(No Model.)

2 Sheets—Sheet 1.

J. RAE.

MAGNETIC ORE SEPARATOR.

No. 273,309. Patented Mar. 6, 1883.

Fig: 1

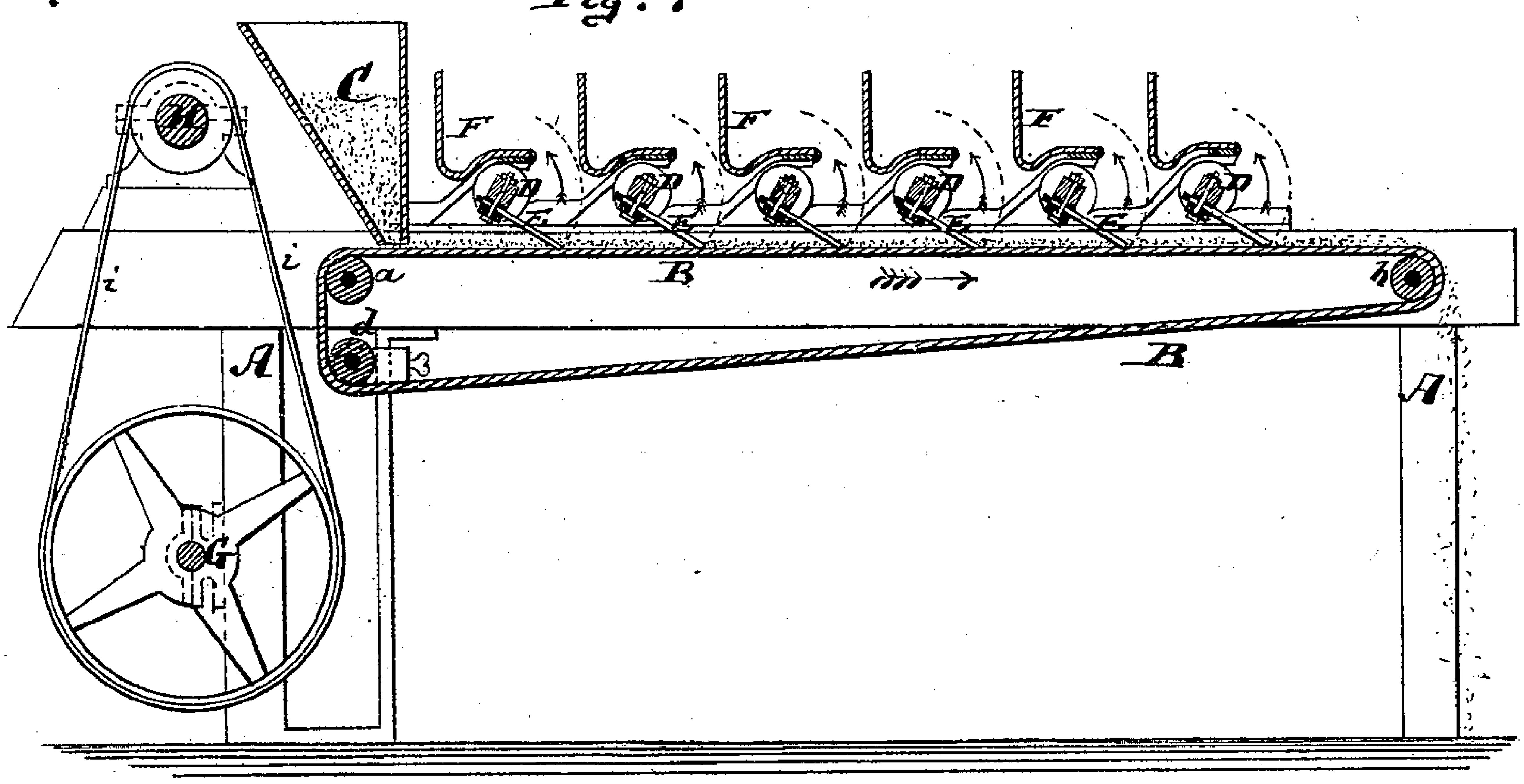
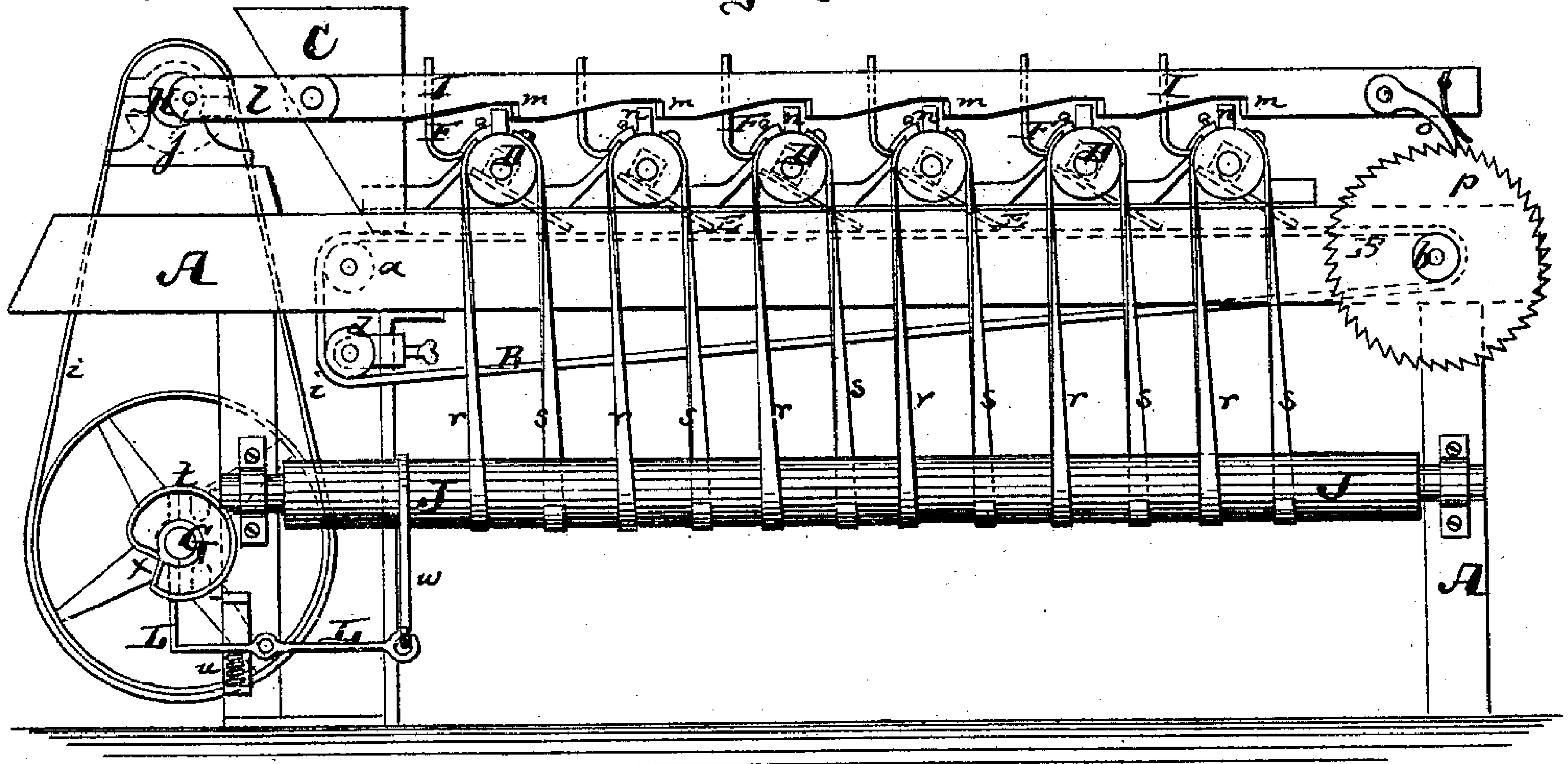


