United States Patent

[11] 3,572,519

[72] Inventor **Yoshitomo Tezuka**
Tokyo, Japan

[21] Appl. No. **813,206**
[22] Filed **Apr. 3, 1969**
[45] Patented **Mar. 30, 1971**

[73] Assignee **Kabushiki Kaisha Aida Tekkosho**
Kanagawa-Ken, Japan

[54] **ARTICLE TRANSFER APPARATUS ADAPTED TO AUTOMATICALLY FEED MATERIAL TO ONE OF PRESSES OR OTHER PROCESSING MACHINES**
2 Claims, 10 Drawing Figs.

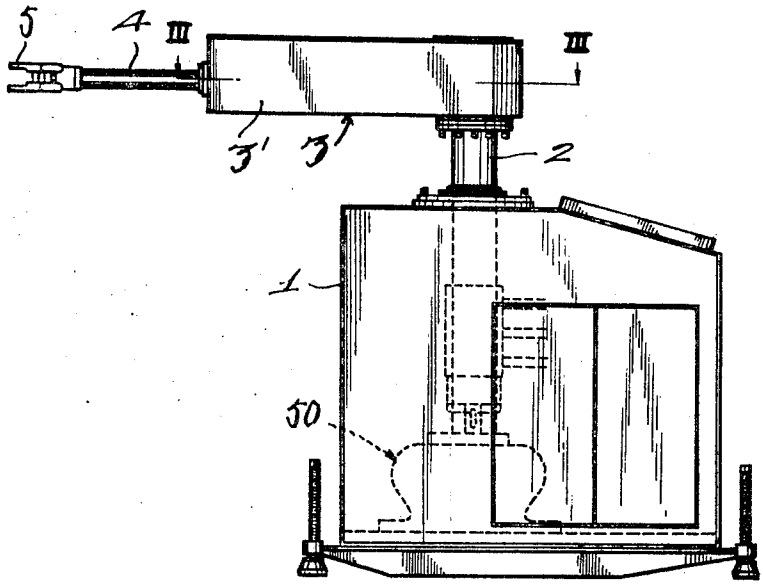
[52] **U.S. Cl.** **214/1,** 74/422
[51] **Int. Cl.** **B25j 9/00**
[50] **Field of Search** ..... 214/1 (B)3, 1 (B)4; 74/422

[56] **References Cited**
UNITED STATES PATENTS

3,040,717	6/1962	Rumsey	74/422X
3,488,692	1/1970	Oda	214/1(B3)

Primary Examiner—Gerald M. Forlenza
Assistant Examiner—George F. Abraham
Attorney—Holman & Stern

ABSTRACT: An automatically operated article transfer apparatus for feeding material to one or a first of presses or other processing machines aligned in a working row, transferring a semiprocessed product between adjacent processing machines in the row, or discharging a finished product from the last processing machine in the row to a location at which the product is subjected to further processing or is shipped.



Patented March 30, 1971 3,572,519

5 Sheets-Sheet 1

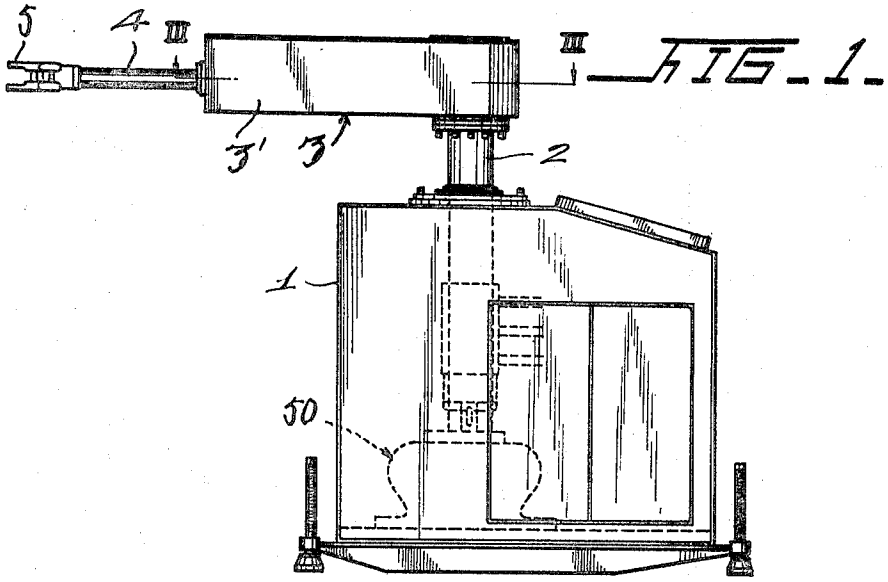
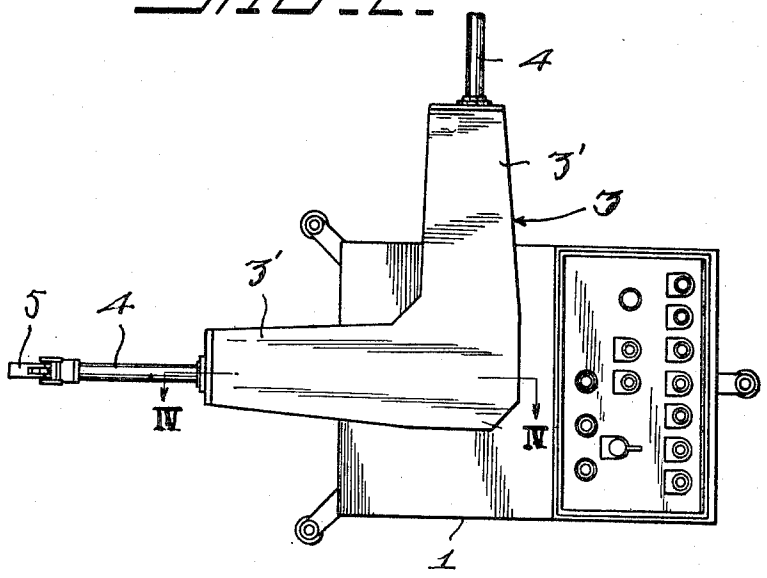


