Dec. 27, 1960 B. GUIGNARD 2,966,010

GRINDING MACHINE FOR ROUNDING OFF THE EDGE OF PLATES OR DISCS

Filed March 13, 1956 5 Sheets-Sheet 1

FIG.1

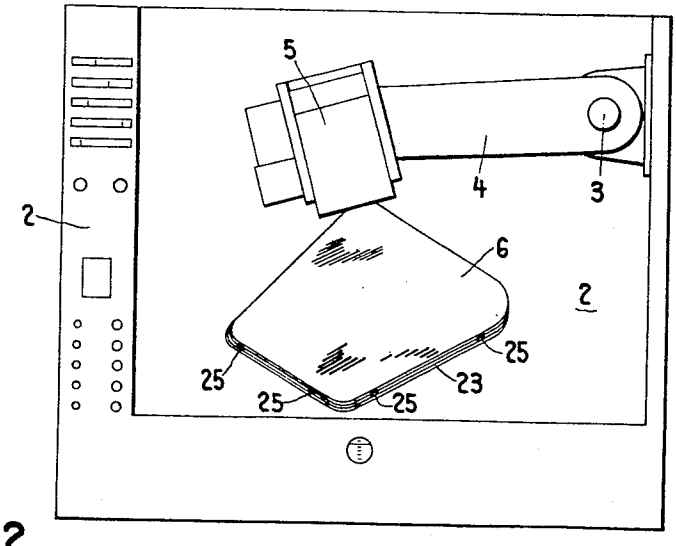
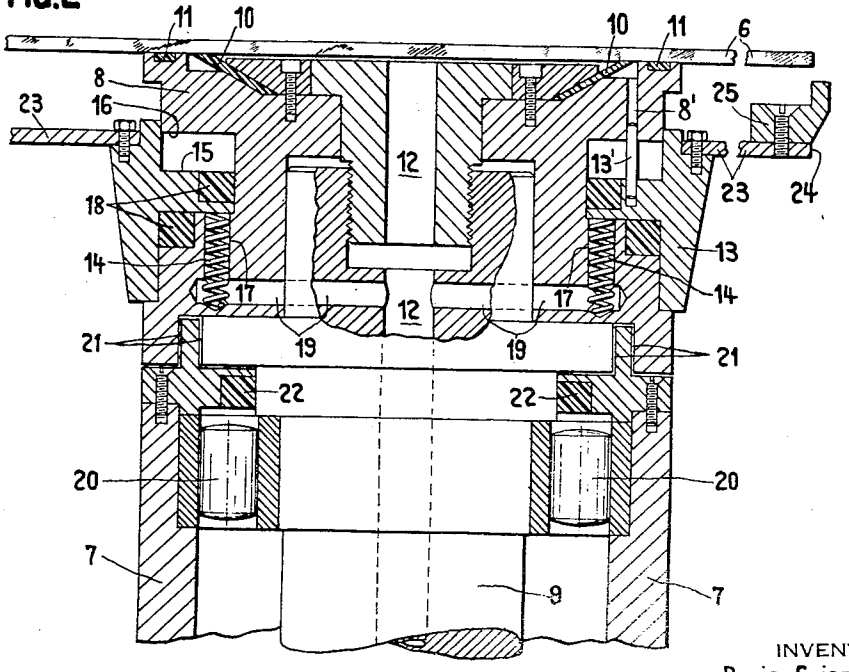


