April 22, 1924. 1,491,182

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MECHANISM FOR POSITIONING AND ACTUATING SPECIAL MACHINES AND TOOLS

Filed Oct. 14, 1921 4 Sheets-Sheet 1

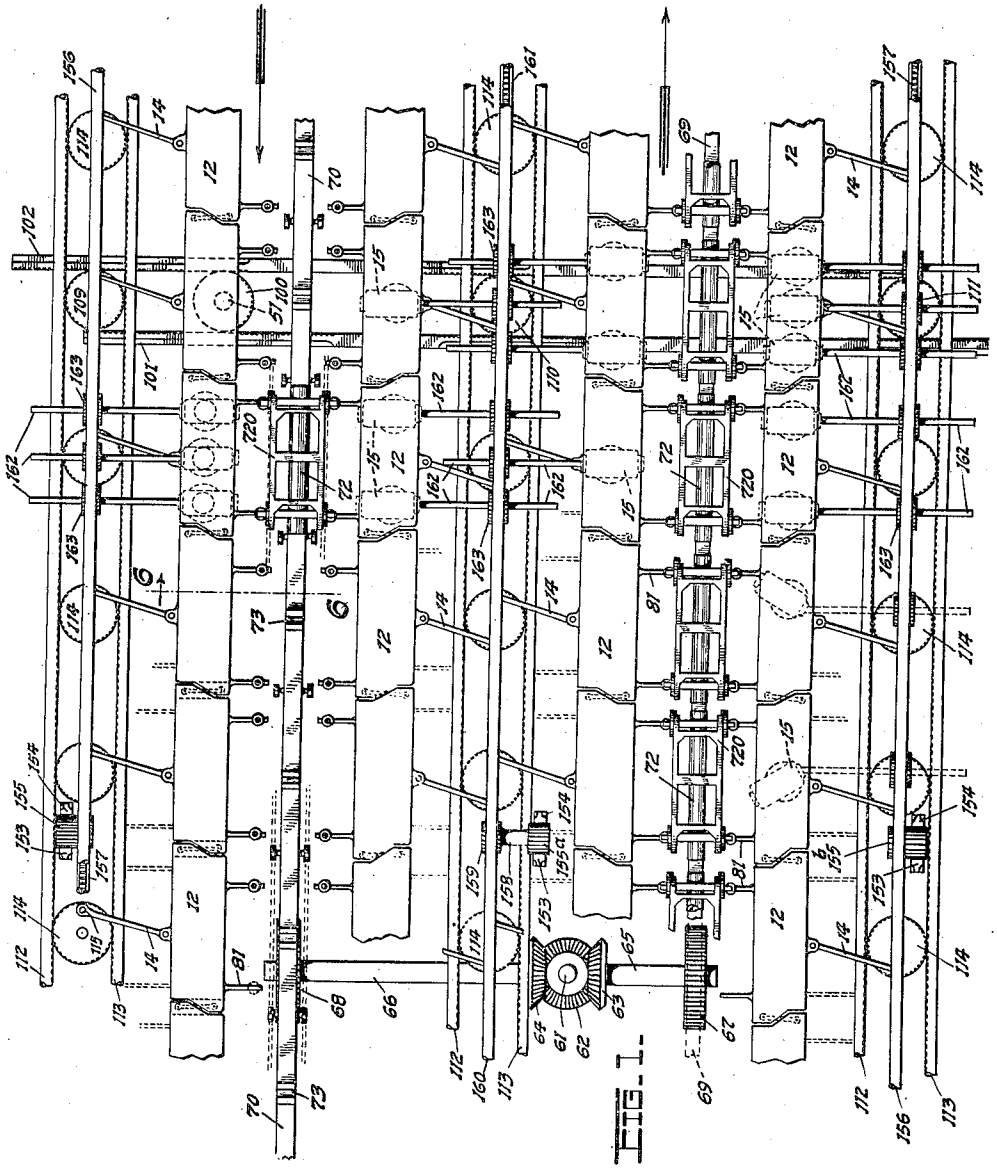


FIG. 1.

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MECHANISM FOR POSITIONING AND ACTUATING SPECIAL MACHINES AND TOOLS

Filed Oct. 14, 1921 4 Sheets-Sheet 2

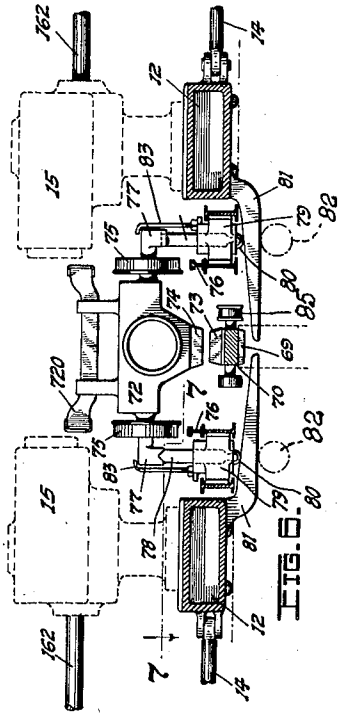


FIG. 6.

