VIBRATORY FINISHING MACHINE

Inventor: Tony Campanelli, 243 Flora Pky., Addison, Ill. 60101

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Primary Examiner—Al Lawrence Smith
Assistant Examiner—Nicholas P. Godici
Attorney, Agent, or Firm—Richard G. Kinney, Esq.

ABSTRACT
A vibratory machine of the bowl type is disclosed having a spring mounted bowl for containing a workload, such as parts and media for deburring them, and a vibratory mechanism rigidly attached thereto having a single eccentric mass or weight at its lower point. The single mass is rotated about the central vertical axis of the bowl and is positioned at a greater distance below the null point than the center of the workload is above that point to cause vibratory gyroscopic motion to be imparted to the workload with little external vibration and with low force and wear on the vibratory mechanism.

10 Claims, 3 Drawing Figures
VIBRATORY FINISHING MACHINE

This is a continuation, of application Ser. No. 172,482 filed 8/17/71 now abandoned.

BACKGROUND OF THE INVENTION

The present invention is directed toward an improvement in vibratory machines of the type employed for deburring and finishing of parts and other uses.

The present invention employs less parts and, more significantly, less moving parts than conventional commercial machines and also achieves lower external vibration with less internal wear. Prior such machines employed a either plurality of rotating masses orbiting about different vertical positions, or employed one or a plurality of orbiting weights at or about the null point or the center of the moving mass.

SUMMARY OF THE INVENTION

A vibratory machine constructed in accordance with the present invention comprises a bowl defining a workload center in which media to be treated is received, means for resiliently mounting the bowl which establishes a null point below the workload center and a vibratory mechanism affixed to the bowl, distinguished by having a sole eccentric mass or weight which mass or weight is orbited at a displacement below the null point greater which the distance than the workload center is above the null point. Means for driving the vibratory mechanism are also provided, which means are preferably adjustable to orbit the eccentric mass or weight continuously over any desired speed of a range of speeds and to thus adapt the machine to different workloads without requiring any alteration in the weight.

BRIEF DESCRIPTION OF THE DRAWINGS

The features of the present invention which are believed to be novel are set forth with particularity in the appended claims. The invention, together with the further advantages thereof, may best be understood by reference to the following description taken in connection with the accompanying drawings, in the several figures of which reference numerals identify like elements, and in which:

FIG. 1 is a side view, partially in section and with parts broken away to show interior parts, of a vibratory machine constructed in accordance with the present invention;

FIG. 2 is a plane view of the machine of FIG. 1 as seen from the plane 2--2 of that figure, looking in the direction of the arrows; and

FIG. 3 is a side view, similar to that of FIG. 1, of an alternative embodiment of the invention.

DETAILED DESCRIPTION

Referring to FIG. 1, there is depicted an improved vibratory machine constructed in accordance with the present invention and generally designated by the numeral 10. The vibratory machine 10 has a hollow toroidally shaped bowl 12 which is open to the top to receive and hold a workload 13 to be vibrated. The workload 13 may be, as shown, deburring medias 14 and work pieces 16. Those familiar with this general type of vibratory machine will recognize that the machine 10 may be used with work load of numerous other types depending upon the end desired to be accomplished. Thus, this type of machine may be used for deburring, radiusing, honing and burnishing as well as screening and grinding. As this is well known in the art, no further detailing will be here undertaken, it being understood that the term “workload” here and in the appended claims encompasses such loads.

The bowl 12 is affixed by means of legs 17 and bolts 17B to a horizontal circular flange plate 19. The underside of the plate 19 has seatings for and receives spiral or coil springs 18. As better shown in FIG. 2, there are eight such springs 18 spaced at equal separations around the circular flange plate 19. The bottoms of the springs 18 are seated on a horizontal internal rim 20R of the machine’s base 20. The base 20 includes an outward rim flange 20F for seating on a flat surface which may be provided with bolt-receiving holes although it has been found that, because of the novel vibratory mechanism hereinafter explained, this is unnecessary as the machine does not normally tend to move about even under a full load and high speed. The base 20 may also be provided with a door 20D for servicing the interior parts.

The bowl 12 is thus spring or resiliently mounted or supported on the base 20. The springs 18 are arranged such that they define an approximately horizontal null plane 18P. At the center of the bowl 12 and the springs 18 is an approximately vertical axis 12C and at or about the interception of this axis 12C and the plane 18P is the vibratory null point which is also the approximate center of gravity of the entire spring mass. The bowl 12 contains a center of volume or center of mass for its workload 13, which is designated 13C and is above the plane 18P. These planes and points are, of course, during vibration moving and thus, e.g., to say that the null point is at the interception of axis 12C and the center plane of the springs is only approximately true, as the true null point will tend to move about this point depending upon various factors such as the weight of the workload and variations of mechanical tolerances. But for any practical machine, this point is known or determinable to engineering tolerances by those skilled in this art.

