

No. 748,996.

PATENTED JAN. 5, 1904.

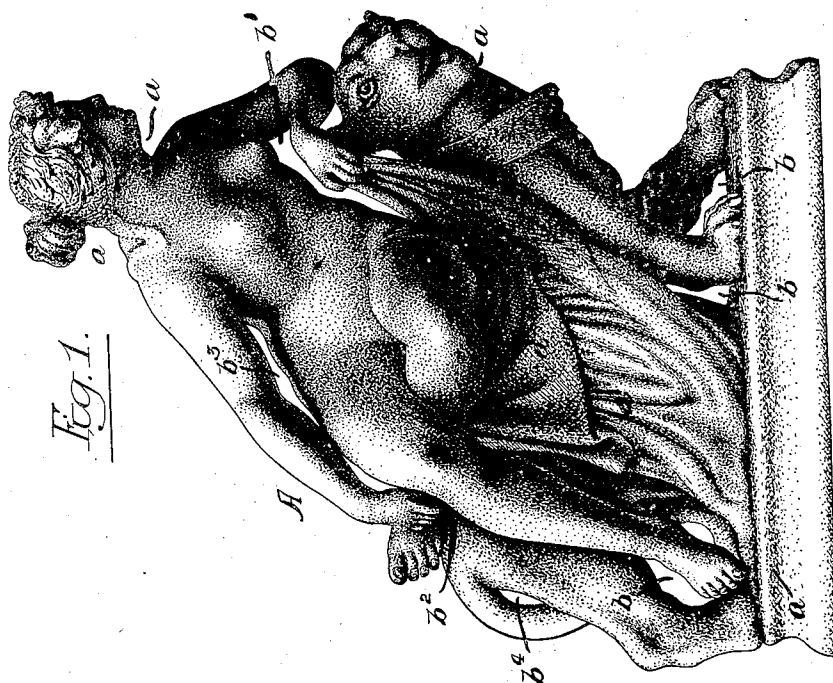
J. F. SPENCER.

MOLD.

APPLICATION FILED SEPT. 5, 1902.

NO MODEL.

5 SHEETS—SHEET 1.



Witnesses:-

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Herman E. Metius.

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5 SHEETS—SHEET 2.

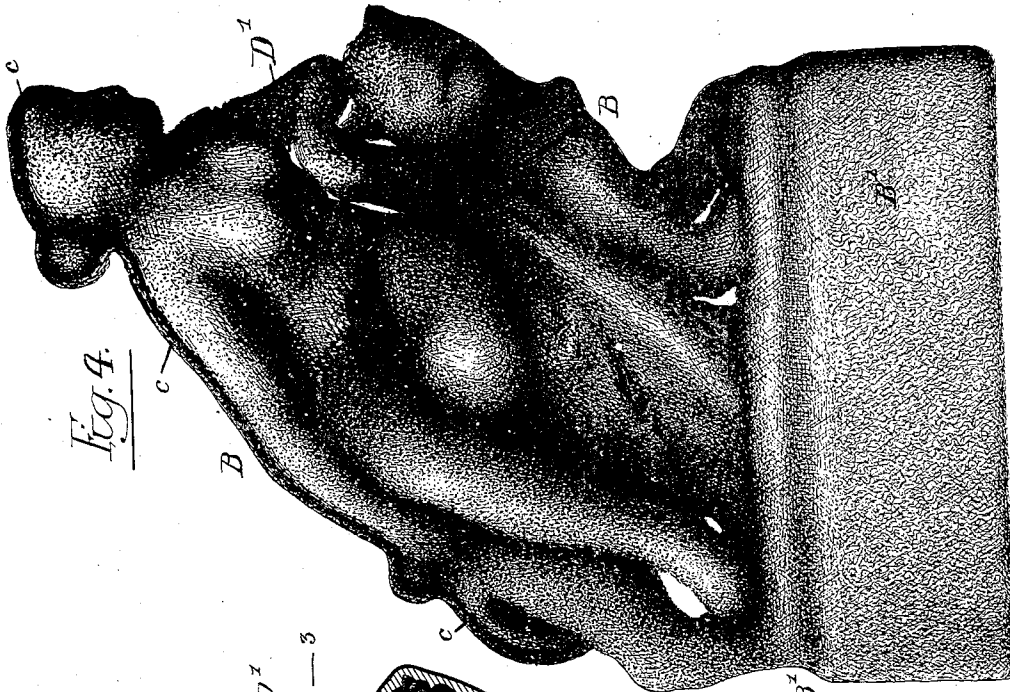


Fig. 4.

