ECONOMIC SAMPLING AND PROTOTYPES WITH FLEXIBLE MOLDS

—Many Companies Could Produce Samples and Short Run Items if They Knew the Details of Molding and Casting. Here is the Beginning of a Series of Articles by a Manufacturer which will Clarify Many of the Applications and Techniques Involved.

R. B. Wagner
J. E. Wiss
The Perma-Flex Mold Company
Columbus, Ohio

THE process of making prototypes and samples in plastics is possible without the use of expensive steel dies by using polysulphide polymer type (modified Thiokol LP's) flexible mold materials, commonly called "CMC".* The materials and apparatus for making flexible molds to carry out the plastic casting process are inexpensive. These compounds are the original room temperature vulcanizing (RTV) tooling materials, and are as simple to use as plaster or gypsum cement.

The shop skills of flexible moldmaking, the use of proper partings, etc. for producing different plastic products have been carefully guarded secrets in the past, thus limiting the practice, in many cases, to craftsmen who learned their trade in ornamental plaster shops.

Instructions in this and in future articles are from our files, are based on actual practice, and written from many years experience in our Perma-Flex prototype and instruction shop. They are related to problems in flexible molding, brought in by various companies availing themselves of our free instruction in the use of Koroseal FMC** or Cold Molding Compounds.

Uses of "CMC" Molds

The uses of "CMC" molds in casting are numerous. They are compatible with plaster, Portland cement concretes, and a number of low temperature type casting resins below 250 deg. F. (with proper parting on mold surface), like the acid phenolics, polyesters, epoxies, acrylics, Epolene-type waxes, Silicone RTV, and low melting point white metals. "CMC" can be cast within itself to produce flexible rubber-like items.

"CMC" forms readily over patterns of modeling clay, wax, soap, wood, plaster, plastic, and most any tangible substance such as live tissue. Even a honey bee can be molded if stiffened with a spray coat of shellac so it will retain its shape, and the necessary parting applied before the molding compound is poured.

Mixing

The writers have found that the mixing of the component parts of Perma-Flex "CMC" is not difficult to perform, but should be done carefully. For utmost success we think that before going into the process of making molds, we should acquaint the user with the nature of the Cold Molding Compounds and weighing procedure.

There are several types of "CMC". Some are three-component mixes and some two-component mixes. Each component is packed separately. The major ingredient, usually called Compound "A", is syrupy in nature, with good pouring quality and reasonably low viscosity. Stable indefinitely under normal storage conditions. "B" Compounds (curative) are a brownish colored creamy liquid, consisting of solids and liquids in suspension. In most cases Compound "B" curative contains lead. Handle with all precautions as to cleanliness. Compound "C" (catalyst) is a yellow or pink fluid. Composition of these ingredients produces a pourable liquid. Curing time of the "CMC" depends on the amounts of curative used, temperature, and time of mixing agitation. The cured "CMC" is a flexible elastic solid with good dimension stability.

We strongly recommend a 4-beam balance or equivalent for simplicity in weight proportioning these compounds. The Perma-Flex 4-beam balance includes 2—1000 gram and 1—500 gram weights. Beams include 1 tare beam for balancing mixing container, 1—500 gram beam graduated in 100 grams, 1—100 gram beam graduated in 10 grams, and 1—10 gram beam graduated in 0.1 grams, total capacity 2,610 grams (approximately 6 lbs.)

Our shop practice for mixing three-component "CMC" is to use stiff paper cups, or larger disposable containers, depending on the volume of mix to be made. The container should be of approximately fifty per cent greater capacity than the volume to be mixed. Weigh the desire amount of Compound "A" into this container—add the "C" to "A" and mix well—then stir in the "B", making sure all three components are completely and thoroughly mixed and taking care that sides of mixing vessel are scraped clean and incorporated so no unmixed portions are present. Stir rapidly, mixing as little air into the mass as possible. On small mixes of about one pound capacity, at least one and one-half minutes of stirring is required. Longer agitation increases the early thickening. For larger batches, longer stirring time will be required to get complete dispersion of the components. In all cases, the operator should make a few, small sample mixes to learn the nature of this material before attempting large volume mixes. In all hand mixing, use a flat paddle rather than a round dowel.

With the two-component "CMC's"—Syrup "A" and Curative "B"—the two parts are mixed together, using proportions as recommended for the particular application, and following the above instructions as to care in mixing. These generally require smaller amounts of "B" and take special care to develop uniformity of mix.

For power mixing, Plastic Mixer, Model "H", from Plaster Supply House (Box 551, Chicago 90, Ill.) is very efficient at slow speeds, 250 to 350 r.p.m., where small batches are required —3 to 5 pounds—mixing the mass about two and one-half to three minutes at 75 deg. F.

Cooling of the "CMC" components will slow down the initial setting time. Under normal room conditions, 70 to 80 deg. F., and three minutes mix time, there will be a rapid initial gelling, so after mixing the material should be poured or used immediately.

Work requiring small mixes can be considerably speeded up by increasing the "B" in the two-part system and the "B" and "C" in the three-component system. The increases of curatives should be done with care. We recommend a small trial batch. In very warm weather, the "CMC" will have a fast initial set unless the components are precooled to a recommended 65 to 70 deg. F. For the values and best uses of the different type "CMC's", it would be advisable to contact the manufacturer.

** T. M. Reg.—U.S. Pat. Office—The Perma-Flex Mold Company.*

*** T. M. Reg.—U.S. Pat. Office—The B. F. Goodrich Company.*

REPRINT FROM
INDUSTRIAL MODELS & PATTERNS—November-December, 1960

ECONOMIC SAMPLING AND PROTOTYPES WITH FLEXIBLE MOLDS

(II) OPEN FACE OR "CHUNK TYPE" FLEXIBLE MOLDS

R. B. Wagner
J. E. Wiss
The Perma-Flex Mold Company
Columbus, Ohio

IN THE last issue we outlined methods of weighing and mixing polysulfide polymer types of flexible mold materials, such as Perma-Flex CMC® (Cold Molding Compound) for their use in making molds for the casting of plastics, plasters, etc. These compounds will be designated "CMC" through the rest of this series.

This issue describes making an easily made open-face mold, called in some shops a "chunk" mold. This is a good descriptive name for a chunk of rubber-like material with a mold cavity contained in it, ready to receive a castable material.

Preparation of Model

(a) *Repair and Revision*

Models or patterns to be molded should be as perfect as possible as to surface; every minute imperfection on the pattern surface will be picked up by the CMC mold and transferred to every casting taken from the mold.