The distance between the work load center 13C and the plane 18P including the null point is defined in FIG. 1 as d. In accordance with the present invention, the machine 10 is provided with a vibratory mechanism 22 which includes a single eccentric mass or weight 22M for orbiting about the axis 12C in a generally horizontal plane and which mass or weight is rigidly coupled to the bowl 12 located a critical distance D from the null point which distance is related to the distance d by the algebraic relation:

\[
D/d > 1
\]

That is the distance D is greater than the distance d. Applicant has found that this ratio may range up to five, but for greater values than this the machine tends to become unstable and requires greater mass or firm affixing of the base. Thus the formula (1) may, be rewritten for most practical machines as:

\[
6 > D/d > 1
\]
The present inventor has discovered that this construction yields good vibratory results on the workload of lower external vibration, while employing a minimum of moving parts.

In more detail, the particular mechanism 22 of the embodiment of FIGS. 1 and 2 includes a vertical shaft 22S one end of which is affixed to the mass or weight 22M to rotate it and the other end of which is affixed to a variable diameter pulley 26. The shaft 22S is mounted in a pair of bearings 22B which are between the pulley 26 and the mass 22M. The bearings 22B are seated at the top and bottom of a vertical tube 22T that surrounds the central portion of the shaft 22S and thus has a central axis coincident with the axis 12C.

At the vertical middle of the tube 22T, it is welded to 22W to a horizontal annular plate 23 which is formed intricately with the bottom edge of a larger vertically disposed drum segment 24 whose upper edge is similarly formed with the interior rim of the plate 19. In this manner the mass 22M and the vibratory mechanism 22, are rigidly coupled (through the plates 23, drum 24, plate 19 and legs 17) to the bowl 12 to impart motion to the workload 13.

Means 40 for rotating the shaft 22 are provided by a variable speed belt drive system, which includes a spring loaded variable pitch pulley 26, mounted on the shaft 22S, a pulley belt 27 and a manually adjustable variable pitch pulley 28.

The mass 22M and the shaft 22S are rotatable over an infinitive variable range of speeds by means of the pulley system's manually adjustable pulley 28 which driven from an electric motor 29. The motor 29 is bolted at 30 to the housing 20 and the pulley belt is horizontally (at plane 18P) disposed through an opening 24H through the side of drum 24. The pulley 28 manual adjustment 28A is also mounted to the base 20 via a standard 32 affixed to the plate 19 and extending upward through the belt 27.

It should be noted that the pulley 26 turns about the null point and thus allows the moving spring mass and the fixed motor 29 to be effectively coupled. The motor 29, pulley 28, control 28A, belt 27 and pulley 26 comprise one means for rotating the mass or weight 22M at any selected speed within the range of speeds.

However, the shaft 22S and mass or weight 22M may be rotated by any convenient means, and may itself be the rotor of an electric motor.

Referring to FIG. 3 there is depicted another embodiment of the invention, generally 10', which means 40 is an electric motor 29' mounted rigidly to the bowl 12 whose rotor 22S' serves as the shaft 22S. The motor 29' is selectively variable in speed from a control 42 which includes a speed selector dial 44 and an on-off switch 46. The console 42 is also connected to motor 29' by means of a flexible insulated cable 48 which passes through a rubber bushing 50 into the housing 20 and through a second bushing 52 through the wall of the drum 24'.

The speed control may be either of the inverter type or rheostat type as is well known in the art.

Except for the alternative means 40 and the consequent elimination of the pulley system and its opening 24H and mountings, the machine 10' of FIG. 3 is identical to that of FIGS. 1 and 2.

An operational embodiment has been constructed and tested which provided excellent performance. For purposes of completeness in this disclosure but not for limitation, this particular machine will be hereafter described in detail. Those skilled in this art will realize that this is illustrative only and that many alternatives and equivalents may be employed without departing from the herein described invention.

This particular machine has a capacity of 1.5 cubic feet of workload having a total outer dimension of 24 inches and inner dimension of eight inches and a height of eight inches. The center of its workload was located approximately seven inches above the plane 18P and its mass 22M was 14 inches below that plane. The mass 22M weighed two and a half pounds and had approximate center at a radius of four inches from the center of the shaft 22S. The pulley 28 was a Maurey 6400M, the pulley belt 27 was 36 inches long (A-36 V belt) and the pulley 26 was Maurey 6400. The motor 29 was a one h.p., a.c., single phase (Reliance Electric Co.).

