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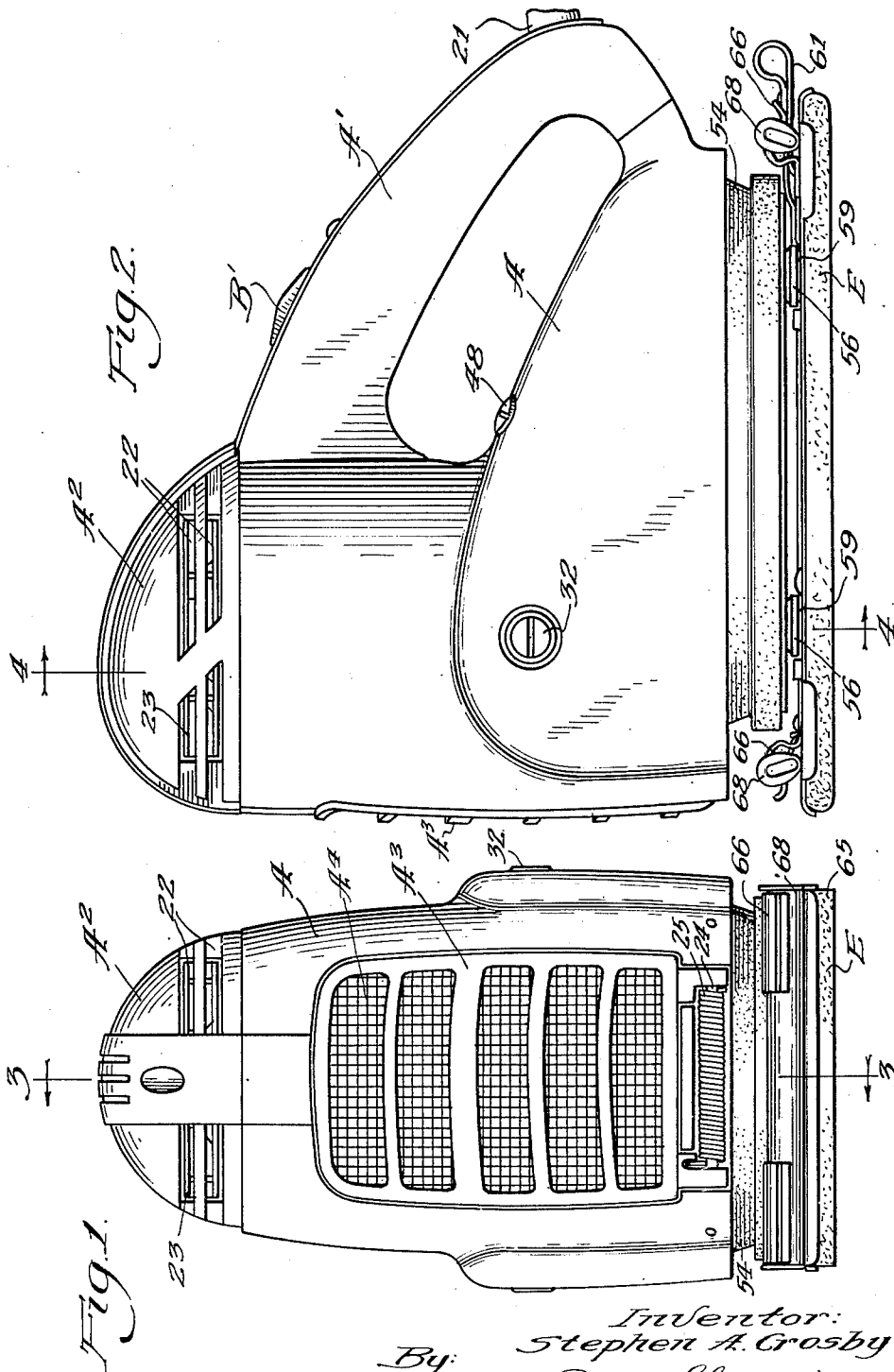
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2,395,537

