June 7, 1960 F. SCHRÖTER 2,939,701

METHOD OF AND MEANS FOR FEEDING WORK PIECES IN THE FORM OF SHEETS

Filed Sept. 19, 1956

6 Sheets-Sheet 1

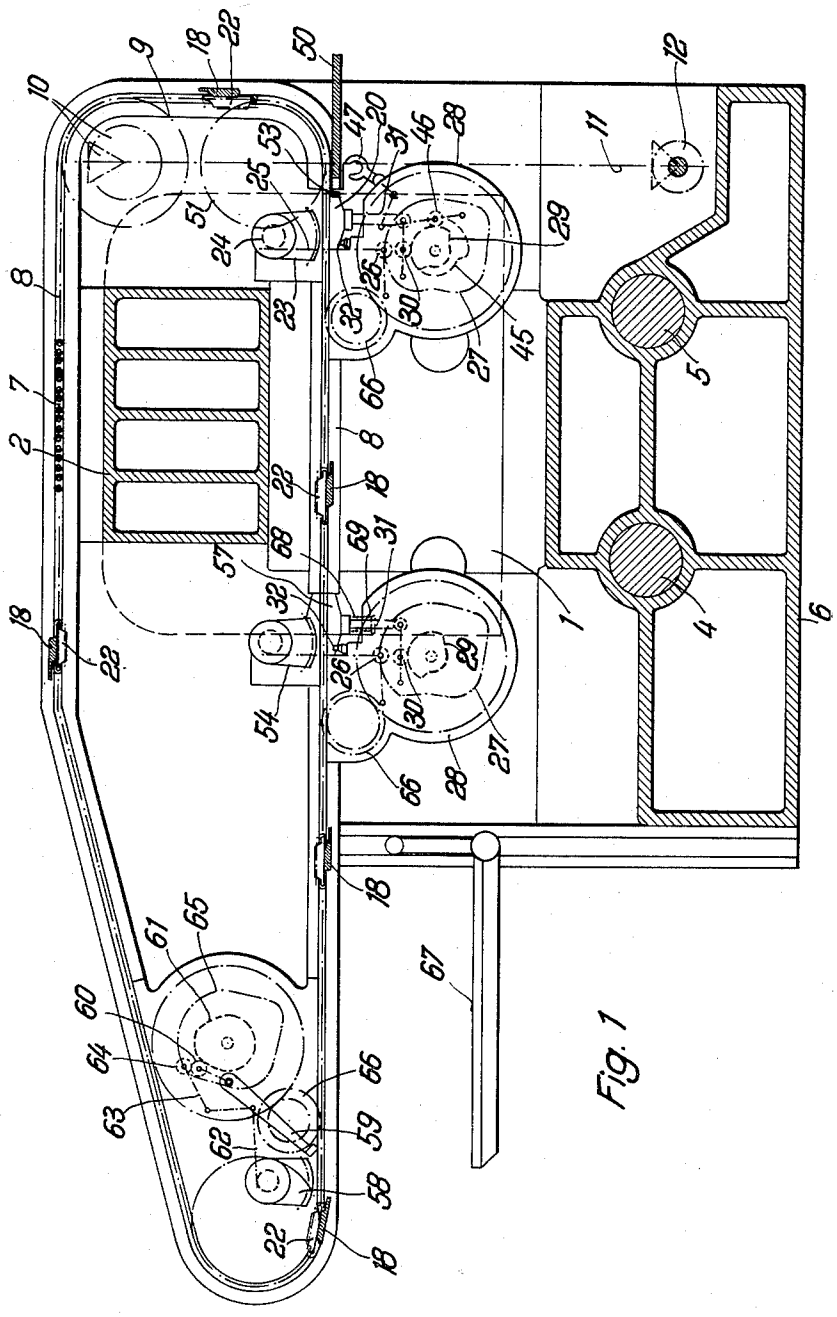

Fig. 1

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Fig. 2

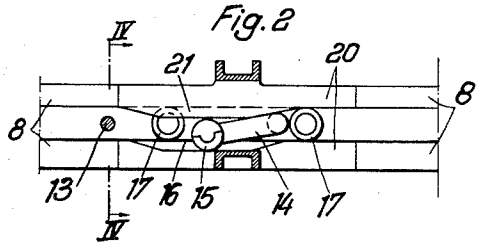

Fig. 4

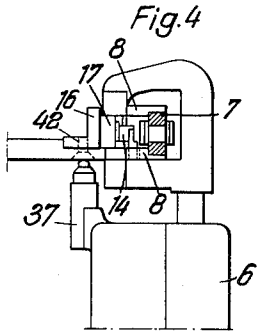

Fig. 3

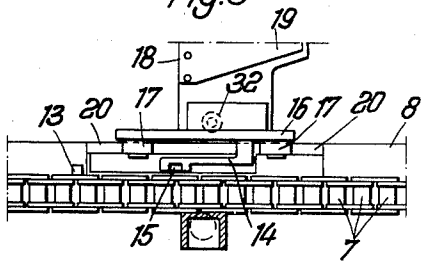

Fig. 12

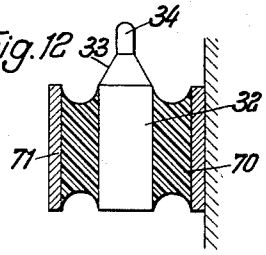

Fig. 5

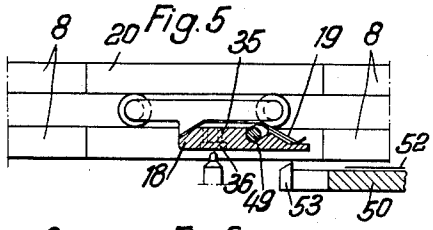

Fig. 7

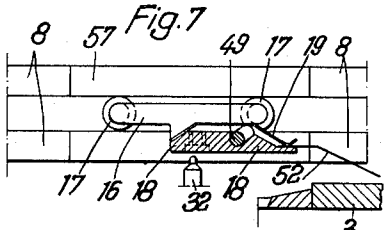

Fig. 6

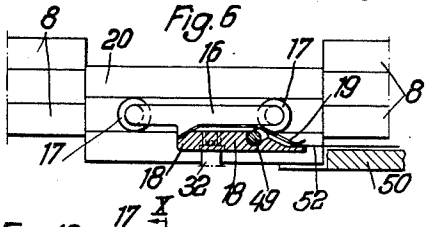

Fig. 8

