Sept. 29, 1942. G. LINKE ET AL 2,297,486

CONVEYING APPARATUS

Filed May 15, 1940 2 Sheets-Sheet 1

Fig.1

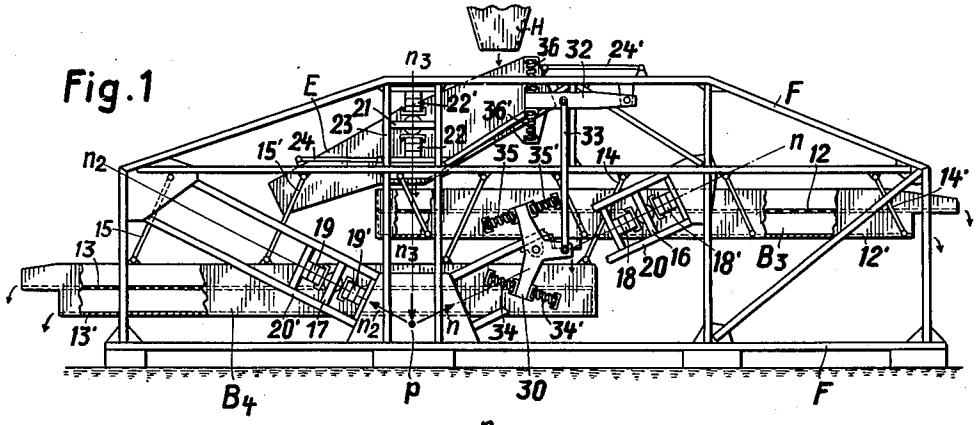


Fig.2

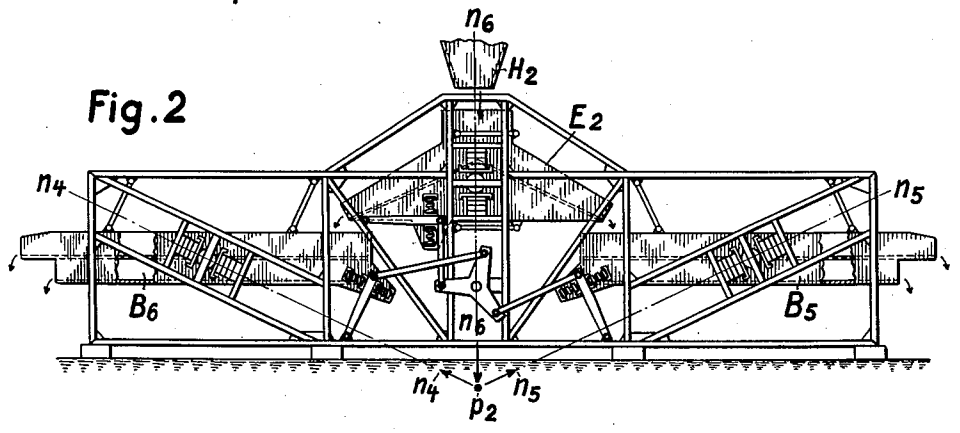
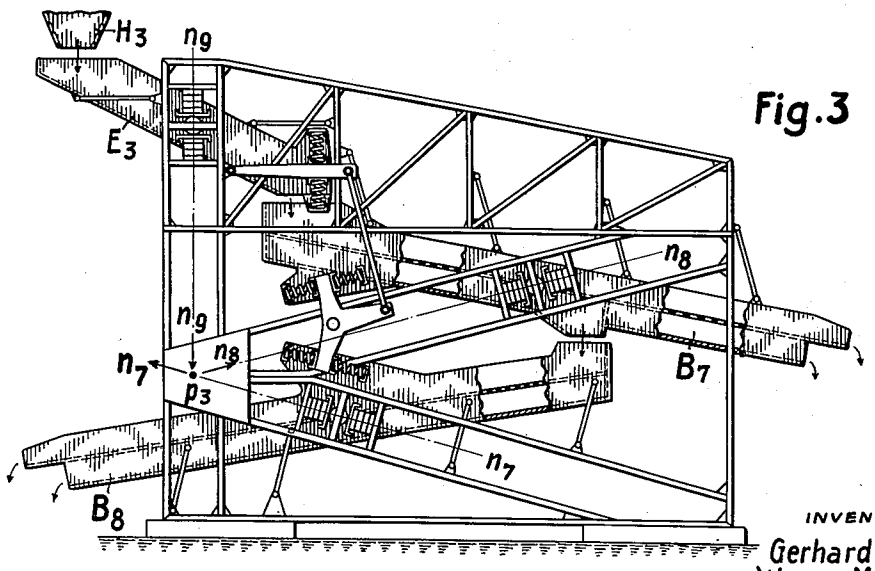


