## The Electromagnetic Pump Operating Principle

In the science of Physics, Laplace's Law describes the interaction between a magnetic field and an electric current when they are applied at right angles to each other and to a conductor of electricity. This Law explains how induction motors function and is better known as Fleming's Left Hand Rule, in which the thumb, forefinger and middle finger are each positioned at a right angle to the others. The thumb is the resulting force Q acting on the conductor when the forefinger pointing up is the magnetic field direction H and the middle finger pointing right is the DC current I.

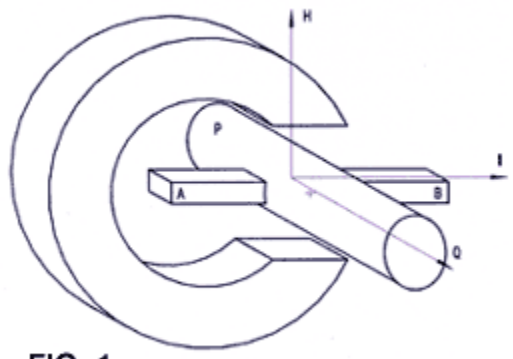



FIG. 1

Figure 1 illustrates the law of using a c-shaped permanent magnet, a pipe P carrying molten metal as the conductor, and a direct current applied to A and B by some external source such as a battery. The CMI Novacast electromagnetic pump uses this principle to move molten metal from the heated bath to a mold and does this without having any moving parts in the pump. In a real pump AC power instead of direct current is used to supply the current and the same AC power energizes the magnetic field of the electromagnet. When configured at right angles to each other, the metal is propelled through a channel composed of a stable, high-temperature ceramic. Thus, the metal does not have contact with any material which could contaminate it.

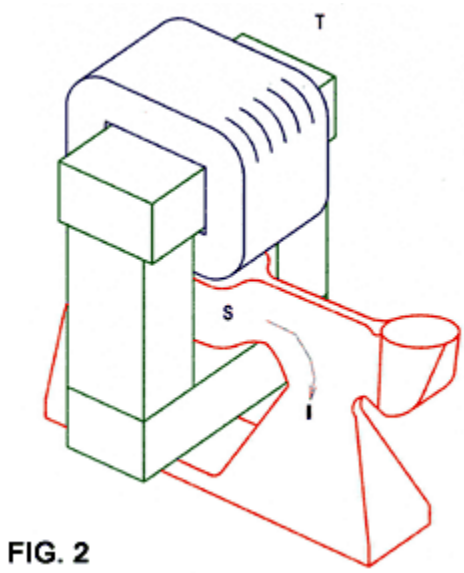
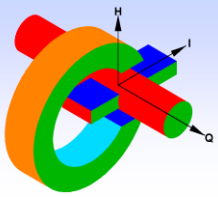



FIG. 2

The remaining figures show the AC electromagnetic components of a real pump with all ceramic shapes deleted. The electrical current is induced by transformer action. The transformer's primary coil T in Figure 2 is connected to an AC single-phase power source. The transformer pole pieces are arranged in the shape of a picture frame and serve as the carrier of magnetic flux. The transformer secondary winding S around the bottom leg of the picture frame is molten metal and is formed by channels in ceramic parts. The shape forms a single turn shorted winding. The turns ratio amplifies the electrical input current to produce very high amperage I in the molten metal.




CMI Novacast Inc. 500 E. Touhy Ave. Unit B Des Plaines IL 60018 USA

Toll-free: 877.699.9023 Phone: 847.699.9020 Fax: 847.699.9023

sales@cminovacast.com www.cminovacast.com

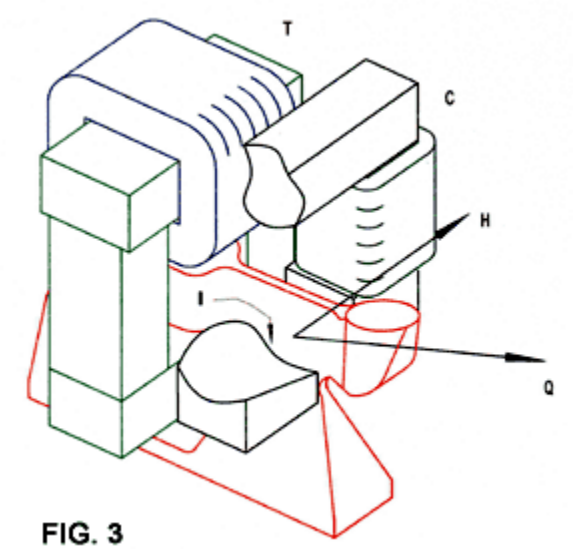



FIG. 3

Figure 3 adds a sectioned view of the electromagnet construction, which consists of a C-shaped pole piece and two excitation coils. The opening in the C straddles the necked-down section of the molten secondary turn, so the magnetic field H crossing the pole gap is perpendicular to the secondary current I, resulting in force Q to move metal through the pump.

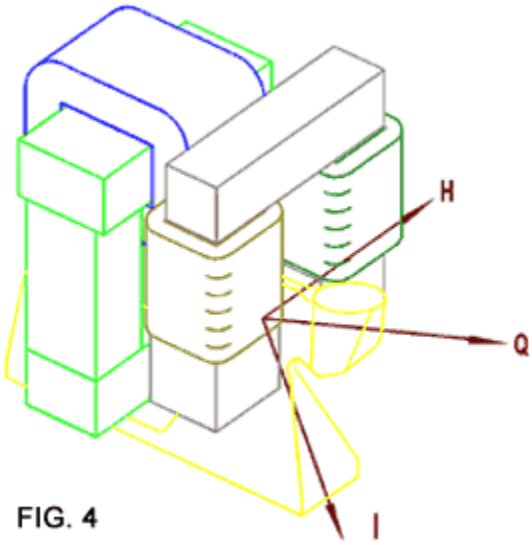
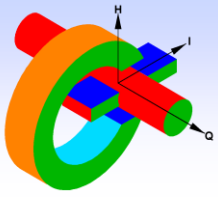



FIG. 4

Figure 4 is the complete pump motor. It is surrounded by or encapsulated in ceramic parts to protect it from molten metal contact. Pump output Q is varied by controlling input power and can be regulated from almost drop-wise flow up to full bore delivery.




CMI Novacast Inc. 500 E. Touhy Ave. Unit B Des Plaines IL 60018 USA

Toll-free: 877.699.9023 Phone: 847.699.9020 Fax: 847.699.9023

sales@cminovacast.com www.cminovacast.com