April 8, 1969 H. A. HAASE 3,437,223

WORK HANDLING AND TRANSFER APPARATUS

Filed June 3, 1966 Sheet 1 of 3

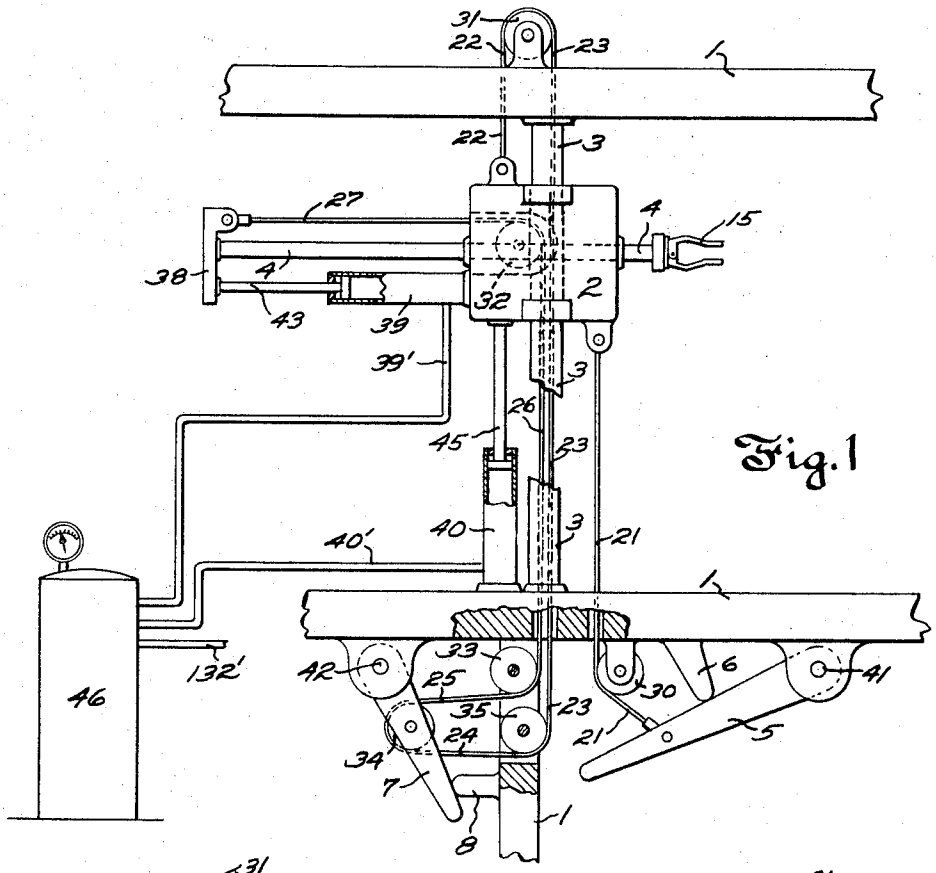


Fig. 1

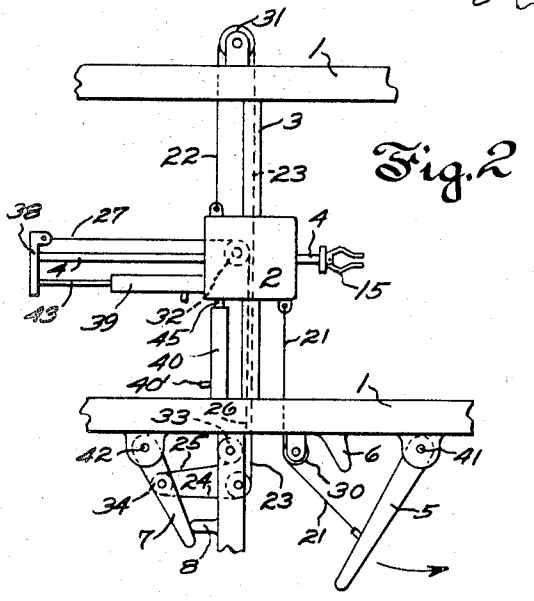


Fig. 2

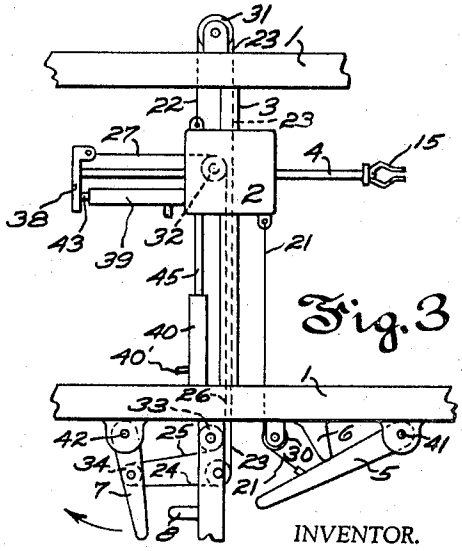


Fig. 3

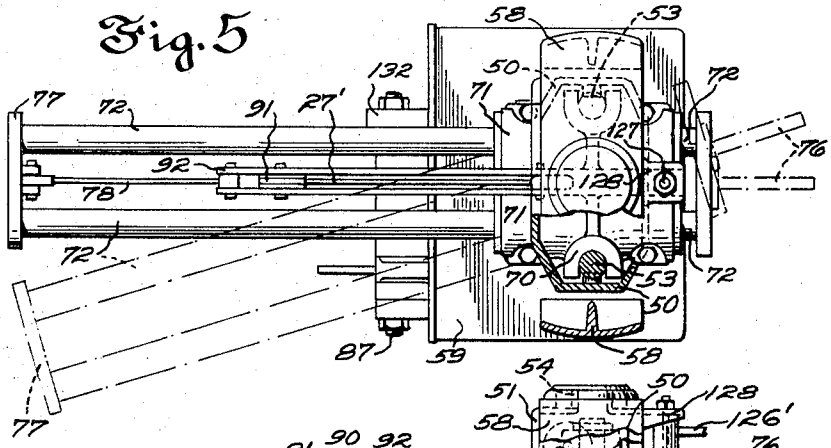
