July 9, 1968 H. E. MOWRY ET AL 3,391,928

SHEET TRANSFER APPARATUS

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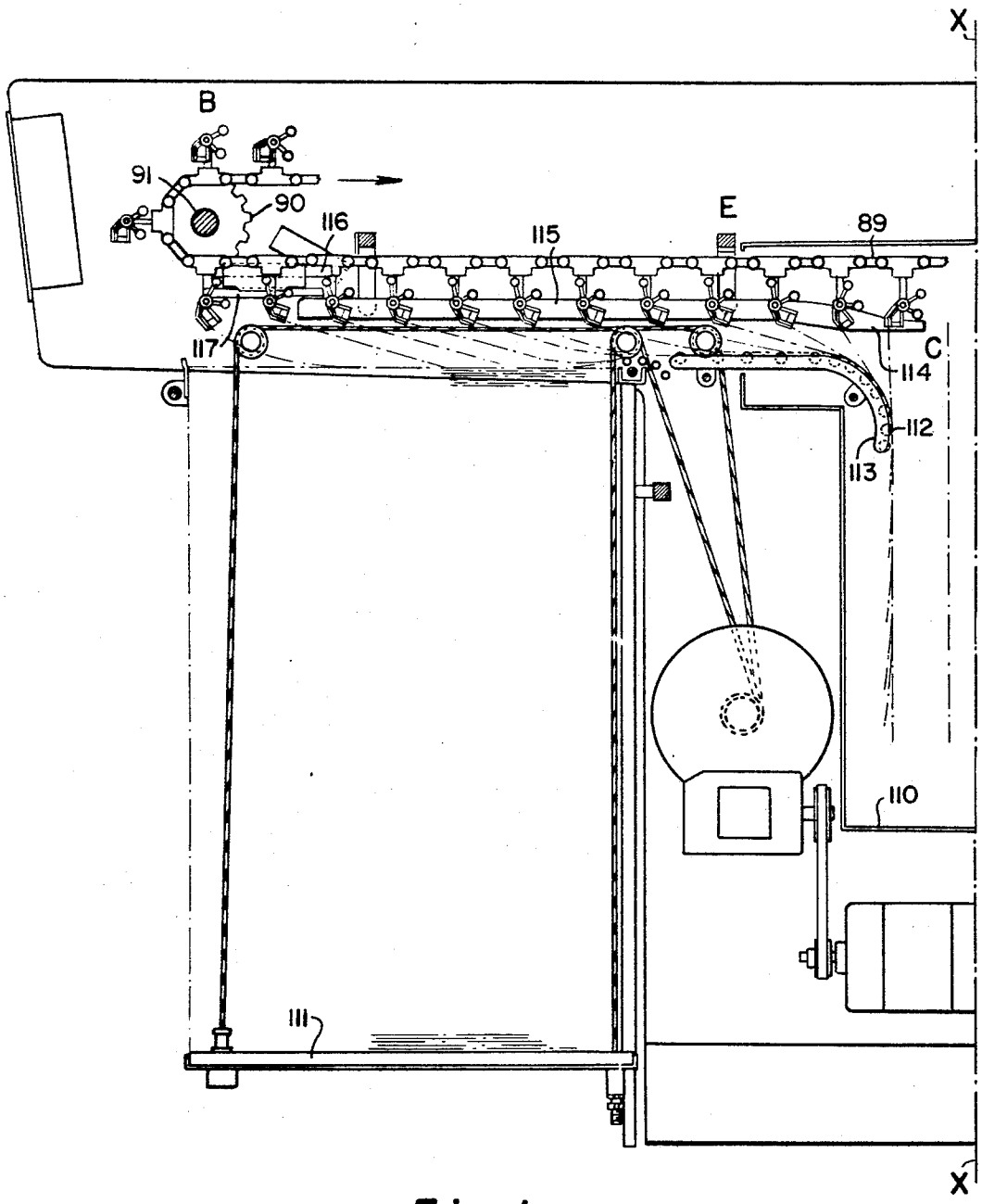


Fig. 1a

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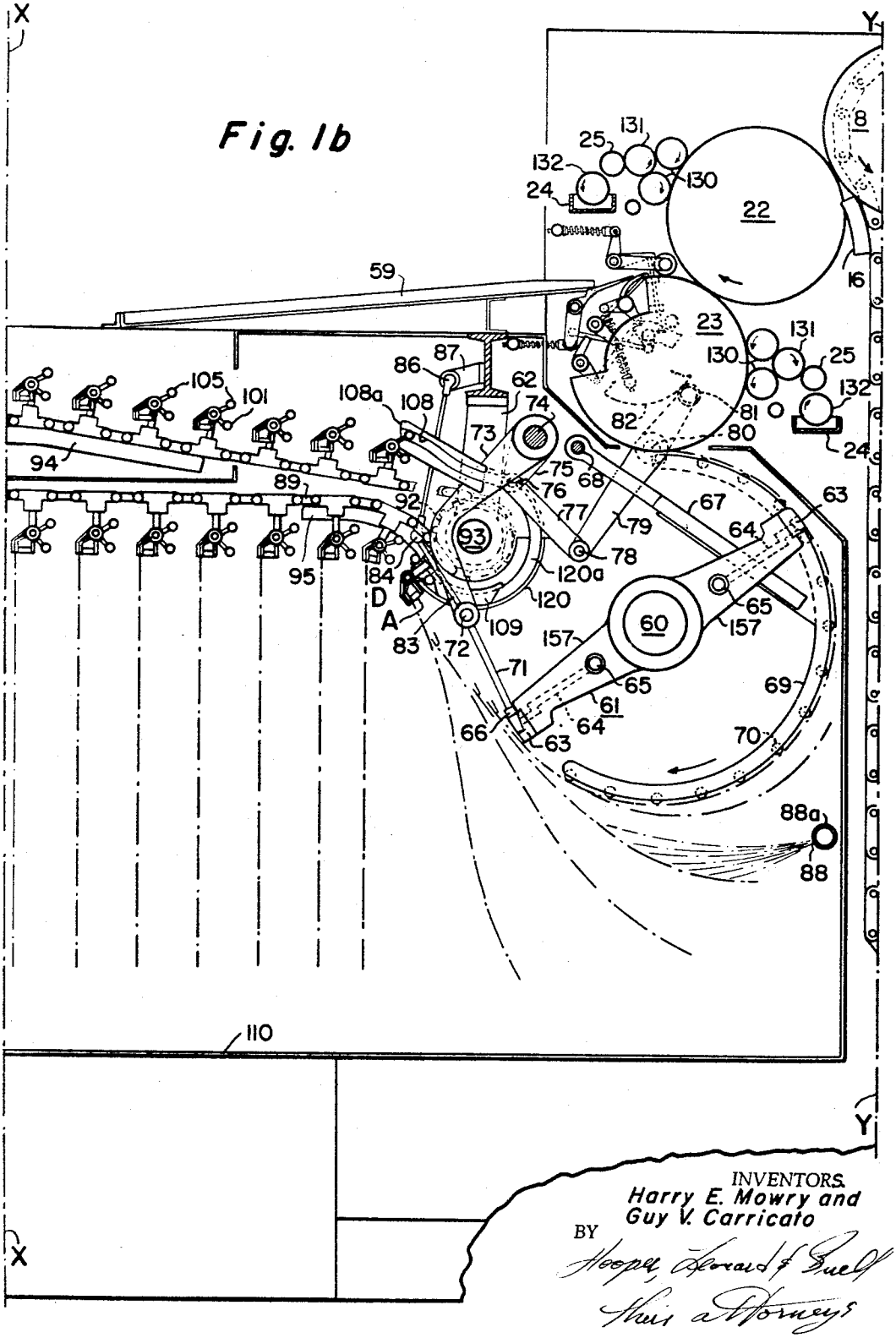
BY
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SHEET TRANSFER APPARATUS

