

April 28, 1959

P. DRYON

2,883,801

PLANTS FOR GRINDING AND POLISHING FLAT GLASS

Filed July 25, 1955

6 Sheets-Sheet 1

Fig. 1

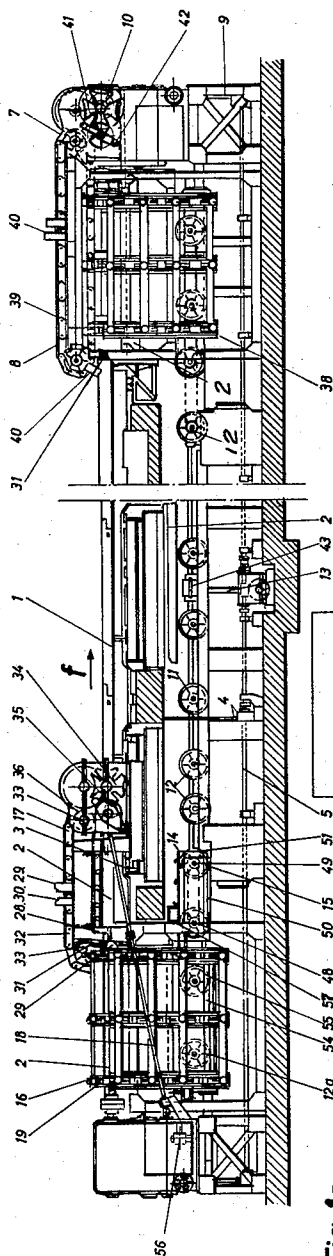
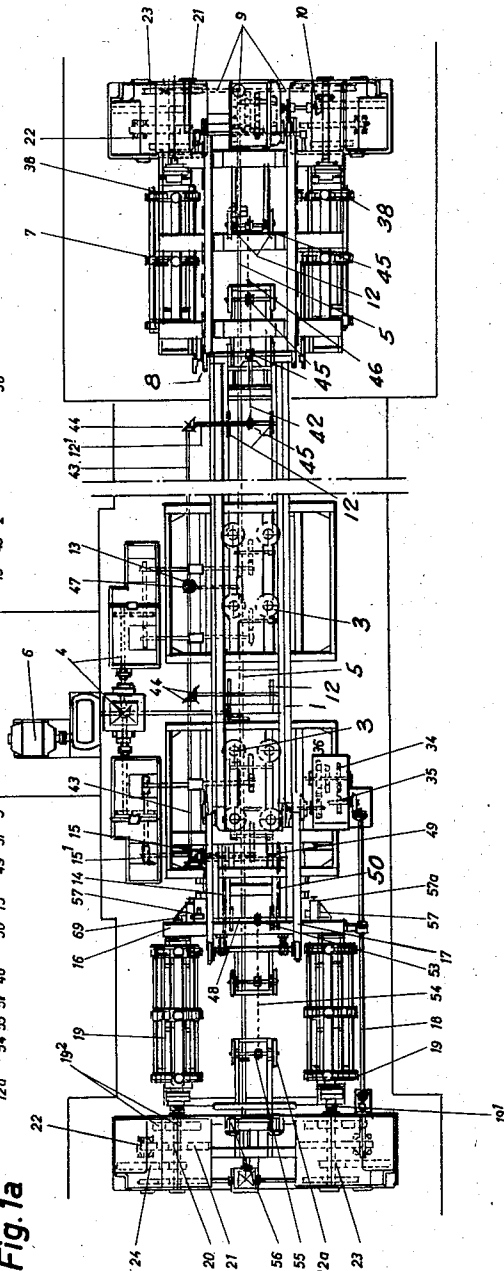


