(No Model.) 3 Sheets—Sheet 1.

C. T. THOMPSON & R. H. SANDERS.

MAGNETIC ORE SEPARATOR.

No. 470,455. Patented Mar. 8, 1892.

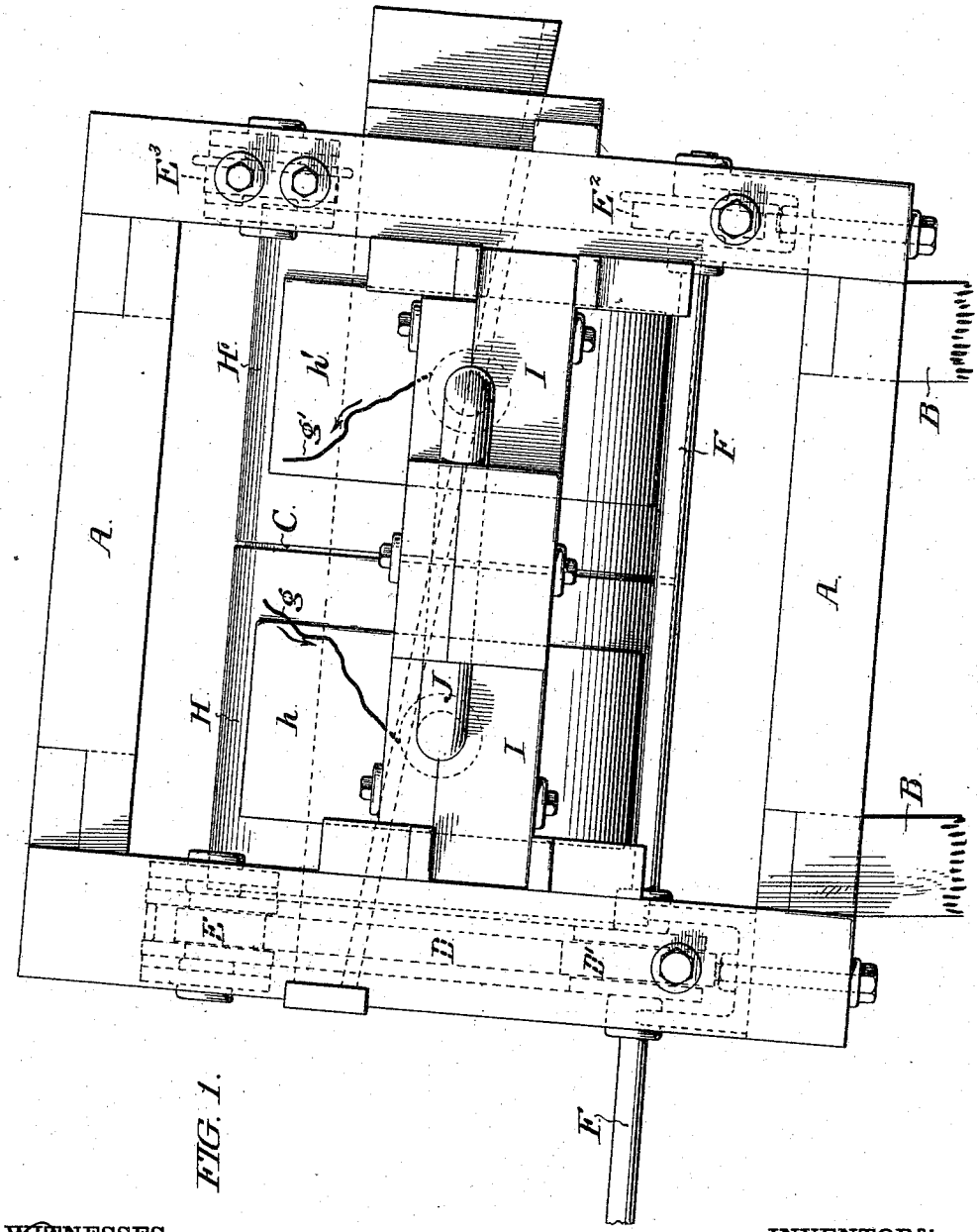


FIG. 1.

WITNESSES:
James H. Bell
A. E. Paige

INVENTORS:
Charles J. Thompson
and Richard H. Sanders
By Hollingsworth & Daly
Attorneys.

