No. 719,397. PATENTED JAN. 27, 1903.

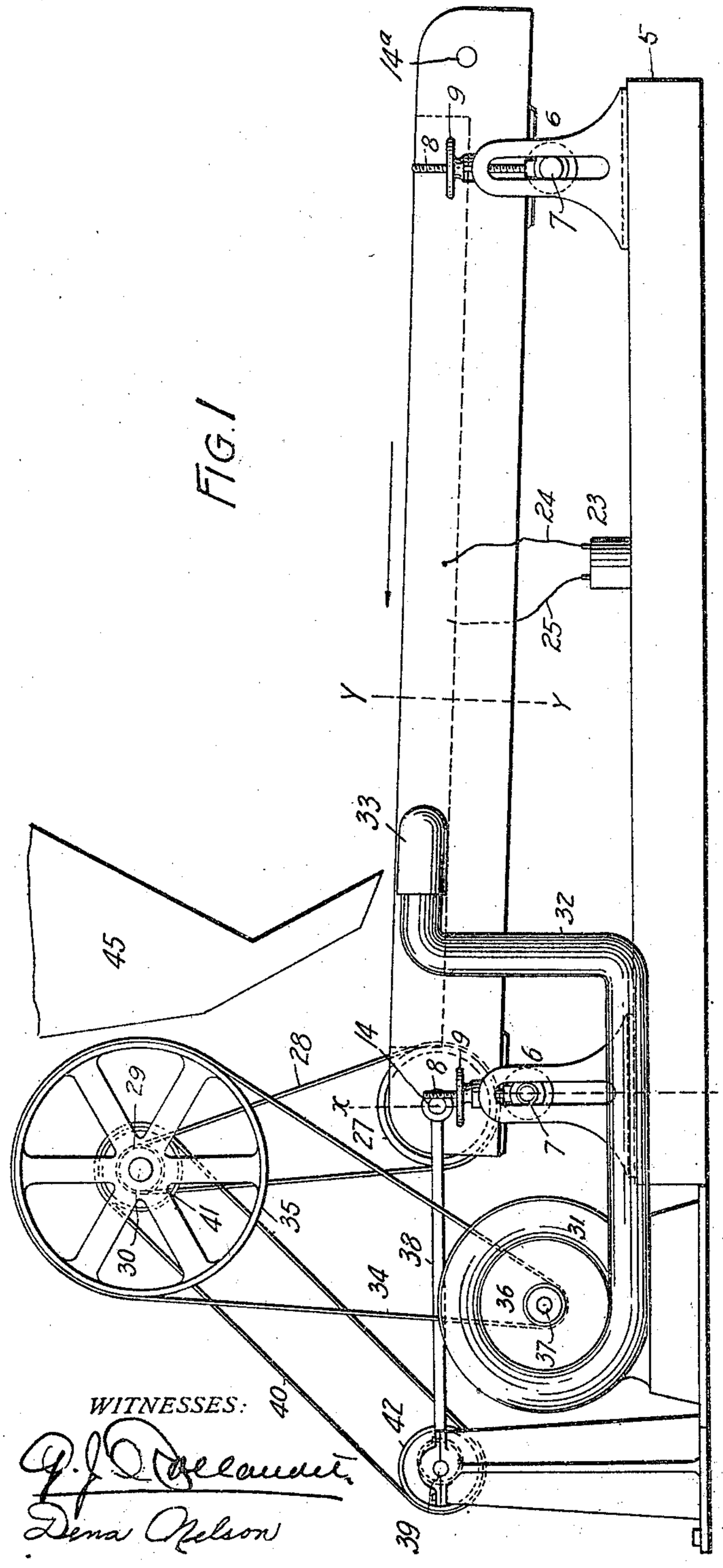
R. E. & E. WAUGH.

DRY ORE SEPARATOR.

APPLICATION FILED SEPT. 21, 1901. RENEWED MAY 27, 1902.

NO MODEL. 4 SHEETS—SHEET 1.

