Jan. 18, 1944. S. A. HUFFMAN 2,339,268

ARTICLE DELIVERY

Filed Oct. 2, 1939 6 Sheets-Sheet 1

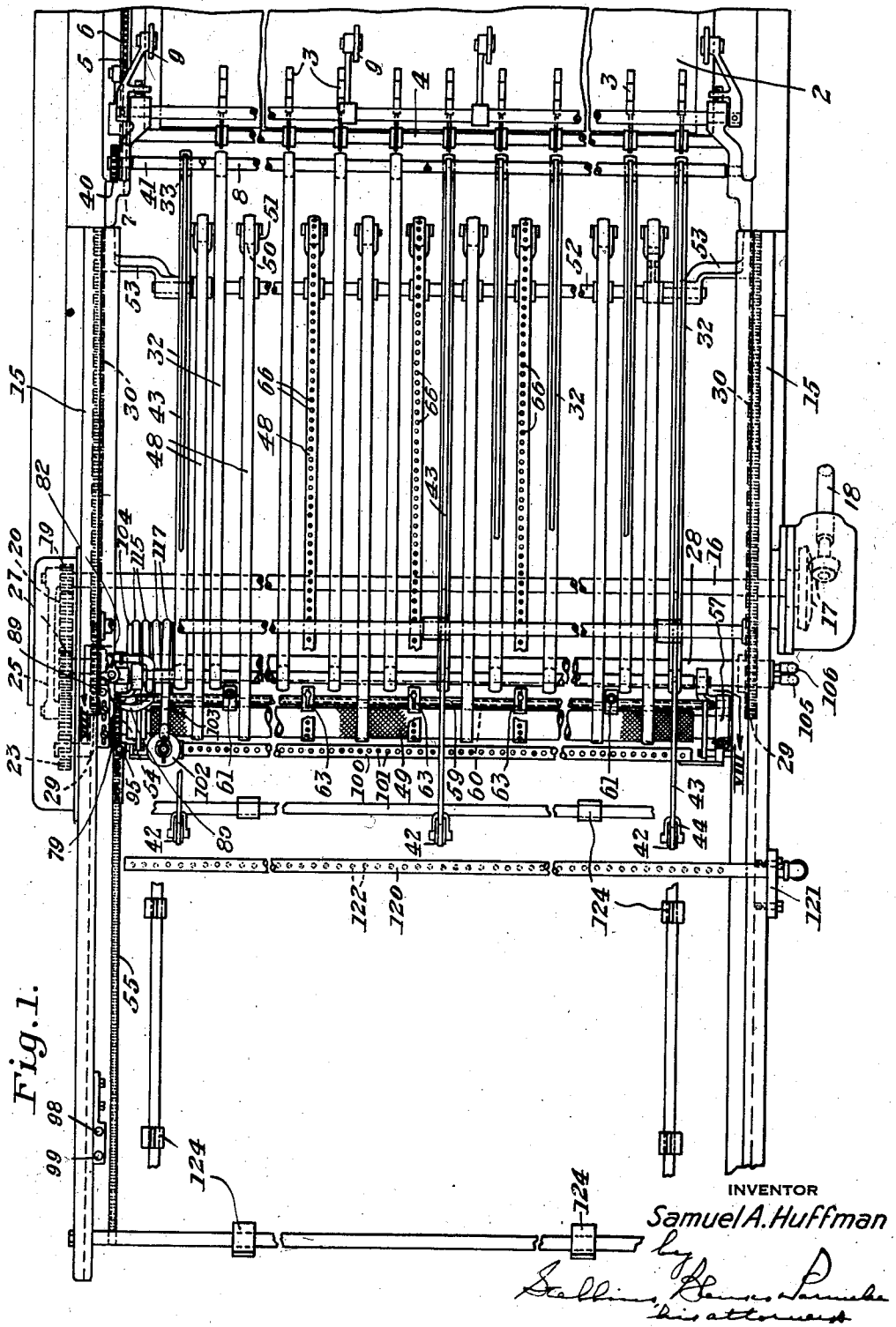


Fig. 1.

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Jan. 18, 1944. S. A. HUFFMAN 2,339,268

ARTICLE DELIVERY

Filed Oct. 2, 1939 6 Sheets-Sheet 2

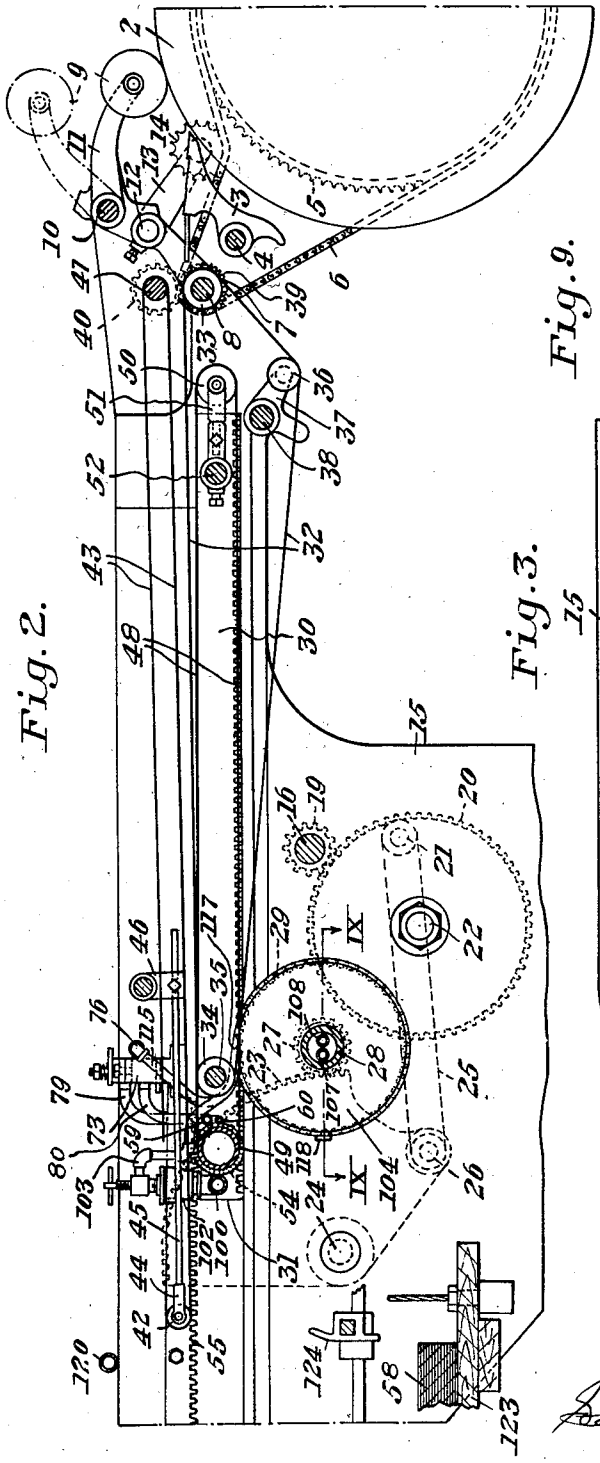


Fig. 2.

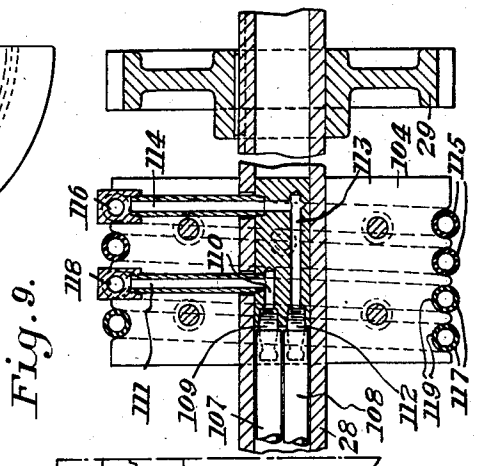


Fig. 9.

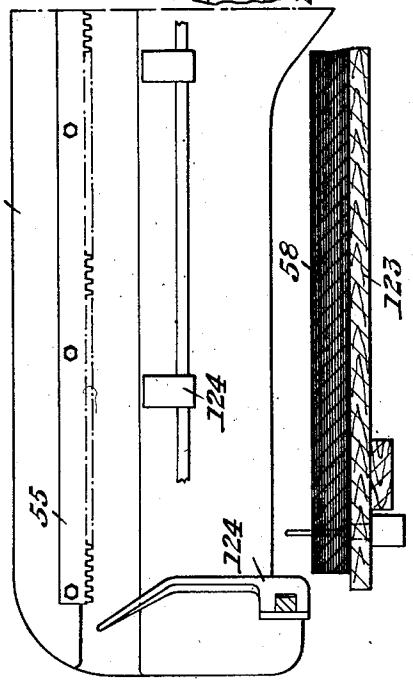


Fig. 3.