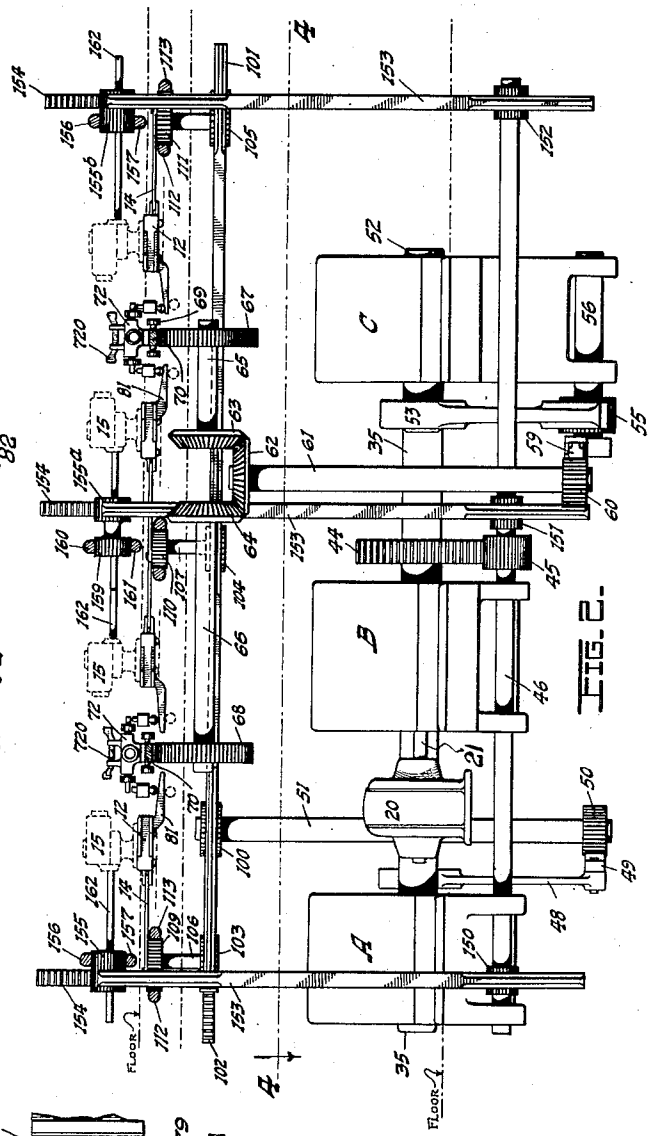


FIG. 2.

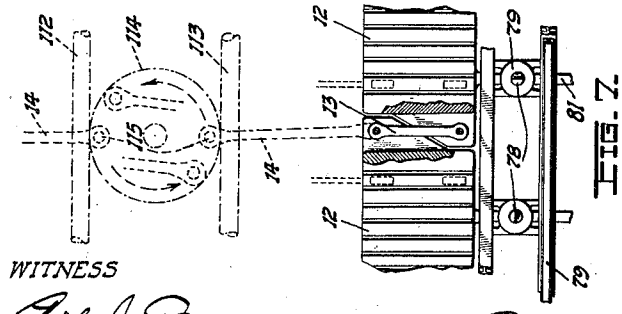


FIG. 7.

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MECHANISM FOR POSITIONING AND ACTUATING SPECIAL MACHINES AND TOOLS

Filed Oct. 14, 1921 4 Sheets-Sheet 3

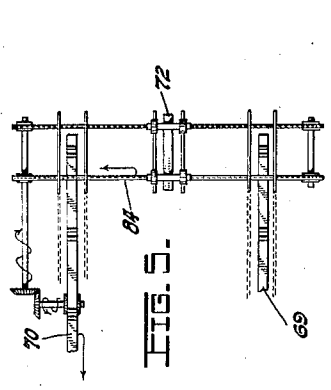


FIG. 5.

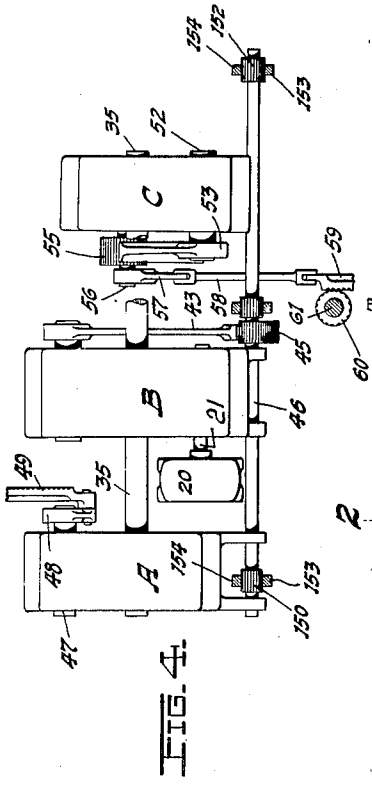


FIG. 4.

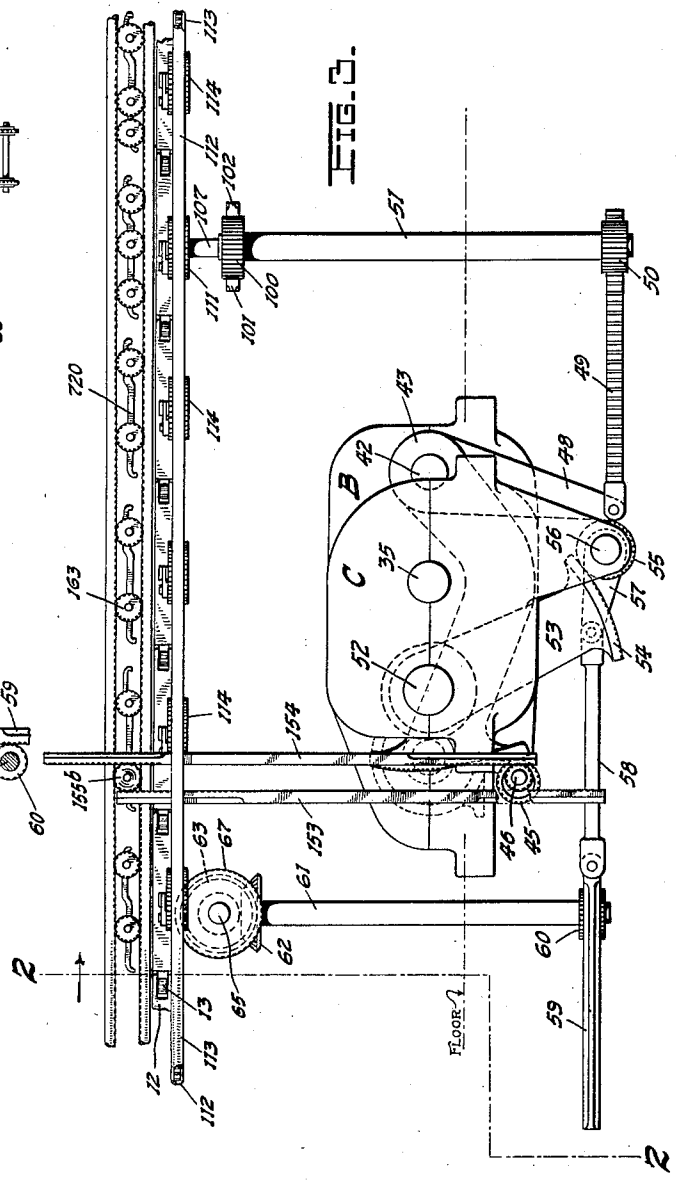


FIG. 3.