RUBBING MACHINE

Filed Oct. 4, 1943

7 Sheets-Sheet 1



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RUBBING MACHINE

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7 Sheets-Sheet 2

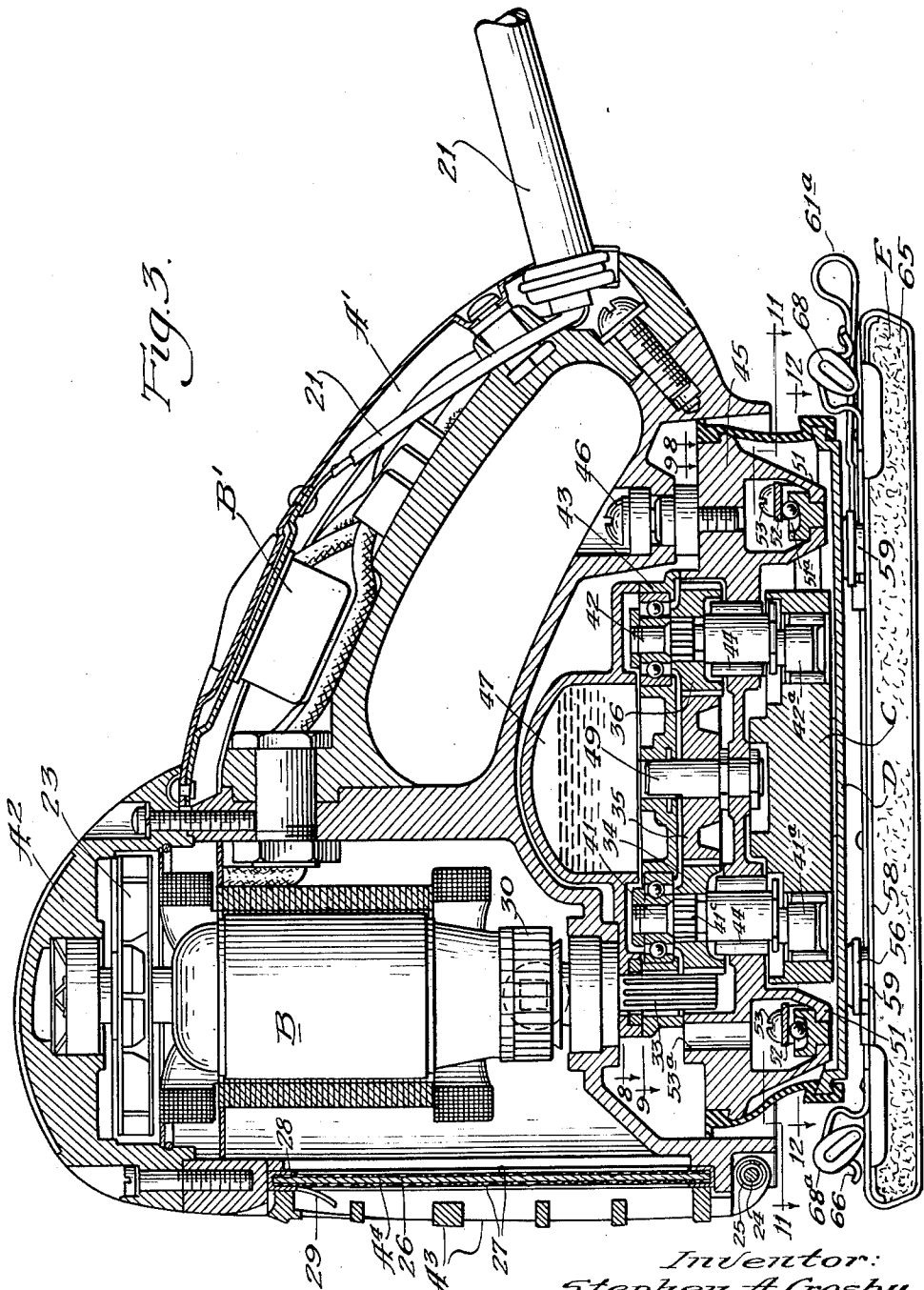


Fig. 3.

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Fig. 4.

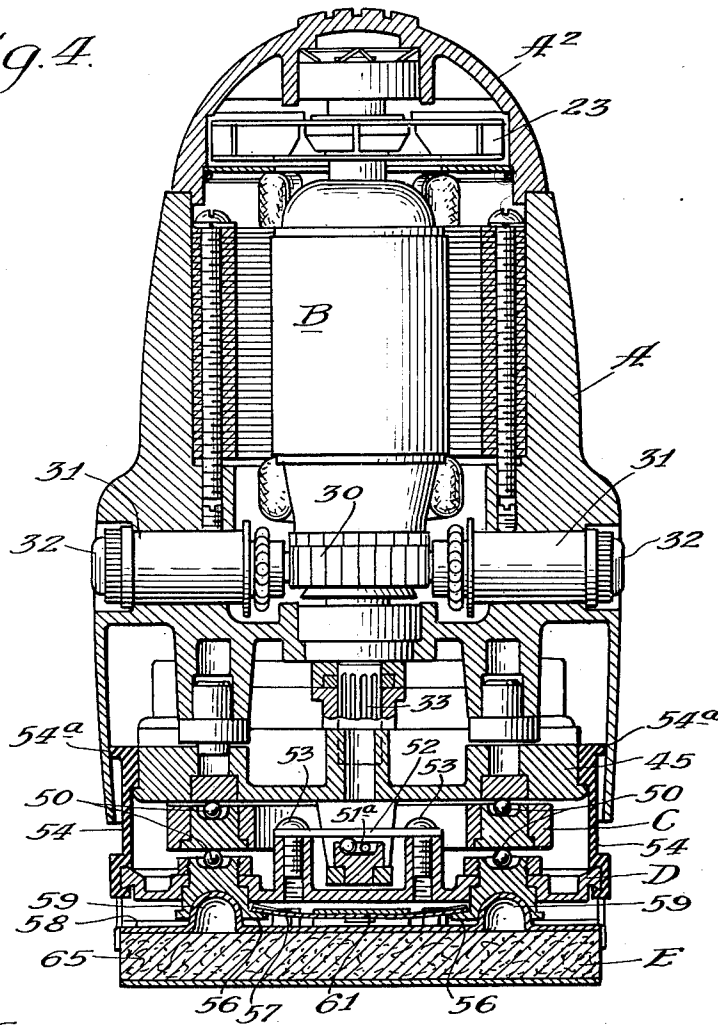


Fig. 5.