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ARTICLE DELIVERY

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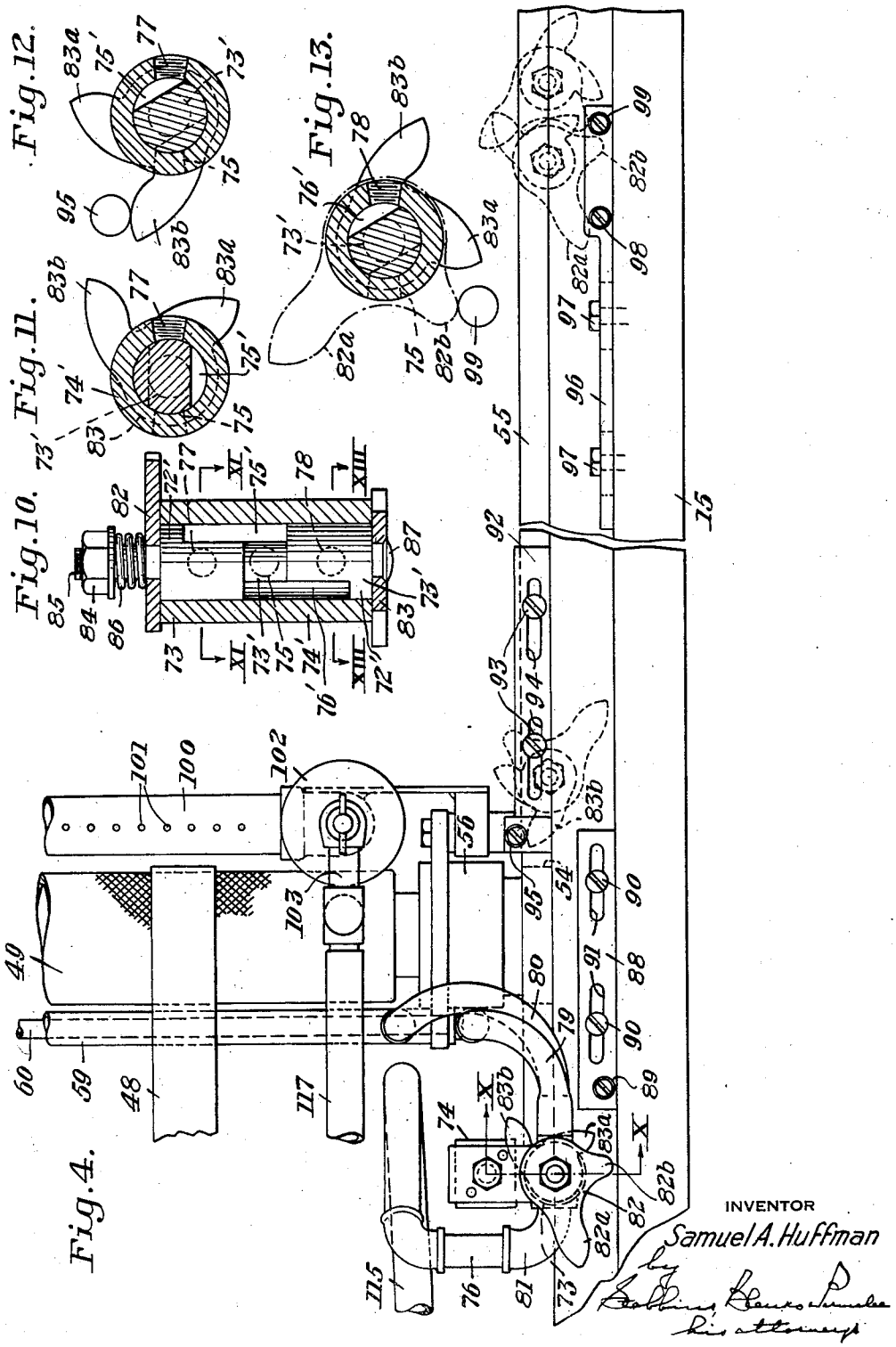


Fig. 12.

Fig. 13.

Fig. 11.

Fig. 10.

Fig. 4.

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Jan. 18, 1944. S. A. HUFFMAN 2,339,268

ARTICLE DELIVERY

Filed Oct. 2, 1939 6 Sheets-Sheet 4

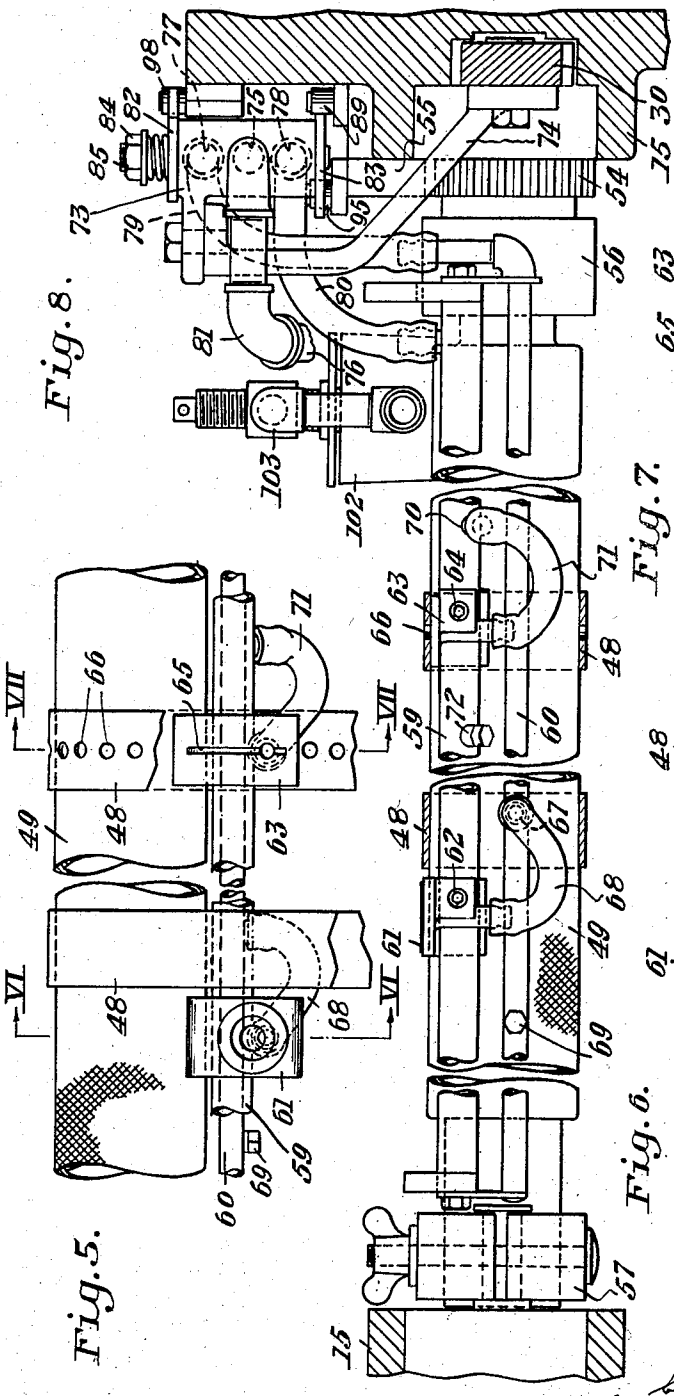


Fig. 8.

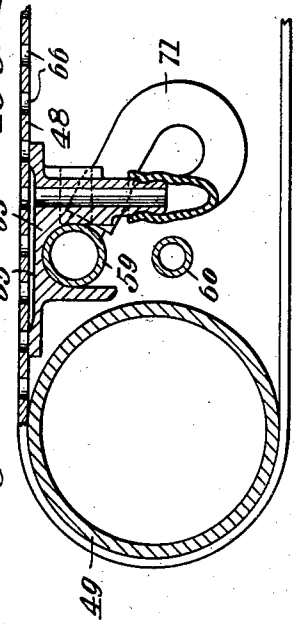


Fig. 7.

Fig. 5.

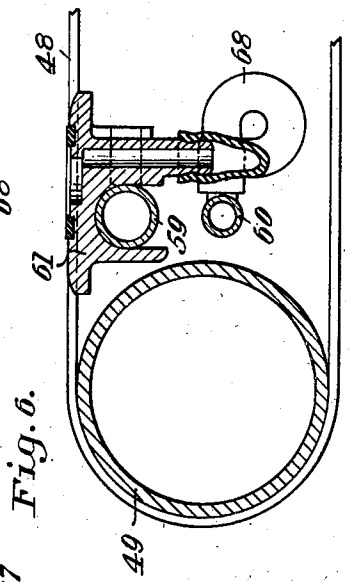


Fig. 6.

