

Jan. 8, 1952

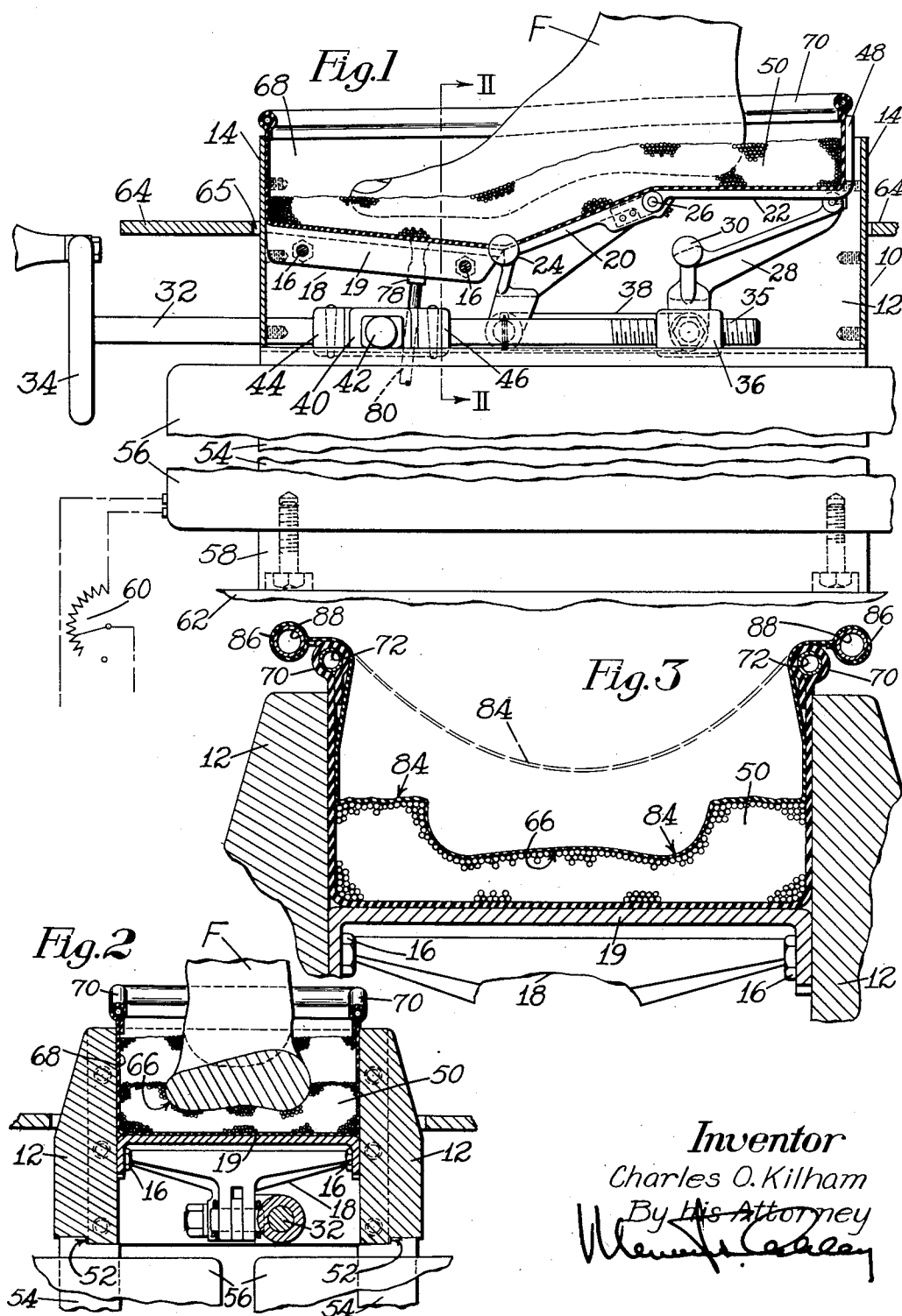
C. O. KILHAM

2,581,489

APPARATUS FOR MAKING CASTS

Filed April 9, 1948

2 SHEETS—SHEET 1



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