

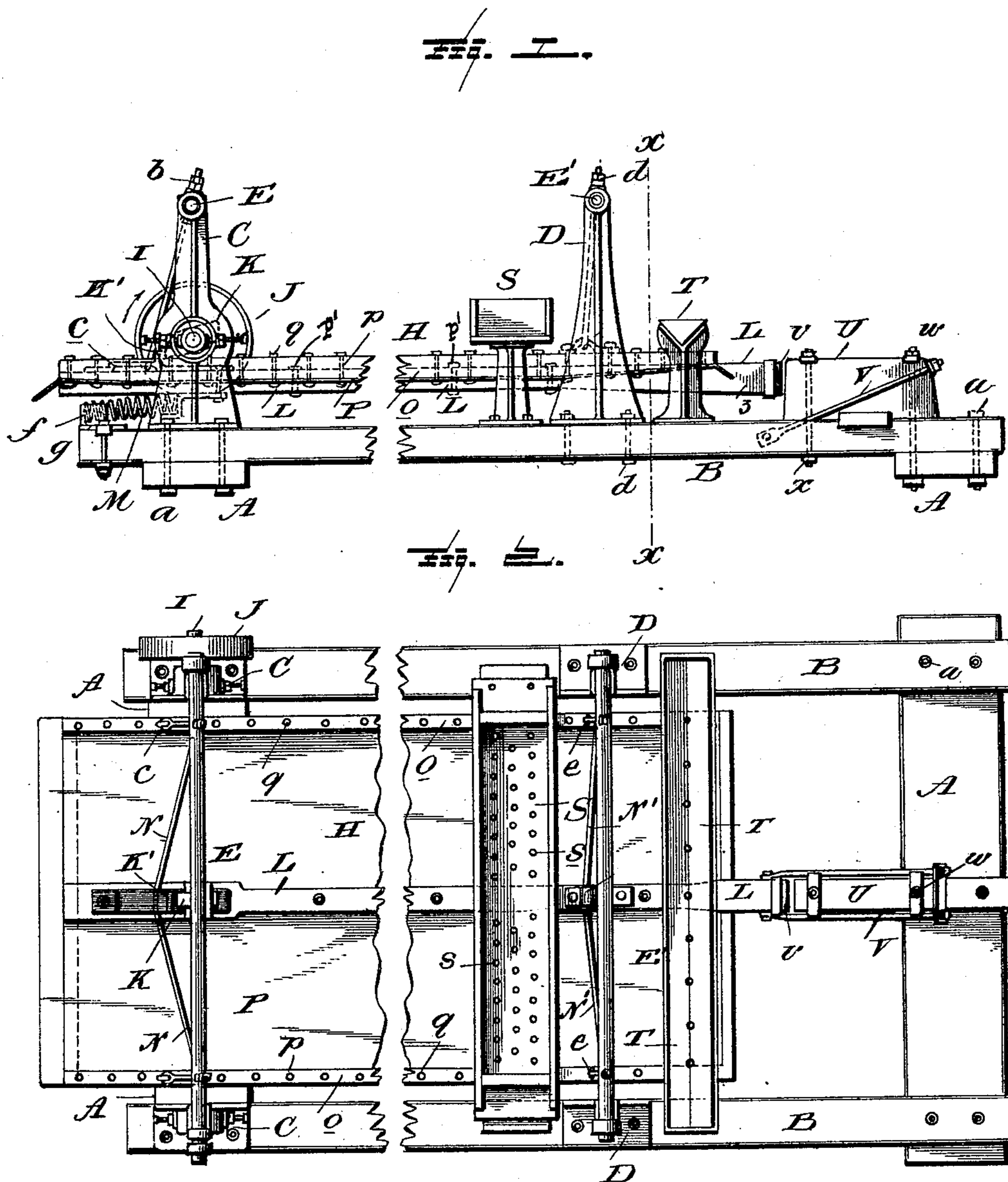
(No Model.)

2 Sheets—Sheet 1.

W. H. H. BOWERS.  
ORE CONCENTRATOR.

No. 481,101.

Patented Aug. 16, 1892.