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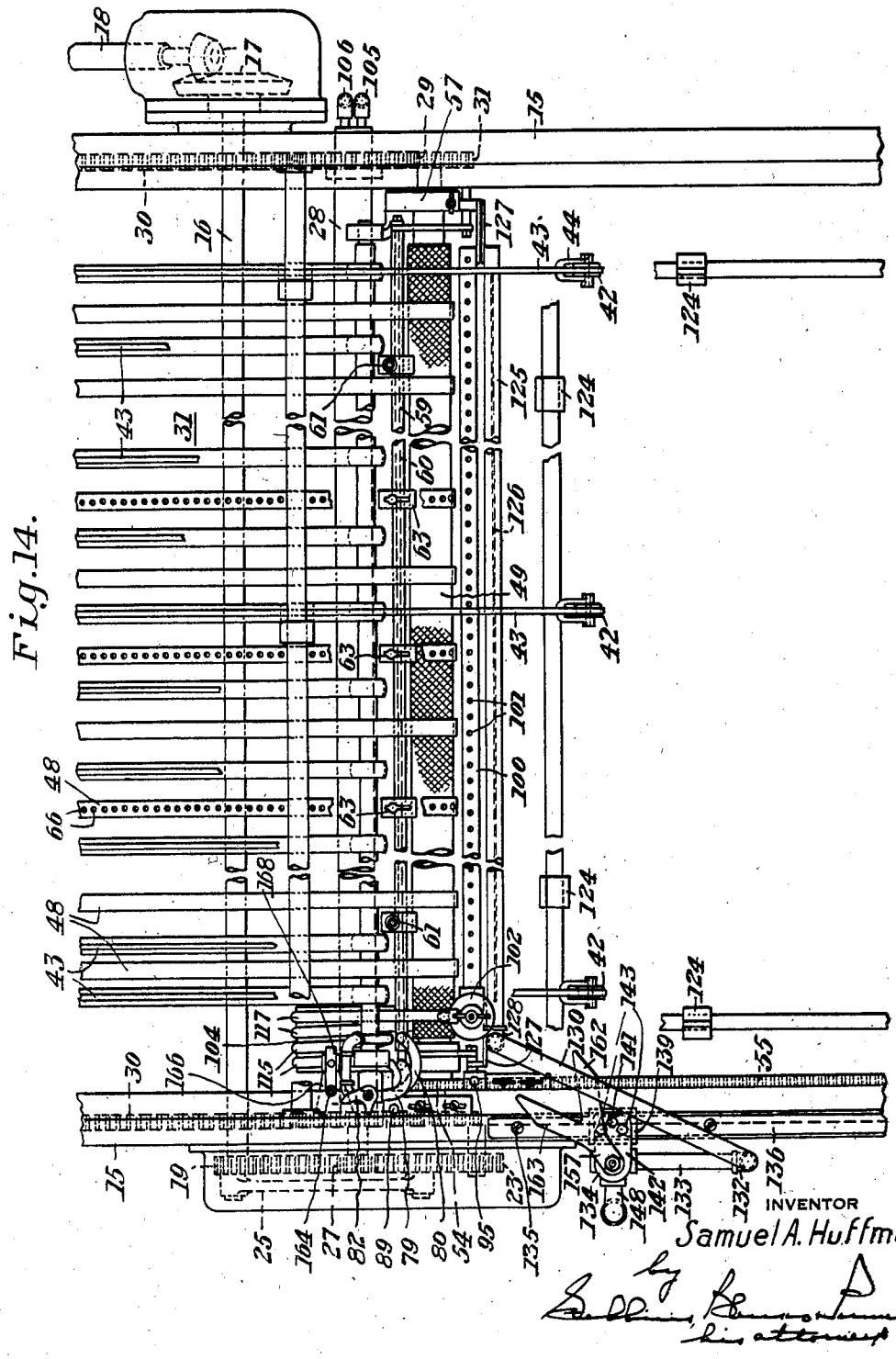
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ARTICLE DELIVERY

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Fig. 14.



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ARTICLE DELIVERY

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Fig.16.

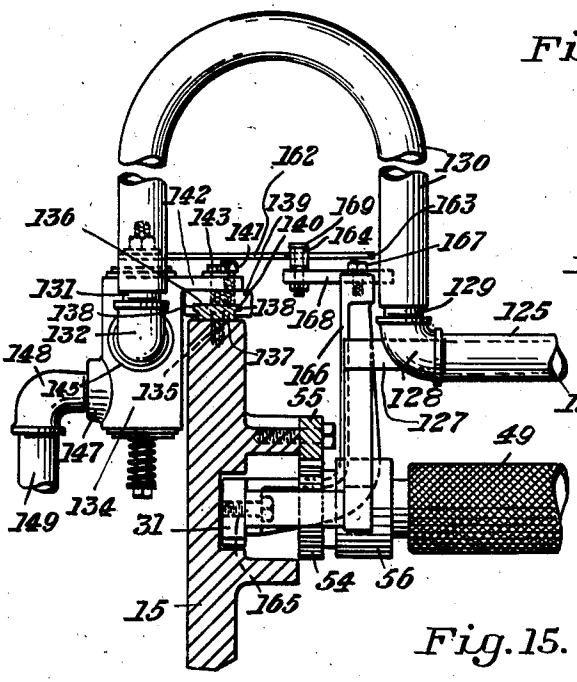


Fig.17.

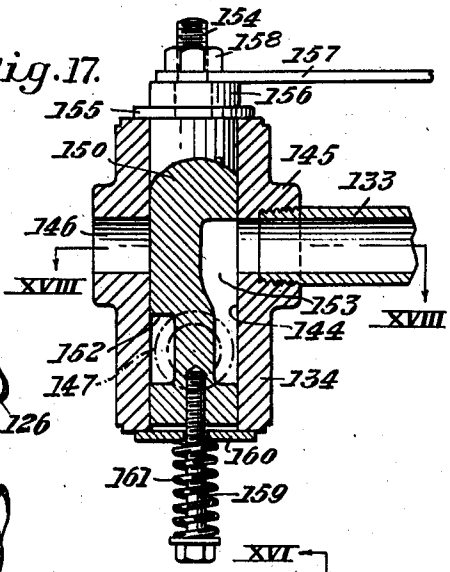


Fig.15.

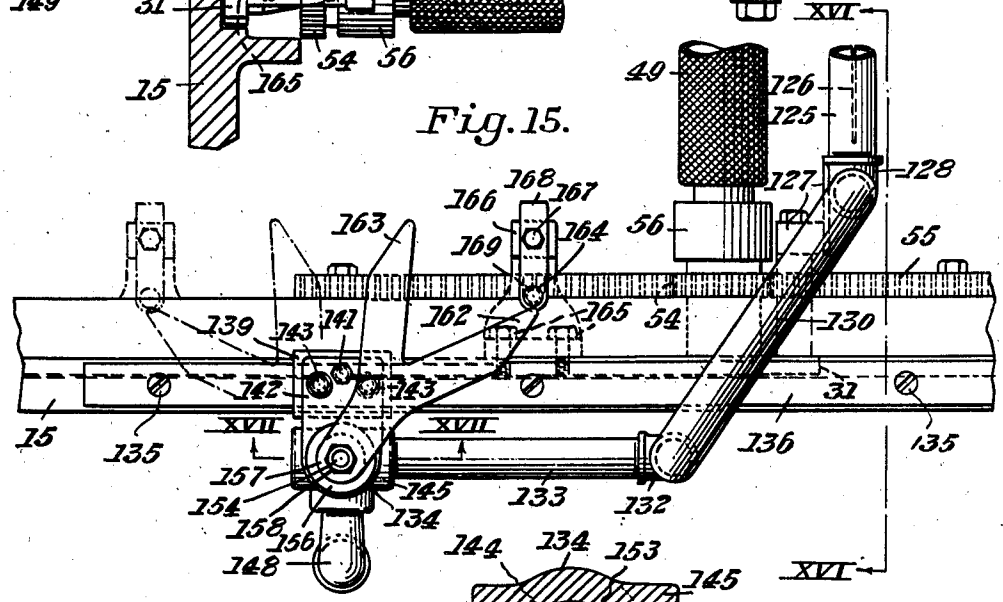
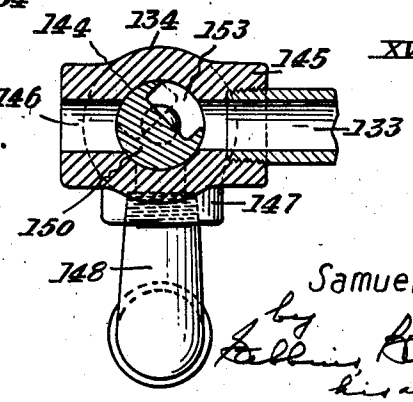


Fig.18.



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2,339,268

UNITED STATES PATENT OFFICE

2,339,268

ARTICLE DELIVERY

Samuel A. Huffman, Avalon, Pa., assignor to Miller Printing Machinery Co., Pittsburgh, Pa., a corporation of Pennsylvania

Application October 2, 1939, Serial No. 297,535

26 Claims. (Cl. 271—74)

This invention relates broadly to the delivery of articles. It embodies a number of novel features certain of which are applicable to the delivery of articles generally—that is to say, without specific restriction as to the particular character of the article being delivered. However, I am primarily interested in the delivery of sheets and especially sheets of paper, cardboard and the like, so the invention will herein be described as exemplified in a method and apparatus for delivering sheets, it being understood that the principles involved are in a number of instances applicable to the delivery of other articles and that the invention in its broadest aspect is not limited to sheet delivery.

