Sand Mould Casting

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Introduction

SAND MOULDING (CASTING) is one of the most versatile of metal-forming processes, providing tremendous freedom of design in terms of size, shape, and product quality. Sand moulding processes are classified according to the way in which the sand is held (bonded).

Bonded sand moulds are based on inorganic bonds and include such processes as green sand moulding, dry sand moulding, skin dried moulds, and loam moulding, sodium silicate-carbon dioxide systems, and phosphate bonded moulds.

Resin Binder Processes. These organically bonded systems include no-bake binders, heat-cured binders (the Shell process and warm box, hot box, and oven-bake processes), and cold box binders.

Unbonded Sand Moulds. With unbonded sand moulding processes, dry, unbonded, free-flowing sand surrounds the pattern. Lost foam processing, which uses expandable polystyrene patterns, and vacuum moulding, are examples of unbonded sand moulds. Lost foam moulds for large castings are sometimes backed up with a no-bake binder system or green sand.

Green Sand Moulding

Green sand moulding can be divided into three basic types:

- Low-density and low-pressure moulding includes manually operated jolt-squeeze units. The green compressive strengths of the sand for these units is generally in the low to mid teens (given in pounds per square inch)
- Medium-density units include automatic or semiautomatic units with rigid flasks that combine jolting action and hydraulic squeeze pressures.
- High-pressure or high-density units produce moulds with hardness values in the high 90 (AFS Hardness Tester C). These units incorporate flaskless moulding technology and use hydraulic pressure and other energy sources for sand compaction.

The third group, that is, the high-pressure or high-density moulding methods, dominate the high-production and highly automated foundry today. This type of green sand moulding lends itself to both flask and flaskless system designs. Some of the major criteria that dictate whether a system is designed as a flask or a flaskless unit is the amount of metal to be poured in each mould and the total mould area that is required. However, all of the systems in this category can be used for high production repetitive work. Dimensional control of castings with these processes is quite good, and the economics of their operation have yet to be matched by any other. Unfortunately, these systems represent a significant capital investment.

Dry sand moulding

The essential difference between dry sand and green sand moulding is that the moisture in the mould sand is removed prior to pouring the metal. Dry sand moulding is more applicable to medium and large castings than to small castings. The moulds are stronger and more rigid than green sand moulds. They can therefore withstand more handling and resist the static pressure of molten metal, which may cause green sand moulds to deform or swell. In addition, they may be exposed to the atmosphere for long periods of time without detrimental effect. Such exposure may be necessary for placing and fitting a large number of cores.

Coal is the most common carbon material used in green sand; pitch is the most common in dry sand.

Other materials in dry sand are gilsonite, cereal (corn flour), molasses, dextrine, glutrin, and resin. These additives are thermosets; at the baking/drying temperatures (150 to 315 °C,) they produce high dry strength and rigid mould walls.

The base sand is normally coarser than in green sand to facilitate natural venting and mould drying.

Skin Dried Moulds

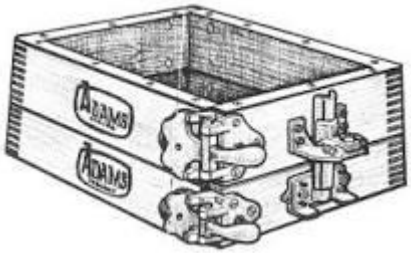
Almost all dry sand moulding has been replaced by the no-bake moulding. Sometimes the pattern may be faced with a no-bake sand mixture and then backed up with a green/dry sand mixture. An intermediate (between green sand and dry sand) type of moulding referred to as skin drying is sometimes used. The process is similar to dry sand moulding in that the same type of sand mixtures and equipment are used. After coating the surface with a refractory wash, the moulds are dried to a depth of 6 to 12 mm. Skin-dried moulds have some characteristics of green sand moulds and some of dry sand moulds such as ease of shakeout and firm mould face, respectively.

Moulding Methods

Green sand moulds can be made in a number of ways. The optimum method depends on the type of casting, its size, and the required production. When only a few castings are required, it may be more economical to have a loose pattern made and to have the mould made by hand. Hand ramming is the oldest and slowest method of making a mould. Unfortunately, it is becoming increasingly difficult to locate a foundry with hand moulding skills. In most cases, the pattern will at least be mounted on some kind of board to facilitate fabrication of the moulds. There are two basic types of green sand moulds: flask and flaskless.

Flask Moulds. A flask can be defined as the container that is positioned on the pattern (or platen in some cases) and into which the prepared sand is placed before the moulding operation. Although there are flasks termed slip flasks, which are slid up the mould as the depth of compacted sand becomes deeper, the most common types of flasks are snap flasks and tight flasks.

