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CATALYST CARRIER FORMING MACHINE

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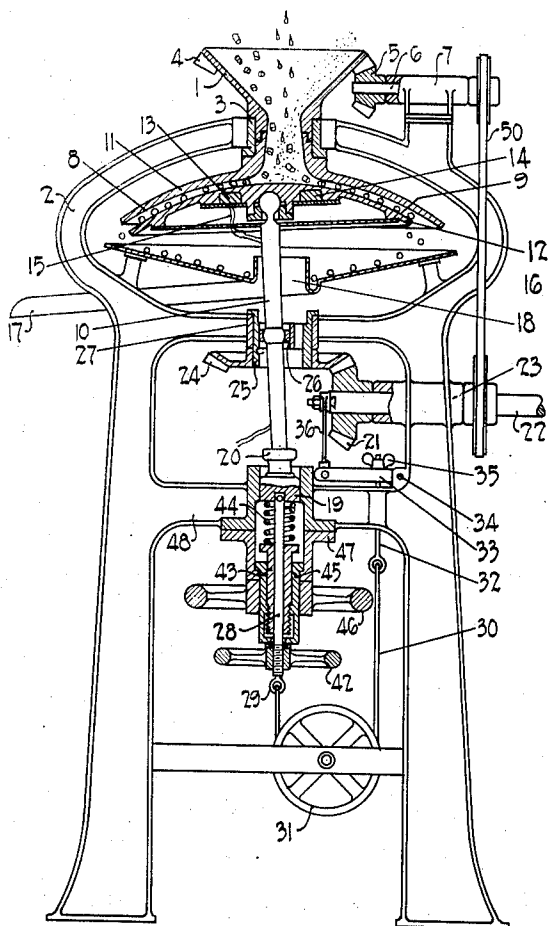


FIG. I

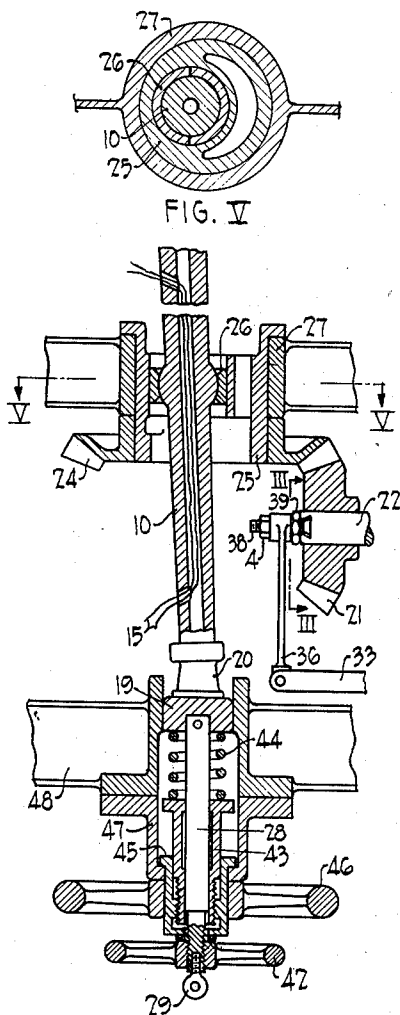


FIG. II

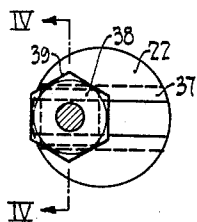


FIG. III

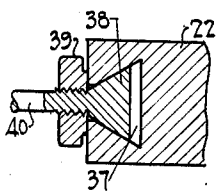


FIG. IV

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CATALYST CARRIER FORMING MACHINE

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11 Claims. (Cl. 18—1)

This invention relates to apparatus suitable for the production of spherical bodies and particularly spherical catalyst carrier bodies.

In the various chemical arts, it is common practice to utilize pelleted carriers impregnated with various catalytically active materials as catalyst bodies, particularly in the instance of vapor phase reactions. Suitable materials which are used as carrier bodies are, for example, pelleted pipe clay, meerschaum, bentonite, bauxite, permittites, majolica, chamotte, alumina, silica gel, metal oxide gels and numerous others of like character and similar properties.

It is an object of the present invention to provide apparatus capable of forming pre-pelleted materials, such as those mentioned above, into spherical bodies, these being known to be far more efficient as catalyst bodies due to the lesser surface area of contact between adjacent bodies when packed in a chamber.

It is a further object of this invention to provide apparatus capable of producing catalyst carrier bodies having a relatively solid inner structure and a relatively porous surface structure.

