No. 644,180. Patented Feb. 27, 1900.

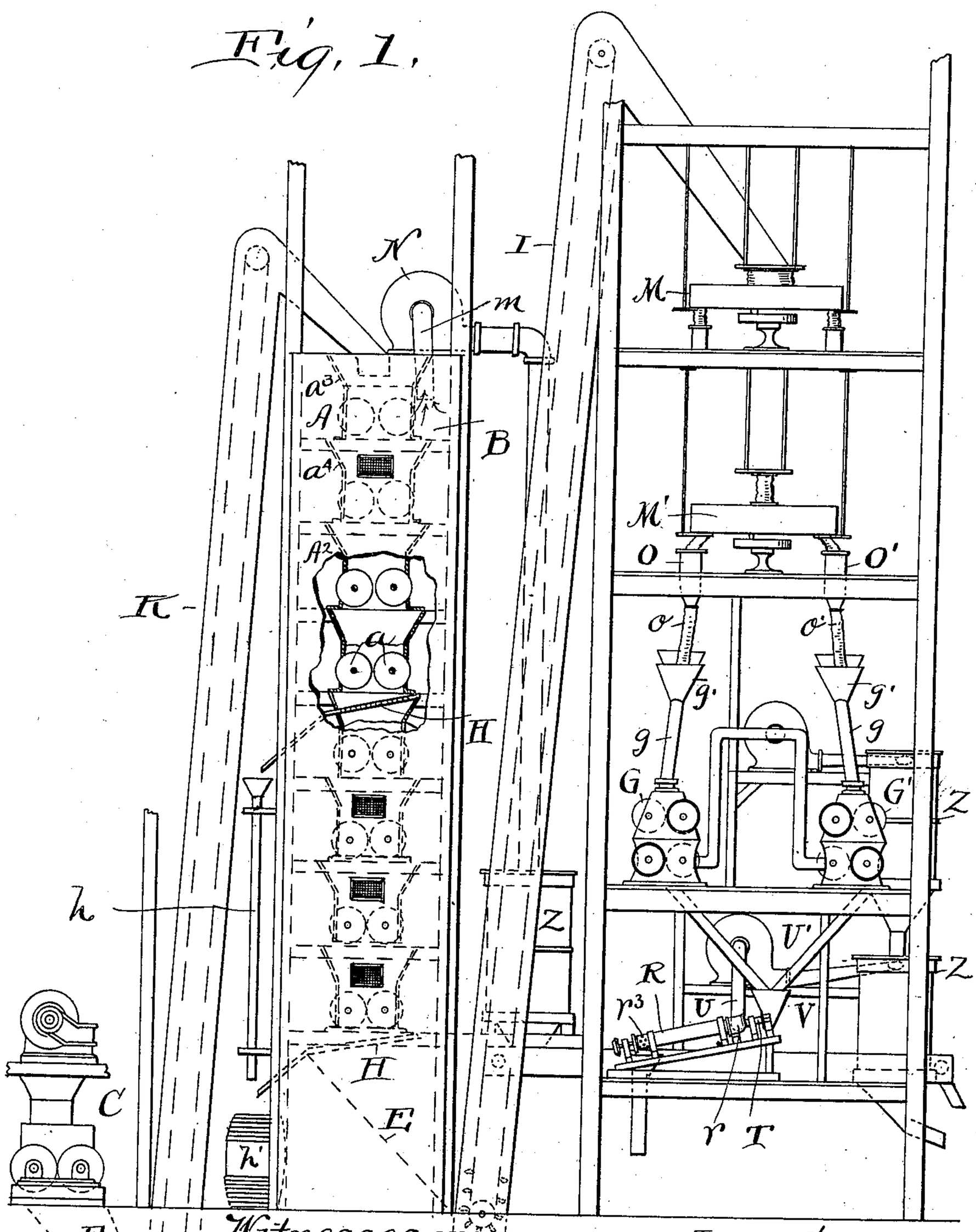
C. H. LANE.

