United States Patent

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[54] **DRIVE MECHANISM FOR BALANCING MACHINE**
13 Claims, 6 Drawing Figs.

[52] **U.S. Cl.** **74/226,** 74/228, 74/242.8
[51] **Int. Cl.** **F16h 7/18**
[50] **Field of Search** 74/226, 227, 228, 216.5, 242.8

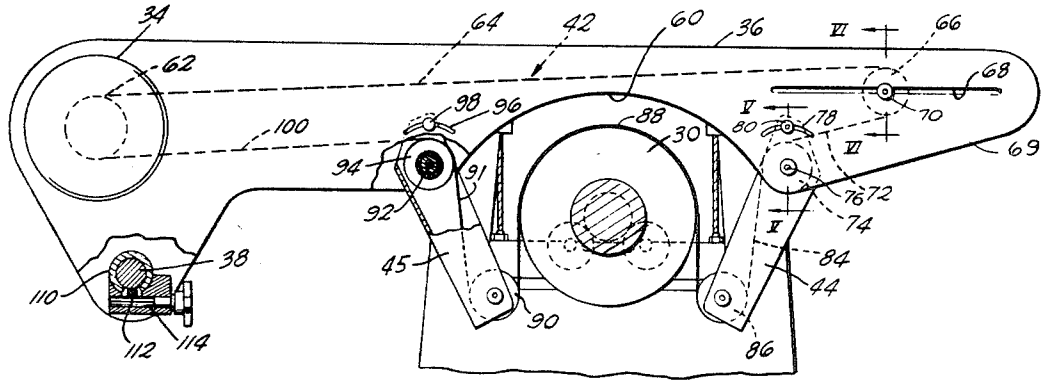
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ABSTRACT: An endless belt drive for a balancing machine of the type wherein a test rotor is carried on horizontally spaced apart bearings. A radial drive arm pivotally mounted on the machine for movement in a vertical plane projects over the test part and carries the drive belt that rotates the test part. A belt drive motor mounted directly on the arm serves as a counterbalance. A pair of guide rollers for the belt are pivotally suspended on the drive arm so that the orientation of a run of the belt that engages the part can be adjusted for parts of different sizes while maintaining a desired vertical orientation of the belt run over the part.