FIG. 1.

FIG. 2.



INVENTOR
Y. TEZUKA
By Holman, Blascoe, Downing & Seibold
ATTORNEYS

Patented March 30, 1971 3,572,519

5 Sheets-Sheet 2

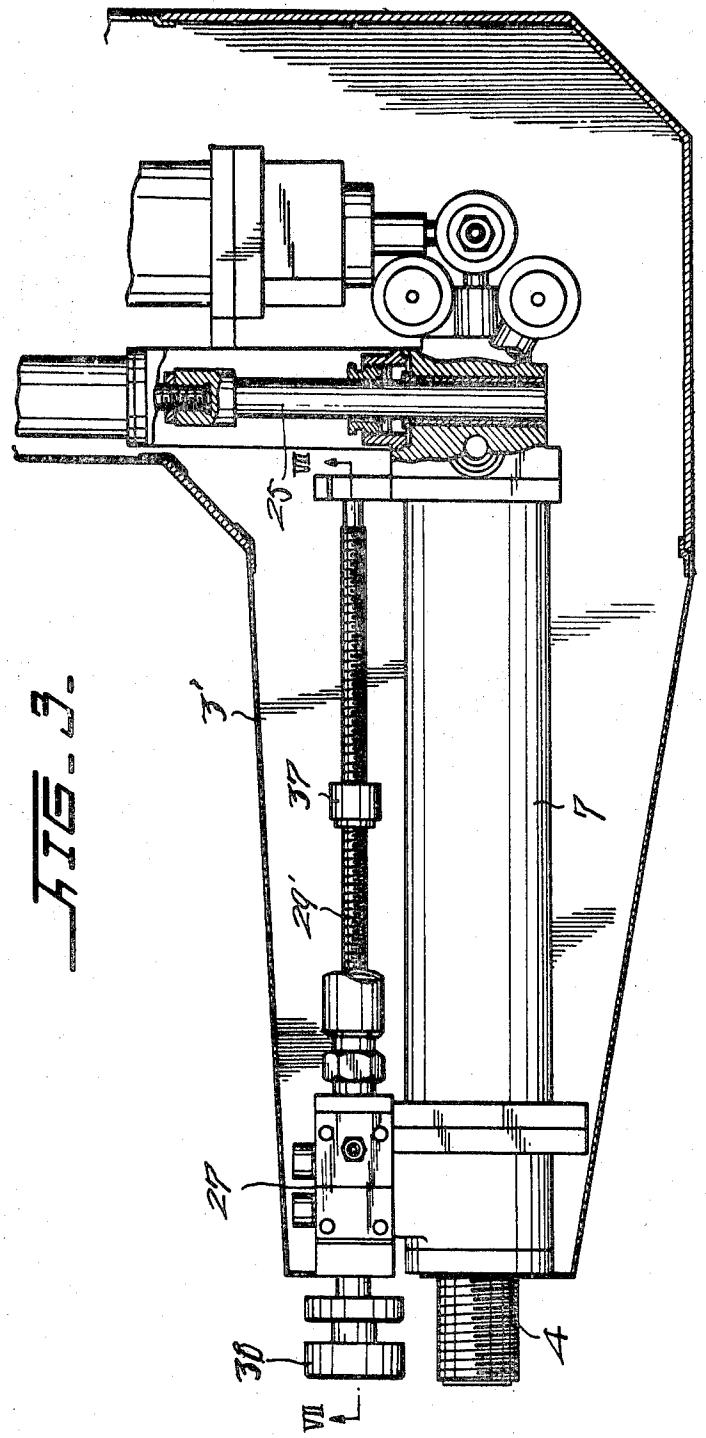


FIG. 3.

INVENTOR
Y. TEZUKA
By Holman, Glascock, Downing & Seibold
ATTORNEYS

FIG. 4.

