



VULCANITE AND CELLULOID

INSTRUCTIONS IN THEIR PRACTICAL WORKING

FOR

DENTAL PURPOSES.

BY

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VULCANITE AND CELLULOID



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1884.

PREFACE.

The aim of the author in the production of this volume has been to present the subject-matter as concisely and plainly as possible, as the work is designed especially for the use of students. Practical hints upon the taking of impressions of the mouth are first given, and these are followed by a consideration of materials and processes, step by step, up to the completion of the case.

The author desires to express his sense of obligation to Dr. J. W. White for valuable suggestions and for furnishing illustrations, as also to the Celluloid Manufacturing Co. and T. B. Welch & Son for esteemed favors.

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VULCANITE.

Vulcanite is the result of the combination of caoutchouc (India-rubber) with sulphur through the agency of high temperature. The earliest information on this subject is found in the specification of Charles Goodyear, in 1844, for producing indurated rubber. His mixture consisted of caoutchouc, sulphur, and white lead. In 1855 he obtained a patent for the use of vulcanite as a base for artificial dentures. The coloring matter used in red vulcanite is vermilion. Black vulcanite has no coloring, but consists of caoutchouc and sulphur, and this product, being nearly pure rubber, shrinks more than the colored vulcanite.

IMPRESSIONS OF THE MOUTH.

The mouth being in a proper condition, the initial step towards the construction of an artificial denture is the taking of an impression. One of four materials may be used for this purpose,—namely, gutta-percha, wax or a combination of wax and plaster, modelling composition, and plaster of Paris.

Gutta-percha.—Gutta-percha is softened in hot water and placed in the impression cup; then inserted into the mouth, and gently crowded into position, the cheeks and lips being pressed against it while so held, thus causing

the softened material to take the form of the mouth. This is allowed to remain until hard enough to retain its form, and then removed and placed in cold water, after which plaster is poured into the impression and forms the cast.

Wax.—This is manipulated similarly to gutta-percha, and may be heated either in hot water or by dry heat. Care should be taken not to have it so hot as to run, as this injures its working properties.

Wax and Plaster.—Many dentists prefer to use these combined, as follows: First obtain the impression in wax; then cut away about one line of the wax covering the whole surface of the impression. Mix a thin batter of plaster, and place enough in the wax impression to nicely cover it. Replace it in the mouth and force it into position, allowing it to harden. When removed and varnished with shellac, a thin coating of soap may, if desired, be applied to the surface. Place the impression in water and allow it to absorb freely. The batter of plaster is then poured into the impression. This is preferable to oiling, as it prevents the formation of air-bubbles or the softening of the surface of the cast. The impression and cast are as easily separated as where oil is used, and this mode is more advantageous in all impressions taken in plaster or plaster and wax.

The following method is preferred for all plaster impressions, as it leaves the model with a dense polished surface: Stain the impression with thin shellac varnish. When dry, apply a *thin* coat of sandarac varnish, and after this is dry pour the plaster. The varnish is composed of gum sandarac dissolved in alcohol.

Modelling Composition.—Next to plaster, this is probably the best material for impressions. To use it to the best advantage, water should be heated in a shallow vessel until it reaches the boiling point. It should then be removed from the flame and the composition placed in it, allowing it to remain until thoroughly softened, by which time the water will have lost some of its heat, and the material will not be too hot to handle when taken out of the water with the spatula. Pass the impression cup over a flame until it is heated sufficiently to prevent the hardening of the material when brought in contact with it. Build up the composition to approximate the form of the arch; then proceed as with wax until the surface begins to harden slightly. Press it around the outside of the ridge, applying also a slight pressure with the index finger upward and forward to that part which overhangs the back of the tray. Allow it to cool still more, and at the end of another minute or so it may be carefully removed, caution being used not to draw in the sides by pressure against the corners of the mouth. Plunge the impression in cold water at once, letting it remain until hard. Before filling it with plaster wet the surface. A smooth, glossy model, with a clear reproduction of each line in the mouth, will be the result. To remove the impression from the cast, heat the water as before; place the cast and impression in it until the compound is softened, when it is easily detached. In most cases No. 2 Modelling Composition will meet all the requirements.

Plaster of Paris (Sulphate of Calcium).—This I consider to

be superior to any of the other materials for taking impressions. All of the others draw more or less where there is an undercut, or where the teeth tip in different directions. I am aware that plaster is not as easily manipulated nor as pleasant to the patient as a plastic material; but most of this unpleasantness may be overcome, if the operator thoroughly understands the use of it and adapts himself to circumstances. When a correct plaster impression is obtained no guesswork is required, as is the case when a plastic material is used. Plaster fractures where there is a heavy undercut or where there are teeth. This is just what we want it to do, as the pieces, when properly placed together in the cup, form a correct impression of the mouth. These pieces are held in place by dropping a little melted wax upon them to attach them to the edge of the cup.

FULL UPPER IMPRESSIONS.

For a full upper impression, select a cup a little larger than the mouth. If the palatine portion is high, the cup should be well raised in the center; if it is a flat mouth, the cup should be correspondingly flat. The edges should extend high or low, according to the amount of absorption. To prevent the plaster extending too far back, build a rim of wax across the posterior edge of the cup. If the patient is easily nauseated, ask him to breathe through the nose; to avoid swallowing, and to place the tongue against the impression tray or the fingers of the operator as he holds it in position. It is sometimes necessary,

in cases of very sensitive mouths, to administer bromide of potassium half or three-quarters of an hour previous to taking the impression. This generally prevents retching, which it would be almost if not quite impossible to otherwise avoid. There are several ways of overcoming nausea, but I think it unnecessary to mention others, as the above will prevent it in most cases. The cup having been chosen, sprinkle the plaster in the bowl of water until it has taken it all up; then stir it a little (if this is properly done there will be no air-bubbles). Fill the impression cup, being careful not to overload it. Dry the palatine portion of the mouth with a napkin, and place a little plaster in the highest part of the arch, working it into position with the index finger, excluding all air-bubbles. The cup and plaster are now gently forced into place, allowing the posterior portion to be pressed up slightly in advance of the anterior part. This forces the plaster where it is needed, namely, at the sides and in front. The head of the patient should be thrown forward, so that the chin rests nearly upon the chest. The cheeks and lips are pressed against the soft material, which is allowed to remain until the plaster in the bowl will break with a distinct fracture. To remove the impression from the mouth, wet the finger with water and raise the lips and cheeks from it. Should it fall when this is done, or be removable afterwards without any force, it should be discarded as imperfect. To have a perfect impression, it must cling to the mouth. This is one of the best tests, but it sometimes fails. Should the plaster set too slow, the setting may be hastened by sprinkling a

few grains of sulphate of potassium or of salt in the water before mixing. Tepid water should be used, as it promotes the setting. Do not be satisfied until you obtain a *perfect* impression, for without this you cannot have a perfect-fitting denture.

Detaching the Upper Impression.—The lips being raised from the sides, press the handle of the cup up and then down. If this does not loosen it, ask the patient to give a slight cough or puff by sending the breath out of the mouth quickly. In removing a case that has a heavy undercut at the anterior of the alveolar ridge, it should be drawn forward and downward at the same time.

FULL LOWER IMPRESSIONS.

A cup should be selected that is best adapted to the case. Sometimes it is necessary to build wax around the rim, to have it deep enough; at other times it will need trimming away. The plaster should extend well down on the inside of the ridge at the back, as this is to be depended upon to a great extent to hold the denture in place. Before forcing the plaster down, see that the cheeks do not fold in upon the ridges. This is prevented by pushing them out with the finger just as the plaster is in position, but before it is crowded into place. Have the patient raise the tongue; then force the cup and contents gently down. The tongue should then be lowered, thus crowding the material close to the ridge upon the inside. Press the cheeks against the plaster, and allow it to harden; after which raise the lips and cheeks away

from the cup, working the handle gently up and down until the impression loosens and may be removed from the mouth.

PARTIAL UPPER IMPRESSIONS.

Where the mouth contains several teeth, an impression can be taken with greater ease by the following method, rather than by filling the cup with plaster: With the spatula place enough plaster against the palatine surface to fill the mouth even with the masticating edges of the teeth. If it is desirable to obtain a perfect imprint of the buccal and labial surfaces, place a little plaster against the inside of the rim of the cup. A perfect impression is thus obtained without a large excess of material. Previous to inserting the cup a rim of wax is built across the posterior edge. It is then passed into the mouth beyond the plaster; then drawn forward and gently pressed into place, causing the heel to go up in advance of the anterior part of the cup, thus forcing the surplus plaster out at the front and sides.

PARTIAL LOWER IMPRESSIONS.

For a partial lower impression the cup should be deeper, but filled with plaster as for a full lower case.

The following is an excellent method of taking impressions where the teeth are elongated and loose, or where they stand in different directions—as, for instance, where the incisors lean in, or a molar on one side tips forward

and one on the opposite side backward. Although this is a difficult case, it may be satisfactorily overcome by first obtaining an impression in wax and then running a model in it. Wax caps are then fitted over the crowns of the plaster teeth, extending almost to the gums. This leaves all of the soft parts and necks of the teeth exposed, allowing an impression to be taken of them in plaster. Select a cup suitable for the case; or one may be made so by building up the sides and lingual portions with wax. Remove the wax caps from the model and place them upon the natural teeth; then take the impression in plaster in the usual manner, removing it the same as in a full case. Replace the plaster that breaks away around the necks of the teeth in the impression, and then run the model.

To Remove a Partial Impression.—Where there are no undercuts the impression may be removed as soon as the plaster will fracture without crushing; but where there are undercuts or dovetails it should be allowed to set hard. The cup is then loosened and carefully removed, leaving the plaster in the mouth. With a pair of foil-pliers remove the wax and any of the plaster that may have been forced over it. This leaves the posterior part of the mouth free. With a thin-bladed knife cut a line through the plaster down to the masticating surfaces of the teeth, and where teeth are absent cut a little deeper. Cut a line over and down to the cuspids upon the labial surface. Insert the knife-blade in the line cut over the teeth upon one side, and by twisting it the plaster will fracture to the line opposite the cuspid. The piece thus secured is

removed. Then the opposite side and front are treated in the same manner. Should the palatal portion be held fast by the molars tipping in and forming a dovetail, cut a line with the knife about a quarter of an inch from the teeth and nearly through to the hard palate, beginning back and coming forward to the cuspid; place the knife-blade in the crevice and twist enough to fracture the plaster, when it may be easily removed. If there are pieces still remaining between the teeth, which prevent the removal of the body of the plaster, they are to be fractured with the knife and taken away laterally. After the plaster covering the palatine portion is removed, place the pieces together in the cup and fasten them with wax. If all of the pieces are put in their proper places, the impression will be found correct, if care has been taken to force the plaster into place in the mouth. For removing the body of the plaster use a small, flattened instrument, bent at an acute angle. This is inserted between the plaster and palate and drawn gently down, when the plaster loosens and is easily taken out. Varnish and proceed as with a full upper impression.

In removing a partial lower impression, the cup is detached, leaving the plaster in the mouth. A line is then cut over the teeth after the manner described in the upper case. The knife-blade is inserted in this line and the plaster broken from each side and in front, that remaining on the inside of the teeth being pressed in with the finger, when it fractures and falls away. With practice, many little devices will be found for removing all partial impressions.

BREAKING TEETH FROM THE MODEL.

To prevent the breaking of teeth from the plaster model, insert small pieces of wire or pins in the impression made by the teeth before running the cast.

PLASTER CASTS.

For all laboratory work strong plaster should be used. That which is moderately coarse is the best, as it is hard and tough when thoroughly set. Its expansion is greatest when mixed thin, and, therefore, better casts are obtained where the plaster is mixed as thick as it may be and work well.

Treat the surface of the impression as before directed. The following is about the right consistence for the varnish :

R.—Shellac, $\frac{3}{4}$ ii ;
Alcohol, $\frac{3}{4}$ i.

Allow this to stand until the shellac is dissolved. After varnishing the impression, place it in water until thoroughly saturated, which may be known by bubbles ceasing to rise. The impression parts from the cast as readily as when oiled, and as in this method no oil is used, its disadvantages are avoided. Remove the impression from the water and fill it with plaster, gently tapping it to force out all air-bubbles. Build the material up about half an inch, and level it off. When hard the impression must be carefully removed by cutting it down and breaking it off, piece by piece, until the cast is free.

THE ARTICULATION.

For a full upper denture on vulcanite a base plate is required. This may be made of wax, gutta-percha, paraffine and wax, or modelling composition, the last being preferable. These are warmed and shaped to the cast, and a piece of softened wax is made into a roll and placed upon this base plate and over the alveolar ridge, to take the place of the teeth, shaping it so that it will assume the general form of the arch. This is then tried in the mouth, and, if too long or too short, trimmed or added to as may be required; the wax being placed so that it will restore the contour as near as possible. This is one of the most important points for beginners, and, I think, one of the most difficult, for, unless care is exercised, the bite will be made too long or too short, causing the teeth to be correspondingly so; but some trouble may be avoided by cutting one or more blocks of soft pine, about half an inch square and thicker than the required bite, and securing them to the base plate with melted wax at points opposite to the occluding teeth. Let the grain of the wood run parallel to the ridge. With a knife split off small portions until the proper length is reached. The wax may be applied and the patient may close the mouth without danger of going beyond the distance established by the blocks.

LENGTH OF THE TEETH.

When in the mouth, and the upper lip is at rest in its natural position, the wax should be about one-sixteenth

of an inch longer than the lip for the upper and about one-sixteenth shorter than the lip for the lower bite. Always mark the median line in the articulation. The wax should be heated a little on the biting surface: then placed in the mouth, and the patient requested to close the teeth upon it just hard enough to give an imprint of their ends. Patients should never be asked to bite naturally, as they will in that case do just the opposite in their effort to have it right. They will throw the chin out or bite sidewise, thus giving the wrong articulation. A good method is to tell them that you wish to try the wax and ascertain the length of the teeth. Then place it in the mouth and request them to hold it in position with the teeth. Remove and trim it, and then replace it in the mouth again, with the same instructions to the patient as before. The author does this several times while taking the articulation, each time observing where the teeth closed, before a satisfactory result has been reached. When the closure has been the same each time, the articulation will be found to be correct, and the patient can be instructed to close a little harder, which he does without an effort, thus giving the correct articulation. But sometimes this will not do, and different methods have to be resorted to. When this fails, the patient may be requested to swallow and to hold the teeth where they closed in swallowing, or to sit upright, and the operator may place one hand between the shoulders and with the other push the head back, bending the neck as short as possible. The mouth being open, request the patient to close it. Another very good method is to engage the

patient in conversation while the wax is in the mouth, and, watching the articulation, when he is off his guard, suddenly catch the jaw in the hand and hold it just where he closed in talking, forcing the teeth into the wax as desired. For a full upper and lower impression, trim both pieces of wax as the case may require, and, softening the edges of each, place them in the mouth. When a correct closure is obtained, mark the median line above and below, and also cut lines in the wax at the sides, so that, in case the sections become separated in removing them from the mouth, they may be easily placed in position; or fasten the parts together in the mouth with double-pointed tacks.

FIG. 1.



THE ARTICULATING MODEL.

For a full upper or lower case, the wax articulation is placed upon the cast and fastened by running a hot spatula (Fig. 1) around the edges. If a metal articulator is used, the cast is fastened to this with plaster. Fill the cavities made in the wax by the teeth with water, and add a little plaster, mixed thin. By jarring, this takes the place of the water, leaving each tooth perfect. Fill enough plaster upon this to bring it even with the top or bottom of the articulator, as the case may be. Smooth this and allow it to harden, after which separate and remove the wax, laying it aside to be used as a guide in restoring the contour. The

base plate is then fastened to the cast and the teeth arranged upon it.

The following method of obtaining a more complete articulating cast of the opposing teeth may be employed: An impression is obtained (in either wax or modelling composition) of the jaw opposite to the one that the teeth are to be made for, and a plaster cast is run in it. When the cast becomes hard and has been separated from the impression, the teeth upon it are inserted into the depressions made in the wax articulation by the natural teeth, and fastened by running a hot spatula around them. Both casts and articulation are fastened in the articulator with plaster and allowed to stand until hard, after which the base plate and teeth are arranged as in the first method.

It will be seen that by this mode we have a full cast of both jaws with all the opposing teeth and soft parts as they are in the mouth. In the first we have only the ends of the teeth of the opposing jaw.

SELECTING THE TEETH.

To make a proper selection, the temperament should be studied. The teeth should harmonize in shape, size, and color with the sex, age, and peculiarities of the patient. Artificial teeth should never be as large for a full denture as the natural ones, as they appear much larger when in the mouth. The arch becoming contracted by absorption, renders a corresponding reduction in the substitutes necessary.