Patterns and models with worn, pitted, patched or damaged surfaces may be revised and repaired readily, using CMC as "waste mold" intermediate step. The repair and correction of the worn pattern is done in wax-type modeling clay, overbuilding those parts slightly that must be finished back to close dimension or very smooth surface. Over this revision a "CMC waste mold" is poured; this serving for forming a duplicate in low-expansion gypsum cement (Hydrocal*). This cast then may be worked back with proper tools to dimension, and surface finished *wet* with Wet-N-Dry fine sandpaper (400 or 600 mesh) to eliminate grain marks or tool marks and develop satisfactory finished surface. This reworked pattern is then set up and molded in CMC as before; the final CMC being used to duplicate the original in epoxy, polyester, or other resin, or in low expansion gypsum cement where maximum dimensional fidelity is needed.

(b) *Use of Parting Compounds*

Models and patterns come in many materials: plaster, wood, clay, plastic, metal, and composites of any or all of these. China, glass, ivory are also occasionally met with, as are cloth, paper, animal tissues, vegetable matter, fruits, etc. Parting treatment differs, naturally, with the character of the model or pattern. A few recommended parting compounds and treatments for the different materials to be molded in CMC follow:

For *damp plaster*, and similar porous cements and concretes, apply a good brush coat of neutral mold soap parting. Allow it to react for five minutes, then remove surface excess, and polish surface with a soft brush, sponge, or wool cloth. This treatment may be repeated for very porous surfaces, as the object is to develop a smooth water-repellent "skin" in the surface pores from which CMC parts readily.

For *dry plaster*, and other porous models, seal the surface with three thin coats of shellac, allowing each coat to dry before applying the next.

Shellac is preferably an "8 oz. cut" (8 oz. orange shellac per gallon of alcohol), and must not be built up on the pattern, but is only to seal the pores and finally to develop a very thin surface film. Wherever there is doubt as to what type of parting to use, and especially on brass or copper-bearing metals, or on lacquered models, the shellac coating is also considered to be best practice. It assures ready release of the CMC when treated with any of the standard partings, such as neutral soap, silicone, or thinned silicone oil partings. CMC softens lacquers, so lacquer type partings used for some plaster work are not suitable for parting CMC.

In applying partings use caution to remove all excess build-up, brush marks, and entrapped pockets of parting compounds. These will otherwise be transferred to the CMC mold surface as defects. (See P.F.M.&Co. Bulletin 60-20 on "Partings.")

As a general rule, non-porous models, animal or vegetable tissues, etc., require little or no parting treatment, the CMC parting readily. However, the shellac and parting treatment is always the safest to follow.

Mold Pouring Set-Up

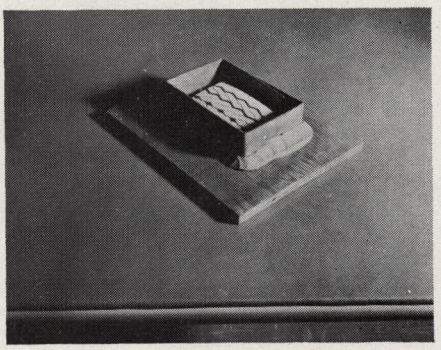
(a) *Mounting Pattern*

To mount model or pattern, a ½" or ¾" WP plywood base makes a good work board or surface plate. It should be sealed with several coats of orange shellac, and should be sufficiently larger than the pattern to permit a minimum margin of 3" from the outer edge of pattern. Before attachment of pattern to board, drill a vent (⅛" to ¼") through the board near where the center of the pattern will be located. This precaution allows for expanding air from porous patterns to drain out without forming blisters and air bubbles between the CMC and the pattern while the CMC is setting. Plaster patters are cemented to the board with Duco or other nitrocellulose cement; wood patterns, or other lightweight materials, are fastened with screws from the back of the board.

(b) *Enclosing Pattern*

Center pattern over the vent and cement or secure it well into position on the work board or surface plate. Where pattern back is irregular in surface and cannot be safely levelled by sanding to fit snug against the board, fill up irregularities with wax type modeling clay, to prevent leakage of the CMC under the mounted pattern during the pour.

Then surround pattern with a metal collet of lead or aluminum strip, keeping the strip height at least ½" higher than the highest part of the pattern. Position strip collet approximately ¾" to 1" from the outer outline of the pattern, and hold it securely in place by running a roll or fillet of wax type modeling clay along the collet base and pressing onto the work board. This prevents leakage of the CMC during and after pouring. Any vertical joints in the collet are dammed shut in the same way. We have found 1/16" sheet lead to be the most satisfactory all-round collet material, being indefinitely reusable, and readily conforming to any irregular outline of pattern. (See Picture #1.)



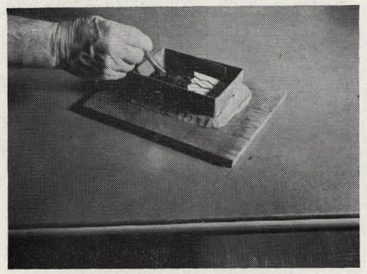
1. Prepared model ready for pouring.

Pouring the Mold

Check assembly for pattern position, secureness of collet, proper parting, etc. Then determine the volume of CMC to be poured in cubic inches. A good rule to follow is 24 times cubic inches required, to determine the amount in grams of the "A" component. It is good practice to add about 10% extra to take care of extras, such as hard-to-measure details and curvatures of the pattern, wastage, etc. Before mixing the main volume, it is good

REPRINT FROM
INDUSTRIAL MODELS & PATTERNS—January-February, 1961

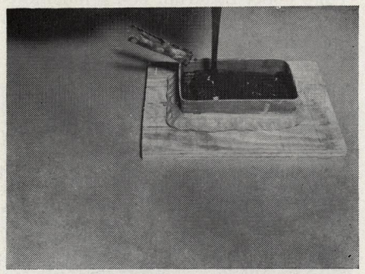
practice also to mix a small portion of CMC (depending on pattern area), enough to give the complete surface of the pattern a thin brush coat, using a small disposable brush. At this point check carefully to make sure that air bubbles haven't been entrapped on the surface of the pattern. While this facing coat is still tacky, mix the remainder of the volume of CMC needed to fill out the mold. (See Picture #2.)



2. Brush Coat Application.

On large patterns, with great surface area and fine, carved detail, good results have been obtained with Plastic Spray Gun, made by Plaster Supply House, Box 551, Chicago 90, Illinois.

The weighing and mixing of the components must be carefully and completely performed. Pour the mixed CMC slowly in a thin stream. This allows entrained air bubbles to break as they flow to the model. Pouring should be started at one side of the assembly near the collet, allowing the CMC to spread and seek it level, covering the pattern with at least ½" of material. (See Picture #3.)



