

July 28, 1959

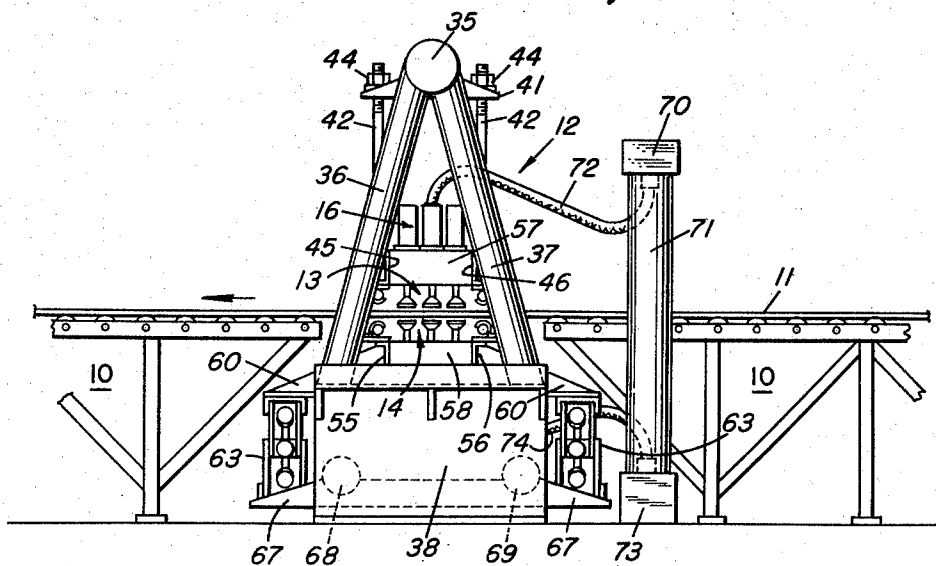
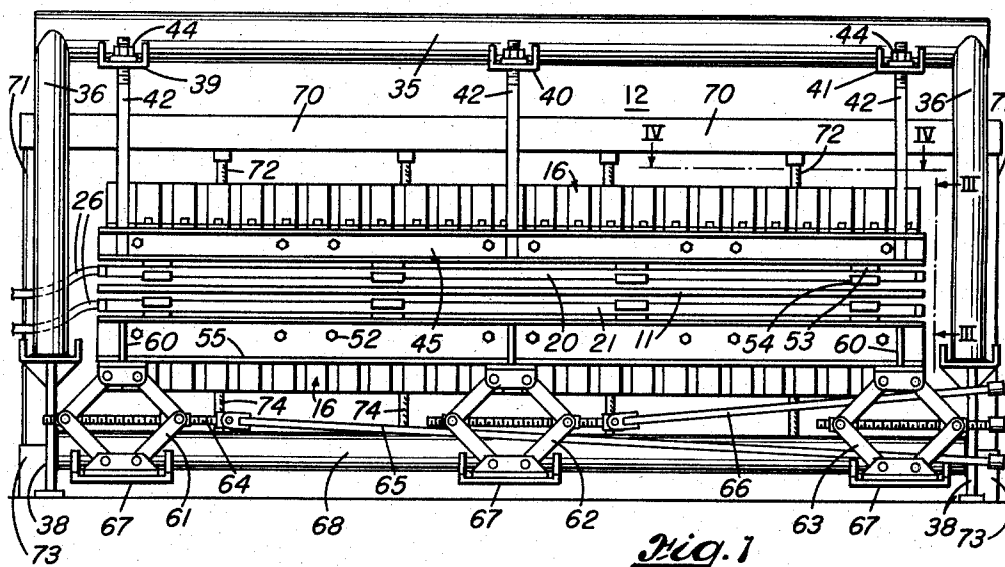
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2,896,646