In arranging teeth in position, bear in mind that there are three temperaments in which the six oral or front teeth

form nearly the arc of a circle—namely, the nervous, bilious, and lymphatic. The outside or buccal cusps of bicuspid and molars are almost upon a line with the most prominent part of the cuspid when looking at the case from the front. Where the denture is set up in this way the bicuspid will not be prominent, as they drop slightly behind the cuspid. In using sectional teeth, it will be found that the edges of the gums do not harmonize between the cuspid and first bicuspid. This form of arch is preferable in the temperaments mentioned to that of the horseshoe, which shows the bicuspid and molars as the patient opens the mouth. The uneven jointing of the gums spoken of may be overcome by grinding the posterior edge of the front block down slightly with a corundum wheel; then polishing with a felt-wheel and pumice, revolving it rapidly. This should be done before the teeth are fastened in place, and not after the plate is finished.

Cases of the fourth or sanguine temperament, or where it predominates, present a horseshoe arch, the bicuspid being thrown well out. People of this temperament seldom have to resort to the use of an artificial denture, as they generally retain their teeth until they are worn almost to the gums before they give much trouble.

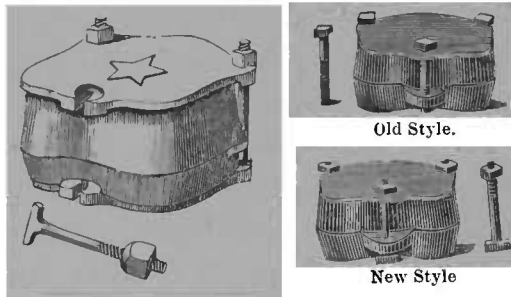
In block teeth the gums should be ground squarely together. When this is done, make a small V-shaped space upon the inside of the block, and then replace them.

WAXING UP THE CASE.

When the teeth are properly arranged upon the model,

flow wax around them with the spatula, being careful that it does not enter the joints. This wax trial plate should be made as nearly like the vulcanite plate as possible. The articulation may be tested by placing this plate in the mouth. The wax should be made smooth with either a blowpipe flame, chip-syringe, or a cloth moistened with benzine. The case should now be detached from the articulator and flaked.

FIG. 2.



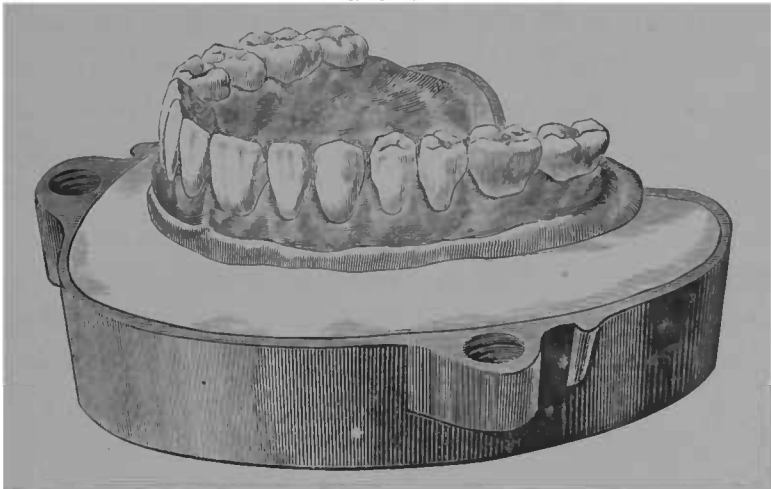
CASTING THE PLASTER MOLD.

Either of the flasks illustrated in Fig. 2 will be found to meet all requirements, and they are used more extensively than any others. The casting of the mold is done by placing the cast with the teeth upon it in the flask. Before doing so, however, saturate the cast with water to prevent its robbing the new plaster of moisture. Mix the batter as thick as it will bear, and pour, partly filling the lower section; then place the cast and teeth in it bottom down (as shown in Fig. 3) and slightly inclined at the anterior portion. This excludes all air-bubbles when it is forced down into place. The plaster should extend up to the wax (Fig. 3). Here the dividing line is made

between the two sections. This allows the teeth to be imbedded in the upper section of the flask.

Where plain teeth are used, without any rubber over the anterior part of the alveolar ridge, and the teeth are resting directly upon the gum, the division should be at their cutting edges, thus fastening them in the lower section, with their bases upon the cast. After the plaster has set, trim it smooth and varnish with shellac,

FIG. 3.



being careful not to get any upon the teeth or gums. Place the ring forming the upper section accurately upon the lower ring, and see that there is no plaster between them. Set the lower section in water, allowing it to take up all it will. (Oil may be used in place of water, if desired, but only the surface which has been varnished should be oiled,—not the teeth or gums.) Then mix the plaster as for an impression; remove the flask from the water, and pour in the material, gently tapping it to force

out air-bubbles. When full, put the top on and press it down. The case is now set aside until hard.

SEPARATING THE FLASK.

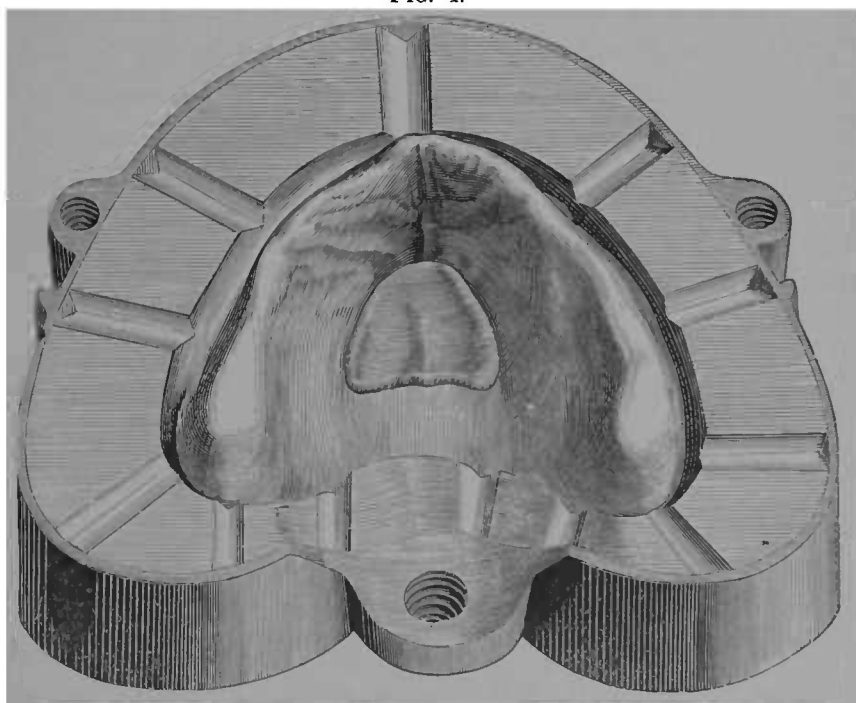
Before the flask is separated it should be warmed to soften the wax, but not enough to melt it. This is accomplished with either wet or dry heat, but wet is preferred, as dry is more liable to melt the wax, causing it to combine with the plaster; or, if gutta-percha is used, it will adhere to the cast if made too hot, making it difficult to remove. In case the wax melts and runs into the plaster, the difficulty may be partly overcome by covering the flask (face upwards) with boiling water, and allowing it to stand for a few minutes. Where wet heat is used, in the following manner, it will prove very satisfactory: Set the flask in a vessel of water, and heat it to about 135° F. when gutta-percha is used; 120° F. where wax or wax and paraffine are used. The flask should remain in the water a few minutes at this temperature, so that the heat may permeate all parts of the mold; then remove it, and the flask will readily separate, bringing the model plate away from the teeth. In case it should accidentally become too warm, immerse it in cold water a moment. This will chill the surface of the wax, when it may be easily removed.

PREPARING THE MOLD FOR THE RUBBER.

When the flask is opened the model plate is taken from the mold. A medium-sized hatchet excavator may

be used for removing the wax from around the pins. This being done, it will be found that some still remains. This is washed out by pouring a stream of boiling water upon it, allowing it to fall about a foot, striking upon the parts of the mold containing the pieces of wax. If gutta-percha is used, it will be necessary to remove it with the instrument, not using hot water. It is impor-

FIG. 4.



tant that all the wax be removed, as rubber loses its integrity when it comes in contact with it. We are now ready for cutting the grooves, or waste gates, which are made for the purpose of allowing the excess of rubber to flow in when the flask is being closed. They should be

cut in the plaster, radiating from the cast to the edge of the flask. Fig. 4 represents this section prepared for packing.

COATING THE MOLD.

The mold should be covered with some substance to prevent the rubber from penetrating and adhering to it, and leaving the plate rough. Either liquid silex, collodion, or tin-foil may be used for this purpose.

Liquid Silex (Silicate of Soda).—This will prevent the rubber from adhering to the model during the process of vulcanizing, and is easily removed from the surface of the plate in finishing. A thin coat of this should be applied to the model with a small, soft brush before allowing it to dry. Wipe off all that will come away. This prevents the thick, white scale of dry silex from forming on the inside of the plate, as it will when a heavy coat is allowed to dry on the cast. In case any of the scale of silex is on the plate, it may be removed with a stiff brush-wheel and wet pumice. Should the liquid become thick by standing, it may be thinned with water.

Tin-Foil.—When this is used the mold should be coated with shellac varnish, and while it is still adhesive the tin-foil should be carefully pressed upon it wherever the rubber plate touches the cast. This being done, coat the tin with collodion, allowing it to dry; then soap it thoroughly. After the case is vulcanized the tin may be peeled off, leaving a polished surface upon the inside of the case.

Collodion.—This works very well, and is used similarly to liquid silex.

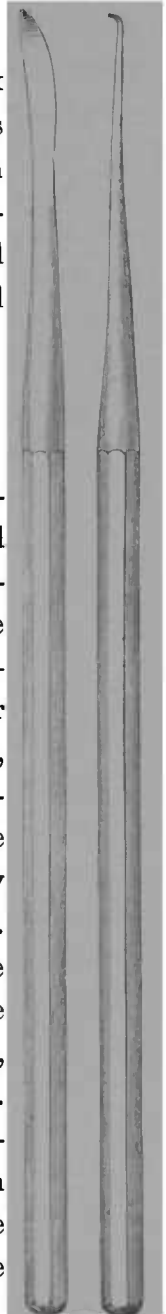
FIG. 5.

TO FASTEN LOOSE TEETH.

Sometimes, upon opening the flask, a block or a single tooth becomes loosened. When this occurs, place a drop of liquid silex or collodion where the tooth belongs, and force it into position. Allow it to stand for a short time until the silex or collodion becomes dry, and it will be held firmly in place.

PACKING THE CASE.

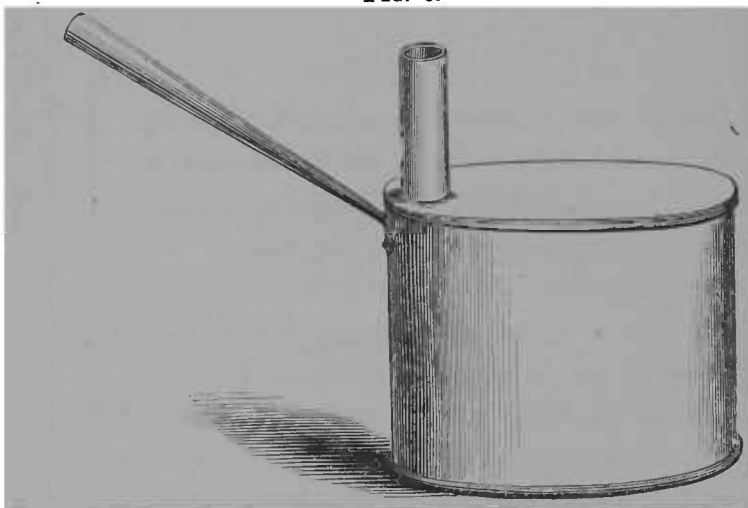
After the case is separated, and before packing the rubber, fill the space before mentioned with oxychloride of zinc, oxyphosphate, or plaster. When this is hard, pack the case. The joints, if perfectly ground, will come out without dark lines, unless poor plaster is used, or there has been too great an excess of rubber, causing the blocks to move. As a further preventive, a narrow strip of pink rubber may be placed behind each joint, tucking it in below the pins and above the upper edge of the blocks. All the instruments needed for this purpose are those represented by Fig. 5. The smaller one of the two may be made from an excavator, blunt at the point, and turned at a right angle. It is necessary to have the hands and instruments clean when packing a case, as any foreign substance injures the rubber either in texture or color. In packing, it is best to have the



mold warm, as it works much better; yet this is not important, as with cold molds and heated rubber the same results are obtainable.

The rubber works best when cut into different-sized pieces. A large piece the shape of the palate may be cut, and also several small ones. Moist heat is preferred for softening rubber, as dry heat is liable to injure it by overheating. Fig. 6 represents a vessel for heating rubber

FIG. 6.



for packing. The material is softened by laying it upon the cover; or the boiler of the vulcanizer may be used, covering it with an earthen plate, on which the rubber to be softened may be placed. These are also convenient for heating the flasks before bringing them together, as the water is boiling and ready to receive them as soon as they are packed.

When the rubber is softened, pack it into place in the mold, using the large pieces where they are required,

and consolidating each piece as it is added, being careful to exclude any particles of plaster. The piece cut for the palatal portion should be pressed into position with the thumb and fingers, first wetting them. Should more rubber than this piece be required, it may be packed upon the other, as it will flow into place when heated. Care should be used not to pack the case too full against the gums, particularly when they are thin and come close to the cast when the flask is closed, as in such case the force of bringing it together crowds the rubber against the porcelain blocks and is liable to fracture them. If left thick in the center, the force is greatest upon the strongest part of the mold, and as the rubber yields it will flow in and around the frail parts without injuring the thinly-ground gums.

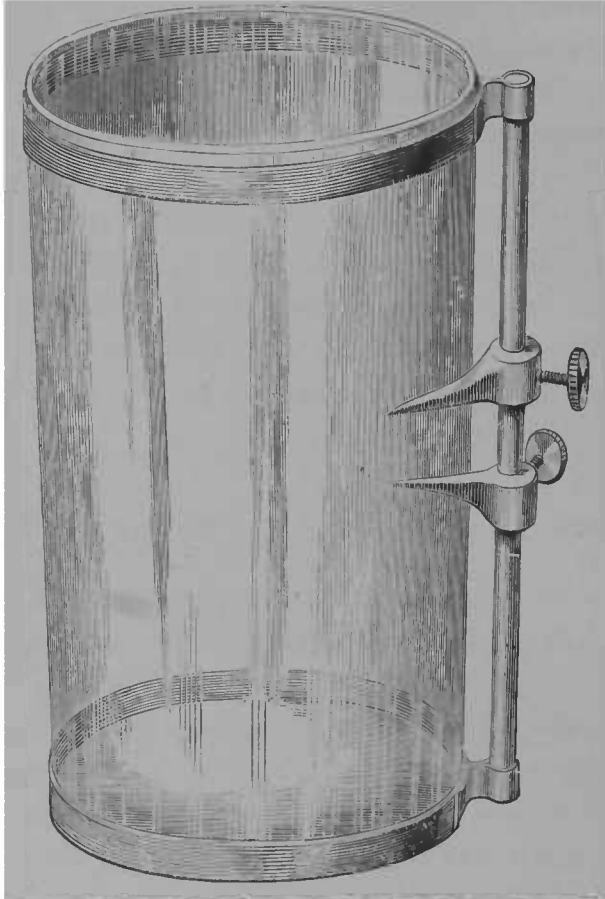
AMOUNT OF RUBBER REQUIRED TO FILL THE MOLD.

Rules are given to ascertain by weight and measure how much rubber it will require for each case. The most practical way is by displacement, and is as follows: Upon removing the model plate, place it in a glass vessel and cover it with water, marking the rise; remove and add rubber until the water reaches the same point. Fig. 7 represents a very simple and useful gauge for this purpose.

With the screw, set the lower point to the level of the water in the glass; then throw in the model plate, and set the upper point to the then level of the water. The glass is now emptied, and rinsed to rid it of all foreign substances

liable to mix with the rubber; then again fill the glass to the lower point with water, and add enough rubber to cause the water to rise to the upper point, which will

FIG. 7.



be just enough to fill the mold. If desired, a little surplus may be added.