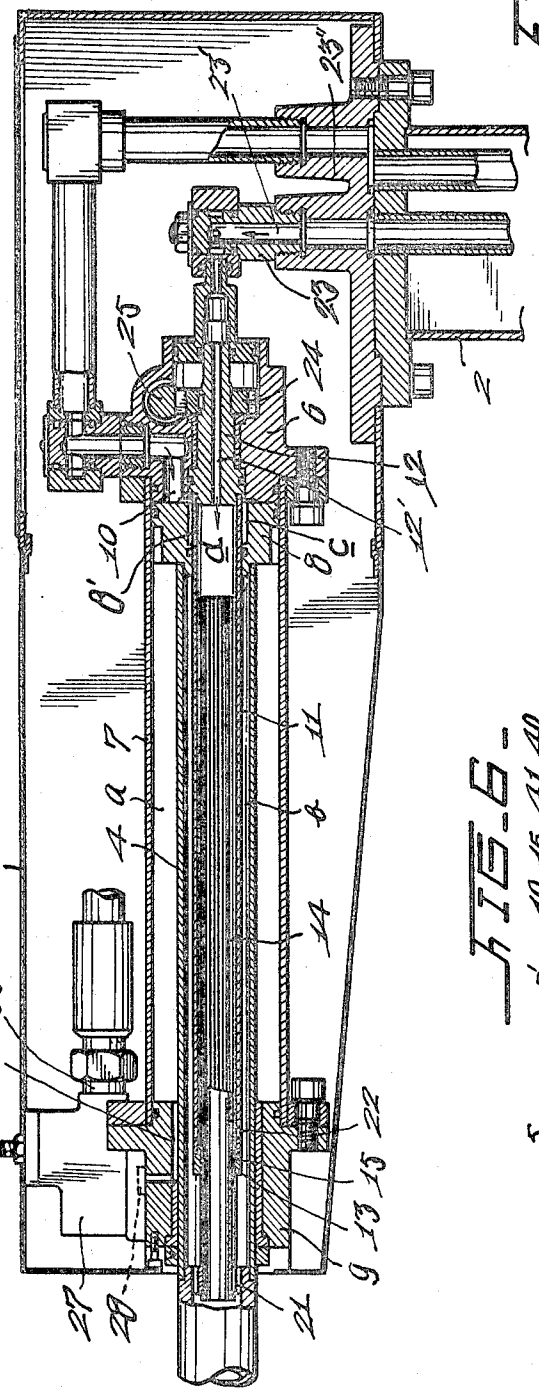


FIG. 5.

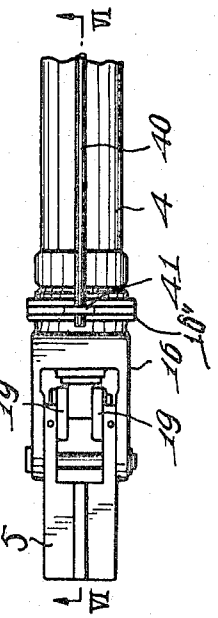
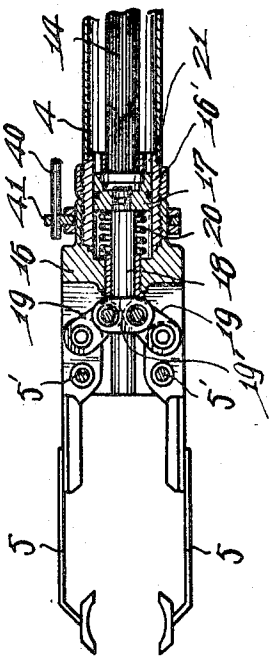


FIG. 6.



INVENTOR
Y. TEZUKA
By Holman, Glascock, Downing & Seibold
ATTORNEYS

FIG. 7.

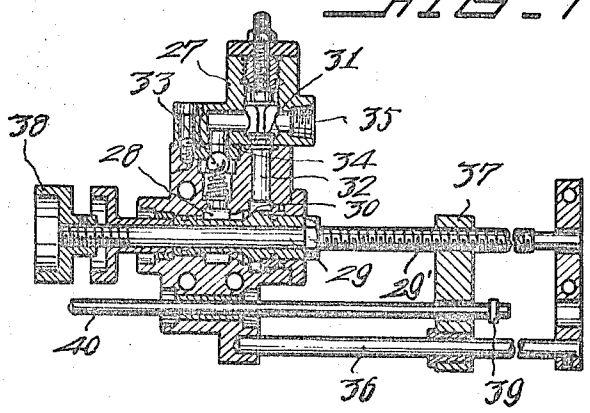


FIG. 8.