Filed Oct. 8, 1965 8 Sheets-Sheet 2

Fig. 1b



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SHEET TRANSFER APPARATUS

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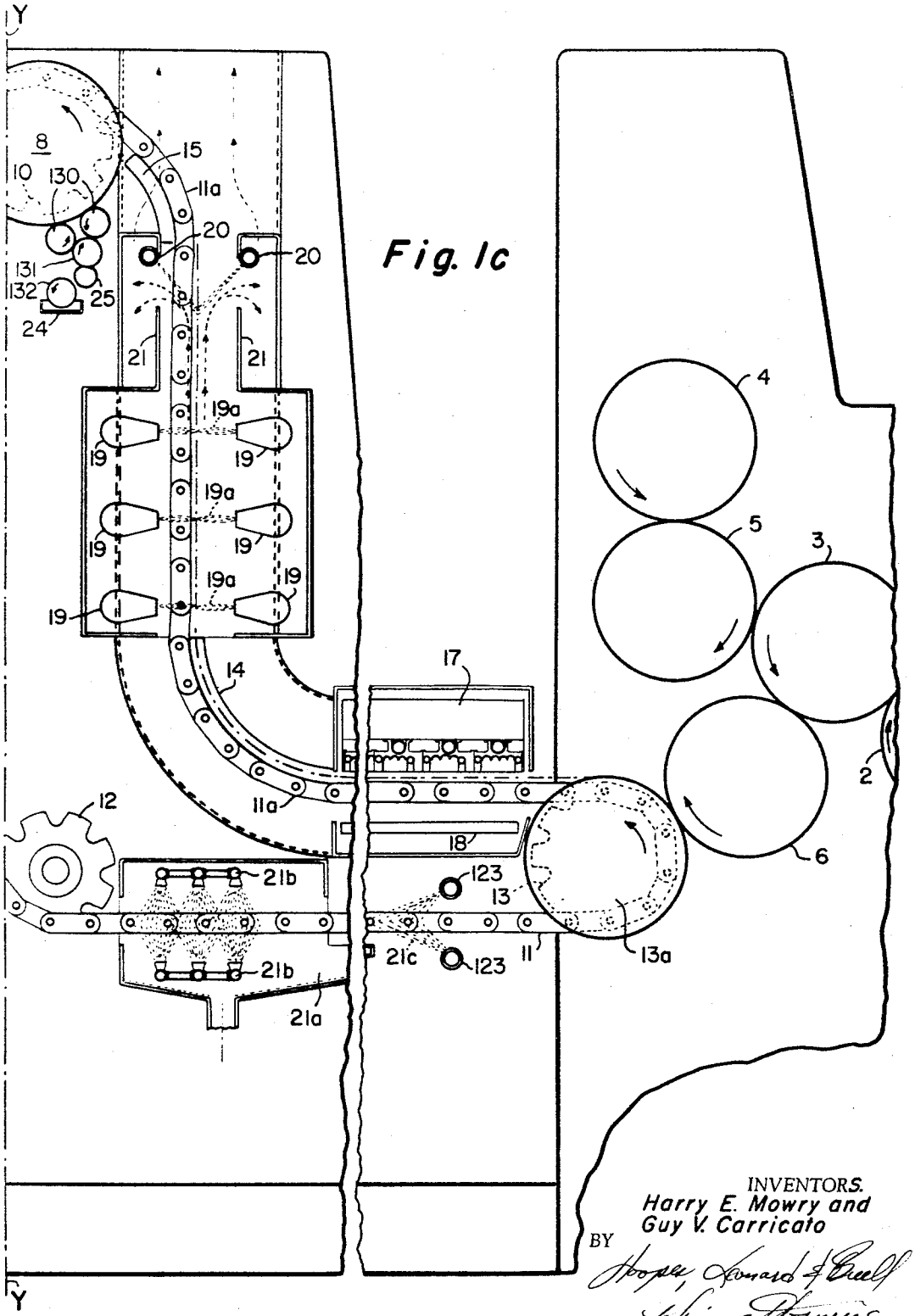


Fig. 1c

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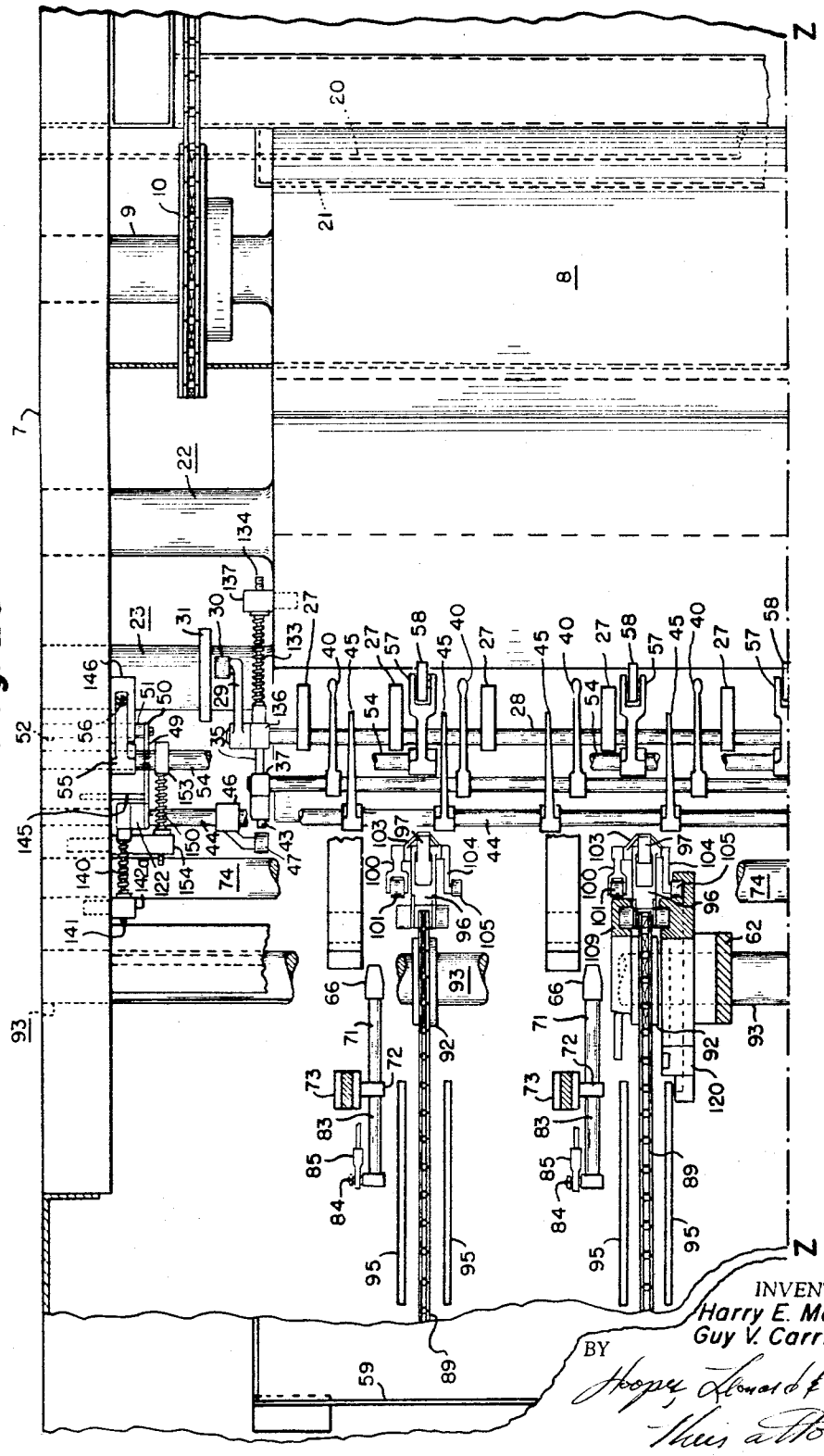
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SHEET TRANSFER APPARATUS

