(No Model.) 4 Sheets—Sheet 1.

T. J. LOVETT.

MAGNETIC SEPARATOR.

No. 487,073. Patented Nov. 29, 1892.

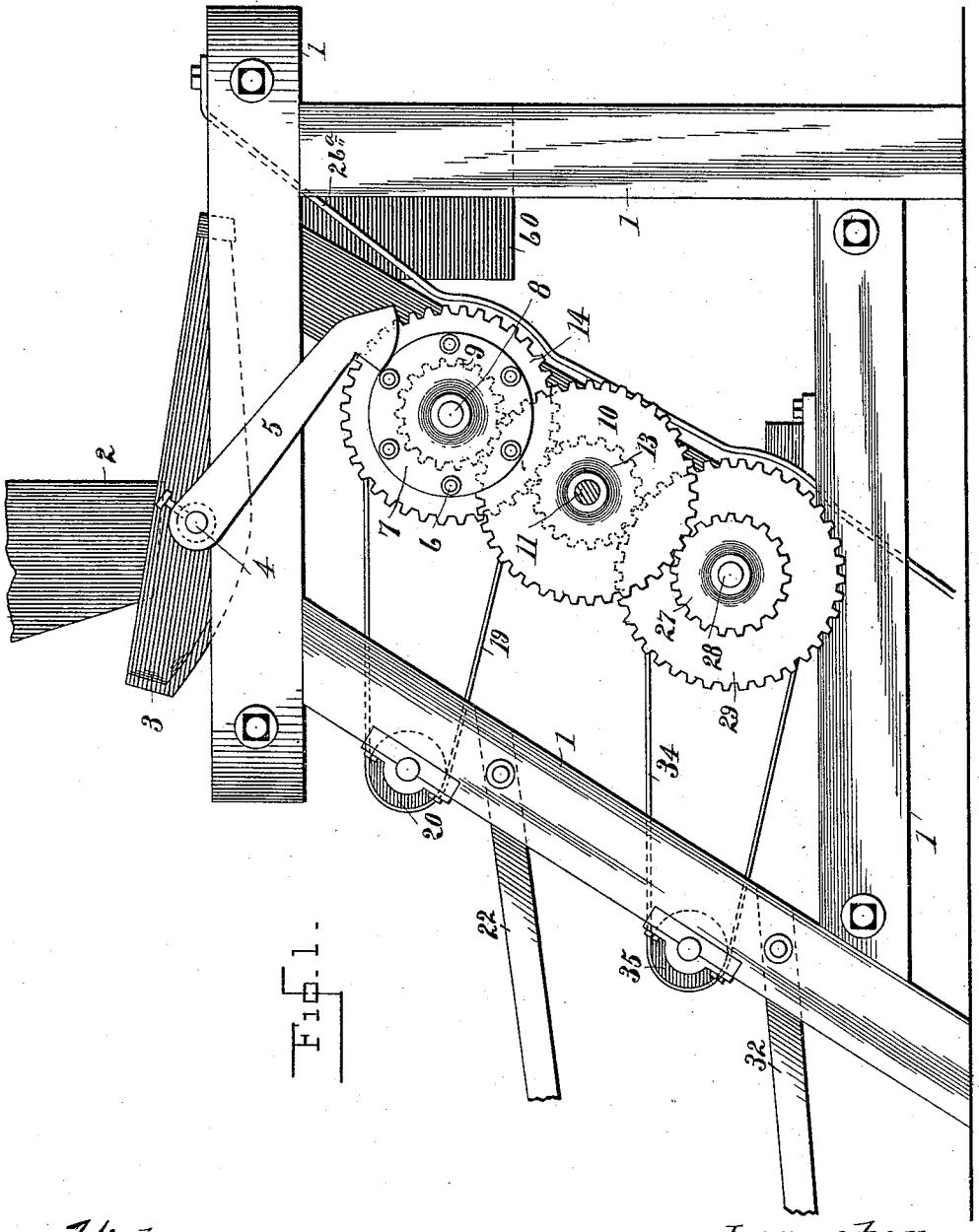

Fig. 1.