Witnesses

L. C. Mills  
J. B. Keefe

Inventor

Wm. H. Bowers  
by *Edw. L. S. Dick*  
his Attorney

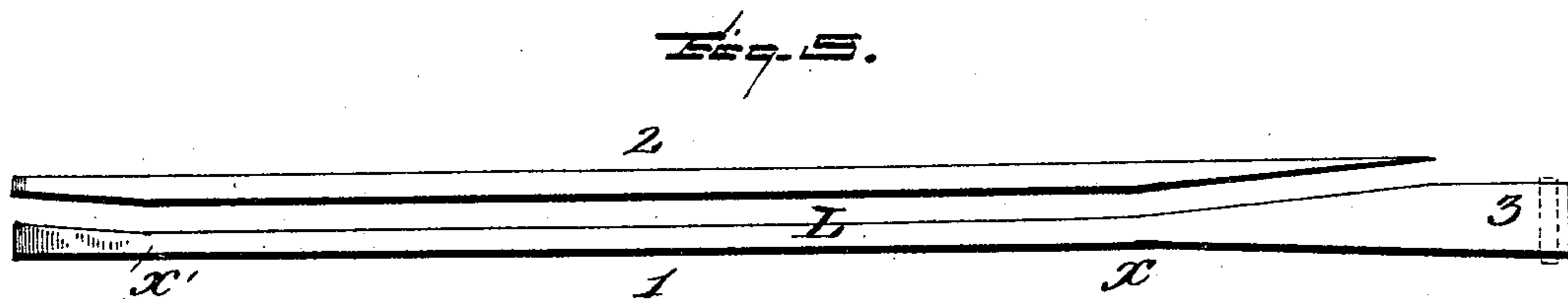
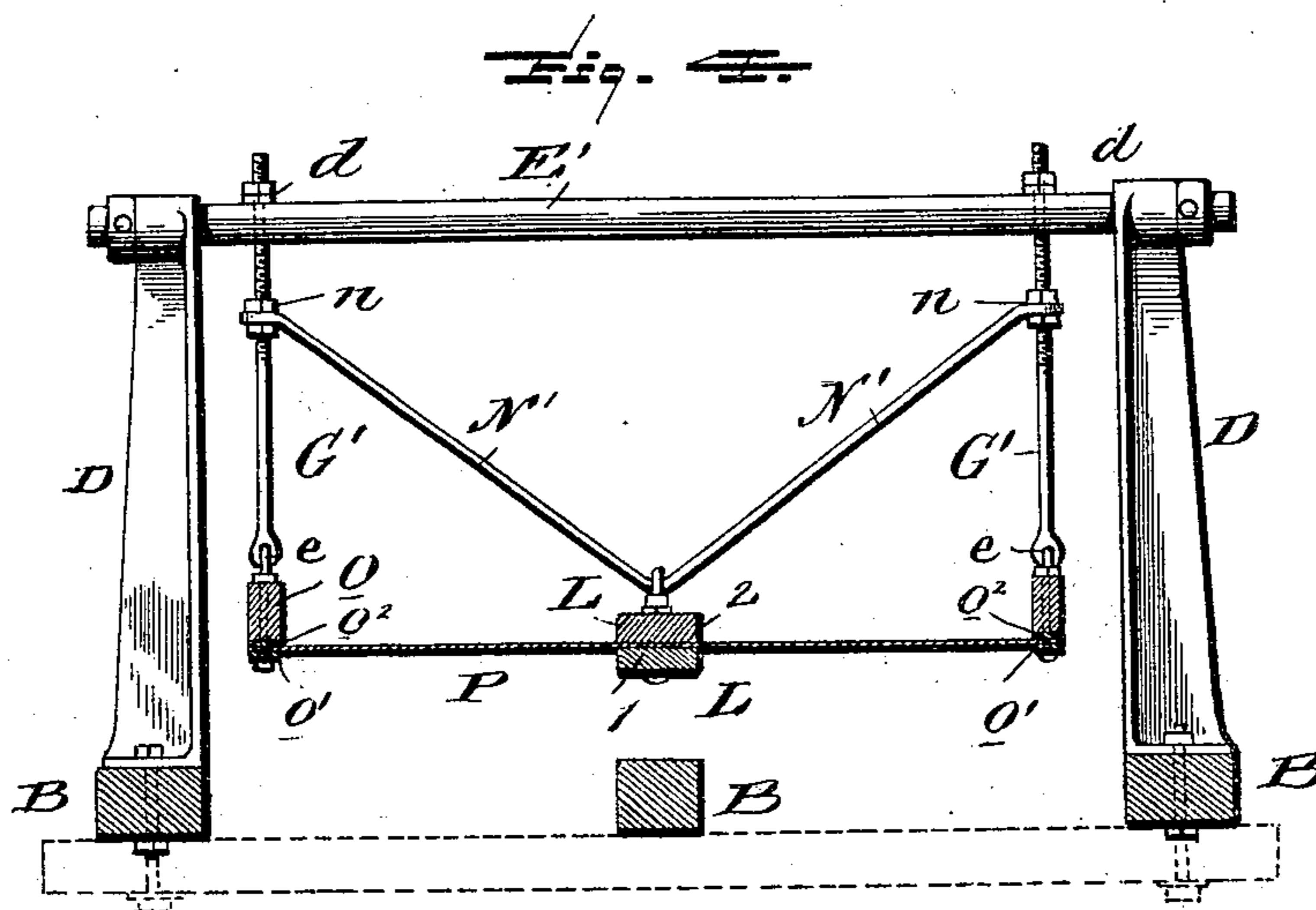
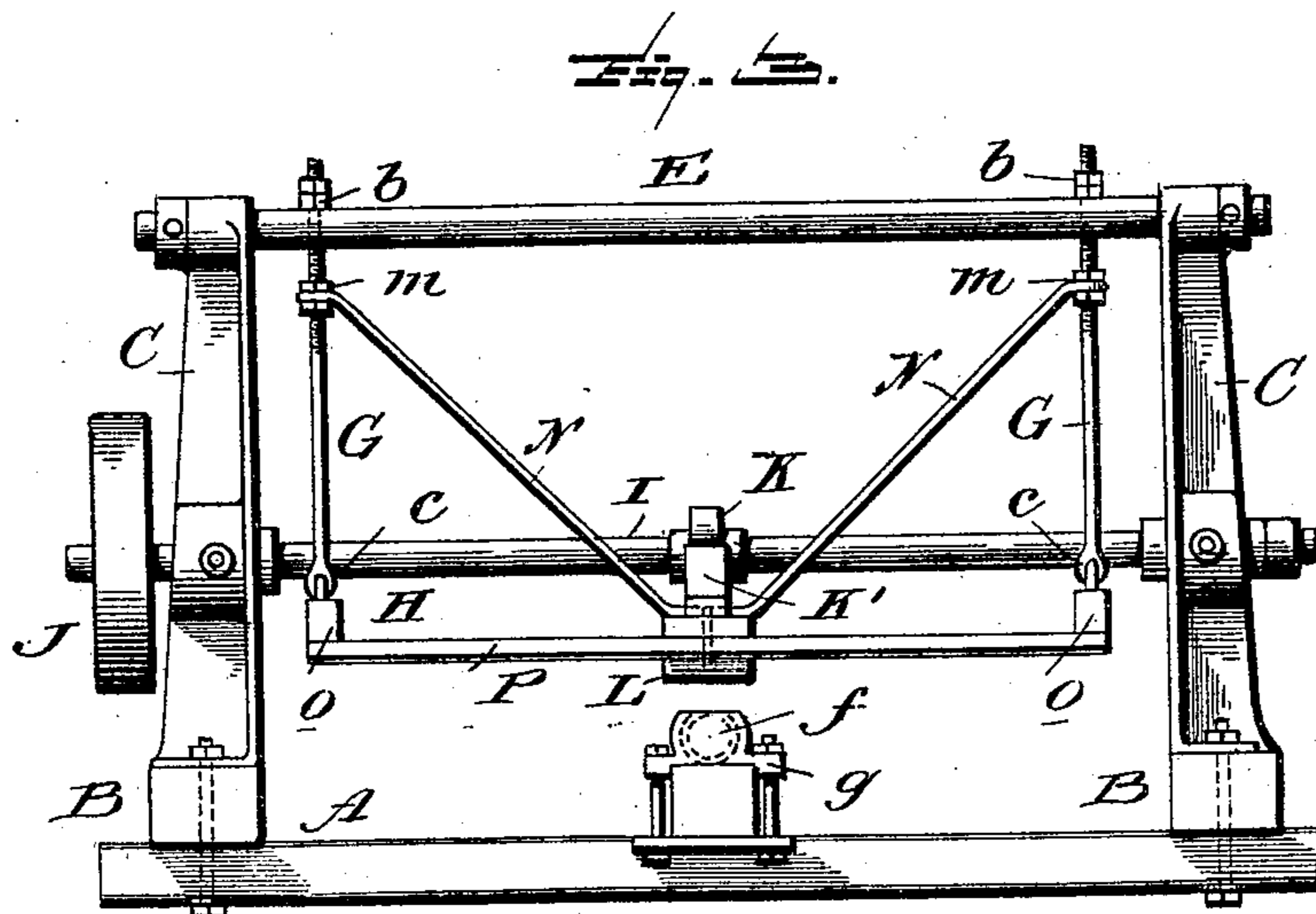
(No Model.)