A still further object of this invention is to provide apparatus capable of producing a product which is absolutely uniform in size and which may be varied in size as desired.

Other objects and advantages of the present invention will appear in the following description of the accompanying drawing, wherein:

Figure I is a sectional elevation of the catalyst carrier forming machine;

Figure II is an enlarged sectional elevation showing the detail of the adjustment mechanism;

Figure III is an enlarged fragmentary sectional elevation through III—III of Figure II;

Figure IV is a sectional elevation through IV—IV of Figure III; and

Figure V is a fragmentary horizontal sectional view through V—V of Figure III showing the eccentric drive and bearing arrangement for the pivoted drive bar.

In the drawing, a feed funnel 1 is mounted in the upper section of the frame 2 of the machine. The feed hopper 1 is rotatable, being provided with a bearing at 3. A ring gear 4 is provided on the upper section of feed funnel 1 and engages a driven gear 5 mounted on shaft 6 which is in turn mounted in a bearing housing 7 on frame 2 as shown.

Attached to revolvable feed funnel 1 is a curved disk 11 having a concave inner face 9, a passage-way being provided in the center thereof to per-

mit the passage of materials fed into feed funnel 1.

A second curved disk 12 having convex inner face 9 is supported by a drive bar 10. The radius of disk 12 is slightly less than that of disk 11. Disk 12 is also provided with electrical heating elements at 13 and 14, wires 15 leading therefrom through drive bar 10 which is formed with a hollow center for this purpose, to a source of current, not shown. Other heating means, such as steam coils, can be used. A collecting funnel 16 of a diameter greater than disks 11 and 12 is disposed beneath the disks, a delivery spout 17 and a center hole 18 being provided therein, the last to permit passage of drive bar 10 through the funnel 16.

Drive bar 10 is attached to vertically adjustable piston block 19 by means of a universal pivot joint 20. Drive gear 21, mounted on shaft 22 which is in turn mounted in bearing housing 23, engages a ring gear 24 which is rigidly attached to eccentric sheave 25. Drive bar 10 passes through eccentric sheave 25 and a split bearing is provided at 26. A bearing is also provided at 27, being mounted on the frame 2 as shown.

Piston block 19 is attached at its lower end to a steel rod 28 which is threaded near the lower end thereof and provided with an eye bolt at 29. A steel cable 30 is fastened to eye bolt 29, passes around a pivot wheel 31 and is fastened at the other end to a second steel bar 32, threaded near its upper end, which passes through frame 2 and a pivot bar 33 pivotally attached to frame 2 at 34. A wing nut 35 on the threaded end of bar 32 serves to take up or afford slack in steel cable 30. At the outer end of pivot bar 33 a link arm 36 is attached by means of a ball coupling, the upper end of link arm 36 being attached to an extension of shaft 22 as is shown particularly in Figures II, III and IV.

Referring to these last figures, a dove-tail slot 37 is formed in the end of shaft 22. A dove-tail bolt 38 is provided with a threaded portion near the dove-tail and a lock-nut 39 as shown. A bearing surface 40 upon which link arm 36 rides is provided as well as a second threaded portion at the end opposite the dove-tail upon which a second nut 41 is threaded to prevent lateral movement of link arm 36.

Referring again to Figures I and II, the lower end of steel rod 28 is threaded to receive a hand wheel 42. A bushing 43, threaded at the lower end, is slidably mounted upon steel rod 28 and

bears against a heavy spring 44 with its upper end, which is suitably shaped for this purpose. The upper end of spring 44 in turn bears against the bottom of piston block 19.

5 A sleeve 45 is rigidly attached to a second hand wheel 46 and threaded upon the threaded portion of bushing 43. Hand wheel 46 bears against housing member 47 which is in turn mounted on frame cross-member 48 or may be formed as an extension thereof.

10 The operation of the machine is as follows: Rotation of shaft 22 and gear 21 will cause rotation of ring gear 24 and eccentric sheave 25. Drive bar 10 being pivoted at 20 and carried by
15 eccentric sheave 25 near its center will transmit a nutating motion to curved disk 12 which is rigidly attached to its upper end. Curved disks 11 and 12 are formed as segments of a sphere, the radius of the sphere of which curved disk
20 12 is a segment preferably being slightly less than that of curved disk 11.

Material which it is desired to form into spheres or balls is passed in pre-pelleted form into the revolving feed funnel 1, from whence, due partially to the centrifugal action of the revolving
25 feed funnel 1 and curved disk 11 and partially to the nutating motion of curved disk 12, it passes between the inner faces of the two curved disks 11 and 12 and is gradually worked outwardly to the perimeters of the curved disks
30 11 and 12 and finally falls into the collecting funnel 16. While passing between the curved disks 11 and 12, the material is formed into perfect spheres in a manner analogous to rolling
35 a plastic material between the palms of one's hands.