MACHINE FOR VIBRATION TREATMENT OF SURFACES

Filed May 5, 1954

3 Sheets-Sheet 1



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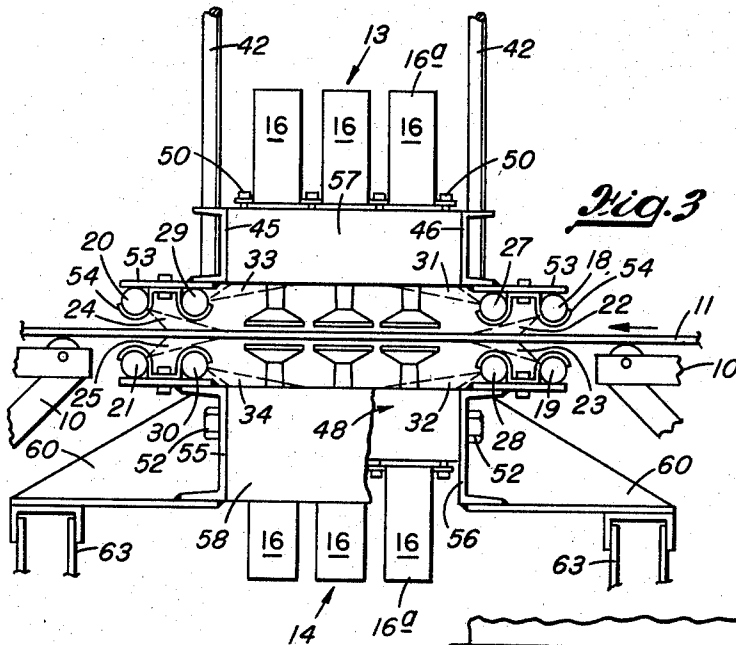
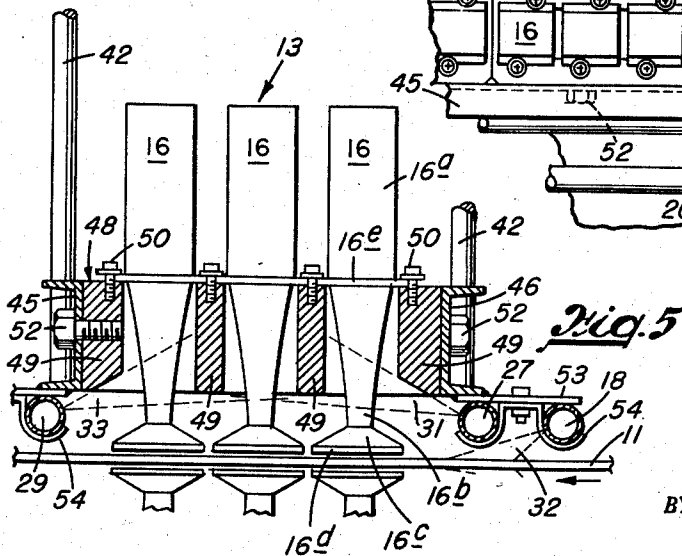
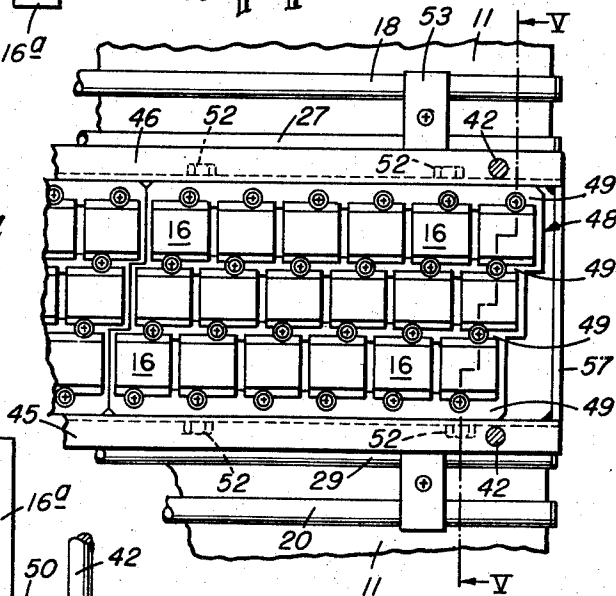


