

Sept. 25, 1962

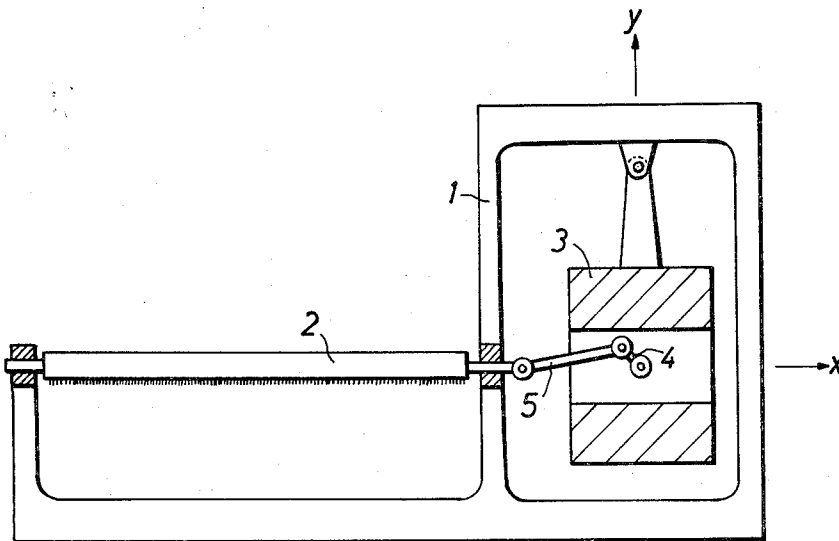
P. HERZHOFF ETAL
BRUSH-COATING MACHINE HAVING ONE OR
MORE OSCILLATING BRUSHES

3,055,338

Filed June 18, 1959

5 Sheets-Sheet 1

FIG. 1



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FIG. 2a

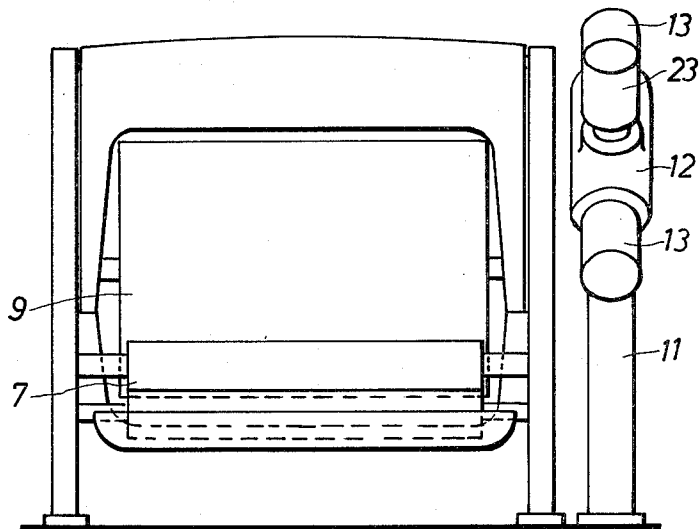
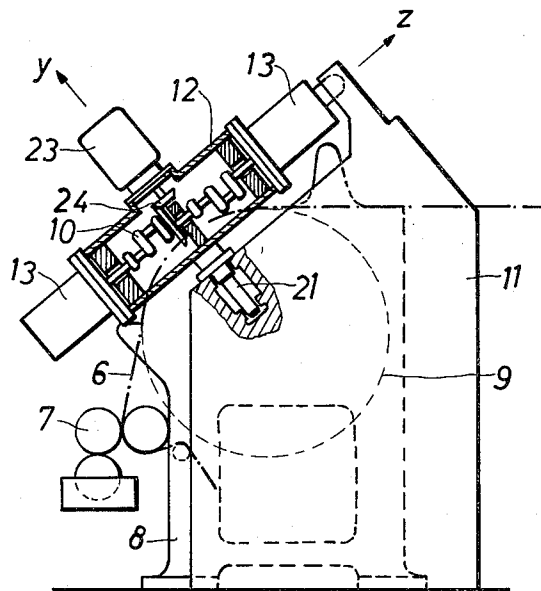


