No. 793,808. PATENTED JULY 4, 1905.

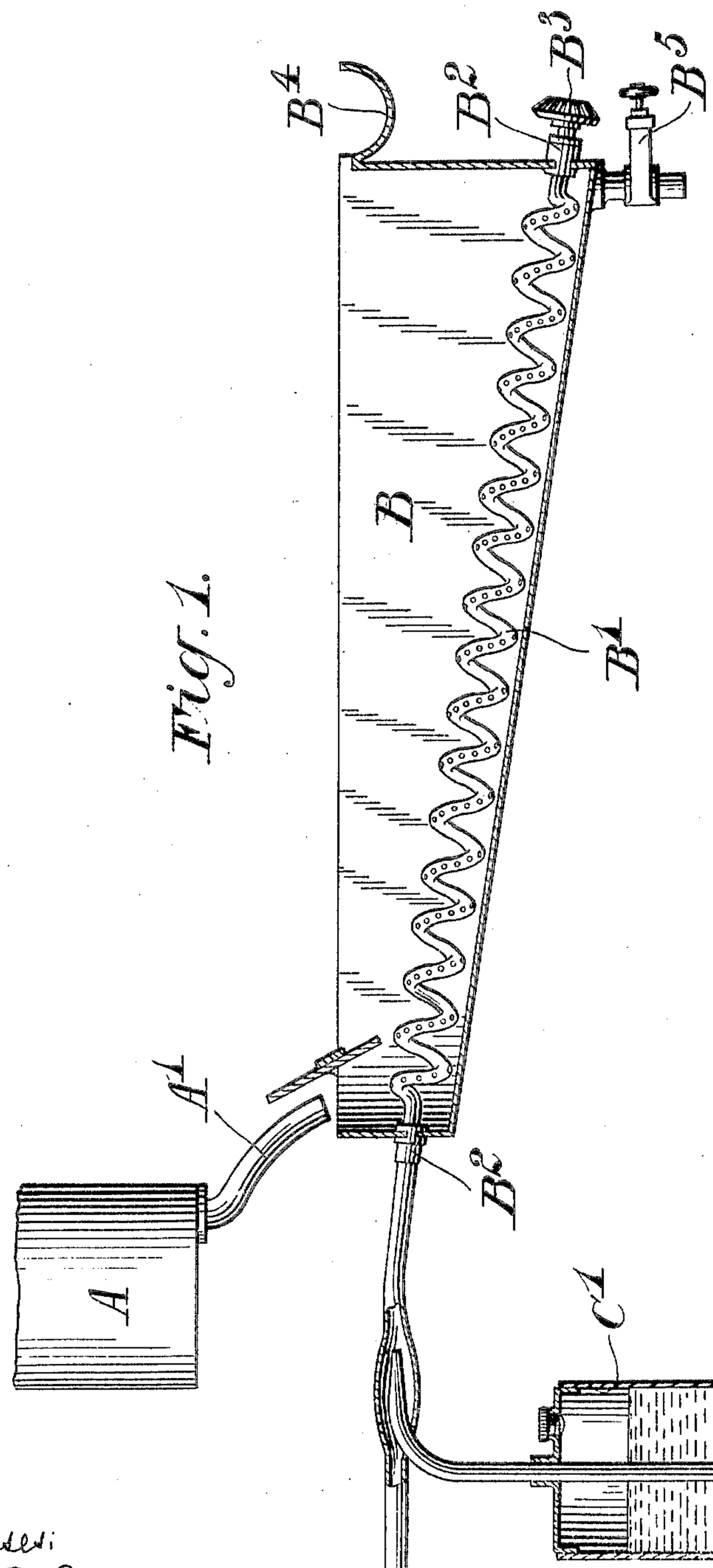
H. L. SULMAN & H. F. KIRKPATRICK-PICARD.

ORE CONCENTRATION.

APPLICATION FILED OCT. 5, 1903.

3 SHEETS- SHEET 1

Fig. 1.



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J. M. Stipnkoop.

