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P. BRÜNINGHAUS
PROCESS AND DEVICE FOR SIFTING SOLID
AND LIQUID MATERIALS

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3 Sheets-Sheet 2

FIG. 9

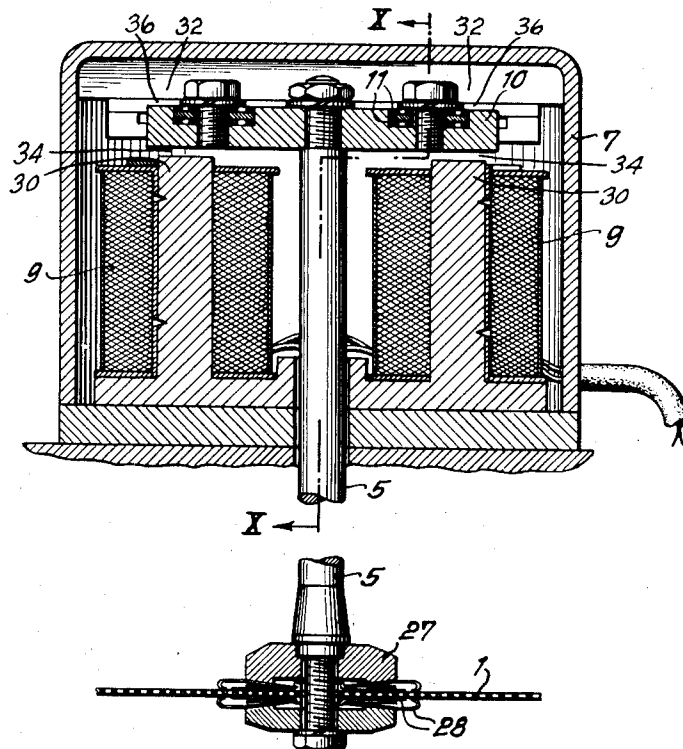
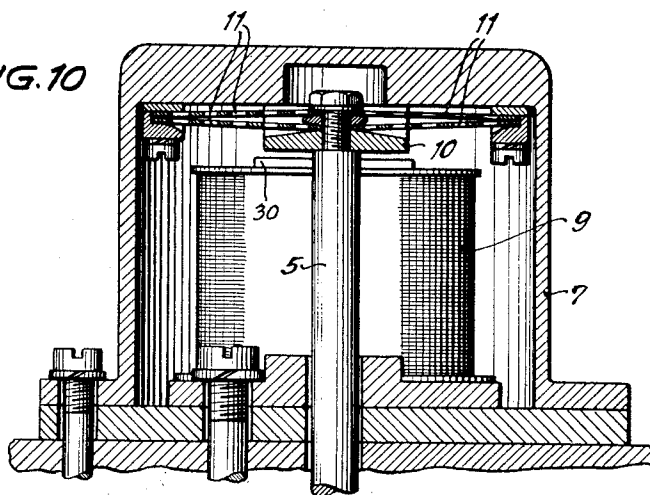