By rotation of hand wheel 42, which is threaded on steel bar 28, the spacing between curved disks 11 and 12 may be adjusted as desired. The
40 heavy coil spring 44 supports and urges piston block 19, drive bar 10 and curved disk 12 upwardly. Steel bar 28 is free to slide within bushing 43 and since hand wheel 42 is threaded on steel bar 28 and also bears against sleeve 45
45 which is in turn rigidly positioned with relation to housing member 47, the vertical disposition of steel bar 28 may be controlled as desired by rotation of hand wheel 42.

It will be understood, however, that any change
50 in the vertical disposition of steel bar 28 will bring about a corresponding change in the degree of compression of spring 44 due to its effect upon piston block 19. Handwheel 46, the rotation of which serves to adjust the vertical
55 position of bushing 43, has accordingly been provided to make the necessary compensating adjustment of the degree of compression of spring 44 without changing the spacing between curved disks 11 and 12.

60 It has been found advantageous to also impart a slight pulsating vertical movement to lower curved disk 12 in order to increase the rate of passage of material between curved disks 11 and 12. This may be accomplished, as shown
65 in the drawing, by providing a bolt as at 38 in the end of shaft 22, bolt 38 being dove-tailed into shaft 22 at 37 and locked in any desired position by means of lock-nut 39. By positioning
70 bolt 38 off center with relation to shaft 22 an eccentric drive action will be effected and a cranking movement imparted to link arm 36 which will in turn reciprocate pivot bar 33. Steel bar 32 is carried by pivot bar 33 as shown in Figure I. A steel cable or chain 30, passes around
75 pivot wheel 31 and connects steel bars 32 and

28. By adjustment of wing nut 35, the effective length of steel cable 30 may be increased or decreased as necessary to compensate for adjustments made in the vertical disposition of steel bar 28 by means of hand wheel 42, as described
5 above.

Thus it will be seen that as shaft 22 is rotated, a reciprocating motion will be imparted to link arm 36 and pivot bar 33, the motion being reduced to one of slight degree due to the
10 mounting of steel bar 32 near the fulcrum of pivot bar 33, and then passed to steel cable 30, steel bar 28, piston block 19, drive bar 10 and finally lower curved disk 12. Split bearing 26 is adapted to slide vertically within eccentric
15 sheave 25 in order to permit the vertical reciprocation of drive bar 10.

The method of operating the machine is as follows: the distance between the curved disks 11 and 12 is first adjusted by means of hand
20 wheel 42 to the diameter of balled material desired. By means of hand wheel 46, spring 44 is adjusted to the desired tension, this depending largely upon the properties of the material to be balled. Wing nut 35 is then tightened until
25 steel cable 30 is taut. Shaft 22 may then be rotated by any convenient source of power, preferably at a speed of approximately 160 R. P. M. A belt drive 50 may also be mounted on shaft
30 22 and utilized to rotate feed funnel 1 and upper curved disk 11, preferably at a speed of the order of 100 R. P. M.

The rotation of shaft 22 at approximately 160 R. P. M. will impart a vertical reciprocating
35 motion at the same time to lower curved disk 12 through drive bar 10 and steel cable 30, as described previously. Rotation of shaft 22 and drive gear 21 will also result in rotation of ring gear 24, which should be of such size as to rotate eccentric sheave 25 at approximately
40 95 R. P. M. and thus impart approximately 95 nutating motions per minute to lower curved disk 12.

The material to be balled should be first extruded or in some other manner preformed into
45 roughly shaped pellets, pills or the like, and should be fed into the machine while in a plastic, pastry-like condition. When forced into the forming channel between the two curved disks
50 by the combined nutating, rotating and reciprocating action of the curved disks, these plastic particles will immediately assume an egg-shape, being gradually worked into perfect spheres as they travel outward toward the perimeters of
55 the curved disks. A small addition of liquid, such as water, entering the feed funnel with the plastic particles, will prevent the formation of small particle-crumbs during the molding process. It will also serve as a binder for the
60 plastic particles, giving the formed spheres, after subsequent drying, a compactness of sufficient strength to inhibit breakage. In this connection, the heating elements 13, 14, which heat the lower curved disk 12 serve to partially dry the
65 moist spheres as they are formed.

