Jan. 30, 1962 W. WROBBEL 3,018,591

DEVICE FOR THE WORKING IN STAGES OF THE SURFACES OF WORKPIECES ON A GRINDING OR POLISHING TRAIN

Filed June 9, 1958 3 Sheets-Sheet 1

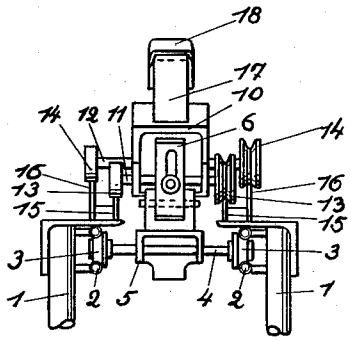


FIG. 1

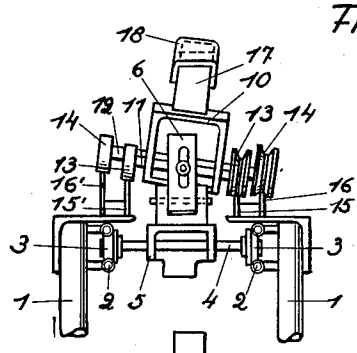


FIG. 3

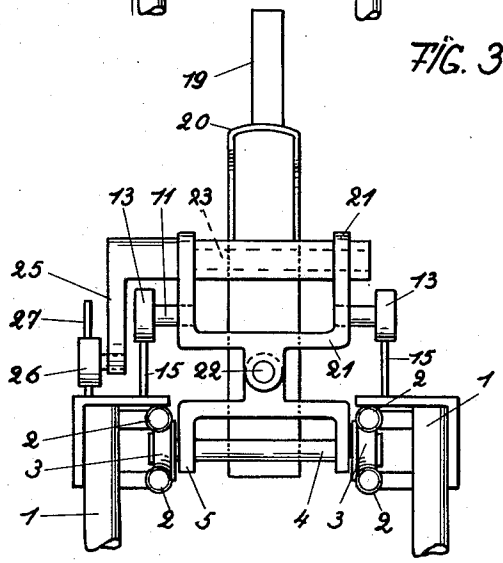


FIG 5

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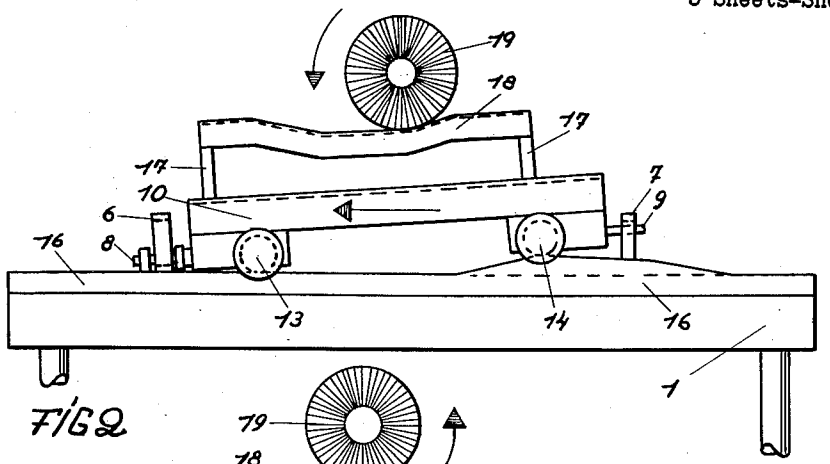


