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(54) Spherical surface grinding device.

(57) The device of this invention has a holder (12, 28) for holding the work (9, 27), work shafts (25, 26) on each of which the holder is mounted, and each of which feeds in the work in the axial direction, and grinding tools (15, 16) each arranged at a specified slope angle for grinding the aforementioned work (9, 27) to the prescribed spherical shape, the aforementioned work shafts (25, 26) and grinding tools (15, 16) being adapted for rough grinding and for precision grinding, respectively, and it is equipped with a transferring device (11, 13, 32, 33) for bringing the holder (12, 28) holding the aforementioned work (9, 27) to the work shaft (25) for rough grinding and to the work shaft (26) for precision grinding, further, the work shaft (25) for rough grinding being provided with a mechanism for forced cutting-in against the grinding tool (15), and the work shaft (26) for precision grinding with a mechanism for constant pressure cutting-in, whereby well finished surface may be realized at high efficiency and after-processings are spared. Accordingly, this invention is quite advantageous in maintenance and control of precision and cost reduction.

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SPHERICAL SURFACE GRINDING DEVICE

The present invention relates to a spherical surface grinding device for manufacturing such optical parts as optical lens, mirror, etc., which enable realization of well finished surface at high efficiency.

In the conventional spherical grinding device, with structure particularly as shown in FIG. 1, a lens 3 held by a collet chuck 1, which is mounted on a rotary spindle 2, to be turned thereby at a low speed, is subjected to spherical grinding by means of a diamond grinding stone 7 turned at a high speed, mounted on a high speed rotary spindle 6 which is inclined at a specific slope angle by a sloping slide shaft 4 and, further, which is placed in a specific position by a parallel slide shaft 5. In doing this work, the glass stock is brought to the collet chuck by worker's hand or by an auto loader, to be held thereby, and is taken out by the same means. The diamond grinding stone generally used is METAL BOND of the order of #100 ~ #400, which produces a finished surface roughness of 2 ~ 6 Rmax. In after-processing, smoothing is performed with diamond METAL BOND pellet and RESINOID BOND pellet and in further later processing, polishing is performed, using such abrasive as CeO_2, etc.

In the device as above-described, however, the lens 3 held by the collet chuck 1 can be ground only by

one diamond grinding stone 7. When it is further to be finished, it is necessary to replace the stone or transfer the lens to another spherical surface grinding device. For again holding the lens by another collet chuck, the lens holding posture will be altered and, therefore, larger margin must be taken for precision grinding. Accordingly, rough grinding and precision grinding can not be performed at high efficiency. Since the forced cutting-in method in rough grinding and the constant pressure cutting-in method in precision grinding, respectively, cannot be readily adopted, well finished surface can not be obtained. Thus this device was unable to be put to use for production in the same tact time.

The present invention provides in one aspect a spherical surface grinding device having a holder for holding the work, characterised by work shafts on each of which this holder is mounted, to be turned therewith, and each of which feeds it in the axial direction, and grinding tools each arranged at a specified slope angle so as to grind the aforementioned work to the prescribed spherical shape, the aforementioned work shafts and the grinding tools respectively being adapted for rough grinding and for precision grinding, and said device being equipped with a transferring device for bringing the holder holding the aforementioned work to the work shaft for rough grinding and to the work shaft for precision grinding.

In a further aspect, the invention provides a spherical surface grinding device having a holder capable of holding the work, characterised by a chuck unit for gripping this holder and comprising a transferring device capable of moving between the position for rough grinding of the work and the position for precision grindings, two work shafts each of which

receives the holder transferred from the aforementioned chuck unit, is rotatable and moves up and down, one being adapted for rough grinding of the work, and the other for precision grinding, and two grinding tools placed respectively facing the two work shafts, which are in concert capable of grinding the work to the desired spherical shape and each of which is located at a specified angle and position relative to the work surface.

In a further aspect, the invention provides a spherical surface grinding device having a holder capable of holding the work characterised by a chuck unit for gripping this holder, and comprising a transferring device capable of moving between the position for rough grinding of the work and the position for precision grinding, two work shafts each of which receives the holder transferred from the aforementioned chuck unit and holds it, and which are rotatable and move up and down, one of them being adaptable for rough grinding of the work and the other for precision grinding, and two grinding tools placed respectively facing these two work shafts, which in concert are capable of grinding the work held by the holder to the desired spherical shape, and each of which is located at a specified angle and position relative to the work surface, the work shaft for rough grinding being so arranged as to feed in the work the prescribed distance against the grinding tool, and the work shaft for precision grinding to feed in the work at a prescribed pressure.

