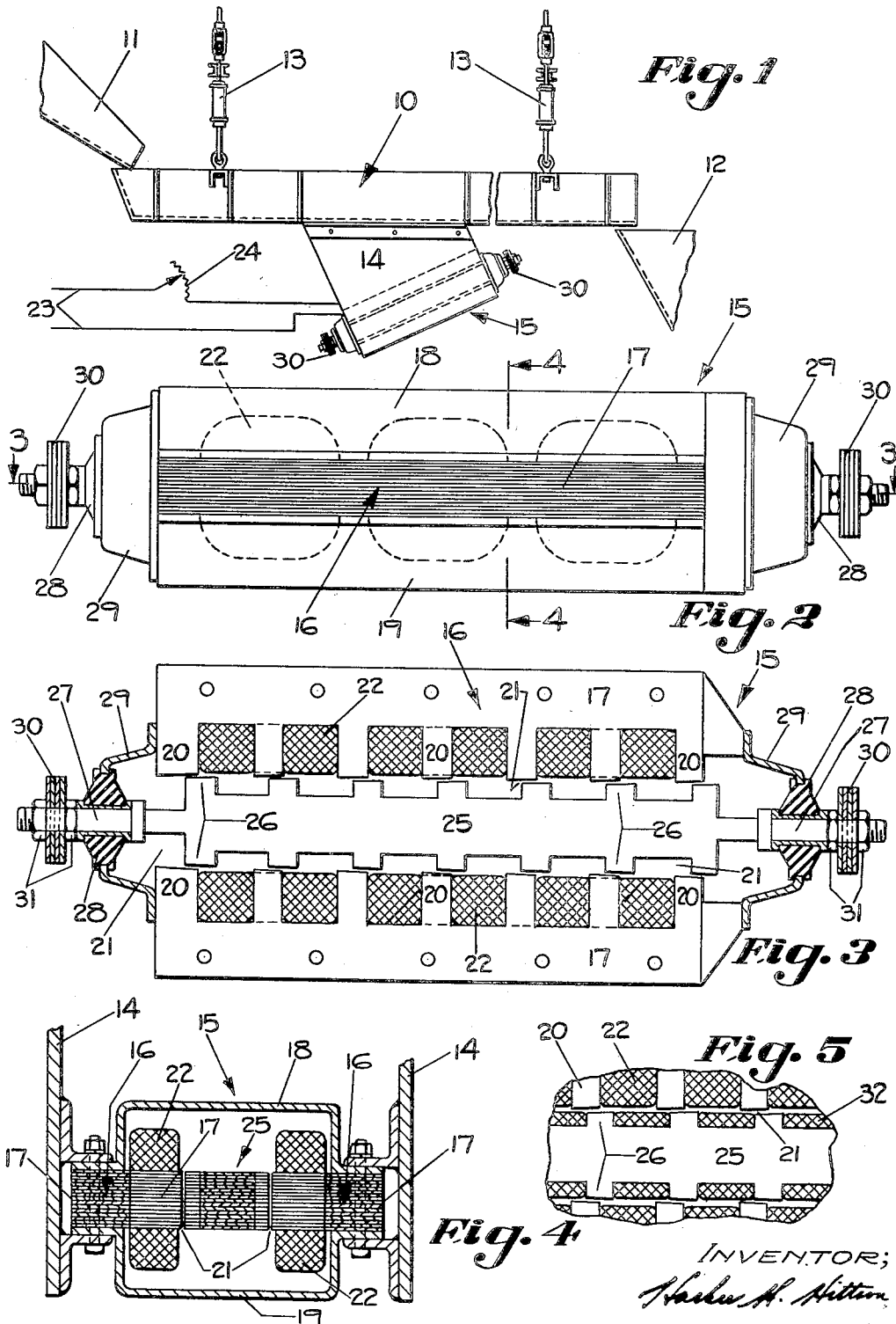


June 29, 1948.

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VIBRATORY CONVEYER

2,444,134

Filed May 27, 1946



UNITED STATES PATENT OFFICE

2,444,134

VIBRATORY CONVEYER

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Application May 27, 1946, Serial No. 672,402

4 Claims. (Cl. 172-126)

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This invention relates to a vibratory conveyer including a vibratory motor or to a vibratory motor, per se.

An object of the invention is to provide an improved conveyer and motor of the reaction type.

Another object of the invention is to provide improved means including discs, preferably made of rubber, for guiding a reaction type armature and also for providing restoring forces to co-operate with magnetic or electrical forces to produce vibration in an electrical motor.

Other objects of the invention will appear hereinafter, the novel features and combinations being set forth in the appended claims.