FIG 2

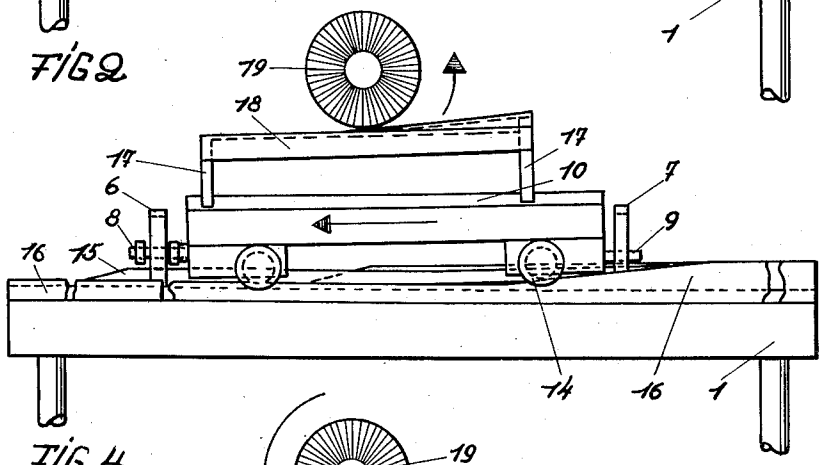


FIG. 4

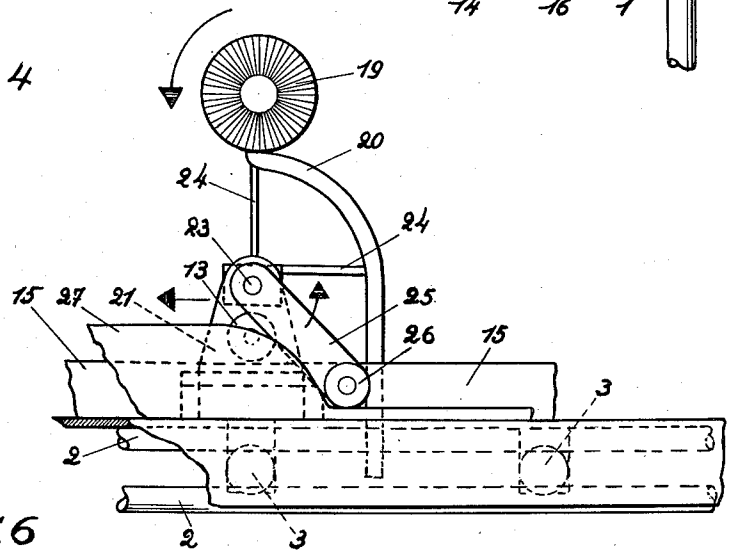


FIG. 6

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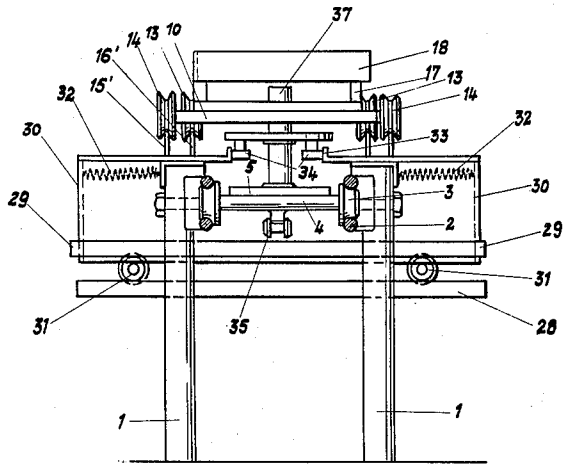