Fig.3



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CONVEYING APPARATUS

Filed May 15, 1940 2 Sheets-Sheet 2

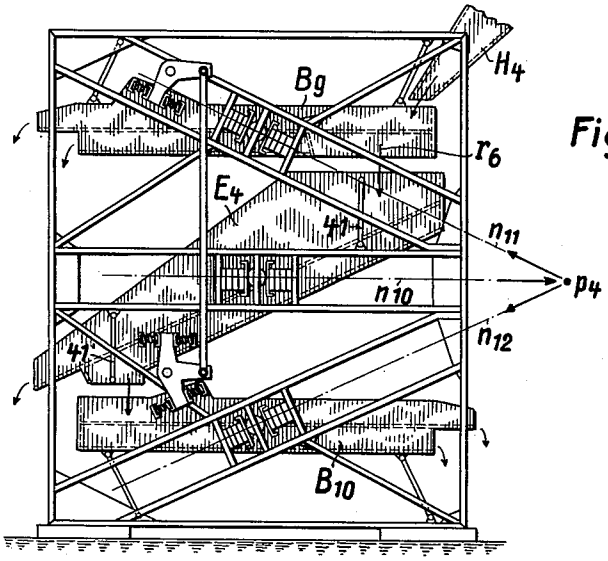

Fig. 4

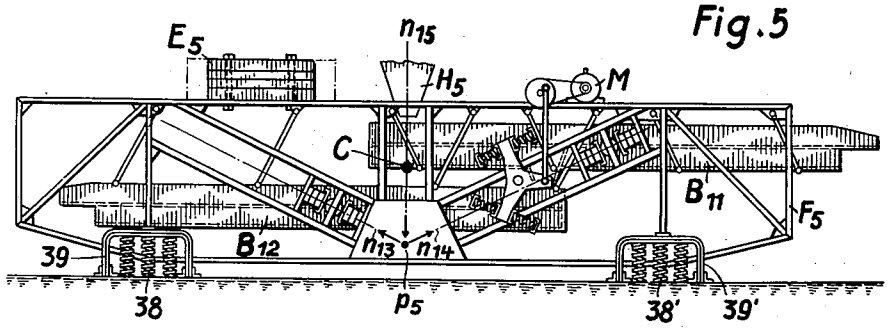

Fig. 5

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UNITED STATES PATENT OFFICE

2,297,486

CONVEYING APPARATUS

Gerhard Linke and Werner Michaelis, Magdeburg, Germany; vested in the Alien Property Custodian

Application May 15, 1940, Serial No. 335,392
In Germany April 28, 1939

9 Claims. (Cl. 209—247)

This invention relates to structural improvements in apparatus for conveying materials in bulk, and more especially, it pertains to oscillating apparatus for providing a hopping motion for material being passed through conveying troughs. The apparatus is of a type comprising a support, two conveying troughs resiliently carried by said support in a position in which the vertical planes of symmetry, longitudinally intersecting said troughs, substantially coincide, and being adapted to be bodily reciprocated or oscillated at a high rate of speed and in paths of motion which are upwardly inclined in opposite directions.

The invention is directed to the neutralizing of unbalanced forces, inertia effects, shocks, impacts and the like arising in oscillating conveying apparatus of the type set forth. The invention is further directed to the elimination of torques incidentally produced and to the changing of their direction during each cycle of movement of the conveying troughs. The ultimate object is to safeguard the buildings or other structures which support the oscillating apparatus against premature destruction through what would otherwise be unbalanced forces, inertia effects, and torques.

Prior art publications dealing with kindred balancing and damping problems in oscillating systems include the British patent specifications 502,817 to Koppers, and 413,689 to Schieferstein, United States Patents 1,495,850 to Jaquelin, 1,769,413 to Binte, and 1,997,499 to Schieferstein.