Fig. 1a



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6 Sheets-Sheet 2

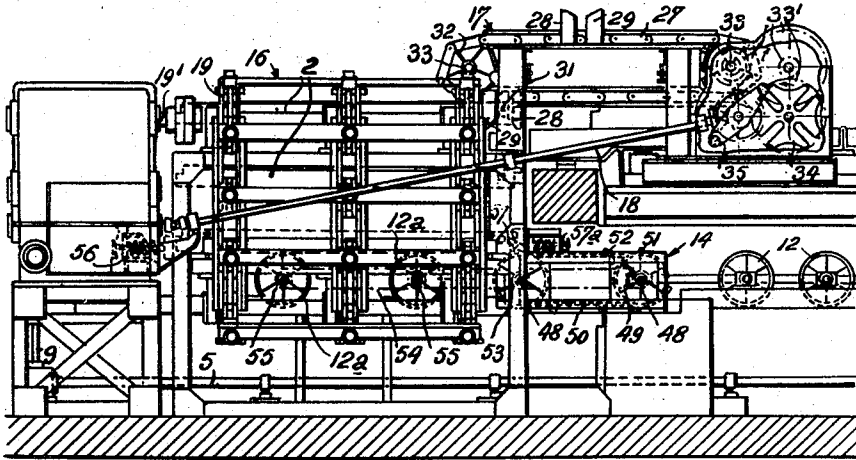


Fig. 2

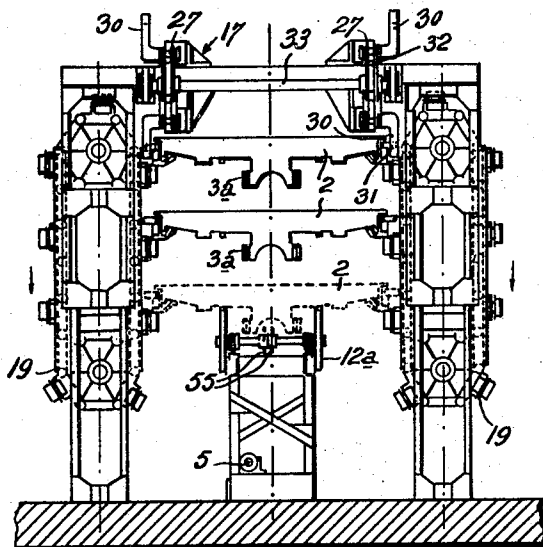


Fig. 3

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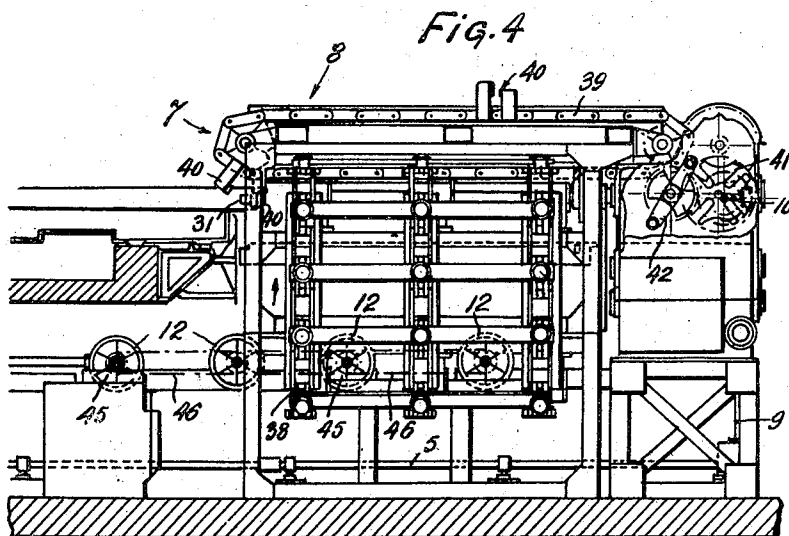
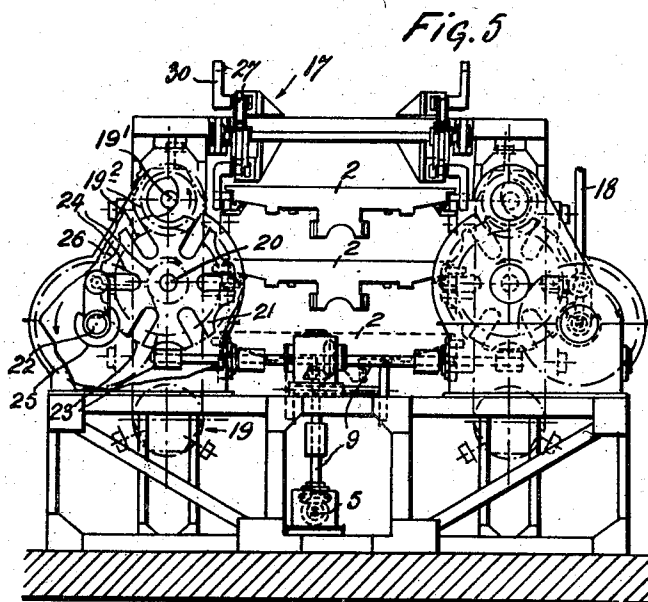
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PLANTS FOR GRINDING AND POLISHING FLAT GLASS

Filed July 25, 1955

6 Sheets-Sheet 3



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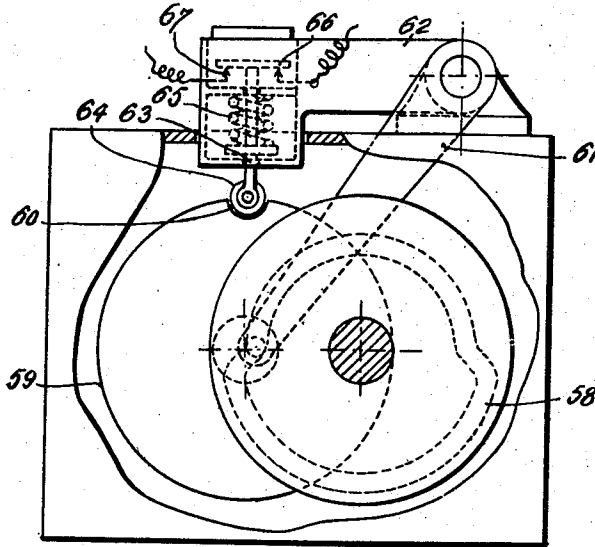
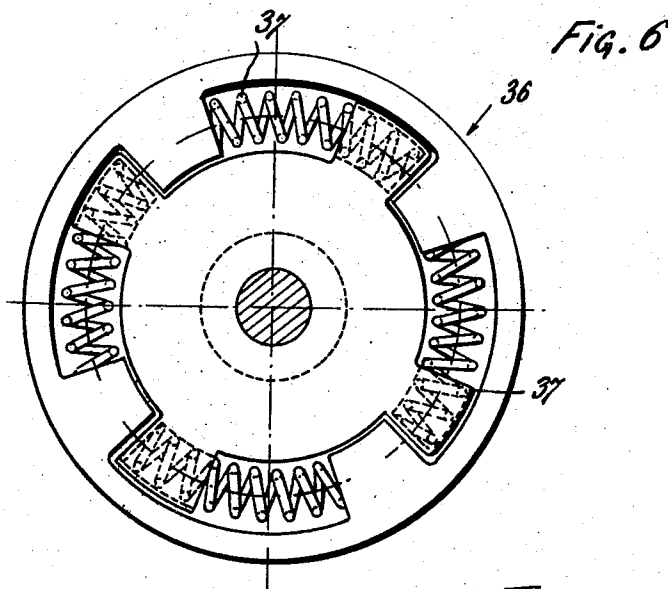
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PLANTS FOR GRINDING AND POLISHING FLAT GLASS

