

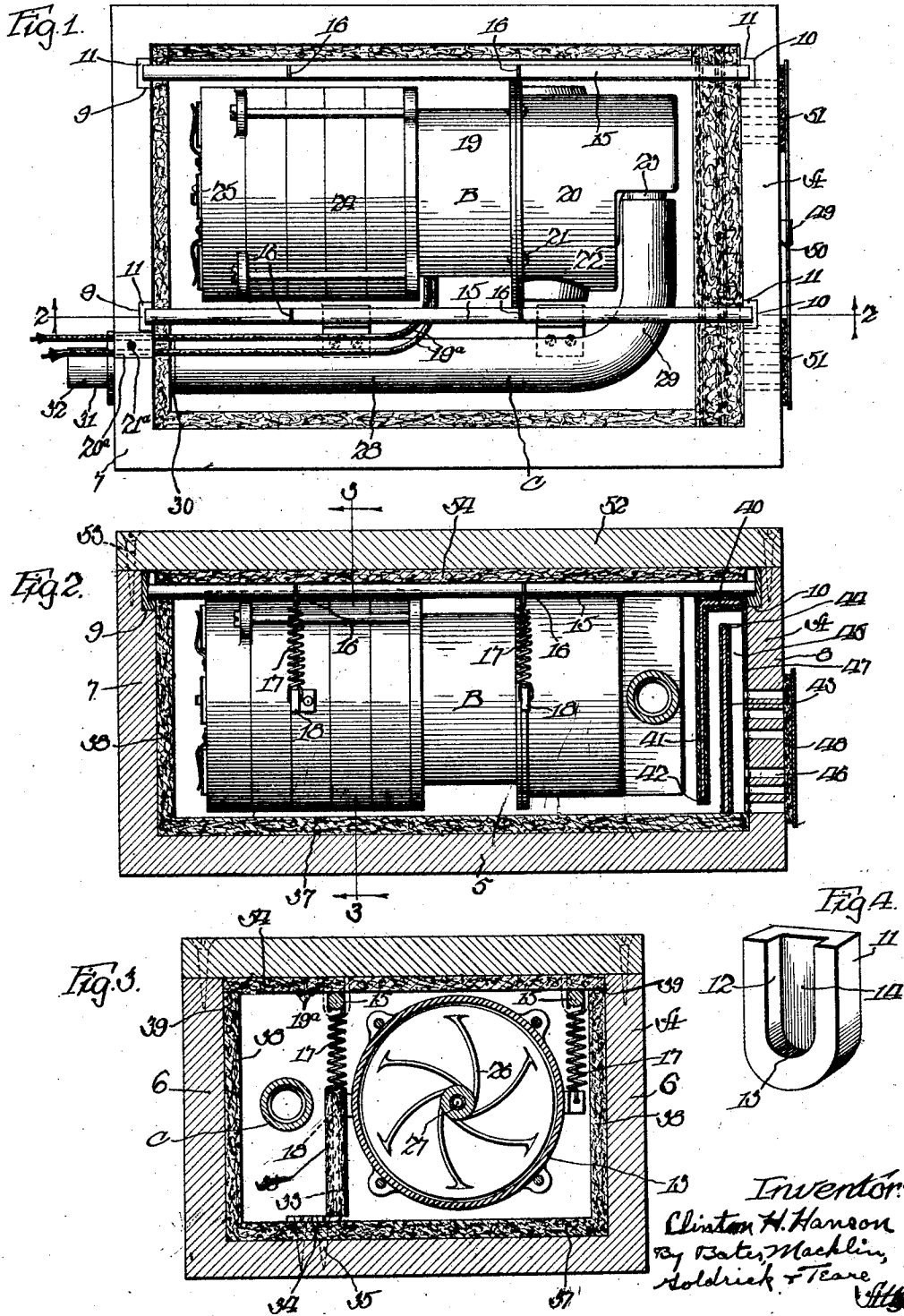
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SUCTION PRODUCING APPARATUS

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## UNITED STATES PATENT OFFICE.

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## SUCTION-PRODUCING APPARATUS.

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This invention relates to suction producing apparatus.

The general object of my invention is to produce a suction producing device which is especially adapted for use in connection with automatic or player pianos to create the necessary vacuum for actuating the hammers, expression devices and other pneumatically operated instrumentalities commonly employed with player pianos.

Another object of my invention is to provide a device of the character indicated which will operate noiselessly so as to prevent any interference with the proper rendition of the music.