FIG.2



INVENTOR
Boris Guignard
BY
Edward V. Connors
ATTORNEY

Dec. 27, 1960 B. GUIGNARD 2,966,010

GRINDING MACHINE FOR ROUNDING OFF THE EDGE OF PLATES OR DISCS

Filed March 13, 1956

5 Sheets-Sheet 2

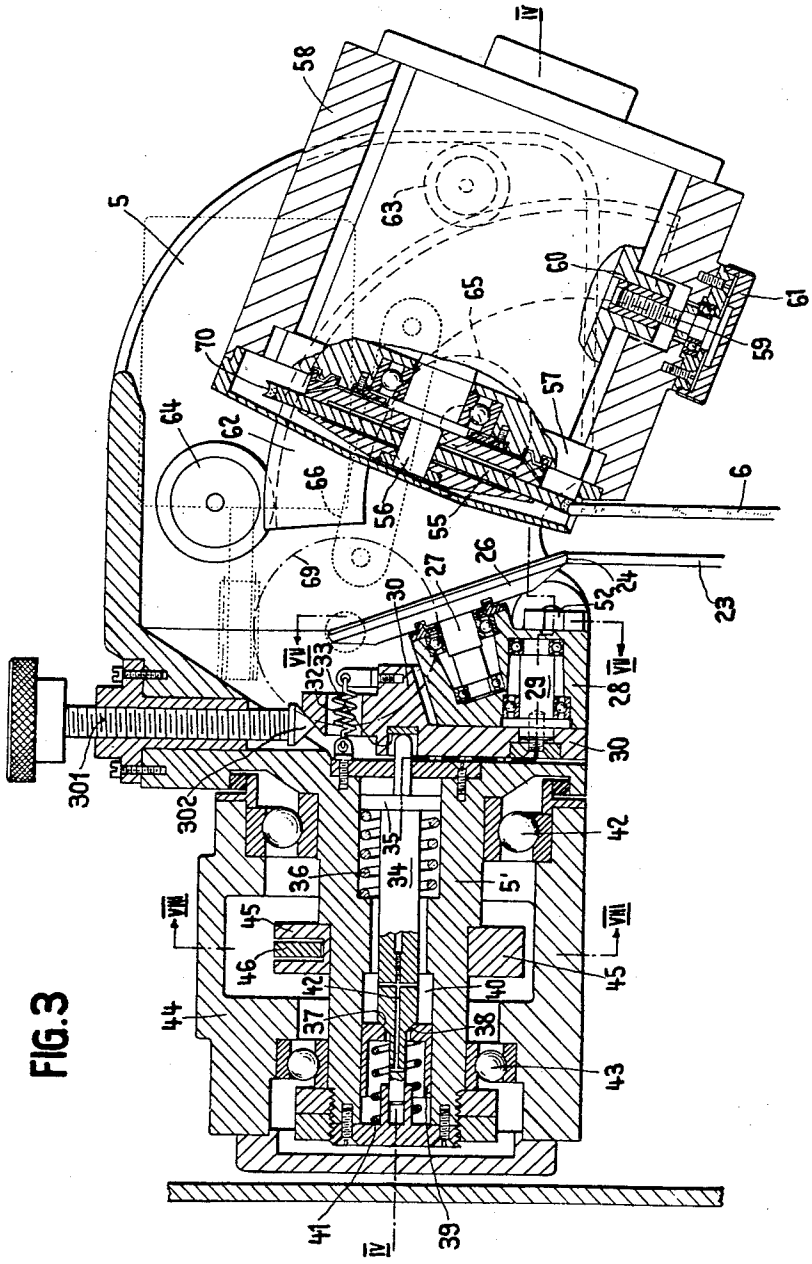


FIG.3

INVENTOR
Boris Guignard
BY Edward J. Connors
ATTORNEY

Dec. 27, 1960 B. GUIGNARD 2,966,010

GRINDING MACHINE FOR ROUNDING OFF THE EDGE OF PLATES OR DISCS