APPARATUS FOR SEPARATING MALLEABLE METAL FROM ROCK, &c.

(Application filed Aug. 27, 1898.)

(No Model.) 4 Sheets—Sheet 1.

Fig. 1.



Witnesses.
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Philip E. Knowlton

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(No Model.) 4 Sheets—Sheet 2.

Fig. 2.

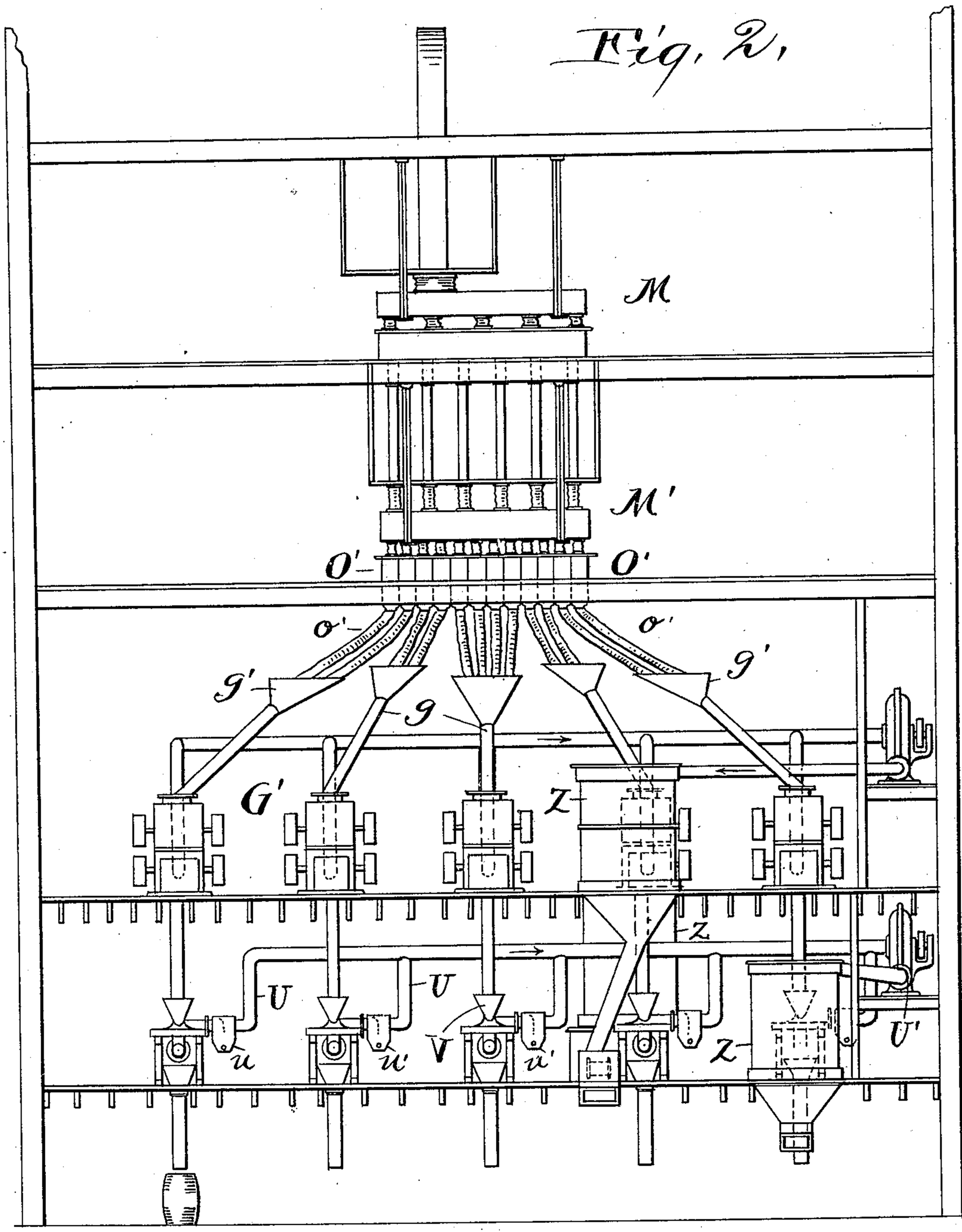

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Fig. 3.