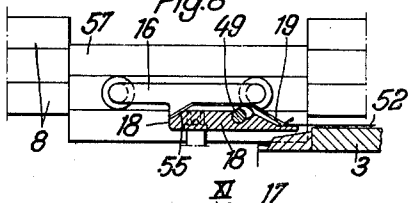

Fig. 10

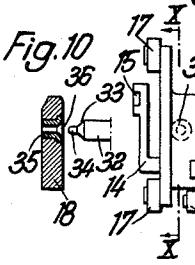

Fig. 9

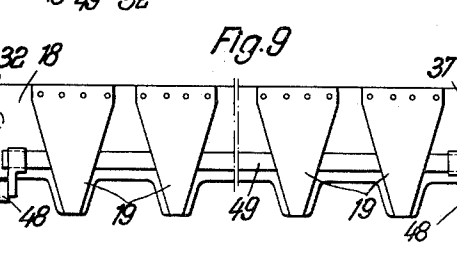

Fig. 11

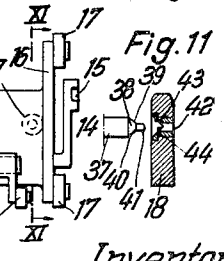

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Fig. 13

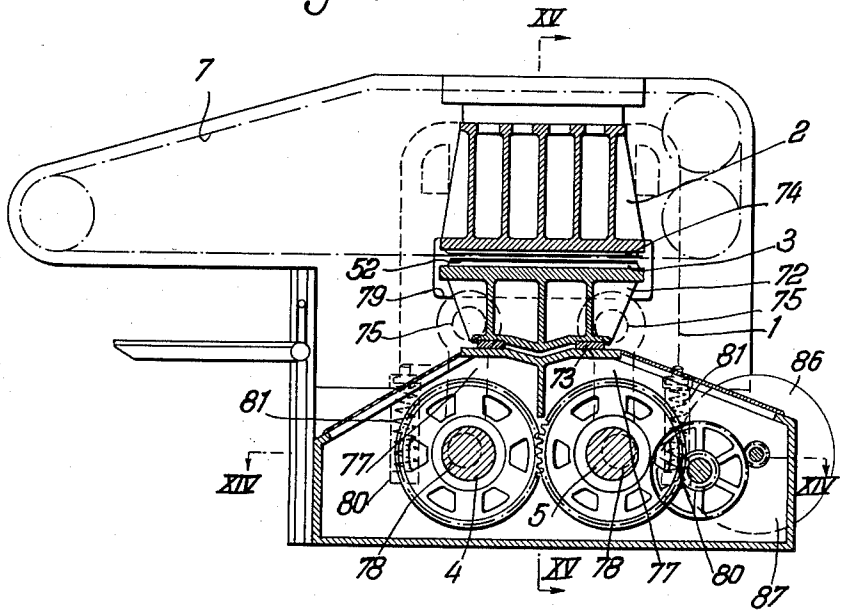

Fig. 14

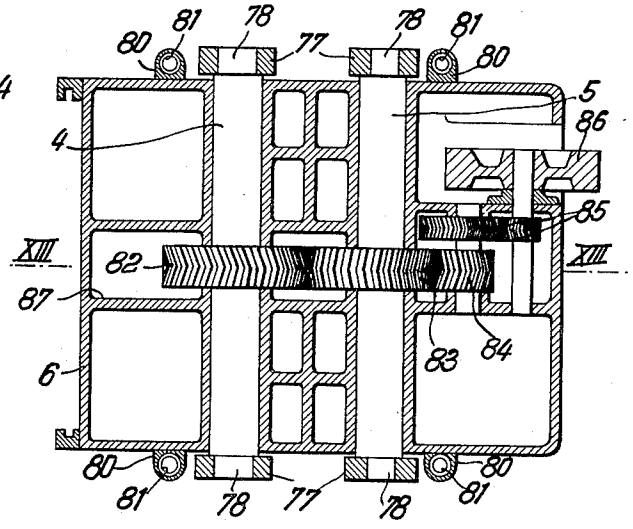

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Fig. 15

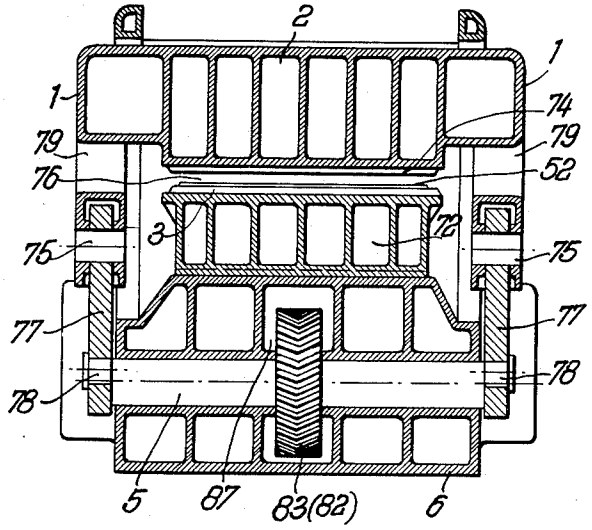

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Fig. 16

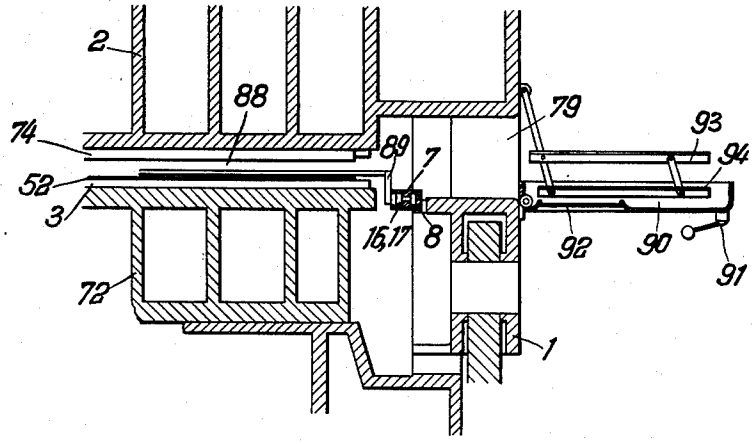
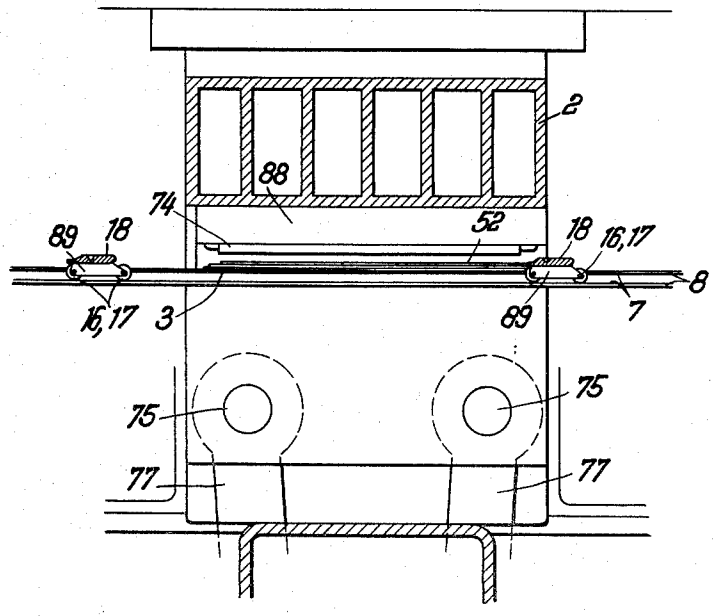