The device according to the invention is quite advantageous in maintenance and control of precision and reduction of cost.

FIG. 1 is a plan view showing a particular structure of a conventional spherical surface grinding device;

FIG. 2 is a conceptual diagram showing the scheme for transferring the work in an embodiment of this invention;

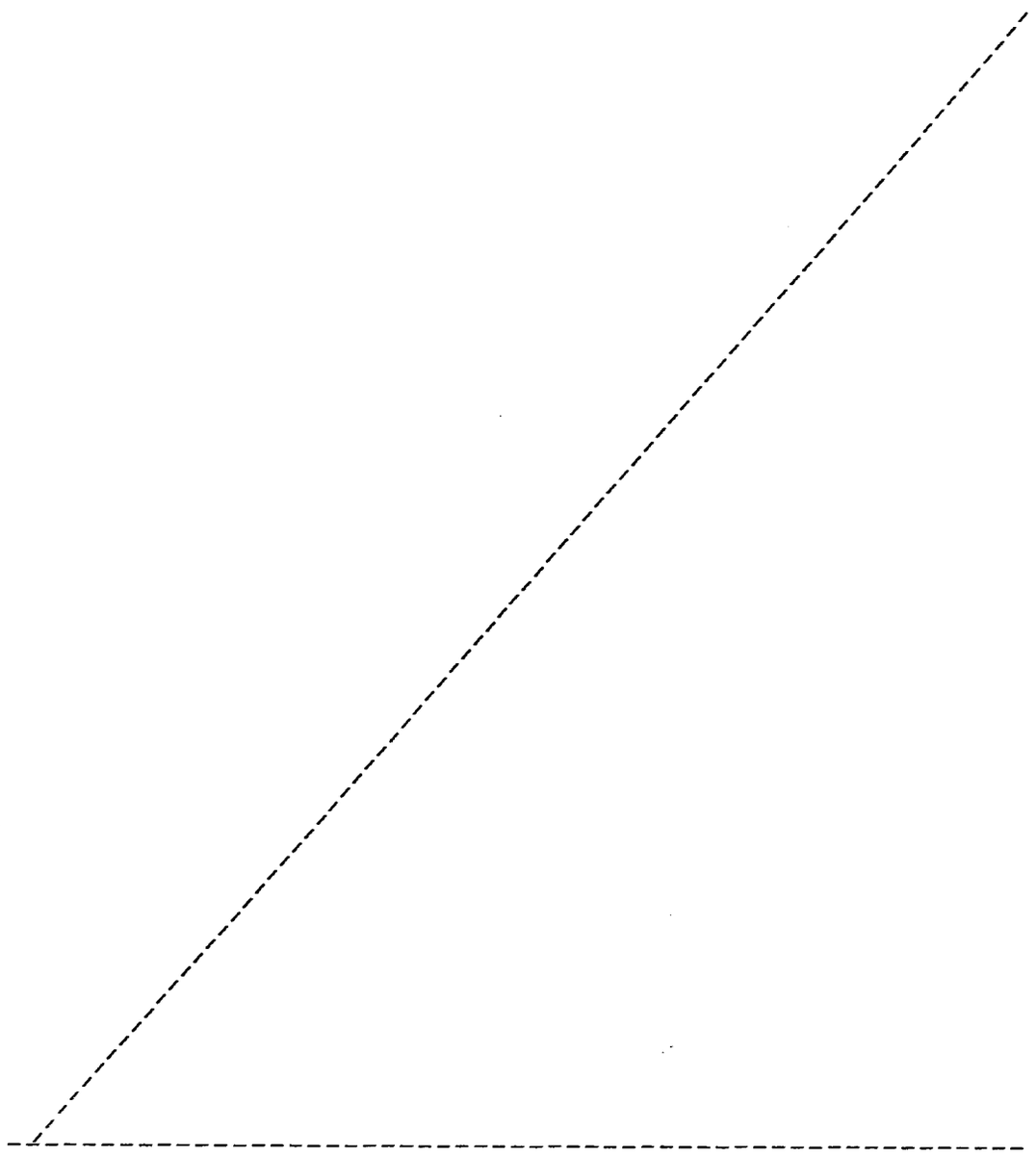

FIG. 3 is a plan view showing this spheric surface grinding device; and

FIG. 4 is a front elevation of the same.