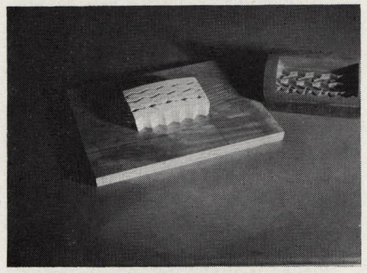
3. Pouring of CMC.

If, by chance, there was insufficient CMC mixed to complete covering the pattern, mix a sufficient quantity of CMC to finish filling the mold. Any number of mixes may be poured against each other without trouble, since CMC bonds to itself without the need for special adhesives, either in the set, or the partly set condition.

After the pour is complete, entrained air bubbles will continue to rise for a time, before thickening and set occur. A light spray of isopropyl or denatured alcohol will break these readily, before the set.

Stripping Mold from Pattern

When set is complete, the collet is removed from the work board, and the edge of the CMC mold is gently lifted from the board, and peeled back to the pattern. When necessary to start release, a thin jet of compressed air at from 80 to 120 pounds pressure will suffice, and a carefully directed stream of air will work easily between pattern and mold. Usually, simple flexing of the mold from the edge in will suffice to part mold from model. (See Picture #4.)



4. Mold and pattern.

The finished CMC mold is now ready for immediate use in casting plaster or similar hydraulic materials like concrete. For plastic forming, the proper parting to separate the resin intended is necessary. Resins, either epoxy, polyester, or phenolic, must be selected so that their exothermic heat will not damage the mold. There are a number of surface coat, and thick-section epoxy resins (U. S. Gypsum EPOXICAL*, for example) that set well at or slightly above room temperatures. This type is recommended, both for safety and for dimensional accuracy of the cast resin. Parting with polyvinyl alcohol (PVA) films has been quite satisfactory, where cure temperatures are held below 225 deg. F. Where the plastic being formed requires a higher finishing cure temperature, it is desirable to lift the partially set cast from the mold and finish cure in an oven at the desired temperature.

No specific recommendations as to resin can be made for prototype or cast pattern use; there are so many different types available, with so many different end uses, that the choice of type should be left to experience or experimentation, for the intended application.

Next Issue: Making a 1-piece plaster enclosed "Dump Type" CMC cavity mold.

Note: Reprints available on this and prior and succeeding articles from The Perma-Flex Mold Co.

ECONOMIC SAMPLING AND PROTOTYPES WITH FLEXIBLE MOLDS

(III) ONE-PIECE DUMP MOLD

R. B. Wagner
J. E. Wiss
The Perma-Flex Mold Company
Columbus, Ohio

In previous issues we discussed mixing Perma-Flex "CMC" Cold Molding Compound* and the making of "Open Faced" flexible molds. These molds work well for flat and simple shapes where exact dimensions are not of prime importance. Items that are complex because of design, detail, shape, size, height, width, or need for dimensional accuracy, require "CMC" *facings* with more uniform thickness. Such facings must be accurately positioned and supported with a rigid backing case, shell, or flask. There are various mold styles with rigid backings such as "Dump Molds", "Laminated Molds", "Two-Piece Case Molds" with *one side seam* or split line, and "Two-Piece Case Molds" with complete *all-around seam* or split line. These types are generally negative or "female" in application. There are also several positive or "male" flexible pattern applications for Cold Molding Compounds requiring rigid backings. We shall write about these patterns in succeeding articles.

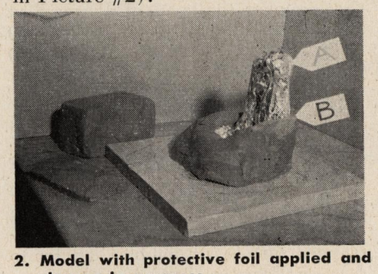
Model Selection

For making a "Dump Mold" (flexible part of mold dumps out of case easily) we will use as an example a model of a figurine ash tray approximately 9" tall (Picture #1). It is well to note that "Dump Molds" are practical only when the model is of less size at its top than at its base. Model being smaller at top makes it possible for the flexible "CMC" part of the mold to be rather conical in shape and drafted to enable its easy removal from the case.

1. Model mounted on workboard.

Clay-Up of Model

The model shown in Picture #1 is made of U. S. Gypsum WHITE HYDROCAL**. After marking model with indelible pencil exactly where seam or split line location is needed, model is centered over vent in work board, gluing it in place with Duco Cement. Working with a dry model, the porous surface is sealed by applying three thin coats of orange shellac. When shellac is dry, model is protected by using a covering of aluminum foil ("A" in Picture #2).



2. Model with protective foil applied and clay-up in progress.

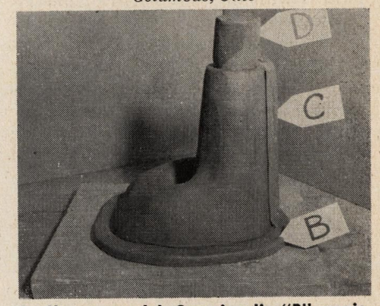
Model Clay-Up

Bat out a loaf of fairly stiff water clay and slice this into slabs about ½" thick. These slabs of clay are laid over the model, cutting and fitting as needed to evenly cover the model ("B" in Picture #2). This ½" of clay determines the thickness of the "CMC" facing of the mold.

Keep in mind during this clay work that wherever clay is placed on model, it eventually will be replaced by the "CMC" rubberlike part of the mold. Because of uneven shapes in models, some areas in the clay-up will have to be built up with a greater thickness of clay to eliminate back drafts, and to provide a smooth drafted clay encasement of the model. This taper of the clay-up will make it possible to slide the rigid case easily from the clay-up. Note in Picture #3 all parts of clay-up taper *upwards*.

Check the clay-up to make sure exterior is not backdrafted in any part and is well tapered and drafted toward top of model. Test clay thickness covering the model at high spots by piercing the clay with a match stick to ascertain if clay is ½" thick. Where thin spots are found. correct this by adding clay to attain needed thickness.

Place flatwise around base of clay-up, a 1" wide by ½" thick strip of clay, thus making the form for the scraping edge and lip of the mold ("B" in Picture #3). Where model is marked for cut seam location, a thicker section of "CMC" is needed to enable the making of the seam joint in a later operation. Apply to this area another ½" of clay, tapering this addition from base to top of clay-up. This tapered strip is about 1½" wide at the base and 1" wide at the top where it joins the pouring sprue ("C" in Picture #3).



3. Clay-up model. Scraping lip "B", registration and cut seam ridge "C", and pouring sprue "D" developed in clay. Ready for shaping plaster pouring case.