Fig. 17



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6 Sheets-Sheet 6

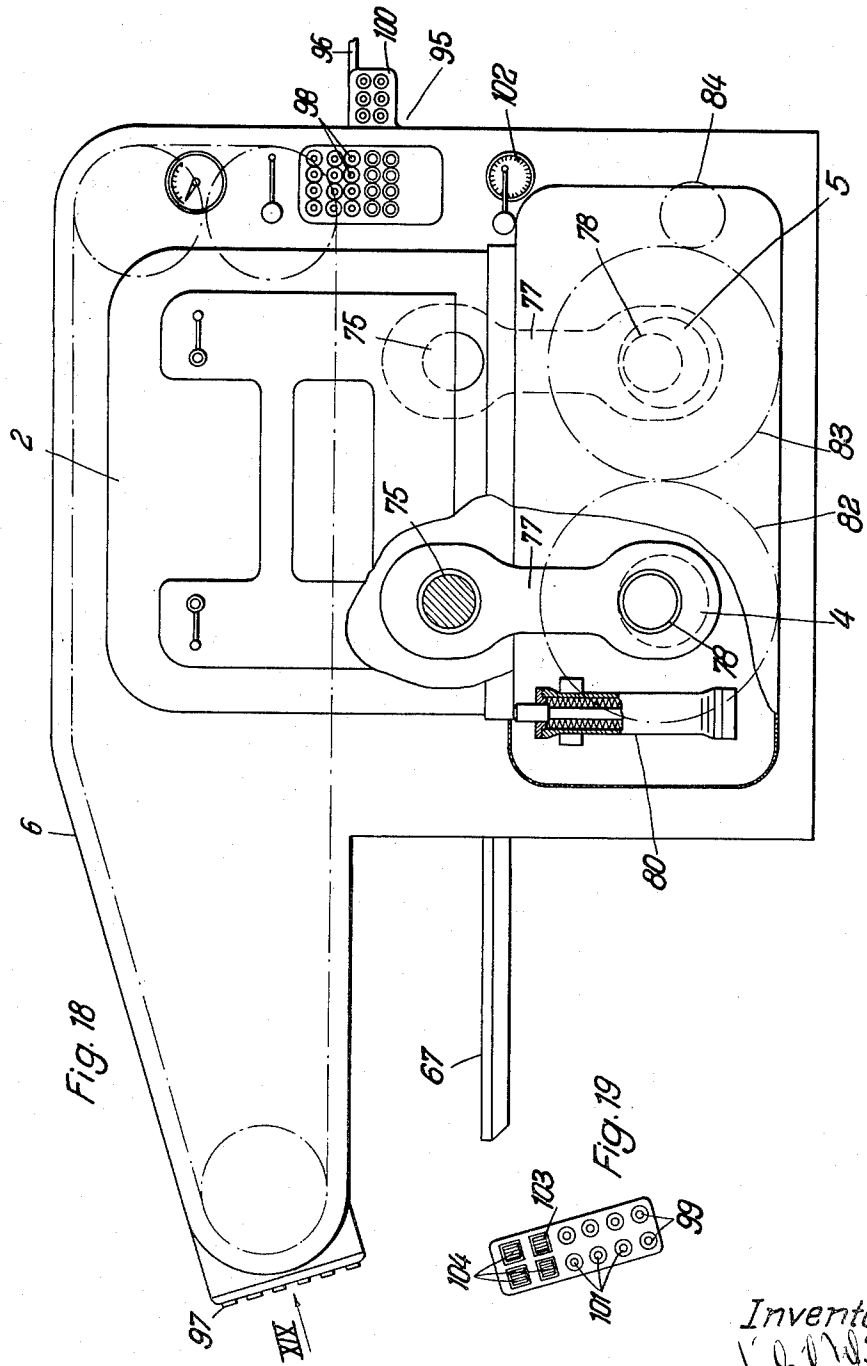

Fig. 18

Fig. 19

Inventor:

United States Patent Office 2,939,701 Patented June 7, 1960

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METHOD OF AND MEANS FOR FEEDING WORK PIECES IN THE FORM OF SHEETS

Friedrich Schröter, Friedhofstr. 14, Hannover, Germany

Filed Sept. 19, 1956, Ser. No. 610,867

Claims priority, application Germany Sept. 28, 1955

22 Claims. (Cl. 271—45)

The present invention relates to a sheet feeding mechanism.

Sheet feeding mechanisms have a number of tasks, the most important of which consists in gripping the sheet-shaped work pieces, which may also be laminated or plate-like. Since it is expedient to accumulate the sheet work pieces to a pile prior to processing them, it is necessary to take the sheets out of the pile and supply them to the grippers. For this purpose, the grippers have to be moved by a conveying device so that the sheets are removed from their initial position, the so-called laying-on or feeding station, and fed to the place of processing, or the so-called processing station. It is necessary to have the work pieces, which were moved between laying-on station and processing station, come to a rest, since only an unmoved sheet can be stamped, punched, printed, grooved or otherwise treated. After having been treated in the processing station, the sheets have to be fed to a so-called discharging or layout station where the treated sheets are preferably again accumulated to a pile.

The resulting problem, i.e., to have to alternately move the grippers and bring them to rest, has heretofore been solved by using discontinuously moved conveying means, such as chains, ropes, belts or the like. While the periodic movement of the conveying means, particularly of the above-named chains, presented no difficulties as long as machines of small size were involved, or a low speed of the conveying chains, or parts of little substance weight and relatively low power, this was entirely different when large carton dimensions and high working speeds became necessary to meet the requirements of modern packing techniques. Particularly the want and request for possibly automatic handling of all working steps required working speeds which are characterized by several thousand working steps per hour for carton sizes with an average of 1000 mm. edge length and more. In order to move the grippers which have to grip such sheets, powers are necessary which involve conveying chains of a mass which can no longer be neglected. Due to the great delays and high accelerations caused when these conveying chains are brought to a standstill or brought to motion again, great mass powers are released which can no longer be handled without excessive strain of the machine parts.

This explains the fundamental task which the present invention has resolved, i.e., it is the object of the present invention to provide a method for operating such machines and the sheet feeding mechanism in such a manner that the heretofore necessary periodic drive of the conveying chains is made superfluous. It is another object of this invention to give to these chains, belts or ropes a uniform speed which always remains the same while the grippers, which directly serve to move the sheets, are to be brought to a standstill in the laying-on, processing and discharging (layout) stations, and also moved between these stations at the speed of the conveying chains.

It is a further object of this invention to guarantee the proper fitting of the sheet work pieces, at least in the laying-on, processing and, if necessary, further processing stations, and to do that independently of the required play between the corresponding machine parts in question and also independently of their wear and tear.

It is another object of the present invention to initially lift the sheet work piece in the processing stations towards the treating or processing tool, as due to the high pressures which are exerted on the work pieces during punching, stamping, printing, grooving and slitting, the work pieces adhere to the plate-like abutment carrying the tools. If it were attempted to pull a sheet, which so adheres to the base, off the same with forces and powers within the plane of the sheet, the result would be that the sheet is torn rather than removed from the base. If, on the other hand, the sheet work piece is raised in regard to the plate-like abutment and/or support, respectively, in such a manner that the work piece moves in vertical direction relative to said abutment and/or support, small forces or energies are sufficient to pull the work piece off the base and move it.

It is a further object of the present invention to stretch the work piece prior to the treatment. Work pieces which are in sheet form, plate-like or laminated have, when being of a great surface, the tendency to become undulated. If they were treated at that stage, there would be the danger that wrinkles or bends are formed, i.e., the undulation is not removed from the work pieces rapidly enough so that a bend will extend over the entire range of its surface which will render the sheet unserviceable. It is, therefore, an object of the present invention to stretch the sheet directly prior to its processing in one plane to eliminate the formation of bends.

It is also an object of this invention to provide the sheet feeding mechanism in its processing station in such a manner that the movement of the tools is exactly vertical with respect to the plane of the sheet. The movable table of the machine must thus exert a kinematically exact movement perpendicular to the plane of the table so that there be no tilting forces which might impair the guide of the table in this direction perpendicular to the plane of the sheet. It is a further object of this invention to provide the machine in such a manner that the tools may be installed or removed perpendicular to the direction of movement of the sheets. In many cases, further additional processing machines are connected with the processing machine proper, for example, breaking or punching devices for punched pieces of carton. These connected machines hinder the installation and disassembling of the tools in the direction of movement of the work pieces so that the above-mentioned task has to be fulfilled in order to render it possible to easily operate the machine. For the same reason, the conveying means, particularly the conveying chains must not hinder the installment or disassembling of the tools so that there is an analogue task to be solved. In addition, it must be said that the room where the work piece is being processed must be well and clearly lighted so that the correct installment of the tools can be controlled.