The apparatus selected for description herein to exemplify the invention is apparatus for delivering sheets from a cylinder to a pile. The cylinder may be the cylinder of a flat bed and cylinder type printing press or it may be the cylinder of a creaser for cardboard box blanks or the like. The apparatus may also receive sheets from any other source from which sheets are taken individually. While the apparatus is illustrated as delivering sheets to a pile, the sheets may be delivered to other mechanism for performing subsequent operations thereon. However, the invention has certain peculiar advantages in delivering sheets to a pile and this is its preferred use.

The invention contemplates a more effective control than has heretofore been obtainable of articles (the term "sheets" will be used hereinafter for simplicity to denote example articles) while being delivered singly to a delivery point and an object of the invention is to insure proper delivery of sheets at the delivery point while at the same time adapting the apparatus to relatively high speed operation. The invention contemplates steadying the sheets immediately prior to delivery so that when they are freed by the delivery means they will be properly positioned. I prefer to employ suction to obtain this steadying effect. I also provided for blowing the sheets upon release by the delivery means to assist in moving them properly toward their ultimate position.

The apparatus shown in the accompanying drawings is of the type employing a bodily reciprocable carriage having thereon an endless carrier. As the carriage moves forwardly with a sheet upon the endless carrier such carrier does not partake of endwise movement. When the carriage reaches the end of its stroke it stops and then immediately moves rearwardly but such rearward movement of the carriage is accompanied by movement of the endless carrier thereon so that the portion of the endless carrier supporting the sheet remains substantially stationary while in engagement with the sheet upon such rearward movement of the carriage. Thus the carriage is in effect withdrawn from beneath the sheet with little or no tendency to carry the sheet with it in the rearward movement. Apparatus of this type is disclosed in copending application Serial No. 207,734.

In apparatus of the type above referred to heretofore employed the sheets are held down upon the endless carrier from above by rollers which cooperate with the forward endless carrier shaft so that upon rearward movement of the carriage the sheets exit between the forward endless carrier shaft and such rollers. Consequently the sheets are contacted on both sides and if they have been freshly printed on their upper surfaces there is danger of smearing the ink. Moreover, apparatus employing rollers for holding down the sheets as above described does not in all cases deliver the sheets in proper delivery position, the frictional contact of the rollers on the sheets sometimes tending to interfere with proper delivery thereof.

I obviate all of the disadvantages of delivery apparatus as above referred to by eliminating any contact with the sheets at their surfaces which are out of contact with the carriage. Normally the carriage will operate generally horizontally and the sheets will lie thereon and in such case the upper surfaces of the sheets are free from contact upon delivery. I provide for maintaining the sheets in position on the carriage by suction and engaging the sheets only at their surfaces which lie against the carriage. I also provide, as mentioned above, for steadying the sheets upon delivery, preferably by suction applied through an element of the endless carrier. Thus a better controlled delivery is effected while at the same time the surfaces of the sheets disposed away from the carrier are not engaged.

I find that when a reciprocating delivery apparatus of the type above referred to is operated at high speed, as is contemplated by the present invention, the carriage may at times return to the delivery point before the previously delivered sheet has fallen clear. The sheets as delivered are positioned above the pile or the support which is to receive them and are intended to fall downwardly thereon. However, and particularly in the case of very light sheets, they may not fall fast enough to be clear of the carriage upon its

subsequent forward movement, in which case the carriage may strike the previously delivered sheet and proper delivery may thus be interfered with. To obviate this condition I provide for blowing the delivered sheets so as to remove them from the path of the carriage upon the succeeding forward movement of the carriage. In apparatus of the type shown in the drawings of the present application this blowing is accomplished by a blower either disposed stationarily above the delivery point or mounted on the carriage at the forward end thereof and blowing the sheets downwardly. When the blower is stationarily mounted the trailing edges of the sheets considered in the direction of delivery are preferably blown downwardly thereby, which ordinarily insures each sheet being clear of the carriage before the carriage returns to the delivery point on its succeeding forward movement. Also the blower assists in controlling the delivery of the sheets to insure their being properly positioned on the pile or on a support to which they may be delivered.

When the blower is mounted on the carriage it is positioned above the path of the sheet and blows a jet of air downwardly upon the sheet as the carriage is withdrawn from beneath the sheet. Thus the blower has a sort of brushing action on the sheet, acting first on the forward portion of the sheet and thereafter acting successively on portions of the sheet farther and farther removed from its forward edge as the carriage is withdrawn. A control valve may be and preferably is provided for the air, such valve being opened when the carriage approaches the forward end of its stroke and being closed after the carriage has moved backward sufficiently that the blower clears the delivered sheet.

The invention also contemplates other novel steps in the delivery of sheets and other articles and certain other novel features of delivery apparatus. These features will become apparent as the following description of certain present preferred embodiments of the invention and certain present preferred methods of practicing the same proceeds. For example, I provide novel means for conducting fluid such as air for suction and for blowing and gas for ink drying burners between a stationary point at the side of the apparatus and the reciprocating carriage and novel control means therefor.

In the accompanying drawings I have shown certain present preferred embodiments of the invention and have illustrated certain present preferred methods of practicing the same, in which

Figure 1 is a plan view of sheet delivery apparatus;

Figure 2 is an elevational view to enlarged scale of a portion of the apparatus shown in Figure 1;

Figure 3 is a view similar to Figure 2 showing a portion of the apparatus at the left hand end thereof viewing Figure 2;

Figure 4 is a fragmentary plan view to enlarged scale of a portion of the apparatus shown in Figure 1 but in inverted position relatively to Figure 1;

Figure 5 is a fragmentary plan view to enlarged scale of a portion of the apparatus shown in Figure 1 but as viewed from the right in Figure 1;

Figure 6 is a vertical cross-sectional view taken on the line VI—VI of Figure 5;

Figure 7 is a vertical cross-sectional view taken on the line VII—VII of Figure 5;

Figure 8 is a fragmentary vertical transverse cross-sectional view to enlarged scale taken on the line VIII—VIII of Figure 1;

Figure 9 is a fragmentary horizontal transverse cross-sectional view to enlarged scale taken on the line IX—IX of Figure 2;

Figure 10 is a central vertical cross-sectional view through the suction valve taken on the line X—X of Figure 4;

Figures 11 and 12 are horizontal transverse cross-sectional views through the valve as though taken on the line XI—XI of Figure 10 and showing the valve in different positions;

Figure 13 is a horizontal transverse cross-sectional view through the valve as though taken on the line XIII—XIII of Figure 10 and showing the valve in a still different position;

Figure 14 is a partial plan view of a modified form of sheet delivery apparatus;

Figure 15 is a fragmentary plan view to enlarged scale of a portion of the apparatus shown in Figure 14 showing the parts in a different position;

Figure 16 is a vertical transverse cross-sectional view through the portion of the apparatus shown in Figure 15 and taken on the line XVI—XVI of that figure;

Figure 17 is a vertical longitudinal cross-sectional view to further enlarged scale through the air control valve employed in the apparatus shown in Figures 14, 15 and 16 and taken on the line XVII—XVII of Figure 15, portions, however, being shown in elevation; and

Figure 18 is a horizontal cross-sectional view taken on the line XVIII—XVIII of Figure 17.

Referring now more particularly to Figures 1 to 13, inclusive, reference numeral 2 designates a cylinder from which sheets are delivered to the delivery apparatus. The cylinder 2 may be the cylinder of a printing press or it may be the cylinder of a creaser. Sheets to be printed upon or creased are fed singly to the cylinder and pass thereabout and are operated upon while carried by the cylinder in known manner. The cylinder rotates in the counterclockwise direction viewing Figure 2. Each sheet is stripped from the cylinder 2 by strippers 3 operated in known manner. The strippers 3 are carried by the shaft 4 and are periodically raised and lowered relatively to the cylinder. They are lowered against the cylinder when a sheet is to be stripped from the cylinder and such sheet passes above the strippers 3 from right to left viewing Figure 2 to the delivery apparatus presently to be described. The cylinder has thereon a sprocket 5 about which passes a sprocket chain 6. The sprocket chain 6 also meshes with a sprocket 7 fixed to a shaft 8 whereby the shaft 8 is driven constantly in the counterclockwise direction viewing Figure 2 whenever the cylinder 2 is rotating. The cylinder 2 is operated by any suitable source of power and its speed is synchronized with the speed of operation of the delivery apparatus in known manner. Rollers 9 carried by a shaft 10 through arms 11 are provided for use in conjunction with the cylinder to hold the sheets thereagainst if desired. In Figure 2 the rollers 9 are shown in operative position in solid lines and in raised inoperative position in chain lines. A shaft 12 carries through an arm 13 a tensioning sprocket 14 for tensioning the sprocket chain 6.

