

TITLE: "PERFECT BINDING CONTROL SYSTEM"

FIELD OF THE INVENTION

The present invention relates to control systems and apparatus for perfect binding.

The invention has been developed primarily for use with perfect binding machines and will be described hereinafter with reference to perfect binding machines. However, it will be appreciated that the invention, in particular the control system, is not limited to this particular field of use and is applicable to other binding formats.

BACKGROUND OF THE INVENTION

Perfect binding is a technique for binding together a block of paper sheets by applying an adhesive to the side of the block that is to be the spine. The paper sheets are collectively referred to as a book block.

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Perfect binding machines are extensively used in the production of relatively cheap books such as paperbacks or non-stitched hardbacks. They are also used in the production of pads and the like.

Unbound book blocks are introduced to the perfect binding machine which then performs successive individual operations on the book block resulting in the individual pages being bound together.

Automated machines of this type generally comprise a station to neatly align the pages of the book block, a station to notch or roughen the spine edge of the book block to improve adhesion by the glue, a station to apply glue to the spine edge and/or sides of the book block, a station to apply a cover or tape to the exposed glue on the spine edge and a final stacking station to position the finished articles ready for unloading from the machine.

Generally, the glue application station includes an open glue reservoir with a roller or rotating brush partially submerged in the glue. As the book block slides over the rotating brush the glue on the surface of the roller/brush is wiped onto the spine edge. It is very difficult to control the amount of glue applied to the book block using this method. The lack of control often results in either insufficient adhesive being applied to the spine or surplus glue residue on the book block. Moreover, this glue application method is unsuitable for use with moisture cure glues as the reservoir, the rollers and the glue itself are exposed to the moisture in the air.

Despite the above problems, the automated binding machines have proved successful in achieving superior production rates when compared to earlier single station

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production methods that did not provide continuous movement of the book block from station to station. However, the glue application problems are exacerbated by the intermittent start/stop motion of the book block whilst in the automated machine.

The intermittent motion of the book block is due to some stations requiring the book block to be stationary and others preferring the book block to be moving with a constant velocity. The resultant acceleration and deceleration of the book block presents particular problems to uniform application of glue to the spine edge and/or adjacent sides of the book block.

It has been found that polyurethane resin (PUR) moisture cure glues provide excellent results in perfect binding applications. However, the control of PUR glue application is critical as any unnecessary glue applied to the book block or left as residue in the glue application station will harden when exposed to moisture in the air.

Previous attempts to accurately control glue application generally consisted of a control system responsive to a detector recognising the leading edge of the book block as it enters the glue application station. The control system then triggers glue application for a fixed period of time. Systems of this type have not proved satisfactory in use with PUR glues as the glue amount varying along the book block length results in undesirable glue residues and variations in the strength of the spine. The glue residues can result in book blocks sticking to one another or glue curing and clogging the applicator nozzles and book block guides. Additionally, when the completed book blocks are stacked excess glue can be squeezed out of covers and from underneath the spine tape causing further problems and adversely affecting the finished appearance of the book.

It is an object of the invention to overcome or at least ameliorate some of these deficiencies of the prior art.

SUMMARY OF THE INVENTION

According to a first aspect of the invention there is provided an apparatus for perfect binding including:

a guide through which a side of a block of sheets of paper may be passed in a first direction, the guide including a base and two upstanding sides wherein one of the sides is movable towards or away from the other side to vary the width of the guide in a second direction transverse to said first direction; and

wherein the guide has an aperture in the base through which the adhesive may be introduced into the guide, thereby coating said block side as it passes the aperture to adhere the sheets together and form a spine;

a transfer carriage adapted to carry said book block through said guide;

a detector issuing a first signal in response to detection of the leading edge of said book block;

a speed sensor issuing a second signal indicative of the velocity of said book block; and

means to control said adhesive introduction during a time determined by the first and second signals.

Preferably the aperture in the base is a slot extending generally in said second direction.

Preferably also, the guide has an aperture in each of the side walls through which the adhesive may also be introduced into the guide. The apertures in the sidewalls are preferably so located as to deliver adhesive to the sides of the block adjacent to said spine to be appropriate for the later application and adhering of a cover.

Desirably, means are provided for controlling the rate of introduction of adhesive into the guide. Preferably at least two such means are provided to respectively control introduction of adhesive into one and the other side of the guide. For the production of thick books over, say, 25mm in thickness it may be desirable to have 3 or 4 such means to separately control introduction of adhesive into the guide at separate locations across the guide.

The means for controlling the rate of introduction of adhesive into the guide may include a metering pump.

Control of introduction of adhesive may also be had alternatively or additionally by controlling, in an appropriate case, the temperature and hence the viscosity of the adhesive.