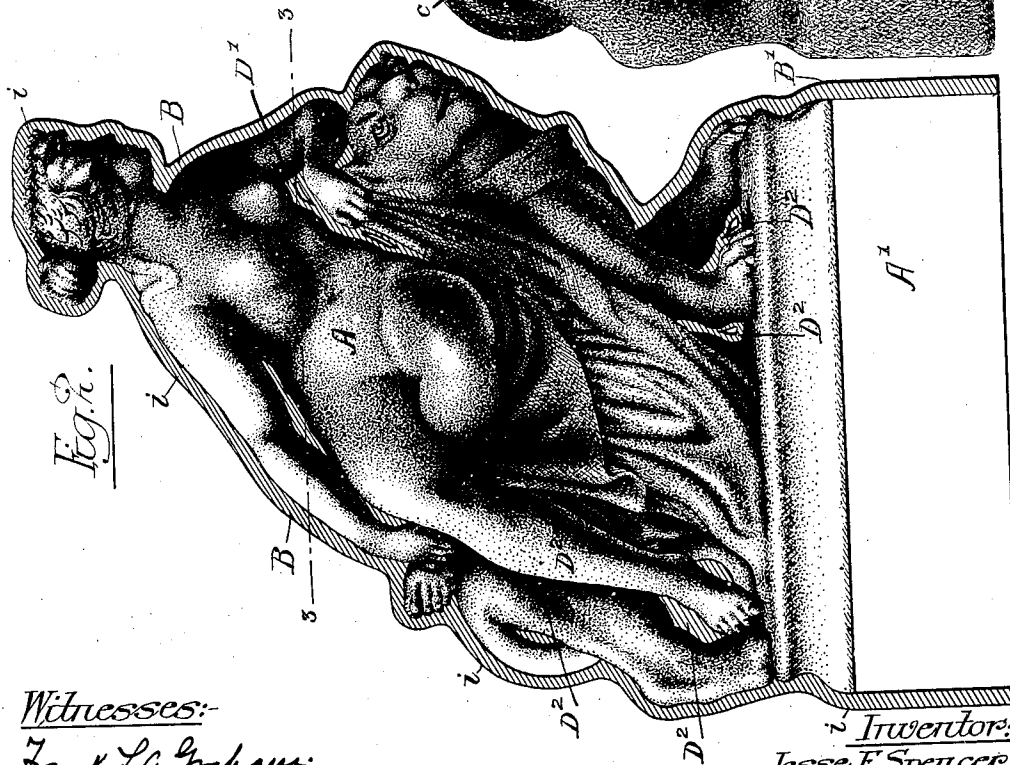


Fig. 5.

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5 SHEETS—SHEET 3.

NO MODEL.

Fig. 8.

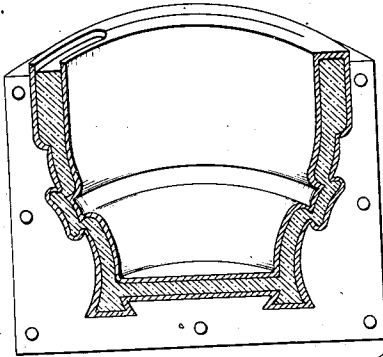


Fig. 6.

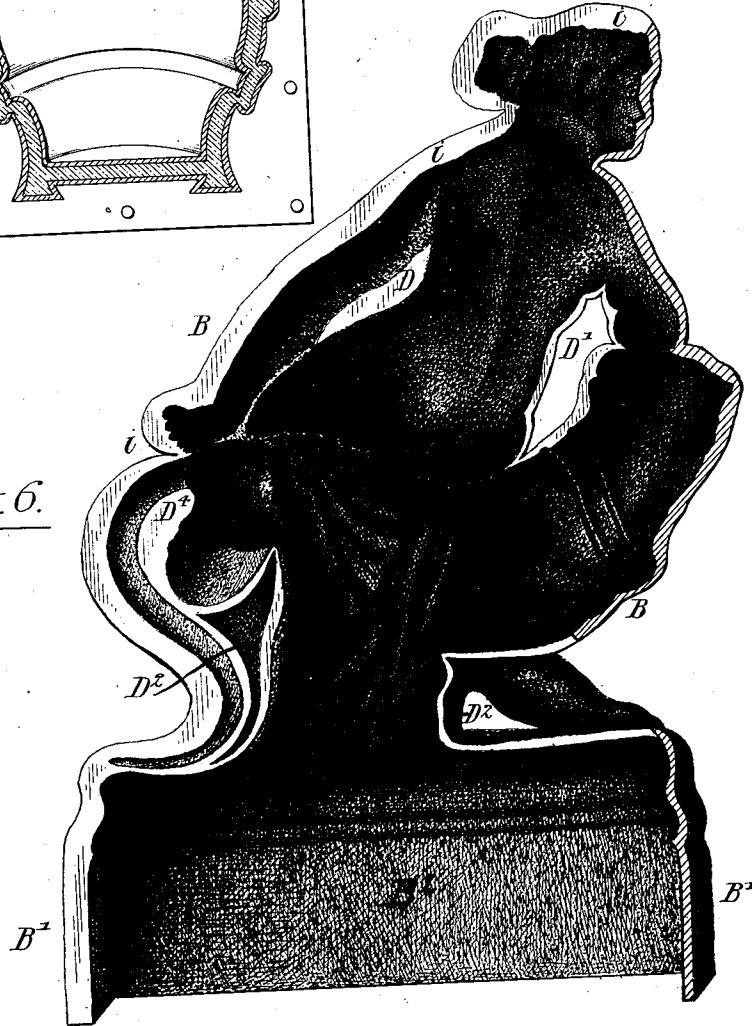
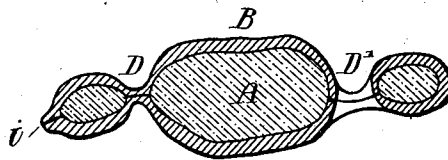


Fig. 3.



