

PATENT SPECIFICATION

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(54) SHEET SENSING DEVICE FOR A ROTARY PRINTING PRESS

(71) We, HEIDELBERGER DRUCKMASCHINEN AG, a body corporate organised under the laws of Germany, of Postfach 1440, 6900 Heidelberg, Germany, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

10 The invention concerns a sheet sensing device for rotary printing presses.

Conventional sheet-fed offset printing presses for perfecting are provided with a sheet turning station between the first and second printing units consisting of two sheet transfer drums and one turning drum. It has been proposed to instal an electronic sensing eye below this turning drum to establish whether or not a sheet is being transferred by the turning drum grippers to the printing cylinder of the second printing unit.

This electronic sensing device is very susceptible to malfunctions caused by paper dust and, therefore, must be cleaned often. Since sensing occurs while the sheet passes, false indications can not be excluded, particularly with higher printing speeds. For instance, although the electronic sensing device establishes the absence of a sheet, turned-over sheet corners, which could damage the rubber blanket of the second printing unit, or a sheet which has been acquired on a slant or inadequately, would not be indicated. Such false indication can cause either machine stoppage or at least spoilage and thus possible damage to the rubber blanket. Moreover, such electronic sensing devices are very expensive.

45 The invention is directed towards the problem of establishing early, with certainty and at little expenditure, whether a fault-free sheet is being transferred, correctly positioned, by the sheet transfer drums or

the whole sheet turning station to the following printing unit.

According to the invention one or more sensing nozzles are provided in the area of the rear edge of a sheet carried by the drum, which nozzle(s) are connected to a pneumatic pressure generator via a feeder system, this feeder system being equipped with a pressure guard between the pressure generator and the sensing nozzle(s).

Sensing occurs during relative motionlessness, i.e. the sheet on the sheet transfer drums and the sensing nozzle(s) show practically no movement with respect to each other while sensing is in progress. Sensing, therefore, is extremely reliable. Moreover, it occurs very early so that even with high printing speeds the rotary printing press can always be stopped in time, or the pressure turned off. With an arrangement of the sensing nozzles along the whole length of a sheet transfer drum not only sheets acquired on a slant can be sensed but also faults at the edge of the sheet acquired such as torn-out portions of the sheet and folded corners.

The construction of the gripping means as suction grippers and their simultaneous function as sensing nozzles constitutes a particularly advantageous development of the invention. Suction grippers and sensing nozzles are thus identical. Only the small expenditure of merely providing for a pressure indicator in the feeder system is required to guarantee perfect supervision of the sheet transfer by sheet transfer drums. This development of the invention is, therefore, also quite suitable for the refitting of a pneumatic sheet-transport installation in already existing rotary printing presses.

85 In an advantageous development of the invention the suction grippers extend in a row along the drum channel of the sheet transfer drum, at least two suction grippers in the central region of the row being 90

arranged to be offset such that they are closer to the drum channel than the remaining suction grippers in the row. The length of a sheet can be measured thereby with an accuracy of less than one millimetre. In rotary printing presses of the perfecting type with a turning station this ensures that sheets which are too short are recognised as such and corresponding commands can be introduced for the control of the machine, e.g. the stopping of printing in the next unit.

One development of the invention makes provision to turn off or regulate the suction effect of individual suction grippers or sensing nozzles, respectively, for the processing of narrower formats. This possibility is also of advantage for the processing of thinner papers because in such cases the danger exists that the thin papers are sucked into the nozzles locally, leading to the possible deformation of the sheet acquired by the suction grippers and sensed.

In a particularly advantageous development of the invention the suction grippers constructed as sensing nozzles are so called rotary suckers, constructed as discs which can be rotated by control means about an axis of rotation running at right angles to the axis of rotation of the sheet transfer drum and each of these discs being provided with a suction hole placed eccentrically to the axis of rotation.

