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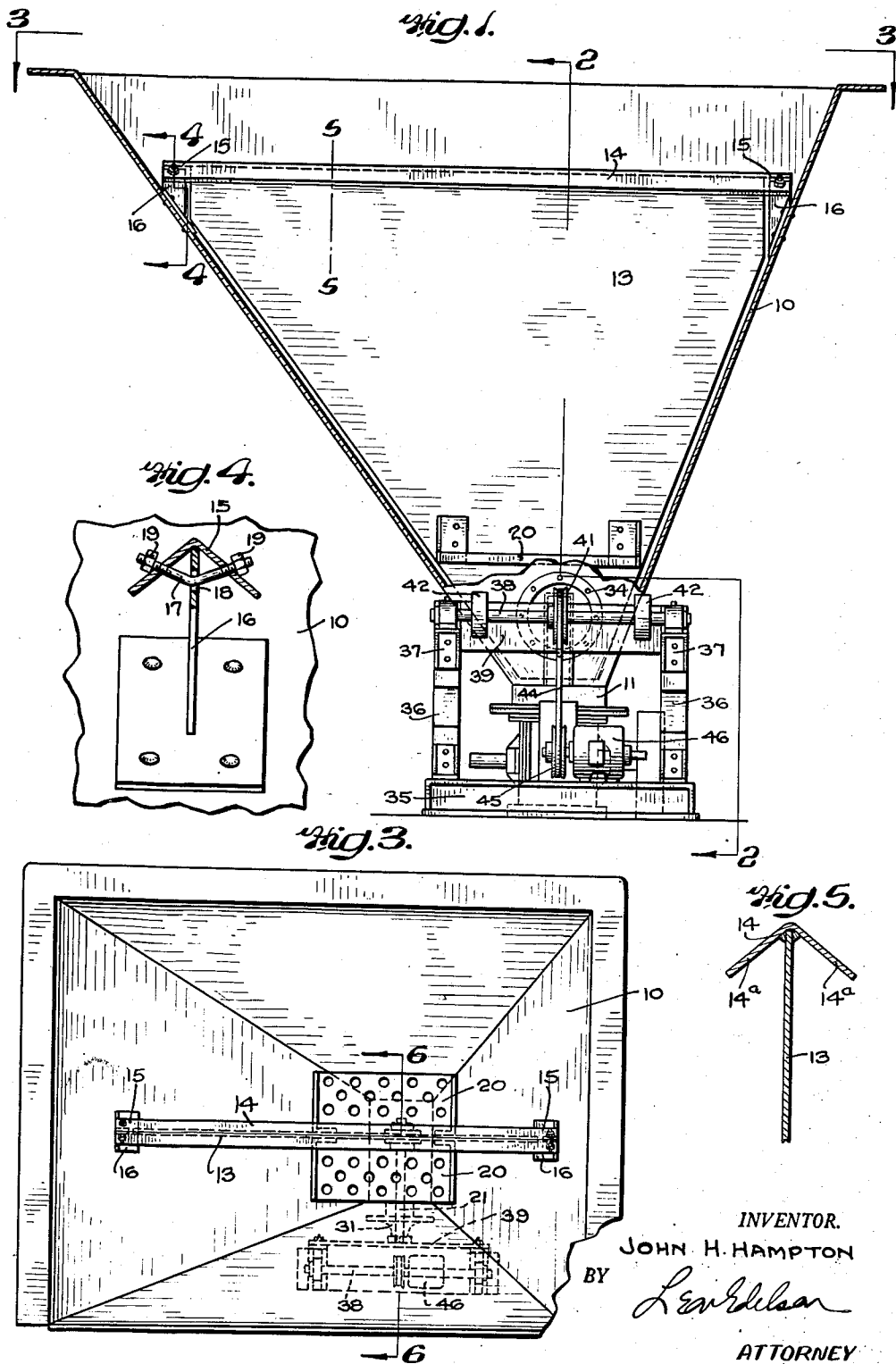
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VIBRATING HOPPER APPARATUS