Fig: 2



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Willy G. E. Schultz

Inventor:
John Rae
by his attorneys
Briesen & Betts

(No Model.) 2 Sheets—Sheet 2.

J. RAE.

MAGNETIC ORE SEPARATOR.

No. 273,309. Patented Mar. 6, 1883.

Fig: 3

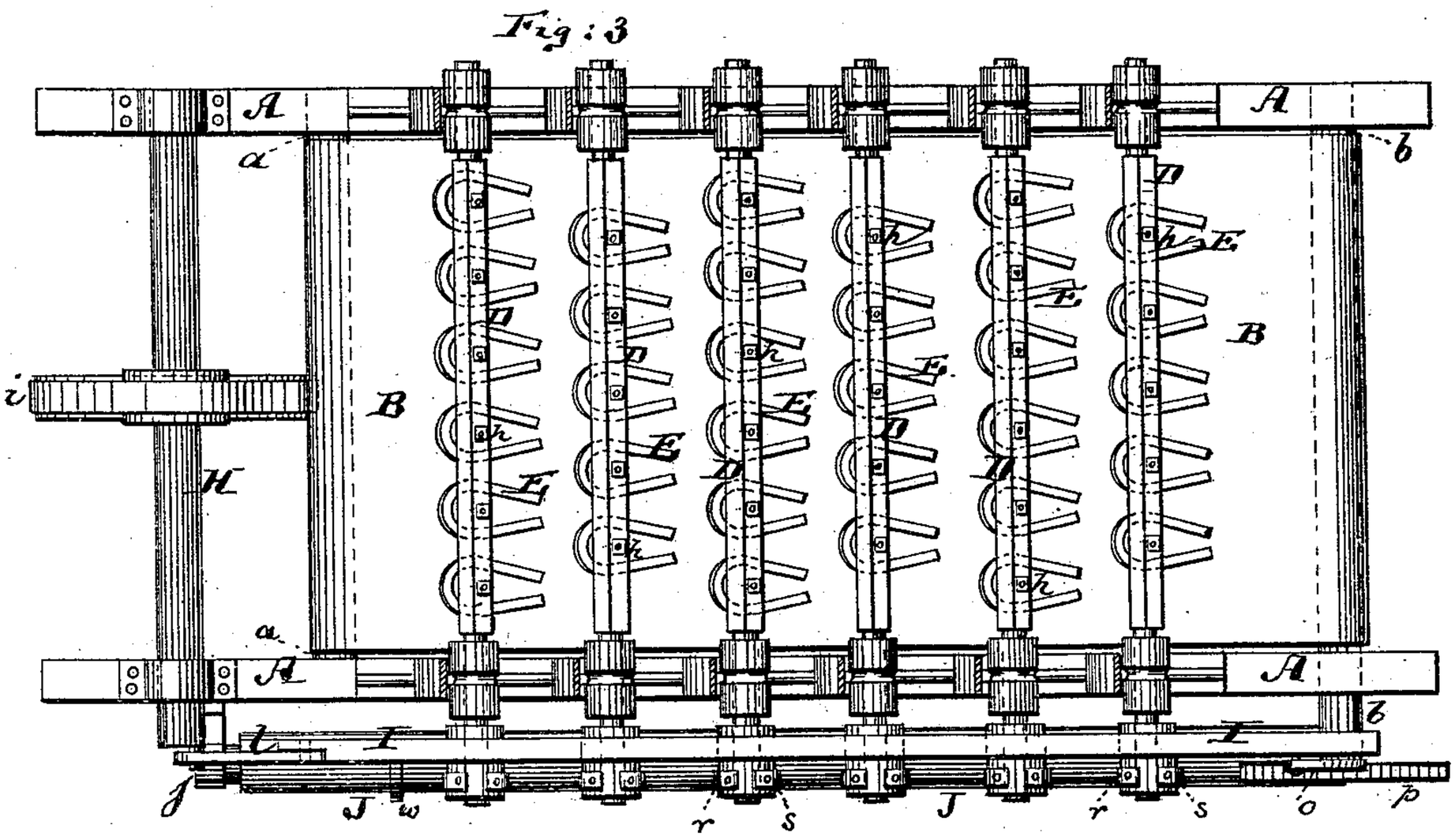

Fig: 4