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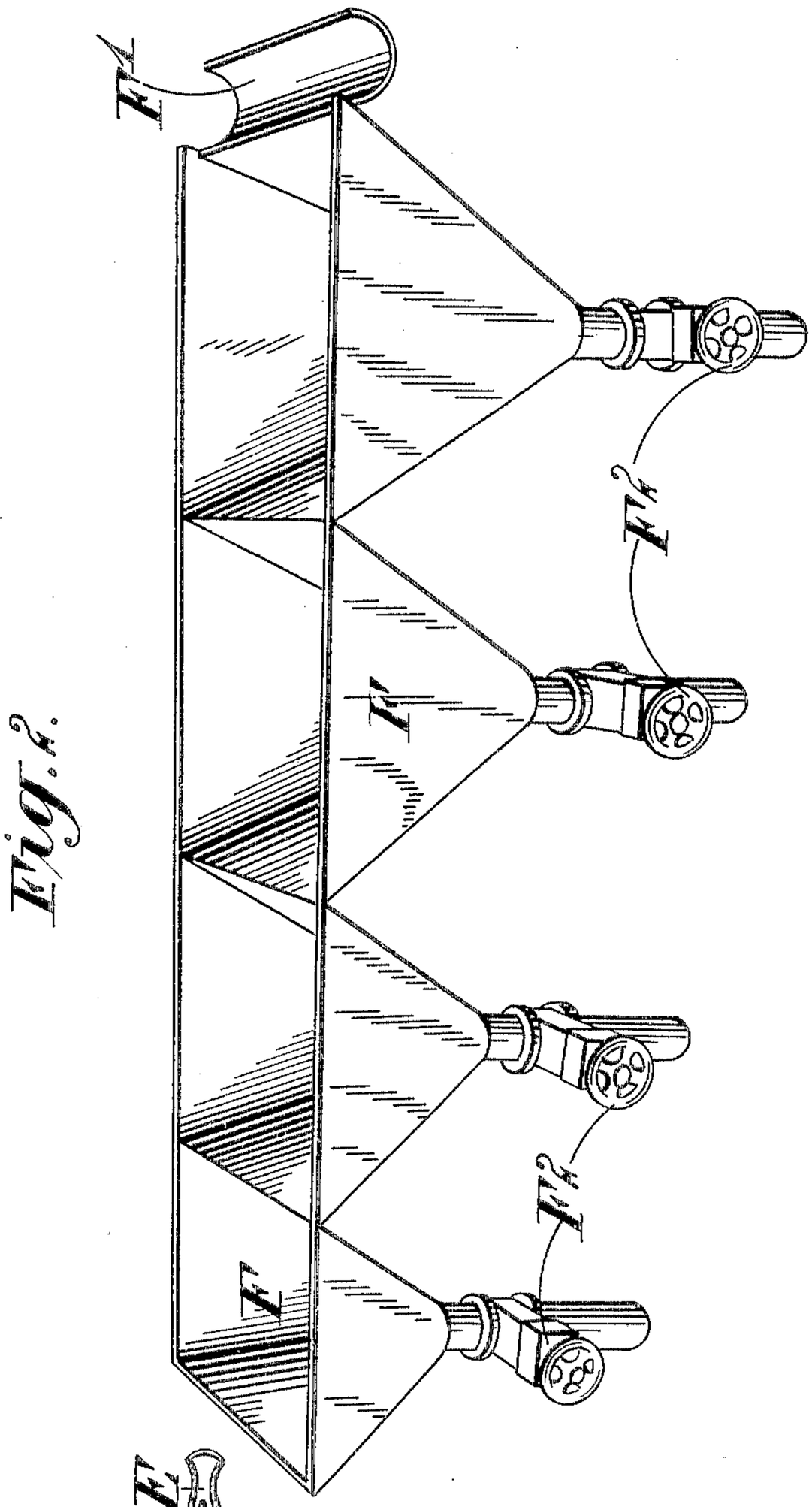

Fig. 2.

