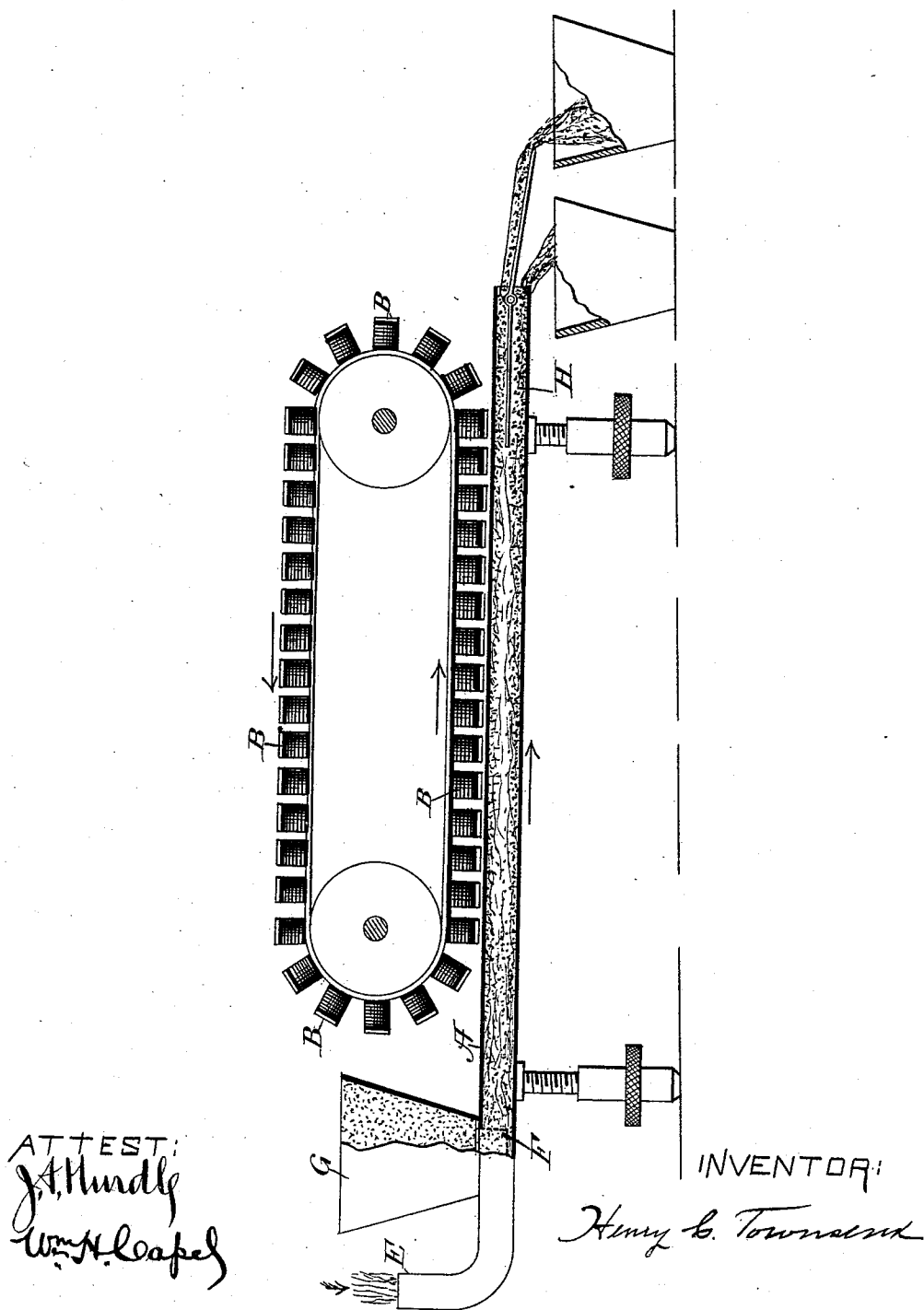


(No Model.)

H. C. TOWNSEND.
METHOD OF MAGNETIC SEPARATION.

No. 453,317.

Patented June 2, 1891.



UNITED STATES PATENT OFFICE.

HENRY C. TOWNSEND, OF NEW YORK, N. Y.

METHOD OF MAGNETIC SEPARATION.

SPECIFICATION forming part of Letters Patent No. 453,317, dated June 2, 1891.

Application filed September 27, 1890. Serial No. 366,303. (No model.)

