The present invention relates generally to vibrating or shaking tables, and more especially to a vibrating table construction which is particularly suitable for use in the field of investment casting.

Apparatus of the type with which we are here particularly concerned is used for investing a wax pattern with a suitable investment material which will harden and form a mold upon removal of the wax pattern. This process is used in making metal castings in various fields, for example, in the manufacture of jewelry and other oriental and commercial investment casting or lost wax technique. It is common practice to pour the investment mixture around the wax pattern which is suitably mounted inside a flask. In order to eliminate any air bubbles that are liable to exist in the investment mixture as well as to compact the mixture and cause it to conform faithfully to the shape of the pattern, it is common practice to vibrate the flask as the investment mixture is poured in. The flask is placed upon a vibrating or shaking table which imparts a rapid reciprocatory motion, normally in a vertical direction, to the flask and its contents.

It is a general object to provide a construction of novel design for a shaking table of this type which permits application to the flask on the table of a variable force, ranging from a minimum or no vibration to the maximum vibration possible with the apparatus.

It is also an object of the invention to start with little or no vibration and progressively increase the vibration applied to the flask and its contents, thus avoiding the danger of knocking the pattern off the sprue former by a severe vibration as is especially likely to happen when a vibrating table first strikes the flask.

It is a further object of the invention to provide a shaking table construction of the general character described in which the shaking table is effectively disconnected from operative relation with the rotating cam or other member which produces the vibration of the table.

These objects of the invention have been achieved in a preferred embodiment of a shaking table having a structural framework, by providing a rotating cam means mounted on the frame, a movable table, and an elastic column means guided by the frame and transmitting motion from the rotating cam axially of the column means to the movable table, said column means being compressible axially thereof to increase the force transmitted by the column means and thereby increase the vibration of the table.

The elastic column means includes a helical spring transmitting motion to the table, which is preferably wound from stock that is substantially rectangular in cross section. As the spring is compressed axially and the turns are brought closer together, the force transmitted through the spring to the table increases in intensity until ultimately the maximum transmission of force to the table is effected when the adjacent turns of the spring come into mutual contact.

Alternatively, there may be used in conjunction with the helical spring a pair of rigid members normally held spaced apart by the spring, these members being brought together as the spring yields under axially directed force until the two rigid members are brought into mutual engagement and thus provide for maximum transmission of force to the table through the rigid members, engagement of these members taking place before the turns of the spring come into mutual engagement.

How the above objects and advantages of my invention, as well as others not specifically referred to herein, are attained, will be more readily understood by reference to the following description and to the annexed drawings, in which:

FIG. 1 is a vertical section through the elastic column means of a vibrating table embodying the present invention showing the parts in the rest position in which no vibration is imparted to the table.

FIG. 2 is a view similar to FIG. 1 showing the elastic column means compressed to the position in which maximum vibration is transmitted to the vibrating table.

FIG. 3 is a view similar to FIG. 2 of an alternative arrangement in which the turns of the helical spring are in mutual contact to transmit maximum vibration.

FIG. 4 is a vertical median section of another embodiment of the invention.

FIG. 5 is a vertical median section of still another embodiment of the invention.

Referring now to the drawings and more particularly to FIG. 1, it will be seen that the vibrating table comprises a frame, indicated generally at 10. Only fragments of the frame are illustrated since any suitable type of supporting frame or structure may be provided for the purpose of mounting in one assembly the various moving parts of the table. Rotating cam 12 is rigidly mounted in any suitable manner on shaft 14, the shaft being rotatably mounted upon frame 10 by means of a pedestal type bearing 15, or any other suitable type of structure. It is contemplated that shaft 14 will be driven by a suitable prime mover, for example an electric motor, not shown in the drawing. Shaft 14 can be directly connected to such a motor or can be driven through the medium of a speed reducing arrangement, such as a gear box, chain and sprocket, or belt and pulley drive, such arrangements being well known in the art and needing no illustration or explanation here.

It is assumed that cam 12 rotates in a clockwise direction when viewed as in FIG. 1 and the cam is provided with two lobes 12a, each of which has a sloping surface on the leading face and a sharp drop on the trailing face. However any other type of cam configuration may be used that is found suitable for a particular operation.