Of decisive importance also is the necessity to be able to adjust the punching or stamping pressure to a predetermined value. Since very large machines are involved, it must additionally be possible to do that not only on the main servicing place for the machine but the correct adjustment of the stamping, punching, grooving or slitting pressure must also be possible when the operating personnel is not at the main servicing place. The machine must, therefore, be so provided that the extent of the stamping, punching, grooving or slitting pressure is known in all places of the machine where the operating personnel

is positioned when servicing the machine, and for the same reason it must be rendered possible to be informed at all places of the machine about the respective distance of the tools with regard to the abutments or supports of the sheet-shaped work pieces.

The drawing shows in detail what further tasks can be solved with the present invention and how this could be done satisfactorily.

Further details and advantages will be seen from the accompanying drawing, which shows one constructional form of the invention as applied to the control of an automatic stamping and embossing machine.

Figure 1 is a vertical longitudinal section through the automatic stamping and embossing machine, some of the parts being shown in elevation.

Figure 2 corresponds to a side elevation of a gripper bar carriage seen from outside, while

Figure 3 is a plan view of the parts shown laterally in Figure 2.

Figure 4 is a side elevation of the important part of a gripper bar carriage with a section through the chain on the line IV—IV of Figure 2.

Figure 5 shows diagrammatically the position of the gripper bar carriage with a section through the gripper bar itself in the laying-on position, prior to the lowering of the gripper bar carriage, while

Figure 6 shows the gripper bar carriage when already lowered and in the laying-on position.

Figure 7 corresponds to the position of the gripper bar carriage prior to lowering into the stamping position, while

Figure 8 shows the gripper bar carriage in the stamping position after the lowering.

Figure 9 is a plan view of a complete gripper bar carriage with gripper bars and grippers.

Figure 10 corresponds to a vertical section on the line X—X of Figure 9.

Figure 11 is a section on the line XI—XI of Figure 9, and

Figure 12 shows the specific constructional form of a setting pin support.

Fig. 13 is a vertical longitudinal central view on a reduced scale compared to Figs. 1 to 12 and taken on line XIII—XIII of Fig. 14 and shows the basic structure of the machine.

Figure 14 shows a horizontal section through the driving- and clutch-gear on XIV—XIV of Fig. 13.

Figure 15 shows a vertical cross-section through the machine on the line XV—XV of Fig. 13.

Figure 16 is a transverse sectional view of a modification of the machine of Figs. 1 to 15, the plane of section extending through the working room of the machine.

Figure 17 is a longitudinal sectional view of the modification of the machine shown in Fig. 16.

Figure 18 is a partial external and partial sectional view of a machine designed in accordance with Figs. 1 to 17.

Figure 19 is a top plan view of the machine viewed in the direction of the arrow XIX—XIX.

It is first of all possible to see from Figure 1 the complete construction of the automatic stamping and embossing machine, which comprises a stationary and if necessary adjustable bottom table, the lateral parts of which can be seen at **1**, and a vertically movable top table **2**, which carries the processing tools, while the bottom table forms the abutment for the tools, this abutment being shown in Figs. 7 and 8 as a counter-stamping plate **3**. For moving the top table, there are provided two crank-shafts or eccentric shafts **4** and **5**, which are mounted in the frame **6** of the machine. These crank-shafts or eccentric shafts are connected by connecting rods (not shown) to the top table, which is also known as the upper platen. This basic structure of the automatic punching and embossing machine will be discussed more fully and in more detail with reference to Figs. 13 to 15.

In order that the workpieces, in the present case sheets which are to be stamped and pressed, out, may be introduced into the machine and conducted through the latter, the following control means is provided according to the invention:

Extending around the upper table **2** is the chain-like conveyor means **7**, which slides in the chain track **8**. The chain driving wheel is indicated at **9**. A bevel gear **10** serves to drive the chain driving wheel or sprocket **9**. The bevel gear **10** leads through a vertical shaft indicated at **11** to the second bevel gear **12**, which is arranged in the region of the driving motor. As can be seen more particularly from Figures 2 and 3, the chain **7** comprises at **13** pin-like projections which can be engaged by a coupling member **14**, which again is to be seen in Figs. 2 and 3. For this purpose, the coupling member is provided at **15** with a semi-circular claw. The coupling member is rotatably arranged on the gripper bar carriage **16**, which comprises guide rollers at **17**. Each two gripper bar carriages carry a gripper bar **18** which is fitted with grippers **19**. As will be seen from Fig. 1, as regards the constructional example which is illustrated, five gripper bars **18** are arranged distributed over the length of the driving chain **7**. The guiding rollers of the carriage **16** slide in a track or rail guideway, which extends and is arranged in the same manner as that of the chain **7** and as compared therewith merely has the distinction that rail track sections, i.e. the rail sections **20** in Figs. 2 and 3, are movable transversely at right-angles to the direction of the rail track. The upper part of the rail section **20** is constructed at **21** as a control rail, so that when a gripper bar carriage runs into the rail section **20**, the control cam **21** of the coupling member **14** is pressed downwardly and in this way gives the latter a movement in a counter-clockwise direction. By this means, the claw **15** of the coupling member **14** is brought out of engagement with the chain pin **13**, so that in this way the gripper bar carriage **16** shown in Figs. 2 and 3 is uncoupled from the chain **7** being used as conveyor means. At the same time, this gripper bar carriage has been brought to a zero speed. This is effected by the fact that a rack element **22**, which can be seen in Figure 1, has come under the influence of a toothed segment **23**, which has also been shown in Fig. 1. Through the toothed rim **24** and the rack **25**, this toothed segment **23** is under the influence of the cam follower **26** and thus of the control cam **27** which is arranged in the control cam housing **28**. The cam disc **27** is so constructed that the two segments **23** engages in the rack section **22** of a gripper bar carriage **16** with gripper bars **18** at the instant when the coupling member **15** has just been disengaged from the associated chain pin **13**. The same cam **27** is so designed that the gripper bar carriage **16** with the gripper bars **18** has reached the zero speed when it has fully entered the rail section **20**. At this instant, a cam disc **29** becomes operative, this cam also being arranged in the cam disc housing **28**. A cam follower **30** running on the cam disc **29** engages in a bar-like extension **31** of the rail section **20** and momentarily lowers the latter, so that gripper bar carriages **16** and gripper bars **18** carry out a transverse movement, which in the case of the constructional example is in a direction perpendicular to the previous direction of movement. Under the influence of this transverse movement, the gripper bar **18** is positioned on a setting pin arrangement which consists of two essential parts. The setting pin **32** shown on the left in Fig. 9 has an attachment **33** which is constructed in the form of a cone. A pin-like insert **34** serves to facilitate insertion. A bushing **35** in the gripper bar **18** is correspondingly formed, that is to say, it comprises a hollow conical recess **36**. Provided on the other side is the setting pin **37**. In contrast to the pin **32**, this setting pin **37** carries a wedge-shaped attachment **38** with the wedge surfaces **39** and **40**. The tip of the wedge, which does not have to exist ma-

terially as such, but need only exist in theory, thus extends longitudinally of the gripper bar 18. A pin-like attachment 41 can provide for the easy introduction of the gripper bar 18 into the setting pin arrangement 37. Accordingly, the gripper bar 18 comprises opposite the pin 37 a bushing 42 which is provided at 43 and 44 with wedge surfaces corresponding to the wedge surfaces 39 and 40. This setting pin arrangement 32 and 37 leads to fitting accuracy in the position of the lowered gripper bar carriage 16, 18, this position being independent of play and any signs of wear. Regardless of whether any play or wear exists or not, the cone 33 extending into the hollow conical formation ensures that the gripper bar 18 and the setting pin 32 are always fixed in one and the same point. Regardless of how long the length of the gripper bar 18 actually is, perhaps depending on varying room temperatures, the wedge surfaces 39, 40 and 43, 44 ensure that the gripper bar 18 is always aligned in a constant manner at a second point clearly defining its position in relation to the frame 6 of the machine. The cam disc housing 28 contains a third cam disc 45 on which a cam follower 46 is adapted to bear. The cam follower or roller 46 controls the claws 47 through a linkage, these claws being so constructed and arranged that they come into engagement with the actuating rollers 48 operating on the cam shaft 49 at the moment at which the gripper bar carriage 16 has reached its lowermost position and the grippers 19 are opened for receiving the sheet which is to be processed. After feeding the sheet, the grippers are conversely closed by rearward movement of the claw 47.

