June 27, 1967 J. G. SCHMIDTKE 3,328,027

SHEET DELIVERY UNIT

Filed May 24, 1965 2 Sheets-Sheet 1

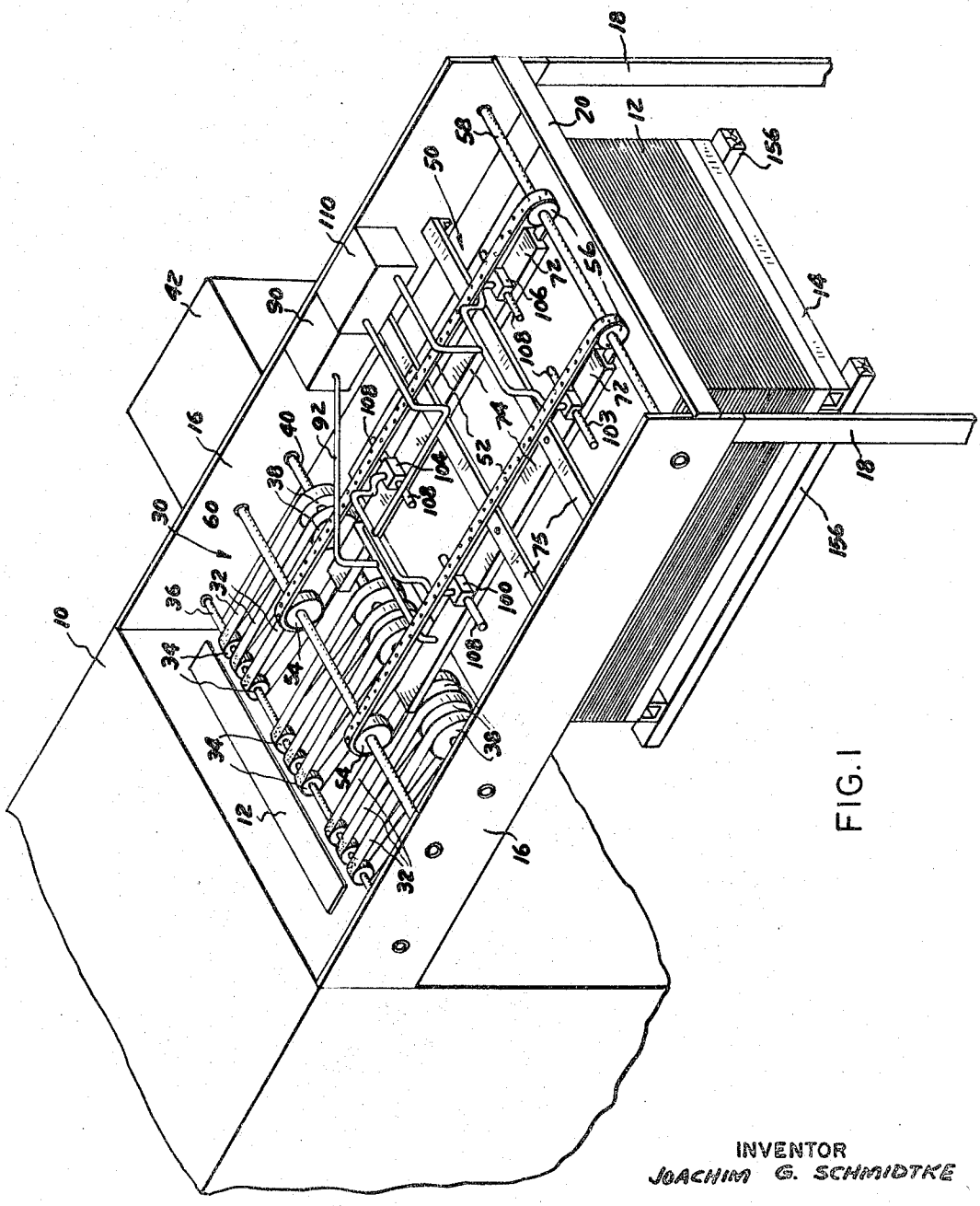

FIG. 1

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SHEET DELIVERY UNIT

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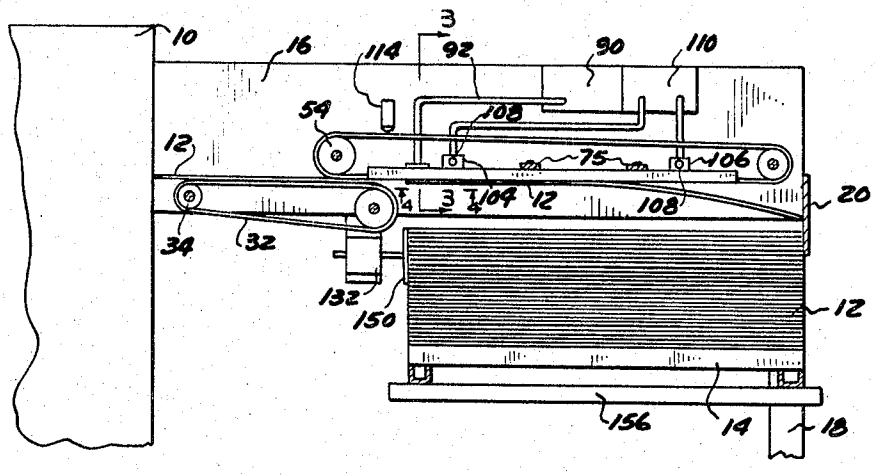

FIG. 2

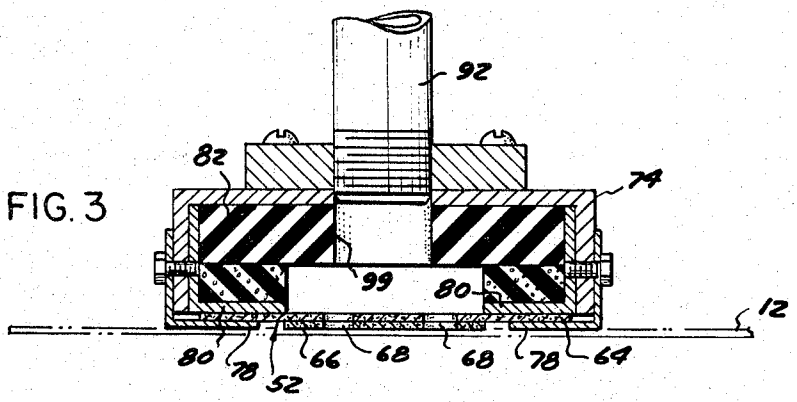

FIG. 3