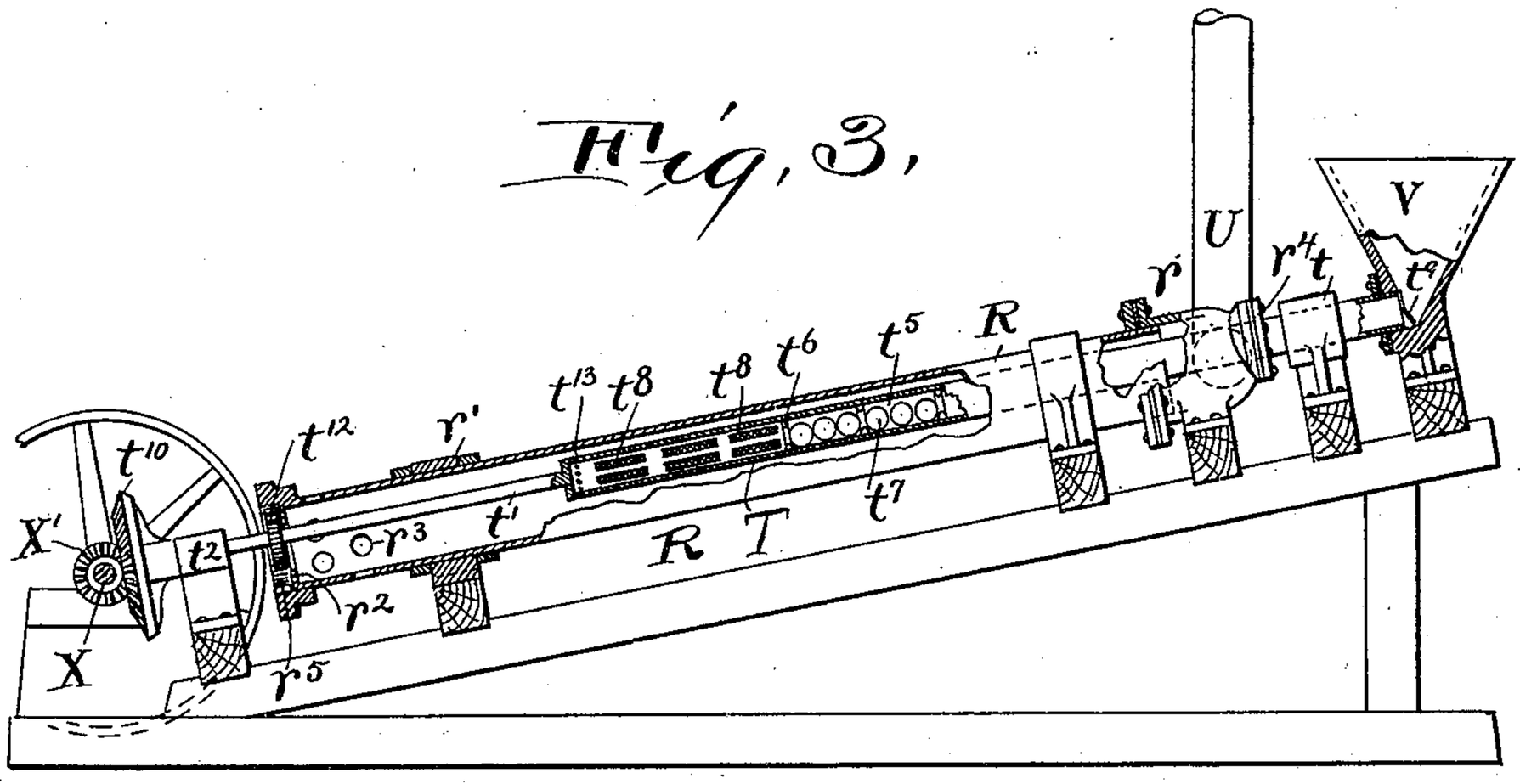