The delivery apparatus comprises opposed side frame members 15 and suitable cross frame members (not shown). The frame carries a drive shaft 16 driven through bevel gears 17 by a power

shaft 18 which may derive its power from the same source of power as rotates the cylinder 2. The speed of rotation of the cylinder and the speed of reciprocation of the reciprocable sheet delivering carriage presently to be described are synchronized so that the carriage makes a complete reciprocation cycle for every two revolutions of the cylinder, as a sheet is delivered from the cylinder at every second revolution. The driving mechanism is adjusted in known manner so that the carriage is in proper position to receive a sheet from the cylinder upon the passage thereof from the cylinder to the carriage.

The drive shaft 16 extends through the apparatus as shown in Figure 1 and carries at the side of the apparatus opposite the bevel gears 17 a driving pinion 19 meshing with a crank gear 20 carrying a crank pin 21, the gear 20 being carried by a shaft 22. A gear segment 23 is pivoted to the frame by a shaft 24 and a pitman 25 has one end pivoted to the crank pin 21 and the other end pivoted to a pin 26 carried by the segment 23. The drive shaft 16 rotates unidirectionally and consequently the crank gear 20 does the same. Through the pitman 25 the segment 23 is oscillated back and forth about the shaft 24 during operation of the apparatus. The segment 23 meshes with a pinion 27 fixed to a hollow shaft 28, which shaft also carries a pair of drive gears 29, one at each end thereof, each of the gears 29 meshing with a rack 30 at one side of and forming a part of the reciprocable carriage 31. Through the mechanism just described the carriage 31 is reciprocated back and forth during operation of the apparatus in synchronism with the delivery of sheets from the cylinder 2 as above explained.

Tapes 32 for conducting the sheets from the cylinder 2 to the carriage 31 are trained about pulleys 33 fixed to the shaft 8 and also about pulleys 34 fixed to a shaft 35 and about tightner pulleys 36 each carried by an arm 37 pivoted at 38. The shaft 8 has fixed thereto a gear 39 which meshes with a gear 40 fixed to a shaft 41 so that the shafts 8 and 41 rotate in unison, the shaft 8 in the counterclockwise direction and the shaft 41 in the clockwise direction viewing Figure 2. Trained about the shaft 41 and about rollers 42 are tapes 43. Each roller 42 is carried by a yoke 44 at the extremity of an arm 45 adjustably positioned by a bracket 46. Thus the tapes 32 and 43 partake of their endwise movement about stationarily mounted shafts, the upper reach of each of the tapes 32 and the lower reach of each of the tapes 43 moving from right to left viewing Figure 2. Sheets passing from the cylinder 2 enter between the upper reaches of the tapes 32 and the lower reaches of the tapes 43. They are conveyed from right to left viewing Figure 2 while resting upon the upper reaches of the tapes 32. The upper tapes 43 are provided as a precautionary measure to insure that the sheets remain upon the tapes 32 in their forward movement. If the forward edge of a sheet should tend to blow up during advance of the sheet it would engage the lower reaches of the tapes 43 and would thus be constrained to remain in place upon the tapes 32. I have found that even sheets freshly printed on their upper surfaces can be advanced between the tapes 32 and 43 without danger of smearing the ink as the tapes 43 come in contact with the sheets only in rare instances and then only with the forward edges thereof. The sheets advanced upon the tapes 32 are fed to the reciprocating carriage 31 as will presently appear.

In Figure 1 most of the tapes 43 are either cut off intermediate their ends or omitted for the sake of clearness of the showing. It will be understood that normally a tape 43 is provided above each tape 32.

The reciprocating carriage 31 comprises an endless carrier designated generally by reference numeral 47, which endless carrier comprises tapes 48 trained about an externally knurled hollow shaft 49 at the left hand extremity of the carrier 47 viewing Figure 2 and about rollers 50 at the right hand extremity of the carrier. Each of the rollers 50 is carried by a yoke 51 which in turn is carried by a cross shaft 52 the ends of which are mounted in brackets 53 connected with the side frames of the carriage 31. The tapes 48 lie intermediate the tapes 32 and the shaft 52 passes between the upper and lower reaches of the tapes 32. Thus the endless carrier 47 and the carrier formed by the tapes 32 cooperate so that sheets advanced upon the tapes 32 are fed to the upper reaches of the tapes 48. The parts are synchronized so that a sheet is fed to the tapes 48 of the carrier 47 when the carriage 31 is toward the right or in its retracted or rearward position.

The shaft 49 carries at one end a gear 54 which meshes with a rack 55 fixedly mounted on the frame of the apparatus. Consequently as the carriage 31 reciprocates the gear 54, always remaining in mesh with the rack 55, oscillates back and forth. The gear 54 is operatively connected with the shaft 49 through an overrunning clutch 56 which is effective for causing the shaft 49 to turn with the gear 54 only when the carriage 31 is moving toward the right viewing Figures 1 and 2. When the carriage 31 moves toward the left, viewing such figures, the gear 54 simply turns by reason of its engagement with the rack 55 but does not turn the shaft 49 with it and consequently at such time the shaft 49 does not rotate. A brake 57 cooperates with the opposite end of the shaft 49 to insure stopping of rotation thereof at the end of the rearward movement of the carriage. Thus when the carriage 31 moves toward the left carrying a sheet delivered to the carrier 47 by the tapes 32 the tapes 48 of the carrier 47 do not partake of endwise movement but simply remain stationary with respect to the other parts of the carriage which moves bodily toward the left to the delivery point where it is desired to deliver the sheet. The carriage stops when the sheet is at the delivery point and then begins its rearward movement. However, upon such rearward movement the clutch 56 connects the gear 54 with the shaft 49 so as to rotate such shaft and consequently the tapes 48 of the carrier 47 are moved in their endwise travel in the counterclockwise direction about the shaft 49 and the rollers 50. This movement is such that the upper reaches of the tapes 48 upon which the sheet rests remain substantially stationary relatively to the side frames of the apparatus while in contact with the sheet, this being due to the fact that the outside diameter of the shaft 49 is substantially equal to the pitch diameter of the gear 54. As the carriage 31 moves toward the right it is, in effect, withdrawn from under the sheet, but, due to the operation of the tapes 48 just described, there is no substantial friction between the sheet and such tapes during withdrawal of the carriage and consequently the sheet is delivered at the delivery point and is free to fall upon a pile of sheets 58 shown in Figures 2 and 3

or upon any other support which may be provided.

The carriage 31 carries immediately to the rear of the shaft 49 two transversely extending pipes 59 and 60. The pipe 59 is disposed above the pipe 60 and is of somewhat larger diameter than the pipe 60. The pipe 59 carries at spaced intervals suckers 61, only two such suckers being shown in Figure 1 although it will be understood that any desired number thereof may be employed. The suckers 61 are disposed intermediate the tapes and their function is to suck down against the carrier 47 the forward edge of a sheet as such sheet is delivered to the carrier 47 from the tapes 32. Suction is applied to the suckers 61 throughout the greater portion of the forward travel of the carriage 31 as will presently appear. The suckers 61 are adjustably positionable on the pipe 59 by means of set screws 62.

The pipe 59 also carries spaced suction members 63 each of which is disposed between the upper and lower reaches of one of the tapes 48 and so as to contact with the bottom surface of the upper reach of a tape as shown in Figure 7. Each of the suction members 63 is adjustably connected with the pipe 59 by a set screw 64. Any desired number of the suction members 63 may be provided. Each suction member 63 has a suction port 65 which is elongated in the direction of the length of the carriage 31. Each tape 48 which overlies one of the suction members 63 contains spaced perforations 66 as shown in Figures 1, 5, 7 and 8. Only those tapes which cooperate with suction members 63 need be thus perforated although if desired for the sake of uniformity all of the tapes 48 may be perforated. Suction is applied to the suction members 63 upon rearward movement of the carriage 31 as will presently appear. At the same time suction to the suckers 61 is relieved. Consequently as the carriage is withdrawn from beneath a sheet which is being delivered such sheet will, by reason of the suction through the members 63 and the perforations 66 in the tapes 48 cooperating therewith, be held down and steadied against the carrier 47. When the carriage 31 begins its rearward movement the forward portion of the sheet being delivered will be over the suction members 63 so that at such time the forward portion of the sheet will be subjected to suction through the perforated tapes to steady it and hold it down against the carrier. As the carriage 31 moves toward the right the upper reaches of the tapes 48 remain, as above explained, substantially stationary with respect to the side frames of the apparatus and consequently with respect to the sheet and the suction members in effect move rearwardly or toward the right beneath such upper reaches. Thus the suction applied to the sheet is applied thereto progressively at points farther and farther removed from the forward edge of the sheet during the rearward movement of the carriage and as the carriage clears the sheet the suction on the sheet is, of course, entirely relieved.

Suction for the suckers 61 is applied through the pipe 60 and suction for the suction members 63 is applied through the pipe 59. The pipe 60 has spaced openings 67, one of which is connected by a hose 68 with each of the suckers 61 as shown in Figures 6 and 8. Those openings 67 which are not used at any particular time for connection with suckers 61 are closed by plugs 69. Similarly the pipe 59 has spaced openings 70, one of which is connected by a hose 71 with each of the suction members 63 as shown in Figures 7 and 8. Those openings 70 which are not used at any particular time for connection with suction members 63 are closed by plugs 72. Thus when suction is applied to the pipe 60 it is applied through such pipe to the suckers 61 and when suction is applied to the pipe 59 it is applied through such pipe to the suction members 63.