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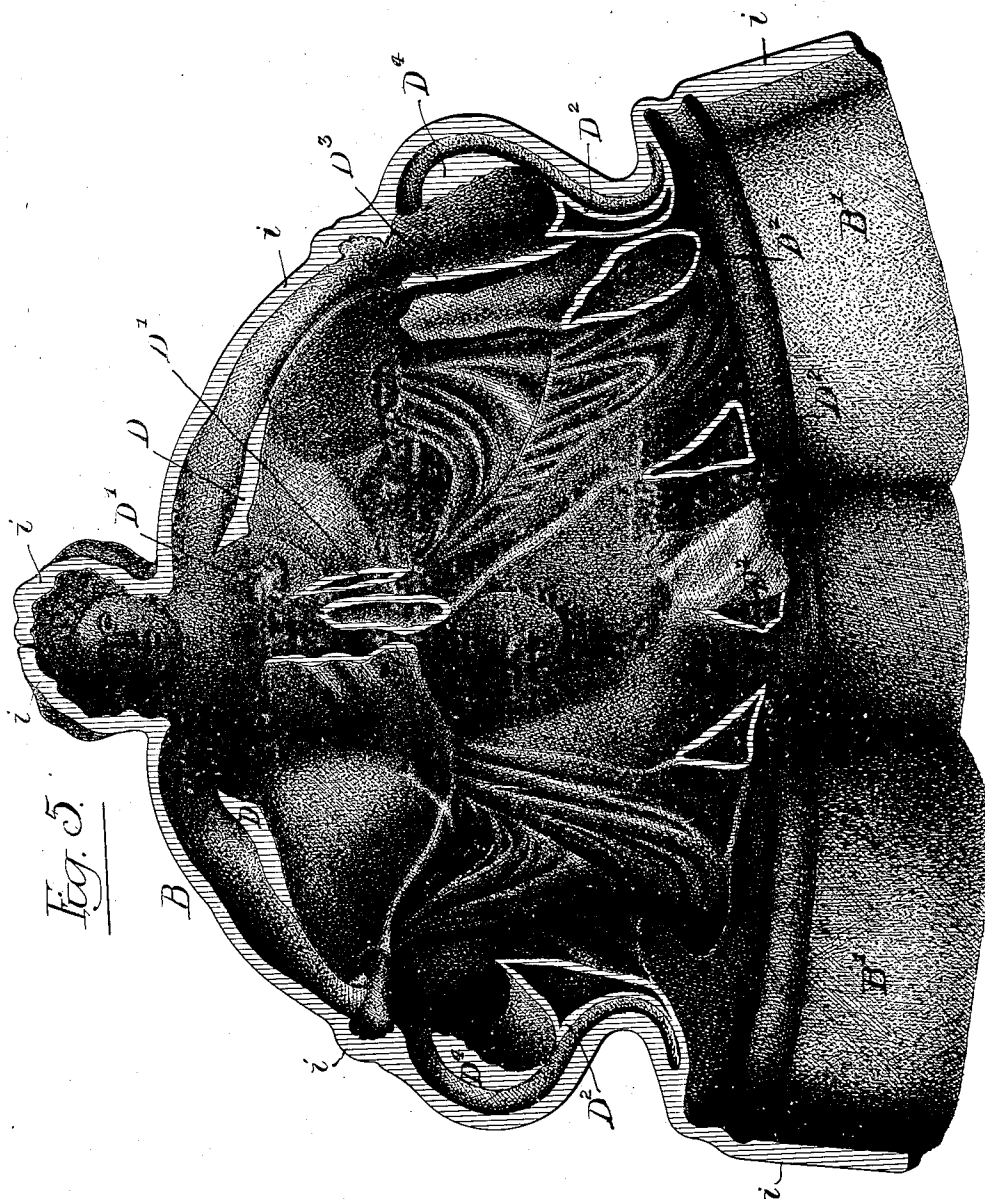
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5 SHEETS—SHEET 4.

NO MODEL.



Witnesses:-

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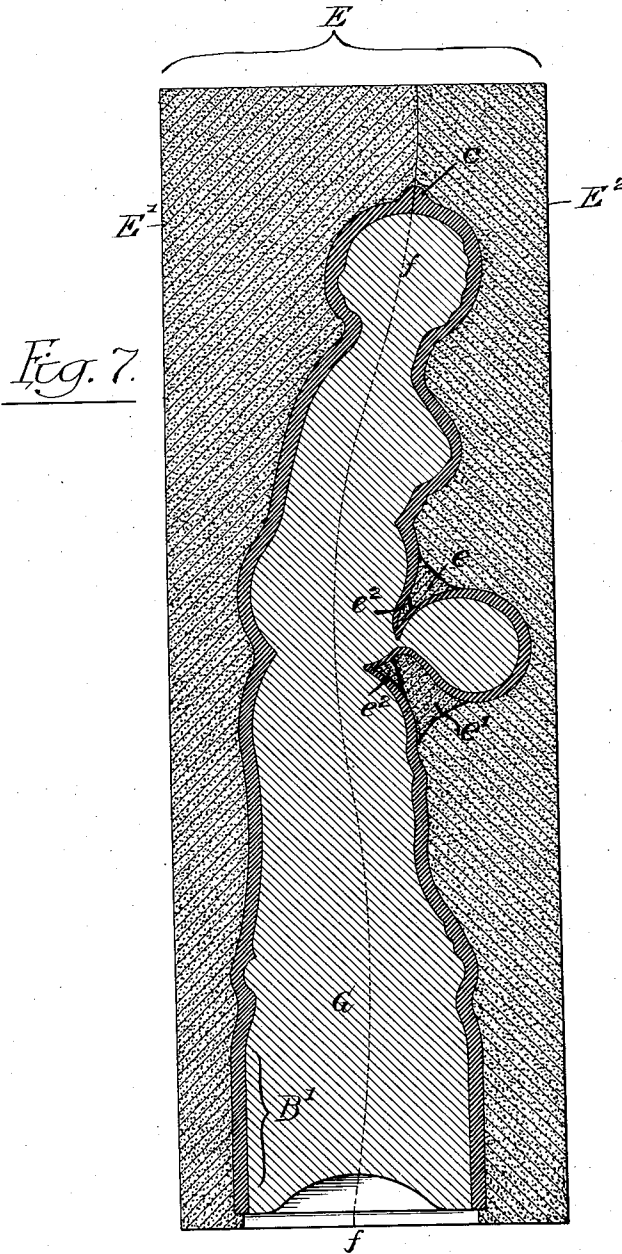
PATENTED JAN. 5, 1904.

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MOLD.

APPLICATION FILED SEPT. 5, 1902.

NO MODEL.

5 SHEETS—SHEET 5.



Witnesses:-

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UNITED STATES PATENT OFFICE.

JESSE F. SPENCER, OF PHILADELPHIA PENNSYLVANIA.

MOLD.

SPECIFICATION forming part of Letters Patent No. 748,996, dated January 5, 1904.

Application filed September 5, 1902. Serial No. 122,204. (No model.)

To all whom it may concern:

Be it known that I, JESSE F. SPENCER, a citizen of the United States, residing in Philadelphia, Pennsylvania, have invented certain Improvements in Molds, of which the following is a specification.

The object of my invention is to make an elastic and substantial mold directly from any plain or intricately-formed pattern it is desired to reproduce without necessarily destroying the said pattern, the mold providing a means by which any desired number of reproductions of the form of the pattern or any fractional part thereof can be made in any suitable material.

The mold is composed of caoutchouc or equivalent compound, and the particular ingredients for proper vulcanization as well as the preparation of the compound and the mixture with the same of any proper adulterants or materials, such as a flexible fabric, will depend on the vulcanization employed and the degree of elasticity desired.