FIG. 7

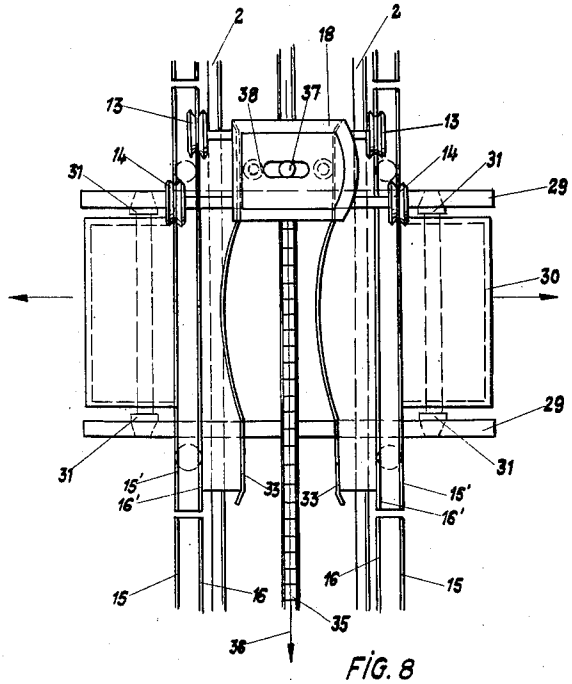


FIG. 8

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DEVICE FOR THE WORKING IN STAGES OF THE SURFACES OF WORKPIECES ON A GRINDING OR POLISHING TRAIN

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11 Claims. (Cl. 51—217)

This invention relates to a method and device for the working in stages of the surfaces of workpieces on a grinding or polishing train, the workpieces being conducted on a conveying truck each past a plurality of working machines. The working of the surfaces which occur regularly in sufficiently large numbers is carried out in an economic manner on so-called grinding or polishing trains. These consist of a number of grinding or polishing machines, which are arranged on a conveying way for the workpieces. These machines are in such cases so constructed that their head, with drive device, working spindle mounting and tool, for example grinding or polishing wheel, is arranged for vertical adjustment on a column, and can be set for the working operation in each case, and in fact in each case one stage of machining is carried out on the workpiece passing by on each machine. In the case of workpieces with plane surface, such as decorative strips or the like, the individual working stages can be set rigidly with their tools and the workpieces can be drawn through beneath these tools in a simple rectilinear movement. If on the other hand the surfaces of the workpieces are profiled, the procedure is adopted in the known polishing or grinding trains, that the head of each of the individual working machines is moved in relation to the passing workpiece. For this purpose copy rulers are used, which must very precisely imitate the section of the workpiece surface to be machined, and the movement of the head is controlled hydraulically, pneumatically or electro-magnetically. This requires a very complicated and expensive control arrangement, and nevertheless often leads to unsatisfactory working results.

These disadvantages are avoided according to the invention in a simple and advantageous manner, due to the fact that the conveying trucks carrying the workpieces are so moved in every working stage in relation to the tool of each working machine, which is stationary in relation to them but is driven, additionally to their advancing movement and during this movement, by raising, lowering, inclining, tilting or rotation, that the part of the workpiece surface to be machined in each case comes to bear on the tool or is lifted from the tool. While, in the known process, in the machining the heads of the working machines are moved, in the case of the process according to the invention they are stationary in relation to the workpieces to be machined, and these are rather brought up to the tools and removed again. This movement can be carried out in a substantially simpler manner than that of the machine heads, and thus leads to a considerable reduction in expense of the entire plant.

A device for carrying out the method in accordance with the invention, with a frame and a guide-way arranged thereon and consisting of rails for a number of conveying trucks, which are couplable with an advancing device, can advantageously be so constructed in accordance with the invention that the running surfaces of the rails imitate in their course the course of the workpiece surface. The method in accordance with the invention accordingly needs for its carrying out a purely mechanical control and conveying arrangement for the grinding and polishing train, wherein the expensive structural elements are avoided, which are necessary in the case of a hydraulic, pneumatic or electro-magnetic control arrangement. In the object of the invention the control, which is necessary in the case of the machining of irregularly shaped workpieces, is taken over by guide-ways, which so move the workpiece that the tools of the working machines, for example the grinding or polishing wheels, remain in engagement with the workpiece surface, without variation of the vertical setting of the tools.

The guide-ways possess the length of the conveying arrangement, and can be differently constructed in every working position. Their construction can take place without great precision if the workpiece is clamped on resilient mountings or the grinding or polishing wheel is resiliently supported. According to the constructon of the guide-ways the workpiece can also be pressed with different pressures in different sections against the grinding or polishing wheel, or the engagement of the wheel can be interrupted. Even the grinding of projections or edges to exact points is possible.