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WORK HANDLING AND TRANSFER APPARATUS

Filed June 3, 1966 Sheet 2 of 3

Fig. 5



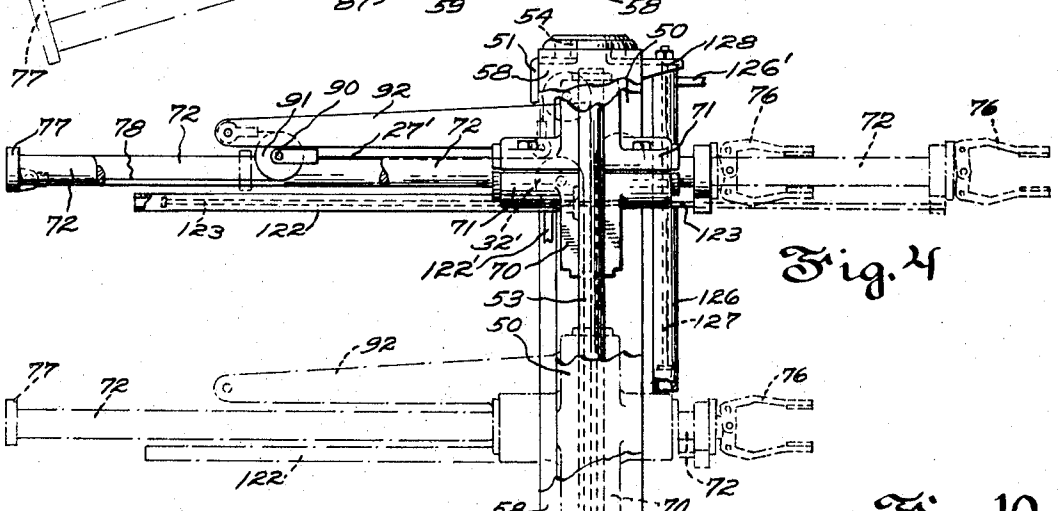
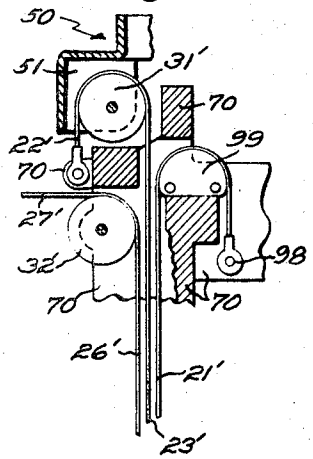


Fig. 4

Fig. 9



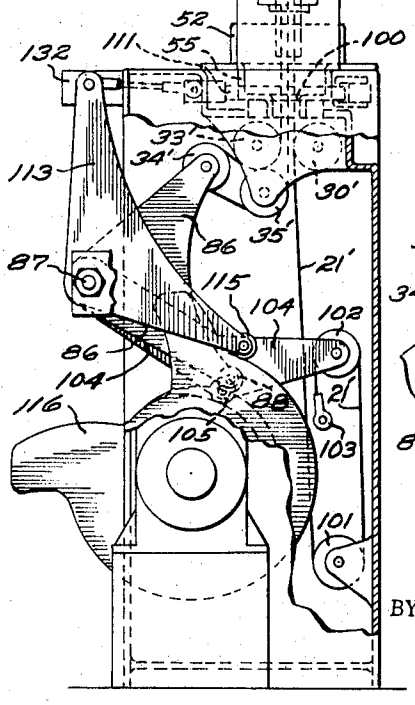
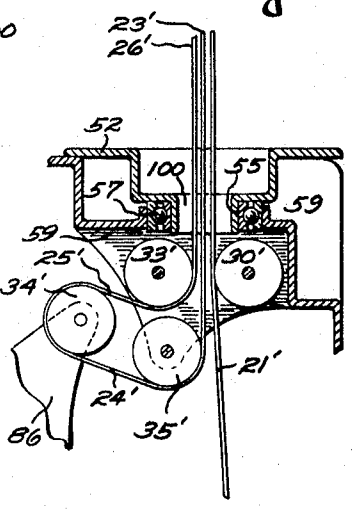