Another object of my invention is to provide an apparatus of the character indicated which is particularly adapted, because of its compactness and extremely shallow height, for installation in player pianos of the so-called "grand" type where very little space is available for devices of this character and, more particularly, such a device which has a container conforming to the esthetic requirements of the manufacturers and users.

A specific object of my invention is to provide, in an apparatus of the character indicated, especially efficient means for mounting the suction unit proper within the container therefor in such manner that all mechanical vibrations and consequent noises that would otherwise arise therefrom, are completely dampened or dissipated entirely within the container and without being transmitted in any wise to the container proper, thereby preventing any sounds arising from, or being set up by, the container which would militate against the desired musical effect of the player piano.

Another specific object of my invention is to provide an arrangement within the container such that the intake conduit for the air being exhausted from the piano pneumatics can accommodate itself by flexing to all possible vibratory movements of the suction unit so that no mechanical vibrations and consequent sounds that would be generated thereby, can be transmitted through said conduit to the exterior of the container, or to the container itself.

Still another object of the invention is to provide novel sound-insulating means for the container, including an arrangement whereby the fluid drawn through the suction unit enters the same at one point, is dis-

charged at another point, and thence travels in a tortuous path through the container before emergence therefrom, sound-dampening or insulating means being provided throughout such passages for deadening or absorbing the sound waves, thereby offering an increased area of sound-insulated surfaces over which the sound waves must travel before their exit from the container.

Other and further objects of my invention will more fully and clearly appear from the description and claims hereinafter following.

In the drawing, Figure 1 illustrates a top plan view of the invention with the cover of the container removed to clearly illustrate the disposition of the various parts of the suction unit. Figure 2 is a longitudinal, vertical, part sectional view on the line 2—2 of Figure 1. Figure 3 is a transverse, sectional view of the invention on the line 3—3 of Figure 2, and Figure 4 is an enlarged, detail view of a cushioning member used in connection with the invention.

Referring to the drawings, A represents a sound-proof container, B the suction unit comprising the usual motor and fan, and C the flexible suction conduit connected to the suction unit and extending exteriorly of the container.

The container A preferably includes a box-like receptacle which is preferably of wood, although the same may be of any other suitable material. Such receptacle preferably comprises a bottom wall 5, side walls 6, and end walls 7 and 8. The top inner edges of the end walls 7 and 8 are preferably provided with spaced recesses 9 and 10, each of which is shaped and arranged to snugly accommodate a cushioning member 11 of the type illustrated in Figure 4. Each of the cushioning members 11 is preferably in the form of a rubber pad provided with a recess 12 extending from the top to a point adjacent the bottom, the bottom of such recess being preferably rounded as indicated at 13, and the recess is of such depth as to leave a rear wall 14 of substantial thickness.

The means for supporting the suction unit B in the receptacle preferably comprises metal rods 15, the opposite ends of each of which fit snugly into the recesses 12 of the cushioning members 11, the cushioning members in turn, of course, resting upon the walls

provided by the recesses 9 and 10. Each rod 15 is preferably provided at spaced points with grooves 16, each of which is arranged to receive a looped portion of one end of a coil spring 17. The opposite ends of the springs 17 are secured to ears 18 formed on the suction unit, and it will be noted that the springs resiliently suspend the suction unit B from the rods 15, so that vibration of the apparatus incident to its operation is absorbed by such springs. It should also be observed that the supporting rods are themselves supported on the cushions 11, permitting slight cushioned lateral and longitudinal movement of the rods 15 should any occur, so as to still further absorb all mechanical vibrations set up by the operation of the suction unit.

The suction unit B comprises any suitable, high speed motor 19, the outlines only of which are indicated in the drawings, such motor having electric wires 19<sup>a</sup> connected therewith and extending outwardly beneath a removable block 20<sup>a</sup>, disposed in a suitable recess in the end wall 7 of the receptacle, such block being adjustably pressed against said wires by means of a screw 21<sup>a</sup>, as shown. Connected to such motor is a hollow inlet or vacuum chamber member 20, secured at one end thereof by suitable fastening means, such as bolts 21, the chamber member 20 being provided with a reduced portion 22 having a nipple 23 formed thereon. A sectional housing 24 is secured to the other end of the motor 19 by any suitable means, such housing being provided with spring controlled flap valves 25 to provide openings for the fluid drawn through the motor, and such housing encloses a multi-stage fan, the motor of which is indicated conventionally at 26, connected to the armature shaft 27 of the motor.