FIG. 2b



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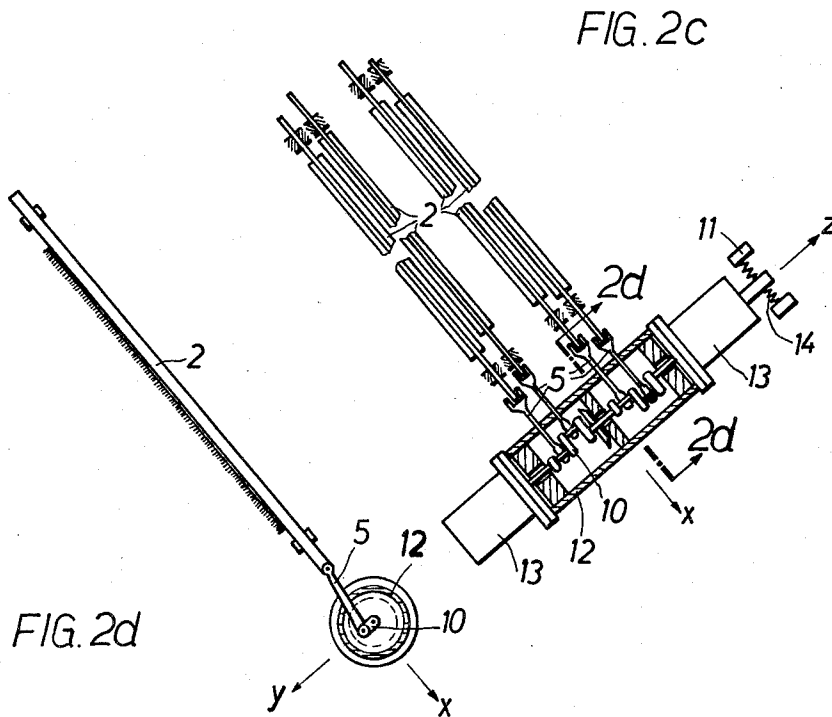
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Filed June 18, 1959

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Filed June 18, 1959

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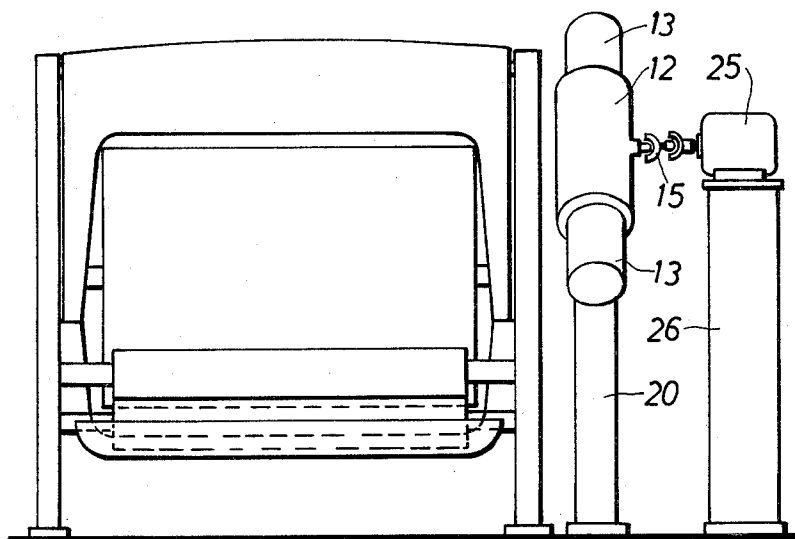