I have found that the most difficult patterns having a wide diversity of intricate forms and of undercut and projecting parts and the most delicate detail can be reproduced directly from the pattern in facsimile form by my elastic mold, the latter being a perfect negative of the pattern to be reproduced and in return producing a perfect positive duplicate, which may be made either solid or hollow and will have all the intricate features of the original.

In the accompanying drawings, Figure 1 is a view of the pattern in the round to be reproduced. Fig. 2 is a sectional view of the pattern within a flexible mold, the section being on one side of the center. Fig. 3 is a sectional view on the line 3-3, Fig. 2. Fig. 4 is an exterior view of the mold. Fig. 5 is a view showing the mold split and partly opened. Fig. 6 is a sectional view of the mold, taken through the center, showing it partly cut. Fig. 7 is a sectional view of a sectional supporting-casing in which the mold is preferably inserted while forming a reproduction therein, and Fig. 8 is a sectional view of a modification of my invention.

I will first give a brief description of my invention.

It consists of an elastic mold made, prefer-

ably, of rubber or a compound in which caoutchouc forms an important part. The pattern A, Fig. 1, and the form for the pouring-head are coated with a comparatively thin coating of rubber in an unvulcanized state, the thickness of the coating varying with the form and size of the pattern. After the pattern A has been coated the mold B thus formed is vulcanized in any suitable manner without removing the pattern. I preferably use the vulcanizing process claimed in the application for patent filed by me on the 20th day of July, 1901, Serial No. 69,051. After the mold is vulcanized a casing E is constructed around it before the mold is removed from the pattern. This casing is preferably made in two or more parts and acts as a support for the rubber mold B in making casts from the mold. After the casing is constructed it is removed from the mold, and the mold is then cut on certain lines, depending upon the form of the pattern, as shown in Figs. 3 and 6, so that it can be flexed sufficiently to allow the pattern A to be withdrawn. The mold and its casing is then complete and ready to be used to make duplicates in wax or other suitable material of the original pattern.

The method of making the mold is claimed in an application for patent filed by me on December 9, 1903, Serial No. 184,477.

In order to illustrate my invention, I have chosen an object of art rather than one of utility to show an intricate pattern, as objects of art, such as shown in the drawings, are generally of more intricate form than objects of utility, and the advantages of the use of my improved mold are thereby more easily understood than if shown in a simpler form.

By the use of my invention I can reproduce the form of any pattern from the simplest to the most complex without making the mold in a number of independent sections, thereby making what I call a "single" mold, which can be made in one piece and treated as a unit during its formation and future manipulation.

My improved mold provides a means of producing at a very low cost a great variety of objects of art and utility in a great variety of materials which can only be made at present at great expense, and it also opens possibilities of producing entirely new things which have not been attempted heretofore on ac-

count of the limitations of the present state of the art.

The pattern to be reproduced may be in a whole or undivided state or made up of a number of independent pieces brought intimately together, said pieces varying in the materials of which they are formed or otherwise.

The pattern may be modeled in the round or flat and of plain or intricate form and either solid or hollow or with both solid and hollow portions combined, and it may have any number of sides or surfaces or undercut or projecting parts, the said surfaces being finely engraved in intaglio or relief or otherwise, as desired, or it may consist of groups of objects made up of different substances and may be composed of strong or fragile, rigid or elastic material or a combination of them all and may be either of a dense nature or porous, providing it will withstand the heat necessary to the production of the mold, if heat is used in the formation of the latter.

Vulcanization by heat in connection with a proper caoutchouc compound is considered the most desirable mode of producing my improved mold, the formation and ingredients for the vulcanization and adulteration of the said compound depending on the vulcanization employed and the elasticity desired; but in case it is desired to reproduce the form of patterns which would not withstand the heat of vulcanization then I resort to any of the well-known means of vulcanization by what is known as the "cold" or "chemical" process.

My improved mold being made directly on the original pattern results in the reproduction of the exact form, size, and proportions and perfect relative position of the different parts of the pattern by a minimum number of intervening steps and with a minimum amount of time and labor. The said mold being very strong and durable, can be roughly handled without the liability of its being injured and can be used repeatedly without deterioration in its smallest detail and will produce many more reproductions of a pattern in a great variety of materials than by any other known means. Its great elasticity and strength, its non-absorbent nature and heat-resisting qualities, its resistance to the action of chemicals, its power of reproducing the most intricate forms and the finest detail with a minimum number of sectional lines showing on the reproduction and with no restrictions as regards to practical size of the pattern to be reproduced, its capacity for retaining its proper shape through hard usage, and its comparatively small cost make it an ideal medium for the reproduction of plain or intricate forms.

I will now describe the process I prefer to use in manufacturing the said mold if it is composed of caoutchouc and its compounds and the pattern to be reproduced is an intricately-formed object, such as the statuette

shown, said statuette being modeled in the round and either solid or hollow.

If the pattern is hollow or has any hollow parts which are completely surrounded and with no vents to allow for the escape of the confined air, then a small vent is preferably made in some inconspicuous part to allow for the expansion and escape of the confined air, as the latter may expand to such an extent under the heat of the vulcanization treatment as to fracture the pattern. This vent is not always necessary, for the pressure of the uncured composition composing the mold, combined with the pressure necessary for vulcanization in the case of vulcanization by heat, is generally enough to counteract the expanding-air pressure, especially if the hollow pattern is made of a strong material; but it is always safer to provide the air-vent, if possible. In case of vulcanization by the cold or chemical process this contingency need not be taken into consideration.

If the pattern is composed of a substance that will be acted upon by the compositions composing the mold either in a solid or fused state, but especially when exposed to heat, then said pattern should receive a thin coating of some material—such as a hard varnish or a thin metal, such as aluminium leaf—that will not perceptibly alter the contour or detail of the pattern and will prevent the chemical action thereupon of the compound forming the mold either in its solid or fused state; otherwise the materials composing the mold will be inclined to form a chemical combination with the pattern which will cause them to stick together to an extent in some cases that will necessitate the destruction of the mold in the separation of the same from the pattern after vulcanization. This applies especially to patterns that are made of metals which are actively acted upon by sulfurous substances in a fused state. If the pattern is of a porous nature and is inclined to absorb moisture, it should be thoroughly dried before giving it its coating of the compound forming the mold, if the latter is to be exposed to heat, for in the case of heat vulcanization the moisture will be inclined to come to the surface of the pattern, and if it comes in contact with many of the compositions that may be used in the making of the mold will be detrimental to the latter and also detrimental to the object which it is desired to reproduce.