Control of suction to the pipes 59 and 60 is effected through a valve 73 shown in Figures 8 and 10, which valve is carried by a bracket 74 bolted to one of the racks 30 and which, therefore, is mounted on and moves with the reciprocating carriage 31. Such valve comprises a casing 74' having a port 75 at one side thereof (the left side, viewing Figure 4) for connection with a suction line 76, a port 77 for connection with the pipe 60 and a port 78 for connection with the pipe 59, the ports 77 and 78 both being disposed at the opposite side of the casing 74' from the port 75 (the right side, viewing Figure 4), and the port 77 being disposed above the level of the port 75 while the port 78 is disposed below the level of the port 75. A conduit 79 connects the port 77 with the pipe 60 and a conduit 80 connects the port 78 with the pipe 59. The suction line 76 is connected with the port 75 by a conduit 81. Within the casing 74' is the valve proper 73', which valve is rotatable within the casing.

The valve 73' is of circular cross section for a short distance from each of its upper and lower ends as shown at 72' in Figure 10 and intermediate such circular portions it is provided with a recess 75' (Figures 10, 11 and 12) which extends lengthwise of the valve opposite the level of the ports 77 and 75 and a recess 76' (Figures 10 and 13) which extends lengthwise of the valve opposite the level of the ports 75 and 78. The recesses 75' and 76' are in communication with each other at the central portion of the valve (that is, opposite the level of the port 75). The cross sectional shape of the valve 73' at the level of the port 77 is shown in Figures 11 and 12 and the cross sectional shape of the valve at the level of the port 78 is shown in Figure 13. As the drawings show, the valve at each of these points has a horizontal cross section of a circle with a segment cut off. The valve is shown in closed position in both of Figures 10 and 11 although Figure 11 has been turned 90° clockwise relatively to its natural position on the sheet of drawings as a horizontal cross section through Figure 10 taken on the line X—X in order that in Figure 11 the casing 74' will be oriented the same as it is oriented in Figure 4. In Figures 12 and 13 the casing 74' is also oriented the same as in Figures 4 and 11.

The central portion of the valve 73'—that is to say, the portion opposite the level of the port 75—may be of any suitable cross section providing for communication between the ports 77 and 75 through the recess 75' and providing for communication between the ports 75 and 78 through the recess 76'. In the structure shown the central portion of the valve takes the form of a central circular stem 77'. Thus when the valve is turned with the recess 75' to the right, viewing Figure 4 and as shown in Figure 12, the ports 75 and 77 are in communication with each other and when the valve is turned with the recess 76' to the right, viewing Figure 4, and as shown in Figure 13, the ports 75 and 78 are in communication with each other.

As shown in Figure 10 the casing 74' is in the form of a sleeve open at the top and bottom and

the vertical distance between the upper face of the upper circular portion 72' of the valve 73' and the lower face of the lower circular portion 72' of the valve 73' is substantially equal to the height of the casing. Riveted to the valve at its bottom by a rivet 87 is a cam follower 83. At its upper end the valve has a threaded stem 85 which passes through an opening in a cam follower 82 and has applied thereto a nut 84, a compression spring 86 bearing between the nut 84 and the cam follower 82. Thus the cam followers 82 and 83 are pressed against the top and bottom of the valve and the top and bottom of the casing respectively. The magnitude of such pressure may be determined by adjustment of the nut 84 and consequent adjustment of the pressure exerted by the spring 86. The connections between the cam followers 82 and 83 and the valve 73' are such that the valve and both of such cam followers rotate together in unison.

Connected with the frame of the apparatus is a bracket 88 carrying an upstanding pin cam 89. The bracket 88 is connected with the frame by screws 90 which pass through slots 91 therein. The slots 91 are elongated in the direction of the length of the apparatus and provide for adjustment of the bracket 88 longitudinally thereof. A second bracket 92 is similarly connected with the frame by screws 93 passing through longitudinally elongated slots 94 in the bracket, this bracket 92 carrying an upstanding pin cam 95. A third bracket 96 is bolted to the frame by bolts 97 and carries upstanding pin cams 98 and 99. As the reciprocating carriage 31 moves longitudinally of the apparatus the pin cams 89, 95, 98 and 99 are interposed in the paths of the cam followers 82 and 83 in a manner now to be described whereby to operate the valve.

The pin cams 89 and 95 are disposed in the path of the lower cam follower 83 which has wings 83*a* and 83*b* as shown, for example, in Figure 11, and the pin cams 98 and 99 are disposed in the path of the upper cam follower 82 which has wings 82*a* and 82*b* as shown, for example, in Figure 4. The carriage 31 is shown in Figure 4 at or near the left hand end of its stroke, it being remembered that Figure 4 is inverted relatively to Figure 1 so that in Figure 4 the forward movement of the carriage is toward the right. As the valve is shown in Figure 4 with the cam followers 82 and 83 in solid lines at the left of such figure, the valve is closed (Figure 11) and both of the ports 77 and 78 are maintained out of communication with the port 75. Upon movement of the carriage toward the right, viewing Figure 4, the valve remains closed until the wing 83*b* of the lower cam follower 83 engages the pin cam 95, this resulting in turning of the valve from the position shown in Figure 11 to the position shown in Figure 12 and thus establishing communication between the ports 75 and 77. This connects the suckers 61 with the suction line so that such suckers are operative. This condition obtains during the forward movement of the carriage 31 toward the right viewing Figure 4 until the wing 82*a* of the cam follower 82 strikes the pin cam 98, this turning the valve to closed position (Figure 11) and rendering inoperative the suckers 61. Immediately thereafter the wing 82*b* of the cam follower 82 strikes the pin cam 99 which turns the valve to the position shown in Figure 13 in which communication is established between the ports 75 and 78. Communication is thereby established between the suction members 63 and the suction line. This condition obtains as the carriage reaches the right hand end of its stroke, viewing Figure 4, and during the return stroke of the carriage toward the left until the wing 83*a* of the cam follower 83 strikes the pin cam 89, which returns the valve 73' to closed position as shown in Figures 4, 10 and 11. This cycle is repeated upon each reciprocation cycle of the carriage 31 and results in operation of the suckers 61 and suction members 63 as above explained with the improved results herein pointed out.

The carriage 31 carries a gas burner 100 having ports 101 in its top and extending transversely of the carriage as shown in Figures 1 and 4. A mixer 102 is provided at one end for the burner 100 and a gas connection 103 enters the mixer where the gas is mixed with air to supply a combustible mixture to the burner ports 101. Such combustible mixture is burned to provide a heat zone through which the sheets pass for the purpose of drying ink therein if the sheets are freshly printed. It will be noted that the tapes 43 extend above the burner, but as the burner is continually moving back and forth during operation of the apparatus it will not burn the tapes. To avoid burning the tapes 43 automatic gas cut-off means may be provided operable upon shutting off of power to the apparatus so that when the apparatus is stopped the gas to the burner will automatically be cut off. However, if the apparatus is stopped with the parts in such relative position that the burner is not under the tapes 43 the gas need not be shut off.

The hollow shaft 28 which carries the gears 29 for reciprocating the carriage 31 also carries a drum 104 as shown in Figures 1 and 9. The drum 104 is fixed to the shaft 28 to rotate therewith. Gas for the burner 100 is supplied at 105 and the suction connection for the apparatus is at 106 (Figure 1). The gas connection 105 and the suction connection 106 are side by side and in alinement with the hollow bore of the shaft 28. A flexible conduit 107 is connected with the gas connection 105 and a flexible conduit 108 is connected with the suction connection 106, such flexible conduits lying within the hollow shaft 28 as shown in Figure 9. The flexible conduit 107 for gas terminates in a nipple 109 communicating through a longitudinal passage 110 with a radial passage 111 in the drum 104. The flexible conduit 108 for suction terminates in a nipple 112 communicating through a longitudinal passage 113 with a radial passage 114 in the drum 104. A flexible conduit 115 is connected at one end with the suction line 76 (Figure 4) and at the other end with the outer extremity 116 of the radial passage 114 in the drum 104. A flexible conduit 117 is connected at one end with the gas connection 103 (Figure 4) and at the other end with the outer extremity 118 of the radial passage 111 in the drum 104. Thus a gas conduit passes from the gas connection 105 through the hollow shaft 28, the drum 104 and the conduit 117 to the mixer 102 and a suction conduit passes from the suction connection 106 through the hollow shaft 28, the drum 104 and the conduit 115 to the valve 73. As the drum 104 is fastened to the same shaft as carries the gears 29 and is of substantially the same diameter as such gears (Figure 9), it automatically takes up the slack in the flexible conduits 115 and 117 upon reciprocation of the carriage 31. Grooves 119 are provided in the surface of the drum to position the flexible conduits 115 and 117 when winding the same up thereon. The conduits are wound up on the drum

when the carriage 31 moves toward the right viewing Figure 1 and are unwound therefrom when the carriage moves toward the left. Turning of the hollow shaft 28 upon reciprocation of the carriage 31 causes the flexible conduits 107 and 108 in the hollow shaft to twist about each other to a certain extent but they are left loose enough to allow for sufficient twisting so that they will not be unduly strained during operation of the apparatus. The shaft 28 ordinarily makes less than two revolutions for each stroke of the carriage so that there is no substantial tendency to twist the conduits 107 and 108 sufficiently to impair their proper functioning.