2 Sheets—Sheet 2.

W. H. H. BOWERS.  
ORE CONCENTRATOR.

No. 481,101.

Patented Aug. 16, 1892.



Witnesses  
L. C. Mills  
J. B. Keefe

Inventor  
Wm. H. Bowers  
by Edw. A. Dick  
his Attorney

# UNITED STATES PATENT OFFICE.

WILLIAM H. H. BOWERS, OF DENVER, COLORADO, ASSIGNOR OF ONE-HALF  
TO THE COLORADO IRON WORKS, OF SAME PLACE.

## ORE-CONCENTRATOR.

SPECIFICATION forming part of Letters Patent No. 481,101, dated August 16, 1892.

Application filed February 12, 1892. Serial No. 421,287. (No model.)

*To all whom it may concern:*

Be it known that I, WILLIAM H. H. BOWERS, of Denver, in the county of Arapahoe, State of Colorado, have invented certain new and  
5 useful Improvements in Ore-Concentrators; and I do hereby declare that the following is a full, clear, and exact description of the same.

This invention relates to certain new and useful improvements in ore-concentrators;  
10 and it consists, substantially, in such features of construction, arrangement, and combinations of the parts of the apparatus as will hereinafter be more particularly described, and pointed out in the claims.

15 The object of the invention, primarily stated, is to separate the valuable particles of crushed or powdered ore from the worthless or valueless gangue matter found in the ore by what is known as the "wet" process  
20 of concentration.

A further or secondary object of the invention is to provide an ore-concentrator which shall effect the concentration of the metallic portions of the ore much more effectively than  
25 has been accomplished in many instances heretofore, as well, also, as to provide a concentrator which shall always be reliable in operation and one in which the concentration shall be effected quickly and without the employment of skilled labor in the management  
30 or control thereof.

A still further object of the invention is to provide an ore-concentrator of the character referred to which shall be constructed of a  
35 comparatively few working parts, and one which shall produce maximum results in a given time, all as will more fully hereinafter appear, when taken in connection with the accompanying drawings, wherein—

40 Figure 1 represents a side elevation of an ore-concentrator constructed and arranged in accordance with my invention, portions thereof being shown by dotted lines, so as to more clearly indicate the same. Fig. 2 is a top or  
45 plan view, and Fig. 3 is an end view, of the same; and Fig. 4, a vertical sectional elevation taken on the line  $x x$  of Fig. 1. Fig. 5 is a detail view of the center or bumper beam.

In carrying my invention into effect I provide a suitable longitudinal base or support

for the entire structure, extending upwardly from which at a suitable distance from each end is a set of vertical supports or uprights, between which is suspended the ends of a longitudinally-reciprocating table, the said  
55 supports being suitably secured to the base by means of strong bolts and nuts. The said table is given a longitudinal reciprocating movement by the employment of suitable actuating mechanism, hereinafter described, 60 and the crushed or powdered ore is supplied thereto simultaneously with the supply of a sufficient quantity of water for effecting the desired concentration of said ore. The central beam and the bottom of the swinging or  
65 longitudinally-reciprocating table is of peculiar construction, as will hereinafter be more particularly explained, and by virtue of such construction the improved results of my invention are accomplished. 70