Referring to Fig. 1 of the drawings, A is the pattern, which in the present instance is a statuette molded in the round and of multifarious form and more or less hollow. The parts indicated by the reference-letter *a* are more or less undercut, while the parts indicated by the reference-letters *b*, *b'*, *b''*, *b'''*, and *b''''* are not only undercut, but are open and surrounded by other parts and have many difficult and intricate features to overcome in the formation of the mold and the with-

drawal of the reproduction from it than is found in the undercut alone and requiring entirely new and original methods to produce a mold in which such reproductions of the pattern can be formed and withdrawn therefrom, for as the pattern is composed of many projecting parts varying in size and form and in some cases being joined at their several extremities to the main body of the pattern, as the arm, hand, and drapery of the figure at *b'*, Fig. 1, while other of the said parts are joined only at one extremity, as the leg at *b''*, Fig. 1. This results in both of the above-mentioned parts being more or less separated from the adjacent parts of the pattern by open spaces of intricate form and varying dimensions, and the said open spaces being more or less surrounded by the parts above mentioned and which open spaces can be of a size much larger than the spaces between the communicating parts of the pattern and through which latter open spaces the parts of the mold formed within the large open spaces must be withdrawn after the necessary cutting in order to remove the pattern and reproductions from the mold.

Figs. 2 and 3 illustrate a pattern having a coating of the rubber compound which forms the mold. The walls of the mold are of varying thickness, and the exterior surface of the mold follows the general contour of the pattern.

The mold B may cover the entire surface of the pattern or any fractional part thereof which it is desired to reproduce and is formed of a comparatively thin layer of the compound of a thickness varying with the character of the pattern's formation and size, generally the undercut and receding parts and parts difficult of access being made the thinnest, so that after the necessary cutting, if the latter is required, their comparatively small bulk will allow of their being easily withdrawn from those parts, while those parts easily removed from the pattern may be made comparatively thick, thereby giving greater rigidity to the mold as a whole; but no parts of the mold should be made any thicker than is required for the necessary stability of the mold, and a rib *c*, Figs. 4 and 7, is preferably formed on the outer surface of the mold where it is to be parted by cutting. The pattern A being ready to be coated by the composition composing the mold will if said mold is to be composed of caoutchouc or its compounds preferably be given a coating of this composition, made liquid by its proper solvent or solvents, this coating, which can be applied either by brushing it on the pattern or by dipping the pattern into it, being so thick that when it is dry or its solvents are evaporated as to give the entire pattern, and especially its receding parts, a tenacious film to which the future layers of the plastic caoutchouc compound will adhere. When the solvents of the liquid coating have evaporated sufficiently to permit of the handling of the pat-

tern, it will be found that this coating while of a sticky nature will not leave the surface of the pattern when the latter is handled carefully. The main coating which is to form the mold is now applied. This may be what is known to workers in caoutchouc compounds as "unvulcanized mixed sheet," or it may be a plastic unformed mass or a thick liquid, or all three of the above combined, which when vulcanized will form an elastic body, any of these forms of the compound being suitable for use if the vulcanization is to be by heat, the mixed sheet, however, being preferred or predominating in its combination with the unformed mass of thick liquid. A sheet of the required thickness is cut into strips or pieces of the desired size and form and applied to the pattern, the sheet being either in its normal or unstretched condition or stretched, as the occasion requires. It will generally be found that in covering the varying surfaces of a complex form the concave surfaces will require the caoutchouc compound to be applied in an unstretched state, the first-applied liquid film holding it in place, while surfaces that are convex in form will permit of the compound being applied either stretched or unstretched, and oftentimes the combination of stretched and unstretched compounds applied to convex surfaces in different layers is found to be very desirable. If in the case of a concaved surface the compound is stretched when applied, it will have a tendency to draw away from the surface on account of its elasticity, the liquid film first applied not being strong enough to hold it in place, and this will result in a space being left between the sheet and the surface of the pattern. If close contact with the surface is not secured and an air-space of any great extent is formed, no good results can be expected.

In placing the pieces or strips on the pattern care must be taken to see that all joints are perfectly made and that there are no open spaces left between joints or layers. The joints are not difficult to make, for the natural tendency of the raw composition is to cement itself together, and one layer of the sheet can be placed upon another until any required thickness is secured, its power of cementation making the different layers a homogeneous mass if they are brought intimately together, or, if necessary, one or more subsequent liquid coatings can be applied to the different layers oftentimes with good effect, as the manipulation of the different layers by the hands will sometimes lessen their adhesiveness.

In the case of a complex pattern such as we are considering the number of layers or thickness of layers applied will be in accordance with the character of the formation of said pattern, some parts of it having, preferably, a thin coating, while others parts have to be made thicker.

While it is desirable to make the mold no

thicker than is necessary to give it its proper stability and its required elasticity, still the proportions of thick and thin coatings must vary considerably on account not only of the formation of the pattern, but also of its size.

Generally in the undercut or receding parts it is desirable to make the mold so thin that, considering its elasticity, it will withdraw in these receding parts without fracturing the most delicate substance that may be cast in it and at the same time have rigidity enough to withstand the pressure of the material used in forming the reproduction of the pattern without getting out of shape, while in those exterior parts of the pattern from which the mold can be easily removed the mold may be made comparatively thicker, thereby making it as a whole more rigid and capable of retaining its proper form, as shown in Figs. 3 and 6.

