

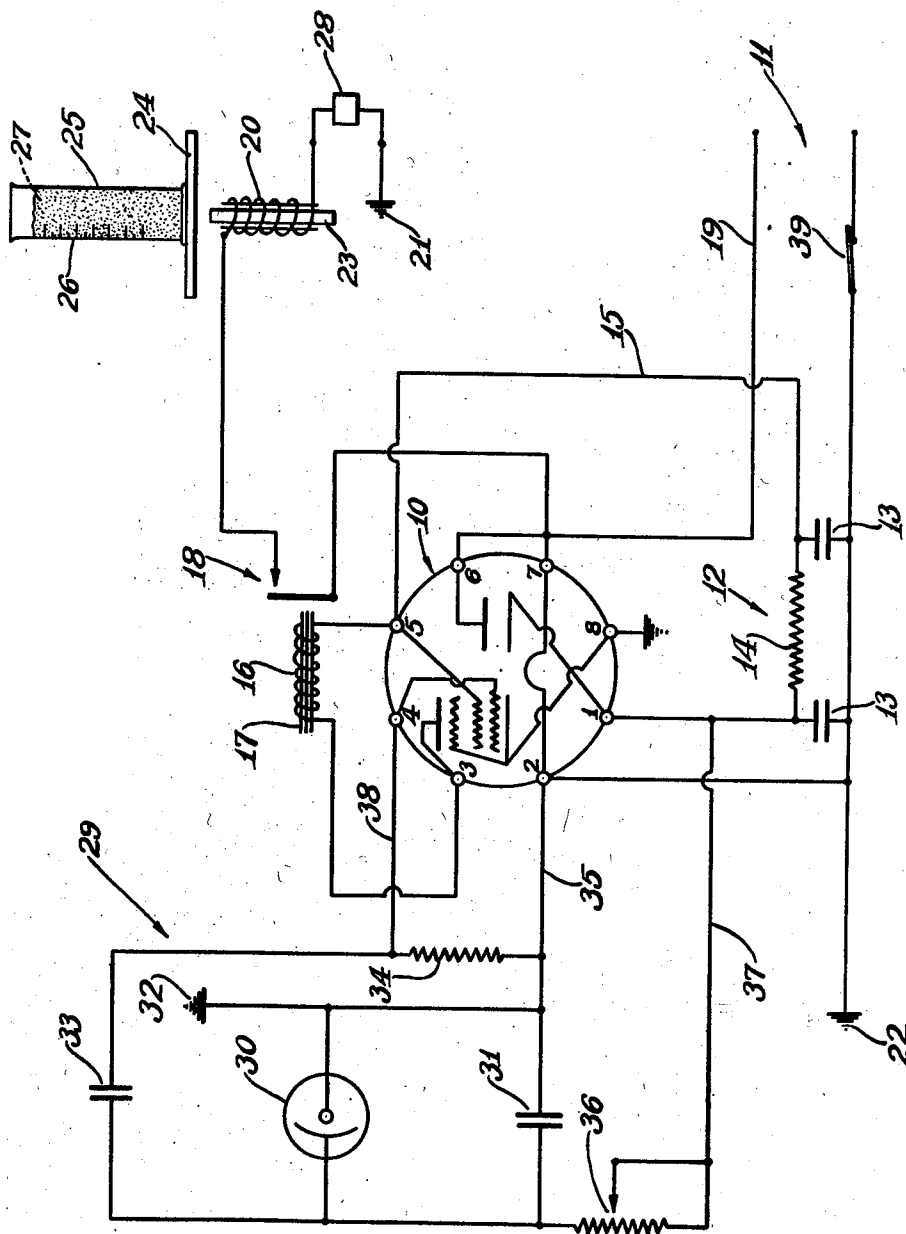
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LE ROY W. LIESCH

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VARIABLE FREQUENCY VIBRATING DEVICE

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Inventor:
LeRoy W. Liesch
By Lee J. Gary, Atty.

