Foundry Moulding Machines and Pattern Equipment

A TREATISE
SHOWING THE PROGRESS
MADE BY THE FOUNDRIES USING
MACHINE MOULDING
METHODS

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SECOND EDITION
ILLUSTRATED

INTRODUCTION

During the past years marvelous advances have been made in the amount of production obtained from the daily efforts of man. This is true not only in the industrial establishments, but it is true in practically all walks of life, and especially does this fact stand forth in our home life, transportation, trucking, farming, merchandising and in the industrial arts; it is evident in the steel mills, machine shops, pattern shops and in some few foundries, especially those foundries engaged in the manufacture of automobile castings. The increased production that is obtainable in these and in many other lines of daily activities, has been brought about by the utilization and application of scientific knowledge, engineering principles and mechanical appliances.

This is a mechanical age. The hard, drudging, physical effort is being taken out of labor. Labor is now, in nearly all instances, being performed by the pulling of a lever, or the pressing of a button. The farmer's life is easy, plowing is performed by power, the wheelbarrow has become a truck, the Japanese jinrikisha an automobile, the hammer and chisel are replaced by lathe and planer; but to the foundry in general these contrasts will not apply, as the moulding in some plants is still being performed in the same manner as it has been for centuries past. The mould is still made in the old-style wood flask, hand rammed by the same old laborious method, and very little accomplished at the day's close. Instead of being fresh and vigorous, the man is exhausted, the production small, and in many cases the castings defective.

A new day is upon us. It is here; we cannot change it; regardless of our individual attitude, it is here to stay; we cannot even delay its workings; we must launch out into the current of modern activities, or the current will strand us upon the reef. Our individual effort will be judged by the amount of work produced. There will be no place for the man who is willing to work through a long, hard day of drudgery in order to perform his daily work, but instead, he who can produce as his day's work, maximum production with a minimum of effort, will be the one who stands the highest.

The manufacturers today are not desirous of obtaining a maximum production by means of exacting hard hours of labor, but instead, in the great majority of industries, the maximum production is obtained by mechanical means, with minimum labor. The foundry has been one of the last industries to adopt mechanical means of saving hard, drudging labor, and the very fact of its being late in starting is perhaps the reason for the rapid development that has been made.

Further progress will have been made when more attention has been given by engineers to detail casting design in order to meet the foundry's requirements as to moulding methods, and by the manufacturer when ordering or having made patterns that are to be used by the foundry.

It is with a view to stimulating cooperation between foundrymen, manufacturers and engineers that this book is written. Their working together will be the means of producing the world's ever increasing casting supply in an easier and better way. The author, believing that pictures are of great value in the presentation of ideas, has endeavored, by a very liberal use of engravings, to illustrate the method of mounting patterns and the making of moulds by machine power. An endeavor has been made in this book to explain the different types of moulding machines together with the pattern and flask equipment necessary for their use, in such a way that the reader will obtain a group of fundamental conceptions in regard to machine moulding that will be of value to him in any line of engineering work in the foundry, and that the practical foundryman will have light shed on that most important question, "Will it be profitable to run this job on a moulding machine, and if so, on what type of machine?"

Chapter I contains much that is elementary in nature and will be of benefit to those who are not familiar with foundry terms. The practical foundryman may feel inclined to skip the elementary matter, but he should take care not to skip the statements of fundamental importance in regard to machine moulding.

With advances coming so rapidly, the best practice of today becomes antiquated tomorrow and it is with a full realization of this fact that some of these methods of producing castings are here shown. They may be obsolete before the book reaches the reader. However, a study of the methods given in this book will afford to the reader an insight into the process of making moulds by machine power, and if viewed in this light, the truths set forth are quite universal.

EDWIN S. CARMAN.

Cleveland, Ohio, November, 1920.

Preface to the Second Edition

The first edition was, as far as the writer is informed, the first attempt of an author to publish a work covering the subject of machine moulding. It was felt, however, that the first edition did not sufficiently cover all of the many details and ramifications of the art of machine moulding, and therefore, in the second edition such details are covered more completely.

Investigation has shown that many of our colleges, institutes and technical and trade schools desire to give to the student a training in up-to-date foundry methods but are unable to do so because of a lack of sufficient data on hand with which properly to prepare a thorough course of study, and it is with a view to supplying these needs that Chapter I has been added. This chapter treats the fundamentals of machine moulding, being both elementary and advanced theory and practice.

The book will also be appreciated by those in the industry who are desirous of changing their methods from hand to machine moulding; also by the manufacturer who is desirous of having his organization furnished with a complete treatise which shows in detail the methods of pattern mounting and machine moulding.

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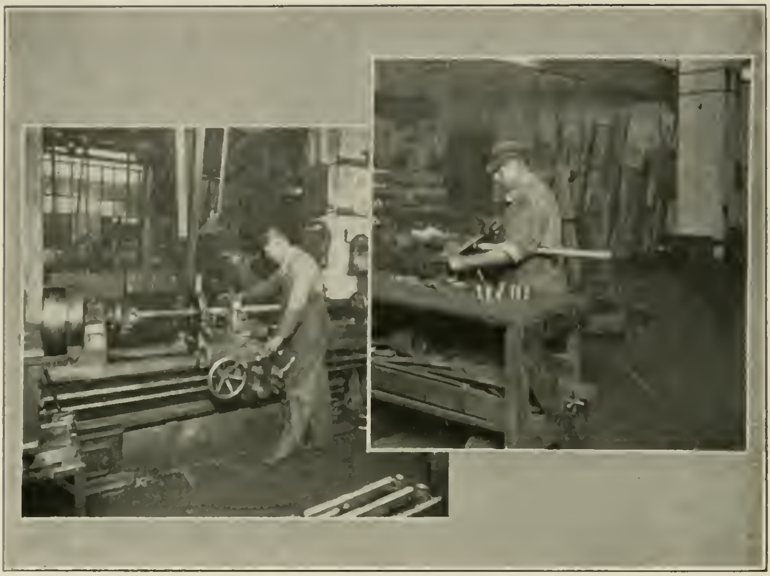


A Study in Contrasts

The man guides the tool. Here the man furnishes the power to push the tool.

Machine Power vs. Human Muscular Power

The mechanic of today has an easier and better job than the laborer of yesteryear.

Hard Work! Tiring and Slow!

The machine does it quickly and accurately.

The Old Method—Five minutes to draw the pattern and one hour to repair the damage done.

The New Method—Five seconds after the lever is thrown over—ready to set cores.

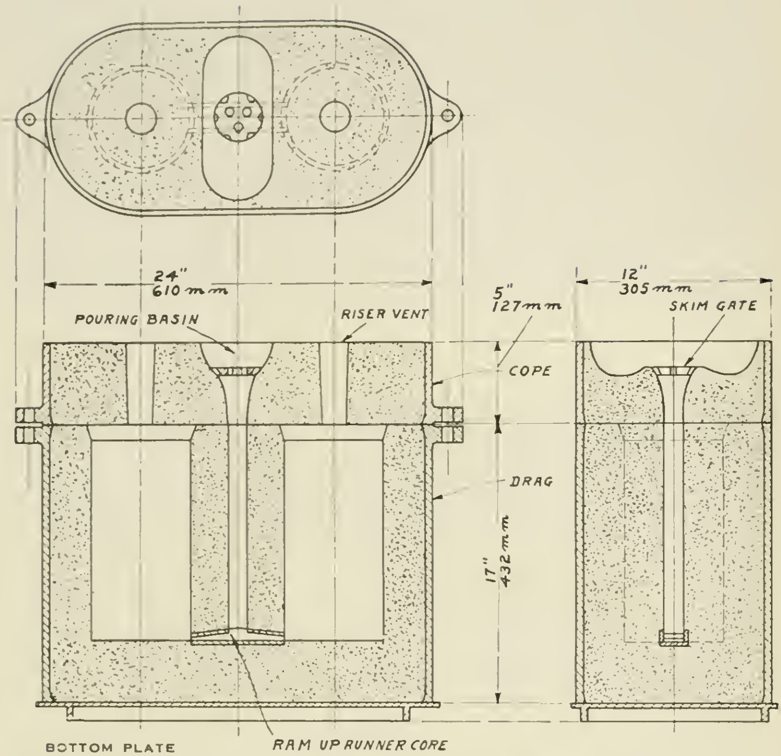


Fig. 1. Plan and Sections of a Well Designed Mould, Explaining the Terms Used in the Following Chapters.

CHAPTER I

General Moulding Principles

The foundry industry is rapidly changing from a basis of performing labor by hand power to a basis of performing labor by machine power. This is evident in all phases of foundry work. Arriving material is unloaded mechanically, the sand is prepared and carried to the moulding stations by a mechanical process moulds are produced by the use of air or other power, the casting is handled mechanically from place to place in the cleaning room where the work is done by sand blasts, pneumatic chippers and power operated abrasive wheels. To cover all the labor-saving devices mentioned would require a much larger volume than the present one, which is restricted to moulding machines and their equipment. The use of moulding machines with the resulting high production demands the use of other labor-saving facilities in order that the other departments of the foundry may keep pace with the moulding machines.

The pattern equipment, flasks, etc., are important items that have seldom been given the proper amount of consideration. Experience has thoroughly demonstrated that in order to secure the best results, proper attention must be given to equipping the machine with patterns, flasks and bottom boards. In equipping the machine with patterns, exceptional care should be exercised to secure the pattern firmly to the pattern-plate, and patterns having a large flat surface should be thoroughly and strongly supported from the bottom in order to remove the possibility of a springing action taking place in the pattern when the mould is being rammed. If the pattern is not properly supported, and a springing action takes place, the mould produced will be full of cracks, and if it is the cope half of the mould, it will drop out when the flask is being handled.

The flasks also should be examined to see that they are rigid and of sufficient strength to prevent a springing action.

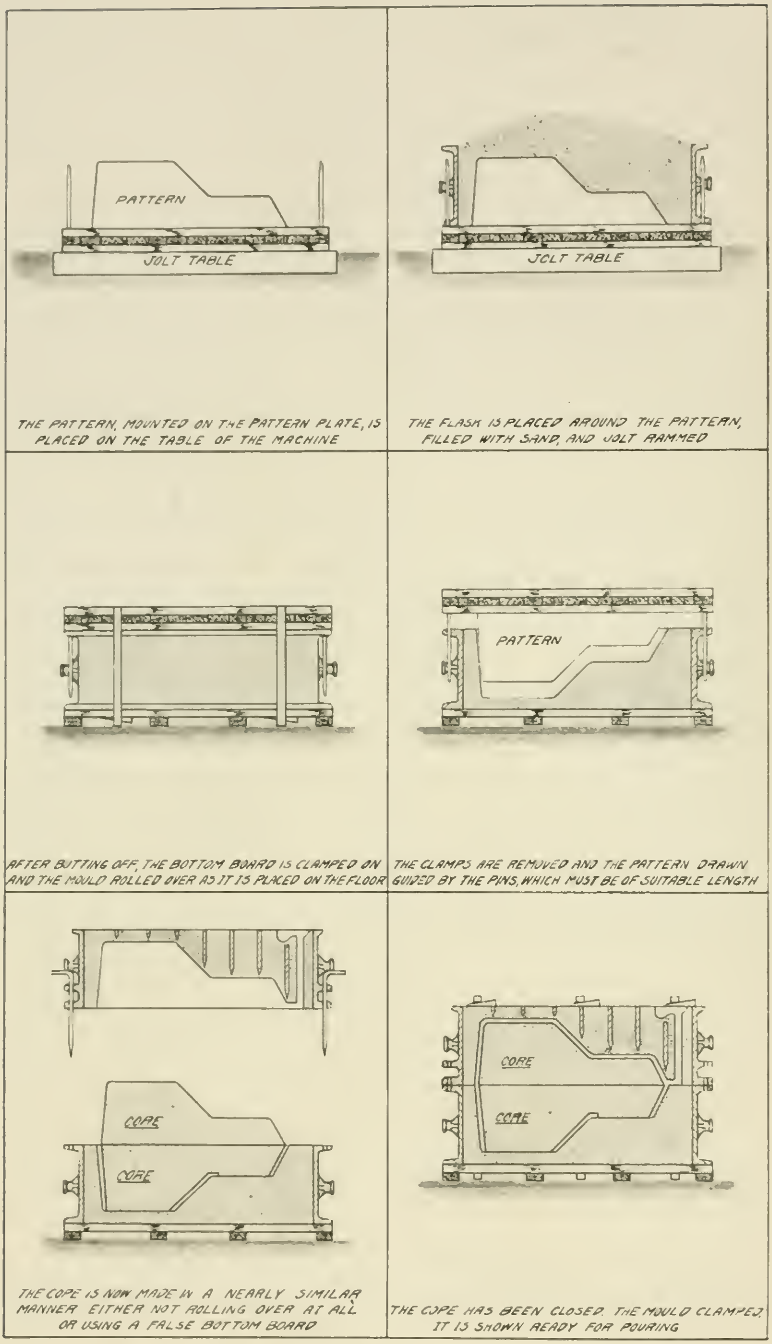


Fig. 2. Method of Making a Mould on the Plain Jolt Machine.

The best results have been produced by the use of flasks that are cast in one piece. This is especially important when designing the cope half of the flask, and yet in some instances it is difficult to cast integral the flask and the proper bars for supporting the sand. If it is found necessary to make use of a separate bar, it should be secured to the flask by means of rivets, or tightly fitted bolts, as a loose bar may prevent the making of a satisfactorily rammed mould.

The above description of the equipment necessary in jolt ramming applies to all machines which make use of the jolt-ramming principle. The rapid change in the foundry industry, from a basis of performing labor by hand power to a basis of performing labor by machine power, has given rise to some popular misconceptions. One of these misconceptions is that a moulding machine is a mysterious piece of mechanism which in some manner turns out finished moulds at one end of it. The exact reverse of this belief is the case, however. A moulding machine performs some of the operations that are performed by hand moulding, merely taking the hardest part of the labor out of the job and eliminating practically all of the guess work and chance which go with hand labor. The pages immediately following are taken up in illustrating graphically the operations of the various types of machines that are used for producing moulds.

Plain Jolt Machine

On page 2 is illustrated the method of producing a mould on the Plain Jolt Machine. The six views show the successive steps in the production of the mould, steps which will be readily recognized by one who has made moulds on any type of machine, or on the floor. The operations and the sequence of operations are exactly the same as those employed by a moulder in making a mould on the floor, with the single exception that the machine jolt rams the sand in the flask, an operation which the moulder would have done by hand. The machine merely does a part of the hard work for the moulder.

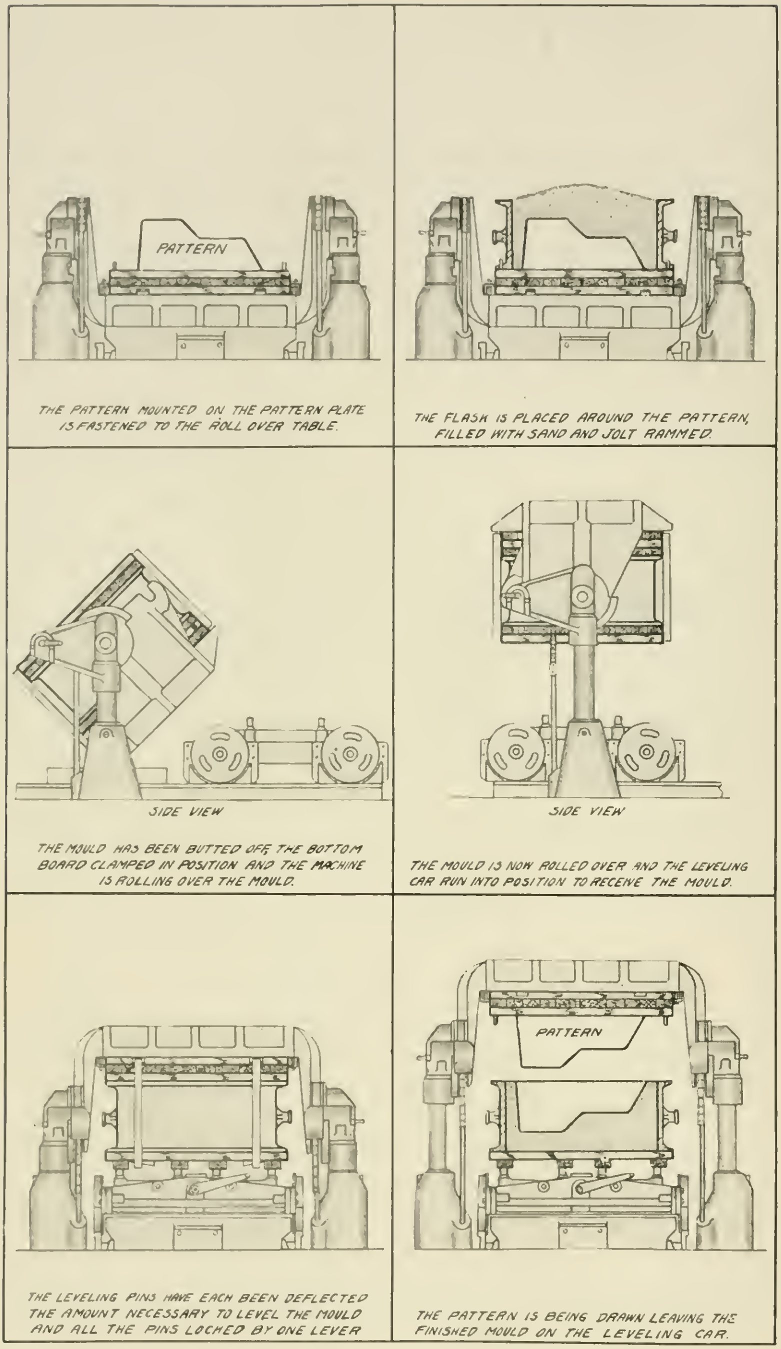


Fig. 3. Method of Making a Mould on the Roll Over Jolt Machine.

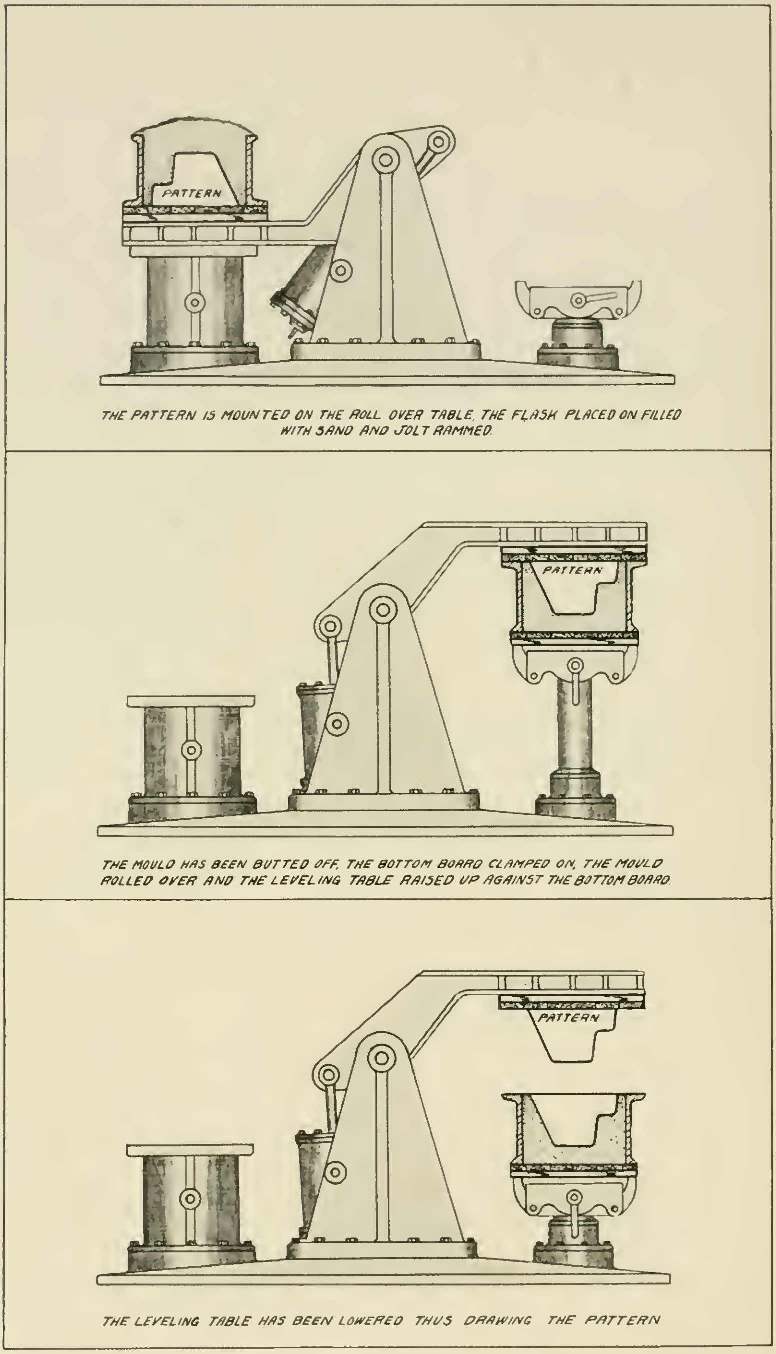
Roll Over Machines

The next set of illustrations on page 4 shows the Roll Over Jolt type of machine producing a mould. The essential operations of making the mould remain unchanged and, as on the Plain Jolt Machine, the machine jolt rams the sand and then, after clamping the mould, instead of the moulder rolling it over by his own muscular effort or by the aid of the crane, he rolls it over by means of air power applied to the Roll Over Machine, and after unclamping it, he draws the pattern by air power on the machine rather than by muscular effort and skill or by the slow and awkward method of using the crane. It is easy to see that such a machine performs the hardest part of the moulder's work, and substitutes for muscular effort the opening and closing of levers and valves. Page 6 illustrates another general type of machine which accomplishes the same results as the machine illustrated on page 4. The mould is jolt rammed, rolled over by an air cylinder, and the pattern drawn by air power as in the previous case. The type of mechanism employed is essentially different, but the operations performed are identical.

Jolt Stripper Machine

Pages 8 and 10 illustrate respectively the operation of the stripper and of the jolt stripper types of machines employed chiefly in making copes. Page 8 illustrates the Jolt Stripper machine which jolt rams the mould and then strips it upward from the pattern, while page 10 illustrates the Jolt Squeeze Stripper machine which jolt rams the mould, squeezes it and then strips it upward from the pattern. The essential difference in the two machines is that the squeezing operation added to the others, eliminates hand butting which is necessary when a mould is only jolt rammed. This is done to avoid the additional labor and to promote uniformity. Chapter X treats this subject in more detail.

The illustrations previously referred to will easily demonstrate to one not familiar with moulding machines, that the method of producing moulds by machine power is not a radical



THE PATTERN IS MOUNTED ON THE ROLL OVER TABLE, THE FLASK PLACED ON FILLED WITH SAND AND JOLT RAMMED.

THE MOULD HAS BEEN BUTTED OFF, THE BOTTOM BOARD CLAMPED ON, THE MOULD ROLLED OVER AND THE LEVELING TABLE RAISED UP AGAINST THE BOTTOM BOARD.

THE LEVELING TABLE HAS BEEN LOWERED THUS DRAWING THE PATTERN

Fig. 4. Method of Making a Mould on the Roll Over Jolt Machine.

departure from the old and established methods of producing moulds, but that machine moulding is merely the substitution of air or other power, in place of human muscles, thus doing away with some of the most disagreeable tasks of foundry work and making the foundry a more pleasant, wholesome and profitable field in which to work.

Squeezer Machines

The moulds referred to thus far are all larger than the class of work known as squeezer work, which on account of its small size can be easily handled by one man even when the flask is full of sand. Such moulds do not require machine power for handling, but it has been found that machine power can be advantageously substituted for hand power in the ramming of the sand. Page 12 shows the sequence of operations of the Plain Squeezer Moulding Machine, which is so well known to everyone connected with the foundry industry, since it is the oldest form of power machine. Its sole function is to ram the sand by squeezing, and the remainder of the work is done by hand. The Jolt Squeezer Moulding Machine, the operation of which is illustrated on page 14, adds the jolt feature to the well known Plain Squeezer, and eliminates the hand tucking which is necessary on practically all drags. It enables the operator to turn out either more moulds with the same effort or the same number of moulds with less effort. Chapter IX goes into this subject in greater detail, taking up the particular advantages gained, and the kinds of patterns on which the Jolt Squeezer Machine is of great advantage as compared to the Plain Squeezer Machine.

There are types of machines other than those mentioned above, but the examples discussed are typical ones which embody practically all of the principles that are used in the foundry today. The other types of machines which have not been mentioned, are different combinations of the same fundamental principles, and the adoption of this or that type of machine is frequently a personal matter with the foundryman.

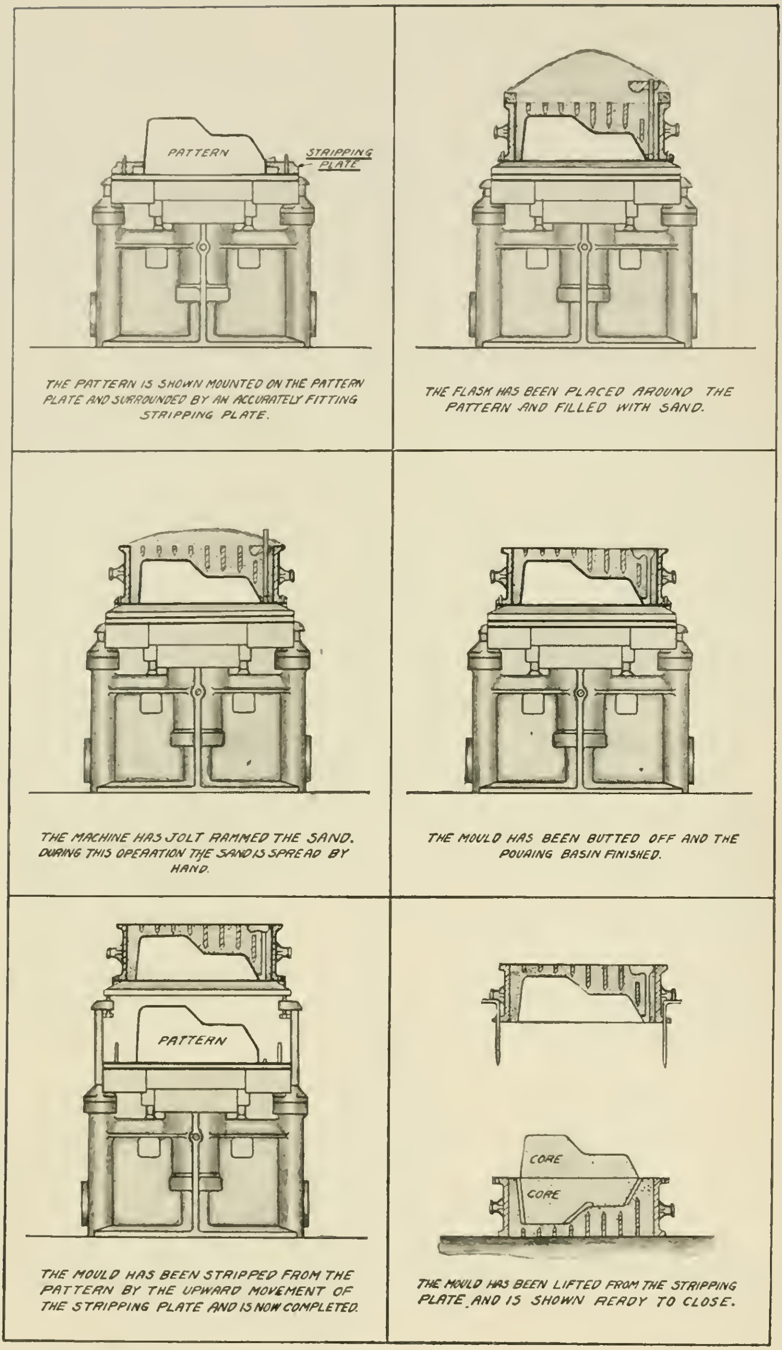


Fig. 5. Method of Making a Mould on the Jolt Stripper Machine.

The foregoing explanatory matter is not intended to be a complete guide to the use of moulding machines; it is elementary in nature and is inserted for the purpose of giving the reader a broad view of the subject before taking up in detail the operation of each machine. This will be done in later chapters describing the machines.

Processes of Moulding

The explanations given in this chapter are not intended to be complete and, in the absence of direct reference to other chapters, the reader is referred to the table of contents for more information on the matters which will be covered briefly in the remainder of this chapter.

In order to allow the mind of the reader to dwell upon the important points covered in the succeeding chapters, it is necessary that a comprehensive view of machine moulding be firmly established in mind so that the details will be clear and no additional attention need be paid to them in the subsequent chapters. Accordingly some of the relatively minor matters of machine moulding will be gone into in this chapter.

Pattern Mounting

Another of the common misconceptions in regard to the use of foundry moulding machines is the idea that the mounting of the pattern is an operation of great cost, requiring a high degree of skill. While it is true that good workmanship is required in mounting patterns for machines, the statement holds true even though the patterns are to be used by hand, that good workmanship is always necessary for the production of good results, and certainly, pattern mounting is no exception to this rule. Any good pattern-maker may easily study out the steps which are necessary in the mounting of patterns for machine moulding, and with a little experience, will find it very simple and not more difficult than the consideration given to the making of the same pattern for hand

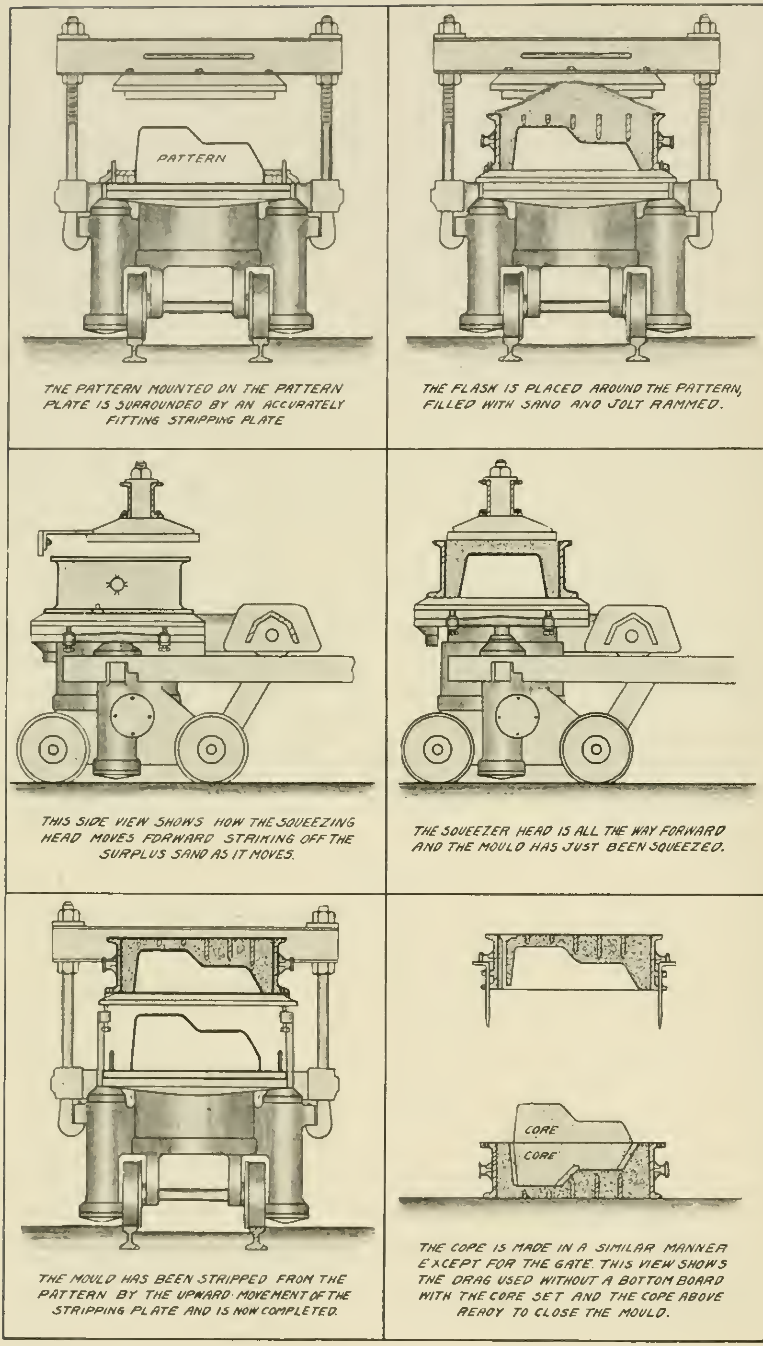


Fig. 6. Method of Making a Mould on the Jolt Squeeze Stripper Machine.

moulding. Essentially the difference between patterns made for floor moulding and those made for machine moulding are as follows:

In patterns made for floor moulding it is assumed that the moulder is a highly skilled workman who is able to overcome many moulding difficulties, and consequently it is assumed that since he is working with moulding sand, which is more readily fashioned than wood, he should be called upon to do the extra work necessary at the expense of the patternmaker who makes the pattern in the simplest manner possible, simplest, that is, from the standpoint of making the pattern. However, when mounting the patterns on machines, some method of securing the pattern is necessary, and it is common to build the pattern onto the board which forms the parting of the mould. Rather than force the moulder to cut an irregular parting, it is now considered good practice for the patternmaker to cut this irregular parting once and for all, and to relieve the moulder of this work. An important economy in the total amount of time spent in the producing of the casting is thus obtained when any quantity of castings is to be made, and, uniformity of method is assured, whereas different moulders might adopt different methods and every casting would vary, to the subsequent disadvantage of the machine shop. Mounting patterns on a moulding machine is not a difficult matter, and does facilitate the making of the pattern in such a way that the total amount of labor spent in the pattern shop and foundry compares favorably with the total amount spent in producing the casting by the old hand method.

Chapter XI on pattern equipment will present many of the details of pattern mounting but it should be said in this connection, that any pattern made for machine moulding can be rammed by hand on the floor, rolled over by hand or crane, and the pattern drawn by hand, thus demonstrating the fact that machine moulding is essentially the same in principle as hand moulding.

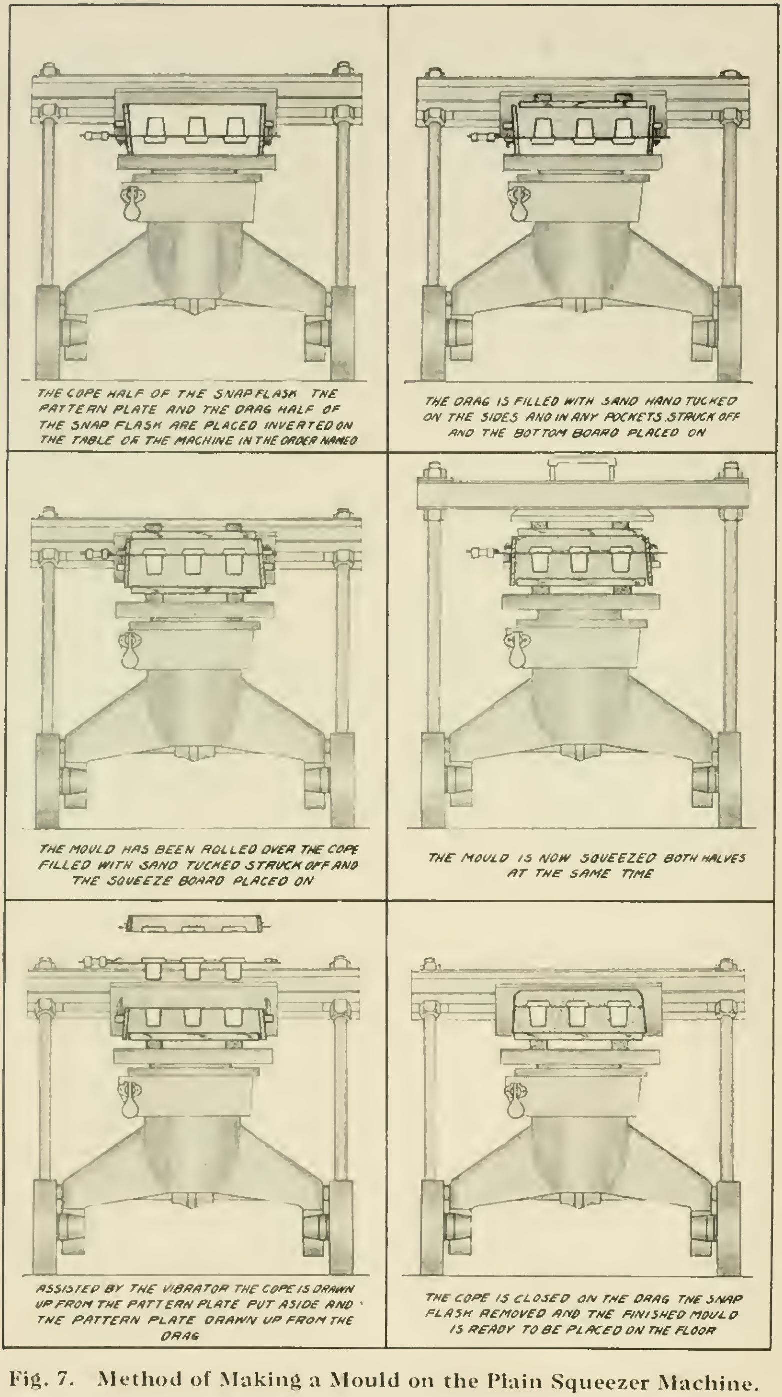


Fig. 7. Method of Making a Mould on the Plain Squeezer Machine.

Jolt Ramming Operation

The jolt ramming operation is combined with various other machine operations and is embodied in many types of machines. It is, therefore, one of fundamental importance. The importance of this operation and the theory of it will be covered fully in Chapter II, and the machines performing it, in subsequent chapters. At this point it might be well, however, to point out some features in regard to this operation.

Use of Upset

The sand, in packing down into the flask at each blow of the machine, necessarily drops down into the flask, and it is necessary to pile sand as high as it can be held on the flask before jolt ramming. On some deep flasks it is not possible to pile enough sand, and in such cases an "upset" is placed around the flask for the purpose of holding more sand. This upset is removed during or after the jolt operation when the sand has jolted down into the flask. An upset is shown in use on page 8 at the upper right hand corner of the page. When jolting down into the flask, the sand will to some extent, follow the outlines of the pattern, as is clearly shown by the top illustration on page 16, in which, at the extreme right of the flask, the sand has jolted down below the top of the flask, while immediately above the pattern, it has been supported and is above the flask.

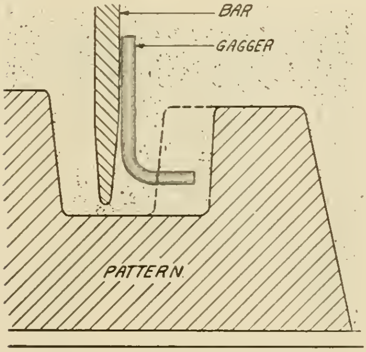


Fig. 8. The Use of a Gagger.

Use of Gaggers

In producing the cope or upper half of the mould on the Jolting Machine, either the Plain Jolt or the Roll Over Jolt, it is frequently necessary to make use of gaggers, as in floor moulding practice. The gaggers are used in identically the same way and no difficulty is ex-

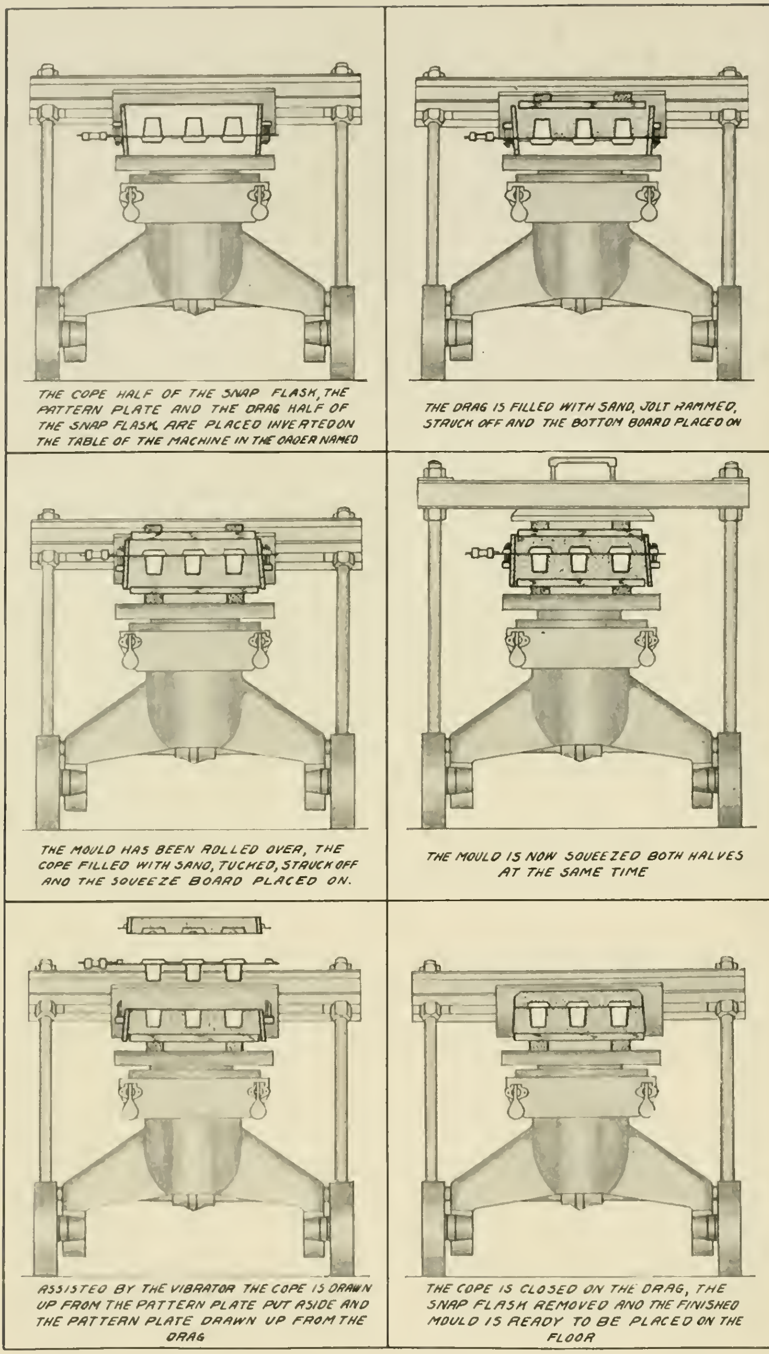


Fig. 9. Method of Making a Mould on the Jolt Squeezer Machine.

perienced in jolt ramming them by machine power. Figure 8 shows the usual method of setting gaggers against a bar with the foot of the "L" shaped gagger projecting into the pocket of sand, which is to be carried, and which needs this additional support. It might be well to call attention at this time to the fact that gaggers should be dipped in a clay wash before being placed in the mould in order to make their use more effective.

Spreading the Sand

Although there is enough sand in the flask it is necessary, before butt ramming, that this sand be distributed evenly over the flask, and this operation naturally requires a small amount of time. In order to eliminate as much of this time as possible, it is good practice to spread the sand from the center of the flask toward the edges, by hand, during the jolt ramming operation, so that at the completion of the jolt ramming the sand is left in a shape such as that shown in the bottom view on page 16 which shows the sand so distributed that it can immediately be butted off.

Butting Off

"Butting off" the mould has been mentioned several times above. By this term is meant the hand ramming which is necessary to supplement the jolt ramming of the machine. When a machine jolt rams the sand, a sufficient density of sand is produced on the pattern and pattern plate, but near the top of the flask the sand is not rammed so tightly and is, in fact, so loose that it requires additional ramming. This is done by hand and can be done very rapidly since no special skill is required, as the part of the mould requiring skilled ramming has already been rammed by jolting, and it is necessary only to pack the sand tightly at the top in order to support the portion of the sand adjacent to the pattern and pattern plate when the mould is being rolled over, while it is resting on the floor, and during the pouring operation. "Butting off" is a hand performed operation in the making of the mould, and it is only natural that one mould will be butted

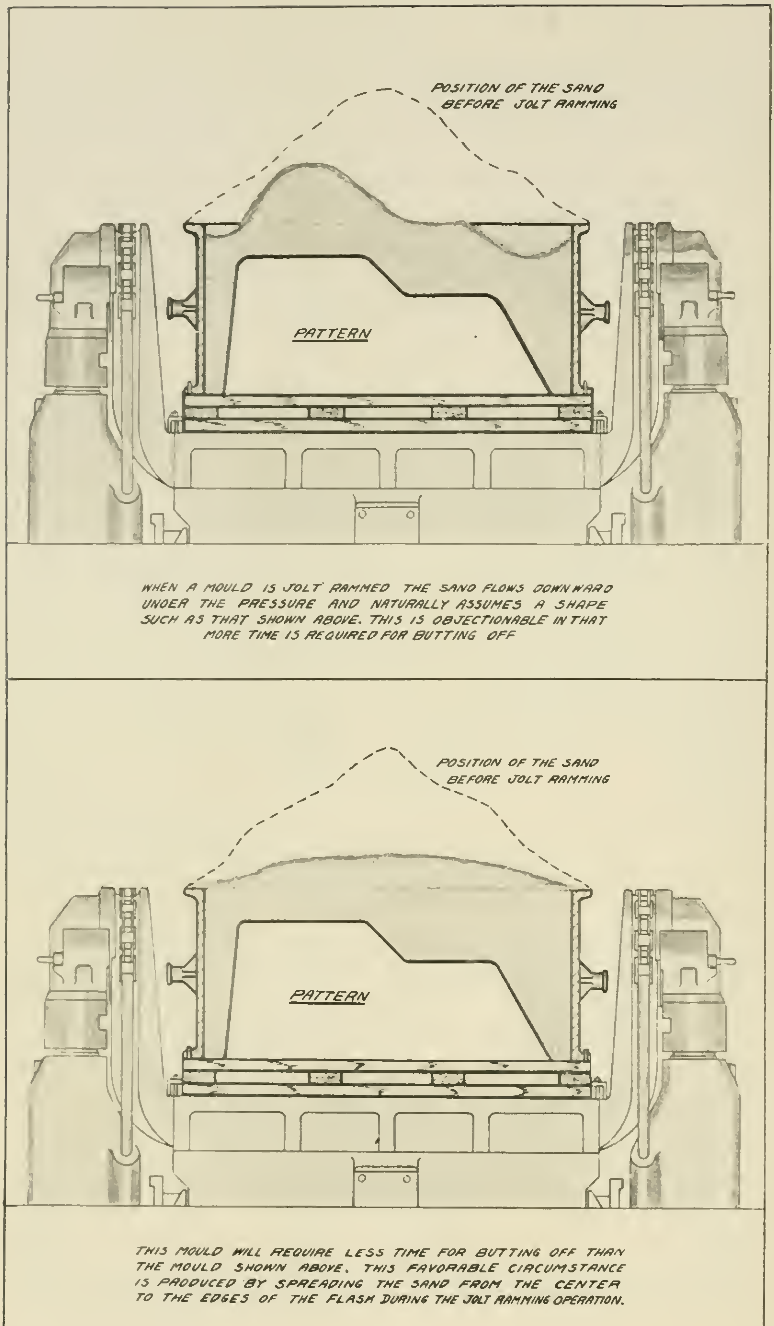


Fig. 10. The Sand Should be Spread During the Jolting Operation.

off to one degree of hardness and the next mould to a different degree. This difference does not appreciably affect the size of the casting when it is used for ordinary work, but is objectionable when extremely accurate castings are required, such as those used in the automobile industry. This difference, slight as it is, causes trouble in jigs which are made for accurate work, and makes it advisable to employ a machine operation, that of squeezing, for butting off the mould. This will be discussed more fully in the chapter which deals with Jolt Stripper and Jolt Squeeze Stripper Moulding Machines.

