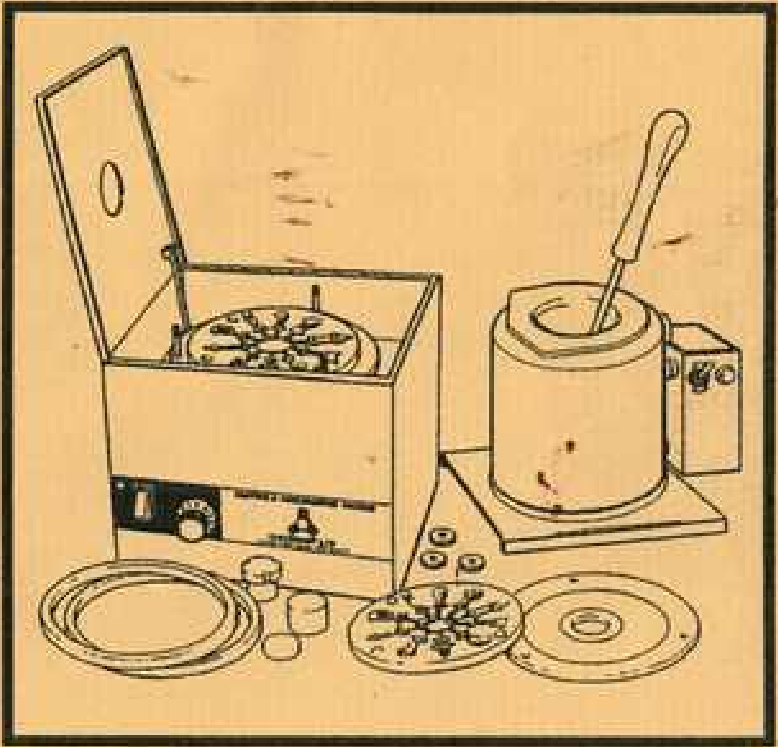
MANUAL



CENTRICAST C.300

Mouldmaking & Casting Machine

INTRODUCTION

Centrifugal Force is nothing new. What is different about the *Centricast** system is harnessing the force to make moulds as well as to cast, making a centrifugal casting system which is compact, inexpensive and extremely versatile.

With the *Centricast** Machine it is possible to make cold-cure moulds from patterns made from almost any sort of material, including some waxes. By studying this manual and making a few moulds, the user will quickly master the techniques of mould-making and casting. The whole system works quickly and easily.

As for casting, the Machine will cast not only white metals, but also other materials such as plaster, rubbers, some plastics, and waxes. This means, for example, it is possible to cast wheels and tyres for models, or wax for lost wax casting (no problems with heat or pressure), and moulds will not deteriorate in storage. The design of the machine is such that it is not out of commission while a mould is curing, because it can be removed from the Tri-arm, and another pair of plates used for casting.

This Manual goes into some detail about Silicone Rubbers because they are important to the Machine. When you are familiar with them and how they behave, you can make variations, use faster catalysts, and take short cuts; but until you are, stay with the standard catalyst. A mould is a tool, and to get good results make good moulds!

It is important that you do not let the centre boss of the Tri-Arm exceed 90°C

(**Centricast* is a trade name used by Centricast Ltd)

CHAPTER 1 - THE MACHINE

The *Centricast®* Centrifugal Mouldmaking and Casting Machine is of unique design, for which Patents were granted. The Machine complies with the EC Regulations on EMC and is CE marked.

The Electrics. The machine plugs into the standard 240 volt mains, and the current is transformed to DC within the machine to a lower voltage to suit the motor. The three core mains cable is rubber covered and fabric sheathed, and is supplied in the UK fitted with a 13 Amp plug, correctly 3 Amp fused. Machines sent outside the UK are not supplied with a plug, and can also be supplied 110 volts 60 cycles if wanted. The mains cable is clamped within the casing, and the red neon light shows that the mains power is on. The on/off switch is also a thermal overload cut out, and if circuits were to be overloaded it will simply switch off.

The Motor. The powerful DC motor is Thyristor controlled by a specially designed PCB, and the speed is infinitely variable from approximately 200 to 900 rpm. A microswitch will prevent the motor from running when the lid is raised, and a dynamic brake on the PCB will help quickly stop the motor when it is switched off (or the lid raised).

The Cabinet. The cabinet is all steel construction, primed and stove enamelled. The bottom plate, which gives access to the motor and electrics should not be removed **unless the machine is isolated from the mains.** The lid has a double lip - the raised lip to prevent any accidental spillage on the lid from running off, and the dropped lip to prevent accidental spillage escaping from the case.

The Casting and Mouldmaking System. Figure 1 shows an exploded view of the system (see also Figure 19); these parts together with a set of former plugs (see Figure 5) are all that is required for mouldmaking and casting. Familiarise yourself with the parts and names, because they will be referred to in the mouldmaking section.

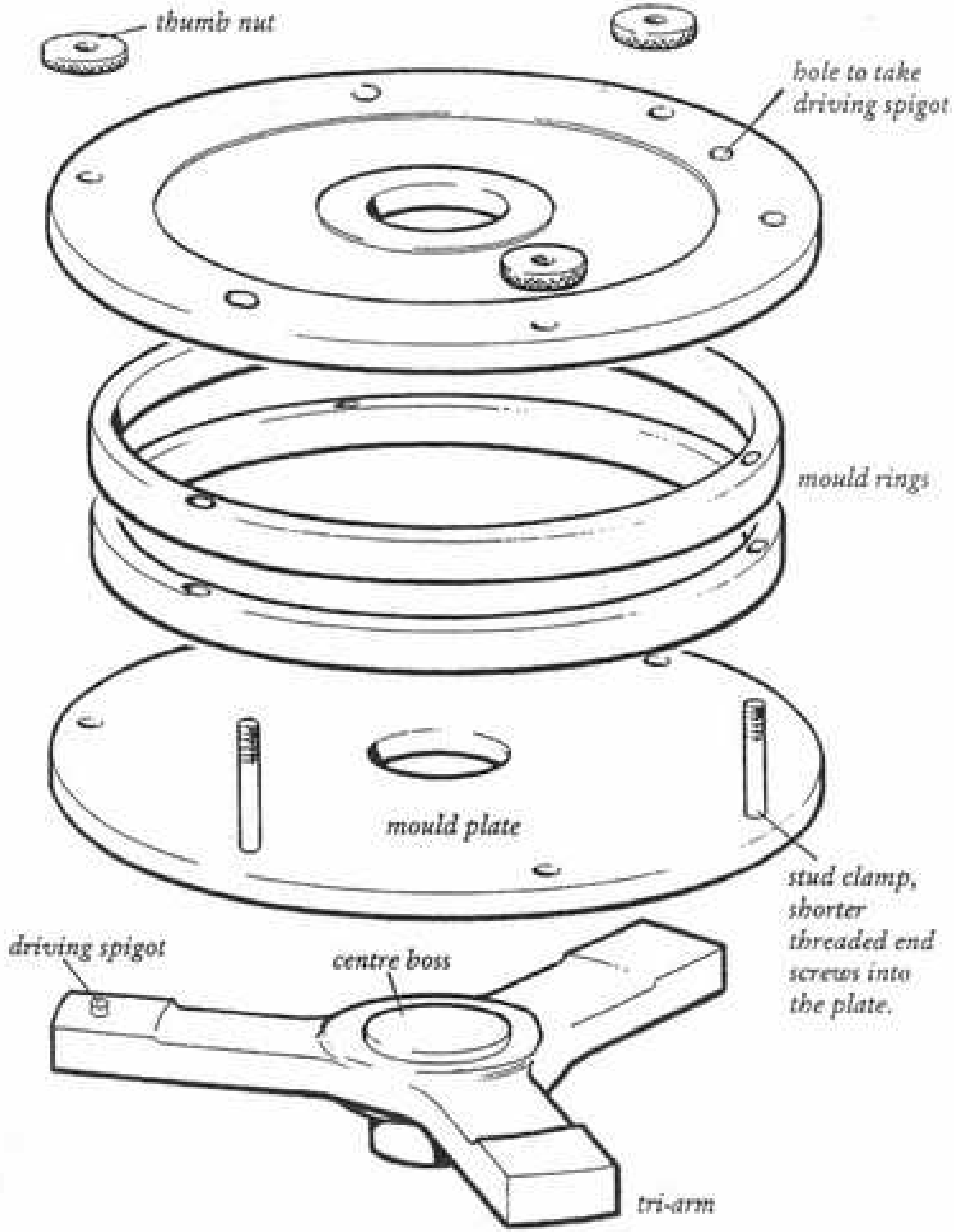


Fig.1 Exploded view of the C.300 mouldmaking and casting system. Top and bottom plates are identical.