The operation of the arrangement which has been described will be seen from the description of the machine as set out above.

In detail, it is also to be pointed out that a gripper bar carriage 16 with gripper bars 18, which in Fig. 1 is situated immediately in front of the laying-on position, which can be seen by the laying-on table 50, is brought to this position by means of the deflecting wheel 51 through the chain 7. The workpiece is disposed on the laying-on table 50 in the form of the sheet 52. As soon as the gripper bar carriage under consideration has entered the rail section 20, after its coupling member 14 has already been uncoupled beforehand from the associated driver pin 13 of the chains 7 and after the said carriage has been brought to the zero speed by the toothed segment 23, the cam disc 29 through the roller 30 and the bar 31 effects the lowering of the gripper bar carriage with the gripper bar 18 on to the setting pin arrangement 32, 37. It is to be seen from Fig. 6 that the gripper bar 18 is resting on the said pins. At this instant, the grippers are opened under the action of the claws 47 and the roller 46 and cam disc 45 controlling the said claws. The workpieces 52 are laid on at the front guide element 53. At this instant, the claw 47 actuates the cam shaft 49 through the roller 48 in such manner that the grippers are closed. The rail section 20 is raised again with the gripper bar carriage, so that the sheet 52 is lifted up. This is immediately followed by the lifting movements of the rail section 20, the acceleration of the gripper bar carriage to the speed of the conveyor chain 7 and the coupling of the gripper bar carriage through the associated coupling member 14 in the associated pin 13 of the conveyor chain 7, so that the already lifted sheet 52 is gently withdrawn and thus guided into the working cycle of the machine. The same operations are similarly repeated in the processing stations, which are the stamping and embossing stations in the stamping and embossing machine which is under consideration. It is only the essential parts of this processing station which are shown in Fig. 1. There will again be seen the toothed segment 54, which in the said station, now initially decelerates the gripper bar carriage to the zero speed and later accelerates it again to the speed of the conveyor chain. Before this segment 54 becomes operative, the uncoupling of the gripper bar carriage concerned has already taken place through the correspondingly arranged control rail 21 and through the coupling member 14. It will be understood from Fig. 7 that the workpiece, in the position of the gripper bar carriage which exists prior to the lowering, is already urged in the bearing position against the bar 18 by the grippers 19 on the basis of the control processes illustrated in Figs. 5 and 6. The gripper bar 18 is now lowered to the height position of the tool abutment 3, so that the workpiece 52 in the lower position shown in Fig. 8 is located at a place in which the processing by stamping or embossing or by both together can take place. Now follows the lifting process, which has the advantage that the workpiece 52 is lifted in relation to the tool abutment 3. This lifting movement is advantageous, because the workpiece 52 is easily jammed in the recesses of the tool abutment 3, so that a withdrawal in the plane in which it is situated would present difficulties. Since the setting pins 32 and 37 in the stamping position are offset by a small amount in the direction of travel relatively to the bushings 35 and 42 receiving them, these are moved in Fig. 7 somewhat towards the left with the lowering of the gripper bar. By this means, the sheet 52 which is indicated as being curved in Fig. 7, is stretched out on the counter-stamping plate 3 without a rearward movement of the rear edge of the sheet being necessary. As soon as the rail section which has been indicated by 57 to distinguish it from the rail section 20 of Figs. 5 and 6 has again reached the height position of the rails 8, the toothed segment 54 again accelerates the gripper bar carriage 16 to the speed of the conveyor chain 7. The coupling between the gripper bar carriage and associated pins 13 of the conveyor chain 7 immediately follows, whereupon the processing operations are completed.

A toothed segment 58 is again provided at the discharge station for decelerating the speed of the gripper bar carriage arriving from the processing stations to the zero speed. Provided for this purpose is a pressure element 59 which serves the same purpose as the claw 47 in the laying-on position. The pressure member 59 bears on the rollers 48 and thus on the cam shaft 49, so that the grippers 19 are opened for the purpose of delivering the finally processed sheet. The pressure member 59 is under the action of a control roller 60, the movements of which are determined by the cam disc 61, while the rack 62 and the linkage 63, the control roller 64 and the cam disc 65 serve for the movement of the toothed segment 58. All the cam discs can have their own driving means. A simpler arrangement is however to effect the drive from the conveyor chain 7. The driving wheels for this carry the reference numeral 66. The finally processed sheets released from the gripper 19 are stacked on the stacking table 67.

In order to make the positioning of the gripper bars 18 on the setting pin arrangement 32 and 37 independent of the weight effects of the gripper bar arrangement 16, 18, it is possible according to Figure 1 for springs 68 to act on a collar 69 of the bar drive 31, so that the positioning takes place with predetermined forces and accelerations. Since these accelerations could cause undesirable oscillations and vibrations, the setting pin 32 according to Figure 12 is vulcanised into an angular rubber ring 70, which in its turn is mounted in the vulcanised steel casing 71. With this arrangement, while the pin 32 is held almost rigid in the radial direction, a certain degree of yieldability of the holding means for the pin is obtained in the axial direction, so that the necessary damping of the laying-on movement is obtained without interfering with the fitting accuracy. The remarks made concerning the pin 32 also apply for the pin 37.

Figs. 13 and 15 show the basic structure of the machine in detail.

In these figures 72 denotes the fixedly mounted lower table or lower platen of the punching and embossing ma-

chine. Only defined adjusting movements of the lower platen are possible which are performed with the aid of the wedges 73, which will be explained with reference to Fig. 18. These movements will not change the stationary arrangement of the lower table. There is provided furthermore the movable upper table or an upper platen 2. The latter supports the stamping tool 74, possibly in the form of strips of steel, whereas the counter-punch plate is indicated at 3. The sheetlike workpiece itself, which is just in position between the punch plates with the stamping tool, is shown at 52. This relates so far only to measures known per se.

Side pieces 1 are provided on the upper platen 2, as is particularly shown in Figure 15, which laterally overlap the lower platen 72 and which are under the influence of a plurality of pull rods, which exclude the occurrency of tilting forces which can become effective on the upper platen 2, even when workpieces are being worked which engage the tool on one side only. In the embodiment strong gudgeon pins 75, carried by the side pieces 1 engage pull rods 77 in the form of strong connecting rods lying on both sides of the guide path 76 for the workpieces, the other end of which in each case encloses the crank- or eccentric-pin 78 of the eccentric- or crank-shafts 4, 5. The side pieces 1 themselves are constructed to be rigid against transverse forces, as the large-area hollow cross-sections in Fig. 15 show, so that it is easily possible to provide the openings 79 therein, which are therefore of particular importance, because they make it possible, in spite of the provision of a movable upper platen in contrast to hitherto known machine constructions of this kind, to be able to assemble and dismantle the tools 74 through the openings 79, that is from the side. The upper platen 2 itself is so definitely located in any position by its guides and by the four rod drive, that even workpieces 52 lying on one side only, which occur particularly in the case of smaller than maximum sizes, always lying against the front edge of the punch have to be worked, are incapable of making any change in these clearly predetermined positions of the upper platen in spite of the great tilting forces produced in conjunction with a high stamping pressure. The upper platen 2, as is shown in particular in Fig. 13 is in addition braced against the side pieces 1 by springs 80 lying in spring containers 81, whereby the spring stresses are preferably so dimensioned, that they correspond to at least the weight of the moving parts 2, 1, 74. Thus no directional change of forces with their damaging results occur during the movement of the upper platen. Of course instead of springs and spring containers 81, 80 also other power accumulator constructions or energy storage means can be employed, somewhat in the form of oil dashpots.