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Fig. 2a



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SHEET TRANSFER APPARATUS

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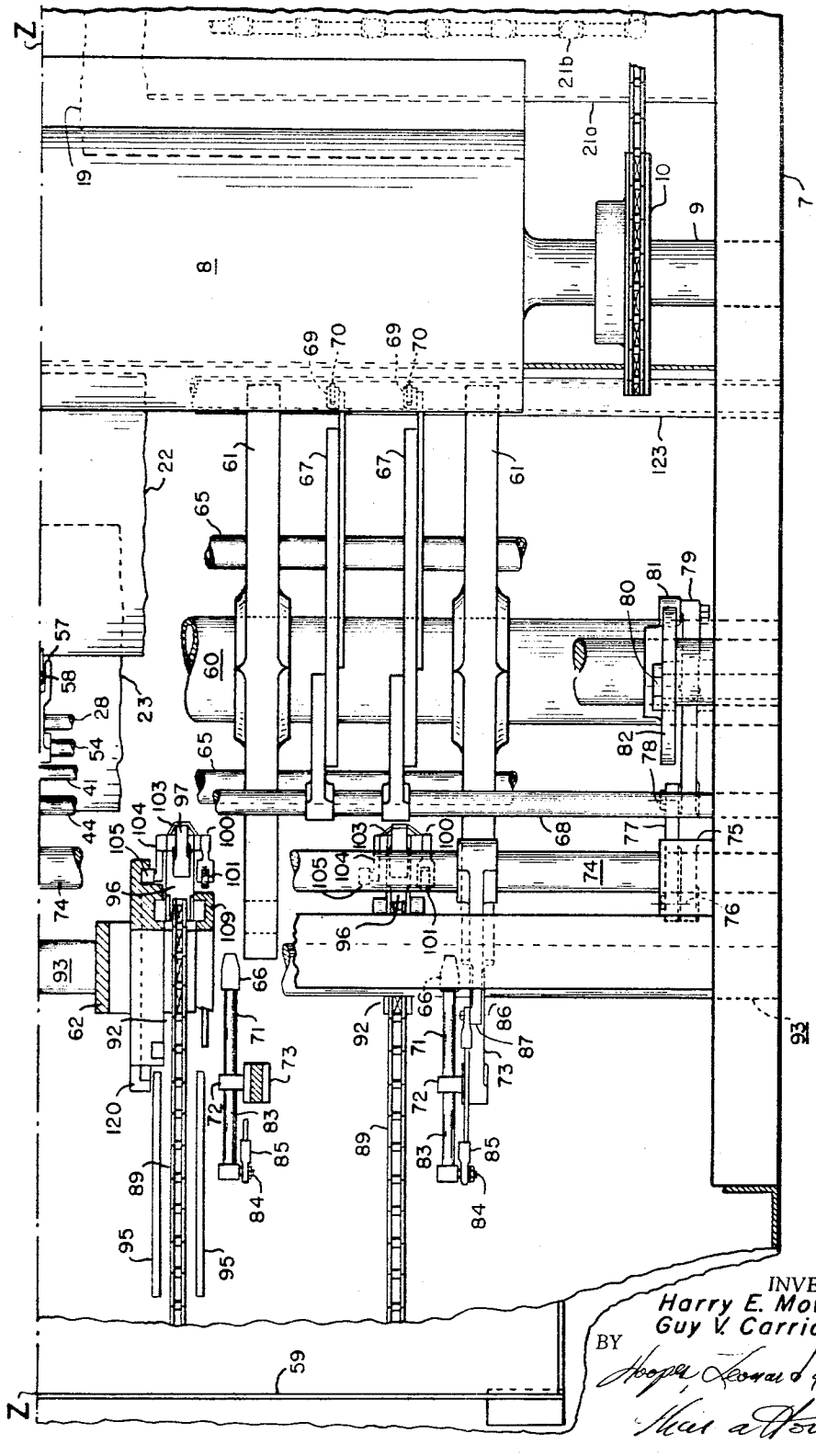


Fig. 2b

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SHEET TRANSFER APPARATUS

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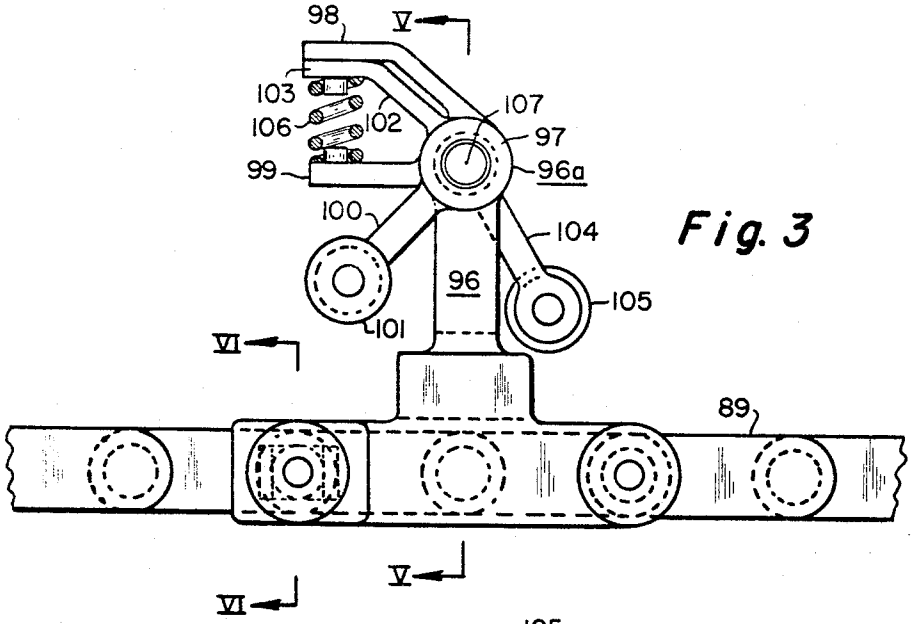