Fig. 10



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April 8, 1969 H. A. HAASE 3,437,223

WORK HANDLING AND TRANSFER APPARATUS

Filed June 3, 1966 Sheet 3 of 3

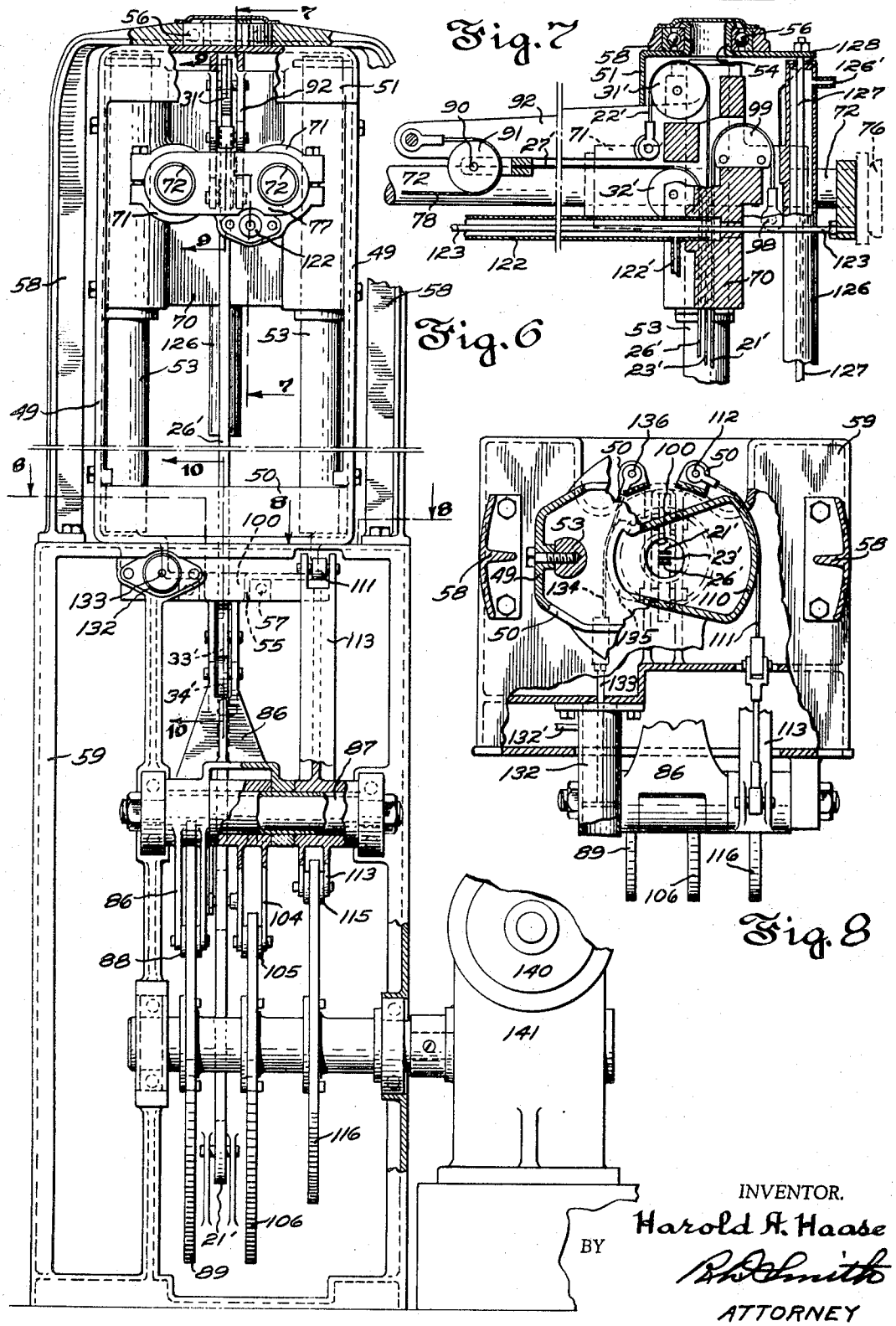


Fig. 7

Fig. 6

Fig. 8

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3,437,223

WORK HANDLING AND TRANSFER APPARATUS

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Int. Cl. B25j 5/00; B65g 25/00
U.S. Cl. 214—730 10 Claims