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2 Sheets-Sheet 1



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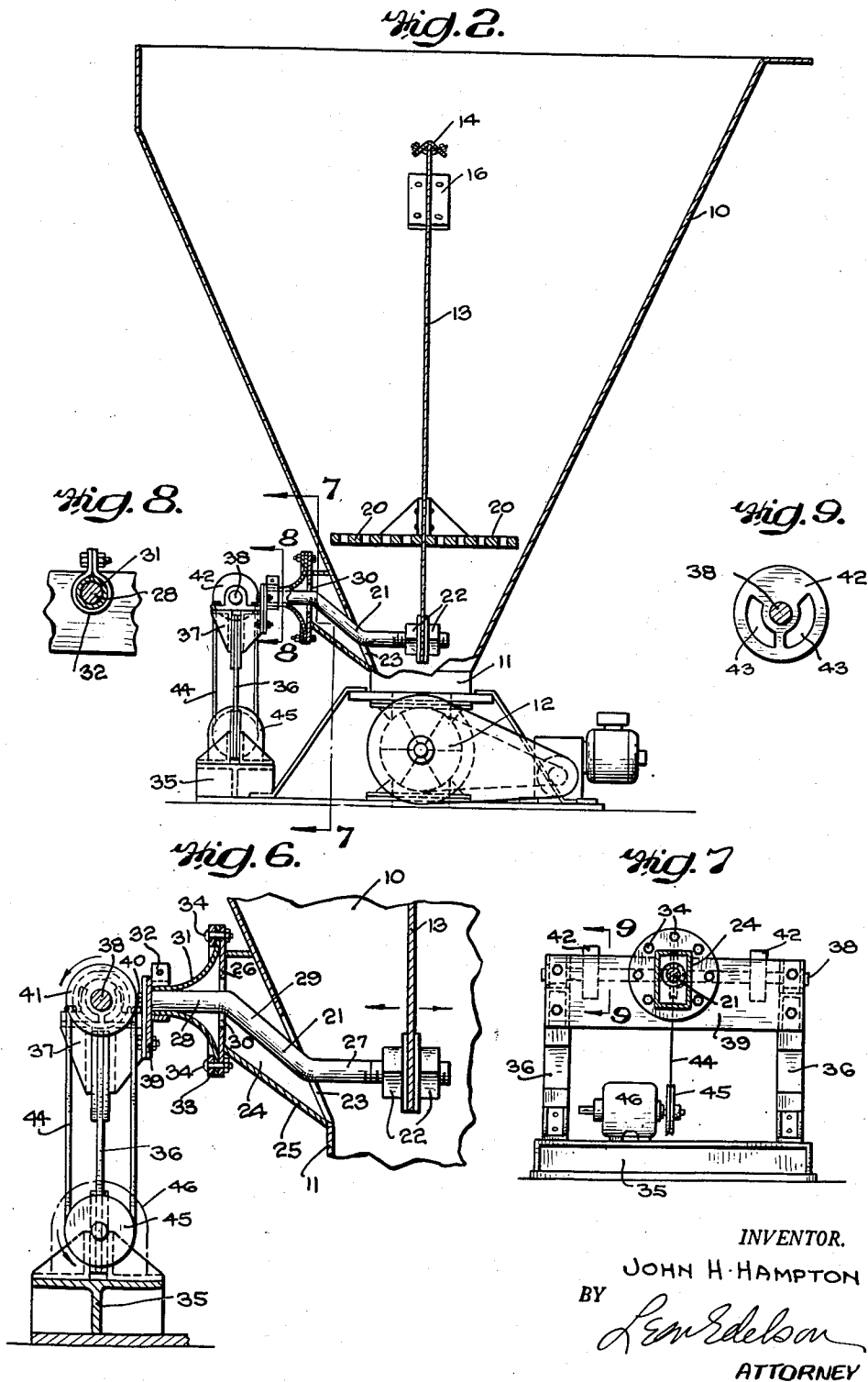
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VIBRATING HOPPER APPARATUS

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This invention relates generally to soot and dust hoppers and more particularly to an improved construction of such hopper having means operatively associated therewith for agitating the material collected in the hopper to prevent such arching of the material above the hopper discharge opening as would interfere with its free discharge from the hopper.

Among the principal objects of the present invention is to provide a simple, inexpensive and effective mechanism for vibrating finely comminuted material as it is received in a hopper to insure continuous gravitational flow of the material through and from the hopper, the mechanism being designed for continuous operation by an electric motor drive means which is simple and economical in construction, which is adapted to be readily installed for operative association with the hopper and which is exceedingly effective and efficient in operation.

Other objects and advantages of the present invention will appear more fully hereinafter, it being understood that the present invention consists substantially in the combination, construction, location and relative arrangement of parts, all as shown in the accompanying drawings, as described in detail hereinafter and as finally pointed out in the appended claims.