Flaskless Moulds. During the last few decades, flaskless moulding equipment has become increasingly popular, especially when moulds of less than 160 kg are being considered. As the name implies, the flaskless moulding machine has no flask. Rather, the flask is replaced with a box or moulding chamber that is an integral part of the moulding machine.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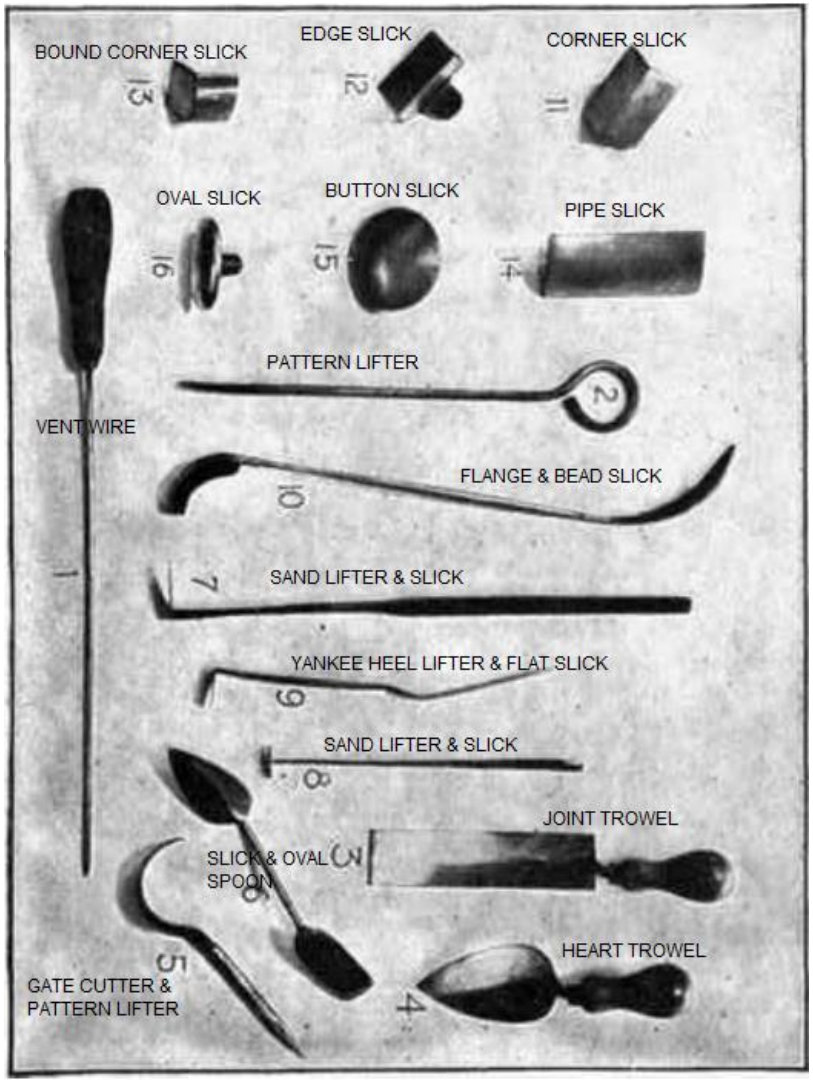
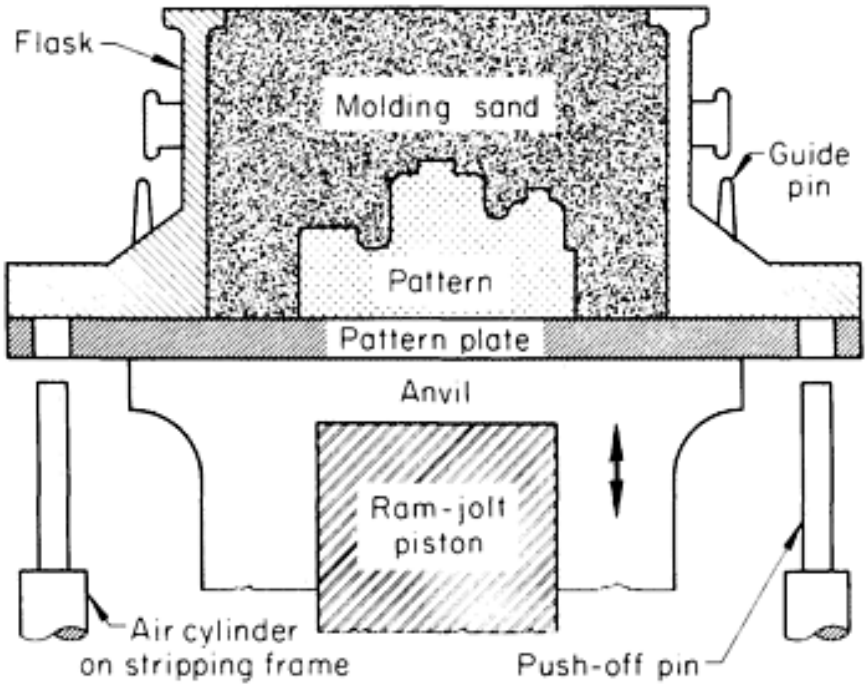
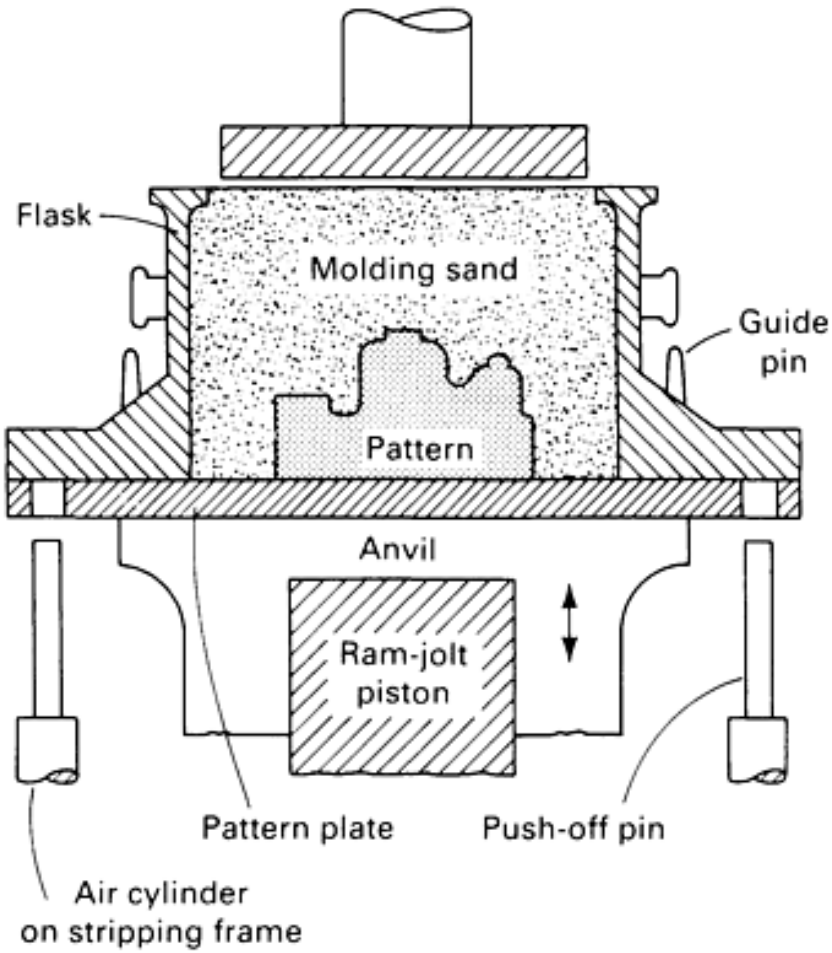
Moulding by hand