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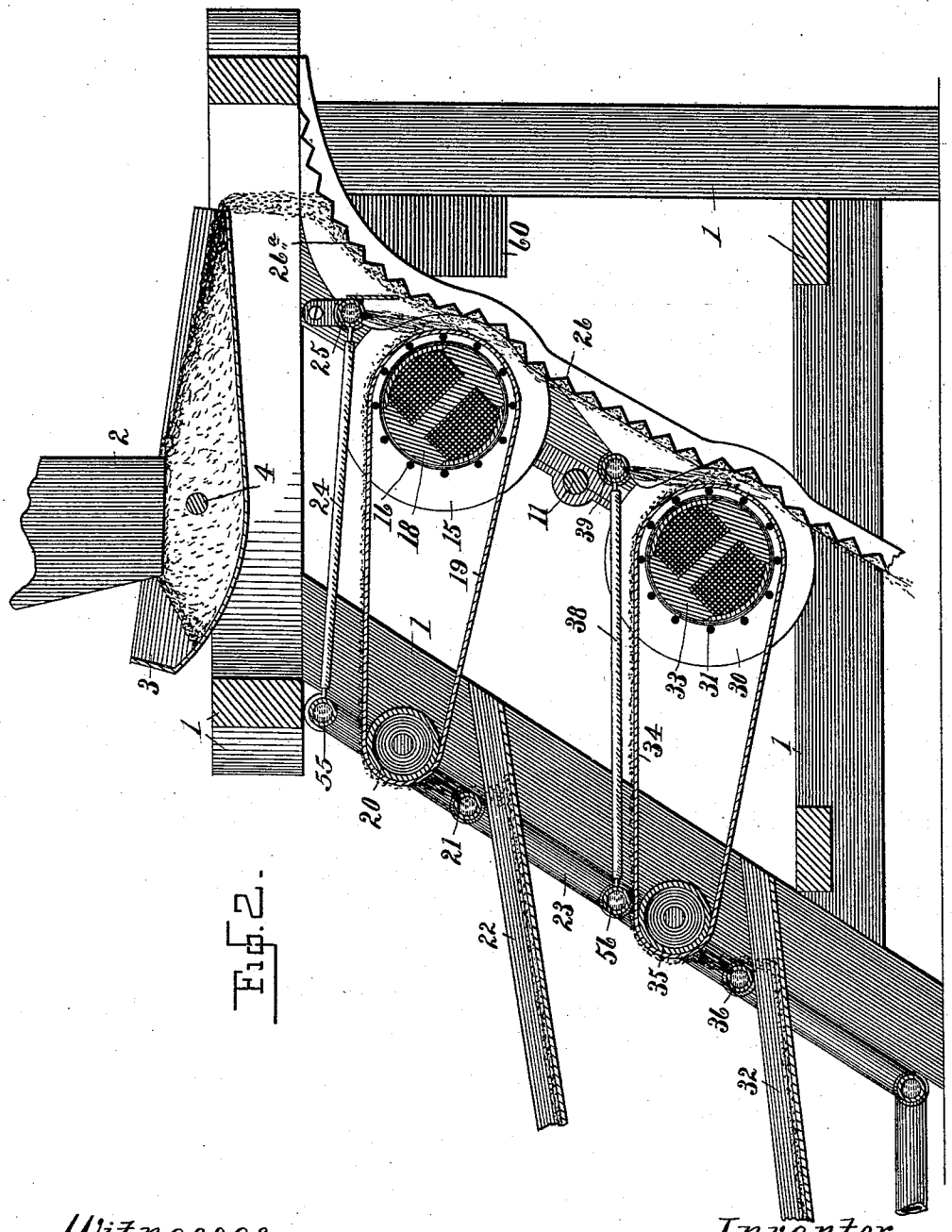

Fig. 2.