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Filed Oct. 14, 1921 4 Sheets-Sheet 4

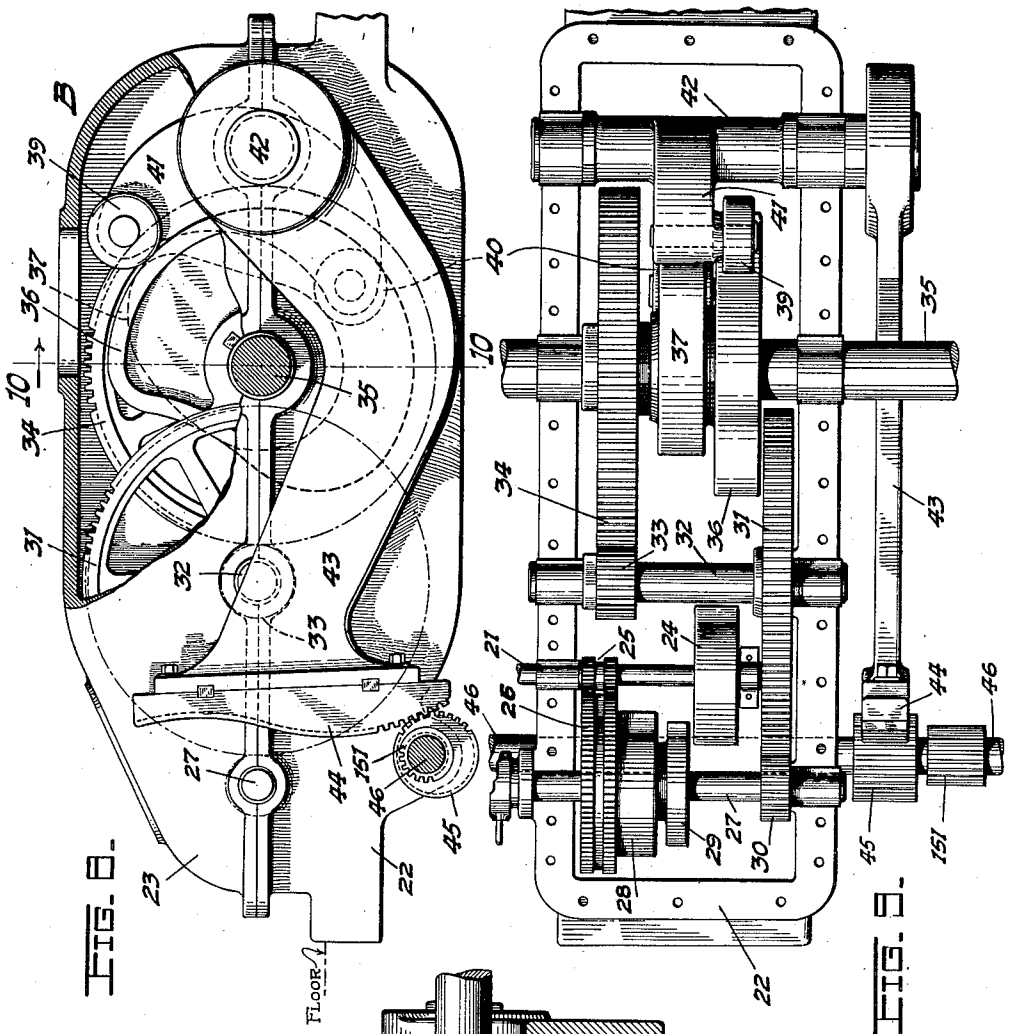


FIG. 8.

FIG. 9.

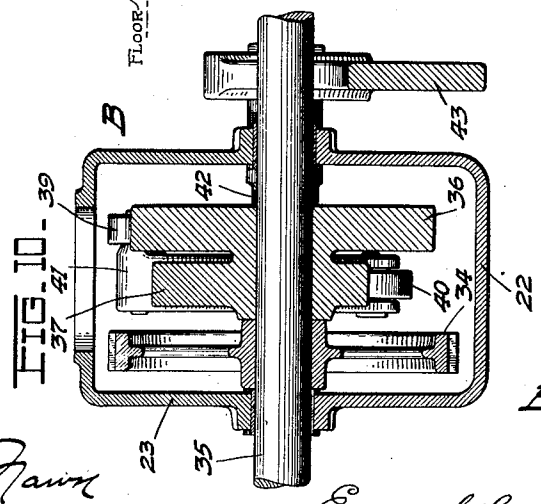


FIG. 10.

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Patented Apr. 22, 1924. 1,491,182

UNITED STATES PATENT OFFICE.

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MECHANISM FOR POSITIONING AND ACTUATING SPECIAL MACHINES AND TOOLS.

Application filed October 14, 1921. Serial No. 507,785.

To all whom it may concern:

Be it known that I, BIRGER TORVALD ANDREN, a subject of the King of Sweden, but having declared my intention of becoming a citizen of the United States, residing in the city of Milwaukee, county of Milwaukee, and State of Wisconsin, have invented certain new and useful Improvements in Mechanism for Positioning and Actuating Special Machines and Tools; and I do declare the following to be a clear, exact, and complete description thereof, such as will enable persons skilled in the art to which the invention pertains to make and use the same, reference being had to the drawings which accompany this specification for an illustration of one construction in which my invention has been embodied.

In Patent No. 1,397,020, granted to R. S. Smith, November 15, 1921, on an application filed, on January 21, 1918, Serial No. 212,934, there is disclosed an assemblage of machines and tools which by their related, connected and successive operations, punch from sheet metal plates and strips the side and cross bar and other blanks used in the construction of an automobile or other vehicle frame, shape such blanks into channels or otherwise according to the particular requirements and purposes appertaining to each, perform the necessary milling or machining operations thereon, assemble the several constituent elements of the frame in their relative positions, and secure all of such elements in their respective final and permanent positions by means of rivets, or other means of fastening, so that in a continuous operation of mechanical devices a completed automobile or other vehicle frame is automatically produced. The operations of the several machines comprised in the assemblage referred to occur in sub-divided time cycles, a portion of each time cycle being allotted for the simultaneous performance of the successive and progressive manufacturing and machining operations, followed by a conveyor movement of the frame elements during the remainder of the time cycle, to advance the elements for the performance of the next succeeding series of operations constituting the progressive steps in the process of fabricating a completed frame. The assemblage as a whole is thus operated upon a time schedule which provides for the automatic production of a given number of completed automobile frames per minute during the operation of the assemblage.

