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(12) (19) (CA) **Demande-Application**

(21) (A1) **2,253,983**
(86) 1997/05/28
(87) 1997/12/04

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(51) Int.Cl.^{6} B41F 21/08, B41F 13/03
(30) 1996/05/29 (196 21 507.2) DE

(54) **SYSTEME DE TRANSPORT DE FEUILLE POUR UNE PRESSE ROTATIVE**
(54) **SHEET CONVEYER FOR A ROTARY PRESS**

(57) L'invention concerne un système (1) pour transporter un matériau en forme de feuille (2) dans une presse rotative, comprenant une première glissière de guidage (6a) et une deuxième glissière de guidage (6b) parallèle à cette dernière, dans laquelle un premier et un deuxième élément d'avancement (10a, 10b) respectifs, formant l'induit d'un organe d'entraînement électrique linéaire sont guidés sans jeu. Les deux éléments d'avancement (10a, 10b) sont conçus sous forme de chaînes comportant au moins deux maillons individuels (22a, 22b) en matériau magnétisable et sont raccordés par une traverse (16) à des éléments de préhension (14), fixés à celle-ci, pour maintenir la feuille (2). L'entraînement des éléments d'avancement (10a, 10b) s'effectue par des postes d'entraînement (8a, 8b) qui sont disposés à l'extérieur des glissières de guidage (6a, 6b) et comportent des bobines (28) formant le stator de l'organe d'entraînement linéaire et séparées mutuellement par une distance (D) sensiblement inférieure ou égale à la longueur (L) des éléments d'avancement (10a, 10b).

(57) The invention relates to a sheet conveyer (1) for conveying sheet-like material (2) in a rotary press. Said conveyer comprises a first guide rail (6a) and a second guide rail (6b) extending parallel thereto. An associated first and second advance member (10a, 10b) forming the armature of an electrical linear drive is guided without play. The two advance members (10a, 10b) are in the form of link chains with at least two individual links (22a, 22b) consisting of magnetisable material, and are connected by a bar (16) to grippers (14) fastened thereto and for holding the sheet (2). The advance members (10a, 10b) are driven by drive stations (8a, 8b) arranged outside the guide rails (6a, 6b) and having reels (28) which form the stator of the linear drive and are arranged at a distance (D) from each other, said distance being substantially smaller than or identical to the length (L) of the advance members (10a, 10b).

CA 02253983 1998-11-09

PCT

WELTORGANISATION FÜR GEISTIGES EIGENTUM
Internationales Büro

INTERNATIONALE ANMELDUNG VERÖFFENTLICHT NACH DEM VERTRAG ÜBER DIE INTERNATIONALE ZUSAMMENARBEIT AUF DEM GEBIET DES PATENTWESENS (PCT)

(51) Internationale Patentklassifikation 6 :
B41F 21/08, 13/03

A1

(11) Internationale Veröffentlichungsnummer: WO 97/45267

(43) Internationales Veröffentlichungsdatum: 4. Dezember 1997 (04.12.97)

(21) Internationales Aktenzeichen: PCT/EP97/02750

(22) Internationales Anmeldedatum: 28. Mai 1997 (28.05.97)

(30) Prioritätsdaten:
196 21 507.2 29. Mai 1996 (29.05.96) DE

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(81) Bestimmungsstaaten: CA, CN, CZ, JP, US, europäisches Patent (AT, BE, CH, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE).

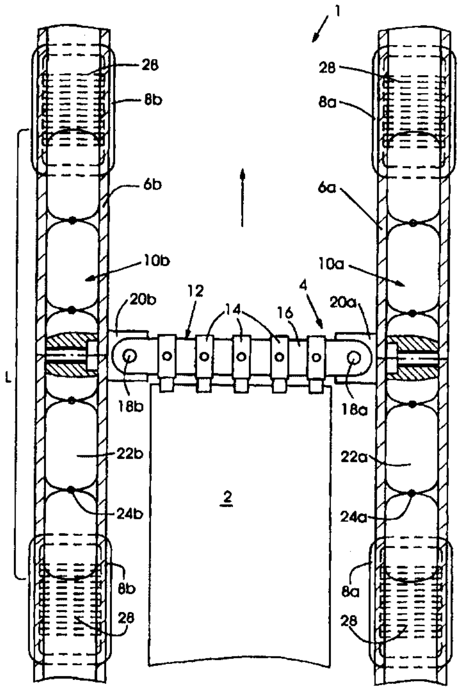
Veröffentlicht
Mit internationalem Recherchenbericht.

(54) Title: SHEET CONVEYER FOR A ROTARY PRESS

(54) Bezeichnung: BOGENTRANSPORTSYSTEM FÜR EINE ROTATIONSDRUCKMASCHINE

(57) Abstract

The invention relates to a sheet conveyer (1) for conveying sheet-like material (2) in a rotary press. Said conveyer comprises a first guide rail (6a) and a second guide rail (6b) extending parallel thereto. An associated first and second advance member (10a, 10b) forming the armature of an electrical linear drive is guided without play. The two advance members (10a, 10b) are in the form of link chains with at least two individual links (22a, 22b) consisting of magnetisable material, and are connected by a bar (16) to grippers (14) fastened thereto and for holding the sheet (2). The advance members (10a, 10b) are driven by drive stations (8a, 8b) arranged outside the guide rails (6a, 6b) and having reels (28) which form the stator of the linear drive and are arranged at a distance (D) from each other, said distance being substantially smaller than or identical to the length (L) of the advance members (10a, 10b).



