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PACKAGING GLUING MACHINE

Key words

Packaging, type of construction, machine technology.

Summary

The food industry needs to attract consumers with attractive packaging. An example might be a package opening to the form a three-dimensional figure. Manufacture of such packages involves the creation of a typical box that is glued after the placement of the product placement. Then, an extra cover, forming interesting spatial model, is glued to the box. The fusing machine described in the article was designed for a company where the extra covers had been manually glued with double-sided adhesive tape. The device takes the box from the store at a speed matched to the cycles of its work. Subsequent cycles of operation of the devise are box transport to the gluing position, cover loading from a tray, cover lubrication with adhesive, and pressing the cover to the box for a specified time interval. The finished product is directed to a flat table to the next packaging step.

Introduction

Packaging prepared in the printing consists of two parts: a proper package, containing the product, and an additional decorative lid. The lid is supplied in

the form of flat fused elements that must be assembled and glued to the product. Then the whole package is wrapped in shrink-film. During intuitively unpacking, the customer opens the additional cover that creates a spatial form. In the presented case, a "safari" animal is produced (Fig. 1). Only then the customer can access the chocolates placed inside the carton. Such an attractive form of packaging is addressed to children, who are the main target for this product [2, 3].



Fig. 1. Final form of the package

So far, the packaging manufacturing practice was primitive and inefficient, because it was based on gluing two elements with an additional cardboard lid (Fig. 2). Each step was performed manually and the result is shown in Fig. 3. Experience has shown that the hot bonding technique with a limited lifetime glue cannot be used due to the need for precise and reproducible (serial) application of an additional lid on the box [1]. Mechanical application of the adhesive requires fast assembly of related parts. In practice, components are glued with double-sided tape. The effectiveness of this process was not sufficient. In order to increase the efficiency of the process and improve the obtained effect with a limited number of errors occurring in the production, the development team decided to build a machine with an automatic bonding cycle [4].



Fig. 2. Glued elements: lid of the packing and carton



Fig. 3. Glued pieces

1. Construction and operation

Fusing (Fig. 4) comprises a body (1), the storage boxes chain conveyor (2), the displacement mechanism for the lids with head gripping and manipulating the lids (3), the reservoir of adhesive and the glue feed mechanism (4) with the magazine of lids (5).

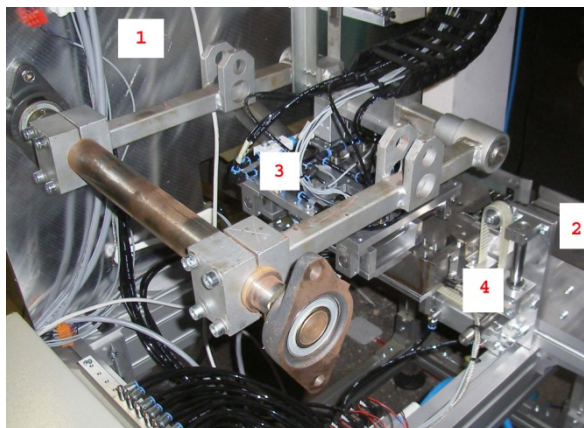


Fig. 4. Machine during the installation process

Construction materials are aluminium alloy AL5083 12 mm thick, 1.4301 and 1.4305 steel. Aluminium alloy AL5083 parts were machined with proprietary group milling technology of multiple items from one plate in two operations on the milling centre.

The body is made of aluminium AL5083 plates seated on a frame of aluminium profiles. The chain conveyor is mounted to the frame, as well as the container for boxes. At the input location, the fusing machine receives cartons with the proper contents and lids, which are packed in packages. For proper operation of the whole process, adhesive is supplied periodically. A glued package appears at the output (Fig. 3). The form of the box container is determined by the shape and size of the rectangular boxes. Boxes are delivered in packets for the vertical tray where they are taken by chain conveyor hooks. The periodically moving chain conveyor supplies the boxes to the box-gluing zone. Due to inaccuracies in the positioning of the chain conveyor connected with its tension, scale errors, and errors of the operation of positioning the chain, a conveyor with an optical sensor and the mechanical referencing system (Fig. 5) was built.



Fig. 5. Principle of the box positioning on the chain conveyor

The chain conveyor (Fig. 5) stops the box (1) before reaching the predetermined position. Then, the actuator acting as a fixed base is extended (3). The swivel clamp of CLR FESTO type (3) pushes the box to a fixed base. Determination of the position in a direction perpendicular to the motion direction is provided by a contoured side, pressing the box to the fixed side. In the absence of a box, the conveyor continues the periodic movement, until a box on the gluing position is detected.

The magazine is a typical, well-known solution with skewed guides and pneumatically adjustable pressure. It is seated on three adjustable supports, which allows lid adjustment in relation to the carton located on the chain conveyor. Three-point support allows movement of the magazine in the horizontal plane. This movement is a combination of linear and rotary motion.

Delivery of the adhesive was initially carried out using a typical pump. However, because of the low price of the device requirement, it was decided to build a mechanical glue delivery module. The choice of this solution was influenced by the shape of the box, which significantly deviates from the flat surface. In addition, it was decided to apply multipoint glue application, with clearly marked drops of glue. A locally thicker layer of glue properly fused the box to the lid.

The glue delivery system (Fig. 6) consists of a heated glue tank (1) with a retractable frame (2) with evenly spaced screws (3) immersed in the adhesive. The mechanism (4) driven by pneumatic actuator via a toothed belt moves the frame and glue from the screws (3) to the lid, and the adhesive is applied.