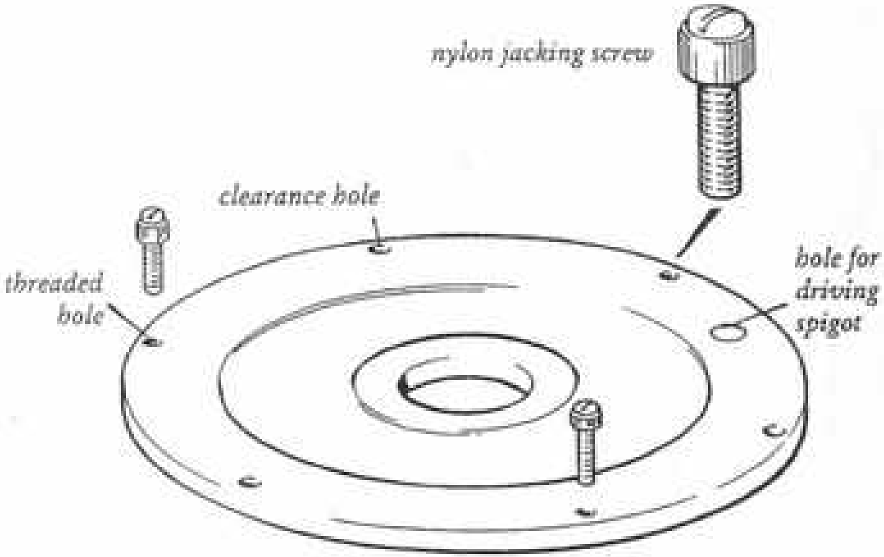


Fig.2 Showing details of the C.300 7" plate. The plate has 6 holes (3 threaded and 3 clearance); the 10" plates have 8 holes (4 threaded, 4 clearance)

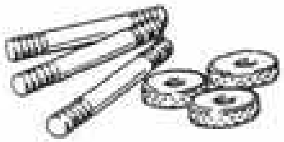


Fig.3 The C.300 Stud Clamps and Nuts. The stud clamps are in four heights to suit up to 2½" moulds. The longest stud (C.252 'D' Stud) is 3¼" long and is threaded down one end for over 7/8"; you can cut and tailor it to the length you want.

The Tri-arm is fitted to the motor shaft, and at the end of one arm there is a driving spigot (one only) for the mould plate. The two mould plates are universal - they can be top or bottom plate - but it is essential that only the flat side faces inwards.

Starting with the bottom plate (Fig.1), the whole assembly is put together in the order shown. The stud clamp (Fig.3) is threaded each end, one end having less thread than the other. The lesser threaded end is screwed home into the bottom plate. The required rings are

dropped over the studs, and the top plate put on last (using the unthreaded holes called *clearance* holes.

When the thumb nuts are tightened up, the assembly can, if you wish, be lifted off the Tri-arm. This means that while a mould is curing it can be set aside somewhere else (level), and another set of plates used for casting. The rings are normally only used for mouldmaking, and are not used when casting, although there may be instances when using one ring as support may be useful.

Also available are the *Economould* sets of frames which enable smaller moulds to be made, thus saving rubber when prototype work or only one or two items are required. These work in exactly the same way as the round rings.

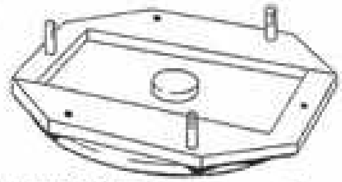


Fig.4 Economould Frame set up ready to use (first half). Each frame is in two identical parts - 4 parts to a set.

The full range of equipment available for the C.300 Centricast Machine is shown in *The Sculptors' Catalogue*. Briefly, available are:

7" Plates, 7" x 3/8" Rings, 7" x 5/8" Rings
10" Plates, 10" x 3/8" Rings, 10" x 5/8" Rings
Stud Clamps for ¾", 1¼", 2" and up to 2½" height moulds
Economoulds in 7" and 10" both in 3/8" and 5/8"
Ladle and Ingot Mould.

The C.300 Centricast Machine is now supplied with the Universal Former Plug Set which can be used for moulds from ¾" to 2½" in height. The plugs and stud clamps are changed around according to the height of the mould.

CHAPTER 2 - SILICONE RUBBER

Room Temperature Vulcanising (RTV) Silicone Rubbers are already established as one of the finest mouldmaking materials ever made. Because of their heat resistance, low order of shrinkage (normally less than 1%), and incompatibility with most organic and inorganic materials, RTV Silicone Rubbers are ideal for the fabrication of flexible moulds for casing polyester resins, some epoxy resins, acrylics, urethane, waxes, plasters, etc., and some for casting low melt metals. Rubber moulds can be made quickly and easily, giving excellent surface finish and detail, and being flexible can be used for intricate castings.

This Manual will deal with Silicone Rubber Mould Making for the Centricast* Casting and Mouldmaking Machine only. General methods of mouldmaking and handling Silicone Rubbers are dealt with in the *Silicone Rubber Booklet* published by Alec Tiranti Ltd, and which also deals with hand casting in white metals.

Whilst centrifugal casting has in the past meant casting low melt metals only, the Centricast* Machine is very versatile and will enable the user to cast in other materials, such as wax, plaster and resin. Casting in wax is particularly easy, because heat and pressure are not vital as in pressure casting wax. One important point to remember is that since heat and pressure are not required to vulcanise the silicone rubber, it is possible to make moulds from almost any kind of original - plastic, wood, Milliput, and hard wax as well as metal.

For white metal casting, RTV-31 Silicone Rubber is used, because it has a much high temperature resistance than other silicones (up to 310°C). It also has a Shore A hardness of nearly 60. If other materials are being cast, then other rubbers can be used - check with our Technical Department. A small Technical Sheet is available showing what current rubbers and catalysts are available; Safety Data Sheets are also available on rubbers and catalysts.

CHAPTER 3 - MAKING A MOULD

Universal Former Plug System

The Universal Former Plug System will cover mould depths between ¾" - 2½" total thickness. The plugs will also cope with in between sizes too, because of the sliding TP1/TP2 (see Fig.5).

SP = Spacer Plug, TP = Top Plug, BP = Bottom Plug
RP = Reservoir Plug ('A' doubles as a large Reservoir Plug).