(57) Zusammenfassung

Ein Bogentransportsystem (1) zum Transport von bogenförmigem Material (2) in einer Rotationsdruckmaschine umfaßt eine erste Führungsschiene (6a) und eine parallel dazu verlaufende zweite Führungsschiene (6b), in der ein zugeordnetes erstes und zweites, den Läufer eines elektrischen Linearantriebs bildendes Vortriebselement (10a, 10b) spielfrei geführt ist. Die beiden Vortriebselemente (10a, 10b) sind als Gliederketten mit mindestens zwei Einzelgliedern (22a, 22b) aus magnetisierbarem Material ausgebildet und werden durch eine Traverse (16) mit daran befestigten Greifern (14) zum Halten des Bogens (2) verbunden. Der Antrieb der Vortriebselemente (10a, 10b) erfolgt durch außerhalb der Führungsschienen (6a, 6b) angeordnete Antriebsstationen (8a, 8b) mit Spulen (28), die den Stator des Linearantriebs bilden und die in Abständen (D) zueinander angeordnet sind, welche im wesentlichen kleiner oder gleich der Länge (L) der Vortriebseinrichtungen (10a, 10b) sind.

Sheet transport system for a rotary printing machine

Description

The invention relates to a sheet transport system, a forward drive device, a web threading device and a transport gripper system for a rotary printing machine in accordance with the preamble of claims 1, 2, 23, 24, 25, 26 and 27.

Sheet transport systems for rotary printing machines are known from the prior art and are used, for example, in the feeder region of a printing machine to remove a sheet from the sheet stack and to feed the same to a first printing unit. Furthermore, it is known to use sheet transport systems to transport the sheets within the printing machine from printing unit to printing unit or to transport the sheets from the last printing unit to the deliverer stack in the deliverer region, the transport of the sheets in the different printing machine sections being carried out at as a rule by sheet transport systems of different constructions. Thus, in the feeder region, mechanically driven, essentially rectilinearly moved suction devices in the form of lifting and dragging suckers are used. Between the printing units, that is to say within the printing machine, the sheet transport is then usually carried out by means of sheet transfer cylinders or drums with gripper devices arranged thereon. In the deliverer region, the sheets are finally transported by gripper bars, which are fixed to two circulating endless chains that are arranged parallel to each other.

Furthermore, DE-A 25 01 963 discloses the practice of transporting the sheets through the entire printing machine with the aid of a sheet transport system in the form of a gripper carriage with a gripper bar arranged thereon. The drive of the gripper carriage is in this case provided by first and second forward drive elements, which are guided in associated endless guide rails that run on both sides in the housing of the printing machine, and which form the rotor of an electric linear motor. Along the two guide rails there extend endless stator coils, which produce an electromagnetic traveling field for the forward drive of the gripper carriage. In this case, provision may be made for the coils to be subdivided into a plurality of electrically independent subsections, which are assigned to the respective printing units, in order to be able to control the speed of the gripper carriage with high accuracy, for example when it is passing a press nip. A disadvantage with the sheet transport system described is that the stator coils are constructed as endless coils, which leads to a high electrical power demand and makes necessary a comparatively high control and regulation outlay and costs associated with this. Thus, in particular in order to achieve the in-register feeding of sheets into the press nips of the respective printing units, it is necessary to drive each individual winding of the endless coil by means of a separate control device, in order to obtain the required accuracy.

The invention is intended to achieve the object of providing a sheet transport system for rotary printing machines which may be used universally in the individual subsections of a printing machine, whose movement takes place with an accuracy that is required for the in-register sheet transport in a printing machine and which, in addition to a reduced outlay on devices for controlling and regulating the forward drive movement, has a comparatively low electrical power demand.

According to the invention, the object is achieved by the features of claims 1, 2, 23, 24, 25, 26 and 27.

According to a first embodiment of the invention, a sheet transport system for a rotary printing machine comprises a sheet transport device which has sheet holding means and whose forward drive is provided by a first forward drive element that is guided in a first guide rail and by a second forward drive element that is guided in a second guide rail running essentially parallel to the first guide rail, the first and second forward drive elements forming the rotors of an electric linear drive, and the first and second forward drive elements being formed by link chains which are made of magnetizable, preferably permanent magnetic material and in each case contain at least two individual elements which are connected to one another in an articulated manner.

According to a first embodiment of the invention, a sheet transport system for a rotary printing machine comprises a sheet transport device which has sheet holding means and whose forward drive is provided by a first forward drive element that is guided in a first guide rail and by a second forward drive element that is guided in a second guide rail running essentially parallel to the first guide rail, the first and second forward drive elements forming the rotors of an electric linear drive, and the first and second forward drive elements being formed by link chains which are made of magnetizable, preferably permanent magnetic material and in each case contain at least two individual elements which are connected to one another in an articulated manner. Provided on the first and second guide rails are a plurality of drive stations, which form the stator of the linear drive and whose distance from one another is essentially less than or equal to the length of the forward drive elements, the movement of the first and second forward drive elements being controlled and regulated by a control device assigned to the drive stations.