The suction conduit C is of flexible material comprising a portion 28 extending substantially parallel to the suction unit, and a curved portion 29 connected to the nipple 23 on the vacuum chamber member 20, as clearly shown in Figure 1 of the drawing. The portion 28 of the conduit C is connected to a short length of pipe 30 which is secured in the end wall 7 of the receptacle, such pipe 30 being fitted snugly in such end wall and held in position by a suitable bracket 31. The exterior portion 32 of such pipe is connected to a conduit which extends to the musical instrument, not shown, in a well-known manner. It should be noted that by reason of the disposition of the conduit C, lateral movements or vibrations of the suction unit in all directions are permitted by lateral flexing of the portion 28 of the conduit, and lateral flexing of the curved portion 29 of such conduit, whereas longitudinal vibrations of the suction unit in all directions are also permitted by similar flexing of the con-

duit. In other words, the universal movement or vibration of the suction unit is permitted by the universal flexible movement of the suction conduit C without injury to the conduit, or the communication of the vibrations of the suction unit to the container.

While I have shown the conduit C as composed of a single section of flexible material, nevertheless it will be understood by those skilled in the art that the same efficient results can be obtained with other constructions, the important feature residing in the fact that there are at least two portions of the conduit, considered as an entirety, which extend at angles to each other and therefore permit of flexibility both vertically and horizontally, or a combination thereof without the possibility of transmitting mechanical vibrations and accompanying noises through such conduit to the container or exteriorly thereof.

The lateral swinging of the suction unit is limited by the adjacent side wall 6, and by upstanding posts 33 which are preferably disposed between the suction unit and the flexible conduit C as shown in Figure 3, each of such posts having a base portion 34 resting on top of the bottom layer of felt 37 and secured to the bottom wall 5 of the container A by screws 35 or other suitable fastening means. Each of the posts 33 is covered with a thick layer 36 of sound-insulating material for the purpose of preventing noise due to striking of the suction unit against the posts during operation of the suction unit, or when the suction apparatus is being handled.

The bottom wall 5 of the receptacle is provided with a relatively thick layer of sound-insulating material 37, preferably felt, and the side walls 6, and the end wall 7, are provided with similar layers 38 of sound-insulating material, the layers 38 of the material extending upwardly to points closely adjacent to the edges of the side walls 6 and end wall 7 as indicated at 39. The end wall 8 of the receptacle has secured adjacent its upper edge, preferably at a height slightly above the bottom walls of the recesses 10 in the wall 8 of the casing, a supporting web 40 extending inwardly from the wall 8 in a horizontal direction for a suitable distance, and formed on the inner end of such web is a downwardly projecting baffle wall or partition 41 which extends transversely across the container A, and has its lower end 42 spaced a relatively small distance from the layer 37 of the insulating material on the bottom wall 5 of the container. Such web 40 and partition 41 are covered on all sides with sound-insulating material, preferably felt. A separate, oppositely disposed, upstanding baffle wall or partition 43 is disposed between the end wall 8 and the baffle wall 41, and has its lower end tightly fitting against the layer 36

of insulating material on the bottom wall 5 of the container, and its upper end 44 spaced a relatively short distance from the under surface of the web 40, the partition 43 extending transversely across the container and having its end portions curved inwardly as shown at 45 and secured to the end wall 8 of the receptacle. The partition 43 is also entirely covered with sound-insulating material, preferably felt. The end wall 8 is provided with a plurality of openings 46, and on the inner surface of such end wall is disposed a layer of sound-insulating material 47 which substantially entirely covers said wall except over the openings 46. On the outer side of the wall 8 is provided a resilient plate 48 secured to the wall 8 by a suitable screw 49, there being a spacing member 50 interposed between the plate 48 and the outer surface of the wall 8, as clearly shown in Figure 1, so as to space the plate 48 from the wall 8. At each end of the plate 48 on its inner surface are provided pads 51 of insulating material which are resiliently held by the plate 48 against the wall 8 of the container in position to yieldingly close the openings 46.