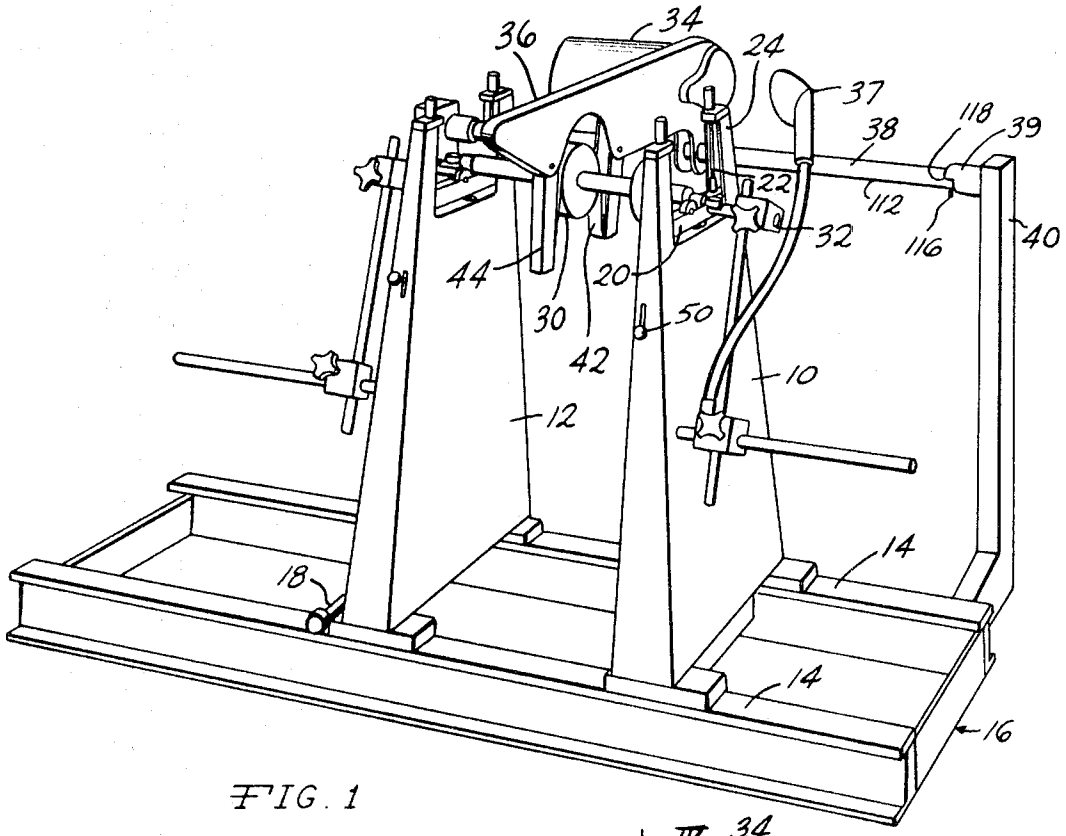


FIG. 1

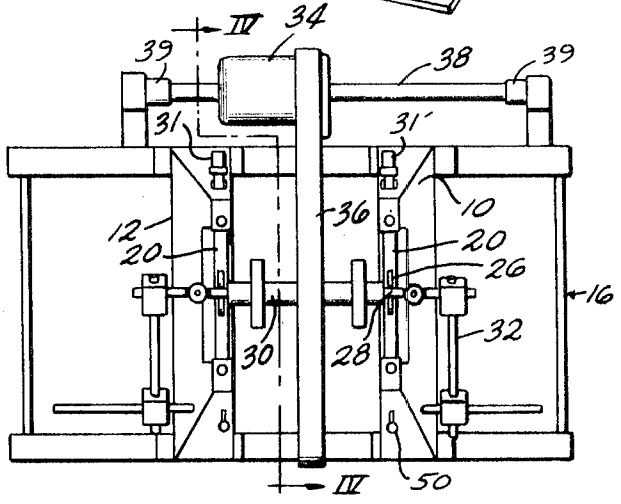


FIG. 2

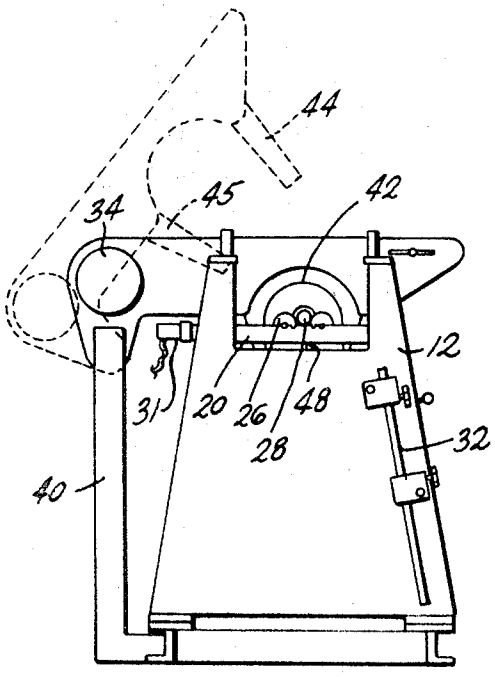


FIG. 3

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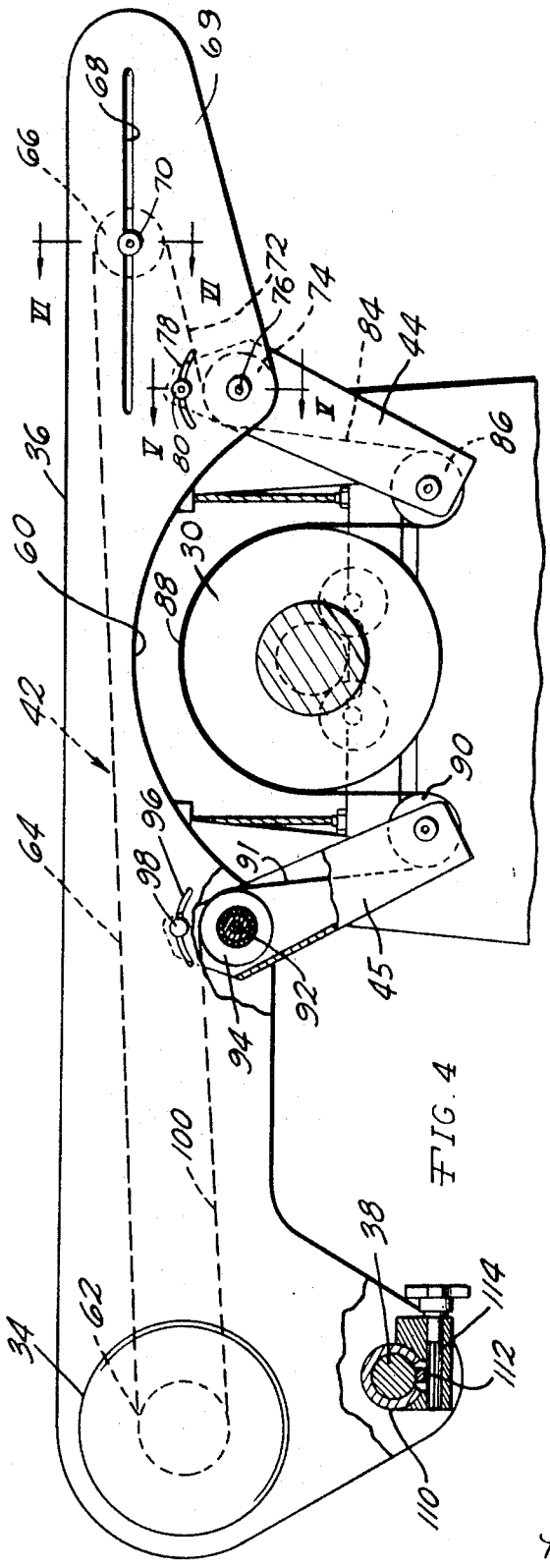


FIG. 4

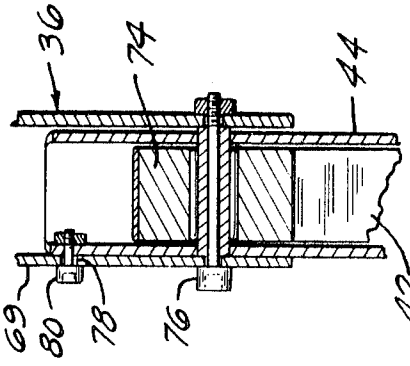


FIG. 5

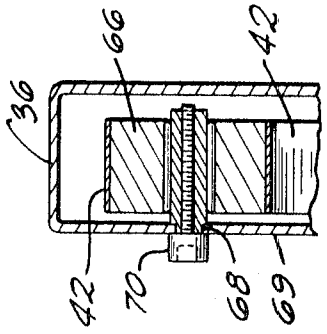


FIG. 6

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DRIVE MECHANISM FOR BALANCING MACHINE

The present invention relates to balancing machines and more particularly to an improved endless belt drive for the same.

Objects of the present invention include providing an endless belt drive for a balancing machine that is constructed simply and economically as an integrated unit; that effectively rotates different parts whose diameters vary over a wide range; that is easy to use, facilitates rapid assembly and disassembly of different parts on the balancing machine, and simplifies other operations when parts are being balanced; that minimizes side thrust on test parts of different diameters; and/or that operates effectively for a wide variety of parts.

Other objects, features and advantages of the present invention will become apparent in connection with the following description, the appended claims and the accompanying drawings in which:

FIG. 1 is a perspective view of a balancing machine having the drive mechanism of the present invention;

FIG. 2 is a top view of the balancing machine of FIG. 1;

FIG. 3 is an end view of the balancing machine taken from the left side as viewed in FIG. 1 with certain parts repositioned;

FIG. 4 is an enlarged vertical section taken on line 4–4 of FIG. 2 to more fully illustrate the drive mechanism of the present invention;

FIG. 5 is an enlarged vertical section taken on line 5–5 of FIG. 4; and

FIG. 6 is an enlarged vertical sectional view taken on line 6–6 of FIG. 4.

Referring more particularly to FIGS. 1—3, the illustrated balancing machine generally comprises a pair of complementary, right-hand and left-hand stanchions 10 and 12 which are spaced apart horizontally and mounted on rails 14 of a base 16. Stanchion 10 is a stationary whereas stanchion 12 is mounted on rails 14 for horizontal movement by suitable means such as a motor-driven pinion and rack (not shown) operated by lever 18 to adjust the horizontal spacing between the stanchions. Inasmuch as stanchions 10, 12 are substantially identical, only one of the stanchions and corresponding portions of the suspension system mounted thereon will be described in greater detail with like reference numerals identifying like parts on the stanchions 10,12.