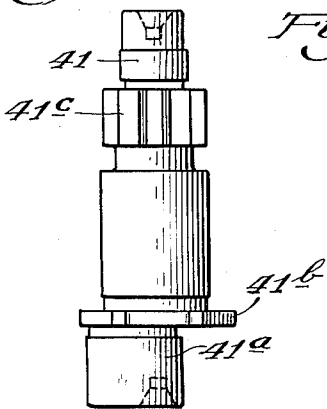


Fig. 6.

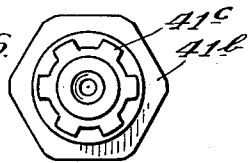
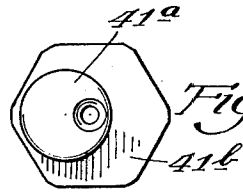


Fig. 7.



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Fig. 8.

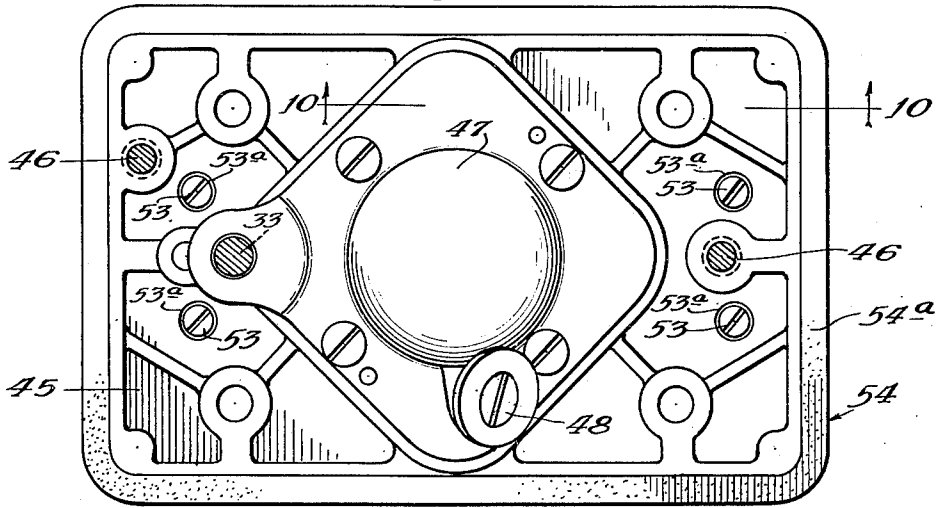


Fig. 9.

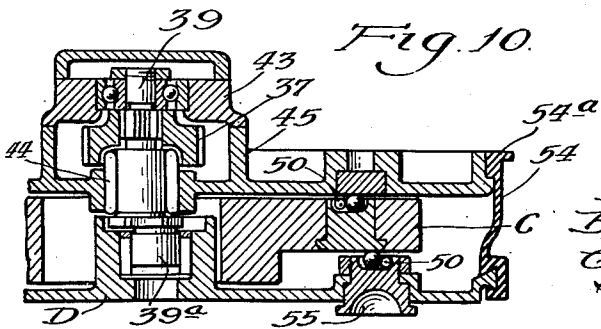
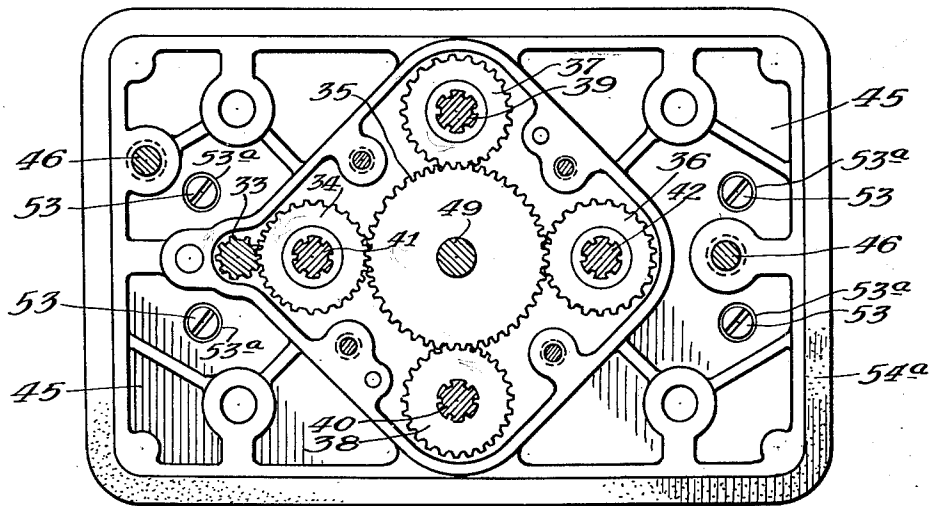


Fig. 10.

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Fig. 11.