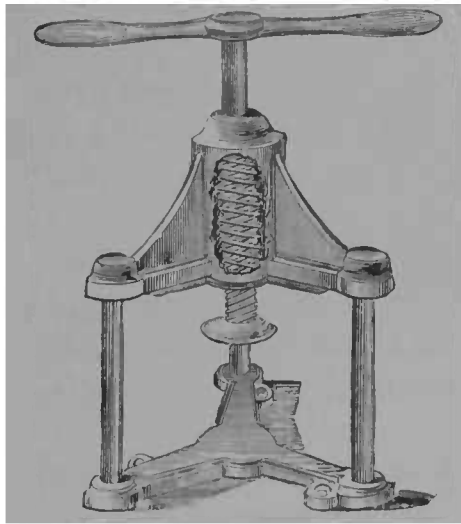
CLOSING THE FLASK.

The case having been packed, the sections of the flask

are placed together and closed, either by a clamp or screw bolts.

Rubber is of a yielding nature, but if pressure is applied suddenly, before it is heated, there is great liability of fracturing the cast or teeth. One of the best of the devices that have come under my notice for closing a flask is Welch's automatic flask press. (Fig. 8.)

FIG. 8.



The flask is placed in this, and the clamp screwed down and put into a vessel of water, where it is allowed to stand for a short time and boil, when it will be found to be closed. The screws may now be put in to hold it in place while vulcanizing. If screw bolts are used for closing the flask, they should be turned only as far as can be done with the fingers. The case is then put into boiling water and allowed to heat for a few minutes; then remove and gently turn each screw, giving time between

the turns for the rubber to run. As soon as it requires force to turn the screws, heat it again, and so continue until the flask is closed. Dry heat may be used, but there is danger of injuring the rubber by overheating.

VULCANIZING.

A high degree of heat is required to vulcanize rubber. This is maintained for a longer or shorter period, in accordance with the temperature. As a medium, hot air, hot water, or steam may be employed. Water or steam, confined in a steam-tight vessel called a vulcanizer, is most commonly employed for this purpose. (See Fig. 9.)

The vulcanizer generally has a single chamber. The flask is covered with water; then allowed to heat gradually, from thirty to forty-five minutes being necessary before the required heat for vulcanizing is obtained, and the thicker the plate the longer it should be in attaining this point.

The "New-Mode" vulcanizer will be considered under the head of celluloid apparatus.

Elastic Force of Steam.—Prof. Wildman writes with reference to this subject as follows:

"As high steam is used in vulcanizing, it is important that the operator should be conversant with the nature of the agent which he employs to accomplish his end. It is perfectly safe; but the following will show him that it must be used with discretion and judgment. Numerous experiments have been made by scientific men to ascertain the elastic force of steam at different temperatures. The

FIG. 9.

Whitney Vulcanizers.

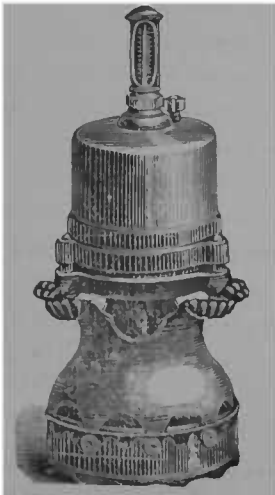


For Alcohol and Gas.



For Kerosene.

Hayes Vulcanizers.



results of their investigations are not uniform; although they agree in showing the immense force exerted by this agent at high temperatures. Haswell's tables are looked upon as authority. The results of the investigations of the Franklin Institute Committee, in the higher degrees, give a greater elastic force than the table below quoted. I shall, however, quote the results of the experiments of the commission of the French Academy appointed by the French Government to investigate this subject, for the reasons that, from the manner in which they were conducted, they are probably as reliable as any, and that they are extended to a more elevated temperature than the others.

Elasticity of steam, taking atmospheric pressure as unity.	Temperature, F.	Pressure per square inch, lbs.
1	212°	14.7
1½	233.96°	22.05
2	250.52°	29.4
2½	263.84°	36.75
3	275.18°	44.1
3½	285.08°	51.45
4	293.72°	58.8
4½	300.28°	66.15
5	307.05°	73.5
5½	314.24°	80.85
6	320.36°	88.2
6½	326.26°	95.55
7	331.70°	102.9
7½	336.86°	110.85
8	341.78°	117.6
9	350.78°	132.3
10	358.88°	147

Elasticity of steam, taking atmospheric pressure as unity.	Temperature, F.	Pressure per square inch, lbs.
11	366.85°	161.7
12	374°	176.4
13	380.66°	191.1
14	386.94°	205.8
15	392.86°	220.5
16	398.48°	235.2
17	403.82°	249.9
18	408.92°	264.6
19	413.78°	279.3
20	418.46°	294

“I would here call the attention of those using high steam to an important consideration. In raising steam, *the ratio of increase of pressure or elastic force is far greater than that of the increase of temperature.*

“By referring to the above table, commencing at 212° and taking steps as near fifty degrees as is given in the ascending scale, we find this exemplified; thus,—

From 212°	to	Increase of Temperature.	Increase of force per sq. inch	Giving a force per sq. inch.
212°	to 263.84°	= 51.84°	22.05 lbs.....	36.75 lbs.
“	363.84° to 314.24°	= 50.40°	44.10 lbs.....	80.85 lbs.
“	314.24° to 366.85°	= 52.61°	80.85 lbs.....	161.85 lbs.
“	366.85° to 418.46°	= 51.61°	132.15 lbs.....	294. lbs.

“This comparison shows clearly how rapidly the pressure increases at high temperatures, and warns the operator that a strong instrument combined with care and judgment in its treatment are indispensable to safety. Besides the rapid increase of pressure, it must be borne in mind that, at high temperatures, copper, of which the

boiler is composed, becomes weakened, and in a measure loses its power to resist this great imprisoned force. Copper in passing 212° to 320° F. loses about one-tenth of its strength, and at 550° it has lost one-fourth of its tenacity."

When using a vulcanizer or rubber for the first time it is always better to employ a test piece. Invest a piece of rubber in plaster covered with tin-foil, and place it beside the flask. When the vulcanizer is opened, remove the plaster from the test piece, and if it is of the right hardness, upon scraping it will give a shaving like that of horn; if too soft, it will not be springy, and when bent will remain so; if too hard, the shaving will be brittle and crisp and the rubber dark. In case it is not vulcanized enough, reclose the vulcanizer, and continue the process for a time, in accordance with the indications of the test piece. Place the flask in the vulcanizer and fill it two-thirds full of water; this allows space for the steam, with less liability of blowing out the safety disk before 320° is reached. Dust a little black-lead, soapstone, or whiting over the packing. This prevents sticking and the escape of steam in case the packing is imperfect. Replace the cap and screw down firmly. The heat is now applied, for which gas, alcohol, or coal-oil may be employed. Vulcanizers are generally constructed so that either gas or coal-oil may be used. The flame should be so regulated that it will not deposit carbon, for this acts as a non-conductor, and in a measure delays the heating of the case. It should be gradually raised to 320° F., and this should not occupy less than half an hour. If the piece

is thick, an hour will not be too long, for when heated too rapidly the case is sure to be spongy or porous. When the vulcanizing point (320° F.) is reached, the flame should be so regulated that the temperature will remain stationary at that point until the case is finished. The operator should always be watchful, as neglect will not only ruin the case, but greatly endanger life.

The length of time for vulcanizing varies with the different varieties of rubber, ranging from fifteen minutes to an hour and a half. The time is usually stated upon the package, but it is best to use a test piece, as thermometers vary. Where the heat is carried too high, the rubber becomes dark and brittle. This injures it for dental purposes. What has been written applies to red rubber. When black rubber is used, care should be exercised in raising the heat, especially when the piece is thick. After it has reached 320° F. it will vulcanize in the same time as the red, but it is considered best to use a lower heat and longer time. Black rubber has greater strength and toughness than the others. In using pink rubbers, the heat may be raised more rapidly, as they contain more foreign matter, and have very little strength. They are unfit for the entire plate, but may be used for gums in connection with other rubber. When employed in this way, the same time and care are required as with the base alone.

To attain the best results in hardening rubber, the heat should be gradually raised to the vulcanizing point, and not higher than 320° F. When vulcanized, turn off the flame and allow the case to stand until cold; or, should

the operator prefer, to facilitate the cooling, he may allow it to stand a few minutes, replace the thermometer cap, and plunge the vulcanizer into cold water. Then unscrew the top and remove the flasks, which must not be opened until thoroughly cold, as there is great danger of springing the plate. No harm is done by this process unless the water is allowed to cover the thermometer, in which case it is liable to separate the column of mercury.

OPENING THE FLASK.

When the flask is cold, remove the top and carefully separate the remaining parts. With a pointed knife remove the plaster near the margin of the flask; after which gently tap the flask with a hammer, and the plaster will separate, being easily removed from the rubber with water and a stiff hand-brush. If the mold has been coated as directed, the case is now ready to finish. Before going further, however, the flasks should be thoroughly cleaned, in order to leave them in good condition for future use.

FINISHING THE CASE.

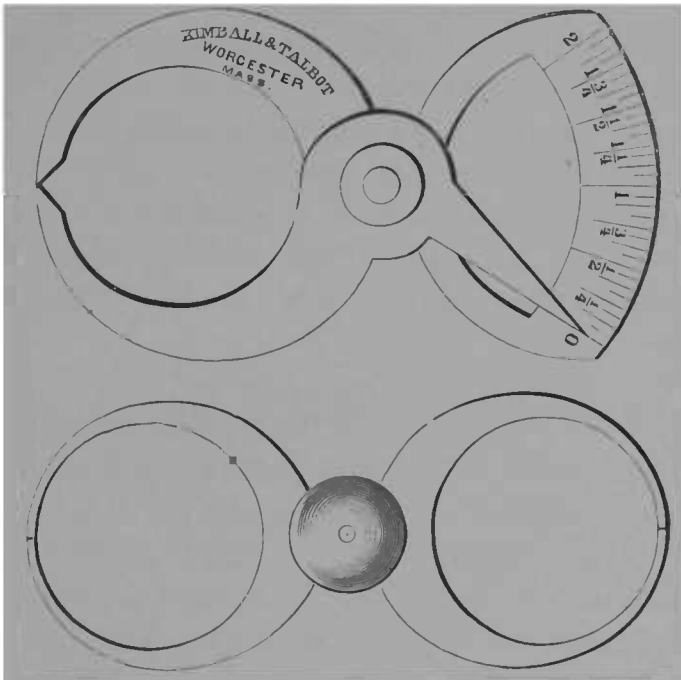
Files and scrapers of different designs are required for this work. After filing the case into form, the scrapers are used for smoothing it and reaching any points not accessible to the file.

The palatal surface should be made smooth and even. With a graver cut away the excess of material around the teeth. Some prefer coarse-cutting lathe-burs for dressing the plate down. When using these care should

be exercised to prevent cutting through the plate. To avoid this mishap, use the callipers from time to time (Fig. 10) to ascertain its thickness.

When the plate is of the desired thickness, it is made smooth with fine sand-paper. Then use powdered pumice

FIG. 10.



made into a paste with water. This may be employed by means of any of the following appliances revolved in the lathe: cork turned into a cone shape, sole leather cut into different sized wheels, and felt cones or wheels. After removing the scratches, the case is polished with a soft brush-wheel and prepared chalk made into a paste with water. Any inaccessible places not reached by the

above means may be burnished with a steel burnisher. The part of the plate next to the mouth must not be changed, as it will injure its perfect adaptation. It may, however, be polished with a stiff brush-wheel and pumice without damage. Dress the posterior edge of the upper plate down thin. Do not leave the edges sharp, but round them to prevent cutting the tissues in case the plate extends too far up on the sides and front. (This applies to both upper and lower dentures.)

The perfect fit of a plate may be destroyed by allowing it to extend too far back upon the soft palate. If the case has no suction, and all previous steps have been correct, it is well to ascertain that it does not extend too far up, or that the muscles do not prevent its going into place.

MOUTHS WITH A HARD OR BONY RIDGE IN THE CENTER.

There is often trouble about plates fitting such mouths, particularly where the ridge extends far back. These cases are generally overcome by using a shallow, oblong air-chamber, which incloses all of the hard part, and only deep enough to prevent rocking.

PARTIAL DENTURES.

The general instructions for constructing a full denture will apply to the mode of procedure for making partial cases. If there are but few teeth to be supplied, the articulation may be taken by softening a piece of wax and forming it into a roll. Place this upon the remaining teeth, crowding it up against the parts where the teeth

are to be inserted and over the crowns of the remaining ones. Direct the patient to close the jaws; press the wax around the teeth, and when partly hardened remove and cool it with water, afterwards replacing it in the mouth to test its accuracy. The cast is now run, and the wax articulation placed upon it. This is fastened to the brass articulator, or to one made of plaster. The plaster is now poured into the other part of the wax articulation (or an impression may be taken of the opposite jaw, as before directed). When it is hard, the wax is removed and the teeth ground to fit close to the gums. If plain teeth are used, a little is scraped away from the cast where they touch the plaster, in order to insure their fitting close to the natural gums. If desirable, they may be tried in the mouth while on the wax, and, if correct, replaced upon the cast, fastening in place with heated wax; after which invest them in plaster, allowing it to cover the cutting edges of the teeth that have no wax above them, so that in separating they are not moved. When there is a narrow neck of rubber extending out from the plate to a single tooth, it should have additional thickness to prevent its being broken off. In partial lower cases, where the front teeth are left standing, a piece of metal should be imbedded in the rubber to stiffen and prevent the plate from being easily broken.

VULCANITE PLATES WITHOUT PRESSURE.

These are more especially designed for cases where the porcelain gums have to be ground so thin that they would

be liable to fracture upon bringing the flask together in the common way. They may be used in any case, if desired, and are often preferable in partial sets.

Proceed in the usual manner until the teeth are ground and articulated in the mouth on a trial plate (if one is used); then replace them upon the cast, filling the palatine portion to the articulating edges of the teeth with a solid mass of wax, using care not to displace the teeth. Remove one central block, taking out what wax there is under the gum, being careful not to remove any that is against the tooth or pins. Paint a thin coat of liquid rubber upon the cast where the wax has been removed. The rubber should be cut into small pieces, and well softened with heat. This is packed so that it takes the place of the wax. This done, replace the block, seeing that it goes into place the same as before it was removed. Take each block off separately, and replace the wax with rubber until it is packed solidly under each block; then paint the cast above the porcelain gum with liquid rubber as far as the vulcanite is to extend. Having packed what rubber is required outside and above the porcelain blocks, the case may be partly flaked. Place enough plaster in one half of the flask to extend over the gums and tops of the teeth. Then the cast is forced down into the flask, and the plaster made smooth and even with the articulating surfaces of the teeth. When hard, remove the wax from the palatine portion of the cast. Should particles of wax adhere to the pins and about the teeth, remove it by pouring boiling water upon the case. Finish packing, first painting, with a thin coat of liquid rubber, the teeth

and cast where the vulcanite is to extend. Then pack small pieces of warm rubber solidly under the teeth and pins. Cut a piece of rubber large enough to cover the palatal portion. Warm this and press it firmly into place with the fingers, wetting them to prevent sticking. Finish flasking, and place the case in the vulcanizer. It should always be borne in mind that the plate comes out vulcanized as it is packed, and, if care is used to have it smooth, the case will be the same when vulcanized. When uneven, the surface is smoothed with a hot spatula before being flasked. In packing a case in this manner, pink rubber may be used with black or any other colored rubber, and the operator may know that it will stay just where it is packed and not become displaced, as when pressure is used.

There is very little danger of its being porous when made in this manner, if packed and vulcanized with care. Each piece of rubber must be made solid before it is left.

METALLIC CLASPS ATTACHED TO VULCANITE PLATES.

There are cases where it is either impossible or not desirable to use atmospheric pressure for the retention of a partial denture. For cases of this kind clasps of metal are desirable, and to construct them properly Prof. Wildman gives the following instructions :

“ When made of metal, it must be either gold or gold alloyed with platinum. Silver will not answer, as rubber will not vulcanize hard in contact with this metal. First bend the clasp to fit the tooth accurately ; then make the

attachment by which it is to be held to the rubber (this may be done by soldering a thin plate of gold or platinum to the clasp in such a position that it will be inclosed in the rubber); then perforate the plate with numerous holes, which should be countersunk on both sides. This plate entering the base, the rubber filling the holes forms pins which rivet the clasp securely to the rubber plate (see Fig. 11).

“ Or the attachment may be made in this manner: On

FIG. 11.



the parts of the clasp that can be covered with rubber drill one, two, or three holes, as the space may admit; insert gold or platinum wire; solder with gold solder; then cut off at the proper length and head them. These act in retaining the clasp in the same manner as the

FIG. 12.



double-headed pins in securing the tooth to the base, and afford the advantage over the perforated plate of being more easily manipulated and less liable to become displaced in pack-

ing the mold. The clasp is to be attached to the model plate, and will remain secured in the mold when it is opened” (see Fig. 12).

