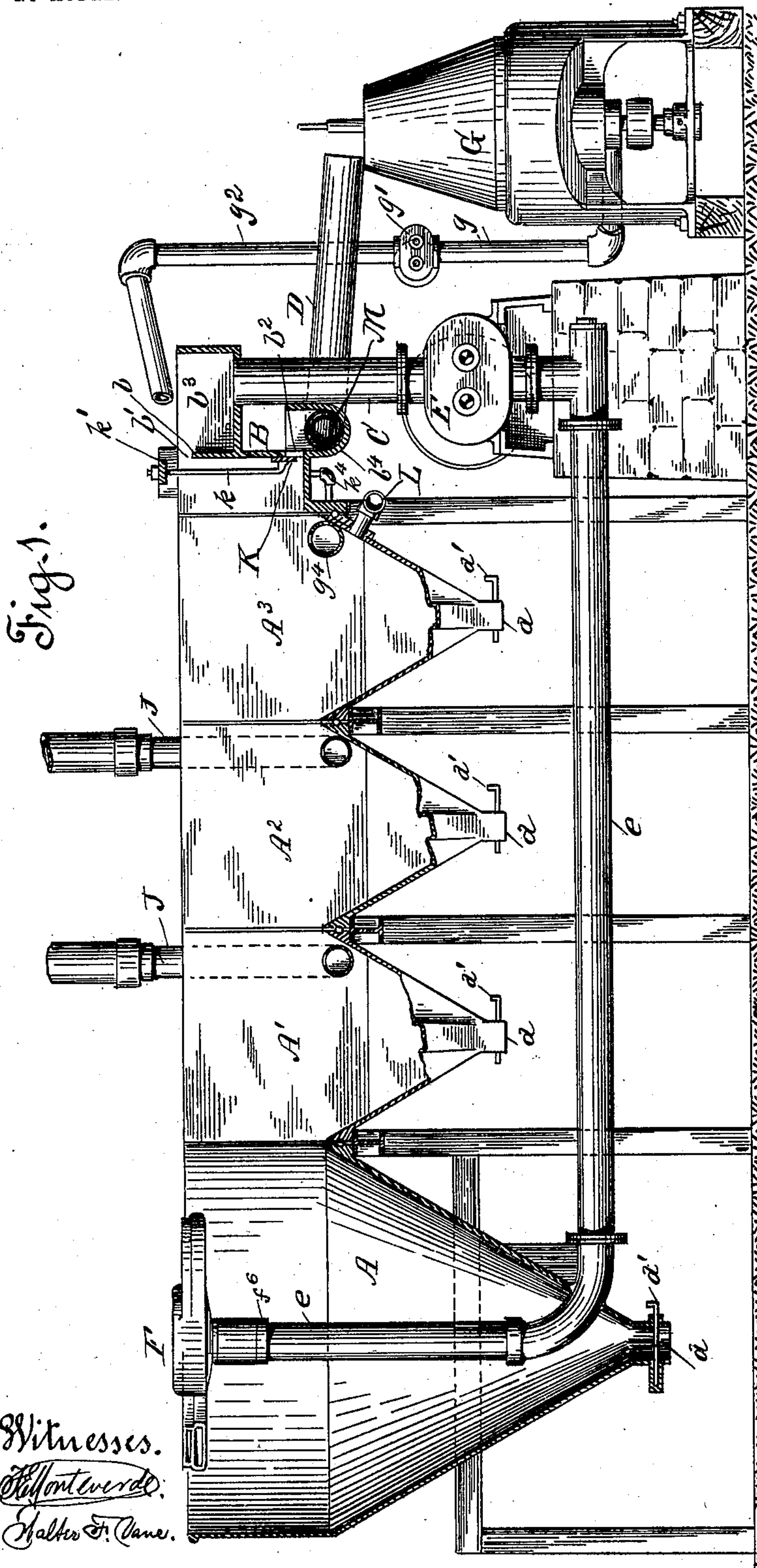
J. W. VAN METER & M. P. BOSS.