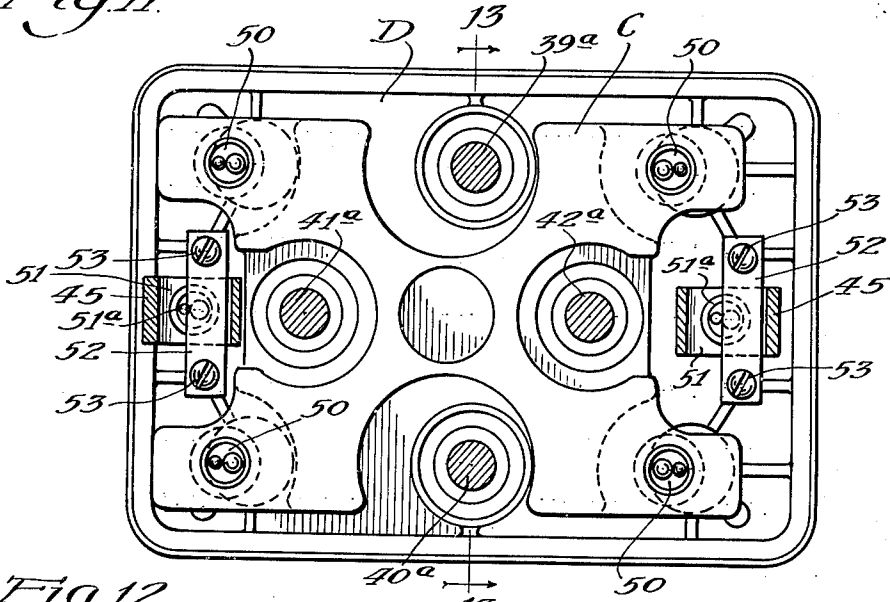


Fig. 12.

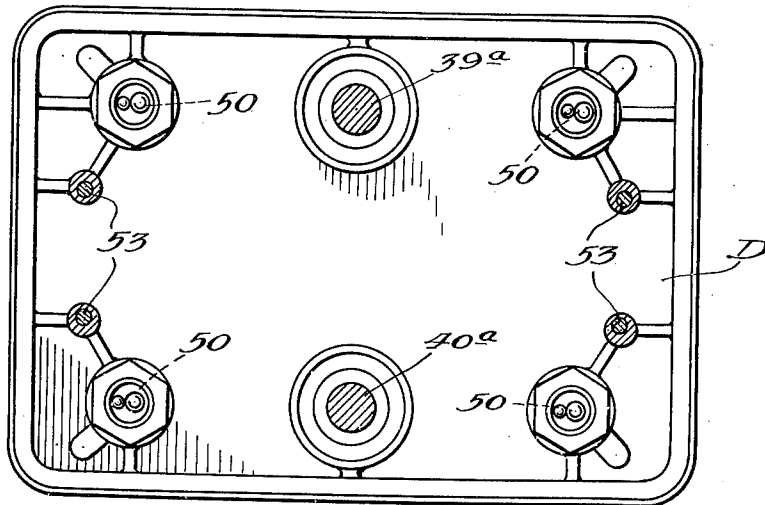
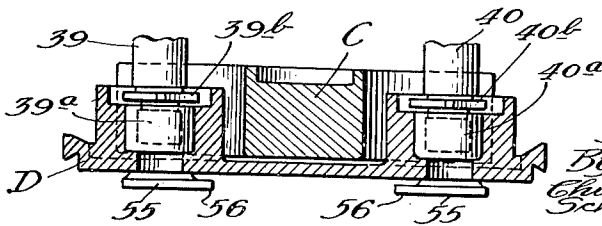


Fig. 13.



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Fig. 14.

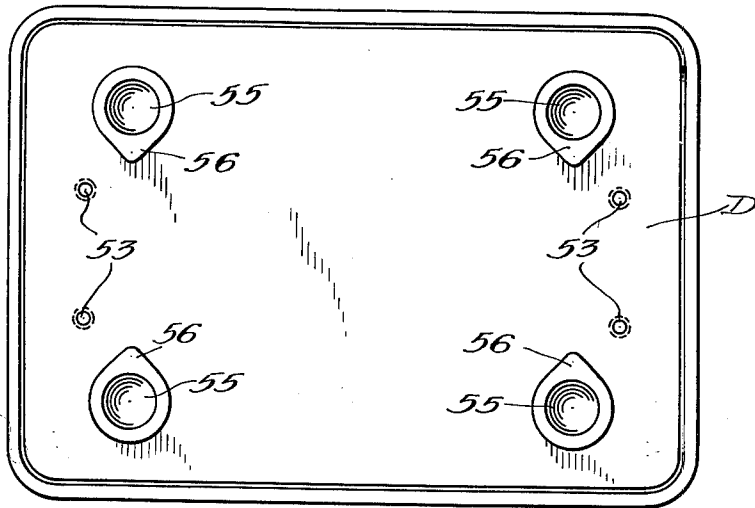
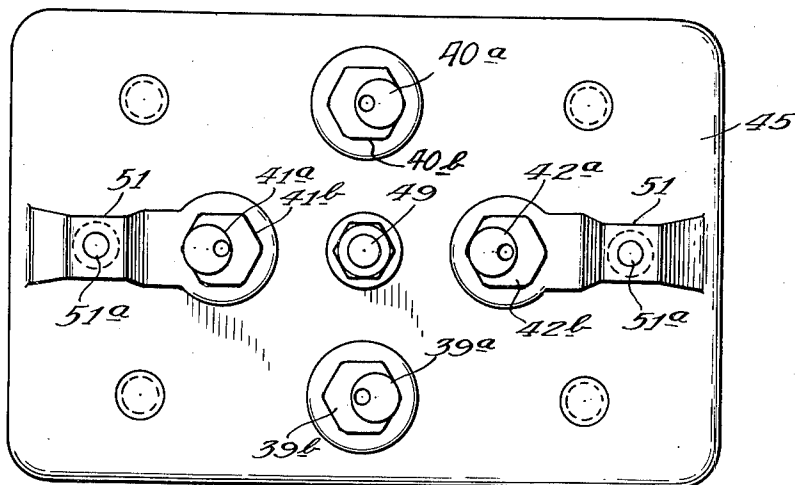


Fig. 15.



