IJISET - International Journal of Innovative Science, Engineering & Technology, Vol. 1 Issue 6, August 2014.
www.ijiset.com
ISSN 2348 – 7968

Protection and Control of Electrically Operated Over-Head Track Cranes (EOT) Using Multi-Functional Programmable Counter and Inductive Proximity Sensor.

Chandrashekar.p

Electrical and Electronics Engineering, PESITM-Shivamogga, Karnataka-India
Email:Cschandran44@gmail.com

Abstract

Control and Protection Devices Play a Great Role in the Working of the Electrical Equipment's. The protection of EOT Cranes from Free-Fall/ Breakdown of due to Over-Speed needs a Protection and control devices to minimize the accidents And avoid damage to Human life and Equipment.

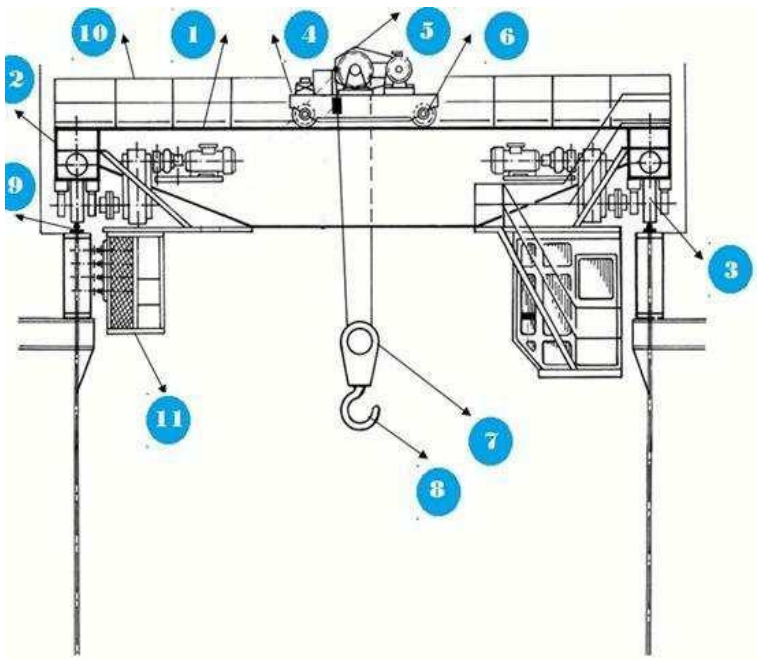
In the Existing System Hydraulic-Operated Caliper Brake unit is used for Protection due to Breakdown and Free-Fall of Crane. The Present system is Operator Dependent and time delayed. Adequate alarm and Isolation from Power Circuit are not available. It is not been Integrated with the Existing Process Automation System.

The main Objective of the Current Project is to utilize the Flexible Operation Of Counter and Sensor for Control and Protection of Crane from failure. Programmable Counter ProvidesInformation about the Initial and Final set Values of Speed through Sensor. It sets the Alarm during fault Condition. In addition the most Important things is that it sends Signals to the Caliper Brake unit and VVVF drive unit to take Necessary Actions and These things are Operator Independentand fully Automated.

Introduction

The most adaptable and the most widely used type of power driven crane for indoor/outdoor service is undoubtedly the three motion EOT crane. It serves a larger area of floor space within its own travelling restrictions than any other permanent type hoisting arrangement. The three motions of such crane are the hoisting motion, long Travel and the cross Travel motion. Each of the motions is provided by electric motors. In a steel plant, rolling mill, thermal powe plant, Hydro power plant, nuclear power plant, All manufacturing Industry this type of crane is considered indispensable. In short in all industries, wherein heavy loads are to be handled, EOT crane find its application.

Working Principle



1. Bridge– 2 No's
2. End carriage– 2 No's
3. Wheel of the bridge– At least 4 No's
4. Trolley (without auxiliary hoist) – 1

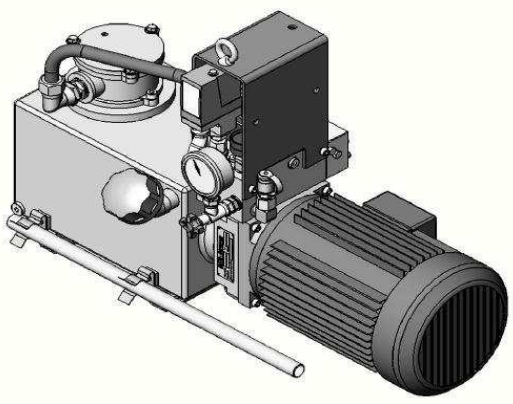
5. Hoisting machinery set– 1 No’s
6. Wheels of Trolley– At least 4 No’s
7. Bottom Block(without auxiliary hoist) –1
8. Lifting hook– 1
9. Rail on the gantry girder for crane movement– 2 No’s
10. Rail on the bridge for Trolley movement– 2 No’s
11. Operators cabin– 1 No’s