One of the features of the construction of the assemblage referred to in the said patent is that which comprises an arrangement of certain conveyor jigs or carriers, which support the various frame elements and successively present such elements in the intervals of movement of the conveyor jigs to the special machines and tools placed at the several stations along the line of movement of the conveyor jigs. When the work is properly positioned at the stations at which the special machines and tools are placed, the latter are actuated to perform upon the frame elements the various operations which such machines and tools are designed to accomplish, all as clearly explained in the patent above referred to.

In Patent No. 1,408,156, granted February 28, 1922, on an application filed by me, on March 5, 1921, Serial No. 450,074, there is disclosed a movable platform composed of connected sections having a linear arrangement, for positioning the special machines and tools at the several stations, which platform sections are bodily and as a unit moved laterally with relation to the direction of their length to accurately position the several special machines and tools at the moment that the work upon which they are to operate is brought into a position of rest at the station at which the particular machine or tool is placed. I have embodied a plurality of such movable platforms in the present construction, and have arranged them in parallelism upon opposite sides of the line of travel of the conveyor jigs or carriers, so that the special machines and tools adjusted upon the oppositely arranged movable platforms may be simultaneously brought into position, and then actuated for the performance of their functions in that portion of the time cycle allotted for their positioning movement and operation.

The present invention comprises means

for simultaneously moving the platforms so as to bring the special machines and tools adjustably supported thereon into proper position for operation. It also comprises means for actuating the several special machines and tools synchronously, when properly positioned with relation to the work, so that such machines and tools perform their different operations simultaneously and like operations successively, between the advancing movements of the conveyor jigs or carriers from station to station of the assemblage.

I have incorporated a centrally located power plant as a part of the present construction, from which power plant a plurality of longitudinally reciprocating members, formed as racks, are actuated to separately transmit the several motions to the movable platforms and the special machines and tools supported thereon. These reciprocatory racks act as tension and compression members to effect a direct transmission of motion, through interposed gears, to the parts which they operate. By this means, synchronous movement of all of the parts actuated by each rack is achieved in a manner which is more efficient than that which follows the employment of a longitudinal shaft through which the power is transmitted to the parts by the torsional stresses upon the shaft. The power plant referred to embodies certain features of special construction which are adapted to the present particular use.

A rack thus actuated is also employed for imparting the step by step feeding movements to the several conveyor jigs or carriers. When the rack actuating the jigs or carriers has reached the end of its forward throw, the jigs or carriers are disconnected from the rack by means of devices which lift them out of engagement with their actuating rack. At the same time, the jigs or carriers are doweled and positioned accurately with respect to the machines and tools, which latter are at that instant brought into position for the performance of their several separate operations. While the jigs or carriers are thus independently supported, the actuating rack is given a return movement, and is then in a position to again engage the jigs or carriers when the latter are lowered from the positions to which they have been elevated. Engagement of the jigs or carriers with the rack while in its retracted position having been effected, the rack is again actuated in proper timing for a further feeding movement, and the jigs or carriers are progressively advanced another step, that is, to the next station in advance.

The lateral movement of the platforms toward the line of the work to position the special machines and tools, is utilized to effect the disengagement of the jigs or carriers from their actuating racks; and the reengagement of the parts is effected upon the reverse movement of the platforms, the machines and tools having performed their functions and the actuating rack having been retracted meanwhile.

My invention will be particularly described later on in this specification, and the novelty thereof will be pointed out in the appended claims.

The drawings.

In the drawings which are attached hereto,

Figure 1 is a plan view showing in a conventional manner the arrangement of the movable platforms, and the means for actuating the work carriers or conveyor jigs and the special tools and machines.

Fig. 2 is a view in end elevation looking from the left of Figs. 1 and 3, and on the line 2—2 of the latter figure, some of the parts being shown in section, showing the relative arrangement of the gear boxes, and some of the operating mechanisms.

Fig. 3 is a view in side elevation looking from the right of Fig. 2.

Fig. 4 is a plan view on the line 4—4, Fig. 2, showing the cam and gear boxes, some of the connections being shown in section, with the proportions of the parts reduced, in comparison with the said Fig. 2.

Fig. 5 is a plan view showing in a conventional manner, the cross conveyor by means of which the carriers or conveyor jigs are transferred at the end of one line of their movement to the other line.

Fig. 6 is an enlarged view in end elevation of parts shown in Fig. 2, some of the elements being shown as in section.

Fig. 7 is a plan view on the line 7—7, Fig. 6, showing the manner of connecting and actuating the sections comprising one of the movable platforms.

Fig. 8 is a view in side elevation of the middle gear box, part of the upper casing thereof being broken away to more clearly show the interior thereof.

Fig. 9 is a plan view of the construction shown in Fig. 8, the upper casing being removed to show the relative arrangement of the gears, cams and shafts contained therein; and

Fig. 10 is a vertical sectional view on the line 10—10 Fig. 8, showing the arrangement of the cams and gear upon the main shaft.

The movable platforms, the special machines and tools, and the work carriers.

Referring now to the drawings, the movable platform sections 12 are constructed and arranged in the manner disclosed in

Patent No. 1,408,156, hereinbefore referred to. The actual manner of connecting the said platform sections 12 with their actuating means so that the sections comprising each of the plurality of platforms may be moved together as one part, is shown in Fig. 7 wherein the platform sections are coupled at their ends, as by pivoted links 13, and are connected at each end as shown in Fig. 7, by a crank-actuated connecting rod 14, all as is disclosed in the said Patent No. 1,408,156, so that the linear arrangement of the platform sections is preserved during the lateral movement of the platform as a unit. From the foregoing it will be understood that Fig. 1 is, as already stated, merely a conventional showing, in which for the sake of simplicity of illustration, a single connecting rod 14 is shown as connected to each section of the movable platform, but that in the actual construction two such connecting rods 14 are employed for each platform section.

The special machines and tools which are adjustably mounted and positioned upon the movable platform sections, in the manner described in the Patent No. 1,408,156, are indicated in dotted lines in Figs. 1, 2 and 6, some of such machines and tools being indicated by the numeral 15.