ABSTRACT OF THE DISCLOSURE

Apparatus for transferring work articles selectively from place to place, such as from one processing machine to another, in two-dimensional or three-dimensional space in paths of travel that are selectable by manipulating separate remote control handles sequentially or simultaneously. The article to be transferred may be picked up and may be deposited, or otherwise handled, with high precision by a reaching arm mounted on a carrier block that is vertically movable, and the arm is otherwise so mounted that it can be moved horizontally as well as being able to sweep about a vertical axis. On the carrier block there is pivotally mounted a cornering pulley. A continuous, flexible, nonstretchable draft member has one end attached to the reaching arm and the other end attached to the carrier block and between the two forms a tackle trained about the cornering pulley and about certain frame stationed pulleys. Regardless of the vertical position of the carrier block and whether the carrier block is still or is moving, the reaching arm can be moved horizontally, and regardless of the horizontal position of the reaching arm and whether the reaching arm is still or is moving, the carrier block can be moved vertically. An additional draft means is employed for causing vertical movement of the carrier block. There are separate handles in a common location reachable by the same operator for pulling on the continuous draft member and on the additional draft means respectively. The draft member and draft means are pulled upon in opposition to biasing means tending to restore the reaching arm and its carrier to normal positions. The movements of the reaching arm and carrier block can be caused in automatically programmed timed relationship by adjustably related actuators such as power driven actuating cams.

Brief summary of the invention

This invention relates to apparatus of the automaton or robot type incorporating a reaching arm that can be actuated to perform and repeat predetermined command movements comparable in part to those of a human operator, such arm being capable of traveling in selective paths between various working positions in two-dimensional or three-dimensional space. Such apparatus can perform a wide variety of industrial tasks such as transferring work articles or materials from one place to another and conditioning or treating the same. It has many analogous uses such as loading and unloading work pieces or materials with respect to various kinds of production machines such as punch presses, machine tools and conveyors, and can convey a paint spray gun in selected paths of travel while properly aimed at the work to be sprayed, or can shift work pieces through successive positions relative to electric welding contacts whereby to locate the desired spots of welding.

Apparatus heretofore proposed for mechanical handling purposes such as the above has been costly, space consuming and cumbersome as well as relatively slow and sluggish in its response to controls owing to dependence for motivating force on valve controlled hydraulic systems and electronic memory systems involving complicated electrical components and circuitry.

An object of this invention is to provide a simpler, smaller and quicker responding mechanism for positioning and repositioning a reaching arm with greater speed and accuracy than in this type of apparatus as heretofore known.

Another object of ths present improvements is to devise a mechanism for selectively motivating a reaching arm in paths that can be guided by either successive or simultaneous manipulations of a choice of manual controls, or when desired in paths that can be programmed in advance to cause the reaching arm to perform a predetermined series of movements automatically.

Another object is to provide positive arm motivating instrumentalities that are free from the lost motion or backlash that characterizes trains of gears so that the reaching arm can be positioned quickly and positively by either forward or backward motion of the arm motivating mechanism.

Another object is to employ a piston equipped fluid cylinder arranged to function like a spring for constantly biasing the reaching arm to return from all positions to which it is forcefully impelled by the motivating mechanism. Such cylinder is preferably given bleed connection to a considerably larger reservoir filled with compressible resilient fluid thus to provide approximately constant biasing action throughout considerable distances of movement of the reaching arm and its motivating mechanism.

Another object is to produce a machine of the character described which shall be readily convertible from one action-programmed condition to a wide choice of different programmed conditions so that the machine can quickly be moved from job to job and easily reset to serve an unlimited number of different applications, in contrast to the single purpose, non versatile automation mechanism that is permanently built into the particular production equipment which it supplements.

These and other objects of the invention will be understood in fuller particular from the following description of apparatus embodying the improvements having reference to the accompanying drawings wherein:

FIG. 1 is a symbolic representation of apparatus constructed and operating according to the invention for variously positioning a reaching arm shown withdrawn from its extended positions.

FIG. 2 represents the same apparatus with the reaching arm in bodily lowered position.

FIG. 3 represents the same apparatus with the reaching arm projected toward the right and outward from the apparatus.

FIG. 4 shows in side elevation a fully constructed machine incorporating the principles of apparatus action represented in FIGS. 1–3 supplemented by power mechanism for effecting a predetermined series of programmed motivation of the parts.

FIG. 5 is a plan view looking downward on FIG. 4 with parts partially broken away to expose features of construction.

FIG. 6 is another view of the entire machine in elevation looking from the left at FIG. 4 with parts broken away.

FIG. 7 is a view taken in section on the planes **7—7** in FIG. 6 looking in the direction of the arrows.

FIG. 8 is a view in section on the planes **8—8** in FIG. 6 looking in the direction of the arrows.

FIG. 9 is a fragmentary view in section on the plane **9—9** in FIG. 6 looking in the direction of the arrows.