Other objects of the invention intimately connected with the former and advantages obtained will become apparent to experts in this field as the description proceeds.

The nature and scope of the invention are briefly outlined in the appended claims and will be more clearly understood from the following specification taken together with the accompanying drawings, in which

Fig. 1 is a side elevation showing by way of an example an oscillating system containing a screening apparatus, which is redesigned according to this invention, and

Figs. 2 to 5 are side elevations showing structurally modified screening apparatus embodying the salient ideas of this invention.

The invention consists in that an oscillating balance element is structurally associated with the oscillating masses of the apparatus concerned in a specific position and in counteraction thereto, and that the weight of said balance element and the amplitudes of its oscillating motion are specifically proportioned relatively to those of the oscillating masses, as described and claimed hereinafter.

In Fig. 1 of the drawings an apparatus for conveying and treating, namely classifying or "dressing" material in bulk is diagrammatically shown by way of an example, which exhibits the salient features of the invention and comprises:

(1) A skeleton frame F serving as support for

(2) Two horizontally disposed, oscillating conveying troughs B3, B4, which are provided with dressing screens 12, 13 and bottom plates 12', 13' and are movably suspended by sets of inclined links or pendulums 14, 14', 15, 15' above each other and in staggered position to each other, in which the vertical planes of symmetry longitudinally intersecting said troughs coincide; the troughs B3, B4 are provided at points registering with their centers of gravity with laterally projecting ear laps 16, 17 and are resiliently held by pairs of elastic cushions 18, 18', 19, 19' retained in end to end disposition within guide beds 20, 20', so that the troughs can be bodily reciprocated or oscillated in opposite directions to each other and on paths of movement inclined from the level,

(3) A balance element E is according to this invention structurally associated with said troughs B3, B4 and adapted to be reciprocated in counteraction to thereto and on a path of movement so disposed and directed relatively to those of the troughs, that the oscillating forces and the reacting inertia effects virtually active in the centers of gravity of the troughs and balance element meet with their respective lines of action n, $n2$, $n3$ at one common point p of intersection; the weight of the balance element and the amplitudes of its reciprocating motion are so chosen relatively to the weight and the amplitudes of the reciprocating motion of the troughs, that said oscillating forces and reacting inertia effects, balance each other.

In the embodiment of the invention shown by way of an example in Fig. 1 the balance element E is designed as a chute for feeding the material descending through the hopper H into the upper trough B3; the balance element is provided on both sides with laterally projecting ear laps 21, registering with its center of gravity, and is resiliently held by elastic cushions 22, 22', retained in a guide bed or frame 23 and engaging in end to end disposition said ear laps 21; the balance element E is linked at both ends to the skeleton frame F by horizontally disposed links

24, 24' and is adapted to be bodily reciprocated up and down by oscillating forces indicated by their virtual line of action *n*3.

As described above the balance element E is so disposed relatively to the troughs B3, B4, that the said line of action *n*3 of the oscillating forces and resultant inertia effects passing through the center of gravity of the balance element E meets at one common point *p* of intersection with the lines of action *n*, *n*2 of the forces and inertia effects active at the troughs B3, B4.

(4) Means are provided for jointly reciprocating the troughs B3, B4 in opposite directions to each other, and for reciprocating concurrently the balance element E in counteraction to the troughs as indicated by the arrows at *p*, namely so as to neutralize the inertia effects arising as the result of the reciprocating movements of the troughs and being virtually active at their centers of gravity.

Said reciprocating means comprise a double cranked rocking lever 30, a prime mover, not shown, for rocking said lever, and means for resiliently interconnecting the arms of the latter with the troughs B3, B4 and the balance element E.

In the embodiment of the invention shown in Fig. 1 said connecting means comprise an auxiliary rocking lever 32, a rod 33 connecting the latter with the double cranked lever 30, and pairs of helical springs 34, 34', 35, 35', 36, 36' interengaging in end to end disposition the said levers, troughs and balance element.

The line of action *n*3 pertaining to the balance element E is not necessarily vertically directed but may be inclined from the level or may be even horizontally directed (see Fig. 4) according to the specific arrangement and disposition of the oscillating masses and other structural characteristics of the conveying apparatus concerned.