Filed July 25, 1955

6 Sheets-Sheet 4

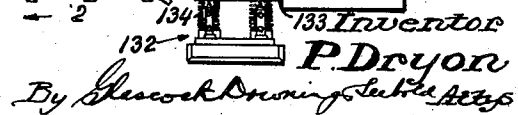


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PLANTS FOR GRINDING AND POLISHING FLAT GLASS

Filed July 25, 1955

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Fig. 8

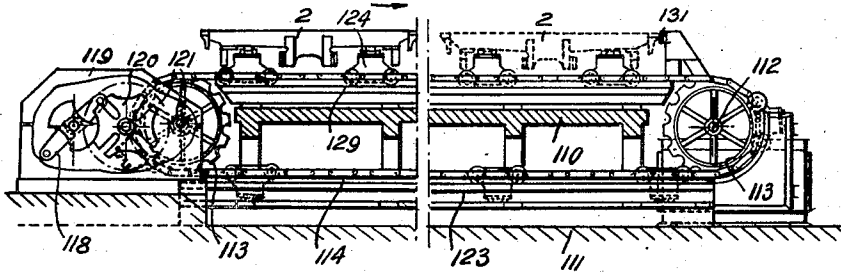


Fig. 9

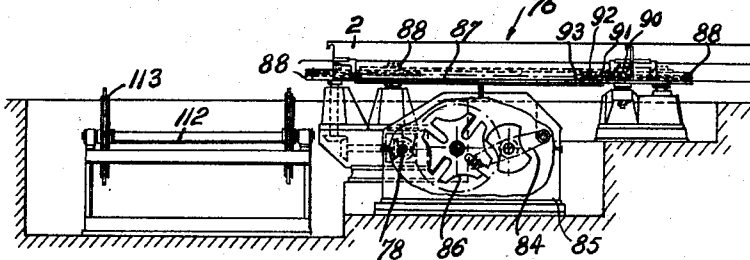
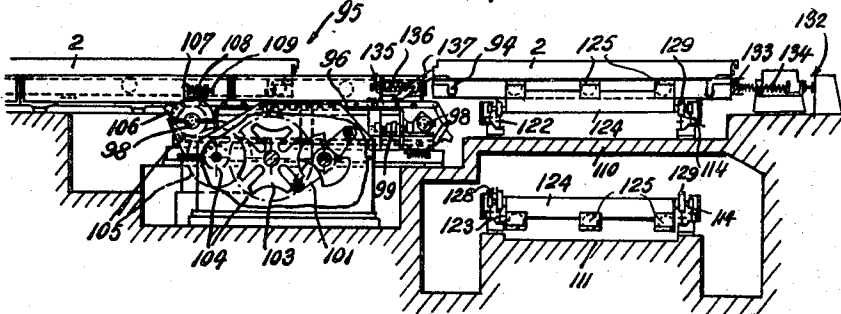


Fig. 10



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PLANTS FOR GRINDING AND POLISHING FLAT GLASS

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Application July 25, 1955, Serial No. 524,182

Claims priority, application Belgium August 12, 1954

15 Claims. (Cl. 51—110)

This invention relates to the grinding and polishing of flat glass and concerns the plants used for this purpose of the type comprising tables or supports on which the glass sheets or plate-glass are sealed and which are carried along a path hereafter called working path, then passed from this working path to a path arranged in parallel relation therewith and hereafter called return path on which the tables or supports are caused to move in a direction opposite to that of their travel on the working path, and ultimately, at the end of the return path, again passed to the beginning of the working path for repeating the aforesaid cycle.

The working and return paths may be located at substantially the same level in which case the movements of the tables or supports are effected in a substantially horizontal plane or these paths may be located at different levels, and particularly one above the other, in which case the tables or supports are lowered from the working path to the return path and raised from the return path to the working path.

Plants of the kind aforesaid are known per se and in operation it is essential that the tables or supports should occupy very accurately the required locations on the working and return paths to be carried along these paths and to be transferred from one path to the other.

In the known arrangements, the transfers or passages of the tables or supports from one to the other of the said paths is effected in a single movement at a substantially uniform speed and thence, owing among other of the inertia of the moving bodies, the permitted travelling speeds are limited, while due to the improvements in the processes of treating glass these speeds should require to be increased. The result is after all a loss of efficiency of these plants.

The invention mainly aims to remedy this disadvantage and to provide, together with an increase in the travelling speeds of tables or supports, a peculiar accuracy of the transfer movements with the result of a markedly improved rate of efficiency of the plants.

To secure this result according to one feature of the invention, instead that the passage of the tables or supports from one to the other of the said paths be effected in one single continuous movement, the transfers are performed in a series of successive elementary movements and each of such movements comprises an initial acceleration period and a final deceleration period and may be preceded (or followed) by a period of rest; use is made of the periods of slow or reduced and, or zero speed of the elementary movements for causing another table or support to partake to each of said transfers and thus carry it from one path to the other as well as to move a table or support which has reached one of the said paths away from the location in which it has been brought and cause said table or support to commence its travel on the working path or on the return path. Meantime the speed of "rotation" of the tables or supports is accelerated.

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According to another feature of the invention, a table or support which has completed its transfer movement to reach the working path, is carried away from the location in which it has been brought by means of an initially accelerated and subsequently slowed down motion timed with a period of slow or reduced and, or zero speed of the transfer movement, the last period of the said eloining motion being effected with the aid of a resilient force.

According to another feature of the invention, at the end of the travel on the working path, the carrying of a table or support which has to be brought to partake to a transfer movement comprises an initial period of acceleration and a final period of deceleration, the said carrying movement being timed with a period of slow or reduced and, or zero speed of the transfer movement.

According to yet another feature of the invention, a table or support which has completed its transfer movement from the working path to the return path and has reached the return path, is carried along this latter path, and the carrying motion of said table or support on said return path, just before the table or support is caused to partake to the transfer movement returning it to the working path, is time controlled, particularly by regularising the speed thereof so as to ensure an exact coordination with a period of slow or reduced and, or zero speed of an elementary movement of the transfer motion.

Alternatively, the carrying motion just referred to may comprise an initial period of acceleration and a final period of deceleration.

According to another alternative, the tables or supports may be conducted on the return path substantially in the same manner they are conducted on the working path, in which case the return path may be used also as a working path or as an extension of the working path as will appear later.

According to a preferred embodiment, the various movements which include acceleration and deceleration periods are controlled by means of Maltese cross mechanisms or similar mechanisms. Moreover, the movements of the various devices or elements of the plant are coordinated or timed, particularly all derived from those of a common driving motor shaft.