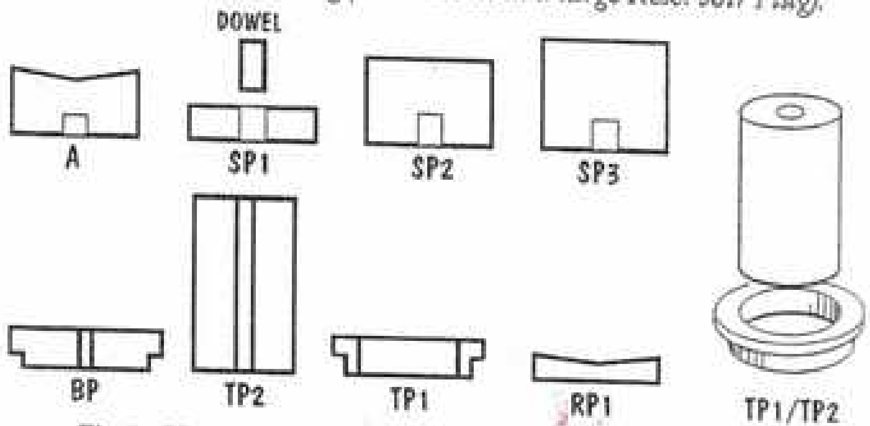


Fig.5 Universal Former Plug Set and Dowel. Note how TP1/2 slide fit to adjust for various heights.

Plug A is the first plug used in making a Centricast mould, and it forms the floor of the reservoir; it is possible to extend the height of **Plug A** by using the spacer plugs **SP1**, **SP2** or **SP3** locating them with the Dowel, as shown in Fig.6. **Plug BP** forms the locating button on the bottom of *all* moulds.

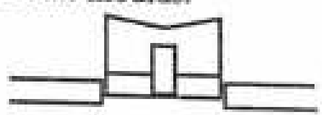


Fig.6 Plug A extended by using SP1 and the Dowel

Plugs **TP1 / TP2** are used in combination, to produce the pouring hole; it is a push fit, and can be used on any size of mould, pushing down onto the reservoir plug **RP1** for ¾" moulds, and **Plug A** for all other moulds.

The following Table is a guide to which equipment is used to make which mould - *this applies to 7" or 10" diameter sizes.*

Mould	Rings	1st Half Mould	2nd Half Mould
¾"	2 x 3/8"	Plug A	RP1 + TP1/TP2
1¼"	2 x 5/8"	Plug A + SP1	Plug A + TP1/TP2
2"	2 x 3/8" 2 x 5/8"	Plug A + SP2	Plug A + TP1/TP2
2½"	4 x 5/8"	Plug A + SP3	Plug A + TP1/TP2

The following illustrations show the plug arrangements in making the bottom half of the mould followed by the top half.

First Half Mould (bottom) *Second Half Mould (top)*
(cross-hatched area = Chavant Clay: hatched area = silicone rubber)

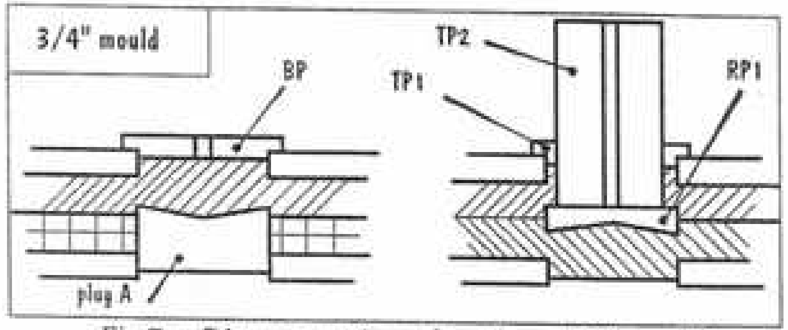


Fig.7a Diagrammatic explanation of ¾" mould

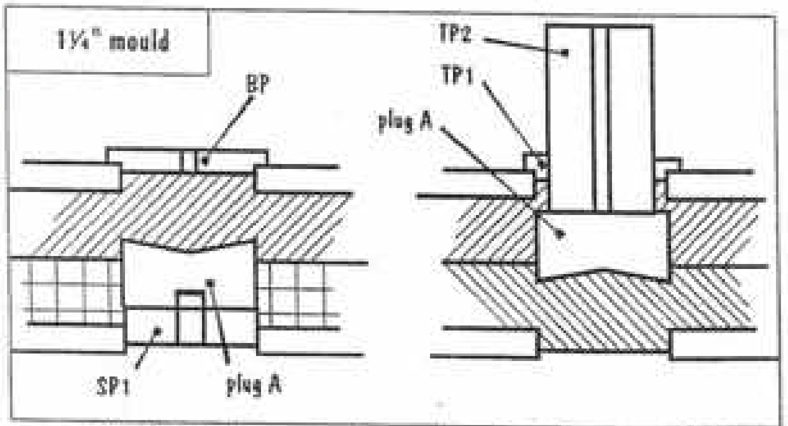


Fig.7b Diagrammatic explanation of 1¼" mould

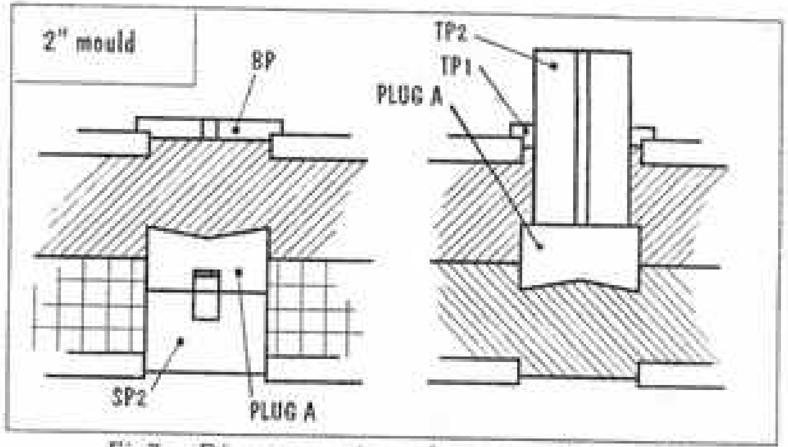


Fig7.c Diagrammatic explanation of 2" mould

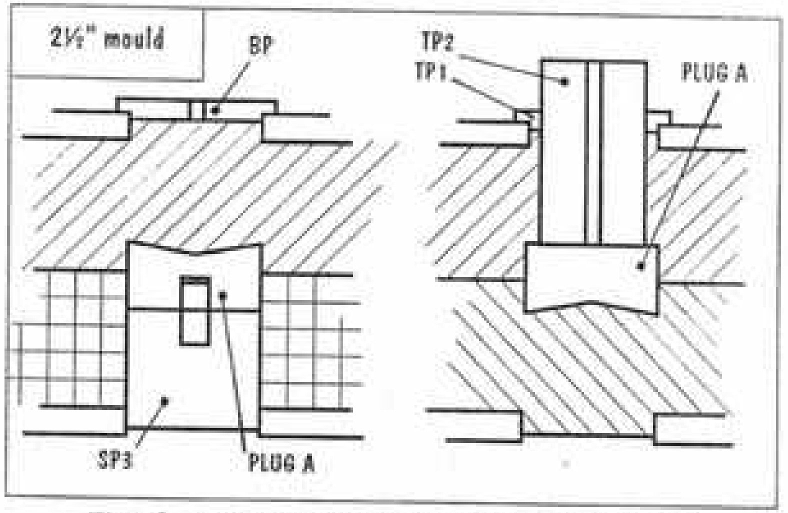


Fig.7d Diagrammatic explanation of 2½" mould

For your own special needs it is possible to mix the SP Plugs for intermediate mould sizes where you may need a greater depth for the top or bottom halves. For moulds over 2" in height, and where a special length of stud is needed, a 3¼" stud is available (C.252) which is threaded down one end for over 7/8"; this can be cut and tailored to suit the length you need. The full range of stud clamps is shown in *The Sculptors' Catalogue.*

Design Considerations for the First Half Mould (Bottom)

When placing pieces in the modelling material, it is useful to consider the direction of the centrifugal force. The machine always spins *clockwise*, so that forces within the mould will always be *anticlockwise*.