Striking Off

After the sand has been butted off, it is necessary to clamp in position a bottom board, the same as in hand moulding. This bottom board must support the sand evenly over the entire surface of the mould, both during the roll over operation and subsequently on the floor and during the pouring operation. This bottom board must be bedded onto the flask correctly, and this is done in the following manner: The top of the mould is "struck off" with a straight edge, either wood or steel, so that the sand over the entire mould is exactly level with the top surface of the flask; a hand full or two of loose sand is then scattered thinly over the surface of the flask and the bottom board is placed on and worked back and forth by hand until it makes for itself a solid bearing over the entire mould. This extra sand is not necessary because the flask is out of alignment, but because the bottom board is always a little warped or burned in places, due to its having been subjected to extreme heat and to water. The strike off operation consists simply of scraping off the excess portion of the sand, and is performed by the use of a wide or a narrow bar, depending upon the size of the flask being struck off. Figure 12 illustrates the use of a wide and a narrow strike-off bar. In this case, since the flask is of medium size, the wide strike-off bar has an advantage in that the mould can be struck off in one stroke. This is not true of the larger size of flasks, where a wide bar would hold so much sand that it would be difficult for the moulder to

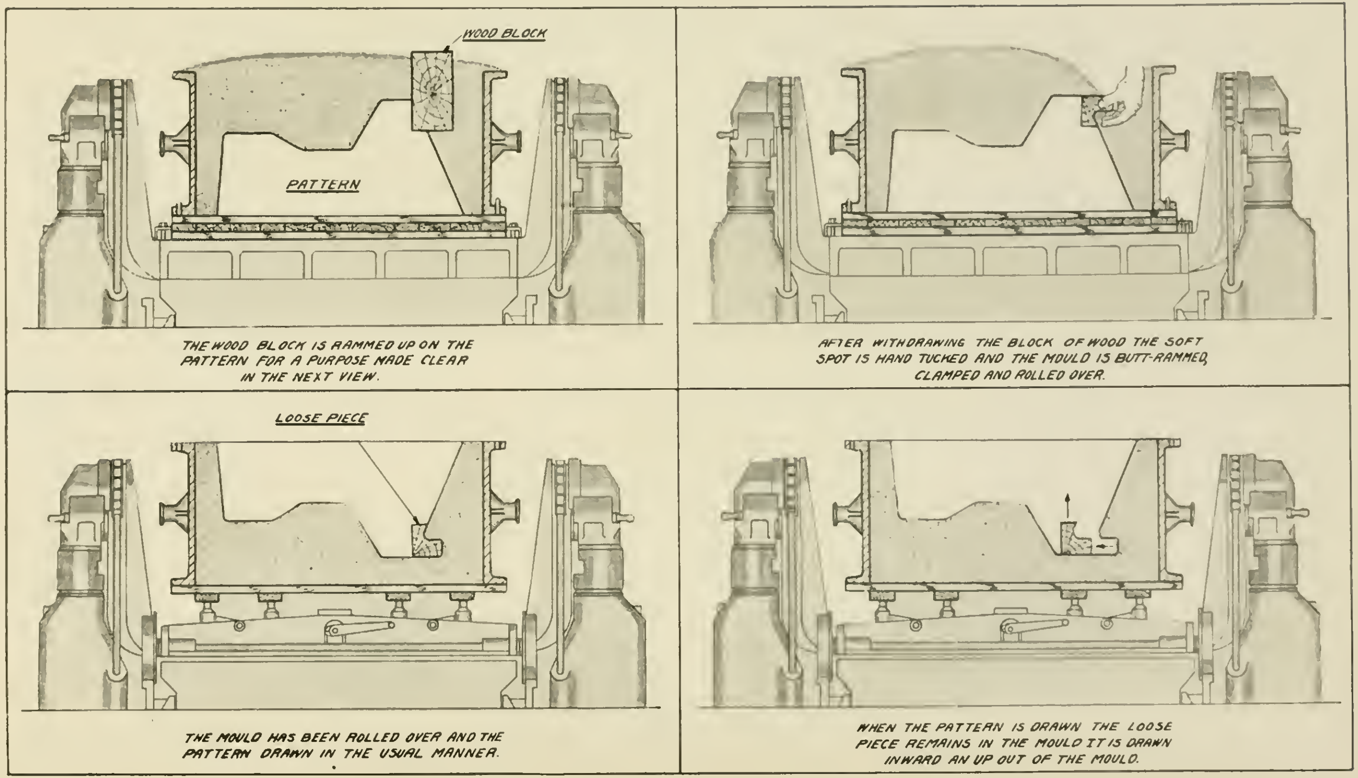


Fig. 11. The Use of a Pattern Having a Loose Piece on the Roll Over Machine.

draw the bar. In such a case a narrow bar has the advantage of cutting through the sand, loosening it all thoroughly on the first stroke, and yet removing at every stroke as much as it is practicable for the moulder to handle.

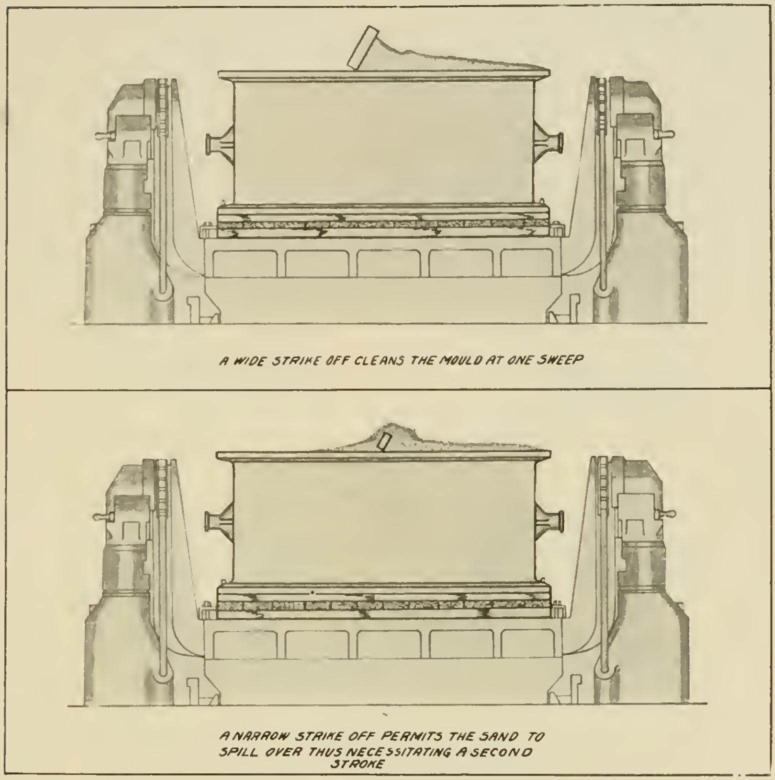


Fig. 12. The Use of Wide and Narrow Strike Off Bars.

The clamping of the pattern, flask and bottom board together, needs no comment here and the rolling over is also a very simple operation and needs no further comment.

Pattern Drawing Operation

Removing the pattern from the rammed sand is performed in essentially the same manner on the machine as on the floor, namely, the pattern is lifted vertically, or as nearly vertically

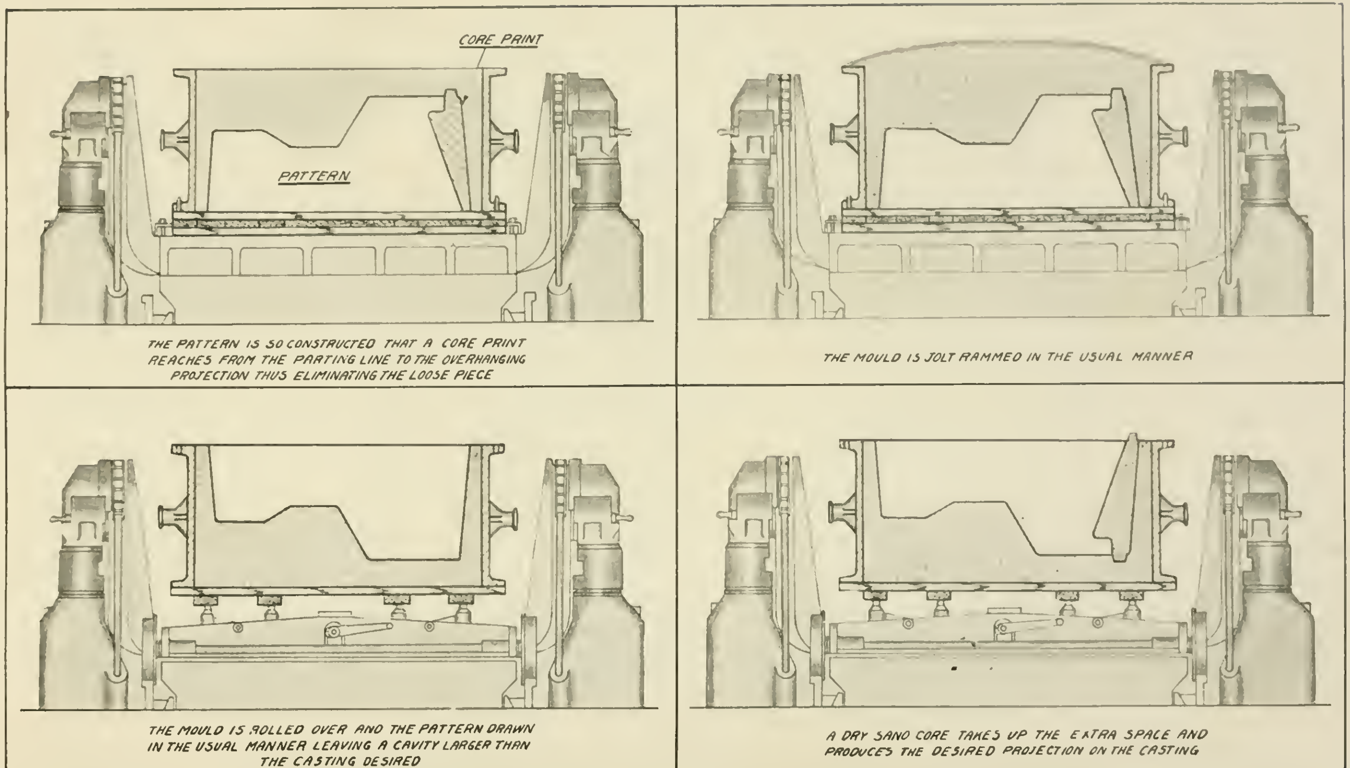


Fig. 13. The Casting Produced is the Same as the one in Figure 11.

as possible, from the sand. The details, however, vary greatly in the two cases. In floor moulding the pattern is rapped back and forth and from right to left by using a maul or hammer on the rapping pin, which is inserted in a plate built into the pattern for this particular purpose. This rapping damages both the pattern and the mould and also makes the mould over-size. The pattern is then drawn by the aid of lifting hooks which are attached to plates built into the patterns and, accompanied by additional rapping, the moulder lifts the pattern as nearly vertically as possible. Contrasted to this method, the machine operator opens a valve, which places the vibrator in operation, and then opens another valve, which places in operation an air cylinder, which either draws the pattern upward from the mould or the mould downward from the pattern.

The Vibrator

The vibrator, which is a device similar to a pneumatic hammer, is shown diagrammatically in Figure 14. It is attached either to the pattern or to the table of the machine to which

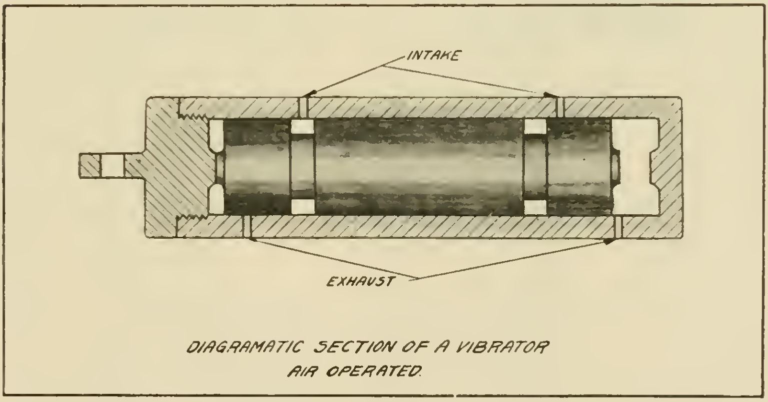


Fig. 14. Diagram of an Air Operated Vibrator.

the pattern is rigidly fastened. In either case the reciprocating action of the vibrator produces a series of shocks which are transmitted to the pattern. These shocks are of such

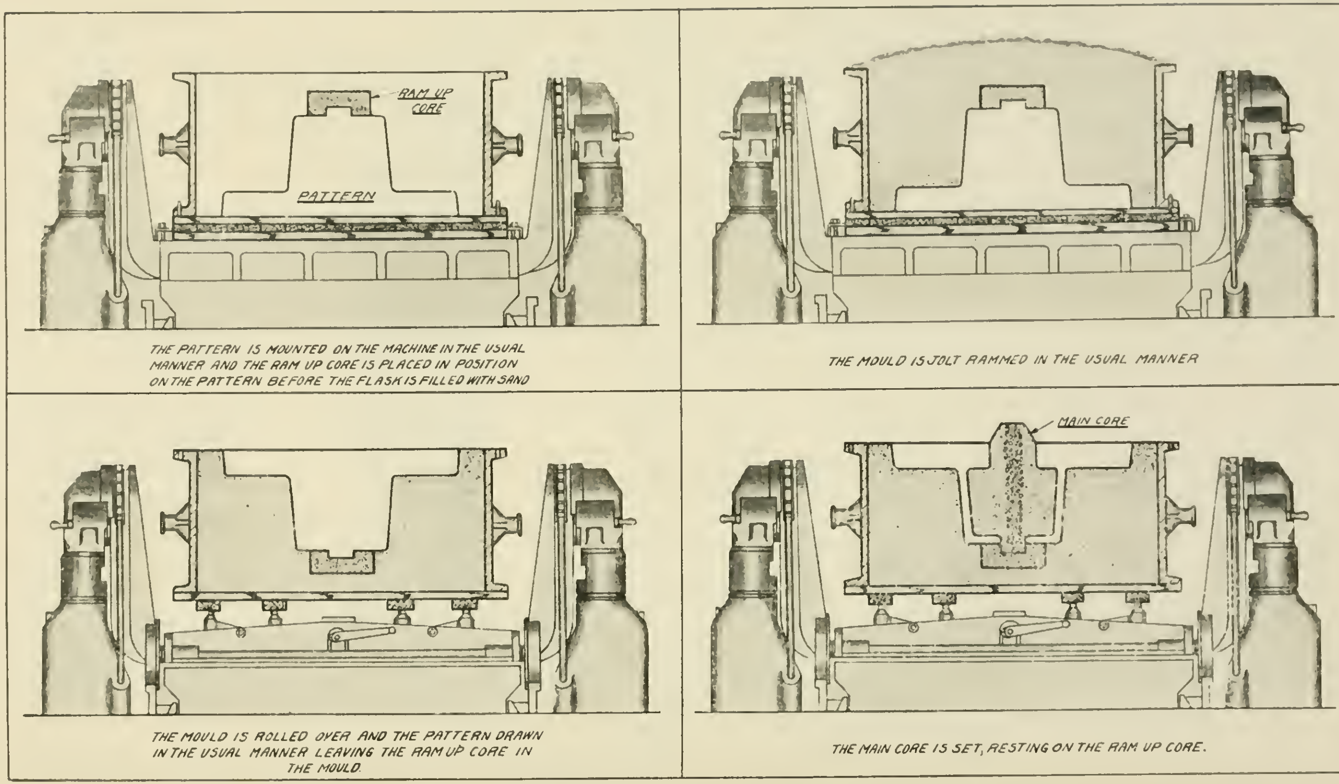


Fig. 15. The Use of the Ram Up Core on the Roll Over Jolt Machine.

small intensity that no measureable enlargement of the mould takes place, and yet the friction of rest existing between the pattern and sand is overcome, as is also the friction of rest existing between the various parts of the machine which accomplish the pattern drawing. The action of the vibrator accomplishes perfectly the result for which it is designed, and has the advantage of not damaging the pattern.

Overhanging Projections

The drawing of the pattern assumes a pattern which, in the trade term, "has draft." This means that the pattern is of such a shape that it can be drawn vertically up out of the mould, leaving behind it the sand of the same shape as the pattern, without tearing or breaking the edges of the sand. The design of many castings is such that the pattern has overhanging projections which cannot be drawn from the sand in the usual manner, and special methods must be employed in such cases. Two means are generally employed—first, the overhanging projections of the pattern may be made loose, so that when the main pattern is drawn this auxiliary portion of it remains embedded in the sand of the mould, and is drawn separately in another direction into the cavity left by the withdrawal of the main pattern. This method is illustrated on page 18 which shows the sequence of operations in ramming up a mould from a pattern containing a loose piece, and the subsequent removal of the loose piece, leaving in the mould a cavity of the desired shape.

Cores

A second method of producing such a casting is by the use of a core, which is a separate block of sand, that has been baked with a binding material and is hard so that it retains its shape and can be placed in the cavity of the mould after the pattern has been withdrawn. Extra allowance must be made on the pattern for the core which will be introduced into the mould later. This portion of the pattern is known as the coreprint because it leaves an impression which will be

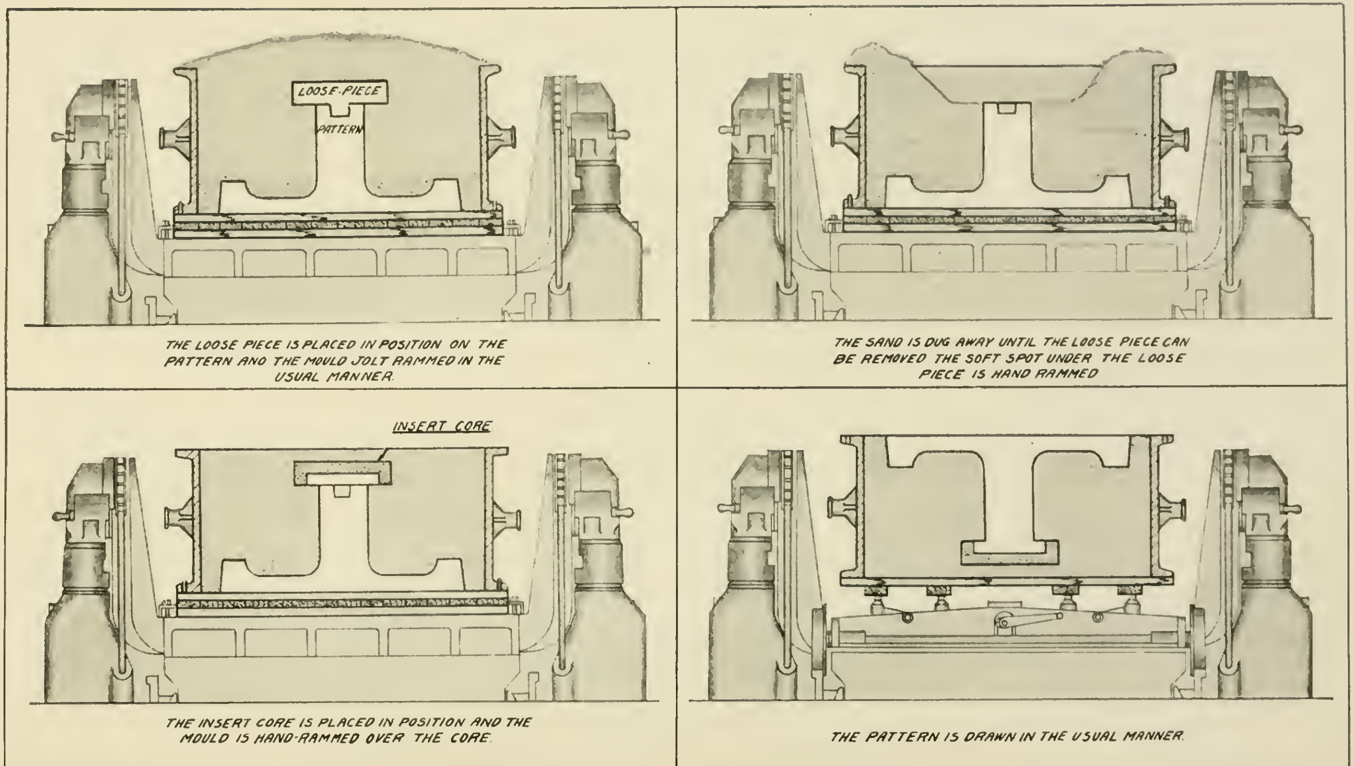


Fig. 16. The Use of the Inserted Core on the Roll Over Jolt Machine.

filled by the core. Page 20 shows the method employed in making a casting by means of a core which is set into the mould after the pattern has been withdrawn. It can readily be seen that this core must have sufficient bearing surface upon which to rest, and must be anchored firmly in place so that it will not float loose when the mould is poured. In this case the projections at the top and the bottom of the core are used for locating and for holding it firmly while the mould is being poured. Sometimes cores are the only method of solving problems similar to the one discussed above, but there are many uses for cores other than as a substitute for a loose piece on the pattern. Cores are frequently used where a rather thin body of sand would be washed away by the flow of metal into the mould; to produce holes in the side walls of castings; to support heavy cores which must be set later; to receive the impact of metal which falls vertically thru a portion of the mould; and for other purposes.

Ram Up Cores

The term "ram-up core" is frequently heard in the foundry and occasionally a mistaken view is held that a ram up core cannot be rammed on a jolt machine. Page 22 illustrates clearly one of the many uses of the ram up core. It derives its name from the fact that it is placed on the pattern and remains there while the sand is rammed, whether this is done by hand ramming or machine ramming. When the pattern is drawn the core is left firmly embedded in the sand of the mould for any one of a number of purposes. On page 22 a ram up core is shown in use for the purpose of supporting the concentrated weight of a heavy core, which otherwise would have crushed the green sand at this point.

Inserted Cores

Another form of core of similar purpose is the "inserted core" which is of such shape that it cannot readily be rammed up on the pattern due to overhanging projections, which would cause trouble by breaking off, and also would require hand

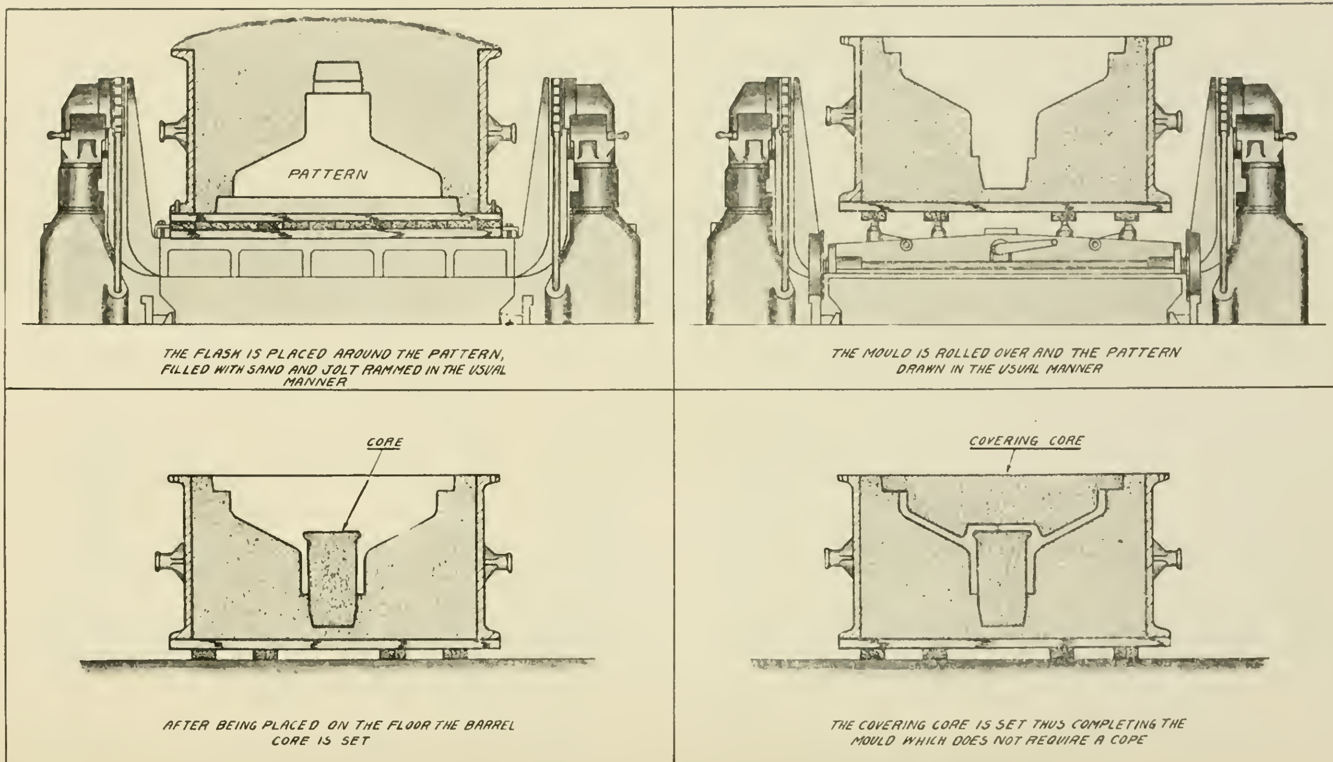


Fig. 17. The Use of the Covering Core on the Roll Over Jolt Machine.

tucking beneath them. The method of inserting such a core is shown on page 24, which shows clearly that the mould is jolt rammed, a hole is dug down to the loose piece, which is then removed and the inserted core set in place, the ramming being completed by hand. This kind of a core is correctly called an "inserted core," but is of the same general class as a ram up core.

Covering Cores

The term "covering core" is frequently used in the foundry and page 26 illustrates the method of its use in a casting where the covering core also serves as the cope half of the mould. The illustrations on that page are self-explanatory and need no further comment here.

Gating

Reference has been made to the pouring of the mould and to the flow of metal into the mould. The passageways provided for the metal to enter the mould are known as the "gate," and the making of them is known as the operation of gating. The term, "gate," includes the pouring basin into which the metal is poured directly from the ladle, and all parts of the passageway leading from the pouring gate to the cavity forming the casting. In Squeezer work it is customary to refer to the vertical portion of the gate as the "sprue," and to the horizontal portion of the gate as the "runner." Other special names are applied to gating, indicating the method employed to prevent dirt and slag in the iron from entering the mould; thus the names "skimmer gate," "strainer gate" and "swirl gate" are practically self-explanatory. The typical mould illustrated in Fig. 1 contains a strainer gate which

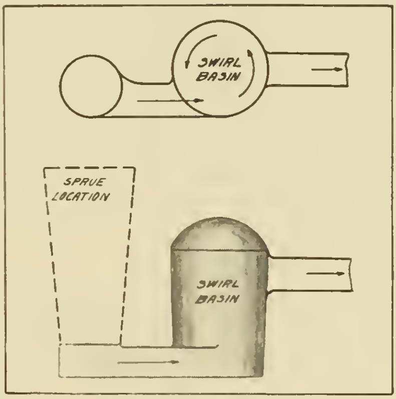


Fig. 18. Diagram of Swirl Gate.

consists essentially of a strainer core placed in the gating system at some convenient point, a strainer being a core perforated with a number of small holes which permit the passage of the iron but keep out the slag and dirt. The swirl gate is illustrated in Figure 18. In this gate the iron is led into a circular basin which it enters at an angle, causing the iron to rotate rapidly in the basin. Any slag or dirt floating on it will collect in the center, and the clean iron is drawn from the outside edge. The basin into which the iron is poured from the ladle is so shaped that, to some extent, it insures the entrance of clean iron into the mould. An aluminum pattern is used to form pouring basins of uniformly correct shape. The views on page 8 illustrate the method of using it and the typical mould in Figure 1 illustrates the shape of the basin and its position in the finished mould. In using it, the iron is poured into the larger of the two depressions until it flows over into the smaller one and down the gate. The basin is kept full of iron by rapid pouring, and the slag accumulates on the top, allowing clean metal to enter the gate. When first starting to pour, a small amount of slag is likely to be carried down the gate before the basin is full and this slag may get into the casting and cause trouble. In order to prevent this, some foundries place a small piece of thin sheet metal over the gate entrance. This holds back the metal until the slag has had time to rise, and insures only clean metal entering the mould. The sheet metal then melts, admitting the iron.

The point at which the iron is introduced into the mould, and the rate of flow of the iron as determined by the size of the gate, the height of the pouring basin above the point of entrance, and the fluidity of the iron are matters of great importance in securing a good casting. Difficulty has been experienced in a number of cases in which the castings were bad until some change was made in the gating system, after which good castings were obtained.

Although the subject of gating is one of great importance, it is a subject upon which very little can be said from a theoretical standpoint, and the subject remains the exclusive field of the skilled and experienced moulder, when machine moulding as well as when hand moulding. This point should be noted, however. The type of pattern employed on moulding machines, being mounted on a permanent plate, readily adapts itself to the use of a gate pattern built onto the board in such a way as to be a permanent part of the pattern equipment, thus insuring uniformity of gating, and after experimenting to secure the best gate, it then becomes an automatic matter that each subsequent mould has the best gate, whereas the most skillful of moulders, in cutting each gate individually, will vary slightly from time to time. The result of past experience in gating seems to be a sort of intangible knowledge which takes the form of judgment, which has not been expressed by a definite set of rules.

Moulding Sand

The proper moulding sand is an absolute essential in producing moulds either on the floor or on the moulding machine. The selection of moulding sands is rapidly assuming the aspect of a definite science of sand grading, and some important research work along this line has recently been done. The major portion of this information has been published in the Transactions of the American Foundrymen's Association, volume XXI, page 19, and the tests for grading moulding sand are briefly recapitulated here as follows:

1. A general microscopic test which provides general information in regard to the chemical composition of the sand, size of the grains, their shape and the amount of bond. This test eliminates those sands which are readily recognized as unsuited to moulding purposes.

2. Rational chemical analysis of the sand gives directly the quartz, clay and feldspar contained in the sand. The percentages of these various elements determine the fusibility of the sand, and consequently determine whether or not it can be subjected to the heat of the molten iron.

3. The fineness of the sand is determined by the percentage of the total passing thru a succession of screens of 20, 40, 60, 80 and 100 meshes to the inch, respectively. A coarse sand may be used for heavy work while a fine sand is required for finer work. In addition to this, there also exists the factor that a sand composed about one-half of relatively large grains and the other half of relatively small grains will not vent well, because the small grains will so completely fill the spaces between the large grains that the gases will not have sufficient room for escape.

4. The transverse strength is tested on a specimen of the sand prepared and tested under standard conditions. This takes the shape of a bar 1″ square, 4½″ long, supported 4″ apart and broken by the application of a weight at the center. This test is made with from 5% to 7½% moisture and a second test with 10% moisture.

5. The crushing strength is measured on a standard 1″ square block of sand 2½″ high.

6. The permeability to air is measured on a 2″ square block 1″ thick prepared under standard conditions with a given quantity of air forced thru the sand. This test checks to some extent the information obtained in test No. 3.

7. The strength of the clay bond present in the sand is measured by the percentage of dye absorbed per unit of clay in the sand. It is readily seen that this is not a test of the amount of clay present, but of the strength of the clay which is present.

These seven fundamental tests for moulding sand form the basis of proper sand selection and their importance should not be overlooked. In the absence of laboratory facilities, a good magnifying glass will furnish much valuable information in regard to the properties of the sand, provided the significance of what is seen is fully understood. Many sand troubles may be avoided by the use of a good magnifying glass.

CHAPTER II

Theory of Jolt Ramming

Recent foundry development has produced no one operation which is more fundamental than the jolt ramming operation. It accomplishes the ramming of the mould in a more satisfactory manner than the squeezer machine and is applicable to all sizes of moulds from the smallest to the largest. The theory explaining the jolting action of a machine in ramming the mould is of such fundamental importance that a chapter is here devoted to it. The importance of this operation is emphasized by the fact that practically all machines, having more than one operation, incorporate the jolt operation for ramming the sand in the mould. Common examples are the Jolt Roll Over Pattern Draw Machine and the Jolt Squeeze Stripper Machine.

Every foundryman is familiar with the skill required in the production of a hand rammed mould; with the exactness of ramming which must be obtained over the pattern of varying shape and at varying depths in the flask. A perfect casting requires perfect ramming—a thing that is very hard to attain in practice. The least defect in the ramming causes swells, scabs, blow-holes, or run-outs. When such a task is undertaken by hand-ramming, trouble is experienced in securing a mould with a surface of uniform hardness and without the adjacent hard and soft spots, which, when the metal is poured, cause the gases to flow along the surface of the mould to the soft spots instead of entering the surface of the sand without flowing.

It is obvious that the moulder cannot, without exceptional skill, produce with his small tamp a surface of even strength and texture without setting up initial strains in the body of the sand. The pouring of the hot metal against the rammed sand weakens the binding elements and releases the strains caused by uneven ramming, allowing the sand to flow in the path of least resistance until it becomes of uniform hardness, sufficient to withstand the pressure of the metal. This movement of the sand is one of the causes of the rough, uneven surfaces that are usually seen on the castings produced by hand-rammed moulds. In contrast with the above described hand method, in the mould that is produced by jolt ramming on a machine, the iron will lie properly and the gases, without flowing, will immediately enter the sand. Jolt ramming is accomplished by lifting the table, pattern, flask and sand a short distance and then allowing them to drop and contact with an anvil which stops and reverses the table, pattern, and flask but allows the sand to continue in its descending course, producing a pressure in the sand, especially in that sand lying nearest the pattern and pattern plate. By repeated machine blows the sand is caused to flow to the bottom of the mould and to pack into the flask corners and around the pattern in a uniform manner, the jolting action of the machine causing the grains of sand to flow in the direction of least resistance, and, therefore, the mould is packed in an even and uniform manner and without setting up unequal strains between the various particles of sand or between the several parts of the mould.

The development of the jolt ramming method of moulding has produced a machine that will jolt ram a mould complete in from 5 to 30 seconds of time, operating with a stroke of 1″ to 2″ in length, and at a rate of 150 to 250 strokes per minute. One should not lose sight of the fact that jolt ramming the mould properly, is only the first operation performed on the mould, and that it is easy for the moulder to introduce the variable human element in the latter stages of the work; for instance, a mould which has been jolt rammed may be improperly butted off; the pattern may be hand drawn so crudely as to damage the surface of the mould, requiring a great amount of slicking and patching. These variations introduced in the latter phases of making the mould will eliminate some of the advantages of jolt ramming. This constitutes a very strong reason in favor of the machine which not only jolt rams the mould but which performs the subsequent operations of butting off, rolling over and drawing the pattern, with an accuracy and uniformity equal to that of the jolt ramming.

Since the saving in time effected by means of jolt ramming is usually not more than 50 per cent of the whole, it is advisable that more time be saved by using a machine that not only jolts but also rolls the mould over and draws the pattern from the sand. These operations are being performed by machine power in from 10 to 60 seconds of time, producing a mould that has not been distorted or broken, and leaving the patterns undamaged by rapping.

Ramming Requirements

The requisites of ideally rammed moulds, then, are as follows:

(a) Uniformly rammed sand.

(b) Correct density in various parts of the mould.

(c) Uniformity of various moulds made from the same pattern.

These requirements necessitate the use of a suitable grade of moulding sand, properly prepared.

Taking these points and considering them separately, we find that the jolt ramming of a machine produced an equal force over the surface of the pattern and pattern plate and this equal force, acting against the equal resistance of the sand, produces an equal result over the entire pattern. The machine, then, normally produces a mould which is of uniform density throughout, whereas a moulder, after much training, can only approximate this desired condition.

The second point—correct density—is subject to the same influences. The machine can readily be adjusted to give a harder or softer blow, which, coupled with the number of blows, will ram the mould to any desired density within given operating limits. A moulder, on the other hand, attempts to match his skill against the machine in producing a proper density of sand and invariably comes out a poor second.

The third point—uniformity of different moulds made from the same pattern—is of great importance to the user of castings. Accurate weighing shows that the castings produced near the end of the day by hand labor are heavier, due to softer ramming on the part of the tired moulder. The difference will amount to an appreciable sum in the first cost of the castings to the user, and probably even more expense will be incurred in the machine shop, for these oversize castings give trouble in jigs and on the layout plates.

It has been found that to produce a machine that will quickly jolt ram a mould in the manner described in the preceding paragraphs, there should be no pause in the upward action of the stroke, but, on the contrary, the upward action of the stroke should start rapidly and at the instant of table contact with the anvil, in order to prevent the moving parts from coming to rest at the end of the slight rebound stroke due to impact only. If this impact rebound is allowed to expend itself before the table again starts on its upward stroke by means of the air power, the pressure on the sand is then released, and instead of being compressed the sand itself rebounds and retards or destroys the packing action. Machines that do not make use of this pressure require a longer time in which to pack the sand.

Fig. 19.

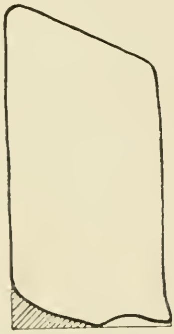


Fig. 20.

Indicator Tests

Indicator cards taken from such a machine are as shown in Figures 19 and 20, in which the extreme width of Fig. 19 represents the pressure required to lift the table with equipment, and the extreme width of the shaded portion of Figure 20 represents the pressure in the cylinder at the time of contact. Since the indicator diagram (Fig. 20) shows that the pressure in the cylinder at the time of contact is only one-half of the amount required to lift the load, it is obvious that the moving parts will rebound, and that, without sufficient pres-

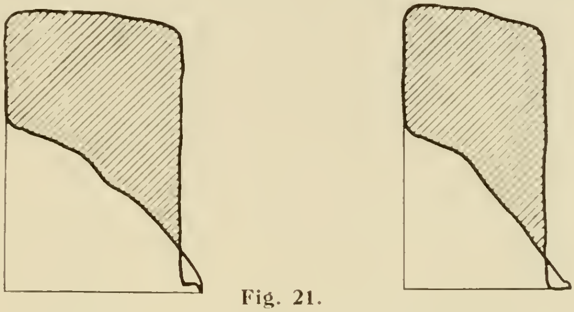


Fig. 21.

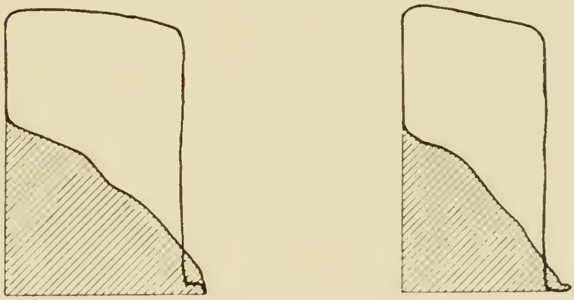


Fig. 22.

sure in the cylinder, the moving parts will, when the force of the rebound is spent, settle back again until sufficient air is admitted to the cylinder to obtain the pressure required to again lift the load.

The indicator cards shown in Figures 21 and 22 are taken from a machine having a balanced piston type valve, so constructed as to close the exhaust ports, thereby trapping the air in the cylinder and also admitting line air to the cylinder before the falling load has contacted with the anvil. This produces, under the piston, a high pressure, greater even than line pressure. This high pressure is present just before the piston contacts at the bottom of the stroke, and prevents the moving parts from settling back again after the rebound at the beginning of the stroke. Upon contacting, the table rebounds and then proceeds steadily upward under full line pressure, maintaining the packing force generated in the sand by

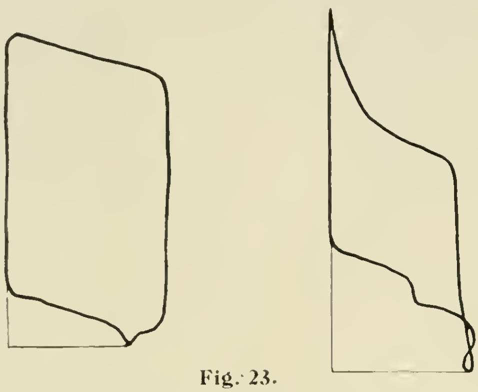


Fig. 23.

the impact. This force, by remaining upon the sand longer, naturally produces more packing effect on it.

The width of the shaded portion of Figure 21 represents the air pressure required to lift the load; the width of the shaded portion of Figure 22 represents the pressure developed by the downward movement of the piston acting upon the air, at atmospheric pressure in the cylinder, after the exhaust is closed, and also upon the admitted compressed air; the resulting pressure is from 10 per cent to 20 per cent higher than the pressure required to lift the load, and takes place at a point in the stroke just before contact is made, and therefore, cushions the blow so that the force of the blow is not transmitted to the base and foundation, the contact being necessary only to cause a quick and decisive reversal of the moving parts.

There are no heavy strains set up in the falling parts as would otherwise be the case if the whole load were allowed to fall with the full force of gravity. The action obtained in the moving parts is rapid, and at the time of contact with the anvil these parts are resiliently reversed in their direction of travel, while the sand, being loose and semi-liquid, continues its downward movement without rebounding and without again becoming loose in the flask.

Design

The design of a machine capable of producing the results noted in the preceding paragraphs has been accomplished only by overcoming many obstacles. The chief difficulties encountered have been the unpacking forces on the sand, and the irregularity of action. Unpacking forces on the sand are produced at two different points in the cycle of operation.

1st. At the rebound after the striking blow. (This has already been covered in preceding paragraphs.)

2nd. At the top of the stroke.

If, when the air is cut off at the top of the stroke, the piston, table and flask decelerate more rapidly than gravity demands, then the sand will tend to decelerate less rapidly than the flask, and the result will be a tendency of the sand to move upward in the flask, producing on the sand an unpacking force which will partially destroy the ramming that has already been accomplished. Any mechanical defect which causes the piston to be retarded unduly after the air has been cut off, will produce this result. A tight piston, either thru poor fitting or binding, will produce this trouble.

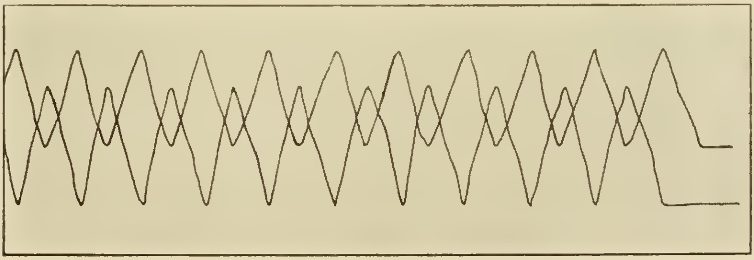


Fig. 24.

Figures 24, 25 and 26 show the result of tests which will indicate the existence of an unpacking force, either at the top or at the bottom of the stroke, and which will serve the further purpose of indicating any irregularity which might be present in the action of the machine. Any of these defects would show in the test curve of the machine, and should, of course, be investigated and eliminated. Figures 25 and 26 show, respectively, a machine working properly and one working irregularly.

Indicator card diagrams taken on foundry moulding machines may seem, at first sight, to be rather out of place, but by the aid of these cards all of the guess work in regard to the

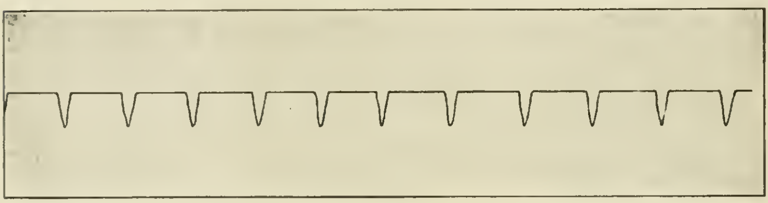


Fig. 25.

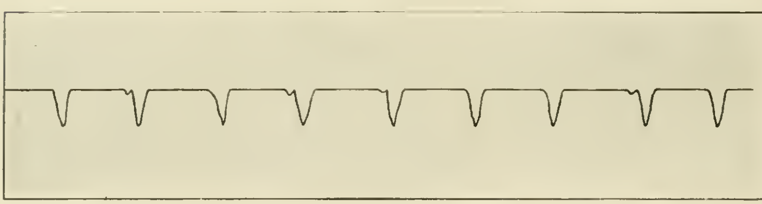


Fig. 26.

setting of valves, as well as the design of valves, can be eliminated. In correcting difficulties existing in the operation of the machine, the indicator cards are used in much the same way as those taken on a Corliss engine—a study of the card revealing the difficulty and a subsequent card showing its elimination. There are adjustments necessary on a jolt machine in a study of which the indicator cards are of valuable assistance. The length of stroke, the force of blow, and the amount of compression are the variable features. The factors affecting these adjustments are as follows: Size of the flask and pattern, grade of sand, moisture of sand, the bond of the sand, the density to be attained, and the metal to be poured One should not get the false impression than an indicator card is necessary every time one of these factors is changed. On the contrary, the indicator cards are never used in the foundry where trial settings quickly bring the proper results. The use of the indicator cards is confined to those who are making a laboratory study of the action of the machine, with a view of improving the machine, or of solving the extremely difficult cases which are not liable to be quickly solved by the guess method. They are also used to secure uniformity in manufacture.

Summing up the jolt ramming machine, the jolt operation is fundamentally basic and important. It substitutes machine power for hand power in performing a large portion of the work done on each mould, and means an even more important difference in the quality of the castings produced; due, however, to the fact that its advantages cannot be utilized to the fullest extent when the subsequent operations are performed by hand, it becomes of the utmost importance to supplement jolt ramming with machine operations for the remaining steps in making a mould. The steps in the operation are as follows:

1. Jolt Ramming.
2. Butting Off.
3. Rolling over (if necessary).
4. Drawing the Pattern.

The most advantageous machine, of course, is one which performs all of these operations.

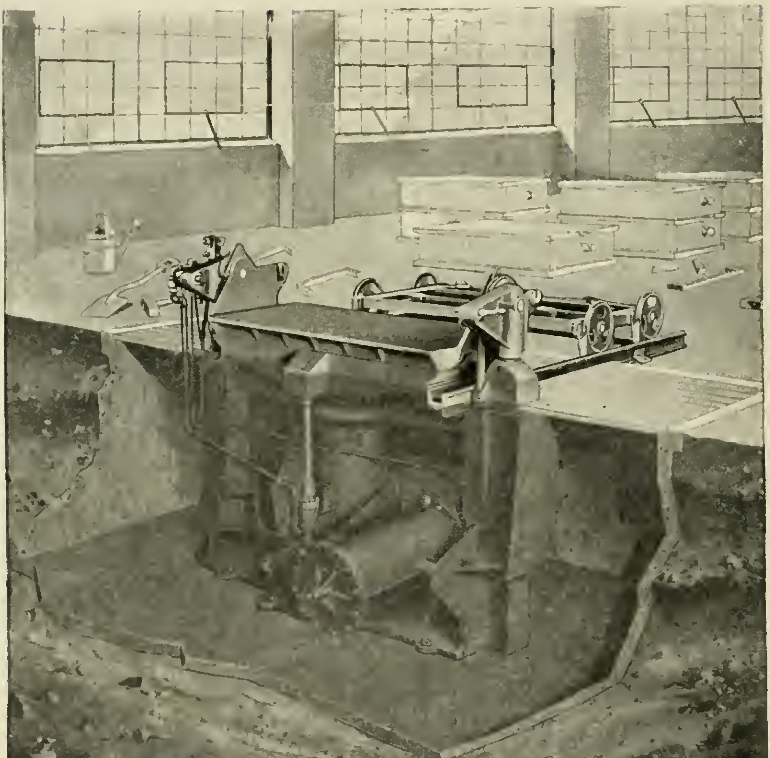


Fig. 27. A Typical Moulding Machine of the Roll Over Jolt Type.

CHAPTER III

Roll Over Jolt Moulding Machine

The Roll Over Jolt Moulding Machine performs the three most fundamental operations in making a mould. It jolt rams the sand, rolls the mould over and draws the pattern, all by machine power, thus eliminating practically all of the hand work in connection with the making of a mould.

In considering the construction and operation of the machine, the subject naturally divides itself into three main headings, viz.,

1. Jolting.
2. Rolling Over.
3. Pattern Drawing.

Each of these divisions can be still further subdivided into the subjects of operation of the machine and construction of the machine. In taking up each of these subdivisions, in order, we have first

Jolting Operation

The jolting mechanism, as built into the Roll Over Machine, is very similar to that of the Plain Jolt Machine, which will be described in detail in Chapter VIII. The essential parts consist of a cylinder and a piston supporting a table, and a valve for the proper control of the air to secure the jolting motion. Many refinements are worked into the parts, such as liners in the cylinder, special oil grooves and oiling devices on the piston, special striking pads, safety limit stops, and valves of various designs, ranging from a simple sleeve valve to special valves designed and used for this purpose only.

The jolting operation introduces severe strains in all parts of the machine and necessitates types of construction which would not otherwise be necessary. It also necessitates steel parts in some cases where otherwise cast iron would be sufficient. In Figure 27 the jolting cylinder is in the center of the machine with the jolt valve to the left of it. In Figure 28 the jolting mechanism is at the left. In Figure 29 the jolting mechanism is at the right side of the machine.

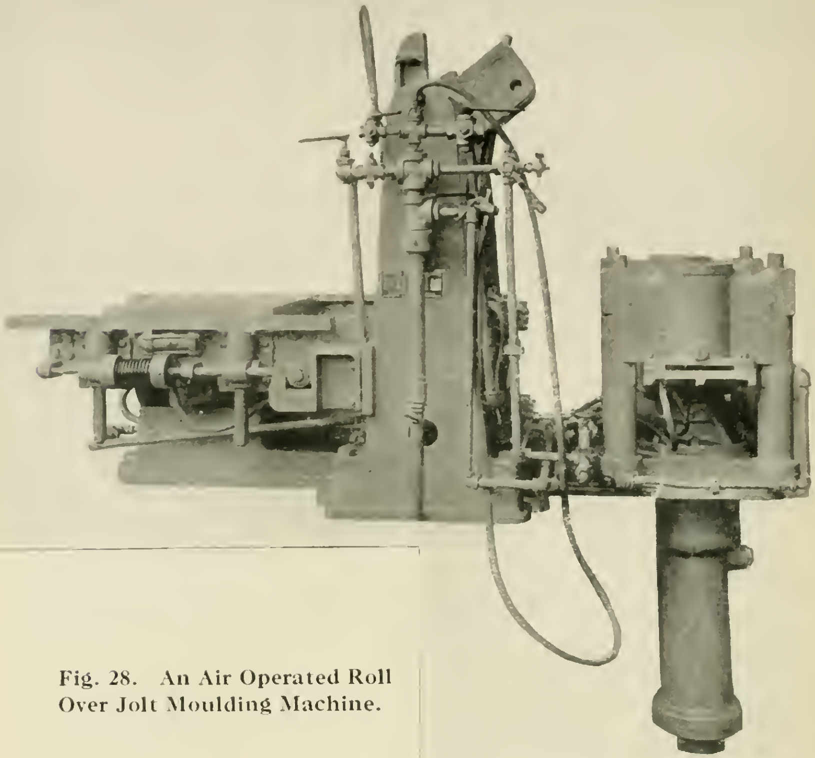


Fig. 28. An Air Operated Roll Over Jolt Moulding Machine.