Other particulars and advantages of the invention will appear from the following more detailed description, illustrated in the annexed drawings, of two plants for grinding and polishing flat glass having the invention applied, it being understood that said description and illustration are by way of example only and that the operations and the apparatus or devices of the grinding and polishing treatment are not part of the invention and for this reason have not been described or illustrated.

In the drawings:

Fig. 1 is a diagrammatical, elevation view of a plant according to the invention wherein the working and return paths are situated at different levels, particularly one above the other, the tables or supports being transferred from one path to the other by means of elevators, i.e. raising and lowering apparatus;

Fig. 1a is a plan view corresponding to Fig. 1;

Fig. 2 shows in elevation at an enlarged scale the raising apparatus and the adjacent parts and devices of the said plant;

Fig. 3 is an elevation view, at right angles with respect to Fig. 2, of the raising apparatus;

Fig. 4 shows similarly to Fig. 2 the lowering apparatus and the adjacent parts and devices of the plant;

Fig. 5 shows diagrammatically the driving gears for the raising apparatus and the device carrying the tables or supports away from the raising apparatus;

Fig. 6 is a detail view of another element of this device;

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Fig. 7 shows diagrammatically a plant according to the invention wherein the working and return paths are arranged substantially at the same level;

Fig. 8 is an elevation and sectional view of a transfer device of the plant in accordance with Fig. 7, the figure showing also a part of the driving gear for said device;

Fig. 9 shows in elevation with parts in section, the driving gear for a device moving a table or support away from a location in which it has been brought by a transfer device on either of the working or return path;

Fig. 10 shows in elevation a device for carrying a table or support from the end of a working (or return) path to a transfer device, the figure showing also in elevation with parts in section, the driving gear for the carrying device;

Fig. 11 shows a control device.

Referring first to Figs. 1 and 1a, 1 designates a guide or frame on which the tables 2 are circulated on the working level, these tables pushing one another in the direction of the arrow *f* and being carried by the tables brought to the said level, and moved on a distance on the guide or frame 1 by means of a rack and pinion driving mechanism 3 of known type, the said pinions being actuated by means of shafts 4 receiving their movement from a general driving shaft 5 driven by means of a suitable motor such as the electric motor 6.

At the end of the guide or frame 1, the treatment of the glass sheets supported on the tables 2 is completed, and these tables are brought to a lowering apparatus 7, to be described later, by means of a mechanism 8, also to be described later, which moves the table nearest to the lowering apparatus apart from the other tables to introduce it in this apparatus.

The drives for the lowering apparatus and the mechanism 8 are taken from the shaft 5 and comprise the driving shafts 9 and 10.

By the operation of the lowering apparatus, the tables 2 are transferred to a lower level, to join a return path 11 onto which they are moved by means of rolls 12 actuated by shafts 12¹ the drive of which is taken from the general driving shaft 5.

The rolls 12 bring the tables 2 to an advance control mechanism 14 therefor, also driven from the shaft 5 through a driving shaft 15, for their engagement in a raising apparatus 16 driven by the shaft 5, lifting the tables 2 to the working level.

At this level, the tables are carried away from the raising apparatus by a mechanism 17 driven by means of a shaft 18 taking its drive from the raising apparatus 16 and thus also from the shaft 5.

The arrangements of the mechanisms 14 and 17 and the raising apparatus 16 will be described later.

The mechanism 17 which moves the tables 2 away from the raising apparatus brings these tables in the field of action of the driving pinions 3 to cause said tables to perform again the described cycle of operations.

With particular reference to the Figs. 2, 3 and 5, the raising apparatus 16 comprises two systems of stud-chains 19, or the equivalent thereof, operated in timed relation in the direction of the arrows in order to engage the tables 2 through their opposite edges and thus ensure the lifting thereof.

The movement is communicated to the systems 19 by means of the shafts 19¹ driven through the toothed wheels 19² from the shafts 20 on which are secured Maltese cross 21 or equivalent members actuated by crankshafts 22 rotated from the shaft 5 by means of the wormwheel mechanism 23 and the toothed wheels 24.

Owing to this arrangement, the system 19 receives a succession of movements each of which comprises a period of acceleration, and a period of deceleration, which may be separated by a period of rest as in the example, said period of rest being controlled by the cams 25 on the crank shafts 22 coming into engagement with the parts 26 suitably shaped for the purpose on the Maltese cross 21.

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The Maltese cross 21 comprises a number of arms which is equal or is a multiple of the number of stairs of the raising apparatus 16, that is the number of places for one table, the tables thus being brought one at a time to the working level by a series of movements each of which is progressively slowed down to zero speed, the following rest period of the systems 19 enabling the table having reached the working level to be carried away from the raising apparatus with the aid of the mechanism 17 now to be described.

Before such description it should be pointed out that rest periods between the successive movements of the systems 19 are not in fact compulsory, it being sufficient that the speed of movement of these systems 19 should be sufficiently reduced during a sufficient period of time to enable the tables 2 to be moved away from the raising apparatus. Such a result may always be obtained in a Maltese cross mechanism or a similar mechanism by suitably proportioning the elements thereof.

This mechanism 17 for carrying the tables 2 away from the raising apparatus 16 comprises one, but preferably two associated chains 27 the successive links of which carry the complementary elements 28 and 29 of a tong 30 to engage with one or two lateral pegs or protrusions 31 on the end section of the tables 2. Fig. 2 shows clearly how a peg or protrusion 31 is engaged by the elements 28 and 29 of the tong 30 at one end of the mechanism 17; it is released by reverse movements of these elements at the other end of said mechanism.

The chains 27 are supported by sprocket wheels 32 on shafts 33 one of which is driven by means of the toothed wheels 33¹ and a Maltese cross 34 driven by the crank 35 actuated by the shaft 18 which as shown in the drawings is coupled with a shaft forming part of the drive for the raising apparatus 16, the arrangement being such that to a period of reduced speed and as the case may be of rest of the raising apparatus corresponds a period of movement and thus of table carrying operation of the mechanism 17, the chain or chains 27 being slowed down, and in the example brought to zero speed, during the periods of motion of the raising apparatus (Figs. 1a, 2, 5).