This has a bearing when deciding how to place the pieces within the mould. For example, if you place a soldier with a gun extended from the shoulder, the position of the piece will have an effect on how it will subsequently cast. In Fig.9 *B* is better angled in the mould to make it easier to scoop up the metal from the reservoir. If *A* configuration was to be used, it would be far more difficult to fill the mould with metal. Remember that when you are laying up the components in the modelling material, you are in effect working back to front. The bottom half of the mould is made in the top ring, and when the rubber has cured and the half mould turned over, figure A would be facing away from the direction of force, so making it harder to fill the extremities even with centrifugal force. Also, it is not essential that pieces come straight out from the middle - they can be laid in at a tangent; **square/rectangular** pieces are often best sprued from a corner and not in one of the sides (Fig.10). For **plastic/malleable** pieces, dig out a hollow in the modelling material and model up round the pieces. If you just push the piece into the modelling material it may distort and stay that way until removed to make the second half of the mould. The piece will then spring back to its original shape and ruin the mould. Always make sure that pieces are put back into the cavities from which they came.

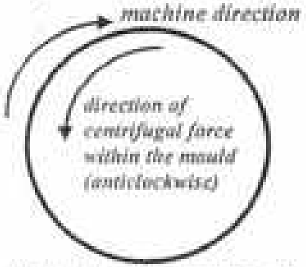


Fig.8 Allow for direction of centrifugal force when laying up in the modelling material (i.e. things are in reverse).

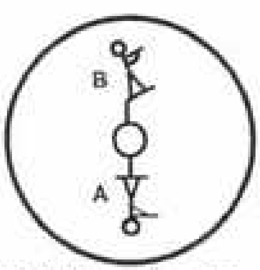


Fig.9 Bottom plate, ring and plug showing bed of modelling material. Fig.A is wrongly placed, fig.B correctly placed.

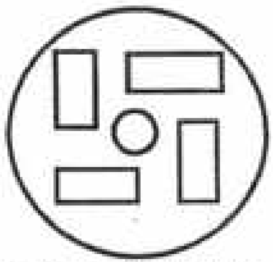


Fig.10 Items laid up in the modelling material at a tangent to the centre - this layout will be correct in the mould.

CHAPTER 4

FIRST HALF MOULD

The parts of the moulding system are shown in Figure 1, and the previous Chapter deals in detail with the former plugs. The Manual will be constantly referring to these.

Screw the short threaded end of the studs into the tapped holes in the bottom plate, locate the tri-arm driving spigot in the blind hole underneath the plate, and also locate the tri-arm boss in the centre hole. Place **Plug A** into the centre hole, conical face uppermost; wedge in place with Chavant or modelling wax (Fig.11)

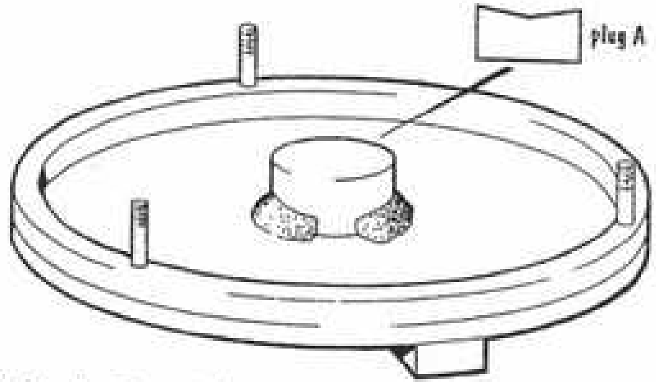


Fig. 11 Wedge the Centre Plug 'A' and the ring with some Chavant modelling material - the plate, plug and ring are then 'fixed' together and can be removed from the Tri-arm as one.

Remove the plate from the tri-arm, complete with ring and plug, and then fill the ring void with Chavant modelling material, leaving a level surface (Fig.12) and the plug proud in the middle. Now half embed the pattern to be moulded - often this can be done by simply pushing the pattern into the modelling material and running the modelling tool round to make a neat seal. Large or deep patterns may need a hollow excavated to fit them, then fill in with more modelling material to seal them in and make a neat edge. It will pay dividends at this stage to take extra care, because a better mould will result. However, life is not always that simple and a few pointers here will save you failure later on.

Fig.12 Ring is filled level with Chavant modelling material ready for embedding the pattern. Note that plug 'A' is proud in the middle.

A decision has to be made as to which is the most favourable place in the pattern to arrange the split line for the two mould halves. Sometimes, because of the shape of the pattern, it may be necessary to build up higher at a particular spot in order to make a suitable split line (Fig.13). This will in no way make it more difficult to make the second half of the mould.

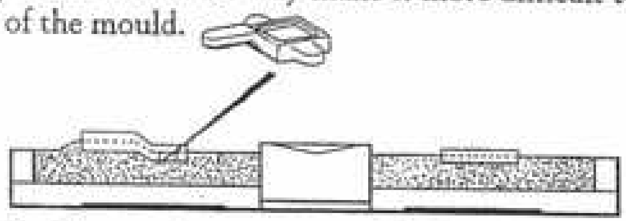


Fig.13 It is sometimes necessary to build up higher at particular spots in order to make a suitable split line.

Avoid deep undercuts, where rubber could be physically locked in (Fig.14). It may be necessary either to alter the modelling, or remove the offending part to mould separately and attach to the model afterwards, either by gluing or soldering (Fig.15).

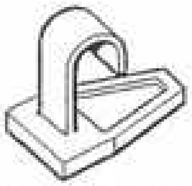


Fig.14 Showing undercut where rubber could be locked in.

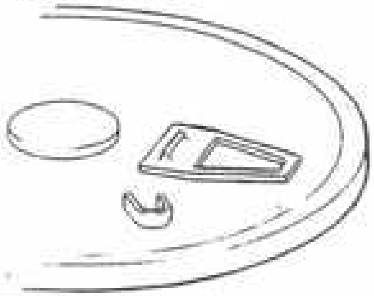


Fig.15 The component shown in Fig.14 has been cut in two for casting; it can subsequently be glued or soldered.

At this stage, if you think something may be sticking up too much, put a straight edge across the top ring and check that there is at least 1/16" clearance (Fig.16).

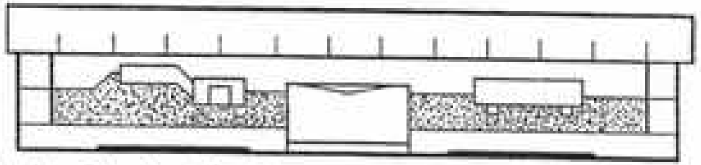


Fig.16 Check with ruler or straight edge across the top ring that there is at least 1/16" clearance.

It is important to try to balance up your components for weight distribution (Fig.17) so that the turntable will run smoothly when casting. When considering mixed patterns for a particular mould, try to select those of a similar bulk, grouping heavy patterns for one mould, the light and delicate for another, and so on. This will help when it comes to speed selection; generally it will be found that the lighter castings will require a faster speed, and the heavy castings a slower one.