The time required for hand ramming is approximately 50 per cent of the total time required in floor moulding, and the jolt ramming feature of the machine practically eliminates this time, as the machine will jolt ram the mould in from 5 to 30 seconds, and it can be "butted off" in less than a minute on medium size moulds. The advantage of the time saved is important, but it is not the only benefit. The bettering of the quality of the castings obtained is a direct consequence of the uniformity of the jolt ramming operation. This applies to the accuracy of the shape of the casting as well as to the accuracy of reproduction.

Roll Over Operation

The roll over operation saves a large amount of time on each mould, although it does not contribute directly toward the production of a higher quality of casting. The saving in time, as compared to rolling over by the crane, is due to the following factors:

1. There is no waiting for the crane.
2. The clamps and wedges used in rolling over are always accessible, since they are always in the same place and the workmen have standardized their method of operation. This is contrasted with floor moulding, where each mould is rolled over on a new location and clamps and wedges must be moved from place to place as demanded.
3. Standardized clamps for bottom boards require less time and are adopted as a part of the machine equipment, whereas they would not be standardized for floor work.
4. The actual speed of rolling over is greater, due to the stability and steadiness of the machine.
5. A suitable place for the rolled over mould is always available on the machine, whereas in floor moulding a portion of the floor must be leveled off for each mould.

The roll over operation is accomplished in the different designs of machines by various methods, based upon various mechanical principles. The machine illustrated in Figure 28 rolls about a center located in the center of the machine at the highest point. Two arms reach down inside of the vertical members, extending thence horizontally to the left, where the pattern plate and flask are mounted. The roll over power is developed by an air operated cylinder which pulls down on a lug extending to the right from the roll over center, and in this way rolls the pattern and flask upward and over until the flask is directly over the leveling device seen at the extreme right of the photograph. It is readily seen that the principle employed is that of a lever having a force applied on one end and the weight acting on the other.

The machine illustrated in Figure 29 operates on the same general principle, and is shown with the table in a partly raised and rolled over position. In this case, however, the axis of rotation is on a line which is about at the floor level. An auxiliary axis of rotation is located at the end of the movable arms, and the table rotates about this axis also.

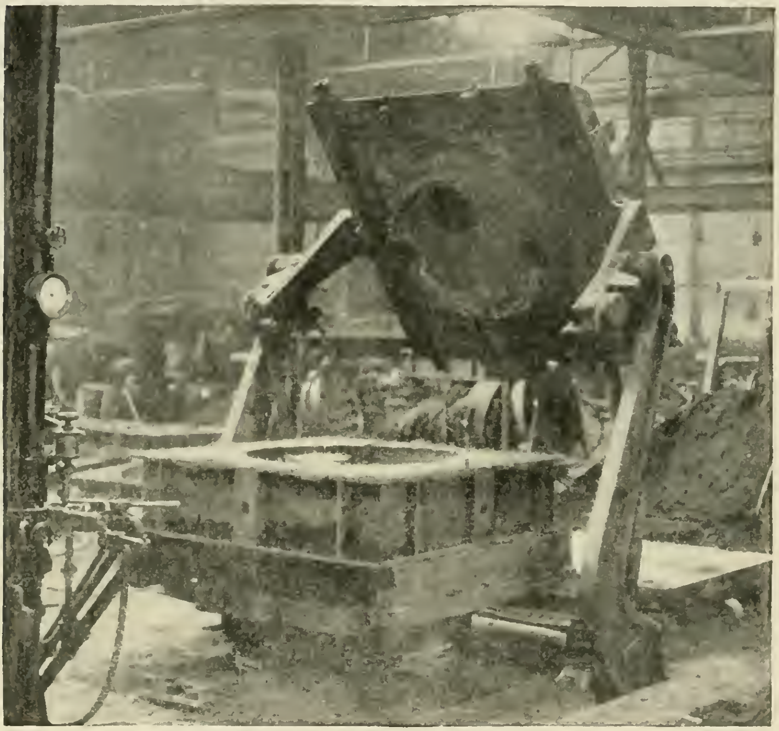


Fig. 29. The Mould is Finished and the Table is Returning to its Original Position.

The machine illustrated in Figure 31 rolls over about the center of gravity of the mould. The center of rotation is the trunnion shown at the extreme left of the machine.

The machine illustrated on page 40 also rolls over about the center of gravity of the mould. The force is developed by the cylinder shown in the right foreground near the bottom of the machine, and is transmitted to the trunnions supporting the roll over table, causing them to rise. As the table rises it automatically rolls over before it reaches the top of its stroke. This rotation takes place about the approximate center of gravity of the mould.

The methods of operating some of the typical types of roll over machines are as follows:

The machine illustrated in Figure 28 is controlled by the valves in the center foreground. The table is shown in the jolting position at the left, and is ready for the pattern to be placed upon it. After the pattern has been placed on the table, the flask is placed on the pattern plate, filled with sand and jolt rammed by the action of an air cylinder. The mould is then rolled over. This is accomplished by a piston pulling down on the lug which is shown extending to the right and upward from the center support of the machine, and causes the table at the other end of the lever to roll over. As the table leaves the horizontal position at the beginning of its roll over movement, the pattern is automatically locked to the roll over table by an air operated device. The opening of another valve causes the piston in the cylinder shown at the lower right hand corner of the illustration, to rise, carrying with it the four leveling pins, which are shown. These pins are air operated and take up

Fig. 30. Showing Clearly the Method of Pattern Mounting Employed.

any irregularities in the thickness of the bottom board, after which they are locked and the clamps are removed from the flask, allowing the flask to be supported on its bottom board by the leveling pins. The leveling table is now dropped vertically downward, leaving the pattern attached to the roll over table, which is rolled back to its original position at the left, ready for the making of the next mould.

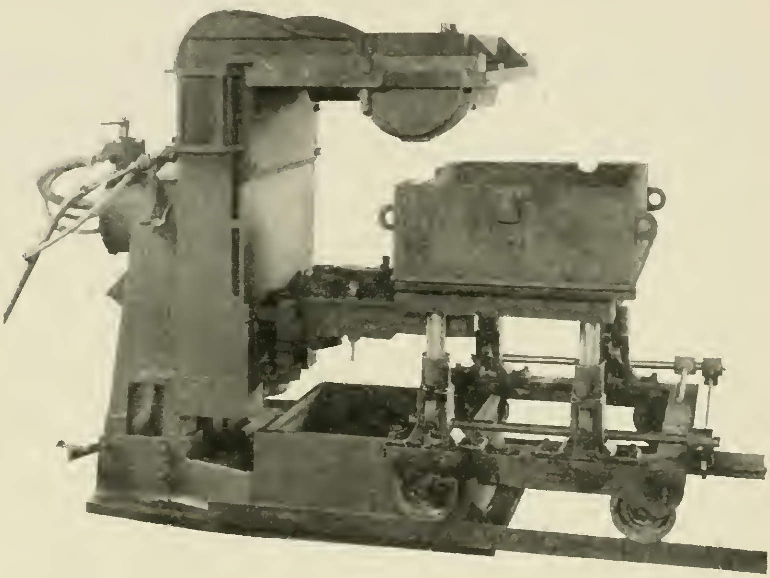


Fig. 31. A Machine with Hand Roll Over and Power Jolt Mechanism.

Another typical roll over machine is shown on page 40. The method of making a drag mould on such a machine is as follows:

The pattern is assumed to be mounted on a plate with suitable means for fastening to the roll over table of the machine which is shown in the illustration at the upper left hand side. The flask is placed around the pattern, filled with sand, and jolt rammed. While jolt ramming, the sand is spread from the center to the edges of the flask, so that the butting off operation can be immediately and quickly performed. The bottom board is next bedded on and clamped to the mould, after which the mould is rolled over by air power operating a piston in the cylinder, shown at the lower right hand corner in the illustration on page 40. This motion is transmitted to the trunnions supporting the roll over table. As these trunnions rise vertically, the table rises with them and a pair of chains, which are coiled about the semi-circular ends of the table, retard the movement of one side of the table, causing it to roll over. The leveling car is then pushed underneath the roll over table, the table lowered until the bottom board depresses each of the pins a slight amount, the pins are locked and the clamps are removed, leaving the weight of the flask supported by the leveling car, and the pattern equipment supported by the roll over table. Aided by the vibrator, the pattern is drawn vertically upward from the mould, which is then pushed out on the leveling car, and the table is rolled back to its initial position, ready for the making of the next mould.

The series of operations discussed for the two machines above are typical of the various types of Roll Over machines, and while minor differences in the operations will exist, due to differences of design and construction, yet the fundamentals have been stated above. It is well to bear in mind that these machines have three major functions.

1. The Jolting of the Mould.
2. Rolling it over.
3. Drawing the pattern.

Roll Over Construction

The construction of the various parts of the roll over apparatus varies, of course, as widely as the methods employed. Some factors are, however, common to all of the methods. These are as follows:

1. The action of the jolting feature of the machine demands heavy, strong parts which will have a long life under hard service.

2. Since the machine operates in practically a shower of dirt and dust, all working parts must be protected from the action of the sand. Parts which cannot be totally enclosed in sand proof chambers should have every protection applied to them in the way of tight fitting bushings and proper design of parts so that sand will shed away from such places rather than accumulate and wear in.
3. The subsequent accuracy of the pattern drawing operation depends absolutely upon the accuracy of the position of the roll over table at the completion of rolling over. It is most important, therefore, that the table shall be properly aligned, and that all working parts shall be carefully fitted so that great accuracy is obtained in the final position of the table.
4. It is of importance that the parts of the roll over mechanism should be so designed that they will require a minimum of air consumption for the operation, and so that undue weight will be avoided.

Pattern Drawing Operation

This operation is very important from two viewpoints—it is a valuable source of time saving, both directly and indirectly, and it promotes, in a great measure, the higher quality of castings produced. The pattern drawing operation as accomplished on the Roll Over type of machine, usually requires about 5 to 30 seconds and when this is compared with the lengthy process employed in floor moulding, the gain in the direct time saved becomes at once apparent. Indirectly also, time is saved in that the pattern drawing operation is accurate to within an amount less than the taper of the pattern, so that the sand in the mould is left undamaged, and need not be slicked and patched. These useless operations of slicking and patching require a great amount of time when the pattern is drawn by hand, as there is always more or less damage done to the mould in that case. These operations of slicking and patching are a total loss of time, and the machine, in eliminating them, saves time.

The method of accomplishing the pattern draw varies in the different designs of machines. It is immaterial whether the roll over table is moved upward away from the leveling table, or whether the leveling table is moved downward from the roll over table—the result accomplished is the same. In all cases the pattern is supported by the roll over table and the mould must be supported by the leveling table, which is either movable or stationary, and is provided with some means of equalizing the variations or inequalities of the bottom board. Ordinary wedges or depressable pins are commonly used for this purpose.

The machine illustrated on page 40 draws the pattern by lifting it upward from the flask. The machines illustrated in Figures 28, 31 and 32 all draw the pattern by lowering the mould away from the stationary pattern.

The principal points of interest are not in the method of accomplishing the movement, but rather in the accuracy with which the roll over table is held at right angles to the line of pattern draw, and in the accuracy with which the flask is brought to exact right angles with the line of pattern draw before its weight is released from the roll over table and allowed to rest on the leveling table. One of the greatest difficulties is in deflection of the roll over table or of the leveling device. If, when the mould is released from the roll over table, the decrease in weight supported by it causes the table to spring slightly, the pattern will move in the sand, and will break up the mould before the pattern draw is even started. The same conditions will exist if the weight of the flask causes the leveling table to deflect, for if the pattern, attached to the roll over table, remains stationary and the mould should tip slightly the result would be a damaged mould. It is essential that the pattern be moved in a straight line, and the accuracy of the straight line motion is necessarily destroyed by any looseness in the fit of the bushings located in any of the members causing this motion. Accordingly, too much care cannot be taken with the design of bushings and bearings and with the accuracy with which they are fitted.

The question of removing the finished mould from the machine is usually considered in the design of the leveling table. In some cases the leveling table is provided with wheels and is run out from under the roll over table. This method is used in the machine illustrated on page 40. In other cases, such

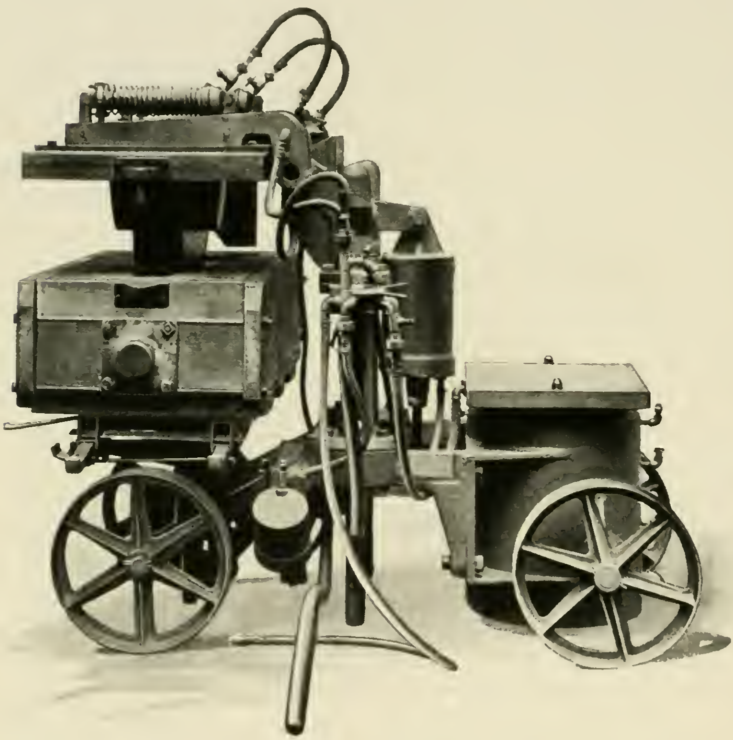


Fig. 32. A Portable Roll Over Jolt Machine for Small Moulds.

as the one illustrated in Figure 28, the leveling table remains stationary, and the roll over table returns to its original position, far enough removed from the leveling table position to allow the crane to take away the finished mould without interfering with the operation of making the next mould.

The advantages of machine pattern draw, as contrasted to hand pattern draw are far reaching, extending in fact from the foundry all the way to the machine shop and to the assembly floor where the casting is finally used, and also even to the Treasurer's Department which no longer pays for overweight castings. The pattern is drawn in approximately 5 to 30 seconds and this is in contrast to the old method of drawing a pattern where it must first be rapped, which damages it seriously, and which will damage the mould seriously before the pattern is drawn.

Machine Moulded Castings

Hand made castings vary from 5 per cent to 15 per cent in weight with corresponding variation in shape, whereas, machine moulded castings are identical as to weight and shape. In rough work, where great accuracy of shape is not a requirement of the parts, the variation in hand made castings is not a serious detriment to their use. On the other hand, the requirements for certain grades of castings are so exact that hand made castings do not measure up to the required specifications, and in such cases the uniformity of machine castings is of greater importance. The outstanding examples of this latter class of castings are those used in the automotive industry. As a rule, these castings are used by the thousands and the machine shops are specially equipped for the handling of each casting, with jigs and tools designed for it and with piece work rates set and procedure systemized to the last degree. In such cases a slight additional amount of metal here or there will seriously interfere with the use of the accurately fitting jigs, and will decrease the speed of the workman who is on a piece-work rate. Small metal allowances are also the rule, as for instance, in the embloc cylinders which have usually a 3/16 thickness of wall and 3/16 thickness of water jacket. The variation allowed is very minute and the overall allowances of variation in the castings are always so small as to be negligible.

The Making of a Drag Mould on the Floor Contrasted with the Roll Over Jolt Moulding Machine

Below is set forth a detailed comparison between the making of a mould by hand on the floor, and on the Roll Over type of machine. In comparing the operations, the viewpoint in mind should be the amount of physical labor necessary to perform each operation, the amount of time consumed, and the quality of the work done.

FLOOR

The Pattern Plate

A flat reinforced pattern plate of suitable size is placed on a leveled portion of the foundry floor.

Pattern

The drag half of the pattern, assumed in this case to be a split pattern, is laid on the board in the location that is desired.

Flask

The flask is placed on the pattern plate surrounding the pattern and in such relation to the pattern that there will be sufficient room for gating and sufficient sand thickness between the pattern and the flask.

Facing Sand

On all heavy and high grade work, facing sand is used; otherwise moulding sand is riddled onto the pattern.

MACHINE

Pattern

The pattern, mounted on the pattern plate, is attached to the roll-over table of the machine.

Flask

The flask is placed on the pattern plate, the pins locating it.

Facing Sand

On all heavy and high grade work, facing sand is used; otherwise moulding sand is riddled onto the pattern.

FLOOR

Sand

Sand is put into the flask either by hand shoveling, by grab buckets, or from an overhead bin. The method employed depends on the size of the flask and on shop equipment.

Ramming

The mould is rammed either by hand or by a pneumatic rammer, which is substantially the same size as the hand rammer, but is operated by a small air cylinder. This operation consumes approximately 50% of the total moulding time, and introduces the variable human factor into the density of the rammed sand. This operation also constitutes a large part of the hard physical labor of the foundry and contributes a large share towards making it such an unpleasant place in which to work.

Striking Off

Steel bars are better practice than wooden ones for striking off the flask. A wide strike off bar has been found to be very advantageous on small and medium size flasks.

MACHINE

Sand

Sand is put into the flask either by hand shoveling, by grab buckets, or from an overhead bin. The method employed depends upon the size of the flask and on shop equipment.

Ramming

The mould is rammed by jolting, accomplished by power and controlled by a valve. The butting off is done by hand.

Striking Off

Steel bars are better practice than wooden ones for striking off the flask. A wide strike off bar has been found to be very advantageous on small and medium size flasks.

FLOOR

Bottom Board

The bottom board is fitted into place by scattering a handful or two of sand over the surface of the mould and working the board back and forth over it to obtain a uniform bearing at all points.

Clamping the Bottom Board

"C" clamps are employed, being tightened by means of wedges. The clamps must be moved from one location to another on the floor as the moulds are put up.

Rolling Over

The rolling over of a mould involves the use of a crane on medium and large size moulds, and frequently calls for the assistance of several other men besides the moulder and helpers working on the mould being rolled over. The danger of a damaged mould, due to the shifting of the bottom board, is always present. Delays while waiting for the crane, or for other workmen, are common. Extra space is always required in an already busy foundry. This must be cleared especially for the pur-

MACHINE

Bottom Board

The bottom board is fitted into place by scattering a handful or two of sand over the surface of the mould and working the board back and forth over it to obtain a uniform bearing at all points.

Clamping the Bottom Board

Either "C" clamps or special clamps are used.

Rolling Over

Power applied to the machine automatically rolls the mould over.

Floor	**Machine**
pose. After rolling over, the bottom board is unclamped.	
Drawing the Pattern	Drawing the Pattern
The pattern is first rapped by means of a rapping pin inserted into the rapping plate which has been built into the pattern for the purpose. The pin is rapped back and forth and from left to right with a hammer or mallet, loosening the pattern in the sand so that it may be withdrawn with as little damage to the mould as possible. The lifting handle is then inserted in the plate provided in the pattern and the pattern drawn as nearly straight upward as possible, taking care not to damage the mould any more than can be avoided.	The vibrator is placed in operation and the machine draws the pattern.
Slicking and Patching	Slicking and Patching
Some damage is invariably done in drawing the pattern, and the moulder now slicks over these places and patches up any broken corners or surfaces. These two operations are very detrimental to the shape and size of the casting, and also impede the escape of the gases at the time of pouring. In addition, this op-	Not required.

FLOOR

eration frequently consumes more time than any other one operation connected with making moulds, and as the time thus spent is a total loss, the inefficiency of such a method is great.

Preparing for the Next Mould

The pattern plate, wedges, clamps, patterns, rapping and slicking tools must now all be moved to the next location on the foundry floor. This involves a large amount of time spent in leveling the place on the floor upon which to work and in moving small tools and equipment; all of this time is non-productive.

MACHINE

Preparing for the Next Mould

The machine upon completing one mould, is ready for the making of the next.

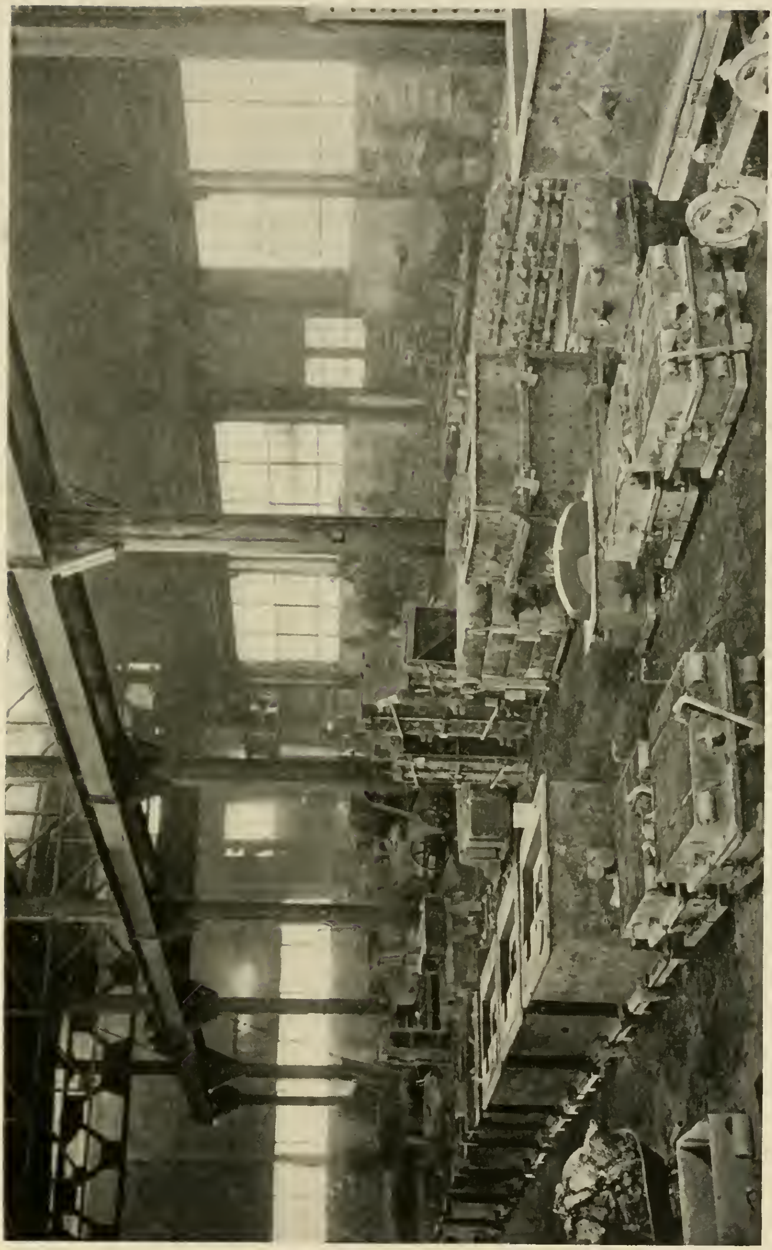


Fig. 33. The Result of One Day's Work by Four Men and a Moulding Machine.

Fig. 34. A large Roll-Over Jolt-Moulding Machine, with Foundations Cut Away to Show the Construction Underneath the Foundry Floor.

CHAPTER IV

Roll Over Jolt Moulding Machines For Large Size Molds

Large moulds, as referred to in this chapter, will be considered to include moulds of from 3,000 to 20,000 pounds in weight. Manufacturers commonly rate their machines in terms of the maximum load and the maximum flask sizes. Flasks ranging in length from 72″ to 150″ are usually regarded as of a size requiring large Roll Over Machines.

The principles of construction and operation of the large Roll Over Jolt Machines have already been covered in the preceding chapter, and the reader is referred there for details.

The handling of the large size moulds with their attendant heavy equipment brings up the question of the crane equipment necessary for handling of patterns, flasks, bottom boards, moulds, setting cores and closing moulds. The use of a crane for so many operations would seem to necessitate an exceptional amount of crane service but when the number of moulds produced per day is considered, it will be seen that a large machine requires about the same amount of crane attention as a medium size machine. The machine does not add to the demands upon the crane, but rather lessens them. For instance, a foundry may be employing a number of floor moulders, all being served by the one crane. In changing over to machine moulding, say, for example, two moulding machines would be used to put up the same total number of moulds, using fewer men but the same crane. This crane would now be relieved of rolling the moulds over and of drawing the patterns, these operations being performed by the machines.

The output of large machines, measured in tonnage produced, does not vary greatly from the output of medium size machines as the greater weight per casting is just about evenly offset by the smaller number of moulds produced. When the figure is reduced to a "tons per man" basis, it increases somewhat with the size of the machine used.

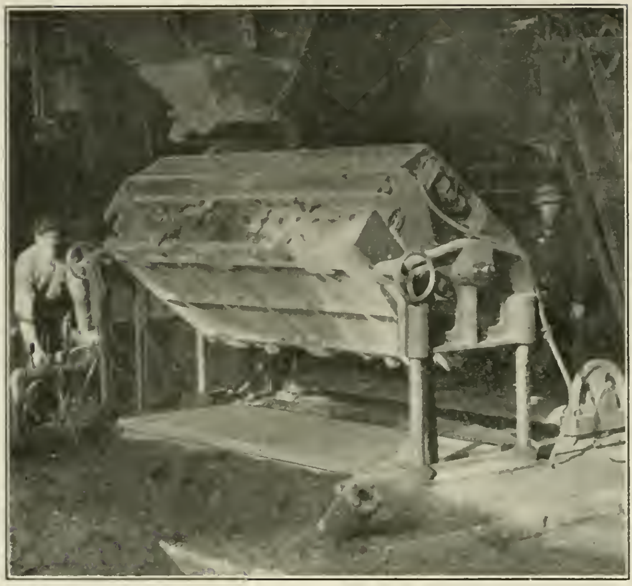


Fig. 35. Tunnel Segment Mould — Lower or Drag Half — Made on a Roll-Over Jolt Machine. In the view shown above, the machine is rolling over the mould after it has been jolted and bottom board clamped.

After the rolling-over operation is completed, the mould is lowered on the run-out car, shown in the rear, clamps removed and pattern drawn from the mould.

The lower view shows the completed lower half or drag mould before the cores are set.

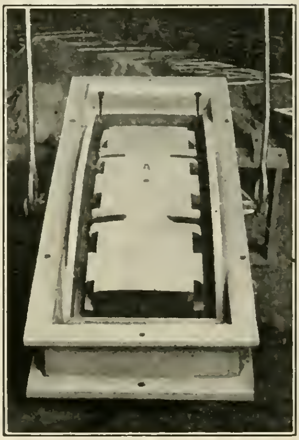
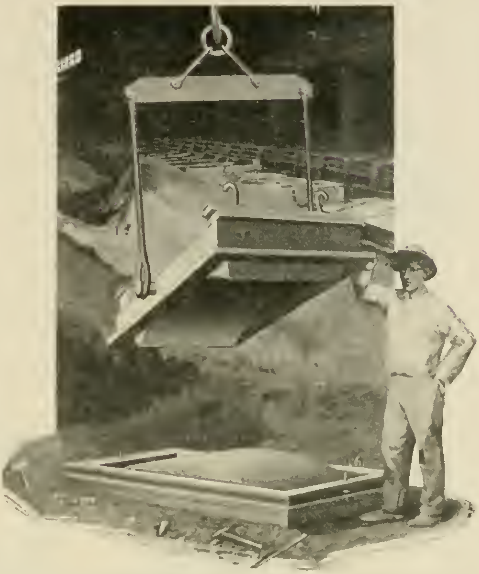
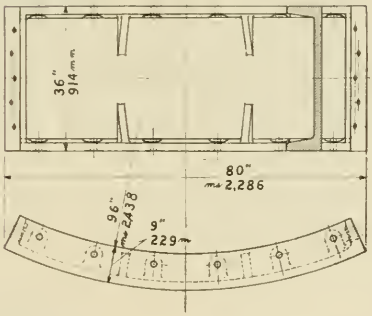


Fig. 36. Tunnel Segment Mould—Upper Half or Cope—Made on a 42″x97″ plain jolt-moulding machine.



Tunnel Segment Casting Weighing 1500 Pounds. Used in making tunnel linings for the New York subway system.



PRODUCTION

Method of Moulding	No. Men	Hours	Quan. Moulds	% Increase
Without Machine....................	2	9	7	...
Cope—42″x97″ Plain Jolt............ Drag—42″x97″ Plain Jolt............	2	9	14	100%
Cope—42″x97″ Plain Jolt............ Drag—42″x106″ R. O. Jolt...........	6	9	*141	570%

* With sand conveying system.

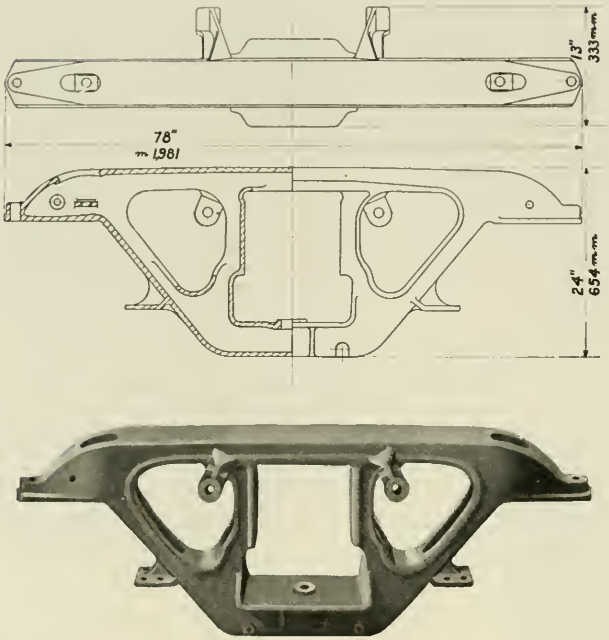


Fig. 37. Railway Truck Frame Steel Casting—Weight 470 Pounds. The standardization of railway equipment has resulted in large quantity production of the various castings.

The production figures given below are based on using two machines of the Roll-Over Jolt type—one for the lower or drag half and the other for the upper or cope half of the mould.

PRODUCTION

Method of Moulding	No. Men	Hours	Quan. Moulds	% Increase
Without Machine..........	5	9	15	.....
Cope—42"x97" Plain Jolt....... Drag—42"x97" Plain Jolt..........	5	9	*40	166%
Cope—42"x106" R. O. Jolt........... Drag—42"x106" R. O. Jolt...........	7	9	*120	470%

*With sand conveying system.

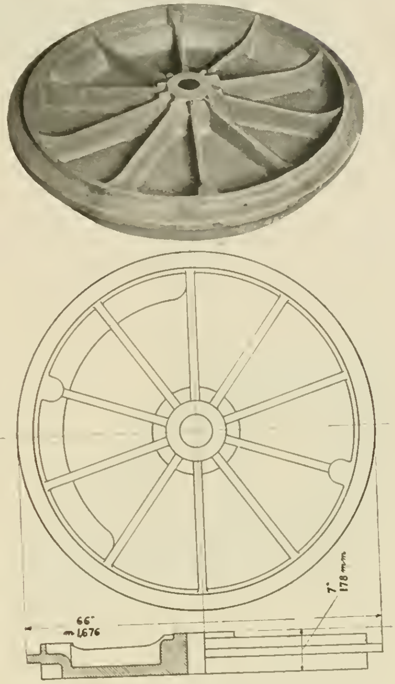


Fig. 38. **Marine Engine Cylinder Head—Weight 2400 pounds.**

The shipbuilding industry has not attained the quantity production shown on the preceding pages, yet a very great saving can be made by the use of moulding machinery on smaller quantity production as is shown in the following tabulations.

The production figures given below are based on making the cope and drag moulds on the same machine.

PRODUCTION

Method of Moulding	No. Men	Hours	Quan. Moulds	% Increase
Without Machine....................	4	9	1	.....
Cope—72"x72" Plain Jolt............. Drag—72"x72" Plain Jolt.............	4	9	2	100%
Cope—60"x92" R. O. Jolt............ Drag—60"x92" R. O. Jolt............	4	9	3	200%

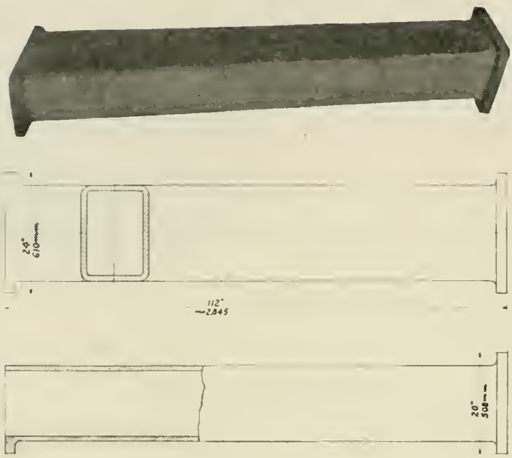


Fig. 39

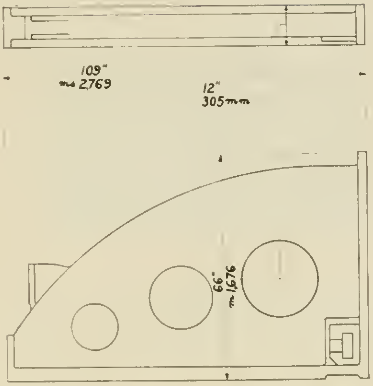
Marine Engine Column—Weight 4000 pounds.

Where the quantity of castings required from one pattern is not sufficient for continuous production, or even for a full day's production, any number of different patterns can be used during the day. The changing of the pattern on the Roll-Over Jolt-Moulding Machine requires only a few minutes of time.

The production figures given below are based on making the cope and drag moulds on the same machine.

PRODUCTION

Method of Moulding	No. Men	Hours	Quan. Moulds	% Increase
Without Machine..................	4	9	1	.....
Cope—42"x97" Plain Jolt.......... Drag—42"x97" Plain Jolt........	4	9	2	100%
Cope—66"x150" R. O. Jolt........ Drag—66"x150" R. O. Jolt........	4	9	5	400%



A large number of machine tool castings are adaptable for machine moulding, particularly on the Roll-Over Jolt type of machine.

In some instances, where a casting does not readily lend itself to machine moulding, a slight change can be made in the design without impairing its utility or strength, thereby making it possible to mould on machines.

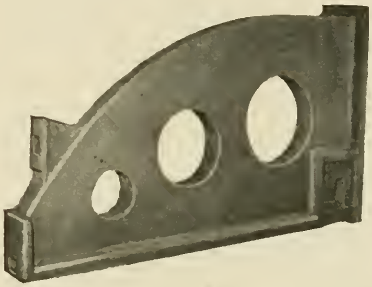


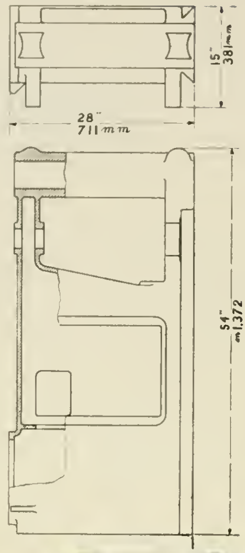
Fig. 40

Planer Housing Casting—Weight 5000 Pounds

The production figures given below are based on making the cope and drag moulds on the same machine.

PRODUCTION

Method of Moulding	No. Men	Hours	Quan. Moulds	% Increase
Without Machine	4	9	1	.....
Cope—72"x72" Plain Jolt Drag—72"x72" Plain Jolt	4	9	2	100%
Cope—66"x150" R. O. Jolt Drag—66"x150" R. O. Jolt	4	9	5	400%



Milling Machine Column.
Weight of Casting—
700 Pounds

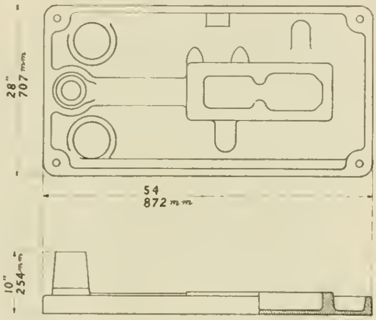
A 45"x72" Roll-Over Jolt-Moulding Machine made both the upper or cope half and lower or drag half of the mould for producing this casting.

The production figures given below are based on making the cope and drag moulds on the same machine.

Fig. 41

PRODUCTION

Method of Moulding	No. Men	Hours	Quan. Moulds	% Increase
Without Machine..........	4	9	4	.....
Cope—54"x66" Plain Jolt..... Drag—54"x66" Plain Jolt......	4	9	8	100%
Cope—45"x72" R. O. Jolt... Drag—45"x72" R. O. Jolt...	4	9	14	250%



A Milling Machine Base Casting made on a Roll-Over Jolt-Moulding Machine having an over-all flask capacity of 45″ in width by 72″ in length. This machine is capable of jolting and rolling over half moulds up to 4,000 pounds in weight.

Fig. 42

Weight of Casting—1040 Pounds.

The production figures given below are based on making the cope and drag moulds on the same machine.

PRODUCTION

Method of Moulding	No. Men	Hours	Quan. Moulds	% Increase
Without Machine....................	3	9	4	.....
Cope—54″x66″ Plain Jolt............ Drag—54″x66″ Plain Jolt............	3	9	8	100%
Cope—45″x72″ R. O. Jolt........... Drag—45″x72″ R. O. Jolt............	3	9	18	350%

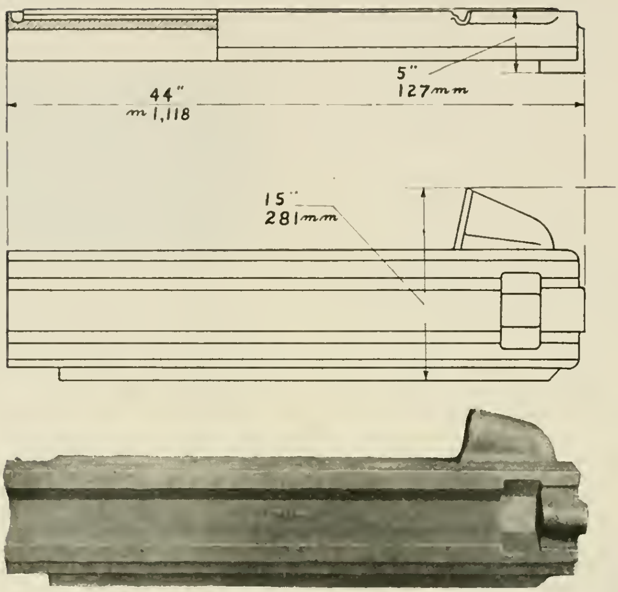


Fig. 43

Milling Machine Table Casting—Weight 500 Pounds.

A 45"x72" Roll-Over Jolt-Moulding Machine made the moulds for producing this casting. Its simplicity in design makes possible a large production by hand moulding, yet a very large increase has been obtained by machine moulding, as noted in the following tabulation.

The production figures given below are based on making the cope and drag moulds on the same machine.

PRODUCTION

Method of Moulding	No. Men	Hours	Quan. Moulds	% Increase
Without Machine...	3	9	11	...
Cope—42"x60" Plain Jolt............ Drag—42"x60" Plain Jolt............	3	9	18	64%
Cope—45"x72" R. O. Jolt........... Drag—45"x72" R. O. Jolt...........	3	9	32	190%

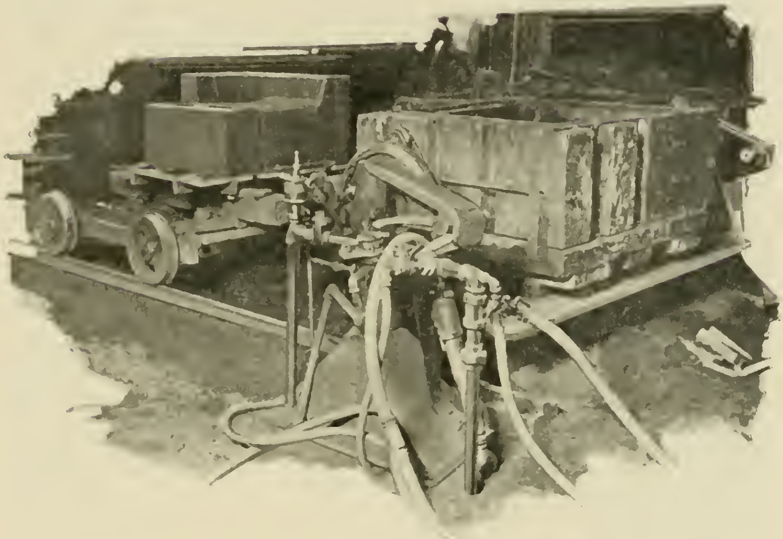


Fig. 44. A Large Roll Over Machine Used in the Core Room.

Fig. 45. A Roll Over Jolt Moulding Machine Suitable for Making Medium Size Molds.

CHAPTER V

Roll Over Jolt Moulding Machines For Medium Size Moulds

Medium size moulds are considered to include those ranging in weight from 1,000 to 3,000 pounds, and from 44″ to 64″ in length. Such a class of work requires a crane for handling flasks and moulds, but the bottom board and cores can usually be handled by hand. The machine illustrated on page 70 is a machine belonging to the class which produces medium size moulds.

Medium size moulds, being of moderate weight, demand a production of a large number of moulds per day, in order to keep the figure of "pounds of iron per man per day" as high as it should be. Since high production is important, it is advisable to touch on a few points in regard to the methods of producing the cope and drag moulds. This is solved in a wider variety of ways on this type of machine than on any other. The simplest method is to produce drag moulds in the forenoon, change patterns in the middle of the day, and then to produce cope moulds to go with the drags. The disadvantage of this method is that production is limited, and that the drag moulds, which remain on the floor for several hours before being closed, are liable to physical damage, settling dust and drying out. It is the practice in some shops to avoid the undesirable feature of having drag moulds sit on the floor for several hours by making six or eight drag moulds, changing patterns, making six or eight cope moulds and then repeating the cycle. This requires very rapid methods of changing patterns, or too much time will be lost in making the changes. The most obvious remedy, where larger production is desired, is the employment of two Roll Over Machines, one producing copes, while the other produces drags. The drag moulds are then closed as rapidly as they are made, and a very desirable competition is established between the crews of the drag and cope machines, and, at times, between the core setters and the machine crews. The utilization of the competitive spirit is an excellent aid to production.

A variation of this method, in large quantity production, is the use of a Roll Over Machine for the drags and of a Stripper Machine for the copes. When using a Roll Over Machine for making copes, the crew operating the cope machine have a harder task than those operating the drag machine, on account of their having to form a gate in the cope, and also because of the frequent necessity of setting gaggers in the cope. This condition is, however, reversed when a Stripping Plate Machine is employed for making the cope, as the crew operating the cope machine can then easily produce more moulds than the crew operating the Roll Over Machine, making drags. In fact, it has been found possible for a single Stripping Plate Machine to keep up with two Roll Over Machines making drags, and this unit of three machines provides a highly efficient disposition of men and machines, resulting in a high production. The competitive spirit which is introduced into the work can be used to good advantage.

All the methods discussed thus far have dealt with the mounting of one pattern, or at least of only one flask on a machine, using a machine of the proper capacity and size. An alternative method frequently employed is the use of a machine large enough to accommodate two moulds side by side. The machine shown in Figure 131 produces both a cope and a drag half at each operation, since the cope and drag patterns are mounted side by side on the Roll Over Table. This same method is employed in conjunction with the Stripping Plate Machine. Figure 132 illustrates the mounting of two drag patterns side by side on the table of the Roll Over Jolt Moulding Machine. A small Stripping Plate Machine operates twice as fast as the Roll Over Machine and produces enough copes for all of the drags.

There remains one other method which is sometimes employed as an aid to production when the pattern is symmetrical about both center lines, that is, the center line joining the pins and the line perpendicularly bisecting this line. The same pattern may then be used for making both cope and drag moulds. In some cases where one half of the gate is mounted on the plate, the mould becomes essentially non-symmetrical about the principal center line and requires care in closing, as the cope mould must be turned end for end before closing. In order to avoid the possibility of closing the mould improperly, it is best, in all cases, to endeavor to keep the pattern and gates symmetrical about both center lines.

Fig. 46. A Medium Size Roll Over Machine.

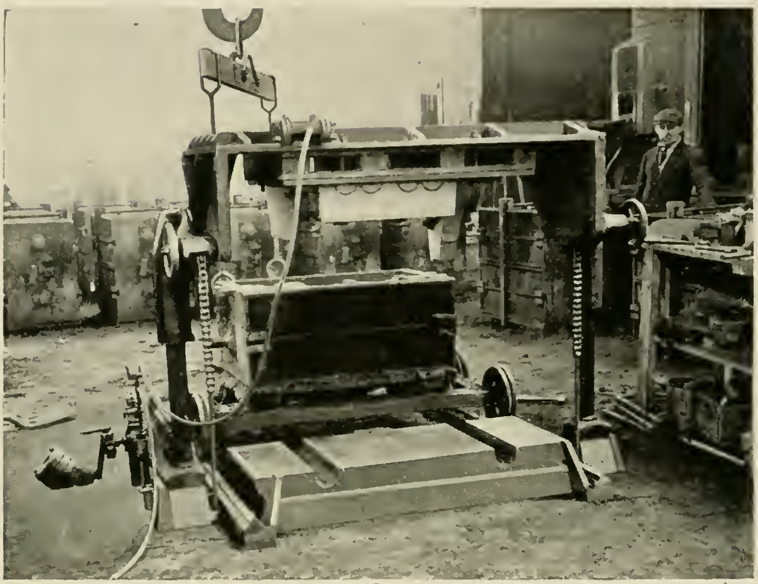


Fig. 47

Automobile Cylinder with Upper Half of Crank Case cast en bloc—Made on a Roll-Over Jolt-Moulding Machine.

This view shows the pattern drawn from the mould, which is deposited on the run-out car and ready for the crane to remove to the foundry floor for setting the core.

After sufficient drags have been made to begin core-setting, the drag pattern is removed from the machine and the cope pattern substituted. This changing of pattern consumes about five minutes in time, as only four bolts are used in securing it to the roll-over table.

Foundries producing these castings in large quantities find it advisable to use two machines in producing the mould—one to be used in making the cope half and the other the drag half of the mould.

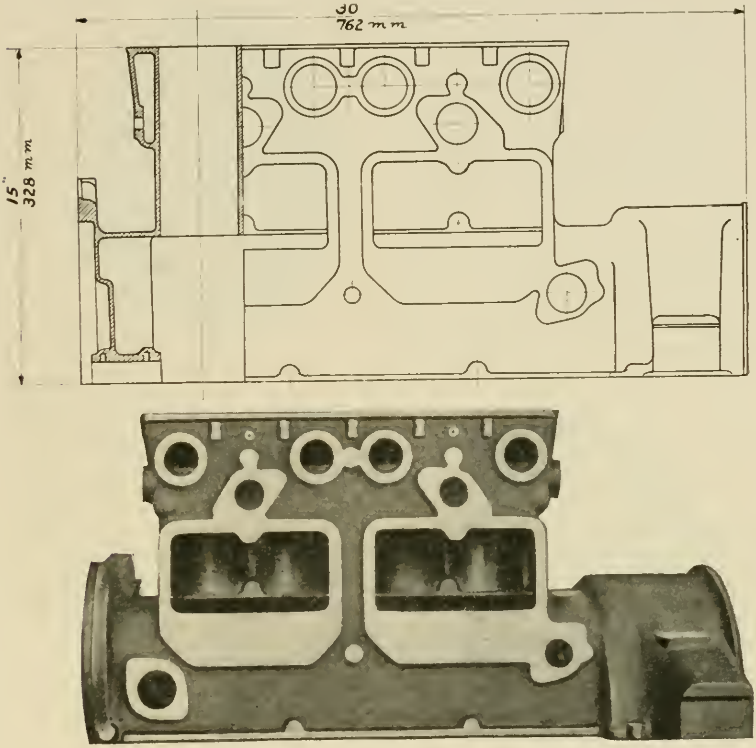


Fig. 48

Automobile Cylinder en bloc. Weight 175 Pounds.

The production figures given below are based on making the cope and the drag on the same machine.

PRODUCTION

Method of Moulding	No. Men	Hours	Quan. Moulds	% Increase
Without Machine....................	2	9	2	.....
Cope—36"x48" Plain Jolt............ Drag—36"x48" Plain Jolt............	2	9	4	100%
Cope—34"x64" R. O. Jolt............ Drag—34"x64" R. O. Jolt............	4	9	48	1100%

An Automobile Truck Wheel Produced in a Steel Foundry.

Beginning work in the morning, 10 to 15 drags are made, permitting the core-setter to start work. The drag pattern is then removed from the machine and the cope half of the mould is made. Rotation in this manner makes possible the closing of the mould before the floor is completely filled.

If the quantity is sufficient, it is advisable to use two machines, one for the cope and one for the drag.

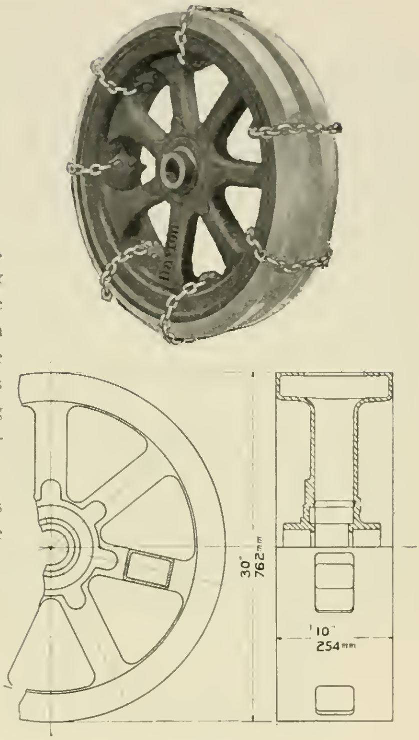


Fig. 49

Weight 240 Pounds.