Instead of the individual elements of magnetizable material, provision may likewise be made here to replace the individual elements of the link chains by closed conductor loops, the linear drive in this case being constructed as a known asynchronous drive.

According to a further embodiment of the invention, the forward drive elements are formed by flexible belts of magnetizable material, preferably soft iron, which have slots or other inhomogeneities. In the case of this embodiment of the invention, the drive to the forward drive element is provided in accordance with the known reluctance principle.

According to a preferred application of the inventive sheet transport system, the latter is arranged between an upstream and a downstream printing unit of a printing machine, the sheet holding means being formed by gripper devices, which take over a sheet from the gripper devices of the upstream printing unit and transfer it to gripper devices of the downstream printing unit.

Furthermore, the inventive sheet transport system can be arranged in the same way in the region of the deliverer of a printing machine, the sheet holding means being formed by gripper devices which take over a sheet from an upstream printing unit and deposit it on a stack. In this case, in the event of a plurality of sheet transport devices being used in the region of the sheet stack, the control device preferably controls the movement of the forward drive elements in such a way that the distances between two successive sheet transport devices are less than the length of a transported sheet, such that an imbricated formation of the deposited sheets is formed.

According to a further preferred application of the inventive sheet transport system, the latter is arranged in the region of the feeder of a printing machine, the sheet holding means of the sheet transport device being formed by suction devices, which remove the sheets to be transported from a sheet stack and feed them to a first printing unit of the printing machine. In this case, provision may be made for the control device to change the speed of the first and second forward drive elements during one revolution of the sheet transport device in such a way that the speed of the sheet transport device is reduced when a sheet is being removed by suction from the sheet stack, and is subsequently increased to a predefined value.

Instead of the individual elements made of magnetizable material, in the case of this embodiment of a forward drive element, provision may likewise be made to replace the individual elements of the link chains by closed conductor loops and, in this case, to construct the linear drive as a known asynchronous drive.

In the case of this embodiment, provision may be made in the same way for the forward drive element to be formed by a flexible belt of magnetizable material, which is provided with slots, the linear drive in this case operating in accordance with the reluctance principle.

A novel forward drive device, which is formed by at least one forward drive element and one guide rail and associated drive stations, is preferably used as a pulling device or as the drive for a known web threading device in a web-fed rotary printing machine.

In a similar way, it is possible to use the novel forward drive device as a transport gripper system or as a drive for a known transport gripper system for printed products, such as is used, for example, in further processing devices such as binders, etc., in order to transport the finished printed products.

According to a further embodiment of the invention, the distance between two drive stations over one or more subsections of the guide rails is greater than the length of the forward drive elements, so that the movement of the forward drive elements in this subsection takes place essentially without any drive, solely by virtue of the movement energy of the forward drive element or elements.

Further features of the invention are contained in the subclaims.

The invention will be described below using preferred embodiments and with reference to the drawings, in which:

Fig. 1 shows a schematic plan view of a inventive sheet transport system having a gripper bar, such as is used, for example, between the printing units or in the deliverer region,

Fig. 2 shows a schematic side view of the sheet transport system of Fig. 1,

Fig. 3 shows a schematic, three-dimensional illustration of a further embodiment of an inventive sheet transport system having gripper devices, in which the forward drive elements are formed by flexible belts of magnetizable material,

Fig. 4 shows a schematic side view of two printing units of a sheet-fed rotary printing machine, between which there is arranged an inventive sheet transport system having a large number of circulating sheet transport devices and a plurality of web paths, as well as dryer devices assigned to the web paths,

Fig. 5 shows a sheet transport system that is arranged in the deliverer region of a printing machine and has dryer devices and a large number of circulating sheet transport devices,

Fig. 6 shows a schematic illustration of an inventive sheet transport system having suction devices, which is arranged in the feeder region of a printing machine.

The inventive sheet transport system 1, illustrated in Fig. 1, for the transport of a sheet 2 in a printing machine 3 (shown in Figure 4, for example), in particular a sheet-fed rotary printing machine, comprises a sheet transport device 4, first and second guide rails 6a, 6b essentially running parallel to each other, and drive stations 8a, 8b that are arranged at a distance D from each other along the guide rails 6a, 6b.

The novel sheet transport device 4 of the sheet transport system 1 further has a first forward drive element 10a guided in the first guide rail 6a and a second forward drive element 10b guided in the second rail 6b, as well as sheet holding means 12 which connect the two forward drive elements 10a, 10b to each other and extend essentially over the width of the printing machine or of the printing unit cylinder (not illustrated). The sheet holding means 12 may be formed, for example, by grippers 14 that are usually used in sheet-fed rotary printing machines, for example tong-like grippers, which are fixed to a cross member 16. In the same way, however, the holding means 12 may also be formed by suckers or suction grippers fixed to the cross member 16 for example the suckers 84 shown in Figure 6, such as are known, for example, from the feeder region of sheet-fed printing machines.

In the case of the preferred embodiment of the invention, the first and the second forward drive elements are formed by link chains that are shown in Fig. 1 and have at least two, but preferably five or more, individual elements 22a, 22b. The individual elements 22a, 22b consist of magnetizable material and may be constructed as permanent magnets with N,S poles, being made, for example, from Samarium cobalt, neodymium iron boron or an otherwise known permanent magnetic material having an energy density that is as great as possible. Furthermore, it is possible to produce the individual elements 22a, 22b solely from a ferromagnetic material, for example soft iron, the linear drive operating in accordance with the reluctance principle known in the prior art.