A cover 52 is adapted to be removably secured to the top edges of the receptacle by suitable fastening members such as screws 53 placed at suitable intervals, and upon the inner surface of the cover 52 is secured a continuous pad of insulating material 54, such pad being of a size as to exactly fit within the walls of the container, and of a thickness as to bear snugly against the top edges of the layers 38 of insulating material on the side walls 5, end wall 7 and web 40 when the cover is secured in position, thereby pressing against the upper surfaces of supporting rods 15, and clamping the electric wires 19<sup>a</sup> between the layer 54 of insulating material on the cover 52, and the upper edges of the insulating material 38 upon the end wall 7, the block 20<sup>a</sup> serving also to press the wires against the upper edges of the insulating material 38.

When the suction unit is operated, the fans 26 are rapidly rotated by the motor, causing a suction in the unit, and due to the operation of the motor and fan, considerable vibration is normally set up, which vibration is absorbed by the supporting coil springs 17, by the combined swinging and yielding properties of said springs, so that such vibrations of the suction unit are not transmitted to the supporting rods 15, and even if such vibrations reach the supporting rods, it will be appreciated that they are greatly lessened in power, and any vibration set up in the rods 15 is absorbed by the rods themselves which are flexible and the cushioning members 11 in which the rods are mounted. It is thus apparent that all of the mechanical vibrations due to the operation of the suc-

tion unit are effectually dampened or absorbed so that none of the same reach the walls of the container A and hence no sympathetic vibrations are set up in such container.

The sound waves set up by operation of the suction unit are absorbed on all sides by the thick layers of sound-insulating material, and the fluid exhausted from the suction unit, which probably conducts a large portion of the sound waves, is exhausted at the closed end of the container and thence travels toward the other end of the container, being deflected by the partition 41 and compelled to travel beneath such partition, thence upwardly between the partitions 41 and 43, and downwardly between the partition 43 and the layer 47 of insulating material on the end wall 8. The air then passes out through the series of openings 46, where it is again intercepted or retarded by the sound-absorbing pads 51 which are yieldingly held over the openings by the plate 48. From the preceding description, it will be seen that, by discharging the air at the left hand end of the suction unit as viewed in Figure 1, and then requiring that air to finally pass out at the opposite end of the container, I provide the maximum possible area of sound-absorbing surfaces for that air to come in contact with in its travel so that the noise is, as has been demonstrated in actual practice, completely eliminated or absorbed within the container. Stated in another manner, the entire interior surface area of the container is provided with sound-absorbing material so that the sounds carried by the air are most effectively dampened or absorbed and this, in combination with the mounting of the suction unit so as to prevent transmission of any mechanical vibrations to the container, provides a more perfectly noiseless apparatus for the purpose indicated, than any heretofore.

Another important feature of my improvements resides in the particular method of suspending the suction unit within the container. Upon removing the cover of the container, it is evident that the entire suction unit can be bodily lifted out by grasping the rods 15, after the conduit C has been disconnected from the nipple 23, and the wire retaining block 20<sup>a</sup> removed. This is of great importance both in assembling the parts and in facilitating the oiling or inspection of the apparatus after it is in service and it will be noted that no part is destroyed in such removal of the unit, and the parts may be re-placed without the aid of any tools or particular experience on the part of the user. Further, when the suction unit is removed from the container, by simply disconnecting the suspension springs 17 from the rods 15, the suction unit can be handled with the greatest facility either for

oiling or inspection or adjustment of any of the parts.

Other advantages of my improved construction are found in the following. By  
 5 arranging the suction unit horizontally and keeping the dimension of the fan sections of relatively small diameter, the overall height of the apparatus is very small and in fact much less than that of any other ap-  
 10 paratus for a similar purpose, so far as I am aware. This makes the apparatus particularly advantageous for use in grand pianos where the space available for appara-  
 15 Furthermore, as will be evident from an inspection of the drawings, while the suction unit may move in any direction either vertically, laterally or longitudinally, neverthe-  
 20 against which the suction unit will come in contact with, regardless of the position in which the apparatus may be placed in ship-  
 ment or in handling, thereby preventing any injury to the parts while at the same time  
 25 confining such possible movement to relatively small, predetermined limits.

While I have herein shown and described what I now consider the preferred manner of carrying out my invention, the same is  
 30 merely illustrative, and I contemplate all changes and modifications that come within the scope of the claims appended hereto.

I claim:

1. In a suction apparatus of the character  
 35 described, the combination with a container, of a suction producing unit disposed within said container, a flexible tube for conducting air from the exterior of the container to the  
 40 interior of said unit, flexible vibration insulating means for suspending said unit within the container, the air after being  
 acted upon by said unit being delivered therefrom under pressure into the space sur-  
 rounding said unit and tube.