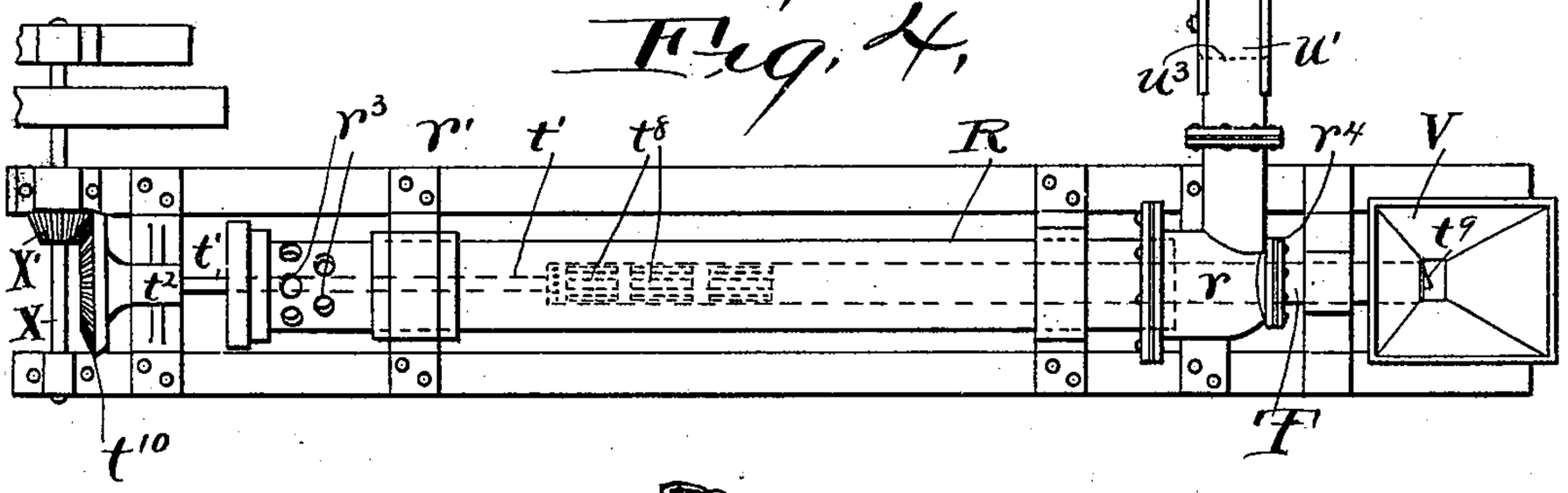