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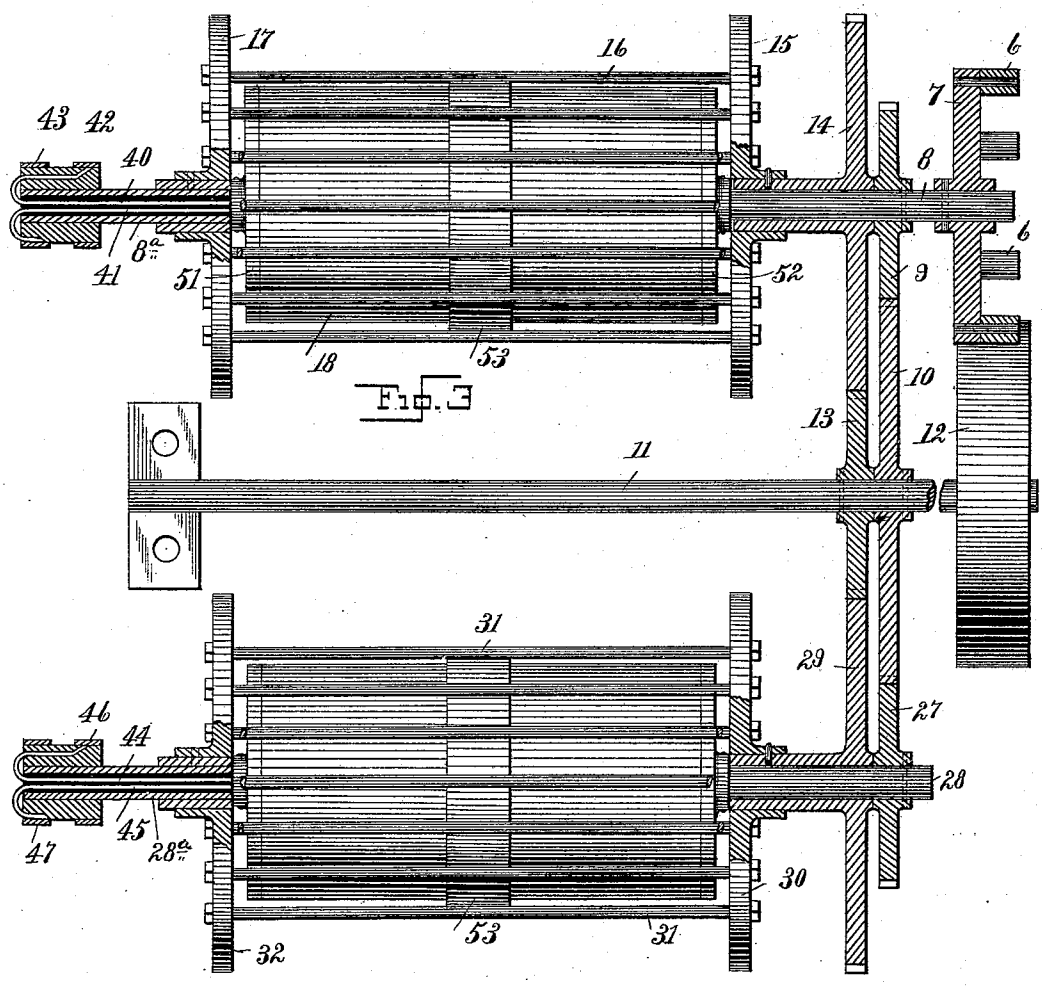
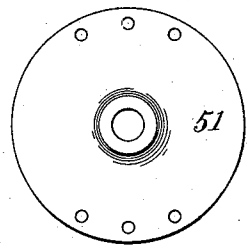


Fig. 3.

Fig. 4.



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(No Model.) 4 Sheets—Sheet 4.