The portions of the mold B within the open spaces of the pattern A, as seen at D' D², Fig. 2, cannot be made solid, as it would be impossible to withdraw the mold at these parts without fracturing the mold or its contents. Therefore those parts of the pattern which form an open space such as seen at b', Fig. 1, should be covered with as thin a layer of the rubber compound as the necessities of the case will allow, and after vulcanization when these abutting surfaces are cut and separated to allow of the withdrawal of the pattern from the mold these parts, as seen at D', Figs. 4 and 5, being hollow and comparatively thin and elastic can be so manipulated as to withdraw easily through the sinuous passages through which they enter to the large open space; but in that part of the pattern which forms an open space such as seen at b³ and b⁴, Fig. 1, the adjacent walls of the mold may be connected by making the mold solid, and these spaces, as seen at D and D⁴, Figs. 5 and 6, providing these parts of the pattern are so formed that they will allow of these solid parts of the mold to be cut and withdrawn when separated without danger to that portion of the pattern or reproduction. Such solid connecting parts are desirable, as they make the mold more rigid and hold the parts in their natural relative positions, and when cut or split vertically into longitudinal sections they avoid the danger of leakage, which would exist when such parts are not made solid and are cut. It also allows of a simpler form of sectional casing. In the formation of this solid connecting part it should be made no thicker than the necessities of proper rigidity require and yet thick enough to allow for the necessary splitting of the parts, as above mentioned.

It is better generally to give the whole surface of the pattern A a single coating of the sheet before attempting to increase the thickness of those parts that it is necessary to make thicker. The operator after a little experience will soon recognize the necessary treatment of the pattern and will find when

he understands the great possibilities of the manipulation of the caoutchouc compounds that the most intricately-formed pattern is easily covered.

While I preferably make the mold B entirely of an elastic caoutchouc compound—that is, pure caoutchouc with its necessary ingredients to form a perfectly vulcanized elastic compound, said compound being considered the best for a mold of small or moderate size and which while being more costly has more elasticity and resistance to the action of those chemical substances that may be cast in it—yet in some instances, and especially where the mold is of a large size or extreme elasticity is not necessary or it is desired to economize in the use of the above caoutchouc compound, the said compound may have mixed with it any required adulterant or the mold may be made of a facing of either of the above, and the caoutchouc compound may be backed in any or all of its parts with any suitable strengthening or supporting medium, such as a flexible fabric, or it may be faced with any caoutchouc compound, as above, and a suitable strengthening or supporting material added and then another backing of any of the above caoutchouc compounds applied to this, especially if the vulcanizing medium to be employed is of a nature that will be absorbed by the flexible fabric, and thereby detrimental to the mold. In this combination of layers of different materials the liquid caoutchouc compounds previously mentioned should be freely used between the layers in order to make as homogeneous a body as possible.

As it is a very important matter that the molds shall be properly filled, it is found advisable in many cases to add to the mold proper an extension B', which forms a pouring-head.

The size, form, and location of the pouring-head B' may vary with each mold, and it should be made to connect with the least conspicuous part of the pattern, which is generally the base of the pattern, if it has one. In some cases it may be found desirable to have two or more pouring-heads in connection with the mold, and these may be connected by a proper channel, if desired.

To form the pouring-head B', any suitable pattern A' of the required size and form is secured to that part of the main pattern A upon which the pouring-head is to be located, this being best done when that part of the pattern which the pouring-head is to join has had at least one coating of the material forming the mold. The form is then held to the pattern, and the material forming the mold is then continued on over the form until it has received its proper coating, and it is now treated as part of the pattern.

It may be found desirable to divide the patterns into sections in order to cover all the parts with the caoutchouc compound. When these separated parts are uniformly covered,

they are brought together again in their proper positions and fastened by the addition of some of the compound, and when the pattern and all its parts are joined again in their natural relative positions it is vulcanized.

When it is desired to make a mold having both the contour of the interior as well as the exterior of the pattern and the interior is so formed that the caoutchouc compound can be conveniently applied, the interior may be treated in the same way as above and a negative of the interior thus secured, either attached or unattached to the exterior of the negative, as desired, as illustrated in Fig. 8. The mold covering the pattern being ready to be vulcanized is placed in the vulcanizing apparatus, preferably such as that described in the application for patent filed by me on December 12, 1903, Serial No. 184,945, and vulcanized by the process set forth in the application alluded to in the first part of this specification or by any other suitable vulcanizing process.

As certain stages of vulcanization by heat result in the mold becoming very soft and plastic, care should be taken in placing the mold in the vulcanizing-chamber to see that the softened mold will not be forced out of its proper position by the weight of the inclosed pattern pressing it upon the bottom or sides of the vulcanizing-chamber or anything else which would force it out of shape.

Generally the mold can rest upon that part of the pouring-head which is left uncovered; but where a mold has no such place that is practical to support it then it may be fastened at the bottom or suspended by a wire from the top of the vulcanizing-chamber, (this will depend upon the vulcanizing medium employed,) said wire being fastened to some suitable part of the pattern and passing through the mold.

After vulcanization is secured and when the mold is cold and set and in its normal vulcanized condition it should not be cut or removed from the pattern until the supporting-casing E has been formed.

It is a matter of great importance that the elastic mold in all its parts, and especially in those parts that have been cut and separated, should be brought together easily and held securely in their normal relative positions when the mold is being manipulated for purposes of reproduction, and there are often many cut and divided parts in the interior of the mold, such as $D' D' D^2 D^3$, to which access is difficult and which cannot be brought exactly together and held securely in the absence of an outer supporting-casing. Such casing, however, forms the subject of my divisional application, filed December 11, 1903, Serial No. 184,789, and a detailed description of such casing and the method of making the same will be unnecessary.

The supporting-casing E may be made of plaster-of-paris or other suitable material,

which is cast around the mold while it is still on the pattern. This supporting-casing E is made in two or more parts $E' E^2$, depending upon the shape of the mold. The undercut portions $ee' e^2$ are filled, as fully described in the companion application referred to above.

After the supporting-casing E is set it is removed, and the mold is cut at the points desired, so that the pattern can be withdrawn from the mold. After the pattern is removed the mold can be closed and the supporting-casing secured in position, so as to properly support it when duplicates of the pattern can be reproduced in the mold.

In some instances where certain of the parts of the mold are made rigid enough not to require additional support a skeleton casing may be sufficient to support those parts that require strengthening, and where a mold can be made so rigid as to retain its proper form when being filled by the composition forming the reproduction the casing E or other extra means of support and retention can be dispensed with, and the mold can be kept closed in its normal position by pins, clasps, or wrappings.