The rotary suckers serve to tension the sheets on the sheet transfer drum. At the beginning of each tensioning process the suction holes located eccentrically with respect to the axis of rotation of each disc are farthest away from the cylinder channel. During the tensioning of the sheet they approach the drum channel wall. The initial position of the suction openings at the start of tensioning and sensing has the advantage that sheets which do not lie smoothly or tightly on the sheet transfer drum are not indicated as being too short, and do not result unnecessarily in any fault-stops. During the sensing process, therefore, the sensing nozzles according to this embodiment move towards the drum channel of the sheet transfer drum, and should the tensioned sheet be too short the suction openings move beyond the back edge of the sensed sheet, causing, e.g. the rotary printing press to be switched off.

A particularly advantageous development with regard to the processing of thin sheets consists in that the suction holes of those rotary suckers which are closer to the drum channel have a smaller cross-section than the suction holes of the remaining rotary suckers arranged in a row. The small cross-section of these suction openings results in a choking effect which reduces

the suction force of the rotary suckers located closer to the drum channel with respect to that of the others in the row. This results in a protection of thin papers in the vicinity of the back edge of the sheet.

A development which is significant for small diameters of sheet transfer drums is distinguished by the arrangement of at least two sensing nozzles between the gripping means arranged in a row, and the drum channel, these sensing nozzles being connected to a pneumatic pressure generator via an air control device and an interconnected pressure guard.

The additional sensing nozzles can be controlled separately. Thus sensing can occur under reduced pressure. Separate nozzles have the further advantage that they can be fitted better to the cylinder circumference, thus contributing to accurate sheet transfer particularly with small diameter sheet transfer drums. For should the sensing nozzles lie on a secant within the circumference of the sheet transfer drum the back edge of the sheet is sucked inwards, and the grippers lying on the circumference of the next sheet transfer drum lift the back edge of the sheet up again, resulting in a wavy transfer. The stronger this waviness the greater the danger of image deterioration in the following printing units due to a more inaccurate transfer.

With the use of sucking gripper means a particularly economic development of the invention consists in providing only one common air control device and only one pressure guard for the gripping means constructed as suction grippers and the sensing nozzles which are formed into suction nozzles.

It can also be of advantage to shape the sensing nozzles as blower nozzles. Blower nozzles are self-cleaning and hence require less maintenance. Sensing nozzles working with air-blast can be used best in connection with grippers. But they can also be used with gripper means constructed as suckers, since the positive pressure used for sensing can be held low enough that the blast-pressure exerted locally exerts a force on the sheet which is less by a multiple than that of the suction grippers which grip the back edge of the sheet.

Several embodiments of the invention are now described, by way of example only, with reference to the drawings, in which:—

Figure 1 shows a sheet turning station with suction grippers to grip the back edge of sheets simultaneously constructed as sensing nozzles.

Figure 2 shows a sheet turning drum with hinged suction grippers working as sensing nozzles.

Figures 3-5 show a representation of the effect of the sensing nozzles constructed

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as rotary suckers,

Figure 6 shows suction grippers formed as sensing nozzles of a sheet transfer drum arranged on a chain wheel shaft,

5 Figure 7 shows a construction of a suction bar for a sheet transfer drum according to figure 6,

Figure 8 shows a sheet turning station in which suction grippers and sensing nozzles are connected to separate negative pressure generators,

Figure 9 shows a storage drum according to figure 8,

Figure 10 shows a sheet turning station with clamping grippers to grip the back edge of sheets and with sensing nozzles constructed as blast-nozzles, and Figures 11 and 12 show special arrangement of sensing nozzles.

20 In figure 1 a sheet turning station for a multicolour sheet-fed rotary printing press is represented which can be switched from first printing to perfecting printing. This sheet turning station consists of three sheet transfer drums arranged between two successive printing units. The printing units themselves are not represented. The first sheet transfer drum 1 accepts the sheet from the printing cylinder of the preceding printing unit and transfers it to the sheet transfer drum in the middle, designed as storage drum 2 in the following. In the second print position of the sheet turning station the third sheet transfer drum, provided with a turning device and hence called turning drum 3, accepts the sheet on storage drum 2 by its back edge and feeds it, turned over, to the printing cylinder of the following printing unit.

