"FIELD WEAKENING"

Forklift OEM's are always looking for that one special feature to help sell their vehicles. One of those features introduced many years ago is Field Weakening. Field Weakening adds increased speed to any electric forklift, which enables higher productivity for the operator.

Field Weakening (FW) or Field Shunting has been an available option on electric trucks for many years. This month and continuing next month, we will discuss what FW is and how it works.

Basically FW is like an overdrive in an automobile. In the forklift, FW gives a slightly higher speed than bypass or IA on a level surface. As usual, you never get something for nothing. In the case of FW you will gain higher speeds at the cost of lower torque. FW therefore is used only in situations where long level travel is the primary operating mode.

Field Weakening or Shunting does just what its name implies: weakens the drive motor series field. The series field in a drive motor is like an electro-magnet. The actual strength of the magnetic field depends on the current flowing through the series field at a given time. To start a heavy forklift it requires high currents, which yields extremely high torques. As the vehicle speed increases, the current decreases and the necessary torque requirements reduce. Once top speed is reached the only way to increase speed is to energize the bypass or IA contactor. This applies full battery voltage across the motor for full available speed without gearing. How do we attain a faster speed than bypass? By weakening the series magnetic field we can gain higher speeds with lower torque.

The magnetic field of the series windings limits the actual RPM of the drive motor. If we somehow reduce the strength of the magnetic field, we can allow the armature to run at an increased RPM in turn driving the vehicle slightly faster. We discussed the option of adding field weakening to an electric forklift. This option gives higher speeds at the sacrifice of reduced torque. By weakening the drive motor magnetic field we can actually increase our motor RPM thereby

increasing our top speed on a level surface. Lets look at the components which are necessary and how they work to give us this increased speed.

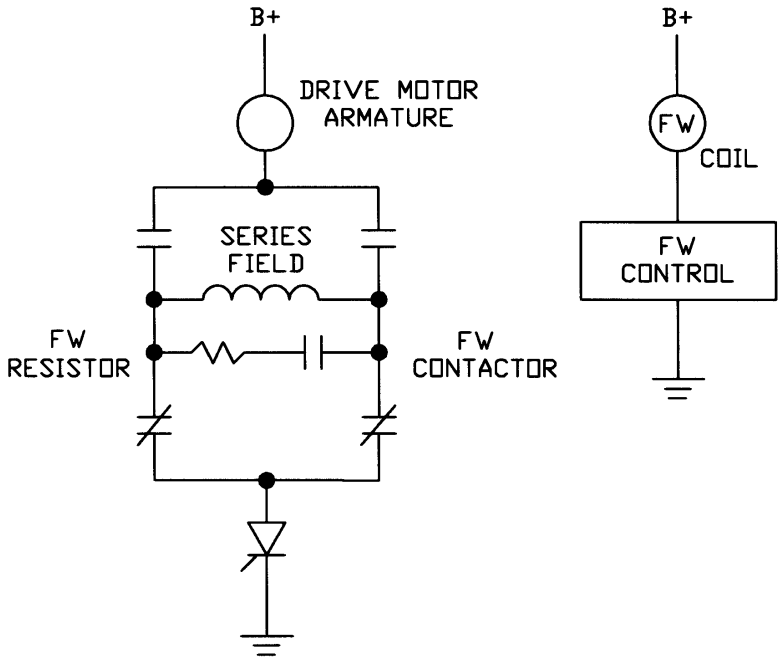

FIG. 1

The components needed for any type of field weakening system include a high power resistor (with very low resistance), a single pole contactor and a control or" brain" to determine when to open and close the contactor. (Refer to Figure One to see a typical hookup for the field weakening components) Notice that the field weakening resistor is placed in parallel with the motor field. During normal operation, the field weakening contactor remains open and the field weakening resistor has no effect on the vehicle operation. The field weakening control monitors different system points and energizes the contactor at the most efficient time in the speed curve. Once the system has energized the IA or bypass contactor and the motor current reduces to a preset adjustable value, the field weakening control energizes the field weakening contactor. This allows a small amount of motor current to bypass the motor field and flow through the field weakening resistor. The overall battery current remains the same, but now some of the motor current is dissipated by the field weakening resistor. This reduction of field current weakens the magnetic strength of the motor field and allows the motor to turn at a higher RPM increasing vehicle speed. The vehicle will operate in this field weakening condition until the operation requires increased current such as a hill or gentle incline. At this point - again a preset, adjustable level - the field weakening control drops out the field weakening contactor and goes back to a IA or bypass mode.

The field weakening control in charge of the field weakening contactor typically has two adjustments. One adjusment controls the field weakening contactor pickup point and another controls the dropout point. Both settings are related to current, which determines when the current in the motor is low enough to utilize field weakening, or high enough to drop field weakening out.

There are various types of field weakening controls. Some are built within the main control card such as EVI and others require separate auxiliary cards, as with the older M210 system. While field weakening is a standard feature on some models, it can easily be added to most types of electric trucks.