Fig. 1a shows that in the drive is inserted a resilient coupling 36 illustrated in detail in Fig. 6, the springs 37 of which are adapted to be compressed while the chain or chains 27 move a table 2, the arrangement being such, as will be observed from the drawings, that before the positive carrying action of the chains 27 ceases on the table 2 which has just been moved away from the raising apparatus, said table has joined the tables carried on the guide 1 and is just on the point to have its racks 3a engaged by the pinions 3. The springs 37 which have been compressed expand at this moment, causing the aforesaid engagement, the table being thence conducted through the pinions 3 and pushing the other tables on the guide 1 so as to move the entire series of said tables towards the lowering apparatus 7 at the other end of the guide.

With reference to Fig. 4, the lowering apparatus 7 which is similar to the raising apparatus already described also comprises two systems of stud-chains 38 or the equivalent thereof, actuated in timed relation in the direction of the arrows so as to receive and support the tables 2 through the opposite edges thereof and to ensure the lowering of these tables to the lower level.

The drive for the chain systems of the lowering apparatus is similar to that of the chain systems of the raising apparatus 16 except as to the reversal of the direction of movement, that is it also comprises Maltese cross such as 21 actuated by means of crankshafts such as 22 rotated from the shaft 5 through the counter shaft 9 and the intermediary of a wormwheel mechanism and toothed wheels. Owing to the similarity with the driving gear for the raising apparatus, the drive of the lowering apparatus will not be described in detail.

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The tables 2 are introduced in the lowering apparatus by means of a mechanism 8 the construction of which is similar to that of mechanism 17 and which similarly comprises one chain or associated chains 39, successive links of which are provided with tong elements 40 engaging the peg or protrusion or protrusions 31 on the table to be introduced in the lowering apparatus 7 and accelerating this table to move said table away from the succeeding tables and to carry it on the lowering apparatus during the appropriate time interval of the operation of said lowering apparatus.

To this end the mechanism 8 is actuated from the driving gear for the said lowering apparatus, through the intermediary of a Maltese cross 41 driven by means of a crank 42 on a shaft 10 of such driving gear, in a manner similar to what has been described in relation with the driving of the eloining mechanism of the tables 2 which is associated with the raising apparatus.

The operation of the lowering apparatus brings the tables 2 successively on a train of rollers 12 ensuring the translation of the tables on the lower level towards the raising apparatus in a reverse direction to that of travel of the tables at the working level.

To this end, rollers appropriately supported in the frame by suitable trunnions are simultaneously rotated by means of a driving shaft 43 and the intermediary of bevelled pinions 44 with the exception of the rollers 12 located immediately underneath the lowering apparatus and some of the next rollers which are driven from one of the rotated rollers by means of sprocket wheels 45 and a chain or chains 46. As already indicated the actuation of the rollers 12 is obtained from the shaft 5 by means of one or more shafts 13 connected to the shaft 43 by bevelled pinions devices 47 (Fig. 1a).

It will be observed that the tables being delivered by the lowering device to the roller conveyor 12 as fast as they are brought to the working level by the raising apparatus an appropriate coordination of the speed of the rollers 12 enables the tables to be brought into the raising apparatus, in a suitable position and at the appropriate moment for being taken up by the systems of stud-chains 19 and raised from the lower level to the working level. Thus the system of rollers 12 arranged and operated as aforesaid could be simply extended to and within the raising apparatus 16. Preferably however, the part of the roller conveyor immediately preceding the raising apparatus 16 and extending into the latter is arranged to provide for a positive carrying of the tables thus making sure that the introduction in the raising apparatus shall take place within the required time interval, particularly the periods of reduced speed and, or of rest of the systems 19.

To this end, shafts 48 have been provided each having one but preferably two sprocket wheels 49 on which are arranged chains 50 bearing yieldable pawls 51, for example counter-weighted pawls movably mounted on the connecting pivots 52 of the links of the chains 50, one at least of the said shafts 48 being driven at a predetermined speed either from the shaft 5 or, as illustrated, from the shaft 43 and in this latter case through the intermediary of a counter-shaft such as the shaft 15 and suitable bevelled pinions 15'.

The chains 50 are so arranged that the tables 2 carried by the preceding rollers 12 pass closely thereover or rest thereon, and the number of pawls 51 is such that should the speed of any one of the tables which has been brought by the preceding rollers 12 be lower than that of the chains 50 and thus that a relative or sliding movement will occur between these chains and said table, the pawls which follow immediately the rear edge of the table engage the latter and cause the table to acquire the speed of the chains and to enter the raising apparatus 16 during the desired interval of time.

Moreover, one of the shafts 48 may comprise a sprocket wheel 53 connected by means of a chain 54 to one or

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several similar pinions 55 mounted on a supporting shaft or shafts bearing the rollers 12a arranged in the lower part of the raising apparatus 16.

In this manner the tables are positively carried, within the required period of time, in the location from which they will be taken up again and raised by the systems 19 of the raising apparatus.

To ensure in any case the correct positioning of the tables in the raising apparatus 16, this apparatus may be provided with devices suitable for the purpose, particularly, as illustrated, with buffers, preferably spring buffers as shown at 56, as well as with an antagonist stop pawl such as the spring actuated pawl shown at 57.

Assuming that for any reason, for example a slight advance in time of its introducing movement, a table has been moved beyond the desired location enabling it to be correctly taken up by the systems 19, the spring of the device 56 against which the table has been urged will be compressed until the table has been stopped and will then expand to return said table to the prescribed position.

Should this return movement carry the table beyond the said position, it will engage the pawl 57 which either will retain the table in the correct position or will yield resiliently and then push slightly the table backwardly to cause it to take said prescribed position. The springs of the devices 56 and 57 are devised for the purpose and may be made adjustable by known means, as by means of screw or the like as shown at 57a for the pawl 57.