Filed March 13, 1956 5 Sheets-Sheet 3

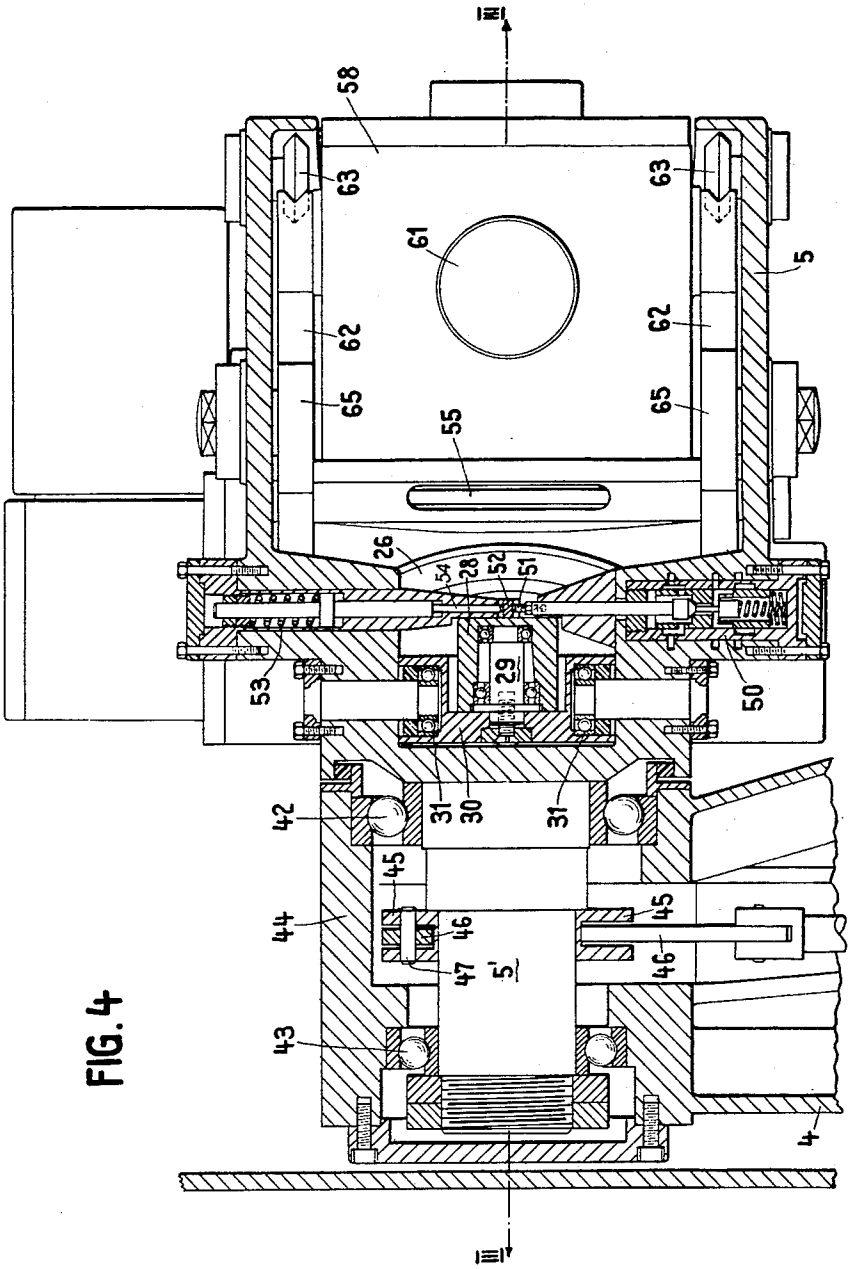


FIG. 4

INVENTOR
Boris Guignard
BY Edward T. Connors
ATTORNEY

Dec. 27, 1960 B. GUIGNARD 2,966,010

GRINDING MACHINE FOR ROUNDING OFF THE EDGE OF PLATES OR DISCS

Filed March 13, 1956 5 Sheets-Sheet 4

FIG.5

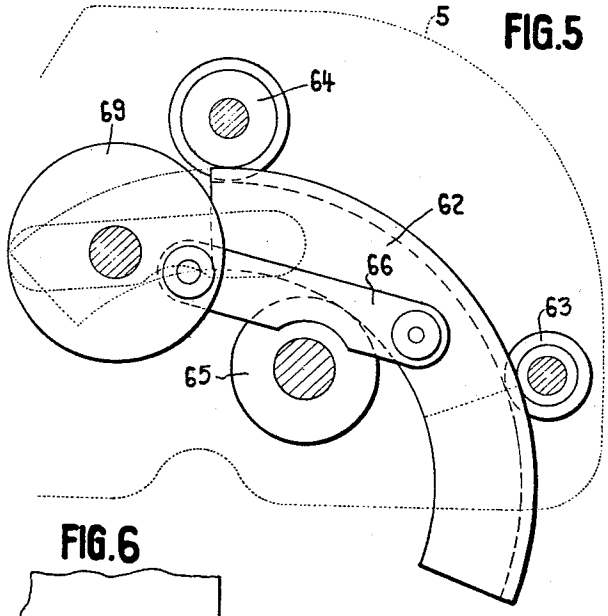


FIG.6

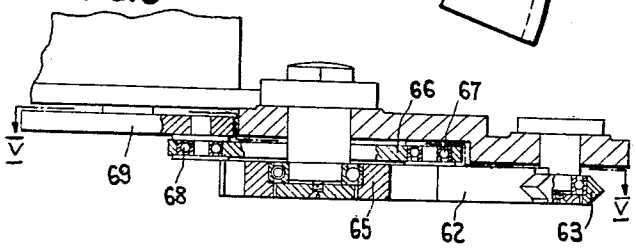
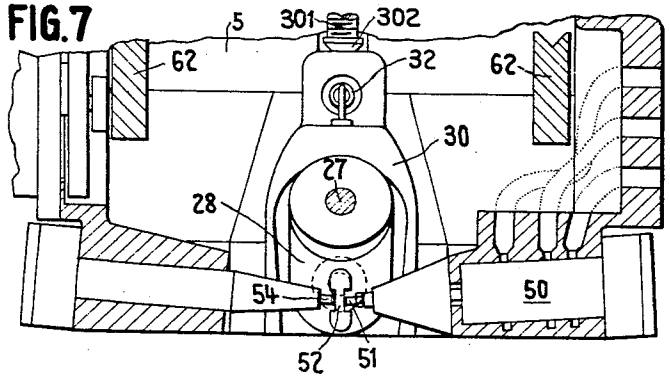


