May 10, 1966 S. MESSERSCHMIDT 3,250,042

DEVICE FOR LAPPING AND GRINDING BALLS

Filed May 22, 1964 2 Sheets-Sheet 1

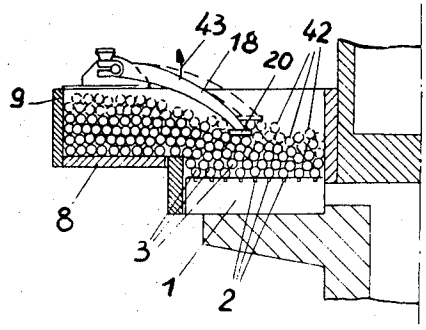


Fig. 1

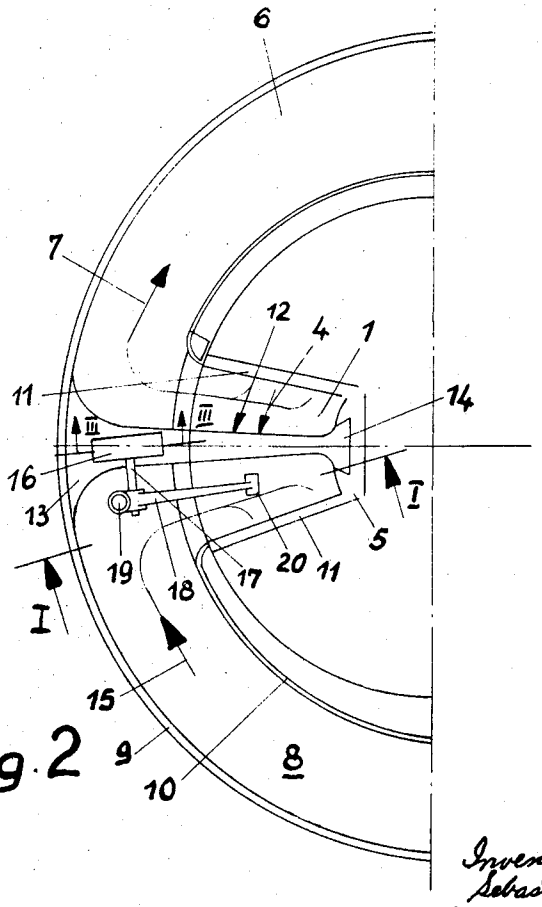


Fig. 2

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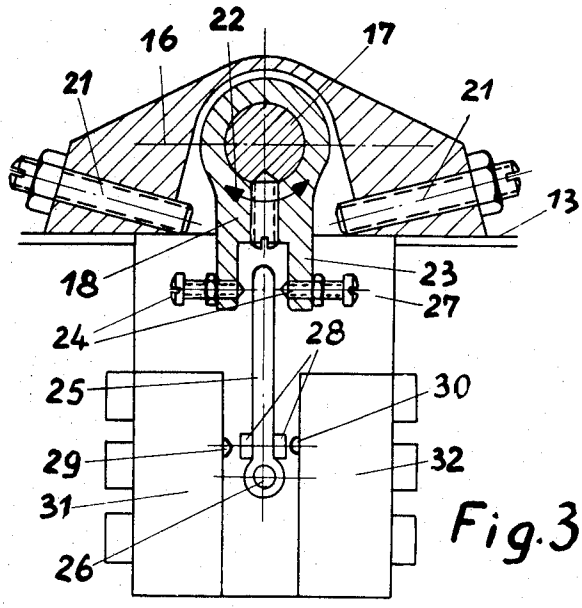