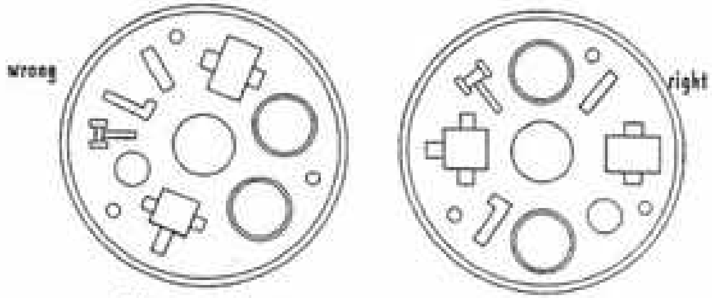


Fig.17 Balancing up components so that the turntable will run smoothly.

When arranging patterns on the modelling compound (unless there are other considerations such as shape or ease of sprueing), you should bear in mind that when casting, it is better to cast *light to heavy* - that is the lightest pattern towards the outside and the heaviest nearer the reservoir. The reason for this is that the lightest or thinnest parts of the casting will start to solidify first, and the heavy sections being still fluid are still able to draw metal via the sprue from the reservoir.

Embed location key formers (Fig.18). Normally three are sufficient, but do not place them equidistant - this will make it much easier when putting the mould together. It is a good idea to have two keys proud and one recessed.

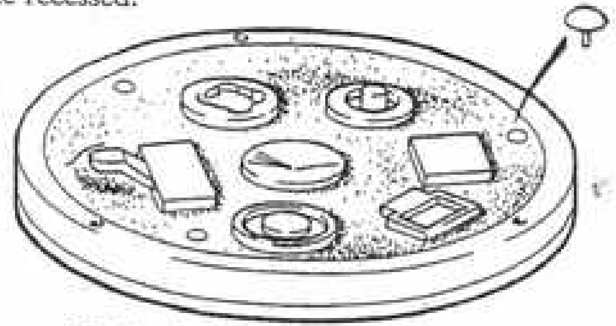


Fig.18 Put in location key formers.

A standard 6¼" mould ¾" high uses about 493g of rubber (see page 28 for other size moulds), this means around 250g per half mould. The following instructions are for the basic way of making moulds. There are refinements and you will yourself develop variations. Some of the refinements will be outlined afterwards. If you have vacuum facilities, by all means de-air the catalysed rubber (see *Silicone Rubber Booklet* for details); if you do not have vacuum facilities, it is not essential - most people do not have them anyway.

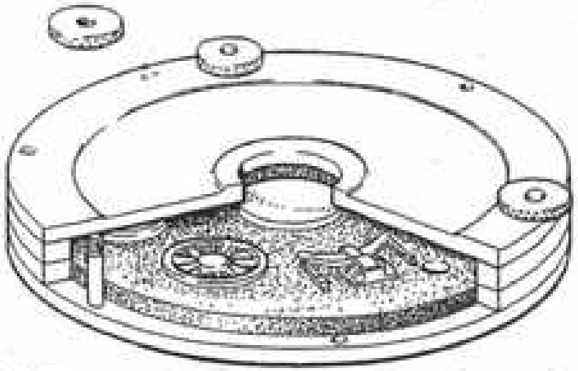


Fig. 19 Cut out view showing the assembled system ready to spin in rubber

Stand the machine in a level place, and put the plate with the patterns set up, onto the tri-arm. Add the second ring. Catalyse sufficient rubber, and paint all over the patterns carefully, using a soft brush.

Do not use a stippling action, but try to flow the rubber on with the brush. Now pour more of the catalysed rubber until the rubber is virtually level with the top of the second ring. Then close the system up by adding the top plate and screwing it down with the thumb nuts (see Fig.19). Close the lid of the machine, set the speed to fairly slow, and switch on. The rubber will spin to the outside of the mould box (which is the ring/plate combination), creating a depression in the centre to which extra rubber has to be added. This is best achieved by adding rubber with a spatula (allow the machine to take the rubber off the spatula), adding small quantities until filled. When nearly full, turn speed down to slowest, and as the rubber starts to come up the central hole, switch off and top up the depression by hand, until the rubber is half way up the hole at least.

Now is the time to push in the the second plug - *Plug BP*. Push the plug down firmly until the flange rests on the plate. You may need to hold it there for a minute or two until the excess rubber has pushed up the centre hole in the plug and relieved the pressure. Your mould should now look like fig.20 and the left half of Fig.7. The centre hole on the top plate and the former plug *BP* simply form the locating button on the bottom of the mould; this stem ensures that the button is not too deep.

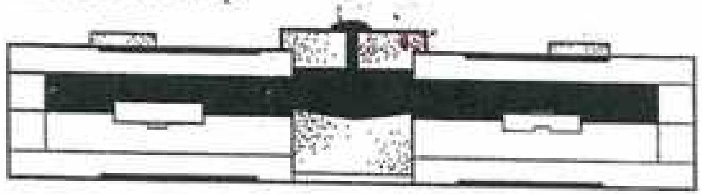


Fig.20 The first half of the mould - the bottom half (shown black) finished (see also Fig.7a)

At this stage, the mould should be left to cure. The mould plates, clamped together as they are, can be removed from the machine, leaving it free for further mould making or casting with another set of plates.

NOTE: Each half mould is always made face down, so that air can rise away from the mould face.

SECOND HALF MOULD

When the first half mould has cured, dismantle the mould plates. To do this, unscrew the thumb nuts, and screw in three (or four on the 10" plates) Nylon Jacking Screws supplied, into the now vacant threaded holes in the top mould plate, until they are just touching the mould ring (Fig.2).

When they are all in place, commence jacking by turning each screw (by hand!) one turn at a time. The mould plate will gradually come away from the moulds. Remove the top plate and mould ring, remove Jacking Screws, and unscrew the studs from the bottom plate - these can now be screwed into the top plate's threaded holes (again, by the shorter threaded end). Place the top ring over the studs; this is now set up ready to receive the half mould just produced. You will now be able to peel the first half of the mould from the modelling material.

Clear away the modelling material, and clean up the second plate and ring. Check for any rubber seepage around the edge of the patterns - this can be removed with tweezers, or heavier pieces with a scalpel. Make sure the original masters and the first half mould are absolutely clean. Re-place first half mould into bottom ring. Replace any dislodged masters into the first half of the mould. Spray the first half mould well with parting agent, and allow to dry (5-10 minutes). Put back onto the tri-arm.

Insert plug **RP1** into the central recess in the bottom half of the mould (this will form the reservoir), see Fig.21. Be very careful after spraying with release agent not to touch any part of the mould surface, particularly when applying the initial layer with the brush; confine the brush to the pattern only, if sufficient rubber is used it will creep over the pattern edges. Locate the top ring over the studs, put assembly back onto the tri-arm and pour in catalysed rubber until the rubber is virtually level with the top of the second ring. Then close the system up by adding the top plate and screwing it down with the thumb nuts (Fig.21).

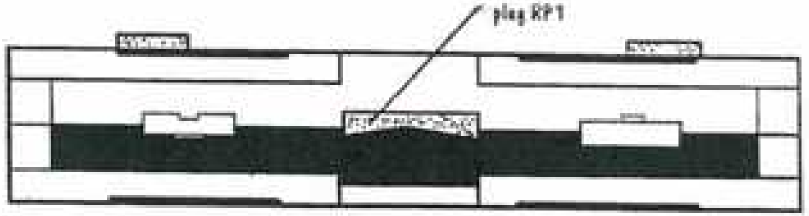


Fig.21 Everything is assembled ready to put in the rubber. Plug RP1 is put into place, the initial layer of rubber is put over the components, catalysed rubber poured up to the top of the top ring, and the mould closed up ready to put in the last few grams of rubber. (for clarity, the rubber has not been shown as partly poured).