Fig. 4.



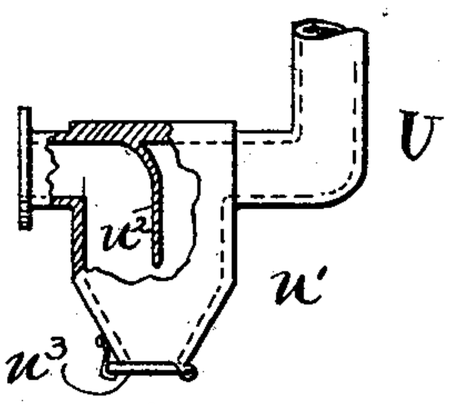


Fig. 5.

Fig. 6.

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Fig. 7.

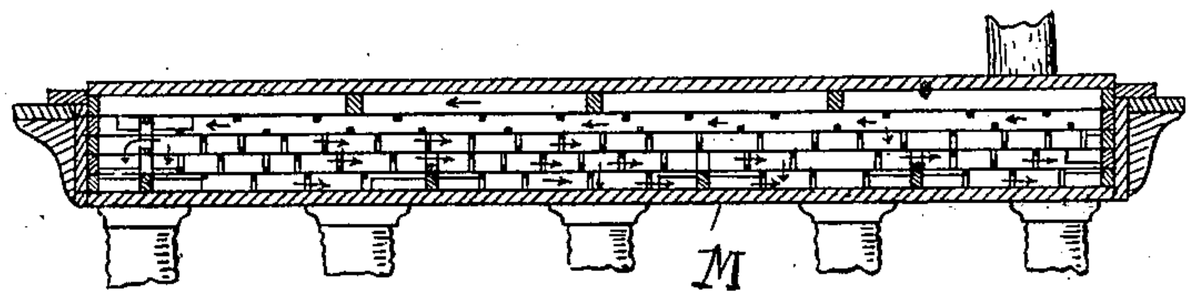
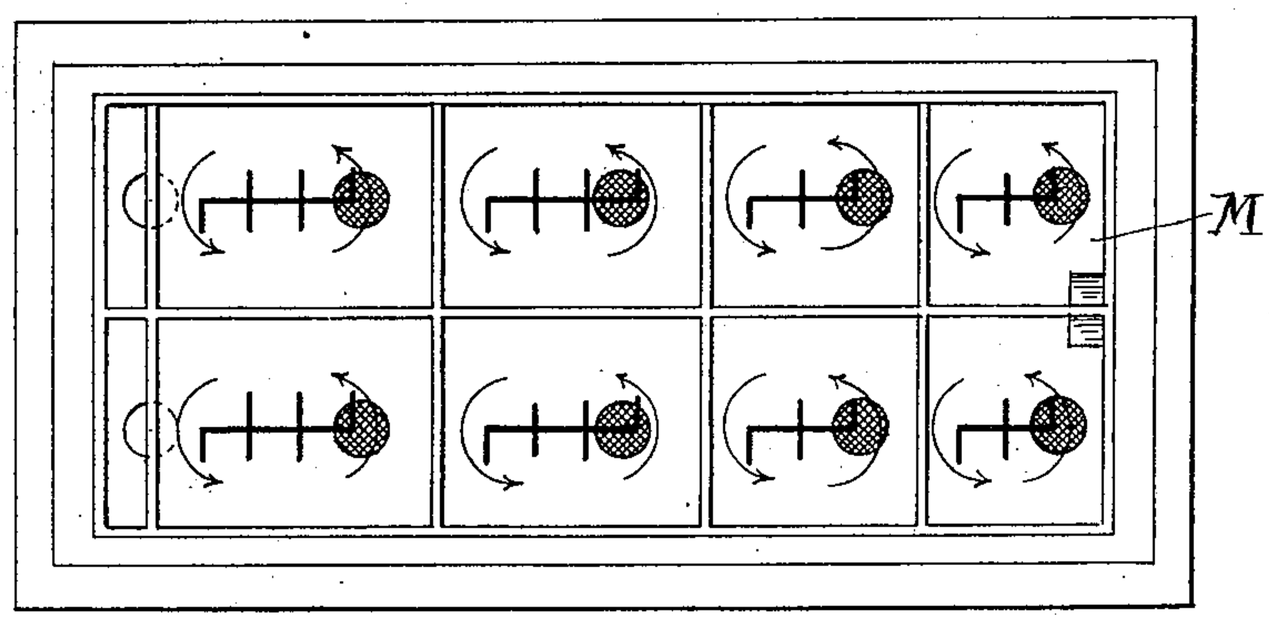


Fig. 8.



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UNITED STATES PATENT OFFICE.

CHARLES H. LANE, OF CLEVELAND, OHIO.