Preferably, means are provided to control movement of one of the sides which is movable towards or away from the other side to accommodate thickness variations between one such block and another such block. Such thickness variations may be due to variations in paper thickness between blocks in one binding run or variations in block thickness in one binding run as compared to another binding run.

The blocks of sheets will usually be roughened and/or V-notched in the usual manner done in perfect binding if this is desired or necessary.

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According to a second aspect of the invention, there is provided a control system for use with a perfect binding machine, comprising:

a transfer carriage adapted to carry a book block;

a detector issuing a first signal in response to detection of the leading edge of the book block;

a speed sensor issuing a second signal indicative of the velocity of the book block; and

control means to apply adhesive to the book block during a time determined by the first and second signals.

Preferably, the adhesive is introduced via a guide and said detector is positioned adjacent said guide. Preferably also, the speed sensor is operatively associated with the transfer carriage.

In a preferred embodiment of the invention, the transfer carriage is adapted to simultaneously carry a plurality of book blocks.

The detector is desirably a fibre optic sensor configured to provide a through beam across said guide.

The speed sensor is desirably a gear driven incremental encoder geared to the transfer carriage.

Desirably, the adhesive is a polyurethane resin moisture cure glue.

BRIEF DESCRIPTION OF THE DRAWINGS

A preferred embodiment of the invention will now be described, by way of example only, with reference to the accompanying drawings in which:

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Figure 1 is a side view of an automated perfect binding machine having a perfect binding apparatus according to the first and second aspects of the invention and a control system according to the third aspect of the invention;

Figure 2 is an enlarged perspective view of the perfect binding apparatus and control system shown in Figure 1;

Figure 3 is a plan view of the apparatus shown in Figure 2;

Figure 4 is a front elevational view of the apparatus shown in Figure 2; and

Figure 5 is a side elevational view of the apparatus shown in Figure 2.

PREFERRED EMBODIMENT OF THE INVENTION

Referring to Figure 1, there is provided a perfect binding machine 10 including a transfer carriage 12 adapted to carry a book block 18 through a perfect binding apparatus 20 (shown in more detail in Figure 2).

The binding apparatus 20 includes a guide 21 for guiding the side of the book block 18 that is to be the spine. The guide 21 is comprised of a block 22 having a slot 23 through which the side which is to be the spine is passed. The recess 23 is defined by a base 24 and a fixed sidewall 25 which are part of the block 22 and a movable sidewall 26 which is a side of a slidable plate 27. The slidable plate 27 is mounted to the block 22 by means of locking screws 28. The position of the slidable plate 27 on the block 22 and hence the width of the recess 23 may be adjusted as desired by the use of an adjusting screw 29. An aperture in the form of slot 31 is located in the recess 23 and extends into the base 24, fixed sidewall 25 and movable sidewall 26.

Within the block 22 are two passages 32 and 33. The passage 32 communicates with the slot 31 adjacent the fixed sidewall 25 and the passage 33 communicates with the slot 31 adjacent the movable sidewall 26. The passage 32 communicates with a first AX 100 F element control valve (not shown) and the passage 33 communicates with a second AX 100 F element control valve (not shown). Passages 37 and 38 put the control valves in communication with an FKS gun (not shown). An FKS gun is produced by Robatech AG of Muri, Switzerland and is capable of precisely maintaining the temperature of an adhesive and of delivering adhesive under pressure. An AX 100 F element is produced by Robatech AG and is a precisely controllable metering valve. The FKS gun is supplied with heated adhesive via a heated hose (not shown).

Electrical control of the FKS gun is provided by a cable (not shown). Compressed air is also supplied to the FKS gun. Control of the AX 100 F control valves is provided by adjustment screws and by air controlled solenoids (not shown).

In use, the plate 27 is adjusted to a position suiting the thickness of a block of sheets of paper to be bound. Adhesive is supplied via the heated hose to the FKS gun 39 and then to the AX 100 F control valve elements and from then to the slot 31. The book block 18 is passed through the recess 23 and in so doing will have adhesive applied to it both on the spine and to the sides adjacent the spine for later application of a cover.

The perfect binding machine 10 also includes a control system including transfer carriage 12, a detector 50 and a speed sensor 52. As described previously, transfer carriage 12 is adapted to carry the book block 18 through the binding apparatus 20.

The detector 50 is positioned on the binding apparatus 20 and speed sensor 52 is associated with a shaft 60 of the transfer carriage. The detector 50 is comprised of a fibre optic sensor 54 with accompanying receiver 56, together providing a through-beam 58 across the guide. The through-beam 58 is broken by the leading edge of the book block and results in the detector issuing a first signal, for example a voltage or current signal.

Referring to Figure 1, the speed sensor 52 in the form of a gear driven incremental encoder and is geared to the transfer carriage at shaft 60. The gearing of the encoder to the shaft may be achieved by any number of conventional methods. Movement of the transfer carriage in the direction indicated by the arrows results in a corresponding rotation of shaft 60. The speed sensor 52 is triggered by the rotation of shaft 60 and issues a second signal, for example an electrical pulse signal, having a pulse frequency indicative of the velocity of the book block 18.