In the accompanying drawings, which are illustrative of a preferred construction of the present invention, Figure 1 is an end elevational view, partially in section of a hopper in association with the vibratory mechanism of the present invention;

Figure 2 is a view, also partially in section, as taken along the line 2-2 of Figure 1;

Figure 3 is a top plan view as taken along the line 3-3 of Figure 1;

Figure 4 is a sectional view as taken along the line 4-4 of Figure 1 showing a constructional detail of the hopper;

Figure 5 is a sectional view as taken along the line 5-5 of Figure 1;

Figure 6 is a view of the apparatus on a somewhat enlarged scale as taken along the line 6-6 of Figure 3;

Figure 7 is a sectional view as taken along the line 7-7 of Figure 2;

Figure 8 is a sectional view as taken along the line 8-8 of Figure 2; and

Figure 9 is a face view of one of the eccentrically weighted elements of the apparatus as viewed from the line 9-9 of Figure 7.

Referring now more particularly to the drawings, it will be observed that the apparatus of the present invention includes a downwardly con-

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verging hopper 10 having a discharge throat 11 at its bottom end with which is operatively associated a motor driven rotating gate mechanism 12 or other suitable device for controlling the discharge from the hopper of the finely comminuted solid material received therein, which material may be powdered coal, fly ash, dust, cement or the like. It is a known fact that such materials tend to form a natural arch over the discharge opening of the hopper which interferes with the gravitational discharge of the material therefrom and in order to prevent such arching of the material the hopper 10 is internally provided with a centrally disposed, vertically extending plate 13 which is adapted to be vibrated in such manner as to subject the material in the hopper, particularly in the zone thereof wherein the material tends naturally to form a compact arch or bridge, to such vibration that arching or bridging of the material is effectively prevented. The mechanism for vibrating the plate 13 will be described in detail hereinafter, it being noted at this point that the plate 13 is of a size and shape and so arranged as to substantially bisect the interior of the hopper 10, the upper edge of the plate being so pivotally supported within the hopper as to permit the suspended body of the plate to be freely oscillated about its supporting pivots.

As most clearly appears in Figures 1, 4 and 5, the upper edge of the plate 13 has welded thereto a longitudinally extending angle member 14 the angularly related branches 14^a-14^a of which are symmetrically disposed to either side of the plate 13. The opposite ends of the angle member 14 respectively project beyond the corresponding ends of the plate 13 to provide for the plate 13 a pair of freely projecting supporting elements 15 (see Figure 4) each of inverted V-shape. These supporting elements 15-15 are respectively fulcrumed on a pair of supporting brackets 16-16 riveted or otherwise suitably secured to opposite side walls of the hopper 10, the general arrangement being such that when the opposite ends of the member 14 are respectively mounted pivotally upon the supporting brackets 16-16 the plate 13 fixed to and supported by the member 15 is free to oscillate about its pivotal supports. In order to prevent displacement of the oscillatable plate 13 from its supporting brackets 16-16, a pair of suitably bent bolts 17 (see Fig. 4) are respectively loosely projected through and secured to the angularly related sides of each plate supporting element 15 by means of nuts 19 threaded thereon. If desired, the oscillatable plate 13 may be fitted adjacent its lower end

with a pair of screen members 20—20 disposed in horizontal coplanar relation and of such size and shape as to provide for adequate screening of the material received within the hopper without, however, interfering with oscillation or vibration of the pivotally suspended plate 13. To this end, the marginal edges of the screen 20—20 terminate short of the corresponding proximate walls of the hopper 10.

Secured to the lower end of the plate 13 at a point immediately above the discharge throat 11 of the hopper 10 is a rod 21 operative to effect the desired oscillation or vibration of the plate 13, the inner end of this rod being suitably connected to the plate 13 by a coaxing pair of clamp nuts 22 threaded on to the rod. The rod 21 projects laterally of the hopper 10 through an opening 23 formed in one side wall thereof, this opening being in turn externally covered by a housing 24 suitably welded or otherwise secured to the hopper. The housing 24 is provided with an inclined bottom wall 25 and with a centrally apertured outer wall 26, the rod 21 being reversely bent, as most clearly appears in Figure 6 to provide a pair of vertically offset substantially parallel portions 27 and 28 and a connecting intermediate portion 29. The intermediate portion 29 of the rod 21 extends substantially parallel to the inclined bottom wall 25 of the external housing 24, while the outer portion 28 of the rod extends horizontally outwardly through the opening 30 in the outer wall 26 of the housing 24. It will be apparent that when the outer portion 28 of the arm is axially reciprocated, the inner portion 27 thereof will be correspondingly reciprocated with resultant vibration or oscillation of the plate 13 relatively to its upper pivotal supports.