FIG. 10 is a fragmentary view in section on the plane **10—10** in FIG. 6 looking in the direction of the arrows.

For explaining basic principles of mechanical action

which characterize the improved apparatus there will first be discussed the representation of typical operating parts appearing in FIGS. 1–3.

In said figures there is represented symbolically an apparatus frame including at least two horizontal beams **1** spaced vertically apart by a post **3** and by other stationary frame structure not shown in these figures of the drawings. The article or material handling and transfer element **15** of the machine is represented as a claw **15** which may be assumed to be capable of closing to grasp a work piece and of opening to release it.

Claw **15** is carried on one end of a reaching arm **4** which is slidable lengthwise through a carrier **2** in a direction that is angularly related to the main or vertical path of movement of the carrier. In its vertical travel carrier **2** is guided by the frame post **3** but in FIGS. 1–3 is not free to swivel thereon. Claw **15** may be opened or closed in any of the possible positions to which it may be moved by arm **4** through remote control transmitted to the claw through conventional means (not shown) that are capable of trailing the claw. Such means may be mechanical such as flexible draft lines, or may be a pneumatic cylinder powering the claw energized through flexible conduits trailing the claw, or an electromagnetic prime mover energized by electric current fed to the claw through trailing flexible conductors. Or for a claw there may be substituted a vacuum cup or magnetic attractors to which work pieces will cling.

The remaining parts represented in FIGS. 1–3 are for motivating the above mentioned carrier and reaching arm so as to place claw **15** or its equivalent at any desired point in a plane that is common to the movements of the carrier and of the reaching arm.

From FIG. 1 it will be evident that the carrier **2** reciprocates in a main rectilinear path herein shown as vertical and that carrier **2** conveys the reaching arm upward and downward bodily. By means to be described the reaching arm is capable of movement relative to the carrier in a course that is angularly related to the vertical or main path of movement of carrier **2** at whatever height the carrier is positioned and whether or not the carrier is in motion.

To represent means for manual motivation of the above described parts there are shown two handle-equipped swingable actuators **5** and **7** capable of pulling respectively on the carrier **2** and/or on the reaching arm **4** through the medium of flexible draft means. Preferably such draft means shall comprise thin, flexible, substantially nonstretchable, metallic ribbons trained about various cornering devices such as pulleys to form a tackle system as follows:

Five of the pulleys **30, 31, 33, 34** and **35** are carried by the frame **1** or some extension thereof. The sixth pulley **32** is rotatably mounted on the carrier **2**, itself, and travels bodily in unison therewith, its vertical movement being accommodated by a vertical slot in the tubular wall of frame post **3**. A draft means in the form of metallic ribbon **21** is trained about the frame mounted pulley **30** and connects the actuator **5** with only the carrier **2**. The continuous length of another metallic ribbon or draft member will be identified by reference to component spans of its length. The bight of spans **22** and **23** is trained about the frame mounted pulley **31** downward past the carrier **2** and is trained about frame mounted pulley **35** therebeyond to become span **24**. The bight of spans **24** and **25** is trained about pulley **34** which is pivotally mounted on and bodily swung by actuator **7**. Span **25** in turn is trained about frame mounted pulley **33** beyond which it becomes span **26** which extends upward toward carrier **2** along the main path of movement thereof. At the carrier **2** span **26** is cornered about the carrier borne pulley **32** and is continuous therebeyond, becoming span **27** which is connected to the anchorage head **38** of reaching arm **4**. Thus pulley **32** functions as a cornering device that converts the vertical pull of span **26** to a horizontal pull of span **27** toward the right on the reaching arm **4**.

The two metallic ribbons **21** and **22–27** are kept taut in all spans thereof by resilient devices which yieldingly and respectively oppose the downward movement of carrier **2** and the advancing movement of arm **4** caused respectively by actuators **5** and **7**. The same resilient devices also constantly bias said carrier **2** and **4** to return in directions opposite to those in which they are impellable by their respective actuators. While springs might be employed as such resilient devices FIG. 1 shows each of the resilient devices to comprise a pneumatic cylinder and a cooperative piston. Cylinder **39** is fixed on carrier **2** while its piston **43** is fixed on the tail bracket **38** of the reaching arm **4**. Cylinder **40** is fixed on frame **1** and its piston **45** is fixed on carrier **2**.

It is preferred for promoting constancy of bias power that the cylinders **39** and **40** have bleed connections at **39′** and **40′** to a relatively large body of pressurized air confined in a reservoir tank **46** as is discussed in greater particular in the following description of an operative practicable machine or apparatus embodying the invention.