Reference being had to the annexed drawings by the letters and figures marked thereon, A A represent base-ties, upon which the base or beams B B are held, and secured by means of the bolts and nuts  $a a$ , the said base or beams  
75 B B preferably being a little longer than the apparatus itself and extending lengthwise of the same in the manner shown. Supported on said base or beams a suitable distance from the tail or lower end is a pair of vertical or upright supports C C, while supported  
80 in like manner a suitable distance from the head or higher end is another pair of similar supports D D, the said supports being united at the top by cross-bars E and E', respectively. 85 The said cross-bars E and E' constitute, practically, two rock-shafts, since in the operation of the apparatus they are caused to rock in their bearings, so as to impart to the concentrator a swinging or longitudinally-reciprocating motion. Hence on referring to said  
90 parts they will be called "rock-shafts," they (the rock-shafts) having loose bearings in the upper ends of the vertical or upright supports C C and D D. Fitting within the said rock-shaft E and vertically adjustable therein by means of the nuts  $b b$  are two hangers or rods G G, to the lower ends of which the sides of the swinging or reciprocating table H are secured at near one end in any suitable man- 100

ner, preferably by the links or eyes *c c*, as shown. Similar hangers or rods *G' G'* pass through the rock-shaft *E'*, and are also adjustable therein vertically by means of the nuts *d d*, these hangers or rods *G' G'* being also secured in like manner to the sides of the table at a suitable distance from the opposite end thereof, the connecting links or eyes in this instance being marked *e e*.

Having its bearings in the supports *C C* is a drive shaft *I*, on one end of which is attached or secured a drive-pulley *J*, to which may be fitted a suitable driving-belt from any preferred source of motive power—such, for instance, as a small engine. The said drive-shaft *I* has mounted thereon centrally a cam or dog *K*, which comes in contact with a small tappet or projection *K'*, arranged on or secured to the rear end of a central bumper-beam *L*, which extends longitudinally of the swinging table or concentrator, and it is in this way that the said table receives its longitudinal reciprocating motion. The central beam *L* is made from a piece of timber, substantially square in cross-section, of suitable length and is sawed or cut so as to form two parts *1 2*. (See Fig. 5.) The forward or higher end *3* of the lower part *1* is the full thickness of the timber and gradually inclines inwardly or rearward for a suitable distance. That section of the lower part *1* between *x* and *x'*, which is the central part thereof, is substantially flat and of the same thickness throughout, and from *x'* to the rear end or lower part the timber gradually thickens, so as to form a slightly-inclined end, as shown in the drawings. The upper part *2* and lower part *1*, it will be seen, when put together form a timber substantially square in cross-section. The under side of the lower part *1* is also cut away, as seen in Fig. 5, so as to make the center portion thereof thinner than the parts nearer the ends. In this way the greatest amount of flexibility is obtained and the central or thinned-out portion of the bumper-beam is rendered extremely sensitive to any jarring and vibrates in vertical directions rapidly and unceasingly during the operation of the machine.

As shown in Figs. 1 and 5, the central beam *L* as a whole tapers slightly toward the rear or tail end of the concentrating-table—that is to say, while its central portion is the thinnest part its rear end is not so thick as is its front end. The object of this construction is to obtain rigidity at the higher or fore end, extreme flexibility at the center, and less flexibility at the lower or tail end of the concentrator-table.

Secured at one end to a bracket *f*, which is attached to a small block *g*, arranged centrally between the beams *B B* and in line with the beam *L* of the table, is a coiled spring *M*, the other end of which spring is secured to the underside of the bumper-beam *L* at the rear end of the table. On the backward lunge or movement of the said table this spring will be compressed, and then as the table starts to return

the spring will accelerate such return by its expansive force. In reverse manner when the table has been brought forward and reached the extent of its return movement the said spring will have become lengthened or distended and by its retractive force will also assist the table in its return from its forward movement. In this way a continuous, regular, and uninterrupted reciprocating movement of the table will be had between the vertical supports. The central bumper-beam *L* is supported a suitable distance from each end by means of diagonal hangers *N N* and *N' N'*, such hangers being adjustable at their upper ends on the rods *G* and *G'* by means of the adjusting-nuts *m m* and *n n*, as shown. It will thus be seen that the rods *G* and *G'* are adjustable with respect to the rock-shafts, while the diagonal hangers are independently adjustable with respect to the said rods *G* and *G'*. By so having it both the desired elevation and inclination of the table as a whole may be had and the bottom of the table is supported along its central longitudinal line, so that it will not sag in the middle and so that this central portion may be adjusted vertically. The said longitudinally-reciprocating table is provided with two sides *O O* (curved to correspond with the cut or curve in the bumper-beam) and is left open at both ends, as shown. The bottom *P*, of thin metal, is placed between the two parts *1* and *2* of the bumper-beam and secured in position by bolts and nuts, as seen in the drawings at *p'* in dotted lines, and is also secured to the sides by means of a series of bolts *p*, passing down through them and secured by nuts *q*. It is manifest that the bottom when secured in place will assume the same contour and shape of the cut or curve of the bumper-beam and sides of the concentrator.