Fig. 3

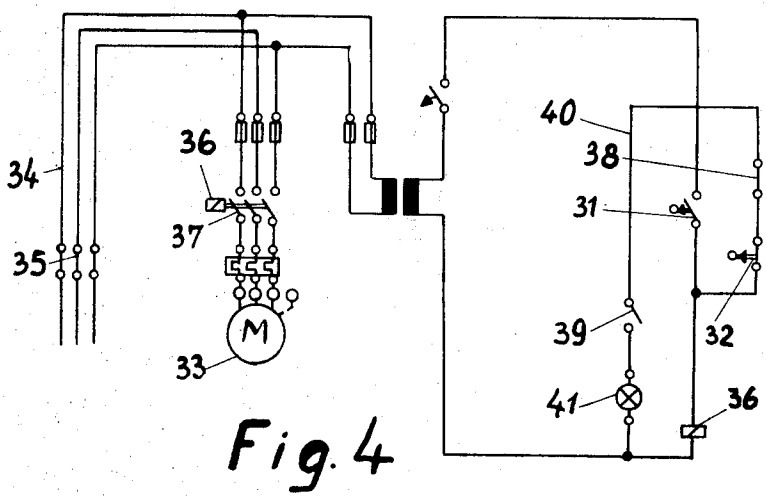


Fig. 4

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United States Patent Office 3,250,042
Patented May 10, 1966

3,250,042

DEVICE FOR LAPPING AND GRINDING BALLS

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Filed May 22, 1964, Ser. No. 369,472
Claims priority, application Germany, May 31, 1963,
M 57,046
8 Claims. (Cl. 51—116)

The invention relates to a device for lapping and grinding balls with a magazine rotating in a substantially horizontal plane, which repeatedly feeds the continuous stream of balls to a ball inlet leading to the lapping wheels.

In the manufacture of balls, the endeavor to achieve a rational mode of working is not directed solely to obtaining greater precision as regards measurement and shape, but also to saving manual labour, that is as far as possible automation of the lapping operation.

An important step in this direction is the use of an annular magazine with systematic continuous passage of the balls. It is true then that trouble can still occur through varying of the addition of oil and grinding agent or through irregularities in the leading-off of the grinding dust. Thus stoppages can then occur at the ball inlet if the balls are not reliably gripped and entrained by the lapping wheels. This generally leads to serious trouble and possibly also to a considerable amount of rejected material.

The object of the invention is therefore to device and establish the conditions for a substantially automatic satisfactory method for lapping and grinding the balls, in order to be able to immediately detect and eliminate disturbances with all the detrimental effects resulting therefrom.

With this object in view it is proposed according to the invention to arrange an arm making contact with the layer of balls in the vicinity of the ball inlet to the lapping wheel and connected with a signal, final control element or the like which becomes operative according to the position of the arm.

The control or supervision therefore takes place directly at the danger point itself, so that any irregularity in the operation can already be detected at the moment it actually occurs.

In the simplest case it is sufficient to notify the disturbance by an optical, acoustic or some other similar signal which attracts the attention of the operator so that he can take the necessary action.

However, it is quite possible to exert a control function on the working operation, which in extreme cases leads to the stopping of the machine.

This embodiment of the invention also takes into consideration the fact that a disturbance in the circulation of the balls first becomes apparent directly at the inlet to the lapping wheel. By radial arrangement, however, a sufficiently large field of traverse is obtained for the feeler arm.

It has been found particularly advantageous to provide stops limiting the field of traverse of the feeler arm and to make these stops adjustable according to the actual working conditions. The field of traverse of the feeler arm can be adjusted in a simple manner according to the size of the balls actually being worked.

It is also within the scope of the invention to make the arrangement so that the feeler arm in at least two positions cooperates with one of two parallel-connected switch elements of the regulating, signalling or other circuit, whereby the switch element is normally closed when the swivel arm is in the upper swivel position and normally opened when it is in the lower swivel position.

As a result the feeler arm, which as the ball bed rises produces a signal or the like by opening a switch and in descending with the level of the ball bed after rectifying the disturbance and clearing the ball stoppage, first again closes the switch opened on account of the disturbance, whereby however normal working is only restored when the second switch is also actuated after the feeler arm has descended.

