July 14, 1959 T. H. BRUMAGIN 2,894,397

SUPPORTS FOR MECHANICAL VIBRATORS

Original Filed Nov. 29, 1948 2 Sheets-Sheet 1

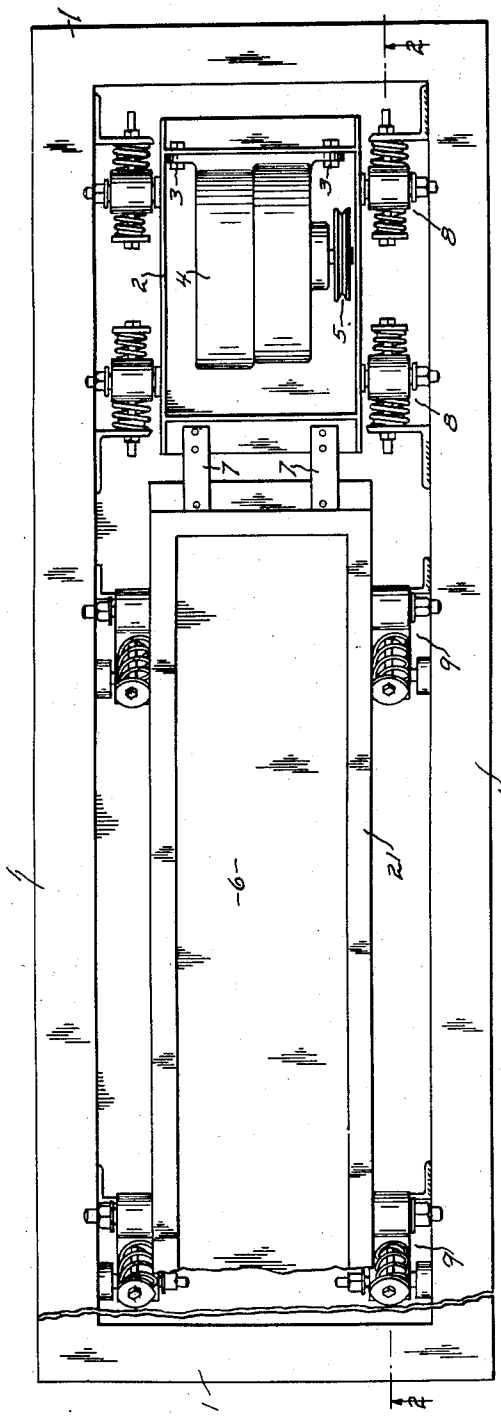


Fig. 1

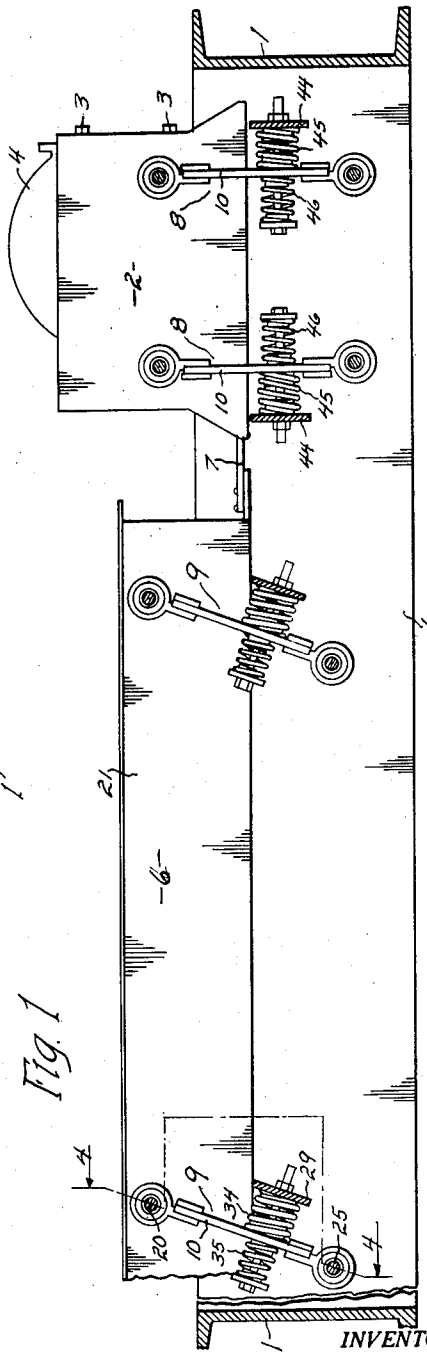


Fig. 2

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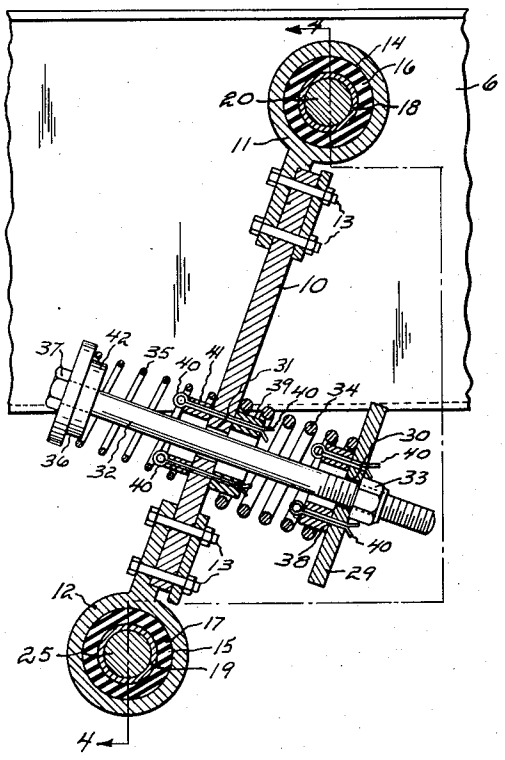


Fig. 3

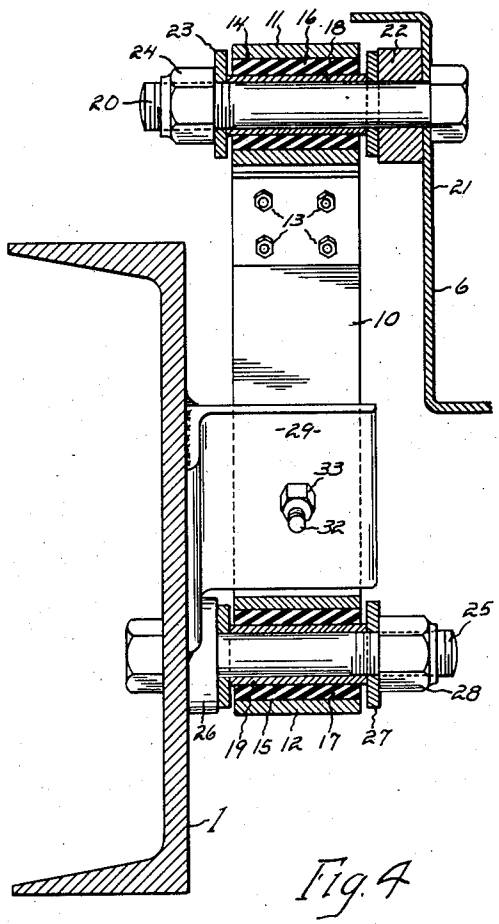


Fig. 4

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SUPPORTS FOR MECHANICAL VIBRATORS

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Original application November 29, 1948, Serial No. 62,469, now Patent No. 2,678,720, dated May 18, 1954. Divided and this application January 18, 1954, Serial No. 404,517

3 Claims. (Cl. 74—61)

This invention relates to vibratory loads and supports therefor.