Moulding Machines
Jolt-type moulding machines

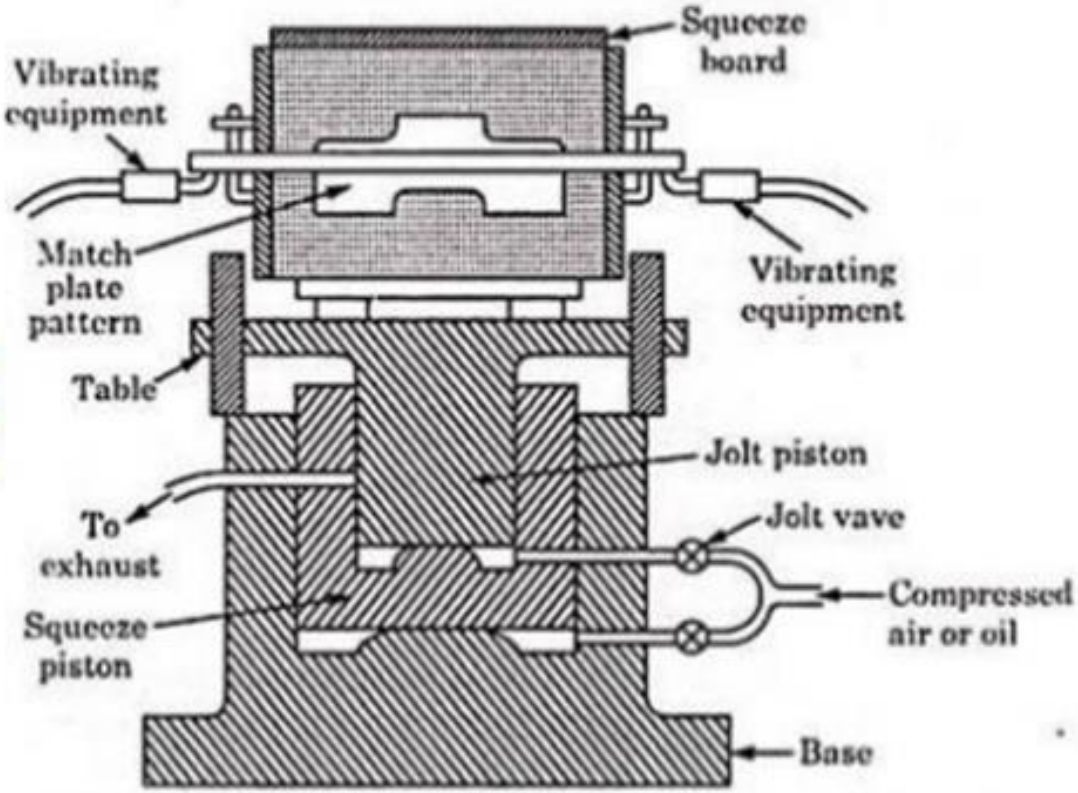


Primary components of a jolt-type moulding machine



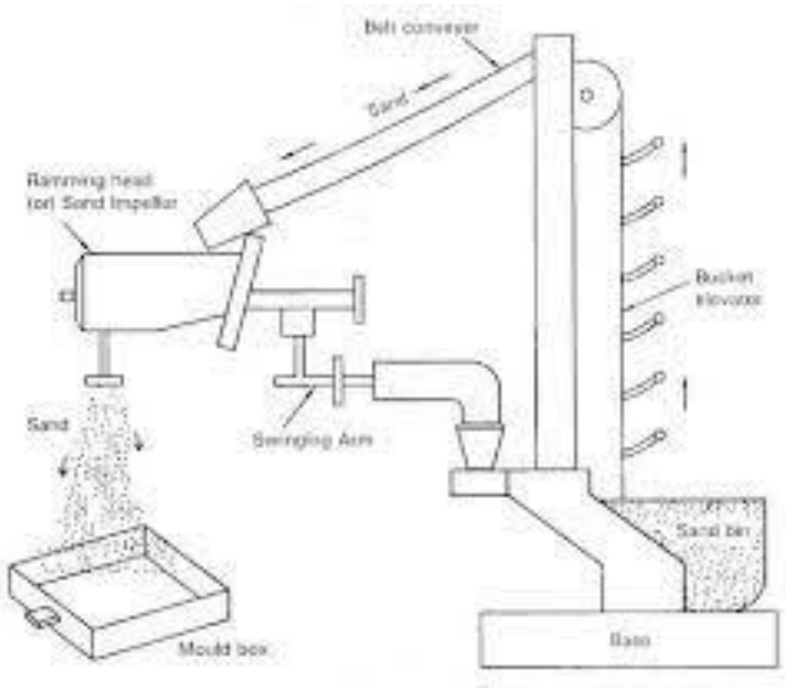
Jolt squeeze moulding machine with solid squeeze heads