The contact surface of the feeler arm resting on the ball bed is preferably provided with a coating of wear-resisting material. For this purpose leather and also a large range of plastics come into question because these not only have a long life but prevent damage to the balls.

In another embodiment of the invention, a speed regulator for the magazine drive can be coordinated to the feeler arm. Thus, for example, any further rise in the level of the ball bed in the region of the ball inlet to the lapping wheels is counteracted by a reduction in the speed at which the magazine rotates. It is also possible to connect up behind the speed regulator a switch element which cuts out the drive of the magazine and only responds when the ball accummulation continues to increase in spite of the decrease in the speed of rotation of the magazine.

Finally, it likewise comes within the scope of the invention to coordinate to the feeler arm a regulator for the addition of oil and/or abrasive, which exerts a controlling effect in the event of any disturbance and reestablishes the optimal friction conditions between the lapping wheels.

Further features, details and advantages of the invention will become apparent from the following description of a preferred embodiment illustrated by way of example in the accompanying drawings, in which

FIG. 1 is a vertical section through a ball inlet and the magazine of a lapping device, taken on line I—I of FIG. 2;

FIG. 2 a broken-open top plan view of the device illustrated in FIG. 1;

FIG. 3 a section on line III—III of FIG. 2, and

FIG. 4 a simplified circuit diagram of the device.

The lapping device operates with two lapping wheels which rotate plane parallel to each other about a vertical axis, the lower of these wheels being designated by **1** and having a series of concentric grooves **2** in which the balls **3** are guided. Facing the rotating lower lapping wheel **1** travelling in the direction of the arrow **4** is the upper stationary lapping wheel **5**.

The lapping wheels **1**, **5** are arranged eccentrically within an annular magazine **6** surrounding them and forming a continuous groove extending in the direction of the arrow **7** and formed by the bottom surface **8** and the two side walls **9** and **10**.

The ball inlet **11** consists of a sector-shaped aperture in the upper lapping wheel **5** and projecting into this aperture **11** is a shoe designated by **12** the foot **13** of which merges in the form of an arc into the outer boundary wall **9** of the magazine **6** while the other end **14** rests on the lapping wheel holder. This shoe **12** extends substantially radially across the magazine **6** and through the ball inlet **11** so that the balls travelling in the magazine **6** in the direction of the arrow **15** are deflected from their circular path and, as indicated by the arrows, fed between the lapping wheels **1** and **5**. The rear side of the shoe **12** is similarly constructed so that it is capable of guiding the stream of balls passing out from between the lapping wheels into the groove of the magazine **6**, as indicated by the arrow **7**.

On the foot **13** of the shoe **12** a bearing **16** is provided for a substantially tangential shaft **17** on the free end of which a feeler arm **18** projecting into the ball inlet **11** is

fixed by means of a knurl-head screw **19** or the like. This feeler arm **18** terminates in a plate **20** which, as shown in FIG. 1, rests on the balls within the ball inlet **11**. This plate **20** preferably has on its bearing surface a wear-resisting coating of plastic substance or leather, which however is not shown on the drawings.

Two adjustable stops **21** are provided in the bearing **16** and limit the swivel range of the feeler arm **18** in both directions, as indicated by the arrow **22**. The fork **23** of the feeler arm **18** carries two adjustable contact elements **24** which act on a switching lever **25** mounted at **26** in a swivel housing designated as a whole by **26**. Through the intermediary of contacts **28** this switching lever co-operates with contacts **29** and **30** of parallel-connected switches **31** and **32**.

In the circuit diagram illustrated in FIG. 4 the driving motor for the magazine **6** is designated by **33**. In the feed circuit **34** leading to the motor, apart from the main switch **35**, another switch **37** controlled by a relay **36** connected up behind the two switches **31** and **32**, is provided. The relay **36** is series-connected with the two switches **31** and **32**. It operates two other switches **38** and **39**, the switch **38** being connected in series with the switch **32** whereas as the switch **39** is provided in the circuit **40** in which the signal lamp **41** is located.

