(57) Abrégé/Abstract:
The sheet conveyance device used in a converting press for paper or cardboard sheets having at least one feeding station, a converting station, a waste stripping station and a delivery station for converted sheets, comprises two endless gripper bar chains (5, 6) assembled for conveying the sheets from the feeding station to the delivery station, a transverse driving shaft (2) equipped with driving wheels (3, 3') for the endless gripper bar chains (5, 6) and at least one device for sheets capture secured to the endless gripper bar chains (5, 6). The transverse driving shaft (2) is separately driven from the other press stations by at least one independent motor/reductor (1). The independent motor/reductor (1) is able to function in driving cycles including at least one motion phase and one deceleration and/or braking phase controlled by a control device (CDE), each independent motor driving cycle duration being equivalent to a converting cycle duration of said converting station.
ABSTRACT

The sheet conveyance device used in a converting press for paper or cardboard sheets having at least one feeding station, a converting station, a waste stripping station and a delivery station for converted sheets, comprises two endless gripper bar chains (5, 6) assembled for conveying the sheets from the feeding station to the delivery station, a transverse driving shaft (2) equipped with driving wheels (3, 3') for the endless gripper bar chains (5, 6) and at least one device for sheets capture secured to the endless gripper bar chains (5, 6). The transverse driving shaft (2) is separately driven from the other press stations by at least one independent motor/reductor (1). The independent motor/reductor (1) is able to function in driving cycles including at least one motion phase and one deceleration and/or braking phase controlled by a control device (CDE), each independent motor driving cycle duration being equivalent to a converting cycle duration of said converting station.
DEVICE FOR SHEETS CONVEYANCE

The present invention relates to a device for sheet conveyance in a converting press for paper or cardboard sheets having at least one feeding station, a converting station, a waste stripping station and a delivery station for converted sheets. The conveyance device includes two endless gripper bar chains assembled for conveying the sheets from the feeding station to the delivery station, a transverse driving shaft equipped with driving wheels for the endless gripper bar chains and at least one device for sheet capture secured to the endless gripper bar chains.

The word "transverse" as used herein means an horizontal direction perpendicular to the machine axis.

In known converting presses, usually only one electric motor drives the whole machine. This motor directly actuates an inertia flywheel, a clutch brake device being inserted between this flywheel and the other machine parts. This system drives all elements functioning with synchronism, in particular the movable beam of the platen press, the waste stripping and blank delivering stations, as well as the chains bearing the gripper bars ensuring sheets capture and conveyance from one station to the next one.

A sheet conveying and converting cycle includes a sheet stop phase during which the sheets undergo a converting operation, such as blanking or waste stripping, and at least one moving phase during which the sheets are conveyed from one station to the next. This moving phase necessarily includes an acceleration and a deceleration phase and, usually, between these, a phase during which the sheet slightly moves at a constant speed.
Various embodiments carrying out this kind of cycle are already known in which the wheels driving the chains are interdependent in rotation with a coupling unit which is, by axial displacement, alternatively engaged by or released from a driving unit, while standby means release or immobilize the wheels driving the chains, although the driving unit is alternatively driven in one or other rotative direction.

Such mechanical devices are described for example with patents CH 219422 and CH 411555. For such devices, an oscillating toothed segment operating onto the transverse driving shaft of the gripper bar chains via a pinion is actuated by a rod connected to an eccentric secured on the top of a shaft driven by the general machine driving device, which carries out a complete rotation by a back and forth movement of the oscillating toothed segment.

In relation with this kind of mechanical drive, one deals with a single motion law, determined by the parts geometry. This kind of driving device is very suitable for low or average rates up to approximately 5’000-6’000 sheets/hour; beyond this level accelerations and decelerations at the beginning and at the end of the motion phase become very strong. However, after the sheet blanking operation, the sheets are still connected only by their nicks, which can break in the case of strong acceleration, causing a machine jam.

Several mechanical devices were proposed to overcome this defect. The patent CH 411555 suggests placing driving of the toothed segment under the control of a double cam sending a rocking motion to a lever which, by means of a connecting rod drives the toothed segment, whereas among the
two lever elements cooperating with the two cams, the one, which imparts the return free motion to the toothed segment, is elastically closed up against the cam. The cam system allows amendment of the motion law by relieving the start-up, however, for a set of reference cams, this motion law cannot be amended beyond a certain amount without changing cams.

Also known are devices which attempt to remove the time delay needed for the blanking operation. In one of those devices, the manufacturer gave a linear motion to the two blanking station platen, so that the latter travel together with the blanked sheets, a solution which allows removing the time delay while modulating the linear displacement motion of the endless gripper bar chains.