A particular advantage of the present machine is that organic, combustible material, such as ground sawdust, may be fed simultaneously
70 into the feed funnel along with the plastic particles, together with liquid binder if desired. The rotation of the feed funnel and upper curved disk serves in this instance to also prevent piling of the combustible material and to insure thorough distribution. In the forming channel 75

between the two disks the combustible material is worked into the surface of the plastic spheres to an appreciable depth, leaving the center of the spheres undisturbed and solid. Subsequent carbonization of this imbedded material in a reducing flame leaves a cellular structure near the surface of the spheres. The carbon formed may then be removed in an oxidizing flame and the spheres thereafter impregnated with any desired catalyst. The advantage of such a catalyst carrier is obvious, since most comparable carriers are completely porous, and when impregnated retain a large percentage of the catalytic material in their centers where it serves no useful purpose.

I claim as my invention:

1. In apparatus of the class described, the combination comprising an upper curved disk formed as a segment of a sphere and having a concave inner face, a lower curved disk formed as a segment of a sphere and having a convex inner face opposing the inner face of said upper curved disk and spaced therefrom, a central opening in said upper curved disk whereby material may be passed between the inner faces of said curved disks, a drive bar supporting said lower curved disk, said drive bar being arranged and adapted to impart a nutating motion to said lower curved disk.

2. Apparatus according to claim 1 wherein the sphere of which the upper curved disk forms a segment has a radius slightly in excess of the sphere of which the lower curved disk forms a segment.

3. Apparatus according to claim 1 wherein the drive bar is also arranged and adapted to impart a pulsating vertical movement to said lower curved disk.

4. Apparatus according to claim 1 including means arranged and adapted to continuously rotate said upper curved disk.

5. In apparatus of the class described the combination comprising a frame, an upper curved disk formed as a segment of a sphere supported by the upper end of said frame and having a concave inner face, a lower curved disk formed as a segment of a sphere and having a convex inner face opposing the inner face of said upper curved disk and spaced therefrom, a central opening in said upper curved disk whereby material may be passed between the inner faces of said curved disks, a cross member in said frame, a drive bar supporting said lower curved disk at its upper end, resilient means supporting the lower end of said drive bar, said resilient means being supported by said cross member, said resilient means normally urging said drive bar upwards, said drive bar being pivotally mounted on said resilient means, means limiting the maximum upward travel of said drive bar, a second cross member disposed above said first cross member and eccentric means supported by said second cross member and mounted on said drive bar arranged and adapted to impart a nutating motion to said lower curved disk through said drive bar.

6. Apparatus according to claim 5 wherein said upper curved disk is rotatably mounted in the frame.

7. Apparatus according to claim 5 wherein said means limiting the maximum upward travel of said drive bar is also arranged and adapted to impart a pulsating vertical movement to said drive bar.

8. In apparatus of the class described, the combination comprising an upper curved disk formed as a segment of a sphere and having a concave inner face, a lower curved disk formed as a segment of a sphere and having a convex inner face opposing the inner face of said upper curved disk and spaced therefrom, a central opening in said upper curved disk whereby material may be introduced between the inner faces of said curved disks, a drive bar supporting said lower curved disk, said drive bar being arranged and adapted to impart a nutating motion to said lower curved disk, spring means under compression supporting said drive bar, said spring means normally urging said drive bar upwardly and means arranged and adapted to adjust the degree of compression of said spring means.

9. In apparatus of the class described, the combination comprising an upper curved disk formed as a segment of a sphere and having a concave inner face, a lower curved disk formed as a segment of a sphere and having a convex inner face opposing the inner face of said upper curved disk and spaced therefrom, a central opening in said upper curved disk whereby material may be introduced between the inner faces of said curved disks, a drive bar supporting said lower curved disk, said drive bar being arranged and adapted to impart a nutating motion to said lower curved disk, spring means under compression supporting said drive bar, said spring means normally urging said drive bar upwardly, a restraining element rigidly connected to said drive bar and arranged and adapted to limit the upward travel of said drive bar to a pre-set maximum, means arranged and adapted to adjust the vertical disposition of said restraining element and independent means arranged and adapted to adjust the degree of compression of said spring means.

10. Apparatus according to claim 9 including means arranged and adapted to impart a pulsating vertical movement to said restraining element.

11. In apparatus of the class described, the combination comprising an upper curved disk formed as a segment of a sphere and having a concave inner face, a lower curved disk formed as a segment of a sphere and having a convex inner face opposing the inner face of said upper curved disk and spaced therefrom, a central opening in said upper curved disk whereby material may be passed between the inner faces of said curved disks, drive means supporting said lower curved disk, said drive means being arranged and adapted to impart a nutating motion to said lower curved disk.

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