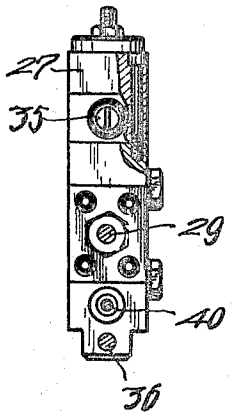
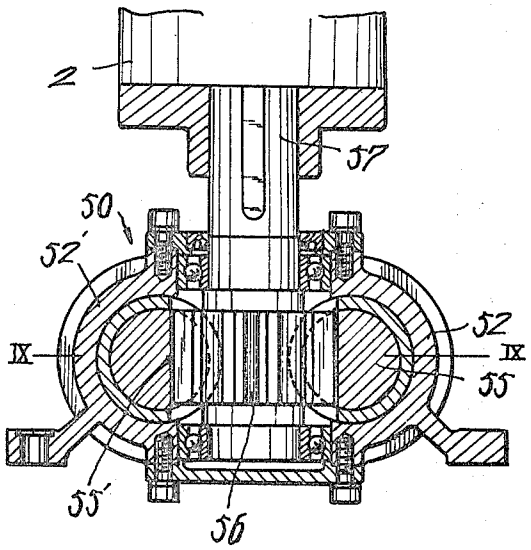
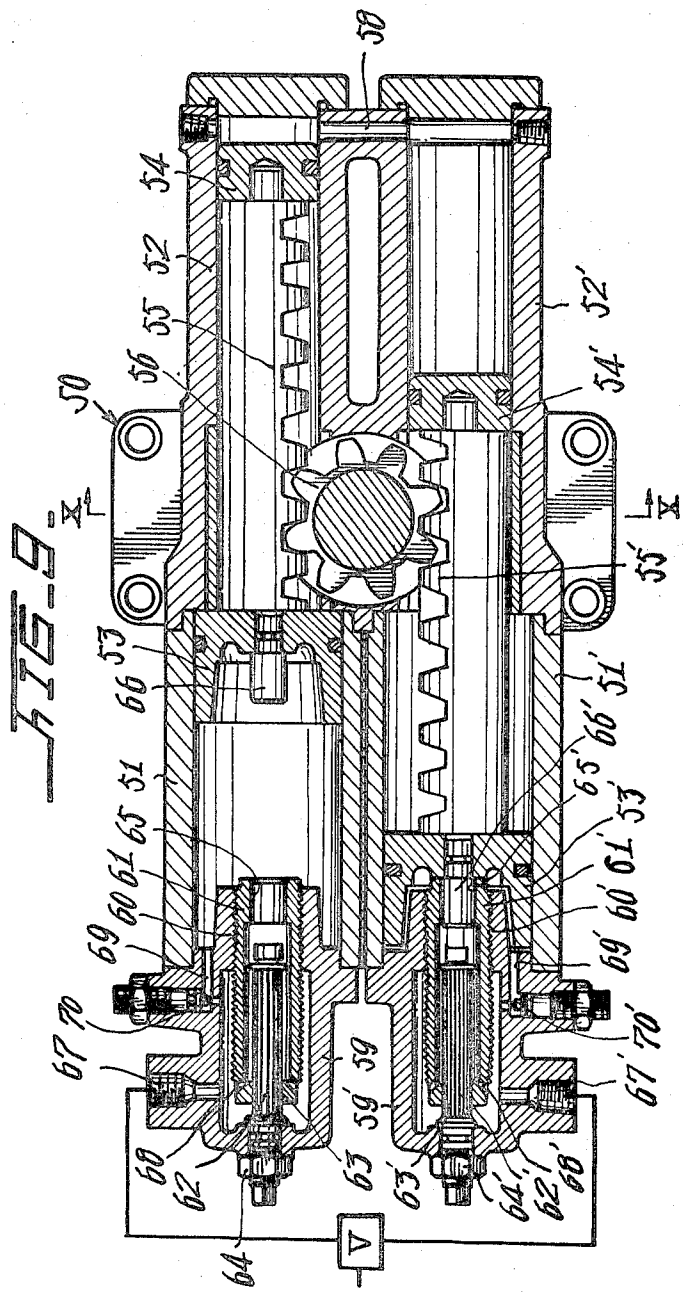


FIG. 10.



INVENTOR
Y. TEZUKA
By Holman, Glascock, Downing & Seebold
ATTORNEYS

FIG. 9



INVENTOR
Y. TEZUKA
By Holman, Glascock, Downing & Seibold
ATTORNEYS

ARTICLE TRANSFER APPARATUS ADAPTED TO AUTOMATICALLY FEED MATERIAL TO ONE OF PRESSES OR OTHER PROCESSING MACHINES

The present invention relates to an article transfer apparatus and, more particularly to an automatically operable article transfer apparatus.

A preferred form of present transfer apparatus generally comprises a vertical main shaft adapted to have imparted thereto a given angle of reciprocal rotational movement; an article transfer arm assembly fixedly secured at one end to the upper end of the main shaft for swiveling movement as the shaft rotates and radially extending from the shaft, the arm assembly including a pair of identical arm units each being defined by a first hollow cylindrical rotatable arm member having a piston secured at one end and a pair of article gripping pawls pivotally supported at the other end, a second hollow cylindrical stationary arm member secured at one end to the upper end of the main shaft and surrounding the first arm member and piston; means for supplying and discharging fluid under pressure to and from one and the opposite sides of said piston; valve means for controlling the supplying the discharging of the fluid to and from the opposite side of the piston; and a second piston fitted in the first arm member at the other end adapted to open and close in response to the action of the fluid within the first arm member.