The invention is applicable to various kinds of vibratory loads; but inasmuch as one of its most important practical applications is to vibratory conveyors, it will be described herein as applied to that use; and those skilled in the art will then understand how to apply it to other types of vibratory loads, for example to screens for screening discrete materials, etc.

As is well known, a vibratory conveyor comprises an elongated bed in the form of a pipe, trough, box or the like, disposed generally horizontally and a power driven vibratory mechanism connected to it at one end communicates longitudinal vibrations to it; whereby material deposited on the bed at one end is caused to travel continuously over the bed toward the other end, and to be discharged therefrom at the other end, or at points along the length of the bed.

The vibrating bed is supported so as to have an upward component of movement as it moves forwardly, and a downward component as it returns rearwardly, in order to propel the material forwardly; and it is desirable to support it in this manner by frictionless supports.

These requirements have led to the employment of elongated, resilient supports; one end of the support being connected to a part of the stationary main frame of the conveyor, and with the support extending therefrom at an inclination to the vertical, and the other end being connected to the conveyor bed.

The aforesaid power driven vibratory mechanism that vibrates the bed comprises vibrating parts connected to the bed; and it has been found advantageous to support these vibrating parts independently of the bed so that their vibratory movements may be solely in directions longitudinally of the bed and without the upward and downward components of bed movement.

In some cases, a frame carries the vibration producing parts and is known in the trade as a "cradle" or "cradle frame," and is itself vibrated by the vibrations produced thereby, and the cradle is supported for vibration longitudinally of the conveyor bed and is connected to the bed.

A patent application copending herewith, Serial Number 62,469, filed November 29, 1948, describes a vibratory conveyor, comprising: a conveyor bed and an improved support therefor by which the bed is given certain characteristics of movement when vibrated longitudinally; and also describes an improved vibrating "cradle" (as defined above) and an improved support therefor, by which the cradle vibrates with improved movement characteristics different from those of the bed, and communicates its vibrations to the bed.

Said copending application Serial Number 62,469 has issued as Patent 2,678,720, May 18, 1954 and the subject matter covered by it is the improved support for supporting the conveyor bed on the main frame.

This application is divisional from said copending application the subject matter sought to be covered here-

by being the aforesaid improved cradle and improved support for supporting it and for adjusting its vibratory movement and an improved manner of operation thereof.

In general, the said cradle comprises a cradle frame, in which out-of-balance rotary parts are driven by power, and so constructed as to develop rectilinear vibrations and vibrate the cradle frame rectilinearly thereby.

The cradle frame is supported on a stationary main frame by a plurality of elongated rigid link elements, hingingly connected at one end to the cradle frame, and at the other end to the main frame; and all of equal length and disposed substantially parallel; and all substantially at right angles to the direction of the rectilinear vibrations of the cradle frame.

Springs are provided on opposite sides of the rigid link elements in which force accumulates upon vibratory movement of the cradle frame in either direction; and which discharge accumulated force upon vibratory movement in the alternate direction. The springs are preferably pre-loaded coil-springs; and their pre-load tension is adjustable.

The spring action is adjustable to cause the cradle frame to have a natural or harmonic periodicity of vibratory movement, whereby little power is needed to keep it vibrating.

The cradle frame is connected to the conveyor bed by a connection extending in the direction of the vibrations of the frame.

It is the primary object of the invention to provide a vibratory cradle and improved supporting means therefor having the construction and mode of operation described, in general, above.

Other objects will become apparent to those skilled in the art to which the invention appertains.

The invention itself is set forth in the appended claims.

The invention is fully disclosed in the following description taken in connection with the accompanying drawing, in which:

Fig. 1 is a top plan view of a conveyor mechanism embodying the invention, with parts broken away;

Fig. 2 is a side sectional view of the embodiment of Fig. 1 from the plane 2—2 of Fig. 1;

Fig. 3 is a view to enlarged scale showing separately and in longitudinal section a part shown in elevation in Fig. 2;

Fig. 4 is a view from the plane 4—4 of Fig. 2; or the view may be considered as taken from the plane 4—4 of Fig. 2.