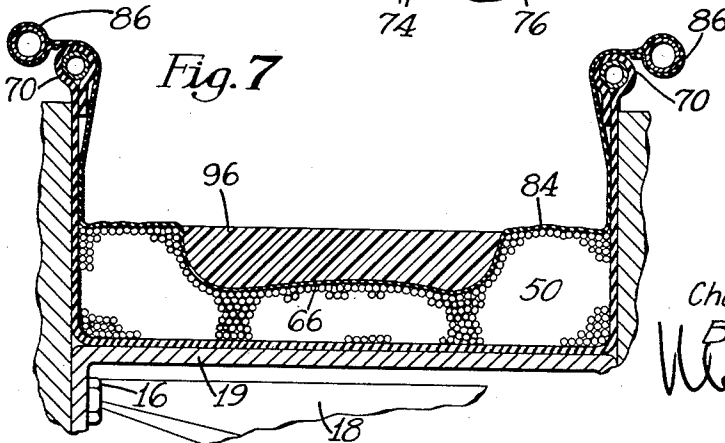
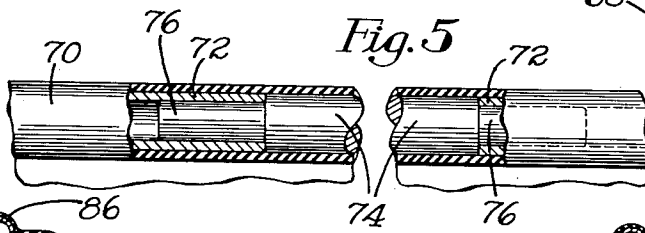
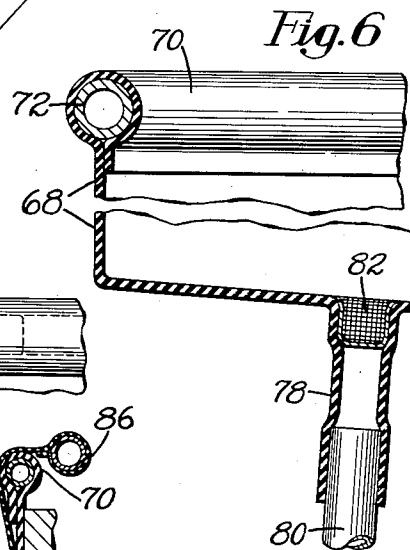
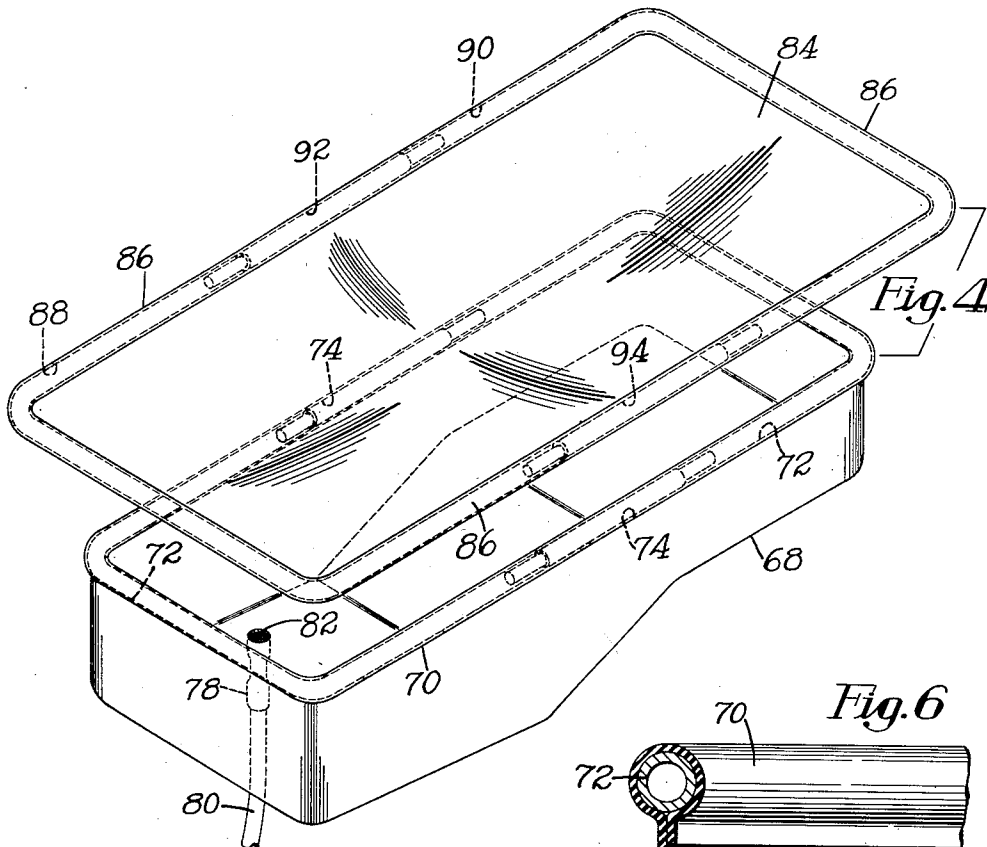
C. O. KILHAM