THE MOST PREFERABLE MODE IN EXERCISING THE INVENTION

In the following, an embodiment of this invention is described with reference to the accompanying drawings:

FIG. 2 is a conceptual diagram showing the scheme for transferring the work. the lens 9 on conveyor 8 is transferred in the direction of a by auto-hand 10 and is taken in by a holder 12 supported on a chuck unit 11, to be held thereby. The chuck unit 11 is on index table 13, turned by 120° in the direction of b, to conduct the rough grinding, then, further turned by 120° in the direction of c, to conduct the precision grinding and again turned by 120° in the direction of d to the former position, where the lens 9 is detached from the holder 12, taken out in the direction of e and put on a conveyor 14. The aforementioned operations are continuously run one after another in the same tact time.

FIG. 3 presents a particular embodiment, giving a plan view of a spherical surface grinding device and FIG. 4 is its front elevation. In this figure, 15 denotes a diamond stone for rough grinding, METAL BOND of the order of #100 ∿ #400. Numeral 16 designates a

diamond grinding stone for precision grinding, METAL BOND of the order of #800 ∿ #1500. Numerals 17 and 18 give respective rotary spindles of the aforementioned grinding stones, and 19 and 20 their driving motors. Numerals 21 and 22 designate sliding drive motors for transferring the aforementioned grinding stones to their specified positions. Further, by drive motors, not shown in the figures, the stones are inclined at specified slope angles pivoting around 23 and 24. Numerals 25 and 26 denote rotary spindles on each of which the chuck unit 28 holding the lens 27 to be ground is mounted, and which turn at about 5 ∿ 50 rpm and 29 and 30 designate their drive motors. The rotary spindle 25, being for rough grinding, is forcibly fed in for a specified distance against the diamond grinding stone 15, realizing the grinding in the forced cutting-in way. The rotary spindle 26, being for precision grinding, is fed in against the diamond grinding stone 16 at a specified constant pressure, realizing the grinding in the constant pressure cutting-in way.

Numeral 31 designates an auto-hand for taking the lens stock 27 into this spherical surface grinding device, which performs the operation of getting the work to be held by or taken out of the holder 28, etc. Numeral 32 represents the chuck unit which supports the holder 28 and is mounted on rotary index 33, and 34 stands for the

machine base.

In the following, the operation of the spherical surface grinding device composed as hereabove-described is described.

First, the auto-hand 31 takes in the lens stock 27 from outside and sets it on the holder 28, to be held thereby. The holder 28, as it is, being held by the chuck unit 32, is turned by 120° in the direction of f by the rotary index 33, to be set in position, and is secured by the rotary spindle 25 upon the chuck unit 32 releasing it. The diamond grinding stone 15 so arranged as to grind the lens stock 27 to the desired radius of curvature is running at as high a speed as 8,000 ∿ 1,200 rpm. Against this stone, the lens stock 27 fixed on the aforementioned rotary spindle 25 is forcibly subjected to a constant dimension cutting-in, while turning at 5 ∿ 50 rpm, for performing the rough grinding. After this grinding, the holder 28 is released from the rotary spindle 25, again supported by the chuck unit 32 and, then, turned further by 120° in the direction of f, to be set in position. Then the lens stock 27 secured on the rotary spindle 26 similarly as above-described is subjected to a cutting-in at a constant pressure, while turning at 5 ∿ 50 rpm, for performing the precision grinding. After this grinding, the work is again supported similarly by the chuck unit

32 and again turned by 120° in the direction of f, to be returned to its former position. Thereafter, the lens finished by the precision grinding as above-described is taken out from the spherical surface grinding device by means of the auto-hand 31. A series of operations as above-mentioned are continuously carried out each in the same tact time.

According to the embodiment above-described, Rmax of the order of 0.2 μm can be readily achieved after finishing by precision grinding with tact time about 20 ∿ 50 sec and this process is automatable.