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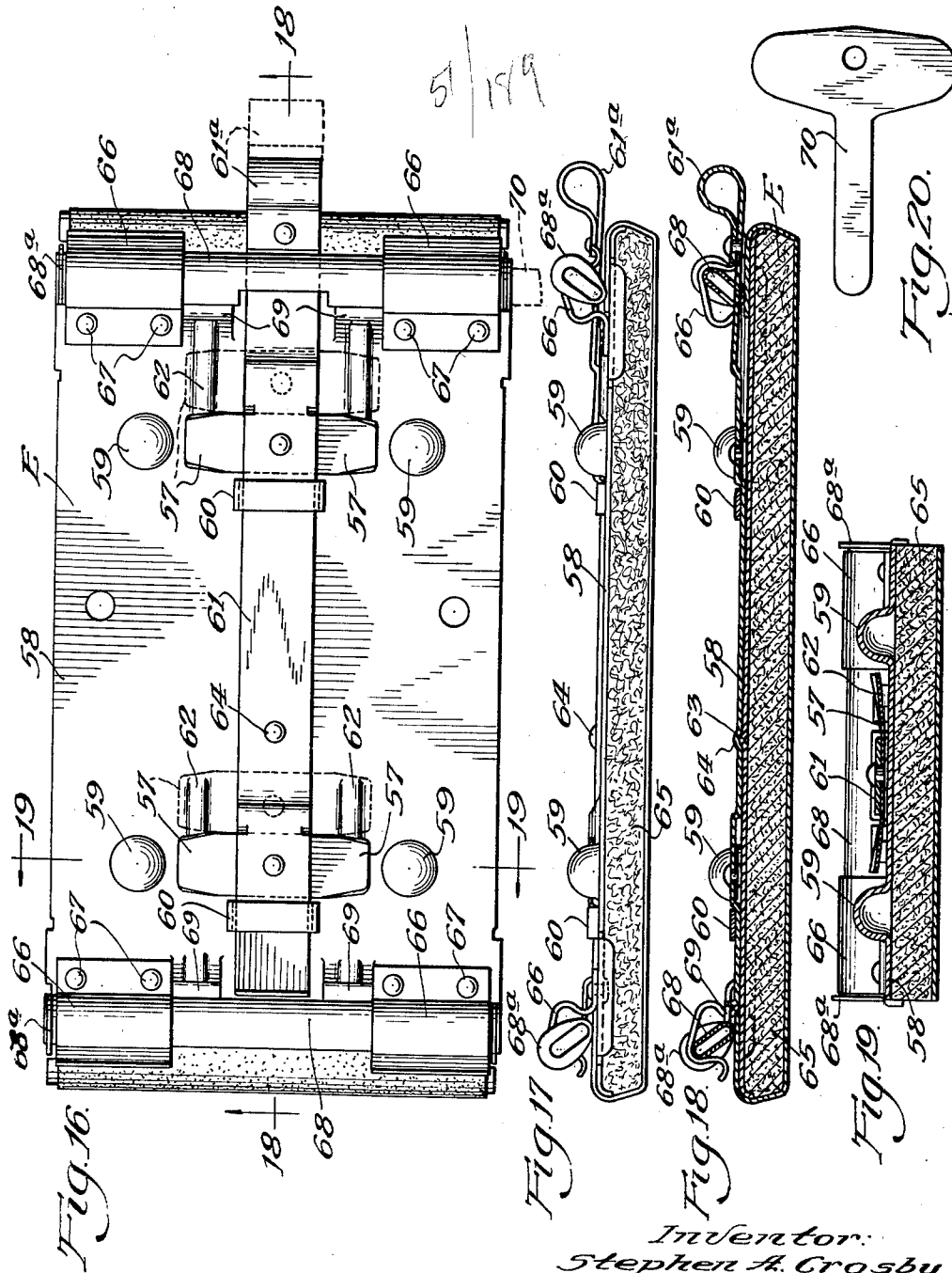
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RUBBING MACHINE

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7 Sheets-Sheet 7



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UNITED STATES PATENT OFFICE

2,395,537

RUBBING MACHINE

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Application October 4, 1943, Serial No. 504,855

17 Claims. (Cl. 51-170)

This invention relates to rubbing machines, and more particularly to small power driven sanders or polishing machines for use on various structural materials.

The primary object of the invention is to provide a portable rubbing machine which will reduce the physical fatigue and time spent in various sanding, lapping, and polishing operations in the manufacture of products made of wood, metal, or plastics.

Another object of the invention is to provide a portable rubbing machine where vibration is largely cancelled out by balancing the inertia forces in the operating head of the machine with forces generated in an opposed counterpoise driven by synchronized dual cranks.

