April 30, 1968 SUSUMU TAKADA 3,380,198

PARALLEL PLANE HONING EQUIPMENT

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Fig. 1

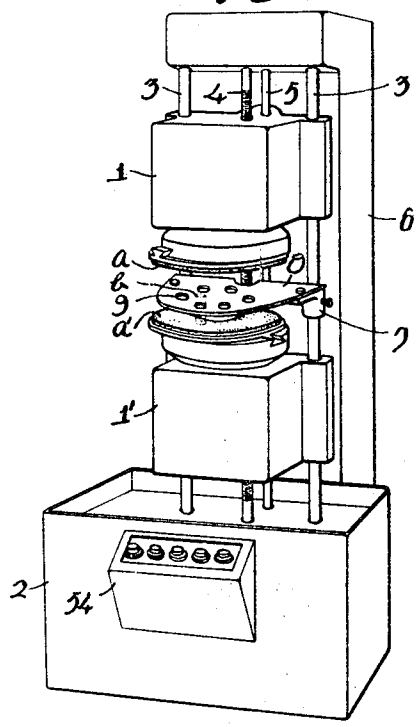

Fig. 3

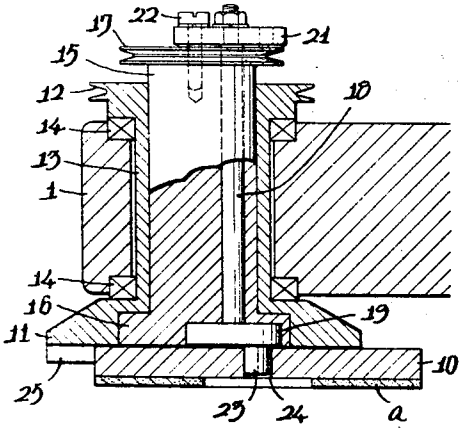

Fig. 4

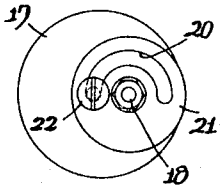

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Fig. 2

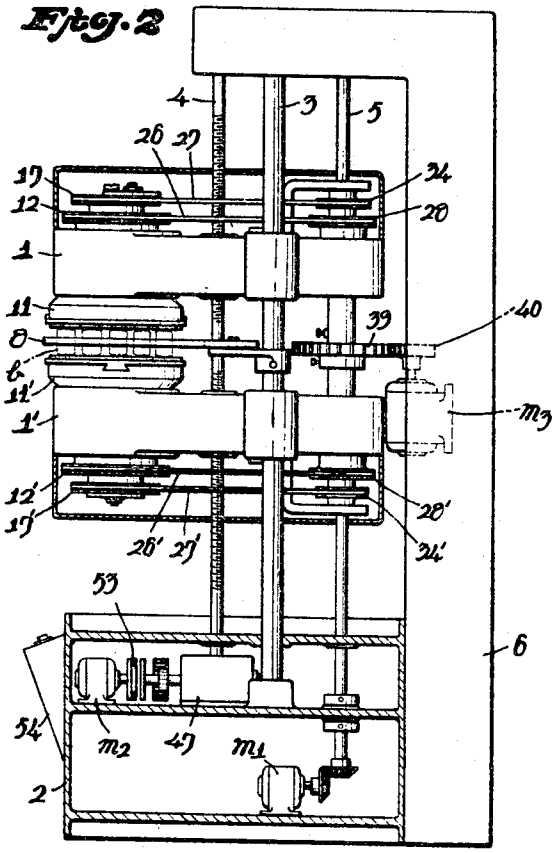

Fig. 6

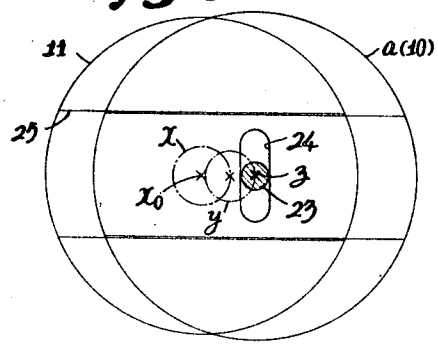

Fig. 5

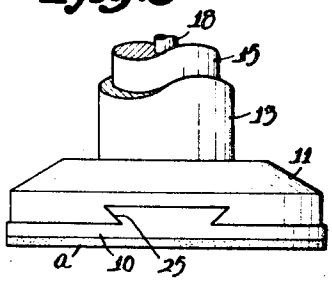

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Fig. 7

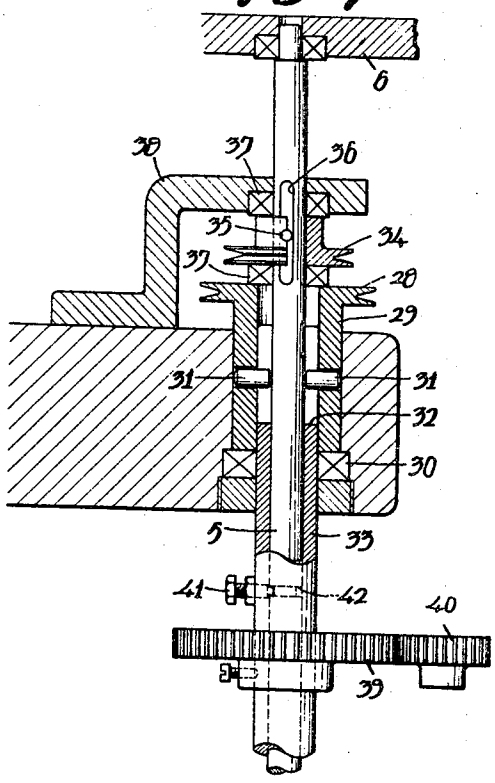
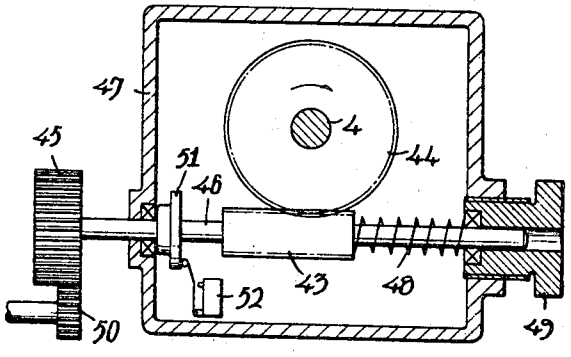


Fig. 8



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PARALLEL PLANE HONING EQUIPMENT

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4 Claims. (Cl. 51—54)

The present invention relates to a parallel plane honing equipment for grinding works precisely by pressing a grinding wheel to surfaces of the works eccentrically.

In accordance with the conventional plane honing machine, the grinding operation has been achieved by rotating honing wheels at a single position, while the works are rotatably moved. Accordingly, more complicated mechanical construction was necessary for treating the works which naturally causing more expenses in manufacturing the conventional equipment.

Moreover, said conventional equipment has other fatal defects as that a volume of grinding productivity is limited and in addition, said equipment was not sufficient to achieve precision operation due to such mechanical construction in which works are moved rotatingly during the grinding process.

Particularly, in the conventional lapping machine, an extra high precision machine for tracing out the standard surface which is provided in the machine was needed.

Main object of the present invention is, therefore, to avoid such defects as aforementioned and that more precision grinding at a lower cost could be realized.

At the same time, the particularly designed mechanical construction having same dimensional area to the conventional honing machine offers more volume of works.

Furthermore, the present invention also features for non-necessity of the high engineering techniques in operating machine but simply treating the eccentric movement to the grinding wheel having two surfaces with the three surfaces combination system between the works and the surface of the grinding wheel.

It will be featured again that the present mechanism employs the particular honing performance having two step torque process.

It will be now described in detail of the present disclosure with the accompanying drawings below.

Drawings show one of the examples according to the present invention.

FIGURE 1 is a transversial view of the present invention.

FIGURE 2 shows a side view of a part cut according to FIG. 1.