The present invention is embodied in a construction in which there are two parallel opposed or reverse lines of travel, at the sides of each of which lines the movable platforms are arranged, so that all of the said platforms may be moved laterally at the proper time to accurately position the special machines and tools thereon, with relation to the work presented to them by the intermittingly moving carriers or conveyor jigs. This arrangement for travel as described effects an economy in the longitudinal space required for the accommodation of the maximum number of such special tools and machines, as well as in the power required for the operation of the movable platforms and the special machines and tools positioned thereon. The carriers or conveyor jigs are transferred from one line to the other when movement to the end of the line is completed.

To actuate the movable platforms and the special machines and tools mounted thereon, it is necessary to place a suitable actuating mechanism at each side of each line of travel of the carriers or conveyor jigs. But in the present construction, a single such mechanism located between the parallel lines of travel, will be sufficient for the actuation of the two lines of platforms arranged at the inside of or between the said parallel lines of travel. Therefore, only three actuating mechanisms are necessary to effectively move the four lines of platforms in the manner referred to, as will be more fully recited in connection with the later detailed description of the construction and operation of the mechanisms.

The gear boxes.

The present construction comprises a plurality of gear boxes, A, B, and C, for containing the gears and cams, together with their actuating shafts, which transmit motion to the operating elements of the machine. These gear boxes are formed in two parts, which are joined together in a horizontal plane, and bearings for the several shafts are formed in the box sections, at their meeting edges. A main driving or cam shaft is journalled in aligned bearings in the several gear boxes so as to transmit motion to the actuating cams upon the said shaft and within the several gear boxes.

A motor 20 drives a shaft 21, Fig. 9, journalled in the middle gear box B. Each gear box is composed of a base 22 and a cap 23, the latter being fitted on the base 22 and secured thereto to form a closure containing the gears and cams and their shafts. A flywheel 24 rotates with the shaft 21. A pinion 25 fixed to the shaft 21 engages a gear 26 loose upon a shaft 27, and carrying one member 28 of a friction or other clutch. The complemental member 29 of the clutch is fastened upon the shaft 27, so that when the clutch members are engaged, the rotation of the shaft 21 will be transmitted to the shaft 27. The shaft 27 also carries a fast pinion 30, which latter meshes with a gear 31 fixed upon a shaft 32. A pinion 33 also fixed on the shaft 32 meshes with a gear 34 fastened upon the main or cam shaft 35, the latter being provided with cams 36 and 37 which rotate therewith. Cam followers 39 and 40 carried by an oscillating yoke 41, rest upon the peripheries of the cams 36 and 37 respectively. The yoke 41 is formed as a part of a rock shaft 42.

All of the shafts 21, 27, 32, 35 and 42 are journalled in bearings formed in the meeting edges of the base and cap members 22 and 23 of the gear box as before stated. This arrangement of the journals of the shafts referred to is merely one of convenience, as will be apparent, but is not necessarily a part of the construction, inasmuch as the said shafts may be journalled in any other suitable manner. The main shaft 35 extends laterally from the gear box B so as to drive the mechanisms associated with the adjacent gear boxes A and C.

The rock shaft 42 is provided with a horizontally extending arm 43, curved at its mid-length to provide a clearance for the shaft 35 in the upward vibration of the said arm 43. The free end of the arm 43 has attached to the vertical face thereof a rack 44, of irregular outline, but curved to corre-

spond with the changing radii of an eccentric gear 45, fixed upon a shaft 46 journalled in bearings formed in flanges at the lower part of the bottom member 22 of the gear boxes A and B. By means of this construction, the shaft 46 is given a reciprocating rotary motion at varying speed, for a purpose which will be hereinafter disclosed.

As before stated, the main shaft 35 extends into the gear boxes A and C, and is provided on each end with cams similar to the cams 36 and 37 designed to oscillate a yoke similar to the part 41, and provided with like cam followers. The general arrangement of the cams on the shaft 35, with the yoke provided with cam followers, and the rock shaft upon which the yoke is mounted, is the same as is shown in Figs. 8, 9 and 10.

In the gear box A, the yoke is formed as a part of or is mounted on the rock shaft 47, journalled in the gear box A, as before. The end of the said rock shaft 47, projecting at the outer side of the gear box A, and toward the gear box B, is provided with a radial arm 48, which is connected at its lower end to a longitudinally reciprocating rack 49, in engagement with a pinion 50, at the lower end of a vertically supported shaft 51, so that vibration of the arm 48 under the influence of the cams in the gear box A, will transmit a reciprocating rotary motion to the vertical shaft 51, for a purpose which will be hereinafter disclosed.

An arrangement of like devices within the gear box C imparts an oscillation to a rock shaft 52, journalled in the gear box C, in the manner previously described with reference to the mounting of the shafts in the gear box B. In the gear box C, the shaft 52, extending to the outer side of the gear box and toward the gear box B, is provided with an arm 53, which latter is formed at its free end with a toothed sector 54, engaging a pinion 55 fixed on a shaft 56, journalled in bearings depending from the gear box C. The shaft 56 is provided with a radial arm 57, to the free end of which is pivotally connected a link 58, which link is similarly connected at its other end to a rack 59, designed to have horizontal reciprocation in a fixed path. The rack 59 engages a pinion 60 on the lower end of a vertical shaft 61. It follows that a reciprocating rotary motion will be imparted to the shaft 56 under the vibrations of the arm 53, for a purpose which will be later described.

Means for actuating the work carriers or conveyor jigs.

The shaft 61, previously described as having a reciprocating rotary motion imparted thereto by the cams of gear box C, is provided at its upper end with a beveled gear 62. The last mentioned gear engages and rotates oppositely positioned beveled gears 63 and 64, fixed upon the adjacent ends of aligned shafts 65 and 66 respectively, so that the said shafts 65 and 66 are rotated simultaneously in opposite direction. The remoter ends of the shafts 65 and 66 carry gears 67 and 68, which engage the undersides of racks 69 and 70, the purpose of which is to impart to the carrier or conveyor jigs 72, a step by step movement to position the work 720 thereon with respect to the special machines or tools, for the performance of the designed machining operations.

Fig. 6 shows somewhat more in detail the construction of the parts just described. The upper side of each rack is provided with spaced notches or recesses 73, adapted to receive a fin 74 depending from the underside of the conveyor jig or carrier. The notches or recesses 73 on the upper side of the racks 69 and 70, are spaced apart a distance which is equal to the extent of movement of the rack in the step by step movement of the said conveyor jigs or carriers in feeding the work from one station to another. Each forward movement of the rack will therefore advance the conveyor jigs or carriers 72, and the work supported thereon, from their respective positions at one station to a like position at the next succeeding station. The throw of the radial arm 57 on the shaft 56, under the influence of the cams in box C, will be such as to impart to the racks 69 and 70 the desired extent of movement to impart the step by step feeding movement to the conveyor jigs or carriers.

