

Summarization and Future Development Trend of Flexographic-Press in China

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Abstract

This paper summarizes the development of flexographic printing press at home and abroad, and comes to the conclusion that there is still a big gap between China's flexographic printing press and foreign advanced models. Then this paper summarizes the working principle and structural types of flexographic printing press, and obtains the advantages, disadvantages and practical scope of different configurations of flexographic printing. Finally, this paper analyzes the problems existing in China's flexographic printing press at present, and the future should focus on upgrading the flexographic printing press from the aspects of design, motion control structure and algorithm, remote maintenance and pollution reduction, so as to create a Chinese brand green, high-end and intelligent flexographic printing press and promote the development of printing industry in China and the world.

Keywords

Flexographic press, Working principle, Business Model, Upgrade.

1. Introduction

Flexographic printing is the fastest developing and most widely used printing process in the world. Its characteristics of green environmental protection and wide application range have become the first choice of various printing schemes. At present, 70% of the packaging and printing industry in the United States adopts flexographic printing, and 50% in Western European countries[1]. At present, it is still developing. At present, most of the global printing industry is concentrated in Asia, and the center of Asian printing industry is in China. The development of China's printing industry is inseparable from flexographic printing. The development level of domestic flexographic printing press directly determines the overall level of China's printing industry.

At present, China's flexible board printing technology is basically mature, but there are still many deficiencies, especially in terms of printing speed, printing accuracy and intelligent control. In terms of mechanical structure, many enterprises in China are using more traditional flexible board printing machines with gear transmission. Flexible board printing requires high mechanical accuracy, If the mechanical structure design is unreasonable and the manufacturing accuracy is poor, it will affect the printing quality of the whole equipment. At the same time, it has always been the main technical bottleneck of China's flexible board printing press in terms of tension control, color deck synchronization technology and color registration error control. This paper summarizes the development of flexible board printing press in China, and puts forward the feasible direction of future development.

2. Development status of flexographic printing press at home and abroad

Flexographic printing technology was invented in the 1920s. Because the dye aniline used at that time had strong toxicity, the printing technology did not get great development. By the 1970s, printing materials had developed unprecedentedly. The technology of cermet anilox roller and polymer resin plate was mature, which promoted the maturity of flexographic printing technology. This technology has attracted more and more attention in many printing technologies. The United States was the country with the highest level of research and development of flexographic printing technology at that time. Through continuous technological innovation and development, the application of this

technology in the commercial market achieved unprecedented success [2]. In other countries in the world, flexographic printing has also become the mainstream of the printing industry, and its market application share has been improved.

China introduced the first flexographic printing press from the United States in 1979. Although China started late in this field, China began to promote the use of flexographic printing technology on a large scale in the mid-1980s. In the 1990s, with the use of water-based ink in flexographic press, the environmental protection of printing has been improved. The use of the ink conveying system composed of ink tank and ink roller has also greatly improved the quality of printing.

From the introduction of foreign equipment and technology to the absorption, digestion and redevelopment of technology, China has the domestic capacity of flexographic printing. Although China has been able to produce high, medium and low-end flexographic printing equipment, it can not achieve complete localization, and the core parts and high-end control system still need to be imported. At present, many domestic users still use flexographic printing presses from European and American companies, mainly including Mark Andy, Comco and allied gear in the United States, Aquaflex in Canada, Gallus in Switzerland, Omet, Cerutti and GIDUE in Italy, Nilpeter in Denmark, W&H and F&K in Germany, etc.

Digitization has become the mainstream trend of flexographic printing press. At present, many high-end models of foreign manufacturers have realized full digital operation. Operators do not need to prepare for complex prepress operation. They only need to input printing parameters on the equipment as required, and the printing press can realize full automatic production. For example, the seven color flexographic high fidelity digital printing press launched by kidu company in Florence, Italy in 2014 has realized digitization and is at the forefront of flexographic printing press [3].

In order to improve the production efficiency of printing and packaging products, online processing has become an inevitable direction for the development of flexographic printing at home and abroad. Online production is realized by adding post press processing processes such as polishing, die-cutting, film coating and cutting to the printing machine, combining pre press and post press processing together, and post press processing is carried out directly after the substrate is printed, This method is especially suitable for digital printing, which is famous for fast, small batch, personalized and on-demand printing, and can meet the needs of printing machinery buyers to purchase post press processing functions while purchasing printing machines [4].

At present, shaftless transmission technology is more and more widely used in high-end flexographic printing presses. Foreign manufacturers have used it on a large scale, and the models using this technology in China are gradually increasing, but many key technologies still need to be overcome.