FIGURE 3 is a side sectional view of the essential part for rotating movement of the grinding wheels.

FIGURE 4 is a partial plane view according to FIG. 3.

FIGURE 5 is a front view of the sliding part of the grinding wheels according to FIG. 3.

FIGURE 6 is an explanatory drawing of the rotation of the aforesaid sliding part of the grinding wheels.

FIGURE 7 is a side sectional view of the power transmission device which rotates the rotating member of the grinding wheels shown in FIG. 3.

FIGURE 8 is a plane sectional view of the pressing device of the grinding wheels facing each other.

Referring now to the drawing, and in particular to FIG. 1, sliding arms **1**, **1'** having wheel grinders *a*, *a'* move up and down through the rotation of a turn buckle **4** being conducted by guide poles **3** provided on a bed **2**.

A rotating axis **5** is rotated by a motor m_1 provided within the bed **2** and the rotating axis **5**, guide poles **3** and turn buckle **4** are respectively supported the front end of a flame **6** provided in the rear part of the bed **2**.

Between the sliding arms **1**, **1'** which are conducted

by the guide poles **3**, a holder **8** between the grinders *a*, *a'* is removably maintained through a bracket **7**.

In the holder **8**, holes **9** for holding works *b* are provided and proper scale of holder may be used depends on the sizes and shapes of the works *b*.

The grinders *a*, *a'* are respectively secured on surfaces of desks **10**, **10'** and each surface is maintained in flanges **11**, **11'** with a passage. The flanges **11**, **11'** are respectively fitted to the sliding arms **1**, **1'** facing in opposite and that the rotating movement of the grinders *a*, *a'* of the above is constituted, however, said constitution is respectively common to both blocks. Accordingly, it will be further described for the mechanical operation of the rotating movement effected by a block of the sliding arm **1** and the wheel grinder a referring to drawings basing FIG. 3 to FIG. 6.

The flange **11** is secured in the sliding arm **1** through a cylindrical axis **13** connecting to an upper pulley **12** and thrust blocks **14**. In the flange **11** and the cylindrical axis **13**, a center axis **15** is inserted and a flange **16** forming in the lower end of the center axis **15** is provided within the flange **11**, while on the upper end of the center axis **15**, a pulley **17** is secured.

Within the center axis **15**, a control axis **18** is further inserted and a disk **19** provided in the lower end of the axis **18** is fitted within the flange **16**. The upper part of the control axis **18** is screwed into a disk **21** having a passage hole **20**. The disk **21** is fixedly secured to the center axis **15** by tightening of a screw **22** which combined with the center axis **15** through the passage hole **20**.

Accordingly, the control axis **18** simultaneously rotates within the cylindrical axis **13** with the center axis **15** through the disk **21**. On the lower surface of the disk **19** provided within the flange **16**, a pin **23** is projected at an eccentric-position to the control axis **18**. The pin **23** is inserted into a side-long passage hole **24** of the disk **10** positioned in the lower surface of the flange **16** and the disk **19**. Accordingly, the disk **10** moves as much as an eccentric amount of the center axis **15** of the pin **23** provided by the rotation of the center axis **15** being along with a passage **25** of the flange **11**.

In FIG. 6 a locus *x* shows a rotation of the control axis **18** inserted into the center axis **15**, while another locus *y* shows a transfer of the pin **23** which may be controled by the control axis **18**. Accordingly, the rotating movement of the grinder a illustrated an optimum eccentricity amount when the pin axis *z* is settled in the most distant place from the central point x_0 of the cylindrical axis **13** and the center axis **15**.

A device for the rotating movement of the grinder *a'* of the sliding arm **1'** is also the same to the grinder *a* of the sliding arm **1** in the mechanical construction, accordingly, a signal marked with a point shows symmetrically a signal without any mark.