One object of the present invention is to provide an article transfer apparatus of the above type in which the gripping, releasing and transferring of an article can be performed by the action of fluid under pressure such as air under pressure.

Another object is to provide an article transfer apparatus in which an arm member which pivotally supports article gripping pawls can be advanced toward and retracted from an article to be transferred.

A further object is to provide an article transfer apparatus in which an article being transferred can be turned around upwardly and downwardly in the course of its transfer.

Another object is to provide an article transfer apparatus in which a plurality of articles in different positions can be simultaneously transferred from the different positions to other different plural positions.

A still further object is to provide an article transfer apparatus which is compact and can be employed in conjunction with any suitable processing machine.

The term "article" employed herein refers to material or a blank which is to be fed to one or a first one of a plurality of processing machines aligned in a working row, a semiprocessed product which has been subjected to a certain degree of processing by a preceding processing machine in a series of processing steps and is ready to be subjected to a next processing step by a succeeding processing machine in the working row and a final product which is ready to be discharged from the working row and transferred to another location.

The above and other objects and advantages of the present invention will be more readily apparent to those skilled in the art from the following description taken in conjunction with the accompanying drawings which illustrate a preferred embodiment of transfer apparatus constructed in accordance with the present invention and in which:

FIG. 1 is a side elevational view of a preferred form of transfer apparatus according to the present invention,

FIG. 2 is a plan view of the transfer apparatus,

FIG. 3 is a view in partial cross section on an enlarged scale taken substantially along the line III–III of FIG. 1 as seen in the direction of the arrows,

FIG. 4 is a sectional view taken substantially along the line IV–IV of FIG. 2 as seen in the direction of the arrows,

FIG. 5 is a fragmentary plan view of the article gripping mechanism employed in the transfer apparatus,

FIG. 6 is a sectional view taken along the line VI–VI of FIG. 5 as seen in the direction of the arrows,

FIG. 7 is a sectional view taken substantially along the line VII–VII of FIG. 3 as seen in the direction of the arrows showing the control mechanism for controlling the advancing and retracting strokes of the retractable article gripping member support arm,

FIG. 8 is a fragmentary side elevational view of the control mechanism shown in FIG. 7,

FIG. 9 is a sectional view of the drive mechanism for rotating the article gripping mechanism taken along the line IX–IX of FIG. 10 and as seen in direction of the arrows, and

FIG. 10 is a sectional view taken along the line X–X of FIG. 9 as seen in the direction of the arrows.

The article transfer apparatus comprises a casing 1, a hollow vertical main shaft 2 having an upper end portion extending above the top of the casing 1 adapted to be reciprocally rotated in opposite directions by a drive mechanism housed in the casing 1 and which will be later described in more detail, and a hollow article transfer arm assembly 3 having the base or rear end thereof secured to the upper end of the shaft 2 for rotational movement therewith and extending radially from the shaft. The article transfer arm assembly 3 has a substantially triangular or bifurcated configuration comprising a pair of identical units 3' which extend approximately at right angles with respect to each other and are secured together at one or the rear ends thereof. Since the units 3' are identical in construction and operation, only one of these transfer arm units will be described herein. A first retractable and rotatable hollow cylindrical article support arm member 4 is supported for advancing and retracting movement and rotational movement within the arm unit 3'. One or the fore end of the first article support member 4 supports a pair of article gripping pawls 5 which are pivoted at 5' to the extension of the fore end of the support member 4 for pivotal movement toward and away from each other. The hollow main shaft 2 is adapted to be rotated at the lower end thereof by means of a drive mechanism 50 which is mounted within the casing 1 in the lowermost position therein.

As more clearly shown in FIG. 2, the transfer arm unit 3' is a hollow cylinder and includes a second stationary hollow cylindrical article support arm member 7 extending horizontally within the interior of the arm unit in spaced relation to the inner surface thereof and has its rear or base end secured to a base securing member 6 which is, in turn, fixedly secured to the upper end of the shaft 2. The member 7 has a diameter larger than that of the first arm member 4 and surrounds the first arm member in spaced relation thereto. The member 4 extends at its fore end beyond the fore end of the member 7 while the other or rear end of the first arm member terminates short of the rear end of the second arm member 7. The rear end of the member 4 has a piston 8 firmly secured thereto and the piston in turn is loosely fit within the second arm member 7 at the rear end thereof for longitudinal movement together with the first arm member 4. An annular arm securing member 9 is loosely disposed around the first arm member 4 at a point slightly spaced from the fore end of the member 4'' and fits in and is secured to the second arm member 7 at the fore end of the member 7. The piston 8 and arm securing member 9 cooperate to define an annular chamber *a* between the first and second arm members 4 and 7. The inner periphery of the piston 8 is provided with an annular recess 8'.

