ELECTROPERM MAGNETS: THE COMBINATION OF TWO MAGNET TECHNOLOGIES

Three types of lifting magnets: Permanent, Electro and Electroperm

Permanent Magnet Material

What is a permanent magnet?

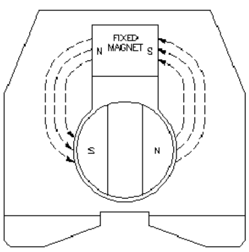
Certain materials and compounds when exposed to a strong magnetic field become magnetized; the magnetic domains of the molecules become aligned and stay aligned when the magnetic field is removed. Different magnetic materials have different properties. In other words, some permanent magnetic material is “stronger” or has a higher energy level than other permanent magnetic materials. Magnetic materials, listed in order of their strength, are ceramic, alnico, and neodymium iron boron also known as neo or rare earth magnets.

Permanent Lifting Magnets

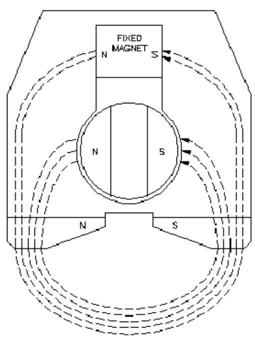
Permanent lifting magnets utilize permanent magnet material to produce the magnetic field.

Permanent magnets are turned on and off mechanically. This is accomplished by internally “shorting out” the magnetic field. A moveable magnetic pack is rotated such that its north pole is aligned with the fixed magnets south pole and the moveable south pole is aligned with the fixed north pole to complete the magnetic circuit internally. When the magnet is turned on the fixed north and moveable north pole are aligned and the fixed south and moveable south pole are aligned to drive the magnetic field out of the bottom of the magnet to complete the magnetic circuit through the material to be lifted.

PERMANENT MAGNET "OFF"



PERMANENT MAGNET "ON"



Permanent lifting magnets have certain limitations. The amount and strength of the magnetic field produced, which determines the lifting capacity, is determined by the properties of the permanent magnetic material used in the magnet. The newer magnet material allows a stronger magnet to be designed in a smaller package. The magnetic performance of a permanent magnet through adverse conditions such as an air gap is less than an electromagnet. Air gap is the distance between the magnet and the load being lifted. It can be rust, scale, edge stagger on coils, and uneven layers of billets or loose material. Air is a detriment to the flow of magnetic flux. Magnetic strength is required to penetrate through the air gap. Because the magnetic properties of the permanent magnet material limits the amount of magnetic strength produced, the magnet material limits the air gap penetrating ability.

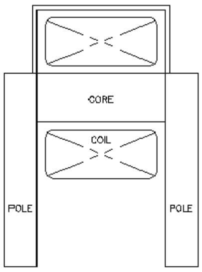
In addition, the magnet is turned on by mechanical means such as a handle. Lifting magnets that are designed for close proximity operation as defined by ANSI B30.20 have a breakaway force of 2 to 3 times the rated lift. This means that the mechanical operation has to interrupt a magnetic force of thousands of pounds. This limits the practical lifting capacity of the permanent lifting magnet.

Electromagnets

The field of an electromagnet is developed by the passing of a direct electrical current through a conductor wound around a steel core. The first use of electromagnets in material handling applications date back to the 1890's. Electromagnets are manufactured in various shapes and configurations to suit the application. The traditional magnet used in a steel mill to lift scrap and solid slabs is a round magnet. These can range in diameter from 30 inches to 100 inches. Rectangular magnets are used to lift plates, billets and bundles of merchant product. Quad-Pole or Bi-Polar magnets are used to lift coils with the eye horizontal or eye vertical. New rectangular shaped magnets have been developed for improved scrap handling efficiency in melt shops. Electromagnets can also be manufactured to be used on hot material.

Electromagnets require the flow of electrical current through the coil to develop the magnetic field. When the flow of electricity stops, the magnetic field is no longer generated. The strength of the electromagnet is determined by the design of the magnet. As the current draw of the magnet is basically unlimited, the strength of an electromagnet is basically unlimited. This is necessary to overcome adverse conditions such as air gap on solid material and loose material such as scrap. This is important when lifting bundles and coils with the eye vertical or horizontal.