APPARATUS FOR SEPARATING MALLEABLE METAL FROM ROCK, &c.

SPECIFICATION forming part of Letters Patent No. 644,180, dated February 27, 1900.

Application filed August 27, 1898. Serial No. 689,682. (No model.)

To all whom it may concern:

Be it known that I, CHARLES H. LANE, a citizen of the United States, residing at Cleveland, in the county of Cuyahoga and State of Ohio, have invented a certain new and useful Improvement in Apparatus for Separating Malleable Metal from Rock, &c., of which the following is a full, clear, and exact description, reference being had to the accompanying drawings.

The invention relates to the separation of malleable metals, particularly copper, from the rock, sand, or gravel with which they are mixed as found with nature.

The object of this invention is to provide an apparatus into which the material as found in nature may be delivered and wherein this material will be acted upon by various instrumentalities into which it is successively and automatically delivered, with the result of segregating the metal from the rock and of saving the former either as pure metal or as a concentrate.

The invention consists in the construction and combination of parts contained in the apparatus which automatically effects the results stated in proper sequence, all substantially as shown in the drawings and hereinafter described, and pointed out in and by the claim.

In the drawings, Figure 1 is a front elevation of the apparatus. Fig. 2 is an end view of the right side of the apparatus. Fig. 3 is an enlarged side view, partly broken away, of one of the air-separators. Fig. 4 is a plan view of the same. Fig. 5 is an enlarged view of one of the settling-chambers. Fig. 6 is a detached perspective view of the feeding device on the cylinder T. Figs. 7 and 8 are respectively a sectional side elevation and a sectional plan of a plansifter suitable for employment as a part of the apparatus shown herein.

The apparatus includes a bank or roller crushing-machines A A′ A^2, &c., arranged at different elevations and relatively so placed that each machine discharges its product to the action of the next machine below it. As shown, these machines are supported one above another in a closed tower B. These roller crushing-machines are of familiar construction and include a pair of driven rolls a a and means, as hoppers a^3 a^4, for delivering the material to the action of such rolls. The distance between the rolls of each pair is a trifle less than the distance between the rolls of the pair which is next above it and which precedes it in acting upon the material. In practice I believe it to be the best to employ about eight machines in the bank of machines and to place the rolls in the first machine one-half an inch apart and to reduce the distance one-sixteenth of an inch in each succeeding machine. The rolls in the last machine will therefore be one-sixteenth of an inch apart. It is clear, however, that any number of such machines may be employed and that the distance between the rolls in the successive machines may be lessened by any suitable amount, these being details which will be regulated to best adapt the apparatus to the particular kind of material with which it is to be used.

It is necessary to deliver the material to the top machine in condition to be properly operated upon by it, and to that end preliminary crushing-machines C of any construction and number may be employed, provided they are adapted to reduce the particular material to the proper size. The material, if of the proper size without preliminary crushing, is placed in a hopper F. If preliminary crushing is necessary, the machines C discharge into this hopper. An elevator K, preferably of the bucket type, takes the material from this hopper and discharges it into the hopper a^3 of the upper roller crushing-machine A. As the material passes through this machine the rock is crushed and all of the particles of metal too large to pass between the rollers otherwise are flattened out. A similar action takes place in the next crushing-machine, into the hopper a^4 of which the product of the first machine is delivered.

Inclined screens H are placed at intervals between two machines, so that the product of the upper machine will fall upon them, and the material which passes through the screens will fall into the hopper of the next machine. The mesh of the screen is such that substantially all of the crushed rock may pass through it, but the flattened-out pieces of metal cannot. This metal slides down the screen, which passes out through the wall of the tower, and

is discharged into a chute *h*, through which it passes to a suitable receptacle *h'*.

There may be as many screens as the nature of the material being worked requires. These screens are placed at suitable places—viz., below a pair of rolls, whereby the metal has been so spread out by the flattening operation that it will not readily go through the next pair of rollers or where the quantity of flattened metal is so great that its removal is desirable. Two of such screens are shown in the drawings.