Referring to the drawing, Figs. 1 and 2, there is shown at 1 an elongated rectangular main base or frame which conveniently may be fabricated from channel-section steel. At 2 is a cradle frame fabricated from steel; and upon which is rigidly secured as by bolts 3—3, a housing 4, within which is a vibrator preferably of the rotary unbalanced weight type, rotatably driven by a belt pulley 5, connected by a belt to a motor under the housing 4, the belt and motor not being shown for simplification, in view of the fact that such vibrators and drives therefor are well known.

At 6 is an elongated trough-like conveyor fabricated from steel, extending generally horizontally, and connected at one end to the cradle frame 2 by steel straps 7—7.

At 8—8 are generally vertical supports, connected at upper and lower ends respectively to the cradle frame 2 and main frame 1. At 9—9 are supports connected at upper and lower ends respectively to the conveyor 6 and main frame 1; and these supports 9—9 extend upwardly from the main frame 1 at an upwardly forward angular inclination to the vertical as shown. A part of the invention resides in the construction of the supports 8—8 and 9—9 and they will presently be described in detail.

In general operation, however, the cradle frame 2 is vibrated back and forth longitudinally of the main frame by the vibrator in the housing 4, and the supports 8—8 support the cradle frame 2 while allowing it to vibrate freely; and are yieldable resiliently, forwardly and rearwardly; and the resilience may be adjusted to have a periodicity relative to that of the vibrator which aids and does not oppose its vibratory movement. The conveyor 6 is vibrated by the cradle frame 2 and the supports 9—9 may be like or similar to the supports 8—8 and, being likewise adjustable, support the conveyor in a manner similar to the support of the cradle frame 2 by the supports 8—8; but the supports 9—9 being at an angular inclination for the purposes referred to, their resilience may be adjusted to a different value.

The supports 9—9 are best shown in Figs. 3 and 4.

A link or link element 10 preferably of rigid material such as steel, has bearing elements 11—12 which may be of cast metal, secured to its opposite ends by bolts 13—13. The bearing elements have respectively cylindrical bores 14—15 therein in which are sleeves or tubes 16—17 of rubber or like torsionably yieldable material; and telescoped through the tubes and projecting beyond their ends are sleeves 18—19 of metal. The rubber or the like is in each case vulcanized or otherwise secured, against slipping, to the wall of the bore and to the sleeve.

A bolt 20 is projected through the side wall 21 of the conveyor trough 6, through suitable spacers 22 and through the metal sleeve 18 and through a washer 23; and a nut 24 on the bolt clamps the sleeve 18 rigidly to the trough.

Similarly, a bolt 25, a spacer 26, a washer 27, and nut 28 clamp the sleeve 19 rigidly upon the main frame 1.

As the trough 6 is vibrated longitudinally relative to the main frame 1, the bearing elements 11—12 will have an oscillating rotary movement relative to the bolts 20—25 permitted by torsional yielding of the rubber tubes 16—17; whereby bearings without frictional wear and requiring no lubrication are provided.

There will be any desired number of supports 9—9 along the length of the conveyor and on each side thereof as shown in Figs. 1 and 2 and adjacent to each of them is a transverse abutment 29, which may be conveniently provided by welding a short length of angle section steel to the main frame as indicated in the drawing. The abutment 29 is opposite the intermediate portion of the link 10 and has a perforation 30 therein; aligned with a perforation 31 in the link element.

A tie element in the form of a bolt 32 is projected through the perforations 30—31 and a nut 33 is screwed on the tie bolt on the outer side of the abutment 29.

A coil compression spring 34 surrounds the bolt 32 and abuts upon one side of the link 10 and upon the abutment 29. Another coil compression spring 35 surrounds the bolt 32 and abuts upon the other side of the link 10 and upon a washer 36 under the head 37 of the bolt 32.

The spring 34 is made stronger than the spring 35 by being wound from larger diameter material; or by being shorter; or both.

