Sept. 6, 1960 C. G. MENARD 2,951,320

CLAMP FOR INTERNAL GRINDING MACHINE

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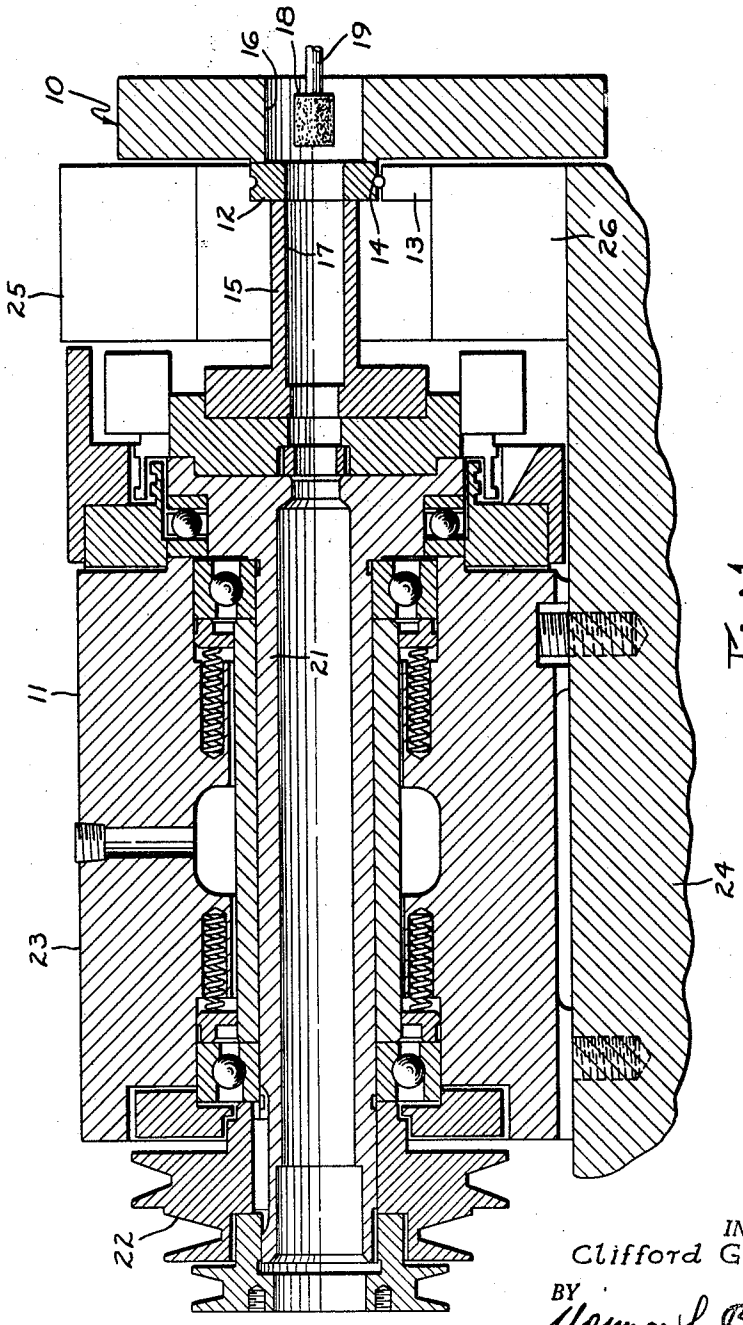

Fig. 1

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CLAMP FOR INTERNAL GRINDING MACHINE