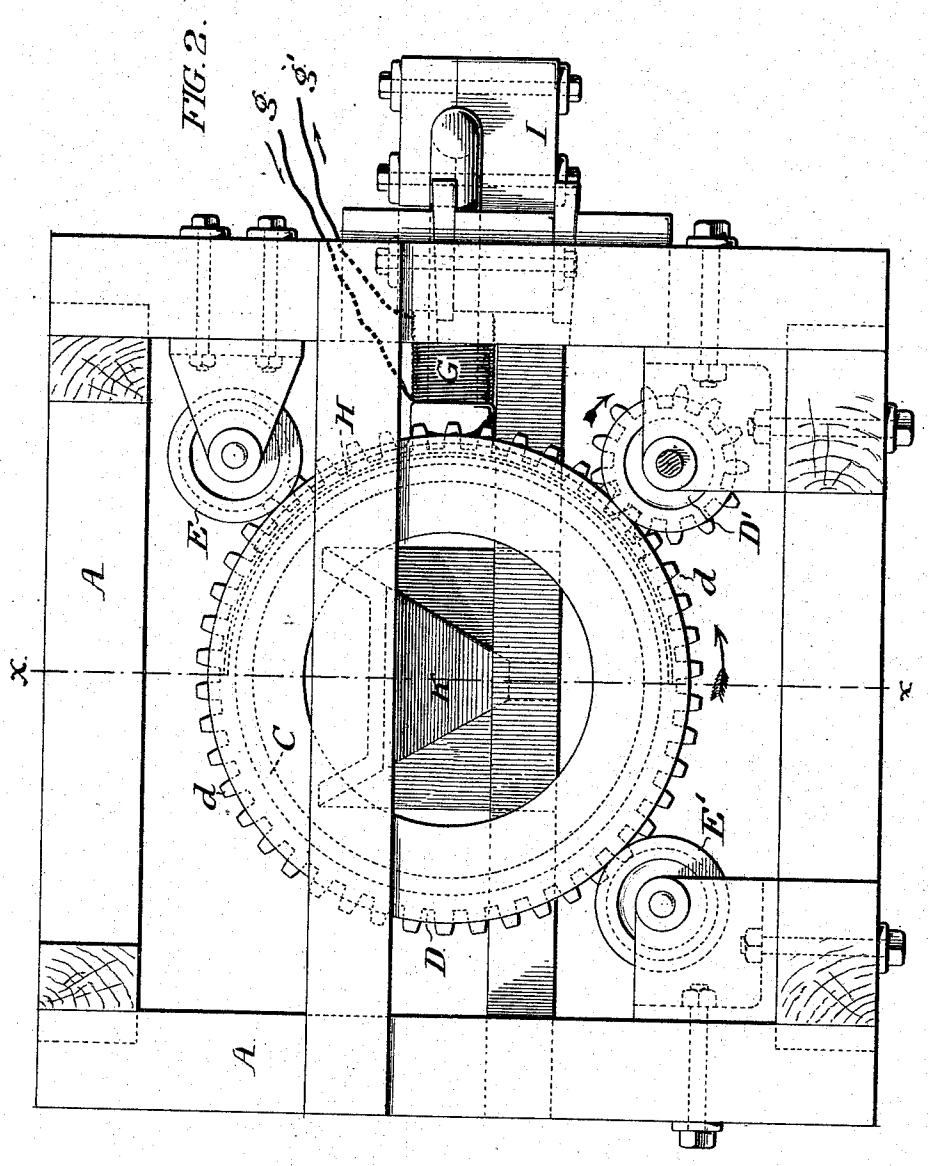
(No Model.) 3 Sheets—Sheet 2.

C. T. THOMPSON & R. H. SANDERS.

MAGNETIC ORE SEPARATOR.

No. 470,455. Patented Mar. 8, 1892.

FIG. 2.