A further object of the invention is to provide a portable rubbing machine having an electric motor which is cooled by air sucked through an improved and replaceable filter.

Another object of the invention is to provide an improved rubbing pad having an improved gripping and tensioning device for detachably holding a strip of abrasive on the pad.

Another object of the invention is to provide an improved transmission unit having a counterpoise driven by a pair of cranks which are geared to another pair of cranks which operate the drive head and are located in a common plane.

A further object of the invention is to provide an improved readily detachable rubbing pad making a ball-and-socket type of driving connection with the drive head so that the pad may be slightly flexed during operation to conform to regularly curved working surfaces.

Another object of the invention is to provide an improved unit where the various moving parts are enclosed and protected from dust and dirt which may be encountered in the use of the machine and to provide proper lubrication for the various operating parts.

The invention is illustrated in a preferred embodiment, in the accompanying drawings, in which:

Figure 1 is a front elevational view of a rubbing machine embodying the invention; Figure 2 a side elevational view of the same; Figure 3, a vertical sectional view, taken as indicated at line 3-3 of Figure 1; Figure 4, a vertical sectional view, taken as indicated at line 4-4 of Figure 2; Figure 5, an elevational view of one of the crankshafts; Figure 6, a top plan view of the crankshaft; Figure 7, a bottom plan view of the crankshaft; Figure 8, a top plan view of the

transmission unit, partly in section, taken as indicated at line 8-8 of Figure 3; Figure 9, a plan view of the transmission unit, partly in section, taken as indicated at line 9-9 of Figure 3; Figure 10, a fragmentary sectional view, taken as indicated at line 10-10 of Figure 3; Figure 11, a plan sectional view, taken as indicated at line 11-11 of Figure 3; Figure 12, a plan sectional view, taken as indicated at line 12-12 of Figure 3; Figure 13, a fragmentary transverse sectional view, taken as indicated at line 13-13 of Figure 11; Figure 14, a bottom plan view of the drive head to which the rubbing pad attaches; Figure 15, a bottom plan view of the transmission unit illustrated in Figures 8 and 9; Figure 16, a top plan view of a sanding pad; Fig. 17, a side elevational view of the sanding pad; Figure 18, a vertical sectional view, taken as indicated at line 18-18 of Figure 16; Figure 19, a vertical sectional view, taken as indicated at line 19-19 of Figure 16; and Figure 20, a plan view of a key for operating the tensioning and gripping tumblers on the sanding pad shown in Figure 16.

In the embodiment illustrated, A designates a housing frame provided with a handle A', a housing cap A², and a hinged grille A³ for holding a removable filter panel A⁴ in proper position; B, a vertically disposed electric motor provided with current through a switch B'; C, a counterpoise; D, a driving head; and E, a sanding pad which is attached to the driving head D.

In the embodiment illustrated, the housing frame A is provided with a handle A' through which electric current is supplied to the motor by means of suitable wiring 21. The main housing is surmounted by the cap A² provided with slots 22 through which air may be blown by the fan 23 provided at the upper end of the motor B.

The front end of the housing has a window-like opening which is protected by the grille door A³ which is hinged at 24 and urged to closed position by a coil spring 25. A filter panel A⁴ fits snugly in the opening in the front of the housing and is held in position by the door A³.

The filter panel is formed of a thin porous fibrous sheet 26 which is placed between two metal wire screws 27. The edges of the panel are bound, as indicated at 28, and formed so as to fit snugly in the opening and direct all air sucked through the windings of the motor by the fan 23 through the filter sheet 26. After the machine has been in operation for sometime, dirt and dust will accumulate on the front side of the panel. To remove this it is merely necessary to open the door A³, draw out the filter panel which is

equipped with a finger tab 29, and most of the dust may be removed by tapping the panel sharply. After the panel becomes too dirty, it may be readily replaced by a new one.

The motor B receives its power from the wiring 21 through a convenient finger switch B' arranged in the handle A'. Preferably the motor is of the universal type and a 1/2 horse power 110 volt motor is sufficient to drive the sanding head 4500 times per minute in a 1/8 inch orbit. As shown in Figure 4, the commutator 30 is engaged by brush members 31 and the brushes may be removed by means of cap screws 32. The motor shaft is provided at its lower end with a gear 33 which extends down into the transmission unit, and as shown in Figure 9, drives gear 34, which in turn drives idler gear 35. The gear 35 drives gear 36 and it also drives gears 37 and 38, the latter two being splined to crankshafts 39 and 40, respectively, which are provided with cranks 39a and 40a which impart orbital movement to the drive head D. In like manner, the gears 34 and 36 are splined to crankshafts 41 and 42, respectively, which have cranks 41a and 42a to drive the counterpoise C in an orbital movement which is 180° out of phase with the orbital movement of the drive head D.

The upper ends of the crankshafts 39, 40, 41, and 42 are anti-frictionally journalled in a top bearing plate 43 and are also anti-frictionally journalled, as indicated at 44, in the center bearing plate 45 which is secured to the main housing frame A by means of cushioned screws 46. The top bearing plate 43 is surmounted by an oil reservoir 47 into which oil may be introduced through the cap screw 48. The idler gear 35 is journalled on a fixed shaft 49 which is secured to the top bearing plate 43 and extends down through the center bearing plate 45.