FIG.7



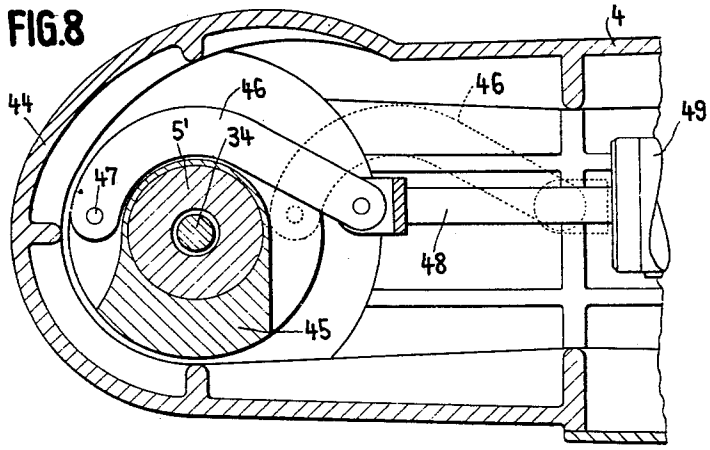
INVENTOR
Boris Guignard
BY Edward Connors
ATTORNEY

Dec. 27, 1960 B. GUIGNARD 2,966,010

GRINDING MACHINE FOR ROUNDING OFF THE EDGE OF PLATES OR DISCS

Filed March 13, 1956 5 Sheets-Sheet 5

FIG.8



INVENTOR
Boris Guignard
BY Edward V Connors
ATTORNEY

United States Patent Office 2,966,010 Patented Dec. 27, 1960

2,966,010

GRINDING MACHINE FOR ROUNDING OFF THE EDGE OF PLATES OR DISCS

Boris Guignard, Lucens, Switzerland, assignor to Ebauches S.A., Neuchatel, Switzerland

Filed Mar. 13, 1956, Ser. No. 571,249

Claims priority, application Switzerland Apr. 30, 1955

7 Claims. (Cl. 51—33)

This invention relates to a grinding machine for rounding off the edge of plates or discs, particularly of glass panes for automobiles and other vehicles, wherein a grinding disc is led along at least a portion of the edge of the plate for grinding the same.

In well known grinding processes of the above kind the cutting face of the grinding disc has a concave profile for producing the corresponding convex rounding on the edge of the plate. This grinding disc which is in the same plane as the plate to be worked for the whole grinding process grinds the desired rounding on the edge of the plate passed in front of the rotating grinding disc. It will, however, be appreciated that the roughly shaped plates have irregular and sharp edges and will therefore cause an irregular wear of the grinding disc so that the desired regular shape of the concave profile of the grinding disc will soon be destroyed. For this reason the grinding disc is to be trued after relatively short operating periods thereby causing relatively high operating costs and shortening of the operating time of the grinding machine because the grinding discs have to be replaced rather frequently.

It is a first object of this invention to avoid the above drawbacks of the well known grinding processes by imparting to the grinding disc an oscillating motion during the grinding operation in such a way that the angle of inclination between the plane of the grinding disc and the plane of the plate is continuously changed. Thereby more regular wear of the cutting surface of the grinding disc is obtained and deviations of the profile of the cutting surface of the grinding disc from the theoretically correct shape will not result in a corresponding deviation of the profile of the rounding produced on the plate. Therefore it is possible to use the grinding discs during appreciably longer periods without truing them than it was possible with the well known grinding machines having grinding discs rotating continuously in a fixed plane.

The quality of the worked edge of the plate may further be improved when, in accordance with this invention the grinding disc is continuously adjusted during the grinding operation in such a way that the working pressure of the grinding disc acts in a perpendicular direction to the tangent to the edge of the plate in the working place.

For a better understanding of the invention reference may be had to the attached drawing and to the following description of one embodiment of the invention.