A third rotatable hollow cylindrical arm member 11 having a diameter smaller than that of the 4 extends within the first arm member 4 in spaced relation to the inner surface of the member 4. The fore end of the member terminates short of the fore end of the first arm member while the rear end extends beyond the rear end of the first arm member and the piston 8 whereby the member 11 defines a second annular chamber *b* in cooperation with the member 4. The member 11 also defines a third annular chamber *c* in cooperation with the recess 8' in the inner periphery of the piston 8. The chamber *c* is in communication with a compressed air passage 10 formed adjacent the base securing member 6. A rotatable stub-shaft 12 is rotatably received in the base securing member 6 and is provided with a center through bore 12'. An annular member 13 having a portion of a diameter smaller than that of the third

arm member 11 is fitted in the member 11 at the fore end thereof by means of the portion of smaller diameter and has splines in its inner periphery. The member 11 is provided with openings 22 which are in communication with the annular chamber *b*. An inner long shaft 14 defined by a hollow cylinder extends within the member 11 with the fore end extending beyond the fore end of the arm member 11 while the other or rear end terminates short of the rear end thereof to define a chamber *d* in cooperation with the internal surface of the member 11. The internally splined annular member 13 and the shaft 14 are keyed to each other at 15 as shown in FIG. 4 for rotational movement in unison in a manner as will be described hereinafter. A hollow cylindrical tip member 16 is connected to the fore end of the first arm member 4 and is also connected to the inner splined shaft 14. The tip member 16 has a rear portion of reduced diameter which is formed with a cylindrical opening or cylinder portion 16' within which a piston 17 is reciprocally and slidably disposed. The piston has a piston rod 18 connected thereto which extends horizontally from the outer face of the piston. The tip member constitutes an extension of the first arm member 4. A pair of links 19 are pivotally connected at one end to a single link 19' which, in turn, is secured to the fore end of the piston rod 18 while the other ends of the links 19 are connected to the pair of article gripping pawls 5 which are pivotally connected to the tip member 16. A return spring 20 is disposed around the piston rod 18 between the tip member 16 and the piston 17 and the cavity of the piston 17 is in communication with an annular space 21 defined between the portion of reduced diameter of the tip member and shaft 14. Thus, the piston cavity is in communication, through the annular space 21 and annular chamber *b*, with the cylindrical chamber *d* which in turn communicates though center bore 12' of the stub-shaft 12 with center bore 23' or air passage in a vertical conduit member 23. The member 23 in turn connected to a hollow arm unit mounting member 23'' connected to the upper end of the main shaft 2. The axis about which the arm unit 3 swivels coincides with the axis of the air passage 23'. A pinion 24 is secured to the outer periphery of the stub-shaft 12 at a point between the opposite ends of the shaft, and a rack 25 provided adjacent the outer periphery of the stub-shaft is in meshing engagement with the pinion 24. The rack 25 is connected to a pneumatically operated piston (not shown).

The outer or fore end of the annular chamber *a* communicates through a passage 26 formed in the securing member 9 with a passage 28 provided in a valve box 27 within the arm unit 3' disposed adjacent to the fore end of the unit (FIGS. 1, 7 and 8). The valve box passage 28 communicates, through a passage 32 controlled by a valve 30 secured to a valve rod 29, a flow rate regulation valve 31 and a passage 34 controlled by a check valve 33, with a compressed air outlet 35. The valve rod 29 has a threaded portion 29' on which a movable member 37 is threadably engaged to be guided along such portion 29' by a stationary guide bar 36. By manipulating a handle 38 fixed on the outer end of the valve rod 29, the position of the movable member 37 may be adjusted. A control bar 40 extends loosely through an opening formed in the movable member 37 as well as an opening in the valve box 27. One or the rear end of the control bar 40 has an engaging member 39 secured thereto for engaging the movable member 37. The other or fore end of the control bar 40 is connected to an ear 41 which is, in turn, loosely received in the annular groove 16'' as shown in FIGS. 5 and 6.

In operation, in order to advance the article gripping pawls 5 to a position in which the pawls can grip an article to be transferred, air under pressure is supplied from a suitable air-under-pressure source (not shown) through the air passage 10 to the piston whereupon the piston 8 is moved to the left as seen in FIG. 4. The movement of the piston 8 to the left in this manner as mentioned above advances the first arm member 4 to which the piston 8 is secured with respect to the second arm member 7 in the same direction whereupon the air within the annular chamber *a* is forced through the air passage 26, the passage 28, the open valve 30 and the passage 32 into the inlet and outlet 35 from which the air is discharged. As the first arm member 4 is moved to the left, the control bar 40 is also moved simultaneously to the left as seen in FIG. 4. As the control bar 40 is thus moved, the member 39 engages the movable member 37 to move the movable member forward together with the control bar 40. As the movable member 37 is thus moved, the valve 30 seals off the passage 32 whereby the discharge of air under pressure through the passage is blocked and the movement of the first arm member 4 is stopped and the piston and together with the arm member is held in this position. When the position of the movable member 37 is previously set by manipulating the handle 38, the advanced position of the article gripping pawls 5 can be predetermined.