The conveying device of the object of the invention can advantageously be so constructed that every conveying truck consists of an under part and a workpiece-carrying upper part movable in relation thereto, its own guide-way being allocated to each part. The lower part of the conveying truck can here expediently be couplable with the advancing device and the upper part can be so mounted on the under part that on the one hand it participates in the advancing movement of the under part and on the other hand it is shiftable perpendicularly of this movement as well as being rotationally movable in all directions. For this purpose the guide-way of the under part of the truck can have a rectilinear course, and that of the upper part of the truck can be made to imitate the form of the workpieces. Furthermore the upper part of the truck can advantageously run with two pairs of wheels on the guide-way, and each wheel can have its own rail.

The conveying trucks themselves can advantageously be so constructed in accordance with the invention that the spacing between the upper part and the lower part is variable from working site to working site. For workpieces of different forms a plurality of upper parts differing from one another in their assembly can be used with one and the same lower part, due to the fact that a plurality of differently designed upper truck parts are interchangeably mounted on the lower truck part.

For the machining of greatly curved workpieces the conveying trucks can advantageously be so constructed that the upper parts of the trucks are provided with a clamping arrangement for the workpieces, and this arrangement, with the clamped-in workpiece, is movable, for example rotatable, in relation to the upper part of the truck. For this purpose a control rail and an arm can be provided, in which arm a guide roller running on the control rail is mounted.

In accordance with the invention the workpiece can advantageously also be moved transversely of the guide-way, due to the fact that in the region of the tool a carriage with sections of the guide rails mounted thereon is movable in the guide-way by means of stops such for example as rollers, which are mounted on the under part of the truck and rest on guide rails of the carriage, transversely of the direction of travel and of the endless belt driving the under part of the truck, and the upper truck part running on the guide rails is connected in transversely movable fashion with the under part of the truck. The carriage can here expediently be held in the rest position by return springs, and the upper part of the truck can be guided with a transversely disposed slot on a bolt projecting from the under part of the truck.

The invention is illustrated by way of example by reference to details of the device for carrying out the method

in accordance with the invention in the accompanying drawings, wherein:

FIGURE 1 shows a conveying arrangement with an extended workpiece, in front elevation,

FIGURE 2 shows a lateral elevation thereof,

FIGURE 3 shows a laterally tilted conveying arrangement, again in front elevation,

FIGURE 4 shows a lateral elevation thereof,

FIGURE 5 shows a conveying arrangement with a curved workpiece, again in front elevation,

FIGURE 6 shows a lateral elevation thereof,

FIGURE 7 shows a conveying arrangement movable transversely of the guide-way, in a front elevation, and

FIGURE 8 shows a plan view thereof.

In the drawings, **1** designates a frame constructed in suitable fashion and consisting of a plurality of sections, which are preferably similar. These are allocated in each case to a grinding and polishing machine (not shown) of suitable construction. They are firmly connected with one another, and in their entirety form the guide-way of a grinding and polishing train, which is provided at one end with a drive device for an endless belt or chain moving the conveying trucks of the train and at the other end with a reversing device for the conveying trucks. On the frame **1** there is arranged a roll-way **2**, consisting of two pairs of rails. The individual rails of this roll-way **2** lie horizontally and are secured parallel to one another at a specific interval. Between them there run rollers **3**, which are mounted on spindles **4**. These pertain to an under part **5** of the conveying truck, which is couplable with the endless belt (not shown in FIGURES 1 to 6), and is driven by this belt. The rollers **3** have some clearance from the upper rails of the roll-way **2**.