PLATE TEETH FOR VULCANITE WORK.

An ordinary metal plate tooth may be used with rubber by soldering a narrow strip of gold or platinum plate to the ends of the pins: this, being imbedded in the rubber, renders it very secure. A narrow strip of rubber extending to a single tooth may be strengthened by allowing the

gold strip perforated with holes and roughened on the edges to pass some distance into the rubber.

Instead of forming the loop as mentioned, it will be preferable in many cases to punch holes in the strip for the pins to go through, and solder the piece close to the tooth, dressing the pins even with the surface of the metal strip, the same as in metal plate work. The piece soldered to the tooth should be bent so that it will extend into the rubber for some distance, and perforated with holes. Solder may be flowed over the strip at the angle to strengthen it. The rubber may be cut away, leaving nothing but the piece of gold and sub-lining of rubber at the base of the tooth. This method is employed with great advantage in cases where, upon closing the jaws, the points of the opposing teeth close nearly to the gums. This also permits of the use of a very thin tooth, which is often required in cases closing far up, and almost if not quite touching the opposing teeth.

REPAIRING.

The method usually given in the books is simply for the repair of a tooth or block, and is as follows: If a tooth or block has been broken, or any change is to be made in the position of either, the teeth or fragments thereof are removed, and an irregular-shaped groove or dovetail formed in the base, occupying the space to be supplied. Into this space the tooth or teeth are perfectly arranged and supported with wax, filling the dovetail with the same, and giving additional fullness to compen-

sate for waste in finishing. All portions of the piece, except the lingual face of the plate and teeth, are then imbedded in the lower section of the flask. The upper section of the mold is obtained in the usual way. When separated and all traces of wax are removed, the rubber is packed into the cavity around the tooth or teeth. Grooves are then cut, extending out from the mold; the two sections are heated and forced together, and the process of vulcanizing conducted the same as for a new piece,—the same time and degree of heat being required. The renewed heat employed renders the surface of the material previously vulcanized somewhat darker. It is claimed that this may be bleached by immersing the case in alcohol and exposing it to the sun's rays for four or five hours.

REPAIRING WITHOUT PRESSURE.

The plate should first be cleansed; then slightly oiled on the inside, and a cast run in it. When this has hardened sufficiently, separate the plate and cast, also removing the broken teeth. Dovetails are now cut in the vulcanite plate, which is then replaced upon the cast and the teeth ground into position; after which they are removed, and the surface covered by them is painted with liquid rubber, as are also the teeth and pins. The teeth are then replaced, and heated rubber packed solidly under them and into the dovetails. The whole is then invested in one mass of plaster and vulcanized in the usual way. This does away with the flaskings, and shortens the time materially.

To repair where there is a crack through the plate, first fasten the parts together accurately with wax, and run a cast as previously described. The plate is removed from the cast, and a strip cut out the whole length of the crack. Dovetails are formed on either side. The pieces are then replaced upon the cast. If desirable, fasten them by investing in the lower half of the flask, leaving all places clear where the rubber is to go. The parts are then painted with liquid rubber, and the vulcanite packed solid. Finish flasking and vulcanize.

LOWER PLATES WITH SUCTION.

In 1866 Dr. George H. Hurd obtained a patent for what he termed the "Flange Suction" for lower plates. I have seen one of these plates in the mouth that has been worn for several years. It has a tenacious suction. The patient speaks of it in the highest terms, and says that from the first she has "experienced no trouble in wearing or keeping it in place." Dr. Hurd's directions for making these plates are in substance as follows:

The impression is first taken in wax; then, using that as an impression cup, with plaster of Paris. Cut off the extreme projecting plaster down at the sides of the tongue; varnish and fill up, making a full cast across from heel to heel, extending far back upon the process, to keep the lip from shoving the plate back when the muscles and lip are strained down upon it.

Dr. Hurd uses gutta-percha base plate, first dipping it in hot water and the cast in cold water; presses it down

to the cast while hot. The antagonizing wax is allowed to strike first at the sides to keep the plate up against the gums. When the articulation is made the patient is instructed to swallow, to obtain a correct position. The teeth should be set directly upon the center of the margin, perpendicular in front, and inclined a little at the sides, so as to give sufficient room to form a good outside flange for the lip to hold down upon; then throw around the outside three or four strips of sheet wax, making the flange one-third of an inch thick. The inside is rounded up inward similarly, only that it is not so thick and high, forming a flange for the tongue to rest upon and hold it down, and excluding the air. The saliva also settles under the tongue and assists in keeping out the air. The muscles of the lower lip fall in upon the outer flange and hold the plate down at will, keeping the air out of the chamber. The flange must rest gently against the cheek, to keep the plate steady and firm. The teeth must be kept level on the face, so that, if a ruler is laid down upon them, they will touch at once. Vulcanize by heating slowly to avoid porous rubber. Finish by filing off, commencing at the hard margin on the under side of the outside flange, increasing it as you near the edge of the plate at the cheek, and forming a chamber; also cutting away on the inside very much of the plate, as the sublingual muscles and glands under the plate will cause it to raise when the tongue raises. This flange can be made of flexible rubber and quite thin, without a cell, so as to hold firm and move with the muscles. But hard rubber will reach all cases and is more desirable. Dr. Hurd does

not recommend the flexible rubber unless in extreme cases of malformation.

REFITTING GOLD OR VULCANITE PLATES WITH VULCANITE LINING.

A gold or vulcanite plate, which can no longer be worn in consequence of the absorption of the alveolar ridge, may be made to fit perfectly by using either of the following methods, as given by Dr. Richardson. The second method is preferred, as its results are more certain :

“*First Method.*—Take, for example, a full upper set on either gold or vulcanite. Secure, in the first place, an accurate impression of the mouth in its changed condition in plaster, and from this a plaster model in the manner usually practiced. Perforate the palatal portion of the plate with from eight to twelve holes at different points, and also the extreme borders, from heel to heel of the plate, at intervals of one-eighth to half an inch apart, and near the edges. These holes may be enlarged to the dimensions of a medium-sized knitting-needle; or, if the piece is of vulcanite, to twice or three times that size.

On the lingual and buccal surfaces the holes are well countersunk with a bur drill. The plaster model, with the central portion raised to form a chamber (and which should be made to correspond, as nearly as possible, in position, form, and thickness with the chamber in the plate, if one exists), is next heated throughout by placing it over a spirit-flame, or in the baking furnace of an ordinary cooking stove, or the muffle of a furnace.

When of a temperature that will barely admit of its being taken in the hand, remove and cover the face of it with a sheet of India-rubber or gutta-percha, as prepared for vulcanite work, and press it down upon the face of the model with the fingers. Apply the perforated plate to the model, being careful to secure a proper relation of the two; then press the former firmly down upon the model. To render the vulcanite material still more plastic and compressible, the whole may now be returned to the furnace and subjected to a uniform heat throughout, when it may be removed, and firm and steady pressure made upon the plate and teeth, until forced as nearly as practicable into contact with the face of the model. Portions of the gum will be forced through the apertures and out at the borders of the plate; these should be well packed into the countersinks and under the edges of the plate, when the model with the rubber plate adherent may be placed in a vulcanizing flask and incased bodily in plaster. It is then placed in the heater and vulcanized. If all the steps in the process have been carefully conducted, the fit of the plate will be perfectly restored, with no material change in the antagonism, or none at least that is not susceptible of ready correction. The union between the vulcanite lining and the plate will be strong and lasting, and altogether impermeable to the fluids of the mouth.

“In the case of lower pieces the holes should be made along the external and internal borders of the plate near the margins. In all other respects the manipulations are the same as those described above.

“It is scarcely necessary to observe that, in the use of

gold plates, the method is inapplicable whenever it is designed to re-swage the same plate for the permanent piece.

“Second Method.—Perforate the plate, whether gold or vulcanite, as before directed; and, employing this as a cup or holder, take an impression of the mouth in plaster, pressing the plate up closely to the parts. The plaster forced through the holes, and filling the countersinks on the opposite side of the plate, will serve to bind the plaster to the plate, and prevent, with cautious manipulation, the two from separating as they are detached from the mouth. When removed, the plaster impression lining the plate is trimmed even with the borders of the latter, and varnished and oiled. The lower section of the vulcanizing flask is now filled with a batter of plaster on a level with its upper surface, and the impression, filled with the same, is turned over and placed in the center of the flask, with the edges of the plate touching the surface of the plaster. The plate and adhering plaster are now carefully separated from the model. After cutting out the plaster from the holes and countersinks in the plate, the plaster forming the impression is detached from the plate, and the holes and countersinks filled with wax. The plate is then readjusted over the model, and (the surrounding surface of the plaster in the flask having been varnished and oiled) plaster is poured in upon the upper surface of the plate and teeth, filling the upper ring. When the plaster is sufficiently hard, the two sections of the flask are separated, and grooves formed running out from the matrix to the margins of the flask. A sufficient quantity of vul-

canizable rubber is now either placed upon the model or packed in upon the palatal surface of the plate; before doing which, however, the wax filling the holes and countersinks in the plate (and which was placed there to prevent portions of plaster last poured, in forming the matrix, from running in and filling them up) should be worked out with a small instrument. The whole being sufficiently heated, the two sections of the flask are forced together, expelling redundant material. The piece is then vulcanized as in the former case."

TO MAKE A NEW VULCANITE PLATE AND PRESERVE THE ARTICULATION.

Where from any cause an accident has happened to a plate which necessitates a new one, reproducing the exact arrangement and articulation of the teeth, the following method, as described by Prof. Wildman, may be employed with success:

"Roughen the palatal surface of the rubber-plate, to cause the plaster to adhere to it; then use it as an impression-cup to take a plaster impression, being careful when it is in the mouth to preserve the articulation. In this impression cast the model; trim, and cut keys or conical holes at several points in its outer face. Now, before separating the impression from the model, make a cast of the face of the teeth in two or three perpendicular sections extending to the base of the model, using a solution of soap or other parting substance on the plaster mold. Remove this mold of the face of the

teeth, which indicates their true position relative to the model. Then take the impression from the model. By the aid of heat sufficient to soften the rubber, remove the teeth from it. Next make a model plate with prepared gutta-percha, wax, or modelling compound. "Now secure the sections of the mold of the face of the teeth to the model (their place will be indicated by the keys); adjust the teeth in their proper positions in the plaster mold of them, and build up with gutta-percha or wax to the proper form of the model set. This being done, test its accuracy of contour and articulation by placing it in the mouth. Then, using the model, proceed as for making a new set."

As will be seen by the preceding, it is necessary that the patient be present,—first for the impression; then for the placing in of the trial plate; and, finally, for the fitting in of the case. This would all be required if the original plate was not accurate in fit and articulation; but when it is, and this process is rendered necessary by breakage, the author has adopted the following method, in which the presence of the patient is not required: If the plate is broken into two or more pieces, it may be fastened together by holding the parts in position and dropping hot wax upon them. This being done, oil the palatal surface of the original plate, and cast the model in it; trim to the edges of the plate, giving the usual form to the model, making conical holes to secure the sectional molds of the outer face of the teeth as described in the previous method. When hard, remove these plaster sections, and also the plate, from the model.

To avoid fracture, the plaster cast and rubber plate may

be heated until the vulcanite readily yields, when they are easily separated without injury. After removing the plate, proceed the same as described in the previous method, except that the case is packed and vulcanized without trying it in the mouth.

When the plate is cracked in half, after waxing the broken parts together, secure a model as directed. The outer guides will not be required. Remove the denture, and with a fine Swiss saw cut away the palatal portion of the plate to within about an eighth of an inch of the inner surface of the teeth. In this remaining portion cut dovetails to retain the new rubber, and also form an undercut channel in the portion which fits over the alveolar ridge in the line of the break as far as the edge of the rim; secure the parts to the model with wax. The cut-out palatal portion may then be laid back in place, to aid in waxing up that part. Invest in the flask covering the labial and grinding portions of the teeth as in other repair work. After separating, remove the part desired to be replaced with new material; pack and vulcanize as usual.

BLEACHING VULCANITE.

To bring out the color of vulcanite, it should be bleached. This is particularly the case with pink rubbers, as their appearance is unsightly without it. After the denture is finished and ready for the mouth, place it in a glass vessel, covering it with alcohol, and expose it to the rays of the sun from one to six hours. The vessel should be covered with glass to prevent the alcohol from evaporating.

AIR-CHAMBERS.

Where air-chambers are required, and they are not cut in the impression, block-tin or sheet-lead covered with tin (which may be obtained at the dental depots) may be used. They should be about No. 16 (United States gauge) in thickness. The shape should be in miniature of the arch, and they should be placed as nearly as practicable in the center of the plate, which brings them posterior to the anterior palatine arteries and nerves. In many cases the Land air-chamber will be found preferable.

TO CONSTRUCT A VULCANITE PLATE WITHOUT THE USUAL SCRAPING AND POLISHING.

This is done by waxing the case just as it is desired to have it when finished ready for the mouth. Burnish tin-foil over the wax (as described under the manipulations for "New-Mode" celluloid work); varnish the cast with shellac and press tin-foil evenly upon it, or (which is better) use a metal cast, and proceed in the usual manner. Instead, however, of picking the wax out upon separating, pour boiling water upon it. This leaves the tin upon the plaster. Pack the case and vulcanize. If care has been exercised, the case will be nearly finished, with the exception of removing and polishing where the surplus has been.

MOUTHS HAVING SOFT PLACES.

Dr. C. H. Land described the method of managing these cases, in the DENTAL COSMOS, vol. xxv., page 557, as follows :

“To secure good results in an artificial denture, a correct impression is first in order and first in importance. Plaster of Paris is, in our estimation, the only material with which a normal impression can be obtained. The various other materials used for the purpose force the muscles and soft tissues out of position, resulting in an inaccurate cast. Having secured a normal impression,—the negative from which a positive is to be obtained,—it should be considered as representing merely the outlines; the conditions to be noted after a careful study of the parts. With the patient in the chair and the cast in hand, the conditions may be indicated by a series of characters and figures penciled on the cast. For instance, the thickness of the tissues may be represented by figures 64, 32, 16, 8; the sixty-fourth, the thirty-second, the sixteenth, and the eighth of an inch in thickness. *F* will indicate flexible; *R*, ridged, etc. With such a record an intelligent idea can be formed of the requirements in the particular case, and the necessary modifications will be easily comprehended and accomplished; the adaptation to the hard and soft, rigid and flexible, parts secured; the pressure obtained just where wanted—most in the soft parts, and least in the rigid. In order to trim a cast judiciously, one must have a thorough understanding of the individual mouth. A very important consideration is to so conform the plate to atmospheric pressure principles that in its use the soft parts of the mouth will be molded by the denture. The movements of the tongue and the direct pressure of the lower jaw contribute largely to bring about this result. The fact that the mouth does thus conform to the denture

shows the importance of a careful preparation of the cast, in order that pressure may be brought to bear where it is most efficient and least distressing, and to secure atmospheric pressure in establishing adaptation and retaining the plate.

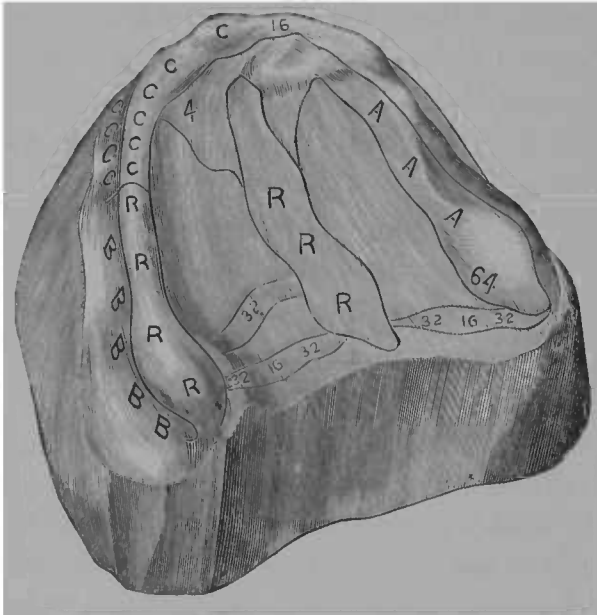
“The surface of the plate should always be finely finished; a rough and uneven surface prevents nice adaptation, and is unclean and unhealthy. With air or any foreign substance between the denture and the surface of the mouth covered by it, perfect contact is prevented. If both rubber and celluloid plates were more highly finished before insertion in the mouth, there would be less complaint of these vegetable bases for artificial dentures.

