

# Research on PLC-Based Pneumatic Controlling System of Flying Splicer of Web-Fed Offset Presses

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**Abstract:** Flying splicer is a key component of web-fed offset presses for automatically replacing the exhausting web roll with a new one without stopping the machine. The composition and working principle of pneumatic controlling mechanism for operating the flying splicer is analyzed according to the processing requirements of automatic web alternation. By using the software FluidSim, the pneumatic sequential operation controlling circuitry with multi-cylinders for driving the flying splicer is designed, in which the air cylinders cooperate to accelerate the new reel to the circumferential velocity of the expiring web, paste the adhesive end of the new reel on the expiring web, and cut off the remaining piece of expired web. A system scheme and designing method of the PLC-based pneumatic controlling system suitable for automatic web roll change on high speed offset printing presses is brought out.

**Keywords:** Pneumatic control, flying splicer, web pasting, tension control.

## 1. INTRODUCTION

Flying splicer is an important part of the web-fed offset printing presses which can perform the replacement of the exhausting web roll with the new roll automatically. The web-fed offset printing presses running at the average web speed of 80m/s use up a web roll of 1 meter diameter in approximately 15 minutes, while manual changing of the web roll frequently will result in waste of the raw materials, such as paper, ink and dampening solution, and the decrease of production efficiency. So the flying splicers are usually adopted to change the reels automatically without slowing down the press running speed on the modern printing presses [1].

At present, the main suppliers of flying splicer include MEG Tech, ManRoland, Baldwin, etc. The newest product of MEG could accomplished the reel change at the maximum running speed of 1079m/min, which is primarily used for newspaper web-fed offset printing presses and semi-commercial web-fed offset printing presses [2, 3].

## 2. WORK PRINCIPLE OF THE FLYING SPLICER

The flying splicer is basically composed of reel chucks, reel arm, new reel accelerating mechanism, pasting and cutting off mechanism, and web pre-tension control system [4].

The pre-tension control unit is composed of the dancing roller, drawing rollers and diaphragm brakes, all of which perform the web tension detecting and adjusting [5, 6]. During the printing process, the tension of the running web may be influenced by many factors, such as the roll shape,

the printing speed, the substrate performance, and etc. [7]. Once the tension of web fluctuated, the dancing roller would be shifted by the pulling power of the web and the sensor for monitoring the stroke of the dampening cylinder supporting the dancing roller would send the displacement increment to the central control PC [8, 9]. The adjustment instruction then would be sent to the pneumatic valve, which controls the stroke of the diaphragm besides the reel chuck for modifying the rotating velocity of the roll, subsequently the tension of the web is corrected [10, 11]. The position alternation of the engaged roll and idle roll is acted by the motor which drives the reel arm to rotate and moves the web roll to the working position.

The reel accelerating mechanism is composed of driving motor, accelerating belt, activating cylinder of the frame, and velocity monitor, all the parts speed up the standstill new reel to march with the running web for automatic web changing. The pasting of the front end of the new reel to the expiring web and the separating of the residual expired web is carried out by the pasting and cutting off mechanism, which is basically composed of pasting arm, foam roller, cutting knife, and their driving pneumatic cylinders [12].

The reel stand usually holds two or three web rolls in the chucks, one of them is unwinding for feeding web into the printing units, and the other ones are ready for substituting the running web as long as the running one is expiring and needs to be changed. Before the idle reel is clamped on the reel stand, its front end is trimmed into V- or W-shape and stuck to its surface with the double-sided adhesive seal. Along its V-shape edge, the double-sided adhesive tape is also pasted on its surface. The metal or black mark is especially stuck on the front end for monitoring the rotating speed of the roll.

When the capacity of using web roll is enough, as shown in Fig. (1), the reel arm is held at the fixed position to keep the using web roll in the working position. The web is unwinding with the constant tension maintained by the pre-tension unit and the brake mechanism [13], and the new roll

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