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APPARATUS FOR MAKING CASTS

Filed April 9, 1948

2 SHEETS—SHEET 2



Inventor
Charles O. Kilham
By his Attorney
Wm. H. Kelley

UNITED STATES PATENT OFFICE

2,581,489

APPARATUS FOR MAKING CASTS

Charles O. Kilham, Beverly, Mass., assignor to
United Shoe Machinery Corporation, Flemington,
N. J., a corporation of New Jersey

Application April 9, 1948, Serial No. 20,075

1 Claim. (Cl. 18—5.1)

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This invention relates to apparatus for making casts of objects and is illustrated herein by way of example with reference to apparatus for making casts of human feet.

A method of making casts of objects such as human feet is disclosed in United States Letters Patent No. 2,057,039, granted October 13, 1936, on an application filed in the name of Clifford K. MacDonald, this method being carried out with the aid of an apparatus in which a mobile mass of discrete magnetizable material, such as iron particles or balls, is provided for receiving an impression of an object and, after an impression has been formed therein, the particles are magnetized by an electro-magnet to render them immobile or rigid and thus retain the impression, thereby permitting the object to be removed from the impression and molding material to be deposited therein to produce a cast from the impression or mold.

It is desirable when forming an impression in discrete or comminuted material in this manner, to line the impression with a thin layer of flexible material to render the impression smoother than it would be otherwise, and also to cover the small spaces between the particles and thus render the impression capable of holding a molding material in a plastic or semi-plastic condition. The material used for lining such impressions heretofore, as disclosed in the patent referred to, has usually consisted of a thin sheet of impervious stretchable material, such as rubber or a composition thereof or, if desired, the lining material might consist of a sheet of fabric such as silk impregnated with wax. The thin flexible sheet is laid over the mass of iron balls to cover the impression after the latter has been rendered immobile by magnetization and the sheet is then pressed into the impression either manually or with the aid of a suitable instrument or tool to line the impression. While this method of lining an impression in a solidified mass of small particles is satisfactory under ordinary conditions so far as results are concerned, it is not as convenient as might be desired and takes considerable time. Moreover, if extremely accurate casts are desired, this procedure may not always insure such results because of the danger of the lining material slipping in the impression or the possibility of its not being pressed fully into all portions thereof, especially if the impression is of an odd shape not easily reproduced in replica or cast form. Furthermore, the prior methods of lining the impression are not as economical as might be desired because a flexible sheet of

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waxed silk must usually be discarded after being used only a few times whereas a thin sheet of impervious material such as rubber wears out quickly due to the manner of pressing it into the impression or mold.

An object of the present invention is to provide an improved apparatus for use in making casts from impressions or molds formed in a loose mass of discrete or comminuted material with the aid of which the difficulties above referred to are reduced or eliminated and which is more economical, faster and more accurate to use than apparatus used heretofore.

