Apparatus for feeding the top sheet of a stack of paper sheets to a suction conveyor includes a vacuum pickup device for feeding the top sheet to feed rollers and onto the conveyor and an air jet manifold for riffling the front edges of the sheet for facilitating pickup. In order to prevent warp and curl of the uppermost sheet or sheets of the stack, a section of the air pressure line leading to the air jet manifold is provided with a plurality of external cooling fins and is disposed in the vacuum box of the suction conveyor in the air stream flowing to the blower inlet manifold. This cools the air flowing to the air jet manifold, and warping and curl of the uppermost sheets in the stack are minimized or prevented.

7 Claims, 5 Drawing Figures
FIG. 3  SUCTION BLOWER, 70
FIG. 2  AIR PUMP, 100
VACUUM CONVEYOR, 20
AIR JET MANIFOLD, M
FIG. 1
ANTI-CURL SHEET FEEDING APPARATUS

FIELD OF THE INVENTION

This invention relates to apparatus for separating sheets such as wrappers, coated or laminated papers or the like from a stack and feeding them to a conveyor.

DESCRIPTION OF PRIOR ART

The U.S. Pat. to Bailey, No. 2,276,683, March 17, 1942 is illustrative of the general type of sheet feeding apparatus to which the present invention relates. The apparatus includes an automatically elevated or indexed table, supporting a stack of sheets to be fed. A vacuum pickup head is operated to pick up the uppermost sheet of the stack and direct it to one or more pairs of preliminary feed rolls, whereupon the sheet passes over a glue roll and is deflected onto a suction conveyor. The suction conveyor can be of the type shown in the U.S. Pat. to Stokes, No. 1,701,317 or the U.S. Pat. to Davis, No. 1,818,198, which conveyor conducts the sheets to a processing station.

The U.S. Pat. to Leibold, 3,425,686, Feb. 4, 1969, discloses an air treating apparatus for a sheet material separator wherein air is drawn from a vacuum-type pickup head or sheet feed unit by a vacuum-type pump, is forced through a humidifier unit and emerges from discharge openings in a sheet separating blower. Water in the humidifier unit both humidifies and cools the air.

SUMMARY OF THE INVENTION

In order to insure that the pickup feeds only the top sheet in the stack, it has been customary to provide an air jet manifold at the front or delivery edge of the stack of sheets, which manifold directs a series of air jets across the top of the stack and against the front edges of the sheets in the stack. This system not only facilitates pickup of the top sheet but effects a preliminary separation of the uppermost sheets and insures that only a single sheet will be picked up by the vacuum pickup head. For sake of convenience, the source of air under pressure for the aforesaid air jet manifold is usually provided by an air pump or compressor that is associated directly with the sheet feeding apparatus.

Experience with sheet feeding apparatus of the type described has revealed that the uppermost sheet or sheets of the stack occasionally warp or curl, which effect is often aggravated in case the sheets are coated or are of a laminated construction. The aforesaid warping or curling of the sheets has interfered with the regular and uniform picking up of a single sheet and the feeding of the same to the feed rolls for the suction conveyor.

My consideration of the aforesaid sheet curling problem led to the conjecture that the problem might result from the fact that the air leading to the air jet manifold has been heated to a temperature that is somewhat above ambient temperature, and that this heating takes place in the air pump or compressor, particularly where the pump is part of or adjacent to the feeding apparatus. In other words, it was considered that the amount of energy supplied to the compressed air by the air pump or compressor might raise the temperature of the compressed air sufficiently above ambient temperature to cause the aforesaid sheet curling problem. Accordingly, steps were taken to provide a source of compressed air for the aforesaid air jet (sheet riffling) manifold which was at ambient temperature, that is, at the same temperature as that of the stack of sheets being picked up and fed. This utilization of ambient temperature air for the air jet manifold was found to eliminate or sufficiently reduce the curl or warping of the sheets to an extent that provides a uniform, consistent sheet pickup and feeding action.

Thus, and in accordance with the present invention, means are provided for cooling the compressed air flowing from the compressor source to the air jet manifold down to ambient temperature, for preventing curl and warp of at least the top sheet of the stack before that sheet is picked up and fed to the conveyor.

In a preferred embodiment of the invention, the compressed air cooling device is provided in a connecting line between an air pump associated with the machine and the air jet manifold and the cooled portion of the line is formed of metal and is provided with a plurality of cooling fins. Since most installations of the type described employ a vacuum or suction conveyor, the feeding apparatus will incorporate a suction fan or blower for drawing air through a vacuum box that supports the conveyor belt. Thus, another and preferred feature of the invention is that of disposing the cooled portion of the connecting air line, between the compressed air source and the air jet manifold, in the stream of air entering the suction blower for the vacuum conveyor. The most convenient and preferred disposition of the cooled portion of the air line is in the vacuum box or suction chamber of the vacuum conveyor, preferably at the zone of connection of the suction blower inlet manifold to the conveyor vacuum box or suction chamber.