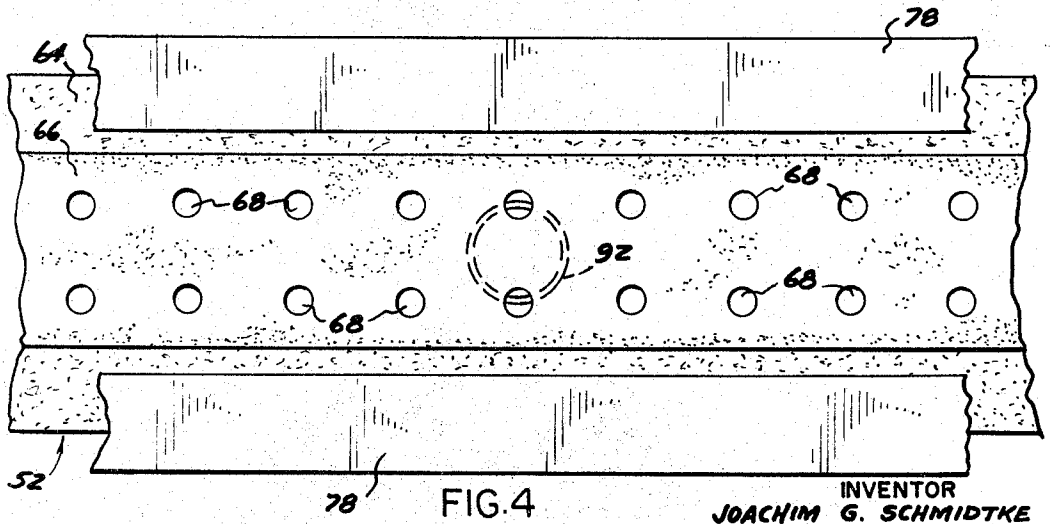

FIG. 4

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SHEET DELIVERY UNIT

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4 Claims. (Cl. 271—68)

This invention relates to a delivery unit operative to receive sheets of material such as paper and the like from a processing unit and to stack the sheets one above the other.