For forming pouring sprue, roll a plug of clay about 1½" in diameter and 2" long. This plug is set to location on top of the clay-up ("D" in Picture #3). Work over the outside of the clay with a water wetted brush, brushing over the surface of the clay until all joints where the clay pieces meet are filled and made smooth. This clay is then dusted with soapstone and given a coat of neutral soap parting to prevent the clay from adhering to the plaster pouring case which is made directly over this assembly. Soaping also helps to smooth the clay.

Place lead strip collet around clay-up, keeping collet about 1½" from the clay. This will act as a dam and contain the forthcoming plaster work that is to be done, and form a neat finish to the rim of the pouring case ("C" in Picture #4).

4. Plaster pouring case in progress. Note lead collet retainer ring "C". Plaster undercoat "A" has been applied ¼" thick, and fibered shell coat "B" is being applied.

Plaster Pouring Case

The clay-up is covered with two layers of plaster and each layer should build up to about ¼" thickness. On small molds use enough plaster to complete case with one batch. The plaster is prepared in a basin about half full of clean water, into which is strewn plaster until it reaches the surface of the water. This amount of plaster should

be sufficient for the case. Let the plaster soak in the water, and allow to remain *undisturbed* except when dipping small amounts from the batch. Utilizing the different stages of plaster plasticity, all operations to make the case are accomplished with this one batch of plaster.

With a small pan, dip from the soaking batch enough plaster to first coat the clay-up, mixing this until it becomes a creamy slurry. Carefully splash this plaster slurry onto the clay-up by scooping into the hand some of the plaster and flipping it in a backhanded manner onto the clay-up. Practice makes perfect on this flipping of plaster. Repeat this splashing until clay is completely covered.

When the first coating has started to gel, repeat the previous operation, applying the second coat of plaster. If first coat starts to slip from application of second coat, wait for the first coat to gel further. When the second coat has gelled to a rather firm consistency ("A" in Picture #4), the unused plaster left in basin is mixed. Fiber reinforcing for the case, used in small bats or pads, is dipped into the remaining plaster. These bats of fiber and plaster are placed carefully, covering the "splash" coats entirely with approximately ½" to ¾" thickness of plaster-impregnated fiber ("B" in Picture #4). Larger molds take greater thickness of fiber. When the placement and imbedding of the fiber is completed, smooth the fiber rough appearance of the case, using a small pad of fiber dipped into plaster and wiping the plaster over the fiber job for a smoother effect.

Cleaning Up Pouring Case

Let the plaster become well set before removing the collet; then trim the case where needed, cutting off plaster splashes over pouring sprue plug, etc. With an indelible pencil, mark the *exact* location of the case in relation to the work board to assure positive repositioning of the pouring case. Remove the pouring case with care so as not to break the model from the work board. Clean up the inside of the case, using 220 or 280 "Wet and Dry" grit paper. With wetted grit paper, sand inside of case, removing any bumps or irregularities to make the inner case clean and smooth.

Drill ¼" holes through case for air vents. These vents should be drilled at the low or deep spots inside of case; the low spots in the case are the high spots of model. It is necessary to vent case well to allow entrapped air to escape when pouring "CMC". Having finished the case, remove the clay and aluminum foil from the model and inspect the model for any damage that may have occurred during the case making. This is not likely, as the foil is a good protective covering. The model, having three coats of shellac previously applied, is ready for the application of the correct type parting. (Refer to previous issue or Perma-Flex bulletin on Partings No. 60-20).

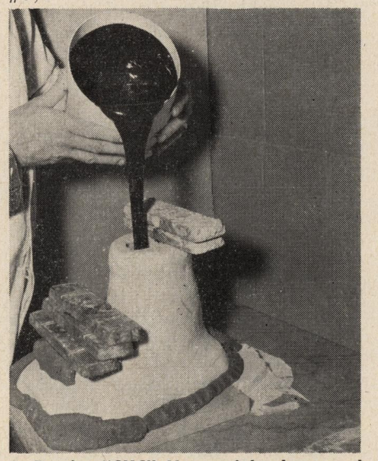
Pouring Case Preparation

Plaster pouring cases may be used while damp. With 3-component type "CMC" apply neutral soap parting to inside of damp case. With 2-component type "CMC" apply soap parting plus a coating over the soap of Perma-Flex B-B Parting or D-C No. 7 grease. DO NOT APPLY B-B PARTING TO MODEL.

Dry plaster cases require three coats of thin shellac as a sealant; then apply the B-B Parting or D-C No. 7 grease.

Before mixing the main volume of "CMC", mix a small batch (refer to pouring "CMC") carefully, brushing this over the model to minimize entrapped surface air bubbles. (Refer to January-February, 1961 issue.)

Reposition the pouring case, and be guided accurately to the place, by the line previously marked on work board. To hold case in place and make assembly leak proof, place a roll of wax clay around the case at the work board. Several heavy metal bars may be placed on the case to hold it down and keep it from floating. When the case is filled with liquid "CMC", cases may also be held down with clamps, and on large cases clamps are recommended (Picture #5).



5. Pouring "CMC". Note weighted case and clay luting on workboard to stop leakage and hold case in position.

Pouring "CMC"

Mix the "CMC" according to manufacturer's directions (Perma-Flex Bulletin PF-2). Then fill the case by pouring the "CMC" in a thin stream into the pouring sprue along the side of the model where the tapered slot occurs for the making of the seam. Fill to the top of pouring sprue (Picture #5). As the "CMC" oozes out of the vents, plug them with wax modeling clay. Wait for the "CMC" to cure. (Check manufacturer's directions PF-2.) With the "CMC" well cured, remove the case by directing a jet of compressed air into the air vent holes and between the 'CMC" and the case at the pouring sprue. This should loosen the assembly. Case can then be removed from "CMC" mold and model. Cut and trim excess sprue and air vent spurs from the "CMC" part of mold. For short run jobs, this pouring case will do as a production case. For long periods of mold use, a better case is needed.

6. Completed production mold. Level top for scraping overhangs case and stops leakage into case.

Making Production Case

Make the production case much the same as the pouring case was made, except use a stronger and harder low expansion gypsum cement (ULTRACAL 30**), reinforcing with fiber, etc. —differing from the pouring case by not making case to work board, but stopping case at "CMC" scraping lip (Picture #6). On large type production cases, besides being reinforced with fiber, use metal rod reinforcing. Also, some cases may be tied with fiber and plaster to a wooden framework. Hollow fiberglass reinforced plastic tubes and rectangular sections are very good supporting frames for large ULTRACAL cases where ultimate dimensional stability is required.