In this connection, if a motor m_2 is normally operated for rotating the turn buckle **4** by fitting the works *b* with the holder **8**, both surfaces of the works *b* are ground by the grinders *a*, *a'* being effected by the sliding arms **1**, **1'**. And thus, the desired honing process is achieved on the both surfaces of the works *b* by operating the grinder *a* with belts **26**, **27** and the grinder *a'* with belts **26'**, **27'**. In this case, the belts **26'**, **27'** are hung in cross-shape and the rotating direction of the grinder *a'* is made to be opposite to the direction of the grinder *a* in order to prevent the skidding of the works *b* in the holder **8**, at the same time, to increasing grinding efficiency.

In accordance with the present example, the sliding arms **1**, **1'** are, however, moved symmetrically, only the sliding arm **1** can be moved up and down by securing the sliding arm **1'**.

In FIG. 7, a pulley **28** is for operating the belt **26** and a cylindrical axis **29** of the pulley **28** is inserted into the

rear part of the sliding arm **1** having a thrust block **30** therein. Within the cylindrical axis **29**, a cylindrical axis **33** having a passage **32** in which pins **31** which are driven from the both sides of the cylindrical axis **29** is provided. Further, within the cylindrical axis **33**, the rotating axis **5** penetrates therethrough and a knock pin **35** of a pulley **34** positioned on the upper surface of the pulley **28** meets a key passage **36** of the rotating axis **5** so that the pulley **34** is supported by a bracket **38** which is held in the surface of sliding arm **1** through thrust blocks **37**. Accordingly, the belt **27** is rotated with the rotation of the pulley **34**. In the middle part of the cylindrical axis **33**, a gear **39** is fixedly secured and the pulleys **28**, **28'** are rotated by gearing with a pinion **40** which transmits the rotation of a motor m_3. On the cylindrical axis **33**, a stopper screw **41** is secured and the front end thereof combines to a passage **42** of the rotating axis **5** so that the cylindrical axis **33** maintains the constant position.

The construction mechanism mentioned in the above is common to the construction mechanism of the pulleys **28'**, **34'** provided in the rear part of the sliding arm **1'**.

In this connection, the rotation of the cylindrical axis **33** is transmitted to the pulleys **28**, **28'** and the movement of the rotating axis **5** is transmitted to the pulleys **34**, **34'** respectively even if the sliding arms **1**, **1'** may move up and down at the turn buckle **4**.

In FIG. 8, a worm **43** is combined with a worm wheel **44** which is fixedly secured on the turn buckle **4** and said worm **43** is built together with an axis **46** having a gear **45**. The front end of the axis **46** supported by a casing **47** is held by a bar **49** which presses a spring **48**. At this sense, if the overload is generated on the turn buckle **4** which rotates by the transmission of a pinion **50**, only the worm **43** rotates for the advancement without having rotated the worm wheel **44**. A flange **51** secured on the axis **46** contacts with a switch **52** which cuts the power source at off position in case the axis **46** accidently advances. Accordingly, the motor m_2 is for stopping the rotation of the turn buckle **4** when the grinders *a*, *a'* contact with the works *b* with a proper friction being approached by the sliding arms **1**, **1'**. Further, between the motor m_1 and the pinion **50**, a clutch **53** is provided. Also, in the front side of the equipment, a control disk **54** is provided.

In short, the aforesaid parallel plane honing equipment is particularly featured in the works maintained in the proper position and the movement of the grinder surface is rotated in a meandering movement having an eccentric amount being combined with circularity and reciprocation movements, at the same time, it is further characterized in realizing a pressure system to the grinder surface and the works.

Namely, the disk **10** which rotates with the flange **11** may tend to rotate with the central axis x_0 of the flange **11**, however, the disk **10** operates the meandering rotation movement along with the center axis x_0 as the eccentric amount of the pin **23** provided in the flange **16** is multiplied to the rotation of the flange **11** with the rotation having diameter consisting of the length of the flanges **11**, **16** of the center axis x_0 and the axis point *z*.