FIG. 3a

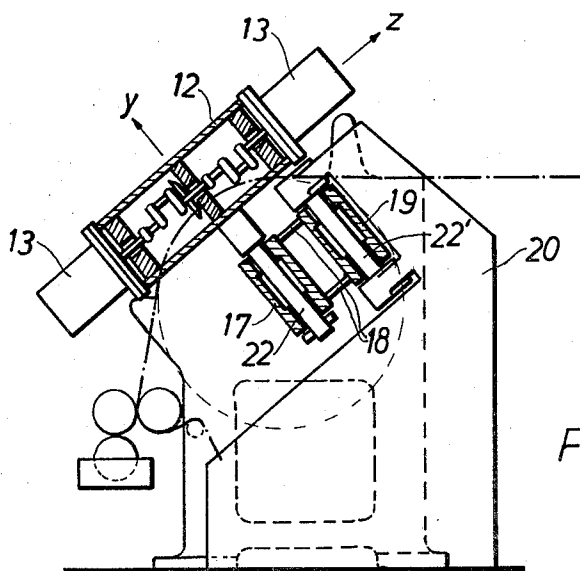


FIG. 3b

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Filed June 18, 1959

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FIG. 3c

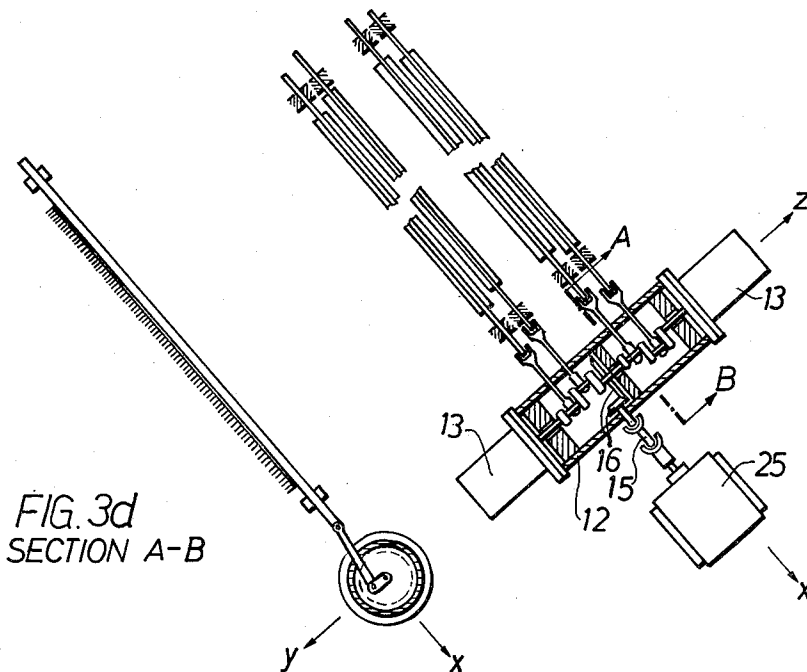


FIG. 3d
SECTION A-B

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3,055,338

BRUSH-COATING MACHINE HAVING ONE OR MORE OSCILLATING BRUSHES

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Filed June 18, 1959, Ser. No. 821,153

Claims priority, application Germany June 28, 1958
12 Claims. (Cl. 118—120)

This invention relates to brush-coating machines, such as baryta-coating machines which are used in the paper industry. In such machines a continuously moving web of paper is coated with baryta pigment and the coating is then spread over the web of paper by means of brushes oscillating at right-angles to the direction of movement of the paper. The brushes are generally driven by means of a crank mechanism.

Known machines of the aforementioned type possess the disadvantage that, with increasing brush velocity, reaction forces resulting from the acceleration of the oscillating brush masses are transmitted by the brush drive to the machine frame and to the building in which the machine is housed causing vibrations and disturbances to be set up in the machine which lead to a reduction in the quality of the finished coating. Furthermore, depending upon the situation of the building, vibrations and disturbances can be set up not only in the immediate vicinity of the machine but also at some considerable distance therefrom.