The present invention is useful in connection with a wide variety of operating machines such as bronzing machines, presses, shears, and the like, used in graphic arts and other industries, which provide as their output a series of relatively large thin sheets. If these sheets are relatively short they may be directly received in a pile on top of the skid. The skid may be lower in timed relation to the feed of sheets from the machine in order to maintain the top of the stack at approximately the delivery level. When the sheets are relatively long, the force with which they are rejected from the bronzing machine or other similar unit, may not be sufficient to cause them to move through the entire width of the stack under their own power. The situations in which this problem occurs are dependent upon the width, weight, and thickness of the paper, and the manner in which it is ejected from the operating machine. When additional energy must be imparted to the sheets in order to cause them to stack regularly it is the present practice to employ what are termed ejection tapes. These tapes consist of a conveyor-like arrangement of narrow closed loops which are disposed immediately below the ejection level of the operating machine and which support the sheets on their underside and impart sufficient energy to the sheets so that they will shoot across the width of the previous sheets so as to neatly stack thereon.

The present invention is addressed to those situations where the width of the sheet being operated upon is sufficiently great and the sheet is sufficiently thin so that ejection tapes will not cause the ejected sheets to move across the width of the stack with sufficient energy to insure a neat stack. In essence it consists of a conveyor belt comprising a number of closed loops which are disposed parallel to the ejection tapes with one end over the output end of the ejection tapes and the other end over the final stack. Unique vacuum means are provided to attract the forward edge of a sheet passing over the ejection tapes to this upper conveyor. The conveyor then carries the sheets over the stack and releases them so that they pile up neatly.

In a preferred embodiment of the invention, which will subsequently be described in detail, the operating unit in connection with which the invention is employed, is a bronzing machine. This unit delivers the forward edge of its output sheets to the beginning of a group of closed loop ejection tapes moving in lines parallel to the direction of delivery of the sheets. A plurality of closed loop over head vacuum belts extend from a line adjacent to the output ends of the ejection tapes across the major part of the width of the stack. These tapes consist of elongated closed loop belts with perforations at regular intervals which rotate about a pair of parallel separated axes disposed in the horizontal plane. The lower side is active and contacts the paper and the upper side is simply the return. On the lower side the belt moves through an elongated vacuum manifold. The manifold acts to draw in air through the perforations in the belt. A vacuum pressure connection is made to the manifold adjacent to the end disposed over the ejection tapes so that a maximum suction is exerted on sheets at that end and the force of retention of the sheets decreases along the length of the belt to a level insufficient to support the sheets at the extreme end adjacent to the forward end of the paper stack.

The vacuum belts are moved in synchronism with the ejection tape so that a sheet delivered to the ejection tapes from the machine moves across the length of these tapes and is then picked up by the rear edge of the vacuum belt and lifted and carried across the width of the sheet stack. As the forward edge of the sheet approaches the end of the stack, it begins to drop off and fall on top of the previously stacked sheets.

As the sheet reaches this position an air blast is directed at the sheet from positions intermediate on the vacuum belts. This blast is downwardly directed and acts to free the sheet from the vacuum belt and move it downwardly onto the stack. The air blast is actuated by photo-electric detection means which senses the approach of the forward end of the next sheet into position with respect to the forward end of the vacuum belts.

The stack incorporates previously known means to lower a supporting skid in timed relation to the addition of sheets to the top of the stack in order to maintain the stack height at proper delivery height, as well as jogger means which bear against the edge of the stack to maintain it in an aligned manner.

It is therefore seen to be a primary object of the present invention to provide a delivery system for a machine operating upon sheet goods which includes a moving vacuum belt system disposed above the delivery height of the sheets operative to draw the sheet upwardly and convey them over a stack of previously delivered sheets and then to deposit them on this stack.

