Nov. 13, 1956 J. N. PORTERFIELD 2,770,347

COLLAPSIBLE TUBE TRANSFER MECHANISM

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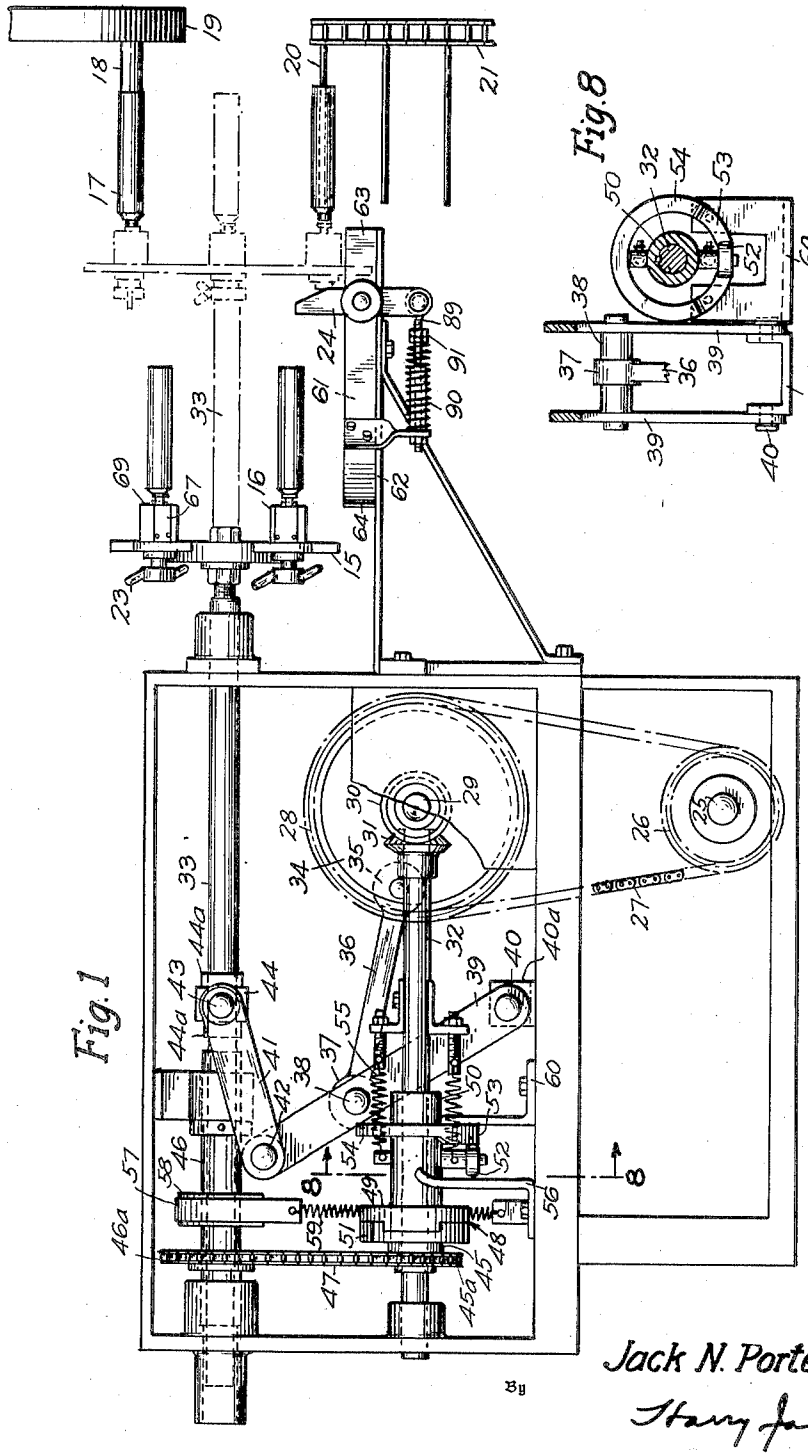