In order to prevent the trough leaking at the sides, I place between the metal bottom and the sides pieces *O O* canvas or any other suitable material *O<sup>2</sup>*. (See Fig. 4.) This I have found answers the purpose admirably. Underneath the edge of the bottom *P* of the table I prefer to place a strap of steel or wood *O'*, (see Fig. 4,) which will prevent any liability of buckling, and also reinforces it at the point where the bolts pass through it and serve to bind the metal bottom closely to the sides at the spaces between the bolts. The gangue is emptied or discharged from the tail or lower end of the apparatus.

I form or construct the bottom *P* of the table of very thin sheet metal, such as steel or copper, so that it may be made to freely vibrate in vertical directions, in the manner to be described, very much in the same way as a membranous substance stretched over a hollow drum does when struck, causing the ore and water thereon to ripple or vibrate. This capability (of the bottom of the table) of vibration in vertical directions is very much heightened by making the bumper-beam flexible in the manner described. This action ef-

fects a result which I have never been able to accomplish by any other form of table, since by virtue thereof the powdered or crushed ore is caused to stir or ripple *en masse*, thus causing the metallic portions thereof to gravitate to the bottom, where it lodges and forms a thin film, the gangue in the meantime being caused to discharge from the tail or lower end of the table, as hereinbefore stated.

10 The concentrates or valuable material desired to be recovered is driven over the head or high end of the table by the force of the blow imparted to the bumping-beam by the bumper-block.

15 S represents the trough which supplies the powdered ore to the swinging table or concentrator, the same being provided in its bottom with a series of perforations *s*, through which said ore passes.

20 T represents the water-supply trough, which also is provided with perforations in the bottom for the passage of the clear water onto the head of the concentrating-table.

Located at the forward end of the swinging or reciprocating table is a bumper U, against which the front end of the central beam L of the table strikes or comes into contact as the table is reciprocated. The force of the impact between such beam and block imparts to the bottom of the table and to the ore and water thereon a compound motion, consisting of a longitudinal jarring and a vertical vibration, which latter motions produce a sort of ebullition in the mass of material on the bottom of the table. The end of the beam L may be provided with a rubber or similar elastic cushion *v*, and the bumper-block U is secured in place by means of a metal strap V, passing around the same and having its ends secured to the base or beams. Bolts *w* and *x* also pass down through said block and beams as an additional security.

In the construction of my machine the aim and object throughout is to construct the frame, the bumper-beam, sides, as well as the floor of the table, of material and shape so that the ore not only gets the blow action to drive over the high end of the table the concentrated valuable material, but this blow imparts a vibration or an action similar to that produced by tapping on a drum-head, causing a vertical ebullition or vibration of the water and ore on the table, thus permitting the particles of greatest gravity to settle to the bottom and allowing the lighter or worthless matter to rise on top and be carried over the tail or lower end of the table. This action alone not only saves the large particles of ore and permits them to be recovered, but it causes the finest particles to settle to the bottom and pass over the head or higher end of the table with the coarser valuable material.

Having thus described my invention, what I claim, and desire to secure by Letters Patent, is—

1. In an ore-concentrator, the concentrat-

ing-table having a flexible bottom and a flexible beam to which the bottom is secured, arranged between the sides of the table, means for vibrating the table, and a bumper-block against which the said beam strikes as the table is vibrated, substantially as described. 70

2. In an ore-concentrator, a table having a bumper-beam formed with one of its ends gradually diminishing in thickness as the center is approached, substantially as set forth. 75

3. In an ore-concentrator, the combination of a table having a central bumper-beam composed of two longitudinal parts, the lower part gradually decreasing in thickness as the center is approached and the upper part gradually increasing in thickness as the center is approached, substantially as set forth. 80

4. In an ore-concentrator, the combination of a table having a central beam composed of two parts, the lower part gradually decreasing in thickness as it nears the center, the upper part gradually increasing in thickness as it nears the center, a bottom of suitable thin metal secured between the said two parts forming the bumper-beam, and side pieces which correspond to the incline of the said bumper-beam, substantially as set forth. 85