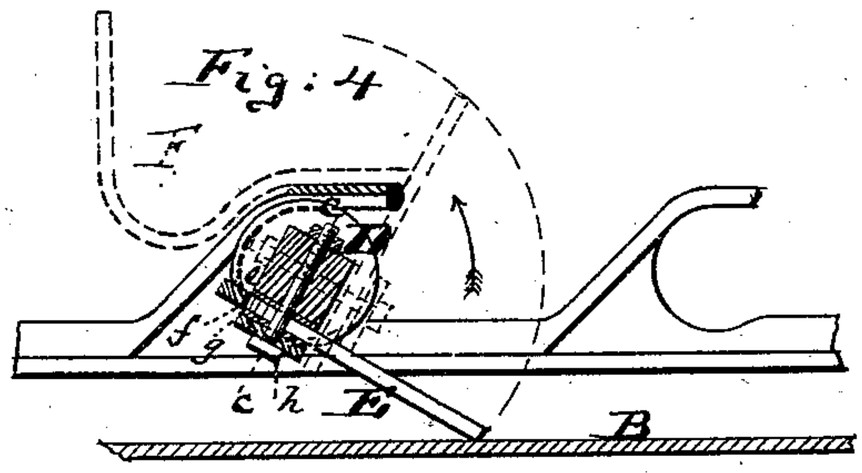

Fig: 5

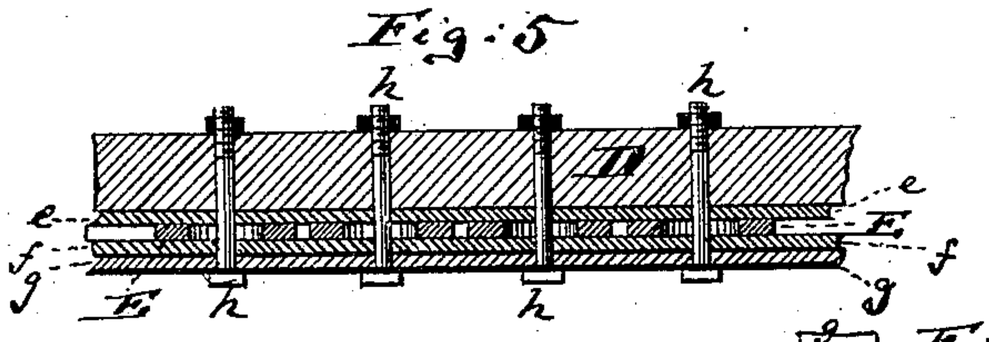

Fig: 6

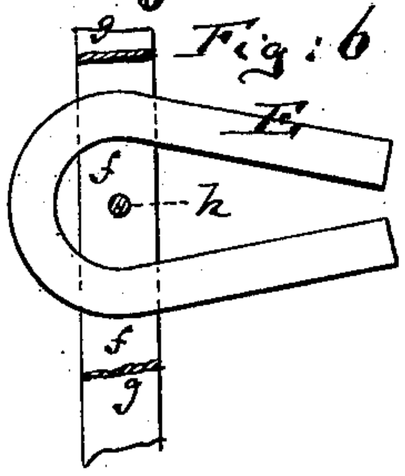

Fig: 7

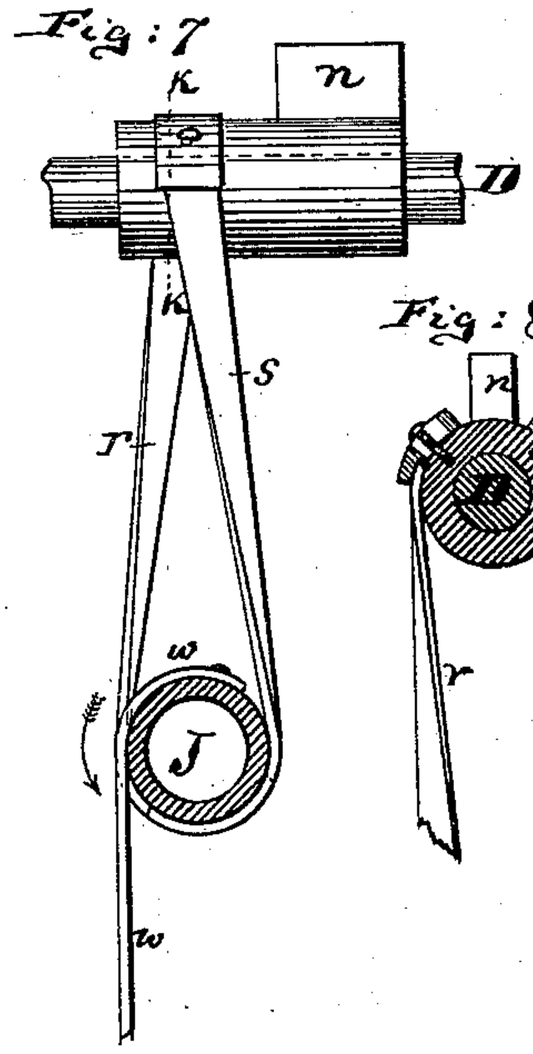

Fig: 8

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UNITED STATES PATENT OFFICE.

JOHN RAE, OF NEW YORK, N. Y.