“At the level of the sea the atmospheric pressure is said to be fifteen pounds to the square inch, but no such amount of pressure is required to retain a properly fitting artificial denture. The saliva or fluids of the mouth are also of great importance in retaining a denture in position. If the plate and mouth were made perfectly dry, it would not be easy to secure such adaptations as would be required to hold the plate in position. The utility of the atmosphere is not, however, fully demonstrated in the retention of a plate until an air-space is created by means of an air-chamber. This air-chamber should cover at least four-fifths of the palatine arch, and include certain parts of the alveolar walls. With this provision and a judicious trimming of the plaster cast on the outer portion of the alveolar ridge, a large part of the denture is made to act as an air-chamber, and this should be understood as but a temporary means in assisting the mouth to conform more

readily to the denture; the result will be vacuum by complete contact, which does not take place until all the air is excluded, and the air-space filled up by the mouth conforming to it.

“To insure a comfortable adaptation, the pressure must be so equalized that, as the alveolar ridge recedes, undue stress will not be brought on the hard palate. For this

FIG. 13.



reason an air-space, covering almost the entire surface of the palatine arch, is desirable, as thus the pressure is better distributed and brought to bear directly on the alveolar ridge, where there will be the least danger of injuring the mouth, and thus avoiding the riding or rocking of the plate on the hard palate. The conventional air-chamber, with its acute angles invariably placed on the most rigid

portion of the hard palate, soon outlines itself in the tissues, demonstrating a failure to properly utilize atmospheric pressure, and injuring the mouth by inducing absorption unnecessarily.

“The illustration (Fig. 13) is an exact copy of a mouth for which I am now preparing a set of continuous-gum teeth. The conditions may be indicated by letters, *A, A, A*, 64, 4, meaning that within these outlines the tissue is about the sixty-fourth part of an inch in thickness at one end and one-fourth of an inch at the other; *R, R, R*, very rigid; *C, C, C*, 16, the one-sixteenth of an inch in thickness; *B, B, B*, very sensitive to pressure; 32, 16, 32, mean parts of an inch in thickness. On the side, *A, A, A*, a large piece of the process had been torn away in extracting the first molar, which accounts for its peculiar condition.”

TO REMOVE TEETH FROM A VULCANITE BASE.

The teeth must first be passed through a flame until hot, or immersed in oil and boiled. The author prefers covering the denture with sand and heating for a few minutes, when the teeth are easily removed by inserting a pointed instrument between them and the plate, leaving them clean and without the disagreeable odor of the rubber (unless they are made too hot) or breaking of the blocks.

REPAIRING VULCANITE WITH AMALGAM.

It is sometimes necessary to make a quick repair of a case where there is one tooth or a block broken. This may often be done by forming a globular-shaped under-

cut in the plate, and grinding the block into place and holding it there while packing in strong, quick-setting amalgam. I have done this on several occasions, and find that it works very well.

REPAIRING VULCANITE WITH SHELLAC.

Where there is a small hole in the plate, it may be repaired so that it will last for some time, by mixing gum shellac and vulcanite filings. This is heated and dropped into the hole; then made smooth with a hot spatula.

TO REPAIR VULCANITE PLATES WITH WOOD'S FUSIBLE METAL.

For resetting a tooth or block, enlarge the socket within, cutting a dovetail in the plate for anchorage. Mold the metal into the socket with a hot spatula. Heat the tooth so that it will melt the metal, and press it into place. With the thumb, covered with cloth or chamois, mold the metal into shape. When it is congealed it may be built up where needed. In other cases the tooth may be retained in its place with the finger, or by means of plaster, as for soldering, and then cemented to the metal. Pins without heads should be bent, so as to retain their hold, always molding the metal securely around them. When there are holes in the plate to be sealed up, they should be countersunk on both sides, and the holes, if round, made oblong or angular.

LIQUID RUBBER.

To make rubber liquid any of the following solvents

may be used: Benzine, turpentine, ether, chloroform, and bisulphide of carbon. The rubber is cut into small pieces, placed in a vessel, and covered with either of the above liquids.

SPRING PLATES.

These are available only in partial cases, and are very little used, as their general tendency is to force the teeth out, particularly where the plate presses too hard against them. Scrape just a little away from the palatal portion of the bicuspid and molars upon the cast; grind the teeth into place, and wax them up, allowing the wax to extend about half an inch from the teeth all around, and leaving the central portion of the mouth uncovered. Air-chambers or clasps are not used in connection with this work.

ARTICULATING THE TEETH AGAINST VULCANITE.

The following is given by Prof. Wildman, and is often of great advantage: "In upper sets, when there are only a few under front teeth remaining, and they are irregular as to position or height, it is advantageous to form an articulation with rubber just back of the points of the artificial teeth. This is done, after the teeth are arranged upon the model plate, by placing soft wax upon the back of the teeth, and allowing the patient to bring the jaws together sufficiently to form the desired articulation. An impression of the antagonizing surfaces of the under teeth is thereby secured, which must be carefully preserved in the model, and also in finishing the rubber set.

This will in many cases prove of great utility, giving a bearing for the natural teeth, which could not be obtained otherwise without making the artificial teeth irregular and unsightly. Again, there are many cases, when the front teeth are properly articulated, in which we find some one or more of the inferior molars projecting up so far as not to admit of the use of an antagonizing porcelain tooth having sufficient substance to enable it to bear the force of mastication. In such cases rubber may be substituted with good results. The proper length and form of the antagonizing face may be obtained with wax, on the same principle as mentioned in the preceding case.”

TO TAKE THE WARP OUT OF A VULCANITE PLATE.

It is claimed that the following manipulations will take the warp out of a vulcanite plate, when from any cause it has sprung. Obtain a correct impression of the mouth, and run a plaster cast in it. Heat the vulcanite plate in an oven, teeth downwards. Allow it to remain a few minutes until the plate becomes pliable, being careful not to blister it by overheating. It is then placed upon the cast and forced into position at all parts; pressed down with a napkin and held until cold. It may be changed by heating in boiling water, and proceeding in the same manner.

SOLUTION OF SOAP FOR SEPARATING PLASTER.

Some prefer the employment of soap to shellac varnish

in separating plaster, and for the benefit of such the following formula is given:

R.—White soap, \bar{z} i;
Rain water, O i.

The soap should be cut into thin strips, and put in the water, which is heated to the boiling point, dissolving the soap. It is then bottled for use. In employing this solution, pour out what is needed for the occasion, throwing away what is left. Do not put the brush in the bottle after using it upon the plaster, as it causes the solution to become turbid.

COLORING PLASTER FOR IMPRESSIONS.

Where the soap solution is used, it is better to color the impression, so that the line between it and the model may be readily seen when separating. To color the plaster, a little aniline may be placed in the water, in which it is mixed, or a little vermilion added to the dry plaster will answer the same purpose. This does not injure the material. When shellac varnish is used, it is unnecessary to color the impression, as the varnish imparts color enough to be easily detected upon separating.

PACKING FOR VULCANIZERS.

Packing made with a web is the best, as that without softens too much upon being heated. When a new packing is required, remove all of the old and press the new into its place by means of a chisel-shaped instru-

ment. An old penknife will answer the purpose. Before screwing the top upon the vulcanizer, dust either powdered soapstone, whiting, or stove-blackening upon the new packing. This will prevent its adhering to the vulcanizer or tearing upon opening.

PORCELAIN TEETH ATTACHED TO A METAL BASE WITH RUBBER OR CELLULOID.

The following method of attaching porcelain teeth to a metallic base is far superior to that of soldering, for several reasons: The contour may be restored the same as when a vulcanite base is used. This process is more cleanly, because the permeation of the secretions of the mouth will not take place, as in soldered cases. There is no danger of warping the plate from soldering the teeth to it, and the liability of fracturing the teeth is less, as they rest evenly upon a solid base. An injury to them is easily repaired without changing the plate. Gold, platinum, or silver may be used for the base. When silver is used, it must be tinned where it comes in contact with the vulcanite, as the sulphur in the rubber destroys the silver.

Dr. P. G. C. Hunt employed this method as early as 1859, and published a description of it. It is practically the same as that for which Dr. S. D. Engle obtained a patent some years later. The manipulative details, as described by Dr. Hunt, are here given:

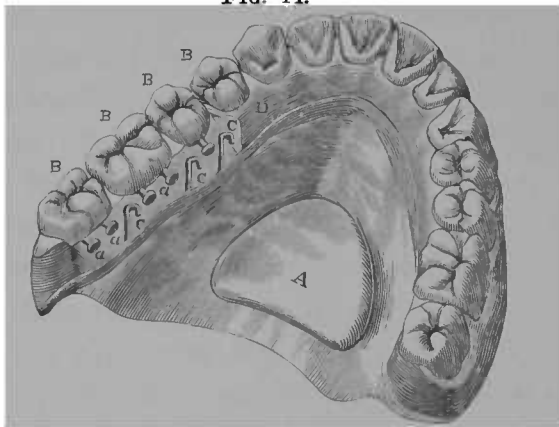
“Take the impression, make metallic dies, and form the plate as for work in the ordinary way. After fitting the plate in the mouth, get the articulation, the fullness,

and length of the teeth; remove the wax and plate from the mouth, and make the plaster articulation. If a full set, after separating the articulation, and before removing the wax from the plate, take a small, light pair of dividers, set them say an inch apart, and with one point following the margin of the wax representing the cutting-edge of the teeth, and the other point marking permanently the plaster, you have always in the dividers so set a gauge for the length of any particular tooth. A convenient substitute for the dividers may be formed from a piece of wire of convenient length, one-half the diameter of a common excavator, by suitably twisting its middle for a handle, and its ends being sharpened and pointing in the same direction, one or one and a half inches apart.

“ Thus far we proceed as we do for ordinary gold plate work. We will now suppose the teeth ground and jointed, leaving as much space between the teeth and plate as the plate will admit of. We next mark with a sharp-pointed instrument on the labial surface of the plate each point where it is necessary to place a loop for purposes hereinafter described; then apply wax to the external or labial parts of the teeth and plate in any manner sufficient to retain the teeth in position; remove the wax from the lingual parts of the teeth and plate, and mark the position on the metal where it is desirable to insert the loops; remove the teeth and wax, and with a small bow-drill make holes through the plate at the several points previously determined on for the attachments, about the size of the ordinary plate punch-hole; take a wire or ordinary gold plate cut in strips say from a half

to one line in width, being governed by the amount of room there is under the base of the teeth, and with small, round-nosed pliers bend the strip around; grasp both ends with square-nosed pliers; draw the round-nosed pliers from the loop, still grasping the square-nosed pliers with the left hand, and with a hammer strike the top of the loop a sufficient blow to keep the ends from springing apart; cut off the ends, and dress down to fit the holes in the plate; after which solder on charcoal or other suitable substance without investment. [Fig. 14 illustrates the bent or hooked wires soldered to the base.]

FIG. 14.



“Pickle, dress, and polish that portion of the plate to be exposed to view. Bend and flatten the pins; arrange the teeth according to the articulation, waxing so as to cover up the loops, if practicable. The loops should be placed as near the base of the teeth as possible, the rubber forming, when finished, a part of the general concave shape which is desirable in upper dentures, and

which it is not possible to obtain with ordinary soldered work. Then with silicate of soda paint the joints, to keep the rubber from forcing in where it would show after vulcanizing. Flask, vulcanize, and finish as usual."

The rubber may be allowed to project beyond the edge of the plate on the labial surface, if desirable, and this in many cases will be found to be very satisfactory, as by such means the rubber may be left thick near the alæ of the nose, when the loss of the cuspids may necessitate a support to the soft parts adjacent, and which in this manner can be readily supplied. If the rubber extends upward so far as to irritate the parts, a few minutes will suffice to make the necessary alteration.

When celluloid is used for attaching the teeth, the palatal portion of the blank should be sawed out, leaving only the part covering the alveolar ridge, which may be trimmed away so that there will be but little excess of material. For lower plates the ordinary full lower blank is used, trimming to suit the case. After preparing the blank in this manner, the manipulations are the same as for a celluloid base. The teeth being arranged upon the metal plate and the contour restored in wax as desired, fill the plate with plaster, and also the lower section of the flask. Imbed the plate in this, forming the line of separation at the edge of the wax rim, thus allowing the palatal portion of the metal to be covered with plaster. After the other section is formed, separate as for vulcanite. The metallic plate will remain in the lower section, and the teeth in the upper. With celluloid, plain teeth are preferable.

To attach either vulcanite or celluloid to a metal plate where the teeth are not soldered, the writer submits the following directions: Either turn a band upon the outside of the plate, and solder wire, marking the border of the wax upon the palatal surface, or solder wire around the labial portion, turning at the heel, and bringing it upon the palatal portion of the plate, forming a border for the rubber or celluloid that supports the teeth. Small loops or headed pins must be soldered on the plate for the material to grasp. In this way the necessity is obviated of drilling holes in the plate. After the wire and loops are soldered, the plate may be re-swaged, if it has sprung. The counter-die should clear the wire on the outside, or it will be forced off. The pins or loops may be raised after the re-swaging. It is not absolutely necessary to use the wire or turned band.

CELLULOID.

Celluloid was brought into use about the year 1869. Since then it has been employed as a base for artificial dentures to a considerable extent. At the present time there are three modes of molding it,—namely, with steam, glycerin or oil, and by dry heat. The last mentioned seems to give the best results. Either plain or block teeth are used. The manipulations are similar to those for vulcanite, until flasking.

FLASKING FOR CELLULOID.

The mixed plaster should be free from air-bubbles. In all cases part the flask at the edge of the wax. When there is considerable undercut at the anterior part of the alveolar ridge, cut off the heel of the cast before flasking. This elevates the anterior portion so that pressure is brought to bear in a direct line upon the part that is undercut, thus avoiding the danger of fracturing. (See Fig. 25). It is sometimes necessary to cut away the thin edge of plaster which projects over the matrix, in the half of the flask containing the teeth. Place the two sections of the flask together, and see that there is enough room at the anterior part of the cast, as, if this precaution is not taken, the cast may be broken or pieces of plaster mixed

with the celluloid. After separating, remove the wax thoroughly with boiling water. Powdered soap-stone, rubbed over the cast, prevents the plaster from adhering to the plate. Cut a groove for the surplus around the inside of the flask, not less than one-eighth of an inch from the cast, and entirely in the half containing the cast. There should be no cross-gates connecting the groove with the model, and the groove should be large enough to receive all of the surplus, as it is very hard to bring the edges of the flask together where it will not hold the excess.

It is well, especially with gum teeth, where there is much surplus, to trim the plaster all around between the cast and the edge of the flask to about the thirty-second of an inch. This will give the material a chance to escape. All the sharp edges of the plaster liable to fracture should be rounded off. In the case of gum teeth holes should be drilled opposite to each joint, not over one-eighth of an inch in diameter, and as deep as desired. This relieves the blocks from some of the pressure.

MOLDING.

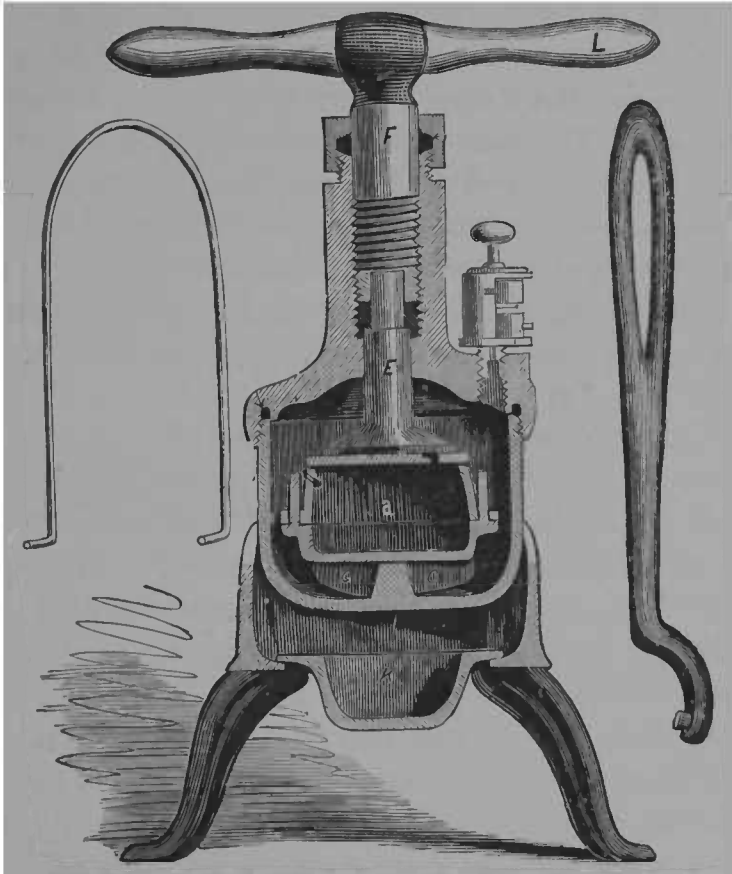
A blank should be selected as near the size of the cast as possible, and should not be wider than is necessary, as folding in from the sides is liable to take place, forming creases in the plate.