On the under part of the truck, **5**, there are mounted two spars **6** and **7**, each carrying a slot. Through each of these there is pushed a bolt **8** and **9**, which are arranged in the ends of the upper truck part **10**. The upper part **10** of the conveying truck is connected by the spars **6** and **7** and the bolts **8**, **9** with the under part **5**, for example by means of stop nuts mounted on the bolts **8**, with security against thrust and traction, and is driven by the under part **5** in the direction of the arrow. The upper part **10** can here be offset laterally in relation to the under part **5**, and also inclined in the direction of movement. In the upper truck part **10** there are arranged two axles **11** and **12** of different lengths, upon each of the ends of which there is rotatably mounted a roller **13** and **14**. These rollers **13**, **14** run on two pairs of rails **15** and **16**, which are secured on the frame **1** and the running edges of which are profiled.

In the case of the form of embodiment of the object of the invention as shown in FIGURES 1 to 4, a holding arrangement **17** for the workpiece **18** to be machined is arranged on a mounting portion of the upper truck part **10**, the workpiece having an extended form in the case of these forms of embodiment. By the holding arrangement **17** the workpiece **18** is firmly connected with the upper truck part **10**, and positively follows the movements thereof. An additional intermediate member may if necessary be provided in the holding arrangement.

Since the upper truck part **10** is only connected with the under part **5** as regards thrust and traction, the workpiece **18** can be moved and controlled in every plane through the guide rails **15**, **16**. The running edges of the rails **15**, **16** are adapted to the shape of the workpiece **18** and are so arranged that the latter is pressed against the tool **19** of the grinding and polishing machine in every position during the advancing movement. In order to render lateral deviation of the upper truck part **10** with the workpiece **18** in relation to the tool **19** impossible, the rollers **13**, **14** are so constructed that they are provided with a groove, expediently wedge-shaped in cross-section, the flanks of which rest against the guide rails **15**, **16**.

The rails of the rail pairs **15**, **16** may be made similar within the pairs. In this case the upper truck part **10** is only moved in a vertical plane lying in the direction of advancement. In order also to incline the upper truck part **10** laterally, differences in the height of the running edges must exist, as represented in FIGURE 3, between the rails **15**, **15'** and **16**, **16'** of each pair.

As may be seen from FIGURES 5 and 6, in the case of curved workpieces **20** the holding arrangement for these may be so constructed that the workpieces **20** are pivotable during the advancing movement of the upper truck part **10** about a horizontal axis lying transversely of this part. For this purpose the upper truck part can consist of a first part **21**, which is mounted on the under part **5** for hingeing about a spindle **22** lying in the direction of advancement. On part **21** there is mounted a mounting part **23** carrying two holding arrangements **24** for the workpiece **20**. Furthermore the lower part **21** carries the axle **11**, which may be divided, and the rollers **13**, which run on the pair of rails **15**. On the mounting part **23** there is firmly mounted an arm **25** of lever form, carrying a cam follower roller **26** at its free end. This roller runs on a rail **27**, which has cams of such a shape that the arm **25** is pivoted in the direction of the arrow during the advancing movement of the part, and in this movement the mounting part **23** with the holder **24** and the workpiece **20** is so rotated thereby that the machined surface always rests on the tool **19**, which rotates oppositely to the direction of advancement.

In the case of the form of embodiment as illustrated in FIGURES 7 and 8 of the device for the carrying out of the method in accordance with the invention the conveying arrangement carrying the workpiece **18** can be shifted transversely of the direction of advancement and of the tool **19**. The workpiece consists in this case for example of the grill of a motor vehicle radiator, of frame shape and curved on one side.