APPARATUS FOR THE CONCENTRATION OF MINERALS BY MEANS OF OIL.

APPLICATION FILED AUG. 19, 1903.

NO MODEL.

2 SHEETS—SHEET 1.



Witnesses.
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2 SHEETS—SHEET 2.

Fig. 5.

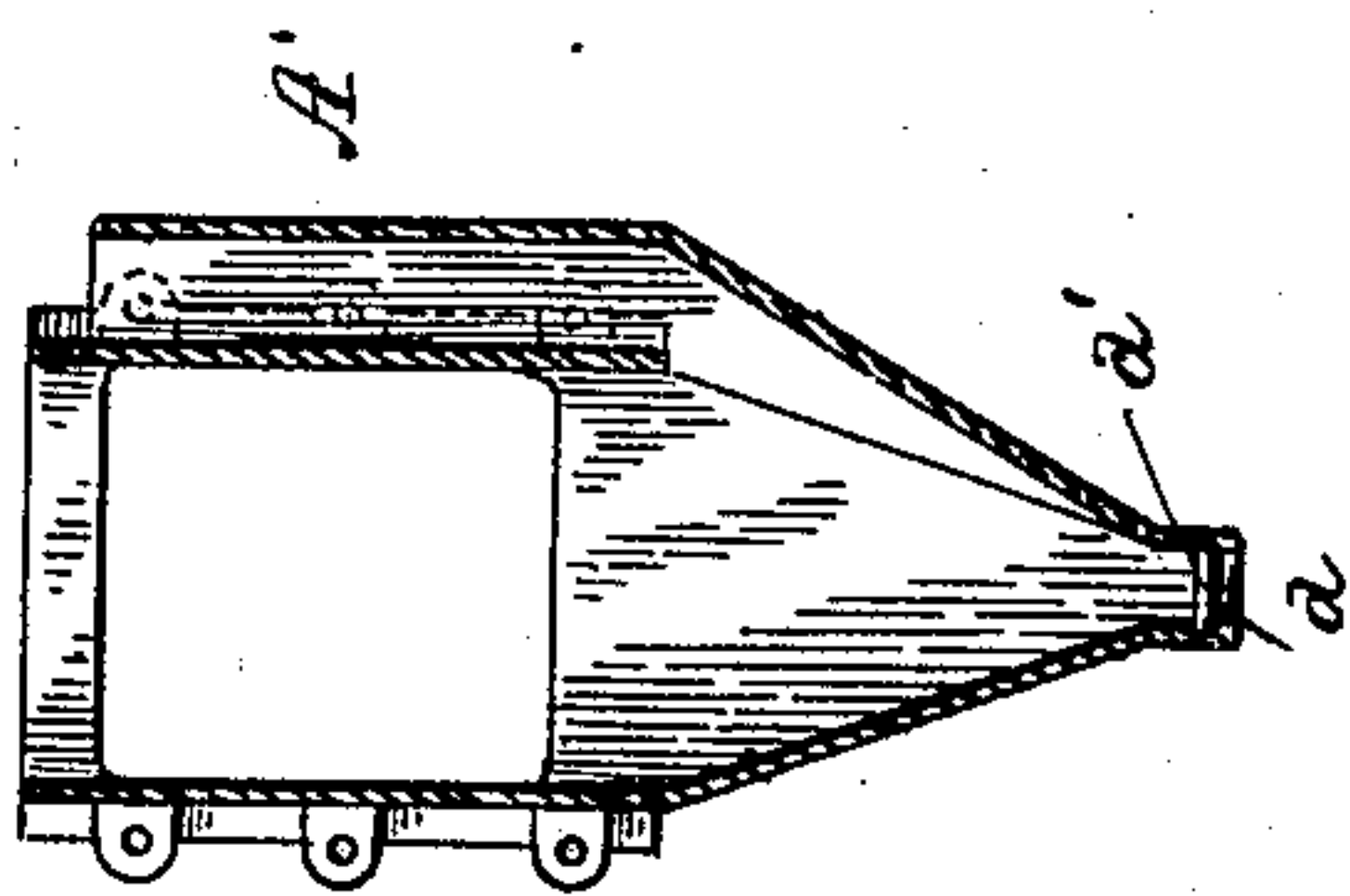
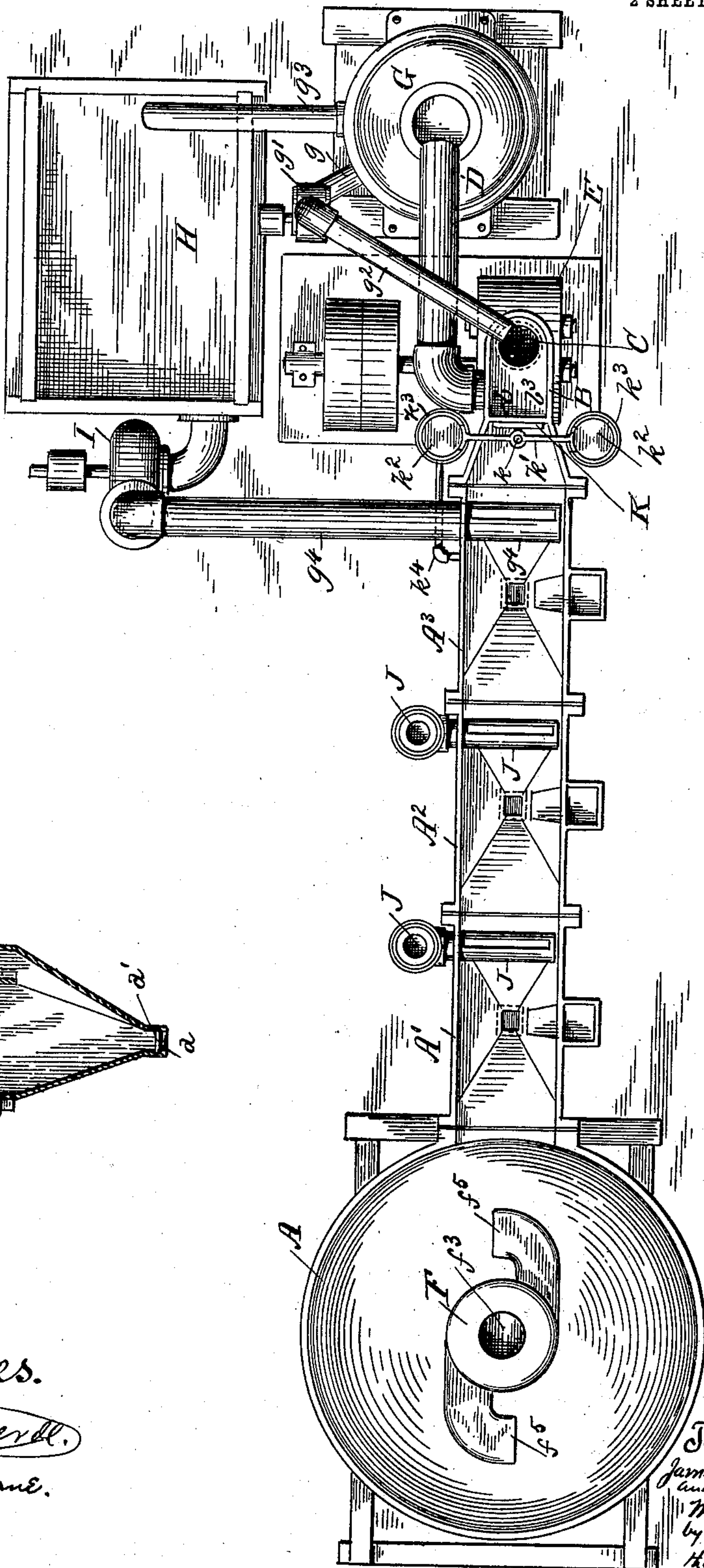


Fig. 6.