40 Storage drum 2 has twice the diameter of sheet transfer drum 1 and turning drum 3. Correspondingly it is equipped with two diametrically opposed drum channels 4. At the back wall of each of these drum channels 4 a row of clamping grippers 5 is provided for receiving the front edges of sheets and, at the front wall, a row of suction grippers is provided for holding the back edges of sheets.

50 Suction grippers 6 are connected with a negative pressure generator via a pressure feed 7. In order for suction grippers 6 to be able to work as sensing nozzles the pressure feed 7 is connected to a pressure guard or sensor 9 controlled with respect to the sensing period.

Figure 2 also shows a sheet turning station of a multi-colour sheet-fed rotary printing press which can be switched from first printing to perfecting printing but which consists of only a single turning drum 10. The printing cylinder 11 of the preceding printing unit, just like the printing cylinder of the following printing unit, has two printing surfaces. Turning drum

10, correspondingly, has two sheet transfer surfaces. At the back wall in the two drum channels 4 of the turning drum 10 clamping grippers 13 are provided which are hinged and are able to accept inside drum channel 4 a sheet 15 in order to turn it over. Seen in the direction of rotation, the front wall of cylinder channel 4 is provided with a row of hinged suction grippers 14 which acquire the back edge of a sheet 15 on a printing cylinder 11 and transfer it during the continued rotation of turning drum 10 to the clamping grippers 13 inside the drum channel 4. The suction grippers 14 are also constructed as sensing nozzles.

80 Figure 3 shows one of the possible arrangements and uses of suction grippers 6 as sensing nozzles according to figure 1 and a preferred construction of the grippers. It gives a schematic representation of a sheet guiding surface of the storage drum 2. The clamping grippers 5 have acquired the front edge 16 of the sheet 15. At the back end of this sheet guiding surface of storage drum 2 a suction bar 17 is provided, equipped with a row of disc-shaped rotary suckers 18. Each of these rotary suckers 18 has an eccentric hole 19 which works simultaneously also as a sensing nozzle. The suction hole 19 is arranged eccentrically with respect to the axis of rotation of the disc-shaped rotary sucker 18 and can be moved from the position 20 indicated in broken lines into the extended position indicated in full lines by rotation of the disc-shaped rotary suckers 18 by a lever system (not shown) during a sheet tensioning process. In the central area of the row of the rotary suckers 18 arranged along the drum channel 4 two rotary suckers 21 and 22 are arranged to be offset. They lie further from drum channel wall 23 and therefore closer to the back edge of the sheets than the normal rotary suckers 18. It is their task to determine the length of sheets.

Figure 1 shows the moment when suction grippers 6 are opposite the end of sheet 15. Suction holes 19 of rotary suckers 18 then are in the position 20 shown in broken lines in figure 3. As is also shown in figure 1 a control opening 24 has passed the front wall of a control groove 25 such the negative pressure generated by negative pressure generator 8 via pressure feed 7 causes suction sucking the back end of sheet 15. With continued rotation of storage drum 2 rotary suckers 18, 21 and 22 are swung into the position shown as extended and pressure guard 9 does not cause the printing press to be turned off, provided the sheet is without faults and has been transferred correctly. Should a portion of the back edge of the sheet be torn out, however, as shown in Figure 3 at 26, these

rotary suckers suck in fresh air and the negative pressure collapses or is reduced correspondingly. The pressure guard 9 indicates a fault and the printing press switches off. Such commercially available pressure guards can be adjusted to the desired pressure difference.