Fig. 1 is a front view of the machine,

Fig. 2 is an axial section of the working table for the plate to be worked,

Fig. 3 is a section of the machine on the line III—III in Fig. 4,

Fig. 4 is a section of the machine on the line IV—IV in Fig. 3,

Fig. 5 is a section on the line V—V in Fig. 6,

Fig. 6 is a side view of the mechanism illustrated in Fig. 5 with several parts in section,

Fig. 7 is a section on the line VII—VII in Fig. 3, and Fig. 8 is a section on the line VIII—VIII in Fig. 3.

The grinding machine shown in front view in Fig. 1 has a machine frame 1 and a working recess 2 in which are provided a grinding head 5 mounted on an arm 4 pivoted at 3 and a working table for a plate 6 to be worked, for instance a glass pane for a vehicle or the like.

The working support for the plate 6 is shown in axial section in Fig. 2 and has a pivot coluun 7 fixed in the said working recess 2 of the machine, the working table 8 with its driving shaft 9 being pivoted in the pivot column 7. The working table 8 has a conical holding membrane 10 of resilient material, for instance rubber or the like and a supporting ring 11 of resilient material, for instance rubber. The working table 8 and its driving shaft 9 have an axial bore 12 this bore being connected in a well known manner not illustrated to a vacuum pump at the driven end of the shaft 9. By means of the vacuum pump the air enclosed between the holding membrane 10 and the plate 6 applied to the working table 8 may be pumped out through the bore 12 and a vacuum may be produced below the plate 6, by which the plate 6 is pressed against the edges of the membrane and against the supporting ring 11 and is fixedly held on the working table.

A model plate support 13 is mounted on the working table 8, the support 13 being axially displaceable but secured against rotation on the working table 8 by means of a pin 13' engaging a bore 8' of the working table 8. The support 13 may be held in an upper position by a number of compression springs 14, in which position the upper shoulder 15 of the support 13 abuts against a shoulder 16 of the working table 8. In this rest or zero position of the model plate support 13 a hollow space is formed on top of the bores 17 in which the compression springs 14 are inserted, the said hollow space being practically hermetically sealed by ring packings 18 provided between the model plate support 13 and the working table 8. Through the bores 17 and radial bores 19 of the working table 8 the said hollow space communicates with the axial bore 12 of the working table 8 and of its shaft 9 so that an underpressure is set up in the said hollow space between the model plate support 13 and the working table 8 whenever the vacuum pump is operated, whereby the model plate support 13 is pulled downwardly into the position illustrated in Fig. 2 against the action of springs 14. Since corrosive liquids are used as a grinding means access of such grinding means to the bearings 20 of the working table 8 and of its shaft 9 is prevented by a labyrinth gland 21 and a ring packing 22.

A model plate 23 is screwed to the model plate support 13, the edge 24 of this model plate 23 having similar shape as the plate 6 to be produced but may be of different size than the plate 6. Adjusting pieces 25 are fixed at suitable intervals along the edge of the model plate 23, the said adjusting pieces 25 engaging the edge of the plate 6 from outside when the model plate support 13 is in its upper position, that is when the grinding machine is in its rest position, for adjusting the position of the plate 6 to be worked. Thus, at the beginning of each working cycle a plate 6 is applied onto the working table 8 whereby its position is determined by the adjusting pieces 25, whereafter an underpressure is produced in the bore 12 causing in the manner set out above fixing of the plate 6 on the working table 8 and lowering of the model plate support and the model plate 23 into the position illustrated in Fig. 2 in which the adjusting pieces 25 are spaced from the edge of the plate 6 to be worked.

In the further progress of the working cycle the grinding head 5 is lowered by means acting onto the arm 4, for instance a hydraulic cylinder (not shown) until a control

disc 26 pivoted in the grinding head 5 abuts against the edge 24 of the model plate 23 thereby preventing further lowering of the grinding head 5 (Fig. 3). By means of a shaft 27 the control disc 26 is rotatably mounted in a control part 28, this control part 28 being pivoted in a cradle 30 by means of a shaft 29 and the cradle 30 being pivoted by means of bearings 31 (Fig. 4) on an axis which is perpendicular to the shaft 29. By means of a pulling spring 32 a control face 33 of the cradle 30 is continuously held in contact with the upper end of a carrying pin 34. A strong compresion spring 36 acts onto a flange 35 of the carrying pin 34 for spacing the cradle 30 during the working intervals, that is when the control disc 26 is not loaded, from a stop pin 301 fixed in the rear wall of the grinding head 5 and having a conical stop face 302. The lower end of the carrying pin 34 is inserted with its conical seat 37 into a conical bore 38 of a piston 39 arranged in a liquid filled cylinder 40 and pressed in its rest position against the conical seat of the carying pin 34 by a comperssion spring 41. The carrying pin 34 has a canal 42 interconnecting the spaces of the cylinder 40 situated above and below the piston 39 respectively.