Fig. 1

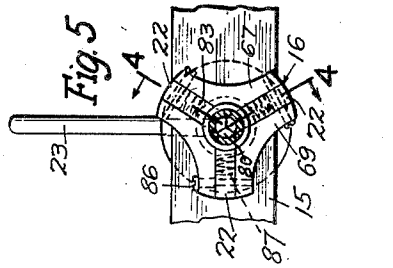
Fig. 8

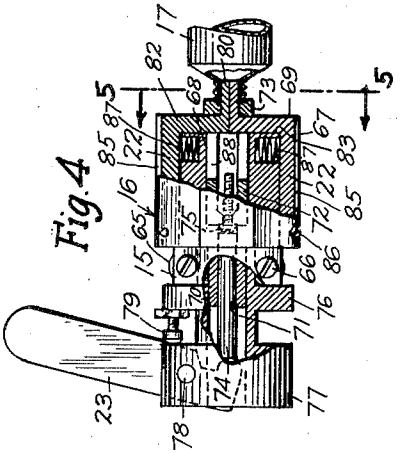
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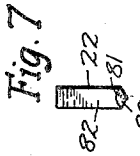
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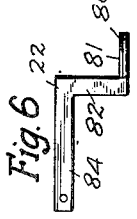
COLLAPSIBLE TUBE TRANSFER MECHANISM

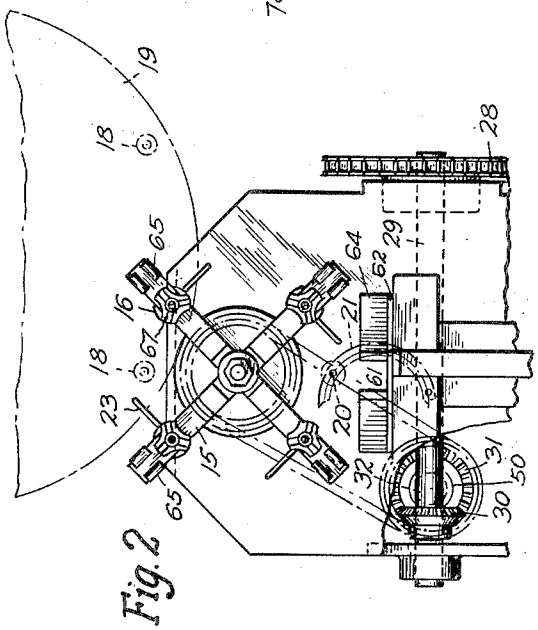
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COLLAPSIBLE TUBE TRANSFER MECHANISM

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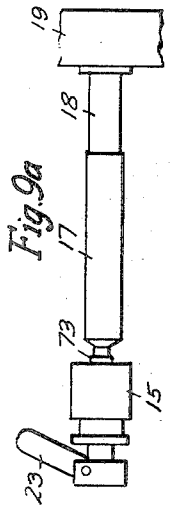