FIG. 1



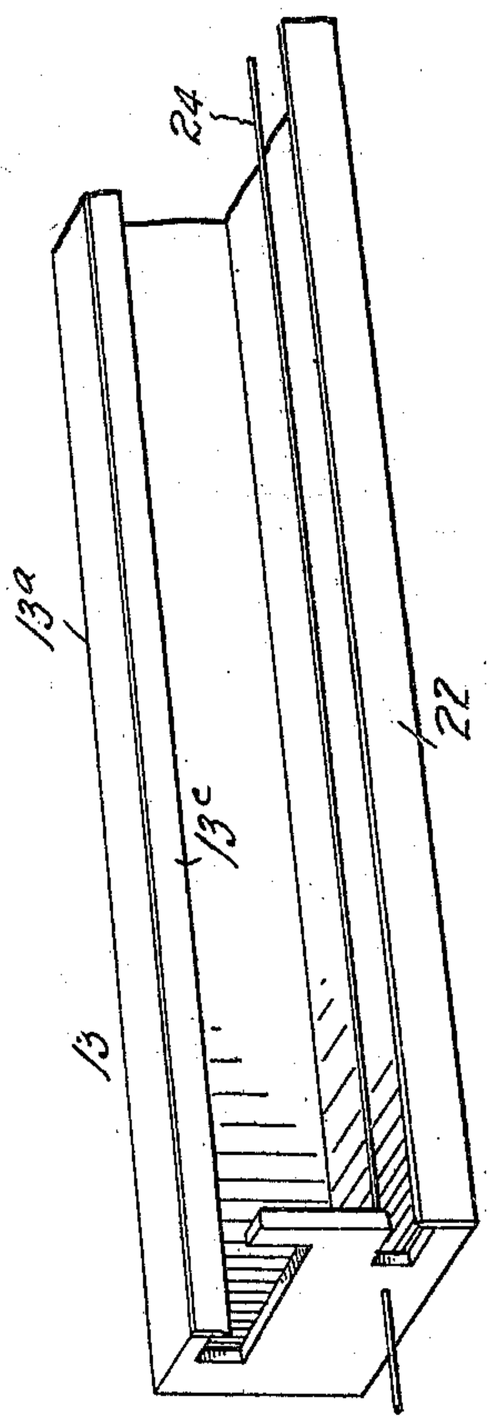


FIG. 2

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NO MODEL. 4 SHEETS—SHEET 2.

FIG. 3

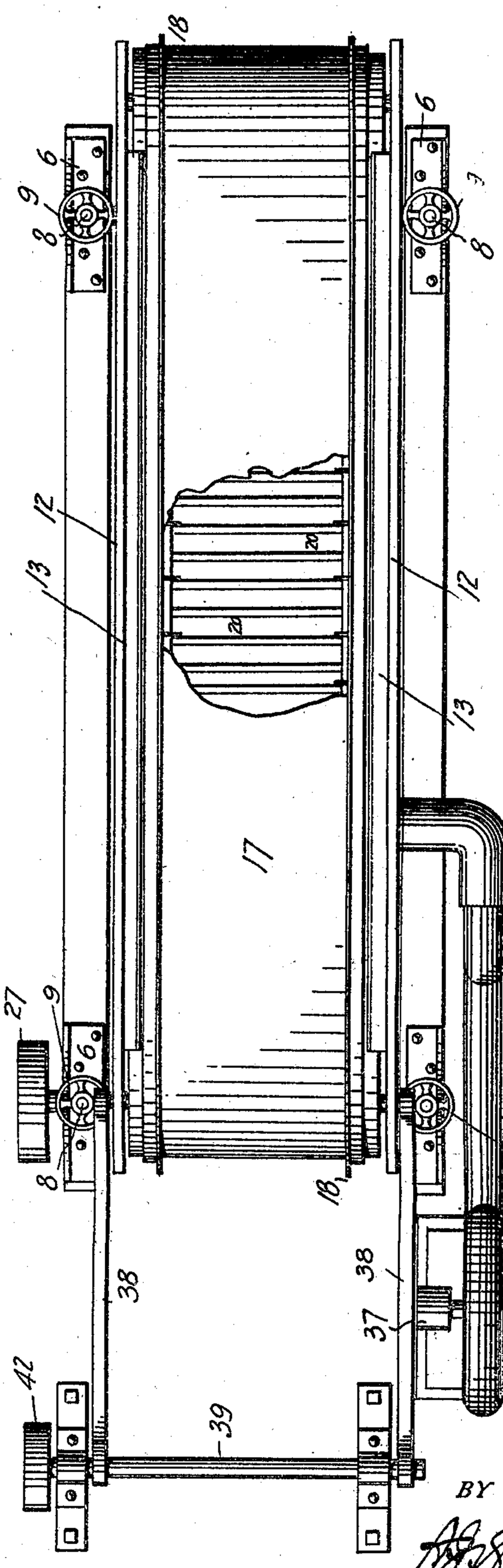
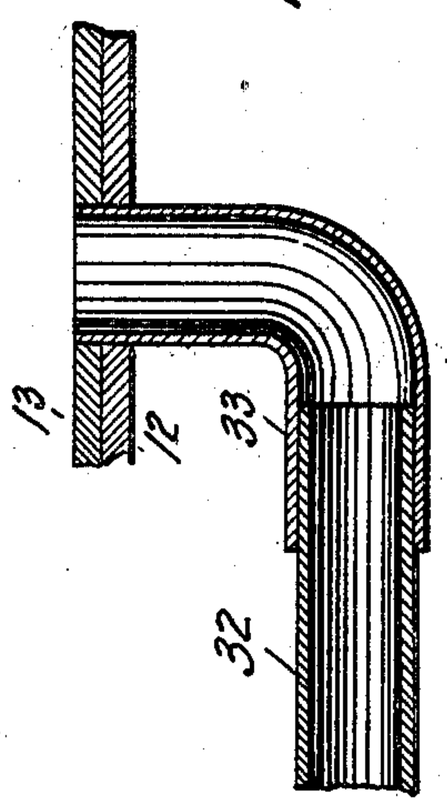