Attempts have been made to reduce the aforementioned vibrations and disturbances by increasing the mass of the machine frame, by suitably stiffening the machine frame, by supporting the machine on parts of the building in which it is housed (this necessitates tolerating the vibrations imparted to the building by the machine) or by mounting the brush driving mechanism on a separate heavy bracket located in the vicinity of the machine. In recent years, however, no substantial progress has been made in these directions. None of the aforementioned expedients prevents the entire reaction forces resulting from the acceleration of the oscillating brush masses from being transmitted by the brush drive to the machine frame or to the bracket located in the vicinity of the machine.

To reduce the aforementioned vibrations and disturbances it might be thought that the brush-coating machine could be mounted on rubber sleeves or the like in the manner of the shock-absorbent mountings provided for machine tools, and that by so doing at least the immediate surroundings of the machine would be protected from vibrations, if not the actual machine frame itself. This expedient, however, does not result in quiet running of the machine and the forced vibrations of the entire machine body which are associated with such resilient mountings interfere in certain circumstances with the adjustment of the machine relative to the other units of the plant, such as the unwinding and drier sections.

We have now found that the aforementioned disadvantages are obviated if steps are taken to ensure that the reaction forces resulting from the acceleration of the oscillating brush masses are not transmitted to the machine frame, except to a very slight degree, by mounting the brush driving mechanism on one or more balancing masses each of which is suspended either resiliently or in the manner of a pendulum and adapted to oscillate relative to the machine frame, the minimum brush operating frequency being at least 1.5 times the maximum natural frequency of oscillation of the suspended balancing mass or masses. If, in the case of a one-brush drive, the balancing mass is suspended in the manner of a pendulum, the paths of the centre of gravity of the brush mass and of the centre of oscillation of the balancing mass lie

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approximately on one straight line. If the machine is equipped with a plurality of brushes of equal mass, and if the brushes move in pairs in opposite directions, so that the reaction forces resulting from the acceleration of the brush masses can be combined to form a force couple, the balancing mass will be constructed as a rotary oscillator, the axis of rotation of which is substantially the principal axis of inertia and is parallel to the vector of the force couple. If, in addition to a force couple, the combination of the reaction forces also gives a resultant force, the balancing mass will be suspended as a double pendulum the pivots of which are parallel to the vector of the force couple. The balancing mass is then formed as a rotary oscillator, the centre of gravity of which lies somewhat below its point of suspension so that the balancing mass makes pendulum movements about its axis of suspension. The axis of suspension of the balancing mass is the pivoting axis of a hinge which by suspension from a second pivoting axis forms the double pendulum with the rotary oscillator. The balancing mass in the form of a rotary oscillator is constructed as a tubular body with a weighting mass at each end of the tube. The brush driving mechanism is arranged in the interior of the tube. If the brush driving mechanism is a crankshaft drive, the connecting rods thereof are formed as pendulum bearings, in view of the movements of the rotary oscillator. The brush-driving mechanism is driven either by a motor mounted on the balancing mass or by external means for example by means of a Cardan shaft or belt drive.

In order that the invention may be more clearly understood an experimental model brush coating machine and two preferred embodiments of the invention will now be described by way of example with reference to the accompanying drawings, in which:

FIG. 1 shows, in elevation and part sections parallel to the x—y plane, an experimental model for explaining the basic principle of the brush coating machine in accordance with the invention;

FIGS. 2a to 2d show a 4-brush coating machine with a balancing mass in the form of a rotary oscillator; and
FIGS. 3a to 3d show a 4-brush coating machine with a balancing mass suspended as a double pendulum.

The different elevations and sections a, b, c and d in FIGURES 2 and 3 are related to each other as follows:

FIGS. 2a and 3a are front elevations in which the brush-coating mechanism is not shown for the sake of clarity.

FIGS. 2b and 3b are side views in the X direction and part sections in the y—z plane.

FIGS. 2c and 3c are plan views of the brush-coating mechanism in the Y direction and part sections in the x—z plane.

FIGS. 2d and 3d are sections through the brush-coating mechanism parallel to the X—Y plane.