Figure 14 allows it to be seen that the crank- or eccentric-shafts 4, 5, are coupled, via the spur gears 82, 83 provided with herringbone teeth. The drive of the gear 82 is effected at 84 by a pinion with a gear train 85 with the incorporation of flywheel 86. Thus there exists the possibility since the gear coupling 82, 83 is provided in the middle of the machine frame 6, to construct this frame at 87 as a gear casing filled with lubricant, so that the machine is capable of operating noiselessly and unattended.

In Figs. 16 and 17, the reference 2 represents the movable upper plates, while the reference 72 indicates the lower fixed platen forming the abutment for the moving upper platen. Accordingly, 74 represent the upper tools and 3 the lower tools, while the workpiece in the form of a sheet is indicated at 52. The elements for moving the latter are in the form of gripper bars 18, the grippers themselves having been omitted in order to simplify the drawing. At 1, the upper platen comprises cheek-like guiding and moving attachments which serve to accommodate the crank pins 75. The crank pins 75 serve for the mounting of the connecting rods 77 which impart the driving movement to the upper platen 2 from a drive means which is not illustrated. The frame of the machine is indicated at 6. As far as described so far, such machines have already been discussed hereinbefore.

Such a machine embodies the following development:

Whereas it has previously been usual and has been embodied in the machine design according to Figs. 1 to 17 to arrange conveyor means, more especially in the form of chains, necessary for moving and guiding the movable elements, that is to say, the gripper bars 18, in such a manner that they immediately adjoin the gripper bars 18 laterally, so that they were disposed centrally in front of the working chamber 88 between the top and bottom tools 74, 3, a complete departure from this arrangement is used according to the invention. The guide rails 8 for the chain 7 have now been arranged above the working chamber 88 or, as in the constructional example, below the said chamber, in order to achieve the result that the said chamber 88 is fully accessible from the side. This obviously means a different guiding arrangement for the gripper bars, and this has been carried out by these bars being supported by lateral plates 89. In the case of the constructional example, no direct connection with the elements or links of the chain 7 is provided, but the gripper bars 18 are connected through the plates 89 to separate gripper bar carriages 16, which in their turn are adapted to be coupled to links of the chain 7 or to be uncoupled therefrom when the gripper bars 18 are stationary. Due to this arrangement, the working chamber 75 is now completely free, especially when the stationary periods of the gripper bars are chosen as shown in Fig. 17, so that then no other parts are in the path of the top and bottom tools 74 and 3. Since the parts 2, 1 of the upper platen are so arranged that the space 79 between these parts of the working chamber 88 can be completely seen, in addition to the advantage for facilitating the assembly and dismantling of the tools 74, 3, there is also the advantage of improved inspection of an access to the working chamber 88, which can also be illuminated by the arrangement of suitable lighting sources, so that the entire working process can be suitably supervised. This also applied when the door arrangement 90 is closed by a locking means 91, because an inspection window 92 can be so arranged in the door 90 that it at least corresponds to the projection of the working chamber 88 on to the door 90. Plate- or rail-like arrangements 93, 94, which are disposed at the height of the top and bottom tools, 74, 3 and which automatically come to the operative position when the door 90 is hinged downwardly, complete the measures for facilitating easy replacement of tools when the tools are removed from the machine.

In Figs. 18 and 19 the movable upper table 2 is shown, as well as the connecting rods 77 for moving the same, the eccentric shafts 4, 5 with the eccentrics 78. The herringbone spur gears 82, 83 and the driving pinion 84 are indicated by their pitch circles. The figures show also the shock absorbers 80 of Fig. 13 and the machine frame 6, as well as the discharge table 67.

To enable the control of such machine from various points, the following additional means are provided:

The main control station 95 is apparent near the feed table 96 for the workpieces. A secondary control station 97 is disposed close to the discharge table 67. The main control station is provided with two control push buttons 98, which operate an adjusting motor for displacing the wedge pieces 73, which are shown in Fig. 13 as being provided between the lower table 72 and the machine frame 6. With the aid of these adjusting wedges the height of the space 76 between parts 2 and 72 (Fig. 15) can be adjusted to any desired value through the intermediary of parts 77, 75, 1. Thus the force can be varied with which the tools 74 act on the workpiece 52. The auxiliary control station 97 comprises also two control push buttons 99, which correspond to the control push

buttons 98 of the main control station 95. Thus the operator of the machine can vary the degree of punching of the machine from the auxiliary control station 97 when the workpieces falling on the discharge table 67 indicate that the degree of punching must be increased. The same is true if the degree of punching must be reduced. What has been said in connection with punching operations applies analogously for the printing on or other processing of workpieces in the form of sheets or plates. A series of additional control push buttons 100 and 101 are provided for electrically adjusting so-called front and side marks. These front and side marks are disposed at the feed table 96 and serve to vary and so to adjust the position of the workpiece relative to the machine that the workpieces have the proper registry. Since control push buttons 101 which correspond to the control push buttons 100 of the main control station 95 are provided also on the auxiliary control station 97 close to the discharge table, the operator working the discharge table 67 can vary the registry when the workpieces falling on the discharge table 67 indicate that such variation is necessary. In addition to the control push buttons 98, 100 and 99, 101, respectively, a graduated disc 102 is provided, which indicates the amount of the total adjustment of the table 72 relative to the machine frame 6, which carries the adjusting wedges 73. In correspondence with the arrangement on the graduates disc 102, a counter 103 is provided on the auxiliary control station 97 to indicate how many steps were necessary to achieve the total adjustment indicated by the graduated disc 102. Thus the counter 103 indicates at the discharge table 67 when the push buttons 99 are actuated how many switching steps have just been performed due to the actuation of the buttons 99 because said number of steps is the difference between the originally indicated number and the new number. Thus complicated transmissions between the main graduated disc 102 and such auxiliary graduated discs can be avoided. Additional graduated discs not shown, which correspond to the construction of the graduated disc 102, serve to indicate the total adjustments of the front and side marks. Corresponding counters are provided at 104 at the auxiliary control station 97 and the difference between the original number and the new one indicates again how many switching steps have been performed by the actuation of the switching buttons 101. Additional actuating members serve to influence the main driving motor and the auxiliary drives.

What is claimed is:

1. A method for the automatical processing of workpieces in sheet and plate form, said method comprising connecting drivers moved at constant speed to grippers for one of said workpieces, separating said drivers and grippers in a feeding station for said workpieces, reducing to zero the previous driver speed of the grippers which are separated from the driver whereas the driver movement is continued at constant speed, moving the grippers after separation from the driver transversely to the previous direction of movement to move them close to the workpiece to be gripped while the driver continues to be uniformly moved, actuating the grippers which are stationary and separate from the driver with the driver continuing its uniform movement and thus gripping the workpiece, moving the gripper with the gripped workpiece back to the driver while the driver continues its movement, accelerating the gripper and workpiece to the constant speed of the driver, and interconnecting the gripper and the driver which is moved at constant speed.