Fig. 4



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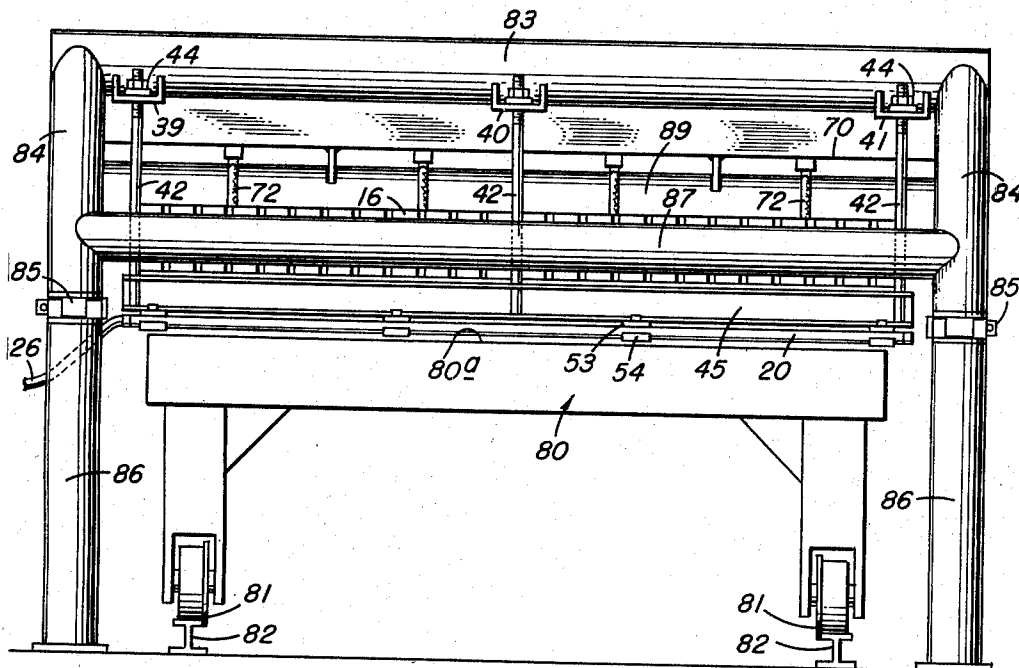


Fig. 6

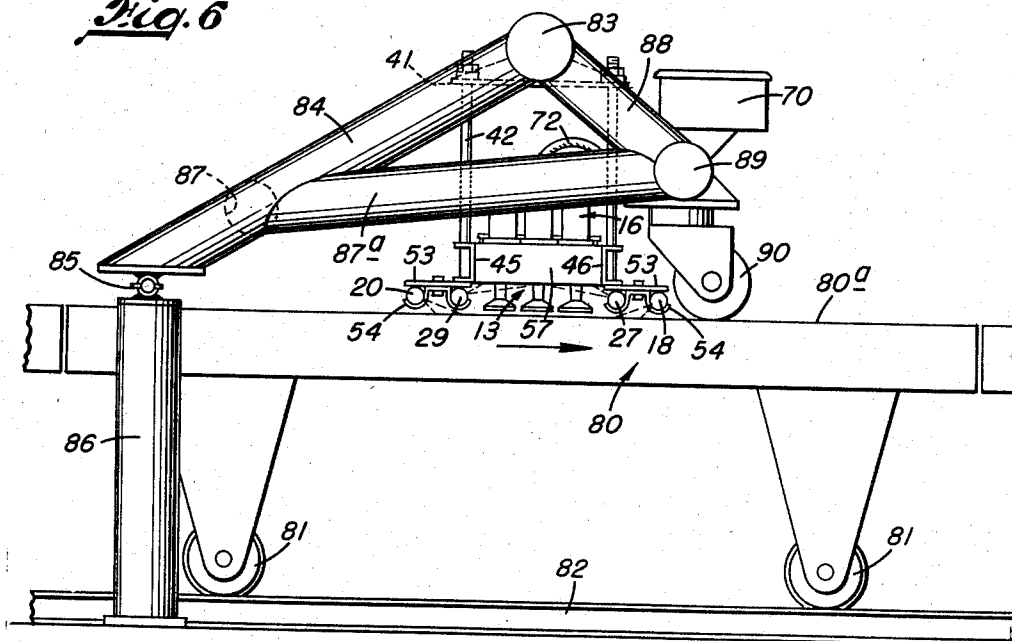


Fig. 7

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1

2,896,646

MACHINE FOR VIBRATION TREATMENT OF SURFACES

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Application May 5, 1954, Serial No. 427,736

2 Claims. (Cl. 134—122)

This invention relates to machines for developing sonic or ultrasonic waves in a fluid medium contacting a surface to produce or enhance an action of the medium on the surface. It is particularly suited for the rapid treatment of large surfaces, such as those of sheets of glass for cleaning or other purposes.