5. In an ore-concentrator, the combination of a longitudinally-reciprocating table or concentrator, a retracting-spring therefor adapted to accelerate the forward movement of the table by its expansive force and to assist the return thereof by its retractive force, an ore-supply trough, and a washing-water-supply trough, substantially as described. 90 100

6. In an ore-concentrator, a table having a central beam composed of two parts between which the bottom is secured, one or more of the said parts being cut away at the center, whereby increased flexibility is secured, as set forth. 105

7. In an ore-concentrator, the combination of a longitudinally-reciprocating table having a central bumper-beam gradually decreasing in thickness as its center is approached, side pieces curved to correspond with said bumper-beam, a bottom secured to said beam and side pieces, means for reciprocating said table, and a spring secured to said table, substantially as described. 110 115

8. In an ore-concentrator, the combination of a longitudinally-reciprocating table having a bumper-beam composed of two parts, substantially as described, side pieces curved underneath to correspond with the cut in the bumper-beam, a bottom secured between the parts of the said beam and to the sides of the table, means for reciprocating said table, and a retracting-spring secured at one end to the said beam, substantially as described. 120 125

9. In an ore-concentrator, the combination of a longitudinally-reciprocating table or concentrator having a bottom of thin sheet metal, a flexible central beam, a bumper against which said table comes into contact, and an ore and water supply trough, substantially as described. 130

10. In an ore-concentrator, the combination of a longitudinally-reciprocating table or concentrator having a bottom of thin sheet metal, a retracting-spring therefor at one end adapted to accelerate the forward movement of the table by its expansive force and to assist the return thereof by its retractive force, a bumper at the other end, and an ore and water supply trough, substantially as described.
11. In an ore-concentrator, the combination of the two sets of vertical supports, a longitudinally-reciprocating table or concentrator suspended between said supports, a retracting-spring located at one end beneath the table, a bumper located at the other end, and an ore and water supply trough, substantially as described.
12. In an ore-concentrator, the combination of the longitudinally-reciprocating table having the central flexible beam, a tappet arranged on one end of said beam, and the drive-shaft provided with the cam for striking said tappet, substantially as described.
13. In an ore-concentrator, the combination, with a longitudinally-reciprocating table or concentrator having a central beam thinner at its intermediate portion than at its ends, of the vertical supports, the rock-shafts held by said supports, and the vertically-adjustable hangers or rods passing through said rock-shafts and secured to the sides of the table, substantially as described.
14. In an ore-concentrator, the combination of a longitudinally-reciprocating table or concentrator, the vertical supports, the rock-shafts, the vertical hangers, and the diagonal hangers adjustable with respect to said vertical hangers, connected with the bottom of the table between its sides, substantially as described.
15. In an ore-concentrator, the combination of a longitudinally-reciprocating table or concentrator, the rock-shafts, the vertical supports, the vertical hangers adjustable vertically in said rock-shafts, and the diagonal

hangers independently adjustable with respect to said vertical hangers, connected with the table or concentrator between its sides, substantially as described.

16. In an ore-concentrator, the concentrating-table consisting of a flexible bottom, a flexible central beam, and side pieces to which the bottom is secured, in combination with rigid strips secured to the said side pieces outside of or below the bottom, substantially as set forth.

17. In an ore-concentrator, the concentrating-table consisting of the flexible bottom and the side pieces to which the bottom is secured, in combination with packing-strips placed between the bottom and the side pieces and rigid strips secured to the edges of the side pieces below the bottom, substantially as set forth.

18. In an ore-concentrator, the concentrating-table consisting of the flexible bottom, the side pieces, and the central flexible bumper-beam, in combination with the rigid strips secured to the edges of the side pieces below the bottom, substantially as described.

19. In an ore-concentrator, a table having a bumper-beam with a rigid fore end, a flexible intermediate part, and a rear end of less flexibility, substantially as shown, and for the purposes set forth.

20. In an ore-concentrator, the concentrating-table having a flexible bottom, a flexible beam decreasing in thickness inwardly from its end or ends and arranged between the sides of the table, means for vibrating the table, and a bumper-block against which the said beam strikes as the table is vibrated, as described.

In testimony whereof I have hereunto set my hand this 20th day of January, 1892.

WILLIAM H. H. BOWERS.

Witnesses:

L. C. NILES,  
F. B. KEEFER.