Witnesses.

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UNITED STATES PATENT OFFICE.

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APPARATUS FOR THE CONCENTRATION OF MINERALS BY MEANS OF OIL.

SPECIFICATION forming part of Letters Patent No. 762,774, dated June 14, 1904.

Application filed August 19, 1903. Serial No. 169,987. (No model.)

To all whom it may concern:

Be it known that we, JAMES W. VAN METER and MARTIN P. BOSS, citizens of the United States, residing in the city and county of San Francisco, State of California, have invented certain new and useful Improvements in Apparatus for the Concentration of Minerals by Means of Oil; and we do hereby declare the following to be a full, clear, and exact description of the same.

Our invention relates to that class of apparatus in which a separation of the precious minerals from the pulp is obtained by means of oil through which the pulp passes. Crude oil is usually employed for this purpose, and after the oil has become charged with mineral a separation of the minerals from the oil is made in a centrifugal machine in a manner well known.

Our invention seeks to materially improve the separation of the mineral from the pulp, by means of the oil, by providing an apparatus which, in addition to presenting several details of improved construction and arrangement, is capable of having a continuous operation carried on in it without appreciable loss, as the oil is returned to the circulation for use again.

Our invention consists in the apparatus in general and in its details of construction, arrangement, and combination, which we shall now describe by reference to the accompanying drawings, in which—

Figure 1 is a side elevation, partly in longitudinal section, of our apparatus. Fig. 2 is a detail elevation of the final vessel of the series, together with the separating discharge vessel B. Fig. 3 is a sectional detail of the rotary distributor F. Fig. 4 is a detail elevation of the sleeve f^6 of the rotary joint of the distributor. Fig. 5 is a top plan of our apparatus. Fig. 6 is a section of one of the minor vessels of the series.

A is the main vessel at the head of the series of vessels which together form the channel through which the oil during its functional course flows. This vessel may be of any suitable type; but in practice it is a spitzkasten. The remainder of the series of ves-

sels forming the said channel are also best shaped as spitzkastens, and there may be as many of these as may be desired. We have here shown three, A' , A^2 , and A^3 . All these spitzkastens are united to form a continuous channel, the upper portion of A communicating with A' , and A' with A^2 , and A^2 with A^3 , the communication in each case being through large openings in the sides of the upper portions of each. The spitzkastens A' , A^2 , and A^3 are smaller than the head spitzkasten A, and while this is not essential it is best in practice, as the greater part of the separation and discharge of the gangue take place in the head vessel. Each spitzkasten has a bottom discharge-opening at a , which is controlled by a suitable gate or cock a' .

To the end or foot spitzkasten A^3 is bolted the separating discharge, which consists of a vessel B, communicating directly with the upper portion of said spitzkasten and having an end wall b terminating short of the top to leave an upper opening at b' and terminating short of the bottom to leave a lower opening at b^2 . The upper opening communicates with an extension or pan b^3 , from which a pipe C extends downwardly. The lower opening communicates with a trough b^4 , which connects with a second trough D.

The pipe C leads down to a pump E, from which a pipe e returns under the shorter spitzkastens to the lower portion of the main spitzkasten A, which it enters and terminates in the vertical axis of the same. Upon this upturned end of pipe e is mounted rotatably the duplex distributor, (designated as a whole by F.) This consists of a stem portion f , surmounted by a hub divided by a horizontal partition into an oil-chamber f' , which communicates with the stem f , and a pulp-chamber f^2 , in the top of which is an opening f^3 , through which the pulp is fed from any suitable source.