The individual elements 22a, 22b of the forward drive elements 10a, 10b are movably connected to one another via joints 24a, 24b. The joints 24a, 24b may be constructed, for example, as known ball and socket joints or as simple belts connecting two successive individual elements 22a, 22b to each other, for example plastic or rubber belts. The individual elements 22a, 22b have a preferably circular cross section and are guided without play in the first and second guide rails 6a, 6b. Formed on one of the individual elements 22a, 22b in each case of the first and second forward drive element 10a, 10b, said individual element preferably being arranged in the center of the forward drive elements 10a, 10b, are mutually opposite projections 20a, 20b, to which the cross member 16 is fixed. As shown in Fig. 1, the cross member 16 is preferably fastened to the projections 20a, 20b by joints 18a, 18b, so that an oblique register correction to the transported sheet 2 can be performed by changing the relative position of the first and second forward drive elements 10a, 10b. The guide rails 6a, 6b have a cross-sectional shape that is adapted to the cross-sectional shape of the individual elements 22a, 22b, the projections 20a, 20b that are fixed to respectively one of the individual elements of each forward drive element 10a, 10b extending to the outside through a longitudinal slot 26a, 26b which is formed in the guide rails 6a, 6b and illustrated in Fig. 2. In order to achieve better sliding guidance, it is possible for the bodies of the individual elements 22a, 22b and the inner faces of the guide rails 6a, 6b to be coated with a known antifriction coating, for example with a Teflon coating.

As illustrated in Fig. 2, the drive stations 8a, 8b are preferably arranged in pairs above and below the guide rails 6a, 6b, and contain known electromagnetic coils 28, which are supplied with power via a control and regulation device 30 (illustrated schematically) and generate an electromagnetic traveling field to drive the sheet transport device 4 forward. In other words, the drive stations 8a, 8b with the coils 28 form the stator, and the forward drive elements 10a, 10b with their individual elements 22a, 22b of magnetizable material form the rotor of an electric linear motor or linear drive. The drive stations 8a, 8b on the two guide rails 6a, 6b can be constructed in the most diverse manner. Thus, the coils 28 of the drive stations 8a, 8b may engage around the associated guide rail 6a, 6b in a U- or C-shape, for example on the side facing away from the slot 26a, 26b. In a similar way, it is conceivable to construct each of the drive stations 8a, 8b as pairs of coils arranged only above and below the guide rails 6a, 6b; or to use in the drive stations 8a, 8b coils with a known cross-flux or transverse-flux arrangement. The choice of the coils depends on the type of linear drive used.

In the case of the embodiment of the invention illustrated in Figures 1 and 2, the number of individual elements 22 of the first and second forward drive elements 10a, 10b is preferably selected in such a way that the length L of a forward drive element 10a, 10b essentially corresponds to the distance D between two drive stations 8a, 8b on one of the guide rails 6a, 6b, so that the forward drive elements 10a, 10b are continuously in the active range of the traveling field because of the extent of the drive stations 8a, 8b. However, provision may be made in a similar way for the distance D between two drive stations 8a, 8b of one guide rail 6a, 6b to be, at least in some sections, smaller than the length L of an associated forward drive element 10a, 10b.

Furthermore, the distance D between two drive stations 8a, 8b on one guide rail 6a, 6b may be, at least in some sections, greater than the length L of a forward drive element 10a, 10b, so that the forward drive element 10a, 10b is located completely outside the drive stations 8a, 8b and thus outside the active range of the electromagnetic traveling field. In the case of this embodiment of the invention, the forward drive of the novel feed transport device between two drive stations 8a, 8b of the first and second guide rails 6a, 6b takes place solely as a result of the movement energy which was fed to said sheet transport device or to the first and second forward drive elements 10a, 10b in one of the upstream drive stations 8. Thus, for example, in the region between two printing units, in which precise positioning of the transport device 4 is not required, it may be advantageous to arrange the drive stations 8 at a distance of, for example, two to ten times the length L of a forward drive element 10a, 10b. By this means, the number of drive stations 8 and hence the outlay on devices may be further reduced. In regions in which the transport device 4 must be moved with high precision and accuracy, for example in regions in which the in-register transfer of a printed sheet to a downstream printing unit takes place, it is, on the other hand, possible for a plurality of drive stations 8 to be arranged one after another directly or at a short distance.

In the case of a further embodiment of the invention, shown in Fig. 3, provision may furthermore be made to construct the forward drive elements 10a, 10b of the embodiment shown in Fig. 1 and Fig. 2 as continuous belts provided with slots 118 or strips 110a, 110b of flexible magnetizable material, for example soft iron or a similar material with ferromagnetic properties. In the same way as in connection with the above-described link-chain embodiment of the invention, it is possible for the forward drive elements 110a, 110b also to be constructed as or to contain permanent magnets which are formed, for example, from Samarium cobalt, neodymium iron boron or another permanent magnetic material, preferably one from the group of rare earths. For the improved guidance of the forward drive elements, the strips 110a, 110b may have additional guide bodies 120, which are guided in an associated guide 122 of the guide rail 6a, 6b, which is preferably of flat construction. In the same way as the forward drive elements 10a, 10b formed by link chains of the embodiment according to Figs. 1 and 2, the strip-like forward drive elements 110a, 110b of the embodiment of the invention illustrated in Fig. 3 have, in the preferred embodiment, a length L which essentially corresponds to the distance D between two drive stations 8a, 8b on a guide rail 6a, 6b.