INDUSTRIAL APPLICABILITY

According to this invention, the holder holding the work is transferred to the work shaft for rough grinding and to the work shaft for precision grinding and, further, the work shaft for rough grinding is provided with the mechanism for forced cutting-in against the grinding tool, while the work shaft for precision grinding is provided with the mechanism for cutting-in at a specified pressure, respectively. For this reason, well finished surface is realizable in short time at high efficiency and such after-processings as smoothing and polishing may be spared. Besides, automation of the processes is

feasible and maintenance of quality and cost reduction are easy.

CLAIMS:

1. A spherical surface grinding device having a holder (28) for holding the work, characterised by work shafts (25,26) on each of which this holder is mounted, to be turned therewith, and each of which feeds it in the axial direction, and grinding tools (15,16) each arranged at a specified slope angle so as to grind the aforementioned work to the prescribed spherical shape, the aforementioned work shafts and the grinding tools respectively being adapted for rough grinding and for precision grinding, and said device being equipped with a transferring device (32,33) for bringing the holder holding the aforementioned work to the work shaft for rough grinding and to the work shaft for precision grinding.

2. A spherical surface grinding device having a holder (28) capable of holding the work, characterised by a chuck unit (32) for gripping this holder and comprising a transferring device (33) capable of moving between the position for rough grinding of the work and the position for precision grindings, two work shafts (25,26) each of which receives the holder transferred from the aforementioned chuck unit, is rotatable and moves up and down, one being adapted for rough grinding of the work, and the other for precision grinding, and two grinding tools (15,16) placed respectively facing the two work shafts, which are in concert capable of grinding the work to the desired spherical shape and each of which is located at a specified angle and position relative to the work surface.

3. A spherical surface grinding device having a holder (28) capable of holding the work, characterised by a chuck unit (32) for gripping this holder, and comprising a transferring device (33) capable of moving between the position for rough grinding of the work and the position for precision grinding, two work shafts (25,26) each of which receives the holder transferred from the aforementioned chuck unit and holds it, and which are rotatable and move up and down, one of them being adaptable for rough grinding of the work and the other for precision grinding, and two grinding tools (15,16) placed respectively facing these two work shafrs, which in concert are capable of grinding the work held by the holder to the desired spherical shape, and each of which is located at a specified angle and position relative to the work surface, the work shaft for rough grinding being so arranged as to feed in the work the prescribed distance against the grinding tool, and the work shaft for precision grinding to feed in the work at a prescribed pressure.

4. A spherical surface grinding device according to

Claim 3 wherein the aforementioned transferring device is rotatably installed.

5. A spherical surface grinding device according to Claim 4 wherein the aforementioned transferring device is provided with three chuck units.

6. A spherical surface grinding device according to Claim 3 wherein the aforementioned grinding tools are adjustable to the specified angles and positions, respectively, to suit the radius of curvature of the work intended to have.