The counterpoise C, as shown in Figures 10 and 11, is of irregular outline to provide clearance with respect to the drive head cranks 39a and 40a. As best shown in Figures 4 and 10, special ball thrust bearings 50 are provided for the counterpoise C to make contact with the center bearing plate 45 and the drive head D. It has been found advantageous to place a ball bearing in the alloy steel socket of smaller diameter than the main ball bearing to better maintain the position of the main ball bearing which carries the head. It will be understood that the orbital movement of the counterpoise is fully determined by the ball thrust bearing and the two cranks 41a and 42a.

The drive head D is supported for orbital movement by the center bearing plate 45 which, as shown in Figures 4 and 15, has a depending stirrup-like portion 51 which has a ball bearing socket 51a and forms an anti-frictional connection with a cross-bar 52 which is secured to the drive head by means of screws 53. As shown in Figures 8 and 9, the center bearing plate 45 is provided with holes 53a to permit access to the screws 53. As indicated above, the orbital motion of the drive head is provided by the cranks 39a and 40a which are very accurately synchronized with the movements of the cranks 41a and 42a of the counterpoise. In order to obtain very accurate timing, the gears 34, 36, 37, and 40 have their teeth and splines cut at the same time in a set and the crankshaft shown in Figures 5-7 is provided near its bottom with a hex head 41b which is quite useful in getting the splines 41c in proper relation to the eccentricity of the crank 41a.

The marginal edge portion of the drive head D and the center bearing plate 45 are provided with a dovetail or attaching flange so that a rubber sleeve 54 may be cemented thereto and prevent dust and dirt from entering the transmission assembly through the side. The rubber sleeve 54 is preferably provided at its top edge with an outwardly extending bead 54a which hugs the inside of the housing wall, as shown in Figure 4, and excludes dust.

As shown in Figures 13 and 14, the bottom of the drive head is provided with drive sockets 55 in the form of heat-treated alloy steel inserts having nibs 56 for engagement with fingers 57 provided on the sanding pad.

As best shown in Figures 16-19, the sanding pad E has a thin steel backing plate 58 provided with upwardly struck dome-like detents 59 positioned to fit into the sockets 55 on the driving head. The backing plate also has a pair of keepers 60 to carry a slidable latching member 61 on which the flexible fingers 57 are mounted. The backing plate also has upwardly extending ribs 62 so that when the latching bar is drawn rearwardly by the handle 61a to the dotted position shown in Figure 16, the fingers will be flexed and held in a position from which they may readily re-engage the nibs 56 on the drive head.

The ball-and-socket driving connection between the drive head and backing plate permits the pad, during operation, to be flexed concavely or convexly to conform to desired curves on the object being worked upon, such as an airplane wing.

As shown in Figure 18, the backing plate may be provided with a detent 63 to engage a socket 64 in the latching member when it is in latching position and prevent accidental disengagement.

A suitable felt pad 65 may be cemented to the bottom face of the backing plate. In order to properly tension a strip of fabric or abrasive, such as sandpaper, around the pad a special gripping and tensioning mechanism is provided at each end of the backing plate 58. A pair of inverted U-shaped spring keepers 66 are riveted to the backing plate at each end, as indicated at 67. This cantilever support provides an open jaw through which the end of the strip of abrasive may be inserted. A hollow oval shaped tumbler member 68 is confined by said keepers and is provided with end flanges 68a to prevent them from slipping out endwise. The backing plate 58 is provided with upwardly extending stops 69 to limit the rearward oscillation of the tumbler member 68. It will be noted that the loop portion of the keeper is slightly larger in its top portion than adjacent to the backing plate. Accordingly, the tumbler member, viewed at the left of Figure 18, may be rotated clockwise from the position shown in Figure 18 until it snaps up completely out of contact with the backing plate. This leaves an open space between the mouth of the keeper and the backing plate into which the strip of abrasive may be projected. The tumbler is then turned counterclockwise and it will engage the strip, press it against the backing plate, and pull it rearwardly until the tumbler strikes the stop 68. During this movement the upper edge of the tumbler swings across the loop and snaps into the position shown in Figure 18, so that the strip is held firmly in position. The tumbler member has an axial slot which may be conveniently engaged by a suitable key 70, shown in Figure 20, and the tensioning device can thus be readily operated. In the embodiment illus-

trated, a similar tensioning device is shown at each end of the pad, but it will be understood that any simple clamp for the strip can be used at the opposite end from the tensioning device.

To operate the device it is merely necessary to place the rubbing machine on the article to be worked upon and start the motor by the switch B'. The motor then causes the four crankshafts to rotate at a very high rate of speed and the rubbing pad moves in a circular orbit of about $\frac{3}{8}$ of an inch with respect to the housing frame. At the same time the counterpoise is driven 180° out of phase with the sanding pad at exactly the same rate of speed. This causes the inertia forces, which would otherwise be transmitted to the handle, to be cancelled out for the most part and the fatiguing effect on the operator is practically eliminated. When the sanding pad is placed in contact with material to be abraded, a slight additional unbalanced force is added, but as that force is only about $\frac{1}{2}$ of 1% of the one balanced out by the counterpoise, its effect is practically negligible.