MAGNETIC ORE-SEPARATOR.

SPECIFICATION forming part of Letters Patent No. 273,309, dated March 6, 1883.

Application filed June 14, 1882. (No model.)

To all whom it may concern:

Be it known that I, JOHN RAE, of New York, in the county and State of New York, have invented an Improved Magnetic Ore-Separator, of which the following is a specification.

Figure 1 is a vertical longitudinal central section of my improved magnetic ore-separator. Fig. 2 is a side elevation of the same; Fig. 3, a plan or top view of the same; Fig. 4, a detail vertical section, on an enlarged scale, through the center of one of the magnets, showing its connection with the carrying-shaft. Fig. 5 is a section on the line *c c*, Fig. 4. Fig. 6 is a top view of one of the magnets. Fig. 7 is a detail side view of the end of one of the magnet-carrying shafts, showing its connection with the elastic belts. Fig. 8 is a detail cross-section of said shaft on the line *k k*, Fig. 7.

The object of this invention is to produce a practical apparatus for separating the particles of iron from the sand and other impurities that accompany it—that is to say, ore containing iron is crushed or pulverized, together with all its constituents, and the machine is to separate therefrom all the particles of iron, leaving the impurities—such as crushed quartz, sulphur, and the like—entirely free of iron, and vice versa.

The invention consists in a new combination of parts for vibrating the magnets, so that they will shake off any impurities that may in the first dip adhere to them, and in then carrying the particles of iron that adhere to the magnets into receivers or troughs.

The invention also consists in other details of improvement hereinafter more fully specified.

In the accompanying drawings, the letter A represents the frame of my machine. This frame furnishes bearings for the shafts *a b d*, around which is passed an endless belt, B, that is to be moved in the direction of the arrow shown in Fig. 1, and upon which the powdered ore containing the impurities is deposited from a hopper or vessel, C. To suitable brackets projecting from the side rails of the frame A are secured the bearings of cross-shafts D D, to which the horseshoe-magnets E E are fastened in such manner that the said magnets will be above the endless belt B, and adapted to dip into the substance carried on said belt. Each shaft D, above the belt B, carries a series of said horseshoe-magnets E. The manner in which these magnets are fastened to the shafts is more fully shown in Figs. 4, 5, and 6—that is to say, each magnet is between two sheets, *e f*, of insulating and non-conducting substance placed against the under side of the shaft D, which under side is flattened to give a better bearing. A plate, *g*, of iron or other substance, is then placed against the lower sheet, *f*, and suitable bolts, *h*, are passed through the shaft D and plate *g*, so that each of said bolts is embraced by one of the magnets E, as indicated in Fig. 6. By this means the magnets are firmly attached to the shaft in suitable numbers, and are nevertheless insulated from the bolts *h*, shafts D, plates *g*, and from each other, so that each will have its own independent action, the magnets being so fastened to the shaft that in the normal position their poles will incline toward and be nearly in contact with the upper surface of the belt B. Above each shaft D is supported, by suitable brackets on the frame, a trough or receiver, F.

G is the driving-shaft, hung in the frame A, and receiving rotary motion by suitable mechanism. This driving-shaft imparts rotary motion by belt *i* to a shaft, H, which carries a crank-pin, *j*, and to this crank-pin is jointed by suitable link, *l*, a rod, I, which extends over the tops of the shafts D D, near one side of the machine, and which has series of notches, forming shoulders *m m*, respectively, in front of upwardly-projecting studs *n*, that are secured upon said shafts D. A pawl, *o*, is pivoted to the rod I, and engages into the teeth of a ratchet-wheel, *p*, that is mounted upon the shaft *b*. Each of the shafts D is, at one side of the machine, rigidly connected to two straps, *r* and *s*, whose lower ends are in like manner fastened to a longitudinal shaft, J, which is hung in the framing of the machine. The straps *s* are made of elastic material, such as india-rubber. Whenever, during the rotation of the shaft H, the rod I is drawn toward said shaft H, the shafts D D D will be rocked in one direction and the straps *s* stretched or elongated, and on the return motion of the rod I the shafts D D D will be rocked in the opposite direction by the retractile action of the