An object of the invention is to provide a practicable machine for rapidly treating large surfaces with sonic or ultrasonic waves in a fluid medium.

Other more specific objects and features of the invention will appear from the description to follow.

It is known that, if the surface of an object is exposed to a fluid medium in which high-frequency waves are generated, relatively powerful action of the liquid against the surface can be induced. The action can be a cleaning one or a corroding one, depending upon the natures of the surface, material and the fluid medium, respectively, and the intensity and duration of the treatment. The action becomes very intense when the fluid medium is a liquid and the vibration is powerful enough to produce cavitation therein.

High-frequency (sonic or ultrasonic) waves have been found to be particularly effective in the cleaning of plate glass following grinding and polishing thereof. It is common practice to support a sheet of plate glass for grinding and polishing by imbedding it in a layer of plaster of Paris on a supporting table, the plaster quickly setting to provide a solid support under every portion of the plate. However, following the removal of the glass from the table, both the glass and table have strongly adherent coatings of hardened plaster, the removal of which has been a serious problem. It has been found that exposure of the plaster-encrusted surfaces to water in which high-frequency waves are generated is very effective in removing the plaster, but there still remained the problem of how to economically apply the treatment to large surfaces.

In accordance with the present invention, the problem is solved by a machine through which glass sheets or tables can be continuously moved on a production line and which applies to the surface as it moves there-through a film of water and generates in the water film powerful high-frequency waves effective to remove all foreign particles from the surface.

A full understanding of the invention may be had from the following detailed description with reference to the drawing, in which:

Fig. 1 is a front elevational view of a machine in accordance with the invention for cleaning both faces of a sheet of glass.

Fig. 2 is a side elevation of the same machine looking at the right side as viewed in Fig. 1.

Fig. 3 is an enlarged side elevation taken in the plane III—III of Fig. 1.

Fig. 4 is a plan view of a portion of the machine taken in the plane IV—IV of Fig. 1.

Fig. 5 is an irregular section taken along the line V—V of Fig. 4.

2

Fig. 6 is a front elevational view of a machine in accordance with the invention for cleaning the upper surface of an object, such as a table.

Fig. 7 is a side elevational view of the machine shown in Fig. 6.

Referring first to Fig. 2, there are shown portions of a continuous conveyer 10 for conveying sheets 11 to be cleaned through a cleaning machine 12 in accordance with the invention. The conveyer may be of any known type that will support the sheets 11 at a constant level during passage through machine 12.

The machine 12 comprises upper and lower electro-mechanical vibrators 13 and 14, respectively, having working faces that are closely positioned to the upper and lower surfaces, respectively, of the sheets 11 as they move through the machine. In other words, the working face of each vibrator lies in a plane that is parallel and closely spaced to one boundary of the path through which the sheets 11 move.

Referring to Figs. 3, 4 and 5, each vibrator 13 and 14 comprises a plurality of identical separate vibrator units 16 arranged in three rows extending transversely of the conveyer, with the units in each row staggered relative to those in the other rows, so that every portion of the surface to be cleaned sweeps past at least two of the units 16.

Each vibrator unit, as shown, comprises a vibration-generating portion 16a, a vibration transmitting portion 16b, and a shoe 16c, the outer faces 16d of which constitute the previously mentioned working face of the vibrator. The units 16 are disclosed and claimed in the copending application of Leon W. Camp, filed May 5, 1954, Serial No. 427,848, now Patent No. 2,723,386. For an understanding of the present invention, it is sufficient to state that when the units 16 are energized their shoes 16c are strongly vibrated in direction perpendicular to their faces 16d, i.e., toward and away from the plate 11 that is to be cleaned.

When the space between the faces 16d and the plate 11 is filled with water or other cleaning liquid, waves are generated therein which produce alternate compression and rarefaction that is highly effective in cleaning the plate.