In the accompanying drawings,

Fig. 1 is a side elevational view of a vibratory feeder or conveyer incorporating the features of my invention;

Fig. 2 is a side view of the motor disconnected from the conveyer deck;

Fig. 3 is a longitudinal sectional view taken on the line 3-3 of Fig. 2, looking in the direction of the arrows;

Fig. 4 is a transverse sectional view taken on the line 4-4 of Fig. 2, looking in the direction of the arrows; and

Fig. 5 is a view of a portion of a modified motor.

As illustrated in Fig. 1 of the drawings, the vibratory feeder or conveyer includes a deck 10 adapted to be fed material as from a chute 11 and to deliver said material to a chute or receptacle 12. Deck 10 is mounted on or suspended from a superstructure, not shown, preferably by four spaced vibration absorbing suspension mounts 13, there preferably being two on each side thereof. The deck 10 may be otherwise mounted for unobstructed vibratory motion.

Rigidly attached to the deck 10, as by a pair of spaced downwardly extending plates 14, is a vibratory electro-magnetic motor 15 of the reaction type. The motor 15 includes a field structure 16 which is formed of a pair of laterally spaced longitudinally extending similar cores 17 formed of silicon steel laminations which are preferably riveted or otherwise attached together to provide a low reluctance magnetic path. The field cores 17 are held in proper spaced relation by top and bottom housing plates 18 and 19 which cooperate with the cores 17 to provide an enclosure for certain elements hereinafter described.

The cores 17 are provided with spaced poles or projections 20 forming aligned air gaps, such as 21, between them. A plurality of energizing

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coils 22, of which there are three on each side in the structure indicated, are provided and these coils are either connected in series or parallel, as desired, or in series parallel combinations to energize the field structure 16. Coils 22 may be energized from any desired source of alternating or pulsating current by way of conductors 23 which may include an amplitude adjusting rheostat 24 in series therewith. Said coils may be energized either from straight alternating current or from pulsating direct current as provided by inserting a rectifier in one of the conductors 23 or they may be energized from mixed current in a manner well understood in the art of vibratory conveyors.

An elongated armature 25, made of stacked silicon laminations, is provided and said armature 25 is preferably provided with separate poles or projections 26 equal in number to the field poles 20 and spaced comparably with the spacing of said poles 20.

The adjacent faces of the poles 20 and 26 may be made parallel and the planes thereof may be parallel to the axis of the armature 25 along which it vibrates. However, as illustrated in the drawings, said pole faces are only substantially parallel with said axis and lie in planes which make a slight angle to the axis of said armature 25 so that as the armature 25 moves to the left, as viewed in Fig. 3, of the drawings, the face of each pole 26 will in effect move toward the face of a pole 20 along an axis at right angles to the axis of vibration or longitudinal axis of the armature 25.

The armature 25 includes similar axially extending shafts 27 at opposite ends thereof, which shafts are removably but rigidly attached to center sleeves of resilient discs 28 which are preferably made of rubber. The peripheries of the discs 28 are preferably rigidly attached to metallic cups 29 which are attached to the upper and lower housing plates 18 and 19 by screws or the like, not shown.

At their outer ends the shafts 27 are provided with adjustable weights 30 provided by a plurality of washers, the number and/or size of which may be adjusted, said washers 30 being removably held in place between a pair of nuts 31 which also co-operate with shoulders on the shafts 27 to mount the armature 25 for unobstructed vibratory motion on the rubber energy storing discs 28.

As is best illustrated in Figs. 1 and 4 of the drawings, the field structure of the motor 15 is rigidly attached to the deck 10. As a consequence

said deck 10 and field structure and all those parts which are rigidly attached to either constitutes one vibratory mass which is a relatively heavy mass as compared with the reaction mass which is hereinafter described, the heavy mass including the deck 10 which is the element doing work on material to be conveyed, such as granular material.

The armature 25 together with the parts which are rigidly attached to it, including the shafts 27 and adjustable weight discs or washers 30 constitutes a reaction mass which has an appreciably less weight than that of the field or deck mass. The ratio is preferably at least 4 to 1 in favor of the deck or field mass. As a consequence of this fact, in order for the deck to have sufficient amplitude of vibration, it is evident that the amplitude of vibration of the armature 25 must be considerably greater since the relative amplitudes of vibration will be inversely proportional to their weights. That is, the product of the weight of the reaction mass and its amplitude will approximately equal the product of the field mass and its amplitude for any vibration of the motor 15. To this end the vibratory motor 15 is preferably substantially of the indefinite stroke type; that expression being used to designate one in which the axis or line of vibration of the armature 25 is substantially parallel with the planes determining the faces of the poles 20. In any event there is preferably sufficient clearance in the air gaps 21 so that the armature 25 can vibrate through any desired angle without the faces of the poles 25 necessarily striking the faces of said poles 20.