Figures 4 and 5 show two other sources of faults leading often to malfunctions during run-on, particularly with perfecting. In figure 4 the sheet 15 is too short. It would then not be taken over correctly by the grippers of turning drum 3. In figure 4 the offset rotary suckers 21 and 22 are in their end position at the end of the tensioning phase of the sheet. The suction hole 19 of each rotary sucker 21 and 22 here has half passed the back edge 27 of the sheet. This slight release of suction hole 19 is already sufficient, however, to lower the negative pressure enough for the pressure guard to cause the printing press, or printing, to be stopped.

Figure 5 shows a turned-over corner 28 of sheet 15. Already at the start of the tensioning process suction hole 19 of the outermost rotary sucker 18 is not covered so that pressure guard 9 causes the machine to be stopped as soon as negative pressure is applied.

The invention can also be used to advantage with sheet transfer and transport by means of chain grippers. Figure 6 shows such an embodiment. On a chain-wheel shaft 30 of a chain gripper system 31 a sheet transfer drum 32 is arranged which is equipped at the front wall of its drum channel 33 with a suction bar 34. This serves to hold the sheet 15 fed past a turning drum 35 by chain gripper system 31, at its back edge until the grippers of turning drum 35 have securely gripped this back edge of sheet 15.

Figure 7 shows the construction of this suction bar 34. Suction bar 34 is equipped with uniformly spaced suction holes 36 which are sympathetic with respect to each other. They serve as suction grippers and as sensing nozzles at the same time. In the central region of the suction bar 34 one further sensing hole 37 each is provided, apart from the normal group of suction holes 36. Sensing holes 37 are closest to the drum channel wall 38. If the back edge 27 of a sheet 15 is too short or if this sheet 15 is even just slightly at a slant the negative pressure system of suction bar 34 is exposed to air and a pressure guard, not shown, causes the rotary printing press, or the printing, to be stopped.

Figure 8 shows a sheet turning station for multicolour sheet-feed rotary printing presses where the printing unit cylinders have a relatively small diameter, i.e. the 65 circumference of the individual drums has

a relatively sharp curvature.

Like that in Figure 1, this sheet turning station consists of a sheet transfer drum 1, a storage drum 2 and a turning drum 3. Drum channels 4 are equipped with clamping grippers 5 and suction grippers 6 as per the embodiment in figure 1. Apart from suction grippers 6, however, further sensing nozzles 40 are arranged inside drum channels 4. They are placed in a row parallel to the row of suction grippers 6 (see figure 11). Seen in the direction of rotation of storage drum 2 they follow the suction grippers 6. The suction surface of the sensing nozzles 40 can be arranged high enough to lie directly on the circumferential surface of storage drum 2 such that the back edge of the sheet is not sucked inward during sensing with the consequent danger of a wavy transfer of the back edge to the grippers of turning drum 3.

Besides negative pressure generator 8, supplying control channel 25 via pressure feed 7 and suction grippers 6 via control opening 24, a further negative pressure generator 41 is provided which can generate a temporary negative pressure in sensing nozzles 40 via a pressure feed 42, a control groove 43 and a control opening 44. A pressure guard 9 is connected into the pressure feed 42. Due to the arrangement of a separate negative pressure generator 41 sensing nozzles 40 are able to work with a low constant pressure. It does not need to be adjusted to the various paper types to be handled, as when suction grippers are simultaneously sensing nozzles, which means that the pressure guard 9 does also not need to be regulated.

Figure 9 shows a schematic side view of storage drum 2. According to the representation storage drum 2 is supported in the side wall 48 of the frame on shaft-end 46 and in the opposite side wall 49 of the frame on a further shaft-end 47. On the inside of the first mentioned frame side wall 48 a valve ring 50 is mounted symmetrically to shaft-end 46 and on the free frontal side 51 of which runs a valve ring 52 of the same size which is firmly anchored to storage drum 2. Valve ring 50 mounted on frame side wall 48 is equipped with control grooves 25 and 43 which are connected to their associated negative pressure generator 8 or 41 via pressure feed 7 or pressure feed 42, respectively, and the pressure guard 9. The control openings 24 and 44 already mentioned are located in the valve ring 52 rotating with storage drum 2. Control opening 24 is connected to suction grippers 6 via a suction pipe 53 and control opening 44 to sensing nozzles 40 via another suction pipe 54.

