

Feb. 13, 1962

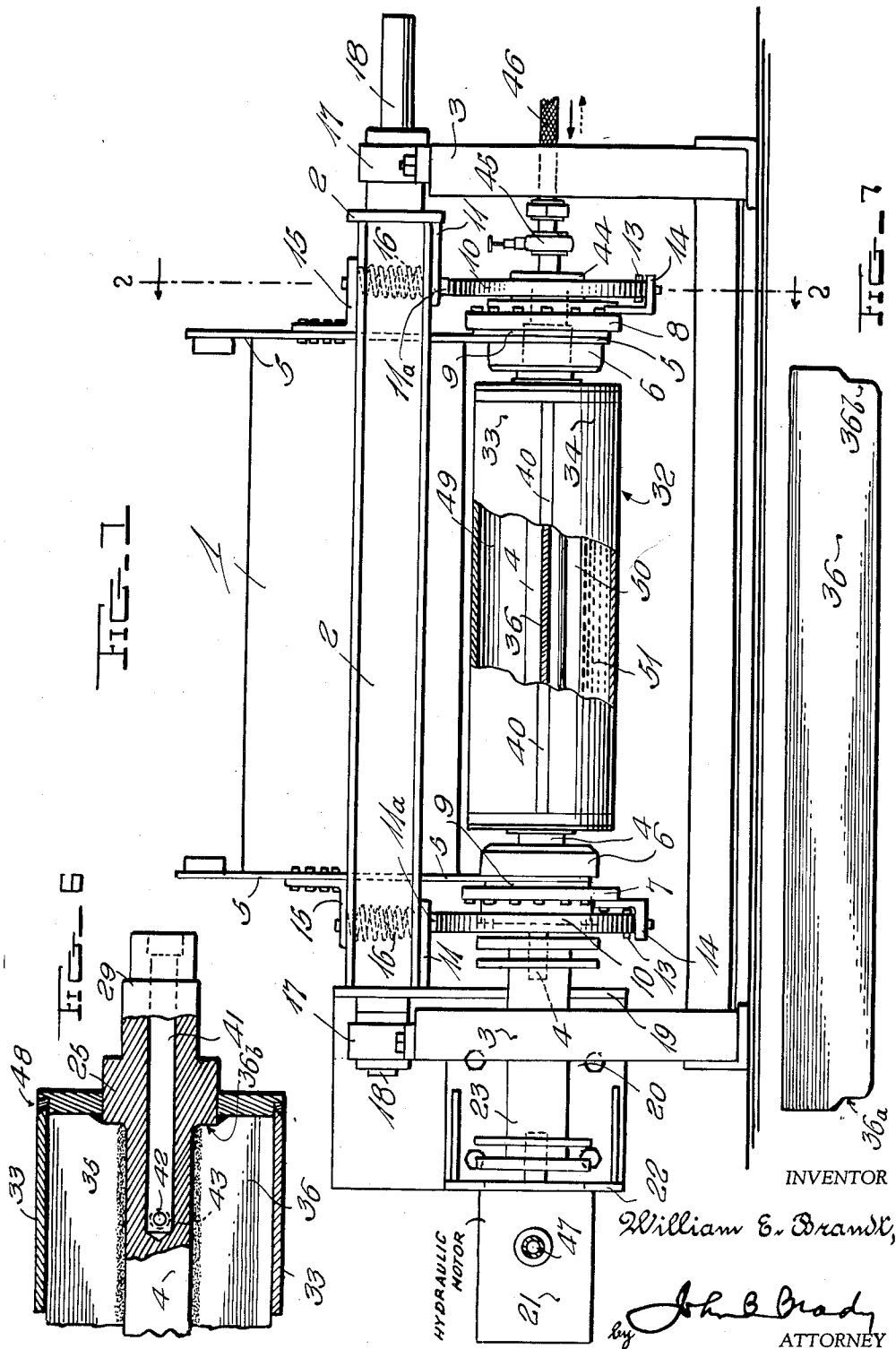
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FLUID BALLAST CONTROL SYSTEM FOR MACHINE FOR PRECISION
FINISHING OF PARTS BY CONTROLLED VIBRATION