WITNESSES:

James H. Bell

A. E. Paige

INVENTORS:

Charles T. Thompson
and Richard H. Sanders
By Hollingsworth & Whaley
Attorneys

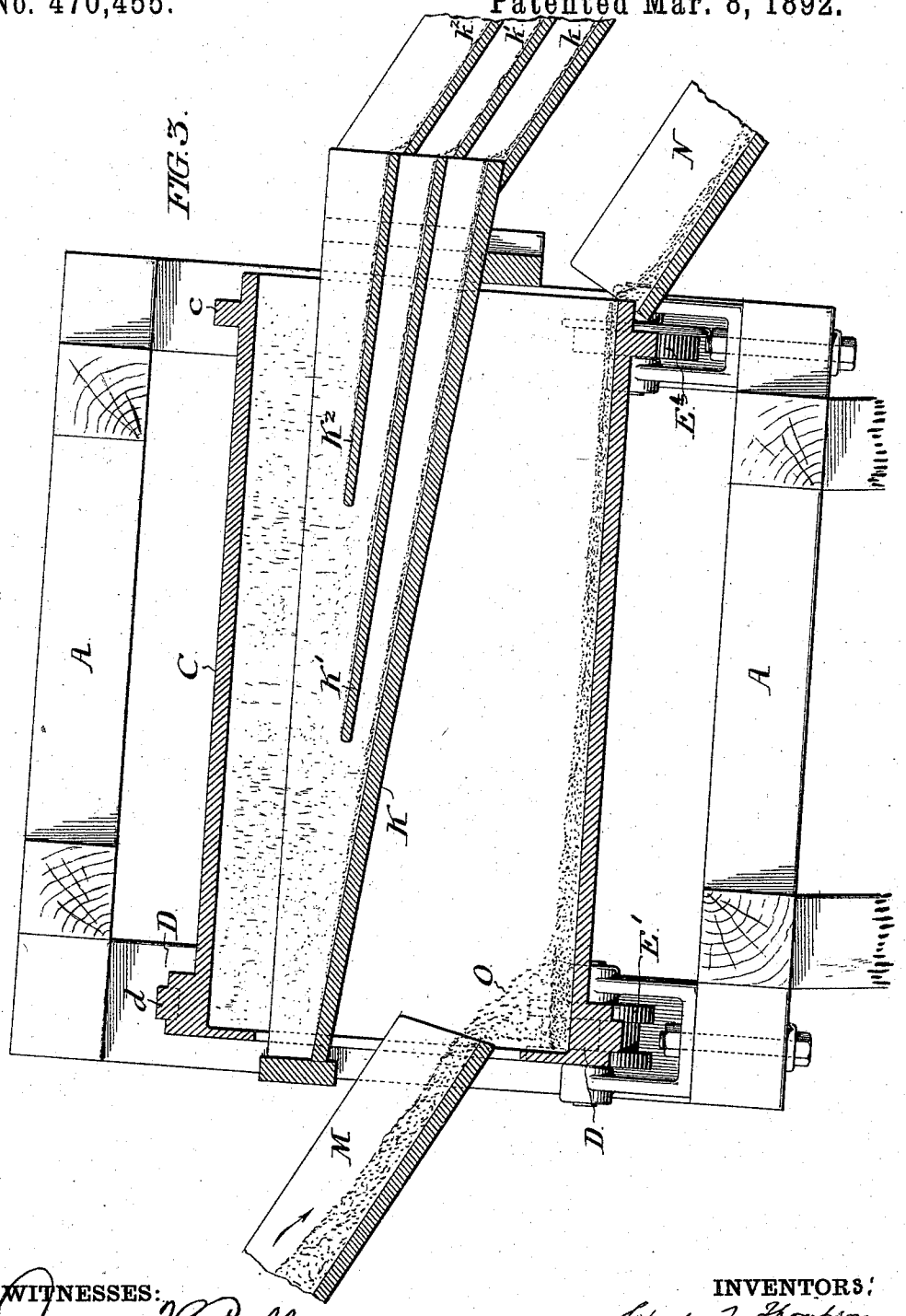
(No Model.) 3 Sheets—Sheet 3.

C. T. THOMPSON & R. H. SANDERS.

MAGNETIC ORE SEPARATOR.

No. 470,455. Patented Mar. 8, 1892.

FIG. 3.



WITNESSES:
James H. Bell
N. E. Paige

INVENTORS:
Charles T. Thompson
and Richard N. Sanders
By Mollingsworth & Bailey
Attorneys

UNITED STATES PATENT OFFICE.

CHARLES T. THOMPSON AND RICHARD H. SANDERS, OF PHILADELPHIA, PENNSYLVANIA.

MAGNETIC ORE-SEPARATOR.