Under certain conditions the slight angularity of the faces of said poles 20 and 26 may be such as to limit this maximum amplitude of vibration of the armature 25, but in any event it is adequate to allow a relatively high amplitude of vibration of said armature 25 and in no case can said armature 25, when vibrating, move directly toward the field poles 20.

As clearly illustrated in Fig. 3 of the drawings, the deenergized or normal position of the armature 25 with respect to the field structure 16 is such that the armature poles 26 are offset laterally or along the axis of the armature 25 with respect to the poles 20. In other words, there is considerable reluctance in each of the air gaps 21. Consequently whenever current flows in the windings 22 the armature 25 will be attracted to the left, as viewed in Fig. 3, or, in other words, so as to tend to reduce the reluctance of the air gaps 21 by attracting the armature 25. This will happen during each half cycle if the coils 22 are energized from alternating current or during each impulse if they are energized from mixed current or from rectified direct current.

When the armature 25 is thus attracted by magnetic action to move to the left, as viewed in Fig. 3, the rubber discs perform two important functions. First of all, they operate as frictionless guides to guide the armature in rectilinear or straight line motion along the center of the motor and thus prevent any sliding frictional contact between any two moving parts of the motor. They are particularly effective to prevent contact between any face of a pole 26 and any face of a pole 20.

Furthermore it is to be noted that the shafts 27 do not slide with respect to the sleeves of the rubber discs or mountings 28 but are rigidly attached thereto. It may be stated that these rubber discs or mountings 28, 29 are a standard arti-

cle heretofore commonly employed to mount machinery and to prevent transfer of vibration from a vibrating machine to a supporting floor, frame or superstructure. The structure of these mountings, per se, is a well known commercial article.

In addition to the guiding function provided by said mountings, the deflection of the rubber discs 28 also builds up a restoring force so that as the alternating flux is reduced or extinguished between successive impulses this restoring force will act to move the armature 25 to the right or just the reverse of that to which it is moved by the magnetic attraction. In other words, the current impulses or alternating current will produce vibration of the armature 25 particularly in co-operation with the restoring force provided by the rubber discs or mounts 28.

The restoring force provided by the discs or mountings 28 is preferably such that the motor is tuned to have a natural period of vibration, preferably close to though not exactly coincidental with the frequency or periodicity of the current impulses which energize said motor 15. This natural period of vibration may be adjusted by adjusting the weights 30 for any particular mounts 28. The advantages of this resonant type operation are well known in vibratory motors and need no further elaboration.

In Fig. 5 of the drawings I have shown a modification of the armature 25, the rest of the motor being the same as that previously described. In this structure the armature 25 is provided with energizing coils 32 which are preferably energized from a source of direct current so as to polarize said armature 25. If this is done and the field coils 22 energized from alternating current the frequency of vibration of the armature 25 will be cut in half from what it would be if the field coils 22 were energized from straight alternating current and the non-polarized field, as illustrated in Fig. 3, were employed.

The frequency of the source of current may be any commercial frequency or special frequency, such as 60 cycles, 50 cycles, 30 cycles or 25 cycles or, for that matter, even the lower frequencies may be specially generated. It is intended, however, that in most instances the motor will operate from commercially available current which predominately are 60 cycles in this country.

It may be pointed out that the motor in both modifications is essentially a magnetic attraction type motor rather than a strictly electric motor. That is, the moving forces derived from the electric current are manifest by magnetic attraction on the iron of the armature 25 rather than a structure in which a current carrying coil is impelled because of its presence in a magnetic field.

During the operation of the device alternating or pulsating current will be supplied to the motor 15. The armature 25 will reciprocate rectilinearly relative to the field structure 16. It will have a relatively large amplitude of vibration because of its relatively small weight. The energy storing and guiding discs or mounts 28 will guide the armature 25 for unobstructed frictionless vibration, and the reaction which this vibratory mass will have upon the field structure 16 and the rigidly attached deck 10 will be such as to convey the usual conveying and/or vibratory motion to said deck 10.

As clearly illustrated in Fig. 1 of the drawings, the axis of vibration imparted by the motor 15 to the deck 10 is such as to effect a conveying action on any granular material held by said

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deck 10. Said material will therefore be conveyed at a rate determined by the amplitude of vibration of the motor 15, from the left to the right, as viewed in Fig. 1 of the drawings.

It is to be particularly noted that this unit has all the desirable characteristics of a reaction type motor and that simple, relatively inexpensive and commercially available energy storing rubber spring discs 28 are provided as the source of mechanical restoring energy to co-operate with magnetic forces to produce the vibration. The cumulative result is a very simple, inexpensive and highly efficient reaction type electro-magnetic motor.