Fig. 3

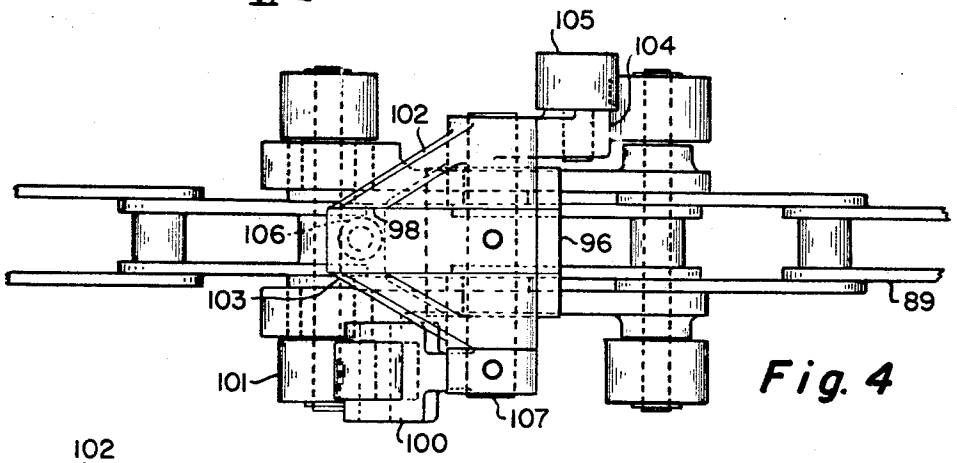


Fig. 4

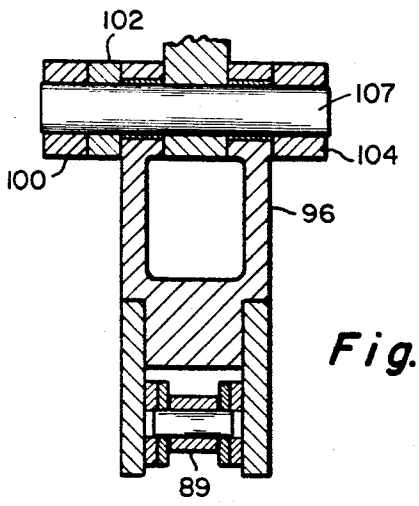


Fig. 5

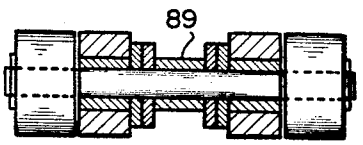


Fig. 6

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SHEET TRANSFER APPARATUS

Filed Oct. 8, 1965 8 Sheets-Sheet 7

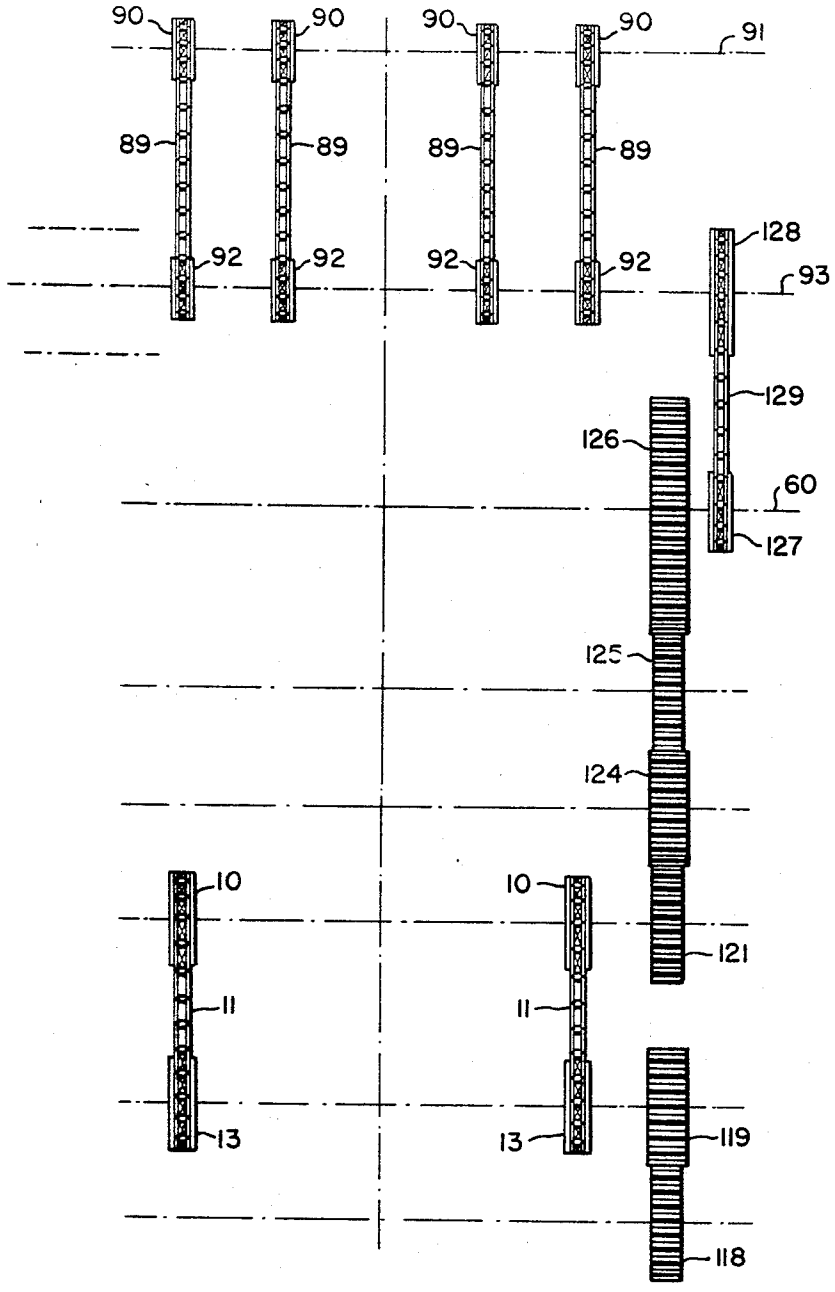


Fig. 7

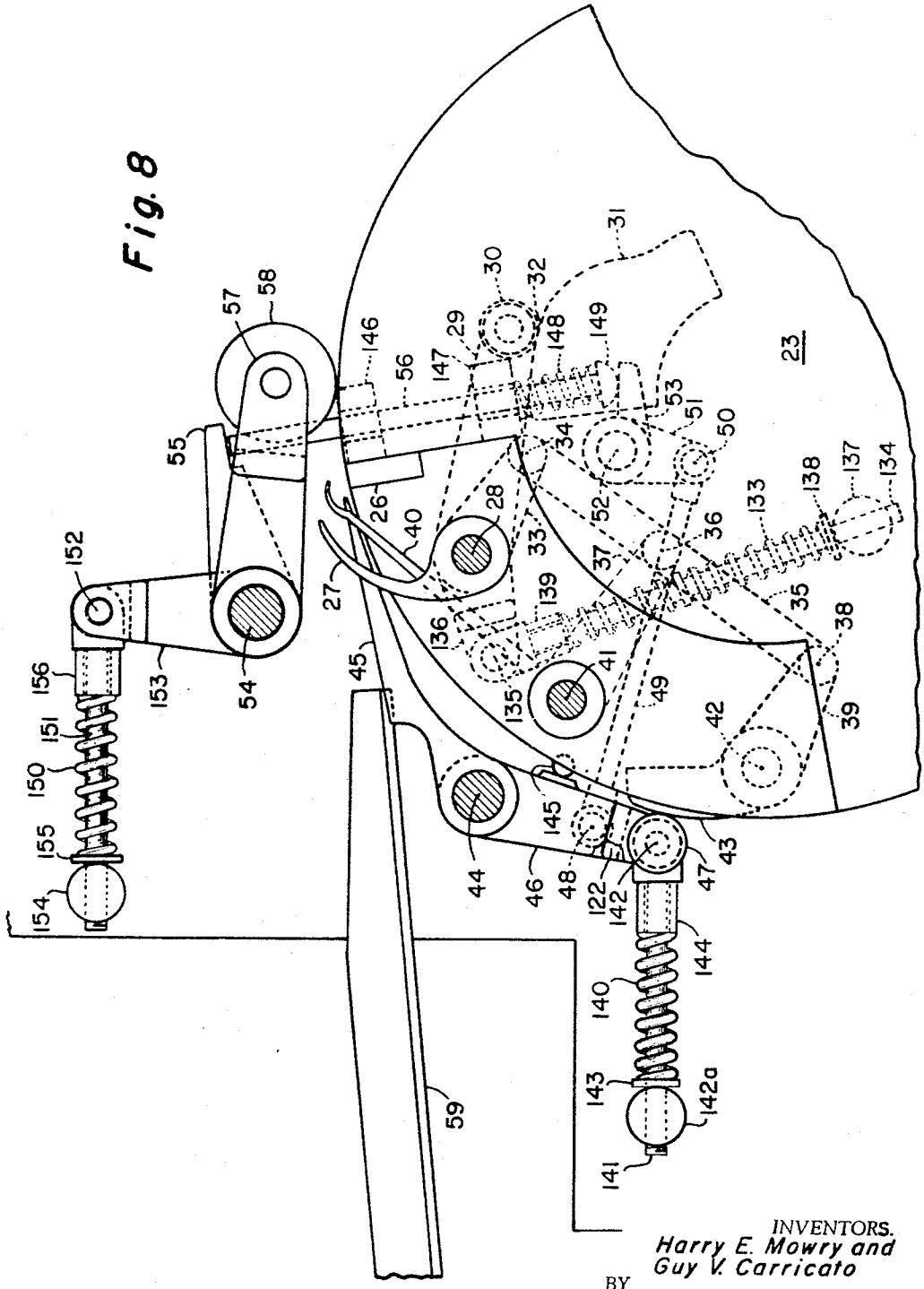
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SHEET TRANSFER APPARATUS