FIG. 4.



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NO MODEL. 4 SHEETS—SHEET 3.

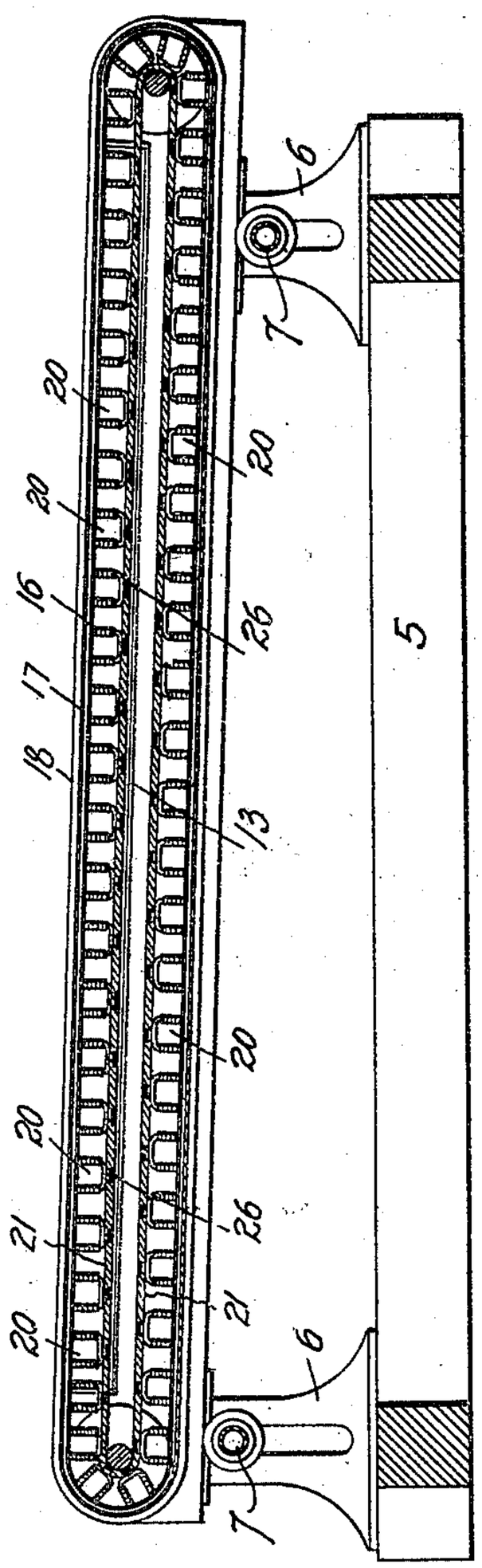

FIG. 5

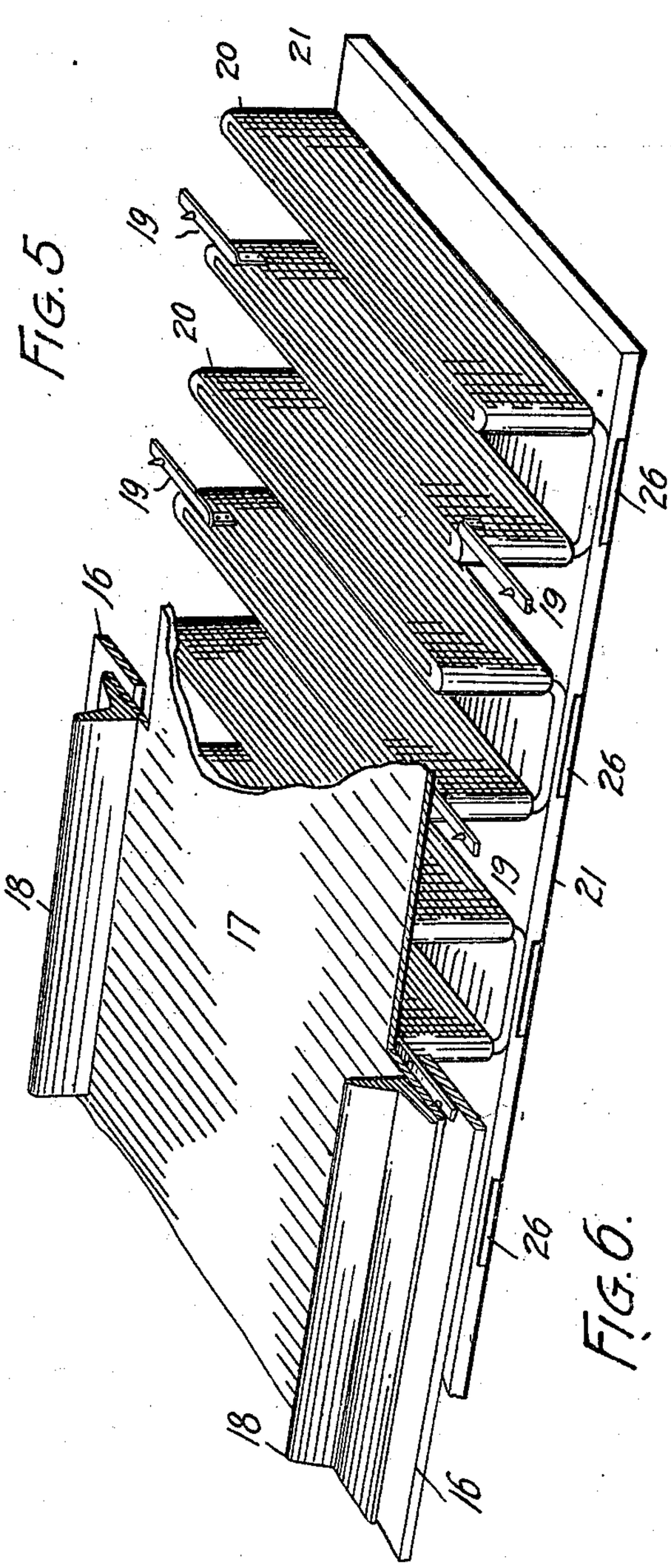

FIG. 6.

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APPLICATION FILED SEPT. 21, 1901. RENEWED MAY 27, 1902.

NO MODEL. 4 SHEETS—SHEET 4.