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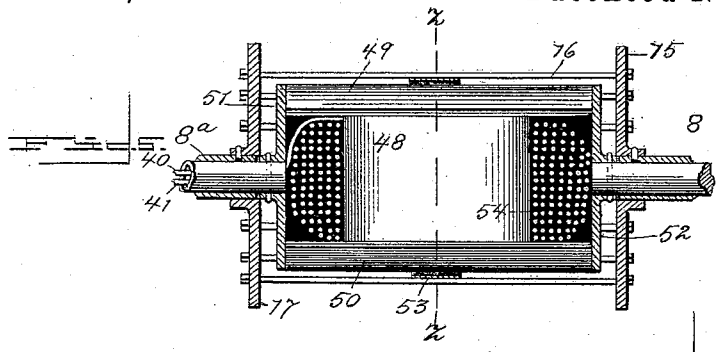


Fig. 6.

Fig. 7.

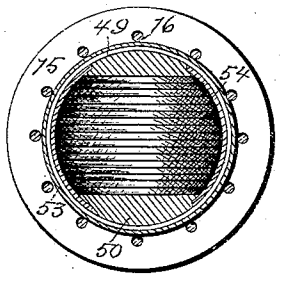


Fig. 10.

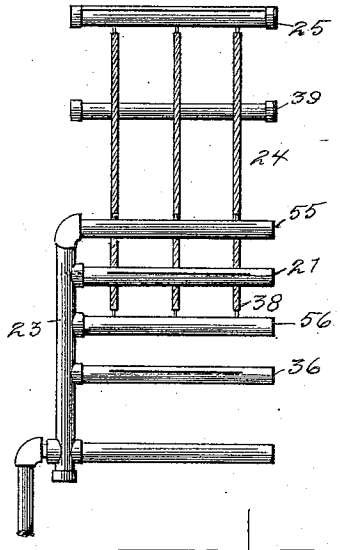
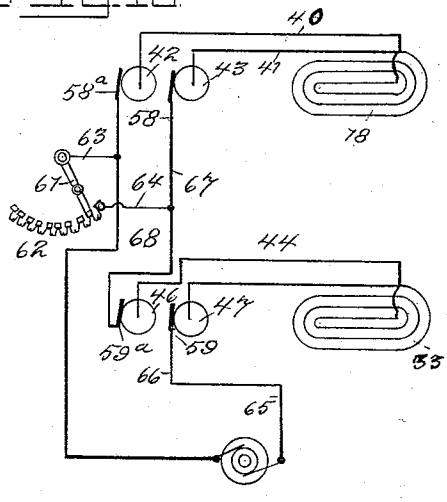


Fig. 8.



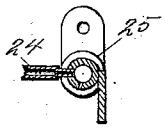


Fig. 9.

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UNITED STATES PATENT OFFICE.

THOMAS J. LOVETT, OF CHICAGO, ILLINOIS, ASSIGNOR, BY MESNE ASSIGNMENTS, TO THE INTERNATIONAL ORE SEPARATING COMPANY, OF NEW JERSEY.

MAGNETIC SEPARATOR.

SPECIFICATION forming part of Letters Patent No. 487,073, dated November 29, 1892.

Application filed February 13, 1892. Serial No. 421,428. (No model.)

To all whom it may concern:

Be it known that I, THOMAS J. LOVETT, a citizen of the United States, residing at Chicago, in the county of Cook and State of Illinois, have invented certain new and useful Improvements in Magnetic Ore-Separators; and I do hereby declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same.

My invention relates to that class of ore-separating machines in which either a permanent magnet or an electro-magnet is employed to attract the particles of magnetite in a magnetic ore and thereby separate the magnetite from the non-magnetic impurities which are allowed to escape in the tailings. It is important that machines of this kind should be capable of working the ore either wet or dry, for while with nearly all kinds of magnetic ore a wet separation is the most perfect and convenient, yet under some circumstances, as when water is scarce or a freezing temperature prevails, the dry separation is preferable. It is also desirable that the machine should have the sets of magnets of varying magnetic strength. The weak set of magnets will give a pure concentrate, but allow a considerable quantity of iron to escape in the tailings. This escaping iron should be taken up by a more powerful magnet, and as the concentrates from the second operation contain certain impurities they should be kept separate from the purer concentrates resulting from the first-described operation. This I accomplish by having several sets of electro-magnets and a resistance-box in connection therewith, so that more or less current can be thrown into the coils of the respective magnets. It is further important that while the magnetite shall not be given a too-rapid movement, but be allowed to separate itself gradually from its impurities, it shall be subjected to a rapid reversal of magnetic polarity, so that the particles may be kept continually shifting their relative positions, thereby eliminating all non-magnetic matter.