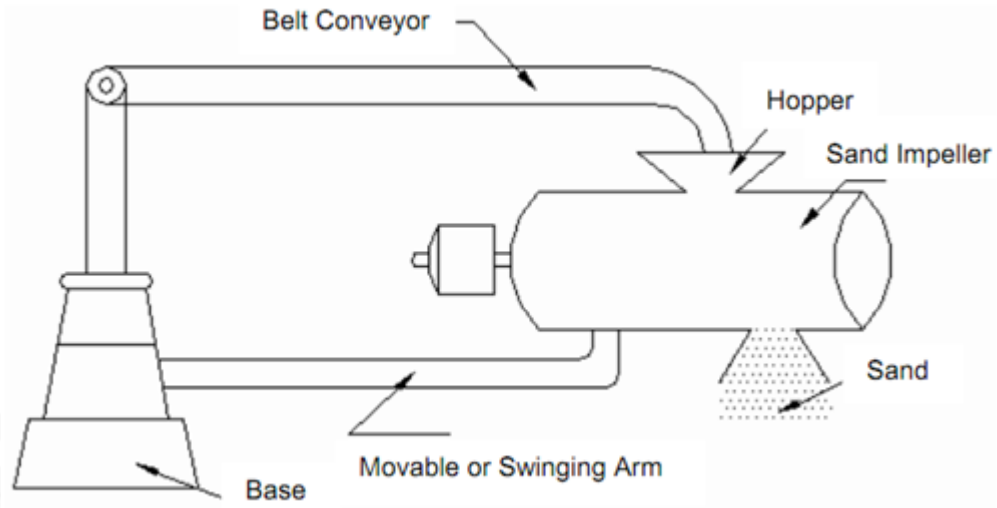
Jolting and Squeezing Moulding Machine

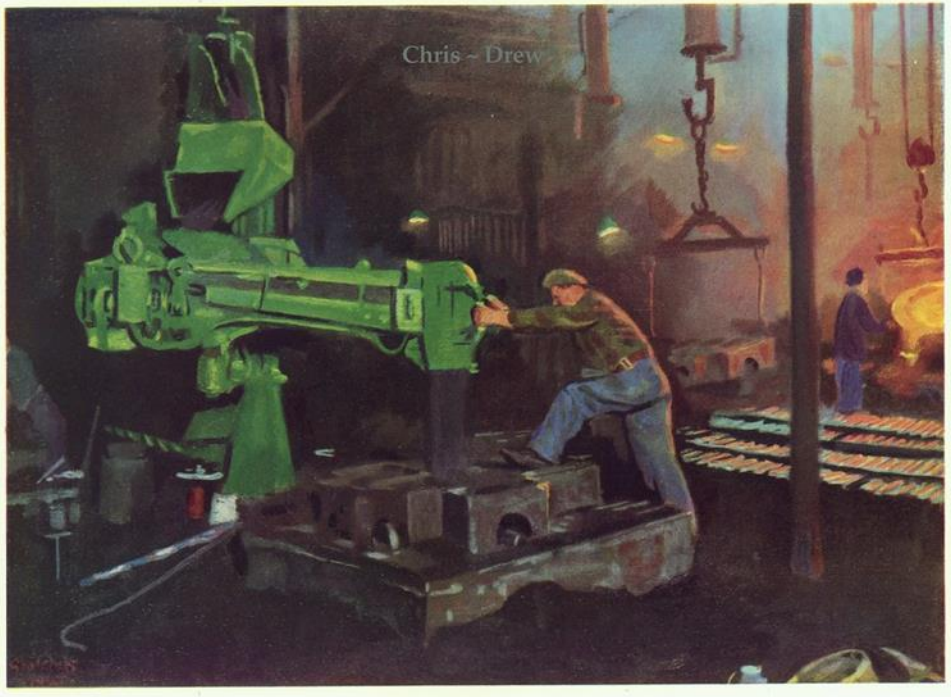


Sand slinger moulding machines

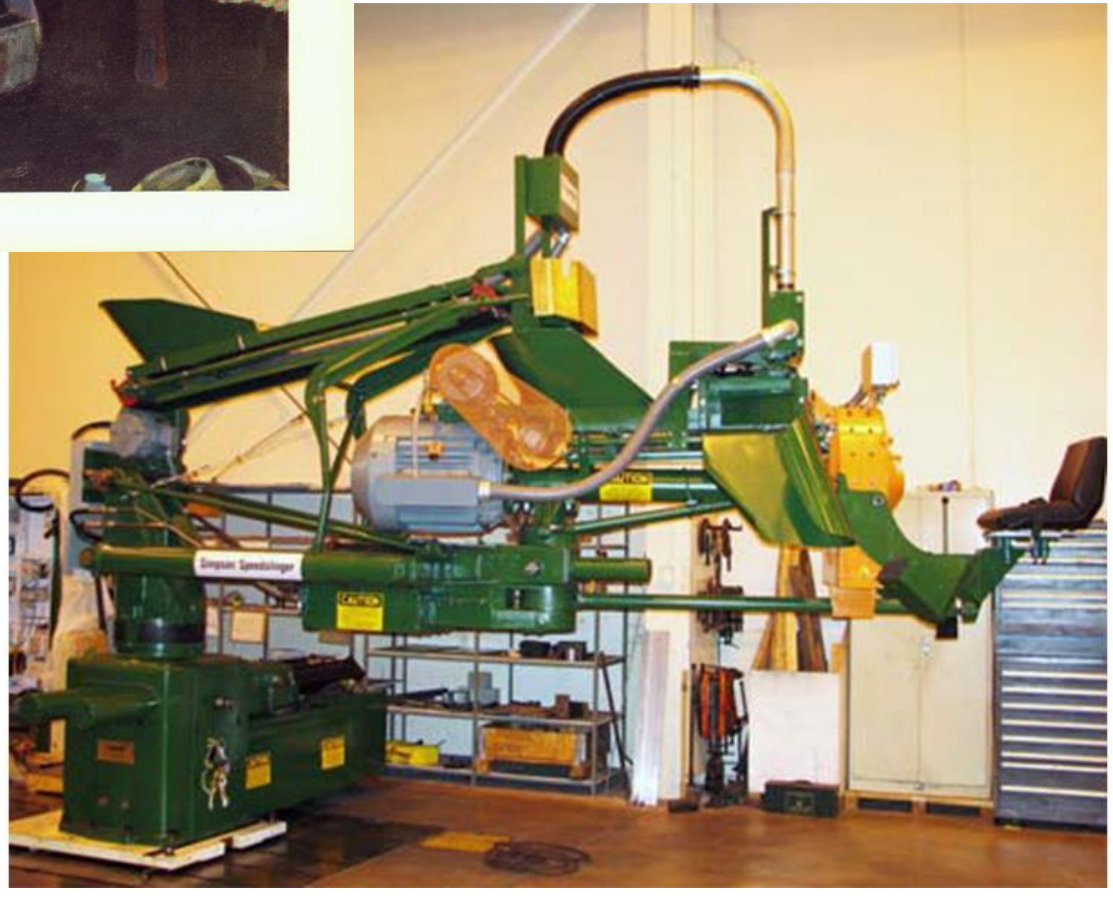
These machines deliver the sand into the mould at high velocity from a rotating impeller. Moulds made by this method can have very high strengths because a very dense mould can be made.