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VARIABLE FREQUENCY VIBRATING DEVICE

Le Roy W. Liesch, Chicago, Ill., assignor to
Velsicol Corporation, Chicago, Ill., a corpora-
tion of Illinois

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This invention relates to improvements in a device for vibrating an impact plate at a controlled frequency, said impact plate being adapted to hold a sample of discrete material of such character as to have its bulk density increased or its volume reduced by such vibration.

In the handling, packing and shipping of discrete material, especially in the dry state, it is desirable to know the extent to which the volume occupied by the material will change or its bulk density increase when the material is subject to vibration or impact forces.

This knowledge is particularly valuable in the marketing of packaged discrete materials which between the time of packaging and the opening of the package for use the package may be roughly handled or may be subject to the vibration and impact forces incident to shipping.

The present invention comprises a simple, accurate and economically constructed device which can be employed to index a material with regard to its characteristics of changing bulk density in response to vibration, impact or shock forces, the device being particularly characterized by its flexibility as to the nature of the vibration, that is, the frequency of vibration which may be imparted to a sample of discrete material and the ease with which the device may be operated.

Other objects and advantages of the present invention will be apparent from the accompanying drawing and following detailed description.

The single figure comprising the drawing is a schematic wiring diagram of the electric circuit employed, the physical structure of the impact plate being shown diagrammatically.

Referring in detail to the drawing 10 indicates an electron tube of the amplifier-rectifier type such as a T-117L7 tube. The tube 10 and the circuit associated therewith is energized from a source 11 of alternating current. The tube 10 carries eight terminals, numbered 1 to 8 respectively; terminals 2 and 7 comprising the filament or heater terminals; terminal 3 comprising the plate terminal; terminal 4 comprising the control grid terminal; terminals 1 and 6 comprising rectifier terminals and terminal 5 comprising an auxiliary grid terminal.

It is to be understood that a conventional triode used in conjunction with a full or half wave rectifier tube may be substituted for the tube 10. However, the amplifier-rectifier tube of the type shown is preferred.

The filament or heater connected between terminals 2 and 7 provides energy for the discharge of electrons and is connected directly across the

alternating current source 11. The plate circuit voltage is supplied from terminal 1 of the rectifier section of the tube, the current being filtered through a filter 12 comprising condensers 13 and resistance 14. From filter 12 lead 15 connects to auxiliary grid terminal 5 and through relay coil 16 to plate terminal 3. It can therefore be seen that variations in plate current will be effective to change the flux in core 17 around which coil 16 is wrapped. A relay switch 18 is activated by current passing through coil 16 to open the alternating current circuit from line 19 through a solenoid coil 20 to ground 21, the opposite side of the alternating current line being grounded at 22.

As will be hereinafter more fully described a pulsating current is passed through the relay coil 16 which causes relay switch 18 to periodically open and close. The opening and closing of the switch 18 intermittently energizes the solenoid coil 20. A core 23 is positioned within the solenoid coil 20 and as current periodically passes through coil 20 the core vibrates along its longitudinal axis. An impact plate 24 is positioned above the core 23 and as said core moves upwardly it impinges upon the lower surface of the plate 24, the rate of impacts upon the plate 24 being determined by the opening and closing of relay switch 18.

In utilizing my invention a beaker 25 may be positioned upon the impact plate 24, said beaker being provided with calibrations 26. Discrete material 27 may be positioned in the beaker 25 and plate 24 may be subjected to a series of impacts. As a result thereof the discrete material 27 will tend to settle in the beaker and the extent of settling for a given number of impacts per unit of time may be determined by the calibrations 26. Thus the characteristics of the discrete material 27 for a predetermined frequency of impact for a predetermined time may be ascertained. As has been hereinbefore described this information is particularly valuable wherein discrete material is packaged and the packages are subjected to relatively rough handling or where the packages may be transported over distances. An index as to the degree of settlement may thus be obtained.