Each hub-chamber has oppositely-extending radial spouts f^4 and f^5 , the ends of each pair of spouts being turned in opposite directions, after the manner of a water-sprinkler, in order by the oppositely-exerted pressure of the liquids discharged therefrom to

effect a rotary motion of the whole distributor. This distributor may have any suitable bearing. The construction here shown consists of a sleeve f^6 , screwed to the top of pipe e and bearing on its own top the hub of the distributor. In this sleeve are slots f^7 , which are so disposed relatively to the base of the stem f that if said stem rises too high they will be partly exposed, for a purpose we shall hereinafter mention. The distributor lies high up in the spitzkasten, and it will be observed that its diameter is relatively small to that of the vessel, so that the distribution of its contents is central rather than peripheral.

G is a centrifugal separator, the special construction of the interior of which forms no part of our present invention, and it will therefore be sufficient to say that it is a separator of that well-known class which by reason of interior rotating devices effects a separation of the constituents of liquids according to their specific gravities. The trough D, heretofore mentioned, leads to and is so disposed as to discharge its contents into the centrifugal G. From this separator issues a pipe g , which leads to a pump g' , from which a pipe g^2 leads up to and is adapted to discharge its contents into the open top of the extension or pan b^3 of the separating discharge vessel B, directly over the pipe C. Another pipe g^3 also issues from the centrifugal G and leads to a tank H, from which a pump I takes its contents and delivers it by a pipe g^4 to the final spitzkasten A^3 , approximately on the level of the base of the separating discharge vessel B, as shown. Upon this same level there enter into the spitzkastens A' and A^2 pipes J, which are to connect with a source of water-supply.

The foregoing is sufficient to give an understanding of the use of our apparatus, a description of which we shall now make and shall then describe further details of construction necessary to its perfect operation.

The entire channel formed by the series of spitzkastens is first supplied with oil from any source and at any point. Then the pulp, with water, is supplied to the pulp-chamber of distributor F. Issuing from this, the pressure causes the distributor to rotate, and thus to throw out the pulp and water into the main or head spitzkasten. The liquid in this vessel is thereby given a rotary movement, due to the discharging streams of pulp and water. The pulp and water sink through the oil in the main spitzkasten and the mineral constituents of the pulp are caught by said oil. The centrifugal motion in the body of liquid throws the pulp outwardly to the walls of the vessel and by contact therewith the separation of the pulp is facilitated. The gangue thus separated from the mineral and the water pass off, in greater part, through the bottom discharge of the spitzkasten A. What re-

mains, however, both of gangue and water flows radially or outwardly into spitzkasten A' and in this a portion of both settles and is drawn off from its bottom discharge; but to replace the water thus switched out of the circulation, as it were, and to furnish a bed for the oil to flow on fresh water is admitted to said spitzkasten A' through the pipe J. Meanwhile some of the gangue and water pass over into the next spitzkasten A^2 , wherein the operation is repeated, and likewise in the foot or final spitzkasten A^3 . During this course the oil itself is flowing on in the channel and is being gradually relieved of the gangue. Now it is obvious that by the time the mineral-enriched oil reaches the end of the channel and passes beyond its supporting-bed of water into the separating discharge vessel B it will be composed of two portions—one, a relatively lower portion, rich in mineral, (for being heavier it will be below) and the other, a relatively upper portion, comparatively free of mineral—and this condition, which has been growing from the head of the channel, becomes the most pronounced at the foot of said channel. At this point we make a separation of the relatively poorer upper portion of the oil from the relatively richer lower portion by skimming off the former over the upper end of the wall b through the top opening b' and by letting the latter out through the lower opening b^2 under the wall. The oil, poor in or free from mineral, passes into extension or pan b^3 and down through pipe C, and by the pump E is returned through the pipe e to the oil-chamber f' of the distributor F. From this chamber the oil is discharged by the rotary distributor to mix again with the pulp and water in spitzkasten A and to go through its course once more. The oil, rich in mineral, which passes through opening b^3 is conveyed by troughs b^4 and D to the centrifugal separator G. In this the minerals, together with the water supplied to the centrifugal, are thrown from the oil and pass off through pipe g^3 to the tank H, wherein the minerals settle, while the water is sent by pump I and pipe g^4 to the spitzkasten A^3 . The oil now freed from minerals passes from the centrifugal by the pipe g to pump g' , by which, through the pipe g^2 , it is returned to the circulation by being delivered into the extension or pan b^3 and pipe C.