Cutting Mold Seam

After stripping the production case from the "CMC", remove model and "CMC" from the work board. Using a grooved cutting knife, cut a groove or keeway the full length of the seam taper strip, keeping point of grooved knife ¼" from model. With a straight bladed knife, cut through remaining ¼" of "CMC" to the model, following the indelible marking placed on the model for locating this seam cut. This line is easily followed by stretching the "CMC" away from the model as cutting progresses. When placing the flexible part of the mold into the case, exercise care to position the seam to perfect register where groove cut occurs.

Refer to previous issues as to proper partings, etc., before using mold.

Next Issue: Making a 2-piece French type mold.

*—T.M. Reg.—The Perma-Flex Mold Co.
**—T.M. Reg.—U. S. Gypsum Co.

ECONOMIC SAMPLING AND PROTOTYPES WITH FLEXIBLE MOLDS

R. B. Wagner
J. E. Wiss
The Perma-Flex Mold Company
Columbus, Ohio

(IV & V) "FRENCH" MOLDS

Despite the great variety of mold and pattern shapes where flexible molds are adaptable, it is possible to mold most of these variable shapes using only a few different basic types of molds. Previously we described the making of an "Open Face" mold and a "Dump" mold. Here we will describe the making of a "French" mold or "Two-piece" mold.

The processes and techniques for making more flexible molds are basic; that is, applying surface sealant, parting compounds, clay-up, making cases by splash coat methods, reinforcing with fiber, iron rods, etc., pouring the "CMC"*, and the treatment of the molds for their intended end use. So, in describing the making of different style molds hereafter, we refer to these basic operations as outlined in detail in previous articles.

Size, shape, and detail of the model or pattern will usually determine the mold style best suited for practical shop use. In this issue we will outline steps in making a two-part "French" mold.

"French" Mold or Two-Part Mold Model

Models with irregular shapes, tall, top heavy, leaning to one side, or with extremely fine detail, are best molded so that later casting can be done with the mold in an upright (standing) position, provided that there is enough base to the model for fastening it to a work board. Items that need molding in the round, and require a gate or a special tapered sprue, will be described at a later date. Our example for making a "French" mold is a White Hydrocal** model of a Sailfish on a base, approximately 2½′ tall by 1½′ wide, on about a 10″ diameter base.

Mounting Model

Instead of a wooden work board for this molding operation, the model is attached to a plaster plate approximately 1¾″ thick and adequately larger than the model base, to permit a 4″ or 5″ margin from the outside model perimeter. First, mark on the plate where the model will cover. Within this area, roughen (to about 1/16″ deep) the surface of the plate and also roughen the bottom of the base of model, using a small, sharp chisel. Seal both under the model and the roughened plate with orange shellac, then butter the plate with a creamy mix of Hydrocal (Ill. No. 1). Press model to the plate. Where the excess Hydrocal oozes out from between the model and

Ill. No. 1

plate, lute this joint using conventional pointing tool (Ill. No. 2).

Ill. No. 2

Developing the Split Line Clay-up of Model

With indelible pencil mark on the model exactly where splitline is needed, then give model three thin coats of orange shellac. Lay model on work bench, shim and block up model so that splitline is approximately level. Now, using odds and ends of wooden blocking or what have you, build up blocks from work bench to about 1″ of the splitline, doing this completely around the model ("A"—Ill. No. 3). Bat out some loaves of *water clay* and slice into slabs 1″ thick and 4″ wide. Place these slabs on the wooden blocking, making a "land" or plateau about 4″ wide abutting the model.

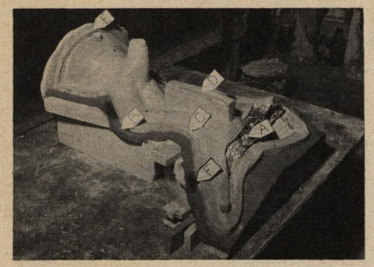
This land is similar to the parting line formed by a matchplate. Add more thickness of clay in some places than others as needed to follow the contours of the indelible marking on the model. At this time the clay work does not have to be well fitted or pointed to the model, as it is just a starting point for making the first half of the pouring

Ill. No. 3

case, although the surface of the clay should be made smooth ("B"—Ill. No. 3). Give this clay land a coat of shellac.

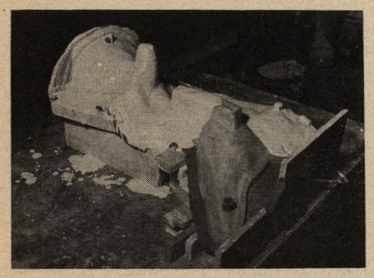
Cover model with aluminum foil for protection ("A"—Ill. No. 4) and clay up model with ½" thickness of clay, drafting clay taper toward the way the case is to be removed. Then place a ⅝" by 1½" strip of clay flatwise around clay-up, and on the land("C"—Ill. No. 4), and on the base plate ("E"—Ill. No. 4). This strip of clay should follow completely around the model. Remember that however we shape or place the clay on the model, it will be reproduced in the rubberlike "CMC" part of the mold, thus this clay strip patterns the lip or flange that will contain the registering groove and the scraping edge of the model. The clay land should extend at least 1″ out from the clay flange strip, affording ample flat bearing surface edge to the pouring case ("B"—Ill. No. 4). (Note that for identification the clay land is in darker color than clay-up of model.)

Reprint from
INDUSTRIAL MODELS & PATTERNS



Ill. No. 4

Place clay plugs, approximately 1½" diameter, as needed to form pouring sprues. On this example we placed the round plug at the highest part of the fish tail. We also placed an oblong lump of clay to form a narrow sprue as shown at "D", Ill. No. 4. This was done to make the pouring case usable for double duty. This oblong type sprue is desirable for hot melt molding materials and will be plugged up when pouring "CMC". Place several pieces of clay about ½" thick by ¾" x 2" on each side of the clay land to form (in the pouring case) plaster "joggles" or keys for alignment of the pouring case halves ("F"—Ill. No. 4). Larger molds will require more joggles. It is advisable to make a few "spy" holes or vents in the pouring case, so place 1" diameter plugs of clay at the extremites of the clay-up on mold to form these spy holes as can be seen in foreground of Ill. No. 4—"E".



Ill. No. 5

Plaster Pouring Case—First Half

In building the pouring case for "DUMP" mold (previous article), we molded the model in an upright position upon a work board. In *this* instance, the model is on its side using a wooden board placed parallel with the base plate to form a flat bottom on the mold. This board is well shown on the right side of Illustration No. 5. The picture also shows starting application of the first splash coat of plaster slurry for the pouring case. Before applying this first coat of plaster, clay-up should have been treated with a dusting of talc and a coat of soap type parting compound. Make plaster work of pouring case as usual, reinforcing with fiber and metal rods as needed for size and shape of case being molded (Ill. No. 6).