Obviously those skilled in the art may make various changes in the details and arrangement of parts without departing from the spirit and scope of the invention as defined by the claims hereto appended, and I therefore wish not to be restricted to the precise construction herein disclosed.

Having thus described and shown an embodiment of my invention, what I desire to secure by Letters Patent of the United States is:

1. A vibratory conveyor including a deck adapted to impart vibratory movement to a load carried thereby, means for imparting vibratory movement to said deck including a vibratory motor of the reaction type, said motor including a field structure connected to said deck and having spaced substantially parallel pole faces and having energizing field coil means thereon adapted to be energized from pulsating current, an armature structure constituting a reaction mass and having appreciably less weight than said field structure and attached deck, said armature and field structure having generally parallel pole faces which are normally slightly offset relative to said field pole faces along the axis of vibration of said armature whereby when said field coil means is energized said armature will be magnetically attracted to move rectilinearly substantially parallel with said field pole faces, and means mounting said armature for rectilinear vibratory movement relative to said field structure for unobstructed vibration without sliding friction, said means including a rubber disc at each end of said armature and means attaching the center of each disc to said armature and its periphery to said field structure, said discs performing the double function of guiding said armature for rectilinear movement while keeping the armature pole faces out of frictional contact with the field pole faces and providing restoring force to return said armature to its normal position whenever the attracting magnetic forces are reduced sufficiently, all whereby said armature will freely vibrate whenever said field structure is energized by undulating current.

2. A vibratory motor including a member adapted to impart vibratory movement to a load attached thereto, means for imparting vibratory movement to said member including a vibratory motor of the reaction type, said motor including a field structure connected to said member and having spaced substantially parallel pole faces and having energizing field coil means thereon adapted to be energized from pulsating current, an armature structure constituting a reaction mass and having appreciably less weight than said field structure and attached member, said armature and field structure having generally parallel pole faces which are normally slightly offset relative to said field pole faces along the axis of vibration of said armature whereby when said

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field coil means is energized said armature will be magnetically attracted to move rectilinearly substantially parallel with said field pole faces, and means mounting said armature for rectilinear vibratory movement relative to said field structure for unobstructed vibration without sliding friction, said means including a rubber disc at each end of said armature and means attaching the center of each disc to said armature and its periphery to said field structure, said discs performing the double function of guiding said armature for rectilinear movement while keeping the armature pole faces out of frictional contact with the field pole faces and providing restoring force to return said armature to its normal position whenever the attracting magnetic forces are reduced sufficiently, all whereby said armature will freely vibrate whenever said field structure is energized by undulating current.

3. A vibratory conveyor including a deck adapted to impart vibratory movement to a load carried thereby, means for imparting vibratory movement to said deck including a vibratory motor of the reaction type, said motor including a field structure connected to said deck and having spaced substantially parallel pole faces and having energizing field coil means thereon adapted to be energized from pulsating current, an armature structure constituting a reaction mass and having appreciably less weight than said field structure and attached deck, said armature and field structure having generally parallel pole faces which are normally slightly offset relative to said field pole faces along the axis of vibration of said armature whereby when said field coil means is energized said armature will be magnetically attracted to move rectilinearly substantially parallel with said field pole faces, and means mounting said armature for rectilinear vibratory movement relative to said field structure for unobstructed vibration without sliding friction, said means including a spring member at each end of said armature and means attaching the center of each spring member to said armature and its periphery to said field structure, said spring members performing the double function of guiding said armature for rectilinear movement while keeping the armature pole faces out of frictional contact with the field pole faces and providing restoring force to return said armature to its normal position whenever the attracting magnetic forces are reduced sufficiently, all whereby said armature will freely vibrate whenever said field structure is energized by undulating current.

4. A vibratory motor including a member adapted to impart vibratory movement to a load attached thereto, means for imparting vibratory movement to said member including a vibratory motor of the reaction type, said motor including a field structure connected to said member and having spaced substantially parallel pole faces and having energizing field coil means thereon adapted to be energized from pulsating current, an armature structure constituting a reaction mass and having appreciably less weight than said field structure and attached member, said armature and field structure having generally parallel pole faces which are normally slightly offset relative to said field pole faces along the axis of vibration of said armature whereby when said field coil means is energized said armature will be magnetically attracted to move rectilinearly substantially parallel with said field pole faces, and means mounting said armature for

rectilinear vibratory movement relative to said field structure for unobstructed vibration without sliding friction, said means including a spring member at each end of said armature and means attaching the center of each spring member to said armature and its periphery to said field structure, said spring members performing the double function of guiding said armature for rectilinear movement while keeping the armature pole faces out of frictional contact with the field pole faces and providing restoring force to return said armature to its normal position whenever the attracting magnetic forces are reduced sufficiently, all whereby said armature will freely vibrate whenever said field structure is energized by undulating current.

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