FIG. 10



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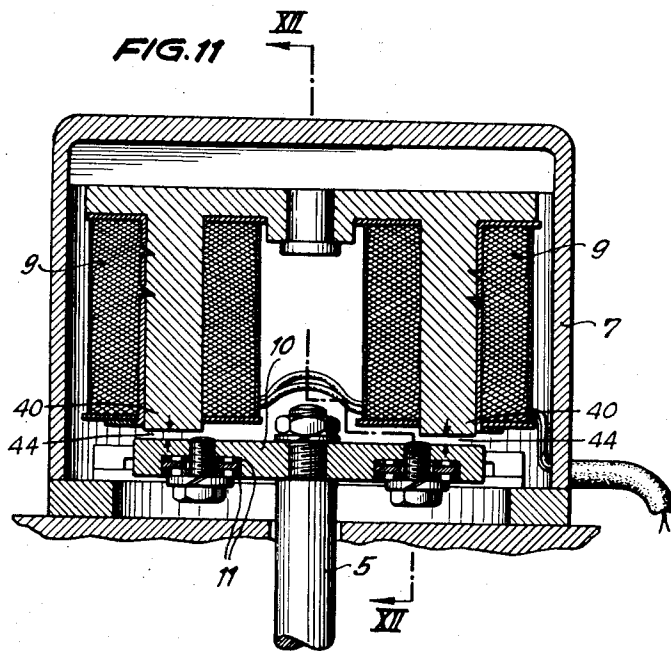
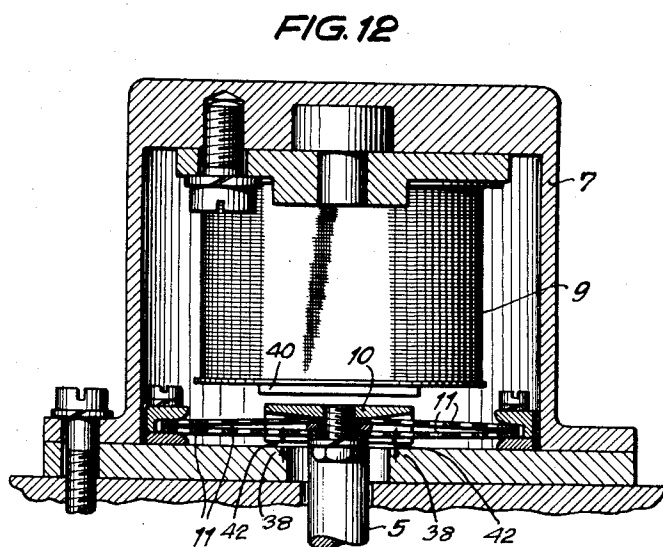
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PROCESS AND DEVICE FOR SIFTING SOLID AND LIQUID MATERIALS

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6 Claims. (Cl. 209—310)

The present invention relates to a process and device for sifting solid and liquid materials.

In most of the known sifting apparatuses, screens are firmly secured in frames and are vibrated by means of the said frames. This method is derived from the old screening by hand. The only new features are the units for starting the vibrations, which are becoming increasingly more powerful and rapid in accordance with modern requirements.

In all these devices, a frame supporting a screen tightly drawn and firmly secured thereon is caused to vibrate by use of different mechanical means, for instance by knocking, beating, unbalanced weights, or electro-magnetic vibrators. The vibrations are transmitted by secondary impact to the goods to be screened or onto the screening means, respectively. In the case of fine and extra-fine screening operations, where extremely small-mesh sieve nettings are used, a serious difficulty is encountered inasmuch as the nettings fail to follow the oscillations of the frame, more particularly where large areas and heavy goods are concerned. As a consequence, dead zones are formed on the netting where no screening action occurs. From the aspect of energy-economy, too, it is wasteful first to induce vibrations in a heavy frame, in order to cause vibration of the netting.

These difficulties cannot be overcome by hitherto known methods for direct impulsion of the sieve netting by means of various mechanisms. These mechanisms transmit the vibrations by means of stiffener bands and cross-members which pass on the vibrations to the taut netting. In the frame transmission mentioned above, the movements between netting and goods to be screened act more or less by friction, such movements, when viewed in a plane, being of circular or elliptical or other form; but when the transmission occurs perpendicularly to the plane of the netting, a tossing effect will result which may keep the goods to be screened in suspension, but is not conducive to a rapid screening action.

It is the object of the present invention to provide a method and an apparatus for screening solid and liquid materials, which is capable of overcoming the above-mentioned inconveniences.

The device according to the invention provides a direct transmission of motion to the netting, causing such intense vibration of the goods to be screened that excellent screening results will thereby be obtained.

According to the invention, means are provided for starting the vibration of the netting and causing sinusoidal oscillations of high-frequency therein, which means, more particularly in the form of rods, are distributed in the device so as to have spaced points of attack. In order to provide the sinusoidal oscillations, it is necessary that the netting have a certain freedom of movement, that is to say: it should not have a special tension in any direction. Furthermore, the netting has to be started at a certain minimum frequency in order to perform the required vibration. It is also desirable to superpose harmonics on the sinusoidal oscillation, which may be generated

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electromagnetically as longitudinal vibration of the transmitter rods, said vibrations having limited amplitudes. This arrangement leads to progressive transverse waves which insure total motion of the entire netting due to their high capacity of reflection.