Fig. 9a

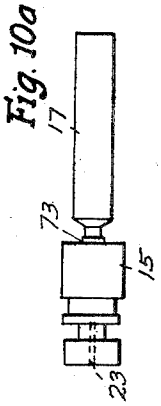


Fig. 10a

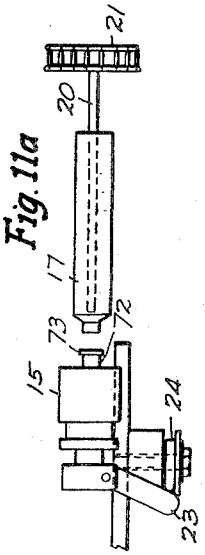


Fig. 11a

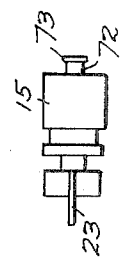


Fig. 12a

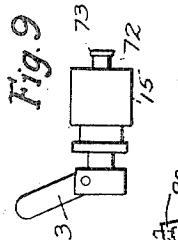


Fig. 9

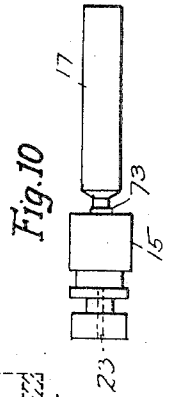


Fig. 10

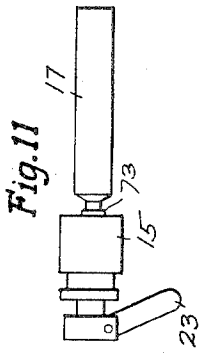


Fig. 11

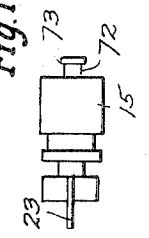


Fig. 12

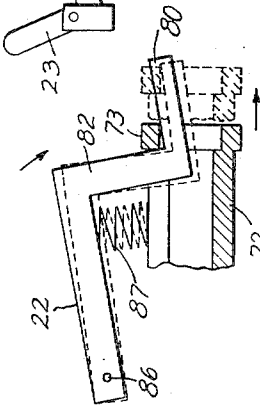


Fig. 13

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United States Patent Office 2,770,347 Patented Nov. 13, 1956

2,770,347

COLLAPSIBLE TUBE TRANSFER MECHANISM

Jack N. Porterfield, Chico, Calif.

Application October 14, 1952, Serial No. 314,729

16 Claims. (Cl. 198—25)

This invention relates to collapsible tube transfer mechanism and particularly to the means for removing collapsible tubes from the mandrels of a printing or the like machine and remounting the tubes on the pins of a conveyor for further operation thereon.

The various objects of the invention will be clear from the description which follows and from the drawings, in which

Fig. 1 is a side elevational view of the transfer mechanism, showing in dash-dot lines, the forward or operative positions of the tube grippers.

Fig. 2 is an end elevational view thereof showing the turret of the tube printer and part of the conveyor in dash-dot lines.

Fig. 3 is a top plan view thereof with certain parts broken away to reveal adjacent parts.

Fig. 4 is a combined elevational view and sectional view of the tube gripper taken on the line 4—4 of Fig. 5.

Fig. 5 is a vertical sectional view of the tube gripper taken on the line 5—5 of Fig. 4.

Fig. 6 is a side elevational view of one of the gripping fingers.

Fig. 7 is a front elevational view thereof.

Fig. 8 is a vertical sectional view of the clutch controlling cam and adjacent parts taken on the line 8—8 of Fig. 1.

Figs. 9–12 are top plan views of one of the tube grippers showing the various positions assumed thereby after the forward stroke has begun and the gripper frame has been rotated a quarter turn from the previous position thereof.

Figs. 9*a*–12*a* are similar views of the same gripper at the end of each of the respective forward strokes corresponding respectively to the similarly numbered figures 9–12, Fig. 9*a* showing the forward position of the gripper assumed thereby as it is advanced from the position of Fig. 9.

Fig. 13 is a view in side elevation, partly cut away, somewhat enlarged, showing the operation of the tube gripping structure, according to the present invention.

In the practical embodiment of the invention shown, the four arms 15 each carrying the gripper 16, constitute a frame which is intermittently rotated through a quarter turn and also reciprocated forwardly and rearwardly a complete stroke in a horizontal path for each quarter turn. Fig. 9 shows the gripper as it appears when it is uppermost in the gripper frame 15 and beyond the initial part of its forward stroke toward the final position of Fig. 9*a* at the end of the forward stroke. In the later position, the gripper has gripped the tube 17 on the mandrel 18 of the turret 19, which may be that of a tube printing machine. The turret is intermittently rotated in a manner forming no part of the present invention, so that the turret is at rest with one of the lower mandrels thereof arranged coaxially of the topmost gripper, which is also at rest, preparatory to the removal from the mandrel of the printed tube thereon.

From the position of Fig. 9*a*, the gripper is withdrawn

rearwardly with the withdrawn tube held thereby, and given a total of a quarter turn during successive portions of two consecutive strokes, that is, during the last part of its rearward stroke and the initial part of its forward stroke, into the position of Fig. 10 at a side of the gripper frame 15. Thereafter, from the position of Fig. 10, the second forward and inoperative stroke of the gripper is completed to the position of Fig. 10*a*. The next or second rearward stroke and initial part of the second forward stroke and completion of the quarter turn bring the gripper frame to the position of Fig. 11 at the lowermost part of the gripper frame. The end of the third forward stroke of the frame arranges the gripper in the position of Fig. 11*a* in horizontal alignment with the pin 20 of the conveyor 21, which pin reaches a position in alignment with the tube carried by the gripper as the gripper moves into its forward stop or rest position. The conveyor preferably moves continuously, but in view of the greater diameter of the tube 17 compared to that of the pin 20, the movements of the parts may be synchronized so that no interference or tube damage occurs. As the gripper moves into the tube discharging position of Fig. 11*a*, the gripping fingers 22 thereof are brought together under the action of the finger-operating lever 23, which strikes the yielding stop lever 24, as will be more fully described hereinafter, whereby the tube is released and given a forward push on to the pin.