The operation of the parts illustrated in FIGS. 1–3 can be started with arms **5** and **7** stationed against their respective frame stops **6** and **8** and so held by the resilient force constantly exerted by pneumatic cylinders **39** and **40**. Assuming first that only actuater **5** is swung downward about its pivotal connection **41** to the frame **1**, against the biasing force of pneumatic device **40**, there will result as shown in FIG. 2 only a pulling of the carrier **2** downward together with its carried pulley **32**. This causes no movement of reaching arm **4** relative to carrier **2** and any slack tending to result in span **26** of the flexible draft means from the bodily lowering of pulley **32** will be taken up in equal amount by the simultaneous downward pulling of carrier **2** on span **22** which draws upward an equal amount on span **23** and thus maintains constant the overall length of draft member **22–27**.

If instead of moving the actuator **5**, only the actuator **7** is swung to the left about its pivotal mounting **42** on frame **1**, while actuator **5** remains stationary against its frame stop **6** as shown in FIG. 3, carrier **2** will remain stationary while the arm actuating pulley **34** is thus swung bodily to the left. In this case span **24** can not yield because the carrier has not moved. Therefore the bodily displacement of pulley **34** to the left will draw only on spans **25, 26** and **27**, causing approximately twice as extensive draft thereon as the distance of bodily displacement of pulley **34** itself. From the foregoing it will be clear that actuator **5** and **7** can be swung either alone or simultaneously to independent chosen extents necessary to position the claw **15** at any desired point in a vertical plane.

A practical embodiment of the invention in an apparatus constructed and functioning on the principles demonstrated in FIGS. 1–3 is illustrated in FIGS. 4 to10 where on equivalent of frame **1** is constructed as a swiveling turret designated **50** as a whole. Such turret is supported on a cabinet pedestal **59** to be turnable about a vertical axis. Turret **50** carries mechanism capable of maneuvering the reaching arm **72** in all of the ways demonstrated in FIGS. 1 to 3 plus the added ability of swinging the reaching arm about the aforesaid vertical axis a limited angular extent. The mechanism with which turret **50** is equipped will be described with occasional reference to comparable parts in FIGS. 1 to 3.

Turret **50** is a skeleton structure comprising a top cap **51** united with a bottom cap **52** by side walls **49** and is strengthened by two vertical posts **53** secured at their sides to side walls **49**.

Top cap **51** has a hub formation **54** journaled in a ball bearing **56** that is lodged in the top span of the frame yoke **58** of the pedestal **59**. The bottom cap **52** of the turret **50** has a hub formation **55** journaled in a ball bear-

ing 57 lodged in the top wall of pedestal 59. Means for turning turret 50 about its vertical axis are hereinafter described.

A slideable carrier 70, comparable to carrier 2 in FIGS. 1–3, is guided in its main or vertical path of travel by the posts 53 and provides two parallel, spaced apart, horizontally directed slide bearings 71, 71 for a double shafted reaching arm 72, 72 comparable to arm 4 in FIGS. 1–3. The operative end of arm 72 carries a claw 76 whose function is like that of claw 15 in FIGS. 1–3 and for which can be substituted various other work handling devices herein before mentioned. The trailing ends of the two shafts of reaching arm 72 are bridged by a tie bar 77 which affords anchorage for an arm motivating draft member in the form of metallic ribbon 78 that cooperates with flexible draft means comparable to those illustrated in FIGS. 1–3 as is next described.

As in the case of FIGS. 1–3, the draft member that motivates arm 72 will be identified in terms of certain component spans of its length and may as a whole constitute a continuous length of substantially nonstretchable metallic ribbon trained about certain pulleys which are likened to pulleys appearing in FIGS. 1–3 and therefore designated by the same reference numerals as in FIGS. 1–3, primed. Thus pulley 32′ is pivotally mounted on carrier 70 and moves bodily in unison therewith in a vertical path. Pulley 31′ is pivotally mounted on the top cap 51 of turret 50. Pulleys 33′ and 35′ are pivotally mounted on pedestal 59 and the arm motivating pulley 34′ is carried by an actuator 86 which differs from the actuator 7 in FIGS. 1–3 by being a cam follower in the form of a bellcrank pivotally supported on the pedestal 59 at 87. One arm of bellcrank 86 carries a roller 88 which rides on the periphery of a power rotated cam 89 whose contour causes the bellcrank to oscillate as the cam rotates and may be shaped to suit the extent and timing of longitudinal travel to be imparted to reaching arm 72.

The tackle arrangement for motivating reaching arm 72 differs from that for motivating arm 4 in FIGS. 1–3 in that the span 27′ is not anchored directly to the trailing end of reaching arm 72 but instead is anchored to a floating pivot pin 90 carrying the draft multiplying pulley 91 which engages the bight of ribbon 78. As before described one end of ribbon 78 is anchored to the reaching arm 72. Its other end is anchored to a boom 92 that projects rigidly from the carrier 70. The function of ribbon 78 in passing about pulley 91 is to double the extent of travel of arm 72 as compared with the draft of ribbon span 27′.