To prevent escape of any of the material from the hopper 10 by way of the side openings 23 and 30, the outwardly projecting portion 28 of the plate vibrating rod 21 is fitted with a bell-shaped rubber diaphragm 31, the reduced outer end of this diaphragm being secured to the rod 29 in closely embracing relation with respect thereto by means of a suitable clamp 32, while the flared inner edge of the diaphragm is tightly clamped against an annular flange 32 formed on the outer end of the housing 24 by means of an annular clamp member 33 secured to the housing flange 32 by a series of circumferentially spaced bolts 34. It will be understood that the diaphragm 31 is sufficiently flexible to permit limited but rapid reciprocation of the plate vibrating rod 21, while adequately sealing the hopper against escape of material by way of its lateral openings 23 and 30.

The mechanism for axially reciprocating the plate vibrating rod 21 is disposed exteriorly of the hopper 10 closely adjacent its discharge end and comprises a main base member 35 suitably fixed to the floor or other support for the hopper, said base member having mounted thereon a pair of laterally spaced, vertically extending leaf spring units 36—36. The upper ends of these leaf spring units are respectively fitted with brackets 37—37 which serve as journal blocks for the opposite ends of a rotatable shaft 38 disposed approximately in the horizontal plane of and at right angles to the outwardly extending end portion 28 of the plate vibrating rod 21.

Interconnecting the shaft-bearing brackets 37—37 in laterally spaced parallel relation to the shaft 38 is a horizontally extending connecting plate 39 to approximately the midpoint of which is secured the outer end of the plate-vibrating

rod 21, as by a bolt 40 projected through the plate 39 and threaded into the rod 21. The rotatable shaft 38 and the plate 39 are thus both carried by the brackets 37—37 mounted upon the upper ends of the leaf spring units 37—37 and are connected as a unit to the plate-vibrating rod 21, with the result that when the upper ends of the spring units are vibrated the rod 21 is correspondingly axially reciprocated to vibrate the pivotally support plate 13 in the hopper 10.

To effect the desired vibration of the spring units 37—37, the rotatable shaft 38 journaled therebetween is centrally fitted with a belt pulley 41 and with a pair of eccentrically weighted wheels 42—42 disposed equidistantly to either side of the pulley 41, the pulley 41 and the weighted wheels 42—42 being all suitably keyed to the shaft 38 for rotation therewith. The wheels 42—42 are preferably eccentrically weighted by removing portions thereof, as at 43—43, as shown in Figure 9. The pulley 41 is connected by a belt 44 to a pulley 45 keyed to the shaft of an electric motor 46 suitably mounted upon the base member 35, the arrangement being such that as the motor drives the shaft 38 through the belt drive as described the unbalanced wheels 42—42 on the shaft operate to cause it to vibrate laterally of its axis of rotation upon the supporting leaf spring units 37—37. This vibration of the shaft 38 is in turn imparted to the plate 39 connected to the rod 21 and consequently the latter is axially reciprocated to effect vibration of the hopper plate 13 in correspondence with the vibrations of the rotating shaft 38.

Inasmuch as the hopper plate 13 is rigidly connected to the supports for the rotating shaft 38 by means of the rod 21, lateral vibration of the shaft 38 is directly transmitted to hopper plate 13 with little, if any, noise. In view of the fact that the outer end of the reciprocating rod 21 is completely sealed within the flexible diaphragm, leakage of dust and the like from the hopper laterally by way of the openings through which the rod 21 projects is effectually precluded. Inasmuch as the rod 21 is subject to a slight rocking action in a vertical plane when it is reciprocatorily actuated by the laterally vibrating shaft 38, the flexible diaphragm 31 serves the additional important function of so flexibly supporting the outer end of the rod 21 as to permit the latter shift freely and without binding restriction under the vibratory influence of the rotating shaft 38. Thus, the motor 46, operating at normal speed and with a minimum of load thereon, is operative to effect efficient vibration of the hopper plate to insure against any arching or bridging of the finely divided material across the discharge opening in the bottom of the hopper.

It will be understood, of course, that the present invention is susceptible of various changes and modifications which may be made from time to time without departing from the general principles or real spirit thereof, and it is accordingly intended to claim the same broadly, as well as specifically, as indicated by the appended claims.

What is claimed as new and useful is:

1. In an apparatus of the character described, a hopper adapted for receiving comminuted material and discharging the same through an opening in the bottom thereof, a vibratory plate member hingedly suspended within said hopper and adapted for agitating the contents thereof to prevent material arching over the discharge opening, and mechanism for vibrating said plate member without vibrating said hopper, said

mechanism including a horizontally reciprocable rod secured to the lower end of said plate member, and an assembly positionally fixed relative to said hopper and supportingly disassociated therefrom including vertically extending yieldable means connected to said rod, a horizontally extending shaft mounted on said yieldable means and extending laterally of said rod, means for effecting rotation of said shaft, and eccentrically weighted elements on said shaft operative upon rotation of said shaft to vibrate said yieldable means whereby to axially reciprocate said rod and vibrate said plate member suspended as aforesaid within said hopper.

