

Tilting Angle Measurement of Wagon Tippler

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Abstract— This paper proposed for tilting angle measurement of wagon tippler using absolute encoder in place of limit switch arrangement. The unloading cycle starts when the wagon is positioned over the tippler table, wagon along with the table rotates and discharges the material into the underground hopper. There wagon tipplers rotates about 0 to 180°. To measure the tilting angle an absolute encoder mounted on the rotating shaft. Absolute optical encoder rely on multiple light sources and photo detector assemblies, as well as code disks with segment patterns arranged as a series of annular rings. This code disk variant provides an absolute measurement by using a binary output to represent each individual shaft angle as the disk rotates between a radial arrangement of photo detectors and a linear sequence of light sources. The length of the rotational arcs for both opaque and transparent segments on the disk decrease based on their radial distance from the shaft. The accuracy of the shaft position generally depends on the quantity of the disk's annular rings, and as the disk rotates the light that passes through each ring produces a continuous signal stream. The electronics array then converts this stream of output into a binary code. Absolute encoders have code disks that retain the last angular position of the shaft from the point at which it stopped moving, even if the system shuts down. This provides a fail-safe by preserving data in case of power failure or malfunctions.

Key words: Absolute Encoder, Wagon Tippler, PLC

I. INTRODUCTION

Wagon tippler is used to dump raw material in hopper from wagons. The wagons are placed in the table by side arm charger unit and hold by clamp. By rotating the table the wagons are unloaded. The table must rotate up to 180 degrees to insure complete dumping of raw material. Mostly dry raw material will dump at 140 degrees. Machine apparently rotates the wagon around an axis somewhere near the center of gravity dumping the raw material into an underground hopper where a conveyor system hauls it away. The wagon clamping system holds wagon in place as it's rotated. The clamping system is having four vertical clamps which are operated by hydraulic oil pressure.

A Programmable logic controller (PLC) controls the complete system. Controller ensures smooth operation of the machine. The machine is operated at constant speed, while stopping of machine, to avoid shocks it is required to slow down the speed before stopping.

II. PROPOSED METHODOLOGY

Proposed method focus on replacement of current limit switch arrangement with rotary encoder system. A rotary encoder, also called a shaft encoder, is an electro-mechanical device that converts the angular position or motion of a shaft or axle to an analog or digital signal. For implementation of said methodology an absolute encoder to be fix at tilting shaft using flexible coupling. It has a shaft

mechanically coupled to wagon table rotating shaft, which rotates a encoder disc rigidly fixed with driver shaft. A succession of opaque and clear segments is marked on the surface of the disc. Light from source diodes reaches to the receivers through the transparent slits of the rotating disc. An analogue signal is created. Then electronically, the signal is amplified and converted into digital form. This signal is then transmitted to the data processor.

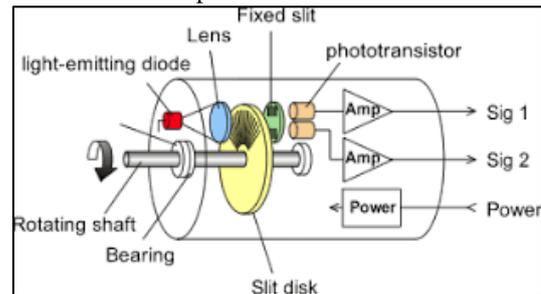


Fig. 1: Absolute Optical Encoder

III. PRESENT STATUS

Currently tilting position is observed by hardwire physical limit switch arrangement, as the wagon table rotate a striker welded with shaft cut the limit switch which are fixed at predefine position. This arrange is not an accurate method for angle measurement. Limit switch arrangement is need lots of electrical wiring and mechanical assembly that make this system less reliable, needs time to time maintenance. Limit switch provide only a contact or digital input to control system which are only useful for monitoring purpose, it is less helpful for breakdown analysis.

IV. PROPOSED MODIFICATION

Absolute rotary encoders provide a definite value for every possible position. All this values are reflected on one or more code discs. The beams of infrared LEDs are sent through code discs and detected by Op to-arrays. The output signals are electronically amplified and the resulting value is transferred to the interface. In proposed paper an absolute rotary encoder is used with profibus interface. To use the encoder with Profibus-DP interface as a slave in the network, a master module for Profibus-DP is required in a PLC. Encoder interface with plc shown below.