Filed Oct. 31, 1958

3 Sheets-Sheet 1



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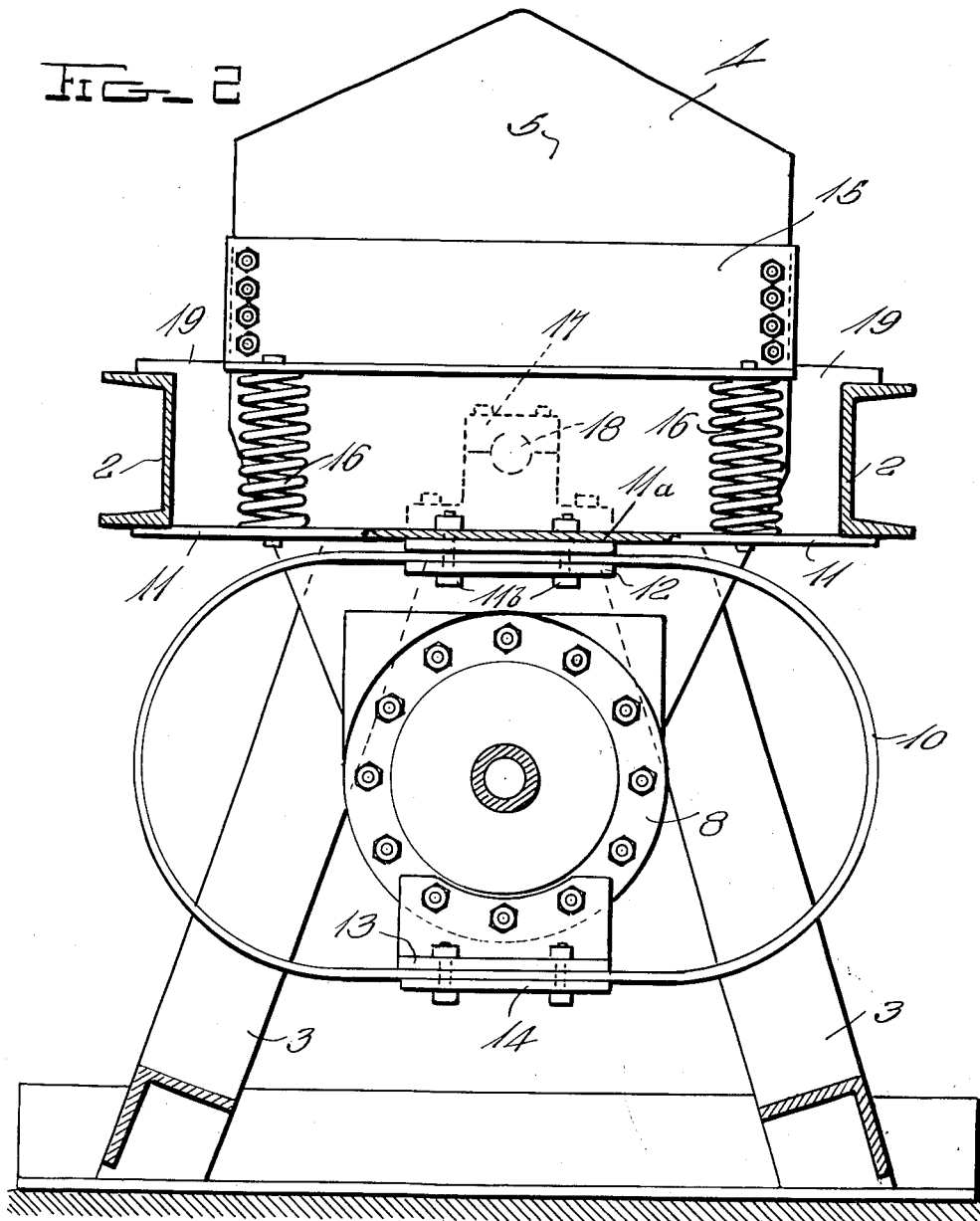
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3 Sheets-Sheet 2