The closed tower B, in which the roller crushing-machines A A', &c., are placed, has connected to its top a blower-pipe *m*, through which the dust produced in the crushing operations in the tower is drawn out by a fan N.

When the material is discharged from the lower machine into the hopper E, all of it is reduced to a size not greater than the distance between the last pair of rolls—viz., one-sixteenth of an inch—and much of it is finer. Some of the particles of metal, however, are so small that they have not been flattened at all in passing through these machines.

It is necessary to the successful operation of the air-separators to be presently explained that the material upon which each operates shall consist of flattened-out or flake metal and rock particles smaller than the copper. Therefore much (probably all) of the material must be again passed through crushing-rolls; but rolls placed at a certain distance apart might produce this result with respect to the larger particles of the material, while they would not act at all upon the smaller particles, or if the rolls were placed near enough to properly act upon the smallest particles they would be so near that they would either crush the larger particles unnecessarily fine or they would not permit said larger particles to pass at all. The roller crushing-machines G G', &c., through which the material is passed before it reaches the air-separators, are therefore made to differ from each other in the distance between the crushing-rolls, and suitable materials are delivered to each of said machines, of which there may be any number. To obtain suitable material for the several machines G G', &c., the product of the bank of rolls A A', &c., is graded by means of one or two plansifters M M' or their equivalents. The plansifter may be of any suitable construction. In the drawings in Figs. 7 and 8 I have shown in a sectional side elevation and a sectional plan view a plansifter suitable for the purpose. The plansifter so shown in the drawings is substantially the same as the plansifter shown in Figs. 25 to 27 of the Haggenmacher Reissued Patent No. 11,252, dated July 28, 1892. The product of the roller crushing-machines A A', &c., having been delivered into the hopper E is raised and delivered to the upper plansifter M by any suitable elevator I, which is preferably of the bucket type. The plansifters are constructed, preferably, to produce about twenty-four grades of the material. There may, however, be employed a less number of roller crushing-machines G, and in such case two or three grades of the material most nearly alike will have to be fed to one of these machines. The number of grades of material to be mixed for each machine G and what grades will be so mixed will depend upon the quantity of the several grades. For example, if there is enough of what we may call the "No. 1" grade to supply one machine only that grade will be fed to the machine adapted to act upon it; but if the quantity of the Nos. 1, 2, and 3 grades when mixed together is only sufficient for one machine such grades will be mixed and fed to said machine. Means are therefore provided for mixing different grades which come from the plansifter in accordance with the necessity of the case, as above indicated. For example, each grade of the material is discharged into one of the independent hoppers O O', &c. The feed-pipe *g* for each machine G G', &c., has a funnel-shaped upper end *g'*, each of which is placed adjacent to several of the hoppers O O', &c. The material is discharged from these hoppers through flexible pipes *o o'*, &c., the lower ends of which may be secured within that funnel into which it is desired to discharge the material.

It is clear that the products of the several crushing-machines G G', &c., will differ from each other in fineness, but that they will be alike in character—that is to say, said product will be made up of flattened metal particles and particles of rock which are finer and lighter than said particles of metal.

Associated with each of the crushing-machines G G', &c., is an air-separator, which is constructed substantially as hereinafter described. Each of these air-separators is especially adapted to the material to be acted upon, the differences being in one or both of the following particulars, viz: first, in the force of the air-current employed, and, second, in the width of the mesh of the screens through which said material is sifted to the action of the air.