A bearing carrier 20 is suspended on stanchion 10 by a pair of flexible cables 22 that are rigidly fastened at their lower ends on respective opposite ends of carrier 20 and are vertically adjustably fastened at their upper ends on respective upright arms 24 on stanchion 10. Arms 24 are spaced apart laterally of the machine and project substantially above the carrier 20. A pair of adjustable roller bearings 26 mounted on each carrier 20 rotatably support shaft end portions 28 of a test rotor 30. Adjustable end thrust retainers 32 are mounted on each of the stanchions 10, 12 outboard of the rotor 30 to engage the opposite ends of the rotor and prevent axial motion of the rotor. Retainers 32 have suitable bearings or rollers engaging rotor 30 to allow free rotation and oscillation thereof during testing. Conveniently, one of the retainers 32 serves as a support for a strobe light 37. Carriers 20 extend rearwardly through stanchions 20 and mounted directly on the rear end of the left and right carriers 20 is a respective transducer pickup 31, 31′ that moves with its respective carrier during translation thereof and provides an electrical output signal representing the displacement of the carrier. In the preferred embodiment, the pickups 31, 31′ are inertia-type transducers known as a seismic pickup. Other suitable transducers could also be used, for example, the piezoelectric crystal pickups of the general type disclosed in U.S. Pat. No. 2,656,710, granted to I. A. Weaver et al. on Oct. 27, 1953, and entitled "Means for Adjustment of Balancing Machines."

Rotor 30 is rotatably driven by a motor 34 mounted on the rear end of a drive arm 36 which in turn is mounted on a horizontal rod 38 journaled at 39 on uprights 40. Arm 36 extends radially outward from rod 38 toward the front of the machine and over rotor 30 when the arm is in the driving position illustrated in full lines. An endless belt 42 driven by motor 34 is housed in arm 36 by rollers mounted on the arm 36 and on pivoted downwardly depending, secondary arms 44, 45 disposed at opposite sides of rotor 30. The belt 42 travels downwardly on arms 44, 45 and upwardly over the rotor 30 to revolve the same. The drive arm is movable horizontally on rod 38 and the arm and rod can pivot as a unit to the raised position illustrated in dotted lines in FIG. 3 to disengage the drive from rotor 30. This also facilitates assembly and disassembly of rotor 30 on carriers 20 and other balancing operations such as adding weights to the rotor.

Although the cable suspension of carriers 20 is useful in the preferred embodiment of the balancing machine being described, it will be understood that other suitable suspensions could also be used. However, the details of the illustrated suspension are disclosed in greater detail in my copending application Ser. No. 845,248 filed concurrently with the present application and entitled "Cable Suspension System for Balancing Machines." Mounted inside stanchions 10 and 12 are locking clamps adapted to selectively engage a pin 48 journaled in and depending downwardly from each carrier 20. The clamps are operated by suitable levers 50 when it is desired to lock the carriers against horizontal translation as set forth in greater detail in my copending application identified above.

Referring more particularly to FIG. 4, the drive arm 36 projects generally radially outwardly from rod 38 over rotor 30. Motor 34 is fastened directly on the arm 36 radially above rod 38 and slightly offset from rod 38 in a horizontal direction (to the left as viewed in FIG. 4) away from the rotor 30. Arm 36 is made of heavy gauge sheet metal or the like formed into a housing having a generally channel-shaped transverse cross section to accommodate belt 42 therein. Arm 36 has an arcuate cutout portion 60 positioned radially outwardly from the rod 38 to accommodate the rotor 30 therein. The size of the cutout 60 is selected to accommodate a wide variety of parts having different diameters.

Belt 42 is drivingly engaged with a pulley 62 on motor 42 and extends outwardly from motor 34 along a first generally horizontal run 64 to a first roller 66 spaced radially outwardly of rod 38 beyond rotor 30. Roller 66 is rotatably carried on arm 36 by means of a locking screw 70 that rides in a radial slot 68 in the sidewall 69 of the arm as shown in FIG. 6 so that the radial position of roller 66 can be adjusted and the roller locked in place. The belt 42 passes around the radially outer portion of roller 66 and then along a second run 72 to a third roller 74 rotatably carried on the outer arm 44. Arm 44 is also generally channel-shaped and opens inwardly toward the rotor 30. Arm 44 is pivotally fastened on the main drive arm 36 by a screw 76 which also fastens roller 74 on the arm. Arm 44 is arranged to be locked in a selected pivoted position by means of a locking screw 80 that rides in an arcuate adjusting slot 78 in the sidewall 69 above screw 76.