To all whom it may concern:

Be it known that I, HENRY C. TOWNSEND, a citizen of the United States, and a resident of New York, in the county of New York and State of New York, have invented certain new and useful Methods of Separating Magnetic from Non-Magnetic Substances, of which the following is a specification.

My invention relates to the separation of magnetic from non-magnetic material by the agency of magnetism, and is especially applicable to the separation of the iron particles from magnetic sands, though it may be used in the separation of the magnetic material from any substance previously reduced to a divided or granulated state.

My invention consists in an improved method of separating magnetic from non-magnetic material by establishing a flow or stream of liquid—such as water—in which the materials are carried in divided form and producing in the liquid stream two flowing strata, in one of which the magnetic material is maintained by magnetic action opposed to another force, as gravity, while the non-magnetic materials are forced or maintained in another stratum and diverting the stratum of flowing liquid and magnetic material through a channel separate from that through which the stratum holding the non-magnetic material passes.

In carrying out my invention the proper mixture of the divided substances with the liquid—such as water—may be produced in any desired manner, preferably by allowing the liquid to flow through a reticulated or open-work receiver, into which the divided substances are introduced, although the manner of setting up or producing the liquid stream in which the substances are carried by the flow of the liquid may be varied in any desired manner without departing from my invention. The desired flow of the liquid may be produced by introducing water under a suitable head into a trough or chute or by forcing water through a trough or chute by means of a pump or otherwise. While I prefer to use gravity as the force which shall hold or shall carry the non-magnetic substances to a separate stratum of the liquid for delivery through an orifice separate from that through which the stratum of flowing liquid containing the

magnetic substances flows, I do not limit myself to the use of such force, the essence of my invention consisting in producing from the liquid stream containing the substances in division two separate strata, one containing the magnetic material which is kept or moved into such stratum against the opposing force by means of magnetism, such opposing force being left free to act upon the non-magnetic particles and maintain or move them into the other stratum.

A further feature of my invention consists in assisting the flow of the stratum of liquid and magnetic material by the action of a moving magnetic field, as hereinafter described.

I have in the accompanying drawings shown in skeleton a simple form of apparatus to aid in the explanation of the method or process constituting my invention. The invention is, however, not confined to the particular construction of apparatus shown. It may be carried out by means of other mechanical constructions, as will be obvious to those skilled in the art.

In the drawings, A indicates in section the chute, trough, or conduit through which a stream of liquid may flow in the direction of the arrow, being confined therein.

B B, &c., indicate magnets of any desired form or construction located above the trough and in as close proximity to the upper face or cover thereof as practicable, so as to act upon any magnetic substances contained in a stream of liquid flowing through such trough or chute. The magnets may be permanent or electro-magnets, and it is preferable to give them a movement in the direction of the arrow along the upper side of the trough, for which purpose they may be mounted upon a belt, as indicated, carried upon two wheels or drums rotated by any suitable power. A suitable traverse or movement of the magnet or magnets might be produced by any other desired arrangement.

At the outlet end of the conduit or trough two openings are provided on different vertical planes, one of which is adapted to direct the water near the top of the conduit into a separate receiver from that into which the water at the bottom of the conduit or trough passes. The lower opening preferably takes in the greater part of the moving stream, es-

pecially where the magnetic substances form a small proportion of the total solid material. Water or other liquid under pressure or head may be introduced at the end E of the trough or conduit. Preferably a slight inclination is given to the trough or conduit A to assist in the flow.

At F is indicated an open-work basket or receiver reaching nearly to the bottom of the trough and in the path of the flowing liquid. Into this the divided substance—such as magnetic sand—is introduced by means of the hopper G. The openings in the receiver F are of sufficient size to allow the sand or other substance in divided form to be washed out freely and carried along by the stream of liquid flowing through the conduit. Receivers having different-sized openings may be used for materials of different degrees of fineness.

It is desirable that the head of water should be sufficient to keep the conduit full to its top, so that any material raised against the top plate will be carried along in a moving stream of liquid, washing said plate. It is especially desirable that a head sufficient to fill the tube or trough should be maintained if the magnetism employed is sufficiently strong to raise the magnetic particles to said plate, though it would be within my invention to so adjust the magnetism when a stream of water not entirely filling the trough is used that the magnetic particles should flow along on the upper surface of the stream, but out of contact with the upper plate. In this case, however, especial care would have to be taken in adjusting the conditions or in the location of the dividing plate or diaphragm H, which separates the two strata at the exit end of the tube or trough, so that the stratum containing the magnetic substances shall flow over it.