The production figures given below are based on making the cope and drag moulds on the same machine.

PRODUCTION

Method of Moulding	No. Men	Hours	Quan. Moulds	% Increase
Without Machine.	3	9	9	. . . . .
Cope—42"x60" Plain Jolt. . . . . . Drag—42"x60" Plain Jolt.	3	9	18	100%
Cope—34"x64" R. O. Jolt. . . . Drag—34"x64" R. O. Jolt. . . .	3	9	45	400%

Remarkable progress is being made on tractor work and the large quantity of castings required makes machine moulding a necessity.

A pair of 34″x64″ Roll-Over Jolt-Moulding Machines were used in obtaining the production noted below, one making the cope half and the other the drag half of the mould.

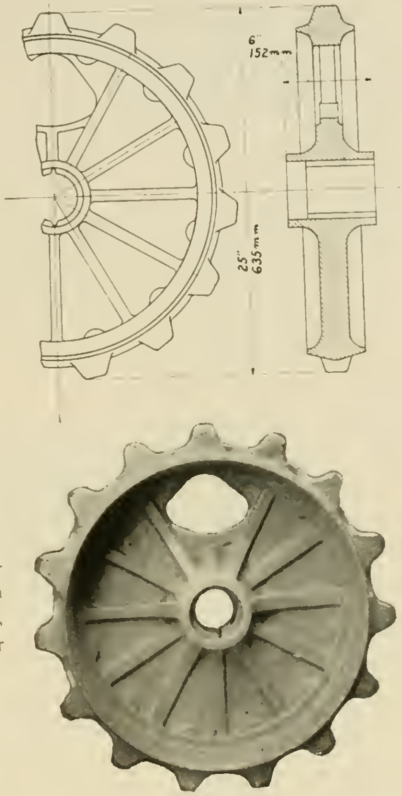


Fig. 50

Tractor Sprocket Wheel—Weight 115 Pounds.

PRODUCTION

Method of Moulding	No. Men	Hours	Quan. Moulds	% Increase
Without Machine....................	6	9	30	.....
Cope—36″x48″ Plain Jolt............. Drag—36″x48″ Plain Jolt............	6	9	60	100%
Cope—34″x64″ R. O. Jolt............ Drag—34″x64″ R. O. Jolt............	8	8	110	208%

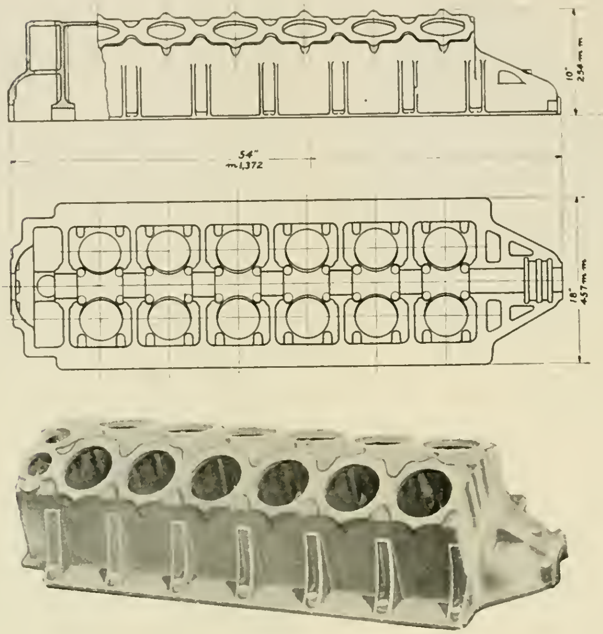


Fig. 51

The Upper Half of Liberty Motor Aluminum Crank Case — made on a 34"x70" Roll-Over Jolt-Moulding Machine.

The large production noted in the tabulation below was obtained with a pair of these machines, one making the upper or cope half and the other the lower or drag half of the mould.

Weight of Casting 100 Pounds.

PRODUCTION

Method of Moulding	No. Men	Hours	Quan. Moulds	% Increase
Without Machine....................	8	9	16	.....
Cope—42"x60" Plain Jolt............ Drag—42"x60" Plain Jolt............	8	9	32	100%
Cope—34"x70" R. O. Jolt............ Drag—34"x70" R. O. Jolt............	8	9	102	540%

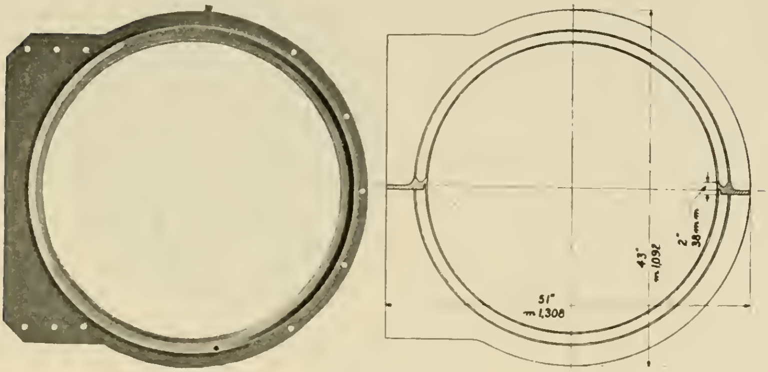


Fig. 52.

Weight 230 Pounds.

Steel Casting of a Lower Ball Race for 6 Ton Armored Truck.

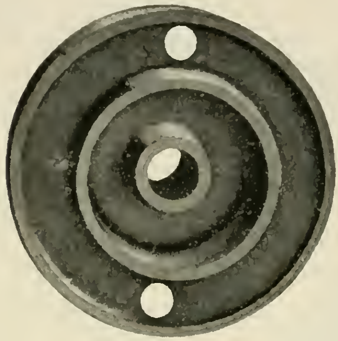
Made on a 32"x54" Roll-Over Jolt-Moulding Machine. A dense and uniform casting is very essential in work of this kind. Loss from defective castings is reduced to a minimum by machine moulding, thus making a saving in labor and metal and also increasing the production.

Production based on using one machine for both the cope and the drag half of the mould.

PRODUCTION

Method of Moulding	No. Men	Hours	Quan. Moulds	% Increase
Without Machine....................	3	9	20	.....
Cope—24"x36" Plain Jolt............ Drag—24"x36" Plain Jolt............	3	9	32	60%
Cope—32"x54" R. O. Jolt............ Drag—32"x54" R. O. Jolt............	3	9	45	125%

Milling Machine Drive Pulley.



Weight of Casting 150 Pounds.

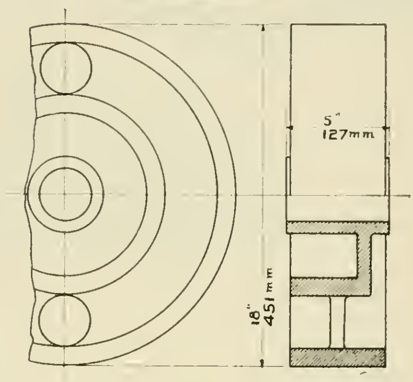


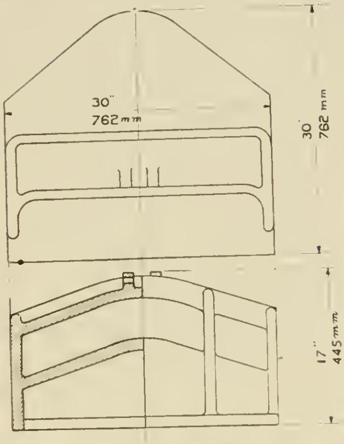
Fig. 53

Production based on using one machine for both the cope and the drag half of the mould.

PRODUCTION

Method of Moulding	No. Men	Hours	Quan. Moulds	% Increase
Without Machine.....................	3	9	20	.....
Cope—24"x36" Plain Jolt............ Drag—24"x36" Plain Jolt............	3	9	32	60%
Cope—32"x54" R. O. Jolt............ Drag—32"x54" R. O. Jolt............	3	9	45	125%

Casting Used in the Shipbuilding Industry.



Towing Chock. Weight 500 Pounds.

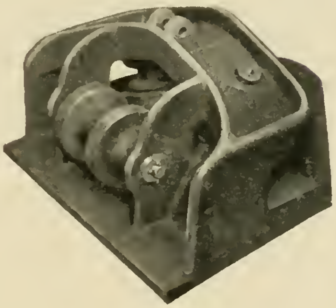
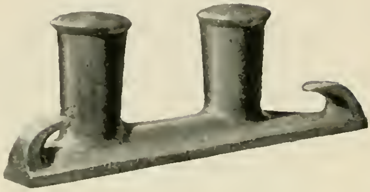


Fig. 54

Production based on using one machine for both the cope and the drag half of the mould.

PRODUCTION

Method of Moulding	No. Men	Hours	Quan. Moulds	% Increase
Without Machine	4	9	4	..
Cope—36"x48" Plain Jolt Drag—36"x48" Plain Jolt	4	9	8	100%
Cope—34"x64" R. O. Jolt Drag—34"x64" R. O. Jolt	4	9	20	400%



Casting Used in the Ship-building Industry.

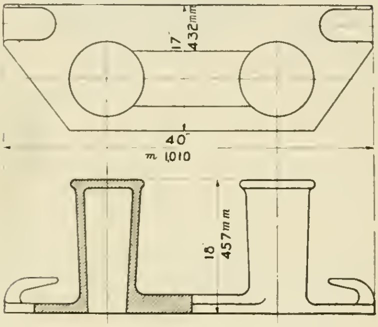


Fig. 55

Combination Mooring Timberhead.

Production based on using one machine for both the cope and the drag half of the mould.

PRODUCTION

Method of Moulding	No. Men	Hours	Quan. Moulds	% Increase
Without Machine.......	4	9	5	...
Cope—42″x60″ Plain Jolt.... Drag—42″x60″ Plain Jolt....	4	9	9	80%
Cope—34″x64″ R. O. Jolt... Drag—34″x64″ R. O. Jolt...	4	9	22	340%

Shipbuilding Industry

CASTINGS REQ'D		MACHINE MOULDING				HAND MOULDING			SAVING		
Name	Quant	R.O. Mach.	Out-Put	No. Men	Cost Each	Out-Put	No. Men	Cost Each	Value	%	Man Days
12" Bits - C	600	45"x72" 2 bx	30	4	$ .70	2	2	$5.25	$2730.	86	520
Core	2400	32"x54"	140	2	.086	16	1	.375	693.	77	116
TOTAL				6			3		3423.		636
9" Bits - B	1800	45"x72" 2 bx	35	4	.60	3	2	3.60	5220.	83	992
Core	7000	32"x64"	140	2	.086	36	2	.33	1780.	74	296
TOTAL				6			4		7000.		1288
6" Bit - A	600	34"x64"	40	3	.413	6	2	1.75	802.	76	155
Core	1200	22"x37"	150	1	.04	25	1	.24	240.	83	40
TOTAL				4			3		1042.		195
Mooring Rings Dwg. H-52 #d #o	1200 300	34"x64"	40	4	.525	9	6	3.60	4462.	85	850
Core #d #o	2400	22"x37"	100	2	.12	18	1	.33	630.	63	107
TOTAL									5092.		957

Fig. 56

Tabulation showing production by machine and by hand moulding on a number of ship castings. The total value of saving by machine moulding on the quantity noted amounts to $16,359.00.

The total amount of labor by hand moulding. . .	3,767 man days
The total amount of labor by machine moulding	691 " "
Saving in labor . . .	3,076 " "

Average percentage of saving. . . . 81%

Shipbuilding Industry

CASTINGS REQ'D	MACHINE MOULDING				HAND MOULDING			SAVING		
Name	Mach	Out Put	No Men	Cost Each	Out Put	No Men	Cost Each	Value	%	Man Days Per Mo.
Driving Coller (28" dia.)	32"x54"	40	2	.26	3	1	3.50	3.24	93	294
Windlas Side	32"x54"	24	2	.44	3	1	3.50	3.06	87	156
Several Small Elbows; Ash Gun Baffle Plate; Discharge Valve - Chest Liner	32"x54" or 22"x37"	40-50 of any of these	2	.21 to .26	4 to 6	2	1.75 to 2.62	1.54 to 2.36	88 to 90	520

Fig. 57

Total saving per month . . . $8,347.00
Total saving in labor . . . 970 man days
Average percentage of saving . . . 89%

CASTINGS REQ'D	MACHINE MOULDING				HAND MOULDING			SAVING		
Name	R.O. Mach	Out Put	No Men	Cost Each	Out Put	No Men	Cost Each	Value	%	Man Days Per Mo.
Housing Slides	34"x64"	40	3	.41	4	1	1.50	1.09	73	182
Winch Head (Cstg. 24" dia. Bot. (" 18" " top	34"x64"	40	3	.41	2	2	5.25	4.84	92	962
Anchor Chain Stopper	34"x64"	12	3	1.38	1 in 1-2/3 days	2	7.00	5.62	80	338

Fig. 58

Total saving per month . . . $8,076.64
Total saving in labor . . . 1,534 man days
Average percentage of saving . . . 84%

Fig. 59. A Floor of Automobile Casting Moulds in the Plant of the Allyne-Ryan Foundry Co., Cleveland, Ohio, U. S. A.

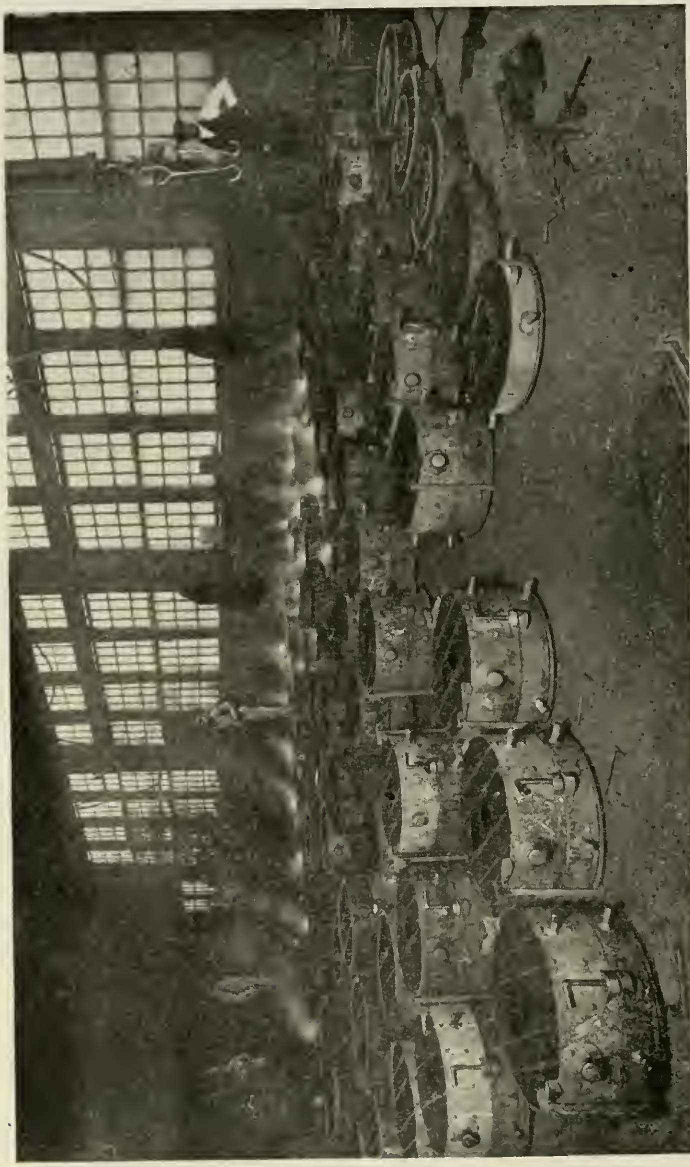


Fig. 60. The Day's Production in Semi-steel.

Fig. 61. The Farm Tractor Sprocket that was Made.

Fig. 62. At the Plant of The Interstate Foundry Co., Cleveland, Ohio, U. S. A.

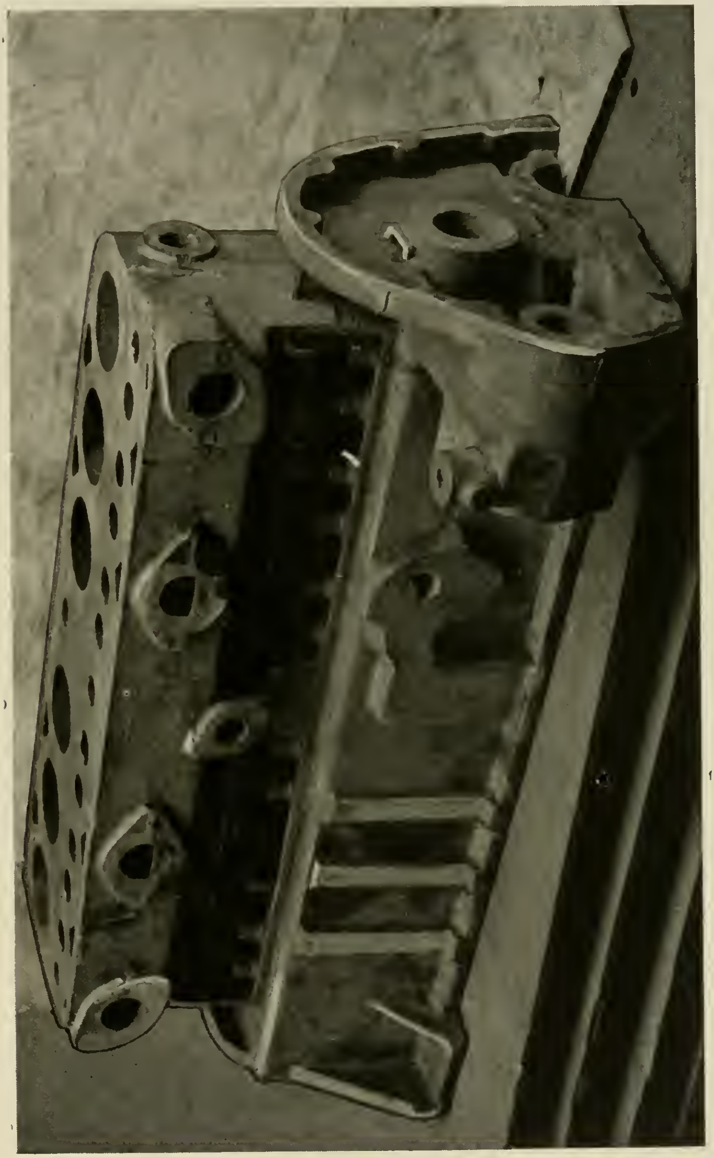


Fig. 63. Six Cylinder en bloc Automobile Casting Made From Above Moulds.

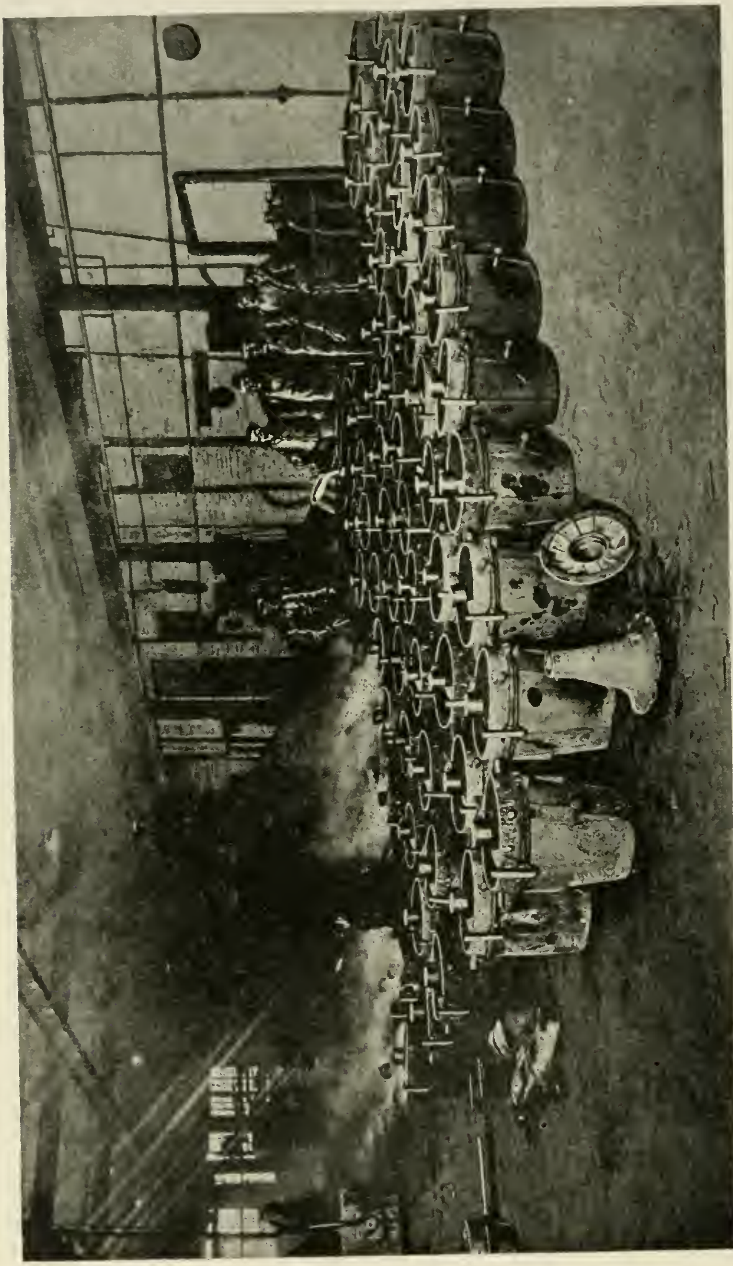


Fig. 64. Fordson Tractor Housing—Made by The Ferro Machine and Foundry Co., Cleveland, Ohio, U. S. A.

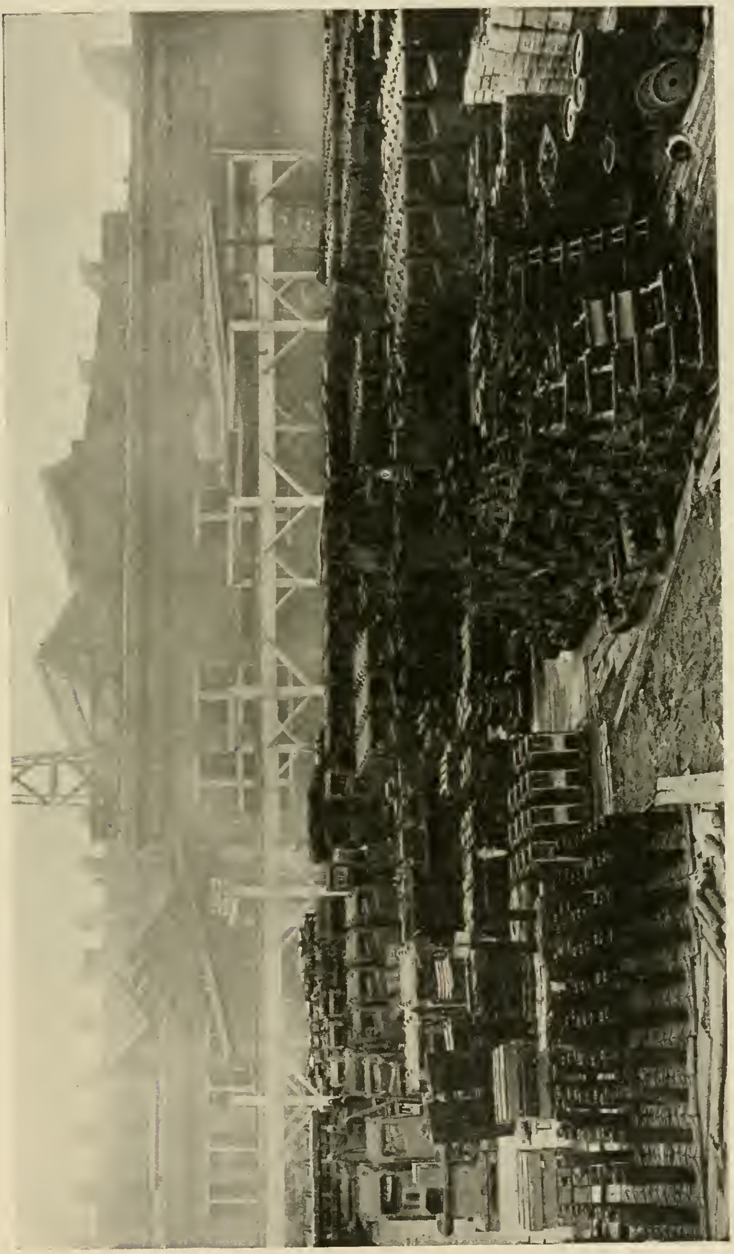


Fig. 65. Castings Produced by Machine Moulding at The Modern Foundry Co., Cincinnati, Ohio, U. S. A.

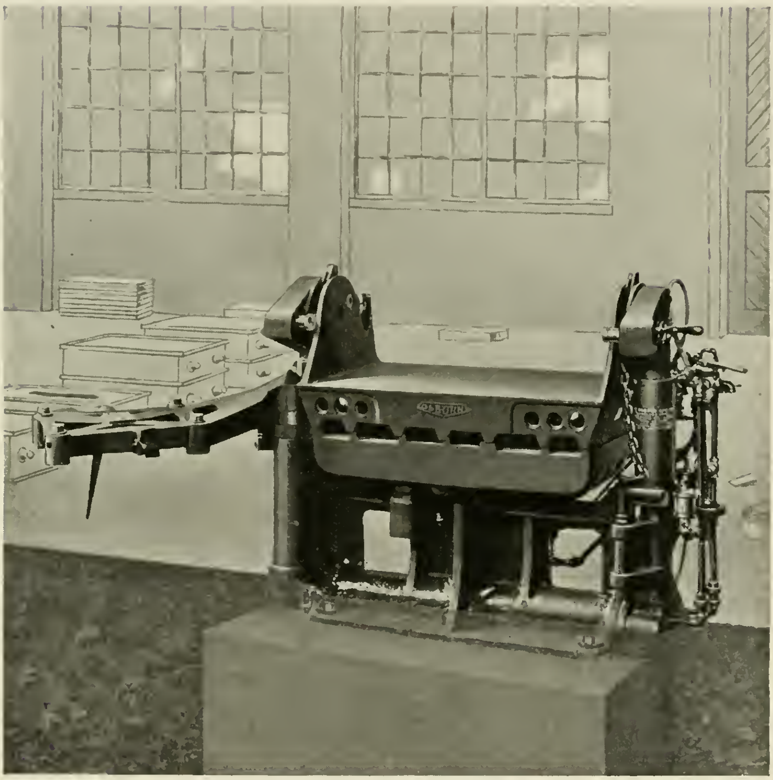


Fig. 66. A Small Roll Over Jolt Machine Showing the Foundation.

CHAPTER VI

Roll Over Jolt Moulding Machines for Small Moulds

The good results produced from the use of Jolt Moulding Machines on the large and medium size work, creates a demand for a Jolt Moulding Machine that will quickly handle the many small patterns adaptable to jolt moulding. The machine should be small, self contained and protected from sand and grit. It should not require a pit in which to set, nor should the falling sand from the flask obstruct its working. The different operations of the machine should be performed in the simplest manner possible and without consuming an excessive amount of time. Especially is this true of the operations other than the jolting of the mould, as when these operations are compared with the operations of a moulder making a mould on the floor, it is evident that he does not spend much time in clamping the bottom board onto the flask, or in the rolling over of the mould, and, therefore, these operations when performed on the machine and considered from the standpoint of time alone, require the utmost speed in the operation of the machine. However, there enters at this point an element not thus far considered, i.e., while the moulder when making the mould on the floor, can perform a few of the individual operations in the same time, or even faster than the machine, nevertheless, the performing of these operations throughout the entire day consumes the vitality and strength of the moulder, and it is a fact that in the latter part of the day his operations are neither as uniform nor as accurate and certainly are not nearly as speedy as they were at the beginning of the day's work; while the operations performed by machine power are constant throughout the entire day and demand very little effort on the part of the operator.

There was a time, now past, when these most vital points did not require the consideration that must now be given them, for at that time there was an abundance of skilled manpower available, workmen could be had to perform these tasks at a low rate of wages, and in order to secure a livelihood the workman produced a large day's work at the expense of breaking down his health and strength. Conditions, however, have changed and those days have seemingly passed forever, as the

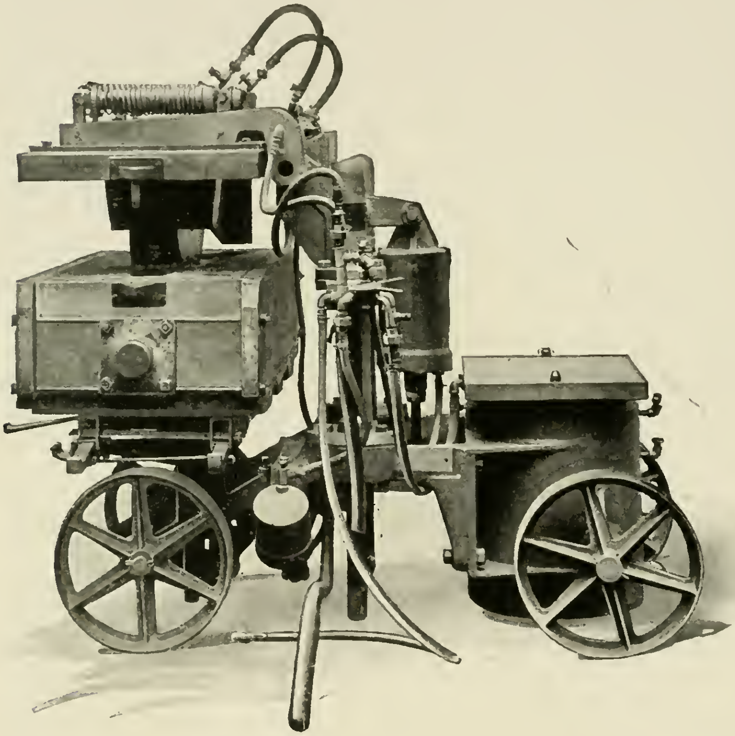


Fig. 67. A Portable Roll Over Jolt Machine for Small Moulds.

workman has come to a position where he is satisfied that he should produce the necessities of a livelihood without the hard work which in the past has been so necessary to maintain a satisfactory foundry production. He is beginning to realize that the manufacturer and foundryman should furnish him with machines that will perform the heavy and drudging part of the day's work, without exacting the maximum of his effort, and that will yet produce equal or greater results than those obtained by the old time methods.

For producing the smaller size of what has been termed "Small Moulds," there has been a demand for a Roll-Over Jolt Moulding Machine mounted on wheels, either operating on the foundry floor or on Tee rails, placed in the foundry floor in such a manner that the machine can be conveyed from one end of the floor to the other. The claim is made that a greater production can be obtained with less effort on the part of the operators, since the distance that the moulds are carried from the machines to the floor, is less than when the machine is permanently located; others maintain that the machine permanently located has an advantage over the portable machine, claiming that the time and energy consumed in moving the machine are equal to that required in carrying the moulds the short distance further. This again is largely a matter of individual preference, and should be determined by the conditions in the foundry in which the machine is to be used. Many foundries, using this particular type of machine for small work, prefer to set it in a permanent location under the chute of a sand-conveying system, which has been found to be a highly desirous installation in foundries producing castings in large quantities, while others prefer to make use of the available sand-cutting machines, in bringing the sand, after it has been tempered, from the floor into a pile alongside the moulding machine, where it is then readily shoveled into the flask before the mould is made.

The numerous castings and foundry floors shown in this chapter will give a good idea of the production obtained and will suggest to the reader the great possibilities of machine moulding when applied to this class of work.

The castings produced by this type of machine are true to pattern, uniform in weight and, when they are machined by the use of jigs, have a decided advantage over the ones made by hand ramming.

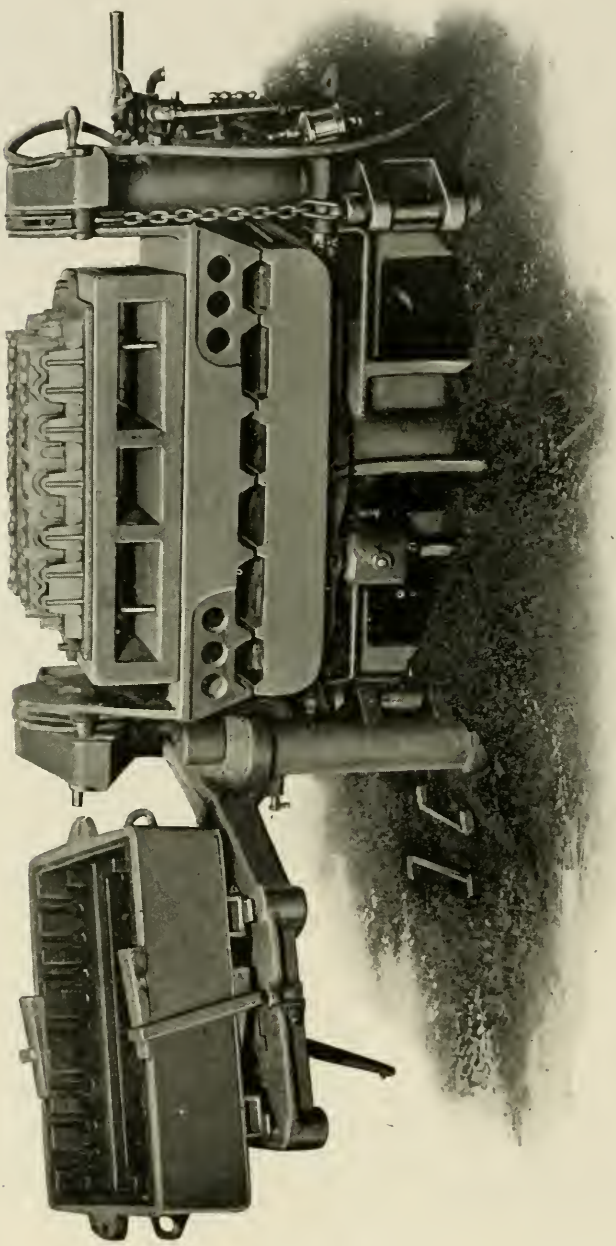


Fig. 68. An Automobile Cylinder Head.—Two in a mould—made on a 22"x37" Roll-Over Jolt-Moulding Machine. This view shows the mould deposited on the swing-out table and ready for removal to the foundry floor. The roll-over table, to which the pattern is attached, is in its initial or jolting position.

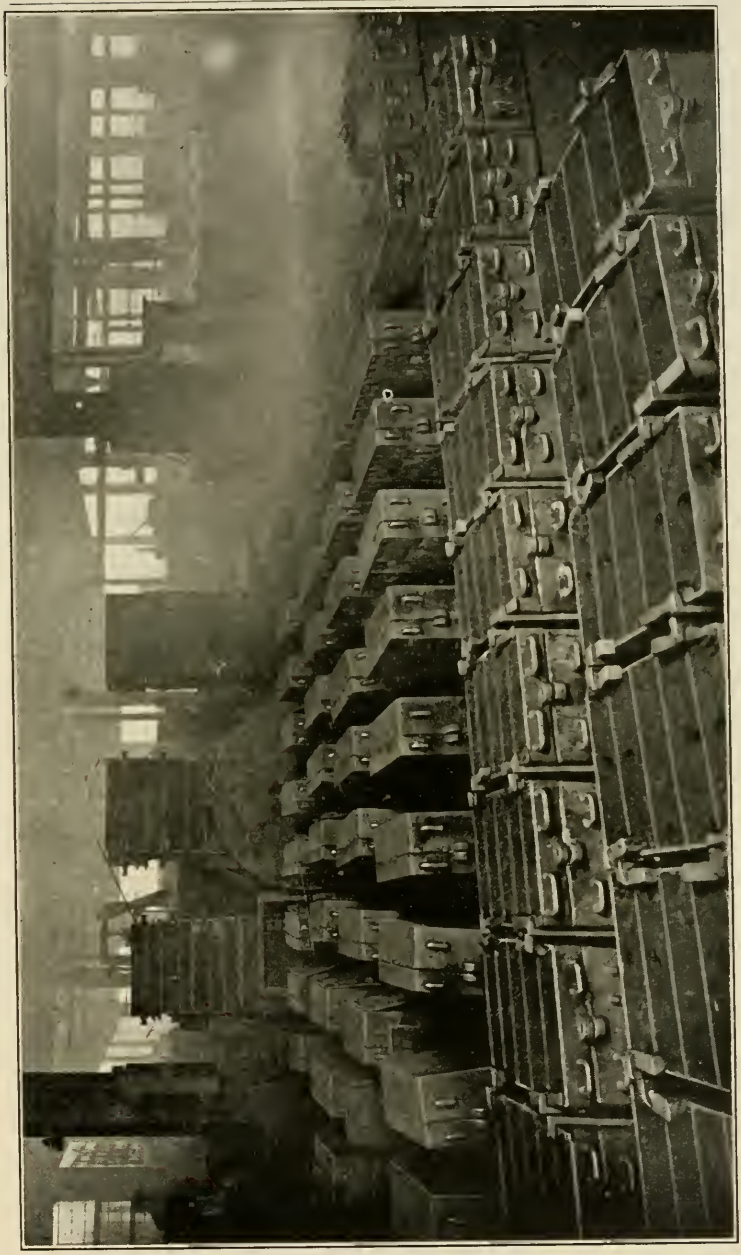
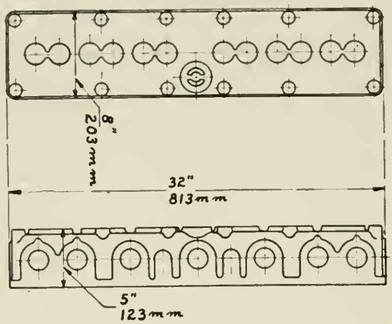


Fig. 69. A Day's Production of Cylinder Head Moulds from One Machine.

Automobile Cylinder Head.



Weight 38 Pounds.

Fig. 70

Production based on making both the cope and the drag half of the mould on the same machine.

PRODUCTION

Method of Moulding	No. Men	Hours	Quan. Moulds	% Increase
Without Machine....................	3	9	30	.....
Cope—20"x27" Plain Jolt............. Drag—20"x27" Plain Jolt.............	3	9	60	100%
Cope—22"x37" R. O. Jolt............ Drag—22"x37" R. O. Jolt............	3	9	200	567%

Steel Casting Bracket for 6 Ton Armored Truck.

Weight 50 Pounds.

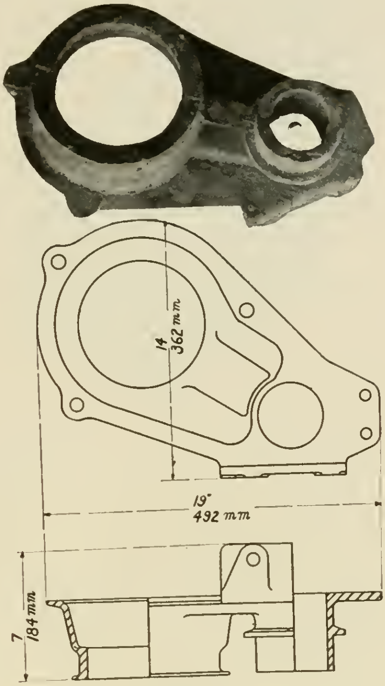


Fig. 71

Production based on making both the cope and the drag half of mould on the same machine.

PRODUCTION

Method of Moulding	No. Men	Hours	Quan. Moulds	% Increase
Without Machine....................	3	9	11	.....
Cope—20"x27" Plain Jolt............. Drag—20"x27" Plain Jolt.............	3	9	22	100%
Cope—22"x37" R. O. Jolt............ Drag—22"x37" R. O. Jolt............	3	9	36	227%

Steel Casting Sprocket for 6 Ton Armored Truck.

Weight 125 Pounds.

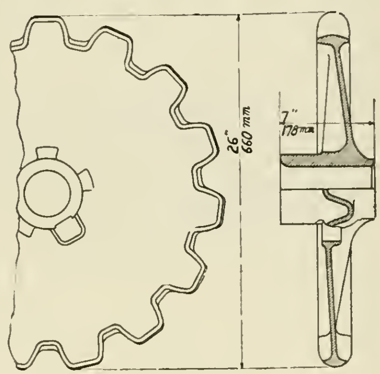


Fig. 72

Production based on making both the cope and the drag half of mould on the same machine.

PRODUCTION

Method of Moulding	No. Men	Hours	Quan. Moulds	% Increase
Without Machine	3	9	10	.....
Cope—20"x27" Plain Jolt............. Drag—20"x27" Plain Jolt.............	3	9	18	80%
Cope—22"x37" R. O. Jolt............ Drag—22"x37" R. O. Jolt............	3	9	32	220%

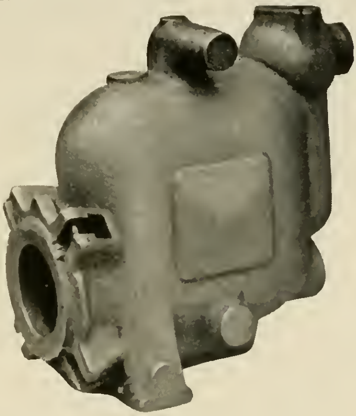
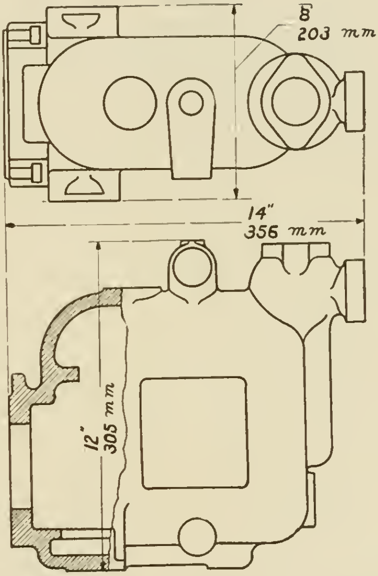


Fig. 73
High Pressure Steam Trap.



Weight 61 Pounds.

Production based on making both the cope and the drag half of mould on the same machine.

PRODUCTION

Method of Moulding	No. Men	Hours	Quan. Moulds	% Increase
Without Machine....................	2	9	18	.....
Cope—20"x27" Plain Jolt............. Drag—20"x27" Plain Jolt.............	2	9	27	50%
Cope—22"x37" R. O. Jolt............ Drag—22"x37" R. O. Jolt............	2	9	42	133%

Timberhead Casting Used in the Shipbuilding Industry.

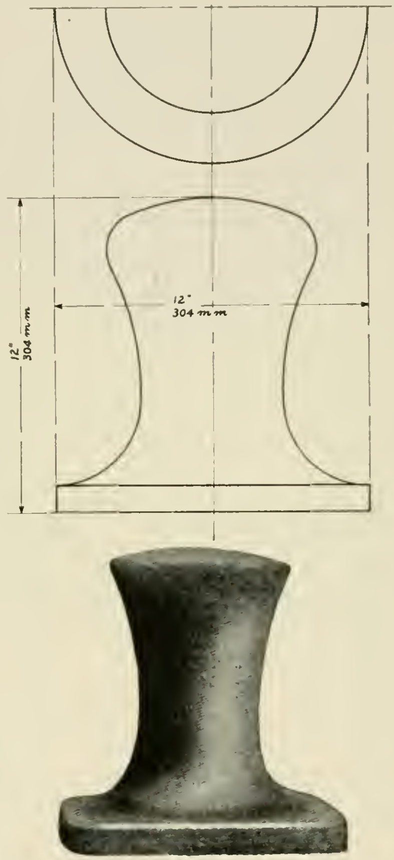


Fig. 74

Production based on making both the cope and the drag half of mould on the same machine.

PRODUCTION

Method of Moulding	No. Men	Hours	Quan. Moulds	% Increase
Without Machine....................	3	9	21	.....
Cope—18"x18" Plain Jolt............ Drag—18"x18" Plain Jolt............	3	9	36	71%
Cope—22"x37" R. O. Jolt............ Drag—22"x37" R. O. Jolt............	3	9	48	130%

Cleat Casting Used in the Shipbuilding Industry.

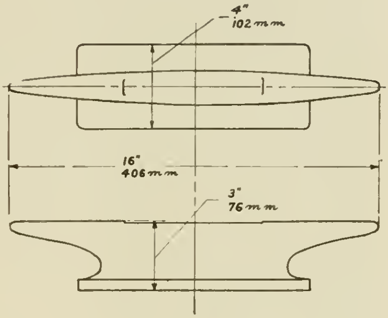


Fig. 75

Production based on making both the cope and the drag half of mould on the same machine.

PRODUCTION

Method of Moulding	No. Men	Hours	Quan. Moulds	% Increase
Without Machine....................	3	9	36	.....
Cope—18"x18" Plain Jolt............. Drag—18"x18" Plain Jolt.............	3	9	60	67%
Cope—22"x37" R. O. Jolt............ Drag—22"x37" R. O. Jolt............	3	9	100	180%

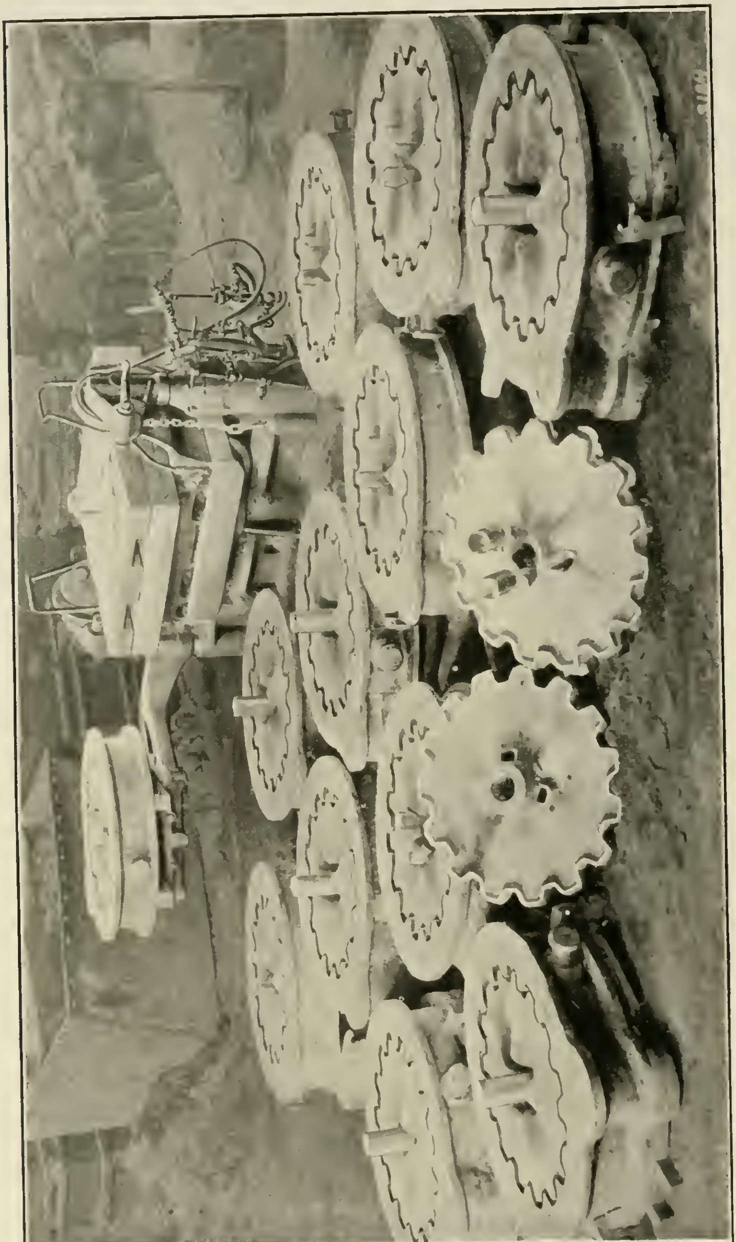


Fig. 76. Part of a Day's Output at the Steel Plant of The Wellman-Seaver-Morgan Co., Cleveland, Ohio, U. S. A.