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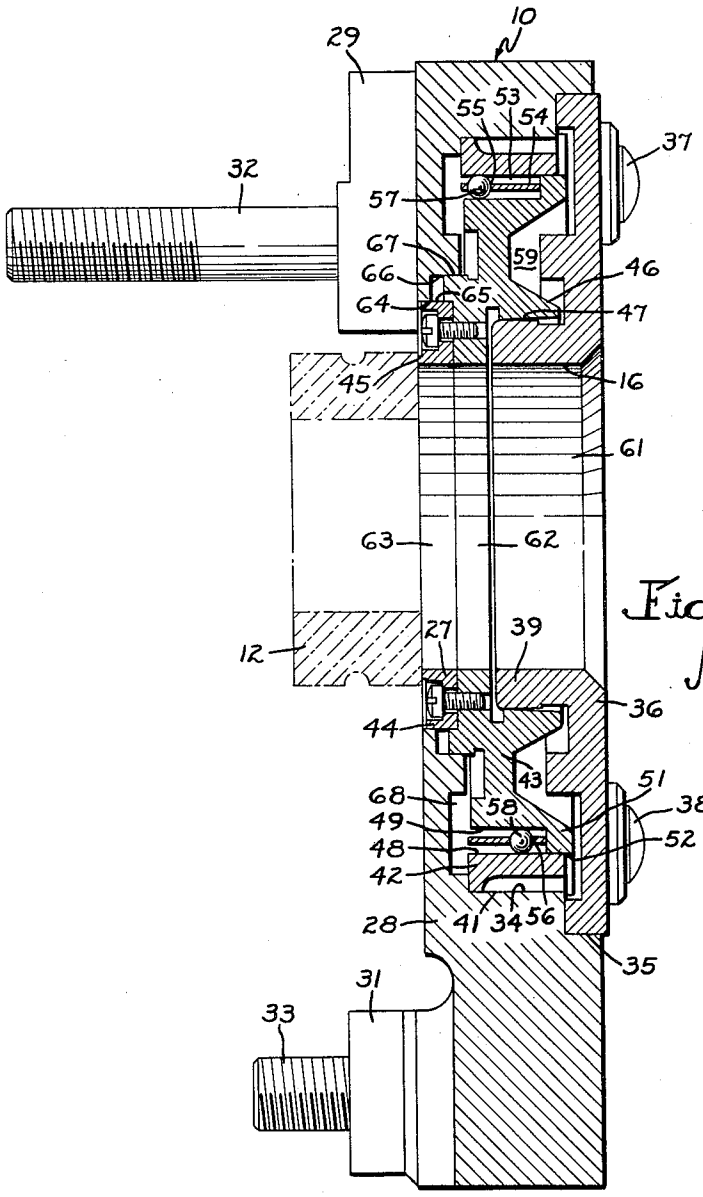

Fig. 2

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CLAMP FOR INTERNAL GRINDING MACHINE

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1 Claim. (Cl. 51—236)

This invention relates generally to a clamp for an internal grinding machine and more particularly to a pneumatically-actuated clamping plate for holding a workpiece in place during internal grinding.

In the art of internal grinding it is common practice to support a workpiece by contact of its periphery with a pair of horizontal rolls and to rotate the workpiece on these rolls by means of a driving head. The driving head is situated somewhat eccentrically of the workpiece so that a component of friction force is obtained which presses the workpiece downwardly onto the rolls and holds it in place. At the opposite end of the workpiece from the driving head is located a pressure plate which holds the workpiece against the driving head and prevents axial motion. It is necessary that this clamping plate be capable of removal from the workpiece area during the loading or removing of workpieces from the machine. A common method of constructing this clamp is in the form of a pneumatic piston wherein air pressure behind the piston forces it against the workpiece and holds the workpiece in place; during the removal of a finished workpiece and the introduction of a new workpiece, the air pressure is removed from the piston whereby access to the work area is possible. Considerable difficulty has been experienced in the past with this type of clamping plate because of the tendency of the piston to bind in its cylinder. When binding takes place, the clamp is liable to be inoperative so far as maintaining pressure on the workpiece is concerned. Also, during removal of the workpiece, it may be difficult to release the workpiece from engagement. Various means have been developed for mounting the plate without binding, but none of them have been entirely successful. The difficulties experienced with the prior art devices have been obviated in a novel manner by the present invention.

It is therefore an outstanding object of the invention to provide a clamp for an internal grinding machine in which a pneumatically-actuated clamping plate is so mounted as to be free of binding.

Another object of this invention is provision of a clamp for an internal grinding machine which is inexpensive to manufacture, rugged in construction, and which presents a minimum of need for maintenance.

It is a still further object of the present invention to provide a clamp which is pneumatically actuated, which clamp is capable of straight line motion without difficulty experienced due to binding.