2. In an apparatus of the character defined in claim 1 wherein the yieldable means includes a pair of laterally spaced leaf spring members, and a cross member interconnecting the upper end portions of said leaf spring members, and wherein said cross member is connected substantially at its midpoint to the outer end portion of the vibrating rod.

3. In an apparatus of the character defined in claim 1 wherein the yieldable means includes a pair of laterally spaced leaf spring members, and a cross member interconnecting the upper end portions of said leaf spring members, wherein said cross member is connected substantially at its midpoint to the outer end of the vibrating rod and wherein the eccentrically weighted rotatable shaft is disposed substantially in the horizontal plane of the outer end portion of said vibratory rod.

4. In an apparatus of the character described, a hopper adapted for receiving comminuted material and discharging the same through an opening in the bottom thereof, a vibratory plate member hingedly suspended within said hopper and adapted for agitating the contents thereof to prevent material arching over the discharge opening, and mechanism for vibrating said plate member without vibrating said hopper, said mechanism including a horizontally reciprocable rod secured to the lower end of said plate member, and projecting outwardly therefrom through an opening in the side wall of said hopper, means for sealing said hopper side wall opening including a housing on said hopper side wall, said rod additionally projecting outwardly as aforesaid through an opening in the side wall of said housing, and a bell-shaped flexible diaphragm disposed in embracing relation to the outer end portion of said rod, the base end of said diaphragm being secured to one of said side walls and the opposite end portion being secured to said rod and an assembly positionally fixed relative to said hopper and supportingly disassociated therefrom including vertically extending yieldable means connected to said rod, a horizontally extending shaft mounted on said yieldable means and extending laterally of said rod, means for effecting rotation of said shaft, and eccentrically weighted elements on said shaft operative upon rotation of said shaft to vibrate said yieldable means whereby to axially reciprocate said rod and vibrate said plate member suspended as aforesaid within said hopper.

5. In an apparatus of the character described, a hopper adapted for receiving comminuted material and discharging the same through an opening in the bottom thereof, a vibratory plate member hingedly suspended within said hopper and adapted for agitating the contents thereof to prevent material arching over the discharge opening, and mechanism for vibrating said plate member without vibrating said hopper, said mechanism

nism including a horizontally reciprocable rod secured to the lower end of said plate member, and projecting outwardly therefrom through an opening in the side wall of said hopper, means for sealing said hopper side wall opening including a housing on the outside of said hopper side wall, said rod additionally projecting outwardly as aforesaid through an opening in the side wall of said housing which is upwardly offset from said opening in the side wall of said hopper, and a bell-shaped flexible diaphragm disposed in embracing relation to the outer end portion of said rod, the base end of said diaphragm being secured to said housing and the opposite end portion being secured to said rod, and an assembly positionally fixed relative to said hopper and supportingly disassociated therefrom including vertically extending yieldable means connected to said rod, a horizontally extending shaft mounted on said yieldable means and extending laterally of said rod, means for effecting rotation of said shaft, and eccentrically weighted elements on said shaft operative upon rotation of said shaft to vibrate said yieldable means whereby to axially reciprocate said rod and vibrate said plate member suspended as aforesaid within said hopper.

6. In an apparatus of the character described, a hopper adapted for receiving comminuted material and discharging the same through an opening in the bottom thereof, a vibratory plate member hingedly suspended within said hopper and adapted for agitating the contents thereof to prevent material arching over the discharge opening, and mechanism for vibrating said plate member without vibrating said hopper, said mechanism including a horizontally reciprocable rod secured to the lower end of said plate member, and projecting outwardly therefrom through an opening in the side wall of said hopper, means for sealing said hopper side wall opening including a housing on the outside of said hopper side wall, the outer end portion of said rod being upwardly offset from the inner end portion thereof and said rod additionally projecting outwardly as aforesaid through an opening in the side wall of said housing which is upwardly offset from said hopper side wall opening, and a bell-shaped flexible diaphragm disposed in embracing relation to the outer end portion of said rod, the base end of said diaphragm being secured to said housing and the opposite end portion being secured to said rod, and an assembly positionally fixed relative to said hopper and supportingly disassociated therefrom including vertically extending yieldable means connected to said rod, a horizontally extending shaft mounted on said yieldable means and extending laterally of said rod, means for effecting rotation of said shaft, and eccentrically weighted elements on said shaft operative upon rotation of said shaft to vibrate said yieldable means whereby to axially reciprocate said rod and vibrate said plate member suspended as aforesaid within said hopper.

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