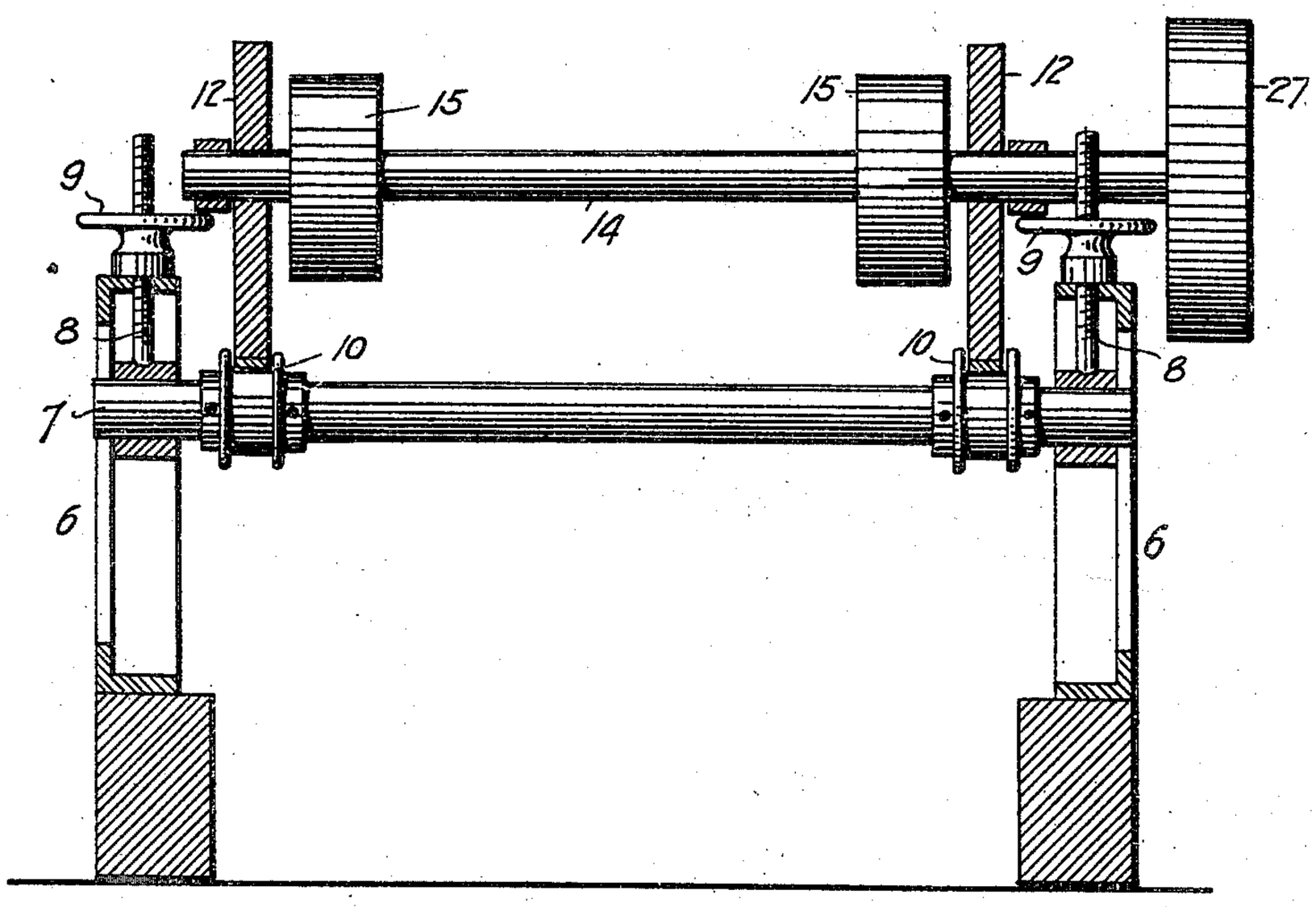

FIG. 7

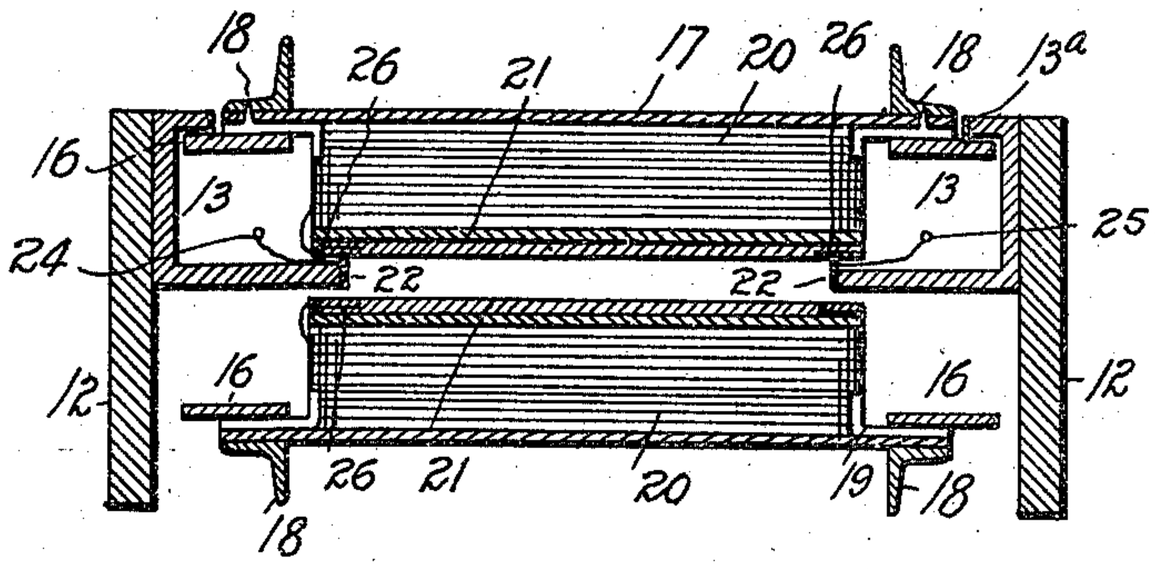

FIG. 8

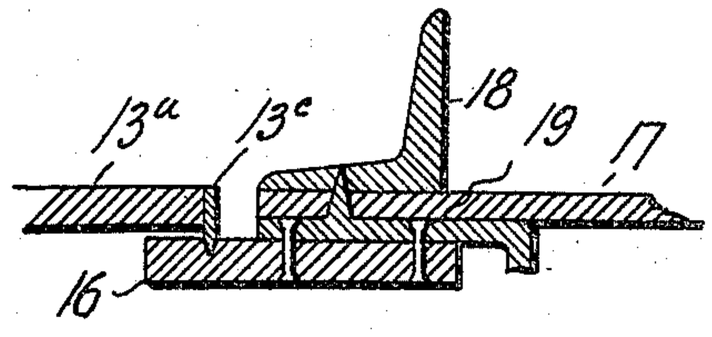

FIG. 9

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UNITED STATES PATENT OFFICE.

ROBERT E. WAUGH AND EUGENE WAUGH, OF DENVER, COLORADO, ASSIGNORS OF FOUR-SEVENTHS TO JAMES H. McSHANE, FELIX J. McSHANE, HENRY J. PASCHEL, AND CLEMONT L. WEST, OF OMAHA, NEBRASKA.

DRY ORE-SEPARATOR.

SPECIFICATION forming part of Letters Patent No. 719,397, dated January 27, 1903.

Application filed September 21, 1901. Renewed May 27, 1902. Serial No. 109,199. (No model.)

To all whom it may concern:

Be it known that we, ROBERT E. WAUGH and EUGENE WAUGH, citizens of the United States of America, residing at Denver, in the county of Arapahoe and State of Colorado, have invented certain new and useful Improvements in Dry Ore-Separators; and we 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, reference being had to the accompanying drawings, and to the figures of reference marked thereon, which form a part of this specification.

Our invention relates to a dry ore-separator in which both air and magnetism are utilized to perform the concentrating or separating function. We employ an endless traveling fibrous apron provided with electromagnets transversely arranged on its inner surface, the apron being employed in conjunction with a box or receptacle in which air is introduced under pressure, the arrangement being such that the only escape of the air from the box or receptacle is through the fibrous apron. The arrangement is also such that the magnets are energized only on the upper or working portion of the endless apron, so that as soon as the apron moves downwardly and begins its return movement beneath the air-box the magnetic material previously held by the magnet on the apron is allowed to drop off into a suitable receptacle. By reason of the transverse arrangement of the magnets with reference to the working surface of the apron the magnetic material forms transverse riffles on the working surface of the apron, which riffles have a tendency to prevent the escape of non-magnetic concentrates with the gangue over the tail of the table.