The foregoing detailed description has been given for clearness of understanding only, and no unnecessary limitations should be understood therefrom for some modifications will be obvious to those skilled in the art.

I claim:

1. A portable rubbing machine, comprising: a supporting frame, a single drive head mounted on said frame for orbital movement with respect thereto, a counterpoise mounted between said drive head and frame for orbital movement with respect to the frame, and driving means for driving said drive head and counterpoise in out of phase synchronism to balance out inertia forces at a high speed.

2. A machine as specified in claim 1, in which the counterpoise is disposed within the vertical outline of the drive head.

3. A machine as specified in claim 1, in which the driving means includes four crankshafts which are geared together, two of said crankshafts driving the drive head and the remaining two driving the superposed counterpoise.

4. A machine as specified in claim 1, in which the driving means includes four crankshafts which are geared together, two of said crankshafts driving the drive head and the remaining two driving the counterpoise, the cranks of said four crankshafts operating in the same horizontal plane.

5. A machine of the class described, comprising: a housing frame containing a driving motor, means for filtering and circulating air through the windings of said motor, a drive head mounted on the underside of said housing frame for orbital movement with respect thereto, a counterpoise between said drive head and housing frame for out of phase orbital movement in synchronism with the drive head, a pair of crankshafts for driving said counterpoise, another pair of crankshafts for driving said drive head, said pairs of crankshafts being geared together and driven by the motor, and a rubbing pad detachably mounted on the bottom of said drive head.

6. A machine as specified in claim 5, in which the means for filtering and circulating the air comprises a filter screen removably mounted in an opening in the front of the housing frame, a perforate door for said opening to hold the screen in position, and a fan at one end of the motor for drawing air through the filter screen and winding of the motor.

7. A machine as specified in claim 5, in which the means for filtering air passing through the motor includes a removable panel having a thin porous fibrous sheet disposed between a pair of metal screens, the edges of said panel being shaped to make a snug fit with an opening housing frame.

8. A machine of the class described, comprising: a supporting frame; a transmission unit secured to said frame and including a depending drive head mounted for orbital movement with respect to the frame, and a counterpoise in said unit for partially balancing out inertia forces in the drive head when driven at high speed; means for driving said drive head and counterpoise in the transmission unit in out of phase synchronism; and a flexible rubbing pad having a detachable ball-and-socket driving connection with the bottom of said drive head.

9. A machine as specified in claim 8, in which the rubbing pad has a thin metal backing plate provided with a slidable latch for engaging nibs on the drive head adjacent to the ball-and-socket connections.

10. A machine as specified in claim 8, in which the rubbing pad has a thin metal backing plate provided with a slidable latch for engaging nibs on the drive head adjacent to the ball-and-socket connections, a fibrous pad secured to said backing plate, and oscillatable gripping means provided on the upper side of the backing plate for gripping and tensioning a strip of abrasive material about the fibrous pad, said gripping means being key-operable.

11. A rubbing machine comprising: a supporting frame, a drive head mounted on said frame for orbital movement with respect to the frame, a plurality of drive sockets and attachment nibs on the bottom of the drive head, a rubbing pad having a backing plate provided with drive bosses to fit into the sockets on the drive head, a latching member slidably mounted in keepers on said backing plate and having fingers to engage yieldingly the nibs on said drive head and hold the pad thereon, and means for driving said head.

12. A machine as specified in claim 11, in which the backing plate is provided with ribs over which the fingers slide when the latching member is disengaged from the nibs to flex the fingers and facilitate re-engagement with the nibs.

13. In a machine of the character set forth, a backing plate for a strip of abrasive material, and a tensioning and locking device for said strip comprising an inverted U-shaped keeper of spring metal having one end secured to said plate and the other end free and providing a mouth to receive the end of the strip, and an oval shaped tumbler in said keeper shaped to fit the channel therein and be yieldingly held out of contact with the plate when said tumbler is turned to horizontal loading position, and said tumbler when partially turned in the keeper being adapted to grip the end of said strip of abrasive and force it rearwardly and lock it between the tumbler and plate.

14. A device as specified in claim 13, in which the backing plate is provided with stops to limit the rearward tensioning oscillation of the tumbler.

15. A device as specified in claim 13, in which the tumbler is hollow to provide a key receiving slot at its end, and said tumbler has flanges on its ends to hold it against axial movement in the keeper.

16. In a machine of the character set forth, a

backing plate for a strip of abrasive material, means for securing said strip to one end of said backing plate, and tensioning means at the other end of said plate for gripping and tensioning the strip about one face of the backing plate, said tensioning means having an oval shaped tumbler adapted to engage frictionally the abrasive strip to press it against the backing plate, and said tensioning means having a spring member for yieldingly urging said tumbler towards said plate. 10

17. In a machine of the character set forth, a backing plate for a strip of abrasive material, means for securing said strip to one end of said backing plate, and tensioning means at the other

end of said plate for gripping and tensioning the strip about one face of the backing plate, said tensioning means having an oval shaped tumbler member adapted to engage frictionally the abrasive strip and press it against the backing plate, and said tensioning means having a spring member for yieldingly urging said tumbler toward said plate, said spring member providing an inverted U-shaped channel to receive an edge of the tumbler loosely and permit the upper portion of said tumbler to be snapped across the center of said channel to lock the tumbler in tensioning position.

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