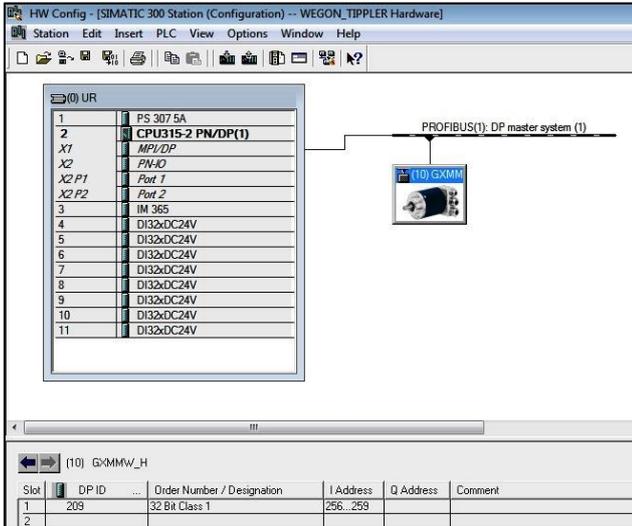


Fig. 2: Encoder Interface with PLC using Profibus

As the above figure shows one no. of encoder connected to plc, encoder consisting address of register 32bit (256 to 259). When the shaft rotate, encoder generate count accordingly. That count use to measure angular position of tippler. After physical installation of encoder electrical connection done using profibus cable. Software configuration will be done as per above figure. After configuration encoder need to calibrate as per physical movement. An absolute encoder does not generate output as pulses but as digital words that identify its position as a static reference point within an absolute coordinate system. As a result, even in the event of power outage, an absolute encoder maintains record of its absolute position. Upon restart, the system can resume motion immediately, without rehomeing.

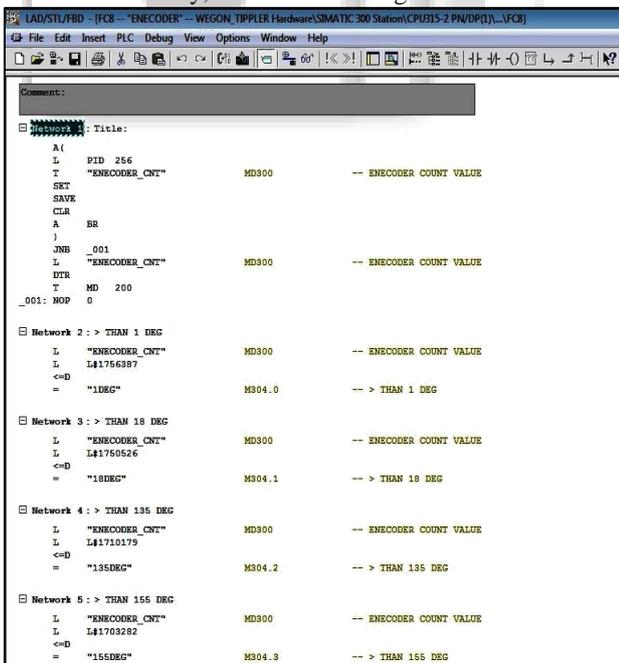


Fig. 3: Program for Tippling

Fig-3 shows the programming of encoder signal, encoder provide creation no. of count for particular position which is read by plc. That count is stored at the address mention in software configuration (fig-2).

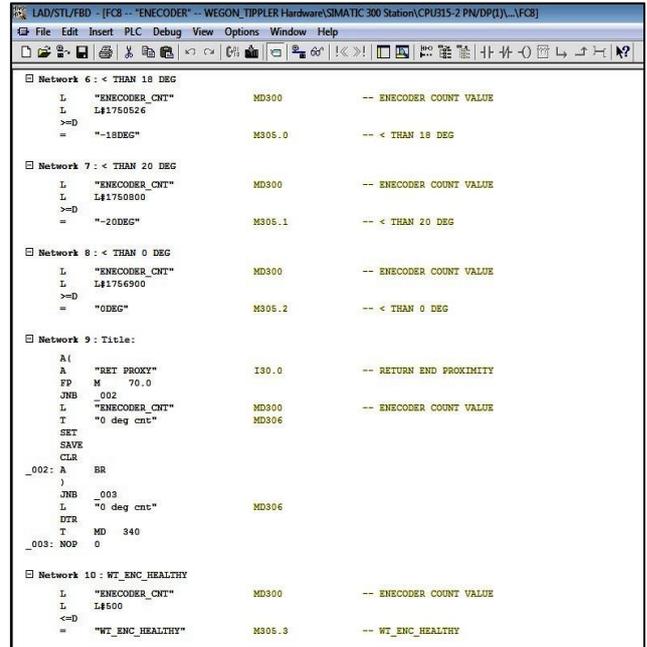


Fig. 4: Program for Tippling Return



Fig. 5: Operator Interface at HMI

V. RESULT

Sr. no	Encoder output(Count)	Postion (Degree)
Tippling operation		
1	1756387	1
2	1750526	18
3	1710179	135
4	1703282	155
Tippling return operation		
1	1750526	-18
2	1750800	-20
3	1756900	0

Table 1:

VI. CONCLUSION

In this proposed paper we will use absolute encoder for measurement tilting position of wagon tippler. Encoder is highly reliable and accurate, it provide high resolution output and exact position .Encoder is directly connected with PLC over a PROFIBUS network, this will avoid complicated hard wiring. Encoder provide analog signal which is useful for better operation and fault analysis.

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