Close the lid of the machine, set the speed to fairly slow, and switch on. The rubber will spin to the outside of the mould box (which is the ring/plate combination), creating a depression in the centre to which extra rubber has to be added. Again, add the catalysed rubber with a spatula (allowing the machine to take the rubber off the spatula), adding small quantities until filled. When nearly full, turn the speed down to slowest, and as the rubber starts to come up the central hole, switch off and top up the depression by hand, until the rubber is at least half way up the hole.

Now is the time to put in Plugs **TP1** and **TP2** which form the pouring hole in the top mould. Insert TP1 first, and then slide in TP2 until it is up against RP1. You may have to hold it there for a short while until excess rubber has come up the central hole in TP2 and relieved the pressure - see right side of Fig.7 and Fig.22.

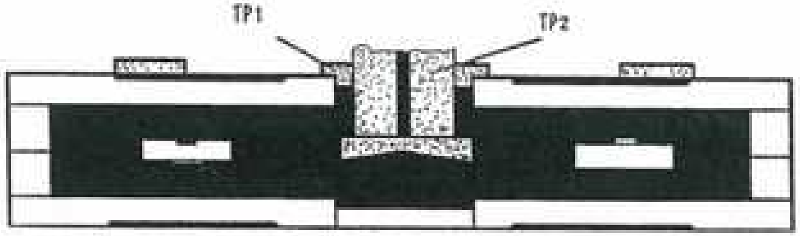


Fig.22 Plug TP1 has been inserted into the hole in the top plate, and Plug TP2 has been pushed through up tight against Plug RP1.

Until the rubber has gelled, check from time to time that Plug TP2 has not been forced up by the pressure of surplus rubber. Again, the clamped plates with the curing mould can be removed from the machine to set aside while the rubber cures, leaving the machine free to use.

When the rubber has cured, remove the top plate as before by using the jacking screws. When the rubber has finally cured (i.e. up to full Shore A hardness) leave open to the air for at least 24 hours if possible. This will allow residual alcohol (a by-product of curing) to evaporate, and so not cause talc or graphite to co-agulate!

It is preferable not to use heat to assist curing because this may cause differential shrinking.

Fast Curing. Faster curing can be achieved by using one of the Beta Catalysts - *The Sculptors' Catalogue* will show what is currently available. These can achieve de-mould cure times as fast as 1 hour, and in fact this is what most people do once they are experienced in making Centricast moulds.

Very Small Components. If you have very small components, which may move when the machine starts to spin, it is a good idea when you are applying the initial layer of rubber over them to use the fast cure method and allow it to cure before proceeding further. This will hold the components in place when the rest of the rubber is put in - remember that silicone rubber sticks to silicone rubber so additional rubber will stick to the first layer.

Numbering Moulds. If you wish to identify moulds by number, this can be done quite simply with modelling material; attach a small quantity inside the ring, and marking the number by hand (in reverse!). This will automatically reproduce on the mould edge.

Mould Storage. Store moulds carefully. Clean them up and store away from dust and dirt, and make sure that the moulds are not stored bent or folded. Moulds should store indefinitely. It is useful to keep details for each mould about metal used and speed for casting.

CHAPTER 5

CASTING WITH TIN /LEAD ALLOYS

Behaviour of White Metals. It is important to use the various alloys at their recommended working temperatures to get the best results. Not only does the metal produce optimum quality casting, but also by controlling the temperatures properly the silicone rubber mould will have a much extended life. Depending on the type of object, runs of over 1000 or more are not uncommon.

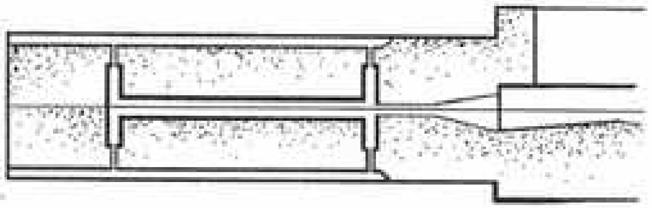
It is important to use an electric melting pot, which is electronically controlled (not with a simple thermostat); this way the temperature can be closely controlled within about ± 1° C. A heavy cast iron crucible helps to keep an even temperature. This type of pot, once up to temperature will hold the metal at the pre-set temperature.

C.178 Centricast cast iron ladle (about 400g capacity)

Fig.23 Electronically controlled white metal melting pot; heating elements, controller and cast iron crucible are an integral unit. The pot needs to be kept about half full for best results. Shown with C.178 cast iron Centricast ladle

Alloys vary in their *freezing* range. They have a *Solidus* temperature and a *Liquidus* temperature; that means that they stars to melt at Solidus and are melted at Liquidus. The suggested operating temperature will be some degrees above Liquidus, because when between Liquidus and Solidus the metal starts to become increasingly sludgy. The *freezing* point then is the temperature at which the metal solidifies (Solidus), but you have to take into account that the pouring temperature to the melting point is not many degrees different. For example, a metal with a Solidus temperature of 216°C , Liquidus of 247°C and a suggested operating temperature of 275°-295°C only has around 65°C to drop in temperature before it is Solidus. The freezing range should be taken into consideration when making sprues and runners. If an ingate is too small in size (or maybe insufficient in number), then metal could solidify in the mould before bulk filling, resulting in voids, or even solidify in the sprues before reaching the mould itself.

Venting. Do not be afraid to experiment with runners, and bear in mind that it is possible to make small air vents (back to pouring hole) in the mould using a small drill (up to 1mm maximum). See Fig. 24. This should be done after testing the casting at working temperature, to see that it fills completely. However, venting is rarely needed.



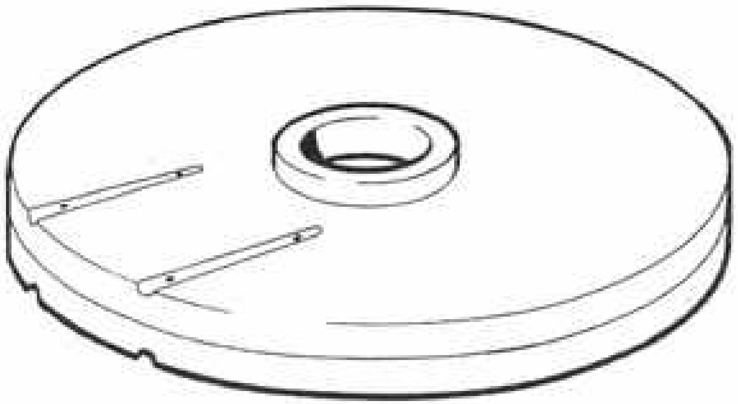
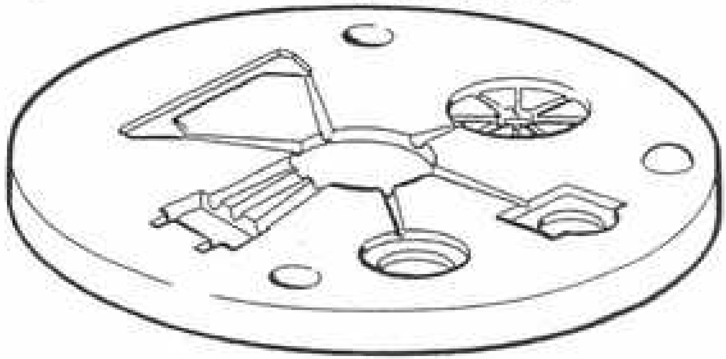


Fig.24 Showing small air vents drilled through to channels above and below

Pouring. When the metal is at its correct temperature, pour the right amount of metal to fill the mould and just leave a ring in the reservoir - pour steadily **at one go without a break,** this is most important. Once you can see a ring start to form in the reservoir, then stop pouring, because the mould cavities and sprues are full; keep the machine running until the metal has set (generally it turns from shiny to dull) otherwise the metal could run back into the reservoir. If you keep on pouring and fill the reservoir you risk spinning loose metal into the machine; there is no danger to anybody because the metal cannot get out and will not damage the machine itself, but it does make a mess inside which has to be cleaned up!