The third rearward stroke and quarter turn of the frame carries the gripper into the position of Fig. 12 and the completion of the fourth or final forward stroke while the gripper starts from the side of the frame, is an inoperative stroke into the position of Fig. 12*a*. The final or fourth rearward stroke and quarter turn, together with the initial part of a forward stroke, completes the cycle and carries the gripper back to the uppermost initial position of Fig. 9.

With the above operation of the grippers in mind, the simplified means for accomplishing the necessary movements and for gripping and releasing the tube may now be described. Power is applied to the shaft 25 (Fig. 1) which carries the sprocket wheel 26 engaging the chain 27, which in turn engages and continuously rotates the sprocket wheel 28 on the drive shaft 29. On the same shaft 29 is the bevel gear 30 meshing with the bevel gear 31 on the clutch shaft 32, the latter being thereby continuously rotated. To impart reciprocatory movement to the parallel driven gripper shaft 33, the perpendicular drive shaft 29 is interrupted (Fig. 3) and a pair of crank discs 34 secured thereto at the adjacent ends thereof, the discs being secured to and connected adjacent the peripheries thereof by one end 35 of the connecting rod 36. The other end 37 of said rod is secured to the cross bar 38 (Figs. 1 and 8) which connects the pair of similar levers 39, each pivoted at the lower end thereof as at 40 to a fixed bracket 40*a*. The upper ends of the levers are connected to the rear ends of the respective links 41 as at 42, the front ends of said links being connected to the respective studs 43 extending from opposite ends of the yoke 44. The shaft 33 passes loosely through and rotatably mounted in the yoke. Collars 44*a* fixed to the shaft 33 on both sides of the yoke insure longitudinal movement of the shaft on movement of the yoke. It will now be apparent that rotation of the crank discs 34 causes longitudinal reciprocation of the driven shaft 33 which carries the gripper frame 15. The length of the reciprocating stroke of the driven shaft in each direction is greater than the length of the tube to be dismounted from the mandrel.

Intermittent rotation of the gripper frame 15 at the proper times is attained by means of a hollow shaft 46 slidably receiving and keyed to the shaft 33 and mechanism for intermittently rotating the hollow shaft. Said

mechanism includes a hollow clutch shaft **45** rotatably and slidably receiving the clutch shaft **32** and sprocket wheels **45***a* and **46***a* on the respective hollow shafts **45** and **46** and operatively connected by the chain **47**. A suitable clutch **48** connects the shaft **45** with and disconnects it from, the continuously rotating shaft **32** at the required intervals. One member **49** of the clutch is provided with a hollow hub **50** keyed to the shaft **32** and rotatable continuously therewith. The other clutch member **51** is secured to the hollow shaft **45** and rotates intermittently therewith. The clutch member **49** is alternately moved toward and withdrawn from the member **51** on each revolution of the shaft **32** to cause engagement of the teeth of said clutch members on the sliding movement of the hub **50** toward the left as viewed in Figs. 1 and 3 thereby to impart the rotation of the shaft **33** to the sprocket wheel **45***a* during a part of such rotation and to disengage the clutch members on the withdrawal of the member **49** and hub **50** toward the right relatively to the shaft **32** thereby to halt the rotation of the clutch member **51** on the remainder of the revolution of the shaft **32**. As best seen in Fig. 8, such movement of the hub **50** is attained on the engagement of the cam roller or follower **52** thereon with the high part **53** of the fixed ring cam **54**. The hub **50** carries said roller **52** and is urged toward the right as viewed in Figs. 1 and 3 to disengage the clutch members, by the springs **55** which are suitably attached at the left ends thereof to the hub and at the other ends to the shaft **32** to rotate with the shaft and hub as a unit, the springs pressing the cam roller against the cam and passing through a central opening in the cam. A suitable fixed bracket **60** supports the ring cam in a fixed position with the hub **50** passing therethrough.