SPECIFICATION forming part of Letters Patent No. 470,455, dated March 8, 1892.

Application filed April 16, 1891. Serial No. 389,166. (No model.)

To all whom it may concern:

Be it known that we, CHARLES T. THOMPSON and RICHARD H. SANDERS, both of Philadelphia, in the State of Pennsylvania, have invented certain new and useful Improvements in Magnetic Separators for Ore and Similar Material, whereof the following is a specification, reference being had to the accompanying drawings.

In said drawings, which show a convenient embodiment of our invention, Figure 1 represents a front elevation of the separator; Fig. 2, an end view thereof, and Fig. 3 a vertical section on the line *x x* of Fig. 2.

Broadly speaking, our improvements consist in combining with a hollow rotatable drum a stationary magnet placed exterior to the drum and having poles which closely envelop a portion of the periphery thereof, the wall or shell of the drum being of such character and the magnet of such energy as to insure the formation of a magnetic field throughout a portion of the interior of the drum. A discharge-chute is arranged within the drum beneath the upper limit of said magnetic field, and suitable means are employed to rotate the drum and cause the travel of the stock through it longitudinally. The material to be treated is fed in at one end of the drum and caused to travel, preferably by gravity, toward the other end. During such travel the portions of the material which are susceptible to magnetic action are attracted toward that part of the interior shell of the drum which is for the time being immediately within the magnetic field, and are held against the inner surface of the drum (the refuse dropping down) until the rotation thereof has raised them to the upper limit of the magnetic field, which overhangs the chute. As soon as that portion of the drum against which they have been held moves past said limit, they drop off therefrom into the chute and are removed, preferably by gravity, to a suitable receptacle.

Minor features of improvement consist in means whereby differences of energy in different parts of the magnetic field may be utilized for effecting a graded separation of the material.

Referring to the drawings, A represents a rectangular open frame-work, which is preferably tilted or inclined as a whole upon its supports B. Within said frame is mounted the separating-drum, which in the present instance is a hollow cylinder C, supported and driven as follows: Around its periphery at one end is a projecting annular flange D, provided with half-shrouded gear-teeth *d*, which engage with the similarly half-shrouded teeth of a pinion D′, mounted upon a driving-shaft F. Guide-rollers E and E′, mounted upon the frame A and having peripheral grooves adapted to receive the projecting portions of the teeth *d*, receive and support the flange D. At the other end of the cylinder an annular flange *c* extends around the periphery, and is received and guided by flanged rollers E^2, E^3, and E^4, the first of which is mounted upon the end of the driving-shaft F. The cylinder is thus freely supported for rotation, but endwise movement is prevented by the engagement of the flanges D and *c* with their respective guiding-rollers.

The wall or shell of the cylinder should of course be of such a character as not to substantially interfere with the formation of a magnetic field throughout a portion of its interior by the stationary exterior magnet. When the cylinder-wall is constructed of substantially non-magnetizable material, practically none of the lines of force which go to make up the magnetic field are cut off by interposition of the wall. If, on the other hand, the material of the wall be magnetizable, it will cut off as many lines of force as it is capable of retaining and will thus divert them from the interior of the cylinder. It is therefore necessary, where a magnetizable material is used for the wall or shell of the cylinder, to employ a magnet of energy more than sufficient to magnetically saturate so much of the wall as would otherwise interfere. In such case the surplus lines of force will be projected into the interior of the cylinder and will produce the necessary field, the interposed wall being, when saturated, substantially non-interfering so far as such surplus is concerned. Hence while we prefer to use non-magnetizable material—such as wood or brass—for the wall of the cylinder, (because we thereby are enabled to use a magnet of less energy,) we do not limit our-

selves to the employment of such materials, and when in our claims we use the expression "substantially non-interfering" to describe the nature of the wall we mean that it is of such a character with reference to the energy of the exterior magnet as to be incapable of retaining within itself or cutting off the whole of the lines of force which that magnet is capable of projecting.