The preferred construction of the cooled or heat exchange portion of the compressed air connecting line is one wherein the line includes a metal pipe (such as a copper pipe) provided with a plurality of cooling fins and with the finned portion of the pipe configured as a loop to present at least two successive finned portions of the line to the air stream.

The manner in which these features and advantages of the present invention can be attained will be apparent from the following detailed description of the preferred embodiment of the invention.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a fragmentary diagrammatic side elevation of a sheet feeding apparatus embodying the present invention.

FIG. 2 is an enlarged vertical section through the air jet manifold.

FIG. 3 is a partial front elevation of an air manifold assembly.

FIG. 4 is a partial plan view of an apparatus embodying the invention with parts broken away.

FIG. 5 is a section taken on line 5—5 of FIG. 4 with parts broken away.

DETAILED DESCRIPTION

Since the present invention relates to the cooling of a compressed air line leading to an air jet manifold for riffling the front edges of sheets in a stack of sheets in a paper feeding apparatus and not to design details of the entire feeding apparatus itself, only those portions of the apparatus essential to a complete understanding of the invention will be described specifically. Sheet feeding machines of the general type to which this in-
invention relates are well known, and the present invention will be described in conjunction with an apparatus for feeding sheets similar to that shown in the aforesaid patent to Bailey U.S. Pat. No. 2,276,683, the disclosure of which is incorporated herein by reference.

Referring first to FIG. 1, in the sheet feeding apparatus diagrammed herein engineering details such as framework and the like are omitted and some mechanisms which are described merely to provide a background for an understanding of the invention are shown in somewhat diagrammatic form. As is known in this art, a stack S of individual sheets P of paper is supported on a progressively elevated or indexed platform 12. The front or delivery edges of the sheets are edged by a fixed front wall 13 the upper portion of which is adjacent the uppermost sheets in the stack S.

The platform 12, as explained in detail in the aforesaid patent to Bailey, is supported on a post 14 that is vertically slideable in a stand 16. The post 14 has rack teeth 17 so that the post can be progressively elevated or indexed by a pinion 18 forming part of an automatic table indexing mechanism known in the art and exemplified by the aforesaid Bailey patent. As sheets P are removed, the table 12 is slowly raised so that the uppermost sheet is within the range of operation of the pickup and feeding apparatus.

The apparatus includes a vacuum conveyor 20 for conveying individual sheets P that have been fed to the conveyor for wrapping or other processing, the nature of which processes are not important to the present invention.

Although details of the pickup device for the uppermost sheet of the stack are not critical to the present invention, a pickup device of known design is illustrated in FIG. 1 and is like that disclosed in the aforesaid Bailey patent. This pickup comprises a nozzled vacuum bar 22 which is connected to a vacuum line 23 and the bar 22 is mounted on a bell crank arm 24 pivoted to the frame (not shown) at 26. These parts are oscillated in timed relation by a reciprocating link 28 operated by mechanism in the apparatus such as that shown in the Bailey patent. With this construction, the front edge portion of a top sheet of paper P is picked up from the stack and delivered to feed rolls.

In the feeding system illustrated diagrammatically in FIG. 3, the principles of the aforesaid Bailey patent are also employed. A first set of feed rolls includes a fixed driven feed roll 30 and an oscillating feed roll 31 which is pivoted out of the way during pickup as shown in dotted lines in FIG. 3 and is then advanced to grip the sheet just picked up against the feed roll 30, all as described in the Bailey patent. The sheet of paper P is then advanced between a second pair of driven feed rolls 32, 34 and is thus delivered upwardly between a glue applicator roll 36 and the front roll 38 of the conveyor 20. The conveyor 20 includes an aproned vacuum belt 40 which is driven by various rolls including the feed rolls 42, 44 appearing in FIG. 1. As in the case of the paper feed rolls, the conveyor drive rolls 42, 44 can be intermittently driven in accordance with mechanism shown in the aforesaid Bailey patent, it being understood that these constructions represent prior art and are not critical to the present invention.

In order to deflect the leading edge of the sheet of paper P being fed by the apparatus from the glue roll 36 onto the vacuum conveyor 20, a stripper arm or blade 46 is provided in accordance with conventional principles. Although it is to be understood that the application of glue to the paper is not an essential feature of the invention, a gluing apparatus is schematically disclosed herein. In addition to the previously mentioned glue roll 36 the glue applicator includes a glue pickup roll 48 that dips into a glue pot indicated diagrammatically at 50, and the glue roll 48 maintains a body of glue 52 in the valley between the rolls 48 and 36 for application by the glue roll 36 to the uppermost side of the sheets of paper P.