To aid the springs in disengaging the clutch members should the springs lag in doing so, a fixed safety roller guide having a bent portion following the shape of the cam and in the path of the roller, is arranged to engage the roller and to move it toward the right into engagement with the low part of the cam during the rotation of the roller. Said guide **56** and the cam surface thereby coact to form a groove in which the roller moves. The U-shape brake band **57** which is pulled into engagement with the brake wheel **58** on the shaft **46** by suitable springs **59**, prevents over-rotation of the shaft **33** and halts the gripper frame **15** in approximately the correct position wherein the operative grippers are aligned with the mandrel and conveyor pin respectively.

However, the brake need not be depended upon entirely to accomplish the requisite accurate coaxial alignment of the grippers **16** successively with the successive mandrels **18** for dismounting the tubes **17** from the mandrels. As shown in Figs. 1, 2 and 3, a guideway **61** is provided for engaging consecutive gripper arms **15** successively and aligning the grippers thereof dependably and accurately with the proper mandrel. Said guideway comprises the platform **62** adjustably supporting the side guide plates **63**, the rear end parts **64** of which diverge rearwardly to provide a flared rear guideway part for the reception and guidance of that arm **15** which extends downwardly from the ecnter of the gripper frame. The inner surfaces of the front parts of the guide plates **63** are spaced apart just far enough to become engaged by the respective elongated rollers **65** on the forward movement of the gripper shaft **33**, the rollers being suitably rotatably mounted at the outermost parts of the side edges of each of the arms **15** as by means of the pivot screws **66** (Fig. 4). Said guide plates thereby control the rotated positions of the arms **15** and hold them exactly as required during the last part of the forward stroke and the first part of the rearward stroke of the shaft **33**.

The means for gripping a tube on the mandrel so that the tube is withdrawn on the rearward stroke of the shaft **33** and the means for releasing the grippers when the tube is to be mounted on a conveyor pin, will now be described. The gripper **16** comprises the body member **67** (Figs. 4 and 5) having a central hole **68** extending partway therethrough from the front face **69** thereof and having a rearwardly extending hub **70** provided with a smaller hole **71** therethrough. A finger-closing elongated hollow member **72** is slidably mounted in the hole **68** and has an enlarged annular flange **73** at its front end. The flange engages the front face **69** in the retracted position of the member **72** and thereby limits the rearward movement of said member. Slidably mounted in the smaller hole **71** of the hub is the pin **74**, the rear end of which is normally engaged by the lever **23** and the front end of which engages the adjustable screw **75** mounted in the rear end of the member **72**. The hub **70** is fixed in the forwardly extending hollow projection **76** of the lever-carrying member **77**, said projection being fixed in the arm **15**. A pivot **78** for the lever **23** passes through said lever and the member **77** and permits the lever to be swung thereabout, thereby to cause the lever to engage and to slide the pin **74** and the member **72** forwardly. A suitable adjustable stop **79** limits the forward movement of the outer part of the lever.

The body member **67** carries three gripping fingers **22** of generally Z-shaped form as best seen in Figs. 4 and 6. The front end portion **80** of the finger is of generally triangular or segmental cylindrical cross sectional shape, the outer surface **81** thereof being convexly rounded so that when the portions **80** of all of the fingers are closest together or in their tube releasing positions, the outer surfaces **81** all lie in the surface of a cylinder or slightly tapered cone of slightly less diameter than the inner diameter of the neck of the tube **17**. Said front portions **80** of the fingers pass through the flange **73** of the member **72**, said flange being longitudinally slidable on the portions **80**. The radial portion **82** of each finger is fitted preferably flush into a suitable radial slot portion **83** in the front face **69** of the body member **67**, while the rear portion **84** of the finger is similarly fitted into the longitudinal slot portion **85** in the body member (Fig. 5). A suitable pivot as **86** passes through the rear end part of the portion **84** and into the body member and permits the finger to swing thereabout to the extent permitted by the flange **73**. A radially arranged spring **87** urges the front portion **80** of the finger outwardly toward an inclined position wherein said portion presses against the inner surface of the neck of the tube into which said portion is inserted, and grips said neck with sufficient force to enable removal of the tube so gripped from a mandrel on which the tube is mounted.