Having briefly outlined our improved construction, we will proceed to describe the same in detail, reference being made to the accompanying drawings, in which is illustrated an embodiment thereof.

In the drawings, Figure 1 is a side elevation of our improved dry ore-separator. Fig. 2 is a fragmentary perspective view of the air-box on one side of the machine, the parts being shown on a larger scale. Fig. 3 is a plan view of the apparatus, the apron being partly broken away to disclose the magnets underneath. Fig. 4 is a section taken through the conduit for introducing air to the air-box. Fig. 5 is a longitudinal section taken through the apparatus. Fig. 6 is a fragmentary perspective view of the apron, shown on a larger scale. The magnets carried by and forming part of the apron are clearly illustrated in this view. Fig. 7 is a section taken through the apparatus on the line x x, Fig. 1, the parts being shown on a larger scale. Fig. 8 is a section taken on the line y y, Fig. 1. Fig. 9 is a fragmentary view of the apron and a portion of the air-box with which it is connected, the parts being shown on a larger scale.

The same reference characters indicate the same parts in all the views.

Let the numeral 5 designate a suitable relatively stationary foundation or base upon which are mounted two standards 6, located at each extremity of the machine. The standards 6 are slotted to receive the extremities of transverse shafts 7, which engage bearings to which are attached threaded stems 8, which pass upwardly through plain or unthreaded openings formed in flanges of the standards. To the upper portion of the stems which project above the standards are applied nuts 9, provided with hand-wheels, by means of which the shaft 7 may be raised and lowered at will when regulating the inclination of the vibratory frame, as hereinafter described. This frame is preferably downwardly inclined from the head toward the tail of the table or from the left toward the right, since for the purposes of this specification the left-hand extremity of the table, referring to Fig. 1, is deemed the head and the opposite extremity the tail thereof.