In the drawings, Figure 1 is a side elevation of my machine. Fig. 2 is a vertical longitudinal section. Fig. 3 is a detail elevation, partly in section, showing the drums mounted on their respective shafts and the gearing for driving the same. Fig. 4 is a detail elevation of one of the disks forming the end of the drum. Fig. 5 is a detail sectional view of one of the drums, showing the arrangement of the magnet therein and accompanying parts. Fig. 6 is a detail transverse sectional view of the same, taken on the line *z z* of Fig. 5, showing the coil in full lines. Fig. 7 is a view in elevation illustrating the arrangement of the water-pipes. Figs. 8 and 9 are detail sectional views of the same. Fig. 10 is a diagraphic illustration of the electrical connections.

In the different views the same part is indicated by the same reference-figures.

1 is the main frame.

2 is the chute, by which the ore is fed from the crusher into the shaking pan or table 3. This chute has riffles formed on its bottom, by which the falling stream of ore is caused to tumble over and over. Thereby especial opportunity is afforded for the magnets to pick out the pure particles of ore. The shaking-table is mounted on the shaft 4. Keyed to this shaft is the arm 5, which is vibrated by contact with the projections 6 on the rotating disk 7. These projections may be of any desired shape; but in the construction illustrated they consist of pins with a coating of rubber. The disk 7 is on the shaft 8 and rotates with it. Motion is given to the shaft 8 by the gear 9, driven by the gear 10 on the main driving-shaft 11. Motion may be given to the main driving-shaft 11 by a crank or by the belt-pulley 12. In the same way gear 10 drives gear 27 and the shaft 28. Gear 13, also on driving-shaft 11, is of less diameter than of gear 10. It meshes with gears 14 and 29, which are mounted on sleeves journaled on shaft 8 and 28, respectively. On these sleeves are disks 15 and 30, preferably of brass or other non-magnetic material. The disk 15 has a companion disk 17, and is connected thereto by a number of brass rods 16. The disk 30 has a companion disk 32, and is similarly connected thereto by a number of brass rods 31. A circular band 53 may be employed to keep these rods properly spaced. Thus are

formed two circular cages or skeleton drums. Within these drums are the magnets 18 and 33. These might be permanent magnets; but preferably they are electro-magnets, as shown, consisting of the core 48, with the pole-pieces 49 and 50. To the end of these pole-pieces are fastened the disks 52 and 51, which are mounted on the shafts 8 and 8ª. A similar magnet is mounted on the shafts 28 28ª. The coil of insulated wire about the upper magnet terminates in the wires 40 41, which connect with the insulated collecting-rings 42 43, respectively. Similarly the lower magnet has the leading-in wires 44 45, connected to the collecting-rings 46 47, respectively.

20 is an idler-pulley, and the endless belt 19 encircles it and the magnet 18 with its surrounding drum. 35 is a similar idler-pulley, and the endless belt 34 encircles it and magnet 33, together with the drum that surrounds the latter.

26ª is an inclined feed-chute, into the upper end of which the shaking-table 3 discharges and which is arranged tangentially to the revolving magnets 18 and 33 and to their surrounding drums. The bottom of this chute has, preferably, transverse corrugations 26, although these might be dispensed with. The discharge-chutes 22 and 32 are so arranged as to receive the concentrates that fall off the belts as they run over the idler-pulleys and back to the magnets. The water which is to facilitate the process of separation and the passage of the stuff along the various chutes is supplied by the pipe 23. The pipe 21 has a line of perforations or a slot which discharges the water upon the belt 19 under pulley 20. Similarly pipe 36 discharges upon belt 34 under idler-pulley 35. Pipes 24 lead from pipe 55 to the slotted or perforated pipe 25, which discharges downward upon the belt 19 over the magnet 18. The pipes 38 lead from pipe 56 to pipe 39, which discharges downwardly upon the belt 34 over the magnet 33.