Further comparable with FIGS. 1–3 is the carrier motivating flexible draft means 21′ which is shown in FIGS. 4–8 as connected to carrier 70 at 98 after passing over the curved top of a half-round anchorage block 99 fixed on the carrier. This enables the vertical span of metallic ribbon 21′ to lie and run closely beside the spans 26′ and 23′ of the arm motivating draft member and approximately coincidental with the axis on which turret 50 swivels. Span 21′ also is brought to run and lie close to spans 23′ and 26′ by a guide pulley 30′ pivotally mounted on pedestal 59. Thus all three spans can pass through the same opening 100 in the hub formation 55 on the bottom cap 52 of turret 50. This enables the three strands to accommodate themselves to a limited degree of turning movement of turret 50 about its vertical axis by twisting in unison whenever turret 50 swivels relatively to pedestal 59.

The lower end of span 21′ is looped about pulley 101 which is pivotally mounted on pedestal 59 and extends upward to be trained about a carrier motivating pulley 102 and then is brought down and anchored fixedly to the pedestal 59 at 103. Pulley 102 is carried by one branch of a cam follower in the form of bellcrank 104 whose other branch is pivotally mounted on pedestal 59 coaxially with pivot 87. At its elbow bellcrank 104 has a roller 105 which rides on the power rotated actuating cam 106.

The turret 50 is caused to swivel on its vertical axis with the aid of a segmental drum 110 fixed on the bottom surface of turret cap 52. Drum 110 serves to guide a turret motivating metallic ribbon 111 having one end anchored to the turret at 112 and the other end anchored to the upward extending branch of a bellcrank 113 whose elbow is pivotally mounted on pedestal 59 coaxially with pivot 87. Bellcrank 113 carries at its other end a roller 115 which rides on the periphery of a power rotated actuating cam 116 and is therefore a follower of said cam.

As in FIGS. 1–3 the pull of each of the various flexible draft spans on the part of the apparatus motivated thereby is yieldingly opposed by a resilient device that appears in FIGS. 4–8. One of the resilient devices comprises a pneumatic cylinder 122 fixed on carriage 70 and cooperating with piston 123 which is fixedly carried by the right end of reaching arm 72. Cylinder 122 with its bleed connection 122′ may be compared with cylinder 39 in FIGS. 1–3. Another pneumatic cylinder 126 with its bleed connection 126′ is fixed on the carrier 70 and cooperates with a piston 127 that is fixed on a bracket 128 extending laterally from the top cap 51 of turret 50. A third pneumatic cylinder 132 with its bleed connection 132′ is fixed on the pedestal 59 and cooperates with a piston 133 to which is attached a metallic ribbon 134 which is guided about a rounded portion 135 of the drum 110 and then anchored to turret 50 at 136.

The machine illustrated in FIGS. 4–8 operates automatically under power such as from a motor 140 and its speed reduction gear 141 which will rotate all of the cams 89, 106 and 116 in unison so that they act upon their respective followers 88, 105, and 115 in accordance with the shapes of the lobes on the individual cams. This serves to move the carrier 70 upward or downward and the reaching arm toward the right or toward the left in FIGS. 4 and 5, and to swivel the turret 50 clockwise or counterclockwise in FIG. 5 whereby the reaching arm 72 can be moved to a choice of different positions in three-dimensional space through predetermined paths and with predetermined timing.

By setting up the machine with lobed cams that have been shaped to carry through designed repetitive cycles of actuation of the parts that are motivated thereby, nearly any desired pattern of performance of the reaching arm can be carried out automatically and synchronized with the related movements of production machinery which my improved apparatus is used to supplement.

As the foregoing disclosure will give rise to many ideas as to how the particular parts herein illustrated and described may be modified in shape or arrangement within the principles of the invention the appended claims are intended to include and cover all fair equivalents of such parts and arrangements that come within the terminology of the claims.

What I claim is:

1. Transfer apparatus for selectively placing a reaching arm in various positions in at least two-dimensional space comprising, an apparatus frame, a carrier slidably mounted on said frame to be impelled in a main path of travel, carrier actuating means connected to said carrier to cause advance and return thereof along said main path, a reaching arm mounted on said carrier in a manner to be longitudinally slidable relatively thereto in a course angularly related to said main path of carrier travel, an arm motivating actuator, a flexible substantially nonstretchble draft member connecting said arm motivating actuator to said reaching arm having at least a portion of its length extending in the direction of said path of carrier travel and including an extended span of said member connecting said arm motivating actuator to said carrier, a cornering device on said carrier engaged by said draft member in a manner to convert the pull there-

of along said main path of carrier travel in a direction along said angularly related course whereby to advance said arm in said angularly related course, the extended span connecting the said arm motivating actuator to the said carrier independently of the said cornering device, and a resilient device yieldingly opposing said advance of said arm and constantly biasing the latter to return along said angularly related course with respect to said carrier.