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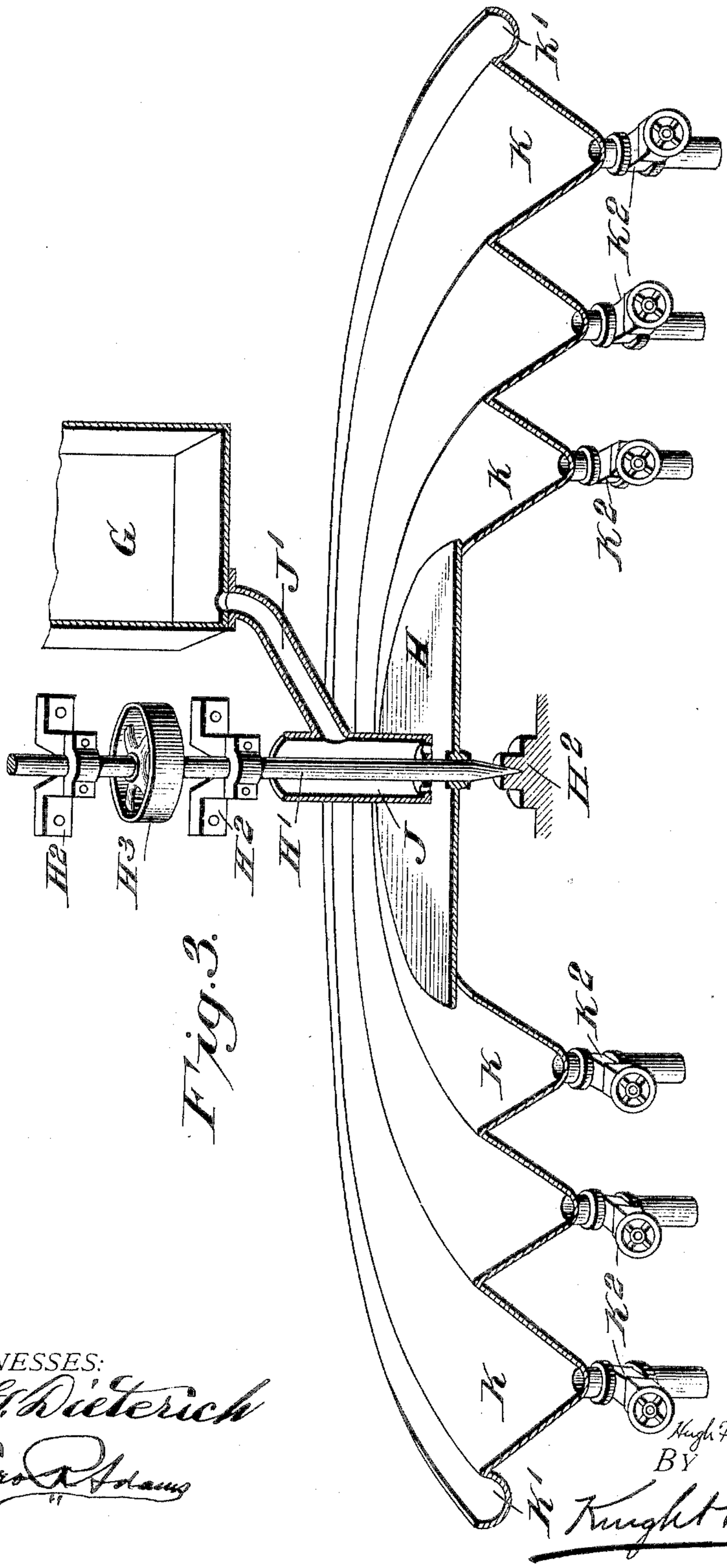

Fig. 3.

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No. 793,808. Patented July 4, 1905.

UNITED STATES PATENT OFFICE.

HENRY LIVINGSTONE SULMAN AND HUGH FITZALIS KIRKPATRICK-PICARD, OF LONDON, ENGLAND.

ORE CONCENTRATION.

SPECIFICATION forming part of Letters Patent No. 793,808, dated July 4, 1905.

Application filed October 5, 1903. Serial No. 175,871.

To all whom it may concern:

Be it known that we, HENRY LIVINGSTONE SULMAN and HUGH FITZALIS KIRKPATRICK-PICARD, subjects of the King of England, residing at London, England, have invented certain new and useful Improvements in or Relating to Ore Concentration, of which the following is a specification.

The present invention relates to the concentration of ores by separation of the metalliferous constituents and graphite, carbon, sulfur, and the like from the gangue by means of oils, grease, tar, or any similar substance which has a preferential affinity for metalliferous matter over gangue.

According to this invention we utilize the power which is possessed by films or bubbles of air or other gas of attaching themselves to solid particles moistened by oil or the like.

According to one method of carrying out our invention suitably-crushed ore is suspended in water. To this suspension a proportion of oil, grease, or tar (hereinafter referred to as "oil") is added and duly mixed with the mass by any suitable means in quantity insufficient to raise the oiled mineral by virtue of the flotation power of the oil alone. A suitable gas is now generated in or introduced into the mixture, such as air, carbonic-acid gas, sulfureted hydrogen, or the like. For example, bicarbonates or carbonates, either soluble or insoluble in water (preferably the latter) or easily-decomposable sulfids and the like may be used with acid solution. In such cases, if desired, the addition of acid may be made to the mixture after the addition of the gas-producing reagent. In the case of solutions containing free alkali the addition of acid sufficient to neutralize this must be made before the gas is produced. If desirable, gaseous bubbles may be produced by electrolytic methods or by means of various other known reactions.

According to another method of carrying out this invention the oil is not added alone; but the pulp is submitted to the action of a current of air or other gas bubbles, the air or other gas being first suitably charged either with the vapor of a volatile oil, such as petroleum of low boiling-point, or with the spray of any other suitable volatile or non-volatile or fixed oil or the like. The oil may be sprayed or reduced to a state of such fine division that minute globules of the same can remain temporarily suspended in an air or other gas current by the use of any suitable spraying or atomizing device and the air-current introduced into the ore-pulp, preferably at the bottom, by means of a pipe or pipes provided with suitable perforations or by other suitable contrivance. The minute oil globules or the condensed vapors or volatile oils attach themselves to the metalliferous particles in preference to the gangue.