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3 Sheets-Sheet 3

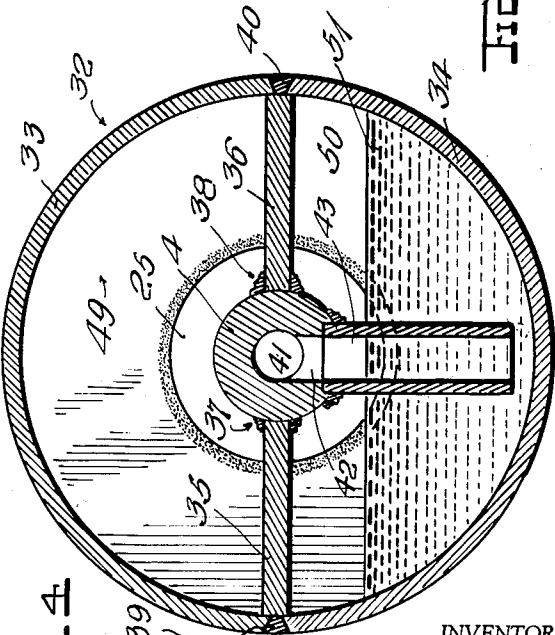
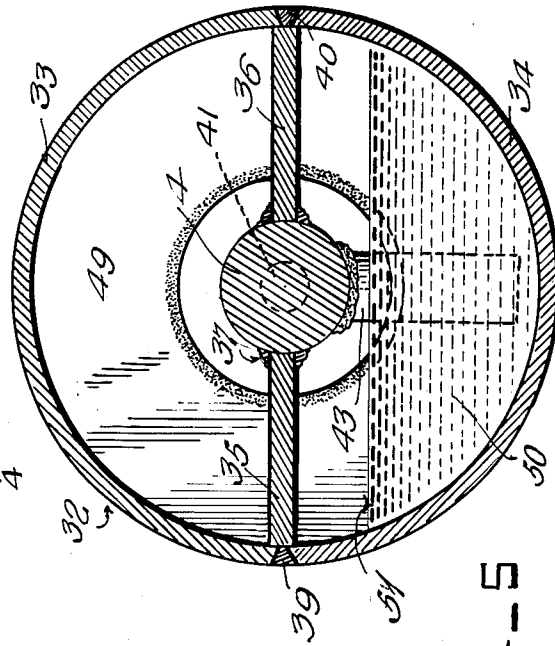
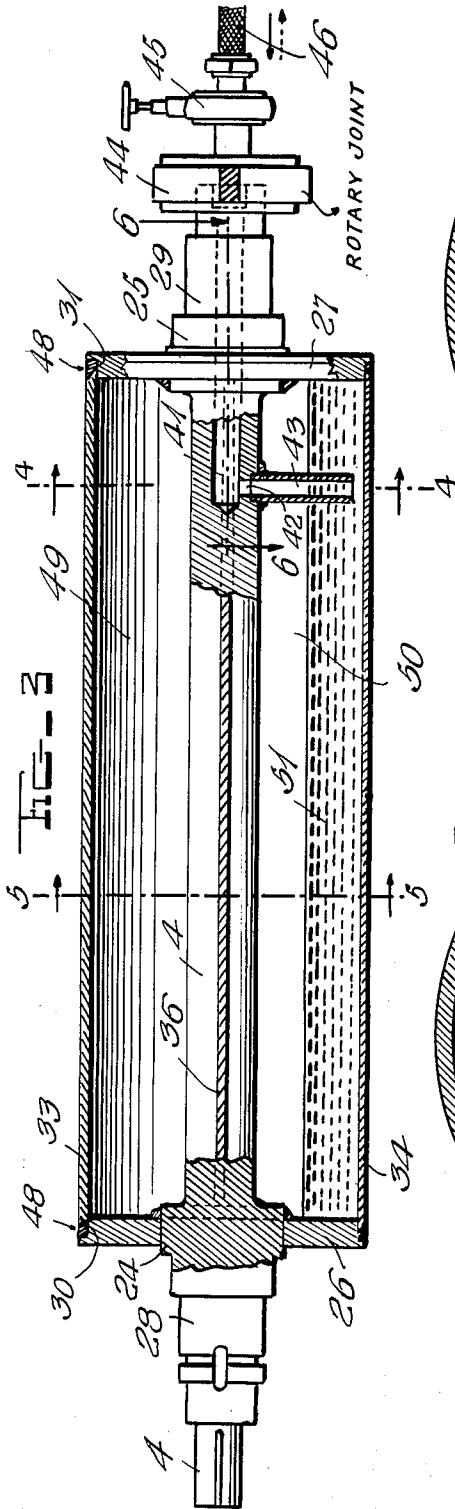