Details of a vacuum conveyor 20 suitable for use in the present invention appear in FIGS. 1, 4 and 5. The conveyor includes a combined frame and vacuum box fabricated from metal parts in a well known manner and indicated generally at 60. As seen in FIG. 5, the vacuum box 60 has a closed bottom plate 62 and side plates 64, 66. The vacuum chamber is completed by end closures (not shown) and by the top plate 68, which in the embodiment illustrated is formed of perforated sheet metal, thereby providing apertures 69 (FIG. 4) for the admission of air to the vacuum chamber.

The conveyor belt 40, previously mentioned, is formed of flexible material such as rubberized canvas and is provided with rows of apertures 41 for admitting air to the vacuum chamber. This construction, which is well known, is employed in connection with a suction blower 70, and referring to FIG. 1 the blower can either be driven from a main drive motor 72 which drives the mechanical portion of the apparatus previously described, but in the preferred embodiment the blower is driven by an individual hydraulic or electric motor 73 associated with the blower.

The blower system includes an air inlet manifold 74 (FIG. 1) that is connected to the side plate 66 (FIGS. 4 and 5) of the vacuum chamber. This side plate is apertured at 76, 78 (FIGS. 1 and 4) so that the blower 70 can draw air from the interior of the vacuum belt suction to the conduit 74 and out the blower exhaust duct 79 (FIG. 1).

With the construction just described, and particularly when apertures 41 in the vacuum belt 40 are closed by sheets of paper P, a sub-atmospheric pressure is induced in the suction chamber of the conveyor so that atmospheric pressure on the sheets of paper P on the conveyor augments the frictional grip of the conveyor belt to maintain the sheets in position.

AIR JET SYSTEM

The air jet system includes an air jet manifold assembly indicated generally at M disposed adjacent the delivery or front edges of the sheets in the stack S. As best seen in FIGS. 2 and 3, the manifold assembly M includes a plurality of laterally spaced manifold blocks 80 which are positioned in front of notches 82 formed in the upper edge of the stack guide plate 13. The number and disposition of the blocks 80 is determined by the width of the apparatus, varies from machine to machine, and is not critical to the invention. Each of the blocks 80 is formed with a vertical array of small nozzles or orifices 84 from which jets of air are directed to rifle up the associated edges of the uppermost sheets of paper P in the stack. Each block 80 is counterbored or otherwise chamfered at 86 (FIG. 2) to conduct air to the orifices 84, and the bore 86 is connected to an air delivery nipple 88. Each nipple is connected by a suitable coupling, such as a short length of flexible tubing 90, with matching nipples 91 projecting from a
manifold pipe 92. The manner in which the blocks 80 are affixed to the apparatus is not important, but as seen in FIG. 3, small clips 94 can be secured to each block 80 and screwed to the sheet guide plate 13. A stripper tab 95 is secured to the top of each block 80 to assist in stripping a sheet P from the vacuum 22 as the latter is raised by the link 28, previously described.

As seen in FIG. 1, a source of air under pressure for the manifold assembly M is provided by an air pump 100. The inlet line 23a for this pump can if desired, be connected to the suction line 23 for the vacuum pickup bar 22 previously described. It is also possible, as in the aforesaid Bailey patent, to supply a separate suction pump for the vacuum bar pickup line 23.

The air pump 100 is preferably driven, in the embodiment disclosed, by its own hydraulic or electric motor 102 and has an air delivery line 104 which may be a flexible hose, and is connected to a nipple 106 leading to an air cooling heat exchanger indicated generally at 108 (FIG. 4). The air cooling heat exchanger 108 is positioned in the suction chamber of the vacuum conveyor and is disposed at the side wall apertures 76, 78 for the vacuum blower inlet manifold 74.

The air cooler 108 presents an extended surface to the stream of air flowing through the suction chamber of the vacuum conveyor, out through the apertures 78, 78 and down through the blower inlet manifold 74 to the blower.

In order to provide an extended surface heat exchanger, the heat exchanger unit 108 is formed as a U-shaped loop having connected legs 110, 112 carrying a plurality of closely spaced fins 114, the fins being secured to the legs in a manner well known in the heat exchange art. The finned tubing section 108 is preferably made of a metal having a high coefficient of thermal conductivity, such as copper tubing, with the fins 114 also being made of a good heat conducting metal. The construction of finned heat exchangers of this type is well known, they are used as inter-coolers for air compressors and as heat sources in residential hot water or heating systems.