It is another object of the instant invention to provide a pneumatically-actuated clamp capable of rotation and having a novel bearing construction to prevent binding.

With these and other objects in view, as will be apparent to those skilled in the art, the invention resides in the combination of parts set forth in the specification and covered by the claim appended hereto.

The character of the invention, however, may be best understood by reference to certain of its structural forms, as illustrated by the accompanying drawings in which:

Figure 1 is a vertical sectional view of an internal grinding machine making use of a clamp constructed according to the principles of the present invention, and

Figure 2 is a vertical sectional view, somewhat enlarged, of the clamp shown in Figure 1.

Referring first to Figure 1, wherein is best shown the general features of the invention, the clamp, designated generally by the reference numeral **10** and shown schematically, is illustrated in use with an internal grinding machine **11**. A workpiece **12**, which is shown as the inner race of a roller bearing, is mounted in the machine **11** in order that its internal bore may be finished. The periphery of the workpiece **12** is supported by support members **13**, friction being reduced to a minimum by the provision of a ball **14**. At one end, the workpiece is contacted by a driving head **15**, and at the other end by the clamp **10**. A bore **16** passes through the clamp and a bore **17** extends into the driving head **15** a considerable distance; both of these bores are provided to admit an abrading wheel **18** mounted on a spindle **19**. The driving head **15** is attached to one end of a spindle **21** which has at its other end a pulley **22**. The pulley **22** is adapted to be connected to an electric motor, not shown, for the rotation thereof. The spindle **21** is suitably mounted in bearings within a workhead **23** of the usual type, which workhead is mounted on a base **24** of the machine. The wheel **18** is driven by means of a motorized head, not shown, which is also mounted on the base **24**, means being provided, not shown, for reciprocating the wheel as it rotates within the workpiece **12**. Also mounted on the base **24** and residing in the space between the workhead **23** and the clamp **10** is a loading chute **25** which overlies the workpiece. In the same manner, an unloading chute **26** lies under the workpiece and under the drive head **15** to receive the workpiece when it is discharged.

Referring next to Figure 2, which shows the details of the clamp **10**, shown only in a general way in Figure 1, it can be seen that the clamp consists generally of a clamping plate **27** mounted in a housing **28**. The housing is mounted firmly on the base **24** by means of abutments **29** and **31** from which extend, respectively, studs **32** and **33**. The housing **28** is provided with a central bore **34** in which are mounted the components of the clamp. A portion **35** of the bore **34** is considerably larger than the remainder and in the annular recess so formed is mounted a cover **36** fastened in place by means of bolts **37** and **38**. The cover **36** is provided with an annular lip **39** which extends well into the clamp. A portion **41** of the bore **34**, having a diameter somewhat reduced from the portion **35**, has mounted therein a hardened steel annulus **42**. The clamping plate **27**, as is evident in the drawings, consists of both a main body **43** which lies within the clamp and a hardened steel pressure member **44** which actually serves to contact the workpiece **12**. The member **44** is fastened to the main body member **43** by suitable screws. The pressure member **44** is provided with a thin lip **45** extending outwardly toward the workpiece and constitutes the portion of the member which actually makes contact with the workpiece. The main body member **43** of the clamping plate is provided with an axially-extending lip **46** which surrounds and makes sliding contact with a finished surface **47** on the outer portion of the lip **39** of the cover **36**.

The annulus **42** is provided with a finely ground internal cylindrical surface **48**, while a similarly ground external surface **49** is provided on the main portion **43** of the clamping plate. The portion of the surface **49** which is furthest from the workpiece **12** is provided with a radially-extending flange **51** which has a finely ground external cylindrical surface **52** formed thereon, which surface makes sliding contact with the surface **48** of the