3. Structure classification and characteristics of flexographic press

Flexographic cylinder press usually refers to a printing press that transmits ink to the plate cylinder through the anilox roller and transfers the pattern to the substrate. This printing method belongs to relief printing[5]. The working principle of the flexographic cylinder press is shown in Fig.1. During the printing process, the ink with strong fluidity is placed in the ink bucket. The ink is brought up by the ink bucket rubber roller, and the thickness of the ink is controlled by the scraper installed on the rubber roller to transfer the ink to the anilox roller. The surface of the anilox roller is evenly distributed with small concave holes with consistent shape to store the ink and make the ink more uniform. The anilox roller transfers the ink to the plate cylinder, and can ensure that the graphic part of the plate is inked and the non graphic part is watered, so as to achieve the balance of water and ink and ensure the printing quality[6]. The printing plate transmits the inked text to the substrate, and the embossing cylinder is used to control the pressure between the substrate and the printing plate and ensure the printing quality. The printing work can be completed after the substrate is dried.

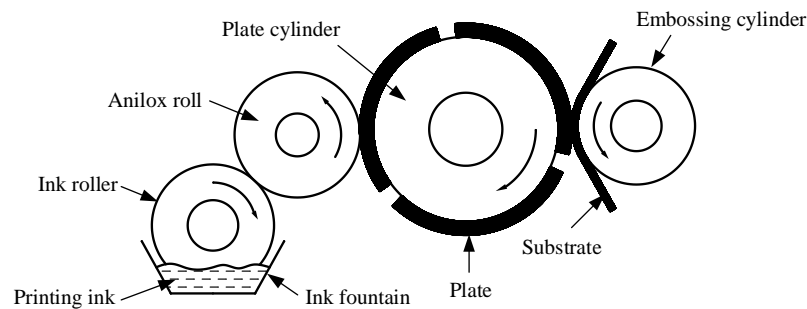


Fig. 1 Working principle of flexographic printing

4. Structure classification and characteristics of flexographic press

Flexographic presses are generally classified according to the arrangement of printing parts. The arrangement will directly affect the convenience of printing operation, the number of printing colors, the quality of printing, the speed of printing and the scope of application of printing. According to the arrangement of printing parts, flexographic cylinder printing press is mainly composed of organic group type, laminated type and satellite type[7].

4.1 Unit type flexographic press

The structural diagram of the unit type flexographic cylinder printer is shown in Fig.2. This type of printer is mainly composed of feeding unit, printing unit, drying unit, post-processing unit and rewinding unit[7].

The feeding unit is mainly composed of uncoiling and loading device, tension control device, edge control device and driving roller. The unwinding and loading device is mainly used to place the rolled substrate. The tension control device can control the required tension according to the substrate of different materials. The edge is the control device to mainly ensure the correct printing position. The edge control device is also equipped in front of the post-processing unit. The driving roller can adjust the paper approaching speed. When the coil is used up, the paper feeding can be stopped through the sensor, At this time, continuous roll change without shutdown can be realized.

After the substrate comes out of the feeding unit, it enters the printing unit and drying unit. The printing unit is the core component of flexographic printing. According to the structural form of the printing unit, it can be divided into integral type and split type. The integral type is generally used for the printing of substrate with small width, such as label printing brush and packaging bag printing. The integral type can be driven by a motor through the transmission shaft, A single unit can also be driven independently by an independent servo motor. The split type is generally used for printing of substrates with large width. The width is large and the cost of a single module is high. Printing enterprises can configure the number of printing modules according to the number of colors required for printing. The split type printing modules are basically driven by a single servo motor. The drying unit is generally arranged together with the printing unit, the integral type is generally arranged below the printing unit, and the split type is generally arranged on the upper side of the printing unit.

The post-processing unit mainly refers to the subsequent process processing of the substrate. The processing process can be equipped with polishing, film covering, bronzing, slitting, die-cutting, punching, silk screen printing, gravure printing or other processes to realize on-line production with the printing module and improve the production efficiency of printed products[8].The rewinding unit mainly rolls the printed substrate.