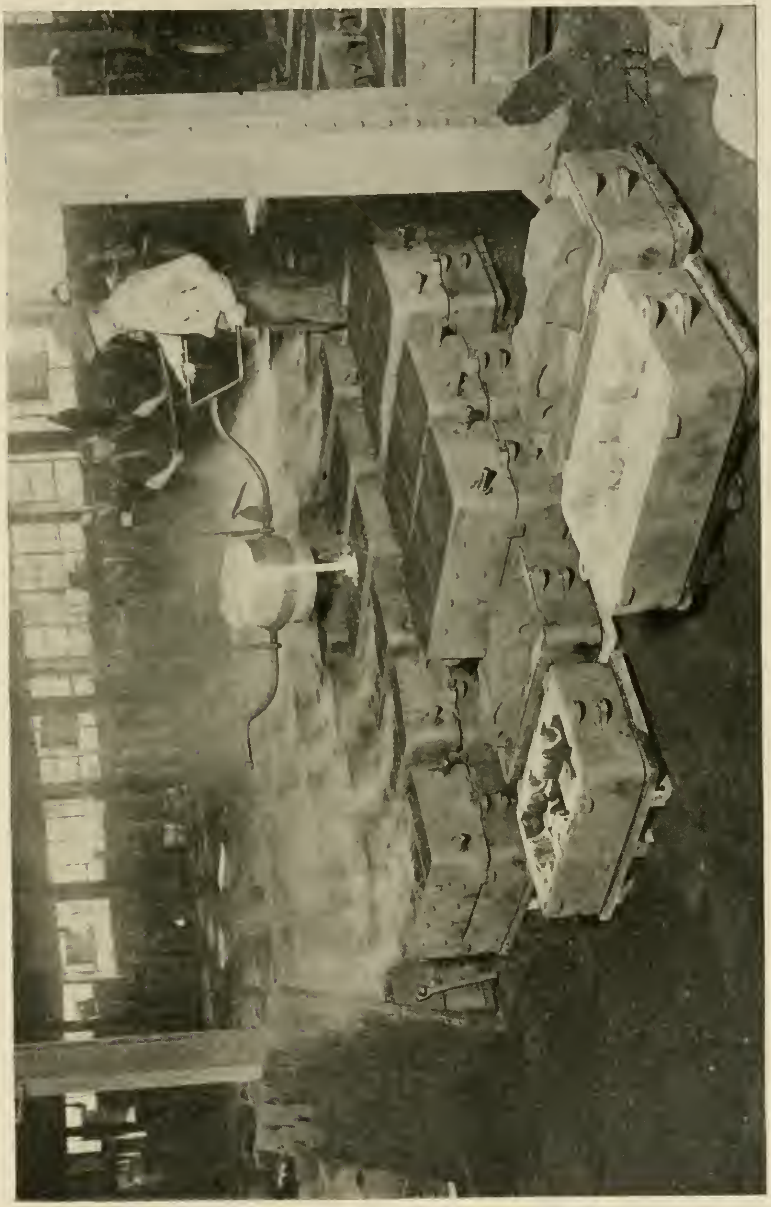


Fig. 77. A Floor of Small Moulds made on a Roll Over Machine.

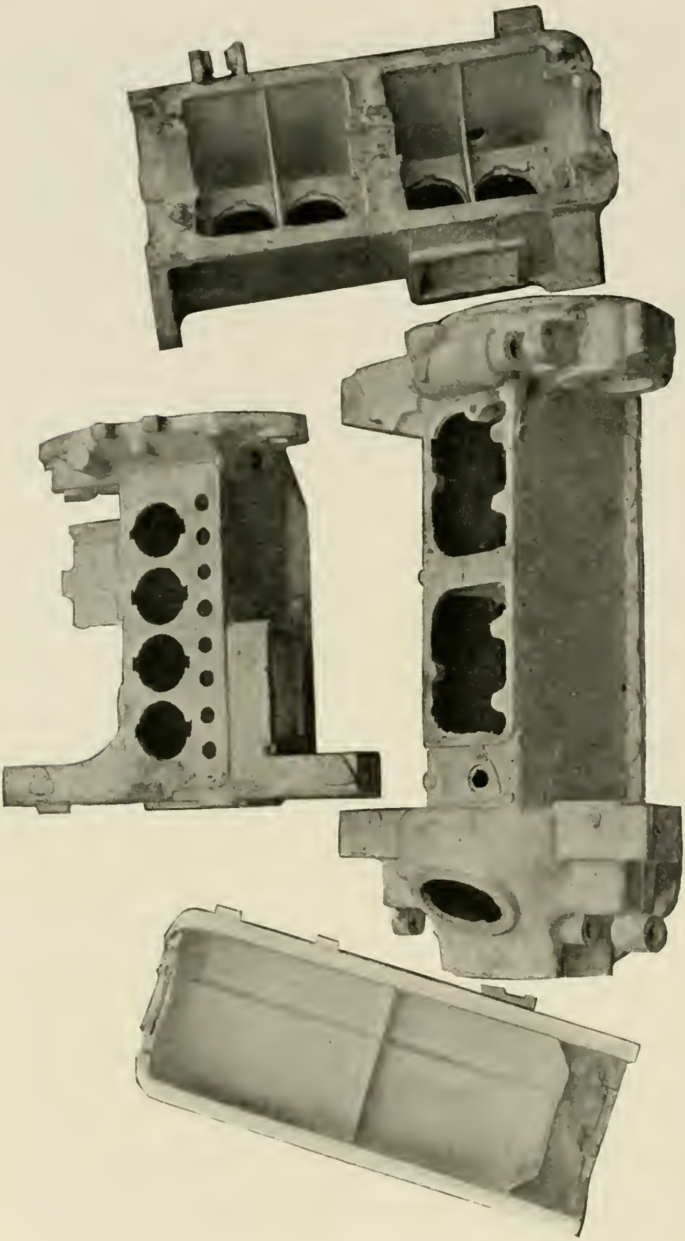


Fig. 78. A Group of Automobile Crank Cases Made in the Plant of The City Brass Foundry Co., Cleveland, Ohio, U. S. A.

CHAPTER VII

Jolt Moulding Machines in Brass and Aluminum Foundries

The jolt moulding machine, having had its early development in the iron and steel foundries, was slow to be accepted as a machine which would produce the proper type of moulds for brass and aluminum castings. Conditions for making aluminum castings are greatly different from those for iron and steel. A different grade of sand is used, and an entirely different density of ramming is desired. For a long time it was believed that a jolt machine could not satisfactorily ram such a mould on account of the hardness of the blow which was associated with many early designs of machines. The mechanical handling of the equipment is a proposition entirely different from the methods employed in grey iron foundries. Pouring progresses continuously throughout the day, and a comparatively small number of flasks and small amount of sand are used over and over during the day; in fact the sand in an aluminum foundry sometimes heats up as much as 40 degrees Centigrade during the day, due to its being used and re-used. Perhaps it required the stress of war conditions with the necessity for a large production with a minimum amount of labor, coming simultaneously with the problem of the Liberty Engine, to cause the foundry industry seriously to try the jolt machine on aluminum castings.

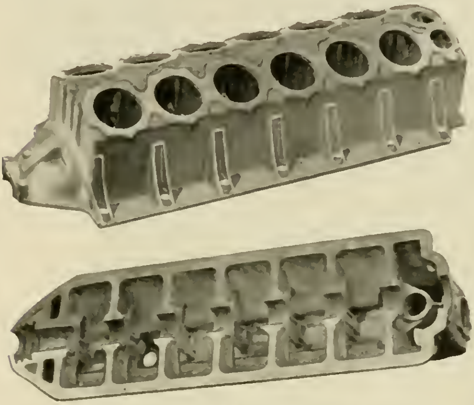


Fig. 79. Liberty Motor Crank Case—Upper and Lower Half.

When the American engineers designed and began building the Liberty Motors in quantities for Government aeroplanes, it was with a full realization of the possible difficulties that would be encountered before all of the many details were perfected and the engine pronounced a success, both from the viewpoint of reliability of operation and of the practicability of its adaptation to manufacturing methods. The 400 H. P., which the motor was to develop, required materials, in

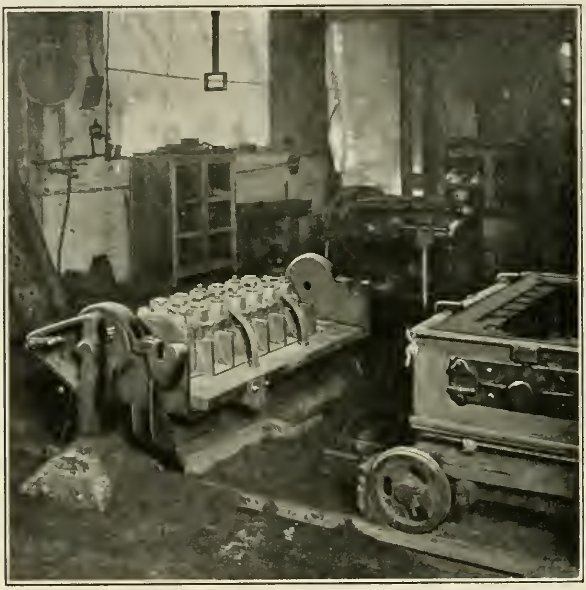


Fig. 80. Pattern Mounted on Roll Over Jolt Machine.

fact demanded materials, that would be almost perfect in their metallurgical qualities and of the highest grade of workmanship.

Of the many different parts of the engine, the crankcase is one that received a considerable amount of attention, as failure in this particular part practically meant complete destruction of the engine. The inspection, therefore, was carefully made and the materials held strictly to the specifications.

The aluminum foundries, with the true Yankee spirit, began with a determined effort to produce castings that would

Fig. 81. Jolting the Drag Half of the Mould.

pass inspection and fulfill all requirements of the specifications. After the casting had been successfully produced, free from defects, the next question that confronted the foundry was that of production to meet the enormous requirements demanded by the Government's program. The same determination that produced the casting successfully from the metallurgical standpoint, also solved the problem of producing the quantities required per day. The Roll Over Jolt Moulding Machine was, after due consideration, decided upon as being the one best adapted to produce the moulds.

The views in this chapter were made in the plant of The Aluminum Castings Company, Cleveland, Ohio, U. S. A., and show the process of moulding and casting the Liberty Motor crank cases. An inside and an outside view of the casting is shown in Figure 79. These views show clearly the construction of the casting, both of the top and bottom half. It will be noticed that the casting has many exceedingly thin sections, as well as a moderately heavy section at the front end. Also that the side walls are practically vertical, making the drawing of the pattern a matter demanding great accuracy. The pattern mounted on the pattern plate and attached to the table of the moulding machine is shown clearly in

Fig. 82. Butting Off the Cope Half of the Mould.

Fig. 83. Drag Half of Mould Ready for Setting Cores.

Fig. 84. Drag Half of Mould with Cores Set.

Fig. 80. It will also be noted in this view that a finished drag mould is on the leveling car of the machine. The bottom boards used are seen standing against the foundry wall at the extreme left.

In Figure 81 the flask is being filled with sand from the bins overhead, which are a part of the sand-conveying system with which this plant is equipped. On this size flask two bins were used in order to fill the flask more quickly.

In Figure 82 the jolting operating of the cope half of the flask is completed and the workmen are "butting off" the loose sand on top of the mould, an operation which can be performed in eight to ten seconds of time.

Fig. 85. Making Cores on a Small Jolt Machine.

Too much emphasis cannot be placed upon the necessity of providing the proper flask equipment when attempting a large production. By analyzing the flask shown in Figure 83, it will be seen that the flask used is one especially adapted to their work. The flask is made of aluminum, and the trunnion piece has been cast separately and provided with dove-tailed slots at each end; the purpose of these slots is to receive the loose pieces that are used as handles in case it is desired to carry the flask without a crane. Bolts are used for securing this trunnion piece to the flask. The pins are located on the side rather than on the end, permitting shorter trunnions. This figure also shows a splendid detail of the drag half of the mould, after the pattern has been withdrawn and the mould set on the foundry floor.

By referring to Figure 84, this same drag half of the mould is shown with cores set and ready to receive the cope. There are six separate cores used in the body of the mould, practically the same in construction, and all made on a small Plain Jolt Moulding Machine, as shown in Figure 85. These cores were produced by first placing in the bottom of the core-box, a dry-sand slab in which has been placed suitable holding lugs to which the carrier handles are attached. The core-box was then filled with green sand and jolt-rammed. The shape of the core demanded the hinge type of box which permitted the swinging of the box from around the core, after which it was carried to the green-sand core racks.

Fig. 86. A View of the Moulding Floor.

In Figure 86 may be seen a row of moulds, part of which are completed and ready for pouring, while others at the farther end of the row are "shaken out" and ready for cleaning. The small core referred to above is here seen with the lifting handles in place, standing beside the drag half of the mould appearing in the foreground.

Figure 87 shows a close up view of the distant end of the row of moulds in the preceding view. The sand has been shaken from the moulds, and the castings appear as they are before being sent to the chipping and cleaning rooms. The remarkable production obtained by the use of moulding machines on this casting is exceptional, as eight men produced 102 moulds per day, the cope and drag being made on different

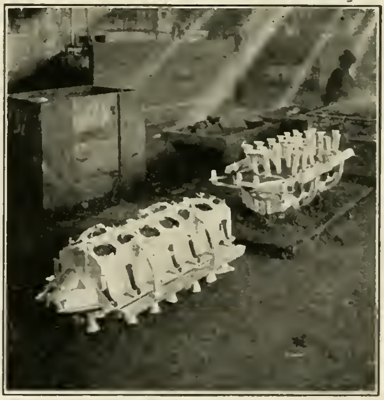


Fig. 86. The Castings as they Appear When Shaken Out.

machines. The best results obtained under former conditions was the production by eight men of 16 moulds per day. It should be noted also that the production from the hand ramming method resulted in a scrap loss of 30%, while the scrap loss from the moulds made on the Roll Over Jolt Moulding Machine was less than 10%.

The success of the Roll Over Jolt Machine in making the Liberty motor crank case castings has called the attention of the progressive brass and aluminum foundrymen to the use of the machine, and in the comparatively short time that has elapsed, machines have been installed in a large number of shops.

No radical departures are made from the practice followed in iron foundries. The finer sand used is more fluid and demands less packing force to produce a given density than the coarser sand used in iron work; also, a much lower density is used for aluminum work, since the liquid pressure exerted by an aluminum casting is only one-third that which would be exerted by an iron casting from the same pattern, and the density of the sand should be proportional to this pressure. The adjustable valve for controlling the jolt stroke is set for a very light blow and from four to ten jolts is considered good practice.

One by one the superstitions in regard to the jolt machine are being dispelled. Some foundrymen hesitated for a long time before attempting copes on a jolt machine, but no one has doubt on this subject any longer. Others hesitated on account of the damage, from the shock of the machine, to moulds already on the floor, but this is a subject which has also dropped from popular interest. The belief that the machine was not suitable for aluminum work has now been successfully pushed into the background, and this type of machine is well on its way toward filling the universal field which it is destined to occupy.

Fig. 88. A Large Plain Jolt Moulding Machine with the Foundation Shown in Phantom.

CHAPTER VIII

Plain Jolt Moulding Machines

Development

In the early development of the jolt ramming method of moulding, the Plain Jolt Machine was built essentially in the same form as we know it today. These early experiments extended over a period of about fifteen years, and resulted in the development of a machine which had proven satisfactory for the production of large varieties of castings.

Reference has been made to the tendency in the foundry to consider that the use of moulding machines must be accompanied by a complete change in the type of patterns used. This mistaken belief has caused many foundrymen to think that they did not possess the necessary knowledge required to re-equip their patterns for machine moulding.

The facts are that any pattern which has been made for floor moulding can be used on the Plain Jolt Machine and also on the Roll Over Jolt Machine. The knowledge necessary for the use of patterns on machines is not complicated and can easily be acquired by any foundryman. Many foundrymen, however, use Plain Jolt Machines when they should be using Roll Over Jolt Machines, and many others are producing moulds on the floor when they should be using machines. Under the economic stress which exists and which will continue to exist, the adoption of labor-saving devices will be in some measure forced upon those who, at present, are not making full use of them.

Production

The Plain Jolt Moulding Machine performs only the one operation, viz., jolt ramming; replacing hand ramming. It is evident, therefore, that the ultimate time saving which may be accomplished by this machine is the saving of the time expended in this one operation. Studies show, that in floor moulding the average time required for ramming is approximately 50% of the total time required for making the mold.

This time is reduced to a very small amount by the Jolting Machine, which jolt rams the mould in 5 to 10 seconds, leaving only the butt ramming operation which does not require careful and expert work, and which can be performed in from 15 seconds to 5 minutes, depending upon the size of the mould. The time of rolling over is not affected, nor is the amount of time required to draw the pattern.

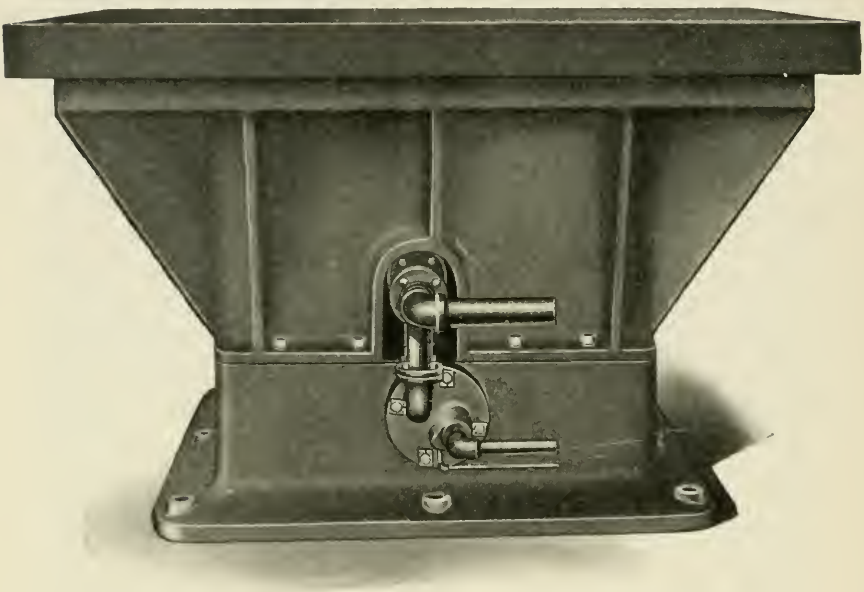


Fig. 89. A Plain Jolt Machine of Rigid Construction.

Quality of Castings Produced

The influence of jolt ramming on the quality of the castings is as marked as is its influence on the amount of production. Ninety-five per cent of all defective castings may be traced to two causes: 1st—unequal ramming; 2nd—slicking and patching due to a faulty pattern draw. Most of those troubles arising out of improper ramming are eliminated on jolt rammed moulds, as the sand is packed practically uniformly and evenly over the surface of the pattern and pattern plate. After the mould is jolt rammed, however, there remains the butting off operation to be performed by hand.

This prevents the ramming operation from being quite as fast as it otherwise would be, and also introduces a slight human variation in the density of the rammed sand. The limitations of the usefulness of the Plain Jolt Machine should be mentioned here. *The ideal moulding machine is one which mechanically performs all of the operations of making a mould with a minimum amount of time and effort and with a maximum of accuracy and exact repetition.* The Plain Jolt Machine falls short of this ideal in that there remains to be done by hand—

1. Butting off.
2. Rolling Over.
3. Drawing the pattern.

Design and Construction

As we know it today, the Plain Jolt Moulding Machine is simple and rugged in construction. Simplicity of construction does not mean, however, that there are no problems affecting the design of the machine or the construction of it. Subjected as it is to the hardest use with a minimum of attention, the Plain Jolt Machine is expected to have a long life of useful service, maintaining its accuracy throughout its life.

One of the principal factors affecting the accuracy of the machine is the relation of the piston diameter to piston length. If the piston is too short in relation to its diameter, it will tend to lean in the cylinder toward the side which is more heavily loaded, and will thus cause a slapping action of the table when it strikes, particularly if the impact surface is of a large area and is located around the cylinder at the top. Adequate length of piston is necessary, as increasing the length of the piston decreases the angle at which the table might lean from the horizontal.

In years past much has been said regarding the merits of the bottom or center strike type of machine, as compared with the top strike machine, in which a large area of the table contacts with the base of the machine. Much can be said regarding the merits of the two different types; nevertheless, there is today no controversy, as both are producing moulds satisfactorily.

The working action of the Jolt Moulding Machine is such as to cause a vibration throughout its different parts. This vibration, of course, becomes exaggerated when the machine is

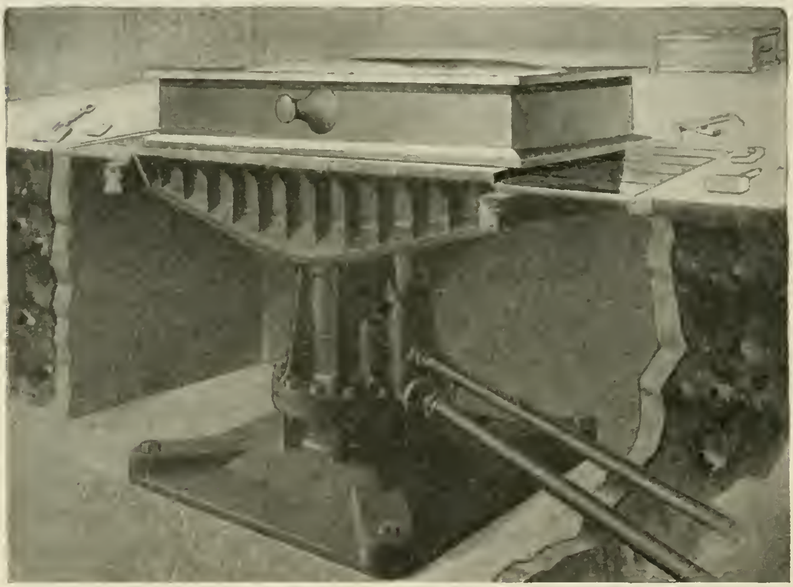


Fig. 90.—The Machine Shown Here is Mounted with the Top of the Table Level with the Floor.

made up of many different castings. It has been found exceedingly difficult to bolt together the different parts of a machine in a manner that will withstand the severe vibration produced in the bolted members. Where bolts are used, it has been found that the best type of lock washers are not sufficiently strong and rigid to hold the parts in place, and, therefore, if bolts are a necessity, a method should be employed that will absolutely prevent the loosening of the bolt; for if only a few bolts loosen, and the remaining bolts hold tight, an exceptional strain is produced on those that are holding, thereby causing a breakage of the casting or of the bolts. Modern tendency is toward a machine designed with as few parts as possible, eliminating the bolted construction, and using in its place a design that will withstand the severe vibration caused by the jolting action.

Fig. 91. A Small Plain Jolt Machine of Simple Construction.

Since the action of the Jolt Machine in operation is severe and very much like the action that is used in breaking up scrap iron for the cupola, it is obvious that a machine that will withstand the repeated blows of jolt-ramming should be of a massive and heavy construction, preventing as much of the blow as possible from reaching the different parts.

In order to produce an economical operation by the consumption of the smallest amount of air, it is well to examine critically the many different syles of valves on Plain Jolt Moulding Machines. It is essential, in order to conserve the compressed air, that there be some means of controlling the amount used, and also to shut off the inlet port of the machine during the exhaust stroke. If the air inlet is permitted to remain open during the exhaust stroke, a large amount of air is uselessly consumed by its blowing thru the machine and into the exhaust.

While the jolt ramming of a mould is a comparatively simple operation, yet considerable difficulty has been encountered in years past, in the ramming of the moulds required in foundries producing castings from various metals. The stroke required, on Jolt Moulding Machines, that will economically and properly pack the sand of a steel casting mould, varies considerably from the stroke that is required to produce the mould into which is to be poured iron, brass or aluminum. In addition to the varying degree of hardness required in the mould, there are the factors introduced by the use of the different grades of sand that are required in making the mould. To meet these varying conditions, it is well to have a machine, the stroke of which can be adjusted to suit the requirements. The stroke, however, when once set for a particular foundry, rarely, if ever, requires further adjustment. The adjustable featue of the stroke, which, of course, is obtained by adjusting the valve on the machine, is, many times, a decided advantage when difficult copes are to be made, which in many instances require a long stroke with a sharp, quick blow, while in the majority of moulds a shorter stroke, with lesser blow, will accomplish the results in the same time and without the same amount of detrimental action to the machine and pattern equipment.

In the early years of moulding machine operation, there existed in the minds of foundrymen the feeling that the machine, when once installed in the foundry, should operate and give entire satisfaction without being cared for by a competent mechanic. They did not realize the importance of keeping the machine properly oiled and free from sand obstruction. There should be in every foundry operating moulding machines, a mechanic with sufficient mechanical knowledge to inspect the machine properly and to keep it in good working condition.

The pattern and flask equipment is another important item that has not been given the proper amount of consideration. Experience has thoroughly demonstrated that in order to secure the best results, proper attention must be given to equipping the machine with patterns, flasks, bottom boards and other necessary auxiliaries. In equipping the machine with patterns, care should be exercised to secure the pattern plate firmly, and patterns having a large flat surface should be thoroughly and strongly supported from the bottom, in order to remove the possibility of a springing action taking place in the pattern when the mould is being rammed. If the pattern is not properly supported and a springing action takes place, the mould produced will be full of cracks, and if a cope, will be likely to drop out when the flask is being handled.

The flasks should also be examined to see that they are rigid and of sufficient strength to prevent a springing action. The best results have been produced by the flasks that are cast solid in one piece in the small sizes and are of securely bolted construction in the larger sizes. This is especially important when designing the cope half of the flask, and yet in some instances it is difficult to cast integral the flask and the proper bars for supporting the sand. If it is found necessary to make use of separate bars, they should be secured to the flask by means of tightly fitted bolts, as a loose bar will prevent the making of a satisfactorily rammed mould. The above description of the equipment necessary in jolt ramming applies not only to this particular chapter, but to all machines which make use of the jolt ramming principle.

The following pages illlustrate the increased production obtained by the use of the Plain Jolt Moulding Machine on a variety of different kinds of moulds. The increase of production in each case is given and it will be noticed that this increase averages about 100 per cent.

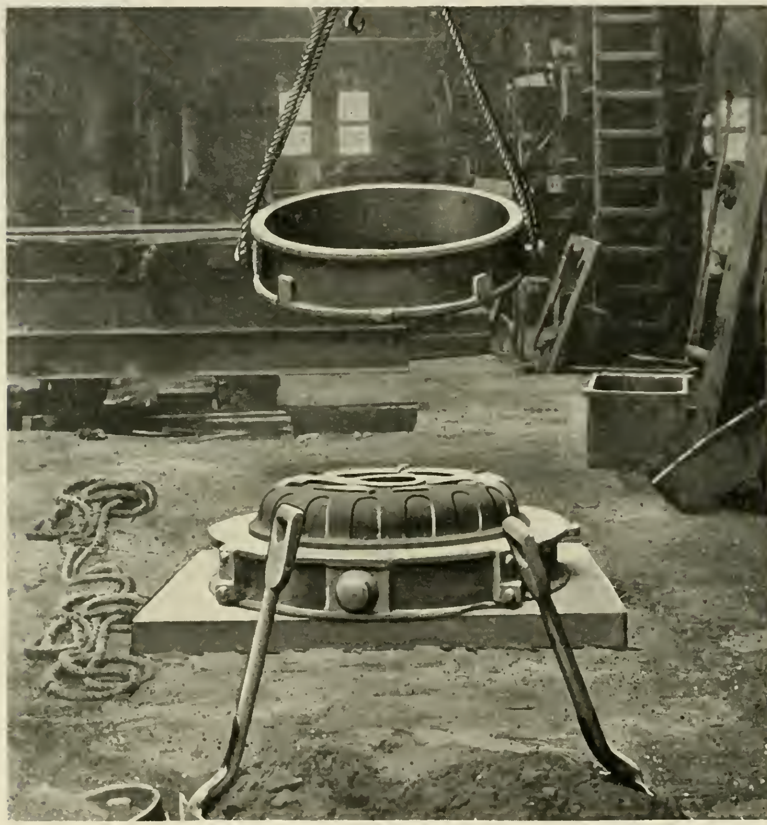
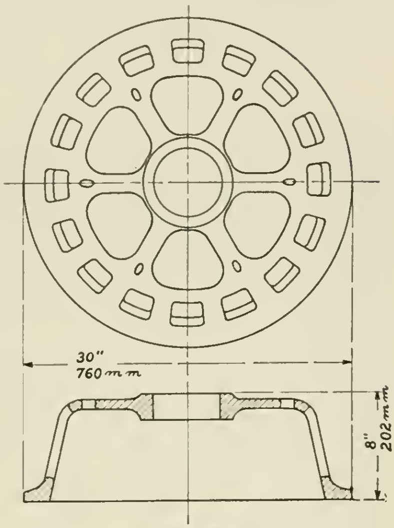


Fig. 92. Generator End Frame made on a 54" x 66" Plain Jolt-Moulding Machine.

The cope and the drag half of the mould are both made on this machine.

Fig. 93. A Floor of Generator End Frame Moulds Made on the Plain Jolt Machine Shown in the Foreground, at the Plant of
THE WESTINGHOUSE ELECTRIC & MFG. CO.
Cleveland, Ohio, U. S. A.

Generator End Frame Casting.



Weight 210 Pounds.

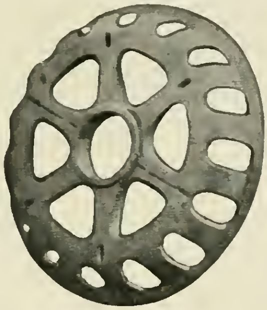


Fig. 94

Production based on making both the cope and the drag half of the mould on the same machine.

PRODUCTION

Method of Moulding	No. Men	Hours	Quan. Moulds	% Increase
Without Machine....................	2	9	6	.....
Cope—54"x66" Plain Jolt............ Drag—54"x66" Plain Jolt............	2	9	12	100%

A Roll-Over Jolt-Moulding Machine would give an increase in production of from 400 to 500%.

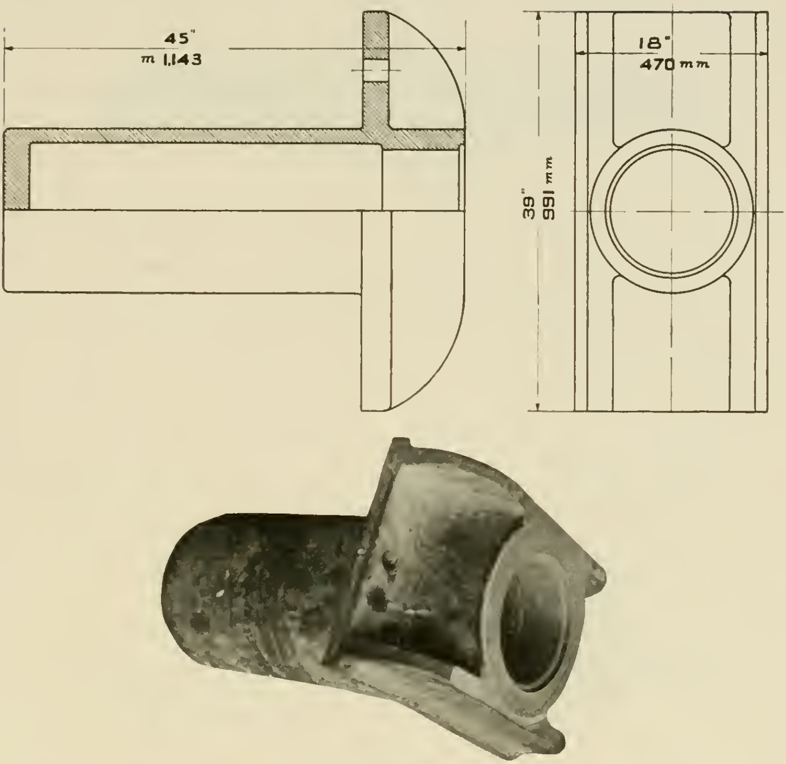


Fig. 95

Steel Casting Press Cylinder. Weight 610 Pounds.

Production based on making both the cope and the drag half of the mould on the same machine.

PRODUCTION

Method of Moulding	No. Men	Hours	Quan. Moulds	% Increase
Without Machine....................	4	9	2	.....
Cope—54″x66″ Plain Jolt............. Drag—54″x66″ Plain Jolt............	4	9	5	150%

A Roll-Over Jolt-Moulding Machine would give an increase in production of from 300 to 400%.

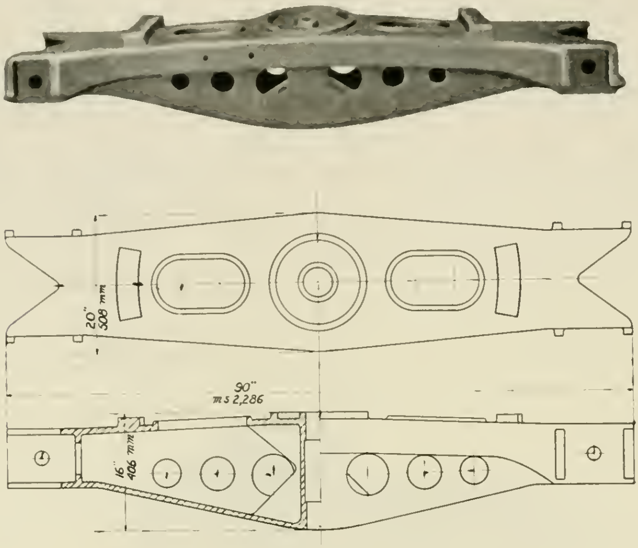


Fig. 96

Railway Truck Bolster—Steel Casting. Weight 430 Pounds.

Production based on making both the cope and the drag half of the mould on the same machine.

PRODUCTION

Method of Moulding	No. Men	Hours	Quan. Moulds	% Increase
Without Machine....................	5	9	12	.....
Cope—42"x97" Plain Jolt............. Drag—42"x97" Plain Jolt............	5	9	30	150%

A Roll-Over Jolt-Moulding Machine would give an increase in production of from 300 to 400%.

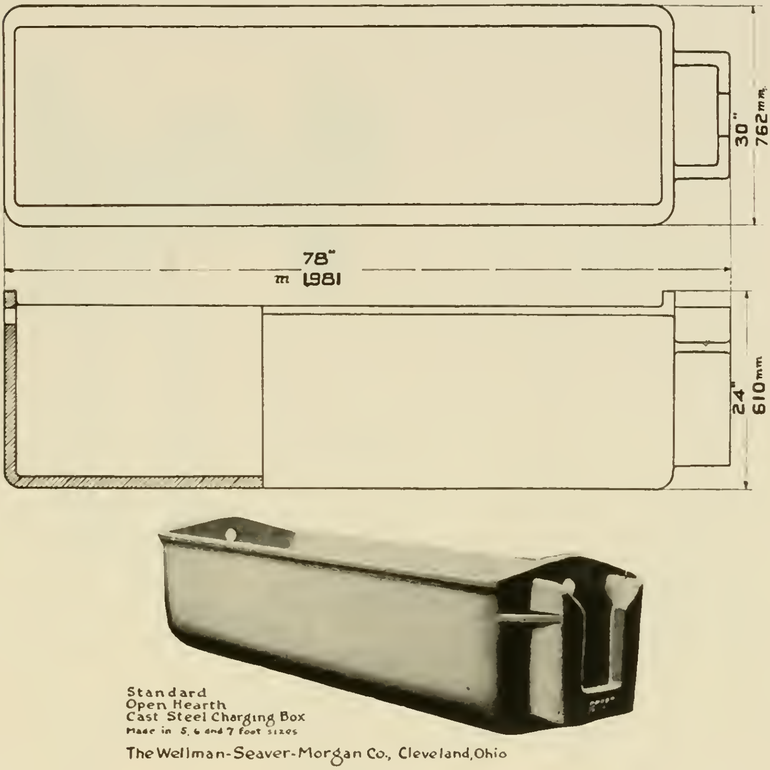


Fig. 97

Weight of Casting 1210 Pounds.

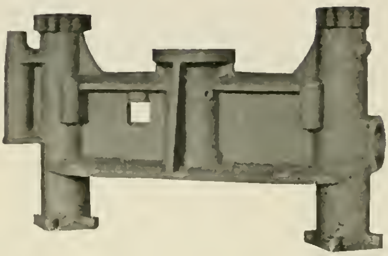
Production based on making both the cope and the drag half of the mould on the same machine.

PRODUCTION

Method of Moulding	No. Men	Hours	Quan. Moulds	% Increase
Without Machine....................	4	9	2	.....
Cope—54″x66″ Plain Jolt............. Drag—54″x66″ Plain Jolt............	4	9	6	200%

A Roll-Over Jolt-Moulding Machine would give an increase in production of from 300 to 400%.

Base and Cylinder Cast Integral.



Weight 1700 Pounds.

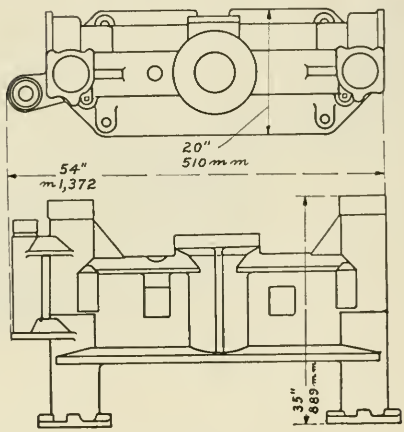


Fig. 98

Production based on making both the cope and the drag half of the mould on the same machine.

PRODUCTION

Method of Moulding	No. Men	Hours	Quan. Moulds	% Increase
Without Machine....................	4	9	2	.....
Cope—54"x66" Plain Jolt............. Drag—54"x66" Plain Jolt............	4	9	4	100%

A Roll-Over Jolt-Moulding Machine would give an increase in production of from 500 to 600%.

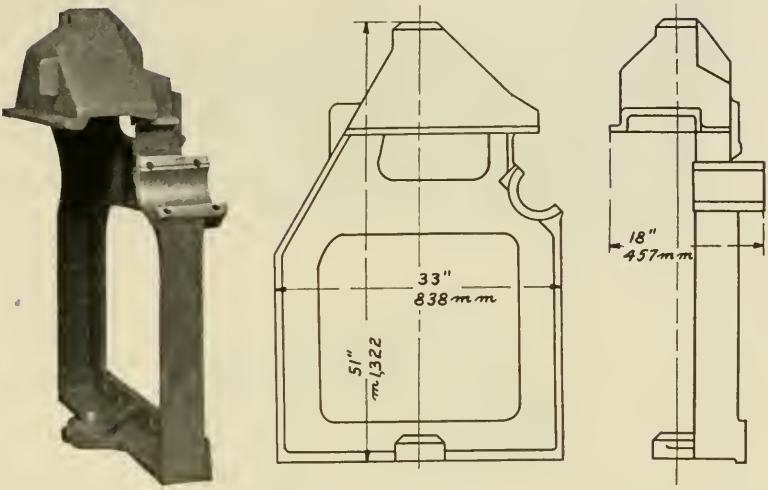


Fig. 99. Side Frame Casting. **Weight 800 Pounds.**

Production based on making both the cope and the drag half of the mould on the same machine.

PRODUCTION

Method of Moulding	No. Men	Hours	Quan. Moulds	% Increase
Without Machine....................	4	9	2	..
Cope—54″x66″ Plain Jolt............ Drag—54″x66″ Plain Jolt............	4	9	4	100%

A Roll-Over Jolt-Moulding Machine would give an increase in production of from 400 to 500%.

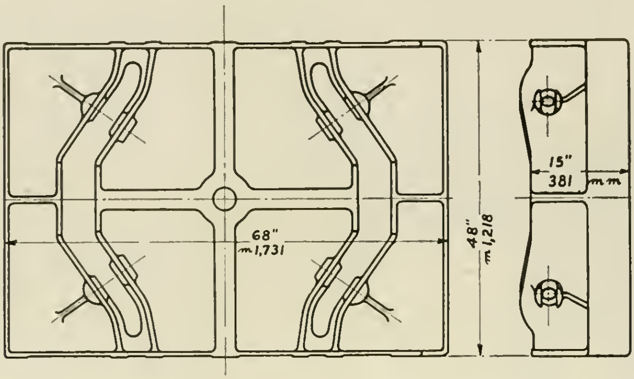


Fig. 100

Truck Center Casting for Locomotive Crane.
Weight of Casting 1680 Pounds.

Production based on making both the cope and the drag half of the mould on the same machine.

PRODUCTION

Method of Moulding	No. Men	Hours	Quan. Moulds	% Increase
Without Machine....................	3	9	1	.....
Cope—54"x66" Plain Jolt............ Drag—54"x66" Plain Jolt............	3	9	2	100%

A Roll-Over Jolt-Moulding Machine would give an increase in production of from 400 to 500%.

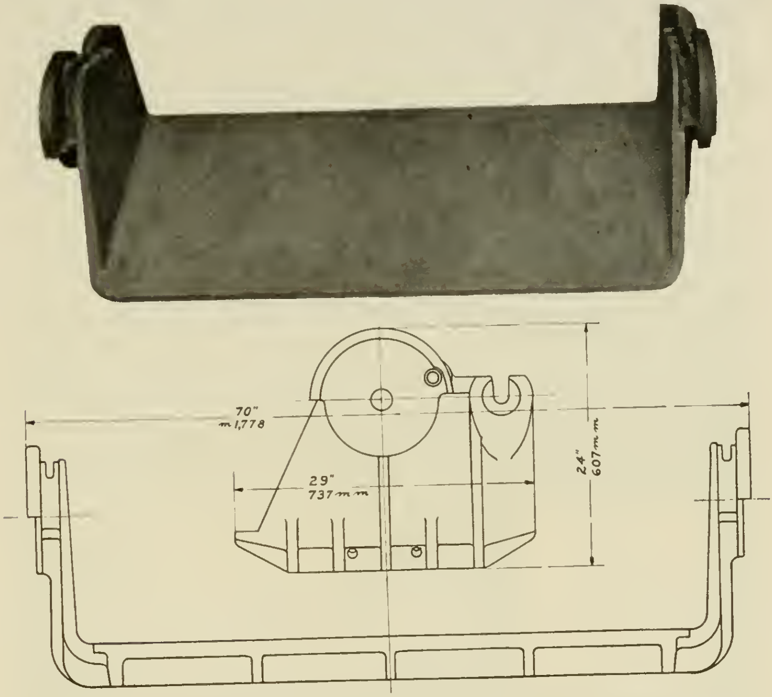


Fig. 101. Large and Difficult Table Casting. Weight 1500 Pounds.

Production based on making both the cope and the drag half of the mould on the same machine.

PRODUCTION

Method of Moulding	No. Men	Hours	Quan. Moulds	% Increase
Without Machine....................	3	9	1	.....
Cope—54"x66" Plain Jolt............ Drag—54"x66" Plain Jolt............	3	9	2	100%

A Roll-Over Jolt-Moulding Machine would give an increase in production of from 500 to 600%.

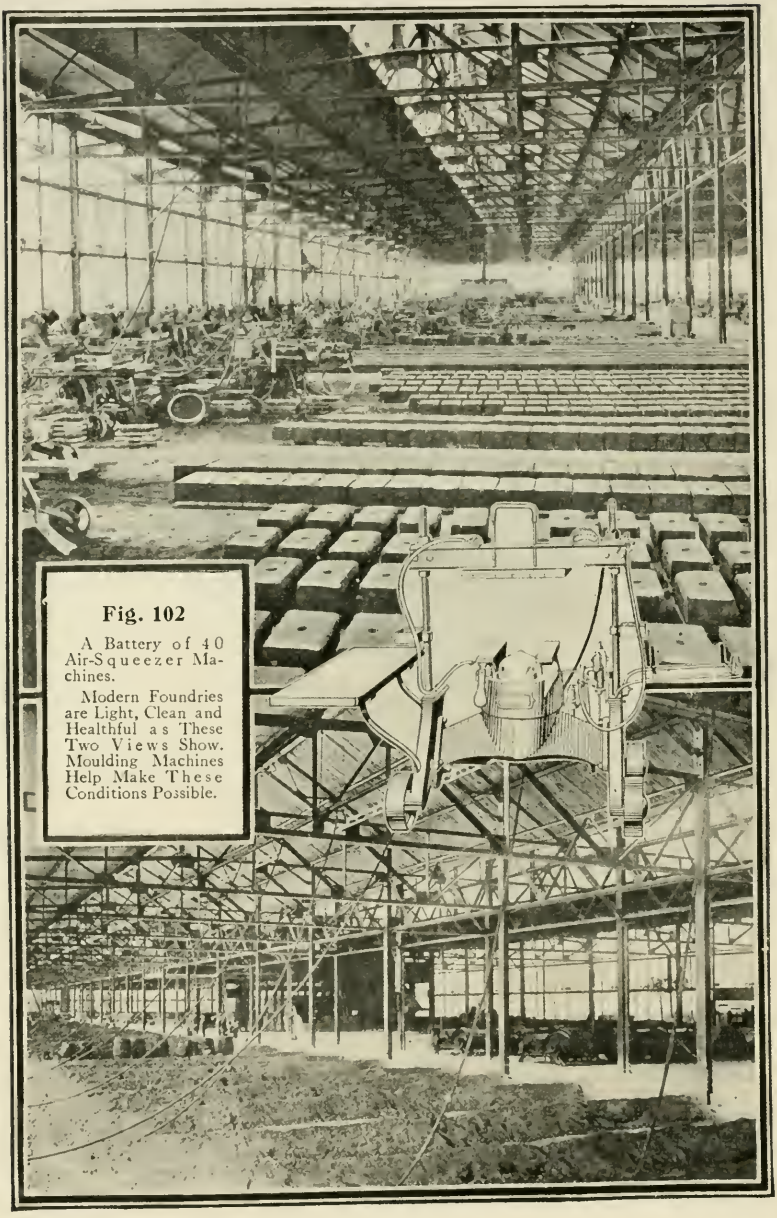


Fig. 102

A Battery of 40 Air-Squeezer Machines.

Modern Foundries are Light, Clean and Healthful as These Two Views Show. Moulding Machines Help Make These Conditions Possible.

CHAPTER IX

Air Operated Squeezer Moulding Machines

Primarily, the air operated squeezer type of moulding machine was designed to replace the old laborious hand method of bench moulding of light work. The question of producing, rapidly and economically, large numbers of small castings from one pattern, is one that cannot be lightly viewed as a subject of little importance; this fact is evident from the varied and interesting devices designed to facilitate the squeezer class of foundry work. The first development in the art of squeezer moulding produced a single pattern with its match of green sand; next, a single gate; then the improving of the green sand match by the substitution of fireclay or oil sand for the delicate green sand; further development produced a match board similar to the modern match plate. The various plates were first used for hand ramming on the bench, but soon a squeezer machine came into favor, and was extensively used throughout the United States of America.

The original type of air operated squeezer was designed for one purpose, that of squeezing the mould, as its name implies, and this type, subject to its limitations, is still doing efficient and rapid work. With the plain squeezer type of machine, the most common and most extensively used form of pattern is the match plate type, although the vibrator frame and hard-sand match are also frequently used.

Combination Jolt Squeezer

Later it was found that a great many patterns belonged in the squeezer class of work, as the weight of the casting was such as could be produced by squeezer moulding, but the depth of the patterns seemed to prevent their use, as the squeezing failed to pack the sand properly at the bottom of the pattern and firmly against the match plate; to meet this difficulty a machine was designed that embodies the principles of both the squeezer and the jolt machines. This machine is in appearance the same as a standard air operated squeezer, but is in reality a Jolt Squeezer Moulding Machine. It has, mounted within the large squeeze piston, a small jolt cylinder, in which operates the jolt piston carrying the table of the machine, usually cast integral with the piston. No changes are required to use either feature of this dual machine, hence a deep mould may be jolted to pack a deep recess, by a slight pressure of the knee against an air inlet valve. A few jolts of the mould settles and begins the packing of the sand in the recess of the pattern and the corners of the flask, after which the mould is squeezed in the usual manner, packing the remainder of the sand in the flask. This feature of double utility

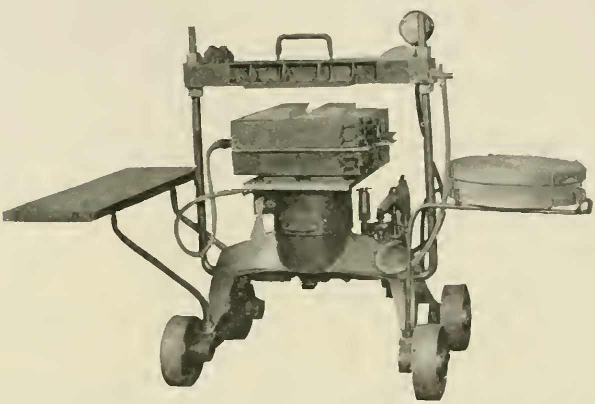


Fig. 103. An Air Operated Squeezer Moulding Machine with the Mould in Position for Squeezing.

is also an effective means of preventing what is known as a "ram-off", an annoyance caused by the sand, after being tucked against the side of the pattern or into a depression, being pushed away again by the squeezing action of the Plain Squeezer Machine. These machines are used not only in the Standard design, but also with other special attachments, for example, a stripping or pattern drawing device, and when so equipped is commonly known as a Split Pattern Machine. These machines are used for a heavier class of work, such as flywheels for small gas engines, valve and pipe fittings, gears, and for such patterns as require stooling. They are usually operated in pairs; the drag pattern mounted on one machine and the cope pattern on the other. The addition of this device does not in any way interfere with the usual operation of the machine as a standard squeezer.