Upon the completion of this forward feeding movement, the conveyor jigs or carriers 72 are detached from their connection with the racks 69 and 70, which latter are then free to have a return movement to again position the racks for another forward feeding movement of the conveyor jigs or carriers.

The conveyor jigs or carriers clamp and hold the work 720, in the present instance, the parts of an automobile frame, in the relative positions which they occupy in the completed frame, as disclosed in the Patent No. 1,397,020, hereinbefore referred to. These conveyor jigs or carriers are provided as shown with flanged wheels 75, which are guided by and moved upon rails or track 76, supported on the frame of the apparatus.

The conveyor jigs or carriers are provided with registering devices which accurately position the said jigs or carriers with relation to the special machines or tools designed to operate upon the work presented thereto. Such devices insure the longitudinal as well as lateral positioning of the parts, and this result may be secured by any suitable means. Fig. 6, however, shows the

projecting ends 77 of the axles of the jigs or carriers as provided with inverted V-notches at one side of the jig or carrier which extend parallel to the path of movement thereof, so as to secure lateral positioning of the work, while those at the other side are provided with transversely extending notches to secure longitudinal positioning of the work. Such notches are entered by the wedge shaped ends of rods 78, the latter being actuated in the movement of the special machines or tools into operating position with relation to the work, as will be hereinafter described.

The said rods 78 are guided for vertical movement in bushings 79 mounted upon the frame of the apparatus and are provided at their lower ends, which project below the bushings, with anti-friction rollers 80, designed to ride on the inclined upper surface of wedge fingers 81 carried by the movable platforms 12, when the latter are moved laterally to position the special machines or tools for operation upon the work supported by the conveyor jigs or carriers. With the movement of the said platforms 12 into the positions described, the jig or carrier 72 is raised and the wheels 75 are lifted from their engagement with the rails or track 76 over which they move. Thus, the fin 74 of the conveyor jig or carrier is freed from its engagement with the notch 73 in the reciprocating rack, so that the latter is free to be retracted prior to another forward feeding movement.

To insure the elevation of the conveyor jigs or carriers to properly position the work thereon, with relation to the special tools or machines, the wedge fingers 81, which are connected with and actuated by the movable platforms 12, are guided at the underside by fixed rollers 82, so that the extent of movement of the conveyor jig or carrier from its position on the rails or track 76, will be determined by the thickness of the wedge finger 81, when the platforms 12 have made their full movement toward the line of movement of the work.

Stops 83, shown in Fig. 6, having projections which lie in the path of the vertical movement of the axles of the conveyor jigs or carriers, restrain the said jigs or carriers from any vertical movement in excess of that which is desired. The stops 83 may be connected to the bushings 79, or otherwise for convenient adjustment as to effective position.

The retraction of the movable platforms after the special machines and tools carried thereby have performed their allotted functions, will act to withdraw the wedge fingers 81 from beneath the rods 78, and will allow the conveyor jig or carrier to again rest upon its supporting rails or track. In such position, the fin 74 of the jig or carrier will engage a notch 73 in the retracted rack 69, so as to be moved forward one step upon the next actuation of the said rack. The alternating movements of the conveyor jig or carrier and the movable platforms supporting the special machines or tools, enables these operations to take place.

At the end of the movement of the jigs or carriers induced by the feeding movement of the rack 69, the jig or carrier 72 is delivered to a cross conveyor 84, which transfers the jig or carrier to the parallel reverse track, on which it will be picked up by the rack 70, which is complemental to the rack 69. The racks 69 and 70 will be mounted so as to move on supporting slides, and for the purpose of facilitating such movement, may be provided with rollers 85, bearing upon the supporting slides.

Means for actuating the movable platforms.

The vertically arranged shaft 51 has been previously described as having a reciprocating rotary motion imparted thereto by means of the cams contained in gear box A. At its upper end the said shaft 51 is provided with a gear 100, which engages parallel racks 101 and 102, so that the oscillations of the said shaft 51 impart simultaneous longitudinal reciprocations in opposite directions to the said racks. The racks 101 and 102 engage and operate in like manner other gears 103, 104 and 105, which are mounted upon the lower ends of short perpendicular shafts 106, 107 and 108. The short shafts mentioned carry at their upper ends complemental gears 109, 110 and 111. Engaging each of the gears 109, 110 and 111 is a pair of parallel racks 112 and 113, arranged in the construction shown so as to have movement at a right angle to that of the racks 101 and 102. Arranged between each of the three pairs of racks 112 and 113, are several gears 114, the number of such gears being proportioned to the number of movable platform sections to be actuated. The outside lines or rows of gears 114 are provided with single crank pins 115, to which the free ends of the movable platform actuating links 14, herein before referred to, are pivotally connected. The inside line or row of gears 114 is provided with two oppositely disposed like crank pins 115, connected in the same manner to the two adjacent movable platform sections. The throw of the cranks is such that the rotary reciprocations of the gears 114 through an arc of approximately 135°, as indicated in Fig. 7, will advance the movable platform sections so as to position the special machines and tools thereon in proximity to the line of work. While in such positions, the special machines and tools will be actuated by the means hereinafter

described for the performances of the functions which they are designed to effect. The dwell which occurs in the rotation of the cams in the gear box A will cause the movable platforms to remain stationary for a time, so as to permit the actuation of the special machines and tools in performing their allotted work. The reverse movement of the gears 114, will withdraw the movable platforms from their advanced positions and during this period of retraction, the conveyor jigs or carriers will be fed forward in the manner hereinbefore described, to present the work carried thereby at another station, for the performance of the next operation.

In the operation of the mechanism as described, the longitudinally reciprocating racks act as tension and compression members, so that the motion of the cams in the gear box A is transmitted simultaneously to all the elements, and the latter are therefore operated in the desired synchronism.

Means for actuating the special machines and tools.

The shaft 46 has been previously described as having a reciprocating rotary motion imparted thereto by means of cams in the gear box B, and the connections therefrom to the eccentric gear 45 fixed upon the said shaft. The shaft 46 has also fixed thereon a plurality of pinions 150, 151 and 152, each of which engages a pair of parallel racks 153 and 154, arranged for vertical reciprocation. At their upper ends the racks 153 and 154 engage pinions 155, 155[a] and 155[b] so that the rotary reciprocations of the shaft 46 are transmitted to the pinions 155, 155[a] and 155[b].