The coil springs 34—35 are preferably held in coaxial alignment with the bolt 32 and with each other. To this end, rings 38—39 are provided in the ends of the spring 34, and lying upon the abutment 29 and link 10 respectively and secured in coaxial positions against shifting by cotter pins 40, passing through holes in the rings and in the link or abutment as the case may be; and a similar ring 41 in one end of the spring 35 is similarly mounted on the link 10 by cotter pins 40; and the washer 36 has a reduced diameter shank 42 projecting into the other end of the spring 35.

The springs 34—35 are adjustably pre-loaded to suitable tension by turning the nut 33 on the bolt 32 as will be understood; and this adjustment may be fixed by a lock nut jammed upon the nut 33; or the nut 33 may be any desired type of self-locking nut.

In operation, as the conveyor trough 6 moves forwardly and rearwardly horizontally, the link 10 correspondingly rocks around its lower supporting bolt 25; and in the forward direction of rocking the spring 34 expands, and the spring 35 is compressed against the washer 36; and in the rearward direction the spring 35 expands and the spring 34 is compressed against the abutment 29.

The reason for and the effects of having the spring 34 stronger than the spring 35 can best be understood by first considering them equal. When the conveyor moves forwardly, it also moves upwardly due to the angular inclination of the links 10, and the load of the material on it must be moved forwardly and also elevated, the load to be moved thus being relatively heavy. When the conveyor moves rearwardly and downwardly, it in effect falls from under the material and slides rearwardly under it, the load to be moved then being a relatively light load. If the spring were of equal size and tension, the vibrator would have to do more work on its forward than on its rearward movement of the conveyor, and the vibratory movement would tend to be non-harmonic or asymmetrical; but with the springs unequal and the spring 34 stronger than the spring 35, the difference of load in the two directions is balanced out, and the vibratory movement is made substantially harmonic and symmetrical, resulting in a freer vibratory movement of the conveyor and a more continuous rapid flow of material over it.

In spite of the difference of load in the two directions of movement, the springs 34—35 when suitably chosen and adjusted, for a predetermined material and conveyor load, will cause the conveyor to tend to vibrate under load with a substantially true harmonic vibration, even without the vibrator, so that all the work the vibrator has to do is to overcome friction and incidental losses, and keep this harmonic movement going on.

This balanced harmonic movement of the load is impossible with a simple resilient leaf spring type of support heretofore employed for conveyors of this type, as it is believed will be apparent.

Improvement in the conveying of loads and in the power consumption at the vibrator are thus effected, in addition to the lengthened life of the supports due to the utilization of coil springs as referred to hereinbefore.

The supports 8—8 under the cradle frame 2, may be like the above described supports 9—9; and Figs. 3 and 4 illustrate them except that here the cradle frame 2 moves horizontally only, and the supports 8—8 are therefore vertically disposed; and the abutments, here 44—44, are placed oppositely with respect to the two links 10—10; and in Fig. 4, the part 6—21 represents the cradle frame.

As to the operation of the supports 8—8, they support the cradle frame 2 on the main stationary frame 1. The cradle frame 2 supports the vibrator 4, and when it is at rest, the supports 8—8 are preferably vertical, or substantially vertical as described and are parallel and of equal length. There are two such supports at each side of the cradle frame 2 and they constitute two parallelograms which, while supporting the frame, constrain it to move horizontally.

When the vibrator is operating, it develops vibratory movement back and forth horizontally and the vibrator 4 and cradle frame 2 are vibrated horizontally thereby; and the supports 8—8 hingingly move in unison back and forth forwardly and rearwardly around their lower ends compressing the springs on the forward sides of the links 10 and permitting expansion of the springs on the rearward sides thereof when hinging in one direction, and vice versa in the other direction.

The springs 45—46 are shown in the drawing as unequal, this being preferred in order that the complete assembly of the supports 8 may be identical with the

assembly of the supports **9** as a matter of manufacturing economy; but this is not essential and the springs **45—46** may all be alike and equal.