These oscillations will generate between netting and goods to be screened, various rolling, overturning, tossing and frictional motions, said motions being performed simultaneously in different planes. For the generation of such vibrations, it is necessary only to grip the netting at isolated points, since the oscillations are propagated in concentric circles.

Dissipation of heat from the oscillating elements is effected by the use of light metals of high heat-conductivity. It is possible to provide a close contact of the magnets with the light metal, for instance by casting them together. In this case, the light metal serving for the dissipation of heat may be so designed that it will at the same time form a protective casing for the magnetic oscillator.

The device made according to the invention is illustrated in the accompanying drawings by way of example, but it should be understood that many modifications in the details can be made without departing from the spirit of the invention.

In the drawings:

Fig. 1 is a diagrammatic showing of the screening device in front view;

Fig. 2 is a side view of the device;

Fig. 3 is a top view;

Figs. 4-8 are diagrammatical representations of oscillatory curves;

Fig. 9 shows a magnet in longitudinal section with a connection between the rod and screen below it;

Fig. 10 is a section along line X—X of Fig. 9;

Fig. 11 is a section, similar to Fig. 9, of a modified form; and

Fig. 12 is a section along line XII—XII of Fig. 11.

Referring now to Figs. 1-3, the screening device is shown to comprise a netting 1, which is mounted between rubber pads 2 in a stationary frame 3 and secured therein by means of bolts 30. A rigid bridging member 4 is likewise secured to the frame by said bolts. On said member 4, an electromagnetic oscillator 7 is firmly anchored, whose energy is transmitted directly to the netting 1 through a vibrating rod 5 and the vibrating movement of a rigid connecting member 6.

Due to the limitation of the amplitude in such an arrangement, the vibrating rod of the oscillator is caused to perform natural motions which are superposed directly on the resulting sinusoidal oscillation. Due to this arrangement, the goods to be screened will be vigorously agitated so that in a very short time a maximum amount will be subjected to screening action at the surface of the screen.

As impulsion mechanisms, I may for instance use electromagnetic vibrators operating at a frequency of 100 oscillations per second.

Fig. 2 is a side view of a screening device thus driven, in slanting position; this arrangement causes residue to be removed automatically. Four oscillating rods 5 are shown in this figure which act on the netting, not uniformly, but with a phase displacement of 180°. This permits generation in the sieve netting of a more intense motion, as well as larger amplitudes, which have a similar course, as shown at the bottom of Fig. 2, at 5a. The curve also shows superposed harmonics.

Fig. 3 is a top view showing a large screen surface to be excited at eleven points designated by 6. The oscillators arranged in the center line operate in opposite rhythm to the oscillators arranged in a line on either side of the center line.

It is obvious that with this arrangement there cannot be any dead zones. By individual adjustment of separate groups, I provide the possibility of varying the intensity of motion at different points of the screening surface. It is, for example, possible to provide a large dissipation of conglomerated goods in the upper part of the sieve by heavier blows, so that in the center of the sieve there will be a sharp screening, whereas a rapid discharge will occur at the lower end.

Figs. 4-8 illustrate the oscillations generated by the magnetic oscillator and executed by the netting. Fig. 4 is a simple sinusoidal oscillation as generated by the magnetic oscillator.

Upon use of alternating current of 50 c.p.s., the generated frequency of the oscillations will be 100 c.p.s. Fig. 5 shows the limitation of the amplitude at *a*. By providing for such limitation, harmonics will be superposed on the oscillations and damped oscillations will result, as shown in Fig. 6. When the oscillations are transmitted to the netting, oscillations as shown in Figs. 7 and 8 will result, in which the harmonics are combined completely with the oscillations over the entire range. In Fig. 7, the frequency of the harmonics reaches about 2000 c.p.s., and in Fig. 8, 4500 c.p.s., thus entering the range of the higher sonic waves.