Sprueing. When the mould is fully cured, start cutting the sprues in the bottom half of the mould. Sprues are channels cut into the mould to allow molten metal (or whatever the casting material) to run between the reservoir and the patterns (see figs. 25 & 26). Look for a place where the casting has a heavy section (this should if possible be the part nearest the reservoir). Using the sprue cutter, start cutting the bottom half of the mould from the pattern towards the reservoir; when nearing the reservoir, start to lift the handle to make a deeper cut as it enters the actual reservoir, thus forming a funnel shape to ease the metal's entry (see figure 25).



25. Showing sprues cut from the reservoir to the mould.

Remember a thin sprue will quickly cool the metal; this is why it is important that the sprue to within 1/8" of the pattern should be funnel shaped, and the rest a smaller cut into the pattern (cut this

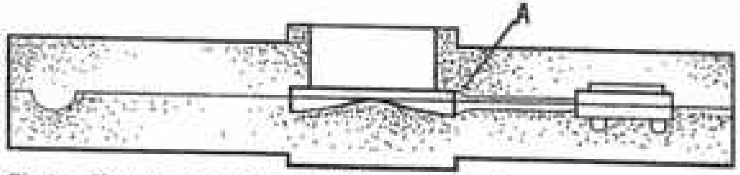


Fig.26 Showing at position A the funnel shape between sprue and reservoir, cut by lifting the handle of the sprue cutter as it enters the reservoir.

from the pattern to the sprue - you will have more control over the cutting). You can always increase the sizes and if necessary add more sprues after test casting, but it is good practice to start with the least number of sprues to each pattern - this will entail less work cleaning up castings.

Having cut all the sprues in the bottom half, wipe talc across them, place the top half in position and press the two halves together - this will leave a guide for you to cut the top sprue. (Alternatively, you can talc the moulds and try a cast - again you will see where the bottom sprue is.) Again, cut a sprue to match the bottom one, but stop short of the mould itself, do not at this stage follow up with a small cut into the mould itself - it may not be necessary.

Talc both moulds and test cast; make several to warm the mould to optimum temperature before cutting extra sprues, making a note of any areas that have not filled. These can be dealt with by cutting heavier sprues, adding further smaller sprues, or modifying the small entry sprue. Remember, venting is another option (see Fig.24).

Having completed the sprue cutting, dust both halves of the mould with talc and assemble on the machine. Set the machine to the estimated speed and switch on. Speeds will vary according to size of pattern and size of plate. For example, a light pattern will require a faster speed than a heavy one; a 10" plate will probably need to be run slower than, say, a 7" plate because of the difference in peripheral speed.

With the metal at the correct temperature pour into the mould reservoir until you see it start to fill; allow the machine to run for a short while until the metal has solidified (generally indicated by the

metal turning dull). Switch off but leave the mould on the machine for about 30 to 40 seconds - this allows the mould to heat up to casting temperature. Open the mould and take out the casting. If further channels need to be cut on the upper mould to match the lower sprue, you will see light marks in the talc where the metal has run in the bottom sprue channel, and this can be used as a guide. If additional sprues have been cut, dust the moulds with talc as before, and return to the machine to make another cast. When this is done, inspect the casting to see if all the patterns have filled correctly.

Some awkward or irregular shaped patterns may need additional sprues, others might benefit from a larger main sprue. With a little practice, you will soon gain experience. If, after the full sprue has been cut, and the mould heated to casting temperature (done by leaving metal in the mould for a minute or two) and casts made at various speeds a mould persists in not filling (usually in deep pockets or sides), try drilling small breather holes (Fig.24). The holes should not be larger than 1mm. It should be noted that rings are only used for mould making and should not be put on the plate with the completed mould when casting; under exceptional circumstances, all but one ring may be used when casting to support the mould when very heavy castings are being made, but this will be rare.

Coring. To produce patterns with holes, or hollow patterns, it is possible to use removable cores.

Fig. 27 Patterns with spigots (compare Fig.29)

If you are making your own patterns, make a spigot the same diameter as the hole required in the final casting, at either end of the pattern (Fig.27). The normal procedure of mould making can now take place. A core is then made the same diameter and length as the spigot from Nylon 66. This core is inserted in the mould (Fig. 28) and normal casting carried out. When the casts are removed from the mould, the core is withdrawn leaving a hollow casting (Fig.29). (If you leave the nylon core out when casting, you will end up with metal spigots!)

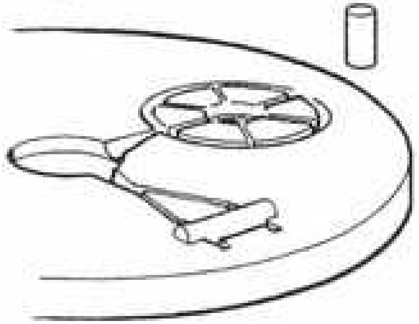


Fig.28 Showing core and mould. The core is simply inserted into its cavity before casting, and withdrawn when the metal has set.

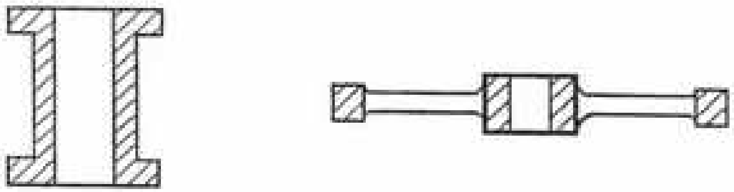


Fig.29 Castings made by using a removable core.

Where a holed or hollow pattern is in existence, as in Fig.29, make a core to fit right through (fig.30) with about 6mm of core showing at each end. The cored item is then half embedded, and the mould is made in the usual way.

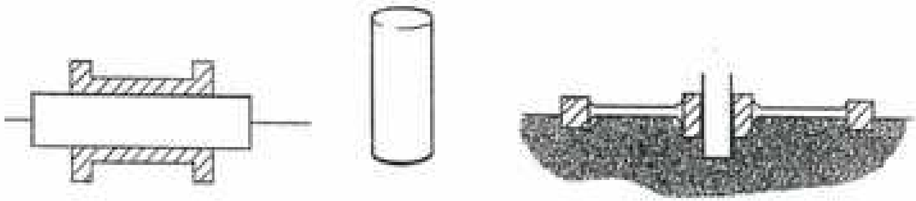


Fig.30 Hollow pattern cored, and cored pattern half embedded ready to make mould.

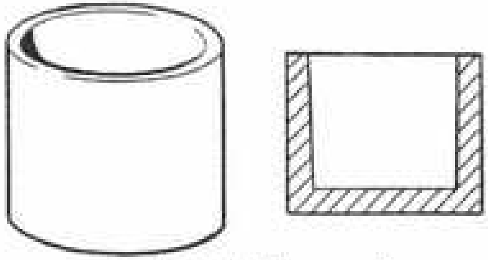


Fig.31 A hollow vessel

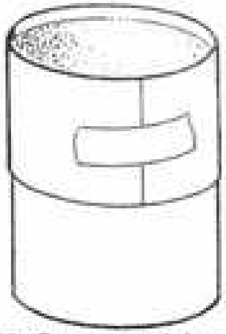


Fig.32 Fence around the vessel

With hollow items (e.g. small vessels - see Fig.31) a special core has to be produced (in effect making a three piece mould). Make a wall round in brass fencing (Fig.32) and pour in silicone rubber. When cured, remove the wall, and with a sprue cutter cut a channel all round (Fig.33), and also notch to orientate the core (or plug) in the mould. Make the mould in the usual way (Fig.34) making sure the notch is uppermost in the first half. Figure 35 shows the core in place in the completed mould ready for casting.