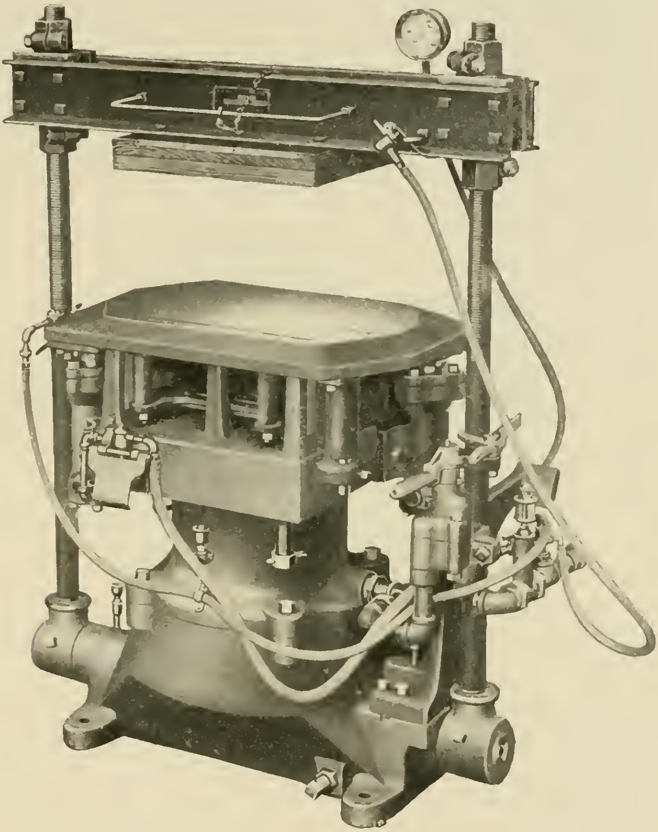


Fig. 104. A Split Pattern Machine

Operation of the Jolt Squeezer Machine

In detail the operation of the Jolt Squeezer type of moulding machine is as follows: The cope flask is placed up side down on the table of the machine; the pattern plate is placed on top of the flask with the drag side up and the drag half of the flask placed in position. The pins which are fastened in the drag half of the flask will align, and hold in alignment, the three parts just mentioned. The drag half of the flask is now filled with sand in the usual manner, and a conveniently operated knee valve allows the operator to jolt the mould at the same time that he reaches for the bottom board. The jolting is performed very quickly, it having been found from experience that from 5 to 20 blows are generally sufficient. As soon as the jolt operation is completed, the operator places the bottom board on the mould, and proceeds to roll the complete

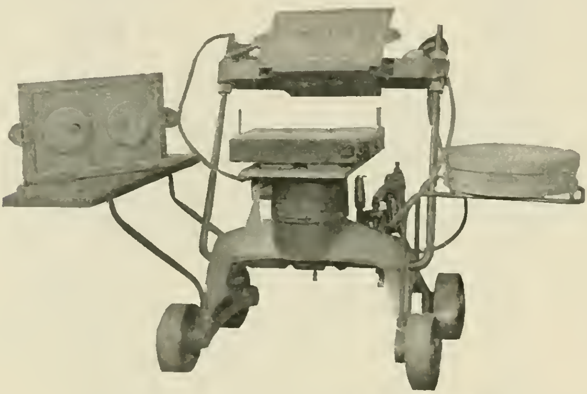


Fig. 105. An Air Operated Squeezer Moulding Machine with the Pattern Drawn from the Mould.

flask over, utilizing the forward edge of the table to hold the bottom board in position during the operation. The cope half of the flask is now filled with sand and the squeezer head pulled forward into position, and the valve handle controlling the squeezing operation pushed down, causing the table to rise and to squeeze the mould against the pressure head. Both halves of the mould are squeezed at one operation, but only the drag half of the mould has been previously jolt rammed. In squeezing the mould, a pop valve is used which automatically releases the pressure when it reaches a certain predetermined value; the squeezer head is pushed back, the squeezer board removed, and, after cutting the sprue, the cope half of the mould is drawn upward from the pattern plate, guided by the pins at either end, and loosened by the vibrator which is placed in operation by a conveniently located knee valve. After setting the cope on a table provided at the left, the operator draws the pattern from the drag half of the mould, utilizing the vibrator to prevent sticking.

There is now a completed drag half of the mould sitting on the bottom board on the table of the machine, and a cope half of the mould on the table at the left, and all that is necessary is to close the two, remove the flask and set the mould in its place for pouring, on the floor. For a graphical explanation of this process the reader is referred to page 14 of Chapter I, where the different steps are illustrated by sketches accompanied by explanatory notes.

The method of making a mould on the Split Pattern Machine is very similar, except that only one half of the mould is made at one time, and the unnecessary steps are omitted. The Split Pattern Machine frequently substitutes a mechanical lifting device for drawing the mould from the pattern, operated either by hand or by air.

Operation of the Plain Squeezer Machine

The Plain Squeezer Machine, without the jolt operation, has the following sequence of operations in making a mould. The cope half of the flask, pattern, and the drag half of the flask are placed on the table in the order named; the drag half of the flask is filled with sand, the corners and edges tucked by hand; the bottom board is placed on the mould and the mould rolled over without squeezing; the cope half of the flask is then filled with sand, the squeezer board placed on top and both halves of the mould are squeezed simultaneously. The remaining operations are identical with those of the jolt squeezer machine.

It can readily be seen that on the plain squeezer machine, the pressure developed on opposite sides of the pattern plate is equal, and a comparatively thin plate will be satisfactory, especially since this pressure is applied slowly. On the Jolt Squeezer

Machine, however, the drag half of the mould is jolted before the cope is filled with sand, and the pattern plate should have sufficient strength to withstand the forces exerted on it.

In comparing the Plain Squeezer and the Jolt Squeezer types of machines, it is well to bear in mind the following facts: The Jolt Squeezer Machine eliminates the hand tucking which is necessary to supplement squeezing on deep moulds, but it requires a much more substantial pattern plate. Due to the elimination of hand labor, the Jolt Squeezer Machine will turn out a slightly larger quantity of moulds per day, and in this way will pay for the increased investment. Another factor, which is too frequently overlooked, is that by eliminating some

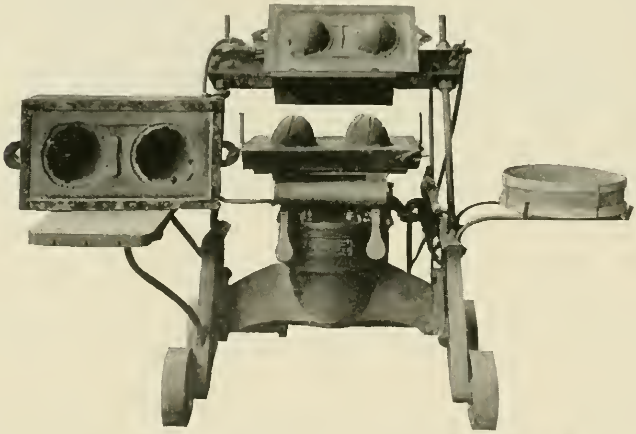


Fig. 106. An Air Operated Jolt Squeezer Moulding Machine Showing a Deep Drag which was Jolted.

of the manual labor, the foundry worker's task is made a more desirable one, and his attitude toward the foundry is much better.

The standard types of Air Operated Squeezer Moulding Machines are usually mounted on wheels. The advantage in the use of this construction is that, if desired, the machine can be moved along the side of the sand heap on the working floor, or it can be permanently located, and the sand piled in a heap beside it.

Another style of air operated squeezer is that known as the Sand Straddler, which is mounted on wheels having a wide span. This machine is designed to straddle or span the sand heap, the sand being piled in long rows, but shorter than the length of the moulding floor, to permit placing the first moulds and to allow working space. As the floor is filled with moulds, the machine is pushed ahead, the sand being taken from beneath the machine.

Design

In air operated squeezer machines of any size or type, should be found incorporated the following principles: All working parts should be fully enclosed or shielded against sand and grit; the place for moulding sand is either in the mould or on the floor, hence the contours of the exposed members of the machine, as far as possible, should be of the inverted "V" design so as to shed the falling sand; simplicity of operation is essential to its proper working under the conditions usually existing in the foundries; pistons should be provided with cast iron piston rings and proper oiling facilities; the strain rods carrying the pressure head should be adjustable for height, to meet the conditions existing due to varying height of flask used; the pressure head and strain rods should be counter-balanced; the operating valve should be in a convenient location at the right of the operator and below the working position of the table; this operating valve should be automatically locked except when the pressure head is in the squeezing position; there should be a release pop valve, releasing the pressure in the cylinder when the mould has been squeezed to a predetermined density, there should also be a pressure gauge, a blow valve, a riddle bracket, and a shelf for holding the cope half of the mould while drawing the pattern from the drag half which is still left on the table of the machine. These features make of the machine a self-contained and independent unit.

Production

The following photographs, Figures 107 and 108 show the production of the squeezer machines. It is easy to see that

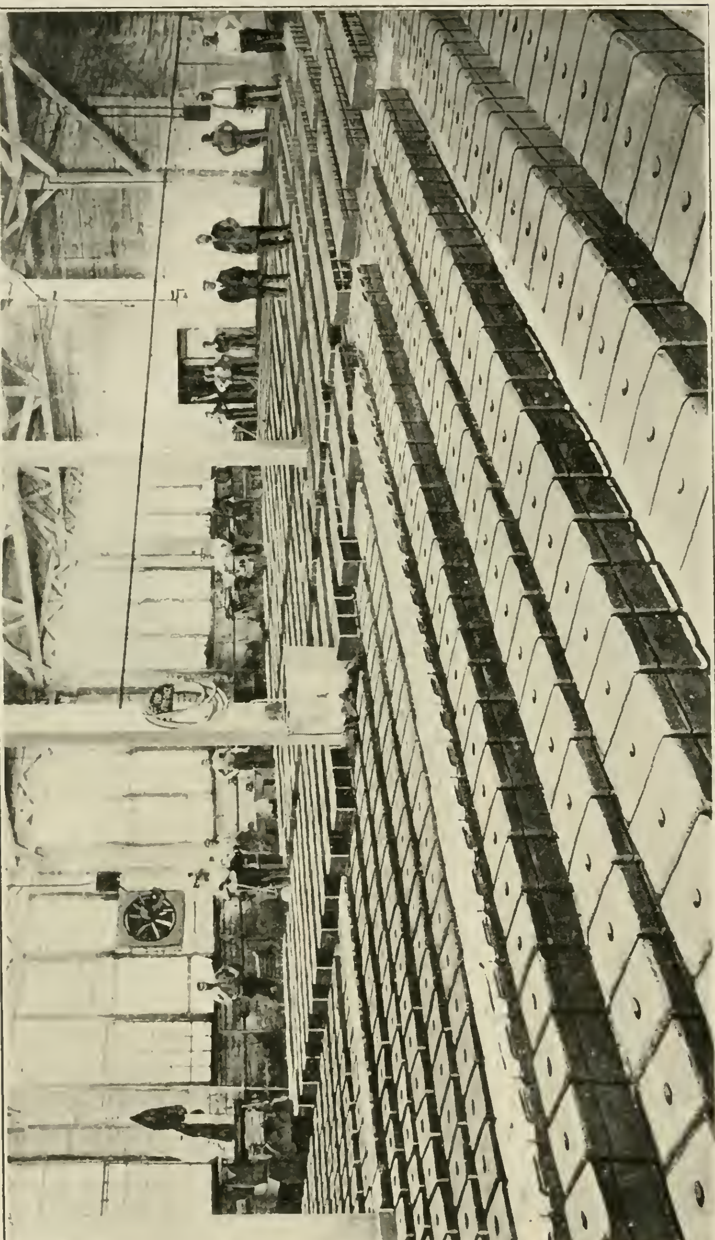


Fig. 107. A Day's Work in the Malleable Foundry of The Westinghouse Electric & Mfg. Co., Cleveland, Ohio, U. S. A.

they produce moulds in large quantities, but such vague generalities are not acceptable to practical foundrymen. Production ranges from 50 to 250 moulds in a working day, depending upon the following conditions:

1. The size of the flask.
2. The number of cores to be set.
3. The difficulty of pattern draw.
4. The mounting of the pattern.

Considering these factors in detail: The first of these is the size of the flask. It is readily seen that a larger flask, being heavier, will fatigue the operator more than a smaller flask, since he must handle each flask several times during the operation of making each mould—first, when he places it on the table with the pattern in between the two halves; second, when he rolls it over with the drag half full of sand; third, when he lifts the cope half from the pattern plate; fourth, when he places the cope half back onto the drag half; fifth, when he removes the flask from the mould; sixth, when he places the finished mould on the floor. In all of the above cases, the greater weight of the larger size is the principal factor, except in the sixth case, namely setting out the finished mould on the floor; here another factor enters into the element of difficulty of handling: This is the shape of the flask or the relation of the width to the length. A mould 14″ x 14″ will be more difficult to handle and will be more tiring to the operator than a mould 10″ x 20″, although the 10″ x 20″ mould is the heavier of the two. This is because the long narrow mould may be held closer to the body, whereas the square mould must be held further from the body, making it very much more difficult to handle and much more tiring.

The second consideration, the number of cores to be set, is, of course, self-evident. The more cores there are to be set, the more will be the time required, and the smaller the number of moulds that can be expected from one man.

The third, the difficulty of pattern draw, affects the speed with which the cope can be drawn up from the match plate, or the match plate from the drag mould, or both, and in this way

Fig. 108. Interior View of The Best Foundry Co., Bedford, Ohio, U. S. A.

a pattern with a difficult draw will decrease the number of moulds which can be produced per day.

The fourth, the mounting of the pattern, is most important and deserves more attention than the others.

Pattern Mounting

The method of mounting the pattern should be given extensive study, as it is here that the greatest advantages in production are possible. The rule in seeking for quantity production is to *make the pattern so that the patternmaker has eliminated as much of the moulders' work as possible.* The reason for this rule is almost obvious. Any operation which can be eliminated in the foundry will be that much time saved over and over again as many times per day as there as moulds made, and this saving of time, large in the aggregate, will more than offset what might seem at first to be a large expenditure of time in the pattern shop.

Viewing the construction of the pattern in this light we have the one extreme, the simple, loose pattern which is sometimes used in an emergency, but which requires a skillful moulder to bed the pattern into a green sand match, and to cut the parting by hand. Since this is only an emergency method of producing moulds the first method to be considered is the use of the gated pattern with a follow board or match. This follow board may be either of wood or of hard sand, and enables the moulder to lay the pattern on the follow board, which takes up the irregularities in the shape of the pattern, to ram up the drag half direct and then, after making the parting, to ram up the cope half. The gates are introduced in the mould without the necessity of the moulder cutting them each time. The next step forward in pattern equipment is the vibrator frame, which allows the use of a vibrator instead of hand rapping.

The match plate is the next forward step in producing moulds on the squeezer machine. It eliminates entirely the handling of a follow board and eliminates the making of a parting and the ramming of green sand against green sand,

Fig. 109. Foundry Interior of The Universal Winding Co., Providence, R. I., U. S. A.

allowing both halves of the mould to be rammed directly against a metal plate. Chapter XI, on patterns will explain more fully the differences in the construction of the various kinds of patterns. Their use is as follows:

The Use of Match Plates and Vibrator Frames

The use of a match plate on an Air Operated Squeezer Machine requires in addition to the match plate, a flask parting compound, a tubular sprue cutter, a quantity of bottom boards, a cope board and the vibrator. The cope half of the flask is placed on the table of the machine, and upon this the match plate—the cope side being turned downward. The parting substance is then dusted over the drag side of the match plate, and sufficient sand riddled into the flask to completely cover the pattern. Sand is then taken from the sand heap to fill the flask, and the flask is "struck off," using the bottom board for a "strike," and the bottom board is placed in position on the mould. The bottom board must be about ⅛″ smaller all around than the inside of the flask. The mould is now rolled over, and the operation is repeated to fill the cope flask. Instead of a bottom board, however, a cope board is used, which is similar to the bottom board, but has a button secured to the face of it, serving to locate the position of the sprue. The pressure head is then drawn forward, the operating valve handle pressed down and held until the relief or "pop" valve operates. The squeezing is then complete. The pressure head is next pushed back, and the cope board removed. The sprue is cut by means of a brass tube sprue cutter, at the point indicated by the impression of the button secured to the cope board. The vibrator is then started by pressure of the knee on an air inlet valve, and the cope half is drawn off and set on the shelf at the left side of the machine. The vibrator is again applied, and the match plate of patterns is withdrawn from the drag half of the mould; the match plate is then placed on the pressure head.

The vibrator frame type of pattern is moulded in a similar manner. The pattern, in its hard match, is placed on the table of the machine, the drag flask set in place, and the sand riddled

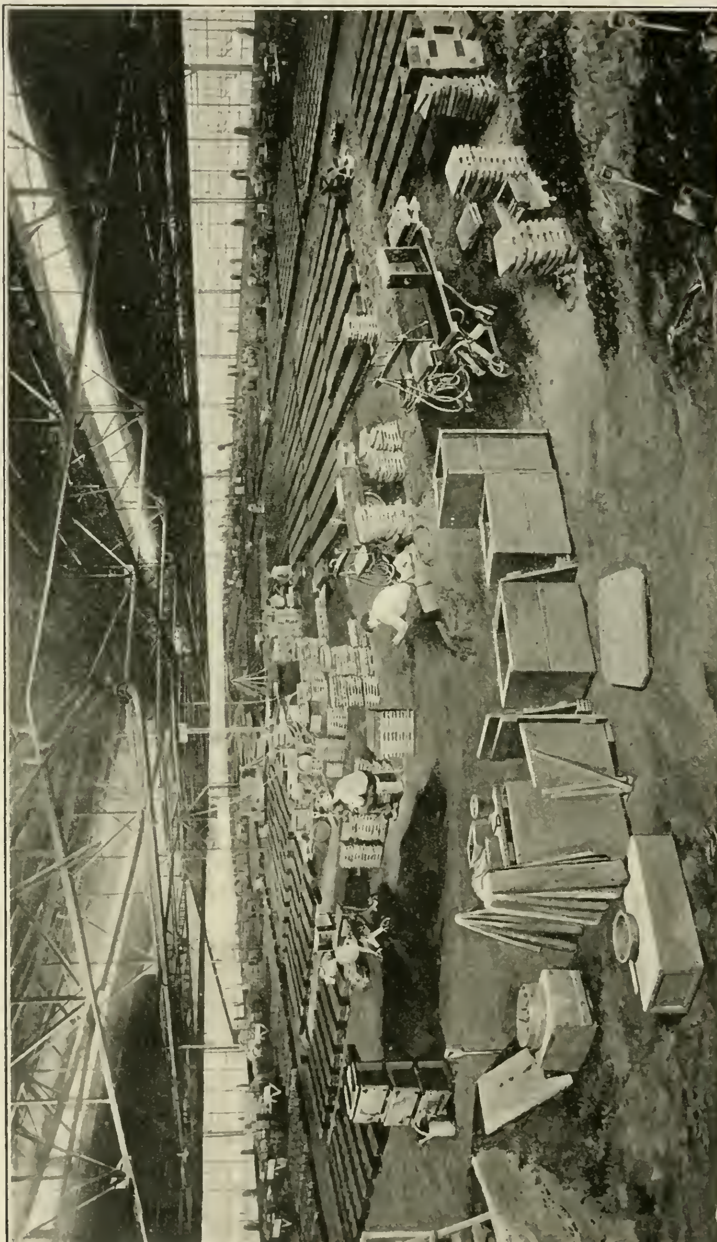


Fig. 110. An Every Day Occurrence at The Federal Foundry Co., Indianapolis, Ind., U. S. A.

into the flask, which is then filled and struck off. The bottom board is then placed, and the mould is rolled over. The match is then removed and replaced by the cope flask. The pattern and the sand in the drag flask are dusted with parting compound, and the cope is filled with sand, in the same manner as the drag. The cope board is placed on the top, the pressure head drawn into position, and the squeezing operation performed as before described. The cope board is then removed and the sprue cut. The pattern is vibrated while the cope half is drawn upward and is vibrated again as it is drawn from the drag. The impressions of the strips holding the pattern in the frame must be stopped off with sand, after which the mould is closed and placed on the pouring floor. The ordinary gated pattern is handled in the same manner as the vibrator frame, except as there is no means of attaching a vibrator to the pattern, it is rapped thru the sprue, as in ordinary bench moulding, and a draw spike is used for lifting the pattern from the drag half of the mould.

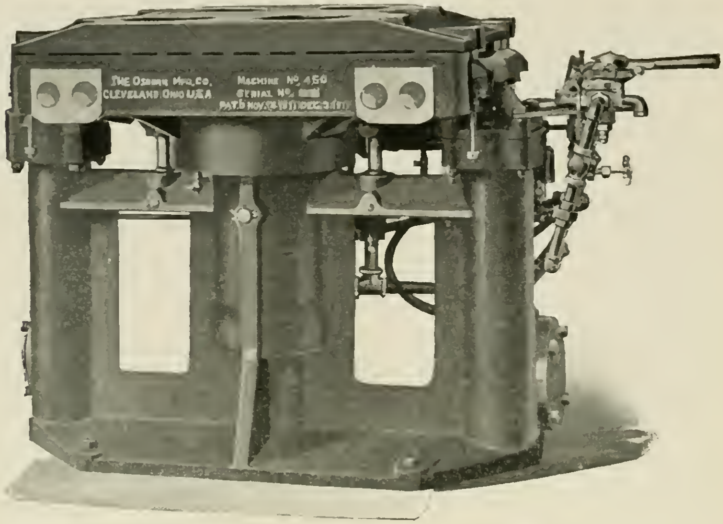


Fig. 111. A Jolt Stripper Moulding Machine.

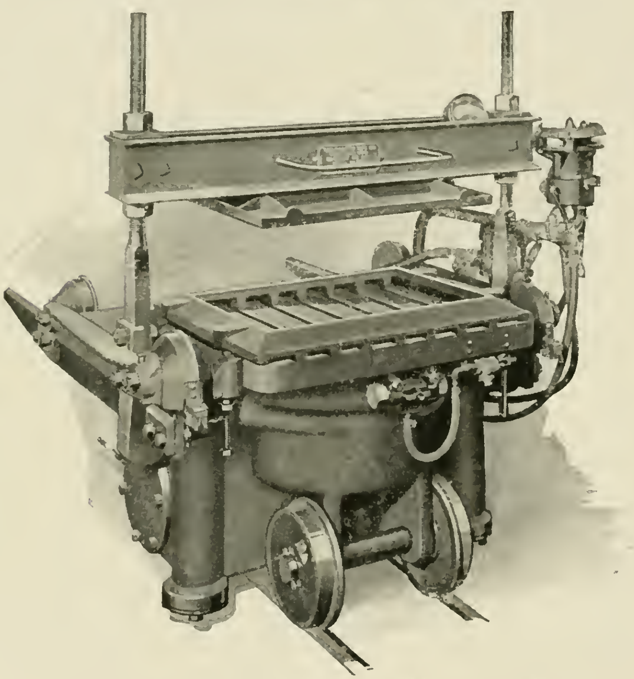


Fig. 112. A Jolt Squeeze Stripper Moulding Machine.

CHAPTER X

Jolt Stripper Moulding Machines

The machines classified under this heading are those which jolt ram the mould, and then strip the pattern from the mould, and those which jolt ram, squeeze and then strip the mould. In both cases the stripping operation may mean either lifting the mould upward from a stationary pattern or dropping the pattern downward from a stationary mould. Figure 113 shows a stationary type of machine used on small work which embodies the first mentioned principle, that of lifting the mould upward from the pattern. This type of machine is further illustrated in Figure 114, which shows the stripping plate in the raised position and the mould lifted from the plate and turned up for inspection. The last mentioned type of machine, viz., the one that draws the pattern downward from the stationary mould, is illustrated in Figure 115, which shows a small stationary hand operated machine. It is readily seen that the roll over operation is not incorporated in any of these machines and that its normal use, therefore, is for making the cope halves of the mould, although the drag halves are frequently produced on these machines. In such cases the drag half of the flask is barred like a cope half. The Jolt Stripper Machine is frequently used in connection with Roll Over Machines, the one making the cope half of the mould, and the other the drag half In such cases the Jolt Stripper Machine is always more rapid in operation than the Roll Over Machine and in some instances it has been found possible for one Stripper machine to supply the

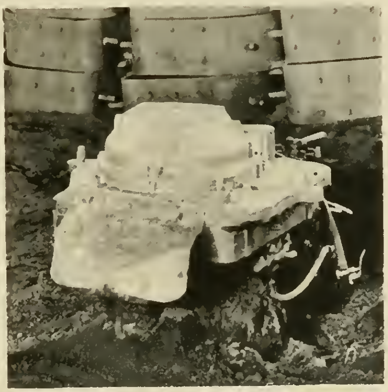


Fig. 113. A Small Jot Stripper Machine in the Foundry.

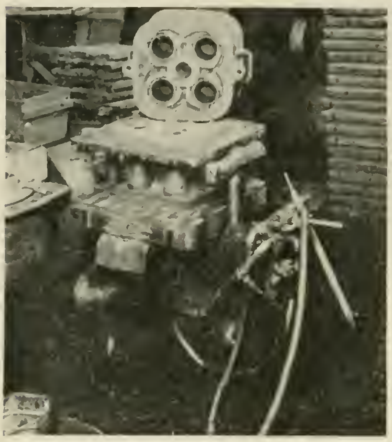


Fig. 114. A Jolt Stripper Machine with the Table Raised.

cope halves of the moulds for the total number of drag halves made on two Roll Over Machines. The choice of the Jolt Stripper Machine for producing cope moulds is usually made as a result of one of two factors; first, the pattern is of such intricate shape with such thin projections of sand, that the ordinary pattern drawing operation would damage the mould. In such cases a stripping plate is necessary for the making of good moulds. In the second case the Jolt Stripper Machine is used with patterns which could also be used to produce moulds easily by any other method, but on account of the large quantity production the advantages of the greater speed of the Jolt Stripper Machine more than offset the increased cost of pattern mounting.

The mounting of the stripping plate, pattern plate and pattern with regards to each other varies in the practice of different foundries. Figure 116, page 151, illustrates the two most common methods. The bottom view shows a method suitable for use with patterns which have already been made, and which can be mounted directly on the special pattern plate, but this special pattern plate must be

Fig. 115. A Hand-operated Machine Which Strips the Pattern Downward.

of the shape of the pattern, so that the total amount of work to be done on the pattern equipment is about the same in each case. The location of the pins is also decided differently by different foundrymen and Figure 116 shows two of the common methods in use. In the top view, the pins are attached to the stripping plate, and the finished moulds after they have been stripped, must be lifted off the pins; while, in the bottom view the pins are attached to the pattern plate, and when the stripping operation is completed, the finished mould can be lifted off of the stripping plate without the trouble of disengaging it from the pins. This method is referred to by foundrymen as stripping the pins, and is preferable whenever conditions warrant.

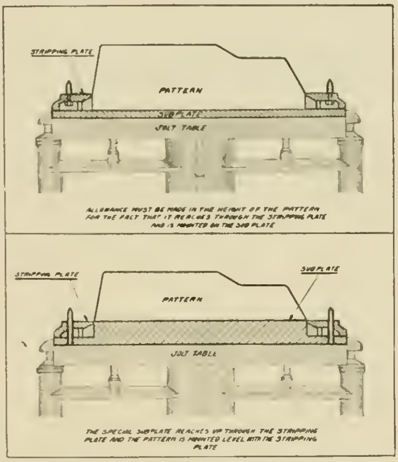


Fig. 116. Two Methods of Arranging Patterns and Stripping Plates.

The gate is frequently mounted on the upper side of the stripping plate and when this is the case the mould must be lifted vertically from the stripping plate. The use of pins attached to the stripping plate is usually advisable in such cases. Fig. 114 shows the plate with the gate constructed in this manner, but the pins are stripped so that the moulder must exercise care not to damage the mould when lifting it from the stripping plate. When using patterns of very intricate shape, where the body of sand is surrounded by portions of the pattern and is of such shape that it needs support, the method employed is known as "stooling." In this method of moulding, the pendant or hanging sand is supported by the stool, while the flask with the mould is withdrawn from the pattern. This will be explained more fully in the following detailed description.

To illustrate this method of moulding, Figure 120 shows a jolt squeeze stripping plate moulding machine, which is especially adapted to this particular type of work.

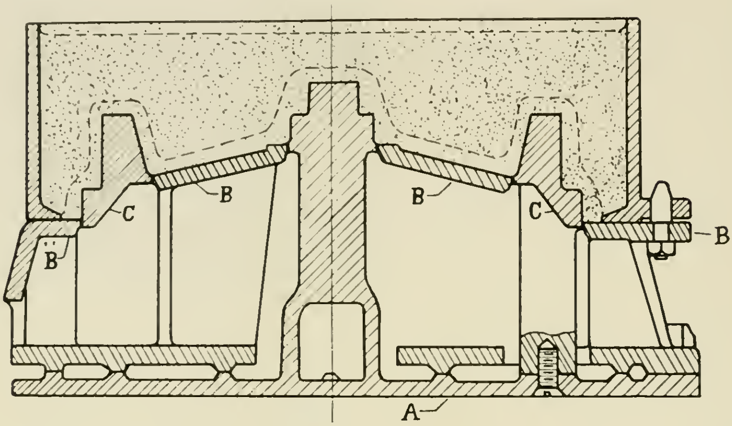


Fig. 117

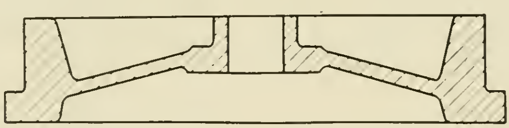


Fig. 118

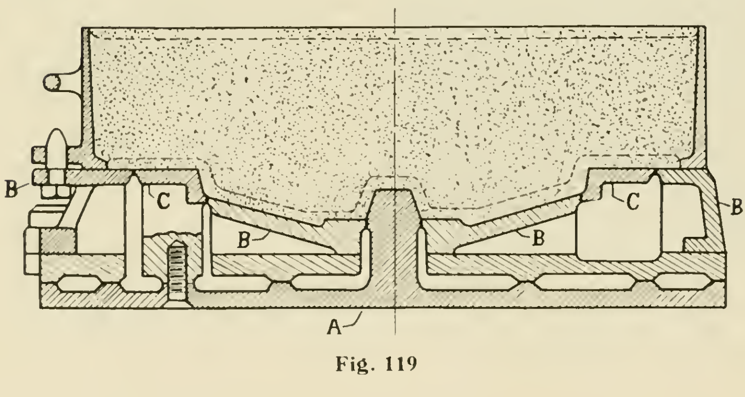


Fig. 119

Figure 117 is a cross section drawing of the drag of an automobile flywheel pattern, while Figure 119 shows a cross section of the cope pattern. The casting produced is shown in outline in Figure 118. It is obvious that the sand between the rim and hub of the drag half of the mould, and also the body of hanging sand in the cope will require supports when stripping the pattern from the mould. The drag and cope pattern equipments consist of sub-plates A, which are bolted and doweled to the jolt table. The Stripping plate B, by means of which the flask is lifted or drawn from the pattern, and which rests on the sub-plate A, is elevated by means of pins at each end of the sub-plate, as well as at the rim of the flywheel C; as the same principle is applied to both the cope and the drag moulds, it is necessary to describe only the drag part of the pattern. The sub-plate has a central projection extending upward and forming the hub of the flywheel, and the coreprint of the hub core.

The rim of the flywheel pattern consists of a ring with a multiple number of downward extending lugs, by means of which it is securely fastened to the sub-plate A, each lug extending thru the holes in the stripping plate B.

The hub and rim of the pattern should be cast integral with or bolted to the sub-plate, and remain stationary while the stripping plate B is being lifted, thus stripping or drawing the mould from the hub and rim. The pendant part of the mould is supported by stripping plate B during this operation.

It will be noted that the stripping plate lifts the flask and at the same time strips the hub of the pattern from around the center of the hub and the inside and the outside of the flywheel rim.

To produce good moulds and consequently sound castings it is necessary not only to be able to strip this type of pattern, but also to make sure that the sand is securely held in position by the stool plates, while the mould is being lifted from the stripping plate. It is also necessary to provide a means to insure the sand being securely held while the mould is carried and placed on the pouring floor; this is accomplished by casting ribs on the flask, as shown by the dotted lines in Figure 117. The section of these ribs should be tapered, the point next to the pattern decreasing to a size about ⅛″, and as close to the pattern as will permit a uniform ramming of the sand over the entire surface of the pattern. The distance

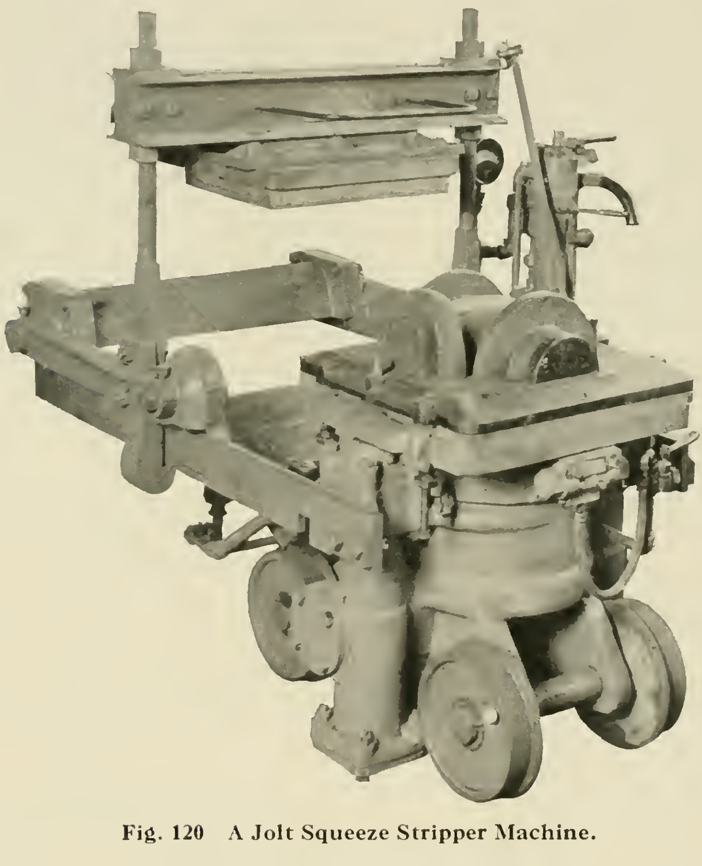


Fig. 120 A Jolt Squeeze Stripper Machine.

between these ribs and the pattern should be not more than ½″. It is important that the ribs referred to be substantial, so as to avoid vibration which would destroy the mould while being jolt rammed.

The Jolt Squeeze Stripper Machine

There are also Jolt Stripper Machines which have the squeezer operation embodied in the machine, and a discussion of the advantages to be gained by their use is in order here. The addition of a squeezer head and a squeezing cylinder

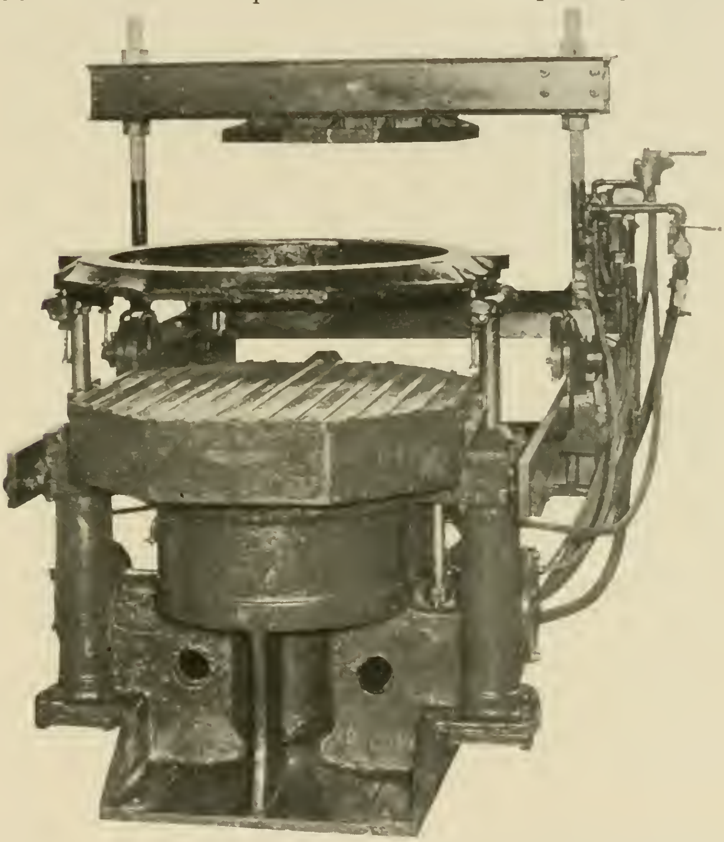


Fig. 121. A Jolt Squeeze Stripper Machine with the Stripping Plate in the Raised Position.

naturally makes the machine more expensive and does not add materially to the speed of operation, since it is possible to butt off the mould by hand in about the same length of time that is required to pull the squeezer head forward, squeeze the mould and then push the squeezer head back again. The advantage, therefore, is not primarily one of speed, but rather one of quality. In ramming the sand by jolting and hand butting off, a variable human element enters into the density of the sand in the mould. It is natural, as the day progresses and the fatigue of the worker increases, that he should ram the sand softer, or if he is an unusually conscientious worker and realizes the tendency of soft ramming, he will probably overdo the matter and ram the moulds harder than he did earlier in the day. In either event the result is non-uniform ramming of the day's moulds, and in the different portions of the same mould. These variations are slight and produce only a relatively slight difference in the shape and weight of the castings. On work which it is not necessary to hold to exact limits, the difference might never prove serious, but the patterns mounted on stripping plate machines are generally used in large quantities and the machine shops are equipped to handle them rapidly. Consider for instance the automobile piston illustrated in Figure 114 These pistons are made entirely in green sand and are butted off by hand. Slight variations in the density of the sand cause slight variations in the outside size of the piston at the head end. This causes more metal to be turned off and increases the machining time. The machinist is able to do more pieces per hour when the pistons are perfectly round and are furnished with the minimum amount of finish metal on them. Figure 132 illustrates a pattern which exemplifies another phase of the importance of uniform ramming. The pattern there shown produced one half of the symmetrical castings. The upper point of the pattern was used as a jigging point and the jigs were made to locate from this portion of the pattern. It was found that when jolt ramming and hand butting off, the distance from one point to the other on the rough casting varied from 1/64 to 1/32 of an inch. This caused much trouble with the jigs, and eventually was overcome by the use of Jolt Squeeze Stripper Machines.

These examples are typical of practically all jobs mounted on the Jolt Squeeze Stripper Machines, since they are all produced in large quantities and the machine shop is equipped with accurate jigs for handling them.

In theory as well as in practice, the addition of the squeezing operation to the jolt ramming operation makes for uniformity of results. Not only is each mould identical with each other mould, but also the density of ramming is uniform from top to bottom of the mould. Figure 126 illustrates graphically the reason for this fact. A jolt rammed mould is densest at the pattern plate, decreasing to such a small density at the top of the flask that hand butting off is required, while the mould which has only been squeezed is generally accompanied by the reverse effect, that is, the mould is denser at the squeezer board and softer further from the squeezer board, requiring, in fact, some hand tucking near the pattern and pattern plate in most cases. The mould which has been jolt rammed and squeezed combines the good points of both and eliminates the hand work of both. The jolting takes the place of hand tucking around the pattern, and the squeezing supplements the jolting operation so that hand butting off is eliminated. The total result of the two operations then is to produce a mould, the density of which is practically uniform from top to bottom as well as over the entire surface of the pattern and pattern plate.

In the types of machines previously mentioned, it is always necessary to perform some of the operations by hand On the Jolt Squeeze Stripper Machine, however, the machine performs all of the essential operations, and the operator merely controls the machine. The natural result is that the 100% power machine produces a larger number of satisfactory moulds than those types of machines which require som steps to be performed by hand. This type of machine possesses, therefore, not only the highest ability to produce castings of uniform size and shape, but also to produce them in the largest quantities. These advantages offset the disadvantage of the higher cost of the special patterns, pattern plate

Fig. 122. Placing the Flask Around the Pattern.

Fig. 123. Squeezing the Mold.

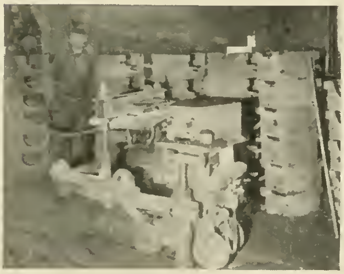


Fig. 124. Stripping the Mold.

Fig. 125. Lifting the Finished Mold from the Machine.

and stripping plates which are necessary, and of the time required for changing patterns which involves, of course, changing the stripping plate also. These disadvantages, however, are not present when the machine can be kept constantly at work at full capacity on one pattern, for then pattern changing becomes unnecessary and the greater pattern expense is distributed over such a large quantity of moulds that it really becomes a low figure when expressed in terms of pattern cost per casting produced.

Operation

For those who are not familiar with the method of producing moulds from the Jolt Squeeze Stripper type of Moulding Machine, the four views on the opposite page depict four stages of the operation. The upper left hand view shows the operators about to place the special cut flask around the pattern on the stripper plate. It will be noticed that the squeezer head is pushed back out of the way, and does not interfere with the locating of the flask. The second illustration, in the upper right hand corner, shows the squeezer head pulled forward into the squeezing position and the table raised in the act of squeezing. In moving forward, the squeezer head strikes off the surplus sand which remains above the top of the flask after it has been jolt rammed, and the squeezing operation compresses this sand the amount of the squeezing stroke, in this case about 2″. The squeezer head is so adjusted that at the completion of the squeezing operation the sand is level with the top of the flask. The figure at the lower left illustrates the next operation in producing the mould. The squeezer head has been pushed back, the vibrator placed in operation and the mould stripped upward from the pattern. It will be noticed that the flask pins are fastened to the pattern plate so that they are stripped as well as the pattern, thus permitting the finished mould to be lifted from the stripping plate more rapidly, as it need not first be disengaged from the pins. The lower right hand figure shows the two operators removing the finished mould from the stripping plate which is ready to be returned to its initial position.

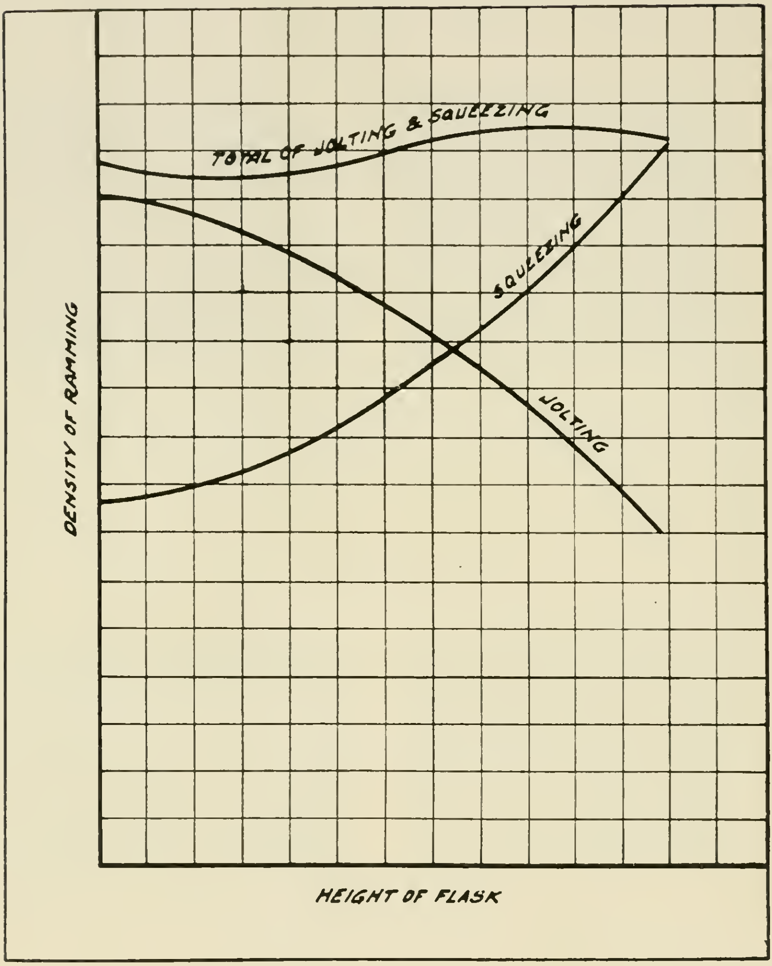


Fig. 126. A Curve Showing Graphically the Density of Ramming Produced as a Result of Both Jolting and Squeezing.

CHAPTER XI

Pattern Equipment

The majority of patterns originally made for floor moulding can be mounted for use on Moulding Machines. In some cases it will be necessary to provide cores or loose pieces to care for overhanging lugs, but it is nevertheless true that the great majority of the patterns made for floor moulding can be mounted for machine moulding. On the other hand, a more satisfactory type of pattern construction may be had by originally constructing the pattern together with the plate. The building of the pattern at the same time the plate is built, offers as advantages, if both are made of wood, rigidity and strength of the pattern, which means less pattern upkeep and longer pattern life. Patterns made for machine mounting, that is, for Plain Jolt or Roll Over type of machines, sometimes cost more and sometimes less, but, on the average, cost about the same, whether made for floor or machine moulding.

Too often the design of the pattern is left entirely to the pattern maker, who, in deciding the type of pattern to be made, is in reality determining foundry practice. There are many pattern shops which make a specialty of patterns for machine mounting.

These pattern makers, who are specialists in their line, are better fitted than anyone else to decide upon such questions as the method of moulding, and they are fully competent to design and manufacture equipment which will give satisfactory production when used with moulding machines. On the other hand, there are pattern shops which have not, as yet, made a study of the mounting of patterns for machine moulding, and who are not in direct touch with the foundry in which the patterns are proposed to be used. It is unfair to these patternmakers to expect them to produce the best designs of patterns when they are not familiar with such factors as the number of castings to be made, the portions which are to be machined or jigged, or the available foundry equipment, including, among other items, the available moulding machine for producing the moulds. It is to the interest of the producer of the castings to see that his patterns are properly designed for the most economical production in the foundry as well as in the machine shop. It is the manufacturer also who knows the quantity of castings desired from each pattern, and since this determines the amount of study and time which may justifiably be spent upon a pattern, it is an important factor which should be utilized to its fullest extent.

The essential fact to bear in mind is, that the making of the drawing, making of the patatern, and the making of the castings are not separate, unrelated steps but that each one is related as in a chain, joined to the link on each side of it, and that the process of transferring the designer's ideas from his brain to finished product is in reality one operation.

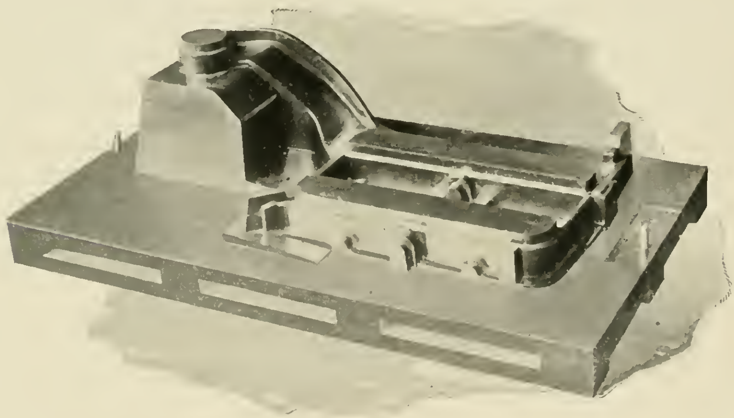


Fig. 127. Correct Mounting of a Fragile Pattern on a Pattern Plate.

Pattern Materials and Construction

Patterns are divided into two general classes, wood and metal. The material used in the making of a metal pattern may be brass, aluminum, white metal or iron, depending, of course, upon the size, and whether or not the pattern in moulding is to be handled or fastened to the table of the machine. Metal patterns are made from master patterns, which, for machine mounting, should be provided with the necessary ribs to reinforce any weak portion of the pattern. It is well, also, where possible, to provide suitable lugs or bosses (preferably inside the profile of the pattern) for fastening the pattern to the pattern plate, although in some instances the pattern and pattern plate are cast integral. The necessity for rigidity of construction cannot be too strongly emphasized in the making and mounting of patterns that are to be used for jolt machine moulding, as the pattern that is so made as to permit a springing action to take place while the machine is being jolted, will cause a vibration that will prove very detrimental to the proper packing of the sand, and if such a pattern is used, the mould will be full of cracks or other imperfections. Therefore, considerable stress must be laid upon the importance of properly reinforcing the flat surfaces of the pattern in such a manner as to prevent vibration.

The pattern should not be designed until the style of the moulding machine for producing the mould has been determined, after which, consideration should be given to the proper size of flask. In determining the size of flask that should be used in connection with the moulding machine, it is well to keep in mind the fact that a machine rammed mould, made in a suitable flask, does not require as large an amount of sand between the pattern and the flask as has been the common practice in the foundries making use of a more fragile type of flask, or in those making use of the ordinary wood flask.

It should also be noted that a larger casting can be made in the same flask on the moulding machine than on the floor. The decreased sand allowance between the pattern and the flask is possible because the motion of the machine is more smooth and regular in rolling over than is the rolling over by crane, where the flask is frequently balanced on one corner as it is being rolled over.

It is well to point out the necessity of considering the advisability of producing the mould in a rectangular flask,

i. e., whether or not the quantity of castings to be made from the pattern is such as would warrant the making of a flask of a special shape, following the outline of the pattern, commonly known as a "cut" flask. This matter of the design of flasks is covered more fully in Chapter XII.

Metal Patterns and Pattern Plates

As has been pointed out, when mounting patterns which are to be used on jolt moulding machines, extreme care should be taken to see that the pattern is thoroughly reinforced and free from all possibility of a springing action taking place in the pattern itself while the mould is being jolted. Patterns for use on this type of machine, and from which

Fig. 128

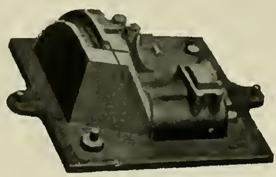


Fig. 129

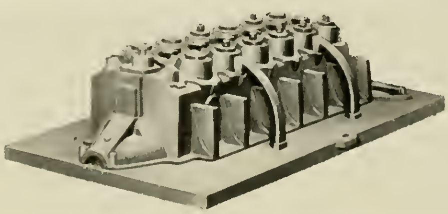


Fig. 130

a large quantity of castings are to be produced, are usually made of metal and mounted on iron plates. The thickness of the plates should not be decided until after determining the height, in order that they may conform to the moulding machine on which they are to be used. Where it is possible, they should be made deep and hollowed out in the back, also reinforced by ribs running in both directions, and, if the plate can be made of sufficient height, holes should be provided on the sides, suitable for attaching clamps to hold the bottom board and flask to the plate while the mould is being rolled over.