The author gives, with some modifications, the molding process of the steam and glycerin machines of the Celluloid Manufacturing Company.

Fig. 15 is a sectional diagram of the celluloid steam machine.

Molding in the Steam Apparatus.—Fill the boiler partly full of water. The amount is not material, but there should always be enough to cover the ribs at the bottom. Have the screw well turned back, until the plunger when

FIG. 15.



placed in position will rest against the top of the boiler; otherwise the flask may be pressed upon while screwing down the cover, and the cast injured. Turn down the cover snugly; see that the gland is turned back, and the

screw works freely. Many failures have occurred by neglecting this simple matter. If it works hard, it is impossible to tell how much or how little pressure is being exerted. There may be too much, and blocks or cast may be broken; or too little, and the plate made porous. In all methods of working celluloid, the sense of feeling is the best guide as to when and how hard to turn; but in order to have this there must be perfect freedom of motion of the parts. The time elapsing before turning is not reliable, as it varies with the heat employed, the temperature at starting, the amount of water in the boiler, the drafts of air to which the flame may be subjected, etc.

After placing the flask in position, turn down the screw very gently with thumb and finger, until you feel it touch the flask. Fill the cup with alcohol and light it, or light the gas. The safety-valve is made in two parts. The upper portion may be suspended by the pins in the lead weight; the valve will now blow off steam (if in proper order) at a temperature of 225° F. Until this occurs no particular attention is necessary, but from that time the exclusive attention of the operator should be given to the molding. Many failures occur from the want of this, for the plate may be easily injured from too much heat without proper pressure. But fifteen or twenty minutes, at the most, will be required from this point, with proper heat, and nothing else should be attended to.

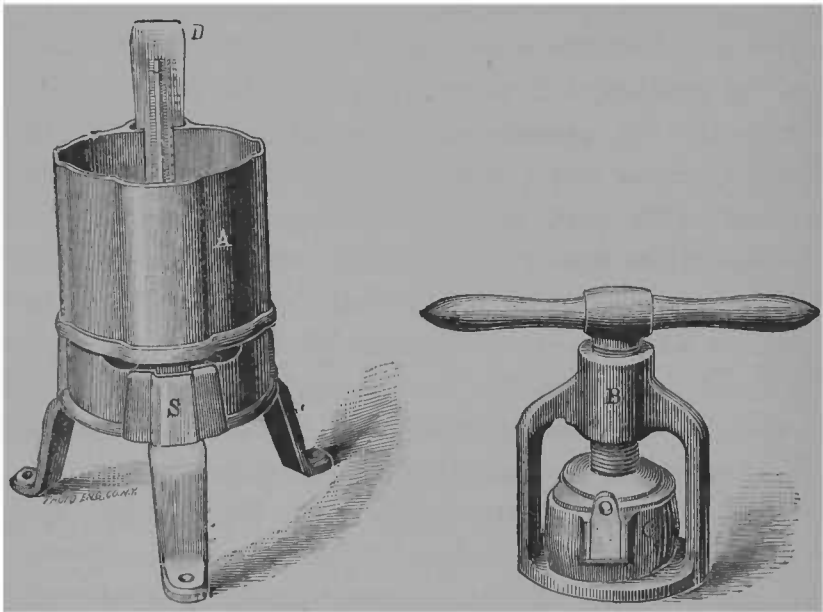
At the point when the steam escapes from the valve, with the upper portion suspended, the plate will soften, and the screw will be felt to yield to light pressure with thumb and finger. The upper weight should now be

dropped down. Turn the screw very carefully, stopping when you feel the resistance increase; as soon as it yields again, turn it more, going slowly and carefully at first, but increasing the pressure somewhat as the steam increases, which you will know by occasionally raising the valve. It is just here that judgment is required,—to avoid, on the one hand, too much pressure before the material is sufficiently softened, which would result in fracture of the cast or blocks, disarranging the articulation, or a “flaky” plate; and, on the other, too little pressure after the heat is up, which would result in injuring the quality of the material. The pressure should be followed up as the heat rises and the screw yields, the object being to get the whole of the plate under pressure, in every part of the mold, by the time the steam blows off quite sharply and steadily on raising the safety-valve. After this the pressure should be increased, but time should always be given between the turns for the slowly-flowing celluloid to escape from under the pressure. Toward the close of the process the pressure should be considerable; in fact, about all that can be applied with the machine, and should be continued as long as the screw can be turned. If the operation has been properly timed, the steam will blow off at the safety-valve at about the time the molding is completed, and the alcohol in the cup is consumed. If it should blow off before that, no harm would be done, as the heat cannot become too great if the safety-valve is kept in proper condition. These remarks apply to the use of alcohol in the cup furnished with the machine. If any other heat is used, the flame should be sufficient

to complete the process within thirty to forty minutes. If more than this time is consumed in the molding, the quality of the plate is injured.

Molding in Glycerin.—Follow the directions already given until the flask is ready to be placed in the tank. Having placed the blank in the flask, put it into the screw clamp and turn down the screw until it touches the flask

FIG. 16.



lightly; set the whole into the tank, and pour enough glycerin into the latter to come about up to the top of the flask. Two pounds of glycerin should be procured; usually a pound and a half will be sufficient to cover the flask, and the remainder can be kept to replenish the tank. The glycerin is left in the tank when not in use, and does not evaporate, but there is a slight waste by

adhesion to the flask and clamp, which should be allowed to drain off into the tank, and the waste will be so slight that the amount named will last a long time.

The heat having been applied, as soon as it is sufficient to cause the screw to yield to gentle pressure (about 225° F.), begin the molding, turning very lightly at first, as directed for the steam machine, and continuing as the material is felt to yield, increasing the pressure to a heavy one as the flask is closed. A great advantage of this process over the steam is that the flask can be lifted out, and the progress of the closing watched. If the flask closes unevenly, loosen up the screw, and shift the flask so as to bring the pressure where required. The heat should not be permitted to rise much above 280° F. If the flask is not closed when that heat is reached, reduce the flame, and do not hasten the closing. A little practice will enable the operator to graduate the pressure exactly, without reference to the thermometer. Lard or oil may be used instead of glycerin, but they are not as cleanly.

Fig. 16 represents the improved glycerin machine and screw-clamp.

COOLING AND REMOVING.

After the screw is down, put out the flame, and at once reduce the temperature by blowing off steam. Allow the flask to become thoroughly cold in all cases before removing the plate. The cooling may be hastened without injury by setting into cold water, but the flask must be kept closed by a flask-clamp or otherwise until entirely cold. In

cases where the material is of extra thickness, or where the shape of the blank is totally altered, longer seasoning is advisable, and the flask should be placed near a stove or over a register (keeping it closed with a clamp) for half a day or more, at a temperature not over 140° F. If these directions are observed, no trouble from warping plates will be experienced.

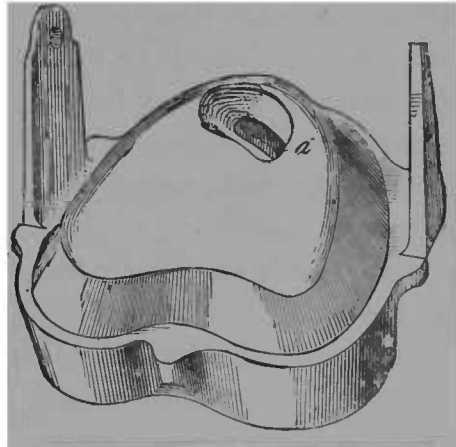
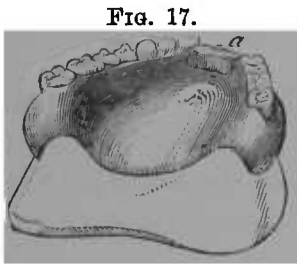
Caution.—Do not use a longer handle than the one furnished with the machine. Do not allow the water to be all converted into steam, as the steam would then become superheated, and a dangerous condition ensue or the plate be ruined, while the safety-valve would not indicate it. Always have plenty of water in the boiler, and, if steam should cease to issue on raising the valve, the heat should be at once withdrawn.

REPAIRING.

Cut away the plate, and fit in the new teeth or block. Form dovetails. Always, if possible, before flasking, fit a new piece, much larger than the portion cut away, to the plate as closely as possible, allowing it to come close to the added teeth; then, having the surfaces clean, cement it fast with spirits of camphor, or a solution of celluloid in camphor. (See "Liquid Celluloid.") Allow it to dry, after which the new teeth should be waxed into place. Invest the piece in the flask, covering the whole plate and teeth in the plaster, except the added piece, which should be left at the bottom of a well or depression in the plaster. Figs. 17 and 18 represent the manner of repairing. Fig.

17 shows the first step in the process, the plate being cut away and the new piece (shown at *a*) fitted and cemented in place. After drying a short time (allowing it to stand a few hours or over night, if convenient), fit the new block to its place, leaving as little space as possible between the plate and the block. This space is to be waxed up to keep out plaster when investing. Fig. 18 shows the piece invested, the whole plate and teeth, ex-

FIG. 18.



cept the new piece *a*, being covered deep in the plaster, which is trimmed as shown. The upper part of the flask is now put in place, and filled in the usual manner. On opening the flask, boil out the wax. Then lay another piece of celluloid, or a ball of tin-foil, or moistened blotting-pad—in fact, anything that will produce pressure—upon the piece *a*, and heat up and press as usual. In this way the new piece becomes a part of the plate by the cementing process, before the pressing is done. If neatly repaired, the line of junction will be scarcely ob-

servable. The sharp edge of the plaster at the bottom of the well or depression should be trimmed out and rounded, as otherwise these edges are liable to fracture and get into the plate. If the new block or tooth is separated from the plate, so that it has no support, and is liable to be pushed down, it should be supported by crowding a small bit of celluloid under it before beginning. The new piece may be placed in position after opening the flask, a few drops of spirits of camphor added, and the case pressed as before; but union by this means is not nearly as certain. There is no certainty about uniting pieces in the machine. It may be done or it may not. But by cementing well-fitting or freshly-filed surfaces together outside the flask, union may be had, and pieces added wherever desired.

Care should be taken to avoid air-bubbles in the plaster, and to pour it smoothly.

If the plate is of sufficient thickness, the repair may be very nicely made without adding any new material. Fit the new block without cutting away more of the plate than is absolutely necessary. Invest the plate, leaving the lingual portion exposed, but covering the teeth; on opening the flask, lay over the exposed plate one or more thicknesses of wet, thick brown paper, or blotting-pad, fitting closely to the teeth and having it thickest in the center, and press as usual. By this means the plate will be spread up to the new teeth, which will be firmly united. Loose teeth, if any, on the plate may be tightened by the same means, having been waxed in place, and the wax afterwards thoroughly boiled out. Some attempt

to repair plates in this way, without using anything to produce pressure, depending upon the swelling of the plate to fill the vacancy. This would be certain to injure the density of the material.

To remove teeth, heat the plate in boiling water or glycerin, when they will come off easily.

Rubber plates may be repaired with celluloid, but, as there is no union, dovetailing or drilling holes is necessary.

FINISHING.

Use files, sand-paper, and scrapers, but do not use too coarse materials. Polish with pumice-stone, and finish with a soft brush-wheel, run at high speed, and whiting or prepared chalk. Dr. H. D. Knight, of Lancaster, Pa., recommends a polish obtained by rubbing with an old cloth wet with camphor. This is valuable between teeth, and in places inaccessible to the brush-wheel. In finishing, care should be taken not to heat the plate by friction, as by so doing the surface may be injured, or the plate sprung out of shape.

HINTS.

If the teeth are not attached, or the celluloid is not closely and firmly molded around them, it is from one of two causes—either the principles mentioned under the head of “Porous Plates” have not been observed, or the plaster is poor.

By wrapping the flask in muslin cloth, dirt is kept from

entering it and mingling with the celluloid. When thin plates are used, care must be exercised in waxing up the case, so as not to have it too thick.

DARK LINES.

Where these appear on the palatal portion of the plate, it is the result of using a plate too wide for the mouth; or of want of sufficient thickness in the center of the blank, causing the material to flow inward as well as outward, and fold upon itself; or, in deep mouths, from beginning the pressure too soon, which tears the plate asunder.

POROUS PLATES.

In the steam machine this cannot result from overheating. The only other cause is want of proper pressure at the right time. The nature of celluloid is such that if it is subjected to a temperature of 270° F., without being under pressure, the camphor evaporates, and the material is puffed up, exactly as a loaf of bread is raised by yeast, and filled with air-cells. For this reason the overflow found in the waste-gates (if they are not full) will always be found porous, though it is no hotter than the rest of the plate. If the plate is porous, therefore, the pressure has not been brought down soon enough, and the plate is ruined in texture for want of it. This result may be partly reached, and the plate may not show it at first; even after being injured it may be brought down by subsequent pressure to an apparently solid condition, but it

will never again be as dense or solid as it formerly was. The plate, however, may be porous in spots. This is the result of want of pressure, but it is caused either by a lack of a sufficient amount of material in a certain portion of the flask, or by too large cross waste-gates, or fracture of thin edges of the mold, either of which will relieve the material from the necessary pressure, and produce porous spots in the plate. To secure the best results there should be not only enough but a slight excess of material in every portion of the flask. Celluloid cannot be depended on to flow from one portion of the flask to another, and there must always be enough directly before the cast to insure a plate of uniform density.

PLASTER.

For the successful working of celluloid it is absolutely necessary to have the best quality of plaster. Very many of the difficulties experienced by dentists in working celluloid are due to the use of unsuitable plaster, as a very large proportion of that offered for sale is entirely unfit for the work. The fine and highly-calcined plaster has not the requisite strength, and will not stand the pressure; blocks are broken, plates do not fit, the articulation is destroyed. For this use a good article of builder's plaster will be found far more satisfactory than the finer grades, although it will not set as quickly or be as white. Do not use salt, sulphate of potash, or other materials to cause rapid setting, as they lessen the strength. The use of tepid water will hasten the setting without injury. Put

the plaster in the water (and not the water on the plaster), allowing it to absorb all that it will take up, leaving no excess of water, making it as thick as can be well poured; stir it thoroughly and pour some into the flask or impression to be filled, and shake down well. Then into what remains in the bowl stir more plaster, until you have a mass so thick that it can be piled up; fill the flask with this and jar it down solidly. The thinner plaster first poured in will run and be driven, by the thicker afterwards added, into all the crevices, and most of it will escape from the flask, leaving a body of solid resisting plaster that cannot be obtained by the ordinary method of mixing. Of course, a very quick-setting plaster cannot be used in this way, but such plaster is not as strong as the slower-setting. The addition of a small portion of clean river-sand or marble-dust will be advantageous.

FORMING PLATES BEFORE MOLDING.

It is well to keep an assortment of all the blanks, so that one of proper form may always be at hand. Never use a plate much wider than the mold, as the material would be compelled to crush inwards. Nor should one be used which is not wide enough. A plate very dissimilar to the model always has more tendency to change its shape than one nearly adapted. By softening in boiling water, the plate may be pressed into any shape before molding, and an excess in any part may be trimmed off in the same manner with a sharp knife.

METAL CASTS.

Better results are obtained by molding either vulcanite or celluloid upon a metal cast than upon a plaster one. After a perfect cast is obtained in metal, there is no danger of fracturing or brushing away small particles, as with plaster. The inner surface of the plate is finished with a hard polish, making it more agreeable even if the fit is no better. The cast is usually made of block tin, or some metal fusing at a low heat, and is manipulated as follows: Form the mold in sand (using the plaster cast as a pattern), and pour the metal into this. Where there is a heavy undercut, it would be impossible to remove the plate from the metal unless the cast is made hollow, which is done by pouring the metal into the sand mold, and allowing it to remain only long enough to cool upon the outside. Then turn it over, letting all of the molten metal run out; after which scrape away enough of the metal to leave only a thin shell. This forms the hollow cast. When cold, saw all around the alveolar ridge with a fine Swiss saw, leaving only enough connection to hold the parts in position. Pour the plaster into this, filling the saw-cuts and forming a solid cast. Now proceed as with a plaster model. When the case is finished and ready to remove, cut the plaster out of the inside of the die, and place the edges of the metal in a vise and crush it. This leaves the plate without injury. A metal cast may be formed by pouring it into the impression, provided it is taken in plaster and the impression is thoroughly dry.

HAVE ENOUGH MATERIAL.