60 is a rheostat or other variable resistance. It has the switch 61 and the resistance-coils 62, arranged in the well-known way.

58 58ª are a pair of brushes bearing on collecting-rings 42 43. 59 59ª are a similar pair bearing on rings 46 47. The insulating-block 57 supports these brushes and carries the electrical connections. (Not shown in the assembled figures, but sketched out in the diagram, Fig. 12.) The rheostat has the connections 63 64.

Referring to Fig. 12, the source of electric current is indicated at 65. The feed-wires are 66, 67, and 68.

The operation of my invention is as follows: The magnet 18 is wound so as to be as strong as or stronger than the magnet 33 when there is an equal current through the coils of each. The rheostat 60 is in shunt relation to the magnet 18. The current passes from battery 65 through feed-wire 66, brush 59, ring 47, lead-wire 45, magnet 33, lead-wire 44, ring 46, brush 59ª, feed-wire 67, and then is shunted, one part through wire 64, rheostat, and wires 63 and 68 to the dynamo, the other through brush 58, ring 43, lead-wire 41, magnet 18, lead-wire 40, ring 42, brush 58ª, feed-wire 68, back to the battery, and the other part through wire 64, resistance-coils 62, switch 61, wire 63, and feed-wire 68 back to the battery. It is evident, therefore, that by cutting out a sufficient number of coils 62 the magnet 18 may be robbed of enough current to bring its power down to that or to less than that of magnet 33, while if all the coils 62 are thrown in nearly all the current will take the path through the magnet 18, and it will become more powerful than 33. Thus the simple movement of the switch 61 can effect any desired change in the relative intensities of the two magnets.

As before indicated, the normal working of the machine is, with the magnet 18, less powerful than magnet 33. The rotation of the main driving-shaft causes the magnets and the drums to rotate all in the same direction, but at different speeds, on account of the gearing 9 10 27 and 14 13 29. The rotating disk 7 causes the shaking-table 3 to vibrate and the crushed ore is fed over into the inclined feed-chute 26ª. Down this it falls by gravity or with the assistance of a stream of water, if the machine is working wet. Coming within the field of the weak magnet 18, the particles of fine magnetite fly to the belt 19 and are carried up and along the upper side of said belt. The magnet 18, revolving at a higher rate of speed than the surrounding belt and drum, (speed ratio preferably four to one,) continuously reverses the polarity of the particles, and this, with the aid of the water-jet from pipe 25, cleans out all non-magnetic impurities. As the belt runs over idler-pulleys 20 the concentrates fall into the discharge-chute 22. Any particles adhering to the under side of the belt are washed off by the water-jet from pipe 21. The non-magnetic particles and those containing a mechanical mixture of magnetic and non-magnetic material pass on down chute 26ª into the field of magnet 33. This being more powerful picks up every particle containing any magnetite whatever, and by the process above described deposits the same in the chute 32. Thus the pure concentrates are discharged in one lot, the impure concentrates in another, and the tailings without appreciable per cents. of iron pass on down the chute 26ª. The impure concentrates may be used for certain special purposes, or they may be crushed more finely and run again through the machine.

It is evident that various changes could be made in the mechanical details of my invention without departing from the principle thereof. The drums might be made of wood or papier-maché, the relative speeds of drums and magnets varied, the shape of the magnets and the number of poles changed, the

electrical connections rearranged, &c. When the water is shut off, the machine will continue to work with dry ore, the action of gravitation and the vibration of parts of the machine causing the forward movement of the material.