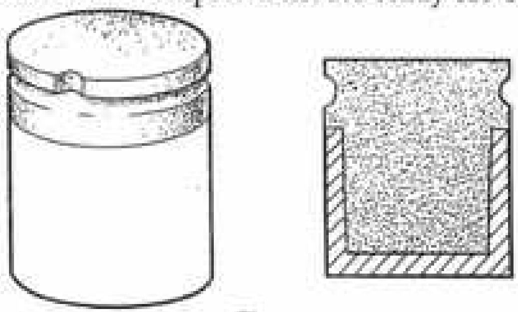


Fig.33 Fence removed, channel cut round, and notch cut.

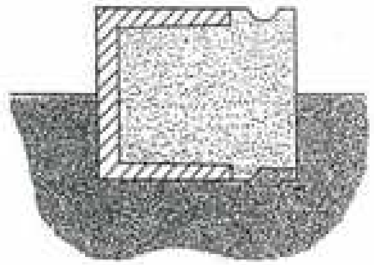


Fig.34 Vessel and plug half embedded ready for mouldmaking.

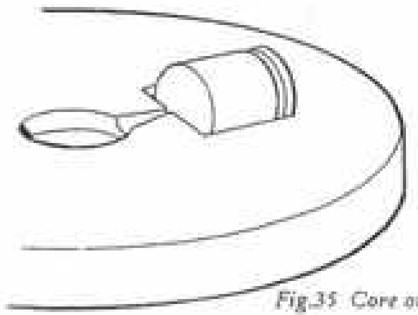


Fig.35 Core or plug in mould ready for casting.

General Notes on Casting White Metals. To get the best results from the Centricast Machine, there are a few basic rules to follow, which apply to most grades of *white metal:*

1. *Dust the mould with fine (commercial) talc or graphite before each spin, in order help the metal run and keep down porosity.*
2. *Cast the metal as near as possible to the suggested operating temperature. Increase temperature only where more flow is required.*
3. *Pour the metal in one fluent action; if the metal is dribbled in or not continuously poured, the mould will not fill completely. It is essential that the mould is dry.*
4. *Allow sufficient time for the metal to set completely before separating the mould halves; the metal may have cooled on the outside but still be soft internally. Do not attempt to water cool hot metal.*

Casting Alloys. There are many casting alloys available, and each will suit a different type of job. Unfortunately, there is not one single alloy to cover all types or bulk of castings. The *Sculptors' Catalogue* will show the metals available and what they are used for. Basically, there are lead free alloys, such as Lead Free Pewter, alloys with high tin or high lead content, alloys to suit flat surfaces and alloys to cast bulky items. Generally higher tin gives better flow. These are the sort of considerations you will need to make.

When estimating the position of the speed control, remember that heavy castings need a slower speed that light castings; as you raise the speed, you are in effect applying more pressure or centrifugal force to act on the molten metal. A larger mass or weight of metal requires less speed to obtain the desired pressure. If you run the machine too fast then force or pressure acting on the metal will overcome the pressure applied to the clamped plates and *flashing* will result: flashing is seepage of metal where the two halves of the mould come together. A balance between the rotational speed and the amount the thumb nuts are screwed down to clamp the mould plates is essential

if they are screwed down too much the mould may deform, too little and it will leak; too much speed will make the mould leak, too low speed will result in poor definition. As you see, you always have a positive symptom to help you determine the correct speed. With your first mould try experimenting with different speeds and make a note of the results - you will soon gain experience.

On the question of clamping, it is best to spin on the nuts loosely first of all, and then to go round tightening them a little at a time until they are all firmly tight.

Cleaning used metal. Do not put used metal back into the metal pot while you are casting, because it generally has talc and muck on it which will give you imperfect castings. Old sprues, spillage in the machine, incomplete castings, etc. can all be melted down and re-used, but the metal needs to be cleaned first. After casting is finished, melt down all the old metal you have (do not mix metals, but clean each type on its own) until the pot is full. Give the metal a good stir and skim off the muck on the surface with a flat scoop which is perforated (this will retain the muck and let the metal drain back). Keep skimming until you have a clean surface.

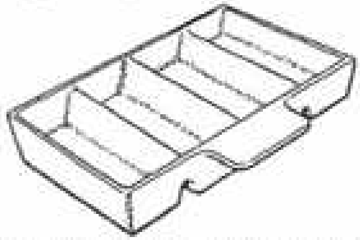


Fig.36 Cast iron ingot mould - each ingot will weigh about 250g

When the metal is clean, cast it into ingots (see Fig. 36) in the iron ingot mould, and when the metal has cooled sufficiently, turn out the ingots; when they are cold, mark them with a sharp tool as to what the metal is - this way you will not have to rely on your memory - they all look very much the same when cold! When the pot is about two thirds empty, melt down more used metal and carry on until all your metal is clean.

Estimating Rubber for Moulds Theoretical amounts of *RTV-31* silicone rubber for the basic sizes (showing weight also allowing for the centre hole and reservoir):

Mould Size		*Rubber*	*(-10% for Hole*
6¼" x ¾"	(15.88 x 1.91 cm)	548g	(493g)
6¼" x 1¼"	(15.88 x 3.18 cm)	913g	(821g)
6¼" x 2"	(15.88 x 5.08 cm)	1458g	(1312g)
9¼" x ¾"	(23.50 x 1.91 cm)	1201g	(1080g)
9¼" x 1¼"	(23.50 x 3.18 cm)	1999g	(1799g)
9¼" x 2"	(23.50 x 5.08 cm)	3193g	(2874g)

The table can be used as a *guide* to estimate the amount of rubber you will need to make up; bear in mind that the amounts above are for a whole mould and should be halved!

For the brave who want to work out their own quantities using the Specific Gravity of the rubber, the formula for a cylinder is $\pi \times r^2 \times h$ (which is 3.14 x radius x radius x mould height). This multiplied by the Specific Gravity of the rubber will give you the weight in grams, but remember that all figures must be in metric. The centre hole is about 10% of the total, and this deducted gives the second figure in the above table.

HEALTH AND SAFETY

Moisture. At all times make sure you are wearing suitable eye protection and that no bystanders are within *spitting* distance. When you throw metal back into the pot, be careful that it does not plop and throw up some spots of hot metal. Never allow water or anything damp to go anywhere near hot metal, and never water cool hot metal or use wet moulds. Extreme care should be exercised to ensure that ingots or metal added to the pot of molten metal are perfectly dry. A serious explosion can result if damp ingots are added to molten metal. Similarly, all tools immersed into molten metal should be perfectly dry.

Metals. Possible toxic or injurious compounds: low melt metals for jewellery, model making and casting. These alloys vary in their metal content, but most contain tin, antimony and lead; they may also have small amounts of bismuth, copper and zinc. Read the Safety Data Sheet supplied with the metals.

Personal Hygiene. Do not smoke, eat or drink in the melting or casting area. Wash thoroughly before meals. In the molten state all the alloys can cause burns if splashed onto the skin and particular attention is drawn to the Protection of Eyes Regulations, where reference is made to the use of eye protectors when handling molten metals. We recommend goggles WV.1012 SM or WV.1012 SXM for this purpose. Take care to protect bystanders. Dust from dusting the moulds with talc is also a hazard and care should be taken not to inhale dust; use either a suitable mask or suitable air extraction.

8/05.