Each air-separator is constructed and operates as follows: An inclined cylinder R is rotatably mounted in bearings *r r'*. The upper bearing *r* is hollow, and the open end of cylinder R projects into it a short distance. A pipe U is connected with this hollow cylinder *r*, and a fan U', connected to said pipe, acts to draw an air-current through cylinder R and out of its upper end. The lower end of cylinder R is as nearly closed as practicable by an internal ring r^2. In the walls of this cylinder, near the lower end, are the holes r^3. Inside of the cylinder R and preferably above its axis is a second inclined cylinder T, whose upper end projects through the end plate r^4 on the end of the hollow bearing *r* and is mounted in a bearing *t*. The shaft *t'* is connected with the lower end of this cyl-

inder and forms an axial continuation thereof, this shaft being mounted in the bearing t^2. The open upper end of the cylinder T projects into the hopper V, into which the product of the associated machine G is discharged, and some device, preferably a spiral wing t^9 on the end of said cylinder, is provided for drawing the material out of the hopper into said cylinder. The inner cylinder T is rotated by the beveled gears t^{10} and X′ on the shaft t' and driven shaft X, respectively. The outer cylinder is rotated by the pinion t^{12} on shaft t' and the internal gear r^5 on cylinder R.

The inner cylinder for a short distance from its upper end is plain. Then for some distance it is divided into pockets t^5 by internal rings t^6. In each pocket are several balls t^7. The lower end of the cylinder T is a skeleton covered with screen t^8, which may be wire or bolting cloth. Three or more different kinds of screen are preferably used. That which surrounds the cylinder next to the pockets is the finest, and each succeeding section is coarser than that above it.

The material drawn into the cylinder T at its upper end slides down as the cylinder is revolved, entering the different pockets successively over the partitions or internal rings t^6. The balls in those pockets act to separate the particles of the material which may have become matted together until finally the material in a powdery condition tails over the last ring into the screen-covered part of the cylinder. Some of the material will sift through the first screen into cylinder R, which may be regarded as a convenient form of air-blast chamber. It is mostly rock-dust, however, which falls through the first screen, and this dust is caught by the air-current passing through the same and carried out by this current through the pipe. When the material passes onto the next screen, that which is sifted through contains some of the metal flakes. The rock-dust in the material which sifts through is blown away, as before, while the flakes of metal fall onto the bottom of the chamber formed by the cylinder R. The same action takes place with respect to the material which is sifted through the other screens which cover the cylinder. The residue, which will be nearly pure metal, passes out through holes t^{13} in the cylinder T into cylinder R. All of the copper which has fallen into cylinder R makes its way to the lower end of said cylinder as the latter revolves and falls out through the holes r^3 or the open lower end thereof.

The force of the air-current in the several air-separators will be graduated to the material being acted upon—that is to say, the current will be least strong in that air-separator which is associated with that one of the crushers G which is crushing the finest. The rock-dust blown out may be carried and delivered into suitable dust-collectors Z.

A settling-chamber u' is connected in and hangs below the pipe U. It contains a transverse partition u^2, which compels the air-current to dive under it and pass through the said chamber. If, as will generally be the case, the air-blast has caught up and carried away some of the metal flakes, these, together with the heavier particles of the rock-dust, will settle down in this chamber, from which this deposit may be removed from time to time through a bottom gate u^3. The material so removed may be returned to the apparatus at any convenient point, preferably where the material is passing to the plansifter, wherefrom it will pass with the other material through the succeeding mechanism.

Having described my invention, I claim—

In an apparatus for separating malleable metal from rock, the combination of a plurality of pairs of crushing-rolls arranged one above another whereby the product of one pair of rolls is delivered by gravity to the action of the next pair below it, a hopper into which the lowest pair of rolls discharges, a plansifter for grading the product of said rolls into various grades, an elevator adapted to automatically lift the material out of said hopper and deliver it to said plansifter, a plurality of pairs of subsequent crushing-rolls, and means for mixing the several grades of the material as desired and delivering severally to the last-mentioned pair of crushing-rolls the said mixtures of the several grades of material, substantially as and for the purpose specified.

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

CHARLES H. LANE.

Witnesses:

E. L. THURSTON,

W. W. WALLACE.