annulus 42. It can be seen, then, that the main portion 43 of the clamping plate and the annulus 42 have surfaces which define an annular space 53 of rectangular cross-sectional form open at the side adjacent the workpiece 12. In this space resides a thin annular retaining member 54 which is normally situated midway between the surface 48 and the surface 49. The retaining member 54 extends axially from the flange 51 to the area of termination of the surfaces 49 and 48 adjacent the workpiece 12. It is formed with a series of apertures 55 and 56 in which reside, respectively, balls 57 and 58. The apertures 55 and 56 are alternately situated around the retaining member 54, the apertures 55 being situated adjacent the workpiece 12 while the apertures 56 being located away from it, so that the balls 57 and 58 alternate in making contact with the surfaces 48 and 49 adjacent the workpiece and away from the workpiece, respectively. Furthermore, the balls 57 and 58 are formed slightly larger in diameter than the distance between the surfaces 48 and 49 so that the balls are under a slight initial stress when the unit is assembled. The lip 46 and the flange 51 of the clamping plate define with the cover 36 an air pressure space 59. Means is provided, not shown, for introducing air under pressure selectively to the space 59 or to a chamber 68 defined by the housing 28 and the clamping plate 27 on the side thereof facing the workpiece.

It should be noted that the bore 16 which passes through the clamp 10 is made up of a section 61 which constitutes the inner surface of the lip 39 of the cover 36, a portion 62 which constitutes a bore through the main portion of the clamping plate, and a portion 63 which constitutes a bore through the contact member 44. The lip 45 of the contact member, of course, surrounds the portion 63 of the bore. The bore 34 through the housing 28 is provided with a short portion of relatively small diameter 64 which engages the surface 65 of the contact member 44 in sliding contact. Next to the portion 64 the bore 34 is provided with a cylindrical surface of slightly larger diameter than the portion 64, namely, a portion 66 which makes sliding contact with an external cylindrical surface 67 of the main portion 43 of the clamping plate.

The operation of the apparatus will now be readily understood in view of the above description. With a workpiece 12 in place, as shown in Figure 1, the drive head 15 is rotated by means of the spindle 21 and the pulley 22. The workpiece 12 is supported on the balls 14 forming part of the supporting members 13. Air under pressure exists in the chamber 59 so that the clamping plate 27 is in its left hand position with the lip 45 contacting the workpiece 12. The workpiece is rotated by the driving head 15 and the clamping plate is also permitted to rotate with the workpiece. The abrading wheel 18 rotates and reciprocates in the workpiece bore thus finishing it in the usual manner. When it is desired to remove the workpiece, air is released from the chamber 59 and pressure air is introduced in the chamber 68 defined by the housing 28 and the clamping plate 27 on the side thereof facing the workpiece. This causes the clamping plate 27 to move to the right until the lip 45 is drawn into the housing 28 and is no longer exposed; thus, the workpiece 12 is released and is permitted to fall into the outlet chute 26 while a new workpiece arrives in the work area from the inlet chute 25.

It can be seen, then, that the clamping plate 27 moves within the housing in an axially reciprocating movement. On occasion the ends of the workpiece 12 may not be exactly parallel so that the clamping plate is called upon to take up a position which is not exactly at a right angle to the axis of rotation. With conventional clamps of this type the result is a binding in the bearings, but in the present case the particular type of bearing insures against this. The clamping plate is capable of considerable pressure tending to make it cant within the housing, but the prestressed axially-spaced balls prevent this. At the same time the clamping plate is capable of free motion in its axial direction from operative to inoperative positions.

It is obvious that minor changes may be made in the form and construction of the invention without departing from the material spirit thereof. It is not, however, desired to confine the invention to the exact form herein shown and described, but it is desired to include all such as properly come within the scope claimed.

The invention having been thus described, what is claimed as new and desired to secure by Letters Patent is:

A clamp for a centerless grinding machine, comprising a housing, a clamping plate slidably and rotatably mounted within the housing, an external cylindrical surface formed on the clamping plate, an internal cylindrical surface formed on the housing, the two surfaces lying in spaced, coextensive, opposed relationship to define an axially-elongated space therebetween, a tubular annular retaining member residing in the said space and having circular apertures therein, a ball located in each aperture and contacting both surfaces, the diameter of each ball being slightly greater than the distance between the surfaces so that the ball is under an initial stress, a first series of the apertures being located in a plane which is at a right angle to the axis of the surfaces adjacent one end of the space and a second series of the apertures located in a similar plane adjacent the other end of the space, the apertures of the first and second series alternating around the circumference of the retaining member, and chambers defined by the housing and clamping plate into which air under pressure may be introduced to actuate the sliding motion of the clamping plate relative to the housing.

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