It will thus be seen that there is a flowing or traveling body of oil which during its course is divested of the gangue and water which were distributed to it at its head, and that also that the relatively upper and lower levels of said body of oil become more and more differentiated with respect to their mineral bearing, and that at the end of the functional course a separation is made between the two levels, the upper being at once returned to the circulation, while the lower is subjected to a separation of its minerals and then is returned to the circulation. It will also be seen that

during this flow or travel of the oil and during the travel of the gangue and water the latter are disposed of by switching them out successively and replacing the water with fresh water, thereby reducing the volume of gangue in rapidly-increasing percentages. Finally, it will be noted that by distributing the pulp, water, and oil centrally instead of peripherally the centrifugal force in the rotating volume of liquid is taken advantage of to facilitate the precipitation of the gangue by contact with the vessel's sides. This, together with the lateral extension of the channel, enables all the vessels of the apparatus, and especially the main spitzkasten, to be constructed individually on a small scale, a very decided advantage in practical experience.

Some details of construction must now be noticed. In order to automatically control the discharge of the relatively lower level of the oil rich in mineral through the opening b^2 , we provide a controlling-gate K. This is carried by a stem k , rising to a cross-head k' , the ends of which are connected with floats k^2 in exterior vessels k^3 , which communicate by a pipe k^4 with the final spitzkasten A^3 at or below the water-level therein. Now if the water-level rises the floats will lift the gate, and thus increase the opening b^2 to take the oil. If the water-level lowers, the gate will descend, and thus contract the opening. In this way the required capacity of discharge is controlled.

In order to control within bounds the water-level, we have an overflow-pipe L connected with the final spitzkasten A^3 and rising to the level desired, the upper end being in a suitable trough l to catch and dispose of the overflow. It is found of advantage in separation to raise the temperature of the oil. This we do by means of a steam-coil M in the trough b^4 , and this heat is of further advantage in providing for the return of heated water from the separator G to the last spitzkasten. The object of the slots f^7 in the sleeve f^6 is this: The pressure under which the oil is returned from pump E will tend to lift the distributor F from its bearing on the sleeve-top, thereby reducing the friction of revolution on said bearing; but if the pressure be too great and the distributor tends to lift too far relief is afforded by the lower end of the stem of the distributor exposing said slots.

Having thus described our invention, what we claim as new, and desire to secure by Letters Patent, is—

1. An apparatus for concentrating minerals by means of oil, comprising a channel through which the oil flows, means for supplying pulp and water to the oil at the head of said channel, means in said channel at intervals for drawing off the settled gangue and water, means at the foot of said channel for separating the relatively upper and lower portions of the

oil, and means for returning said separated upper portion of oil to the head of the channel.

2. An apparatus for concentrating minerals by means of oil, comprising a channel through which the oil flows, means for supplying pulp and water to the oil at the head of said channel, means in said channel, at intervals, for drawing off the settled gangue and water, means, at intervals, for supplying fresh water to replace the water drawn off, and means at the foot of said channel for separating the relatively upper and lower portions of the oil.

3. An apparatus for concentrating minerals by means of oil, comprising a channel through which the oil flows, means for supplying pulp and water to the oil at the head of said channel, means in said channel, at intervals, for drawing off the settled gangue and water, means, at intervals, for supplying fresh water to replace the water drawn off, means at the foot of said channel for separating the relatively upper and lower portions of the oil, and means for returning said upper portion of the oil to the head of the channel.

4. An apparatus for concentrating minerals by means of oil, comprising a channel through which the oil flows, means for supplying pulp and water to the oil at the head of said channel, means at the foot of said channel for separating the relatively upper and lower portions of the oil, means for separating the minerals from the lower portion of the oil, and means for returning both the oil thus separated from the mineral and the upper portion of the oil which is separated from the lower at the foot of the channel, to the head of said channel, to reënter the circulation.