Fig. 1

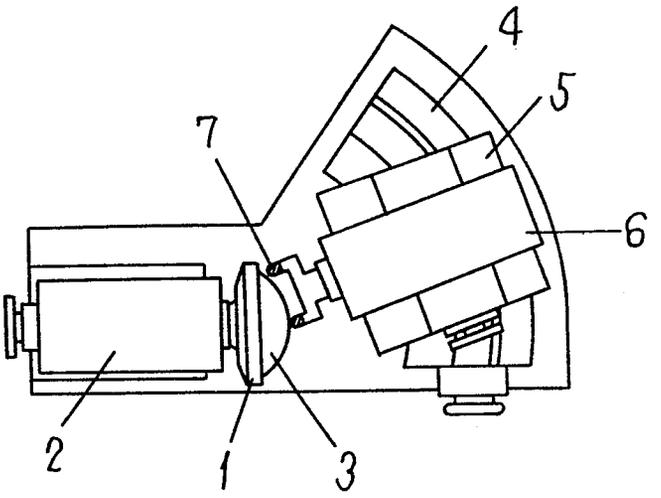

Fig. 2

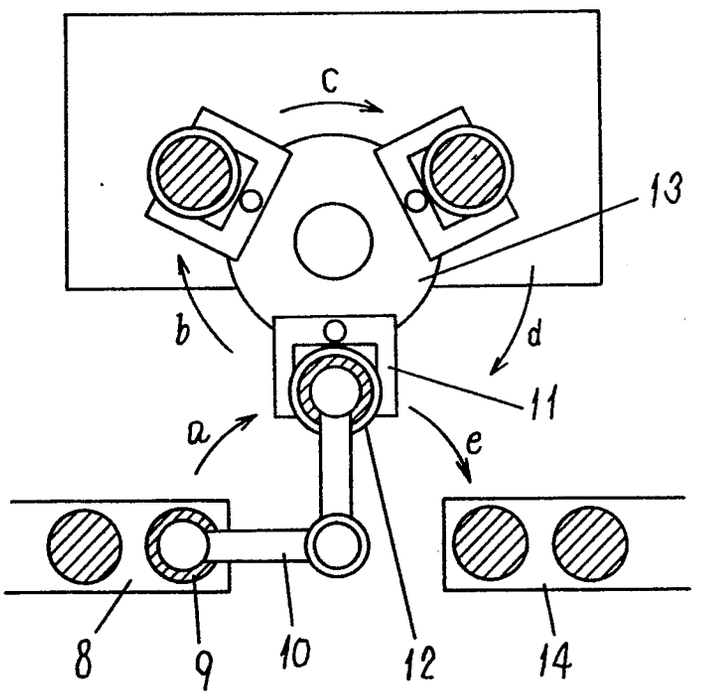

Fig.3

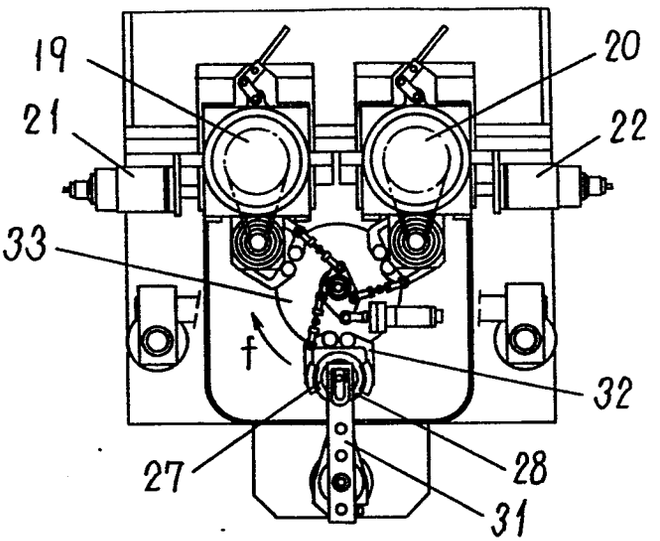
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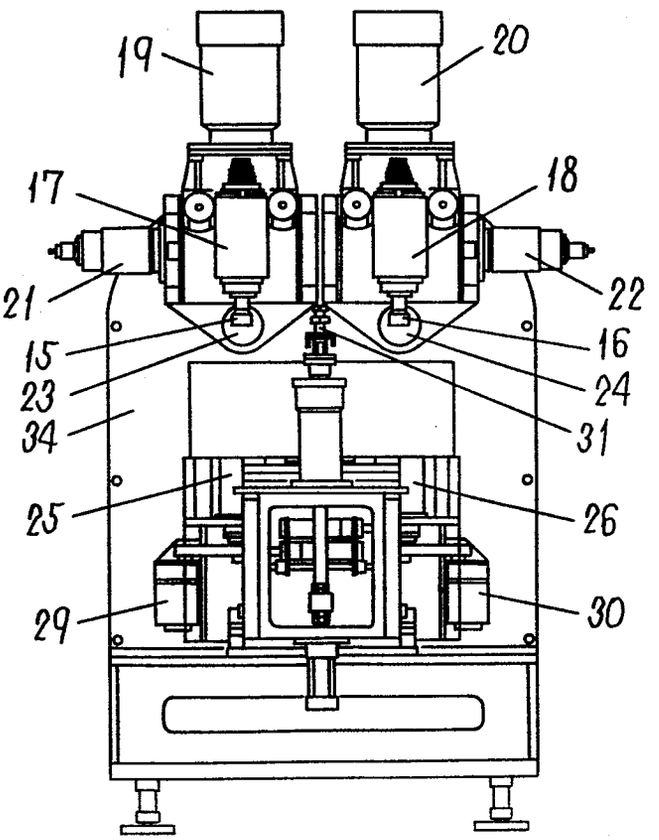
Fig.4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