Having therefore described my invention, what I claim as new, and desire to protect by Letters Patent, is—

1. In a magnetic separator, the combination of two magnetic wheels of different magnetic intensity, two idler-pulleys, two endless belts, each of said belts running around a magnetic wheel and one of the idler-pulleys, and an inclined feed-chute which has riffles therein, which is tangent to each of said magnetic wheels, substantially as described.

2. In a magnetic separator, the combination of two magnetic wheels of different magnetic intensity, two idler-pulleys, two endless belts, each of said belts running around a magnetic wheel and one of the idler-pulleys, and an inclined feed-chute which has horizontal ridges in its bottom and is arranged tangentially to both of said magnetic wheels.

3. In a magnetic separator, the combination of a rotating magnetic wheel, a non-magnetic drum which surrounds said magnetic wheel and revolves at a different speed, an idler-pulley, a belt which runs around said drum and around said pulley, and an inclined feed-chute arranged tangentially to said wheel-drum, substantially as described.

4. In a magnetic separator, the combination of a rotary magnetic wheel, a non-magnetic drum which surrounds said magnetic wheel and revolves at a different speed, an idler-pulley, a belt which runs around said drum and around said pulley, and an inclined feed-chute arranged tangentially to said wheel and drum, together with a perforated water-pipe, located under said belt, substantially as described.

5. In a magnetic separator, the combination of a rotating magnetic wheel, a non-magnetic drum which surrounds said magnetic wheel and revolves at a higher speed, an idler-pulley, a belt which runs around said drum and around said pulley, and an inclined feed-chute, together with a perforated water-pipe, located under said belt, and a second perforated water-pipe located over the magnetic wheel, substantially as described.

6. In a magnetic separator, the combination of a magnetic wheel, an idler-pulley, a belt which runs around said magnetic wheel and said pulley, an inclined feed-chute which has riffles therein, which is arranged tangentially to said magnetic wheel, a shaking-table which discharges into the upper part of said chute, and mechanism by which said table is vibrated simultaneously with the revolution of said magnetic wheel, substantially as described.

7. In a magnetic separator, the combination of a rotating magnetic wheel, an idler-pulley, a belt which runs around said wheel and around said pulley, an inclined feed-chute arranged tangentially to said wheel, a shaking-table which discharges into said chute, projections on a disk on the end of the shaft of the rotating magnet, and an arm which extends from the axis of the shaking-table and is vibrated by contact with the projections on the disk, substantially as described.

8. In a magnetic separator, the combination of a magnetic wheel, an idler-pulley, an endless belt which runs over said wheel and pulley, an inclined feed-chute which is arranged tangentially to said wheel, and a perforated water-pipe located beneath the under side of said belt, substantially as described.

9. In a magnetic separator, the combination of a main frame, two or more subcombinations each composed of a magnetic wheel, an independently-revolving drum of non-magnetic material which surrounds said magnetic wheel, an idler-pulley, and an endless belt which runs around said wheel, drum, and pulley, together with an inclined feed-chute arranged tangentially to said wheels and drums, a discharge-chute under each idler-pulley, the main shaft, and connecting-gearing by which all of said wheels and drums are driven from said shaft, substantially as described.

10. In a magnetic separator, the combination of a main frame, two or more subcombinations each composed of a magnetic wheel, a drum of non-magnetic material which surrounds said magnetic wheel, an idler-pulley, and an endless belt which runs around said wheel, drum, and pulley, together with an inclined feed-chute arranged tangentially to said wheels and drums, a discharge-chute under each idler-pulley, connecting-gearing by which all of said wheels and drums are driven from said shaft, with a system of perforated water-pipes arranged under said idler-pulleys and over said magnetic wheels, substantially as described.

11. In a magnetic separator, the combination of two sets of rotating electro-magnets, an inclined feed-chute arranged tangentially to said rotating magnets, collecting-rings upon the shafts, on which said magnets revolve, and brushes bearing on the same, electrical connections, a source of current-supply, and a variable resistance in connection with the coils of one of said sets of rotating magnets, substantially as described.

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

THOMAS J. LOVETT.

Witnesses:

WARREN W. FOSTER,

A. P. SMITH.