The vibrating table is indicated at 18 and it is designed to provide a supporting surface for flask 19 within which is mounted the pattern 20 on sprue former or gate 21. Flask 19 is designed to hold a quantity of the investment compound which is to be compacted around the pattern and sprue former. Table 18 is reciprocated vertically by motion which is imparted to the table through the elastic column means indicated generally at 22, the column serving to transmit motion from the rotating cam to the table, as will appear. The elastic column is located in a bore 23 in guide element 10a of the stationary frame. Bore 23 serves not only to laterally confine the elastic column means for reasons which will be further explained, but also serves to position the column in a vertical position above cam 12, the column being free to move axially thereof in a vertical direction within bore 23.

Elastic column 22 includes helical spring 25. This spring may be of a conventional nature wound from a wire of circular cross section, but it is preferred that it be wound of stock that is rectangular in cross section,
as shown in FIG. 2. This spring compresses axially from the expanded position of FIG. 1 to the position of FIG. 2 or FIG. 3. The turns are large enough so that there is a central bore within the spring which slidably receives stem 26 attached in any suitable manner to the underside of table 18 and extending downwardly within stem bore 24. The lower end of spring 25 rests upon the free end of leaf spring 28 which is in turn mounted on frame 10 in any suitable manner as by being attached to post 29 which is a portion of the frame.

In the normal rest position, leaf spring 28 supports spring 25 and table 18 in such a position that the under face of leaf spring 25 is above and out of contact with rotating cam 12, as in FIG. 1. Thus leaf spring 28 serves normally to urge the elastic column means away from the rotating cam, and in this normal position the cam turns freely without imparting any vibration to the table. Downward pressure on the elastic column causes the cam to compress in an axial direction, bringing the successive turns of spring 25 closer together. This exerts a downward force on leaf spring 28 which brings it into contact with rotating cam 25 immediately beneath the leaf spring. The strength of spring 25 may be such that the height of the filled flask 19 may be increased to bring about at least a light contact of spring 28 with cam 12, or it may require additional downward pressure applied manually to table 18.

It will be seen that as the downward axially push on spring 25 increases, the column 23 is further compressed and it becomes more rigid, thus transmitting an increasing amount of force to table 18 to impart vibration to the latter. Increased compression of spring 25 brings about increased transmission of vibration producing forces until maximum transmission is reached when the bottom end of stem 26 engages the upper side of leaf spring 28 as shown in FIG. 2. In this position there is a member connecting table 18 and rotating cam 12, since there is no relative motion between any of the intervening parts 26 and 28. As a consequence, the rigidity of the interconnection between the table and cam causes table vibration to be a maximum at this position of the parts.

A modification of the embodiment illustrated in FIGS. 1 and 2 is possible simply by shortening stem 26, as shown in FIG. 3. When the stem is thus shortened, it does not reach leaf spring 28 before the coils of spring 25 come into contact with one another as shown. When this occurs, the spring 25 forms a substantially rigid member which transmits the full force of the vibrations from rotating cam 12 to plate 18 in the same way as stem 26 did in FIG. 2. It is for this reason that a rectangular cross section for the stock from which spring 25 is made is preferred, since the surfaces on successive turns of the spring engage without any tendency to displace succeeding turns laterally as may be true of a spring made from round wire.

There is an advantage to the relatively longer stem 26 in that it acts more fully to confine the turns of spring 25 against relative lateral displacement. However, the same lateral confinement of the turns of the spring may be provided by the walls of bore 23. This permits shortening of the stem as may be desired from the length illustrated in FIGS. 1 and 2.

An advantage of the invention is that all of the parts are held in position by gravity, making assembly and disassembly very easy. Stem 26 is attached to the underside of table 18 and the table and stem are held within spring 25 by gravity, the entire assembly resting upon the top of leaf spring 28. The parts may be disassembled merely by lifting up the table and stem, after which spring 25 can be removed upwardly from bore 23.

A variational embodiment of the shaking table construction is illustrated in FIG. 4 which differs from the embodiment described above only in the features now to be mentioned. A significant change is the omission of spring 28 from below the lower end of the elastic column means and the substitution therefor of helical spring 31. It will be seen that the frame element 10a is counter bored above the short length of small diameter bore 23 to provide a larger diameter bore 30 which permits a helical spring 31 to be added surrounding spring 25. Helical spring 31 rests at its lower end upon the shoulder between locating flats 32 and 33 and is engaged by the colleague of helical spring 18 by engagement with the underside thereof. Spring 31 supports the table at such a position that rotation of cam 12 does not impart vibration to the table when the table is unloaded and raised to the position in FIG. 4.