However, as described above, the distance D may also be less than or, in some sections, greater than the length L.

Finally, in the case of a further embodiment of the invention, provision may also be made to use individual elements which are formed by closed conductor loops instead of the individual elements of magnetizable material. In this case, the linear drive operates in accordance with the known asynchronous principle.

In the preferred embodiment of the invention, sensors 32, 132 are preferably arranged upstream of the drive stations 8a, 8b, as shown in Figs. 1 to 3, said sensors being connected to the control and regulation device 30 and registering the speed and/or the exact position of the first and second forward drive elements 10a, 10b or 110a, 110b within the associated guide rails 6a, 6b. The control and regulation device 30 controls and regulates the electromagnetic traveling field of the drive stations 8a, 8b of the first and second guide rails 6a, 6b as a function of the speed and/or position registered by the sensors 32, 132, in such a way that the transport device 4 carries out a predefined forward drive movement.

Although the control and regulation device 30 can jointly activate and regulate mutually opposite drive stations 8a, 8b of the first and second guide rails 6a, 6b in pairs, in the preferred embodiment of the invention, the control and regulation of the first drive stations 8a, is preferably carried out independently of the control and regulation of the second drive stations 8b. In other words, in the preferred embodiment of the invention, the first and second forward drive elements 10a, 10b or 110a, 110b may be controlled and regulated independently of each other, which makes it possible, for example, to change the relative position of the first forward drive element 10a, 110a in relation to the second forward drive element 10b, 110b, and as a result, for example, to perform an oblique register correction of the sheet in the subsequent printing units. Furthermore, in this embodiment of the invention, it is possible to increase the speed of the first and second forward drive elements 10a, 10b, 110a, 110b by the same amount, in order by this means, for example, to carry out simultaneously a speed and position correction of the inventive sheet transport device 4.

According to the invention, the sheet transport device 4 shown in Figs. 1 and 2 can be used in different sections of a printing machine, without departing from the principle on which it is based.

As Fig. 4 illustrates, it is, for example, possible to arrange the inventive sheet transport system between an upstream and a downstream printing unit of a sheet-fed rotary printing machine, it being possible for the guide rails 6a, 6b to be constructed as closed endless rails. In this case, a plurality of transport devices 4 run within the rails 6a, 6b, take over a sheet 2 from a back-pressure cylinder 50 of the upstream printing unit and transfer it to the gripper devices of a back-pressure cylinder 52 of the downstream printing unit. In this case, provision may be made for dryer devices 54, 56, for example in the form of known IR dryers or hot-air dryers, to be provided above and below the guide rails 6a, 6b, these devices drying the upper side and, if necessary, the underside of a printed sheet 2. According to a further embodiment of the invention, provision may be made for the speed of the sheet transport devices 4 to be reduced in the region of the dryer devices 54, 56 by the control and regulation device 30, in order to prolong the passage time through the dryer devices for example when reeling up the printed products to form known reels, is a considerable reduction in the device outlay. Furthermore, in the case of using the inventive sheet transport system 1 in the deliverer 70 of a sheet-fed rotary printing machine, it may be advantageous if in addition an additional rail path (not illustrated in Fig. 5), which can be activated via a higher-order diverter, is provided in the region of the deliverer stack 72, is constructed in the same way as the rail paths 48 and 60 illustrated in Fig. 4 and which enables the removal of proof sheets without additional mechanically complicated proof-sheet removal devices.

A further possible use for an inventive sheet transport system 1 is to arrange this in a feeder 80 of a sheet-fed rotary printing machine. In the case of this embodiment of the invention, shown in Fig. 6, the guide rails, 6a, 6b are preferably constructed as endless guide rails, which run above the sheet stack 82 to be printed. The holding means 12 may be constructed as known lifting suckers 84, which are fastened, for example, to the cross member 16, shown in Fig. 1, of the sheet transport device 4, and to which suction air is applied via suction-air feed devices (not illustrated). As illustrated in Fig. 6, it is possible for a plurality of sheet-transport devices 4 to circulate independently of one another within the endless guide rails 6a, 6b, the control and regulation device 30 controlling and regulating the drive stations 8a, 8b in such a way that the speed of the sheet transport devices 4 is sharply reduced when the rear edge 86 of the sheet stack 82 is reached, preferably even brought to a standstill, so that when the suckers 84 are extended, or when the suction-air supply is switched on, there is no or virtually no relative speed between the sheet 2 to be picked up by suction and the sucker

84. After the sheet 2 to be transported has been picked up by the sucker 84 and lifted from the stack 82, the speed of the inventive transport device 4 is increased until the transport device and the sheet 2 transported with it reach the imbricated speed necessary for imbricated feeding of the sheets. The

acceleration of the inventive transport device 4 preferably takes place uniformly in this case and has a magnitude such that, when the suction-air supply is cut off in Fig. 6, the transported sheet 2 is certain to have the required imbricated speed. After the suction-air supply has been cut off, the control and regulation device 30 preferably controls the movement of the inventive sheet transport device 4 in such a way that its speed is firstly increased and then - shortly before the rear edge 86 of the sheet stack 82 is reached, is reduced again in the above-described manner.