Adjacent to that side of the cylinder at which the driving-shaft is situated, and which for convenience will be termed the "front," is arranged a powerful magnet, which is preferably constructed as follows: Within a stout frame-work I, mounted upon the frame A, is rigidly mounted a horizontal horseshoe electro-magnet J, a portion of whose coils are indicated at G, the terminals g g' being connected with a dynamo or other suitable generator of electricity. To the ends of the horseshoe are secured wrought-iron plates H and H′ of arc-shaped section, each one of which envelops substantially a semicircle of the cylinder's periphery, the two plates together extending substantially the whole length of the cylinder and in close proximity to its exterior. These plates may be reinforced, if desired, throughout a portion of their arc by means of short backing-plates h h', or they may be otherwise stayed or maintained in position relatively to the cylinder. The plates H and H′ thus constitute enlarged poles of the magnet, closely enveloping substantially one-half of the exterior periphery of the cylinder and capable of acting through its shell upon magnetizable substances within it.

An inclined chute K runs through the interior of the cylinder beneath the upper limit of the magnetic field. A diaphragm K′ extends across this chute a short distance above the bottom, as shown in the sectional view of Fig. 2, and runs from the discharge end thereof to a point somewhat beyond the line of nearest approach of the poles H H′ to one another, and a similar but shorter diaphragm K^2 extends across the chute above said first-mentioned diaphragm, running from the discharge end of the chute to a point somewhat short of said line of approach of the poles. Thus, in fact, three separate chutes are provided, each of which receives material from a different longitudinal part of the cylinder and communicates with a separate receiver, as indicated at k k' k^2, respectively.

A delivery-chute M for the ore O leads into the higher end of the cylinder, and a discharge-chute N for the refuse leads from the lower end of the cylinder.

The operation of the apparatus is as follows: The driving-shaft F being suitably actuated, the cylinder rotates and the ore or other material, which is fed in at a proper rate of speed, travels along the inner surface. The magnet being energized, the enlarged poles thereof H H′ create a strong magnetic field throughout the proximate portion of the interior of the cylinder, and the richer ores or portions of material susceptible to magnetic influence are held (the refuse dropping to the bottom) until in rotating they reach the upper limit of the magnetic field, when they fall into the chute K. The refuse finally works to the lower end of the cylinder and is discharged into the chute N. The strongest part of the magnetic field will be a semicircular band or belt adjacent to the line intermediate between the edges of the two poles H H′, and by reason of this increase in the intensity of the field the portions of the ore least susceptible to magnetic influence (and therefore presumably less rich) will be retained there, even though they have previously passed through the less intense part of the field without detention. The arrangement of the diaphragms K′ K^2 is such that the ore which has been retained in this central part of the cylinder drops upon the diaphragm K′ and passes off to a separate trough k', the second diaphragm K^2 receiving that part of the ore which is detained in the field beyond the belt of greatest intensity and discharging it into a third trough k^2, the three troughs leading to distinct receivers.

In the foregoing description we have specified the use of a single horseshoe-magnet as the simplest type of our invention; but obviously a plurality of magnets might be employed without affecting the general mode of operation. Hence in using the word "magnet" in our claims we are not to be understood as limiting the invention to one such device, but in a sense broad enough to include any number of magnets and any grouping or arrangement of their poles around the exterior of the separating-drum. We have also indicated the entire frame A as tilted or inclined, that being the preferred form; but obviously this detail of construction can be varied without changing the principle of operation, provided proper means be employed for causing the gradual travel of the ore or other material through the cylinder as the latter rotates.

Having thus described our invention, we claim—

1. The combination of a rotatable hollow drum having a substantially non-interfering wall, a stationary magnet whose poles closely envelop a portion of the exterior periphery of said drum, and a chute arranged within the drum beneath the upper limit of the magnetic field, substantially as set forth.

2. The combination of a rotatable hollow drum having a substantially non-interfering wall, a stationary magnet having enlarged arc-shaped poles, which closely envelop a portion of the exterior periphery of said drum, and chutes arranged within said drum beneath the upper limit of the magnetic field and leading from different points in the length thereof, whereby the ores detained in different parts of said field may be separately delivered, substantially as set forth.

3. The combination of a rotatable hollow drum having a substantially non-interfering wall and having annular flanges around its ends, one of which flanges is provided with gear-teeth, a driving-pinion engaging with said teeth, guide-rollers engaging with said flanges, a stationary magnet whose poles closely envelop a portion of the exterior periphery of said drum, and a chute arranged within said drum beneath the upper limit of the magnetic field, substantially as set forth.

CHAS. T. THOMPSON.
RICHARD H. SANDERS.

Witnesses:
JAMES H. BELL,
E. REESE.