With this arrangement a rotational speed range for the shaft and mass 22M from 950 rpm to 2500 rpm was achieved. The springs were made of 5/16 inch diameter spring steel, five inches in height (unloaded) coils in approximately seven turns of an approximate diameter of two inches. The bowl was constructed of 11 gauge steel and the base of 1/4 inch steel plate.

Although for definiteness of this disclosure this one size of machine was detailed, it should be noted that the invention may be employed in other size machines. Indeed, it is the intent of the present inventor to use the invention in 5, 10, 20 and 40 cubic feet capacity machines. Also, although here depicted with a circular arcing (in cross section) bowl, other shapes may be employed, e.g., those having vertical external side walls.

While particular embodiments of the invention have been shown and described, it will be obvious to those skilled in the art that changes and modifications may be made without departing from the invention in its broader aspects and, therefore, the aim in the appended claims is to cover all such changes and modifications as fall within the true spirit and scope of the invention.

I claim:

1. In a vibratory finishing machine of the type having a bowl into which a workload may be charged for being subject to continuous vibration, the bowl having a workload center, and which machine includes a base to which a sprung mass including at least the bowl, is resiliently supported such that a vibratory null point is defined a distance below the workload center, the improvement comprising:

a vibratory mechanism coupled to the bowl and comprising only a single rotatable eccentric mass or weight mounted for rotation about a point which center of rotation is located at a distance below the null point, which distance is greater than said distance between the workload center and the null point; and

means for rotating said eccentric mass or weight.

2. The invention of claim 1, wherein:
said rotating means is selectively variable to rotate said eccentric mass (22M) at different rotational speeds.

3. The invention of claim 1, wherein:
said vibratory mechanism includes a generally vertical shaft (22S) having one end affixed to said mass (22M) said shaft being journaled in bearings (22B) to a housing (22T, 23) rigidly affixed to the bowl (12).
4. The invention of claim 3, wherein:
said rotating means includes:
  a motor (29) mounted to the base;
  a drive pulley (28) coupled to said motor
and driven thereby;
a driven pulley (26) coupled to said shaft for turning
it and positioned approximately at the null
point; and
a pulley belt connecting the drive pulley and driven
pulley.

5. The invention of claim 3, wherein:
said rotating means includes:
  a motor (29') rigidly mounted to the bowl (12)
and having its rotor coupled to rotate said mass.

6. The invention of claim 5, wherein:
said motor is controlled by means (42) for varying its
speed mounted off of the sprung mass, and coupled
thereby by means of a flexible cable (48).

7. The invention as defined in claim 1, wherein:
said vibratory mechanism is part of the sprung mass
and is rigidly coupled to said bowl to impart move-
ment to it and its workload content;
the null point, workload center and center of rotation
of said mass lie approximately along the same ap-
proximately vertical axis; and
said eccentric mass is mounted for rotation about
said axis.

8. The invention of claim 7, wherein the ratio be-
tween the distance (d) from the null point to the work-
load center and the distance (D) from the null point to
the center of rotation of said rotatable eccentric mass
(22M) is in the range between 1 and 6.

9. The invention of claim 8, wherein:
said vibratory mechanism includes a generally verti-
cal shaft (22S) having one end affixed to said ec-
centric mass (22M) said shaft being journaled in
bearings (22B) to a housing (22T, 23) rigidly af-
fixed to the bowl (12); and
said rotating means includes:
a motor (29) mounted to the base;
a drive pulley (28) coupled to said motor and
driven thereby;
a driven pulley (26) coupled to said shaft for turn-
ing it and positioned approximately at the null
point;
a pulley belt connecting the drive pulley and driven
pulley; and
said rotating means isselectively variable at infi-
nitely small increments over a range of speeds by
means of having said drive pulley of the manually
variable effective diameter type.

10. The invention of claim 8, wherein:
said vibratory mechanism includes a generally verti-
cal shaft (22S) having one end affixed to said mass
(22M) said shaft being journaled in bearings (22B)
to a housing (22T, 23) rigidly affixed to the bowl
(12);
said rotating means includes:
a motor (29') rigidly mounted to the bowl (12) and
having its rotor coupled to rotate said mass; and
said motor is controlled by means (42) for varying its
speed mounted off of the sprung mass, and coupled
thereto by means of a flexible cable (48).