Filed Oct. 8, 1965 8 Sheets-Sheet 8

Fig. 8



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United States Patent Office 3,391,928 Patented July 9, 1968

3,391,928

SHEET TRANSFER APPARATUS

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Filed Oct. 8, 1965, Ser. No. 494,185
7 Claims. (Cl. 271—71)

ABSTRACT OF THE DISCLOSURE

Apparatus for handling sheets. The sheets are transferred from an edgewise relation one after the one to a generally spaced apart face to face relation by a rotatable first transfer member having diametrically opposed radially extending arms with sucker means at their extremities and a reciprocable second transfer member having other sucker means for engaging the sheets. The sheets are engaged by the sucker means on the rotatable first transfer member and carried in an arcuate path to a location where the other sucker means on the reciprocable second transfer member engages the sheet and transfers the sheet to a receiver that supports the sheet in generally spaced apart face to face relation.

This invention relates to apparatus for handling sheets. It has to do particularly with apparatus for handling sheets freshly printed with ink to set the ink and control the moisture content of or otherwise treat the sheets, although features of the apparatus have general application.

For purposes of explanation and illustration we shall describe the invention as embodied in apparatus for advancing sheets immediately following printing to enable setting of the ink and conditioning the sheets thereafter. We advance the sheets continuously, first through drying means and thereafter through other conditioning means. During the drying step the paper may become dehumidified and we subsequently control the moisture content by humidifying the paper. However if in any case the moisture content of the paper after setting of the ink should be too high it can be dehumidified in our apparatus.

We advance sheets edgewise one after another at relatively high speed in the first part of our apparatus and thereafter advance the sheets while disposed in substantially parallel spaced apart relation at lower speed for treatment of the sheets such as humidification thereof. We provide automatic transfer means for transferring the sheets from their initial path in which they move edgewise one after another into their final path in which they are disposed in substantially parallel spaced apart relation. In the latter portion of the path of the sheets they are desirably hung from their upper edges. Provision is made to avoid creasing of the sheets by maintaining the gripped edges thereof substantially coplanar with the adjacent portions of the bodies of the sheets during transfer from the first portion of the path to the second portion of the path and throughout the second portion of the path.

We also provide means for delivering the sheets from the second portion of the path to a pile where they are piled or stacked atop one another and we maintain the gripped edges of the sheets and the portions of the bodies of the sheets adjacent the gripped edges thereof substantially coplanar while the orientation of the sheets from substantially vertical to substantially horizontal is being altered.

We provide oscillating or reciprocating means, preferably sucker means, for taking the sheets one by one from the first portion of the path and introducing them into the second portion of the path. Provision is also made for withdrawing sheets for inspection at the will of the operator before the sheets enter the second portion of the path.

Other details, objects and advantages of the invention will become apparent as the following description of a present preferred embodiment thereof proceeds.

In the accompanying drawings we have shown a present preferred embodiment of the invention in which

FIGURES 1*a*, 1*b* and 1*c* taken together constitute a side elevational view with portions cut away of the apparatus (FIGURES 1*a* and 1*b* should be considered as fitting together along the line X—X and FIGURES 1*b* and 1*c* should be considered as fitting together along the line Y—Y despite the fact that for practical reasons there is a small difference in scale among FIGURES 1*a*, 1*b* and 1*c*);

FIGURES 2*a* and 2*b* taken together along the line Z—Z show a fragmentary plan view of a portion of the apparatus shown in FIGURES 1*b* and 1*c*;

FIGURE 3 is a fragmentary detail view to enlarged scale to a portion of a chain and gripper assembly forming part of the apparatus;

FIGURE 4 is a plan view of the part of the apparatus shown in FIGURE 3;

FIGURE 5 is a vertical cross-sectional view taken on the line V—V of FIGURE 3;

FIGURE 6 is a vertical cross-sectional view taken on the line VI—VI of FIGURE 3;

FIGURE 7 is a diagram of the driving gears, sprockets and sprocket chains for our apparatus; and

FIGURE 8 is an enlarged fragmentary view partly in elevation and partly in longitudinal cross section, of a portion of the structure shown in FIGURE 1*b*.

Referring now more particularly to the drawings, there are shown diagrammatically in FIGURE 1*c* elements of an offset sheet printing press. The press may be a conventional offset sheet printing press; however, those skilled in the art will understand that the invention is not limited to use with such a press but may be used with presses of other types. Those skilled in the art will further understand that in the form of press shown sheets are taken and advanced by the various cylinders by grippers which are operated to take and release the sheets in conventional manner. The structure of the printing press forms no part of our invention.

Sheets pass clockwise around transfer cylinder **2** and are taken by impression cylinder **3** around which they pass counterclockwise. The plate cylinder is shown at **4** and the blanket cylinder at **5**. The printing couple is constituted by the impression cylinder **3** and the blanket cylinder **5**. The sheets are printed as they pass around the impression cylinder **3** and engage the blanket cylinder **5** as is conventional in offset sheet printing. The printed sheets are taken by the transfer cylinder **6** around which they pass clockwise.

Our apparatus has supporting structure including side frames **7** in which is journaled a chill roll **8** having roll necks **9**. Fixed to the necks **9** of the chill roll **8** are sprockets **10**. Sprocket chains **11** are trained about the respective sprockets **10**. Each sprocket chain **11** is also trained about a sprocket **12** rotatably mounted in the supporting structure and a sprocket **13** carried by a delivery reel **13***a* rotatably mounted in the supporting structure and also is guided by guides **14**, **15** and **16**. The sprocket chains **11** operate in synchronism since the sprockets **13** are both carried by the delivery reel **13***a* which is driven from the press as illustrated by FIGURE 7 and later described. The sprocket chains **11** carry spaced apart transverse gripper bars having grippers mounted thereon which are operated in conventional manner as known by those skilled in the

art to take sheets from the transfer cylinder **6** and advance them in the counterclockwise direction viewing FIGURE 1*c*. The composite endless element comprising the sprocket chains **11** and the transverse gripper bars and grippers will be identified by **11***a*.

The sheets carried by the endless element **11***a* move toward the left viewing FIGURE 1*c* between an infra-red dryer **17** and a reflector **18** to promote setting of the ink. The infra-red heat not only promotes setting of the ink but also penetrates the paper. This is of especial advantage when ink containing a volatile constituent is used. Some of the volatile constituent of the ink permeates the paper and thus initiates setting of the ink. The infra-red heat is effective in volatilizing such of the volatile constituent as has not permeated the paper.

When the sheets emerge from the infra-red dryer **17** substantially all of the volatile constituent of the ink which has not permeated the paper has been volatilized. The paper passes upwardly through a gas dryer **19** in which flames **19***a* are directed against the opposite faces of the paper to finally set the ink, and the flames burn volatile constituent which has been volatilized in the infra-red dryer and any unvolatilized volatile constituent will be completely volatilized and substantially burned in the gas dryer. As the paper emerges upwardly from the gas dryer **19** the paper has at one or both faces thereof residue from the set ink, particularly when ink containing a volatile constituent is used. The residue tends to cling to and move along with the paper. It is sheared off by air knives **20** which direct generally blade-shaped air blasts against the faces of the paper at an angle in the direction opposite the direction of advance of the paper. The residue removed by the air knives is drawn off through ducts **21**.