Belt 42 passes inwardly over roller 74 and then downwardly along a third run 84 to a third roller 86 journaled in the lower end of arm 44. Belt 22 passes under roller 86 and upwardly along a fourth run 88 that extends over and partially encircles rotor 30 and then downwardly to a fourth roller 90 journaled in the lower end of the rear arm 45. Arm 45 is of substantially the same configuration as the arm 44 and is pivotally mounted on arm 36 by a screw 92. Belt 42 passes under roller 90 and then upwardly along a fifth run 91 through arm 45 and over a fifth roller 94 that is journaled on arm 36 by screw 92 in substantially the same manner as that shown in FIG. 5 for the corresponding roller 74 on arm 44. Arm 45 is provided with a locking arrangement like that for arm 44 and comprising a locking screw 98 that rides in an arcuate slot 96 so that the arm can be adjusted and locked in a selected pivoted position about the screw 92. Belt 42 then passes from roller 94 along a generally horizontal run 100 back to the drive pulley 62.

For different diameters of rotor 30, arms 44, 45 can be locked in a position so that the belt 42 runs vertically from

roller 86 to rotor 30 and also runs vertically from rotor 30 to roller 90. For a given rotor 30, arms 44, 45 are first adjusted to obtain this vertical orientation of the run 88 and the arms are locked in the selected position by the respective screws 80, 98. The roller 66 is adjusted along slot 68 to take up the slack in belt 22 when the arm is in its lowered position illustrated in FIG. 4 to drive rotor 30. The roller 66 is then locked in place by screw 70. In the lowered driving position illustrated in FIG. 4, the center of gravity of arm 36 is to the right of rod 38 so that the weight of arm 36 maintains belt 42 drivingly engaged with rotor 30.

As illustrated in FIG. 4, rod 38 is axially slidable in a sleeve 110 fastened on the drive arm 36. Rod 38 has a longitudinally extending rack 112 mating with a pinion 114 also mounted on the arm 36 so that the horizontal position of the drive arm 36 along the rod 38 can be selectively adjusted depending upon the configuration of the part under test and the location of the portion of the part to be drivingly engaged with the belt 42. Arm 36 may be pivoted upwardly to its raised position illustrated in dotted lines in FIG. 3 with the drive arm including sleeve 110 together with the rod 38 pivoting in the journals 39 on the supports 40. As arm 36 is raised, the center of gravity of arm 36 moves to the left of rod 38 and the weight of motor 62 holds the arm in its raised position. The upper limit of travel of arm 36 may be limited by a suitable stop such as a pin 116 that engages a shoulder 118 on the journal 39.

With the drive mechanism described hereinabove, it will be apparent that the same drive arm 36 can be used for a wide variety of parts and the orientation of the belt 42 can be properly adjusted to obtain the desired vertical orientation of the belt run 88. This eliminates undesirable side thrust on the rotor. On the other hand, the rotor 30 is free to oscillate as required with conventional balancing techniques using soft suspension systems.

It will be understood that the drive mechanism for balancing machine has been described hereinabove for purpose of illustration and is not intended to indicate limits of the present invention, the scope of which is defined by the following claims.

I claim:

1. In a balancing machine wherein a part to be balanced is rotatably supported by a pair of horizontally spaced apart carriers, a drive mechanism for rotating said part comprising a radial drive arm mounted on said machine for pivotal movement in a generally vertical plane and adapted to move from a raised position to an operative position relative to said part, a drive belt, drive means carried on said drive arm and drivingly engaged with said belt, and belt support means carried on said drive arm and operatively disposed on said drive arm so as to carry said belt in engagement with said part when said drive arm is in said operative position.

2. The balancing machine set forth in claim 1 wherein said belt support means comprises a pair of spaced apart roller support members depending downwardly from said drive arm and being spaced apart radially of said drive arm so as to be adapted to be disposed at opposite sides of said part when said drive arm is in said operative position, first roller means mounted on a lower end of a first one of said support members, second roller means mounted on a lower end of a second one of said support members, said belt having a first run passing under said first roller means and running from said first roller means in a vertically upward direction, over said part, and then vertically downwardly and under said second roller means when said drive arm is in its operative position and said belt engages said part.