In order to automatically control the length of time that the plate 24 is subjected to the impact forces a conventional timing mechanism 28 may be connected in series with the solenoid coil 20 and ground 21. The device 28 may be of conventional construction and may be of the type which would automatically disconnect the

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circuit after the lapse of a predetermined period of time.

In order to set up the desirable fluctuations in current in the relay coil 16 an oscillator circuit 29 may be connected to the control grid-cathode of the amplifier section of the tube 10. The oscillator circuit 29 comprises a glow tube 30 which may take the form of a neon type NE-27 tube. The tube 30 is of such character that no current will flow therethrough between its terminals until a predetermined voltage is applied across the terminals. Above this critical voltage the tube will function as a conductor of electricity. When the voltage is reduced below said critical voltage the tube ceases to be a conductor of electricity.

Connected in parallel with tube 30 is a condenser 31. One side of the tube 30 and a side of the condenser 31 are connected to ground 32. The opposite side of the tube 30 and condenser 31 are connected through a condenser 33, a resistance 34 which in turn is connected by means of lead 35 to the filament or heater terminal 2 which is also grounded at 22. Terminal 1 of tube 10 is connected through variable resistance 36 by means of lead 37 to one side of the tube 30 and condenser 31, that is, that side which is also connected to condenser 33. The upper portion of resistance 34 is connected by means of lead 38 to terminal 4 of tube 10 which comprises the control grid terminal of the amplifier section of said tube.

It will be noted that an E. M. F. is impressed across the tube 30 and condenser 31, this E. M. F. being normally controlled by the variable resistance 36. With the switch 39 in the alternating current line closed an E. M. F. is established across condenser 31 and tube 30. The current initially tends to charge the condenser 31. As the condenser is charging the E. M. F. across the tube 30 is insufficient to cause said tube to act as a conductor. When the condenser 31 has been completely charged the E. M. F. across the tube 30 will increase above the critical voltage of the tube 30 and as a consequence current will pass through the tube 30 and the condenser 31 will discharge. During the period that the condenser 31 is charging current will also flow through the condenser 33 and resistance 34. A drop of potential will thereby be established between the control grid and the filament or cathode of the tube. Current will then flow from the cathode of the tube to the plate of said tube and said current will also flow through the relay coil 16 thereby opening switch 18 and deenergizing solenoid coil 20. After condenser 31 has been charged and tube 30 becomes conducting the current which normally travelled through the resistance 34 is effectively short-circuited through the tube 30 and consequently the amplifier section of tube 10 will be rendered inoperative, that is, no current will flow through the plate circuit thereof and hence switch 18 will be closed. Current will flow in solenoid coil 20 until condenser 31 has been completely discharged and begins to charge. In this fashion oscillatory current is set up in the grid circuit of the amplifier section of tube 10, the amplified oscillations being effective to open and close relay switch 18 and energize and deenergize solenoid coil 20.

With a predetermined value of capacity for condenser 31 the period of oscillations established in the grid circuit of the amplifier section of tube 10 will be determined by the E. M. F.

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impressed across condenser 31 and tube 30. As has been hereinbefore described this E. M. F. is controlled by the variable resistance 36. Accordingly, to vary the period of impacts upon plate 24 it is merely necessary to vary the resistance 36.

As an example of the constants employed the filter condensers 13 each comprised condensers of 8 microfarads. The resistance 14 comprised 2200 ohms. Resistance 34 comprised $\frac{1}{2}$ megohm. Variable resistance 36 comprised 10 megohms. Condenser 31 had a capacity of $\frac{1}{10}$ microfarads and condenser 33 had a capacity of $\frac{1}{100}$ microfarads.

It is to be understood, of course, that my invention is not to be limited to the use of these particular constants since the same may be varied depending upon the impact frequency desired, the nature of the electron tubes employed and the like.