In order to swing the fingers inwardly thereby to bring the front portions **80** together and to release the tube against the action of the springs **87**, suitably spaced longitudinal slots as **88** are made in the hollow part of the member **72** rearwardly of the flange **73** for the passage therethrough of the radial portions **82** of the fingers, so that the forward movement of the member **72** to the positions shown in Figs. 11*a*, 12 and 12*a* becomes possible. Rearward movement of the member **72** into the positions of Figs. 9*a*, 10, 10*a* and 11, releases the front portions **80** of the fingers from the constraint of the flange **73** and permits the springs **87** to swing the fingers outwardly into a more inclined position and into gripping engagement with the inside of the tube neck. As has been explained, such forward movement of the member **72** is attained by swinging the lever **23** in a clockwise direction, as seen in Fig. 11*a*, as the lever strikes the yielding stop lever **24** and then continues to move forwardly to a limited extent while in contact with said stop lever. To prevent injury to the parts, the stop lever **24** is pivoted to one of the side guide plates **63** and carries the pin **89** at its lower end, the pin being inserted into the compression spring **90** and thereby permitting limited movement of the stop lever against the action of the spring. As viewed in Fig. 1, the left end of the spring is fixed while its other end abuts against the adjustable nuts **91** on the pin **89**.

Rearward or gripping movement of the member **72** occurs when the flange **73** thereof strikes the exposed end surface of the tube neck during the end portion of the forward movement of the shaft **33** as in Fig. 9*a*. Continued movement of said shaft after the flange engages the tube neck, retracts the member **72** and the pin **74** rearwardly relatively to the fingers **22** and swings the lever **23** in a clockwise direction as viewed in Figs. 4 and 9*a* ready for the next releasing operation by the stop lever **24** at the proper time.

It will be noted from the positions of the parts shown in Fig. 1, that the clutch members **49** and **51** are engaged during the last part of the rearward stroke of the shaft **33** and during the first part of the forward stroke thereof. Since such engagement of the clutch members results in rotation of the shaft **33** and of the gripping arms or frame **15**, part of the quarter turn of said arms occurs during the parts mentioned of the forward and rearward strokes of said shaft. In practice, the shaft makes one-eighth turn on each end part of the rearward and each initial part of the forward strokes, thereby distributing the rotative movement in such a manner as to avoid shock and to maintain the accuracy of alignment.

I claim:

1. In a tube transfer mechanism, a rotatable gripper frame, a plurality of grippers equally spaced apart circumferentially on said frame, means for reciprocating the frame, to retract on one stroke a tube gripped by one gripper and to advance on the opposite stroke another tube gripped by another gripper, means for intermittently rotating the frame in the same direction for part of a revolution during the last part of a tube-retracting stroke and during the initial part of a tube-advancing stroke of the reciprocating means, said frame-rotating means including a clutch, and means for engaging and disengaging the clutch, means to guide and to align the frame and to hold the frame against rotation during the initial part of the retracting stroke and during the last part of a tube-advancing stroke, and means in the path of the frame to operate a gripper to release the tube gripped thereby at the end of a selected tube-advancing stroke.

2. The tube transfer mechanism of claim 1, the means for reciprocating the frame comprising a shaft extending from the frame, a slide block rotatably receiving the shaft, means preventing relative longitudinal movement of the block and the shaft, and means for reciprocating the block.

3. The tube transfer mechanism of claim 2, the means for reciprocating the block comprising a lever, a continuously rotating crank, a connecting rod between the crank and the lever to oscillate the lever and a link connecting the lever to the block.

4. The tube transfer mechanism of claim 1, a shaft extending from the frame, a hollow shaft receiving and keyed to the first mentioned shaft, a sprocket wheel on the hollow shaft, the clutch comprising a first member carrying a sprocket wheel, a second member having means thereon to engage the first member, the second member being slidable toward and from the first member, means for continuously rotating the second member, springs urging said members apart into the clutch-disengaging positions thereof, and a chain connecting the sprocket wheels.