To these ends, the invention provides, in accordance with one aspect, an improved apparatus for making successive casts of objects which comprises a mobile mass of discrete or comminuted material mounted in an impervious flexible container open at the top and having a non-flexible rim, means for rendering the discrete material immobile to retain an impression formed therein, and a thin sheet of impervious flexible material for lining said impression quickly and accurately at all portions thereof regardless of its configuration without altering the shape of the impression. As herein illustrated, a thin sheet of impervious stretchable material, such as rubber, is placed over the rigid mass of discrete material to cover the impression, and means is provided for withdrawing the air from the mass of particles below the sheet to reduce the atmospheric pressure in such area, thereby allowing the atmospheric pressure above the sheet to press the latter forcibly into the impression to line all portions thereof tightly and accurately, the sheet being also caused by said pressure to cling closely to the surface of the impression as long as the air is being evacuated from the mass of discrete material.

In order to render the present apparatus more practicable in use and also to accelerate the lining of the impression, the iron particles or balls are placed in a container which is airtight at the sides and bottom and open at the top but which may be effectively sealed at the top to render it completely airtight by the flexible sheet which is used for lining the impression, this sheet, as indicated above, being also stretchable to a substantial degree which further facilitates its use. Consequently, when the air is withdrawn from the container holding the mass of iron particles or balls, the flexible sheet of impervious material covering the container and the iron particles therein is forced quickly into the impression by the suction caused by the vacuum

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created in the container or, in other words, by the unbalanced pressure of the atmosphere surrounding the sheet, thereby lining the impression tightly and accurately at all portions regardless of shape.

With the above and other objects and features in view, the invention will now be described in detail in connection with the accompanying drawings and will thereafter be pointed out in the claim.

In the drawings,

Fig. 1 is a side elevation of an apparatus adapted for use in making casts of objects by utilizing a mobile mass of discrete or comminuted material such as iron balls for taking an impression, the apparatus being shown receiving an impression of a human foot with parts of the apparatus shown in section or broken away;

Fig. 2 is a transverse sectional view taken on the line II—II of Fig. 1;

Fig. 3 is a transverse section similar to Fig. 2 but on an enlarged scale with the foot removed from the apparatus and the impression in the discrete material lined with a thin sheet of impervious stretchable material;

Fig. 4 is an "exploded" perspective view of a container adapted for use with the apparatus and a thin sheet of impervious material utilized for lining the impression;

Fig. 5 is an enlarged detail view, partly broken away and in section, of a cylindrical edge or rim portion of either the container or the impervious sheet;

Fig. 6 is a fragmentary sectional view through the forward portion of the container showing an outlet for withdrawing air from the container; and

Fig. 7 is a transverse section similar to Fig. 3 after the lined impression has been filled with molding material in a plastic condition to make a cast.

In making casts, in accordance with the present invention, an apparatus similar to that disclosed in the MacDonald patent referred to above is preferably utilized. As disclosed in the patent referred to, the apparatus comprises a rectangular frame or box 10 open at the top and having thick side walls 12 of magnetizable material, such as iron or steel, and thin end walls 14 of brass or other relatively non-magnetizable material, the forward portion of the frame having secured thereto by screws 16 a support, indicated generally by the numeral 18 and comprising a flanged plate 19 inclined upwardly toward the forward or left-hand end of the box, as viewed in Fig. 1, the plate 19 being arranged to underlie the forepart of a human foot F placed in the box and the inclination of the plate approximating the angle of the forepart of a substantially normal foot in a weight-bearing position. The support 18 also has a middle section 20 and a rear section 22 for supporting, respectively, the shank and heel portions of the foot, the section 20 being pivoted relatively to the fixed section 19 by trunnions 24 rotatable in openings in the side walls 12 of the frame, and the rear section 22 being pivotally connected to the middle section by pins 26, thereby permitting angular adjustment of the middle and rear sections 20 and 22 relatively to the forward section 19 to permit the support to be adjusted to the longitudinal contour of the foot of which a cast is to be made. As described in the patent referred to, the rear section 22 is always maintained in a substantially horizontal position by an arm 28 which is parallel to the