In the case of all the above-described possible uses of an inventive sheet transport system 1, there is the possibility of transporting the sheets exclusively by means of a single sheet transport device 4. However, provision is advantageously made to use a relatively large number of inventive sheet transport devices 4 within the guide rails 6a, 6b, which results in a more uniform movement of said devices.

Although the inventive sheet transport system 1 has previously been described using the example of a sheet-fed rotary printing machine 3, it may also be used in an identical way in a known web-fed rotary printing machine, for example as a web threading device. In this case, it is not absolutely necessary to use two mutually opposite guide rails, instead it is quite sufficient to arrange only one guide rail, with a forward drive element arranged therein, along the web threading path, and to fasten the leading end of the paper web to be threaded, for example to the projection 20a, 20b. This does not depart from the basic principle on which the invention is based.

Finally, it is conceivable to use the forward drive elements of the abovementioned transport system to drive the transport grippers in known further processing plants for printed products, such as binding plants, sheet transport device 4, and to which suction air is applied via suction-air feed devices (not illustrated). As illustrated in Fig. 6, it is possible for a plurality of sheet-transport devices 4 to circulate independently of one another within the endless guide rails 6a, 6b, the control and regulation device 30 controlling and regulating the drive stations 8a, 8b in such a way that the speed of the sheet transport devices 4 is sharply reduced when the rear edge 86 of the sheet stack 82 is reached, preferably even brought to a standstill, so that when the suckers 84 are extended, or when the suction-air supply is switched on, there is no or virtually no relative speed between the sheet 2 to be picked up by suction and the sucker 84. After the sheet 2 to be transported has been picked up by the sucker 84 and lifted from the stack 82 (position X), the speed of the inventive transport device 4 is increased until the transport device and the sheet 2 transported with it reach the imbricated speed necessary for imbricated feeding of the sheets. The acceleration of the inventive transport device 4 preferably takes place uniformly in this case and has a magnitude such that, when the suction-air supply is cut off (position Y) in Fig. 6, the transported sheet 2 is certain to have the required imbricated speed. After the suction-air supply has been cut off at the position Y, the control and regulation device 30 preferably controls the movement of the inventive sheet transport device 4 in such a way that its speed is firstly increased and then - shortly before the rear edge 86 of the sheet stack 82 is reached, is reduced again in the above-described manner.

In the case of all the above-described possible uses of an inventive sheet transport system 1, there is the possibility of transporting the sheets exclusively by means of a single sheet transport device 4. However, provision is advantageously made to use a relatively large number of inventive sheet transport devices 4 within the guide rails 6a, 6b, which results in a more uniform movement of said devices.

Although the inventive sheet transport system 1 has previously been described using the example of a sheet-fed rotary printing machine 3, it may also be used in an identical way in a known web-fed rotary printing machine, for example as a web threading device. In this case, it is not absolutely necessary to use two mutually opposite guide rails, instead it is quite sufficient to arrange only one guide rail, with a forward drive element arranged therein, along the web threading path, and to fasten the leading end of the paper web to be threaded, for example to the projection 20a, 20b. This does not depart from the basic principle on which the invention is based.

Finally, it is conceivable to use the forward drive elements of the abovementioned transport system to drive the transport grippers in known further processing plants for printed products, such as binding plants, and folding plants, for example. In this case, the transport grippers for holding the printed products can, for example, in each case be fastened individually to the projections 20a, 20b of the forward drive elements 10a, 10b; 110a, 110b, so that the movement of each transport gripper can be controlled and regulated individually by the control device 30. Furthermore, it may be advantageous in this case, as in the case of the above-described web threading device, to use only a single guide rail 6a, 6b instead of two mutually opposite guide rails.

32	Sensors
50	Back-pressure cylinder of the upstream printing unit
52	Back-pressure cylinder of the downstream printing unit
54	Dryer device
56	Dryer device
58	First rail path
60	Second rail path
62	Diverter
70	Deliverer
72	Sheet stack
80	Feeder
82	Sheet stack
84	Sucker
86	Rear edge of the sheet stack
110a, 110b	Forward drive element of the embodiment of Fig. 3
118	Slots
120	Guide body
122	Additional guide
132	Sensor
D	Distance between two drive stations
L	Length of a forward drive element

PATENT CLAIMS

1. A sheet transport system (1) for a rotary printing machine (3), having a sheet transport device (4) which has sheet holding means (12) and whose forward drive is provided by a first forward drive element (10a) that is guided in a first guide rail (6a) and by a second forward drive element (10b) that is guided in a second guide rail (6b) running essentially parallel to the first guide rail (6a), the first and second forward drive elements (10a, 10b) forming the rotors of an electric linear drive, there being provided on the first and second guide rails (6a, 6b) a plurality of drive stations (8a, 8b), which form the stator of the linear drive, and a control device (30) assigned to the drive stations (8a, 8b), with which the movement of the first and second forward drive elements (10a, 10b) may be controlled and regulated, characterized in that

the first and second forward drive elements (10a, 10b) are formed by link chains which are made of magnetizable material and in each case contain at least two individual elements (22a, 22b) which are connected to one another in an articulated manner (24a, 24b), and wherein the distance (D) of the drive stations (8a, 8b) from one another, is, at least in some sections, essentially less than or equal to the length (L) of the forward drive elements (10a, 10b).