Should it be desired to adjust the velocity of flow of the liquid through the trough, provision may be made for varying the longitudinal inclination of the said trough.

The operation is substantially as follows: The divided substances having been introduced into the receptacle F and liquid being allowed to flow into the trough and through said receptacle, a stream of liquid will be produced in which the magnetic and non-magnetic substances will be carried down beneath the series of magnets over the tube. As the stream flows through the tube, the non-magnetic substances tend to settle to the bottom or into a lower stratum of flowing liquid being unacted upon by the magnetism; but the magnetic particles or substances will be raised by the magnetic action into an upper stratum, though there is a tendency on the part of gravity to lower them. This magnetic action is of course assisted by the buoying action of the liquid. As the stream of liquid continues its flow, the magnetic and non-magnetic substances finally become located in upper and lower strata of the liquid stream, which finally flow out through the exit end in separate streams, one above the other, and may be de-

livered into separate receptacles, as indicated, where the solid material may be allowed to settle and the liquid drawn off and allowed either to go to waste or be used over again. To assist in the movement of the magnetic particles in the upper part of the stream, it is preferable to give a movement to the magnets in the direction of the flow of the stream; or, in other words, to produce a moving magnetic field, which shall act to pull the magnetic particles along with the stream of liquid, so that obstruction or clogging of the magnetic materials at the upper part of the conduit or tube will be avoided. Such movement of the magnetic field is not essential, however, provided a sufficient velocity of flow of the liquid be resorted to to wash the magnetic particles freely along the bottom surface of the upper plate or cover of the trough. Suitable provision may be made for adjusting the relative thickness of the two strata of liquid delivered from the exit end of the tube or conduit by making the dividing plate or wall H, which separates the strata, horizontally adjustable in a vertical direction.

It is desirable to provide large a flow of liquid in proportion to the solid substances introduced in order that the magnetic and non-magnetic particles may move with the greatest freedom with relation to one another in the liquid, and may be washed apart in case there should be a tendency to stick together.

The length of the liquid stream which shall be subjected to the magnetic action may be varied; but generally the longer the stream is subjected to such magnetic action the more thorough will be the separation of the materials.

I am aware that it has been proposed to apply magnetism above a stream containing the magnetic and non-magnetic substances for the purpose of raising the magnetic materials so as to permit them to be diverted or carried away from the liquid stream in which the unattracted materials are suspended or carried away to another point. I do not therefore claim, broadly, the use of magnetism applied from a point above the level of the liquid in which the magnetic and non-magnetic substances are mixed so as to lift any divided magnetic materials at the bottom of the stream.

The essence of my present invention consists in producing two streams or strata of liquid, one containing the magnetic and the other the non-magnetic substances and delivering said liquid streams or strata through separate channels or orifices.

What I claim as my invention is—

1. The herein-described method of separating magnetic from a non-magnetic material, consisting in establishing a flow of liquid in which said materials are carried in divided form, producing in the liquid stream two flowing strata, in one of which the magnetic material is maintained by magnetic action opposed

to another force, as gravity, by which the non-magnetic materials are forced or maintained in another stratum and diverting the stratum of flowing liquid and magnetic material through a channel separate from that through which the stratum holding the non-magnetic material passes.

2. The herein-described method of separating magnetic from non-magnetic material, consisting in producing a shallow stream of commingled liquid and material, subjecting the stream to magnetic attraction from above, thereby raising or maintaining the position of the magnetic particles in the upper stratum of liquid, while permitting the non-magnetic particles to remain at or settle to the lower levels or stratum of the liquid and delivering the said strata through separate channels or orifices.

3. The herein-described method of separating a magnetic from a non-magnetic material, consisting in establishing a flow of liquid in which said materials are commingled and suspended, producing in the liquid stream two flowing strata, in the upper of which the magnetic materials are supported by mag-

netic action and diverting the said upper stratum of liquid and magnetic material through a channel separate from that through which the lower stratum holding the non-magnetic material passes.

4. The herein-described method of separating magnetic from non-magnetic substances, consisting in forming a liquid stream in which said materials are carried in divided form, subjecting the stream to magnetic attraction, so as to produce therein two strata, one containing magnetic substances and the other non-magnetic substances, as described, and assisting the flow of the stratum of commingled liquid and magnetic substances by a moving magnetic field moving in the direction of the flow, as and for the purpose described.

Signed at New York, in the county of New York and State of New York, this 26th day of September, A. D. 1890.

HENRY C. TOWNSEND.

Witnesses:

WM. H. CAPEL,
THOS. F. COUREY.