Another object is to provide such a system wherein the upwardly acting vacuum force exerted on the sheets decreases as the sheet becomes properly positioned over the stack and positive ejection means are employed to separate the sheet from the vacuum belt at the proper point.

Another object is to provide such a system wherein ejection tapes are employed to convey the sheets from the operating machine and a vacuum delivery belt is disposed parallel to the ejection tapes with one end over the forward end of the ejection tapes and its other end near, but separated from, the forward end of the stacked sheets.

Another object is to provide such a delivery system wherein the vacuum belt consists of a closed loop of belt having regular perforations therein which moves in a closed return path over a pair of end rolls and wherein a manifold is provided for the lower side of the belt, the manifold having a vacuum inlet which is exhausted through the perforations of the belt.

A still further object is to provide such a system wherein the positive ejection means consists of an air blast triggered by a photo-electric sensing mechanism which detects the position of the sheet with respect to the stack.

Other objects, advantages and applications of the present invention will be made apparent by the following detailed description of a preferred embodiment of the invention. The description makes reference to the accompanying drawings wherein:

FIGURE 1 is a perspective view of a delivery system formed in accordance with the present invention;

FIGURE 2 is a side view of the delivery system of FIGURE 1;

FIGURE 3 is a longitudinal sectional view through the vacuum tape taken along lines 3—3 of FIGURE 2; and

FIGURE 4 is a transverse sectional view through the vacuum tape taken along lines 4—4 of FIGURE 3.

Referring to the drawings, the preferred embodiment of the delivery system is shown as receiving the output of an operating machine 10. I developed the delivery

system of the present invention for specific use in connection with a bronzing machine which forms metallic decoration on paper, but the delivery system is equally applicable for use with other machines employed in the graphic art industry which operate on separated sheet material as opposed to material in a continuous roll form. For example the delivery system might be useful in connection with printing presses, shearers, embossing machines, and the like. The delivery system is also useful in connection with machines in other industries which operate on relatively large sheets, whether the material of the sheets be paper or cloth, plastic, and the like.

The machine **10** regularly feeds out paper **12** cut in regularly relatively wide, sheets. The object of the delivery system is to neatly stack the sheets **12** on a pallet **14**. Forces generated by static electricity prevent the proper stacking without the provision of additional powering means. While the solution to the problem might lie in providing additional energy to the ejection system to the machine **10**, if the sheet is sufficiently thin and light in weight, the amount of energy of motion which may be imparted to it is limited and relatively small compared to the resistance encountered in motion through the air.

The delivery system of the present invention is supported between a pair of elongated vertically aligned side plates **16** which are supported on the frame of the machine **10** at one end and on vertical posts **18** at the other end. The side plates **16** are aligned parallel to one another and to the direction of feed of the sheets **12** from the machine **10** and are disposed about the same height as the sheets **12** are delivered from the machine **10**, preferably extending both above and below this delivery height. At their extreme forward ends (the ends opposite to the machine **10**) they support a vertical plate **20** which extends transversely to the axis of delivery of the sheets **12** and constitutes a backing plate which the forward edges of the sheets abut to terminate their forward motion. The backing plate **20** is disposed at slightly below the height of delivery of the sheets from the machine as they move downwardly slightly during their motion from the machine to the backing plate.

Immediately forward of the line at which the sheets **12** are rejected from the machine **10**, the side plates **16** support an ejection tape system generally indicated at **30**. The ejection tapes **32** which form part of this system consist of elongated closed loop bands of relatively narrow material preferably having a high friction surface. Nine ejection tapes **32** are employed in the preferred embodiment and they are arrayed in three groups of three each. The loops are journalled at their rear ends on pulleys **34** which are rotatably supported on a shaft **36** having its ends fixed in the two opposed side plates **16**. The shaft **36** extends normally to the axis of ejection of the sheets **12** from the machine **10**. The other ends of the ejection tapes **32** are formed about nine pulleys **38** which are larger than the pulleys **34** and which are fixed to a rotating shaft **40**.