2. A sheet transport system (1) for a rotary printing machine (3), having a sheet transport device (4) which has sheet holding means (12) and whose forward drive is provided by a first forward drive element (110a) that is guided in a first guide rail (6a) and by a second forward drive element (110b) that is guided in a second guide rail (6b) running essentially parallel to the first guide rail (6a), the first and second

forward drive elements (110a, 110b) forming the rotors of an electric linear drive, there being provided on the first and second guide rails (6a, 6b) a plurality of drive stations (8a, 8b), which form the stator of the linear drive, and a control device (30) assigned to the drive stations (8a, 8b), with which the movement of the first and second forward drive elements (110a, 110b) may be controlled and regulated, characterized in that

the first and second forward drive elements (110a, 110b) are formed by flexible belts of magnetizable material, and wherein the distance (D) of the drive stations (8a, 8b) from one another, is, at least in some sections, essentially less than or equal to the length (L) of the forward drive elements (110a, 110b).

3. The sheet transport system as claimed in claim 1 or 2, characterized in that the magnetizable material is formed by or contains permanent magnets.

4. The sheet transport system as claimed in claim 1, characterized in that the magnetizable material is a ferromagnetic material.

5. The sheet transport system as claimed in claim 2, characterized in that the flexible belts consist of or contain a ferromagnetic material, and slots (118) are provided in the belts.

6. The sheet transport system as claimed in one of the preceding claims, characterized in that this device is arranged between an upstream and a downstream printing unit of a printing machine and the sheet holding means (12) are formed by gripper devices (14), which take over a sheet (2) from the

gripper devices of the upstream printing unit and transfer it to gripper devices of the downstream printing unit.

7. The sheet transport system as claimed in claim 6, characterized in that a plurality of sheet transport devices (4) are provided, these circulating at the same time as one another within the guide rails (6a, 6b).

8. The sheet transport system as claimed in one of claims 1 to 4, characterized in that this device is arranged in the region of the deliverer (70) of a printing machine and the sheet holding means (12) are formed by gripper devices (14), which take over a sheet (2) from an upstream printing unit and deposit it on a stack (72).

9. The sheet transport system as claimed in claim 8, characterized in that a plurality of sheet transport devices (4) are provided, these circulating at the same time as one another within the guide rails (6a, 6b).

10. The sheet transport system as claimed in claim 9, characterized in that the control device (30) controls the movement of the forward drive elements (10a, 10b; 110a, 110b) of the sheet transport devices (4) in the region of the sheet stack (72) in such a way that the distances between two successive sheet transport devices (4) are less than the length of a transported sheet (2), such that an imbricated formation of the deposited sheets (2) is formed.

11. The sheet transport system as claimed in either of claims 7 and 8, characterized in that one or more dryer devices (54, 56), past which the printed sheets (2) are guided, are provided in the vicinity of the guide rails (6a, 6b).

12. The sheet transport system as claimed in claim 11, characterized in that, in the region of the dryer devices (54, 56), the first and second guide rails (6a, 6b) are divided up into rail paths (58, 60) which run one above another and in which the speed of the sheet transport devices (4) is reduced, and wherein a diverter (62) is provided, which feeds successive sheet transport devices (4) alternately to the two rail paths (58, 60).

13. The sheet transport system as claimed in claim 12, characterized in that the rail paths 58, 60 run essentially horizontally at a distance from each other, and wherein the dryer devices (54, 56) are arranged above and below each path (58, 60) in such a way that the upper side and underside of each sheet (2) can be dried at the same time.

14. The sheet transport system as claimed in one of the preceding claims, characterized in that the sheet-holding means (12) are formed by gripper devices (14), which are fixed to a cross member (16) that extends from the first forward drive element (10a, 110a) to the second forward drive element (10b, 110b).

15. The sheet transport system as claimed in claim 14, characterized in that the cross member (16) is connected in an articulated manner (18a, 18b) to the first and second forward drive elements (10a, 10b; 110a, 110b).

16. The sheet transport system as claimed in one of claims 1 to 4, characterized in that this device is arranged in the region of the feeder (80) of a printing machine, and the sheet holding means (12) of the sheet transport device (4) are

formed by suction devices (84), which remove the sheets (2) to be transported from a sheet stack (82) and feed them to a first printing unit of the printing machine.

17. The sheet transport system as claimed in claim 16, characterized in that the control device (30) changes the speed of the first and second forward drive elements (10a, 10b; 110a, 110b) during one revolution of the sheet transport device (4) in such a way that the speed of the sheet transport device (4) is reduced when a sheet (2) is being removed by suction from the sheet stack (82), and is subsequently increased to a predefined value.

18. The sheet transport system as claimed in claim 17, characterized in that, after the sheet (2) has been picked up by suction and before the same is released, the speed of the sheet transport device (4) is increased to a speed which essentially corresponds to the speed of an imbricated formation formed by the sheets (2).

19. The sheet transport system as claimed in one of claims 16 to 18, characterized in that the suction devices (84) are fixed to a cross member (16) that extends from the first forward drive element (10a, 110a) to the second forward drive element (10b, 110b).

20. The sheet transport system as claimed in claim 19, characterized in that the cross member (16) is connected in an articulated manner (18a, 18b) to the first and second forward drive elements (10a, 110a; 10b, 110b).