2. A method for the automatical processing of workpieces in sheet and plate form, said method comprising connecting drivers which are moved at constant speed to grippers and thus to a workpiece gripped by said grippers, separating driver and grippers in a processing station for said workpieces at which station the workpieces are worked while occupying a predetermined processing level, reducing the previous driver speed of the grippers to zero whereas the driver movement is continued at constant speed, moving the grippers being separated from the continuous and uniformly moving driver transversely to their previous direction of movement and thus moving them to the processing level, processing the workpiece while the driver continues its uniform movement, moving the gripper with the gripped workpiece back to the driver, accelerating the gripper and workpiece to the constant speed of the driver, and interconnecting the gripper and the driver which is moved at constant speed.

3. A method for the automatical processing of workpieces in sheet and plate form, said method comprising connecting drivers moved at constant speed to grippers for one of said workpieces, separating said drivers and grippers in a feeding station for said workpieces, reducing the previous driver speed of the grippers to zero whereas the driver movement is continued at constant speed, moving the grippers transversely to the previous direction of movement to move them close to the workpiece to be gripped, imparting to the grippers at the end of their transverse movement a transverse position which is independent on play or wear and which is adapted to ensure the registry of the workpiece, actuating the grippers, which are stationary in their previous direction of movement, and thus gripping the workpiece, moving the gripper with the gripped workpiece back to the driver, accelerating the gripper and workpiece to the constant speed of the driver, and interconnecting the gripper and the driver which is moved at constant speed.

4. A method for the automatical processing of workpieces in sheet and plate form, said method comprising connecting drivers which are moved at constant speed to grippers and thus to a workpiece gripped by said grippers, separating driver and grippers in a processing station for said workpieces, reducing the previous driver speed of the grippers to zero whereas the driver movement is continued at constant speed, moving the grippers transversely to their previous direction of movement and thus moving them to the processing level, imparting to the grippers at the end of their transverse movement a transverse position which is independent on play or wear and which is adapted to ensure the registry of the workpiece, subsequently processing the workpiece, moving the gripper with the gripped workpiece back to the driver, accelerating the gripper and workpiece to the constant speed of the driver, and interconnecting the gripper and the driver which is moved at constant speed.

5. The method according to claim 2, wherein the grippers and workpieces have imparted thereto during their transverse movement an additional component of movement in the direction of the driver movement, said component of movement being adapted to stretch the workpiece.

6. A method for the automatical processing of workpieces in sheet and plate form, said method comprising connecting drivers moved at constant speed to grippers for one of said workpieces, separating said drivers and grippers in a feeding station for said workpieces at which station the workpieces are worked while occupying a predetermined processing level, reducing the previous driver speed of the grippers to zero whereas the driver movement is continued at constant speed, moving the grippers transversely to the previous direction of movement to move them close to the workpiece to be gripped, imparting to the grippers at the end of their transverse movement a transverse position which is independent on play or wear and which is adapted to ensure the registry of the workpiece, actuating the grippers, which are stationary in their previous direction of movement, and thus gripping the workpiece, moving the gripper with the gripped workpiece back to the driver, accelerating the gripper and workpiece to the constant speed of the driver, interconnecting the gripper and the driver which is moved at constant speed, connecting drivers

which are moved at constant speed to grippers and thus to a workpiece gripped by said grippers, separating driver and grippers in a processing station for said workpieces, reducing the previous driver speed of the grippers to zero whereas the driver movement is continued at constant speed, moving the grippers transversely to their previous direction of movement and thus moving them to the processing level, imparting to the grippers at the end of their transverse movement a transverse position which is independent on play or wear and which is adapted to ensure the registry of the workpiece, subsequently processing the workpiece, moving the gripper with the gripped workpiece back to the driver, accelerating the gripper and workpiece to the constant speed of the driver, and interconnecting the gripper and the driver which is moved at constant speed, subsequently connecting drivers which are moved at constant speed to grippers and thus to a workpiece gripped by said grippers, separating the drivers and grippers in a discharge station for processed workpieces, reducing the previous driver speed of the grippers to zero whereas the driver movement is continued at constant speed, actuating the grippers which are at a standstill in their previous direction of movement and discharging the released workpiece, accelerating the grippers to the speed of the drivers, and interconnecting the gripper and the driver which is moved at constant speed.

7. A machine for the automatic processing of workpieces in sheet and plate form, said machine comprising a base frame, drive means and processsing tools and in addition thereto conveyor means driven by the drive means and revolving at constant speed and adapted to drive other parts, gripper means for the workpieces and carriers of gripper means for the workpieces, guides for said conveyor means, parts of said guides being transversely movable with respect to the longitudinal direction of the guides, couplings between conveyor means and said gripper carriers, controls for said couplings, said controls being adapted temporarily to connect said gripper carriers by means of said couplings with and to separate them from said conveyor means, moving means adapted to brake to zero speed the gripper carriers when uncoupled from the conveyor means and to accelerate them to the velocity of the conveyor means, additional moving means adapted to move said guide members which are transversely movable relative to the longitudinal direction of the guide, to positions which are parallel to the guides in the end positions of the transverse movement, and control means for the grippers.

8. A machine according to claim 7, said conveyor means consisting of chains and said guides being formed as rail guides, said gripper carriers consisting of bars extending across the width of the workpiece and carrying at their ends carriages set with rollers, said rollers being guided in the guide rails of said chains, said rail guides carrying control rails for the coupling suitable temporarily to connect the gripper bar carriages to or to disconnect them from the chain.

9. A machine for the automatic processing of workpieces in sheet and plate form, said machine comprising a base frame, drive means and processing tools and in addition thereto conveyor means driven by the drive means and revolving at constant speed and adapted to drive other parts, gripper means for the workpieces and carriers of gripper means for the workpieces, said gripper carriers consisting of bars extending across the width of the workpiece and carrying at their ends carriages set with rollers, said rollers being guided in the guide rails of said chains, said rail guides carrying control rails for the couplings suitable temporarily to connect the gripper bar carriages to or to disconnect them from the chain, guides for said conveyor means, parts of said guides being transversely movable with respect to the longitudinal direction of the guides, said conveyor means consisting of chains and said guides being formed as rail guides, couplings between conveyor means and said gripper carriers, controls for said couplings, said controls being adapted temporarily to connect said gripper carriers by means of said couplings with and to separate them from said conveyor means, moving means adapted to brake to zero speed the gripper carriers when uncoupled from the conveyor means and to accelerate them to the velocity of the conveyor means, said moving means comprising racklike parts on said gripper bar carriages, toothed segments adapted to mesh with said rack parts of the gripper bar carriages when the latter are uncoupled from the conveyor chain, camwheels, rollers engaging said camwheels, and links adapted to transmit the roller movements to the toothed segments, additional moving means adapted to move said guide members which are transversely movable relative to the longitudinal direction of the guide, to positions which are parallel to the guides in the end positions of the transverse movement, and control means for the grippers.

10. A machine for the automatic processing of workpieces in sheet and plate form, said machine comprising a base frame, drive means and processing tools and in addition thereto conveyor means driven by the drive means and revolving at constant speed and adapted to drive other parts, gripper means for the workpieces and carriers of gripper means for the workpieces, guides for said conveyor means, parts of said guides being transversely movable with respect to the longitudinal direction of the guides, said conveyor means consisting of chains and said guides being formed as rail guides, couplings between conveyor means and said gripper carriers, controls for said couplings, said controls being adapted temporarily to connect said gripper carriers by means of said couplings with and to separate them from said conveyor means, moving means adapted to brake to zero speed the gripper carriers when uncoupled from the conveyor means and to accelerate them to the velocity of the conveyor means, additional moving means adapted to move said guide members which are transversely movable relative to the longitudinal direction of the guide, to positions which are parallel to the guides in the end positions of the transverse movement, said movable guide portions being formed as short rail pieces which are movable at right angles to rest of the rail guide, said additional moving means comprising camwheels, rollers engaging said camwheels and links adapted to transmit the roller movement to the short rail pieces, and control means for the grippers.