Figures 128, 129 and 130 clearly illustrate the high state of attainment in the art of pattern making. The patterns are of a design requiring the highest grade of workmanship, in order to produce the profiles which will match and maintain the uniformity of section that is required in this particular type of casting—the section in many cases being not more than 3/16″ in thickness.

In Figure 131 are shown the cope and drag halves of a metal pattern, mounted side by side upon the table of a Roll Over Jolt Moulding Machine. A careful study of this view will convince the reader that this style of operation is economical where the pattern is of a length to permit its being used in this manner. In the view here shown it will be noted that sufficient blocking has been provided below the pattern plates to make the top of both cope and drag halves of the flask the same distance from the table of the machine.

The location of the pattern on the pattern plate, when the two are made separate, is worthy of much study, since improper location will result in a mismatched cope and drag. This defect will cause an undue amount of chipping, or, if it is bad enough, will scrap the casting. In matching cope and drag halves on separate plates, the only safe procedure is to work from the pin centers, which must be drilled before the pattern is mounted. This is necessary because a center line can be drawn thru the pin holes more accurately than the pin holes can be located on the center lines. The center line adjoining the two pin holes is perpendicularly bisected, and these two center lines then form the basis of a

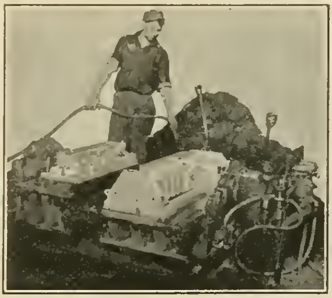


Fig. 131

system of measurement by which the two halves of the pattern are similarly located.

Machine moulding is so thoroughly a part of the automobile industry that very little comment is necessary upon the manner in which patterns are made, and the views which show automobile castings are used only for the information of those other foundrymen who are not familiar with the progress that has been made in the automobile foundries.

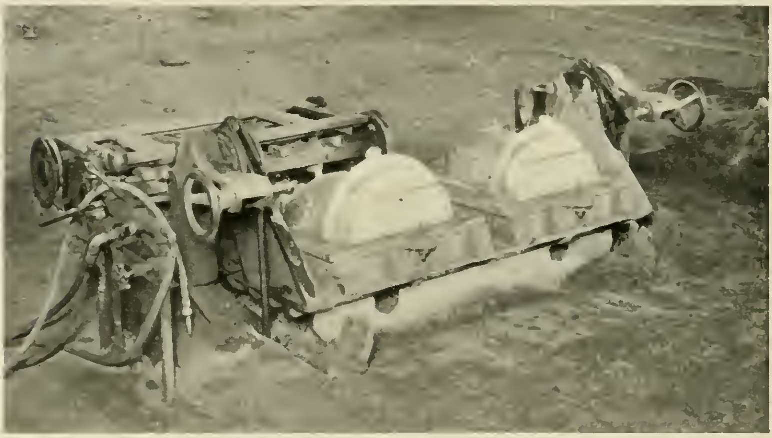


Fig. 132. Two Metal Patterns Mounted Side by Side on a Roll Over Jolt Machine.

Wood Patterns and Pattern Plates

Therefore, in order to show the use of the jolt moulding machine in plants other than the specialty foundries, and the gain to be made from their universal use in foundries, illustrations are shown and a full description given of the method of making and mounting wood patterns upon wood plates; also of the practice in some foundries, where a universal plate is used and patterns of all shapes and sizes are mounted on the plate, in order to fill the standard size flask provided for the standard pattern plates that have been adopted.

Figures 133, 134, 135 and 136 show several patterns mounted on wooden plates. They also show the condition of the patterns after hundreds of castings have been made. These patterns were used on a medium size Roll Over Jolt Moulding Machine.

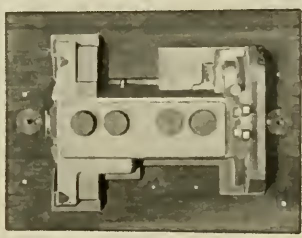


Fig. 133

Fig. 134

The group of patterns shown in Figures 168 and 169 is illustrative of the best method of making patterns for use on Jolt Squeezer Moulding Machines. These patterns were originally laid out and made for jolt moulding; the patterns and plates have been constructed together (the patterns being built solidly into the plate) making both the plate and the pattern more durable than when made separately and fastened together by means of bolts or screws. It has been fully demonstrated by cost records that a pattern of this description can be made at a cost not exceeding that of making the same pattern for floor moulding, and that the life of the pattern is longer.

Fig. 135

Fig. 136

Jobbing foundries are confronted with the necessity of making use of patterns which the customer sends them and which are usually made for floor ramming. If the foundryman desires to make the moulds on a moulding machine, it is necessary to provide plates upon which he can mount the pattern. This situation has been met in some foundries by the use of master pattern plates made either of steel or of wood; if made of wood, they are usually edged with metal cleats

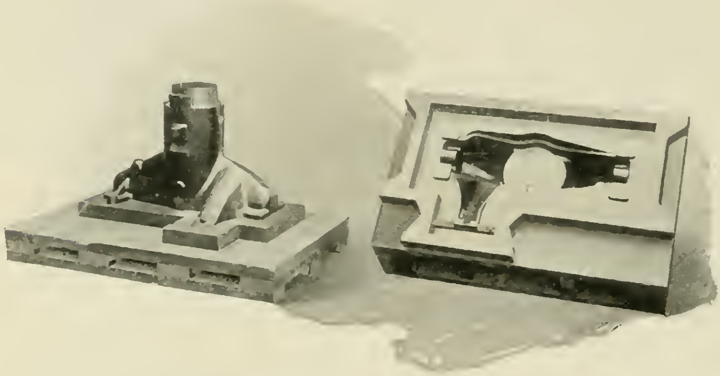


Fig. 137. A Wood Pattern on a Wood Plate with the Core Box on the Right.

upon which the flask is to rest. These cleats also protect the wooden plate. These master plates are provided with center lines which make it a simple matter to align the patterns that are placed thereon.

These center lines are used to locate one half of a set of dowel pins, the other half being mounted in the loose pattern, which will be placed on the plate temporarily. While this method does not offer the advantages that are offered by building the plate and pattern together, namely, rigidity of construction and consequent low pattern upkeep, yet in jobbing shops it is a profitable method of handling work in those cases where the pattern is furnished and only a few castings are to be made.

From the views shown in Figures 138, 139, 140 and 141, it will be seen that there can be mounted on the plates many different shapes, styles and sizes of patterns, the object being always to fill the plate with patterns in order to make use of

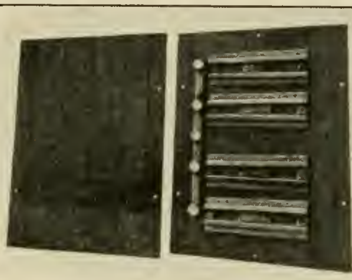


Fig. 138 Fig. 139

all the available space in the flask. The views of the plates shown in Figures 140 and 141 especially emphasize this possibility, as there are several different styles of pattern poured from one gate. The patterns shown in these figures, with the exception of the gear, are so-called "flat back" patterns, requiring no part of the pattern in the cope. By referring to Figure 141 it will be noted that the cope-plate, standing alongside the drag plate, is provided with a depression that

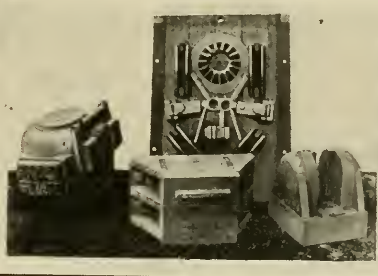


Fig. 140 Fig. 141

aligns with the gear shown on the drag plate; this depression produces the proper shaped cope half of the mould for the gear.

The plate shown in Figure 140 is well covered by a number of small patterns, all of them being shallow. It will be noted, however, that on the floor adjacent to the pattern plate are patterns having a greater depth. By taking off the patterns now moulded on the board these deeper patterns may be easily mounted and located by means of pins. The particular plates shown in these four figures were made to be used in connection with a Roll Over Jolt Moulding Machine.

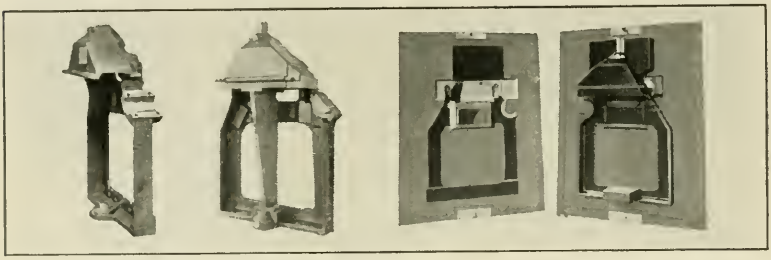


Fig. 142 Fig. 143 Fig. 144

Comparison of Machine and Floor Patterns

In order to bring more clearly before the reader the possibility of the great saving to be made, by making the patterns for machine moulding originally, there are shown in the following views the casting to be produced, the pattern as it was made for use on the moulding floor, and also as it was later mounted to be used on either the Plain Jolt or the Roll Over Jolt Moulding Machine.

Figures 142 and 143 (combined) show a casting difficult to make, and the manner in which the pattern was made for

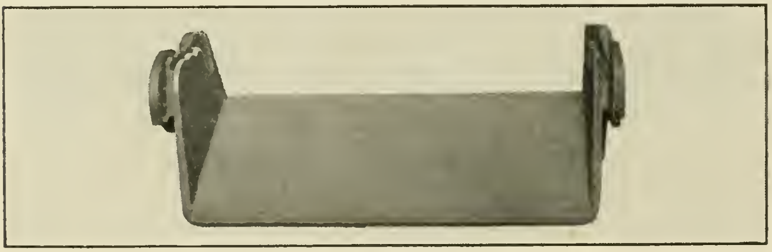


Fig. 145

hand ramming on the moulding floor. Observe the "stop-off" piece used in order to hold the shape of the pattern while the mould was being rammed, which was difficult to do regardless of the stiffening member.

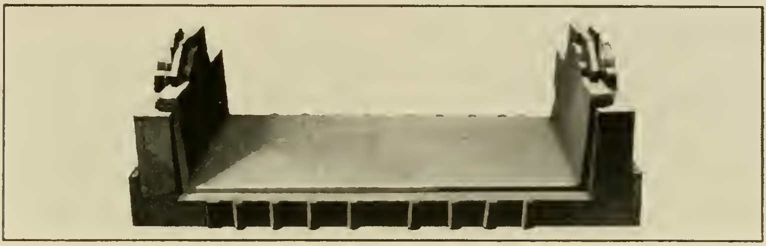


Fig. 146

Figure 144 shows the manner in which a new pattern was later mounted on pattern plates for use on Jolt Moulding Machines. The difficulty experienced in the producing of a casting straight and true to pattern was entirely eliminated by the use of the pattern plates.

Figures 145 and 147 show large and difficult castings. Figures 146 and 148 show patterns as they were originally made for use either on the floor or on Jolt Moulding Machines. However, it was possible to make only the drag half of the mould on the machine when using the patterns without mounting them on pattern plates. This was accomplished by placing the drag pattern flat on a plate on the table of the machine, and after jolt ramming the drag half, the flask and pattern

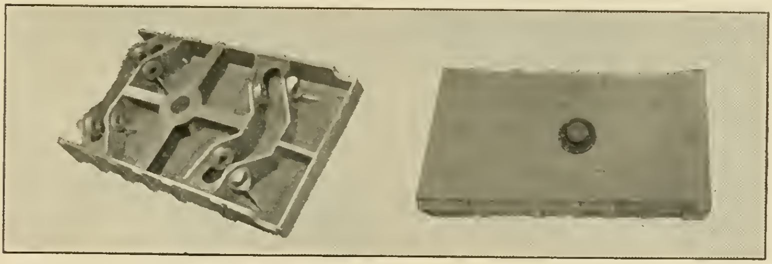


Fig. 147

were rolled over and placed on the foundry floor, and the cope half of the pattern was rammed by hand in the usual way.

Figure 149 is still another view, which again emphasizes the advantage to be gained by mounting the patterns on pattern plates, especially fragile patterns.

In the early days of machine moulding there was developed a method of mounting patterns known as "shell patterns." Such patterns when mounted for machine use were usually made for the production of castings in large quantities, the cope and drag halves being mounted on separate machines—usually the drag on a roll over type of machine, and the cope on a stripping plate machine. The method devised was such as to make use of the shell pattern for either cope or drag plate. The views shown in Figure 150 are of the cope and drag patterns mounted

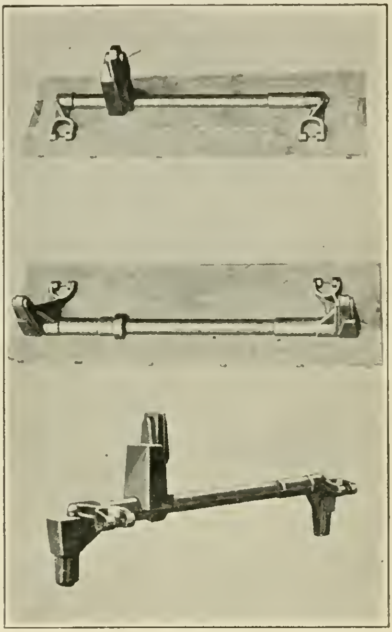


Fig. 149

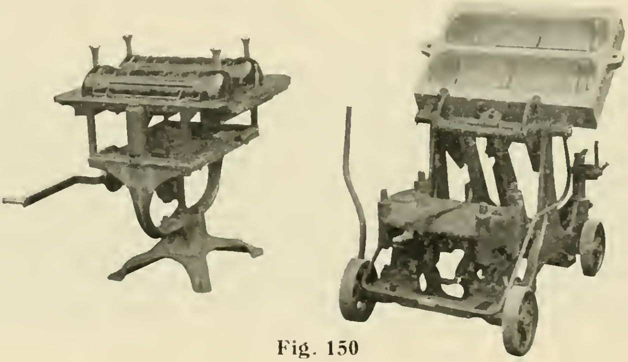


Fig. 150

on a stripping plate and roll over machine respectively. The pattern here shown is a jacket of a hot water gas heater, with the shell varying in thickness from ⅛″ to 3/16″. The shell pattern was used for the cope plate, while a white metal match was made from the shell pattern, and used for the drag plate. Foundries producing stove castings generally make use of this method of pattern mounting, the details of which are well known to the industry.

Patterns for Squeezer Machines

There are several different methods in use for the making and mounting of patterns to be used in connection with air-operated squeezer machines. Some of these methods are applicable in one case while others are preferable in different cases. The various methods of mounting patterns for use on the Squeezer Machine are as follows:

Method of Mounting	*Pattern Cost*	*Production Obtained*
Hard Sand Match	Small	Small
Vibrator Frame	Medium	Medium
Metal Plate	Greatest	Greatest

Suppose that a loose pattern is received at a foundry with an order for castings. If only one or two castings are desired it is possible for a skillful moulder to make these up directly from the loose patterns, using a green sand match, but if any quantity is desired one of the methods mentioned above will be used.

Hard Sand Match

In mounting the patterns for producing a small quantity of castings the gated style is used with a hard sand match. The pattern, or patterns, are mounted together, joined by metal strips which also serve to form gates in the mould. Figure 151 illustrates such a method of mounting four patterns together. It can easily be seen that a follow board must be used with this style of pattern; the most commonly used follow board is a hard sand match.

The material used in making the hard sand match varies although the following formula has been found to give satisfaction: To eight parts, by weight, of boiled linseed oil, add by weight, one part of yellow oxide of lead. A sufficient amount of the mixture is added to new moulding sand (which should be baked to insure it being thoroughly dry)

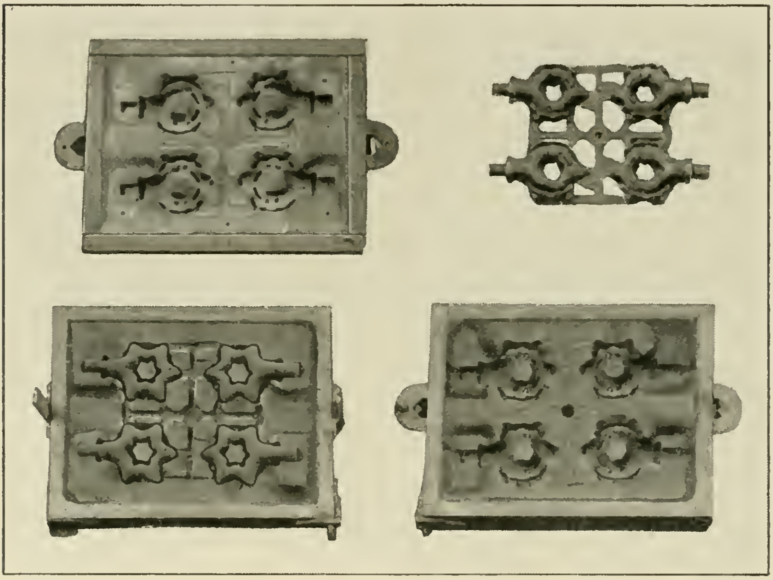


Fig. 151. Upper Left—Hard Sand Match; Right—Gated Pattern; Lower Left—Drag Mould; Right—Cope Mould.

to make it the consistency of well tempered moulding sand. The gated pattern is placed in the flask and the drag and cope rammed in green sand. The cope is then removed and replaced with a wood frame, previously prepared for containing the match preparation. The surface of the drag and of the pattern are then dusted with suitable parting material, and a new cope rammed up in the match frame, using the match material. The surface of the match is then made even with the frame, and a bottom board secured in place with screws. The mould is next rolled over, and the green sand drag removed. The pattern can then be drawn, and any portion of the match that has been injured by the drawing of the pattern can be repaired. The match should then be set aside in a warm place for about twelve hours and allowed to become hard and dry; shellac may be applied for the purpose of further waterproofing. A gate of patterns, together with the hard match and a mould made from the patterns, is shown in Figure 151.

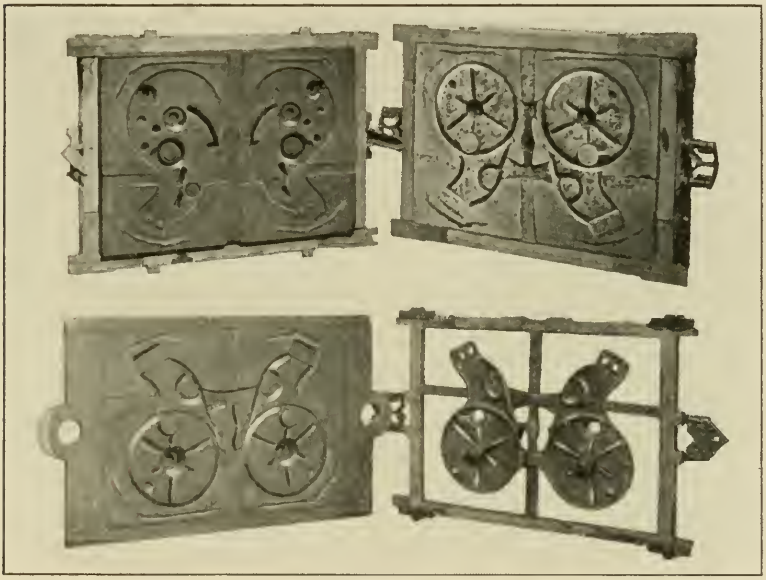


Fig. 152. Upper Left—Drag Mould; Right—Cope Mould; Lower Left—Hard Sand Match; Right—Pattern Mounted in Vibrator Frame.

Vibrator Frame Patterns

Since the gated pattern must be wrapped thru the sprue it is not as rapid in use as is desired, and a modification is introduced in the shape of a vibrator frame, which is illustrated in Figure 152. The vibrator frame, in addition to the pattern and gates, consists of a frame, to which the vibrator may be attached.

In attaching vibrator frames to the gated patterns, it is necessary only to fasten the two together firmly; no allowance in the height of the pattern is necessary to compensate for the thickness of the vibrator frame.

Match Plates

Match plates consist essentially of a metal plate, the opposite sides of which form the cope and the drag half of the mould respectively. Flat plates may have the pattern or patterns attached by means of dowel pins with suitable fastening, both halves of the pattern first being drilled at the same time, and then one half of the pattern being used as a jig to drill the plate. Other forms of plates are cast of an aluminum alloy, and the pattern and plate are cast integral. Figure 153 illustrates the first mentioned variety of match plate. A thin steel plate is cut to the desired shape, and the opposite halves of the split pattern are mounted on opposite sides of the plate and aligned by means of thru dowel pins. The gate is then fastened on and the plate is completed. Figure 154 shows the method of using the finished plate. This method is a very satisfactory one when the parting line is straight and the patterns to be mounted are simple, but when the patterns are of irregular shape, requiring an irregular parting line, with hollowed

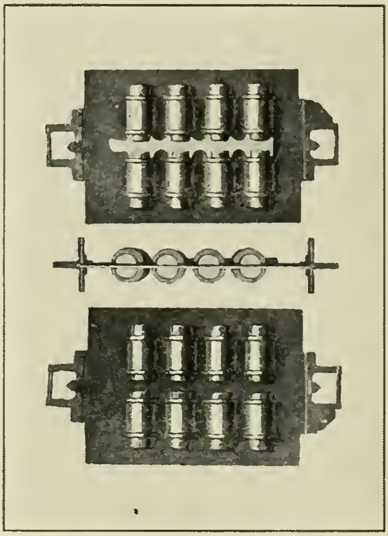


Fig. 153.

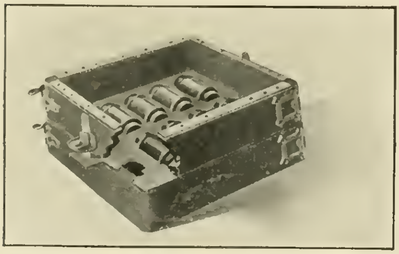


Fig. 154.

out surfaces on either the cope or the drag, it then becomes an almost impossible matter to machine a plate of the required shape, and the most satisfactory practice is the casting of the plate and pattern all in one piece. Figure 135 illustrates a plate of this nature.

In this manner the plate becomes essentially a fin on the casting, as the plate is usually made by ramming up a mould

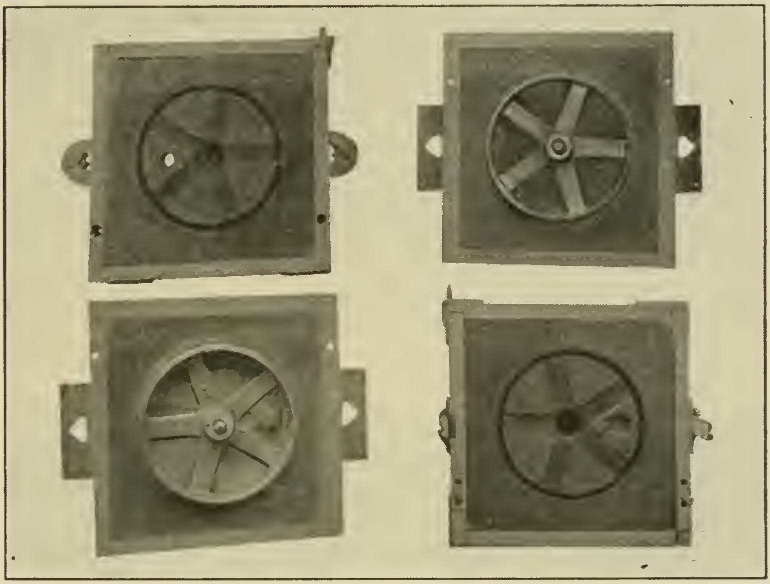


Fig. 155. Upper Left—Cope Mould; Right—Cope Side of Plate; Lower Left—Drag Side of Plate; Right—Drag Mould.

and separating the two halves by a distance equal to the thickness of the plate. The procedure of making the plate is a simple one, and in view of the universal use of the match plate, the process is shown in detail on the following pages.

The match plate is readily seen to be a reproduction of the gated pattern with the plate cast as a part of the pattern, the plate occurring at the desired parting line. A very helpful way of considering the match plate is to consider it as a fin occurring at the parting line, of a thickness previously determined, and confined to the shape desired.

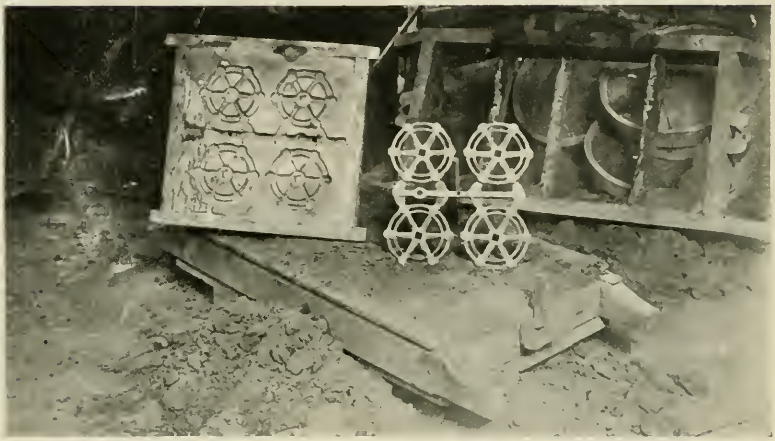


Fig. 156. The Gate of Patterns and the Hard Sand Match Used in Producing the Match Plate Are Here Shown.

Fig. 157. The Gate of Patterns is Placed on the Match and an Extra Length of Green Sand Built On.

Fig. 158. The Drag Flask is Placed on and Clamped, Ready for Rolling Over.

Fig. 159. The Hard Sand Match is Removed, Leaving the Pattern Bedded in the New Drag Half.

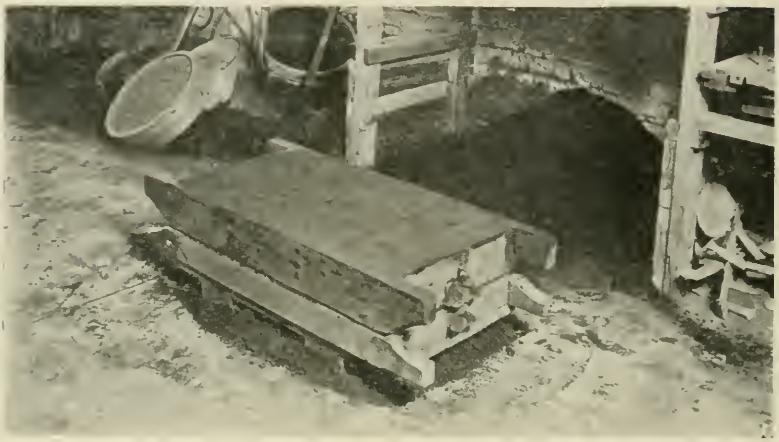


Fig. 160. The Cope is Placed on and Rammed in the Usual Manner.

Fig. 161. The Cope is Removed but the Pattern is Not Drawn at this Time.

Fig. 162. Wood Forms Are Used to Shape the Ends of the Plate and Form the Pin Ears.

Fig. 163. The Mould is Now Complete and is Ready for the Pattern to be Drawn.

Fig. 164. The Pattern Having Been Drawn, the Mould is Closed and Clamped.

Fig. 165. Pouring Must Take Place Rapidly Due to the Thin Sections.

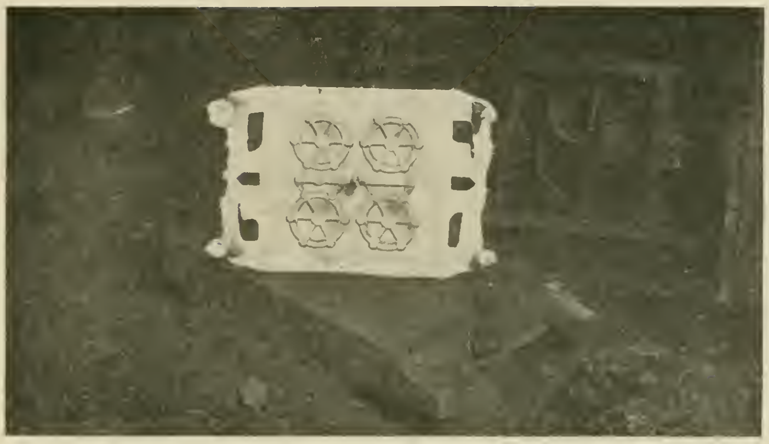


Fig. 166. The Cope Side of the Match Plate. Note the Method of Gating.

Fig. 167. The Drag Side. These Two Views Show the Plate Just as it is Shaken Out.

An alloy composed of

Zinc .... 15 per cent
Copper .... 3 per cent
Aluminum .... 82 per cent

is frequently employed for match plates used on a Jolt Squeezer Moulding Machine. These plates must be made thick enough to have sufficient strength to resist, without deflection, the impact of Jolt Ramming. A second alloy used for the same purpose is

Aluminum .... 69 per cent
Zinc .... 31 per cent

Both of these alloys have a shrinkage of about 5/32″ per foot.

The standard No. 12 Aluminum Alloy composed of

Copper .... 8 per cent
Aluminum .... 92 per cent

is used for match plates which will be used on Plain Squeezer Machines, but is not strong enough for match plates to be used on Jolt Squeezer Machines.

In casting match plates there are two difficulties which must be carefully avoided. The first is poor gating, which may allow some portions of the plate to solidify before metal has reached all portions of the plate, and the other difficulty is unequal shrinkage in the cope and drag halves of the plate. Gating is a very difficult problem, and it should be remembered that a large thin plate must be successfully run in a very short period of time. The lower illustration on page 165 shows the mould being poured from three ladles. This is necessary, as the metal must enter from both sides of the plate simultaneously and meet at the center. A long runner is made, extending the full length of the pattern plate, with numerous openings from the runner into the casting, so that the metal can enter the casting thru the entire length at the same time. When casting comparatively large hubs of metal in connection with thin sections, it is advisable to use an aluminum core which is set into the mould on chaplets, and has new metal all around it. This is accomplished by making a mould from a wood pattern and casting it in plaster of paris. The heavy section, which is to be cored out, is then cut away from the other portions of the pattern and shaved a uniform amount of either 3/16″ or 1/4″. This plaster core is then used as a pattern and reproduced in aluminum which is set into the mould on chaplets, and which allows a uniform thickness of 3/16″ or 1/4″ of metal to be poured around it, burning in the chaplets and effectually preventing shrinkage of the large hub on the pattern.

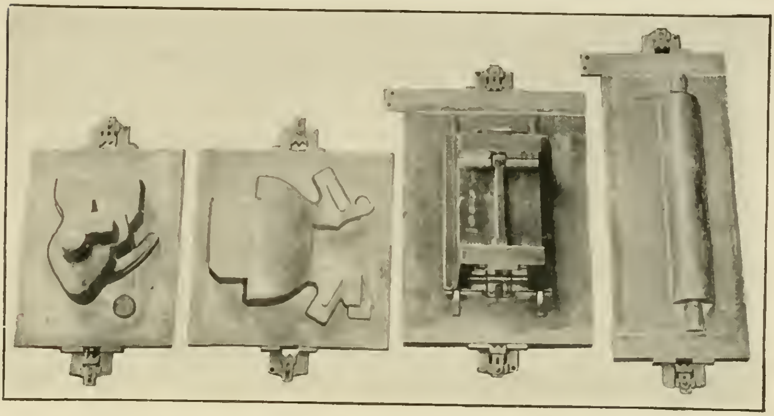


Fig. 168. A Group of Wood Patterns on Wood Plates.

The use of brass chills on the cope surface will also solve many difficulties encountered in unequal shrinkage of copes and drags.

Figure 170 shows graphically the total pattern and moulding costs of producing various quantities of castings from the different types of patterns used on squeezer machines. Since

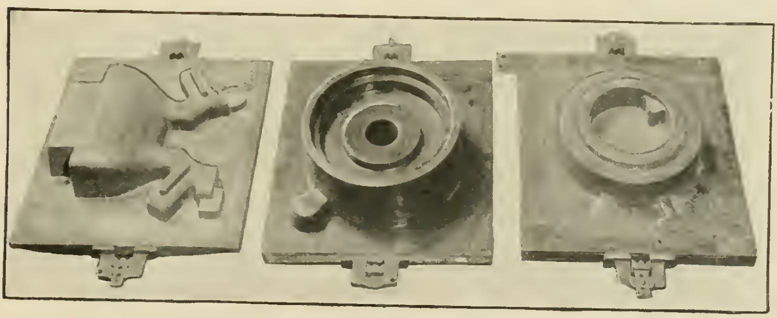


Fig. 169. These Wooden Patterns Were Built on the Plates.

the varying factors of pattern and labor cost will be different in each foundry, the exact figures will not hold true except for one foundry. However, the general shape of the curves are the same in all cases. The height of the curve at its starting point on the extreme left indicates the cost of the pattern and its rise as it progresses toward the right is due to labor and fixed charges on the moulding machine and pattern equipment. In drawing up such a curve for his own use, a foundryman will determine the average cost of his patterns made by the various methods, the average labor cost of producing moulds by the various methods and his own fixed charges. He will then be able to read from his chart the most economical type of pattern to be made and used for any given quantity of castings.

Patterns for Stripping Plate Machines

The patterns used with this type of machine are surrounded by an accurately fitting stripping plate, which is so closely fitted that there is not room for sand to get in between it and the pattern. This requires that the stripping plate be fitted to the pattern by hand, and in considering patterns for these machines, the stripping plate should be regarded as a part of the pattern equipment. It is for this reason that the cost of pattern equipment on the stripper machine is high, and that more skill is required to make them. Two general types of patterns for stripping plate machines are illustrated in Figure 116. An additional method of handling difficult patterns is by means of "stooling." A description of this method is given in the chapter on Jolt Stripper Machines on page 152. The contents of this chapter emphasize throughout the necessity of planning the style and construction of the pattern at the same time that the method of moulding, and the quantities, are being planned. The only too common practice of sending a blueprint to the pattern shop, with instructions to deliver the pattern to the foundry, is essentially wrong. The Planning Department should take care of the production of the casting from its beginning in the mind of the designer, through the Drawing Room, Pattern Shop, Foundry and to its final destination.

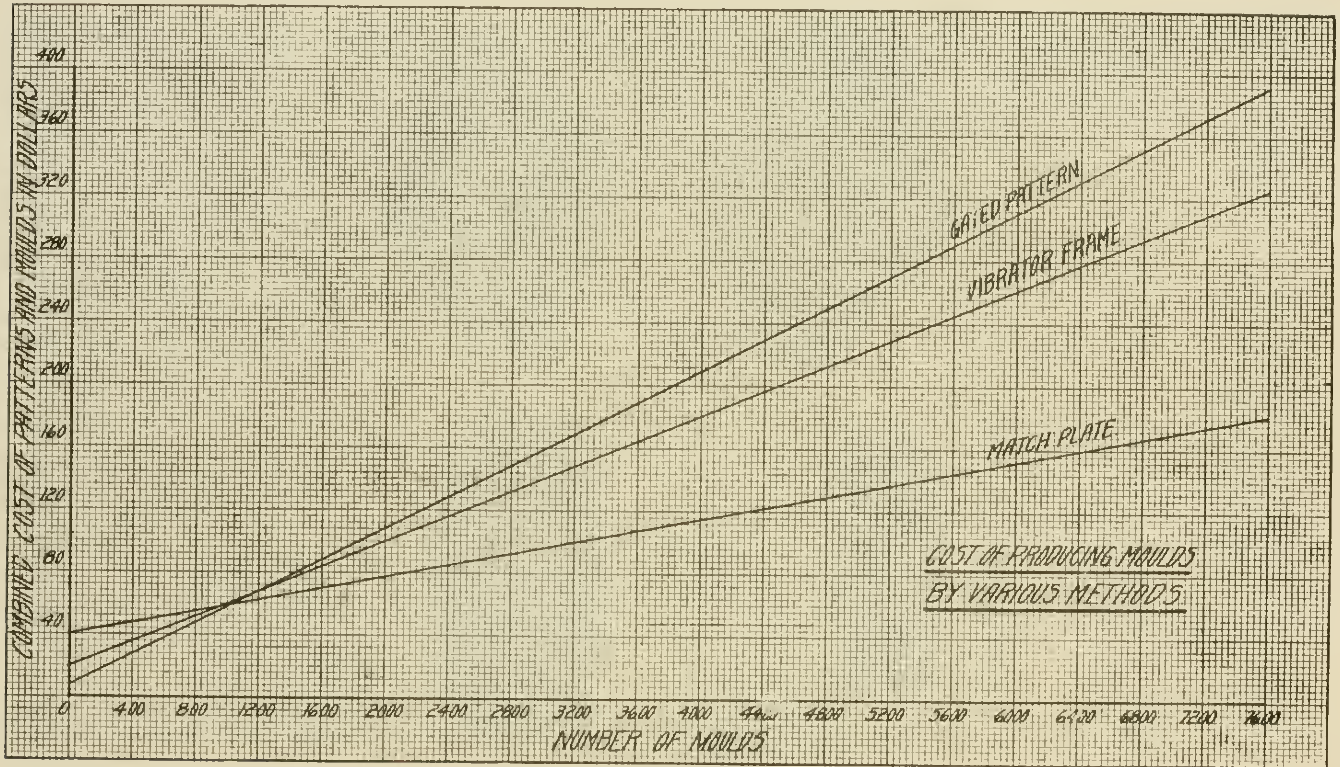


Fig. 170. Cost of Producing Moulds.

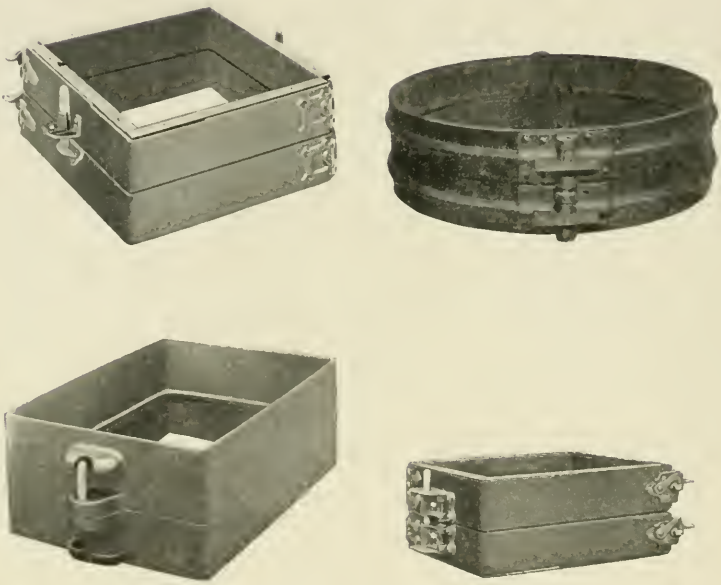


Fig. 171. A Group of Typical Small Flasks of Good Design.

CHAPTER XII

Flask Equipment

Of exceptional importance to the successful operation of moulding machines is the providing of suitable flasks. It is a waste of time and money to attempt the production of good moulds on moulding machines without giving the proper consideration to flask equipment. There are many difficulties encountered with the ordinary flask equipment in use in the foundries producing moulds by hand ramming methods and much loss is occasioned by the use of flasks that are burnt, or that have become loosened by the severe handling incident to foundry practice. Flasks in this condition should not be used, even in hand-moulding, and the time consumed in additional care, as well as the loss occasioned by their use, would more than offset the loss incurred by scrapping the old flasks and making new ones. Those foundries that are accustomed to the use of wood flasks only, find it rather difficult to see immediately the necessity of changing their viewpoint to coincide with modern founding. It had been their practice to nail together roughly a set of flasks for almost every pattern that was to be used, thinking that the cost of wood flasks was small when compared with that of iron flasks. Little attention was given this subject nor were many attempts made to standardize the flask equipment in order to reduce to a minimum the stock of flasks necessary to carry on the foundry operations.

The introduction of moulding machines has made possible the standardization of flasks in such a manner as to reduce the cost of flask equipment below that of the old style methods, so that a better and more durable flask can be made. Such flasks, when made of grey iron or of steel shapes and given the proper consideration in handling, are practically indestructible and, therefore, in the end, are the most economical that can be made.

Design of Flasks

The subject of flask equipment is vitally important in order to bring those who are inexperienced in foundry moulding

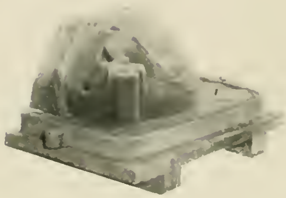


Fig. 172

machine operation, to a full appreciation and realization of the importance of good flask equipment in producing moulds by machine methods; and therefore, the following views are shown to illustrate the styles of flasks that are largely used in moulding machine production. The shape and size of the flask are the first things which should be determined in considering the design. While the ordinary rectangular flask is commonly used in the majority of cases, nevertheless it is frequently advisable to make what is known as "cut flasks," that is, flasks which follow, to some extent, the contour of the pattern. Figure 172 illustrates a rectangular flask, containing one casting per mould, and represents ordinary practice in iron flask design.

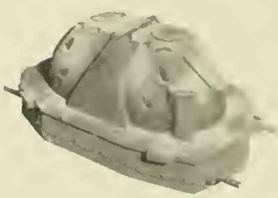


Fig. 173

Fig. 174

Contrasted to this, Figure 173 and Figure 174 illustrate the design of a cut flask for producing two of these same castings per mould. It will be noticed that the corners are cut away, saving expense and weight of iron, and the handling of extra sand, also, that the block of sand shown in the center of Figure 173 has a double use, that is, it serves to support the mound of sand necessary when making each of the two castings, whereas in Figure 172 the mound of sand is used only once. It is easy to see that the weight of flask equipment to be handled is less per casting in the case of a flask designed as shown in Figure 173, and also that the amount of sand to be handled per casting is less.

The shape and dimensions of the flask having been decided upon, the material of which it is to be constructed is the next consideration. Formerly, wooden flasks were preferred rather than iron flasks, in many foundries, and the process of changing to the more satisfactory iron flask has been rather slow. Today, however grey iron and rolled steel flasks are quite commonly used and the satisfaction which has attended their use is well known to the foundry industry.

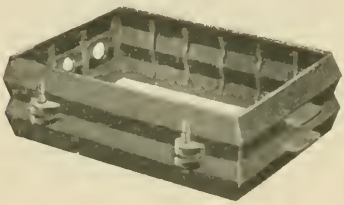
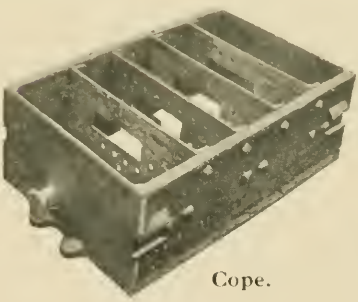


Fig. 175.

Fig. 176.

Some typical iron flasks are illustrated in Figures 175, 176, 177, 178, 180, 181 and 182. In adopting a standard design of flask, to be used in a variety of sizes with jolt ramming machines, the following designs are submitted as representing the result of satisfactory use. Figure 179 is a drawing suitable for use in making flasks ranging from 20″ to 39″ in length, and



Cope.

Fig. 177.

Drag.

Fig. 178.

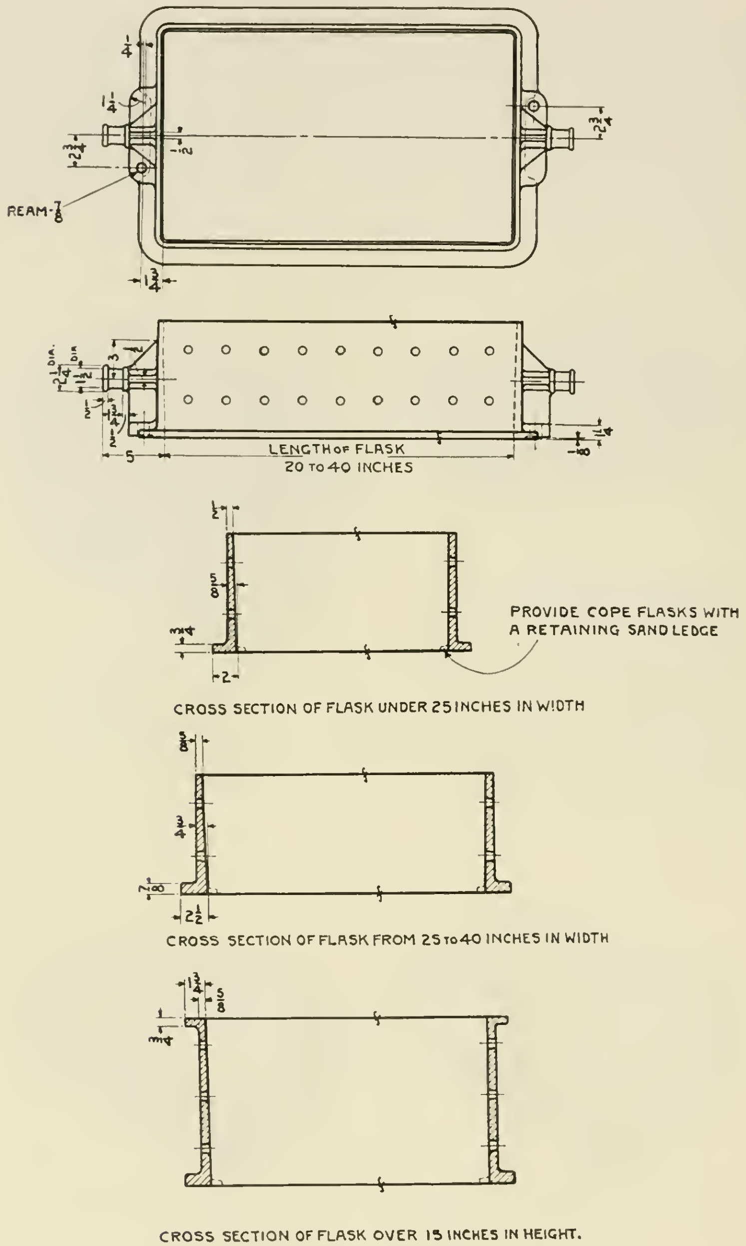


Fig. 179. Standard Drawing for Flasks, 20" x 39" in length.

of appropriate widths and moderate heights. It will be noticed that the flask is fully dimensioned except for the inside length, width and height.

Figures 183 and 184 illustrate drawings suitable for flasks ranging in length from 40 to 59 inches and from 60 to 80 inches, of any widths and any heights.

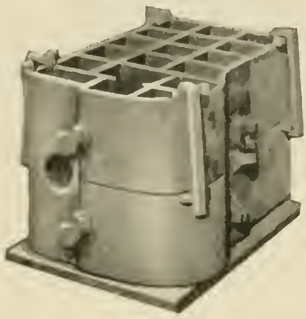


Fig. 180.

Fig. 181.

Fig. 182.

By selecting the proper drawing and using the section which corresponds to the width desired and also using the design corresponding to the height of flask desired, this set of three flask drawings may be used to make any flask from 20 inches in length up to 80 inches in length by 80 inches in width and of any desired height.

The holes shown in the side walls of the flasks are for the purpose of venting the green sand and are spaced at any convenient distance. They may also be used in bolting the bars in cope halves.

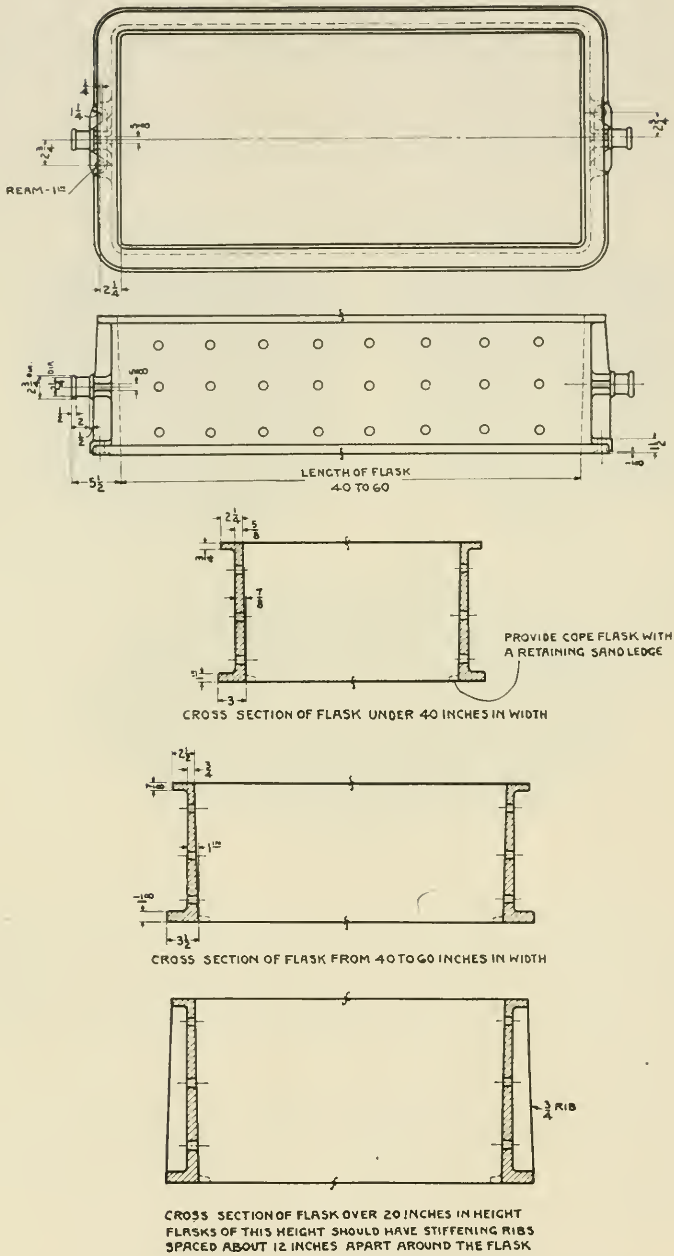


Fig. 183. Standard Drawing for Flasks, 40"—59" in length

The use of the flask pins requires some mention here in order to explain clearly the reason for the four pin hole locations. The ideal place for the location of pins is directly beneath the trunnions, but since their location at this point is attended by the inconvenience of using closing pins of very short length, due to interference with the trunnions, it is advisable to locate the pin holes to one side of the trunnion, care being taken to keep them as close to the trunnion as is practicable. The location on all three of the standard drawings shown is 2¾″ from the trunnion center, and it will be noticed that one ear is provided of suitable size to take both pin holes. In actual use, however, only two pin holes are used, these two being diagonally opposite each other. Of course, cope flasks must be drilled opposite from the drag flask and, in some cases, where the same flask pattern will be used to make both cope and drag flasks, the lug for all four pin holes is necessary. On flasks, which are to be used only as copes or only as drags, there is a possibility of damage to the pin hole, making it advisable to use the other holes, so that, in all cases, only two holes need be drilled and the other two locations are held in reserve.