No one can expect that a plate will fit unless there is enough material to force the celluloid into every part of the matrix.

Cleanliness.—Keep the machines and flasks clean and free from plaster, and do not handle the plates with dirty fingers, especially when hot. Use clean water in the steam-boiler.

Care of Plates.—Patients should be instructed to keep their plates properly cleansed. Soap and powdered pumice are highly recommended for keeping celluloid plates clean and free from stain.

METALLIC CLASPS AND BACKINGS.

Where it is desired to use these, they may be nicely attached, but the ends should be firmly anchored in the plaster, and the free ends should be supported by either pushing a small piece of celluloid under them, or bending at right angles and allowing the end to rest upon the plaster, which will prevent the displacement of the band or backing. (See Figs. 11 and 12. A drop or two of spirits of camphor may be placed on the parts, and the celluloid will tend to flow around them.

Thickening of the Plate.—This, as well as displacement of the teeth and derangement of the articulation, is due to poor plaster, or to too hard pressure before the heat is up.

Thermometers.—These vary sometimes 20° or 30°, and consequently machines used with them are unreliable until tests are made.

THE "BEST" HOT MOIST AIR CELLULOID APPARATUS.

Fig. 19 is a representation of the "Best" Hot Moist Air Celluloid Apparatus; rigged for gas.

This machine is spoken of in high terms by those who have used it. The case is flaked the same as for other machines. An essential point in the successful working

FIG. 19.



of celluloid by this method is to have the plaster in the flasks thoroughly wet. This may be attained by setting the flasks in a vessel of water before placing them in the heater.

Directions for Using.—When the flask is prepared, with the plate in position, place it in the clamp and screw down the top until it slightly presses the flask. Now place it in the oven and apply the heat.

The degree of heat may be determined with sufficient precision by moistening the end of the finger and applying it to the flask, as the housewife tests the heat of the sad-iron. As soon as the contact of the moistened finger produces the peculiar fizz it is time to commence screwing the flask together. The condition of the plate may also be determined by probing with the point of a knife or of an instrument between the edges of the flask. By a sensitive touch the beginning of plasticity of the plate may also be recognized from a slight turn of the screws. As the material softens continue to put on more force (allowing a little time for the material to flow under the pressure), until the sections of the flask are brought firmly together, at which time the heat should be removed, so as to avoid overheating the plate and making it porous.

An important point to be observed is, that while the flask must not be brought together until the heat has properly softened the plate, neither must it be allowed to remain open too long, as the plate will then become hard, from loss of camphor, and prevent the flask's being closed properly. Remove from the oven and allow it to cool gradually and thoroughly, the oven being meanwhile ready for another case.

The foregoing directions have been prepared for the guidance of those who prefer to employ moist heat. The "Best" heater is also used by many of the most successful workers of celluloid as a dry heat apparatus, the fact that it may be used for either method constituting one of its most valuable features.

THE NEW-MODE HEATER, CELLULOID MACHINE AND DENTAL VULCANIZER.

This is the most desirable apparatus in the market for working celluloid, and any one, after becoming perfectly

FIG. 20.



Rigged for Gas. Can be adapted for Alcohol by substituting the lamp for the gas-burner.

familiar with it, will give it preference for superior results. For vulcanizing it requires more time than other vulcanizers, but it leaves the rubber stronger and of a better

By permission, the author gives substantially the instructions which are furnished with the New-Mode Heater. (Fig. 20.)

The New-Mode Celluloid Machine and Dental Vulcanizer and Packer combines in one apparatus important improvements in the means of working both celluloid and rubber. It is based on the conviction of the inventor that perfect work in either can only be made in a dry chamber, and that where a high degree of heat is used, such as is absolutely essential in the manipulation of celluloid, the temperature must be kept uniform until the work is completed, and must not be allowed to change suddenly.

Steam is used to heat up the packing-chamber and investment, but the chamber itself can be and for certain kinds of work must be kept absolutely dry after the molding commences, while the complete control which the operator has over the workings of the machine enables him to maintain the heat at any desired temperature. The hot-box or packing-chamber is nearly surrounded by the boiler, and steam may be admitted to or excluded from the packing-chamber at will. A case may be removed from the heater and another one inserted without reducing the temperature or letting off the steam from the boiler, thus accomplishing a large saving of time. The boiler has no steam-packed plunger or screw to cause uncertainty as to the amount of pressure applied. The top of the boiler is cast in one piece with the boiler; the flask is closed with a small key-wrench by the thumb and finger, the screw-bolts for closing the flask passing through the

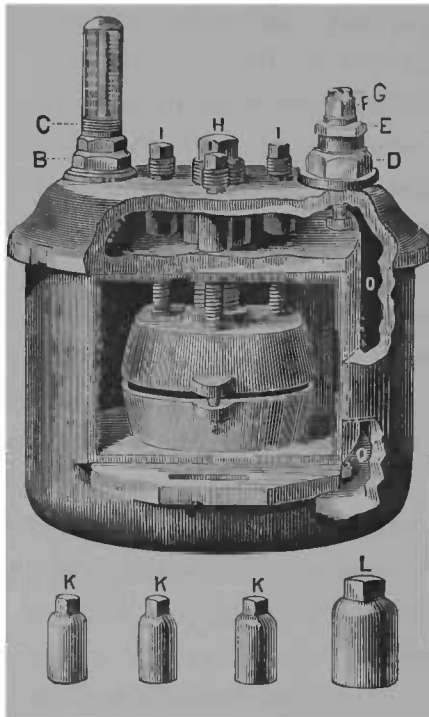
steam-chamber in piers or columns. A steam-tight plate-glass door permits the operator to examine the work at any time during the process of molding, enabling him to apply the proper pressure at the right time, thus reducing the liability to break the cast, investment, or teeth.

The celluloid blanks used in dentistry are subjected to a process of "curing" before they are placed on the market. Dry heat has no injurious effect on the material. If a piece of transparent celluloid be passed through a jet of steam, the transparency will disappear in an instant, and the material will become opaque and lose its hardness. A piece of the same transparent celluloid, heated in a dry chamber to the same temperature as that of the jet of steam, is not affected, its transparency and hardness remaining unchanged. So, too, with rubber. A piece of black rubber vulcanized by dry heat in the steam-tight packing-chamber of the New-Mode machine is of a pure jet-black color when taken out; while a piece of the same black rubber vulcanized by the ordinary method shows brownish discolorations. These simple experiments show conclusively that the action of the steam is the cause of the loss of quality.

The cut (Fig. 21) is a sectional view of the working parts of the New-Mode machine, showing its construction at a glance. It is a cylindrical cast vessel, having two chambers, one within the other, the inner one being supported by piers or columns connecting its sides, top, and bottom with those of the outer chamber, the whole being made in one casting. The outer compartment is the steam-chamber, or boiler, and incloses the hot-air or packing-

chamber on all sides except the front, where the walls of the two chambers converge and become one, for the purpose of permitting access to the packing-chamber. A door, made of the same metal as the boiler, and fitted with lead packing to make it steam-tight, is held in place by a

FIG. 21.



bridge secured by screws. The door is also provided with a plate-glass light (shown in Fig. 20), through which the operator can watch the progress of the molding in the oven. The only communication between the two chambers is by means of a valve having its seat in the top of the packing-chamber, and controlled by a hollow stem which passes through the top of the machine. B is

the mercury-bath; C, thermometer; D, screw-plug; E, lam-nut; F, stem of steam-valve; G, screw-cap; H, large screw for closing the flask; I, I, I, smaller screws for same purpose; K, K, K, L, nickel-plated caps for screws; O, O, steam chamber.

WORKING CELLULOID WITH THE NEW-MODE HEATER.

To secure the best practical results, celluloid should be molded or pressed into the form desired, at the highest possible temperature which will not burn it. To prove this it is only necessary to mold a plate on a metal cast at the lowest temperature at which it can be done, which is about 212° F., and another on the same cast at the highest temperature possible, say 310° or 320° F., and lay the two aside for a few days, when it will be found that the one molded at the lower temperature will not fit the cast, while that molded at the higher temperature will fit as well as when first made. The reason is that the low temperature fails to overcome the tendency of the plate to return to its original form, while the high temperature renders it so thoroughly plastic that this tendency is entirely eradicated. This is proportionally the case with pieces made at intermediate temperatures; the higher the temperature to which the plate is subjected in molding, the more exactly will it hold its new form and the less will be its tendency to warp.

Celluloid may be readily and safely manipulated in the New-Mode Heater at 320° F., a temperature many degrees higher than is deemed safe in other machines, and which

accomplishes perfectly the result above noted. When this very high temperature is employed the celluloid should be in the machine only long enough to permit the closing of the flask; for the reason that heat vaporizes the camphor—the solvent of the material. If too much of this is driven off before the flask is closed, it will be almost impossible to mold the blank to the desired form. The sooner the flask is closed after being placed in the oven, the more readily will it be done and the better will be the result.

The molded surface of a piece of celluloid is much more durable than its interior, and will retain the color better. It is obvious, therefore, that this surface is essential to the integrity of the plate, and should be preserved intact. To insure this, the case should be so prepared that the plate, when taken from the flask, will require little or no labor to make it ready for use. It is possible that some surplus material at the edges may have to be trimmed off and the edges smoothed, but the case is not properly prepared if more than this is necessary. The care and trouble involved in proper preparation will really save time; will absolutely avoid interference with the fit by the too free use of files, sand-paper, pumice, etc., and will insure as durable a plate as can be made in celluloid. Moreover, the artistic taste of the operator may be exercised before the plate is molded more readily than afterward.

DIRECTIONS FOR PREPARING A CASE FOR CELLULOID.

Use pink paraffine and wax for base-plate. The inven-

tor uses a thin paraffine-and-wax sheet as the plate, strengthened by pressing upon it a quantity of warmed paraffine or impression-compound, after first covering the paraffine plate with heavy tin-foil, so that the impression-compound can be removed and the smoothness of the original paraffine plate may be retained. Set the teeth on this in the position desired, and drop melted paraffine and wax around the roots. A very nice form of stick wax is made for this purpose. The method of dropping wax is shown in Fig. 22. After cool-

FIG. 22



ing, carve into the shape of gum desired. A simple scraper like that shown in Fig. 23 is excellent for carving the wax.

Fig. 24 represents a very complete set of carving instruments designed by Dr. W. W. Evans. Nos. 1 and 2 have steel points—at one end of each a carver similar to Dr. Kingsley's vulcanite finishers; at the other end a knife-blade, that of No. 1 being curved, while No. 2 is

straight. The points of No. 3 are ivory, having a wide range of usefulness as burnishers, and especially in working the wax into the interstices to form the festoons of the gum.

The wax may be made very smooth by throwing upon it the flame of a spirit-lamp, with the aid of a blowpipe or chip-syringe, taking care not to destroy the outlines of the carved gum. (It should be constantly borne in mind that one minute spent in careful waxing will save five in finishing.) Cover the wax with No. 60 tin-foil, burnishing it lightly but smoothly to the wax.

Care must be exercised that no wrinkles are burnished in the foil, as they will show in the plate. The palatine portion must be of one piece, having no slits cut in it. The foil used on the outside of the gum takes the form of a horseshoe, and is burnished to the wax, allowing it to extend up a short distance on the labial and buccal surfaces of the teeth. Turn the edges of the foil up one-fourth to one-half of an inch around the upper edge of the piece covering the gum; also the edge of the palatine piece. Invest in the shallow part of the flask with the wax and foil about one-eighth of an inch above the investing plaster, cutting the usual groove for excess of material. Care should be taken that the wax, teeth, and foil are removed with the upper half of the flask in parting, leaving the cast clean and entirely exposed.

Remove the wax by pouring boiling water over it from the spout of a tea-kettle or other vessel. The foil remains upon the plaster. The investment is now ready to be dried out preparatory to receiving the celluloid.

FIG. 23.

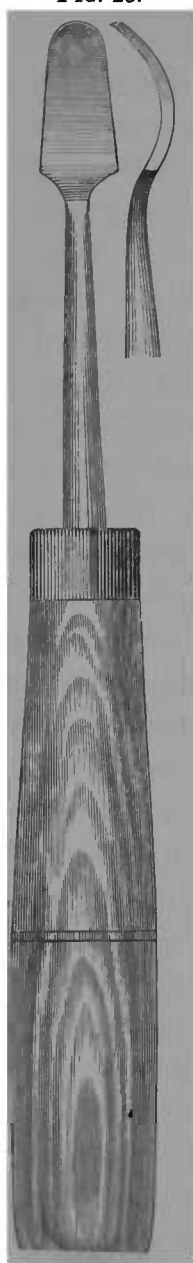
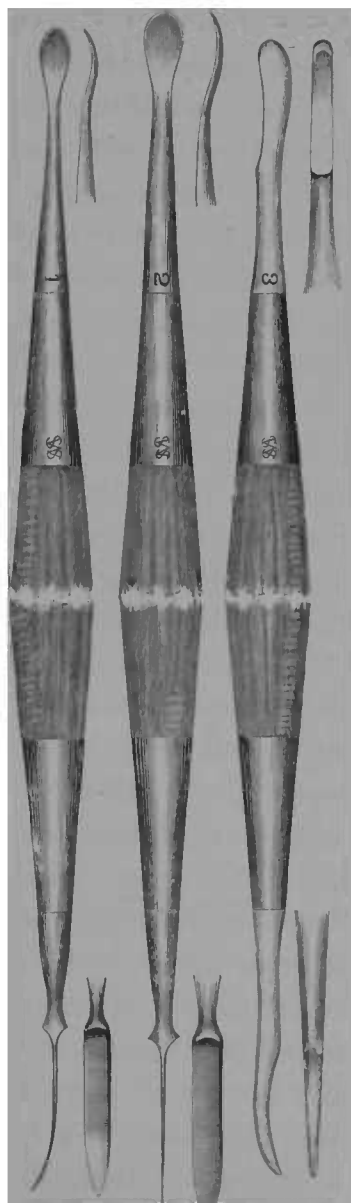


FIG. 24.



DRYING THE CAST AND INVESTMENT.

There are two ways of drying the investment,—first, by raising the temperature to 320° F., keeping the hot-box dry; second, by admitting steam to the hot-box. The former method can be used when the investment is placed in the chamber before getting up steam. If steam is up, however, either method may be employed. In using the dry-heat method, open very slightly the screw-cap of the piston or valve-stem to permit the escape of the steam generated from the water in the plaster, being careful that the steam-valve is firmly seated, as otherwise all the steam made in the boiler will escape. In using steam for drying, admit the live steam into the chamber with the investment by raising the valve from its seat, keeping the screw-cap closed. The steam quickly permeates the plaster, and in five or ten minutes the temperature of the plaster is high enough to convert the water in it into steam. As soon as the plaster is thoroughly heated, shut off the steam by closing the valve, and raise the screw-cap very slightly to allow that in the chamber to escape slowly through the small aperture at the side of the screw. In a few minutes the cast will be perfectly dry, the steam escaping from the chamber carrying with it that generated from the moisture in the plaster. Extreme care should be taken that the steam shall escape very slowly, as otherwise the plaster may be blown out of the flask into the oven by the too rapid expansion of its vaporized moisture. The completion of the drying process is known by steam ceasing to be given off at the

screw-cap, G. The drying may be facilitated by placing a small chip of wood between the two parts of the flask when it is put into the chamber, thus exposing a larger surface to the heat and allowing the moisture to escape more readily.

MOLDING WITH DRY HEAT.

When the investment is dried, remove it from the chamber and insert and carefully adjust the selected blank; replace the flask in the oven immediately under the screws; see that the two sections are so placed that the guide-pins will enter properly into the lugs; open the screw-cap a turn or two to allow the escape of the gas from the hot-box; turn down the large screw until it bears lightly upon the top of the flask, and close the machine. In less than five minutes the material will be sufficiently softened to permit the commencement of the molding. The screws will turn readily with the thumb and finger (using the smaller key-wrench), when the blank is properly softened. Close the flask gradually, stopping occasionally if the resistance is too great. Generally, if the temperature is about 300° F., the flask can be closed in ten minutes; but if the blank is very thick, the molding must proceed slowly, the small screws may be used to advantage, and more time, say thirty minutes, may be consumed. As soon as the flask is closed—unless it is a locking-flask—the flame should be extinguished, the door opened, and the machine allowed to cool. If a lock-flask is used, it may be removed and thoroughly cooled before opening it. the oven being meanwhile ready for another

case. The cooling may be accomplished rapidly, if necessary, by placing the flask in water. When perfectly cold, remove the plate from the investment; it will be found enveloped in the tin-foil which had been burnished to the wax-plate. Peel off the foil. The celluloid will present a hard, brightly-polished surface, received from its contact with the foil, and will need no further finishing than cutting off the excess of material and smoothing down the edges. The extra hardness of the surface will thus remain to preserve the integrity and color of the piece. It is claimed, also, that the contact of the foil renders the outer surface, which is always the densest portion of celluloid, much harder.