If for any reason the ball bed in the ball inlet **11** rises above a certain lever, as indicated at **42** in FIG. 1, the feeler arm **18** will swing in the direction of the arrow **43** about the shaft **17**. One of the contact bolts **24** then strikes against the switching lever **25**, as shown in FIG. 3, so that one of the contacts, for example the contact **28**, bears against the contact **30**, thereby opening a switch **32** which is normally closed. As the parallel connected switch **31** is normally open the relay **36** is deprived of current and the switch **37** in the circuit **34** leading to the driving motor **33** of the magazine **3** opens. At the same time the switch **38** drops but on the other hand the switch **39** closes the feed circuit to the signalling element **41** in the circuit **40**. The excessive rise of the ball bed **42** will thus be indicated to the operator so that he can take the necessary steps to remove the disturbance. When this has been done or if the ball accumulation **42** is again reduced automatically, the feeler arm **18** again drops in the direction counter to the arrow **43**, whereby the switch **32** is closed automatically. The relay **46** does not however yet receive current because the switches **38** and **31** are still open. Only when the feeler arm **18** swings below the normal level of the ball bed in the ball inlet **11** does the contact **28** of the switching lever **25** come into contact with the contact **29** of the switch **31** and consequently closes this as long as these contacts **28** and **29** are in touch. The relay **36** is then tensioned and simultaneously closes the switch **37** in the feed circuit **34** leading to the driving motor **33** for the magazine **6** and also the switch **38** which is in series with the switch **32**. On the other hand the switch **39** is opened so that the signalling device **41** is deprived of current. Only when the ball bed in the ball inlet **11** again reaches its normal level is the connection between the contacts **28** and **29** severed and consequently the switch **31** opened. In this stage the relay is under current through the normally closed switch **32**.

It is evident that the invention is not confined to the embodiment described above and illustrated in the accompanying drawings and that numerous modifications are possible without departing from the fundamental idea of the invention. Thus, the circuit diagram merely shows a particularly simple case for regulating the motor **33** for the magazine **6**. It is, however, quite possible to provide a stepped or infinite regulation for the motor **33**. On the other hand switching elements effecting the dosing of the oil addition and the abrasive material addition can also be provided in a similar manner.

What I claim is:

1. Device for lapping and grinding balls, comprising an annular magazine rotating in a substantially horizontal plane, two superposed lapping wheels arranged within said annular magazine, a continuous stream of balls being continuously fed from the magazine through a ball inlet leading between the two lapping wheels, a feeler arm arranged in the region of the ball inlet and in contact with the layer of balls in the magazine, and switching elements for signalling, regulating and other similar purposes connected with said feeler arm and actuated thereby according to its position.

2. Device according to claim **1**, wherein the feeler arm engages substantially radially in the ball inlet and is mounted to swivel about an axis substantially tangential thereto.

3. Device according to claim **2**, wherein the swivel range of the feeler arm is limited by adjustable stops.

4. Device according to claim **3**, wherein the feeler arm in at least two different positions cooperates with one of two parallel connected switching elements of the regulating, signalling or other circuit, whereby the switching element corresponding to the upper swivel position is normally closed and the switching element corresponding to the lower swivel position is normally open.

5. Apparatus according to claim **4**, wherein at least one adjustable switching lever is coordinated to the feeler arm and in turn acts on the switching elements of the regulating, signalling or other circuit.

6. Device according to claim **1**, wherein the contacting surface of the feeler arm has a wear-resisting coating.

7. Apparatus according to claim **1**, wherein a speed regulator for the magazine drive is coordinated to the feeler arm.

8. Device according to claim **1**, wherein a regulator for dosing the oil and abrasive additions is coordinated to the feeler arm.

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LEONARD S. SELMAN, *Examiner.*