While the location of both the pins and trunnions on the ends of the flask is attended by many advantages in handling the flask, yet in some cases it is advisable to locate the trunnions on the sides of the flasks and the pin holes on the ends. In other cases, this is reversed by placing the pin holes on the sides and the trunnions on the ends.

The jig shown in Figure 185 is used with the standard flask drawings for drilling flasks of any length. When flasks of a large range of sizes are to be drilled it is advisable to make two jigs, as it is very awkward to handle a large jig on a relatively small flask. In using the jig, the slip bushings are fitted into the common hole at the end of the jig and the appropriate hole at the other end. After one hole has been drilled it is advisable to place a tightly fitting plug through the jig and hole in order to locate the second hole accurately.

Bars used in the cope flasks may either be cast in one piece with the flask, or cast separately and bolted in. When using

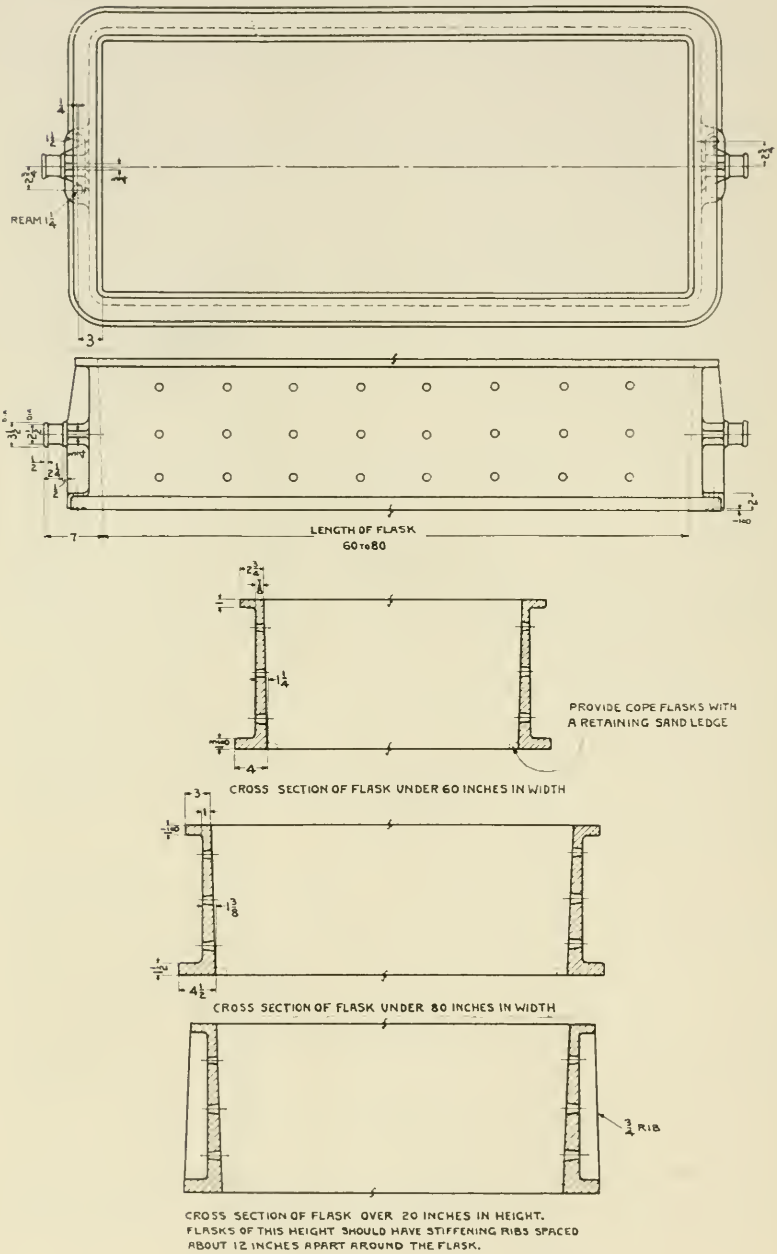


Fig. 184. Standard Drawing for Flasks 60"—80" in length.

the bolted construction, attention must be paid to the fact that the flask will be jolt rammed and rigidity is important.

The proper design of flask bars to facilitate the packing of the sand underneath them during the jolt ramming operation is of importance, as improperly designed bars frequently require the use of gaggers, when correct designs would eliminate their use. The bar should be located at a uniform distance of about ½″ above the top of the pattern, as it has been found that this distance is great enough to allow the sand to be packed uniformly under the bar and yet small enough to hold pockets of sand with a minimum use of gaggers.

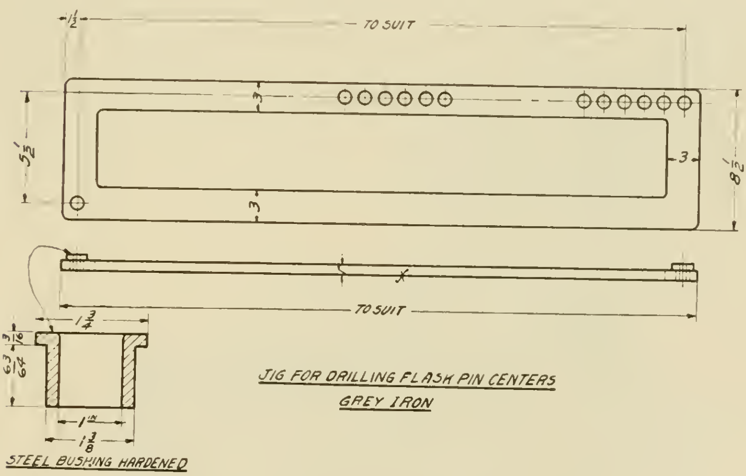


Fig. 185. Jig Used in Drilling Flasks.

The complete flask illustrated in Figure 176 is used in connection with the Roll Over Jolt Moulding Machine. In this view may be seen the type of closing-pin used, which has proved to be the best all around type of pin. Figure 186 is a sketch of a closing pin. The use of this particular type of

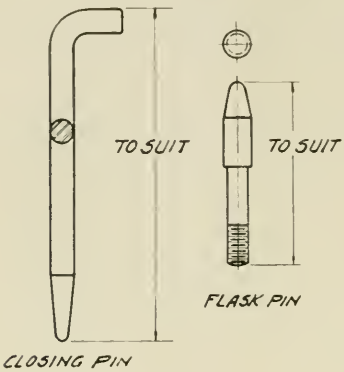


Fig. 186

closing-pin is much better than the old style of fastening the pin in the drag half of the mould, as it prevents the breakage which was so common while the flasks were being shaken out and handled in the foundry and storage yard. The right hand pin is of the design commonly used to locate the flask on the pattern plate. Figure 187 illustrates a pattern used in making flasks. It will be noticed that core prints are used to locate the trunnions instead of ramming them up, as is the practice in some foundries. The undercut portion of the pin ears around the pin holes is seen to be cut away on the pattern, indicating that in this case a cope was used in making the flask, and this portion was coped out. The practice of casting flasks in open sand is not to be recommended, although it can be done in some cases.

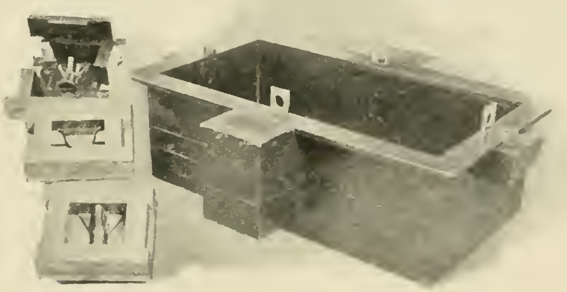


Fig. 187

Figure 188 shows one type of bottom board that is used with grey iron flasks. The bottom board may be either plain or supplied with projections, as here shown. The advantages of the projections are many, inasmuch as they make it more con-

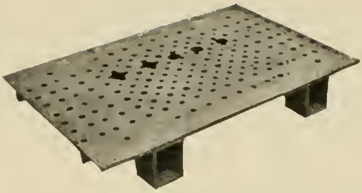


Fig. 188

venient to release the chains when carrying the mould to the foundry floor as well as to attach the chains after the mould has been poured and is ready to be taken to the "shake-out" floor. While the cost of providing the plates with the projections referred to is greater than that of producing the flat plate, nevertheless, when it is considered that the plate is to be used continually, it is well to ascertain whether or not the time saved in crane service does not far exceed the additional expense of providing the extra projections on the plates.

On smaller moulds, however, which are of a size that can be carried away by hand, without the use of a crane, an inexpensive bottom board is made by the use of a cast iron or steel plate with standard channel-iron riveted to its back, as is shown in Figure 189.

Fig. 189

Rolled Steel Flasks

The descriptions thus far have covered flasks that are to be made of castings, either grey iron or aluminum. There has been a flask developed, however, which in many respects for certain sizes, is better than those made by casting. This particular flask, shown in Figures 190 and 191, is made of steel, the section of the flask being designed especially for producing rigidity, by means of ribs which are rolled into the plate.

The manufacturers, realizing that there would be a large demand for a light and rigid flask, have provided special rolls to produce the various shapes required. The shapes are rolled in long bars, and in the manufacture are shaped, by the use of a large bending apparatus, to the desired size; the joint is then firmly riveted.

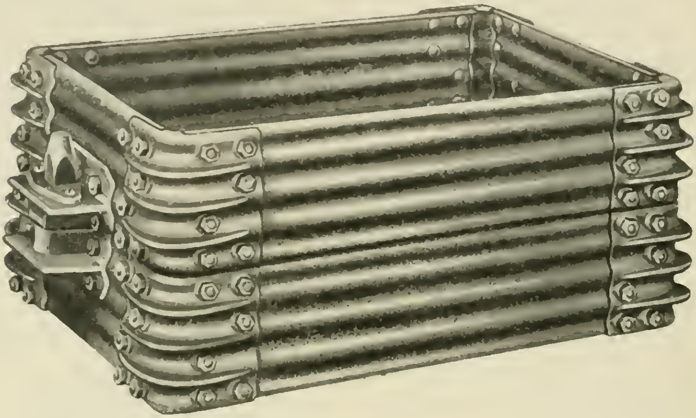


Fig. 190

By referring to the illustration of these flasks, it will be seen that there are light malleable castings provided for carrying the flask pins, as well as a light section handle casting riveted to the corners.

Mention has been made of the importance of the proper flask equipment. It is not too much to emphasize again the fact that without the proper pattern and flask equipment, machine moulding is practically an impossibility, and yet it is not desired to convey the impression that the providing of the

Fig. 191

proper patterns and flask equipment is a difficult task. The fact of the matter is that the proper equipment can be provided with very little, if any, additional cost over that for producing the usual equipment required for floor moulding.

Snap Flasks

As a large amount of the work produced on air-operated squeezer machines is made in snap-flasks, Figures 192, 193 and 171 are shown to illustrate the different styles in common use on those machines.

The manner in which these flasks are used is clearly set forth in the descriptive matter, as well as illustrated in the different photographs in Chapters I and IX.

Fig. 192

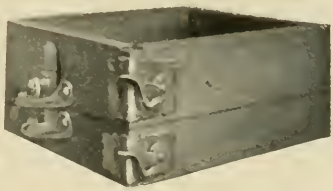


Fig. 193

There is some work of such size and shape as to be readily adapted to squeezer-moulding, and yet, because of its weight, it cannot be successfully made in snap-flasks. Such work is usually made in iron flasks of very light construction, as illustrated in Figure 171.

The flask shown in Figure 175 illustrates one in common use in the aluminum and brass foundry industries.

What has been said of the above flasks and of their adaptation to air-squeezer moulding, can also be said of their use on the hand-rammed, hand roll-over type of machine, commonly used on such work as does not readily lend itself to squeezer moulding.

Flask design and construction has been discussed here in such detail on account of its great importance. When hand moulding, and producing from one to five moulds per day from each pattern, the loss of one minute per mould, due to faulty flask design or construction, is not important, as the aggregate time lost is small. When machine moulding and producing one hundred moulds per day from a pattern, the loss of one minute on each mould then becomes an aggregate loss of one hundred minutes, which is a very serious matter, indeed, as it represents 20.8% of the total time of an eight-hour day. No effort has been made to discuss the construction of special flasks when the quantities of castings produced warrant the expense. When high production is to be obtained the standard flask, as described in this chapter, should be altered in any way that will decrease the time of making the mould, or will increase the quality of the casting. In short, the rules to be followed in flask design and construction are:

Spend time and thought on flask design.

Spend money on flask equipment and it will more than pay for itself.

CHAPTER XIII

Machine Moulded Cores

The exceptional demand of the automobile industry for castings, in addition to forcing the use of a method that was speedier than the method in use a few years ago, also made necessary a way in which to produce the tremendous quantities of dry-sand cores that were required for the production necessary to meet the demand.

There are a number of different styles of moulding machines that are used to advantage in the core room. There are also a number of the smaller cores that can be made by hand on the bench faster than when made on moulding machines. Therefore, it is the medium large, yet delicate and intricate core with which this chapter will deal.

The subject of core-making is one of such magnitude that the little given in this chapter appears insignificant; it is with a keen realization of this fact that the author ventures to show and describe a few of the core-making operations, attempting only to create in the minds of those who are not familiar with the highly developed state of the art, a desire to know more of the possibilities awaiting the introduction of the moulding machine into the core-room. Foundries producing high grade castings have adopted a rigid system of core-inspection by which the various individual cores are measured by gauges, having the allowable limits. In addition to the gauging and inspecting of the individual core, extreme accuracy is required in the setting, and therefore, to insure the core being accurately set, there has been devised a system of assembly jigs in which the detail cores are made fast into the composite core assembly, and are held firmly in place by pouring lead into the interlocking holes provided in the different detail cores. Therefore, with this explanation, the reader is requested to refer to Figure 194,

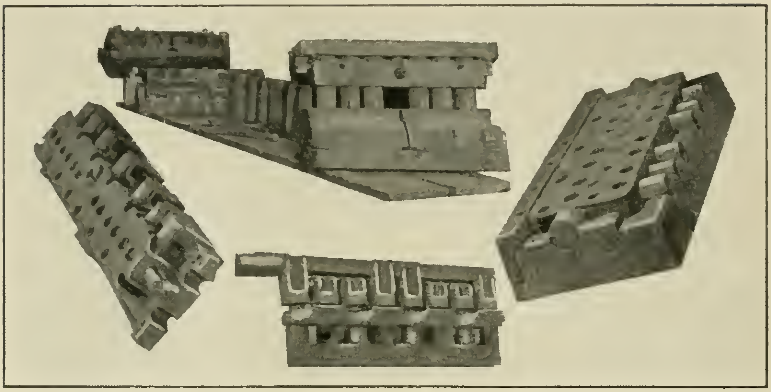


Fig. 194

which illustrates several complicated cores that have been produced on the moulding machine.

By careful study of this view, it will be seen that some of these cores are made in one piece; while other views show several cores assembled together.

Fig. 195

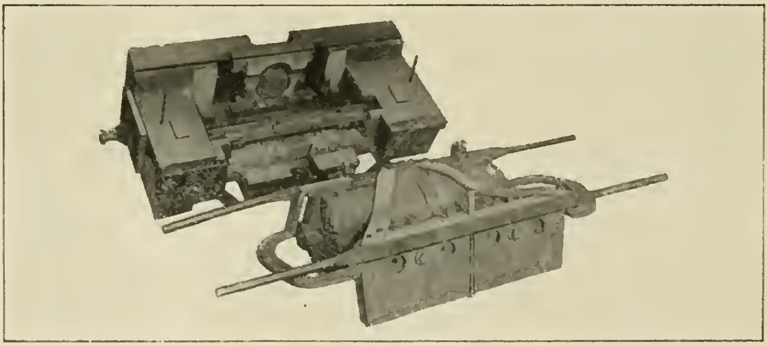


Fig. 196

Handling Complicated Cores by Assembly and Setting Jigs

Fig. 197

Figure 195 shows clearly the manner in which the core is assembled. The various cores, after being assembled into one complete core and gauged for accuracy and then placed into the mould in the ordinary manner, still failed to meet the requirements, as it was found that a sufficient accuracy could not be attained because of variation, due to the cores straining the core-print pockets when being lowered into the mould. This condition was overcome by providing suitable core-setting jigs, as illustrated in Figures 196 and 197. Figure 196 shows, in the background, an assembly jig, and in the foreground, the assembled core attached to the setting jig. Figure 197 shows the manner in which the jig is used while lowering the core into the finished drag half of the mould. It will be seen from this view that the core-setting jig is guided into place by means of the flask pins. The style of castings which this mould will turn out is shown in the foreground.

The cores illustrated in the previous views were made on

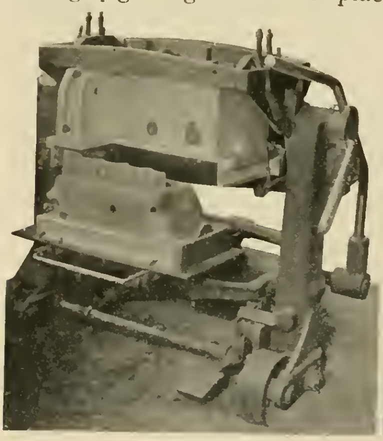


Fig. 198

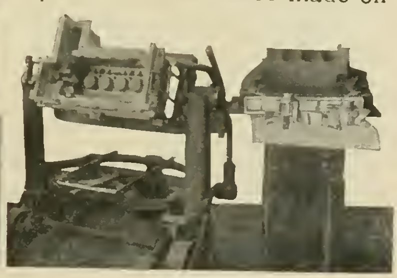


Fig. 199

Fig. 200

the moulding machine illustrated in Figures 198 and 199. From Figure 198 it will be seen that the core has been rammed on the machine and then rolled over, and the patterns and loose pieces drawn from the main core-box. Figure 199 shows the same core after it has been lifted to the side of the machine, the loose pieces withdrawn and the core-box partly rolled back in order that the complicated core-box may be seen to advantage.

Green Sand Cores

Dry-sand piston cores are produced at the rate of six per operation on the machine shown in Figure 201, while in Figure 202, the producing of piston moulds is shown, using the green-sand core method instead of the dry sand.

Figure 202 shows a mould for the handling of grey iron castings for gas engine pistons. This is a good example of green sand cores, as they are made on a moulding machine. The cores are formed integral with the drag portion of the mould in a metal core-box, so arranged as to produce four cores at one cycle of operations. This core-box is of the split type and is parted directly through the centers of the cores. The wrist-pin bosses are secured to the inside of the box on a center

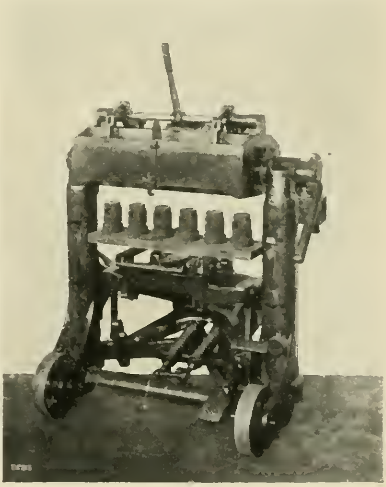


Fig. 201

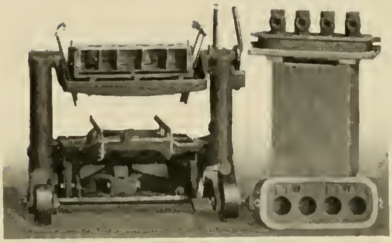


Fig. 202

line at a right angle to the parting line of the box. The top of the box forms a flat surface of sufficient area to form the parting surface of the mould. The members of the core-box are arranged to be separated in a horizontal plane, by means of a lever located at the back of the box, so as not to interfere with the movements of the operator. On the ends of the core-box members are provided tongues which slide in grooves in the upright ends of the frame. A bearing strip provided at the bottom of the box prevents distortion of the box while being rammed.

This core-box was mounted on a Roll Over Moulding Machine and was used in the following manner: With the core-box set in the position shown in the illustration, the drag flask was placed on the core-box with pins on the core-box properly engaging the holes in the flask ears. The core-box was then filled with riddled moulding sand and the sand tamped and packed on the lower side of the wrist-pin bosses, after which the flask was filled and rammed complete. The mould was then "struck off," the bottom board clamped in place, and the table carrying the core-box rolled over. The leveling bars were then brought up against the bottom board and the automatic leveling pins locked. The bottom board clamps were next released, after which the vibrator was started and the members of the core-box drawn apart by means of the lever provided for the purpose. The flask and cores were then lowered to clear the core box, and removed

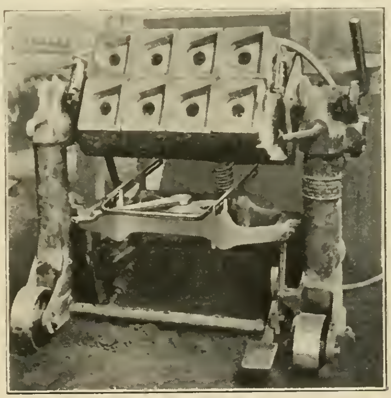


Fig. 203

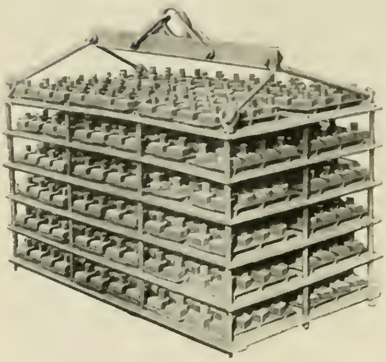


Fig. 204

from the machine to the position shown in Figure 202.

Tunnel Segment Cores

The tunnel segment casting, fully illustrated and described in Chapter IV, pages 60 and 61, required a large number of cores to produce the bolt-holes in each side of the casting. To meet this situation, eight core-boxes were mounted on the moulding machine shown in Figure 203, which required an operation of three hours to produce the rack of cores shown in Figure 204.

In the core-room of the average foundry producing general castings, very little attention has been given to the possibilities of producing cores on moulding machines; yet this vast field of possibilities is awaiting the foundryman who will follow the lead of those now beginning to realize that it is not enough to make the saving possible on the moulding floor, but that this saving should be carried into the production of the core-room. Figure 205 shows a Roll-Over Jolt Moulding Machine used in the production of large cores. The core boxes shown in the background are all used on this one machine in one day. This is a Roll-Over Jolt type of moulding machine, which jolt rams the core, rolls it over, and draws the box from the core by power. On the run-out car may be seen the core that was produced in the box shown mounted on the machine.

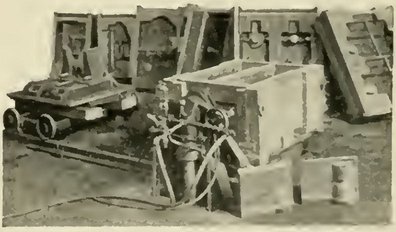


Fig. 205

CHAPTER XIV

Foundations for Jolt-Ramming Moulding Machines

In order to intelligently consider the proper foundations for modern jolt-ramming machines, it is necessary to review briefly some of the machines of earlier types. In many instances it was considered necessary, to effectively jolt-ram a mould, to

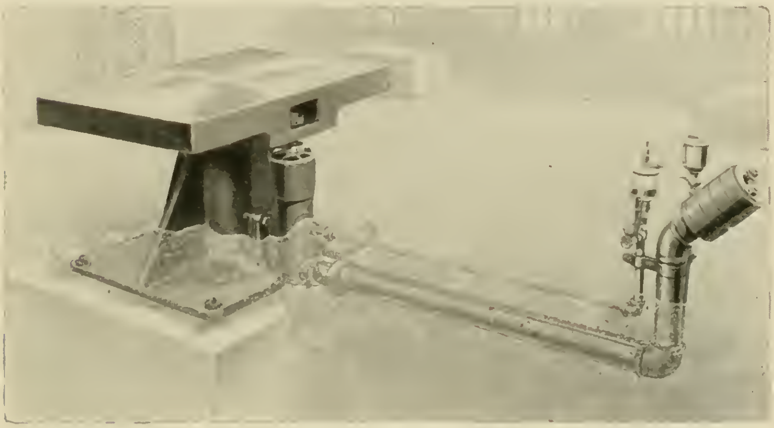


Fig. 206. Plain Jolt-Ramming Moulding Machine with only Sufficient Foundation to Hold the Machine in Place. The Sand may be Filled Around the Machine as the Working Parts are Protected.

have a machine that would produce a heavy blow. This usually was accomplished by building the machine with a stroke of 3 to 4 or even 6 inches in length. This stroke, of course, would produce the heavy blow, its action was not unlike the blow of a steam hammer.

In order to control the ground vibrations produced by such a machine, it was necessary to provide massive foundations, and in many instances the concrete was capped with several layers of wood to aid in the absorption of the blow.

The recent rapid development of jolt-ramming machines has practically reversed the early theory of design, as it has been determined that it is not the force of the machine blow that packs the sand, but that it is packed by the jolting table being suddenly or abruptly brought to rest while the sand in the flask to be packed continues its downward course, thereby producing the pressure which results in the sand packing against the pattern or pattern-plate. It is quite evident, therefore, that

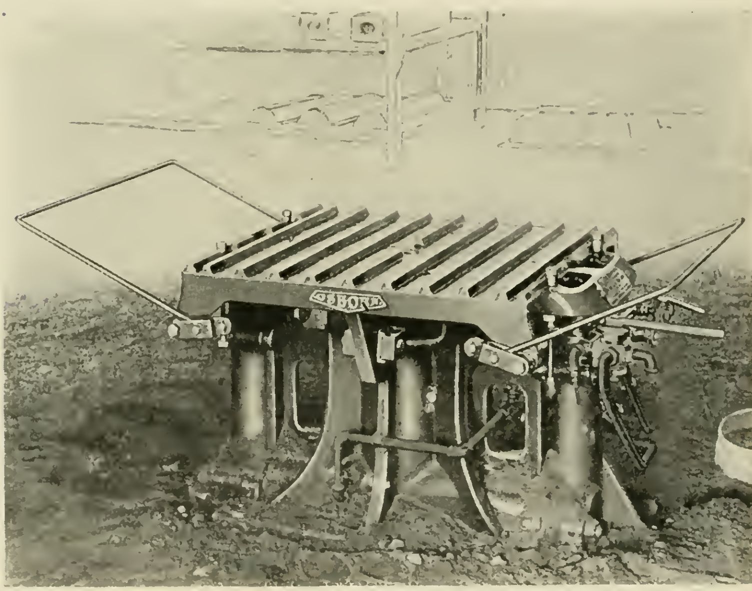


Fig. 207. Foundry Floor View of Jolt-Ramming Power-Stripping Moulding Machine with Working Parts Protected.

if the machine which has been brought suddenly to rest be instantly started again on its upward stroke and not allowed to pause, an increased pressure of the pattern against the sand will result, which causes the sand to lay and not rebound.

A jolting machine necessary to accomplish this need not be unduly massive in its working parts, nor need it have a long stroke, 1 to 2 inches usually being sufficient. It should have means of controlling the force of the blow of the table when contacting with the anvil base, as it is evident that the weight of the moving table (or dead load) must not be allowed to freely drop and contact with the anvil block, or it will produce the unnecessary heavy blow. The up-to-date, modern jolting machine prevents this heavy blow by providing

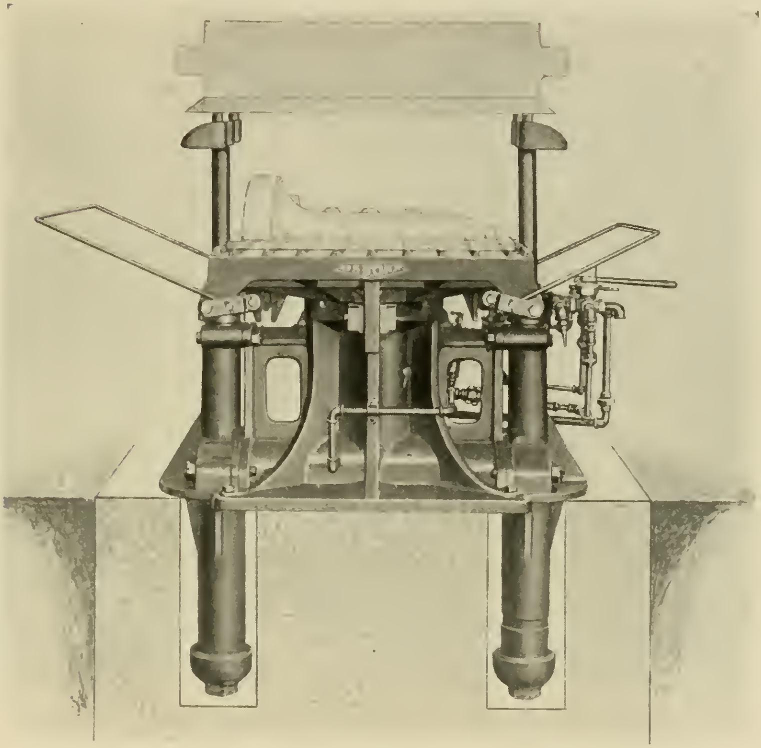


Fig. 208. Same Machine as Fig. 207, Showing Simplicity of Foundation.

an air cushion under the cylinder sufficient to overcome the violent blow caused by the dead load, allowing only sufficient blow to accomplish the instant reversal of stroke.

A machine that accomplishes the foregoing not only will ram a good mould in a very short time, but will do so without excessive or detrimental vibration in either the machine, pattern or foundation.

As we now approach our subject—the machine foundation—it is evident that with such a machine the extremely massive foundation is not essential and, therefore, our consideration will be from the standpoint of economy and accessibility.

Of first importance is the kind and nature of the soil upon which the machine foundation is to be placed. A dry gravel is considered the thing next best to solid rock and will safely stand a load of 6,000 to 8,000 pounds per square foot. Dry sand or

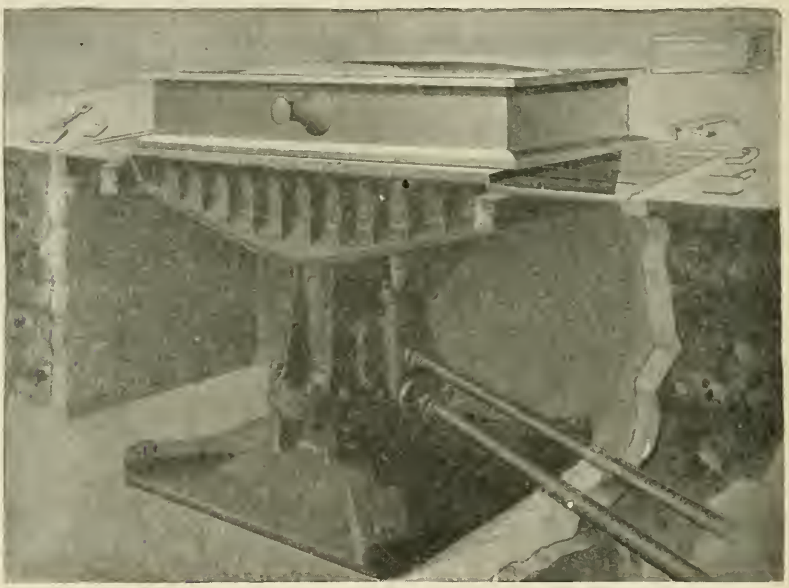


Fig. 209. A Large, 42 x 97-inch, Plain Jolt-Ramming Moulding Machine, Showing Section Through Foundation and Pit.

dry sand and gravel mixed makes a very good foundation base and will withstand a load of 4,000 to 8,000 pounds per square foot. Clay soils vary widely; a soft clay will flow in all directions even under very light load, and should not be loaded more than 3,000 pounds per square foot, while a dry clay will satisfactorily stand a load of 3,000 to 5,000 pounds per square foot. If the foundation is to be placed on *made* ground or *fill,* provision should be made to keep the ground perfectly dry and free from water. With the proper condition existing a satisfactory foundation can be made, such condition being more desirable than a wet or oozy clay soil. When the foundation is placed on *clay* or *fill*, better results can be obtained by having it cover a large area rather than making it of greater depth, unless the fill is of such depth that the foundation may be extended through to solid soil.

Fig. 210. A 64-inch Roll-Over Jolt-Moulding Machine, Showing Section Through Foundation.

It must be remembered that when we place a moulding machine in the foundry we are actually violating the old established principle of machine installation and *placing it in a sand pile* instead of an engine room, or other dirt and dust-proof room, and yet notwithstanding this extraordinary condition, and without giving the machine proper care, many foundrymen expect as good results from the machine in the sand pile as they do from the machine that was placed in a dust-proof room and in charge of an expert mechanic.

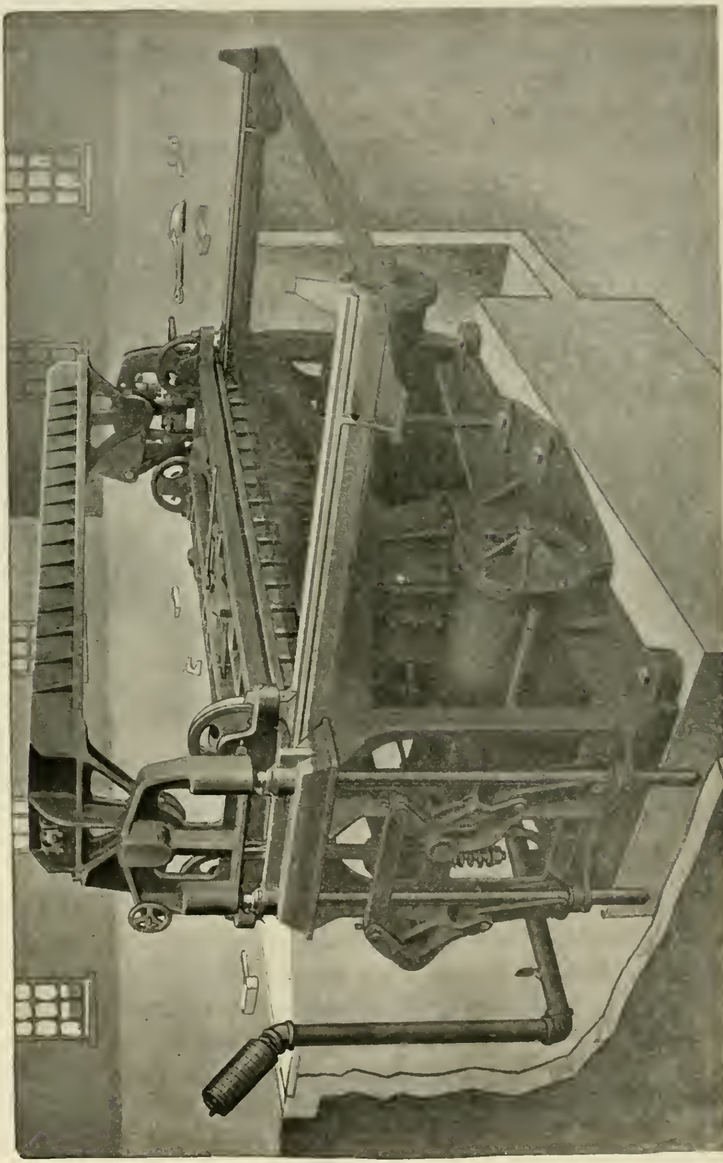


Fig. 211. Same Machine as Fig. 213, Showing Section Through Foundation. The Machine is Set on a Pier in order to obtain Head Room in the Pit.

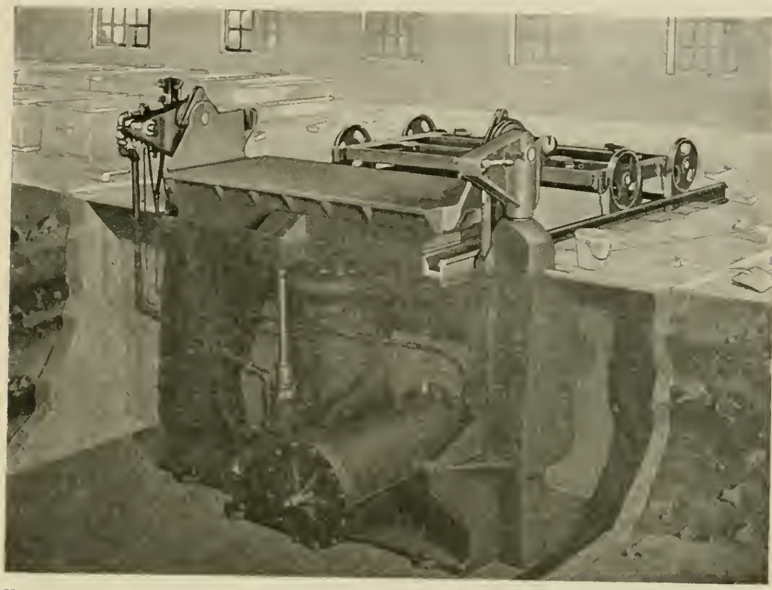


Fig. 212. View of Large, 42x109-inch Roll-Over Jolt-Moulding Machine.

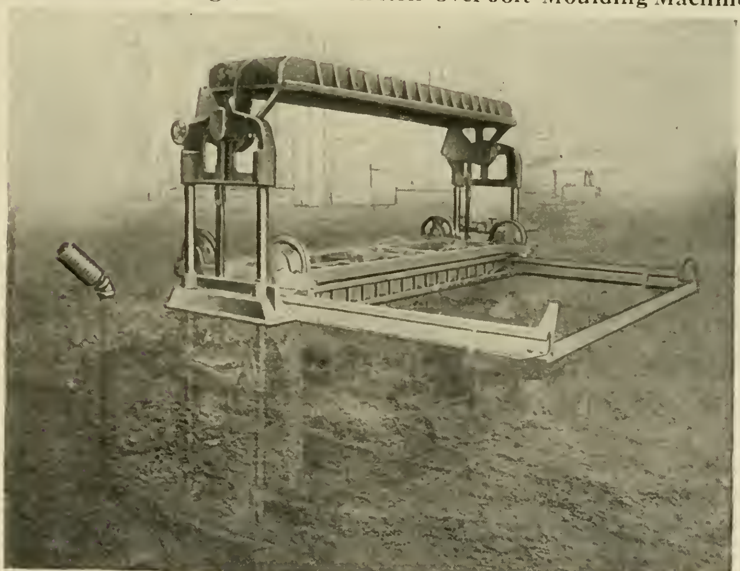


Fig. 213. A 36x150-inch Roll-Over Jolt-Moulding Machine, Base and Foundation Shown in Phantom as it Appears Above Foundry Floor.

The accompanying illustration will demonstrate that it is economy to provide a foundation and setting that will give ample protection to the machine, by making it impossible for

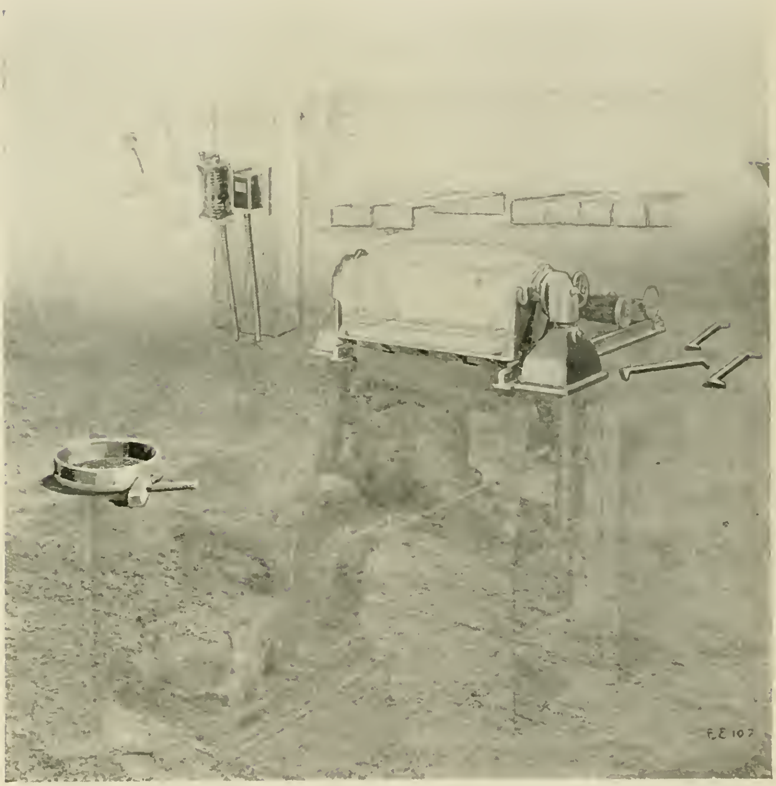


Fig. 214. Foundry Floor View of 42-inch Electrically Operated Roll Over Jolt-Moulding Machine, Showing Foundations in Phantom.

sand to collect on the machine or in its moving parts. They also will show the advisability of providing ample space around the machine so that the mechanic can easily oil, inspect and keep the working parts in order, the same as he does the machine placed in the engine room. The depth of the space surrounding

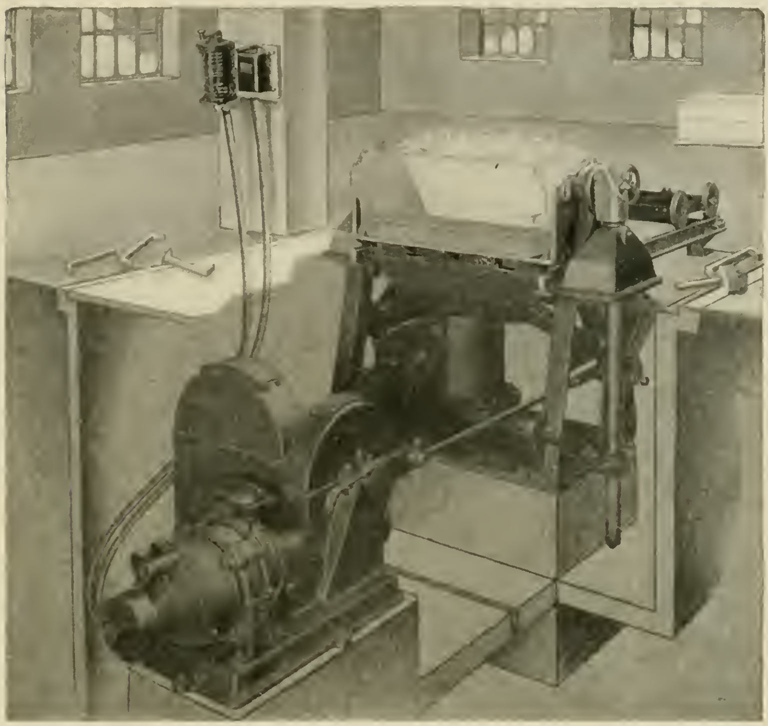


Fig. 215. Same Machine as Fig. 214, Showing Section of Foundation.

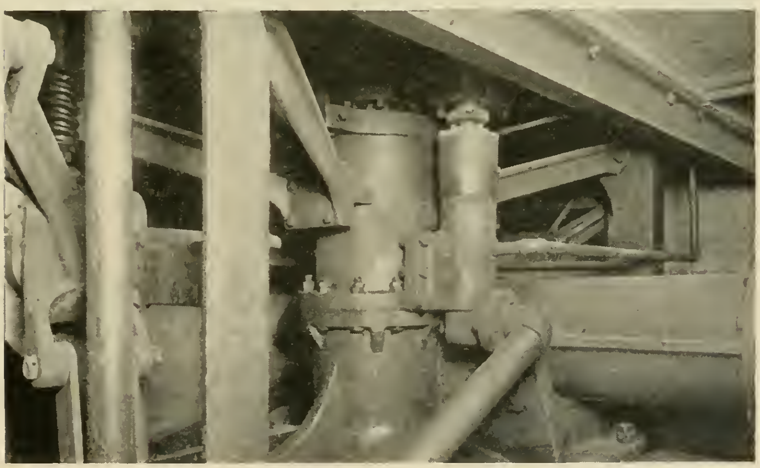


Fig. 216. This Photograph was Taken in the Pit and Shows the Excellent Condition of the Base of this Jolt-Ramming Moulding Machine and its Freedom from Sand, etc.

the machine should be sufficient for a man to stand erect, suitable lighting facilities should be provided and a stairway or ladder should lead into the pit.

The covering of the pit or foundry floor should be made of 2-inch matched planking and should be fitted tight against the

Fig. 217. Entrance Way into the Foundation Pit of a Jolt-Moulding Machine, Showing Steps Leading into the Pit from an Adjoining Basement Room.

machine. The trap door leading into the pit should be hinged and of ample size.

The engineer or architect called upon to design and build the foundry of tomorrow will do well to thoroughly consider the best method of installing and maintaining the moulding machines to be used, placing them in such manner as to insure ample protection from dust and grit and making it easy to give the machines the care and attention they deserve.

Fig. 218. View of Jolt-Ramming Moulding Machine, Taken in the Pit, Showing Construction of the Pier.

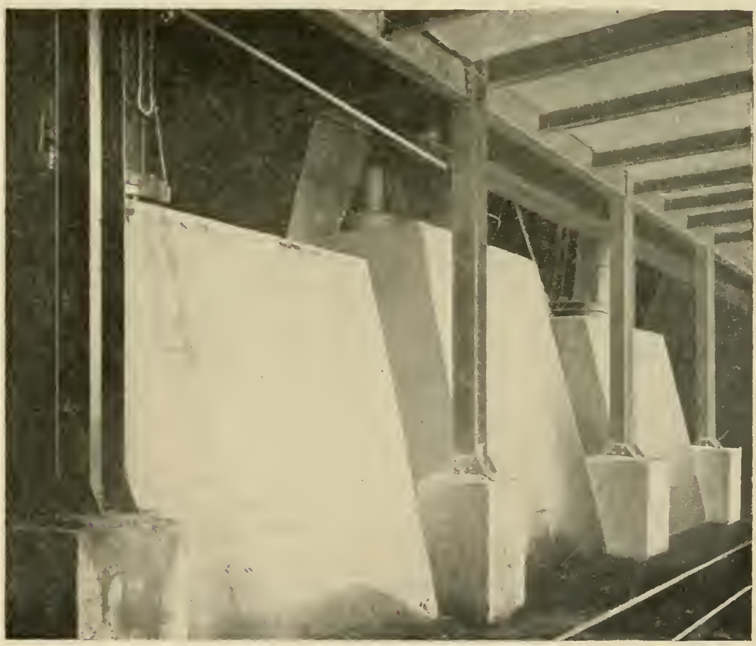


Fig. 219. View Showing Several Jolt-Ramming Moulding Machine Foundations with Piers Built on the Basement Floor.

The author's idea of a foundry that will best meet these practical requirements is set forth in Figure 220. This illustration shows the cross-section of a proposed foundry, having a tunnel or basement extending the full length of the moulding

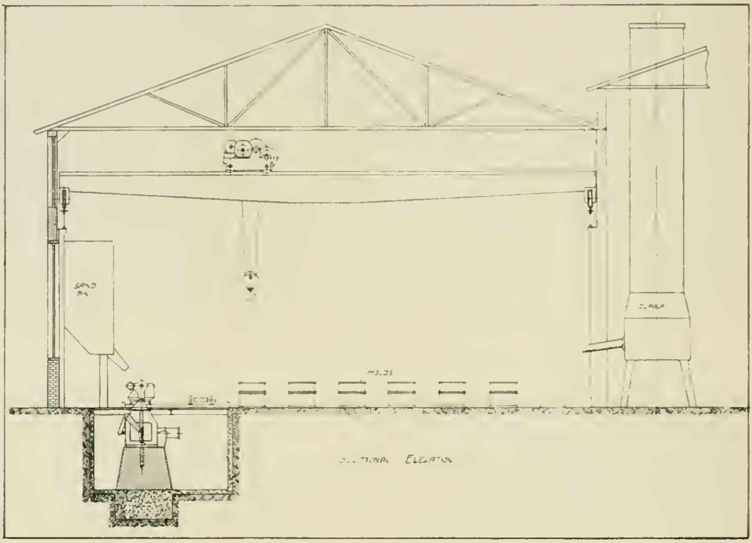


Fig. 220. Cross-Section of the Proposed Foundry, Showing Tunnel for Machine Foundations.

floor. The floor of this tunnel or basement should be at least 7 feet below the ceiling and the width should be sufficient to allow a clear passageway on one side of the machines; the piers for the machine foundations can be placed at any time and to suit any condition.

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