The endless element **11***a* carries the paper around the chill roll **8**. At the time the paper reaches the chill roll **8** the ink has been set and the residue has been removed but the paper is hot and has been dehumidified in the dryers **17** and **19**.

The endless element **11***a* has become heated in the dryers **17** and **19**. To cool it off it passes through a cooling chamber **21***a* where it is sprayed with a cooling fluid, preferably water, through spray heads **21***b*. Cooling fluid, clinging to the endless element is removed by air jets **21***c* issuing from air bars **123**. Thus by the time the endless element gets back to the delivery reel **13***a* it has been cooled and dried and is ready for the succeeding cycle.

A second chill roll **22** and a third chill roll **23** are disposed in cooperative relation with the chill roll **8** as shown in FIGURE 1*b* and are suitably mounted in the supporting structure and driven to rotate at the same surface speed as the chill roll **8**. Each of the chill rolls **22** and **23** carries grippers which are operated in conventional manner and which take the sheets from the endless element **11***a* and carry them around the chill roll **22** in the clockwise direction and thence around the chill roll **23** in the counterclockwise direction. Each of the sheets passes around the chill roll **8** through almost half a revolution and around the chill roll **22** through somewhat less than half a revolution and around the chill roll **23** for either just a short distance or somewhat more than half a revolution depending upon subsequent operations as will presently be described.

Moisture is applied to each of the chill rolls **8, 22 23**. Associated with each of the three chill rolls is a water fountain **24** from which water is delivered to the chill roll through a fountain roller **132**, a ductor roller **25** and suitable cooperating rollers **130** and **131** as shown. The water fountains **24** and associated rollers for applying moisture to the chill rolls may be conventional but the rollers **130** are driven in a direction opposite that of each of the three chill rolls to clean the chill rolls while applying moisture. The amount of moisture applied to each chill roll may be controlled and regulated by control of the corresponding ductor roller **25**. Thus under any particular circumstances the quantity of moisture delivered to the chill rolls may be increased or decreased and the quantity of moisture delivered to the respective chill rolls may be varied. The effect of passage of the sheets against the chill rolls is to cool and humidify the paper.

Provision is made for removing sheets for inspection at the chill roll **23**. The means for performing that function are shown to enlarged scale in FIGURE 8. The chill roll **23** has spaced at intervals thereacross gripper pads **26** with each of which a gripper **27** of conventional construction operates. The grippers **27** are pivoted in the chill roll **23** by being fastened to a turnable shaft **28**. An arm **29** fixed to the shaft **28** carries a cam follower roller **30**. A cam **31** is mounted in the supporting structure of the apparatus and is adapted to be moved by the operator, as, for example, by solenoid operating means, selectively into position underlying the roller **30** and into position laterally offset from the roller **30**. When the cam **31** is in position laterally offset from the roller **30** the grippers **27** remain closed. The normal operation of the grippers **27** to take sheets from the chill roll **22** and carry them somewhat more than half way around the chill roll **23** is accomplished by conventional mechanism which is not shown in the drawings but which is well known to those skilled in the art. When the cam **31** is moved by the operator into position under the roller **30**, the roller **30** raises to the high point **32** of the cam as the chill roll **23** turns in the counterclockwise direction viewing FIGURE 8 which raises the arm **29** and opens the grippers **27**.

An arm **33** is also fixed to the shaft **28**. Pivoted to the end of the arm **33** at **34** is a bar **35**. Pivoted to the bar **35** at **36** is an arm **37**. Pivoted to the bar **35** at **38** is an arm **39**. The arm **37** is fixed to a shaft **41** turnably mounted in the chill roll **23** and to which shaft lifters **40** are fastened. The arm **39** is pivotally mounted in the chill roll **23** at **42** and has a cam extension **43** adjacent the periphery of the chill roll **23** as shown in FIGURE 8.

Fastened to a shaft **44** turnably mounted in the supporting structure are spaced apart separating fingers **45**. Two downwardly extending arms **46** and **122** are fastened to the shaft **44**. Arm **46** carries a cam following roller **47** positioned in transverse alignment with the cam **43**. A rod **49** is pivoted to the arm **122** at **48**. The opposite end of the rod **49** is pivoted at **50** to an arm **51** turnable about a fixed pivot **52** and with which arm is integrally associated a detent **53**. The supporting structure turnably carries a shaft **54** on which is mounted an arm **55**, and a rod **56** is positioned between and adapted to engage the under surface of the outer end of the arm **55** and the upper surface of the detent **53**. Arms **57** are fixed to the shaft **54**, each arm **57** carrying a roller **58**. A sheet receiving chute **59** is positioned to receive sheets delivered toward the left viewing FIGURE 8 at the top of the chill roll **23**.

The grippers **27** are at all times urged toward closed or operative position by a compression coil spring **133** disposed about a rod **134** pivoted at **135** to an arm **136** fixed to the shaft **28**. The outer end of the rod **134** extends through a bore in a bracket **137** mounted on the supporting structure. The spring **133** bears between a washer **138** which lies against the bracket **137** and a stop **139** near the end of the rod where it is pivoted to the arm **136**. Thus the grippers **27** are maintained closed at all times except when means are operated to open them.

The arms **46** and **122** are urged inwardly of the chill roll **23** by a compression coil spring **140** disposed about a rod **141** pivoted at **142** to the arm **122**. The outer end of the rod **141** extends through a bore in a bracket **142***a* mounted on the supporting structure. The spring **140** bears between a washer **143** which lies against the bracket **142***a* and a stop **144** near the end of the rod where it is pivoted to the arm **122**. The stop **145** is carried by the supporting structure and the arm **122** is maintained against that stop by the spring **140** at all times except when the cam **43**

acting through the cam following roller 47 turns the separating fingers 45 to their position nearest the axis of the chill roll 23.

The rod 56 is slidably mounted in guide brackets 146 and 147 carried by the supporting structure. A compression coil spring 148 acts between a head 149 on the lower end of the rod 56 and the guide bracket 147 to urge the rod 56 downwardly so that it always engages the detent 53.

The rollers 58 are at all times urged toward the surface of the chill roll 23 by a compression coil spring 150 disposed about a rod 151 pivoted at 152 to an arm 153 fixed to the shaft 54. The opposite end of the rod 151 extends through a bore in a bracket 154 mounted on the supporting structure. The spring 150 bears between a washer 155 which lies against the bracket 154 and a stop 156 near the end of the rod where it is pivoted to the arm 153. Thus the rollers 58 are caused to bear against the surface of the chill roll 23 except when they are raised by action of the rod 56 as will be presently explained.

As above stated, when the cam 31 is moved into position under the roller 30, the roller 30 raises to the high point 32 of the cam 31 and opens the grippers 27 as the chill roll 23 rotates. Counterclockwise movement of the arm 33 about the axis of the shaft 28 moves the bar 35 upwardly and to the right viewing FIGURE 8 which in turn raises the lifters 40 and swings the cam 43 outwardly relatively to the circumstances of the chill roll 23. The timing is such that as the grippers 27 and lifters 40 are raised the outwardly projecting cam 43 engages the roller 47 and moves the separating fingers 45 down so that the oncoming sheet may be projected over top thereof into the chute 59. Simultaneously the rollers 58 move down and press the sheet against the surface of the chill roll 23 to insure forward projection of the sheet after it has been released by the grippers. The lifters lift the oncoming sheet so that it passes over the grippers and over the separating fingers and into the chute.