Again, when in the plant just described, the accurate synchronizing of two devices or apparatus is required, as for example that of the raising apparatus and the device for moving the tables away therefrom, or that of the lowering apparatus and the device for leading or introducing the tables to said apparatus, suitable devices for the purpose may be provided the action of which will be, for example, the cutting off of the supply to the driving motor should a defect occur in the timing relation or synchronizing. A suitable control device has been illustrated in Fig. 11.

Such control device comprises a cam 58 mounted on a shaft the rotating motion of which is made dependent from the movement of the apparatus or device from which is obtained the drive for the synchronized apparatus or device, such as the raising apparatus or the lowering apparatus, and a disc 59 provided with a peripheral notch 60 and mounted on a rotating shaft the rotating movement of which is subjected to the movement of the synchronized apparatus or device. To this assembly is associated an oscillatable cranked lever one arm 61 of which is led by the cam while its other arm 62 is provided with a movable member adapted to cooperate with the peripheral edge of the disc 59 and the notch therein. This movable member may be a shaft 63 having a roller 64 and urged by a spring 65. The shaft 63 may be further provided with an element 66 of a switch or relay the cooperating element 67 of which is mounted in a fixed position on the arm 62, the elements 66 and 67 being inserted in the supply circuit for the driving motor. The raising apparatus having to operate while the device for carrying the tables away therefrom is stopped, and vice-versa, or the lowering apparatus having to operate while the device leading the tables thereto is stopped, and vice versa, it is necessary but sufficient that the necessary motion period of the synchronized device or apparatus corresponds with a complete rotation of the disc 59 and that during said period the cam 58 operates the cranked lever so as to move the arm 62 away from the peripheral edge of the disc 59 and the roller 64 clear of the notch while permitting the roll to engage the notch during the standstill period of the synchronized device or apparatus.

Under such conditions, should a synchronizing defect occurs, the roller 64 will no longer coincide with the notch 60 at the proper moment and the said roller en-

countering the peripheral edge of the disc 59 will move the member 63 so as to operate the switch or relay to cut off the motor supply and stop the operation of the plant.

Naturally such a control device could be adapted to different operating conditions or be replaced by other devices answering the desired purpose.

In the plant illustrated in the Figs. 7 to 10, the working path 68 and return path 69 are arranged at the same level, and the tables are transferred from the one to the other path by means of transfer devices 70 and 71, the tables travelling along the working path 68, then being led from the working path to the return path by the transfer device 70, then travelling along the return path 69 and being finally returned to the working path by the other transfer device 71 to repeat the same cycle of operations.

In this example, the paths 68 and 69 are similar and the tables 2 are led similarly on each of them; the transfer devices are also similar and the tables 2 are transferred similarly by the one and the other.

Consequently, in the following one of the said paths and one of said transfer device only, will be described together with their respective equipments.

The path 68 comprises parallel guides 72 braced with transverse members 73 and resting on a frame or base member, the guides 72 being preferably provided at their ends with supporting rollers 74 for the tables which facilitate the travelling thereof.

At a distance from its inlet end, the path 68 is provided with toothed pinions 3 for carrying the tables, said pinions being driven in the same manner as in the preceding example, that is from a general driving shaft 5 actuated by a suitable motor such as the electric motor 6.

At its inlet end, the path 68 is provided with a mechanism adapted to move the tables away from the transfer device 71, this mechanism being formed with the two devices 76 and 77 described hereafter, the movements of which are suitably timed and controlled by means of a shaft 78 driven from the shaft 5 through the intermediary of the speed reducing devices 5a, shaft 79, bevel gear 80, shaft 81, bevel gear 82, shaft 83 and the crank 84 accommodated in the casing 85 and actuating therein a Maltese cross 86 the shaft of which is coupled with the shaft 78 by means of suitable toothed wheels.

The device 76 comprises a chain 87 passing over sprocket wheels 88 of which one at least is driven by the said shaft 78 and another may be urged by a tightening device 89. Successive links of the chain 87 are provided with the complementary elements 90 and 91 of a tong, of which the element 90 forms a rigid abutment and the element 91 a resilient abutment, including a spring 92 the tension of which may be adjusted by means of an appropriate screw operated element 93. The device 77 is constructed similarly to the device 76 except that it is not provided with the rigid abutment 90 of the tongs 90—91.

The arrangement is such that when the table 2, led in the appropriate position by the transfer device 71 has to be engaged on the working path, the devices 76 and 77 are operated, the device 76 closing one of its tongs on one of the pegs or protrusions 94 provided at the lower part of the table 2 and carrying the latter forwardly on the working path 68, the element 91 of the device 77 next coming into engagement with the inner surface of the protrusion 94 on the opposite side of the table and thus assisting the carrying thereof. Therefore this table will be brought nearer to the series of tables 2 already carried by the pinions 3 until it contacts with the last table of the series, such a contact occurring just before the racks on the table carried by the devices 76 and 77 will enter the field of action of the said pinions 3. At this moment the springs 92 of the resilient abutments 91 are compressed and retain the table in contact with the preceding tables until the racks thereon are engaged by the pinions 3, while the devices 76 and 77

cease to be operated and the tong 90—91 is opened to release the peg or protrusion 94.

At its other end, the path 68 is provided with a separating device 95, adapted to lead the tables from the path 68 onto the transfer device 70.

This device comprises one, but preferably two chains 96, passing over sprocket wheels 97 mounted on shafts 98 one of which is driven and the other may be urged by a tightening device 99. The driven shaft 98 is operated from the shaft 100 which takes its movement from the shaft 5 at the bevel gear 82, through the intermediary of a crank 101 accommodated in a casing 102 and actuating therein a Maltese cross 103 imparting its movement to the shaft 98 through suitable intermediate toothed wheel trains 104 and 105.

Successive links of the chains 96 are provided with the complementary elements 106 and 107 of tongs intended to cooperate with the pegs or protrusions 94 of the tables, the tong element 107 forming a movable abutment provided with a spring 108 the tension of which may be adjusted, for example by means of a screw device 109.