The pinions 155 and 155[b] are elongated, and are in mesh with horizontally reciprocating racks 156 and 157. The pinion 155[a] is mounted upon one end of the short shaft 158, upon the other end of which is mounted a like pinion 159. The pinion 159 engages and operates in like manner one pair of longitudinally reciprocating racks 160 and 161, which are the same as the racks 156 and 157. The reciprocations of the racks 156 and 157, and 160 and 161, in opposite directions, are simultaneous as before.

Each of the special machines and tools, indicated 15, is provided with a horizontally arranged shaft 162, extending to the rear of such special machine or tool. Pinions 163, one for each of the shafts 162, are arranged between horizontal racks 156 and 157, and 160 and 161, so as to be rotated thereby in the reciprocations of the said racks. The pinions 163 are mounted upon the shafts 162 so as to have a sliding connection therewith, so that the pinions 163 remain in relatively fixed positions while the shafts 162 partake of the movements of the movable platform. This sliding connection may be effected in any suitable form, as by squaring a section of the shaft or providing a spline either on the shaft or on the pinion.

At the conclusion of the movement of the movable platform sections toward the work, and during the dwell before referred to, the cams in the gear box B transmit their motions through the connections previously described to the shafts 162, and to the special machines and tools operated thereby. The formation of the curved rack 44 upon the end of the vibrating lever 43, and of the eccentric gear 45, will be such that at the proper moment the speed of the special machines and tools will be reduced during the time that such special machines or tools are performing their functions.

The engagement of the rack 44 and the gear 45 will be such that the heavier operations imposed upon the mechanisms operated by the shaft 46 will take place while the longer radius of the eccentric gear 45 is in engagement with the rack. By means of this arrangement an increased leverage is secured. The reverse movement of the vibrating lever 43 will withdraw the operating elements of the special machines and tools, so that the latter will be clear of the work in ample time to permit the return or retractive movement of the platforms to take place.

The arrangement of a single pair of racks 160 and 161 with their connected pinions 163, at the central line of the apparatus, likewise permits the actuation of the machines and tools located between the parallel lines of travel, by the common means.

As in the case of the construction previously described, the racks which are actuated from the cams in gear box B, serve as tension and compression members, and so impart to the special machines and tools a synchronous operation. This manner of operation is very desirable in constructions such as hereinbefore described, wherein a large number of mechanical devices are employed for carrying out predetermined functions, and by reason of the brevity of the time cycle within which the operations must take place, it is essential to the attainment of the most satisfactory results that such mechanical devices operate simultaneously in achieving their functions. This result is effectively secured by means of the constructions illustrated.

It will be understood, however, that the construction in which the invention has been embodied, may be changed from that shown without departing from the spirit of the invention or lessening the scope of the appended claims.

Having thus described my invention, what

I claim and desire to secure by Letters Patent of the United States, is:

1. Movable platforms and special machines and tools supported thereon, carriers or conveyer jigs having a path of travel and supporting the work in position for operation thereon by the said machines and tools, in combination with means for moving the platforms to the said path of travel to position the machines and tools in operative relation to the work, and means for actuating the said machines and tools when so positioned.

2. An assemblage comprising a line of special machines and tools and means for moving the line to bring the machines and tools into operative position with relation to the work, work carriers or conveyer jigs, and means for moving the said carriers or jigs intermittingly to advance the work along the operating line and successively position the work with relation to the machines and tools.

3. Movable platforms supporting special machines and tools, work carriers or conveyer jigs adapted to position the work for operation thereon by the said special machines and tools, means for feeding the work carriers or conveyer jigs past the special machines or tools, and means for disengaging the said carriers or jigs from their feeding means to permit the retraction of the latter for another feeding movement.

4. Work carriers or conveyer jigs movable along a line of travel and means for intermittingly moving the said carriers or jigs to position the work carried thereby, special machines and tools arranged adjacent the said line of travel and means to move the said machines and tools into position for operation upon the work, and means for disconnecting the carriers or jigs from their moving means, to permit the latter to make another feeding movement.

5. An assemblage comprising machines and tools adapted to perform like operations successively and different operations simultaneously upon sets of work elements, means for intermittingly feeding the said sets of elements for the performance of the said operations, the said means comprising work carriers or conveyor jigs each presenting a set of work elements and reciprocating actuating means therefor, with means for disconnecting the carriers or jigs from said actuating means at the end of each feeding movement, to permit the said actuating means to be retracted for another feeding movement.

6. Work carriers or conveyer jigs for positioning sets of elements for operations thereon and means for intermittingly moving said carriers or jigs a predetermined distance along their line of travel, the said means comprising a longitudinally reciprocating rack having provisions for positive engagement with the carriers or jigs to move them such predetermined distance, in combination with means for actuating the said rack, and means for disengaging the carriers or jigs from the rack at the end of each feeding movement, to permit retraction of the rack for another engagement with the carriers or jigs.

7. Work carriers or conveyor jigs operating in a path of travel and supporting the work in position thereon for operations, means for intermittingly moving the carriers, a movable platform supporting machines and tools designed to operate upon the work, and means actuated in the movement of platform to disengage the carriers and jigs from their moving means, to permit the retraction of the latter, for re-engagement with the carriers or jigs to effect another movement of the latter.

8. Work carrier or conveyer jigs, means for actuating the said carrier or jigs to feed the work into proximity to machines and tools designed for operations thereon, and such machines and tools with actuating means therefor, in combination with means for elevating the work into operative relation with the said machines and tools and disengaging the carriers or jigs from their actuating means to permit another feeding movement of the latter.

9. A movable platform supporting a special machine or tool, a carrier or conveyer jig for presenting work to the machine or tool for operation thereon, means for moving the platform to bring the machine or tool into operative position with relation to the work, means for advancing the carrier or jig, and means for separating the carrier or jig from its advancing means in the positioning movement of the machine or tool.

10. A movable platform supporting a special machine or tool, a carrier or conveyer jig for presenting work to the machine or tool, means for advancing the carrier or jig, means for moving the platform toward the carrier or jig to bring the machine or tool into operative position with relation to the work, means for separating the carrier or jig from its advancing means to permit a return movement of the latter, and means for limiting the extent of such separation.