In this connection, by setting the position of the pin **23** with proper adjustment of the disk **21** so that the surface of the works *d* is contacted with the two surfaces d_1 and d_2 of the grinder surface, the rotating grinder surface may constitute with the double movement comprising circular movement by the flange and reciprocation movement by the pin **23** and the passage **25**. Accordingly, the present construction is based on the unique mechanism for assuring more precision grinding in which supplemental grinding surface d_2 is particularly provided for amending errors to be generated from the grinding operation executed by the grinding surface d_1 and the surface of the works *d*. Such a grinding method may be thus, called "three surfaces contact system." At this sense, the relation between the grinder surfaces d_1, d_2 and the surface of works *d* will be represented by $d \neq d_1$ and the grinder surfaces d_1 and d_2 are equal.

In this case, on the surface of the works, the grinder surfaces d_1, d_2 having a certain amount of eccentricity of sin curve always contact with the surface of the works in such a route of $d_1 \rightarrow d_2$, $d_2 \rightarrow d_1$. Accordingly, the present honing equipment can provide an efficient honing process and precise result without having any inconveniency effected by non-uniformity of the grinder surface as appeared in the conventional honing equipment.

Now, it will be described for the press-process of the grinder surface when the turn buckle **4** is operated by the pinion **50** of the motor m_2 as shown by an arrow mark in FIG. 8, the axis **46** having the worm **43** moves ahead with rotation (right side in the drawing) against the spring force of the spring **48**, as the worm wheel **44** is in static-state receiving the load from the sliding arms **1**, **1'** of the turn buckle **4**. However, intermediate space between the grinder surfaces may be approached if the worm wheel **44** rotates to the arrow direction which causes the axis **46** to have larger torque than the load of the worm wheel **44** because of an effect of excess shrinkage of the spring **48**. Namely, the grinding operation will be sufficiently achieved by an appropriate approach of the grinder surface and the works, however, the worm wheel **44** stops rotation thereof if the approach becomes too heavy beyond over certain pressure.

In this connection, the worm **43** still maintains rotating operation by the motor m_2 and therefore, said worm **43** further proceeds by pressing the spring **48**. At this state, the operation of the motor m_2 is suspended by the limit switch **52** controlled by the flange **51** having the axis **46**. Accordingly, the rotating torque opposite direction to the above effects to the worm wheel **44** as the worm **43** is forced to move backwardly by the energy reserved in the spring **48**.

As described in the aforesaid statement, in the present grinder surface press-device, a continuous honing operation to be operated each other by the motor and the spring for supplying the torque to the worm wheel can be realized. Consequently, if the limit switch **52** controlled by the flange **51** releases the circuit being effected from the counter action of the spring **48**, the motor m_2 is operated again. Further, the worm **43** and the gear **45** are, of course, made to gear with the counter gear with the proper width.

The pressure torque of the present device will be adjusted by the manipulation of the pin **49** of the spring **48**, whereby an efficient honing result will be obtained.

What I claim is:

1. A parallel plane honing equipment, comprising
a bed,
a threaded spindle rotatably mounted in said bed,
guide poles secured in said bed and disposed parallel with said threaded spindle,
two sliding arms movable toward and from each other, respectively, by rotation of said threaded spindle and guided in the movements by said guide poles,
rotating members having a flange disposed in said sliding arms and having a passage,
disks including a wheel grinder slidably disposed in said passage,
eccentric means for reciprocating said disks in said passage,
means for turning said rotating members,
means for adding pressing torque to the surfaces of said wheel grinder, and
a holder secured in said bed and adapted to support a workpiece to be ground.

2. The honing equipment, as set forth in claim **1**, wherein
said disks move in said passage in diametrical direction.

3. The honing equipment, as set forth in claim **1**, wherein

said eccentric means comprises a pin projecting eccentrically from one of said disks,

a reciprocating plate securing said wheel grinders thereto and receiving said pin, so that upon rotation of said one of said disks, said plate performs a reciprocating movement.

4. The honing equipment, as set forth in claim 1, wherein

said threaded spindle includes a worm wheel,

a worm meshing said worm wheel,

spring means forcing said worm backwardly, said worm tending to move ahead with said worm wheel, thereby rotating said threaded spindle, and

said worm having a shaft,

said shaft carrying a flange moving axially with said shafts,

a limit switch engaging said last mentioned flange and operated upon axial movement of said flange, and

a motor operatively connected with and turning said threaded spindle.

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