Various changes and modifications may be conveniently made in compliance with specific requirements in the structural details of material conveying and treating apparatus of the improved design shown and described, without departing from the spirit and the salient ideas of this invention.

In the structurally modified embodiment of the invention shown in Fig. 2 the troughs B5, B6 are horizontally disposed at the same level, and are spaced from each other; the balance element E2 is arranged above the inner ends of the troughs and is designed as a twin chute for subdividing the material descending through hopper H2 and feeding it into the troughs.

The lines of action *n*4, *n*5, *n*6 of the oscillating forces and resultant inertia effects active in the troughs B5, B6 and balance element E2 meet at a common point to intersection designated *p*2.

In the structurally modified embodiment of the invention shown in Fig. 3 the troughs B7, B8 are slopingly disposed in staggered position above each other; the balance element E3 is designed as a chute for feeding the material descending through hopper H3 into the upper trough; the lines of action *n*7, *n*8, *n*9 of the oscillating forces and resultant inertia effects active at the troughs and balance element meet at a somewhat eccentrically disposed point of intersection designated *p*3.

In the structurally modified embodiment of the invention shown by way of another example in Fig. 4 the troughs B9, B10 are horizontally disposed, being arranged above each other and spaced from each other; the material descends into the upper trough B9 through hopper H4 and partly drops—as indicated by arrow *r*6—through the dressing screen of said trough into an intermediary conveying and screening trough E4 designed as balance element; the latter is arranged in sloping disposition in the space between the troughs B9, B10 for cooperation therewith, and is suspended by vertically directed pendulums 41, 41'.

In this case the line of action *n*10 of the oscillating forces and resultant inertia effects active in the center of gravity of the balance element E4 is horizontally directed and meets with its mates *n*11 and *n*12 at a common point of intersection *p*4 outside the apparatus.

In the structurally modified conveying and dressing apparatus shown by way of another example in Fig. 5 the troughs B11, B12 are horizontally disposed and arranged in staggered position above each other.

A special noteworthy feature of this apparatus consists in that the skeleton frame F5 proper carrying the troughs B11, B12 and the prime mover M for oscillating the troughs is designed to serve as balance element.

Means are provided for resiliently supporting the frame F5, from the floor which comprise a plurality of sets of helical springs 38, 38' vertically arranged and cooperatively associated with U-shaped flat springs 39, 39' enclosing the former; the U-shaped flat springs 39, 39' serve as means for strengthening the resilient supports against accidental laterally directed forces.

According to this invention an additional mass or weight E5, which is preferably composed of a plurality of superimposed blocks for instance of concrete, is displaceably fixed on the frame F5; by appropriately adjusting in the course of empiric testing operations the position of the additional mass E5 relatively to the frame F5 it is possible to shift the center of gravity of the frame F5, indicated at C, right above the common point of intersection *p*5 of the respective lines of forces *n*13, *n*14, *n*15.

By adjusting in the course of the said empiric testing operations the weight of the additional mass E5, relatively to that of the frame F5 and to the resiliency of its spring supports the frequency of the oscillating movements inherent to the frame F5 can be brought into accord with the frequency of the oscillating movements of the troughs B11, B12.

For the same purposes additional masses may be displaceably and adjustably fixed to advantage at the balance elements E, E2, E3, E4 described with reference to Figs. 1 to 4.

The material is fed from hopper H5 into the upper trough B11; both troughs B11, B12 may be conveniently provided with dressing screens or other material treating appliances.

What we claim is:

1. Apparatus for conveying and treating material in bulk, comprising a support, two conveying troughs resiliently carried by said support in a position, in which the vertical planes of symmetry longitudinally intersecting said troughs substantially coincide, and being adapted to be bodily reciprocated in paths of motion which are upwardly inclined in opposite directions, means for feeding the material into said troughs, a balance element structurally associated with said troughs and adapted to be bodily reciprocated in counteraction thereto and on a path of movement so disposed and directed relatively to

those of the troughs, that the paths of motion of the centers of gravity of the troughs and of the balance element meet at a common point of intersection, the weight of the balance element and the amplitudes of its reciprocating motion being so chosen relatively to the weight and the amplitudes of the reciprocating motion of the troughs, that the said oscillating forces and reacting inertia effects balance each other, and means for jointly reciprocating said troughs and balance element.