Sensing nozzles 40 are equipped with regulating screws 55 by means of which either the suction effect is regulated or the connection of sensing nozzle 40 to suction pipe 54 interrupted. Should the format of a sheet 15, for instance, as shown in figure 9, be narrower than the sheet transport surface of storage drum 2, the outer sensing nozzles 40 can be turned off by screwing in regulating screws 55. When there are two negative pressure generators 8 and 41, as shown in the embodiment according to figure 8, sensing nozzles 40 can also be constructed as blower nozzles. This has the advantage that they are self-cleaning and hence substantially maintenance-free.

The use of blower nozzles is of particular advantage, however, in conjunction with clamping grippers, as shown in figure 10. This also shows a sheet turning station, consisting of the sheet transfer drum 1; the storage drum 2 and the turning drum 3. Drum channels 4, however, besides the clamping grippers 5 for acquisition of the front edge of the sheet, are equipped with a further row of clamping grippers 60 for the acquisition of the back edge of the sheet. Immediately next to each clamping gripper 60 a sensing nozzle formed as blower nozzle 61 is arranged as can be seen in figure 12. The blower nozzles 61 are connected to a positive pressure generator 67 via a control opening 64, a control channel 65 and a pressure feed 66. A pressure guard 9 is connected into pressure feed 66. An extremely small amount of positive pressure is adequate to sense the back area of the sheet. Even when processing light weight paper such as air-mail paper, therefore, the back edge of the sheet can be sensed without the thin sheet being blown up. The diameter of the sensing nozzles can be kept extremely small so that even slight deviations in the lengths of the sheets or in the formation of the back edge of the sheets cause the rotary printing press to be turned off through the pressure guard.

WHAT WE CLAIM IS:—

1. A sheet transfer drum for a rotary printing press on which sheets are held by their front and rear edges, comprising one or more sensing nozzles arranged in the area of the rear edge of a sheet carried by the drum, a pneumatic pressure generator connected to the or each sensing nozzle via a feeder system and a pressure sensor located in the feeder system between the pressure generator and the sensing nozzle or nozzles.

2. A transfer drum according to claim 1, wherein the sensing nozzles are constructed as suction grippers which serve to hold the sheet to the drum.

3. A sheet transfer drum according to claim 2, wherein the suction grippers extend in a row along a channel in the drum the central area of the row including at least two suction grippers arranged more closely to the back edge of the sheet than the other suction grippers in the row.

4. A sheet transfer drum according to claim 3, wherein the last mentioned rotary suckers have suction orifices of smaller cross-sectional area than those of the suction holes of the remaining rotary suckers arranged in the row.

5. A sheet transfer drum according to any one of claims 2 to 4 wherein the suction effect of the individual suction grippers or sensing nozzles, respectively, can be turned off or regulated.

6. A sheet transfer drum according to any one of claims 2 to 5, wherein those suction grippers which are constructed as sensing nozzles are constructed as discs which can be rotated by control means about an axis of rotation running at right angles to the axis of rotation of the sheet transfer drum, each disc being provided with a suction hole placed eccentrically to the axis of rotation.

7. A sheet transfer drum according to claim 1, comprising at least two sensing nozzles, arranged and mounted between means for gripping the rear edge of a sheet on the drum and a channel in the drum.

8. A sheet transfer drum according to claim 7, wherein the gripping means is constructed as suction grippers, the sensing nozzles are formed as suction nozzles and the gripping means and sensing nozzles include a common air control device or pressure sensor.

9. A sheet transfer drum according to claim 7, wherein the sensing nozzles are formed as blower-nozzles.

10. A sheet transfer drum substantially as hereinbefore described with reference to Figures 1 and 3, to 5, 2, 6 and 7, 8, 9 and 11, or 10 and 12 of the drawings.