The space between the plate 11 and the shoe faces 16d is kept substantially filled with water, or other cleaning liquid, by spraying it onto the plate immediately ahead of and back of the vibrators 13 and 14. As shown in Fig. 3, water is sprayed from jets in four transverse spray pipes 18, 19, 20 and 21. The jets in each of the pipes are directed to produce sprays 22, 23, 24 and 25 impinging on the plate 11 at a low angle toward the vibrators, so that the water banks up between each surface of the plate and the adjacent surfaces 16d of the vibrators, and escapes past the edges of the shoes 16c carrying with it the dirt that is loosened from the surface of the plate by the sonic waves in the water. Because of the fact that the sprays 24 and 25 at the exit end of the machine are directed opposite to the movement of the plate, they sweep it clean of debris and excess water as it leaves the machine.

The pipes 18, 19, 20 and 21 may be connected at one end by hoses 26 (Fig. 1) to any suitable source of pressure liquid (not shown).

Each of the vibrators 13 and 14 is usually operated at such a high power level that substantial heat is generated in it, and it is necessary or desirable to water-cool it. To this end, additional spray pipes 27, 28, 29 and 30 may be provided having jets for projecting sprays 31, 32, 33 and 34 onto the portions of the vibrator units above the shoes 16c.

The vibrator 13 is supported by a frame including a main tubular cross beam 35 (Figs. 1 and 2) which is

3

itself supported at each opposite end by a pair of tubular pillars in the form of an inverted V welded at the apex of the V to the beam 35. The pillars 36 and 37 rest on a heavy base 38. The cross beam 35 has secured thereto, as by welding, three brackets 39, 40 and 41 from which the vibrator assembly is suspended by six rods 42. To enable accurate vertical adjustment of the vibrator, each rod 42 has a threaded upper end extending through an aperture in its associated bracket 39, 40 or 41 and receiving a nut 44 which rests on the bracket. By tightening or loosening any nut, the upper end of the associated rod 42 may be accurately raised or lowered.

The three rods 42 at the front end of the machine are secured at their lower ends, as by welding, to a front cross beam 45 (Fig. 3), and the three rear rods 42 are similarly secured to a rear cross beam 46. Detachably secured to and extending between the cross beams 45 and 46 are one or more grids 48 (Fig. 4) each having spaced members 49 extending parallel to the cross beams 45 and 46 which support the individual vibrator units 16. Thus, each unit 16 has a flange 16e resting on adjacent members 49 and clamped thereagainst by screws 50. The grids 48 are attached to the cross beams 45 and 46 by screws 52. The assembly described permits rapid and easy replacement of any vibrator unit 16 that may become defective.

Referring to Fig. 3, each of the cross beams 45 and 46 is provided with an extension 53 welded to its lower edge which functions as a support for the spray tubes 18, 27, 20 and 29. Thus, the tubes are shown clamped against the underside of the extensions 53 by clips 54.

The mounting of the lower vibrator units is similar to that of the upper ones, except that the grids 48 supporting the vibrators are secured to a pair of lower cross beams 55 and 56, each of which is adjustably supported at each end and at the middle by jacks which can be manipulated independently.

The two cross beams 45 and 46 are rigidly connected together at their ends by side plates 57 and beams 55 and 56 are connected at their ends by plates 58. By virtue of these side plates and the reinforcing effect of the grids 48, the assemblies are relatively rigid.

Each of the beams 55 and 56 has outwardly extending brackets 60, one at each end and one in the middle, for supporting engagement by separate jacks 61, 62 and 63. These jacks may be of any convenient type, and a conventional scissor type is shown, each having an adjusting worm or screw 64 which is rotated to expand or contract the jack. Suitable extension handles 65 and 66, respectively, are provided on the jacks 61 and 62, so that all adjustments can be made from one side of the machine. The jacks are supported on brackets 67 welded to a pair of heavy transverse tubular beams 68 and 69 which extend between and are welded to the side members 38.

By individually adjusting the six jacks, a small uniform clearance between the working face of the lower vibrator 14 and the under side of the glass sheet 11 can be obtained.

Although the present invention does not relate particularly to the electrical equipment for energizing the electromechanical vibrators, there is shown an upper housing 70 extending transversely in front of the machine and supported by pillars 71 containing main leads or bus bars from which connecting cables 72 are extended to the transducers in each of the grids 48. A similar lower housing 73 extending between the lower ends of the pillars 71 may be provided for containing the main conductors or bus bars from which connectors 74 are extended to the various supporting grids of the lower vibrator 14.