2. In a suction apparatus of the character  
 45 described, the combination with a container embodying a box-like member open at the top, said container having spaced recesses opening upwardly adjacent the upper end  
 50 thereof, supports mounted in said recesses, a suction producing unit carried by said sup-  
 ports, and a cover providing a closure for said container.

3. In a suction apparatus of the class de-  
 55 scribed, the combination with a container; of a suction producing unit therein; means carried by said container and arranged to support said unit for universal vibratory  
 movement; and a suction conduit extending  
 60 through the container and connected to said unit and flexibly partaking of the move-  
 ments thereof.

4. In a suction apparatus of the class de-  
 65 scribed, the combination with a container; of a suction producing unit; means carried by

said container and arranged to support said unit for vibratory movements; and a flex-  
 ible conduit connected to said suction unit, said conduit being provided with a bend  
 within said container to permit flexing of  
 said conduit in consonance with the move-  
 ment of said suction unit.

5. In a suction apparatus of the class de-  
 scribed, the combination with a container; of  
 a suction producing unit disposed in said  
 75 container; of means arranged to support  
 said unit for vibratory movements; and a  
 flexible conduit within said container and  
 having a portion curved about a portion of  
 said suction producing unit.

6. In a suction apparatus of the class de-  
 scribed, the combination with a container  
 comprising a receptacle having its walls pro-  
 vided with layers of sound-insulating ma-  
 80 terial; cushioning members supported by the  
 walls of said receptacle; supporting elements  
 mounted in said cushioning members in such  
 manner that the unit may be moved univer-  
 sally with reference to the elements; a suc-  
 90 tion producing unit carried by said elements,  
 said unit including a motor; electric wires  
 connected to said motor and extending ex-  
 teriorly of said receptacle; and a cover for  
 said receptacle having a layer of sound-in-  
 95 sulating material secured thereto and ar-  
 ranged to fit within the walls of said re-  
 ceptacle and bear against said electric wires.

7. In a suction apparatus of the class de-  
 scribed, the combination with a sound-insu-  
 100 lated container; of a receptacle having its  
 walls provided with layers of sound-insulat-  
 ing material; cushioning members supported  
 by the walls of said receptacle; supporting  
 elements mounted in said cushioning mem-  
 105 bers; a suction producing unit disposed in  
 said receptacle; yieldable means mounted on  
 said supporting elements and arranged to  
 permit universal movement of said suction  
 producing unit with reference to the con-  
 110 tainer and prevent transference of any vi-  
 brations to the container; and a cover for  
 said receptacle having a layer of sound-in-  
 sulating material secured thereto and ar-  
 115 ranged to fit within the walls of said recep-  
 tacle.

8. In a suction apparatus, the combination  
 with a sound-insulated container having  
 openings at one portion thereof; of a suc-  
 120 tion producing unit disposed in said con-  
 tainer; a plurality of yieldable means swing-  
 ably supported in said container and ar-  
 ranged to carry said suction unit; a flex-  
 ible conduit providing communication be-  
 125 tween the exterior of the container and the  
 interior of the unit, and baffle walls arranged  
 adjacent said openings.

9. In a suction apparatus of the class de-  
 scribed, the combination with a sound-insu-  
 lated container having openings at one por-  
 130 tion thereof; of a suction producing unit

disposed in said container; swingably mounted, yieldable means supported by said container and arranged to carry said suction unit; a flexible conduit communicating with the exterior of said container and having a portion within said container provided with a bend; and sound-insulated baffle walls arranged adjacent the openings in said container.

10. In a suction apparatus of the character described, the combination with a container comprising a receptacle having its walls provided with layers of sound-insulating material, said receptacle having a portion provided with openings; cushioning members supported by the walls of said receptacle; supporting elements mounted in said cushioning members; a suction producing unit disposed in said receptacle; yieldable means swingably connected to said support and carrying the said suction unit; an inwardly disposed extension upon said receptacle having a depending projection providing a sound-insulated baffle wall; an oppositely disposed baffle wall spaced from said first wall and the wall of said container adjacent said openings; and a cover for said receptacle having a layer of sound-insulating material secured thereto and arranged to fit within the walls of said receptacle.

11. In a suction apparatus of the class described, the combination with a container comprising a receptacle having its walls provided with layers of sound-insulating material, said receptacle having a portion provided with openings; cushioning members supported by the walls of said receptacle; supporting elements mounted on said cushioning members; a suction producing unit disposed in said receptacle; yieldable means swingably connected to said supporting elements and carrying said suction unit; sound-insulated baffle means disposed adjacent said openings; and a cover for said receptacle having sound-insulating material secured thereto arranged to fit within the walls of said receptacle.