Each shaft 7 is provided with two antifrictional rollers 10, which are provided with flanges. These rollers are engaged by the side pieces 12 of the framework, which side pieces engage the rollers between the flanges.

To each of these side pieces is attached an air box or chamber 13. The side pieces 12 project beyond the air-chambers at the extremities of the machine, and in these extremities are journaled shafts 14 and 14ª. Each of these shafts is provided with a pair of wheels 15, located between the side boards 12 of the frame and engaged by belts 16, attached to the opposite longitudinal edges of the endless fibrous apron 17. This apron is provided at its outer edges with strips of rubber 18, which are angular in cross-section and form flanges projecting above the working surface of the apron, whereby the material discharged thereon for treatment is prevented from escaping over the edges of the apron during the operation of the machine. The belts 16 pass below the upper horizontal strips 13ª of the air-chambers and are engaged by depending flanges 13ᶜ, which form grooves in the belts and make the chambers 13 air-tight, or practically so, at the top.

Attached to the inner surface of the apron by means of metal pieces 19 is a series of electromagnets 20, arranged transversely across the apron at suitable intervals, the pole-pieces of the magnets being in contact with the inner surface of the apron. To these magnets, remote from the pole-pieces, is attached an endless auxiliary apron or belt 21, preferably formed of rubber or some other suitable material which is impervious to air. The auxiliary apron 21 lies parallel with the apron 17 and makes the chambers 13 air-tight below and on the sides adjacent the magnets. The bottom of each chamber 13 is provided with an upwardly-projecting metal flange 22. These flanges are connected with an electric source 23 by means of conductors 24 and 25, leading from the poles of said source and respectively connected with the metal parts 22 of the two chambers. Each magnet is provided at each extremity with a metal contact 26. The two contacts of each magnet are connected with the opposite extremities of the magnet-coils. These contacts 26 also engage the metal parts 22 of the chambers. The electric circuit is thus completed through the coils of the magnets carried by the upper part of the traveling apron when the machine is in operation. As the contact-flanges 22 only extend the length of the box 13, as soon as the apron leaves the box the magnets are deënergized and the magnetic material is allowed to drop therefrom.

To the shaft 14, which projects outwardly on one side of the machine sufficiently for the purpose, is made fast a pulley 27, which is connected with a belt 28, passing around a pulley 29, fast on a shaft 30, operated by any suitable power. It is evident that the rotation of the shaft 14 will actuate the endless apron and its attachments.

Air is introduced to one of the boxes 13 from a blower 31. A conduit 32 leads from this blower, and its free extremity is connected telescopically with a conduit 33, which communicates with one of the air-chambers 13. The blower is operated by means of a belt 34, which connects a pulley 35, fast on the shaft 30, with a smaller pulley 36, fast on the blower-shaft 37.

The vibratory or reciprocating movement is imparted to the apron-frame by two pitmen 38, connected at one extremity with eccentrics on a shaft 39, while their opposite extremities are connected with the shaft 14. The eccentric-shaft 39 is operated by a belt 40, which connects a pulley 41 on the shaft 30 with a pulley 42 on the shaft 39.

Before beginning the operation of the machine the nuts 9, which are provided with hand-wheels for the purpose, as aforesaid, are so adjusted that the apron-frame, composed of the side pieces 12, shall occupy an inclined position, the head of the frame or the extremity farthest to the left in Figs. 1, 3, and 5 being the highest.

When the machine is in operation, the shaft 14 is rotated in a direction to cause the apron and its attachments to travel in the direction indicated by the arrow in Fig. 1. The material to be treated is discharged upon the working or separating face of the apron from a chute or hopper 45. At the same time air is introduced to one of the chambers 13 from the blower 31 and the apron-frame subjected to a vibratory movement by the rotation of the shaft 39. The air passes freely from one chamber 13 to the other, between the apron 17 above and the auxiliary belt or apron 21 below. Hence the spaces between the parts 17 and 21 in which the magnets are located form a part of the chamber. When the machine is in operation, as aforesaid, there are three forces in addition to gravity acting in conjunction to effect the separation of the mineral from the gangue—namely, vibratory force, magnetic force, and the compressed-air force. The air passes up through the meshes of the apron and causes, in conjunction with the vibratory force, the gangue, which is of less specific gravity, to rise to the top, allowing the mineral particles, which are heaviest, to settle on the apron, whereby they are carried along therewith. The magnetic force, acting through the apron, causes the magnetic material to arrange itself in transverse ridges or riffles corresponding with the transverse arrangement of the magnetic poles of the inner surface of the apron. These transverse ridges or temporary riffles of magnetic material overcome any tendency of the non-magnetic mineral particles to pass down the apron's incline and escape at the outlet of the machine with the gangue.