I claim as my invention:

1. A device of the class described comprising a plate for supporting a sample of discrete material capable of changing its bulk density when vibrated, electro-magnetic means for vibrating said plate to vibrate said sample, and means for controlling the frequency of vibration of said electro-magnetic means comprising an electron tube, means for setting up oscillations of predetermined frequency in the grid circuit of said electron tube, and relay switch means in the plate circuit of said electron tube connected to said electro-magnetic means to electrically energize said electro-magnetic means in response to the oscillations set up in the grid circuit of said electron tube.

2. A device of the class described comprising a plate for supporting a sample of discrete material capable of changing its bulk density when vibrated, electro-magnetic means for vibrating said plate to vibrate said sample, and means for controlling the frequency of vibration of said electro-magnetic means comprising an electron tube, means for setting up oscillations of predetermined frequency in the grid circuit of said electron tube, means for controlling the frequency of oscillations in said grid circuit, and relay switch means in the plate circuit of said electron tube connected to said electro-magnetic means to electrically energize said electro-magnetic means in response to the oscillations set up in the grid circuit of said electron tube.

3. A device of the class described comprising a plate for supporting a sample of discrete material capable of changing its bulk density when vibrated, electro-magnetic means for vibrating said plate to vibrate said sample, and means for controlling the frequency of vibration of said electro-magnetic means comprising an electron tube, means for setting up oscillations of predetermined frequency in the grid circuit of said electron tube, said means comprising a glow tube and a condenser connected in parallel, means for establishing voltage across said parallel circuit to charge said condenser, said condenser periodically discharging through said glow tube to set up an oscillating current in said parallel circuit, and means connecting said parallel circuit to the grid of said electron tube to vary the potential upon said grid in response to oscillations in said parallel circuit, and relay switch means in the plate circuit of said electron tube connected to said electro-magnetic means to electrically energize said electro-magnetic means in response to

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the oscillations set up in the grid circuit of said electron tube.

4. A device of the class described comprising a plate for supporting a sample of discrete material capable of changing its bulk density when vibrated, electro-magnetic means for vibrating said plate to vibrate said sample, and means for controlling the frequency of vibration of said electro-magnetic means comprising an electron tube, means for setting up oscillations of predetermined frequency in the grid circuit of said electron tube, said means comprising a glow tube and a condenser connected in parallel, means for establishing voltage across said parallel circuit to charge said condenser, said condenser periodically discharging through said glow tube to set up an oscillating current in said parallel circuit, and means connecting said parallel circuit to the grid of said electron tube to vary the potential upon said grid in response to oscillations in said parallel circuit, relay switch means in the plate circuit of said electron tube connected to said electro-magnetic means to electrically energize said electro-magnetic means in response to the oscillations set up in the grid circuit of said electron tube, and means for varying the voltage applied to said parallel-circuit to change the frequency of oscillation of said parallel circuit.

5. A device of the class described comprising an impact plate for supporting a sample of discrete material capable of changing its bulk density when vibrated, electro-magnetic means comprising an iron core periodically movable into contact with said plate for vibrating said plate to vibrate said sample, and means for controlling the frequency of vibration of said electro-magnetic means comprising an electron tube hav-

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ing a cathode, plate and grid, means for setting up oscillations of predetermined frequency in the grid circuit of said electron tube, and relay switch means in the plate circuit of said electron tube connected to said electro-magnetic means to electrically energize said electro-magnetic means in response to the oscillations set up in the grid circuit of said electron tube.

6. A device of the class described comprising a plate, a calibrated container carried upon said plate for carrying a sample of discrete material capable of changing its bulk density when vibrated, electro-magnetic means for vibrating said plate to vibrate said container and sample, and means for controlling the frequency of vibration of said electro-magnetic means comprising an electron tube, means for setting up oscillations of predetermined frequency in the grid circuit of said electron tube, and relay switch means in the plate circuit of said electron tube connected to said electro-magnetic means to energize said electro-magnetic means in response to the oscillations set up in the grid circuit of said electron tube.

LE ROY W. LIESCH.

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