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section 20 and is rotatably mounted by trunnions 30 in the side walls of the frame, the middle and rear sections being adjusted relatively to the fixed section 19 by means of a horizontal shaft 32 carrying a hand wheel 34 and threaded at its inner portion 35 through a block 36 which, by means of a link 38, connects the arm 28 to the middle section 20. An intermediate portion of the shaft 32 passes through a bracket 40 which, in turn, is pivoted in the opposite side walls of the frame 10 by trunnions 42. A pair of collars 44, 46, pinned to the shaft 32 at the opposite ends of the bracket 40, prevent longitudinal movement of the shaft in the frame. Rotation of the shaft 32 by the hand wheel 34 moves the block 36 along the threaded portion 35 of the shaft to swing the arm 28 about the trunnions 30 and, through the link 38, to swing the middle section 20 an equal amount in the same direction about the trunnions 24, thereby changing the angular position of the middle section to accommodate it to the shape of the shank portion of the foot and simultaneously adjusting the heightwise position of the rear section 22 to accommodate it to the heel portion of the foot while maintaining said section in a horizontal position. The support 18 extends substantially across the full width of the frame 10 and the rear section 22 is provided with an upstanding end wall 48. The support carries a mobile mass of loose comminuted or discrete material 50 preferably composed of small particles or balls which are capable of being displaced under pressure to produce an impression of an object when the object is pressed against them, the particles in the present case consisting of magnetizable material such as iron or steel.

As disclosed in the patent referred to, the particles or balls 50 are piled loosely on the adjustable support 18 and cover this support for a depth of from 1½ to 2 inches. The iron balls are preferably about ⅛ of an inch in diameter and are relatively smooth to reduce friction so that they may be readily displaced when an object such as a human foot is pressed against them, thereby forming an impression of the object which will correspond closely to the shape of such object.

The thick side walls 12 of the frame have shoulders 52 (Fig. 2) at their lower ends which fit into a recess provided by similar shoulders formed on the upper ends of a pair of soft iron cores 54 of an electro-magnet 56 which is substantially U-shaped in formation, the cores being connected at their lower ends by a yoke or crosspiece 58 (Fig. 1) and being wound in series in the usual manner with magnetizing coils of insulated wire through which an electric current may be passed to magnetize the cores and set up a strong magnetic field in the area extending between the cores 54, the latter then forming the opposite poles of the magnet. A rheostat 60, indicated diagrammatically in Fig. 1, is provided for controlling the current. The entire unit, including the frame 10 and electro-magnet 56, is preferably mounted on a support or base 62 provided with a table 64 (Fig. 1) having an opening 65 through which the frame projects, the table preferably being adjustable heightwise relatively to the frame.

In making a cast of an object such as a human foot, the person stands on the table 64 and places one foot in the mass of loose particles 50 and presses against the particles to displace them and thus form an impression of his foot therein, the impression in the present case being of the lower

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portion only of the foot but a deeper impression being formed, if desired, merely by banking the balls higher around the foot while taking care to leave an opening at the top of the impression large enough to permit the foot to be removed from the impression.

After the impression has been made in the iron balls, the discrete mass of material is immobilized or solidified to render it rigid and thereby retain the impression after the foot has been removed from the apparatus. As described in the patent referred to, the mass of iron particles or balls is rendered immobile or rigid by magnetizing said particles and thereby locking or "freezing" them in the positions they occupied while they were still under the pressure of the foot, this being accomplished by passing an electric current through the electro-magnet and setting up a magnetic field in the area occupied by the discrete material which causes it to become rigid and indisplaceable even under substantial pressure as long as the current remains on. The foot is then withdrawn from the mass of iron balls to leave an impression 66 therein (Figs. 2 and 3) which will correspond accurately to the shape of the foot and will remain intact as long as the magnetic field is maintained.

As explained in the patent referred to, after the foot or other object has been removed from the comminuted particles to leave the impression, the latter is lined with a thin sheet of flexible material to render the impression smooth and also to cover the small openings between the iron balls or other particles and thereby render the impression capable of holding a molding medium in a fluid or plastic condition such, for example, as plaster of Paris in liquid or semi-liquid form. One material which has heretofore been used for lining the impression was a sheet of thin rubber which was not only flexible and impervious but also stretchable to a substantial degree, the rubber sheet usually being laid into the impression manually and conformed as accurately as possible to the shape thereof by hand or with the aid of a suitable instrument. Another material sometimes used in the past to line the impression was a sheet of thin textile material, such as silk, impregnated with wax or other impervious coating substance.