Ill. No. 6

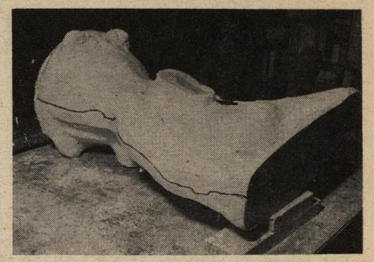
Plaster Pouring Case—Second Half

After the plaster in the first half pouring case just made has set, remove blocking, etc. Now invert the assembly *while keeping the model tightly in place*. Also, while turning model over use care not to knock base plate loose from model.

Before making second half of pouring case, make provisions to assure accurate fit of the first half to match second half of case by cleaning up the surface of the plaster land, using a sharp knife. Trim and taper the countersunk plaster joggles or keys made by the clay pieces placed on the clay land. Cover exposed part of model with foil as done on first half. Shellac the plaster land ("A"—Ill. No. 7). Repeat clay-up

Ill. No. 7

and all steps used in preparation in making the first half pouring case ("B"—Ill. No. 7). Lubricate the shellacked part of plaster land with parting compound to assure easy removal from first half of pouring case. Illustration No. 8 shows both halves of pouring case completed and the plaster locating joggles in splitline.



Ill. No. 8

Completion of Splitline

When second half of pouring case has set, remove it and the clay and foil from the model. Trim up the vent holes ("A"—Ill. No. 9). Trim and clean up pouring sprue and inside of the second half of pouring case. This next step is an important operation, so use utmost care in making the land for the splitline accurately to the model. Using a spatula or pointing tool, smooth the exposed clay part that remains in the first half of pouring case, smoothing this land right up to the model ("B"—Ill. No. 9), following the indelible marking

Ill. No. 9

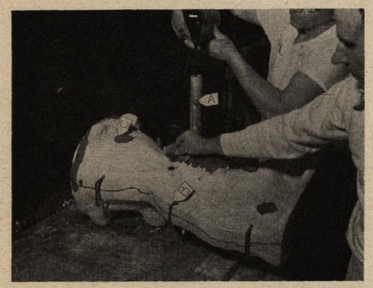
made on the model that shows where splitline location is needed. You may have to add some clay here and there to follow the marking on the model as you smooth and point this clay to the model. Any clay smeared on the model should be *carefully* removed.

With this finished, make a countersunk groove in the clay part of the land going completely around the model, keeping the groove about ½" away from the model. This groove is best made by using a ½" wire loop tool or gouge chisel. Occasionally a short cross groove should be made in the clay also. This will form in the "CMC" part of the mold the "tongue" part of a tongue-and-groove joint, assuring absolute register of the two flexible halves of the mold ("C"—Ill. No. 9). Give this clay and plaster part of the land a coat of shellac.

Ill. No. 10

Pouring "CMC"—First Half

Apply parting compound to model and inside second half of pouring case or any part of assembly that may come in contact with the "CMC". Mix small quantity of "CMC", as recommended, and brush on surface coat, working out any entrapped surface air (Ill. No. 10). Re-position this part of case with the first made half of the pouring case and clamp together securely ("B"—Ill. No. 11). Adjust assembly on work bench

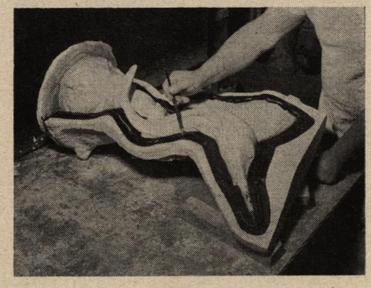


Ill. No. 11

so high parts of models are about level. In many instances it is advisable to add additional height to the pouring case to equalize the level of the "CMC" and to assure complete covering of the high spots on model ("A"—Ill. No. 11). Lightweight aluminum tubes make good riser extensions to pouring sprues. Grease the inside of the tubes lightly with parting compound, place in location over sprue holes and hold in position with a roll of water clay. The assembly is now ready for pouring the first half with "CMC", following manufacturer's directions for weighing, mixing, and pouring "CMC". After the air has escaped from the case through the air vents, and the "CMC" starts to ooze out of the vent holes, plug these vents securely with a wad of clay ("C"—Ill. No. 11).

Pouring "CMC"—Second Half

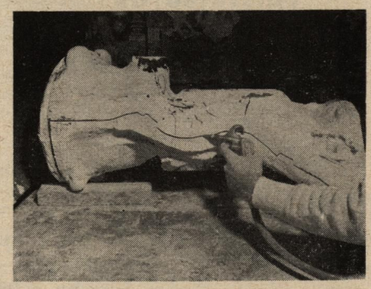
Allow time for the previously poured "CMC" to become well cured. (See manufacturer's directions). If metal risers were used, twist these off and trim the "CMC" even with the case. Then turn over the assembly, "CMC" side down, and lift the first made half of pouring case from the part just poured with "CMC". Remove the clay and foil and clean up the model, as previously done on the other half. If some shellac from the clay land sticks to the "CMC", remove it with alcohol, then coat this "CMC" part of *land* with two coats of shellac (Ill. No. 12). Pour second half, repeating operations as outlined for pouring "CMC" in first half of mold. Make doubly sure that "CMC" part of land is well coated with shellac, and parting compound applied over the shellac.



Ill. No. 12

Removing Half Pouring Case From "CMC"

Twist off metal sprue risers (if used) as before outlined and trim surplus "CMC" level with case. Use a jet of compressed air directed between the "CMC" and the pouring sprue of the case, and at the air vent holes; also along the seams of the two halves of the case (Ill. No. 13). This should

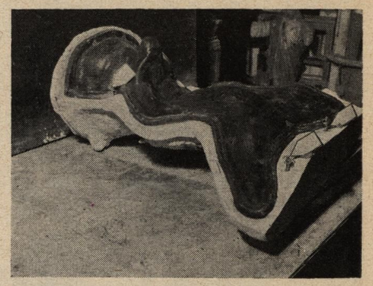


Ill. No. 13

loosen the case so it can be lifted from the assembly. Sometimes cases prove stubborn to remove and patience is required, so keep jetting the airstream into wherever it will go until release is attained. After the case is removed, trim off vent spurs and excess "CMC" at pouring sprues.

Making First Half Production Case

Check the "CMC" and model to see that they are well seated in the half pouring case. Apply to the exposed "CMC" and plaster land a coat of neutral soap parting compound. Use the plaster land part of case as a place to



Ill. No. 14

position the brass joggles (or registering pins and sleeves), placing the female part of joggle face down on the land. About two joggles to each side of each half case are enough, as shown at darts in Illustration No. 14. Larger molds may need more joggles.