The mold is not cut necessarily into independent pieces, but is so cut that the pattern can be readily removed. The mold, as illustrated in the drawings, Fig. 5, is cut at $i i$, and cuts or openings are especially necessary in the form shown, these cuts being made at $D' D' D^2 D^3 D^4$ in Fig. 5 and $D' D'$ in Fig. 3, the necessity for such openings arising not only from the limitations of the elasticity of the mold, but on account of the intricate form of the pattern, its form making it a physical impossibility to remove the mold without cutting it in certain of its parts—for instance, the part that fills the opening b^3 , Fig. 1, between the arm and the body, where the mold is made solid, and b' , Fig. 1, where it is made hollow. When the mold is being formed in its unvulcanized state, account should be taken of where these cuts or openings must eventually be made.

When, as in some cases, it is desired to bring two or more parts of the composition forming the mold together, as seen at D and D^4 , Fig. 5, with the intention of eventually separating them after vulcanization, they may be separated after vulcanization by little or no cutting if when placing the parts together before vulcanization a thin coating of soapstone or a thin metal leaf is placed between them. This plan is often convenient, as in forming the mold it is more plainly seen where the future divisions should be made than after the mold is completed.

It is often desirable to form a rib c, of rubber, on that part of the mold that it will afterward be necessary to cut, especially in those parts of the mold which have thin walls, as the cut parts should be as thick as they can be conveniently made in order to prevent leakage. Also parts of the mold may be made solid in the first place, and after vulcaniza-

tion these parts may be cut out or burned out to the required thickness, and the mold can be cut and trimmed in any other desired manner after vulcanization, or the interior 5 or matrix may be cut and altered and parts removed, as desired.

There are some few cases where it may be necessary on account of the large size of the mold or its exceptionally intricate form to 10 cut and divide the mold after it is finished into two or more independent sections for convenience of handling. The mold can also be constructed in as many separated parts or independent elastic sections as desired, thereby forming a sectional elastic 15 mold. The construction of the same, however, is more difficult and costly than the construction of a single or unitary mold, as is also the future or ultimate use of it. Consequently in most instances I prefer to use a 20 single mold cut or slit only sufficiently to allow it to be opened for the removal of the original and its reproduction, but not separated into independent individual sections.

By the use of the words "cut" or "slit" I 25 mean to imply first a cut or slit which causes an opening in the mold, as at i , Figs. 2, 5, and 6, one or more of the extremities of the said cut or slit remaining united, and, second, a cut or slit which causes an opening 30 in the mold, as at $D D' D^2 D^3$, Fig. 5, said opening causing a complete division of the parts cut in all their extremities, but not separating the mold into independent individual pieces, 35 the parts divided remaining in close association through their adherent parts, which unite them and which bring these cut parts to their natural relative position again when the mold is closed and in its normal state.

After the mold is removed from the pattern it should have any number of small 40 vent-holes pierced through it that may be found necessary to allow for the escape of air in any space where it would be inclined to collect when the mold is being filled with the 45 composition used in making the reproduction. In some cases where the composition of the material used in making the reproduction is of a weak nature and there are delicate parts 50 which might be easily broken in the removal of the mold therefrom the chance of fracturing is much lessened by giving the interior surface or matrix of the mold a very thin coating of vaseline or equivalent substance. 55 This can be applied with a stiff brush of a size that will carry the vaseline into all the details of the matrix. This coating also has other advantages. Thus in pouring a fused substance into the mold it will prevent the 60 formation of the very small air-bubbles which sometimes form on the surface of the reproduction if the coating is not used. The formation of such bubbles may be prevented also by thoroughly drying the interior of the 65 mold before the formation of the reproduction therein.

The mold being closed and held closed by suitable means, such as the sectional casing described, the reproduction is made by pouring 70 into the mold the material G, Fig. 7, desired either in a liquid, semiliquid, or fused state, or the material may, if in a plastic condition, be worked in by hand if the form of the mold will permit it, or if the mold will 75 not permit of the hand being used in filling it then it may be filled by any other suitable means. The mold being filled in all of its parts, the material G, forming the reproduction, if necessary, is permitted to set or harden, 80 and the mold B is then released from its supporting medium, opened and stripped from the reproduction, which will be a perfect facsimile in form of the original pattern.

The process of forming the reproduction in the mold forms the subject of my divisional 85 application filed December 11th, 1903, Serial No. 184,788.

There are some reproductions which may have certain of their parts made from material different from that which forms the main 90 part of the reproduction. In this case a sectional elastic mold can be more conveniently used in order to insert the material.

In the formation of a solid product many 95 of the materials used are apt to be those that would shrink in cooling, setting, or drying. Hence the pouring-head B' is filled and the mold is kept full during the setting and shrinking of the material by the surplus material contained in the pouring-head. This 100 applies mostly to materials used in a liquid or semiliquid state; but where a mold is to be filled by a thick plastic mass the pouring-head is not always necessary, especially if it is not to hold a core in its reproduction; but 105 it is generally desirable to have a pouring-head, as the mold can then be used for either purpose.

The pouring-head should be located or attached at that part of the mold where a core 110 may be most easily inserted, if a core is used, or if more than one pouring-head is used one or more may be used for filling and the others used for the introduction of the core, the size, form, and location of the core-irons varying 115 with the pattern.

If the core-irons are to pass completely through the mold and to extend for a distance beyond the exterior walls, the fitting of the 120 core-irons to the mold and the proper joints are made after the mold is removed from the original pattern and the shape and size of the required core-irons are known.

When a mold has been made without a pouring-head and in its manipulation the 125 necessity for one arises, a substitute for one on the mold can be constructed of any suitable material on that part of the sectional casing out of which the mold opens.

In some cases the mold may be formed over 130 a flat pattern, and after removal from the pattern it may be bent so as to produce a mold

in which can be cast a solid or hollow form other than flat, thereby obtaining a differently-formed product from the original pattern.