In using the present apparatus for making casts, the impression 66 is lined with a thin sheet of flexible material, such as rubber, which is also impervious and stretchable to a substantial degree, the impression being lined, however, in a manner which insures that the lining material will be accurately conformed or shaped to all portions of the impression, regardless of their configuration, and will cling or adhere closely to the surface of the impression without altering its shape during the subsequent operation of producing a cast from the impression. To this end the additional apparatus illustrated in Figs. 4 to 6, inclusive, is provided.

A rectangular container 68 is provided, preferably composed of flexible impervious material such as rubber and corresponding substantially in size to the frame 10, the bottom wall of the container, as shown in Fig. 4, conforming generally to the longitudinal contour of a substantially normal foot so that the container will be adapted to rest upon the sectional support 18 inside the frame. Since the container is composed of flexible material such as rubber, the support 18 may be adjusted heightwise to accommodate it

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to the longitudinal contours of most feet without causing any appreciable distortion of the container, although in extreme cases, involving flat feet or high arches, other containers may be provided which conform more closely to such feet. As illustrated in Fig. 4, the container 68 is open at the top and is provided around its upper edge with a cylindrical rim 70 which is relatively rigid in construction and is preferably hollow, as shown in Figs. 5 and 6. The rim 70 may be formed by wrapping the upper portions of the walls of the container around a pair of U-shaped metal tubes 72 and folding said margins back upon themselves inside the container and securing them in such position by cement or other suitable adhesive, as illustrated in Fig. 6. In order to permit flexing of the container a limited amount lengthwise, the rim 70 is made flexible at an intermediate portion thereof by connecting the U-shaped metal tubes 72 to each other by means of cylindrical connecting members or couplings 74 (Fig. 5) composed of flexible material, such as rubber, these connecting members having reduced end portions 76 which fit tightly into the adjacent end portions of the tubes 72. By such construction the rim 70 of the container 68 is normally maintained in a substantially rectangular shape and in a single plane but the rim can bend or flex at its central portion if the container should be distorted or bent out of the shape shown in Fig. 4 by angular adjustment of the sectional support 18 in the manner described above. At a forward portion of its bottom wall, the container 68 is provided with an opening or outlet 78 which may be connected in the usual manner by a flexible tubing or pipe 80 to a motor-driven vacuum pump (not shown) of any conventional construction adapted to withdraw the air from the container. A wire strainer 82 is inserted into the outlet 78, as shown in Fig. 6, to prevent the particles from dropping through the opening.

The container 68 is positioned on the adjustable support 18 of the apparatus, as illustrated in Figs. 1 to 3, inclusive, with the cylindrical rim 70 projecting upwardly beyond the walls of the frame 10. The mass of discrete material 50, that is, the iron particles or balls, are held loosely in the container, the mass preferably being from 1½ to 2 inches in depth. In this way, the mobile mass of material is confined in a receptacle which is airtight at its sides and bottom but is open at the top to permit the introduction of the foot or other object which is to form an impression in the discrete material. After the impression 66 has been formed, as illustrated in Fig. 2, and the mass of iron particles has been rendered immobile by magnetization to retain the impression, the foot is removed from the frame 10 and the impression is lined to make its inner surface smooth and to cover the spaces between the balls and thereby make the impression capable of holding a molding material, such as plaster of Paris, in a liquid or semi-liquid condition.

In order to line the impression in accordance with the present invention, a thin flexible impervious sheet 84 (Fig. 4) of rubber or similar material is provided, the sheet having around its edge a cylindrical rim 86, similar to the rim 70 of the container 68, and formed in the same manner, that is, by a pair of U-shaped metal tubes 88 and 90, joined together by flexible rubber connecting members 92, 94 so that the rim will remain normally in a substantially flat rec-

tangular position, the sheet itself being of such size that it sags downwardly inside the rim a substantial distance, as indicated in Figs. 3 and 4. The cylindrical connecting members 92 and 94 permit the rim 86 of the sheet to bend or flex as much as may be necessary to permit the rim to correspond in shape to the rim 70 of the container 68 if the latter is distorted by adjustment of the sectional support 18. As illustrated in Figs. 3 and 4, the rectangular rim 86 of the flexible sheet 84 is larger than the rim 70 of the container so that, when the sheet is placed over the top of the container, the rim 86 will be located outwardly of the rim 70, thereby causing the sheet to overlap the rim 70.