A blower 120 is provided which is stationarily mounted on the frame at 121 (although being adjustable therealong), such blower having ports 122 in its under surface and being connected with a source of compressed air. The blower preferably operates continuously during operation of the apparatus although means may if desired be provided whereby the blower will operate intermittently. The blower is positioned above the trailing portions of the sheets as they are moved into delivery position by the carriage 31. When the carriage 31 is withdrawn from beneath a sheet the blower blows air downwardly upon the portion of the sheet nearest the carriage, causing such portion of the sheet to move rapidly downwardly and thus clear the carriage upon the subsequent movement thereof to the delivery position. The blower also assists the sheets in settling in their final delivered position. Its position may be adjusted longitudinally of the apparatus as may be desired.

In the form of apparatus shown in the drawings above referred to there is provided a pile support 123 (Figures 2 and 3) upon which the sheets are delivered in a pile 58. The pile support and its operating mechanism may be of standard construction and need not be described in detail. Joggers 124 are provided for insuring proper arrangement of the sheets in the pile. The joggers likewise may be operated by any appropriate means known in the art.

There is shown in Figures 14 to 18, inclusive, a modified form of sheet delivery apparatus. In general such apparatus is the same as that above described and shown in Figures 1 to 13, inclusive. The apparatus of Figures 14 to 18, inclusive, differs from that of Figures 1 to 13, inclusive, only in that the blower instead of being stationarily mounted is carried by the reciprocable carriage. Parts of the structure of Figures 14 to 18, inclusive, which are the same as parts of the structure of Figures 1 to 13, inclusive, are designated in Figures 14 to 18, inclusive, by the same reference numerals as are applied to such parts in Figures 1 to 13, inclusive.

The structure of Figures 14 to 18, inclusive, comprises a blower 125 in the form of a pipe having in its lower portion a continuous longitudinally extending slit 126 through which a jet of air is adapted to be discharged. The pipe is carried by suitable brackets 127 connected with the frame of the reciprocable carriage 31. At one end of the blower 125 an elbow 128 is connected thereto and connected with such elbow is a nipple 129 which receives one end of a flexible hose 130 the other end of which is received by a nipple 131 connected through an elbow 132 and a pipe 133 with a valve 134.

Mounted on the upper surface of one of the stationary side frame members 15 and fastened thereto by screws 135 is a longitudinally extending connector bar 136 having a base portion 137 and a top portion 138 which overhangs the base portion 137 at opposite sides as shown in Figure 16. The connector bar 136 serves in the nature of a connecting track for fastening the valve 134 to the frame member 15. A fastening block 139 having in its lower portion a T-slot 140 receiving the upper portion of the connector bar 136 is slidable longitudinally thereof. The block 140 may be maintained in desired position longitudinally of the connector bar 136 by a set screw 141.

The casing of the valve 134 has a lateral projection 142 adapted to overlie the block 139 and to be fastened to such block by screws 143. Thus the valve 134 is adjustably supported on the stationary side frame of the delivery apparatus and may be positioned at any desired point along the connector bar 136.

The valve 134 comprises a casing having a cylindrical bore 144 extending vertically therethrough, a connecting portion 145 at which the pipe 133 is connected to the valve so as to communicate with its bore 144 and an exhaust port 146 coaxial with the connecting portion 145 and also communicating with the bore 144. The casing also has a connecting portion 147 with which is connected an elbow 148 communicating with a pipe 149 leading to the blower (not shown). The movable portion or plug of the valve 134 is designated 150 and comprises a generally cylindrical member fitting within the bore 144 and having an annular recess 152 extending thereabout adjacent its lower end and so as to be opposite the air inlet through the connecting portion 147 when the plug is in place in the casing. The plug also has an upwardly extending passage 153 communicating with the annular recess 152 and extending to the level of the connecting portion 145 and the exhaust port 146 and whose horizontal cross-sectional shape is shown in Figure 18. The upper end of the plug is reduced and threaded as shown at 154 and carries an abutment member or plate 155, a spacer 156, a valve operating member in the form of a yoke 157 and a nut 158 for holding the parts tightly in place. By loosening the nut 158 the annular position of the yoke 157 relative to the plug 150 may be adjusted as desired. At its lower end the plug has threaded thereinto a screw 159 which passes through a plate 160 abutting the bottom of the casing, a compression coil spring 161 bearing between the plate 160 and the head of the screw 159. The effect of the spring 161 is to draw the plug 150 down into its proper operative position in the casing and hold it there.

The valve is shown in closed position in Figure 14 and in open position in Figures 15 to 18, inclusive. The yoke 157 has arms 162 and 163 respectively adapted to engage in a manner presently to be described a valve operating member 164 carried by the carriage 31. Fastened to a side frame of the carriage by bolts 165 is a bracket 166 to which is connected at its upper end by a bolt 167 an arm 168 carrying at its outer extremity a pin 169 rotatably carrying a roller 164 which constitutes the valve operating member. The bracket 166 may be positioned at any desired point longitudinally of the carriage.

In Figure 14 the carriage is retracted from its forward position and the valve is closed—that is, the air entering through the pipe 149 does not pass to the pipe 133; instead it passes out through the exhaust port 146 to the atmosphere and no jet of air is emitted by the blower 125. In this

closed position of the valve the passage 153 is out of communication with the pipe 133 and in communication with the exhaust port 146 as shown in dotted lines in Figure 18. As the carriage moves forward, the valve operating member 164 strikes the inner surface of the arm 162 and turns the valve in the clockwise direction viewing Figures 14, 15 and 18 to the position shown in solid lines in Figures 15 and 18 in which the passage 153 is in communication with the pipe 133. This results in admission of air to the blower 125 and the blowing of a jet of air downwardly through the slit 126. Upon return motion of the carriage the roller 164 engages the inner surface of the arm 163, moving the valve from the position shown in full lines in Figures 15 and 18 to the position shown in dotted lines in such figures and in full lines in Figure 14. This shuts off the supply of air from the blower 125 and the air is discharged through the exhaust port 146.

With the blower 125 mounted on the carriage 31 as just described it is not in all cases essential to periodically cut off the supply of air thereto, but the blower may be supplied with air continuously except under certain circumstances, as when operating upon very thin sheets. Sometimes when very thin sheets are being operated upon the jet of air upon the forward motion of the carriage tends to ruffle the sheets in the pile. Consequently when very thin sheets are being operated upon it is preferable to open the valve to admit air to the blower just before the carriage reaches its forward position in which the sheet lying upon the carriage is positioned above the pile. This is provided for by proper positioning of the valve and the valve operating member 164. As the carriage begins its rearward movement the jet of air blown downwardly through the slit 126 first engages the forward portion of the sheet and as the rearward movement of the carriage progresses engages successively portions of the sheet progressively farther and farther removed from its forward edge. The motion of the carriage is fast enough that the effect of the air jet upon the sheet is simply to blow the sheet downwardly and assist it in moving properly and positively into position on the top of the pile and to clear the carriage upon the subsequent forward movement thereof.

As the operation of the apparatus has been explained in connection with the description of the structures above described it will not be repeated. The apparatus functions in a highly efficient manner to deliver sheets at high speed and with improved precision. The suction and blower means for controlling the sheets during delivery are largely responsible for the improved operation of my delivery apparatus. It is, of course, to be understood in view of the above disclosure that the word "article" as used in the claims means any article capable of being delivered by apparatus of the type in question. Primarily sheets are contemplated as the articles to be delivered but, as mentioned at the outset of this specification, certain of the features of the invention are applicable to the delivery of articles generally. Also, where reference is made to the delivery or carrying of articles on a carrier or conveyor it is to be understood that unless the context plainly indicates otherwise the article need not necessarily be carried upon the top of the conveyor. For example, certain of the features of the invention are applicable to apparatus in which articles may be carried on a conveyor but beneath or against the under surface thereof, as, for example, by suction.

While I have shown and described certain present preferred embodiments of the invention and certain present preferred methods of practicing the same, it is to be distinctly understood that the invention is not limited thereto but may be otherwise variously embodied and practiced within the scope of the following claims.

I claim:

1. In the art of delivering articles to a delivery point, advancing an article to the delivery point while holding the article adjacent its forward end in the direction of such advance by movable holding means, stopping the holding means, releasing the forward end of the article at or adjacent the delivery point and steadying the article by suction applied progressively at points thereof progressively removed from the forward end thereof immediately prior to delivery thereof.