In the model brush coating machine shown in FIGURE 1, a brush 2 mounted in a machine frame 1 makes oscillatory movements in the x direction. The drive is external via a Cardan shaft, not shown, and the crank mechanism consists of a crank 4 and a connecting rod 5, mounted on a balancing mass 3, which is suspended in the manner of a pendulum. The centre of gravity of the brush and the centre of oscillation of the balancing mass are at the same height, so that their paths lie approximately in one straight line. According to the theory of oscillations, the balancing mass 3 is an oscillator which performs forced oscillations under the action of the mass forces of the brush 2. Such an oscillator, in the so-called over-critical range with increasing exciter frequency (i.e. crank speed), with regard to the forces transmitted to the frame via the suspension, shows a very favourable behaviour as soon as the crankshaft speed becomes greater

than twice the natural frequency of oscillation of the pendulum. This is well known from the theory of oscillations and hence need not be explained more fully.

The following example will merely be quoted as an illustration: If the weight of the balancing mass is five times that of the brush, then for a working speed of the crankshaft of 4 times the natural frequency of oscillation of the balancing mass 3, a reduction is obtained in the reaction force to 5.5% of the usual rigid arrangement, while the amplitude of the oscillator is 18% of the crank radius.

Instead of the balancing mass being suspended in the manner of a pendulum, resilient mounting of the balancing mass in springs is of course possible, provided the natural frequency of oscillation of the balancing mass is suitably selected.

Brush-coating machines are generally provided with four brushes, each of which may be provided with its own drive and balancing mass in the manner shown in FIGURE 1 of the accompanying drawings so as to obtain quiet running of the machine. It is possible, however, to provide a simpler construction by retaining the customary common crankshaft for the four brushes and by mounting it on a suitably constructed oscillating balancing mass.

In the construction shown in FIGURES 2a-d of the accompanying drawings, a paper web 6 is passed in the usual manner over a coating mechanism 7 and a coating drum 9 mounted in a machine frame 8. It is assumed that the four brushes 2 have the same mass and oscillate in pairs in opposite directions so that the reaction forces can be combined to form a force couple. Accordingly, crankshaft 10 is mounted on a rotary oscillator, the axis of rotation Y of which is also the principal axis of inertia and is parallel to the vector of the force couple. The oscillating mass is mounted on a stand 11 via pin 21 for rotation about axis Y and is formed as a tubular body 12 with a weighting mass 13 at each end. The high moment of inertia resulting from this dumbbell-like mass distribution, together with supporting springs 14, makes easily possible the overcritical tuning which is still required. The brush driving mechanism, in this case the crankshaft 10 with four connecting rods 5, is mounted in the interior of the tube. The drive is via motor 23 mounted on body 12 and a pair of bevel gears 24. The tube wall has openings for the connecting rods 5 and the shaft connecting motor 23 to gearing 24, as well as openings to facilitate inspection of the mechanism. It should be borne in mind that the bearings of the connecting rods 5 must permit angular movements both parallel to the Z-axis and to the Y-axis. This can be achieved by means of plain pendulum bearings or anti-friction bearings, or by cylindrical bearings in rubber bushings.

In describing the machine shown in FIGURE 2 of the accompanying drawings, it has been assumed that the brush masses are equal. In practice, however, this is not always the case, so that in the combination of the reaction forces, a resultant force is obtained in addition to a force couple. Consequently, the balancing mass must be capable of making a deflecting movement in the X direction, in addition to a rotary movement about the Z axis. The oscillator is thus an oscillator with two degrees of freedom and two natural frequencies of oscillation, both of which must be so tuned that the operating speed of rotation lies in the overcritical range, i.e. the crankshaft speed must be at least 1.5 times the maximum natural frequency of oscillation of the suspended balancing mass. FIGURES 3a-d of the accompanying drawings show a proved form of construction of such an oscillator in the form of an obliquely suspended double pendulum, the pivots 17 and 19 of which are parallel to the force couple vector. This rotary oscillator, which in other respects is constructed as shown in FIGURE 2, except that motor 25 is independently mounted on pedestal 26 and connected with shaft 10 by Cardan shaft 15 and