Thereafter, when air under pressure is introduced from the supply source through the center bore 23' and the center bore 12' into the cylindrical chamber *d*, the thus introduced air flows through the annular passage 21 into the cylinder portion 16' whereupon the piston 17 within the cylinder portion 16' is advanced against the action of the return spring 20 to pivot the links 19 about their pivot points thus resulting in pivotal movement of the article gripping pawls 5 about their pivot points 5' in the direction so as to close the pawls. The thus closed pawls grip an article (not shown) to be transferred which is then in the position to be gripped by the pawls. As the pawls 5 pivot in the manner outlined above in the closing direction they firmly grip the article from the opposite sides thereof. After the pawls 5 have gripped the article therebetween, the main shaft 2 is rotated in one direction by the drive mechanism as to be later set forth, and the rotation of the main shaft 2 causes the transfer arm assembly 3 to swivel in a desired direction to transfer the article to a desired position. When the article has reached the desired position, air under pressure is discharged from the cylindrical chamber *d* and the pawls 5 are again opened by the action of the return spring 20 to release the article in the desired position.

If it is desired or necessary to turn the gripped article around upwardly or downwardly midway to the desired position, while being transferred, the rack 25 is moved up or down by a pneumatically-actuated means (not shown) whereby the pinion 24 which is in meshing engagement with the rack is rotated in one or the other direction. The movement of the pinion 24 rotates the stub-shaft 12 and the third arm member 11 which in turn rotates the shaft 14 keyed to the member 11 and also the first arm member 4. Thus, the article can be turned around upwardly and downwardly while being gripped and transferred by the pawls 5.

Furthermore, if any obstacle is present in the path along which a gripped article is to be transferred from one position to another, by suitably manipulating the valve in the valve box 27 air under pressure is fed through the air inlet and outlet 35 into the passage 34 to open the check valve 33 whereupon the air under pressure passes through the passages 28 and 26 into the annular chamber *a*. The thus fed air within the annular chamber *a* moves the piston 8 rearwardly on in the right-hand direction as seen in FIG. 4 so as to retract the first arm member 4 for a time during which the arm assembly 3 may bypass the obstacle.

After the arm assembly 3 has bypassed the obstacle, the piston 8 and accordingly the first arm member 4 is again advanced by suitable valving and the article can be transferred to the desired position without interference by the obstacle.

By turning the main shaft 2 in the opposite direction after the gripping pawls have released the article therefrom, the pawls can be returned to the original position in which they are aligned with a succeeding article which is in a position ready for transfer. By repeating the above-mentioned procedure the succeeding articles can be transferred one-by-one from one position to another.

One form of drive mechanism for reciprocally rotating the main shaft 2 which supports the article transfer arm assembly 3 about the vertical axis in one direction and then in the other direction is illustrated in FIGS. 9 and 10.

More particularly, the drive mechanism generally comprises a first pair of horizontal cylinders 51 and 51' disposed in a one-on-another relation in parallelism and a second pair of horizontal cylinders 52 and 52' similarly disposed and being coaxially aligned with the first pair of cylinders 51, 51', respectively. The pairs of cylinders 51, 51' and 52, 52' receive pistons 53, 53' and 54, 54', respectively. Racks 55 and 55' are respectively disposed within the cylinders 52 and 51' between the pistons 53 and 54 and between the pistons 53' and 54'. The rack 55 has a plurality of downwardly directed teeth and the rack 55' a plurality of upwardly directed teeth. A pinion 56 fixedly secured to a reciprocally rotating shaft 57 is positioned between and engaged on its opposite sides by the teeth on the racks 55 and 55'. The cylinders 52 and 52' mutually communicates at one end by means of a fluid passage means or conduit 58 so that the cylinders 52 and 52' may be filled with oil and maintained under a certain degree of oil pressure. The cylinders 51 and 51' are closed at one or the outer ends by housings 59 and 59', respectively. The housings are provided at the inner ends with cylindrical bosses which extend into the respectively associated cylinders 51 and 51' and have threaded inner peripheries 60 and 60' in which hollow cylindrical stop members 61 and 61' are threadably received by the threads on their outer peripheries. Adjusting shafts 62 and 62' respectively having splines 63 and 63' on their outer peripheries extend through the ends of the respectively associated stop members 61 and 61' having mating splines into the stop members by a substantial distance. Nuts 64 and 64' are threaded on the threaded outer ends of the adjusting shafts 62 and 62' for holding the shafts in position. The stop members 61 and 61' are open at the inner ends as shown 3 by numerals 65 and 65' respectively, and the pistons 53 and 53' are respectively provided with projections 66 and 66' on the outer faces thereof for fitting into the open inner ends 65 and 65' of the stop members. The housings 59 and 59' are respectively provided in their outer peripheries with inlet and outlet openings 67 and 67' through which oil enters and discharges. The stop members 61 and 61' are respectively formed with small openings 68 and 68' adjacent to and inwardly spaced from the outer ends through which the interior of the housings 59 and 59' communicate with the interior of the stop members 61 and 61'. The oil inlet and outlet openings 67, 67' also communicate through openings 69 and 69' in the respectively associated housings 59 and 59' and receive adjustable needle valves 70 and 70' therein with the interior of the respectively associated cylinders 51 and 51'. The oil inlet and outlet openings 67 and 67' communicate through an electromagnetic changeover valve V with an oil-under-pressure supply source (not shown) for alternately supplying and discharging oil under pressure into and out of the respectively associated cylinders 51 and 51'.