The cylinder-like portion 5' of the grinding head surrounding the carrying pin 34 is pivoted in a casing 44 by means of ball bearings 42 and 43. The casing 44 is fixed on the free end of the arm 4. The portion 5' of the grinding head 5 has a disc 45 (Figs. 3, 4 and 8) and a crank rod 46 is attached to this disc 45 at 47, the other end of the crank rod 46 being pivotally attached to the piston rod 48 of a hydraulic control cylinder 49 mounted in the arm 4. By admission of a control pressure liquid on the one or the other side of the piston of the control cylinder 49 the grinding head 5 and its portion 5' may be turned in the one or other direction. The cylinder 49 is controlled in a well known manner by means of a control valve 50 which is shown in axial section in Fig. 4. The control valve 50 has a feeler 51 cooperating with a control projection 52 of the control part 28 in such a way that the control valve 50 admits the pressure or control liquid on the one or other side of the piston of the control cylinder 49 according to whether the control part 28 and the control projection 52 respectively are displaced in the one or other direction from a determined mid position, for instance the position illustrated (Figs. 4 and 7). A pin 54 loaded by a spring 53 presses against the control projection 52 from the side opposite the contacting place of the feeler 51, the pressure exerted by the pin 54 being such that it compensates the counter pressure of the feeler 51 caused by the springs of the control valve.

The grinding disc 55 of the grinding machine is fixed on the shaft 56 of a motor mounted in a slide 57 which may be displaced within a casing 58 in the direction of the axis of an adjusting screw 59 (Fig. 3). The adjusting screw 59 engages a threading 60 of the slide 57 and by turning the adjusting knob 61 of the adjusting screw 59 the slide 57 together with the grinding motor and the grinding disc may be displaced.

The casing 58 of the grinding motor has two arched guides 62 (Figs. 4, 5 and 6) adapted to run between guide rollers 63, 64 and 65 fixed on the side walls of the grinding head 5. A crank rod 66 is pivotally attached to the one arched guide 62 by means of a ball bearing 67, the other end of the crank rod 66 being pivotally connected to a crank disc 69 by means of a ball bearing 68. The crank disc 69 is driven at a constant speed during operation of the grinding machine. By this rotation of the crank disc 69 an oscillating motion is imparted to the casing 58 guided by the arched guides 62 and to the grinding motor and the grinding disc 55, the pivot axis of the said oscillation motion being in the center of curvature of the concave profile of the working surface 70 of the grinding disc 55, that is outside of the grinding disc. By means of the adjusting screw 59 the grinding disc 55 may be adjusted in such a way that the just mentioned conditions are fulfilled.

The above described grinding machine operates as follows:

After having attached a plate 6 to be worked on the working table 8 in the manner specified above the driving motors of the machine are started up whereby the grinding disc 55 and the crank disc 69 are driven at practically constant speeds for instance by means of three-phase motors and the working table is preferably driven by means of a variable speed motor, for instance a direct current motor. Thereafter the grinding head 5 is lowered by a turning movement of the arm 4 in anticlockwise direction in Fig. 1, until the control disc 26 abuts against the edge 24 of the model plate 23 in the manner illustrated in Fig. 3. The impact produced by the sudden deceleration of the grinding head and of the arm 4 is transmitted from the control disc 26 over the shaft 27, the control part 28, the shaft 29, the cradle 30 and the carrying pin 34 to the piston 39 which latter will take up the impact whereby it is pressed downwardly and whereby an exchange of liquid is set up in the canal 42, the downward speed of the piston being limited and the energy of the impact being dissipated by the flow of liquid in the canal 42. Thereby the grinding head slowly approaches a position in which the carrying surface of the cradle 30 abuts against the conical stop surface 302 of the stop pin 301 whereby the relative movement of the cradle is stopped.

During the above described downward movement of the piston 39 the grinding disc 55 has approached and contacted the plate 6 slowly and without impact. Thereby the casing 58 guided on the arched guides 62 continuously oscillates in the above described manner so that the angle of inclination between the plane of the grinding disc and the plane of the worked plate 6 is continuously changed. The working depth may be adjusted as desired by axial displacement of the stop pin 301.