FIG. 4

FIG. 5

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FLUID BALLAST CONTROL SYSTEM FOR MACHINE FOR PRECISION FINISHING OF PARTS BY CONTROLLED VIBRATION

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7 Claims. (Cl. 51-163)

My invention relates broadly to machines for the precision finishing of parts by controlled vibration and more particularly to an arrangement of fluid ballast control for the counterweight shaft of a vibratory machine.

This invention is applicable to machines of the class set forth in my copending applications for patent, Serial Number 641,399, filed February 20, 1957, for Method and Apparatus for Precision Finishing of Parts and Objects by Controlled Vibration and application Serial Number 730,387, filed April 23, 1958 for Machine for Precision Finishing of Parts by Controlled Vibration and application Serial Number D. 50,807, filed May 8, 1958, now Patent No. D. 184,798, for Design for Machine for Precision Finishing of Parts by Controlled Vibration.

One of the objects of my invention is to provide an arrangement of hydraulic means for accurately controlling the amplitude of vibration of a vibratory bowl machine for the precision finishing of parts.

Another object of my invention is to provide a fluid ballast arrangement for controlling the amplitude of vibration of a vibratory bowl machine which completely eliminates centrifugally operated flyweights and eccentric weights disclosed in the machines of my aforesaid copending applications for patent.

Still another object of my invention is to provide a construction of vibratory bowl machine for the precision finishing of parts in which a rotatably driven cylinder is journaled in opposite ends of the vibratory bowl and beneath the vibratory bowl where the hydraulic cylinder is diametrically divided into chambers one of which may be variably filled with liquid for determining the off-center mass of the cylinder for imparting vibration to the bowl as the cylinder is revolved.

Still another object of my invention resides in the construction of an off-center fluid ballast weight consisting of a compartmented cylinder connected adjacent the bottom of a vibratory machine where the centrifugal effect of the fluid ballast weight is determined by the quantity of fluid confined in an off-center portion of the compartmented cylinder for imparting vibratory pulses to the bowl as the cylinder is rotatably driven.

Other and further objects of my invention reside in the construction of a sectionalized, rotatable, cylindrical, hydraulic counterweight for vibratory bowl machines as set forth more fully in the specifications hereinafter following by reference to the accompanying drawings in which:

FIG. 1 is a front elevational view of a vibratory machine having a hydraulic counterweight attached thereto in accordance with my invention where the hydraulic counterweight is broken away and illustrated in section to show the compartmented construction of the cylindrical counterweight and the fluid chamber confined within one compartment thereof forming the off-center counterweight necessary for imparting vibratory pulses to the bowl as the counterweight is rotatably driven;

FIG. 2 is an enlarged transverse vertical sectional view taken substantially on line 2-2 of FIG. 1 and showing particularly the mounting of the cylindrical counterweight with respect to the end of the vibratory bowl;