11. A movable platform supporting a special machine or tool, a carrier or conveyer jig for presenting work to the machine or tool, means for advancing the carrier or jig, means for moving the platform toward the carrier or jig to bring the machine or tool into operative position with relation to the work, means for separating the carrier or jig from its advancing means to permit a return movement of the latter, and means

for holding the carrier or jig in fixed position during such separation.

12. A carrier or conveyer jig for supporting work, a track over which the same is moved step by step, special machines and tools arranged at each side of the track, means for advancing the carrier or jig along the track, and means for lifting the carrier or jig from the track and supporting it in fixed position during the operation by the machines and tools upon the work, and while the advancing means is retracted for another feeding movement of the carrier or jig.

13. A traveling work carrier or conveyer jig, means for moving it intermittingly, a platform supporting a machine or tool for operating upon the work, and means for moving the platform toward the path of travel of the carrier or jig to position the machine or tool with relation to the work, in combination with means for actuating the machine or tool, said means embracing a shaft having a sliding connection with its driving means.

14. In an apparatus designed to perform different operations simultaneously and like operations successively, a succession of intermittingly advancing work carrier or conveyer jigs and means for moving them along the line of their travel, platforms laterally movable toward the said line of travel and special machines and tools mounted upon said platforms and positioned with relation to the work on the carriers or jigs in such lateral movements of the platforms, in combination with means for operating the said machines and tools in the intervals of the intermitting movements of the carrier or jigs.

15. A line of machines and tools designed to perform different operations simultaneously and like operations successively, carriers or conveyer jigs adapted to position the work thereon for operation by the said machines and tools, means for feeding the carriers or jigs along the line of machines and tools in step by step movements, and means for disengaging the carriers or jigs from their actuating means for another feeding movement.

16. Work supporting carriers or conveyer jigs operating along a line of travel, means for advancing the said carriers or jigs, and machines and tools arranged in proximity to the line of travel of the work carriers or conveyer jigs to perform the different operations simultaneously and like operations successively, in combination with means independent of the said advancing means for accurately positioning the said carriers or jigs with relation to the machines or tools for the performance of the described operations upon the work.

17. In an apparatus for performing different operations simultaneously and like operations successively, work carriers or conveyer jigs operating along different lines of travel, and means for actuating such carriers or jigs, a plurality of machines or tools arranged adjacent each line of travel, means independent of the actuating means for supporting the carriers or jigs in fixed position with relation to the said machines and tools during the operations of the latter upon the work, and means for transferring the carriers or jigs from one line of travel to the other.

18. Two sets of parallel lines of opposed machines and tools arranged for the simultaneous performance of different operations and the successive performance of like operations, work carriers or conveyer jigs movable intermittingly between the parallel lines of each set, and actuating means therefor, means for disconnecting the carriers or jigs from their actuating means and supporting such carriers or jigs in fixed positions with relation to the said machines and tools during the operations of the latter, and means for transferring the carriers or jigs from one line to the other for reverse movements.

19. In an apparatus for performing different operations simultaneously and like operations successively, a plurality of work carriers or jigs movable intermittingly but in procession over reverse lines of travel, in combination with machines and tools arranged adjacent the lines of travel of the carriers or jigs for the performance of operations upon the work supported thereon, and means in common located intermediate the lines of travel for actuating the machines and tools in both lines.

20. In an apparatus for performing different operations simultaneously and like operations successively, a plurality of carriers or conveyer jigs for supporting the work which is to be subjected to the said operations, means for advancing the carriers or jigs along their line of travel, machines and tools arranged adjacent the line of travel, and means for actuating the said machines and tools, such means embracing shafts and pinions thereon and longitudinally movable racks engaging the pinions.

21. A parts assembly comprising work carriers or conveyer jigs, a line of machines and tools arranged adjacent the path of travel of the work carriers or jigs, means for advancing the said carriers or jigs intermittingly, means for actuating the machines and tools intermittingly and in alternation with the carriers or jigs, both of said means embracing racks and pinions with means for imparting longitudinal movement to the racks, whereby a synchronous movement of the elements actuated by each rack is secured.

22. A parts assembly comprising movable platforms with machines and tools sup-

ported thereon, work carriers or conveyer jigs, means for intermittingly advancing the carriers or jigs, means for advancing the platforms toward the path of travel to operatively position the machines and tools with relation to the work, and means for actuating the said machines and tools intermittingly and in alternation with the movements of the carriers or jigs, all of said means embracing racks and pinions with means for imparting longitudinal movements to the racks, whereby the elements actuated by each rack are moved synchronously.

23. A parts assembly comprising movable platforms with machines and tools supported thereon, work carriers or conveyer jigs, means for intermittingly advancing the carriers or jigs, means for advancing the platforms toward the path of travel to operatively position the machines and tools with relation to the work, and means for actuating the said machines and tools intermittingly and in alternation with the movements of the carriers or jigs, said several means comprising a main shaft with cams thereon, connections including racks and pinions between the cams and the movable platforms, the carriers or jigs, and the machines and tools, respectively, whereby the mechanisms are actuated independently and the elements operated by each rack are moved synchronously.

24. An intermittingly moving work carrier or conveyer jig, a machine or tool movable intermittingly to a position in operative relation to the work, combined with means for intermittingly actuating the machine or tool for the performance of its work when so positioned, such means embracing a power shaft having a sliding connection with its driving means.

25. In an apparatus for performing different operations simultaneously and like operations successively, a plurality of work carriers or jigs movable intermittingly but in procession over reversed lines of travel, in combination with machines and tools arranged adjacent the lines of travel of the carriers or jigs for the performance of operations upon the work supported thereon, means for actuating the machines and tools in both lines, and means for transferring the carriers or jigs from one line to the other.

26. In an apparatus for performing different operations simultaneously and like operations successively, a plurality of work carriers or jigs movable intermittingly but in procession over reversed lines of travel, in combination with machines and tools arranged adjacent the lines of travel of the carriers or jigs for the performance of operations upon the work supported thereon, a single actuating means for operating the machines and tools in both lines, and means for transferring the carriers or jigs from one line to the other.

In testimony whereof, I have signed my name at Milwaukee, this 27th day of September, 1921.

B. T. ANDREN.

Witnesses:
W. F. WOOLARD,
EMMA HAUG.