3. The drive mechanism set forth in claim 2 wherein said support members are pivotally mounted on said drive arm, first locking means operatively engaging said drive arm and said first support member to selectively lock said first support member in a selected pivoted position relative to said arm, and second locking means operatively engaging said drive arm and said second support member to selectively lock said second pulley support member in a selected pivoted position relative to said drive arm.

4. The balancing machine set forth in claim 3 wherein said drive arm is horizontal in said operative position, said belt has a second run extending generally horizontally from said drive means above said part and around third roller means, and said belt support means includes means for varying the length of said horizontal run.

5. The balancing machine set forth in claim 4 wherein said means for varying the length of said horizontal run includes third roller means adjustably mounted on said drive arm for movement toward and away from said drive means in a generally horizontal direction when said drive arm is in said operative position to vary the length of said second belt run.

6. The balancing machine set forth in claim 1 wherein said belt support means is arranged and disposed on said drive arm so that when said arm is in its operative position said belt has a first generally horizontal run extending outwardly from said drive means and above said part to first roller means carried on said drive arm, a second belt run from said first roller means to a second roller means carried on said drive arm, said second run extending in a direction generally back toward said drive means, a third run extending generally vertically downwardly from said second roller means to a third roller means carried on said drive arm, a fourth run from said third roller means extending vertically upwardly and over said part and then vertically downwardly to fourth roller means carried on said drive arm, a fifth run from said fourth roller means to fifth roller means carried on said arm, said fourth run extending in a direction generally toward said drive means, and a sixth run from said fifth roller means back to said drive means.

7. The balancing machine set forth in claim 6 wherein said belt support means further comprises means for varying the length of at least one of said runs other than said fourth run to compensate for variations in the length of said fourth run.

8. The balancing machine set forth in claim 7 wherein said belt support means further comprises means for selectively adjusting the direction of said third and said fifth runs to thereby orient said fourth run with vertically directed portions between said third roller means and said part and between said part and said fourth roller means.

9. The balancing machine set forth in claim 7 wherein said belt support means comprises a pair of secondary arms pivotally mounted on said drive arm and depending downwardly therefrom so as to be disposed at opposite sides of said part, one of said secondary arms being pivoted on said drive arm at a first pivot axis, the other one of said secondary arms being pivoted on said drive arm at a second pivot axis, said third roller means is rotatably carried on a lower end of said one secondary arm, and said fourth roller means is rotatably carried on a lower end of said other secondary arm so that the direction of said third and said fifth runs can be selectively adjusted by pivoting said first and said second arms on said first and said second axes.

10. The balancing machine set forth in claim 1 wherein said drive arm pivots in said vertical plane about a horizontal axis, said drive means comprises a motor mounted directly on said drive arm radially outwardly of said axis, and the weight of said motor and the location of said motor on said arm are selected so as to maintain said arm in its raised position when said arm is pivoted about said axis in one direction and maintain said belt in driving relationship with said part when said arm is pivoted about said axis in the opposite direction to said operative position.

11. The balancing machine set forth in claim 1 wherein said drive mechanism further comprises means for selectively adjusting the position of said drive arm horizontally along said axis.

12. In combination a part to be balanced and a balancing machine for balancing said part, said part having a circumferential portion adapted to be driven to rotate said part during a balancing operation and wherein said balancing machine comprises a pair of horizontally spaced apart carriers supporting said part for rotation on a first generally horizontal axis, a drive arm mounted on said machine for pivotal movement in a

generally vertical plane about a second generally horizontal axis, said drive arm extending radially outwardly from said second horizontal axis above said first horizontal axis and beyond said part, a drive belt, a motor mounted on said arm above said second horizontal axis, said belt being drivingly engaged with said motor, and belt support means carried on said drive arm and operatively disposed thereon so as to carry said belt in engagement with said part.

13. In a balancing machine wherein a part to be balanced is rotatably supported by a pair of horizontally spaced apart carriers and is adapted to be driven by a belt carried on a drive arm disposed above said part, a pair of secondary arms pivotally mounted on said drive arm and depending downwardly therefrom so as to be disposed at opposite sides of said part, one of said secondary arms being pivoted on said drive arm at a first pivot axis, the other one of said secondary arms being pivoted on said drive arm at a second pivot axis, first roller means carried on a lower end of said one secondary arm, second roller means carried on a lower end of said other secondary arm, and a run of said belt passing under said first roller means, then over said part and then under said second roller means so that the direction of said run between said first roller and said part and between said part and said second roller can be set to vertical by pivoting said arms.