FIG. 3 is an enlarged longitudinal sectional view taken

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through the compartmented cylindrical counterweight of my invention and showing particularly the manner of filling and removing fluid from one of the compartments of the counterweight for pre-determining the effective centrifugal action of the counterweight which is imparted to the associated bowl;

FIG. 4 is an enlarged transverse sectional view taken on line 4-4 of FIG. 3;

FIG. 5 is an enlarged transverse sectional view taken on line 5-5 of FIG. 3;

FIG. 6 is a fragmentary cross sectional view of the fluid supply end of the cylindrical counterweight by which construction the quantity of fluid in one of the compartments of the cylinder may be regulated; and

FIG. 7 is a plan view of one of the radially disposed division plates attached to the drive shaft of the rotatably driven counterweight for dividing the counterweight into internal compartments.

My invention is directed to an arrangement of hydraulic counterweight for imparting vibratory pulses to a vibratory bowl machine used for the precision finishing of parts by controlled vibration. In lieu of arrangements of spring controlled flyweights or centrifugally operated weights illustrated in my applications #641,399 and #730,387 supra, I provide a rotatably driven shaft carrying a cylindrical chamber which is diametrically divided into a pair of hollow compartments into one of which fluid is introduced or withdrawn through one end of the shaft. A measured quantity of fluid is thus maintained in one of the compartments to provide that mass necessary to develop centrifugal pulses when the rotatable shaft is driven for imparting certain vibratory pulses to the vibratory bowl with which the cylinder is associated. The fluid is admitted to one compartment under pressure or is withdrawn therefrom by vacuum to obtain that degree of ballast necessary to develop the vibratory pulses required for transmission to the vibratory bowl. Inasmuch as a measured quantity of fluid may thus be maintained in one of the compartments off-center from the drive shaft, a very fine degree of centrifugal force may be maintained to meet the vibratory requirements for the particular material under treatment in the vibratory bowl. The vibrations induced by the rotation of the hydraulic cylinder journaled in the lower limits of the ends of the bowl which is spring suspended from a suitable cradle cause movement of the material and parts within the bowl for the vibratory treatment of the parts. When looking down into the open top of the bowl the actual movement of the material and parts transversely of the bowl is observed. This transverse movement is speeded up or retarded by a change in the effective mass of the rotatably journaled cylinder. The speed and movement of the material and parts is controlled by the variable filling of the off-center compartment in the rotatable cylinder. Ordinarily controlled vibration is associated with the employment of spring controlled flyweights or the centrifugal weights both of which require considerable machine work with inherent expenses both with respect to the cost of parts and skill necessary in the manufacture and assembly of parts.

Referring to the drawings in more detail, reference character 1 designates the bowl of the vibratory machine which is mounted in the tiltable cradle 2 journaled in the frame 3 by means of stub shafts 18 journaled in bearings 17 mounted on frame 3. The bowl is provided with opposite end plates 5 which extend downwardly beneath the bottom of the bowl 1 and support bearings 6 within which the longitudinally extending shaft 4 is journaled. The bearings 6 are mounted in the end plates 5 in bearing retainers 7 and 8 with a gasket 9 interposed in the assembly as shown.

The bearing retainers 7 and 8 partly support depend-

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ing brackets 14 which are clamped by means of plates 13 and bolts extending therethrough to the elliptically arranged leaf springs 10 which are supported at the tops by bridge plates 11 carried by cradle 2 and clamped thereon by means of plate 12 and spacer bar 11a through which bolts 11b extend.

The opposite end plates 5 of bowl 1 carry angle members 15 which are mounted upon compression coil springs 16 erected on bridge plates 11 of cradle 2 thereby insuring a very substantial spring cushion mounting for the bowl 1.