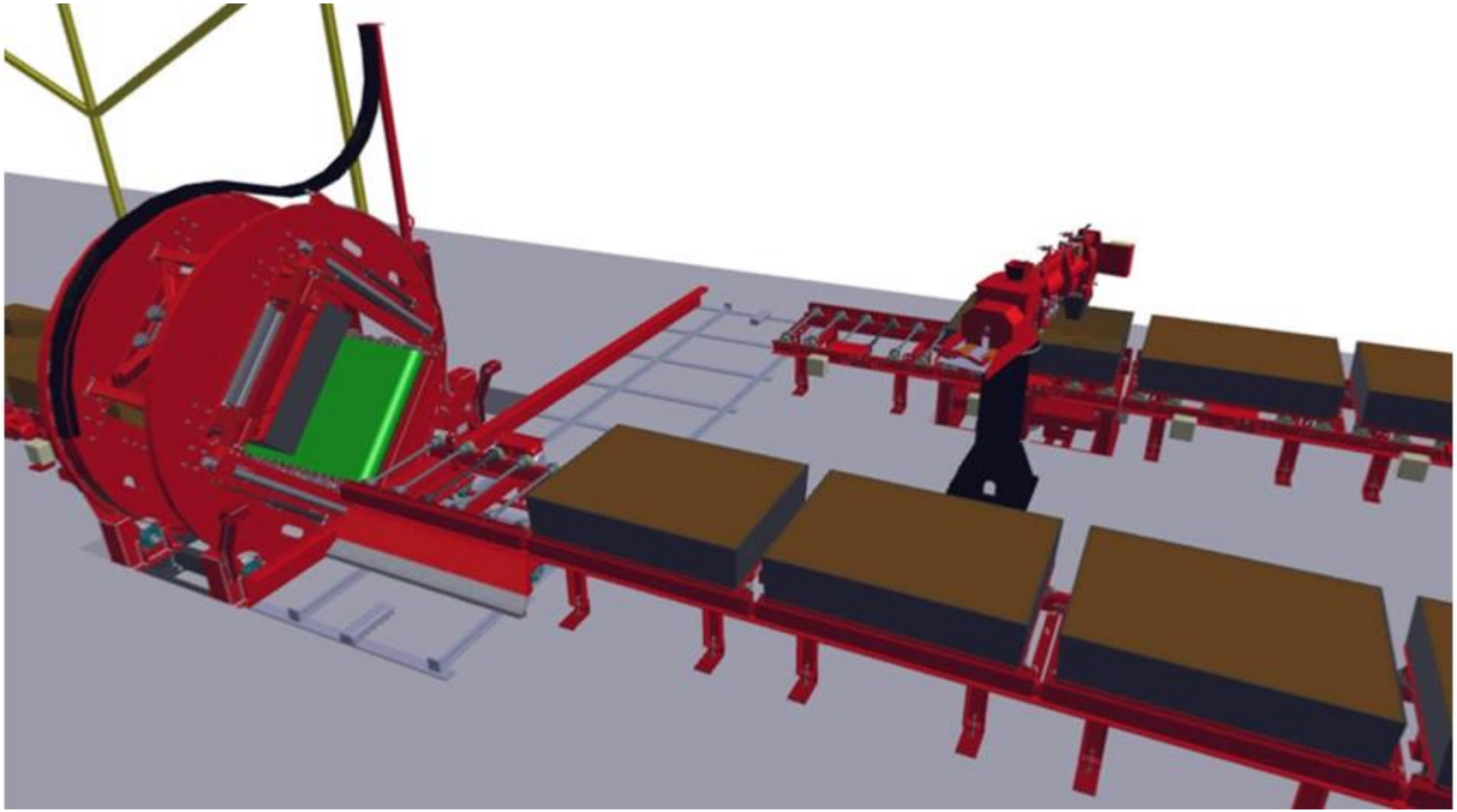






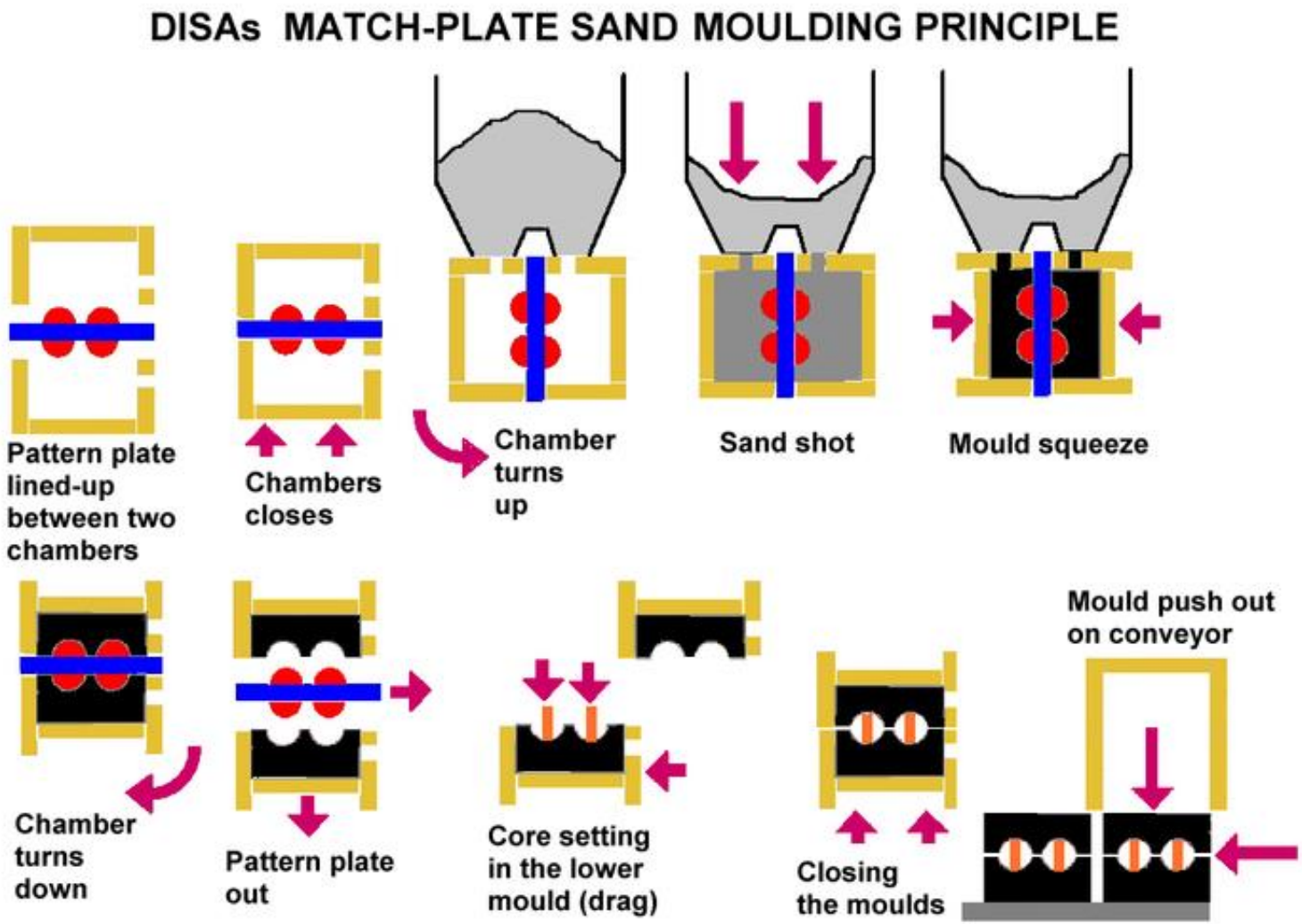
Sand slinger filling moulds for special castings.