One end of the shaft **40** passes through one of the side plates **16** and is connected to a motor drive system **42** of any suitable type. In the preferred embodiment this drive system rotates the shaft constantly but in other embodiments of the invention it might be intermittently rotated or might be driven off of the serviced machine **10**. The upper edges of the drive pulleys **38** and the driven pulleys **34** lie in the same horizontal plane so that the top edges of the ejection tapes **32** extend horizontally. The drive pulleys are relatively larger than the driven pulleys **34** in the preferred embodiment to provide a sufficient degree of driving friction.

The overhead vacuum tape system generally indicated at **50** consists of a pair of thin elongated belts **52** journalled about a pair of rear driving pulleys **54** and a pair of smaller driven pulleys **56**. The driven pulleys **56** are rotatably supported on a shaft **58** journalled in the side plates **16** and extending transversely to the axis of sheet feed. The driving pulleys **54** are fixed to a rotatable shaft **60** that passes through the wall of one of the side plates and is also powered by the motor drive system **42** at the same speed as the ejection tapes system **30**.

The shaft **60** is positioned above the tapes **32** and slightly behind the shaft **40**. The fixed shaft **58** is disposed near the forward edge of the stack of previous sheets **12** which are disposed on the pallet **14**. The heights of the pulleys **54** and **56** are arranged so that the lower sides of the belts extend in the horizontal plane. Because of the location of the pulleys the belts extend from a point slightly to the rear of the forward edge of the tapes **32** almost across the entire width of the stack of sheets **12**. The belts **52** each consist of a relatively wide base member **64** with a narrower section **66** attached to one side and extending down the middle of the belt. The relatively wide backing member **64** may be formed of canvas or other conventional belt material and is preferably chosen for its strength and long life. The extending section **66** is preferably formed of felt or other soft material which may be brought into intimate contact with a paper sheet. A pattern of perforations **68** is formed through both the backing belt **64** and the extending section **66** regularly along the center of the belt.

The lower sides of the belts **52** pass through a pair of vacuum manifold channels **72** which extend in the horizontal plane between the pulleys **54** and **56**. The channels **72** are supported under a pair of cross members **74** which extend between the side plates **16**. The channels have a basic U configuration with inturned flanges **78**. A pair of inner flanges **80** extend inward partially across the section of the channel **72** spaced from the flanges **78**. The backing section **64** of the belt is slightly thinner than the space between the flanges **78** and **80** and rides through this space.

The extending section **66** of the belt passes through the aperture between the opposed edges of the inturned flanges **78** and has a thickness greater than those flanges so that its surface extends beyond their surfaces. The upper section of the manifold is filled with a stiffening material **82** which extends to a level slightly separated from the upper edge of the internal flanges **80**. The space between the upper sides of the flanges **80** and the bottom of the material **82** forms a vacuum chamber.

A blower unit **90** supported on one of the side plates **16** draws in air so as to produce a vacuum within the space between the flanges **80** and the stiffening material **82** by means of tubes **92** which connect through apertures **94** on the top side of the channel members at points adjacent to the ends associated with the pulleys **54**. The channel member acts as a manifold to draw air through the aperture **68** in the belt. A stronger suction exists at the ends of the belts adjacent to the connections to the tubes **92** than at the other extreme ends adjacent to the pulleys **56** and the force of suction tapers along the belt.

Two pairs of air ejection members **100** and **102**, **104** and **106** are supported on top of the two manifold vacuum channels **72**. The units **100** and **104** are located adjacent to one end of each of the channels and the units **102** and **106** are located adjacent to the opposite end. These units each include extending pipes **108** which project outwardly on both sides of the channel members. The pipes contain holes on their lower sides. The units receive air from a blower unit **110** at appropriate controlled intervals. When air is passed to the tubes **108** a downward force is exerted on a sheet held by the vacuum belts and the sheet is ejected onto the previous stack of sheets **12**. The ejection of air through the pipes **108** is controlled by a photo cell unit **114** which senses the end of a sheet being fed on to the vacuum units by the ejection tapes. The photo cell **114** is located above the sheets adjacent to the forward end of the delivery system. When it senses the front of

the following sheet and actuates the blower **110** to provide an air blast through the pipes **108** the sheet in the vacuum belt is ejected therefrom.