The cradle 2 has a depending panel assembly 19 on one end thereof terminating in a bracket 20 serving as a mounting support for the hydraulically driven motor 21. The motor 21 operates a drive shaft 22 which is connected through a coupling 23 to the shaft 4 heretofore described. The shaft 4 shown more clearly in FIG. 3 includes a pair of spaced hubs 24 and 25 upon which the toroidal shaped headers 26 and 27 are welded in position. Beyond the hubs 24 and 25 there are journalled cylindrical surfaces 28 and 29 on shaft 4 as shown, enabling the shaft 4 to be journalled in the bearings 6 carried by the end plates 5 as heretofore explained.

The headers 26 and 27 are provided with recessed rims shown at 30 and 31 adapted to receive the semi-cylindrical sections 33 and 34 constituting the cylinder 32. These semi-cylindrical sections 33 and 34 are welded in position in the recessed rims 30 and 31 of the headers 26 and 27 as represented at 48 and are welded in position along their opposite lineal edges to the ends of radially disposed partition plates 35 and 36 as represented at 39 and 40. The partition plates 35 and 36 are welded in position along opposite sides of shaft 4 as represented at 37 and 38. The partition plates 35 and 36 have a contour represented more clearly in FIG. 4 where the partition plate 36 has been illustrated having the opposite ends thereof recessed at 36a and 36b to conform with the contours of hubs 24 and 25 thereby providing a watertight joint between the partition plates 35 and 36, shaft 4 and the interior wall of cylinder 32. The partition plates 35 and 36 divide the cylinder 32 into two sealed compartments designated at 49 and 50. Compartment 49 simply has a dead air space but compartment 50 constitutes a container for fluid as will be hereinafter explained in more detail.

The shaft 4 is provided with an internal bore adjacent the right hand end thereof when the structure is viewed as in FIGS. 1, 3 and 6. The internal bore 4 which extends from the external right hand end of shaft 4 to a position just inside the header 27 where this bore 41 is joined by a radially disposed bore 42 into which radially disposed tube 43 extends. Fluid passing into bore 41 is changed in direction and passes radially through bore 42 and tube 43 into the compartment 50 where the fluid forms a pool or mass represented at 51 and constitutes the counterweight which is maintained off-center as shaft 4 which revolves and sets up vibratory pulses which are delivered to the bowl 1 for the controlled vibration of the material and parts contained therein.

The right hand end of the hollow shaft 4 is connected through rotary joint 44 and a cut off valve 45 with a fluid supply pipe 46 by which fluid is admitted under pressure through bore 41, tube 43 into compartment 50 and then cut off by closing valve 45. In the event that too large a quantity of fluid 51 is permitted to enter chamber or compartment 50 as indicated by the frequency of vibration to which bowl is subjected and pursuant to the rotary driving action to which cylinder 32 is subjected, excess fluid may be withdrawn through tube 43 and bore 41 by vacuum applied at the end of flexible line 46.

The hydraulic motor 21 which drives the shaft 4 is provided with a fluid in-take indicated at 47. Shaft 4 driven by hydraulic motor 21 develops successive thrust pulses as the fluid 51 in compartment 50 is centrifugally thrown to the inside surface of the semi-cylindrical sec-

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tion 34 of the cylinder 32. This off-center weight of cylinder 32 produces pulses which are transferred to the bowl 1 through the ends 5 thereof, thereby setting bowl 1 and the material and parts therein into controlled vibration for the controlled finishing of the parts. The frequency of the vibration treatment is regulated by the amount of fluid 51 retained in the compartment 50. Such amount of fluid is readily controlled either by admission of fluid to compartment 50 under pressure of the extraction of fluid from compartment 50 through vacuum. This method of frequency control of vibration is far more accurate than is obtainable through spring controlled flyweights or centrifugally operated weights and at the same time all machining of such parts is eliminated.

The fluid ballast centrifugal mass system has the particular advantage of reversibility. That is to say, the hydraulic motor 21 may be reversed in direction for changing the direction of the vibratory pulses impressed upon the bowl whereupon the material and the parts in the bowl move transversely of the bowl in a direction opposite that in which they moved prior to the reversal action.