The aim of the present invention is to deal with a device for sheet conveyance allowing high rates while ensuring at will carrying out an optimal sheets conveying cycle without any excessive accelerations which could likely break the nicks between the sheets blanks. Another aim of the invention is to allow rate adjustment of the sheet conveying cycle, independently of the conveying cycle of the converting station. The rate modification of a sheet conveying cycle deals with acting on the acceleration and deceleration curves and on the respective duration of cycle phases according to the kind of work carried out, without requiring, with parts exchanges of the sheet conveyance device between consecutive jobs.

The invention provides a conveying device for feeding a converting press for paper or cardboard sheets having press stations including a feeding station, a converting station and a delivery station, said conveying
device comprising: a drive coupled to said converting station for driving said converting station through a converting cycle to process said sheets; a conveyor having an endless gripper bar chain for conveying said sheets from said feeding station to said delivery station and operable to deliver unprocessed sheets to said converting station for processing and to remove processed sheets from said converting station; a transverse drive shaft coupled to said conveyor for driving said conveyor; a motor coupled to said drive shaft and operable to drive said drive shaft to drive said conveyor, said motor being operable to drive said drive shaft independently of said drive for said converting station; and a motor control operable to control said motor to operate in a drive cycle including at least a motion phase and a braking phase, wherein a duration of said drive cycle is equivalent to a duration of said converting cycle of said converting station.

The driving of the sheet conveyance device by an independent motor instead of driving it by the same motor as drives the other converting press stations was judged unfeasable for fear of causing mis-synchronization between the sequential sheet run and the blanking platen operation of the downstream stations. The inventors noted that to the contrary, a control, particularly an electronic control, which receives a representative signal of the blanking station platen location and a representative signal of the gripper bar chains location allows control of the independent motor driving the gripper bar chains to run with optimal synchronism related to the platen cycle. During a conveying cycle, a control device driving the independent motor by delivering a suitable electrical current is able to adjust (with much more flexibility than a mechanical device could) the characteristics of the acceleration phase, of the
deceleration phase and of the braking phase of the conveying device. Conveying by means of the independent motor allows in particular better adjustment of the relative duration of the moving and braking phases of the gripper bar chains with the moving and braking phases of the diecutting platen and, consequently, decrease of the duration of the platen braking phase, which allows an increase in the machine production rate.

According to another aspect of the present invention there is provided a control system for a conveying device for feeding a converting press for processing material and having a press station, said control system comprising: a drive coupled to said press station for driving said press station through a press cycle; a conveyor having an endless gripper bar chain for conveying said material to said press station and for conveying material processed by said press station away from said press station; a motor coupled to said conveyor and operable to drive said conveyor independently of said drive for said press station; a motor controller coupled to said motor and operable to apply a drive cycle profile to said motor to drive said conveyor; and a position sensor coupled to at least one of said press station, said conveyor and said motor, said sensor being coupled to said motor controller and operable to provide a position signal to said motor controller, whereby said drive cycle profile applied by said motor controller is influenced by a value of said position signal.

Other characteristics and advantages will be apparent to one skilled in the art from the following description of an exemplary embodiment of the invention, with reference to the drawing, in which
- Fig. 1a and 1b show respectively a side view and a top view of apparatus for the mounting of a driving motor of a conveyance device in a converting press;

- Fig. 2 is a diagrammatic view of the control device of the motor; and

- Fig. 3 shows the recording of a cycle characteristics.

Fig. 1a and 1b show an independent motor/reductor unit 1 directly assembled with an extension of a transverse driving shaft 2 which carries driving wheels 3, 3' for endless gripper bar chains 5, 6 of a converting press. As may be noted in Fig. 1a, the motor is located at the unit 4 level, which, into a prior art converting press, comprised the driving mechanism of the gripper bar chains 5, 6 and the coupling parts of the motor actuating the various press stations, parts which are omitted here. This independent motor/reductor 1 can thus be assembled without modifying the existing machine. For one skilled in the art it will be obvious that the motor can also be secured in a mirror image position, i.e. on the opposite end of the transverse driving shaft 2 of the gripper bar chains, therefore as well in the
position so called “operator’s side” OS shown, also in the position so called “opposite operator’s side” OOS. The independent motor/reductor 1 can also be mounted in a position between frames 7, 8 and actuate the transverse shaft 2 by known means such as pinions, belts, chains, which allows removal of the driving side units 4 and thus reduction of the width of the machine.

The independent motor/reductor actuating the endless gripper bar chains 5, 6 is preferably an electric motor of high dynamic regulation. This independent motor/reductor 1 can be selected from commercially available synchronous, asynchronous, and d.c. motors, with or without a brake. For example, at the time of the depositor’s tests, a brushless synchronous driving device comprising a motor type HXA60VH distributed by ABB Normelec S.A. (Switzerland) allowed the endless gripper bar chains 5, 6 of a converting press to be driven at significant rates, while removing the original mechanical driving means. Several manufacturers offer electric motors with standard outputs able to reach torques up to 200-500 Nm, achieving gripper bar chain accelerations up to 25 to 70 m/s². The cost of such standard motors is lower than that of all mechanical elements of known devices.