The Eot Crane is Primarily Engaged in Handling the Ladle from the supplier to the Casting unit. The temperature of the Hot metal in the ladle Varies around 1600 to 1700K. This Crane can be Operated in 5 Variable Speed which depends on the Requirement .Free-fall/ Breakdown of coupling arrangement or free-fall of ladle from the crane due to over-speed may occur and these accidents have to be overcome. It is not integrated to overcome with the Existing Process automation system. The casting control is done at the third floor where the operator on the Crane gives the pressure set points whereas the compressor controller is at the ground floor. The objective of Current Project is to Protection, Control and breakdown of Eot Crane by using the Multi-Function Programmable Counter an Inductive Proximity Sensor which adds to plant automation.

Caliper Disc Brake - Power Unit (CE8L)

The Hydraulic Power unit CE8L (shown in Fig.1) is intended to deliver a Hydraulic Pressure to open the Emergency Hydraulic Brakes.

Fig. 1



Hydraulic Power Unit CE8L

Power-Flow Diagram of the Hydraulic Power-Unit

BR1-Filling Port

LD1- Flow Limiter

BV-Draining Port ¼ G

LP- Main Pressure Limit Valve

CA1- Check Valve

LP1- Hand Pump pressure limit Valve CA2-Check Valve
M-Electrical Motor CA3- Hand Pump Check

Valve

P1- Gear Pump

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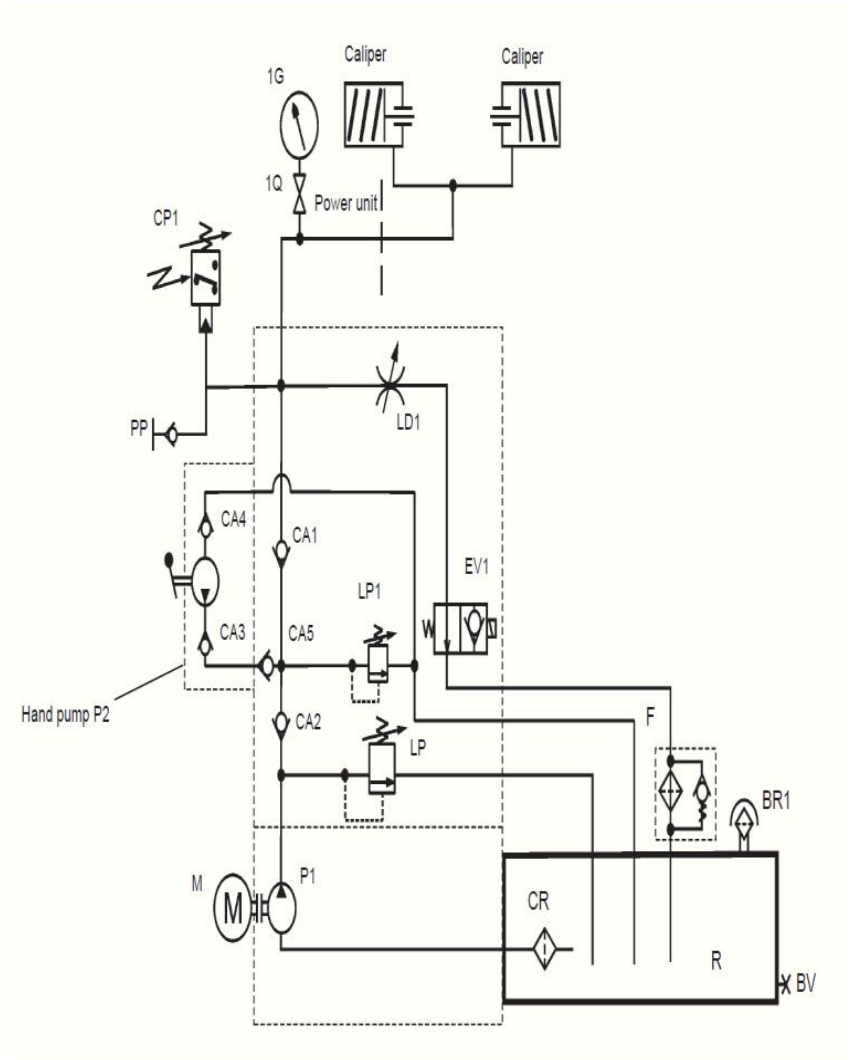


Components:

CA4-Hand Pump Check ValveP2- Hand Pump

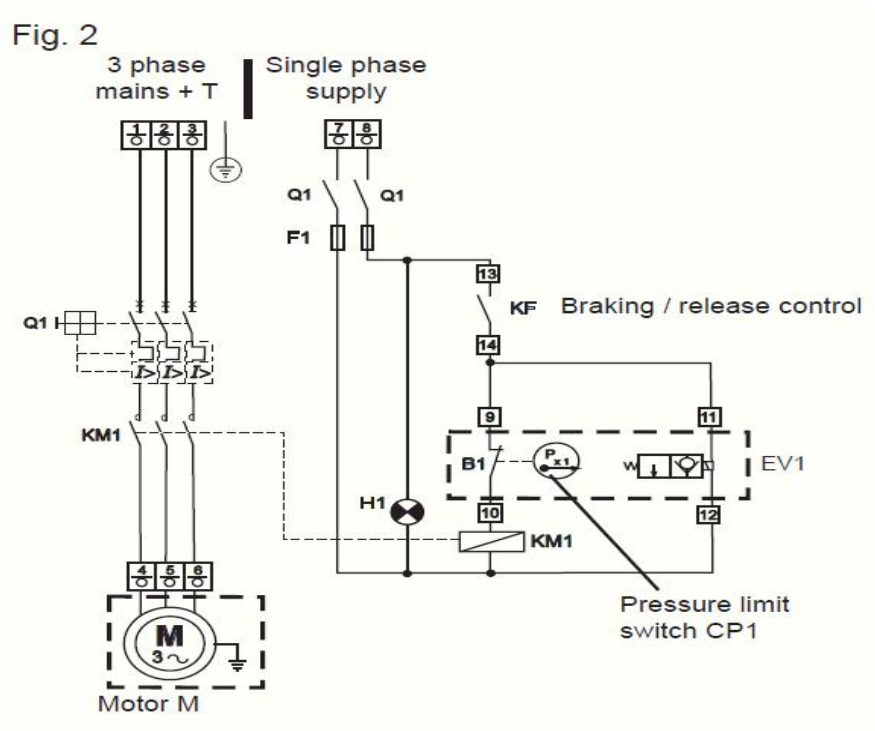
CA5- Check Valve

PP-Pressure Port CP1-Pressure Switch R-Reservoir CR-Suction Strainer 1G-Manometer EV1-Solenoid Valve 1Q-Isolation Cock of the Manometer

2.2 Operating Principle of

Caliper Brake

Fig. 2



Electrical Connection of Caliper Brake Unit

a) Opening of the Calipers

When the Hydraulic Power unit is Switched On, the solenoid valve EV1 (NO) closes and the motor M starts simultaneously. This motor drives the gear pump P1 which gives the oil pressure allowing the hydraulic calipers to Open.

The Opening of the Pressure Switch CP1, included in the working Circuit, stops

the motor M when working Pressure reaches the maximum set level. Then, the installation stays under pressure with the motor M stopped. If Pressure lowers down to the minimum level, the switch closes and starts the pump motor M again.

Drawbacks in the Existing System

1. The Existing System has no Protection under Free-Fall and Breakdown of crane due to any failure such as Breakdown in Various Gear Over-Speed due to failure in various stages of Speed Reduction.
2. The Present System is Operator Dependent
3. There is a Time-delay in the System.
4. Caliper Brakes needs actuator signal from the Operator which is time delayed.
5. The Failure due to any of the above reasons, will lead to Free- Fall of 45 T hot metal from such height due to its own weight. Thus it results in disaster; Evenly Everything will turn into Ashes

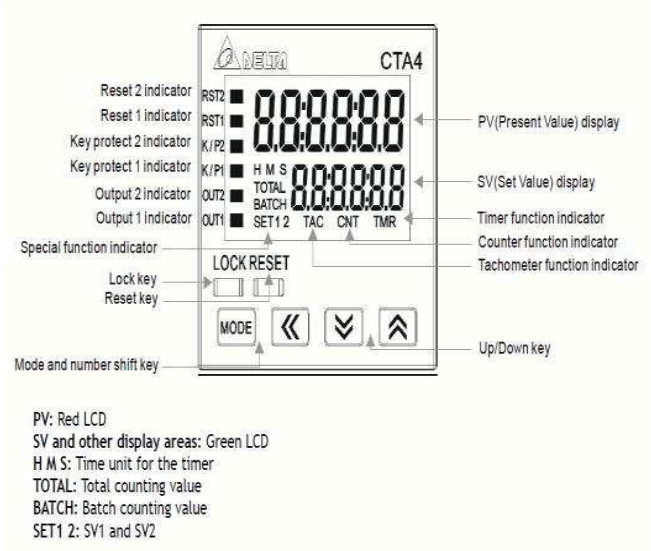
Proposed System of Protection and Control