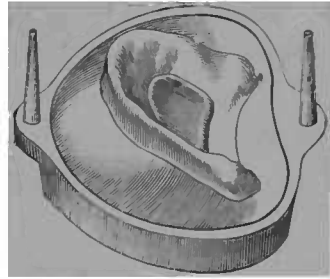
IMITATING GUM MEMBRANE.

The plate produced by the above method is of the ordinary appearance, with smooth, polished gum; but a much more natural, life-like gum will result if the tin-foil, after being burnished to the wax plate, is "stippled." Fig. 29. This is done by "dotting" carefully over its surface with a dull-pointed instrument, which should be held nearly perpendicular to the surface to be operated on. The strokes should be gentle—not hard enough to perforate the foil. When the foil is removed, after the case is molded, the gums present an appearance closely resembling the natural membrane. The stippling need not occupy a great deal of time, and the result it produces is a marked improvement.

DEEP UNDERCUTS.

To obviate the difficulty of molding celluloid plates in cases of deep undercut, without breaking the plaster cast and producing a failure, the method described by the late Prof. Wildman, in the *DENTAL COSMOS* for March, 1875, is recommended. This consists simply in so investing the cast that it shall occupy the position shown in Fig. 25. If so placed, the pressure applied in molding is brought to bear upon the mass of plaster supporting the projection, instead of upon a thin section.

FIG. 25.



REPAIRING.

If a portion of a plate has been broken away and lost, fit a piece of celluloid of the proper shape, leaving it somewhat larger than the space to be filled. Make sure that the surfaces to be united are perfectly clean; even the perspiration from the hand may cause a dark line. Flask and mold as usual.

A crack in a plate or the parts of a broken plate may be joined by scraping the surfaces clean; forming dovetails in the plate each side of the crack; moistening the edges with liquid celluloid or spirits of camphor, and molding a strip of celluloid into the seam.

TO REPLACE A BROKEN TOOTH.

Remove all portions of the broken tooth from the plate,

taking care not to disturb the outlines of the socket. Select a tooth of proper size and shade to replace the broken one. (If the tooth is numbered, a considerable part of the trouble of selection may be saved by taking the number of the mold from the reverse impression in the plate, or from the broken pieces.)

To make the new tooth pass into the hole made by the old one, the hole must be made larger, and to do this the plate should be filled with plaster so that it will cover the front of the gums and face of the teeth, to prevent any possibility of warping the plate out of shape. Heat a large burnisher, or any suitable instrument, in boiling water; place this in the hole several times until the celluloid has become warm enough to be pushed slightly towards the palatal portion of the mouth. This will enlarge the hole sufficiently to allow the new tooth to be inserted in its proper position. Pour plaster over the face of the tooth, to keep it from being forced out of place. Cover the bulge made in the celluloid, by stretching the hole to admit the tooth, with heavy tin-foil. Heat any suitable instrument in boiling water and press it against the bulge until the celluloid is forced firmly around the pins and tooth. The plaster in front prevents the tooth from being forced out of position, and holds the front of the gum in its original form. When the celluloid has moved to its place around the pins, drop cold water on it from a sponge in one hand, while holding the hot compress against it with the other. By this mode a tooth can be replaced without heating the plate, showing no sign of repair. A celluloid plate is damaged by being invested and heated

a second time, and it should not be done for so simple a repair as replacing a tooth, unless some part of the celluloid has chipped away—as, for instance, if a small piece is gone from the front of the socket (enough only to expose the end of the root when in position), drop a little wax upon the vacant spot, after placing the tooth, and carve to the shape desired. Without removing the wax, invest and mold as before described. The wax will pass off into the plaster, and its place will be supplied by the celluloid, of which there is usually enough to permit the flowing of the minute quantity required without damage. In this case it is necessary to heat the plate and use pressure.

If there is a similar deficiency on the inside of the plate, exposing the pins of the tooth, drop wax into the vacancy, and proceed as before, except that in this case the wax is to be removed when the investment is made, and a piece of writing-paper or tin-foil should be placed just below the pins instead of over them, so as to force the flowing of the celluloid to cover them.

Some prefer the following method of replacing a tooth: Heat the tooth selected for the case, and quickly press it into position, protecting the fingers with a napkin. Invest in plaster, covering the teeth and plate as shown in Fig. 18. After the top is poured and hardened, separate and paint a light coating of plaster upon the part covering the repair. Place a piece of thin tin-foil over the exposed portion of the plate, and bring the sections of the flask together in the usual way.

To remove a tooth from a celluloid plate, hold the out-

side surface of the tooth to be removed in the flame of the lamp until the heat softens the celluloid around the pins slightly, when it may be taken off without trouble, and it will come away clean, without any of the celluloid adhering to the pins. Do not move the plate back and forth through the flame, or other teeth than the one desired may be loosened, or their perfect articulation may be interfered with. There is no danger of cracking the tooth so long as the flame does not come in contact with the pins.

VULCANITE.

Where the New-Mode Heater is used for vulcanizing, shrinkage or "creeping" of the rubber from the teeth is obviated. The plaster cast and investment, instead of being soft after vulcanization (as by the other methods), are hard.

TO VULCANIZE RED RUBBER.

Make the cast and investment as in ordinary work. The flask may be heated and packed in the oven; when this is completed, close the machine, and cover the screws for closing the flask with the caps, to make them absolutely steam-tight. Raise the steam-valve and admit the steam to the packing-chamber. After the heat has been raised to 320° F., allow the case to remain in the hot-box at that temperature one and a half hours.

TO VULCANIZE BLACK RUBBER.

A pure jet-black rubber plate may be produced by

using perfectly pure black rubber and the dry process of vulcanization. The rubber should be absolutely free from coloring-matter, as this is only introduced to overcome the effect of the steam in bleaching it when vulcanized in the ordinary way. Dry out the cast and investment thoroughly before inserting the rubber. See that no steam is allowed to enter the packing-chamber during the operation. The time required by the dry-heat method is five hours at 320° F., and the result is a brilliant jet-black piece of work, free from discoloration, which will not shrink or creep from the pins or teeth. The same directions are to be observed when vulcanizing red rubber by dry heat.

NEW-MODE CONTINUOUS-GUM.

To obtain the proper expression, each tooth should be available for placing in any position desired, instead of being arbitrarily held in association with others, as in a block.

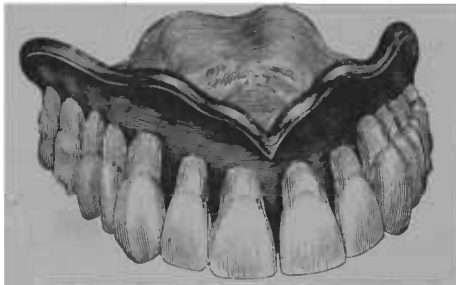
By using plain teeth, with rubber for the base and celluloid (which is well suited for the purpose) for the gum, an exquisite piece of work is made, which is called by the inventor the "New-Mode Continuous-Gum." It is easily the nearest approach to porcelain continuous-gum that has been attained with plastic materials. Its general adoption would do away with "bad joints" and broken blocks. It is the only rubber plate upon which a tooth may be replaced without re-vulcanization, and which after the repair is equal in strength and appearance to the

original piece; and the only one upon which repairs can be repeated any number of times without injury to the original plate. This same style of work can also be done with gold and with cast-alloy plates.

DIRECTIONS FOR MAKING NEW-MODE CONTINUOUS-GUM.

Using teeth made expressly for continuous-gum or celluloid work, set them up in wax in the usual manner, leaving the front or outside of the roots exposed. Cut a thin strip of the wax, warm it, and attach it to the upper edge of the portion of the wax plate representing the

FIG. 26.



gum, forming a rim which extends all around the outer margin. Finish the palatine surface to the form desired; invest in the flask in the usual manner; remove the wax; pack with rubber, and vulcanize. When removed from the flask the case will present the appearance shown in Fig. 26, the front or outside of the roots being exposed, and the narrow, undercut rim extending all around, leaving a space with retaining-grooves between the teeth for forming a gum of celluloid, looking very much as though the substance of the plate had been

gouged out for the purpose. The vulcanite plate is now completed, with the teeth firmly attached to it.

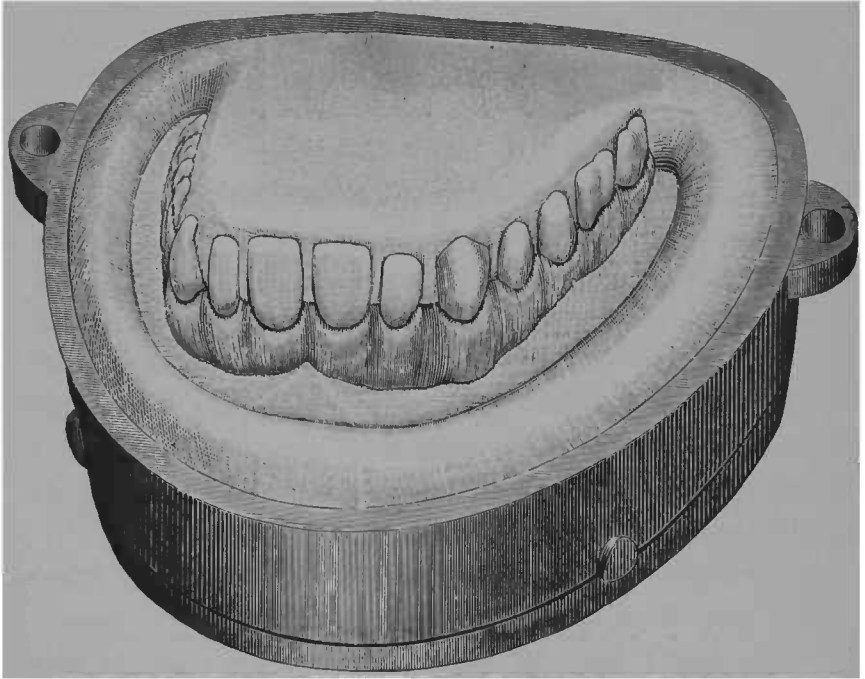
TO PUT ON THE CELLULOID GUM.

Fill the groove with paraffine and wax, which should be melted and dropped on (this compound, not being sticky, does not adhere to the instrument, and is therefore more easily carved to the form desired) until all the space inside the rim, including the retaining-grooves between the necks of the teeth, is occupied. After the wax has hardened, which may be hastened by placing it in cold water, carve it into the desired form of gum. Make the wax smooth in the manner before described under "Directions for Preparing a Case for Celluloid."

Invest the piece again in the following manner: Place the plate in one section of the flask with the teeth upward and raised at the front at a greater or lesser angle, as may be necessary, so that when the investment is completed the upper part of the flask may be removed without dragging. Imbed in plaster to the rim, pouring it over the palatine surface, covering the crowns, and taking care to fill the interstices between the necks of the teeth, but leaving their outer surfaces exposed. After the investment sets, pour more plaster around the inner edge of the flask-ring, forming a ridge, leaving a groove or space between it and the plate. (See Fig. 27.) Complete the investment, and remove the wax from the groove and interstices between the roots of the teeth by pouring boiling water over it. Having selected a celluloid blank of proper

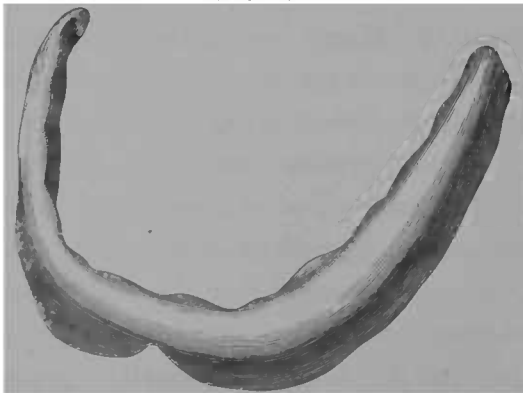
size, saw off the outer rim (see Fig. 28); warm this rim

FIG. 27.



of celluloid in boiling water, and with the hand and a

FIG. 28.

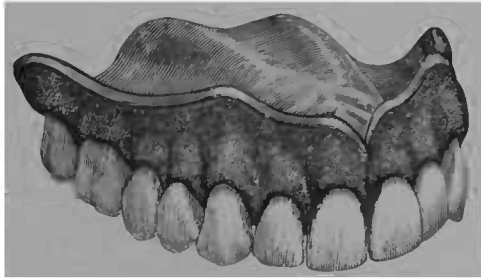


cloth press it closely about the teeth, and hold it to its

place until stiff; it will then remain there until the two parts of the flask are entered upon the guide-pins. Join the two parts of the flask together, and place the investment in the oven of the machine, having previously heated up the chamber. When the temperature of 280° F. is reached, the flask may be closed. As soon as this is accomplished, the case is ready to be removed from the oven and placed in a clamp to cool.

When perfectly cold, remove the plate. The tin-foil will adhere to it, but it can be readily removed by insert-

FIG. 29.



ing the point of a knife under the edge and pulling it off, leaving the surface of the celluloid gum as smooth and polished as that of the foil.

A surface produced by the above method presents a smooth, polished gum; but if the tin-foil is "stippled," as previously described, a striking resemblance to the natural membrane will be produced, the finished plate presenting the appearance shown in Fig. 29. The adjoining edges of the celluloid and rubber will be found perfectly united, each preserving its sharp outline.

Fig. 30 is a palatal view of a finished celluloid case, showing the rugæ as transferred from the model.

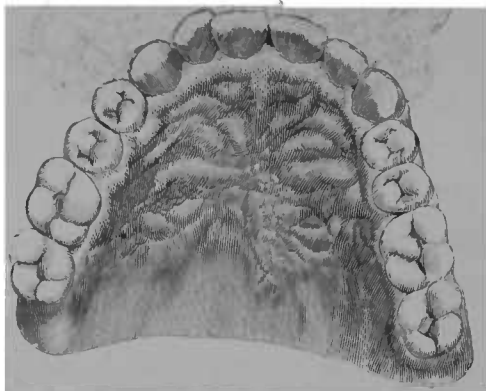
CELLULOID BLANKS.

Five different series of plates are now made, each with from four to eight different sizes, giving a variety of thirty-three plates to select from, which will meet nearly every case.

1. *Ordinary uppers*.—Eight sizes; smallest, No. 3, $1\frac{3}{4}$ inches x 2 wide, running up to No. $6\frac{1}{2}$, $2\frac{1}{8}$ x $2\frac{3}{4}$. The half numbers ($3\frac{1}{2}$, $4\frac{1}{2}$, etc.) are the same sizes as the even numbers, but much heavier.

2. "*A*" plates.—Same sizes and numbers as ordinary uppers, but double thickness, for cases where great absorp-

FIG. 30.



tion has taken place. They are marked "A" on the upper surface.

3. *Lower plates*.—Seven sizes; No. $1\frac{1}{2}$, smallest, to No. $4\frac{1}{2}$.

4. *Partial plates*.—Three varieties, two sizes of each. Nos. 5 and 6 are for ordinary cases; Nos. 7 and 8 are designed for cases where only the front teeth are to be replaced; Nos 9 and 10 are for the side teeth.

5. *Plumper plates*.—Four sizes, Nos. 3, 4, 5, and 6. These are nearly the same sizes as the ordinary uppers of the same numbers, but with very heavy rim, for cases where the gum is much absorbed.

The “A” and “plumper” plates were principally designed for special cases; dentists will find that they are very useful forms of plates, even for ordinary cases. The “A” plates of the larger sizes will afford material sufficient for any case that may present; the shape of the “plumper” plates, which are somewhat pointed in front, will adapt them to that class of mouths. Some of them also are high in the arch.

The various partial plates will furnish material sufficient for any partial case. They can be readily adapted to any required form by cutting away any excess, which is done in a moment with a sharp knife, after softening the plate in boiling water. This is also the case with the “A” and “plumper” plates.

LIQUID CELLULOID.

This is made by cutting celluloid into pieces, and covering it with spirits of camphor. To prevent evaporation, it should be kept in a tightly-stopped bottle.

FINAL DIRECTIONS TO CELLULOID WORKERS.

Use good plaster, and do not mix it too thin; select a plate which nearly fits the cast, with an excess in every part; turn the screws as soon as they will yield to the thumb and finger, and always gently; follow up the rise

in temperature with increased pressure; give the material plenty of time to flow between the turns; increase the pressure toward the close of the molding; reduce the temperature of the piece at once after the completion of the molding, and keep the plate under pressure until it is stone cold.

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