The arrangement is such that at the moment the device 95 is operated, the corresponding tongs 106—107 of the chains 96 are closed on pegs or protrusions 94 on the table and carry the latter positively towards the transfer device 70, spacing it away from the next tables carried by the pinions 3 on the path 68, and release the table by the opening movement of the said tongs at the moment said table has reached, on the transfer device, such a position as to enable it to be carried by said device towards the path 69.

As at the moment the tongs close on the pegs or protrusions 94 of the table, the latter is still advanced by the pinions 3, it is possible that its speed of travel be higher than the speed of the device 95 at this moment, in which case the springs 108 of the tongs may yield under the thrust of the table to progressively return thereafter to their initial position while the separating device carries the table at a higher speed in moving it away from the other tables. The transfer device 70 is formed with a base member comprising an upper support 110 and a lower support 111, at the ends of which are mounted shafts 112 provided with sprocket wheels 113 over which are passed endless chains 114.

One at least of the shafts 112 is rotated from the shaft 79 taking its movement from the shaft 5, and through the intermediary of the bevel gear 115, shaft 116 and toothed wheel train 117, by means of a crank 118 actuating in a casing 119 a Maltese cross 120 coupled to the said shaft 112 by means of suitable toothed wheels 121.

On the support 110 are arranged guides or rails 122 and on the support 111 are arranged guides or rails 123. On the other hand, to the chains 114 are secured cross members 124 each of which has two but preferably three rollers 125 which, as shown, are slidably mounted on their axis 126 and retained in position by means of springs 127. To the roller-mountings 128 of the ends of the cross members 124 are associated rollers 129 adapted to move on the guides 122 and on the guides 123. The Figures 8 and 10 show the manner in which the tables 2 are supported by the cross members 124, and the manner in which the latter are supported by the rollers and guides while they are moved by the chains in the direction of the arrows. At the arrival end of the upper path an abutment 131 may be provided, arranged at the table level, and preventing any excess movement thereof, if need be while compressing the springs 127. At the other end of this upper path an abutment device 132 may be provided opposite the path 68 and intended to ensure the correct positioning of the tables on the transfer device 70. Said abutment device may comprise a cross member 133 urged by springs 134 the tension of which is adjustable, cooperating with

an edge of the table and, on the other hand, in addition (Fig. 10), at least one antagonist abutment 135, urged by an adjustable spring 136 and cooperating by means of a pivoted pawl 137 with the opposite edge of the tables. Examination of the Fig. 10 shows that on the arrival of a table on the transfer device, the forward edge of the table will engage the cross member 133, any movement beyond the correct position causing the springs 134 to become compressed and the return of the table by the expansion of these springs, the movement beyond the said position, in the other direction, being prevented by the pawl 137 and the associated spring 136 which may itself react to restore the correctness of the position of the table.

As it results from the explanations already given in relation with the Figs. 1 to 6, the Maltese cross drive of the devices 70—71, and 76—77 and 95 of each of the paths 68, 69 has the result that in each of them the movement begins with a period of acceleration and terminates with a period of deceleration, the general co-ordination being such that on a period of reduced speed or zero speed of the transfer devices corresponds a period of motion of the devices associated with the paths 68, 69, and vice versa.

As in the example of the Figs. 1 to 6, the coordination of the movements of the various devices may be further controlled, for example by means of devices of the kind described with reference to Fig. 11, so as to cut off the driving motor 6 whenever for any reason a defect occurs in the said coordination. Moreover, the so called return path being exactly the same as the so called working path it may, where necessary, form a second working path or an extension of this path. Naturally however the return path could be constructed and arranged differently from the one described, particularly in the same manner as in the example of the Figs. 1 to 6.

Naturally also the described constructions of the various devices and apparatus of the invention are by way of example and not limitative, and modifications could be made therein without exceeding the limits of the invention. Thus in the example of the Figs. 1 to 6, for engaging the tables in the raising apparatus 16, the roller conveyor 12 could be arranged to retain at the entrance to the raising apparatus several tables in waiting position and resting on free rotating rollers, the table adjacent to the raising apparatus only being operated by means of a device such as described or a device similar to the device moving the tables away from the raising apparatus or to the device leading the tables into the lowering apparatus. Again in the arrangement according to Figs. 7 to 10 two driving motors 6 could be coupled to the shaft 5 and other driving gears, thus permitting to reduce the importance of these elements, these motors then being synchronized by known means.

I claim:

1. An apparatus for grinding and polishing flat glass comprising tables for supporting glass plates, two spaced parallel tracks for supporting said tables and means for moving the tables along said tracks, glass grinding and polishing tool means arranged along at least one of said parallel tracks, transfer apparatus for passing the tables successively from one of the parallel tracks to another, said transfer apparatus including a pair of co-operating transfer devices at each end of the parallel tracks, the respective paths of said pairs of transfer devices being disposed at substantially right angles to each other, one of said transfer devices of each pair including table supporting means extending transversely to the parallel tracks, and means operatively associated with said transfer devices whereby each execute a controlled accelerated-decelerated transfer movement, the accelerated phase of movement of one of the transfer devices of the same pair corresponding to the decelerated phase of movement of the other transfer device of such pair, with such co-

responding accelerated-decelerated and decelerated-accelerated movements of each pair of transfer devices being directed at substantially right angles respecting each other.

2. An apparatus as in claim 1 wherein the last named means include a Maltese cross mechanism.

3. An apparatus as in claim 1 wherein one of said transfer devices comprise members running continuously in the same direction, and means for imparting to said members a periodically variable speed including an initial period of increasing speed and a final period of decreasing speed.

4. An apparatus as in claim 1 wherein the last named means include a common driving mechanism.

5. An apparatus as in claim 1 wherein the transfer devices comprise at least one movable endless chain, sprocket wheels and sprocket wheel shafts for supporting said endless chain, complementary tong elements on adjacent links of the chain adapted to move towards and away from each other upon operation of the chain, table carrying means on the tables to be moved for cooperation with said tong elements, and driving connections including a Maltese cross mechanism between the driving means for the transfer devices and one of the said sprocket wheel shafts for operating said endless chain.