There is shown in Figs. 6 and 7 a structure for cleaning the tops of the tables after they have been used to support sheets of glass during the grinding process. As shown, each table 80 is provided with flanged wheels

4

81 running on a track 82 past the cleaning machine. The latter comprises a vibrator structure identical with the upper vibrator 13 of Fig. 2, the only difference being in the supporting framework.

In Figs. 6 and 7, the main frame comprises a cross beam 83 corresponding generally to the cross beam 35 in Figs. 1 and 2 from which the grids containing the vibrator units are supported in the same way. The cross beam 83 is supported at each end by an inclined beam 84 which is rigidly secured at its upper end to the cross beam 83 and is hingedly supported at its lower end by hinges 85 at the upper end of a supporting column 86. A further cross member 87 is extended between and secured to the two side members 84 adjacent their lower ends. Two additional members 87a and 88 are provided on each side of the machine, the member 87a being joined to the member 84 at a point near its lower end and extending horizontally beyond and below the cross beam 83 where it is joined to the lower end of the member 88, the upper end of the latter being joined to the cross beam 83. At their points of joinder the members 87a and 88 are joined to a third cross member 89, which is provided with wheels 90 adapted to rest upon the upper surface 80a of a table being cleaned.

A large number of the tables 80 are employed, and in practice they are moved continuously in end-to-end relation through the cleaning machine, so that there is never any lack of support for the wheels 90. Because of the fact that the wheels 90 roll on the table being cleaned, they quite accurately gauge the spacing between the working face of the vibrator and the table top, regardless of slight differences in height of different tables. Variation in height of different tables produces a relatively small change in the gap between the vibrator face and the table top because of the substantially greater horizontal distance from the hinge 85 to the vibrator than from the wheels 90 to the vibrator. A relatively fine adjustment of the height of the vibrator is obtained by means of the adjusting nuts on the supporting rods 42, the same as described in connection with Figs. 1 and 2.

Although for the purpose of explaining the invention, a particular embodiment thereof has been shown and described, obvious modifications will occur to a person skilled in the art, and I do not desire to be limited to the exact details shown and described.

I claim:

1. A machine of the type described for treating the upper face of an object moving therethrough a fixed path extending parallel to one dimension of said face, said machine comprising: an electromechanical vibrator having a working face vibrating in direction normal thereto; means supporting said vibrator in stationary position with said working face in closely spaced parallel relation to the adjacent boundary of the said fixed path, said working face extending horizontally the full width of said object face whereby all portions of the latter pass in close proximity to said working face; means for directing a liquid medium into the space between said working face and said object face whereby waves are developed in said medium and applied to said object face as it moves past said working face; said supporting means comprising a frame to which said vibrator is attached, and stationary means hingedly supporting said frame for swinging movement about a transverse axis approximately in the said boundary of the path and substantially spaced longitudinally from said vibrator; and means for supporting said frame adapted to rest on the face to be cleaned, said frame-supporting means being longitudinally disposed closer to said vibrator than is said transverse hinge axis.

2. A machine of the type described for treating the upper face of an object moving in a normally gaseous atmosphere through a fixed path extending parallel to

5

one dimension of said face, said machine comprising: an electromechanical vibrator having a working face vibrating in direction normal thereto; means supporting said vibrator with said working face in closely spaced parallel relation to the adjacent boundary of said fixed path whereby the object face passes in close proximity to said working face; the space between said working face and said fixed path communicating with said gaseous atmosphere for gravitational drainage of liquid from said space to said atmosphere; and means for forcibly projecting a liquid medium into said space whereby said space is filled with said liquid medium despite said gravitational drainage of liquid therefrom to said gaseous atmosphere, and waves are developed in said medium and applied to the face of said object as it moves past said working face; said supporting means comprising a frame to which said vibrator is attached, stationary means hingedly supporting said frame for swinging movement about a transverse axis approximately in the said boundary of the path and substantial-

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ly spaced longitudinally from said vibrator, and supporting means on said frame adapted to rest on the face to be cleaned and being longitudinally disposed closer to said vibrator than is said transverse hinge axis.

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