By the mechanism just described the operator may at his option at any time cause one or more sheets to be delivered to the inspection chute 59. Normally, when the cam 31 is offset from the roller 30, no sheets will be delivered to the chute 59 and all of the sheets will pass in the counterclockwise direction around the chill roll 23 for somewhat more than half the circumference of that roll where they are taken by mechanism now to be described.

Mounted for rotation in the supporting structure is a transverse shaft 60 carrying spaced apart transfer elements 61 each having two diametrically opposed arms 157. At the extremity of each of the arms 157 is a sucker 63 communicating through a port 64 with a vacuum line 65. Each of the vacuum lines 65 communicates with a rotary valve of conventional construction (not shown) through which suction is drawn through each of the suckers 63 from the time when it is straight up until it reaches the position shown in FIGURE 1*b* for the lower arm 157. The arms 157 of the transfer elements 61 take sheets from the chill roll 23 and deliver them to a series of reciprocating suckers 66 presently to be described.

Supporting arms 67 carried by a transverse rod 68 mounted in the supporting structure carry a series of crescent-shaped brackets 69 in which are journaled rollers 70 which may be generally star shaped or pointed. The purpose of the rollers 70 is to guide the trailing portions of the sheets as they are advanced by the arms 157 of the transfer elements 61. Thus as each set of arms 157 carries a sheet by its forward portion in the clockwise direction around the axis of the shaft 60 the sheet is guided by the rollers 70.

Each of the reciprocating suckers 66 is disposed at the extremity of a tube 71 pivoted at 72 to the extremity of a curved lever 73 fixed to a cross shaft 74 journaled for rotation in the supporting structure. Also fixed to the cross shaft 74 is an arm 75 pivoted at 76 to a link 77 which in turn is pivoted at 78 to a lever 79 pivoted at 80 to the supporting structure and carrying a roller 81 at its opposite end. The roller 81 follows a rotary cam 82 of a contour such as to cause oscillation of the lever 79. The rotary cam 82 is mounted on the neck of the chill roll 23 and rotates therewith.

Integral with each tube 71 is an extension 83 pivoted at 84 to a link 85 whose opposite end is pivoted at 86 to a bracket 87 carried by the supporting structure.

Rotation of the cam 82 oscillates the lever 79 which through the mechanism shown oscillates the arms 73 each of which in turn oscillates or reciprocates its sucker 66 along the path indicated in FIGURE 1*b*. The tubes 71 are also connected with a rotary valve so that suction is drawn through the suckers 66 when taking a sheet from one set of arms 157 and that suction is maintained until the suckers 66 reach the position designated A in FIGURE 1*b* at which time the sheet is taken by grippers presently to be described whereupon the suction is released and the suckers 66 return to the position shown in solid lines in FIGURE 1*b* to receive the next sheet. Air jets 88 issuing from an air bar 88*a* are provided for urging the lower portions of sheets taken by the suckers 66 from the arms 157 downwardly and toward the left as indicated in FIGURE 1*b* to facilitate the subsequent conveying of the sheets hanging by their upper edges and in generally parallel relationship extending transversely of their path of advance beyond the position A.

Mounted in the supporting structure for continuous movement in a generally clockwise direction are four endless sprocket chains 89 carrying grippers as will presently be described. For simplicity one of the chains will be described and it will be understood that the other three chains are identical and function in similar manner.

Chain 89 meshes with a sprocket 90 on a shaft 91 and with a sprocket 92 fixed to a shaft 93 driven as will presently be described. The path of the chain is controlled by guides 94 and 95 shown in FIGURE 1*b*. The chain is shown to enlarged scale in FIGURES 3–6. Links of the chain spaced apart at equal intervals carry brackets 96 which project at right angles to the length of the chain, downwardly along the lower reach of the chain and upwardly along the upper reach of the chain. The lower reach is the active reach and the upper reach is the return reach. Pivoted to each bracket 96 is a gripper assembly designated as a whole by 96*a*. Each gripper assembly 96*a* comprises a gripper element 97 having a gripper 98, an arm 99 opposed to the gripper 98 and an arm 100 carrying a roller 101 and a cooperating element 102 having a gripper pad 103 and an arm 104 carrying a roller 105. A compression coil spring 106 is disposed between each arm 99 and the corresponding gripper pad 103 normally pressing the gripper pad 103 against the gripper 98 to close the gripper.

Thus it will be seen that each gripper assembly 96*a* is pivoted to turn about an axis 107 on bracket 96. The elements 97 and 102 of each gripper assembly 96*a* are normally maintained by the spring 106 in the relationship shown in FIGURE 3, i.e., with the gripper closed.

The parts of each gripper assembly 96*a* are weighted so that when the gripper assembly is free from external control it assumes by gravity the position shown at B and at C in FIGURE 1*a*. In other words, regardless of whether a gripper assembly is moving from right to left viewing FIGURE 1*a* along the lower reach of the chain or from left to right along the upper reach of the chain it is oriented as shown at B and C, i.e., with the gripper 98 and pad 103 extending straight downwardly so that a sheet gripped by the gripper will be suspended from its upper edge and will hang straight downwardly with the body of the sheet coplanar with the gripper upper edge.

Cam means are provided for controlling the grippers through the rollers 101 and 105. As a gripper assembly moving toward the right viewing FIGURE 1*b* along the upper reach of the chain approaches the right hand end

thereof its roller **105** enters a cam groove **108** in a guide **108***a*. The cam groove **108** communicates directly with a cam groove **120***a* in a cam **120**. The cam groove **120***a* extends around the axis of the shaft **93**, terminating at D (FIGURE 1*b*). Each cam **120** is carried by a support **62**. The purpose of the cam grooves **108** and **120***a* is to control the orientation of the gripper assemblies. The gripper element **98** and the gripper pad **103** of each gripper assembly are maintained in contact with each other by the spring **106** so the gripper assembly as a whole is free to turn about the axis **107**. As above explained each gripper assembly is weighted so that when not influenced by any cam or cam groove it assumes the orientation shown at B and C in FIGURE 1*a*. The cam grooves **108** and **120***a* maintain each gripper assembly in generally the same orientation as the gripper assembly moves around the axis of the shaft **93** although causing the gripper assembly to tilt slightly to be in position to receive sheets presented thereto by the reciprocating suckers **66**. As each gripper assembly approaches the position for receiving a sheet from the suckers **66** it is opened by the roller **101** riding up on a cam **109** (FIGURE 1*b*). The gripper assembly remains open while the forward edge of the sheet to be taken is presented between the gripper **98** and the gripper pad **103** thereof whereupon the roller **101** rides down the left hand end of the cam **109** viewing FIGURE 1*b* closing the gripper on the leading edge of the sheet. At the same time suction to the suckers **66** is cut off so that the leading edge of the sheet is transferred from the suckers **66** to the gripper assembly.

At about the same time as the gripper assembly grips the leading edge of the sheet and takes it from the suckers **66** the roller **105** passes out of the cam groove **120***a* at D (FIGURE 1*b*) so that thereafter the gripper assembly is free to assume its normal orientation caused by its weighting, i.e., the orientation shown at B and C in FIGURE 1*a*. This is important because the sheets are being conveyed by the grippers hanging from their upper edges and to avoid creases in the sheets the bodies of the sheets should be coplanar with the gripper upper edges thereof. This condition is accomplished as shown in FIGURE 1*b*. The air blasts **88** assist in moving each sheet into generally vertical position. Thus the sheets are successively transferred by the reciprocating suckers **66** from the transfer elements **61** to the gripper assemblies **96***a* and during such transfer the gripped edge of each sheet and the portion of the body of the sheets adjacent the gripped edge are maintained substantially coplanar, avoiding creasing of the sheet.