2. Transfer apparatus as defined in claim 1, together with carrier motivating flexible draft means connecting the said carrier motivating actuator to said carrier to move the latter in an advance direction along the said main path, and an additional resilient device yieldingly opposing the advance movement of said carrier and constantly biasing the latter to return along said main path with respect to said frame.

3. Transfer apparatus as defined in claim 1, together with a pulley carried by the said arm motivating actuator, and in which the said extended span of the said flexible draft member is trained about said pulley.

4. Transfer apparatus as defined in claim 1, in which the said cornering device comprises a pulley pivotally mounted on the said carrier, and the said flexible draft member is trained about said pulley.

5. Transfer apparatus as defined in claim 4, together with a pulley pivotally mounted on the said frame, in which the said extended span of the said flexible draft member has a return bight trained about said frame mounted pulley between the said arm motivating actuator and the said carrier whereby to enable movement of said carrier along its said main path without movement of said reaching arm along its said angularly related course.

6. Transfer apparatus as defined in claim 1, in which the said apparatus frame comprises a rotatable turret together with a pedestal on which said turret is mounted to swivel about an axis extending along the said main path of travel of the said carrier.

7. Transfer apparatus as defined in claim 6, and turret motivating means attached to said turret in a manner to rotate the latter when actuated, together with a third motivating actuator mounted on the said pedestal and connected to said turret motivating means.

8. Transfer apparatus for selectively placing a reaching arm in various positions in at least two-dimensional space comprising, an apparatus frame, a carrier slidably mounted on said frame to be impelled in a main path of travel, a carrier motivating actuator connected to said carrier to cause advance and return thereof along said main path, a reaching arm mounted on said carrier in a manner to be longitudinally slidable relatively thereto in a course angularly related to said main path of carrier travel, an arm motivating actuator, a flexible substantially nonstretchable draft member connecting said arm motivating actuator to said reaching arm having at least a portion of its length extending in the direction of said main path of carrier travel, a cornering device on said carrier engaged by said draft member in a manner to convert the pull thereof along said main path of carrier travel to a direction along said angularly related course whereby to advance said arm in said angularly related course, and a resilient device yieldingly opposing said advance of said arm and constantly biasing the latter to return along said angularly related course with respect to said carrier, the said apparatus frame comprising a rotatable turret, together with a pedestal on which said turret is mounted to swivel about an axis extending along said main path of travel of said carrier, there being turret motivating means attached to said turret in a manner to rotate the latter when actuated, a third motivating actuator mounted on said pedestal and connected to said turret motivating means, carrier motivating draft means connecting said carrier actuator to said carrier, and means to guide said carrier motivating draft means and said arm motivating draft member into closely juxtapositioned parallel relationship in approximate coincidence with said axis of turret rotation, whereby to enable said draft means and said draft member to twist in unison to accommodate rotary movement of said turret relative to said pedestal.

9. Transfer apparatus as defined in claim 8, together with at least three cams having lobed surface shapes rotatably mounted on the said pedestal, the said actuators respectively comprising followers of said three cams to which the said draft means and draft member are connected in a manner to be pulled upon and released by said followers, whereby the surface shapes of said cams predetermine the independent movements of the said reaching arm and the said carrier relative to said turret and predetermine the independent rotary movement of said turret relative to said pedestal.

10. Transfer apparatus for selectively placing a reaching arm in various positions in at least two-dimensional space comprising, an apparatus frame, a carrier slidably mounted on said frame to be impelled in a main path of travel, carrier actuating means connected to said carrier to cause advance and return thereof along said main path, a reaching arm mounted on said carrier in a manner to be longitudinally slidable relatively thereto in a course angularly related to said main path of carrier travel, an arm motivating actuator, a flexible substantially nonstretchable draft member connecting said arm motivating actuator to said reaching arm having at least a portion of its length extending in the direction of said main path of carrier travel, a cornering device on said carrier engaged by said draft member in a manner to convert the pull thereof along said main path of carrier travel to a direction along said angularly related course, whereby to advance said arm in said angularly related course, a resilient device yieldingly opposing said advance of said arm and constantly biasing the latter to return along said mounted on said frame to be impelled in a main path of angularly related course with respect to said carrier, carrier motivating flexible draft means connecting said carrier actuating means to said carrier to move the latter in an advance direction along said main path, and an additional resilient device yieldingly opposing said advance movement of said carrier and constantly biasing the latter to return along said main path with respect to said frame, together with cams having lobed surface shapes rotatably mounted on said apparatus frame, the said actuators respectively comprising followers of said cams to which said draft member and draft means are connected respectively in a manner to be pulled upon and released by said followers, whereby the surface shapes of said cams predetermine the independent movement of said reaching arm and said carrier relative to said apparatus frame.

References Cited

UNITED STATES PATENTS

718,543	1/1903	Starks	214—16.4
951,304	3/1910	Clark et al.	214—33 X
1,566,030	12/1925	Marks	214—135
1,975,252	10/1934	Clark	214—701

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U.S. Cl. X.R.

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