Control means (not shown) generally in the form of a microprocessor, programmable logic controller (PLC) or similar introduce the adhesive into the binding apparatus 20 through slot 31 during a time determined by the first and second signals. Thus, as book block 18 travels through slot 23 across slot 31, the edge of the book block that is to be the spine of the finished book is coated with adhesive. The signals from the leading edge detector and the speed sensor allow the control system to accurately apply glue to this edge regardless of variations in speed of the book block.

When the adhesive has been applied the book block 18 progresses to station 62 where a cover or tape is applied to the spine edge over the adhesive.

The perfect binding apparatus according to this invention has application in long book binding runs producing a relatively large number of identical books. However, it is especially advantageous in short book binding runs producing a small number of books as the width of recess 23 can quickly and easily be adjusted to cater for different sized books.

Thus, while the invention can be used in general book binding it finds particular application in producing books used in a country's payment system.

Books used in a country's payment system are books used by banks, building societies, credit unions, money market corporations, authorised dealers, postal authorities, finance companies and insurance companies. Notwithstanding the generality of the above, such books include cheque books including bank cheques and travellers cheques, money orders, receipt books, deposit books and payments system member internal books or documents. Such books are often produced in short runs and may often be individualised.

Additionally, the control system according to the invention provides for accurate glue application with respect to the instantaneous speed of the book block through the guide at any point during its travel. Thus, even though the book block undergoes non-uniform velocity whilst travelling through the guide due to the intermittent motion of the transfer carriage, the control system provides for a constant amount of glue application.

Whilst the invention has been described with reference to a specific example, it will be appreciated by those skilled in the art from the teaching hereof that the invention may be embodied in many other forms.

**CLAIMS:-****1. An apparatus for perfect binding including:**

a guide through which a side of a block of sheets of paper may be passed in a first direction, the guide including a base and two upstanding sides wherein one of the sides is movable towards or away from the other side to vary the width of the guide in a second direction transverse to said first direction; and

wherein the guide has an aperture in the base through which the adhesive may be introduced into the guide, thereby coating said block side as it passes the aperture to adhere the sheets together and form a spine;

a transfer carriage adapted to carry said book block through said guide;

a detector issuing a first signal in response to detection of the leading edge of said book block;

a speed sensor issuing a second signal indicative of the velocity of said book block; and

means to control said adhesive introduction during a time determined by the first and second signals.

2. An apparatus as claimed in claim 1, wherein the aperture in the base is a slot extending generally in said second direction.

3. An apparatus as claimed in claim 1 or claim 2, wherein the guide further includes an aperture in each of the side walls through which the adhesive may also be introduced into the guide.



4. An apparatus as claimed in claim 3, wherein the apertures in the sidewalls are located so as to deliver adhesive to the sides of the block adjacent to said spine, to be appropriate for the later application and adhering of a cover.
5. An apparatus as claimed in any one of the preceding claims including means for controlling the rate of introduction of adhesive into the guide.
6. An apparatus as claimed in claim 5, wherein two said rate controlling means are provided to respectively control introduction of adhesive into one and the other side of the guide.
7. An apparatus as claimed in claim 6, wherein said rate controlling means include a metering pump.
8. An apparatus as claimed in claim 6 or claim 7, wherein the rate controlling means also control the temperature and hence the viscosity of the adhesive.
9. An apparatus as claimed in any one of the preceding claims including means to control movement of one of the sides which is movable towards or away from the other side to accommodate thickness variations between one such block and another such block.
10. A control system for use with a perfect binding machine, comprising:
 - a transfer carriage adapted to carry a book block;
 - a detector issuing a first signal in response to detection of the leading edge of the book block;
 - a speed sensor issuing a second signal indicative of the velocity of the book block; and



control means to apply adhesive to the book block during a time determined by the first and second signals.

11. A control system as claimed in claim 10 wherein, the adhesive is introduced via a guide and said detector is positioned adjacent said guide.

12. A control system as claimed in claim 10 or claim 11, wherein the speed sensor is operatively associated with the transfer carriage.

13. A control system as claimed in any one of the claims 10 to 12, wherein the transfer carriage is adapted to simultaneously carry a plurality of said book blocks.

14. A control system as claimed in any one of claims 10 to 13, wherein the detector is desirably a fibre optic sensor configured to provide a through beam across said guide.

15. A control system as claimed in any one of the claims 10 to 14, wherein the speed sensor is a gear driven incremental encoder geared to the transfer carriage.

16. A control system as claimed in any one of the claims 10 to 15, wherein the adhesive is a polyurethane resin moisture cure glue.