The grippers carry the sheets hanging from their upper edges and in parallel relationship through a chamber **110** in which they are treated. If the particular ink being used has not been completely set prior to entry of the sheets into the chamber **110** the treatment may include completion of setting of the ink. Also if the sheets have not been sufficiently humidified prior to entry into the chamber **110** they may be humidified in that chamber. Alternatively, if it should happen that the sheets have been too greatly humidified by the moistened chill rolls they can be dehumidified in the chamber **110**. In any event the sheets move through the chamber **110** in parallel spaced apart relationship as shown in FIGURE 1*b*, each sheet hanging from its upper edge and with the gripped upper edges of the sheets coplanar with the bodies of the sheets. The speed of advance of the sheets through the chamber **110** is relatively slow as compared with the speed of advance of the sheets when they are moving edgewise one after the other prior to being taken by the gripper assemblies **96***a*. This speed control of the sheets is one of the features of our process. Each sheet moves first at relatively high speed when the sheets are following each other edgewise and the speed is slowed when the sheets hang in relatively close parallel relationship while passing through the chamber **110**. This is all accomplished from a single drive and each sheet passes smoothly from one portion of the apparatus to the next.

It is desired to pile the treated sheets. This is done upon a pile support **111** (FIGURE 1*a*). In order to pile the sheets each sheet has to be reoriented from vertical to horizontal position. As each sheet approaches the pile the body of the sheet below the gripped upper edge thereof engages a series of rollers **112** shown in FIGURE 1*a* mounted in a bracket **113** carried by the supporting structure. Engagement of the body of the sheet with a series of rollers causes the sheet to change orientation from vertical to an orientation approaching horizontal as illustrated in FIGURE 1*a*. At the same time as the body of a sheet is being thus reoriented its upper edge is being consonantly reoriented by change of the angularity of the gripper assemblies carrying the sheet. Such change of angularity of the gripper assemblies is caused by riding of the rollers **101** of the gripper assemblies up an inclined cam **114** until they reach a level portion **115**. The rollers **101** continue to ride along the level portion **115** which maintains the gripper assemblies in the orientation shown at E in FIGURE 1*a*. With the gripper assemblies in such orientation the sheets are carried along over the rollers **112** to a position overlying the pile support **111** each sheet with its gripped leading edge maintained substantially coplanar with the portion of the body of the sheet adjacent the gripped leading edge.

As a sheet reaches a position overlying the pile support **111** the roller **105** of the gripper assembly carrying the sheet enters a horizontal cam groove **116** whose purpose is to maintain the gripper assembly in fixed orientation. With the roller **105** in the horizontal cam groove **116** the roller **101** rides down a cam **117** as shown in FIGURE 1*a* opening the gripper assembly and releasing the sheet to fall upon the pile of sheets on the pile support **111**. After the sheet has been released the roller **101** rides off of the cam **117** and the roller **105** passes out of the cam groove **116** and the gripper assembly without any sheet assumes its normal position as above described and as shown at B and C in FIGURE 1*a*. It maintains that position until the roller **105** enters the cam groove **108** on the succeeding cycle.

The delivery may be conventional and provided with usual means shown in FIGURE 1*a* for progressively lowering the pile support as sheets are added to the pile. Also conventional joggers may be employed as known to those skilled in the art. Since the delivery per se may be conventional it need not be here described.

FIGURE 7 is a diagram of the drive for the apparatus. A gear **118** driven from the press drive rotates with the cylinder **6**. For example, the rotary speed of the gear **118** may be 108 r.p.m. For gear **118** meshes with a gear **119** of equal diameter which rotates the delivery reel **13***a*. Also rotating with the delivery reel **13***a* are sprockets **13**. Rotating with the chill roll **8** is a gear **121** of the same diameter as the gears **118** and **119**. Rotating with the gear **121** are sprockets **10** of the same effective diameter as the sprockets **13**. Each sprocket **13** and the corresponding sprocket **10** have a sprocket chain **11** meshing therewith.

The chill roll **22** has a gear **124** rotating therewith and the chill roll **23** has a gear **125** rotating therewith. The gears **124** and **125** are in mesh with each other and the gear **124** is in mesh with the gear **121**. The gears **124** and **125** are of the same diameter as the gears **118**, **119** and **121**.

A gear **126** fixed to the shaft **60** and having the same effective diameter as the transfer elements **61** meshes with the gear **125**. Also fixed to the shaft **60** is a sprocket **127**. A sprocket **128** is fixed to the shaft **93**. A sprocket chain **129** meshes with the sprockets **127** and **128**, the diameters of the gear **126** and the sprockets **127** and **128** being such that the shaft **93** rotates at 25.7 r.p.m. Fixed to the shaft **93** are sprockets **92** and fixed to the shaft **91** are sprockets **90** of the same effective diameter as the sprockets **92**. Each corresponding pair of sprockets **92** and **90** has a sprocket chain **89** meshing therewith.

The sheet advancing mechanism in the form shown

is such that when the sheets are advancing edgewise one after another they advance at a relatively high speed whereas when they are passing through the chamber **110** hanging by their upper edges in parallel relationship they advance at a relatively low speed.

Thus we provide for rapid and effective setting of the ink and control of the humidity of the sheets. Our apparatus is entirely automatic and the speed of the sheets is automatically controlled to slow them as they pass from the portion of the apparatus in which they are moving edgewise one after another to the portion of the apparatus in which they are hanging by their upper edges in parallel spaced apart relationship.

Features of the method herein disclosed are claimed in our copending application Ser. No. 494,183, filed of even date herewith.

While we have shown and described a present preferred embodiment of the invention it is to be distinctly understood that the invention is not limited thereto but may be otherwise variously embodied within the scope of the following claims.

We claim:

1. Apparatus for handling sheets comprising first means for initially advancing the sheets by moving them edgewise one after another, the first means including rotatable means with first sucker means for carrying the sheets in an arcuate path, second means for subsequently advancing the sheets by moving them in a second path in which the sheets are disposed in spaced apart generally face to face relationship, the second means including gripper means movable only in the second path, and substantially linearly reciprocable transfer means including second sucker means transferring the sheets from said arcuate path to the gripper means.

2. Apparatus for handling sheets as set forth in claim **1** in which said first means comprises a rotatably mounted transfer element having diametrically opposed arm members, said first sucker means positioned adjacent the end portion of said respective arm members, said first sucker means arranged to engage the leading edge of said sheets and advance said sheets in edgewise relation.

3. Apparatus for handling sheets as set forth in claim **1** in which said first means includes arcuate guide means for guiding the sheets transferred thereon in edgewise relation.

4. Apparatus for handling sheets as set forth in claim **3** in which said arcuate guide means includes roller members for guiding the trailing edge of the sheets transferred in edgewise relation.

5. Apparatus for handling sheets as set forth in claim **1** which includes roll means positioned adjacent to said first means, said first sucker means on said first means operable to engage the leading edge of the sheets from said roll means.

6. Apparatus for handling sheets comprising a first rotatably mounted transfer member having diametrically opposed arm members extending radially therefrom, said arm members having first sucker means positioned on their radial end portions, a second reciprocably mounted transfer member positioned adjacent to said first transfer member and having second sucker means, and said first and second sucker means operable to sequentially engage and transfer sheets in edgewise relation one after the other.

7. Apparatus for handling sheets comprising a first transfer member having a rotatably mounted shaft member, diametrically opposed arm members secured to said shaft and rotatable therewith, said arm members having sucker means on their radial end portions, said sucker means operable to advance sheets in edgewise relation one to the other by moving the sheets in an arcuate path, and a second transfer member having lever means to move other sucker means reciprocally in a substantially linear path for engaging the sheets and transferring the sheets from said first transfer member.

References Cited

UNITED STATES PATENTS

1,783,575	12/1930	MasDonald	271—79
2,355,697	8/1944	Bellache	271—79
3,191,928	6/1965	Neiden	271—79 X

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