In lining the impression 66, the operator locates the rim 86 of the flexible sheet outside the rim 70 of the container, as illustrated in Fig. 3 and, while pressing the rim 86 down lightly toward the container to close or seal the opening between the two members, starts the vacuum pump referred to which commences to exhaust the air from the container which is now substantially airtight because it is sealed at the top by the flexible impervious sheet 84 overlapping the rim 70 of the container. As the air is withdrawn from the container, the flexible sheet 84 which, as stated above, is also stretchable to a substantial degree, is drawn or forced downwardly by the suction caused by the vacuum created within the container or, in other words, by the unbalanced atmospheric pressure around the sheet, to cause the latter to be pressed forcibly against the upper surface of the iron particles or balls 50 and thereby line the impression 66 in the manner illustrated in Fig. 3. In other words, the pressure of the atmosphere above the impervious rubber sheet 84 stretches the sheet and causes it to be pressed forcibly against the iron balls 50, including the impression 66, as the atmospheric pressure within the container 68 is reduced by evacuating the air therefrom. The flexible sheet will also be caused by this same difference in atmospheric pressure to cling tightly to the surface of the impression and thus line all portions thereof regardless of shape so long as the vacuum pump is kept in operation. In this way, all portions of the impression 66 regardless of shape are lined by the thin flexible sheet of impervious material which will remain clinging tightly to the walls of the impression by reason of the vacuum and thus make the impression relatively smooth and also render it watertight and capable of holding a molding material in a liquid or semi-fluid condition.

After the impression 66 has been lined as described, the operator deposits or pours a molding material 96 (Fig. 7), such as plaster of Paris or other suitable material preferably in a liquid condition, into the lined impression, thereby forming a cast of the lower portion of the foot F after the molding material has set or hardened. During the molding operation, the current is passed continuously through the electro-magnet to maintain the magnetic field at full force and thus hold the iron balls locked rigidly in position to retain the impression. Moreover, the vacuum pump is also operated continuously to cause the impervious sheet 84 to cling closely

to the surface of the impression so that the shape of the cast produced therefrom will correspond accurately to the shape of the impression. After the molding material has hardened, the cast is removed from the impression and the vacuum pump is shut off to permit the rubber sheet 84 to contract and return to its normal slack condition, as shown in broken lines in Fig. 3. The electro-magnet is then turned off to release the iron balls and permit the rigid mass to become loose and mobile again and in condition to receive another impression.

While the invention has been described herein with reference to making a cast of the lower portion of a human foot, the apparatus obviously is not limited to operating upon such an object but may be used with equally advantageous results in making casts of other articles or objects whether such objects are deformable under pressure like the human foot or are composed of solid material, such as wood or metal.

Having thus described my invention, what I claim as new and desire to secure by Letters Patent of the United States is:

An apparatus for making successive casts of different shaped objects comprising, in combination, an impervious flexible container having an open top and a non-flexible rim, means for holding said container terminating below said rim, said means having mechanism therein for supporting the container in different heightwise positions relatively thereto, a mass of small iron balls in said container readily displaceable to receive successive impressions of different objects pressed against them, means for creating a magnetic field in the space occupied by said iron balls, thereby locking them rigidly in position after each impression has been formed therein, an impervious flexible sheet for lining each impression after it has been rendered rigid, said sheet having a non-flexible rim thereon larger in circumference than the rim of said container and adapted to be placed over said container after an impression has been made therein to render the container airtight, and means for withdrawing air from the container below said sheet to force the sheet into said impression to line the same by reason of the unbalanced atmospheric pressures above and below said sheet.

CHARLES O. KILHAM.

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