A contact plate 33 is added to the lower end of spring 25 in order to provide a smooth surface for engagement with rotating cam 12. This contact plate is held in place in any suitable way, for example by screw or pin 34 passing through a lower turn of spring 25 and into stem 35 inside the spring. Stem 35 is attached to plate 33. It will be noted that stem 26a attached to plate 18 is shorter than in FIG. 1. It may be made long enough to engage the upper end of stem 35 before the turns of spring 25 come into mutual contact, in which case the two stem sections 26a and 35 form a rigid column through which vibration is transmitted from rotating cam 12 to table 18. On the other hand, spring 25 may be shorter than shown (FIG. 5), then the successive turns of helix 25 come into contact with each other to form the substantially solid member for transmitting the maximum amount of vibration to the table from the rotating cam.

A further embodiment of the invention is illustrated in FIG. 5 which differs from that illustrated in FIG. 4 only in two material respects. In the first place, spring 31 which is made of stock having a rectangular cross section has been replaced by spring 37 which is made of round wire and is shorter. Being shorter permits the addition to the underside of table 18 of sleeve 38. Spring 30 which supports spring 25 on the elastic column upwardly away from rotating cam 12 now engages the end of sleeve 38 which is, in effect, a portion of table 18. Sleeve 38 is guided by engagement with the sides of bore 30 to properly direct the motion of the table in a vertical direction. FIG. 5 also illustrates a shortened version of the stem 26a. In the embodiment of FIG. 5, this stem is provided by screw 26b which enters into and engages the upper turns of spring 25.

A second difference between FIGS. 4 and 5 is found in the rotating cam. In FIG. 4 rotating cam 12a is provided with one or more flattened surfaces 40 rather than the raised lobes, in order to give the cam the desired non-circular outline necessary to impart vibration to the elastic column above it. The frequency of the vibrations can be increased for any given rotational speed of the cam by increasing the number of flats 40.

It will be apparent without additional illustration that spring 37 or spring 31 can be omitted from the device if it is desired to eliminate the function of that spring in lifting the elastic column off the cam in the rest position. Then vibration is always imparted to the table when the cam turns as the end of the column (contact plate 33) now rides on the rotating cam at all times.

From the foregoing description it will be understood that the various changes may be made in the detailed arrangement and construction of the parts of the shaking table constituting my invention, without departing from the spirit and scope of the invention. Accordingly, it is to be understood that the foregoing description is considered as being illustrative of, rather than limiting upon, the present invention as defined by the appended claims.

I claim:

1. Vibrating table construction for vibrating an investment flask and pattern, comprising:
   - a frame;
   - a rotating cam mounted on the frame;
   - a rigid movable table to support the flask;

2. The table construction of claim 1, wherein the table is driven by a cam in the shape of a helix.

3. A laterally displaceable frame mounted on a base, said frame carrying an investment pattern, said frame including a cam in the shape of a helix, said cam driving the frame laterally.

4. An investment pattern mounted on a movable table, said table carrying a rotating cam, said cam driving the table laterally.
and elastic column means guided by the frame and constituting the sole support for the table, said column means transmitting motion from the cam axially of the column means to the table, and said column means being compressible axially to increase the force transmitted by the column means and thereby increase the intensity of vibration of the table.

2. A vibrating table construction according to claim 1 in which the column means includes a helical spring transmitting motion to the table, the spring being compressible to the extent that adjacent turns of the spring come into contact to provide maximum transmission of force to the table.

3. A vibrating table construction according to claim 2 in which the helical spring is substantially rectangular in cross section providing mutually engaging faces on successive turns that engage across the substantially full radial dimension of the turns.

4. A vibrating table construction as in claim 1 in which the column means includes a helical spring and a pair of rigid members concentric with the spring and normally held spaced apart by said spring, said spring yielding under force applied to the table to bring the two rigid members into mutual engagement to provide maximum transmission of force to the table through the rigid members.

5. A vibrating table construction as in claim 1 that also includes resilient means supported on the frame and engaging the end of the column means adjoining the cam to urge the column means away from the cam but yielding under a load on the table to bring the column means into vibration receiving relation with the cam.

6. A vibrating table for vibrating an investment flask and pattern or the like as in claim 6 in which the elastic column means includes a helical spring; and the table also includes a second helical spring concentric with and surrounding the first mentioned spring and supported on the frame, said second spring normally urging the table and column means away from the cam but yielding to engage the cam and column means.

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