Due to the slow rotation of the working table 8 the edge of the plate 6 to be worked is slowly moved along the grinding disc. Simultaneously the edge 24 of the model plate 23 which has a shape corresponding to the desired circumferential shape of the plate 6 passes below the control disc 26. Since the shaft 27 of the control disc 26 and the control part 28 are adapted for pivoting freely on the shaft 29 the control disc 26 will always be so adjusted under the pressure of the edge 24 of the model plate 23 that the plane determined by the shafts 29 and 27 is perpendicular to the tangent to the edge of the model plate in the contacting point of the control disc 26. Therefore, whenever the curve constituted by the edge of the model plate changes its direction the control disc 26 will immediately turn round the shaft 29 to meet again with the above condition, thereby causing a lateral displacement of the control projection 52 of the control part 28. As set out above this results in a displacement of the piston of the control cylinder 49 in such direction that an angular displacement of the grinding head with the grinding motor and of the grinding disc 55 is effected in such a way that the grinding head is brought into tangential position to the edge of the plate 6 to be worked and into parallel position to the control part 28. By these means the grinding disc is so adjusted during the whole grinding process that its working pressure is perpendicular to the tangent to the working place on the plate 6. Thereby variations in the working depth may be avoided and high quality of the surface of the worked edge of the plate may be obtained on the full circumference.

When the plate 6 has been worked to the size and shape determined by the model plate 23 the grinding head 5 is lifted by rotation of the arm 4 in clockwise direction and the driving motors of the grinding machine are stopped. Thereby the carrying pin 34 will rapidly move upwards under the action of the spring 36 whereby its conical seat 37 will be lifted from the conical bore 38 of the piston 39. Thereafter the canal 12 of the working

table 8 and of its shaft 9 is put under atmospheric pressure whereby the worked plate 6 is loosened for removal whereas the model plate support 13 and the model plate 23 will move into their upper position for facilitating the application of a new unworked plate 6 onto the working table 8 in the manner described. Another working cycle may now be started as described.

What I claim is:

1. A grinding machine for rounding off the edge of plates or discs particularly of glass panes, having a curved circumference of any desired shape, comprising a grinding disc having at its rim a grinding surface having a concave profile corresponding to the convex profile to be produced on the said plate, a part having bearing means, a grinding shaft carrying the said grinding disc and pivoted in the said bearing means, first pivot means for pivoting the said part on a first pivot axis outside the said grinding disc and passing through the center of curvature of the said concave grinding surface, an oscillating drive for the said part for continuously oscillating it round the said first pivot axis during the grinding operation, the said grinding shaft being thereby displaced in an oscillating plane perpendicular to the said first pivot axis, a working place where the said grinding disc contacts the said plate, second pivot means for rotating the said first pivot means and the said part respectively round a second pivot axis substantially perpendicular to the plane of the said second pivot means, an angular adjustment of the said part in the said second pivot means for which angular adjustment the said first pivot axis is parallel and the said oscillating plane is perpendicular to the tangent to the said plate in the said working place, adjusting means for the sad part, the said part being continuously adjusted and maintained by the said adjusting means in the said angular adjustment for which the said oscillating plane is perpendicular to the tangent to the said plate in the said working place, the working place being thereby maintained in the said oscillating plane.

2. A grinding machine for rounding off the edge of plates or discs, particularly of glass panes, having a curved circumference of any desired shape, comprising a grinding disc having at its rim a grinding surface having a concave profile corresponding to the convex profile to be produced on the said plate, a part having bearing means, a grinding shaft carrying the said grinding disc and pivoted in the said bearing means, first pivot means for pivoting the said part on a first pivot axis outside the said grinding disc and passing through the center of curvature of the said concave grinding surface, an oscillating drive for the said part for continuously oscillating it round the said first pivot axis during the grinding operation, a working place where the said grinding disc contacts the said plate, second pivot means for rotating the said first pivot means and the said part respectively round a second pivot axis substantially perpendicular to the plane of the said plate, adjusting means operatively associated with the said second pivot means, an angular adjustment of the said part in the said second pivot means for which angular adjustment the said first pivot axis is parallel to the tangent to the said plate in the said working place, the said part being continuously adjusted and maintained by the said adjusting means in the said angular adjustment for which the said first pivot axis is parallel to the tangent to the said plate in the said working place.

3. A grinding machine according to claim 2, comprising arched guides attached to the said part and guiding rollers on a fixed portion of the grinding machine, the said arched guides engaging the said guiding rollers thereby allowing oscillation of the part on an axis outside the said arched guides and the said guiding rollers, the said arched guides being in a plane substantially parallel to the axis of the grinding wheel.