5. The tube transfer mechanism of claim 4, the means for engaging and disengaging the clutch comprising a fixed ring cam, a cam follower carried by the second member and urged by the spring into engagement with the cam, and a fixed guide in the path of the follower and shaped to urge the follower toward the cam.

6. The tube transfer mechanism of claim 1, the means for reciprocating the frame comprising a shaft extending from the frame, a slide block rotatably receiving the shaft and longitudinally movable with the shaft as a unit, and means for reciprocating the block, the clutch comprising a pair of enageable and disengageable clutch members, the means for engaging and disengaging the clutch comprising a fixed ring cam, a follower carried by one of the clutch members, means including a fixed guide urging the follower against the cam in a direction to disengage the clutch members, means for continuously rotating said one of the clutch members and means operatively connecting the other clutch member to the frame shaft.

7. In a tube transfer mechanism, a frame, a plurality of tube grippers carried by the frame, means intermittently rotating the frame comprising a hollow shaft, a frame shaft keyed to and within the hollow shaft, a second shaft parallel and in spaced relation to the frame shaft, a first clutch member keyed to the second shaft and rotatable therewith and slidable relatively thereto, means continuously rotating the second shaft, a second clutch member loose on the second shaft and engageable with and disengageable from the first clutch member, means intermittently engaging and disengaging the clutch members, and means operatively connecting the second clutch member to the hollow shaft.

8. The tube transfer mechanism of claim 7, the means for engaging and disengaging the clutch members comprising a fixed ring cam around the second shaft, and a cam follower carried by the first clutch member.

9. The tube transfer mechanism of claim 8, means for reciprocating the frame shaft comprising a third shaft, a crank on the third shaft, a block rotatably receiving the frame shaft and movable longitudinally with the frame shaft as a unit, and linkage operatively connecting the crank to the block, and gearing connecting the second and third shafts.

10. The tube transfer mechanism of claim 7, each of the grippers comprising a number of radially disposed spring-pressed fingers each having an operative end portion in the form of a substantially cylindrical segment adapted for collapse toward the end portions of the adjacent fingers to form an approximate cylinder of a predetermined diameter, and a longitudinally slidable hollow member terminating in an annular flange surrounding the end portions of the fingers and slidable thereon in one direction to close the end portions and thereby to release a tube within which the end portions are inserted, the flange being slidable in the opposite direction under the pressure of the end of a tube thereon to spread said end portions inside of a tube and thereby to grip the tube, the slidable member having slots therein adjacent the flange for the passage therethrough of those portions of the respective fingers adjacent said end portions.

11. The tube transfer mechanism of claim 10, and means for sliding the slidable member of each gripper comprising a lever pivoted to the gripper and a pin arranged axially of and adapted to move the slidable member and in the path of movement of the lever, and a lever-operating stop in the path of longitudinal movement of the lever.

12. The tube transfer mechanism of claim 7, means for reciprocating the frame, and means to guide and align the frame during the last part of the forward stroke thereof and during the initial part of the rearward stroke thereof.

13. The tube transfer mechanism of claim 7, and means for releasing a selected gripper at the end of the forward stroke thereof including a lever pivoted to the gripper and a yieldable spring-pressed stop in the path of the lever.

14. The tube transfer mechanism of claim 13, each of the grippers comprising a plurality of pivoted fingers each terminating in a segmental tube-gripping front portion adapted to enter a tube, and springs urging the gripping portions of the fingers apart to engage the tube, and means operated by the lever to close said gripping portions together thereby to release a tube gripped by said portions.

15. In tube transfer mechanism to remove a tube from a mandrel, a tube gripper, means for reciprocating the gripper, means for intermittently rotating the gripper, and means for aligning the gripper with the mandrel during part of the reciprocating movement of the gripper, the gripper comprising a plurality of radially disposed fingers, springs urging the fingers apart and an annular member surrounding the fingers and slidable on the outside thereof.

16. In a tube transfer mechanism, a tube gripper comprising a plurality of radially arranged pivoted fingers

of generally Z-shaped form, springs urging said fingers apart, a ring surrounding the end portions of the fingers and slidable thereon, and a lever for sliding the ring in one direction to close the fingers, the ring sliding in the opposite direction to permit the fingers to spread against the action of the springs by the pressure exerted on the ring when the ring is forced axially against an article.

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