The oiled metalliferous particles resulting from either of the processes above described have the power of attaching to themselves with a greater comparative strength than the gangue particles the films or bubbles of gas which exist in the mass and are thus raised to the surface of the liquor by gaseous flotation. They can then be removed by skimming or other suitable means. The gangue particles unwetted by oil or grease are not floated up with the oiled mineral particles, and thus in the main remain at the bottom of the vessel containing the mixture. The oil can then be removed from the oiled mineral by any suitable known means.

In the case in which oil-spray is used the temperature of the mass of pulp may be varied to secure the best results with spray of oils of varying viscosity. Instead of suspending the oil-spray in an air-supply system suitably-devised atomizing-jets operated by air or a jet of steam and air may be introduced directly into the pulp. The gas used may be other than air, such as carbonic acid, steam, or mixtures of these. We have also found that a particle of metalliferous mineral if coated with a minute film of oil, grease, or the like then exposed to air will not readily sink in water. It is therefore unnecessary in some instances to employ gaseous bubbles to effect flotation. For example, according to an alternative method for effecting the separation of metalliferous matter from gangue the metalliferous ore-pulp is intimately mixed

in any suitable manner with a small proportion of oil and then sprayed in as finely divided a state as necessary through air by means of jets, revolving disks, or otherwise, and the sprayed product is then allowed to fall upon the surface of water. The gangue particles wetted only with water at once sink, while the metalliferous particles coated with a thin film of oil and after exposure to air float on the surface of the water and may be removed by skimming or other suitable means. Before bringing the pulp into the necessary contact with air it will be obvious that the bulk of the water may first be removed by subsidence or any other suitable means.

In the accompanying drawings, Figure 1 is a diagram in longitudinal section of an apparatus suitable for carrying out this process. Fig. 2 is a diagram in perspective, partly in section, of another form of suitable apparatus; and Fig. 3 is a diagram in perspective, partly in section, of an alternative form of apparatus.

Referring to Fig. 1, A is a tank for pulp, which delivers through a pipe A′ to a concentrating-tank B, the bottom of which slopes downward from the inlet. The tank B is provided at the bottom with a coiled pipe B′, suitably perforated, supported in bearings B^2, and arranged to be rotated by means of a spur-wheel B^3 or the like. Air is forced into this pipe B′ through a pipe C, and oil is simultaneously introduced into the pipe C from a carbureter or the like C′. At the end of the tank B farthest from the pulp-inlet a launder B^4 is placed to receive the discharge of floating material, and an outlet-tap B^5 is provided at the lowest point of the tank.

Referring to Fig. 2, D is a tank in which pulp and oil are mixed, and the mixture passes through an outlet-tap D′ to an ejector E, through which air under pressure is passed by the pipe E′. The spray of pulp, oil, and air falls into a tank F, filled with water and consisting of a series of communicating pointed boxes, which increase in depth from the inlet end. A launder F′ is provided at the outlet end of the tank, and outlet-taps F^2 are placed at the lowest points of the boxes.

Referring to Fig. 3, G is a tank in which pulp and oil are mixed. H is a circular disk attached to a vertical spindle H′, supported in bearings H^2 and arranged to be rotated through a driving-pulley H^3 or the like. Surrounding the spindle is a cylindrical collar J, connected with the tank G by a pipe J′, so that the pulp and oil are fed through the collar to the rotating disk. Surrounding the disk is a series of annular pointed troughs K, communicating with one another and increasing in depth toward the outside and filled with water. A launder K′ is provided at the periphery of the outside trough to receive the discharged floating material, and outlet-taps K^2 are placed at the lowest points of the troughs.

This process has been described as applied to ore concentration by oil; but it is to be understood that it is equally applicable to concentration by the use of any other substance which has an affinity for metalliferous matter.

We claim—

1. The herein-described process of concentrating ores which consist in bringing the pulp into intimate contact with "oil" in the form of spray and with a gas and thereafter separating the metalliferous constituents from the gangue.

2. The herein-described process of concentrating ores which consists in bringing the pulp into intimate contact with "oil" disseminating the mixture through air and thereafter separating the metalliferous constituents from the gangue in water.

In testimony whereof we have signed our names to this specification in the presence of two subscribing witnesses.

HENRY LIVINGSTONE SULMAN.
HUGH FITZALIS KIRKPATRICK-PICARD.

Witnesses:
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WALTER J. SKERTEN.