4. A grinding machine for rounding off the edge of plates or discs, particularly of glass panes, having a curved circumference of any desired shape, comprising a grinding disc having at its rim a grinding surface having a concave profile corresponding to the convex profile to be produced on the said plate, a grinding disc support having bearing means, a grinding shaft carrying the said grinding disc and pivoted in the said bearing means, a grinding head, first pivot means in the said grinding head for pivoting the said grinding disc support round a first pivot axis, this first pivot axis passing through the center of curvature of the said concave grinding surface, an oscillating drive for the said grinding disc support for continuously oscillating it round the said first pivot axis during the grinding operation, a working place where the said grinding disc contacts the said plate, second pivot means allowing rotation of the said grinding head and grinding disc support respectively round a second pivot axis substantially perpendicular to the plane of the said plate, a control part and a control member mounted on the said control part, the control part being pivoted in the said grinding head, a template similar in shape to the said plate to be worked, means for pressing the said control member against the rim of the said template thereby automatically adjusting the said control part in a direction perpendicular to the rim of the template, and link means for bringing the said grinding head and grinding disc support respectively into alignment with the said control part thereby adjusting the said first pivot axis in parallel position to the rim of the plate in the operating place.

5. A grinding machine for rounding off the edge of plates or discs, along at least a portion of the irregularly curved circumference thereof, particularly of glass panes, comprising a grinding disc, means for leading the grinding discs along at least a portion of the edge of the plate for grinding the same, a grinding disc support having bearing means, a grinding shaft carrying the grinding disc and pivoted in the said bearing means, a grinding head, first pivot means in the said grinding head for pivoting the said grinding disc support on an axis outside the said grinding disc, an oscillating drive for the said grinding disc support for continuously oscillating it on the said first pivot means during the grinding operation, second pivot means allowing rotation of the said grinding head and grinding disc support on an axis substantially perpendicular to the plane of the said plate, a control part and a control disc pivoted in the said control part, the control part being pivoted in the said grinding head, a template similar in shape to the said plate to be worked, the pivot axis of the said control part being located between the pivot axis of the said control disc and the said template, means for pressing the said control disc against the rim of the said template thereby automatically adjusting the said control part in a direction perpendicular to the rim of the template, and link means for bringing the said grinding head and grinding disc support into alignment with the said control part thereby adjusting the axis of the said first pivot means in parallel position to the rim of the plate in the operating place.

6. A grinding machine according to claim 5, comprising a control valve operatively connected with the said control part and operated by angular displacement of the control part, a control cylinder having a control piston connected with the said control valve, the said control piston being in operative connection with the said grinding disc support carrying the grinding disc for adjusting the angular position of the said grinding disc support on the said second pivot means, a pressure fluid supply for the said control valve and the said hydraulic control cylinder, a hydraulic link constituted by the said control valve and the said hydraulic cylinder between the said control part and the said grinding disc support carrying the grinding disc, the said control part and the said grinding disc support carrying the grinding disc being continuously held in alignment by the said hydraulic link.

7. A grinding machine for rounding off the edge of plates or discs along at least a portion of the irregularly curved circumference thereof, particularly of glass panes, comprising a grinding disc adapted to be led along at least a portion of the edge, a part having first pivot means, a grinding shaft carrying the said grinding disc rotatably mounted in the said part, an oscillating drive for the said part for continuously oscillating it on the said first pivot means during the grinding operation, second pivot means for the said part allowing rotation of the said part on an axis substantially perpendicular to the plane of the said plate, a working place on the said grinding disc and a plane in which the rotating axis of the grinding disc is displaced due to the said oscillating motion of the part, adjusting means operatively connected with the said part for turning it on the said second pivot means and control means for the said adjusting means, a template, the said control means being in operative engagement with the said template, the said control means and adjusting means being adapted to adjust the said part to a position in which the said working place of the grinding disc is maintained in the plane in which the rotating axis of the grinding disc is displaced.

References Cited in the file of this patent

UNITED STATES PATENTS

1,724,677	Owen	Aug. 13, 1929
1,850,946	Von Reis	Mar. 22, 1932
1,895,908	Blair	Jan. 31, 1933
2,013,196	Woolens	Sept. 3, 1935
2,151,204	Hartman	Mar. 21, 1939
2,206,842	Indge	July 2, 1940
2,312,270	Simmons	Feb. 23, 1943
2,467,768	Montgomery et al.	Apr. 19, 1949
2,579,337	Reaser et al.	Dec. 18, 1951
2,615,599	Griffing et al.	Oct. 28, 1952
2,693,058	Hagstrom	Nov. 2, 1954

FOREIGN PATENTS

920,050	Germany	Mar. 7, 1955