It will be readily understood that with motions of such frequencies, every single mesh of the netting attains its fullest effectiveness, and there is no possibility that any mesh can be clogged or closed.

By changing the intensity, a simultaneous change occurs in the frequencies of the harmonics. It is thereby possible by providing individual units, which are necessary for exciting larger screening surfaces, to procure at the same time individual control by zones and to generate different oscillations in one and the same screen. This is particularly useful in longer sieves where the top part is then adjusted for dissipation of conglomerations, the center part for sharp screening and the bottom part for prompt discharge of the residue.

Figs. 9-12 show various magnetic oscillators. Figs. 9 and 10 illustrate an oscillator having a rod 5 connected to a netting 1. The outer casing is designated by 7, in which a magnetic coil 9 is arranged. Rod 5 passes through coil 9 and supports at the other end an armature 10 which is attracted by the magnetic coil. Rod 5 is suspended in springs 11 which are tuned to a fundamental frequency. By single or double stops, the generated sinusoidal oscillations are limited in their amplitude and strong harmonics are created by natural oscillation of the transmission members, so that in the netting 1, oscillations as shown in Figs. 7 and 8 will result. For example, in Figures 9 and 10 the lower stops are designated 30 and the upper stops 32 with the limited movement of the armature designated 34 and 36. In Figs. 11 and 12, the head of a rod 5 provided with an armature 10 is brought up close to the magnet coil 9 of an oscillator 7, said head being likewise held by springs 11. The lower stops are designated 38 and the upper stops 40 with the limited armature movement indicated at 42 and 44. By arranging one oscillator 7 as shown in Figs. 9 and 10, and one oscillator as shown in Figs. 11 and 12, an opposite sinusoidal curve is generated and an increase of amplitude by interferences results, since the oscillators are phase-displaced by 180°.

The vibrating rods 5 pass through the netting, and a small hole is provided in the netting for each rod. The small hole is for the passing through of the rod and, enclosing the rod, a plate 27 in Fig. 9 is arranged around

the hole on top of and below the netting. These plates are attached to the rods and curved in a manner to follow the oscillations thereof. In this arrangement, leaf type spring elements 28 are interposed on each side of the screening medium between it and the plates 27 so that the oscillations from each rod 5 will be resiliently distributed at each localized connection to the screen thereby reducing or practically eliminating wear at the point of connection.

What I claim is:

1. A method of screening material with a pervious screening medium, including the steps of imparting high frequency vibrations at generally right angles to the medium at well spaced localized points, creating at each such point radiating annular sinusoidal high frequency waves emanating from and concentric with such point, allowing uninterrupted interference of such waves from adjacent points as they converge and intersect in the areas of the medium intermediate the localized points, and feeding material to be screened to one side of said screening medium.

2. The method of claim 1 further characterized by and including the step of vibrating the screening medium simultaneously in opposite directions at right angles to said medium at adjacent localized points.

3. A method of screening materials, which includes the steps of providing a pervious medium, supporting the medium in a plane in a condition of such tension as to permit unimpeded interference vibrations in certain areas, vibrating the medium positively at a high frequency at well spaced independent localized points generally at right angles to the plane of the medium, creating interference in the intermediate areas resulting from sinusoidal waves radiating in all directions from such points, and feeding material to be screened to the medium.

4. The method of claim 3 further characterized by and including the step of vibrating said medium in opposite directions at the same time at adjacent localized points.

5. In a screening device, a base, a screen frame mounted rigidly on the base, a screen secured in said frame, means on the frame for clamping and holding the screen, a plurality of independent magnetic vibrating units attached directly to the screen for vibrating it at a high frequency at spaced and independent localized points in a direction, at each such point, generally perpendicular to the plane of the screen, said screen being held under a degree of tension such that annular high frequency sinusoidal concentric waves will emanate from each said point.

6. The structure of claim 5 further characterized in that the magnetic vibrating units are constructed to simultaneously vibrate the screen in opposite directions at adjacent localized points.

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