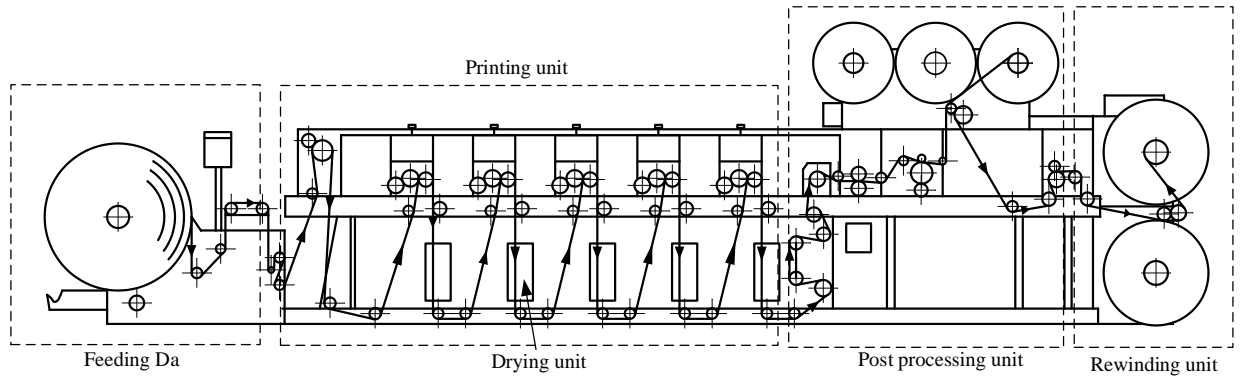


Fig. 2 Structural sketch of machine type flexographic cylinder printing machine



A ZJR-350G unit sleeve flexographic press B YSJ-A high speed computer gravure press

Fig. 3 Unit type flexographic press

Fig.3A is a fully servo sleeve flexography press of Zhejiang Weigang Machinery Co., Ltd. the whole printing module is adopted. All units of the unit are controlled by the geomotor motor, and the eight color group three die cutting station can be realized, and all kinds of membrane materials such as PET, OPP, CPP and PP can be printed. The printing speed reaches 180m / min and the maximum printing width is 350mm. Figure 3B shows the ysj-a high-speed computer gravure printing machine of Xinri machinery and Wolong Machinery Co., Ltd. the printing module adopts split type and is connected through the upper bridge to realize 8-color (adjustable) printing. The printing speed is up to 180m / min and the printing width is 800-1300mm.

4.2 Laminated flexographic press

The structure of the laminated flexographic sleeve printer is shown in Fig.4. The independent printing modules are arranged in layers, which can be placed on one side of the plate wall of the main frame of the printer or arranged on both sides of the plate wall of the main frame. The printing module is driven by the gear train or by the independent servo motor. The advantage of this type of printing is that the path of the substrate can be changed. The path of the substrate can be changed through the guide roller. It is also convenient to change the printing color number. It can also realize one-time double-sided printing. Its laminated structure is also convenient for cleaning, replacing and adjusting parts. The disadvantage is that the tensile size of the printing press is unstable, the substrate is prone to wrinkles, and the color registration accuracy is poor. This kind of structure printing machine is commonly used for products with large graphic area that do not have strict requirements for registration accuracy.

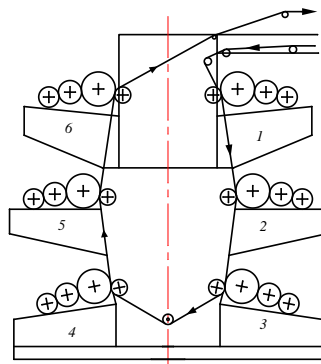


Fig. 4 Structural sketch of laminated flexographic press

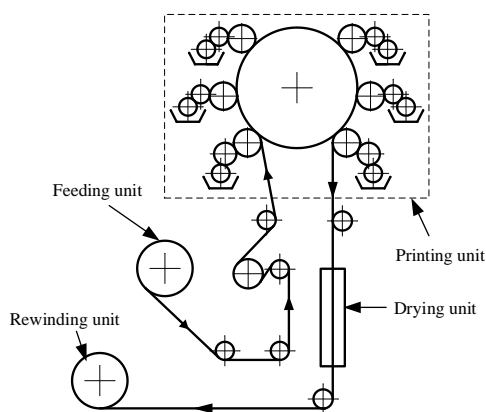


A KSYTB-6 laminated flexographic press B ZBS-320 laminated flexographic press
 Fig .5 Laminated flexographic press

Fig.5A shows the laminated flexographic printing machine of Wenzhou Qixing Machinery Co., Ltd. the printing module of this model is installed on both sides of the plate wall of the main frame, which can realize 6-color printing. The maximum printing speed is 130m / min and the printing width is 570mm. It can print web paper, plastic film, non-woven fabric, woven bag, thin skin and other flexible packaging materials. Fig.5B shows the laminated flexographic printing machine of Zhejiang Weigang Machinery Co., Ltd. the printing module of this model is installed on one side of the main frame plate, which can realize 6-color printing. The maximum printing speed is 60m / min and the printing width is 310mm.