11. In a machine for automatically processing workpieces in sheet, plate and laminated form, with said machine having a base frame and drive means together with processing tools and comprising uniformly rotating conveying means being driven by driving means and adapted to drive other parts, guides for said conveying means with parts of said guides being transversely movable with respect to the longitudinal direction of the guides, gripper means for the workpieces, a carrier of gripper means for the workpieces, a setting pin arrangement provided in the path of said gripper carriers during movements of said gripper carriers transversely to said guides, the said setting pin arrangement consisting of at least two setting pins spaced from each other and one of which is conical, the other being wedge-shaped having a wedged tip extending in longitudinal direction of the gripper carriers, there being recesses in said gripper carriers opposite said setting pins, one of said recesses being hollow-conical, the other of said recesses having plane surfaces inclined toward each other, means for defining the setting pins relative to the machine frame, the center plane of said setting pin arrangement being provided staggered in the direction of movement of the conveying means opposite the center plane of the recess provided for receiving the setting pins, said staggered arrangement adapted for stretching sheet workpieces in one plane.

12. In a machine for automatically processing workpieces in sheet, plate and laminated form, said machine comprising, apart from a base frame and drive means as well as processing tools, uniformly rotating conveying means being driven by the driving means and adapted to drive other parts, said conveyor means consisting of chains, said guides being provided as rail guides, gripper means for workpieces as well as a carrier of gripper means for the workpieces, the said gripper means comprising bars extending over the width of the workpiece, gripper tongues on said bar, means for lifting said gripper tongues to the bar and for laying the tongues on the bar, actuating devices for said means, said gripper carriers comprising bars extending over the width of the workpiece, the ends of said bars carrying carriages having rollers, said rollers being guided in the guide rails of said chains, said guide rails carrying control rails for the coupling adapted to temporarily connect the gripper bar carriage with or to separate from the chain, couplings between conveying means and said gripper carriers, controls for said couplings being adapted to temporarily connect the gripper carriers with and separate from the conveyor means by way of said couplings, moving means adapted to brake to zero the gripper carriers when uncoupled from the conveyor means and to accelerate them to the speed of the conveyor means, additional moving means adapted to bring said guide members being transversely movable with regard to the longitudinal position of the guide into positions parallel to the guide, control means for the gripper means, said movable guide portions being provided with short rail parts and movable perpendicular to the remainder of the rail guide, said additional moving means comprising cam discs, rollers making contact with said cam discs, and links adapted to transmit the roller movement to the short rail portions, said control means comprising claws adapted to engage the actuating means of the means for lifting and rolling the gripper tongues, cam discs, rollers making contact with said cam discs and links adapted to transmit the roller movements to the claws, the said cam discs, rollers and links for moving the rail pieces, braking and accelerating the gripper bar and controlling the grippers being provided in common casings disposed in feeding and processing stations, said two cam discs, rollers and links for braking and accelerating the gripper bars and controlling the grippers being housed in a common casing positioned at the discharge station.

13. A machine according to claim 12, said camwheels, rollers and links for moving the rail pieces, braking and accelerating the gripper bars and controlling the grippers being accommodated in common casing disposed in feeding and processing stations, said camwheels, rollers and links for braking and accelerating the gripper bars and controlling the grippers being accommodated in a common casing provided at the discharge station.

14. A machine for the automatic processing of workpieces in sheet and plate form, said machine comprising a base frame, drive means and processing tools and in addition thereto conveyor means, gripper means for the workpieces and in addition thereto carriers of gripper means for the workpieces, means for transmitting the movement of the conveyor means to the gripper carriers, a movable upper platen, said upper platen being adapted to carry upper tools or abutments for lower tools, a stationary lower platen, said lower platen being adapted to carry lower tools or abutments for upper tools, side plates carried by the upper platen and extending beyond the lower platen, at least two pull rods connected to the upper platen at each side plate, said pull rods consisting of connecting rods of crankshafts or eccentric shafts.

15. A machine according to claim 14, wherein at least one of said side plates is formed with apertures, adapted to enable the assembly and removal of the tools through said apertures, said side plates being rigid against transverse stresses.

16. A machine according to claim 14, energy storage means adapted to take up at least the entire weight of the moving parts.

17. A machine according to claim 14, spur gears on said eccentric shafts, said spur gears having herringbone teeth, another spur gear which is driven by the drive means and in mesh with only one of said gears.

18. A machine according to claim 14, spur gears on said eccentric shafts, said spur gears having herringbone teeth, another spur gear which is driven by the drive means and in mesh with only one of said gears, said gears being disposed in the middle of the eccentric shafts or crankshafts, the frame part accommodating said gears being constructed as a gear casing filled with lubricant.

19. A machine for the automatic processing of workpieces in sheet and plate form, said machine comprising a base frame, drive means, processing tools, conveyor means, gripper means for the workpieces and in addition thereto carriers of gripper means for the workpieces, means for transmitting the movement of the conveyor means to the gripper carriers, a movable upper platen, said upper platen being adapted to carry upper tools or abutments for lower tools, a stationary lower platen, said lower platen being adapted to carry lower tools or abutments for upper tools, said conveyor means disposed outside of two horizontal planes defining the working range of the tools of the machine and traversing the zone of the processing tools so that work pieces are directed between the platens.

20. A machine for the automatic processing of workpieces in sheet and plate form, said machine comprising a base frame, drive means, processing tools, conveyor means, gripper means for the workpieces and in addition thereto said conveyor means consisting of chains, guide rails for said chains, carriers of gripper means for the workpieces, said gripper means comprising bars extending across the width of the workpiece, gripper tongues on said bar, means for lifting the gripper tongues against the bars and for applying the tongues to the bar, actuating devices for said means, means for transmitting the movement of the conveyor means to the gripper carriers, a movable upper platen, said upper platen being adapted to carry upper tools or abutments for lower tools, a stationary lower platen, said lower platen being adapted to carry lower tools or abutments for upper tools, said conveyor means disposed outside of two horizontal planes defining the working range of the tools of the machine and traversing the zone of the processing tools so that work pieces are directed between the platens, plates connecting said chains to said gripper bars.

21. A machine according to claim 19, comprising couplings between conveyor means and said gripper carriers, controls for said couplings, said controls being adapted temporarily to connect said gripper carriers by means of said couplings with and to separate them from said conveyor means, the coupling and uncoupling positions lying beyond two vertical planes which define the working range of the tools in the direction of movement of the conveyor means.

22. In a machine for automatically processing workpieces in sheet, plate or laminated form, the combination of: driver means; driving means for driving said driver means at a constant rate; workpiece carrier means capable of carrying a workpiece in sheet, plate or laminated form and adapted to be coupled to and uncoupled from said driver means, said carrier means being normally coupled to said driver means; coupling means for uncoupling said carrier means from and re-coupling said carrier means to said driver means; decelerating and accelerating means operatively associated with said coupling means for decelerating said carrier means to stand-

still after uncoupling of said carrier means from said driver means and for accelerating said carrier means to the speed of said driver means prior to re-coupling of said carrier means to said driver means; and means associated with said decelerating and accelerating means for controlling the rate at which the latter decelerates and accelerates said carrier means.

References Cited in the file of this patent

UNITED STATES PATENTS

895,659	Morrison	Aug. 11, 1908
1,119,857	Morgan	Dec. 8, 1914
1,133,352	Wood	Mar. 30, 1915
1,489,339	Banzett	Apr. 8, 1924
2,559,235	Tascher	July 3, 1951