11. A rotary printing press incorporating a sheet transfer drum according to any one of claims 1 to 10.

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Sensing nozzles 40 are equipped with regulating screws 55 by means of which either the suction effect is regulated or the connection of sensing nozzle 40 to suction pipe 54 interrupted. Should the format of a sheet 15, for instance, as shown in figure 9, be narrower than the sheet transport surface of storage drum 2, the outer sensing nozzles 40 can be turned off by screwing in regulating screws 55. When there are two negative pressure generators 8 and 41, as shown in the embodiment according to figure 8, sensing nozzles 40 can also be constructed as blower nozzles. This has the advantage that they are self-cleaning and hence substantially maintenance-free.

The use of blower nozzles is of particular advantage, however, in conjunction with clamping grippers, as shown in figure 10. This also shows a sheet turning station, consisting of the sheet transfer drum 1, the storage drum 2 and the turning drum 3. Drum channels 4, however, besides the clamping grippers 5 for acquisition of the front edge of the sheet, are equipped with a further row of clamping grippers 60 for the acquisition of the back edge of the sheet. Immediately next to each clamping gripper 60 a sensing nozzle formed as blower nozzle 61 is arranged as can be seen in figure 12. The blower nozzles 61 are connected to a positive pressure generator 67 via a control opening 64, a control channel 65 and a pressure feed 66. A pressure guard 9 is connected into pressure feed 66. An extremely small amount of positive pressure is adequate to sense the back area of the sheet. Even when processing light weight paper such as air-mail paper, therefore, the back edge of the sheet can be sensed without the thin sheet being blown up. The diameter of the sensing nozzles can be kept extremely small so that even slight deviations in the lengths of the sheets or in the formation of the back edge of the sheets cause the rotary printing press to be turned off through the pressure guard.

WHAT WE CLAIM IS:—

1. A sheet transfer drum for a rotary printing press on which sheets are held by their front and rear edges, comprising one or more sensing nozzles arranged in the area of the rear edge of a sheet carried by the drum, a pneumatic pressure generator connected to the or each sensing nozzle via a feeder system and a pressure sensor located in the feeder system between the pressure generator and the sensing nozzle or nozzles.

2. A transfer drum according to claim 1, wherein the sensing nozzles are constructed as suction grippers which serve to hold the sheet to the drum.

3. A sheet transfer drum according to claim 2, wherein the suction grippers extend in a row along a channel in the drum the central area of the row including at least two suction grippers arranged more closely to the back edge of the sheet than the other suction grippers in the row.

4. A sheet transfer drum according to claim 3, wherein the last mentioned rotary suckers have suction orifices of smaller cross-sectional area than those of the suction holes of the remaining rotary suckers arranged in the row.

5. A sheet transfer drum according to any one of claims 2 to 4 wherein the suction effect of the individual suction grippers or sensing nozzles, respectively, can be turned off or regulated.

6. A sheet transfer drum according to any one of claims 2 to 5, wherein those suction grippers which are constructed as sensing nozzles are constructed as discs which can be rotated by control means about an axis of rotation running at right angles to the axis of rotation of the sheet transfer drum, each disc being provided with a suction hole placed eccentrically to the axis of rotation.

7. A sheet transfer drum according to claim 1, comprising at least two sensing nozzles, arranged and mounted between means for gripping the rear edge of a sheet on the drum and a channel in the drum.

8. A sheet transfer drum according to claim 7, wherein the gripping means is constructed as suction grippers, the sensing nozzles are formed as suction nozzles and the gripping means and sensing nozzles include a common air control device or pressure sensor.

9. A sheet transfer drum according to claim 7, wherein the sensing nozzles are formed as blower-nozzles.

10. A sheet transfer drum substantially as hereinbefore described with reference to figures 1 and 3 to 5, 2, 6 and 7, 8, 9 and 11, or 10 and 12 of the drawings.

11. A rotary printing press incorporating a sheet transfer drum according to any one of claims 1 to 10.

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