6. An apparatus as in claim 1 wherein the transfer devices comprise at least one movable endless chain, complementary tong elements on adjacent links of the chain for intermittent cooperation with table carrying means on the tables to be moved, means for supporting and operating said endless chain, driving connections between the associated means for the transfer devices and said operating means, and a spring coupling device in the said driving connections.

7. An apparatus as in claim 1 wherein the transfer devices comprise at least one moved endless chain, means for supporting and moving said endless chain, complementary tong elements on adjacent links of the chain adapted to move towards and away from each other upon operation of the chain, table carrying means on the table to be moved for cooperation with said tong elements to cause the table to be moved with the chain upon movement of the tong elements towards each other and spring actuated abutment means associated with the tong elements adapted to cooperate with the table carrying means and to cause further movement of the table upon movement of the tong elements away from each other.

8. An apparatus for grinding and polishing flat glass comprising tables for supporting glass plates, two parallel vertically spaced tracks for supporting said tables at two different levels and means for moving said tables along said tracks, glass grinding and polishing tool means arranged along at least one of said parallel tracks, transfer apparatus for passing the tables successively from one to the other of the said parallel tracks at each end of the tracks, said transfer apparatus including table supporting means comprising a pair of cooperating endless members movable in a generally vertical direction and supporting means for said endless members, driving means to impart a step by step translation movement to each of the endless members, each step representing a fraction only of the distance between the said parallel tracks and comprising a period of faster speed and a period of slower speed, thereby moving said tables in translation from one level to the other with alternate periods of faster and slower speed, conveying devices arranged at substantially right angles to the table supporting means including endless members adapted to run continuously in the same direction and operable for moving tables away and towards said transfer apparatus associated with at least one of the said parallel tracks, means operable for periodically actuating said conveying devices with a variable speed including an initial period

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of increasing speed and a final period of decreasing speed and means to operate the last named means during a period of slower speed of the table supporting means of the corresponding transfer apparatus.

9. An apparatus as in claim 8 comprising rotatable driving means for operating the said endless members and the said conveying devices, operable connections including a Maltese cross mechanism between said rotatable driving means and said endless members, operable connections between said rotatable driving means and said conveying devices, said last named operable connections including a spring coupling device and a Maltese cross mechanism.

10. An apparatus as in claim 8 including roller conveying means for the tables comprising a series of spaced rollers extending from a transfer apparatus at one end of a parallel track to another transfer apparatus at the opposite end of the said parallel track and within said transfer apparatus, a common drive for all the said rollers, operative connections between said drive and the rollers located between the transfer apparatus and operative connections between rollers located between the transfer apparatus and the rollers located therein.

11. An apparatus as in claim 8 including roller conveying means for the tables comprising a series of spaced rollers extending from a transfer apparatus at one end of a parallel track to another transfer apparatus at the opposite end of said parallel track and within said transfer apparatus, a common drive for all the said rollers, a speed regulating device for the conveyed tables supported on the rollers within one of said transfer apparatus, said speed regulating device including at least one endless chain, yieldable pawls pivoted on the links of said chain, chain supporting and operating means, a drive for said operating means and control means for said drive, whereby to accurately positioning a table to be transferred in the said transfer apparatus.

12. An apparatus as in claim 8 including roller conveying means for the tables comprising a series of rollers extending from a transfer apparatus at one end of a parallel track to another transfer apparatus at the opposite end of said parallel track and within said transfer apparatus, a common drive for all the said rollers, a speed regulating device for the conveyed table supported on the rollers within one of the said transfer apparatus, and means for synchronizing the movements of the transfer apparatus, the said conveying devices and the said speed regulating device whereby to operate the said conveying devices and the said regulating device within periods of slower speed of movement of said transfer apparatus.

13. An apparatus for grinding and polishing flat glass comprising tables for supporting glass plates, two spaced parallel tracks for supporting said tables, glass grinding and polishing tool means associated with at least one of said parallel tracks, transfer apparatus for passing the tables successively from one to the other of said parallel tracks at each end of the tracks, said transfer apparatus including table supporting means comprising endless movable members running continuously in one direction and supporting members for said endless members, driving means to impart a step by step translation movement

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to said endless members, each step representing a fraction only of the distance between said parallel tracks and comprising a period of faster speed and a period of slower speed, thereby moving said tables in translation from one track to the other with alternate periods of faster and slower speed, conveying devices arranged at substantially right angles to the table supporting means including endless members adapted to run continuously in the same direction and operable for moving tables away and towards said transfer apparatus associated with at least one of the said parallel tracks, means operable for periodically actuating said conveying devices with a variable speed including an initial period of increasing speed and a final period of decreasing speed, means to operate the last named means during a period of slower speed of the table supporting means of the transfer apparatus, and buffer means associated with the said transfer apparatus to correctly position therein the incoming table.

14. An apparatus for grinding and polishing flat glass comprising tables for supporting said glass plates, two parallel tracks for supporting said tables, means for conveying said tables along said parallel tracks, glass grinding and polishing tool means associated with at least one of said parallel tracks, transfer apparatus for passing the tables successively from one of the parallel tracks to the other at each end of the tracks, said transfer apparatus including table supporting means and table conveying means, said table conveying means including Maltese cross mechanisms to thereby move said tables step by step from one track to the other in a succession of translation movements each representing a fraction only of the distance between the tracks and each including a period of faster speed and a period of slower speed, conveying devices arranged at substantially right angles to the table supporting means for moving said tables away and towards said transfer apparatus, means for synchronizing the operation of the said conveying means and said conveying devices, including a common drive therefor, and synchronization controlling means including co-operating elements operable in timed relation with said conveying means and said conveying devices respectively for periodic coincidence with one another of parts thereof, and connection means between said synchronization controlling means and said common drive for cutting off said drive on failure of periodic coincidence.

15. An apparatus as in claim 14 including a rotating disc, a notch in the peripheral edge of said disc, a cooperating cam, means for urging the cooperating cam in engagement with the edge of said disc, a driving motor, supplying means for said driving motor, and switching means associated with the disc and cam device, and said supplying means.

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