I have found the fluid ballast method of frequency control set forth herein highly practical and successful in use and while I have set forth my invention in certain of its preferred embodiments I realize that modifications may be made and I desire that it be understood that no limitations upon my invention are intended other than may be imposed by the scope of the appended claims.

What I claim as new and desire to secure by Letters Patent of the United States is as follows:

1. In a machine for the precision finishing of parts by controlled vibration, a frame structure, a cradle tiltably journalled in said frame structure, a vibratory bowl resiliently mounted in said cradle and having end portions depending through said cradle to a position beneath the bottom of said bowl, a rotatable cylinder extending longitudinally of said bowl and rotatably journalled between said end portions of said bowl beneath said bowl, said cylinder being divided into hollow compartments, means for admitting fluid into one of said compartments while maintaining a dead air space in another of said compartments and means for rotatably driving said cylinder whereby centrifugal forces developed by the displacement of the fluid in the said compartment of said cylinder produce pulses which are transferred to said bowl as vibratory forces.

2. Apparatus for controlling vibration in a vibratory bowl machine comprising a vibratory bowl having opposite end portions depending beneath the bottom of the bowl, means for resiliently supporting said bowl, a shaft extending longitudinally beneath the bottom of the bowl and journalled at opposite ends in said end portions, a hollow cylinder carried by said shaft in a position beneath the bottom of said bowl, said cylinder being divided into compartments and being rigidly affixed to said shaft for rotation therewith, means extending through said shaft for emitting or withdrawing fluid with respect to a selected compartment of the compartments in said cylinder, and means for rotatably driving said shaft and affixed cylinder, whereby displacement of the fluid in said cylinder induces vibratory movement in said bowl.

3. In a machine for precision finishing of parts by controlled vibration, a vibratory bowl having opposite end portions depending beneath the bottom of the bowl, means for resiliently supporting said vibratory bowl for vibratory movement, a hollow cylinder extending longitudinally beneath the bottom of the bowl, means for journalling said cylinder in the end portions of said bowl for rotation beneath said bowl, a fixed diametrically extending partition in said cylinder, dividing said cylinder into two hollow compartments, means for transmitting fluid into one of the compartments in said cylinder and means for rotatably driving said cylinder whereby centrifugal forces developed by the displacement of the fluid within said

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compartment in said cylinder are converted into pulses and transmitted to said bowl for setting up vibratory movement within said bowl.

4. A machine for the precision finishing of parts by controlled vibration comprising a vibratory bowl having its predominant axis extending longitudinally and terminating in end portions depending beneath the bottom of said bowl, means for resiliently supporting said bowl, a rotary shaft journaled in said end portions on an axis coinciding with the predominant axis of said bowl, a hollow cylinder rigidly affixed to and carried by said shaft in a position external to the bottom of said bowl, a pair of compartments within said cylinder, means extending through said shaft for introducing or withdrawing fluid into or out of one of said compartments to provide an off-center mass adjacent said shaft and means for rotatably driving said shaft and affixed cylinder.

5. A machine for precision finishing of parts by controlled vibration as set forth in claim 4 in which said pair of compartments are formed by a pair of radially extending flat partition plates carried by said shaft and wherein said cylinder is constituted by a pair of semi-cylindrical sections connected thereto along the ends of said partition plates.

6. A machine for precision finishing of parts by controlled vibration as set forth in claim 4 in which the

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means extending through said shaft for introducing fluid into one of said compartments is a hollow bore connected through a transverse passage for the transmission of fluid into and out of the compartment within said cylinder which receives the fluid.

7. A machine for precision finishing of parts by controlled vibration as set forth in claim 4, in which said shaft is provided with a pair of hubs spaced lineally from each other and wherein toroidal spaced headers are mounted on said hubs and wherein said cylinder is mounted on the peripheries of said headers, the said shaft containing journals in positions beyond said hubs external to said headers for mounting said shaft in said bearings.

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