2. In the art of delivering articles, advancing an article atop a support which advances therewith, maintaining the article in position on the support during such advance by suction and withdrawing the support from beneath the article while the article remains substantially stationary in the horizontal direction.

3. In the art of delivering articles, withdrawing an endless carrier support from supporting relationship with respect to an article to deliver the same in horizontally stationary position while holding a portion of the article against the carrier by suction, the portion of the carrier in contact with the article being substantially stationary during such contact upon said withdrawal.

4. In the art of delivering articles, advancing an article while supported by a support comprising an endless carrier by moving the support bodily forwardly, stopping such forward movement with the article directly above the point to which it is to be delivered and then moving the support bodily rearwardly while maintaining the article supporting portion of the endless carrier substantially stationary while in engagement with the article and steadying the article by contact therewith at the face of the article next the support only.

5. In the art of delivering articles, advancing an article while supported by a support comprising an endless carrier by moving the support bodily forwardly and thereafter moving the support bodily rearwardly while maintaining the article supporting portion of the endless carrier substantially stationary while in engagement with the article and drawing the article toward the support by suction through an element of the endless carrier adjacent the trailing edge of the support during the rearward movement thereof.

6. In the art of delivering articles, advancing an article while supported by a support comprising an endless carrier by moving the support bodily rectilinearly forwardly and thereafter moving the support bodily rearwardly while maintaining the article supporting portion of the endless carrier substantially stationary while in engagement with the article and during the bodily rearward movement of the support drawing the article toward the support by suction applied thereto through perforations in the endless carrier.

7. In the art of delivering articles, advancing an article while supported by a support comprising an endless carrier by moving the sup-

port bodily forwardly and during such movement drawing the forward end of the article toward the support by suction and thereafter releasing such suction and moving the support bodily rearwardly while maintaining the article supporting portion of the endless carrier substantially stationary while in engagement with the article.

8. In the art of delivering articles, advancing an article while supported by a support comprising an endless carrier by moving the support bodily rectilinearly forwardly and during such movement drawing the article toward the support by suction and thereafter moving the support bodily rearwardly while maintaining the article supporting portion of the endless carrier substantially stationary while in engagement with the article.

9. In the art of delivering articles, advancing an article while supported by a support comprising an endless carrier by moving the support bodily forwardly and during such movement drawing the forward end of the article toward the support by suction and thereafter releasing such suction and moving the support bodily rearwardly while maintaining the article supporting portion of the endless carrier substantially stationary while in engagement with the article and during the bodily rearward movement of the support drawing the article toward the support by suction applied to the article successively at points farther and farther removed from the forward end of the article.

10. In the art of delivering articles, advancing an article while supported by a support comprising an endless carrier by moving the support bodily forwardly and during such movement drawing the forward end of the article toward the support by suction and thereafter releasing such suction and moving the support bodily rearwardly while maintaining the article supporting portion of the endless carrier substantially stationary while in engagement with the article and during the bodily rearward movement of the support drawing the article toward the support by suction applied to the article successively at points farther and farther removed from the forward end of the article until the article is substantially clear of the support, at which time suction is no longer applied thereto and the article is free to fall.

11. In the art of delivering articles, advancing an article while supported by a support comprising an endless carrier by moving the support bodily forwardly and during such movement drawing the forward end of the article toward the support by suction applied to the article independently of the endless carrier and thereafter releasing such suction and moving the support bodily rearwardly while maintaining the article supporting portion of the endless carrier substantially stationary while in engagement with the article and during the bodily rearward movement of the support drawing the article toward the support by suction applied to the article successively at points farther and farther removed from the forward end of the article through perforations in the endless carrier until the article is substantially clear of the support, at which time suction is no longer applied thereto and the article is free to fall.

12. Article delivery apparatus comprising an endless carrier support for an article, means for withdrawing such support from supporting relationship with respect to the article while maintaining the portion of the carrier in contact with the article substantially stationary during contact thereof with the article upon said withdrawal and suction means for holding a portion of the article against the carrier adjacent the trailing edge thereof.

13. Article delivery apparatus comprising an endless carrier support for an article, means for moving said support bodily forwardly while an article is supported thereby and stopping such forward movement with the article directly above the point to which it is to be delivered and moving the support bodily rearwardly, means for maintaining the article supporting portion of the endless carrier substantially stationary while in engagement with the article upon said rearward movement of the support and means for steadying the article by contact therewith at the face of the article next the support only.

14. Article delivery apparatus comprising an endless carrier support for an article, means for moving said support bodily forwardly while an article is supported thereby and thereafter moving the support bodily rearwardly, means for maintaining the article supporting portion of the endless carrier substantially stationary while in engagement with the article upon said rearward movement of the support and suction means for drawing the article toward the support adjacent the forward edge of the support.

15. Article delivery apparatus comprising an endless carrier support for an article, means for moving said support bodily forwardly while an article is supported thereby and thereafter moving the support bodily rectilinearly rearwardly, means for maintaining the article supporting portion of the endless carrier substantially stationary while in engagement with the article upon said rearward movement of the support and means for drawing the article toward the support by suction through an element of the endless carrier.

16. Article delivery apparatus comprising an endless carrier support for an article, means for moving said support bodily forwardly while an article is supported thereby and thereafter moving the support bodily rearwardly, means for maintaining the article supporting portion of the endless carrier substantially stationary while in engagement with the article upon said rearward movement of the support and suction means adjacent the trailing edge of the support when the support is moving rearwardly for drawing the article toward the support during the bodily rearward movement of the support, said suction means being so constructed and arranged as to apply suction to the article successively at points farther and farther removed from the forward end of the article.

17. Article delivery apparatus comprising an endless carrier support for an article, means for moving said support bodily forwardly while an article is supported thereby to a position in which the article is directly above the point to which it is to be delivered and thereafter moving the support bodily rearwardly, means for maintaining the article supporting portion of the endless carrier substantially stationary while in engagement with the article upon said rearward movement of the support and means for drawing the article toward the support by suction during the bodily rearward movement of the support, said means being so constructed and arranged as to apply suction to the article through perforations in the endless carrier.

18. Article delivery apparatus comprising an endless carrier support for an article, means for moving said support bodily forwardly while an article is supported thereby and thereafter moving the support bodily rearwardly, means for drawing the forward end of the article toward the support by suction during substantially the entire forward movement thereof and means for maintaining the article supporting portion of the endless carrier substantially stationary while in engagement with the article upon said rearward movement of the support.

19. Article delivery apparatus comprising an endless carrier support for an article, means for moving said support bodily forwardly while an article is supported thereby and thereafter moving the support bodily rearwardly, means for drawing the forward end of the article toward the support by suction during the forward movement thereof, means for releasing such suction, means for maintaining the article supporting portion of the endless carrier substantially stationary while in engagement with the article upon said rearward movement of the support and suction means for drawing the article toward the support during the bodily rearward movement of the support, said suction means being so constructed and arranged as to apply suction to the article successively at points farther and farther removed from the forward end of the article.

20. Article delivery apparatus comprising a reciprocable carriage, endless conveying means carried by said carriage, means for imparting endwise movement to said endless conveying means upon movement of the carriage in one direction, suction means associated with said carriage for applying suction through said endless conveying means to articles carried thereby, control means periodically operable for applying suction to said suction means and cutting off such suction and means operable upon reciprocation of the carriage for operating said control means.

21. Article delivery apparatus comprising a reciprocable carriage, a flexible fluid conduit connected with said carriage and a drum about which said conduit is adapted to be wound upon movement of the carriage in one direction.

22. Article delivery apparatus comprising a reciprocable carriage, a flexible fluid conduit connected with said carriage and a drum with which said conduit is connected and about which said conduit is adapted to be wound upon movement of the carriage in one direction, the drum having a fluid connection entering the same substantially axially and connecting with said conduit.

23. Article delivery apparatus comprising a reciprocable carriage, a length of flexible fluid conduit connected therewith, a hollow shaft, a drum on said shaft about which the conduit is wound upon movement of the carriage in one direction and a further length of flexible fluid conduit extending through said hollow shaft to the drum and connected with the first mentioned length of flexible fluid conduit.

24. Article delivery apparatus comprising a support for an article, means for advancing the support with an article carried thereby and withdrawing the support from supporting relationship with respect to the article and means movable with the support but mounted beyond the end of the support for blowing an article to assist in moving the article to delivered position.

25. Article delivery apparatus comprising a support for an article, means for advancing the support with an article carried thereby and withdrawing the support from supporting relationship with respect to the article and means movable with the support but mounted beyond the end of the support for blowing an article to assist in moving the article to delivered position, said last mentioned means being disposed so as to blow a portion of the article offset from the support during withdrawal of the support from supporting relationship with respect to such article.

26. Article delivery apparatus comprising means for advancing an article to a delivery point, means for holding the article adjacent its forward end during such advance, means for stopping the holding means when the article has substantially reached the delivery point and means for steadying the article by suction applied progressively along its under surface at the delivery point immediately prior to delivery thereof.

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