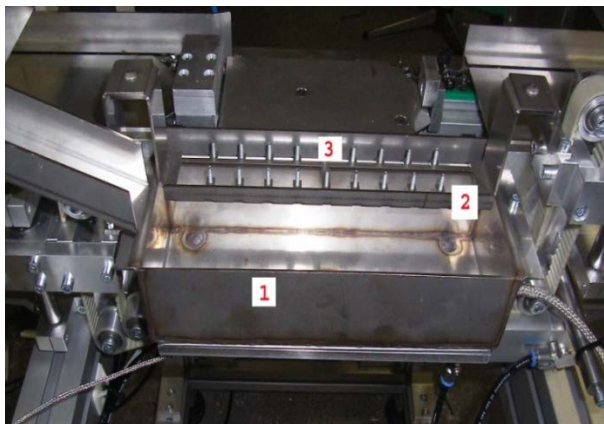


Fig. 6. Glue delivery system

The purpose of the lid movement mechanism are to get the lids from the tray, signal an empty magazine if needed, provide the cover over the glue applicator module, move the lid to be adhered on the box located on the conveyor, let down the lid to contact with the box, wait a few seconds, and return to the starting position. After that, the finished box is moved to the exit of the machine.

2. Control unit

A block diagram of the control system is shown in Figure 7. The PLC controller controls the gluing system. The controller is equipped with an HMI panel, inverter, 16 digital inputs to handle PT100, digital outputs, and outputs that can support PWM.

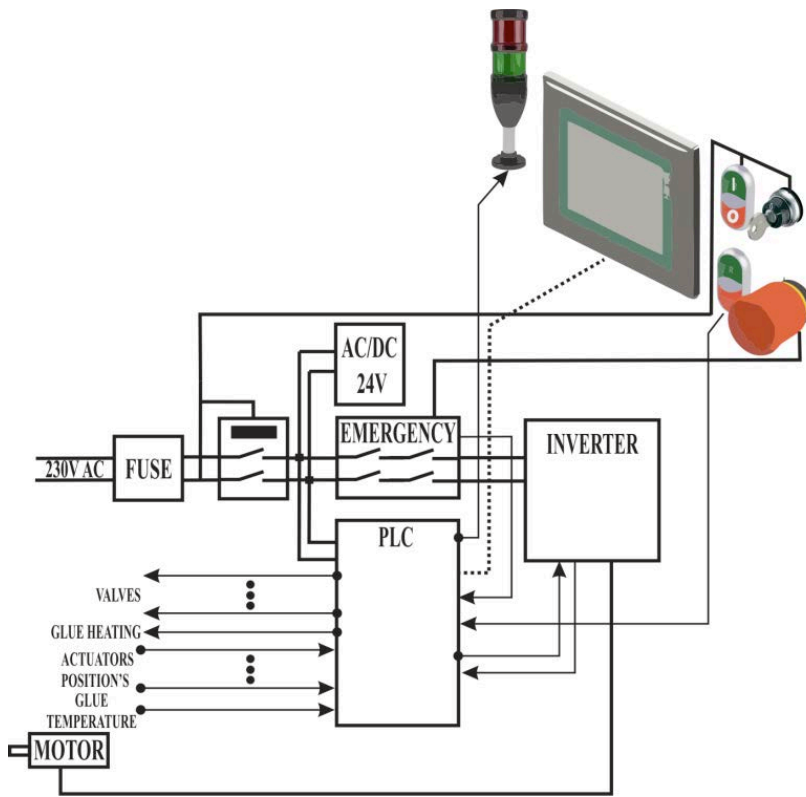


Fig. 7. Block diagram of the control system

The system is equipped with a safety relay with an emergency pushbutton stop and power supply cut off in case of an emergency. The safety relay cuts off the power supply to the inverter, heaters, and the valve island. All actuators are equipped with position sensors for both extreme positions. The system does not have a pressure sensor that allows monitoring the pneumatic system, but a timeout system was implemented in the software to supervise the movement of individual elements of the system. In case of an emergency, an adequate message appears on the HMI desktop, with the possibility to resume system operation. It was necessary to carefully select the sensors working near the glue tank. The temperature reaches 170°C. A capacitive sensor recognizing the presence of a cover was particularly sensitive to temperature.

Conclusion

The machine reached the assumed yield of 7 pcs/min. The mechanical box positioning method and the covers position adjustment in the tray was a good solution. The concept of the application of the glue with the use of a specially designed module was also convenient. The main advantage of this solution is

simple replacement of the frame with glue placing screws. This allows for glue application points position adjustment according to the client's requirements. The use of a tank, which has to be heated, is a disadvantage of this solution, because it generates a long device start-up period. However, the advantage is the fact that the supplementation of the glue in the tank is possible without interrupting the working cycle of the machine.

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Maszyna do klejenia opakowań

Słowa kluczowe

Opakowania, postać konstrukcyjna, maszyna technologiczna.

Streszczenie

Przemysł spożywczy musi przyciągnąć konsumentów atrakcyjnym opakowaniem. Przykładem może być otwierane pudełko do postaci trójwymiarowego obrazu. Produkcja takich rozwiązań polega na tworzeniu typowego klejonego po wyprodukowaniu opakowania. Po tym etapie dodawana jest pokrywa, tworząc dodatkowy interesujący model przestrzenny przyklejany do pudełka. W firmie, dla której zaprojektowano maszynę opisaną w artykule, dodatkowe pokrywy były przyklejane ręcznie za pomocą taśmy dwustronnie klejącej. Urządzenie pobiera opakowanie z magazynu z prędkością dopasowaną do cyklu jego pracy. Kolejne cykle pracy urządzenia to: transport opakowań do miejsca klejenia, załadunek pokrywy z podajnika, pokrycie pokrywy klejem, dociśnięcie pokrywy do pudełka i utrzymanie tego stanu przez określony czas. Gotowy produkt jest skierowany na stół do następnego etapu pakowania.