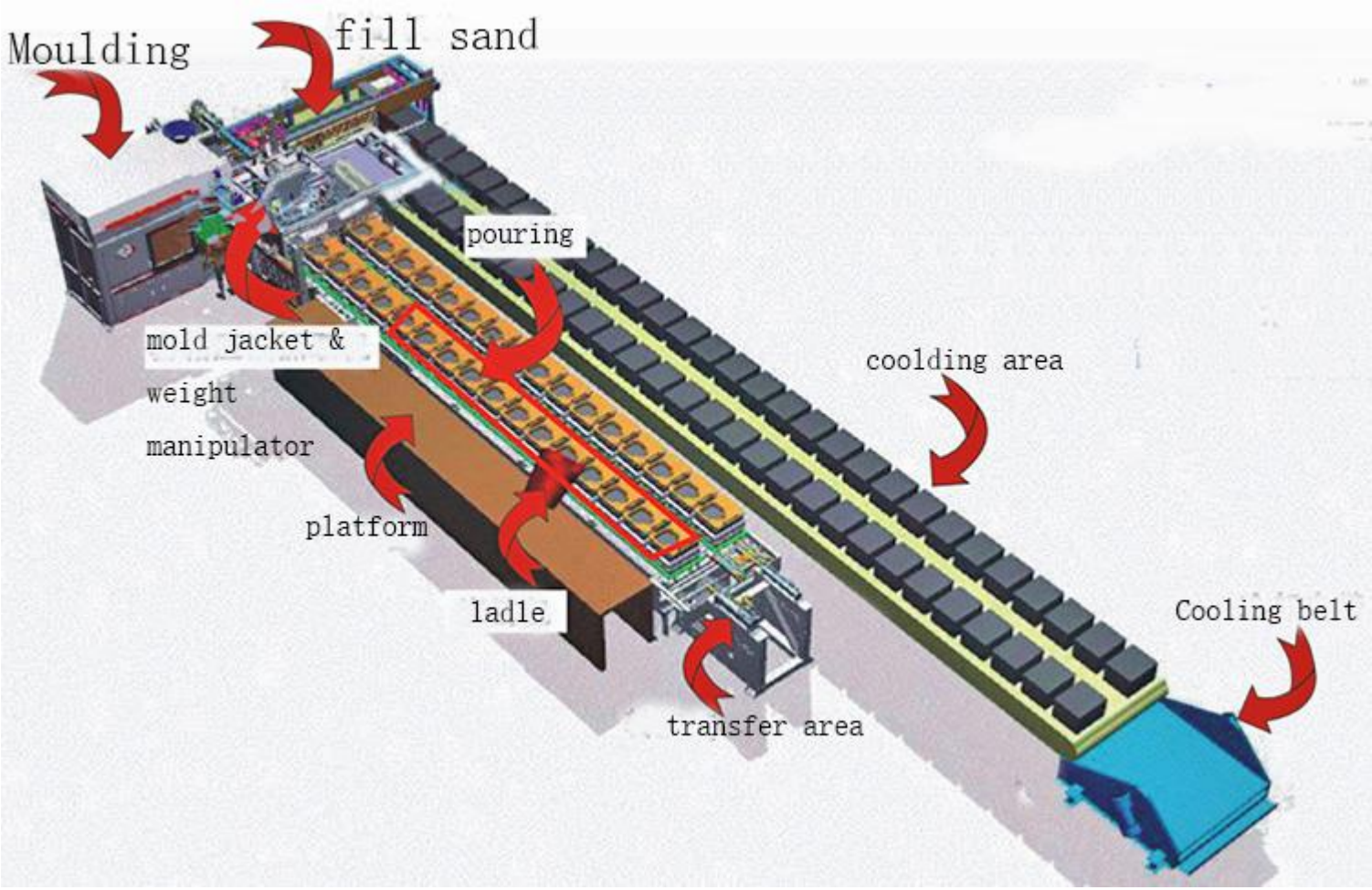


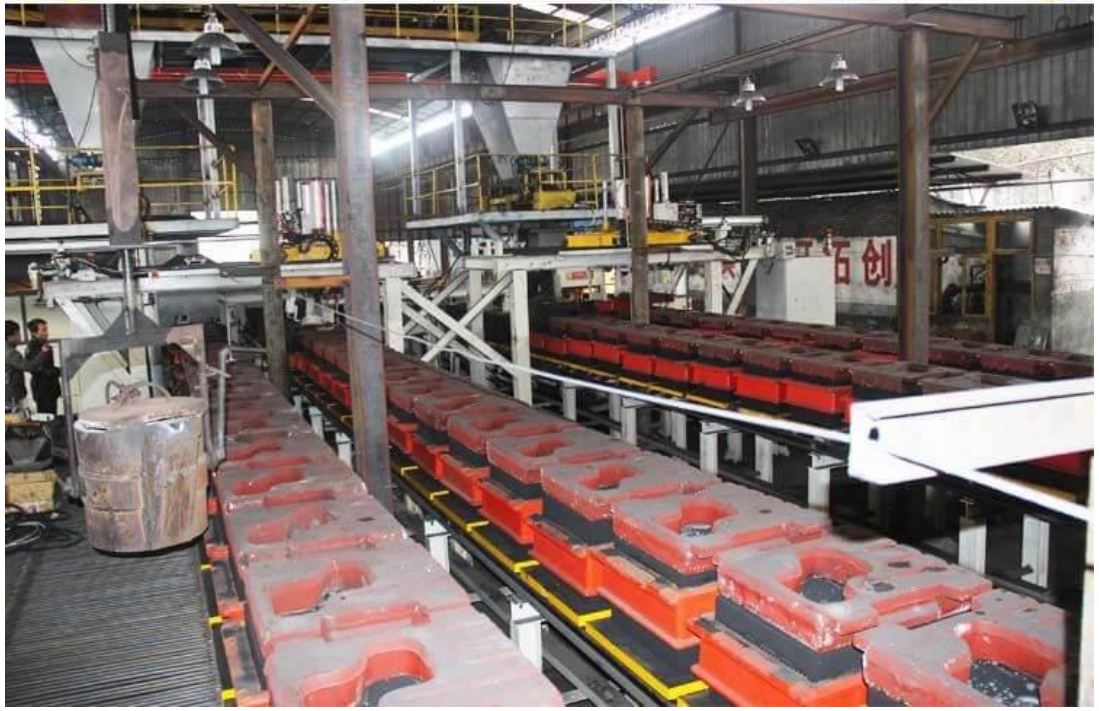


Fast Loop Moulding Line

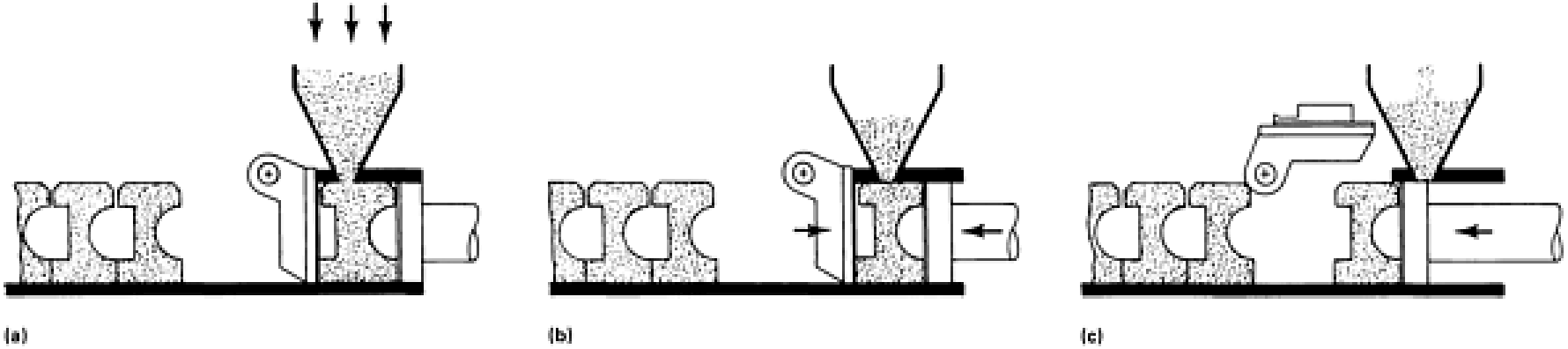
Horizontal flaskless moulding machines



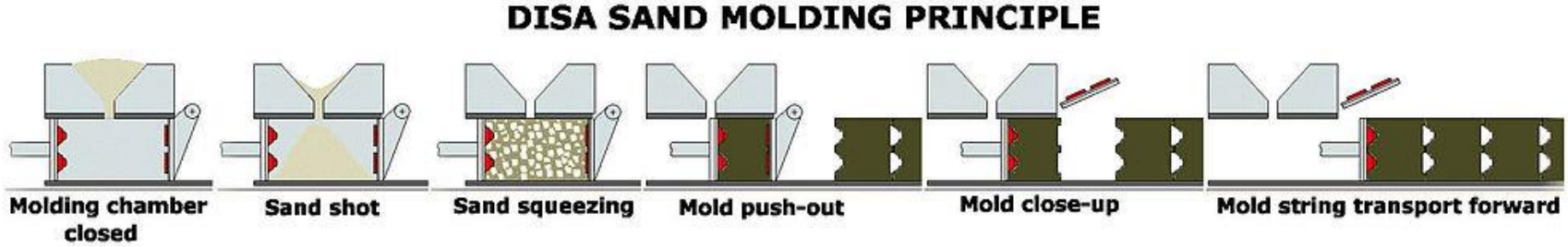

Moulding
fill sand
pouring
mold jacket &
weight
manipulator
coolding area
platform
ladle
Cooling belt
transfer area



Vertically parted flaskless moulding machines



Blow-fill pressure squeeze moulding machine making vertically parted moulds. (a) Moulding chamber filled with sand. (b) Sand compacted by squeeze pressure. (c) Finished sand mould pushed out of moulding chamber.

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Video links

- https://www.youtube.com/watch?v=LmjAQGvSrF0
- https://www.youtube.com/watch?v=1oZnxZj6-Ig
- https://www.youtube.com/watch?v=ZV-jnmPUqZA
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