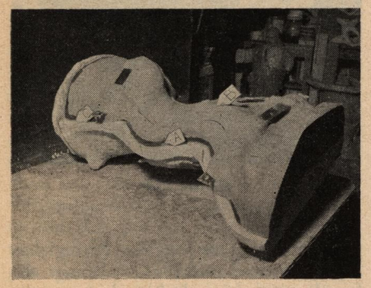
Use Ultracal low expansion gypsum cement for making the production case in the usual manner, using fiber, metal rods, etc., for reinforcing as needed. In some instances, it may be desired to incorporate the means to clamp the two halves of the case together during the making of the case. This is done by imbedding into the fiber and plaster buildup, pieces of strap iron about 3/16" thick and 1¼" wide, allowing the ends to extend out from the side of mold about 3", placing one of these pieces across case near the base and another near top of the mold (Ill. No. 15). When making second half produc-

Ill. No. 15

tion case, do likewise and place the straps of iron so they are so aligned that holes may be drilled through the irons at the side of the mold to receive a carriage bolt and wing nut for

tightening the production half cases together.

In Illustration No. 16 we show one-half of finished production case. Dart "A" in picture points to how the plaster work was finished up to the "CMC" and not overlapping on the land ("C" —Ill. No. 16). The only place the plaster of the production case contacts the land is around the joggles and at the foot of mold. These points of contact are necessary bearing surfaces of the mold match.



Ill. No. 16

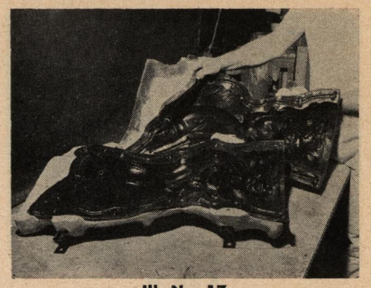
Making Second Half Production Case

Remove remaining half of pouring case and trim up plaster ears around the joggle part. Apply to the "CMC" and plaster part of the bearing around the joggle, and the base of the mold, a coating of soap parting. Then place the male part of joggle into position. Repeat as previously done in making first half of production case.

Finished Mold

Separate the parts of production case and trim up the edges of the plaster and fiber, using a rasp to round off the sharp corners. Separate the two halves of "CMC" from the model. It may be again necessary to employ the use of a jet of compressed air to do this. Place the flexible halves in their respective cases. If any shellac is lifted from the model and adheres to the "CMC" this is easily removed with alcohol, then rinse with water or mold dressing for final cleanup.

The two parts should be placed together carefully so they line up accurately. This should be easily done if joggles fit properly, then tighten up with the bolts and wing nuts when mold is put into use. If no provision was made to hold the two halves together, they may be held with a rope tie or by using C-clamps. Use clamps carefully as it is easy to exert too much pressure against the plaster cases and cause them to crush.



Ill. No. 17

Illustration No. 17 shows the two parts of the "CMC" mold in their respective production cases. The metal straps are clearly defined as to their location. Also, the tongue-and-groove keyway is well shown. This keyway will position the two halves of the "CMC" accurately in relation to the respective halves.

Refer to previous issues as to proper partings, etc., before using mold.

* T.M. Reg.—Perma-Flex Mold Co.
** T.M. Reg.—U. S. Gypsum Co.

Next issue—

Making 2-piece one seam mold. Note—Brass joggles (notches) may be obtained from the Milligan Hardware Co., East Liverpool, Ohio.

ECONOMIC SAMPLING AND PROTOTYPES WITH FLEXIBLE MOLDS

(VI) 2-PIECE 1-SEAM MOLD

R. B. Wagner
J. E. Wiss
The Perma-Flex Mold Company
Columbus, Ohio

The ideal, general purpose, single-cavity style flexible mold adaptable for all mold problems does not exist. We have in previous issues described the making of the most generally used molds that answer most of the flexible mold problems. The necessity of special style molds to meet particular applications or problems sometimes occurs. Most of the operations in the making of flexible molds are basic and have been outlined in previous articles. In the future, these articles will pertain to the molding of different styles, set-ups, etc.

For this article we will describe the making of a time and material saving mold. This is a 2-part case, 1-seam mold, incorporating some of the features of the "Dump" mold and the "French" mold, utilizing the materials saving and 2-part case features of the "French" mold in conjunction with the desirability of pouring the mold complete at one pouring as with the "Dump" mold.

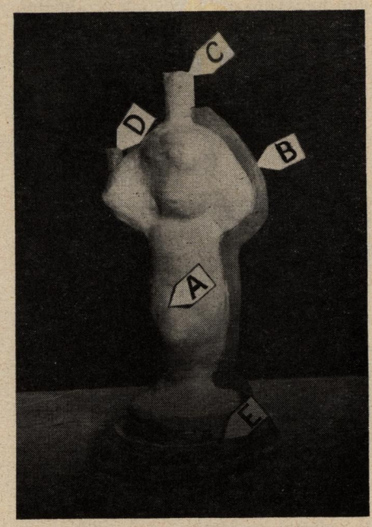
Mounting Model

Model is mounted in the same manner as for a "French" mold by sticking base of model to a plaster plate (B Picture 1).

Ill. No. 1

Model Preparation

Mark with indelible pencil where seam or split line is to be located (A Picture 1). The placement of where the seam occurs is very important, so consider at this time how the clay-up must be drafted so the rigid cases will draw from the clay-up to enable easy removal of the cases from the "CMC" part of mold. After this has been determined, shellac the model and prepare for clay-up.



Ill. No. 2

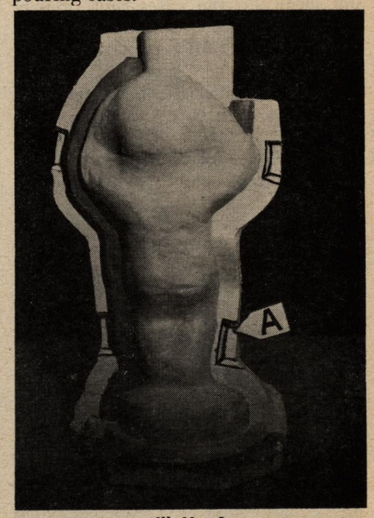
Clay-up of Model

Apply clay over model (A Picture 2). Where the seam is to occur (one side only), add to the caly-up a 1" x 1¼" strip of clay to reinforce this part to 1½" thick, including the ½" thickness of the clay-up. This strip should run from base to pouring sprue at the top of the model (B Picture 2). This "rib" of clay will pattern a good firm section of "CMC", which will be cut with a groove knife to make a tongue and groove seam in a later operation. Picture 2 at "E" shows clay strip to form screeding lip or flange at base of mold. "C" and "D" show clay forms for pouring sprue and vent.