12. In a suction producing apparatus of the class described, the combination with a container, of a suction producing unit disposed in said container and yielding means swingably supported by the container and arranged to carry the suction unit, rigidly supported pads of resilient material normally slightly spaced from the suction unit and allowing limited movement of the suction unit in any direction.

13. In a suction producing apparatus, the combination with a container, a suction producing unit therein, means carried by the container and arranged to support said unit for a universal vibratory movement, resilient pads arranged within the container and rigidly carried closely adjacent to the unit and normally spaced therefrom and acting to

limit the swinging movement within the container.

14. In a suction apparatus with a container having rigid walls, a suction producing unit mounted therein, a resilient means for supporting a suction producing unit normally out of contact with said walls, and means including pads on the walls for limiting swinging movement of the container in any direction during handling or transporting of the container with the unit therein.

15. In a suction apparatus of the class described, the combination of a boxlike container having top, bottom, side and end walls, a suction producing unit therein; means carried by the container and arranged to support said unit for universal vibratory movement, the top, bottom and end walls being spaced slightly away from the unit when so supported, a flexible suction conduit connected to the unit, and leading to one of the walls and rigid stop members having resilient means thereon serving to limit lateral swinging movement, said stop members being positioned between and away from the conduit and unit when the apparatus is in normal position.

16. In combination a container, a suction producing unit therein, said unit having an air inlet at one end and an air outlet at the other end, the unit being positioned in spaced relationship to some of the walls of the container whereby air flowing from the unit is reversed with respect to the general direction of flow through the unit and moves over substantially the entire outer surface of said unit, and a flexible air inlet conduit extending through one of the walls of the container and connected to the unit.

17. In combination, a container, a suction producing unit therein, said unit having an air inlet in one end and an air outlet in the other end, means for so positioning the unit within the container that a passageway is provided for air to flow from the unit in a reverse direction to the general direction of air flow through the unit, whereby the air exhausted from the unit is caused to move along the outer surface of the unit, said container having an opening through which air flowing from the unit may be discharged, and a flexible tubular air conduit extending through the container and operatively connected to the inlet end of said unit.

18. In a suction apparatus of the character described the combination of a container embodying a box-like member open at the top, of a suction producing unit within the container, means carried by the container and yieldably supporting the suction unit in spaced relation to the walls of the container, a cover providing a closure for the container and arranged to engage said means for holding the same in adjusted relationship to the container.

19. In a suction apparatus of the character described, the combination with a container embodying a box-like member open at the top and having a plurality of spaced recesses opening upwardly adjacent the upper portion thereof, spaced rods resting in said recesses, a suction producing unit within the container, yieldable means connecting the unit with the rods in such manner that the unit is held in spaced relationship to the walls of the container, and a cover for the container, said cover having a layer of non-insulating material on the inner side thereof engaging the rods for holding them in adjusted relationship to the container.

20. In a suction producing apparatus of the character described, the combination with a container comprising a box-like section open on one side thereof and a closure therefor; a device insertable and removable through the open side of said section and supported by the latter when in place; a suction producing unit adapted to be likewise inserted and removed through said open side of the container; and means for suspending said unit from said device whereby said device, means and unit may be simultaneously inserted within and removed from the said box-like section when the cover is removed.

21. In a suction producing apparatus of

the character described, the combination with an elongated container having an air exit at one end thereof, of an elongated suction producing unit including a casing and an electric motor disposed lengthwise of the container, means for admitting air to the casing at the end adjacent said exit of the container, the air being emitted from the end of said casing remote from said container exit, whereby a current of air is produced lengthwise through said unit in one direction on the interior thereof, and in the opposite direction lengthwise thereof on the exterior, thereby absorbing the maximum amount of heat from the interior and exterior of said unit in its passage into and out of the container.

22. In a suction producing apparatus the combination with a container of a suction producing unit therein having motor and fan elements, there being an air inlet conduit leading from the exterior of the container to the interior of the unit, and the direction of air flow being such that the air is caused to pass in two directions across the motor, one direction being within the unit and the other direction being outside the unit.

In witness that I claim the foregoing I have hereunto subscribed my name this 8th day of November, 1924.

CLINTON H. HANSON.