5. An apparatus for concentrating minerals by means of oil, comprising a series of communicating vessels, each vessel having a discharge below for the water and gangue, means for supplying oil and pulp and water to the first vessel of the series, and means at the end of said series for separating the relatively upper and lower portions of the oil consisting of a terminal wall in the path of the oil, said wall having separate openings above and below.

6. An apparatus for concentrating minerals by means of oil, comprising a series of communicating vessels, each vessel having a discharge below for the water and gangue, means for supplying oil and pulp and water to the first vessel of the series, means at the end of said series for separating the relatively upper and lower portions of the oil consisting of a terminal wall in the path of the oil, said wall having separate openings above and below, and means controlled by the water-level in the vessels for controlling the lower opening.

7. An apparatus for concentrating minerals by means of oil, comprising a series of communicating vessels, each vessel having a discharge below for the water and gangue, means

for supplying oil and pulp and water to the first vessel of the series, means at the end of said series for separating the relatively upper and lower portions of the oil, and means for
 5 returning the separated upper portion of the oil to the first vessel.

8. An apparatus for concentrating minerals by means of oil, comprising a series of communicating vessels, each vessel having a discharge below for the water and gangue, means
 10 for supplying oil and pulp and water to the first vessel of the series, means at the end of said series for separating the relatively upper and lower portions of the oil, means for re-
 15 turning the upper portion of the oil to the first vessel, means for separating the minerals from the lower portion of the oil, and means for returning said lower oil, when separated, to the first vessel.

20 9. In an apparatus for concentrating minerals by means of oil, the combination with a series of communicating vessels having separate outlets below, and means for maintaining a water-bed in said vessels to support the oil
 25 in its course, of a head vessel having a discharge below for the water and gangue, of a rotary distributor for supplying oil, water and pulp to said vessel, said distributor being disposed in the upper part of the vessel and
 30 arranged to discharge relatively near the axis of the vessel, whereby the rotary movement of the contents induced by the distribution of the material will tend to throw the pulp outwardly against the walls of the vessel and
 35 facilitate the separation of the gangue.

10. An apparatus of the class described comprising a series of communicating vessels, each having a discharge below for the water and gangue, a two-compartment rotary distributor
 40 in the first vessel, said distributor having an opening above into its upper compartment for the pulp and water, and a stem below communicating with its lower compartment, means at the end of the series of vessels for separating the relatively upper and lower portions
 45

of the oil, and a pipe through which the upper oil is returned, said pipe entering the first vessel and communicating with the lower compartment of the distributor whereby the oil is returned to said first vessel.

11. An apparatus of the class described comprising a series of communicating vessels, each having a discharge below for the water and gangue, a two-compartment rotary distributor in the first vessel, said distributor having an opening above into its upper compartment for the pulp and water, and a stem below communicating with its lower compartment, means at the end of the series of vessels for separating the relatively upper and lower portions
 55 of the oil, a pipe through which the upper oil is returned, said pipe entering the first vessel and communicating with the lower compartment of the distributor whereby the oil is returned to said first vessel, and a rotary bearing between said pipe and the distributor, consisting of the slotted sleeve encircling the stem of the distributor.

12. An apparatus of the class described comprising the series of communicating vessels, each having a bottom discharge for the water and gangue, a distributor for oil, pulp and water in the first vessel, a terminal wall disposed in the path of the oil beyond the last vessel said wall having upper and lower openings for separating the relatively upper and lower portions of the oil, means for separating the minerals from the lower portion of the oil, means for returning both the mineral-separated oil, and said upper oil to the distributor of the first vessel, and water connections to the vessels succeeding the first, for replacing with fresh water the water drawn off.

In witness whereof we have hereunto set our hands.

JAMES W. VAN METER.
 MARTIN P. BOSS.

Witnesses:

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 D. B. RICHARDS.