Ill. No. 3

Making First Half of Pouring Case

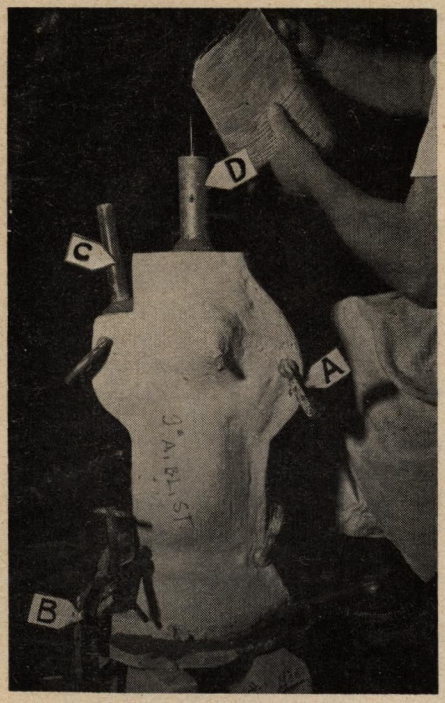
Scribe on the clay-up where division of the case needs to be made. Here, make a fence or dam by pressing cut strips of thin aluminum sheet into the soft clay. Allow strips to protrude from the clay about 1" to 1¼". This will also determine the thickness of the plaster case (A Picture 3). The aluminum strip on the seam side (B Picture 3) of the mold straddles the center of the clay strip where seam will occur. Place on this dam a few oblong shaped pieces of clay approximately ⅜" x ¾" x 2" (C Picture 3) to form in the pouring case, the female part of key or "joggle". A collet is placed about 1¼" out from the clay rib at base of assembly, acting as a fence to contain the plaster when making the pouring case (D Picture 3). Prepare clay-up for making first half of plaster pouring case (parting, etc.). In making this type of mold, the plaster case work is done with model in upright position, using the usual splash coat and fibre embedment method. Pottery plaster is usually used to make pouring cases.



Ill. No. 4

Making Second Half of Pouring Case

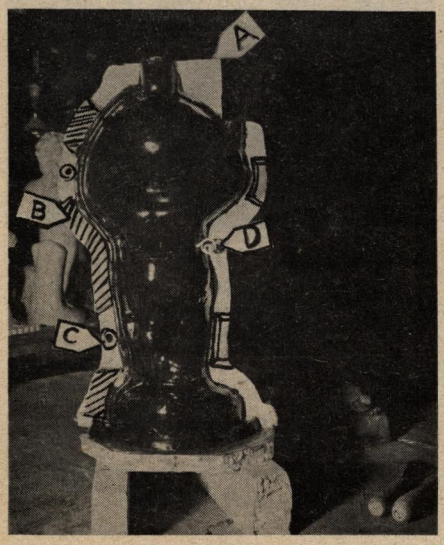
Remove the aluminum fence pieces from first half. Trim and smooth the plaster edge where overlaps of the aluminum fence pieces show on edge of case. Finish the keys or joggles with a slight draft to allow free draw of this second half pouring case (A Picture 4). Repeat operations as when making first half of pouring case.



Ill. No. 5

Preparation for Pouring "CMC"

Before removing pouring case halves from model, mark a reference line where the cases set on the plaster work plate, so they can be easily relocated in relation to the model for the pouring of the "CMC". Remove case halves, clay-up, etc., and clean up model. Trim and clean up the cases and prepare model and cases with proper partings ready for the "CMC" application. Mix a small amount of "CMC" to use as a face coat on model. Brush this face coat over model most carefully so as not to entrap any air blebs on the surface of detail of the model. Relocate case halves to position and clamp together (A Picture 5). Clamp case to the plaster work plate (B Picture 5). Place riser into position (C Picture 5) and position the metal pouring sprue (D Picture 5). After this is done, mix needed quantity of "CMC" and pour as usual.



Ill. No. 6

Making Production Case

In many instances the plaster pouring case will last in service to produce the required number of castings from the "CMC" mold. When much service and long runs are needed, a production case should be made as follows: Remove one-half of pouring case (half with male plaster joggle); leave other part of case on assembly to act as a follow board or dam upon which to form the production case. Clay in the female part of the plaster joggle on seam side of mold (C Picture 6). Also, note that here the male part of the metal joggle or dowel pin is held in place by imbedding the pin about ¼" into this clay. On the opposite side of this half case a hole the size of the joggle pin is drilled about ¼" into the plaster; this is to allow male pin part of joggle to be held in place (D Picture 6). Place approximately ½" by 1¼" strips of clay along follow board in between joggles (shaded area B Picture 6). This clay will stop the plaster work of the production case to allow a pinch on the seam (more fully explained later). On the side opposite the seam, the plaster production case will be built to abut the follow board. Apply parting on assembly where needed, and make the first half of the production case in the usual manner, using low expansion gypsum cement and splash coat method, fibre reinforcing, etc.

Ill. No. 7

Second Half of Production Case

After first half of production case has hardened, remove the pouring case part acting as follow board. Trim and clean up especially where the clay stop was located on the plaster part on the first half pouring case (A Picture 7), then apply parting where needed. Place the female parts of metal joggles into position where male part protrudes from the plaster case just made (B Picture 7), and repeat as making first half production case.

Ill. No. 8

Mold Seam Pinch

To prevent leaking of molds when the seam is subjected to hydraulic pressure (from the liquid materials poured into mold), scrape down the plaster surfaces that abut on the seam side so a slight pinch is exerted on the rubber part of the seam flange or lip (B Picture 8). Dart "A" in Picture 8 shows where clay was applied at "B" in Picture 6. Dart "C" shows where plaster production case stops to allow a scraping lip, and will be the top of the mold when inverted to be filled.

Ill. No. 9

Cutting Mold Seam

After stripping the production case from the "CMC", remove model and "CMC" from the plaster work plate. Use a groove cutting knife—cut groove or keyway the full length of the part of "CMC" that was made of added thickness to receive the seam, keeping point of groove knife at least ¼" away from model. Now with a straight bladed knife, cut through remaining ¼" "CMC" following line marked on model. This line is easily followed by stretching the "CMC" away from the model as cutting progresses. The mold is now complete and ready for use, except for necessary clamps or straps to hold the production case and mold lip tightly together during the casting operation.

Next Issue—

"Laminated Flexible Molds".