bevel gears 16, comprises a tubular body 12 with weighting masses 13 and is suspended at a point somewhat above its centre of gravity from the pivot 17 in the manner of a pendulum by means of pin 22. The suspension pivot 17 acts at the same time as the hinge member of a hinge 18 which, by being suspended via pivot 19 in a second hinge pin 22' of a stand 20, forms with the rotary oscillator the double pendulum which is mounted in the stand 20. In order to keep the angular deflection of the rotary oscillator small, its centre of gravity is situated as far as possible in the line of action of the resultant reaction force. In general, however, this is not essential for the intended screening of the machine frame from the mass forces of the brush drive.

We claim:

1. In a brush-coating machine having at least one brush and oscillatory drive means for said brush, the improvement which comprises support means operatively mounting said brush for substantially straight line oscillations, said drive means being operatively connected with said brush for oscillating said brush and mounted for free oscillatory motion about at least one axis with respect to the machine frame at a natural frequency of vibration, the minimum brush-operating frequency being at least 1.5 times the maximum natural frequency of vibration of the mounted drive means.

2. Improvement according to claim 1 wherein said drive means includes a balancing mass pendulum—suspended from the machine frame and operatively connected for oscillating said brush, the paths of the center of gravity of said brush and the center of oscillation of said balancing mass being situated approximately in one straight line.

3. Improvement according to claim 1 wherein at least two brushes are provided which oscillate in opposite directions and which are mounted by linking means to form a force couple of the reaction forces generated as a result of the oscillation of the brushes during oscillation of the brushes, said drive means including a balancing mass defining a rotary oscillator pivotally suspended from the machine frame about a suspension axis by suspension means and operatively connected for oscillating said brushes, said suspension axis being parallel to the vector of said force couple.

4. Improvement according to claim 3 wherein said balancing mass is a tubular body having a weighted mass positioned at each end thereof.

5. Improvement according to claim 4 wherein said drive means includes a drive linkage arranged within said tubular body.

6. Improvement according to claim 3 wherein the drive means includes a crank shaft means having connecting rod bearings operatively connected for oscillating said brushes, said bearings being defined as pendulum bearings.

7. Improvement according to claim 3 wherein said drive means includes a motor mounted on said balancing mass.

8. Improvement according to claim 3 wherein said drive means includes a motor remote from said balancing means operably connected to said rotary oscillator.

9. Improvement according to claim 3 wherein the center of gravity of said rotary oscillator is removed from said suspension axis whereby said rotary oscillator during operation executes pendulum movements about said suspension axis.

10. Improvement according to claim 3 wherein said suspension means includes a first hinge means and a second hinge means, said axis of suspension coinciding with the axis of said first hinge means, said first hinge means being in turn suspended from said second hinge means, the axis of said second hinge means being parallel to that of said first hinge means and said axes forming a double pendulum mounting for said rotary oscillator.

11. Improvement according to claim 1 wherein at least two brushes of equal mass are provided which oscillate

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in opposite directions and which are mounted by linking means to form a force couple of the reaction forces generated as a result of the acceleration of the brushes during oscillation of the brushes, said drive means including a balancing mass pivotally suspended as a rotary oscillator and operatively connected for oscillating said brushes, the axis of pivot of said rotary oscillator being substantially the principal axis of inertia and being parallel to the vector of said force couple.

12. Improvement according to claim 1 wherein at least two brushes of unequal mass are provided which operate in opposite directions and which are mounted by linking means to form a force couple of the reaction forces generated as a result of the acceleration of the brushes

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during oscillation of the brushes as well as a resultant force of the combined reaction forces generated by said unequal masses, said drive means including a balancing mass pivotally suspended as a rotary oscillator and operatively connected for oscillating said brushes, such balancing mass being pivotally suspended as a double pendulum, the pivoting axes of said double pendulum being parallel to the vector of said force couple.

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