elastic bands *s*. The bands *s* are so adjusted as regards their strain that normally they will hold the shafts D and magnets in the position indicated in Figs. 1 and 4; but by the joint action of the rod I and elastic straps *s* the shafts D and their magnets are rapidly oscillated, so as to cause the magnets to vibrate above the belt B. At each return motion of the rod I its pawl *o*, engaging into a tooth of the ratchet-wheel *p*, imparts a short rotary motion to said wheel *p*, and thereby to the shaft *b* and belt B, and thus the belt is moved gradually forward in the direction of the arrow shown in Fig. 1. The vibrations imparted by the movements heretofore described to the magnets are quite short and rapid. After every five or six vibrations thus imparted to the shafts D and their magnets E by the joint action of the rod I and straps *s*, a more pronounced motion is imparted to said shafts D and magnets E by the following means, to wit: A cam, *t*, is mounted upon the shaft G. Against its edge bears the point of a lever, L, the same being held in contact with said cam by a suitable spring, *u*. The other end of said lever L connects with a band, *w*, which is fastened to the shaft J, as indicated in Figs. 2 and 7. Whenever the notch *x* of the cam *t* comes in line with the end of the lever L, the spring *u* throws that end of the lever L up nearer to the axis of the shaft G, and by that means moves the other end of the lever L down, causing it to pull on the strap *w* and to rock the shaft J in the direction of the arrow shown in Fig. 7. This rocking motion of the shaft J causes it to pull on the shafts D by means of the straps *r*, and to thereby carry the magnets up (into the position indicated by dotted lines in Fig. 4) close to the troughs F. As soon as this motion has been attained the cam end of the lever L is again moved downward by coming out of the notch *x*, which allows the magnets, by their weight, assisted by the stiffness of the metallic band *w*, and, if desired, by a suitable additional spring or weight, to carry the shafts D and magnets E back to their normal position, and also the shaft J, so that the strap *w* will remain substantially taut.

The operation of this machine is as follows: The powdered substance containing iron ore being fed to the belt B through the hopper C and the parts of the machine having been set in motion, a layer of the said substance is moved along the belt, and into this layer dip the several magnets. To the points of the magnets and between their poles will, by this dipping action, be caused to adhere some of the iron ore that is carried by said belt, which, however, will also support considerable impure matter; but by the rapid shaking motion which is imparted to the magnets through the action of the rod I and straps *s* these impurities are shaken off the magnets, so that only the iron ore will adhere to them, and when this has been accomplished, which, as practice has shown me, is accomplished by six or seven shakes of the magnets, the magnets are thrown up against the troughs F with sufficient violence to discharge into the troughs whatever iron ore adheres to them. No impurities will go with the iron ore into the troughs, as they were all shaken off by the motions described. At the same time, and while this action of the magnets is going on, the belt B is moved along, and finally discharges its impurities at the end that passes over the shaft *b*.

The great advantage obtained by the use of this machine is, that no impurities will go into the iron ore that is collected in the troughs; hence the iron will be of greater value than that obtained from ore by the usual magnetic appliances, which have no provision for shaking out the impurities.

Suitable rakes or scrapers may be placed into the troughs F, to scrape out of them the iron ore deposited therein by the magnets for collection into suitable receptacles.

I do not claim sliding magnets through the ore and then swinging them toward a trough, as shown in Patent No. 46,005.

I claim—

1. In a magnetic ore-separator, the combination of the shafts D and magnets E with the feeding-apron B, troughs F, and with mechanism, substantially as described, for first oscillating the shaft D and shaking the magnets, and then swinging the said shaft and throwing the magnets against the troughs F, substantially as specified.

2. The combination of the reciprocating notched rod I with the shafts D, carrying the magnets E and projections *n*, and with the elastic straps *s*, and means, substantially as described, for holding said straps, as and for the purpose described.

3. The combination of the reciprocating notched rod I with the shafts D, magnets E, lugs *n*, straps *s*, shaft J, pawl *o*, ratchet-wheel *p*, shaft *b*, and endless belt B, substantially as and for the purpose specified.

4. The combination of the trough F with the shaft D, carrying magnets E, and with the endless apron B, and with mechanism, substantially as described, for continuously moving said apron B, and for shaking and finally swinging the magnets E, substantially as specified.

5. The combination of the shaft J, straps *r s w*, lever L, rotary cam *t*, spring *u*, shafts D, and magnets E, substantially as and for the purpose described.

6. The combination of the shaft J, straps *r s w*, lever L, rotary cam *t*, spring *u*, shafts D, magnets E, and with the notched rod I and lugs *n*, substantially as specified.

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HARRY M. TURK.