On the frame **1** there are arranged, transversely of the direction of advancement, pairs of rails **28**, **29**, and on them a carriage **30** is movable due to the fact that it is guided with rollers **31** between the pairs of rails **28**, **29**. This carriage **30** is subject to the influence of two return springs **32**, which are stretched with equal initial tension between the frame **1** and the carriage **30**, and hold the carriage **30** fast in its rest position as illustrated in the drawing. Upon the surface of the carriage **30** there are arranged, in the extension of the guide rails **15**, **16**, rail sections **15'**, **16'**. In the middle of the surface of the rails, in the direction of advancement, there is provided an aperture, and curved guide rails **33** are arranged on both sides thereof. The course of these guide rails **33** determines the lateral displacement of the carriage **30**, and must therefore be adapted to the course of the workpiece **18** to be machined. Against these guide rails **33** there rest rollers **34**, which are mounted on the lower truck part **5**. The latter is in engagement with a conveying chain **35**, which rotates in the direction of the arrow **36** and drives the lower truck part **5**. The latter carries an upwardly projecting bolt **37**, which pierces the upper truck part **10** in a transversely disposed slot **38**. Since the upper truck part **10** runs in correct track through its guide rollers **13**, **14** on the rails **15**, **16** and the rail sections **15'**, **16'**, it is shifted in the region of the carriage **30** in relation to the lower truck part **5** with the carriage **30**, transversely of the direction of advancemnt, without its connection with the lower truck part **5**, which effects the advancement, being interrupted.

I claim:

1. Workpiece conveying arrangement, comprising, in combination, support means; rail means mounted on said support means, said rail means having in longitudinal direction thereof different cam portions; first truck means guided along said support means for movement in direction of said rail means, said first truck means having a portion located adjacent said rail means; second truck means mounted on said portion of said first truck

means for movement with the same in said longitudinal direction, said second truck means having a mounting part turnable about two axes transverse to each other, said second truck means including follower means in engagement with said cam portions of said rail means; holding means mounted on said mounting part of said second truck means for holding a workpiece in engagement with stationary machining tool means; and means for moving said first truck means with said second truck means and said workpiece holding means in said longitudinal direction so that said mounting part of said second truck means turns about said two transverse axes when said follower means move along different cam portions of said rail means so that a surface of the workpiece having a contour corresponding to said cam portions is held in contact with machining tool means.

2. Workpiece conveying arrangement, comprising, in combination, support means; a pair of rail means mounted on said support means, said rail means having in longitudinal direction thereof different cam portions; first truck means guided along said support means for movement in direction of said rail means, said first truck means having a portion located between said rail means; second truck means having a first part mounted on said portion of said first truck means for turning movement about a first axis, and a mounting part mounted on said first part for turning movement about a second axis transverse to said first axis, each of said parts of said second truck means having cam follower means in engagement with said cam portions of said rail means; holding means mounted on said mounting part of said second truck means for holding a workpiece in engagement with stationary machining tool means; and means for moving said first truck means with said second truck means and said workpiece holding means in said longitudinal direction so that said parts of said second truck means turn about said transverse axes when said cam follower means move along different cam portions of said rail means so that a surface of the workpiece having a contour corresponding to said cam portions is held in contact with machining tool means.

3. Workpiece conveying arrangement, comprising, in combination, support means; a pair of rail means mounted on said support means, said rail means having in longitudinal direction thereof different cam portions; first truck means guided along said support means for movement in direction of said rail means, said first truck means having a portion located between said rail means; second truck means mounted on said portion of said first truck means for movement with the same in longitudinal direction and turnable about a longitudinal axis, said second truck means including follower means in engagement with said rail means; holding means mounted on said second truck means for holding a workpiece in engagement with stationary machining tool means, said holding means including a shaft turnable on said second truck means about an axis transverse to said rail means, a lever fixed on said shaft; an additional rail extending parallel to said rail means and having cam portions, the free end of said lever of said holding means being in contact with said additional rail; and means for moving said first truck means with said second truck means and said workpiece holding means in said longitudinal direction whereby said second truck means turns about said longitudinal axis when said follower means move along different cam portions of said rail means and whereby said holding means turns about said transverse axis under control of said additional rail so that a surface of the workpiece having a contour corresponding to said cam portions is held in contact with machining tool means.