In operation, the leading edge of a sheet **12** fed out of the operating machine **10** by suitable mechanism associated with that machine (not shown) falls on to the rear end of the ejection belts **32** and is carried forward along the belts, by their motion, until the forward edge of the sheet is in proximity to the rear edges of the vacuum belts **52**. The lower sides of the vacuum belts are spaced with respect to the upper surfaces of the ejection belts **32** so that the forward edge of a sheet is drawn upwardly against the extending sections **66** of the vacuum belt. The soft surface of each belt allows the sheet to at least partially seal off the vacuum aperture **68** in the belt. As succeeding elements along the sheet reach the vacuum, belt, they too are drawn up until the entire length of the sheet is in contact with the belt.

By this time the forward edge of the sheet has reached a section of the vacuum belt adjacent to the end of the manifold **72** quite removed from the vacuum source **99**. Accordingly the suction becomes insufficient to maintain the forward edge and, as is seen in FIGURE 2, the forward edge begins to fall from the manifold against the paper stack. When the trailing edge of the sheet reaches the photocell arrangement **114** an air blast is initiated through the pipes **108** causing a downward force on the entire sheet which overcomes the suction force and blows the sheet downwardly on the top of the stack. This ejection point may come just before the forward end of the sheet reaches the forward end of the pile because of the inertia of the sheet. The forward end of the sheet should have sufficient force to abut the stop plate **20** so as to position the sheet with respect to the stack.

The exact stack arrangement does not form part of the present invention but the unit employed in connection with the preferred embodiment of the invention incorporates an edge aligning unit **150** consisting of a flat plate which abuts the rear end of the sheet is energized by a suitable actuator **152** so as to bear against these edges of the sheet and align them against the backing plate **20**. The pallet **14** is supported on a lowering mechanism which includes a pair of parallel bars **156** disposed under opposed edges of the pallet. The bars are supported by mechanism which is adapted to lower them in timed relation to the addition of sheets to the stack in some suitable manner. This mechanism maintains the stack height of the sheets at the same delivery point independently of the number of sheets in the stack.

Having thus described my invention, I claim:

1. A delivery system for an operating machine which delivers cut sheets at a delivery height, the system being operative to remove the sheets from the machine and to stack them one above the other, comprising: a plurality of elongated, closed loop ejection belts disposed with their upper sides just below the delivery height; means for rotating said belts so as to move sheets delivered to their input side toward their output sides; an array of closed loop vacuum belts having a plurality of closely spaced apertures formed therein disposed with an input side above the output side of a set of ejection belts, and parallel to said ejection belts; means for continuously drawing air through all the apertures in the lower section of said vacuum belts so as to draw sheets disposed on the output end of the ejection belts to the input end of the vacuum belts; means for rotating the vacuum belts to move the sheet disposed at the input end across the vacuum belts; a separate ejection means disposed adjacent said vacuum belts to their output ends and operative simultaneously with the means for continuously drawing air through all the apertures to provide a force to sheets supported by said vacuum belts in the direction away from the vacuum belt; and a stack operative to receive successive sheets delivered from said vacuum belt.

2. The system of claim **1** wherein the ejection means comprise ejection nozzles attached to an air supply operative to provide an air blast against the sheets retained in the vacuum belt upon receipt of an appropriate control signal.

3. The structure of claim **1** wherein the means for drawing air through the lower side of the vacuum belts consists of a manifold surrounding the upper side of the vacuum belt and means for drawing air from the manifold so as to cause a flow of air inwardly through the lower side of the vacuum belts.

4. The structure of claim **1** wherein each of the vacuum belts has a relatively wide backing section and a relatively narrow extending section centered on the outer side of the backing section and the apertures are formed through the backing section and the extending section and the means for continuously drawing air through the apertures consists of manifolds associated with each of the belts, each manifold having a generally downturned U configuration with inturned flanges on the extreme ends surrounding the belts so that the extending section of the belt passes between the aperture and the flanges.

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