4.3 Satellite flexographic press

The satellite flexographic printing machine is shown in Fig.6A The structural feature of this type of printing machine is that the printing unit shares the embossing cylinder, the printing unit is arranged in a satellite manner around the embossing cylinder, and the printing materials are overprinted around the embossing cylinder. The structure printer adopts gear direct transmission, and the substrate passes through the printing unit at one time. Even without the registration control device, the overprint can be very accurate and the printing quality is stable. The disadvantage is that the structure printer is commonly used for single-sided printing, the registration of double-sided printing is difficult, the distance between printing modules is short, and it is easy to rub the substrate when the ink is not dry.



A Knot diagram of satellite flexographic press B KSCI-B series satellite flexographic press
 Fig. 6 Satellite flexographic press

Fig.6B shows the satellite flexographic printing machine of Wenzhou Linxing Machinery Co., Ltd., which can print 12 colors at most, with registration accuracy of ± 0.1mm, printing speed of up to 220m / min and printing width of 770mm. It can print BOPP, PVC, PE, PE breathable film, NY, web paper, non-woven cloth and other materials.

5. Problems and future directions of flexographic press

5.1 Design aspect

At present, the flexographic printing press has a strong structural integrity, which is not convenient for workers to carry out auxiliary operations. As a result, 40% ~ 60% of the operation time of the flexographic printing press is non equipment working time. Most of the time, workers are installing printing plates, cleaning screen rollers and cleaning doctor blades.

In terms of design, it can make the unit flexible, each printing unit is independent of each other, and is arranged in a straight line along the horizontal direction, or regularly stacked and planetary. In this way, the structural characteristics of multi station units are the same, which is convenient for maintenance and the addition of printing functions. Each unit is controlled by independent servo, which is convenient for accurate color registration control and independent control. Functional manipulator can be installed on the unit module line with the same structure for unit adjustment, so as to reduce non equipment working time and facilitate rapid change of production process.

The development of standardized module interface can quickly connect the post-processing process module, ensure that the machinery can complete the processes such as stripping and lamination, bronzing, film coating, polishing, die-cutting, concave convex striking and sheet breaking, complete the printing and post printing processing at one time, improve the production efficiency and reduce the label printing cost.

5.2 Motion control structure and algorithm

At present, most printing equipment in China adopt single drive gear set to realize printing module collaborative printing, or adopt controller and frequency converter to realize multi unit independent servo drive. Due to the poor overprint progress in the printing process caused by mechanical manufacturing error and transmission gap, it is difficult to adjust the overprint accuracy. The controller and frequency converter design is adopted. The phase speed of the independent servo motor is slow and the synchronization accuracy is low, so it is difficult to further improve the overprint accuracy.

In motion control, the technology based on SERCOS bus can be used to realize unit independent control, which is transmitted through optical fiber network to speed up the response speed. In terms of motion control structure and algorithm design, multi-channel cooperative control based on complex process control, high-speed and high-precision drive coordination of multi-axis motion, intelligent control deviation correction and positioning registration, tension conveying and pressure regulation control of various printing processes are studied, and intelligent control, intelligent decision-making and rapid response are realized through algorithms, Achieve the best of equipment running speed and printing quality.

5.3 Remote maintenance

The after-sales service of printing equipment is very important for enterprises to establish brand image and increase product market competitive advantage. At present, most enterprise equipment is carried out by establishing after-sales service outlets in the region, which brings large human resource costs to equipment manufacturing enterprises, and equipment using enterprises are unable to resume production in time, resulting in high work delay costs. The cloud platform technology and the Internet of things module are applied to the equipment to remotely monitor the operation status of user equipment in real time, master the equipment real-time operation data, equipment failure and other information, and carry out remote troubleshooting and technical service support through the cloud platform and the Internet of things module, so as to realize production site management, enterprise internal management and customer management.

5.4 Pollution reduction

Environmental factors have been continuously promoting the development of this printing technology. In addition to the research on ink materials, we can also study and reasonably select the ink storage container materials, anilox roller materials, roller materials and dryer materials in the equipment to

avoid corrosion, improve embroidery resistance, increase hardness, reduce the pollution of the equipment to the environment and damage to the health of printing workers.

6. Conclusion

The green property of flexographic printing determines that it is the inevitable trend of printing development in the future. At present, there is still a certain gap between China's flexographic printing press and the international advanced models. We should be based on the development status of China's flexographic printing press, recognize our own problems and gaps, identify future technological breakthroughs, strive to create a Chinese brand green, high-end and intelligent flexographic printing press, and promote the development of China's and the world's printing industry.

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