The Proposed New System of Control mainly uses 3 Components

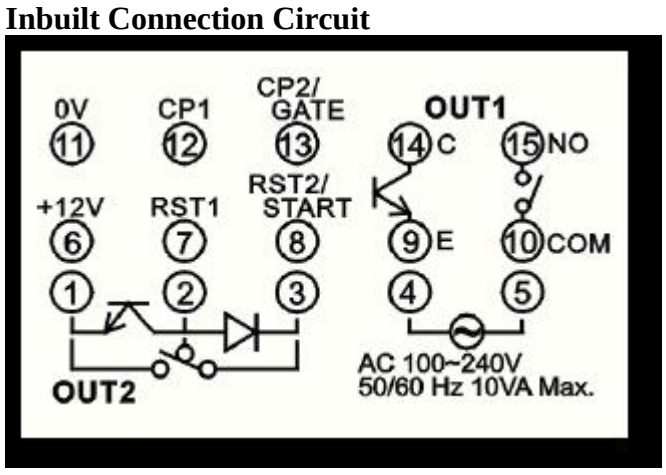
1. Multi-function Programmable Counter.
2. Inductive Proximity Sensor
3. Mild-Steel Disc Unit.

1. Multi-Function Programmable Counter

Display and Indications



Inbuilt Connection Circuit



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Specifications

Power	Input	AC 100 – 240V , 50/60 Hz
Input Voltage Range		85% to 110% , Rated Voltage
Power Consumption		Less than 10VA
External Power Supply		12V dc +10% or -10% , 100mA
Display	Double-Line, 6-digit LCD display	
Input Signal		Non-Voltage input (NPN): ON impedance 1K ohm max. ON residual voltage: 2V max. Voltage input (PNP): High Level: 4.5V to 30Vdc, Low Level:0 to 2V dc
Output 1		Relay: SPST max.250Vac , %A (resistance load) Transistor: NPN open Collector. When 100mA / 30Vdc , residual Voltage = 1.5Vdc max.
Output 2		Relay: SPDT max.250Vac , %A (resistance load) Transistor: NPN opens Collector. When 100mA / 30Vdc, residual Voltage = 1.5Vdc max.
Dielectric Strength		2000Vac 50Vac 50/60 HZ for 1 minute
Vibration Resistance		Without damage: 10 to 55 Hz , Amplitude=0.75mm , 3 axes for 2 hours
Shock Resistance		Without damage : drop 4 times , 300m/s2 , 3 edges , 6 surfaces , 1 corner
Ambient Temperature		O’ C to +50’C
Storage Temperature		-20’C to +50’C
Altitude	200m or less	
Ambient Humidity		35% to 65% RH no condense

2. Operating Principles for Inductive Proximity Sensors

Inductive proximity sensors are used for non-contact detection of metallic objects. Their operating principle is based on a coil and oscillator that creates an electromagnetic field in the close surroundings of the sensing surface. The presence of a metallic object (actuator) in the operating area causes a dampening of the oscillation amplitude. The rise or fall of such oscillation is identified by a threshold circuit
that changes the output of the sensor. The operating distance of the sensor depends on
the actuator's shape and size and is strictly linked to the nature of the material.

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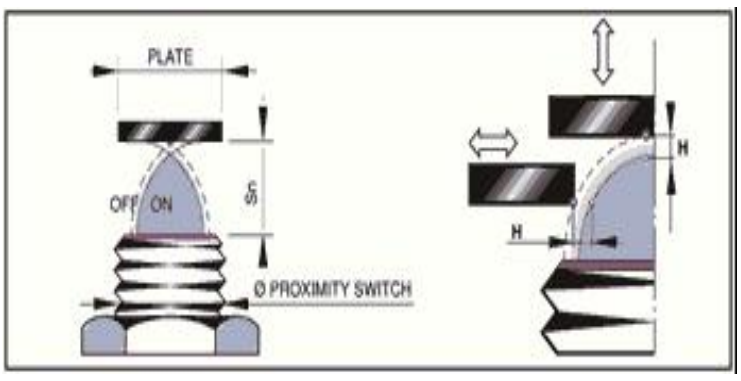

Outputs:

These amplified D.C. sensors contain an output amplifier. They are supplied as 3 wire with function N.O. or NC and as 4 wire with complementary outputs (NO + NC) in the types NPN and PNP. Standard version include protected against short circuit, protected against polarity and peaks created by the disconnection of inductive loads. They are compatible with P.L.C.

Conclusions

From the above set-up and arrangement we can ensure control and protection of crane from possible failure this increases reliability of the system because of operator independent and additional Caliper brake, drive and power circuit can be disconnected immediately after the fault within fraction of seconds . Above all this is the most economical in Cost wise flexible for multiple operations.

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