21. The sheet transport system as claimed in one of claims 16 to 20, characterized in that a plurality of sheet transport

devices (4) are provided, these circulating at the same time as one another within the guide rails (6a, 6b).

22. The sheet transport system as claimed in one of the preceding claims, characterized in that the control device (30) controls and regulates the movement of the first and second forward drive elements (10a, 10b; 110a, 110b) independently of each other and wherein, in order to adjust the oblique register of a transported sheet (2), the relative position between the first forward drive element (10a, 110a) and the second forward drive element (10b, 110b) is changed by the control device (30).

23. A forward drive device for a transport system in a rotary printing machine (3), having at least one guide rail (6a, 6b) and a forward drive element (10a, 10b) that is guided in the guide rail (6a, 6b) and forms the rotor of an electric linear drive, and having drive stations (8a, 8b), which are arranged outside the guide rail (6a, 6b), contain electric coils (28a, 28b) and form the stator of the electric linear drive, a control device (30) assigned to the drive stations (8a, 8b) being provided, which controls and regulates the movement of the forward drive element (10a, 10b), wherein the forward drive element (10a, 10b) is formed by a link chain which has in each case at least two individual elements (22a, 22b) which are made of magnetizable material and are connected to each other in an articulated manner, and the drive stations (8a, 8b) are arranged, at least in some sections, at a distance (D) from each other which is less than or equal to the length (L) of the forward drive element (10a, 10b).

24. A forward drive device for a transport system in a rotary printing machine (3), having at least one guide rail (6a, 6b)

and a forward drive element (110a, 110b) that is guided in the guide rail (6a, 6b) and forms the rotor of an electric linear drive, and having drive stations (8a, 8b), which are arranged outside the guide rail (6a, 6b), contain electric coils (28a, 28b) and form the stator of the electric linear drive, a control device (30) assigned to the drive stations (8a, 8b) being provided, which controls and regulates the movement of the forward drive element (110a, 110b), characterized in that the forward drive element (110a, 110b) is formed by a flexible belt of magnetizable material, which is provided with slots (118), and the drive stations (8a, 8b) are arranged, at least in some sections, at a distance (D) from each other which is less than or equal to the length (L) of the forward drive element (110a, 110b).

25. A forward drive device for a transport system in a rotary printing machine (3), having at least one guide rail (6a, 6b) and a forward drive element (10a, 10b) that is guided in the guide rail (6a, 6b) and forms the rotor of an electric linear drive, and having drive stations (8a, 8b), which are arranged outside the guide rail (6a, 6b), contain electric coils (28a, 28b) and which form the stator of the electric linear drive, a control device (30) assigned to the drive stations (8a, 8b) being provided, which controls and regulates the movement of the forward drive element (10a, 10b), characterized in that the forward drive element (10a, 10b) is formed by a link chain which has in each case at least two individual elements (22a, 22b) which are connected to one another in an articulated manner and are constructed as closed electric conductor loops, and wherein the drive stations (8a, 8b) are arranged, at least in some sections, at a distance (D) from each other which is less than or equal to the length (L) of the forward drive element (10a, 10b).

26. A web threading device for a web-fed rotary printing machine, having a forward drive device as claimed in one of claims 23 to 25.

27. A transport gripper system in a further processing device for printed products, characterized in that this system comprises a forward drive device as claimed in one of claims 23 to 25.

28. The sheet transport system as claimed in one of claims 1 to 22, characterized in that the distance (D) between two drive stations (8a, 8b) over a subsection of the guide rails (6a, 6b) is greater than the length (L) of the forward drive elements (10a, 10b; 110a, 110b), in such a way that the movement of the forward drive elements (10a, 10b; 110a, 110b) in this subsection takes place essentially without any drive, solely by virtue of the movement energy of the forward drive elements which has been fed to the forward drive elements in an upstream drive station (8a, 8b).

29. The forward drive device as claimed in one of claims 23 to 25, characterized in that the distance (D) between two drive stations (8a, 8b) over a subsection of the guide rails (6a, 6b) is greater than the length (L) of the forward drive elements (10a, 10b; 110a, 110b), in such a way that the movement of the forward drive elements (10a, 10b; 110a, 110b) in this subsection takes place essentially without any drive, solely by virtue of the movement energy of the forward drive elements which has been fed to the forward drive elements in an upstream drive station (8a, 8b).

30. The web threading device as claimed in claim 26, wherein the distance (D) between two drive stations (8a, 8b) over a subsection of the guide rails (6a, 6b) is greater than the length (L) of the forward drive elements (10a, 10b; 110a, 110b), in such a way that the movement of the forward drive elements (10a, 10b; 110a, 110b) in this subsection takes place essentially without any drive, solely by virtue of the movement energy of the forward drive elements which has been fed to the forward drive elements in an upstream drive station (8a, 8b).

31. The transport gripper system as claimed in claim 27, characterized in that the distance (D) between two drive stations (8a, 8b) over a subsection of the guide rails (6a, 6b) is greater than the length (L) of the forward drive elements (10a, 10b; 110a, 110b), in such a way that the movement of the forward drive elements (10a, 10b; 110a, 110b) in this subsection takes place essentially without any drive, solely by virtue of the movement energy of the forward drive elements which has been fed to the forward drive elements in an upstream drive station (8a, 8b).