Fig. 2 shows the schematic diagram of the electronic control device of the independent motor/reductor 1. The CDE control device receives from an absolute and incremental coder or sensor 9 a signal emitting the exact location of the blanking platen 10, the signal being used as a master reference within the whole system. The CDE control device also receives from an absolute and incremental coder or sensor 11 the absolute location of the gripper bar chains 5, 6; the CDE control device finally receives the angular
location of the independent motor/reductor 1 scanned by the absolute and incremental coder or sensor 12. The comparison between these signals allows the electronic CDE control device to exactly define the blocking and releasing times of the independent motor/reductor 1, i.e. to define the beginning and the end of the braking phase and to issue the current/tension feeding instructions defining, at any time, accelerations and speed rates of the independent motor/reductor 1.

The Fig. 3 shows five curve 13 to 17 on a same diagram, showing in arbitrary units, for the curve 13, the tension, for the curve 14, the intensity of the current feeding the independent motor/reductor 1, for the curve 15, the acceleration, for the curve 16, the speed as well as for the curve 17, the angular motion of the independent motor/réducteur 1. On this Fig. the X-coordinate axis represents the angular rotation of the independent motor/reductor 1 during one rotation, that is to say 360° which correspond to a sheet travelling from one station to the succeeding one.

On these curves can be noted the relationship between control tension and speed as well as the lack of excessive accelerations. By modifying the preset tension curve, one can easily eliminate the constant speed motion phase, and lengthen or shorten the motion phase duration within each cycle.
CLAIMS:

1. A conveying device for feeding a converting press for paper or cardboard sheets having press stations including a feeding station, a converting station and a delivery station, said conveying device comprising:

   a drive coupled to said converting station for driving said converting station through a converting cycle to process said sheets;

   a conveyor having an endless gripper bar chain for conveying said sheets from said feeding station to said delivery station and operable to deliver unprocessed sheets to said converting station for processing and to remove processed sheets from said converting station;

   a transverse drive shaft coupled to said conveyor for driving said conveyor;

   a motor coupled to said drive shaft and operable to drive said drive shaft to drive said conveyor, said motor being operable to drive said drive shaft independently of said drive for said converting station; and

   a motor control operable to control said motor to operate in a drive cycle including at least a motion phase and a braking phase, wherein a duration of said drive cycle is equivalent to a duration of said converting cycle of said converting station.

25 2. A conveying device according to claim 1, wherein said motor is an electric motor/reductor.
3. A conveying device according to claim 2, wherein said motor is selected from the group consisting of synchronous motors, asynchronous motors and DC motors.

4. A conveying device according to claim 2, wherein said motor includes a motor brake.

5. A conveying device according to claim 1, wherein said motor is directly coupled to an extension of said drive shaft.

6. A conveying device according to claim 1, wherein said motor is coupled indirectly with said drive shaft.

7. A conveying device according to claim 6, wherein said motor is located between lateral edges of said conveyor.

8. A conveying device according to claim 1, wherein said motor control is operable to adjust at least one of a duration and an amplitude of one or more parameters in said drive cycle.

9. A conveying device according to claim 8, wherein said parameters of said drive cycle include an acceleration phase parameter, a deceleration parameter and a braking phase parameter.

10. A conveying device according to claim 1, further comprising:

    a first position encoder coupled to said converting station for detecting converting station positions;
said first position encoder having an output related to said converting station positions and coupled to said motor control;

a second position encoder coupled to said endless gripper bar chain for detecting chain positions, said second position encoder having an output related to said chain positions and coupled to said motor control; and

said motor control is operable to evaluate said outputs from said first and second position encoders to determine said drive cycle based on said evaluation.

11. A conveying device according to claim 1, further comprising:

an angular position encoder coupled to said motor for detecting motor positions, said angular position encoder having an output related to said motor positions and coupled to said motor control; and

said motor control is operable to evaluate said output from said angular position encoder and determine said drive cycle based on said evaluation.

12. A conveying device according to claim 1, wherein said conveyor can be synchronized with a processing cycle of each of said feeding station, said converting station and said delivery station.

13. A control system for a conveying device for feeding a converting press for processing material and having a press station, said control system comprising:

a drive coupled to said press station for driving said press station through a press cycle;
a conveyor having an endless gripper bar chain for conveying said material to said press station and for conveying material processed by said press station away from said press station;

5 a motor coupled to said conveyor and operable to drive said conveyor independently of said drive for said press station;

10 a motor controller coupled to said motor and operable to apply a drive cycle profile to said motor to drive said conveyor; and

15 a position sensor coupled to at least one of said press station, said conveyor and said motor, said sensor being coupled to said motor controller and operable to provide a position signal to said motor controller, whereby said drive cycle profile applied by said motor controller is influenced by a value of said position signal.