In either case, with equal or unequal springs, it will be apparent that if the straps **7—7** were disconnected from the frame **2**, and with the vibrator at rest, the cradle frame **2** would itself have a natural periodicity of horizontal vibration or harmonic motion, back and forth.

My means of the described adjustment for adjusting the tension of the springs, this periodicity may be made equal to that of the vibrator; so that when the vibrator is in operation, the vibrator and frame vibrate in resonance and the work which the vibrator has to do to vibrate the cradle frame **2** is negligibly small; and this continues to be true, when the straps **7—7** are connected to a load to be vibrated such as the conveyor **6**; and as a further consequence, vibrator vibrations are not communicated to the main frame **1**.

The torsionally yieldable sleeves in the ends of the links **10—10** operate in the same manner and perform the same function as described for the sleeves of the supports **9—9**.

While the link **10** is illustrated as comprising a link proper in the form of a bar, with separate bearing elements **11—12** attached thereon, the bearing elements and link may be made in one piece, for example as a forging; it being deemed unnecessary to illustrate such modification since it will be understood by those skilled in the art.

The link **10** need not be made of metal, but may be made of other materials such as wood; and while it will perform its functions as described above when rigid, some resilience in it, if present, will not interfere with its operation as described.

In the foregoing, **1** have illustrated and described a cradle frame as supported from below by the supports **8—8**. It is believed to be apparent without further illustration that the cradle frame **2** may be supported or suspended from above by the supports **8—8**.

In the foregoing, in which the preferred embodiment of the invention is described, the torsionally yieldable sleeves **16—17** are referred to as providing merely frictionless bearing connections for the rigid link element **10**; resilience in the supports being provided by the coil springs.

However, it will be understood that these torsionally yieldable sleeves, being of rubber or the like, are themselves resilient and act like torsion springs; accumulating torque tension in one direction when the conveyor trough moves in one direction from a neutral position; discharging the tension when it returns in the other direction to neutral position; and accumulating torque in the other direction when it moves from neutral position in the other direction, and so on.

In some cases, these sleeves may be relied upon to provide all of the resilience needed, for a fully operative

conveyor, in which case, the structure would comprise the link **10** and the bearing elements **11—12** with the rubber sleeve construction therein; and without the springs **34—35**; and similarly the supports **8—8** may comprise the rubber sleeve construction without the springs **45—46**.

In the operation of such a structure the sleeves **16—17** would aid the vibratory movement of the conveyor and cradle frame, in much the same way as do the coil springs; and therefore in the environment illustrated, constitute a part of the present invention by themselves and apart from the coil springs.

It will be understood by those skilled in the art, that changes and modifications may be made in the embodiment of the invention illustrated herein; and the invention is comprehensive of all such changes and modifications which come within the scope of the appended claims.

I claim:

1. In a vibratory apparatus, a stationary main base; a cradle frame supported on the base by a plurality of elongated rigid links hingingly connected at their opposite end portions to the main base and cradle frame and arranged so that the cradle frame may have horizontal reciprocatory movement relative to the base; a power driven vibrator mounted on the cradle frame and producing vibrations of predetermined fixed periodicity in the direction of reciprocatory movement of the cradle frame to reciprocate the cradle frame, spring means arranged to react between the base and cradle frame and caused to store up and discharge tension by said reciprocatory movement of the cradle frame in each horizontal movement thereof; means to adjust the spring means tension to cause the cradle frame to have a natural free periodicity of reciprocatory movement in both directions substantially the same as that of the vibrations of the vibrator; and the cradle frame being provided with means for communicating vibratory movement to a load to be vibrated.

2. An apparatus as described in claim 1 and in which, the spring means is disposed to react between the main base and portions of at least some of the links between their ends.

3. An apparatus as described in claim 1 and in which the spring means comprises preloaded coil springs at opposite sides of the intermediate portions of at least some of the links and reacting between the intermediate portions of the links and abutment means provided on the base.

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