Compressed air leaving the heat exchanger 108 is conducted from the heat exchange leg 112 out through a nipple 115, which like the nipple 106 extends through the side plate 66 of the conveyor suction chamber (FIG. 4). A connection such as a flexible hose 116 runs from the compressed air discharge nipple 115 of the heat exchanger unit 108 to the manifold pipe 92 as seen in FIG. 1, for providing cooled jets of air that rifle the sheets P, as described.

In operation, sheets of paper P are picked up from the top of the stack S by the vacuum bar 22 and fed onto the vacuum conveyor 20 via the feed rollers 30, 31 and 32, 34 (FIG. 1) as previously described. Jets of air issuing from the orifices or nozzles 84 in the blocks 80 of the manifold assembly M rifle up the uppermost sheets, as seen diagrammatically in FIG. 2. As previously mentioned, it has been found that in prior devices the energy imparted to the air by the air pump 100, which is preferably at the machine 10 and hence may be closely adjacent to the air jet manifold assembly M, is sufficient to raise the temperature of the air emitted from the manifold orifices 84 to a temperature that is somewhat above ambient temperature. However, in the present device and as illustrated in FIGS. 4 and 5, an external stream of air at ambient temperature flows down through the vacuum belt apertures 41, the sup-
porting plate apertures 69, into the suction chamber of the vacuum conveyor 20, over the heat exchanger assembly 108 and down into the blower inlet manifold 74. The relation of the area of the extended surface provided by the fins 114 to the rate of flow of compressed air through the heat exchanger unit 108 is selected so that the external stream of air, even when portions of the vacuum belt 40 are covered by sheets of paper P, will cool the compressed air leaving the heat exchange assembly 108 down to ambient temperature. As also previously mentioned, although the degree of cooling provided only brings the temperature of the air emitting from the manifold orifices 84 down to ambient temperature, since the sheets of paper P are also ambient temperature, this cooling effect is sufficient to prevent the curl and warping of the sheets.

Thus, by a relatively simple expedient, the troublesome problem that has arisen in sheet feeding apparatus of the type to which this invention relates has been solved. Although air jet manifolds of the type disclosed herein have been employed for many years, with the attendant curling problems, applicants recognize that the slight elevation of the air jet temperature above ambient temperature causes these problems, and that this temperature difference can be removed by the simple apparatus disclosed herein represents an improvement in the apparatus.

Although the best mode contemplated for carrying out the present invention has been herein shown and described, it will be apparent that modification and variation may be made without departing from what is regarded to be the subject matter of the invention.

What I claim is:

1. Apparatus for feeding the top sheet of a stack of sheets of paper to a sheet conveyor which conveyor includes a suction chamber having an apertured top, an apertured vacuum belt conveyor running along said top, a suction blower connected to said suction chamber, air pump means at said apparatus, an air line connecting said air pump means to an air jet manifold, said manifold being at the sheet delivery side of said stack and delivering jets of air for riffling the edges of the sheets and means for picking up and feeding the top sheet to said conveyor; the improvement wherein a portion of said air line connecting said air pump means to said manifold is disposed in the stream of air entering said suction blower for cooling the air pumped through the air line substantially down to ambient temperature, for preventing curl and warp of the top sheet of the stack by heat from said manifold air jets.

2. Apparatus for feeding the top sheet of a stack of sheets of paper to a sheet conveyor which conveyor includes a suction chamber having an apertured top, an apertured vacuum belt conveyor running along said top, a suction blower connected to said suction chamber, an air compressor at said apparatus, an air line connecting said compressor to an air jet manifold, said manifold being at the sheet delivery side of said stack and delivering jets of air for riffling the edges of the sheets and means for picking up and feeding the top sheet to said conveyor, the improvement wherein a portion of said connecting air line is disposed in the stream of air entering said suction blower for cooling the compressed air in the line down to ambient temperature, for preventing curl and warp of the top sheet of the stack by heat from said manifold air jets.
3,865,364

3. The apparatus of claim 2, whereby the cooled portion of said air line comprises a metal line that is provided with a plurality of external cooling fins.

4. The apparatus of claim 2, wherein said cooled portion of said connecting air line is disposed in said conveyor suction chamber.

5. The apparatus of claim 4, wherein said cooled portion of said air line is disposed in said conveyor suction chamber adjacent the zone of connection of said suction blower to the chamber.

6. The apparatus of claim 5, wherein said cooled portion of said connecting air comprises a metal line that is provided with a plurality of external cooling fins.

7. The apparatus of claim 6, wherein said finned portion of said air line is configured to present two successive finned portions to said air stream.

* * * * *