4. Workpiece conveying arrangement, comprising, in combination, support means; a pair of rail means mounted on said support means, said rail means having in longitudinal direction thereof different cam portions; first truck means guided along said support means for movement in

direction of said rail means, said first truck means having a portion located between said rail means; second truck means including longitudinally spaced pairs of wheel means in rolling engagement with said rail means; mounting means connecting said second truck means with said portion of said first truck means for movement with the same in said direction, at least partly tiltable in longitudinal direction so that leading and trailing end portions of said second truck means can move away from and toward said first truck means, respectively, and turnable about an axis extending in longitudinal direction; holding means mounted on said second truck means for holding a workpiece in engagement with stationary machining tool means; and means for moving said first truck means with said second truck means and said workpiece holding means in said longitudinal direction whereby said second truck means turns about said longitudinal axis when said follower means move along different cam portions of said pair of said rail means and is longitudinally tilted when said pairs of wheel means engage longitudinally spaced different cam portions of said rail means so that a surface of the workpiece having a contour corresponding to said cam portions is held in contact with machining tool means.

5. Workpiece conveying arrangement, comprising, in combination, elongated support means; a carriage mounted on said elongated support means for movement in transverse direction; a first pair of rail means mounted on said carriage and extending in longitudinal direction of said elongated support means, said rail means having in longitudinal direction thereof different cam portions; a second pair of rail means mounted on said carriage extending in said longitudinal direction and having cam portions extending in transverse direction; first truck means guided along said support means for movement in direction of said rail means, said first truck means having a portion located between said rail means; second truck means mounted on said portion of said first truck means for movement with the same in said longitudinal direction and turnable about a longitudinal axis, said second truck means including first follower means in rolling engagement with said first pair of rail means, and second follower means in engagement with said second pair of rail means; holding means mounted on said second truck means for holding a workpiece in engagement with stationary machining tool means; and means for moving said first truck means with said second truck means and said workpiece holding means in said longitudinal direction whereby said second truck means turns about said longitudinal axis when said first follower means move along said cam portions of said first rail means and whereby said carriage with said first rail means, said second truck means and with said workpiece holding means move in said transverse direction under the control of said cam portions of said second rail means so that a surface of the workpiece having a contour corresponding to said cam portions is held in contact with machining tool means.

6. Workpiece conveying arrangement, comprising, in combination, support means; an inner pair of rail means and an outer pair of rail means mounted on said support means, said outer rail means being parallel to said inner rail means, each pair of rail means having in longitudinal direction thereof different cam portions; first truck means guided along said support means for movement in direction of said rail means, said first truck means having a portion located between said rail means; second truck means mounted on said portion of said first truck means for movement with the same in said direction, at least partly tiltable in longitudinal direction so that leading and trailing end portions of said second truck means can move away from and toward said first truck means, respectively, and turnable about a longitudinal axis, said second truck means including a first pair of wheel means and a second pair of wheel means respectively in rolling engage-

ment with said inner and outer rail means and being longitudinally spaced from each other; holding means mounted on said second truck means for holding a workpiece in engagement with stationary machining tool means; and means for moving said first truck means with said second truck means and said workpiece holding means in said longitudinal direction whereby said second truck means turns about said longitudinal axis when said follower means move along different cam portions of said rail means so that a surface of the workpiece having a contour corresponding to said cam portions is held in contact with machining tool means.

7. A workpiece conveying arrangement as set forth in claim 6, wherein said first pair of wheel means are front wheels and in engagement with said inner pair of rail means, and wherein said second pair of wheel means are rear wheels in engagement with said outer pair of rail means.