2. Apparatus for conveying and treating material in bulk, comprising a support, two conveying troughs resiliently carried by said support in a position, in which the vertical planes of symmetry longitudinally intersecting said troughs substantially coincide, and being adapted to be bodily reciprocated in paths of motion which are upwardly inclined in opposite directions, means for feeding the material into said troughs, a balance element structurally associated with said troughs and adapted to be bodily reciprocated in counteraction thereto and on a path of movement so disposed and directed, relatively to those of the troughs, that the paths of motion of the centers of gravity of the troughs and of the balance element meet at a common point of intersection, the weight of the balance element and the amplitudes of its reciprocating motion being so chosen relatively to the weight and the amplitudes of the reciprocating motion of the troughs, that the oscillating forces and reacting inertia effects, balance each other, and means for jointly reciprocating said troughs and balance element, said troughs being horizontally disposed and designed as dressing screens arranged in staggered position above each other, said balance element being designed as a chute for cooperation with the upper trough.

3. Apparatus for conveying and treating material in bulk, comprising a support, two conveying troughs resiliently carried by said support in a position, in which the vertical planes of symmetry longitudinally intersecting said troughs substantially coincide, and being adapted to be bodily reciprocated in paths of motion which are upwardly inclined in opposite directions, means for feeding the material into said troughs, a balance element structurally associated with said troughs and adapted to be bodily reciprocated in counteraction thereto and on a path of movement so disposed and directed relatively to those of the troughs, that the paths of motion of the centers of gravity of the troughs and of the balance element meet at a common point of intersection, the weight of the balance element and the amplitudes of its reciprocating being so chosen relatively to the weight and the amplitudes of the reciprocating motion of the troughs, that the said oscillating forces and reacting inertia effects, balance each other, and means for jointly reciprocating said troughs and balance element, the said troughs being horizontally disposed and designed as dressing screen arranged above and spaced from each other, the balance element being designed as an intermediary dressing screen slopingly disposed and arranged in the space between said troughs for cooperation therewith.

4. Apparatus for conveying and treating material in bulk, comprising a support, two conveying troughs resiliently carried by said support in a position, in which the vertical planes of symmetry longitudinally intersecting said troughs substantially coincide, and being adapted to be bodily reciprocated in paths of motion which are upwardly inclined in opposite directions, means for feeding the material into said troughs, a balance element structurally associated with said troughs and adapted to be bodily reciprocated in counteraction thereto and on a path of movement so disposed and directed relatively to those of the troughs, that the paths of motion of the centers of gravity of the troughs and of the balance element meet at a common point of intersection, the weight of the balance element and the amplitudes of its reciprocating motion being so chosen relatively to the weight and the amplitudes of the reciprocating motion of the troughs, that the said oscillating forces and reacting inertia effects, balance each other, and means for jointly reciprocating said troughs and balance element, said trough being horizontally disposed and designed as dressing screens arranged in staggered position above each other, the balance element being designed as a frame carrying the said troughs, means being provided for resiliently supporting said frame.

5. Apparatus for conveying and treating material in bulk, comprising a support, two conveying troughs resiliently carried by said support in a position, in which the vertical planes of symmetry longitudinally intersecting said troughs substantially coincide, and being adapted to be bodily reciprocated in paths of motion which are upwardly inclined in opposite directions, means for feeding the material into said troughs, a balance element structurally associated with said troughs and adapted to be bodily reciprocated in counteraction thereto and on path of movement so disposed and directed relatively to those of the troughs, that the paths of motion of the centers of gravity of the troughs and of the balance element meet at a common point of intersection, the weight of the balance element and the amplitudes of its reciprocating motion being so chosen relatively to the weight and the amplitudes of the reciprocating motion of the troughs, that the said oscillating forces and reacting inertia effects, balance each other, and means for jointly reciprocating said troughs and balance element, said troughs being horizontally disposed and designed as dressing screens arranged in staggered position above each other, the balance element being designed as a frame carrying the said troughs, means being provided for resiliently supporting said frame, said supporting means comprising helical springs cooperatively associated with U-shaped flat springs enclosing the former.