In the utilization of the elastic mold, with its pouring-head, in combination with its sectional casing, as seen in the sectional view Fig. 7, it will be found that the pouring-head and sectional casing play a very important part in connection with the mold proper in the production of many of its products, such as in the formation of a solid product, which is made of a material which will shrink in cooling, setting, or drying, or a hollow product, which is formed by the process of pouring the material in and out of the mold, and are especially valuable where the hollow reproduction is to contain a core with or without its proper core-irons, as desired. In the latter case the sectional casing can be made to support the core-irons in the most effectual way possible while the core is being formed within the reproduction. While the core-irons are not necessary to a reproduction which is formed in the elastic mold and constitutes the finished article, they are necessary when the reproduction is to act as a pattern about which a mold is to be formed and the reproduction from which is to be hollow. This applies mostly to that class of reproductions which are made of materials which are not easily fusible, and this class of reproductions is one of the most valuable results of the elastic mold.

Where it is desired to form the reproduction of materials which cannot be cast into the elastic mold because the latter would not withstand the degree of heat necessary to fuse said materials, a solid or hollow reproduction of wax, soft metal, or other fusible material is formed in the elastic mold and its pouring-head. This reproduction is then used as a pattern, about which is formed a mold of any comparatively infusible material, said mold to be constructed as a homogeneous whole or in sections, as desired. The pattern is then removed by melting out or otherwise, leaving the mold in condition after it is dried to have cast into it any material desired.

Where a hollow reproduction is required, as above, a hollow reproduction of easily-fusible material is formed in the elastic mold and pouring-head, and a core of the necessary quality, with its proper core-irons, is then cast or otherwise formed in the reproduction, preferably while the latter is still within the elastic mold, this core being used in the final mold as a core for the final reproduction. The pouring-head permits the core to be carried up into it for any desired distance, which distance is generally from one-quarter to one-third of the capacity of the pouring-head, the balance of the space in the pouring-head being filled with the easily-fusible material forming the reproduction and which eventually plays the part of the pouring-head in the future infusible mold. The reproduc-

tion containing its core is then used as the pattern for the infusible mold in which the final reproduction is to be cast, said mold being constructed as a solid or homogeneous whole or in sections, as desired. If the former construction is adopted, the core, with its proper core-irons, will form, with this mold, a complete and substantial whole when the first-formed reproduction is removed or melted out and which results in the required space being formed for a facsimile reproduction of the original object.

In some cases a hollow reproduction made of the easily-fusible material and without a core may be used about which to form an infusible mold and the core, either with or without core-irons, afterward constructed within the reproduction and the fusible materials then removed. Also in some cases a core of the proper size and form and with its necessary core-irons may be first constructed, preferably, within a mold of the proper proportions and then placed within the elastic mold and the balance of the space in the mold then filled with the fusible material and the reproduction then treated as previously described.

The method of making hollow castings and the core and casing are fully set forth and claimed in the applications mentioned above.

I claim as my invention—

1. As a new article of manufacture, an elastic mold, the walls of which are of varying thickness, and whose exterior surface follows the general contour of the pattern, substantially as described.

2. As a new article of manufacture, an elastic mold whose inner surface is undercut and whose exterior surface follows the general contour of said inner surface, substantially as described.

3. As a new article of manufacture, an elastic mold, the walls of which are of varying thickness, whose inner surface is undercut and whose exterior surface follows the general contour of the said inner surface, substantially as described.

4. As a new article of manufacture, an elastic mold whose inner surface is undercut and whose exterior surface follows the general contour of the inner surface, said mold being so cut on the parting-line that it can be flexed to permit withdrawal of the pattern and the object reproduced in said mold, substantially as described.

5. As a new article of manufacture, an elastic mold, the walls of which are of varying thickness, whose inner surface is undercut and whose exterior surface follows the general contour of the said inner surface, said mold being so cut on the parting-line that it can be flexed to permit withdrawal of the pattern and the object reproduced in said mold, substantially as described.

6. As a new article of manufacture, a single-piece elastic mold of rubber or other vulcanizable material, whose inner surface is under-

cut and whose exterior surface follows the general contour of the inner surface, substantially as described.

7. As a new article of manufacture, a single-piece elastic mold of rubber or other vulcanizable material, whose walls are of varying thickness and whose inner surface is undercut and whose outer surface follows the general contour of the inner surface, substantially as described.

8. As a new article of manufacture, an elastic mold formed from a pattern in the round, the exterior surface of which mold follows the general contour of the pattern, substantially as described.

9. As a new article of manufacture, an elastic mold of rubber or other vulcanizable material having abutting surfaces within the cavity, substantially as described.

10. As a new article of manufacture, an elastic mold of rubber or other vulcanizable material whose inner surface is undercut and whose exterior surface follows the general contour of said inner surface, said mold having abutting surfaces within the cavity, substantially as described.

11. As a new article of manufacture, an elastic mold with parts that are partially separated from the main body of the mold by open spaces, said parts being connected through the open spaces by comparatively thin walls constituting supports for the said parts, substantially as described.

12. As a new article of manufacture, an elastic mold with parts that are partially separated from the main body of the mold by open spaces and connected through said open spaces by comparatively thin walls constituting supports for said parts, said parts being

open through the connecting-walls to allow for the removal of the pattern, substantially as described.

13. As a new article of manufacture, an elastic mold of vulcanizable material, having a rib on its outer surface through which the mold is parted, substantially as described.

14. As a new article of manufacture, an elastic mold of vulcanizable material having a rib located at the line for division of said mold and divided through said rib to allow removal of the pattern, substantially as described.

15. As a new article of manufacture, an elastic mold having a pouring-head formed integral therewith, substantially as described.

16. As a new article of manufacture, a mold of rubber or other vulcanizable material, having a pouring-head and internal abutting surfaces and partially severed to allow removal of the original and reproductions, substantially as described.

17. As a new article of manufacture, a mold of rubber or other vulcanizable material, the walls of which are of varying thickness, and whose outer surface follows the general contour of the pattern, and provided with a pouring-head, said mold having abutting surfaces and partly severed to allow removal of the original pattern and the reproductions, substantially as described.

In testimony whereof I have signed my name to this specification in the presence of two subscribing witnesses.

JESSE F. SPENCER.

Witnesses:

WILL. A. BARR,
FLORENCE HILLMAN.