Having thus described our invention, what we claim is—

1. In a dry ore-separator, the combination with a main frame, of an apron-frame mounted thereon and provided with an air-chamber, an endless traveling apron mounted on

the apron-frame and provided with electromagnets located adjacent the inner surface of the apron which is arranged to close the air-chamber, and means for introducing air under pressure to the air-chamber, the apron fabric being such as to allow the air from the chamber to pass therethrough for the purpose set forth.

2. In a dry ore-separator, the combination with a stationary frame, of an apron-frame movably mounted thereon and provided with an air-chamber, an endless traveling apron mounted on the apron-frame and arranged to close the air-chamber, the apron being provided with electromagnets arranged adjacent its inner surface, means for imparting a vibratory movement to the apron-frame, and means for introducing air under pressure to the air-chamber.

3. In a dry ore-separator, the combination with a stationary frame, of an apron-frame movably mounted thereon, and provided with two air-chambers, one on each side, an endless traveling apron mounted on the apron-frame and provided with electromagnets mounted adjacent its inner surface, the apron and magnets being arranged to close the air-chambers and permit a circulation of air from one chamber to the other, means for imparting a vibratory movement to the apron-frame, and means for introducing air under pressure to the air-chambers.

4. In a dry ore-separator, the combination of an apron-frame provided with two air-chambers, one on each side, an endless traveling apron mounted on the apron-frame, said apron being provided with an auxiliary apron impervious to air and occupying a position separated from and parallel with the main apron, electromagnets located between these two aprons, their pole-pieces being arranged adjacent the inner surface of the main apron, the structure composed of the two aprons and the magnets being arranged to close the air-chambers and form a communication between the two chambers, and means for introducing air under pressure to the air-chambers.

5. The combination of an apron-frame, provided with an air-chamber, an endless traveling apron provided with electromagnets arranged adjacent the inner surface of the apron and traveling therewith through the air-chamber, the apron being arranged to close the air-chamber at the top, and the apron fabric being pervious to the air, and means for introducing air under pressure to the air-chamber.

6. The combination with an apron-frame, provided with an air-chamber, of an endless traveling apron mounted on said frame and closing the air-chamber at the top, and electromagnets connected with the apron, and having their pole-pieces arranged transversely across the inner surface of the apron, and means for introducing air under pressure to the air-chamber.

7. The combination with an apron-frame, provided with an air-chamber, of an endless traveling apron mounted on said frame and provided with electromagnets arranged adjacent the inner surface of the apron, and traveling therewith through the air-chamber an electric source, and means for automatically closing the circuit to energize the magnets while traveling through the air-chamber, and for breaking the circuit to deënergize the magnets as they leave the air-chamber.

8. The combination with an apron-frame, provided with an air-chamber, of an endless apron arranged to travel on said frame and closing said air-chamber at the top, electromagnets connected with the apron and arranged to travel therewith through the air-chamber, contacts arranged longitudinally of the air-chamber and respectively connected with the poles of the electric source, the arrangement being such that the magnets engage the said contacts and close the circuit through the magnet-coils while passing through the air-chamber.

9. The combination with a stationary frame, of an apron-frame mounted to vibrate thereon and inclined downwardly from the head toward the tail of the machine, said apron-frame being provided with an air-chamber, an endless traveling apron mounted on the apron-frame and closing the air-chamber at the top, electromagnets carried by the apron and traveling therewith through the air-chamber, means for introducing air under pressure to the air-chamber, means for imparting vibratory movement to the apron-frame, and means for actuating the apron, substantially as described.

10. The combination with a stationary frame, of an apron-frame mounted to vibrate thereon and provided with air-chambers, one on each side, an endless traveling apron mounted on the apron-frame and provided with electromagnets, the apron and the magnets being arranged to close the air-chambers and establish a communication between them, the apron being provided with flexible flanges applied to the opposite edges of its outer surface, and belts applied to the inner surface of its opposite edges, shafts mounted on the vibratory frame, wheels mounted on the shafts and engaged by the belts of the apron, means for introducing air under pressure to the air-chambers, means for actuating the apron, and means for imparting the vibratory movement to the apron-frame.

In testimony whereof we affix our signatures in presence of two witnesses.

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EUGENE WAUGH.

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A. J. O'BRIEN.