6. Apparatus for conveying and treating material in bulk, comprising a support, two conveying troughs resiliently carried by said support in a position, in which the vertical planes of symmetry longitudinally intersecting said troughs substantially coincide, and being adapted to be bodily reciprocated in paths of motion which are upwardly inclined in opposite directions, means for feeding the material into said troughs, a balance element structurally associated with said troughs and adapted to be bodily reciprocated in counteraction thereto and on a path of movement so disposed and directed relatively to those of the troughs, that the paths of motion of the centers of gravity of the troughs and of the balance element meets at a common point of intersection, the weight of the balance element and the amplitudes of its reciprocating motion being so chosen relatively to the weight and the amplitudes of the reciprocating motion of the troughs,

that the said oscillating forces and reacting inertia effects, balance each other and means for jointly reciprocating said troughs and balance element, said means for jointly reciprocating the said troughs and balance element comprising a double cranked rocking lever, and means resiliently interconnecting the arms of said double cranked lever with said troughs and balance element.

7. Apparatus for conveying and treating material in bulk, comprising a support, two conveying troughs resiliently carried by said support in a position, in which the vertical planes of symmetry longitudinally intersecting said troughs substantially coincide, and being adapted to be bodily reciprocated in paths of motion which are upwardly inclined in opposite directions, means for feeding the material into said troughs, a balance element structurally associated with said troughs and adapted to be bodily reciprocated in counteraction thereto and on path of movement so disposed and directed relatively to those of the troughs, that the paths of motion of the centers of gravity of the troughs and of the balance element meet at a common point of intersection, the weight of the balance element and the amplitudes of its reciprocating motion being so chosen relatively to the weight and the amplitudes of the reciprocating motion of the troughs, that the said oscillating forces and reacting inertia effects, balance each other, and means for jointly reciprocating said troughs and balance element, said means for jointly reciprocating the said troughs and balance element comprising a double cranked rocking lever, and means resiliently interconnecting the arms of said double cranked lever with said troughs and balance element, said connecting means comprising an auxiliary rocking lever, a rod connecting the latter with the double cranked rocking lever, and three pairs of springs individually interengaging in end to end disposition the said levers, troughs and balance element.

8. Apparatus for conveying and treating material in bulk, comprising a support, two conveying troughs resiliently carried by said support in a position, in which the vertical planes of symmetry longitudinally intersecting said troughs substantially coincide, and being adapted to be bodily reciprocated in paths of motion which are upwardly inclined in opposite directions, means for feeding the material into said troughs, a balance element structurally associated with said troughs and adapted to be bodily reciprocated in counteraction thereto and on path of movement so disposed and directed relatively to those of the troughs, that the paths of motion of the centers of gravity of the troughs and of the balance element meet at a common point of intersection, the weight of the balance element and the amplitudes of its reciprocating motion being so chosen relatively to the weight and the amplitudes of the reciprocating motion of the troughs, that the said oscillating forces and reacting inertia effects, balance each other, and means for jointly reciprocating said troughs and balance element, the said support carrying the conveying troughs being designed as balance element, means being provided for resiliently supporting the latter, and means for adjusting the position of the center of gravity of the balance element and the frequency of its inherent oscillating movements.

9. Apparatus for conveying and treating material in bulk, comprising a support, two conveying troughs resiliently carried by said support in a position, in which the vertical planes of symmetry longitudinally intersecting said troughs substantially coincide, and being adapted to be bodily reciprocated in paths of motion which are upwardly inclined in opposite directions, means for feeding the material into the said troughs, a balance element structurally associated with said troughs and adapted to be bodily reciprocated in counteraction thereto and on path of movement so disposed and directed relatively to those of the troughs, that the paths of motion of the centers of gravity of the troughs and of the balance element meet at a common point of intersection, the weight of the balance element and the amplitudes of its reciprocating motion being so chosen relatively to the weight and the amplitudes of the reciprocating motion of the troughs, that the said oscillating forces and reacting inertia effects, balance each other, and means for jointly reciprocating said troughs and balance element, the said support carrying the conveying troughs being designed as balance element, means being provided for resiliently supporting the latter, and means for adjusting the position of the center of gravity of the balance element and the frequency of its inherent oscillating movements, said adjusting means comprising an additional weight displaceably fixed on the balance element.

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