BI–POLAR ELECTRO MAGNET
"OFF"



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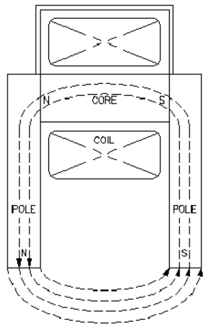

Electromagnet systems are supplied with a battery back-up system when an interruption in power to the magnet would cause damage when the load is dropped. The battery back-up system is an on-line system, which provides instantaneous transfer to battery power in the event of an interruption in power. The new battery technology eliminates most of the maintenance issues that were present with older battery back-up systems.

Electroperm Magnets

Electroperm magnet technology dates back to the 1960's. A true electroperm magnet does not have any moving parts. An electroperm magnet combines the properties of a permanent magnet with the ease of control of an electromagnet.

An electroperm magnet has two packs of permanent magnetic material. One pack is permanently magnetized. The other pack is of equal magnetic strength surrounded by a coil. DC current is passed through the coil for a short period of time to magnetize the pack. When the voltage is applied in the plus or "energize" direction, the magnetic pack is charged in the same magnetic polarity as the permanent magnetic pack. The two magnetic packs develop a magnetic field that is forced out of the lifting surfaces of the magnet turning the magnet on. When the voltage is applied in the opposite direction, the magnet pack is magnetized in the opposite polarity. The magnetic field is then shorted internally within the magnet, turning the magnet off.

BI–POLAR ELECTRO PERM MAGNET
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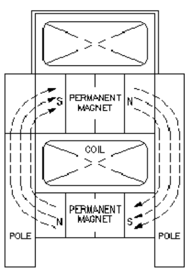

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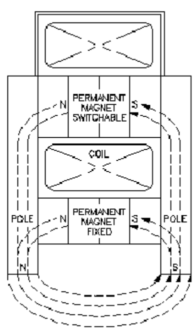

Electroperm magnets are larger and heavier than electromagnets. This difference has been greatly reduced with the development of the newer, more powerful rare earth permanent magnetic material. Electroperm magnet systems are now closer in weight and cost to a comparable electromagnet.

Electrical DC current is only used for a short time to turn the magnet on and off. Once the magnet is turned on it does not need the flow of current since the permanent magnets supply the lifting power. This eliminates the need for a battery back-up system and the concern of cutting the power cable from the crane to the magnet.

The controls for the electroperm can be sophisticated and have many useful features. For instance, the controls can be mounted on the magnet system for smaller plate handling applications or crane mounted for larger slab and coil handling applications.

The amount of magnetic field generated from the magnet can be controlled by the level that the switchable magnetic pack is magnetized. This is useful when the magnet is used to lift thinner plates off of a stack of plates. The magnet control will automatically charge the magnet to full magnet power after the load has cleared the stack of plates.

Another feature of the electroperm magnet control is a current-sensing circuit. This circuit measures the amount of current flowing to the coil to verify that the magnet is energized to the desired magnetic strength.

Electroperm magnet systems for lifting large loads such as slabs and coils also feature a flux sensing circuit. This actually measures the amount of magnetic flux flowing through the entire magnetic circuit, which includes the magnet and the load to be lifted. The flow of insufficient flux would indicate that the air gap in the magnetic circuit is too large.

The magnet must be in contact with the load to turn the magnets on. An interlock is provided to not allow the magnet to be turned on or off if the magnet is suspended. This is also a safety feature to eliminate inadvertent releasing of the load.

Because the field generated by an electroperm magnet is produced by permanent magnetic material, the strength of the magnet is still governed by the properties of the magnetic material. Electroperm magnets do a good job at lifting solid loads. Applications include plate, slabs and coils. They are not the proper magnet for lifting bundles or scrap.

Permanent magnetic material is heat sensitive. The material loses strength or the magnetic properties can be changed if they are exposed to a high temperature. Because of this they are not recommended for use on hot material.

Summary

There are three types of magnets produced: Permanent Lifting Magnets, Electromagnets, and Electroperm Magnets. Each type of magnet has limitations. As with all magnets, the specific application has to be analyzed and the limitations and benefits of each type of magnet should taken into account when making a magnet recommendation.