When oil under pressure is into the housing 59 at the openings 67, the oil flows through the small opening 68 into the stop member 68 and then flows through the small opening 69 to act against the piston 53 to urge the piston toward the right as seen in FIG. 9. As the piston 53 moves toward the right, the piston moves the rack 55 and piston 54 toward the right as seen in FIG. 10 whereby the oil within the cylinder 52 is forced through the passage 58 into the cylinder 52'. As a result, the piston 54' is moved toward the left as viewed in FIG. 10 so that the rack 55' and piston 53' are also moved toward the left. As the piston 53' is moved toward the left, the oil within the cylinder 51' is forced through the open inner end 65' of the stop member 61', the interior of the stop member 61' and the small opening 63' into the opening 67' from which the oil is discharged. At the end of the stroke of the piston 53' toward the left (FIG. 10), the projection 66' of the piston enters the open end 65' and thereafter the oil within the cylinder 51' flows through the small opening 69' and the needle valve 70' into the housing 59'. Accordingly, the rate of movement of the piston 53' gradually decreases as the piston approaches the end of its leftward stroke and finally the piston ceases to move since the projection 66' enters the open end 65' of the stop member 61'. As the rack 55 is moved toward the right and the rack 55' is moved toward the left (FIG. 9), the pinion 56 which engages the racks 55 and 55' is moved in one direction whereby the shaft 57 is rotated in one direction.

On the other hand, when the electromagnetic valve V is changed over so that oil under pressure is supplied into the housing 59' at the opening 67' and then discharged from the housing 59 at the opening 67, the operation of the various parts are reversed, that is, the rack 55' is first moved toward the right (FIG. 9) and the rack 55 toward the left so that the shaft 57 is rotated in the opposite direction. The angle of rotation of the shaft 57 can be adjusted by turning the adjusting shafts 62 and 62' so as to move the stop members 61 and 61' and accordingly their open inner ends 65 and 65' toward or away from the respectively associated pistons 53 and 53'.

While one preferred embodiment of the present invention has been shown and described in detail it will be understood that the same is for illustration only and is not to be taken as definition of the invention, reference being had for this purpose to the appended claims.

I claim:

1. An article transfer apparatus adapted to transfer an article from one position to another, comprising a vertical main shaft adapted to have a predetermined angle of reciprocally rotational movement imparted thereto; an article transfer arm assembly fixedly secured at one end to the upper end of the main shaft for swiveling movement as the main shaft rotates, said arm extending radially from the main shaft, said arm assembly including a first hollow cylindrical rotatable arm member, a piston secured to one end of said arm member, a pair of article grippers pivotably supported at the other end thereof, and a second hollow cylindrical stationary arm member secured at one end to, the upper end of the main shaft and surrounding said first arm member and piston; means for supplying and discharging fluid under pressure to and from one and opposite sides of said piston; valve means for controlling the supplying and discharging of the fluid under pressure to and from said opposite side of the piston; and a second piston fitted in said first arm member at said other end and adapted to open and close said grippers in response to the action of the fluid within said first arm member, said fluid supply and discharge control valve means comprising a passage receiving a valve adapted to be opened or closed in response to the movement of said first arm member therein and another passage parallel to said first mentioned passage and receiving a check valve therein; and the chamber defined by said second hollow cylindrical arm member on the side away from said first piston communicating through said passages with a supply source of fluid under pressure.

2. An article transfer apparatus adapted to transfer an article from one position to another, comprising a vertical main shaft adapted to have a predetermined angle of reciprocally rotational movement imparted thereto; an article transfer arm assembly fixedly secured at one end to the upper end of the main shaft for swiveling movement as the main shaft rotates, said arm extending radially from the main shaft, said arm assembly including a first hollow cylindrical rotatable arm member, a piston secured to one end of said arm member, a pair of article grippers pivotably supported at the other end thereof, and a second hollow cylindrical stationary arm member secured at one end to the upper end of the main shaft and surrounding said first arm member and piston; means for supplying and discharging fluid under pressure to and from one and opposite sides of said piston; valve means for controlling the supplying and discharging of fluid under pressure to and from said opposite side of the piston; and a second piston fitted in said first arm member at said other end and adapted to open and close said grippers in response to the action of the fluid within said first arm member, and said first hollow cylindrical arm member being slidably fitted on a splined shaft received in the arm member in a spline-engaging relation and adapted to have rotational movement imparted thereto in one direction and the other directions about the axis of the arm member.