8. Workpiece conveying arrangement, comprising, in combination, support means; a pair of rail means mounted on said support means, said rail means having in longitudinal direction thereof different cam portions; first truck means guided along said support means for movement in direction of said rail means, said first truck means having a portion located between said rail means; second truck means including longitudinally spaced pairs of wheel means in rolling engagement with said rail means; mounting means connecting said second truck means with said portion of said first truck means for movement with the same in said direction, at least partly tiltable in longitudinal direction so that leading and trailing end portions of said second truck means can move away from and toward said first truck means, respectively, and turnable about an axis extending in longitudinal direction; said mounting means including slotted members secured to said first truck means, shaft means secured to said second truck means extending in longitudinal direction and passing through said slotted members, and stop means on said shaft means engaging said slotted members to prevent movement of said shaft means and said second truck means in longitudinal direction relative to said first truck means; holding means mounted on said second truck means for holding a workpiece in engagement with stationary machining tool means; and means for moving said first truck means with said second truck means and said workpiece holding means in said longitudinal direction whereby said second truck means turns about said longitudinal axis when said follower means move along different cam portions of said rail means of said pair of said rail means and is longitudinally tilted when said pairs of wheel means engage longitudinally spaced different cam portions of said rail means so that a surface of the workpiece having a contour corresponding to said cam portions is held in contact with machining tool means.

9. Workpiece conveying arrangement, comprising, in combination, support means; a plurality of pairs of rail means mounted on said support means, said pair of rail means being longitudinally aligned and having in longitudinal direction thereof different cam portions, the cam portions of each rail means being different; first truck means guided along said support means for movement in direction of said rail means, said first truck means having a portion located between said rail means; second truck means mounted on said portion of said first truck means for movement with the same in said longitudinal direction, said second truck means having a mounting part turnable about two axes transverse to each other, one of said axes extending in the longitudinal direction of said rail means, said second truck means including follower means in engagement with said cam portions of said rail means; holding means mounted on said mounting part of said second truck means for holding a workpiece in engagement with stationary machining tool means; and means for moving said first truck means with said second truck means and said workpiece holding means in said longitudinal direction so that said mounting part of said second truck means turns about said longitudinal and transverse axes when said follower means move along different cam portions of said rail means so that a surface of the workpiece having a contour corresponding to said cam portions of said aligned pair of rail means is successively brought into contact with a plurality of machining tool means which are respectively associated with each of said rail means.

10. A workpiece conveying arrangement, comprising, in combination, support means; a pair of rail means mounted on said support means and having in longitudinal direction thereof different cam portions; first truck means guided along said support for movement in direction of said rail means and having a portion located between said rail means; second truck means located on said first truck means; means for mounting said second truck means on said portion of said first truck means for movement with the same, and turnable about a longitudinal axis and about a transverse axis, said second truck means including at least one pair of follower means respectively engaging said rail means, and being located on opposite sides of said longitudinal axis, and spaced in longitudinal direction from said transverse axis; holding means mounted on said second truck means for holding a workpiece; and means for moving said first truck means with said second truck means and said holding means in said longitudinal direction so that said second truck means turns about said transverse axis when said follower means simultaneously pass over projecting or depressed portions on said rail means, and turns about said longitudinal axis when said follower means simultaneously engage different cam portions of said rail means so that a surface of a workpiece having a contour corresponding to said cam portions may be held in contact with tool means.

11. A workpiece conveying arrangement, comprising, in combination, support means; a pair of rail means mounted on said support means and having in longitudinal direction thereof different cam portions; first truck means guided along said support for movement in direction of said rail means and having a portion located between said rail means; second truck means located on said first truck means; means for mounting said second truck means on said first truck for movement of the same in said direction and turnable about the longitudinal axis, said second truck means including a pair of follower means respectively engaging said rail means; holding means for a workpiece and mounted on said second truck means turnable about a transverse axis; follower lever means secured to said holding means for turning movement with the same about said transverse axis; other rail means having cam portions and extending along said pair of rail means, said other rail means being engaged by said follower lever means; means for moving said first truck means with said second truck means and said holding means in said longitudinal direction whereby said second truck means turns about said longitudinal axis when said follower means simultaneously engage different cam portions of said rail means, and so that said workpiece holding means turns about said transverse axis when said follower lever means engages cam portions of said other rail means so that a surface of a workpiece having a contour corresponding to said cam portions is held in contact with a tool.

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