Sept. 6, 1932. R. L. TEMPLIN 1,875,524

PRESSURE INDICATING MECHANISM FOR ROLLING MILLS

Filed Aug. 28, 1930 2 Sheets-Sheet 1

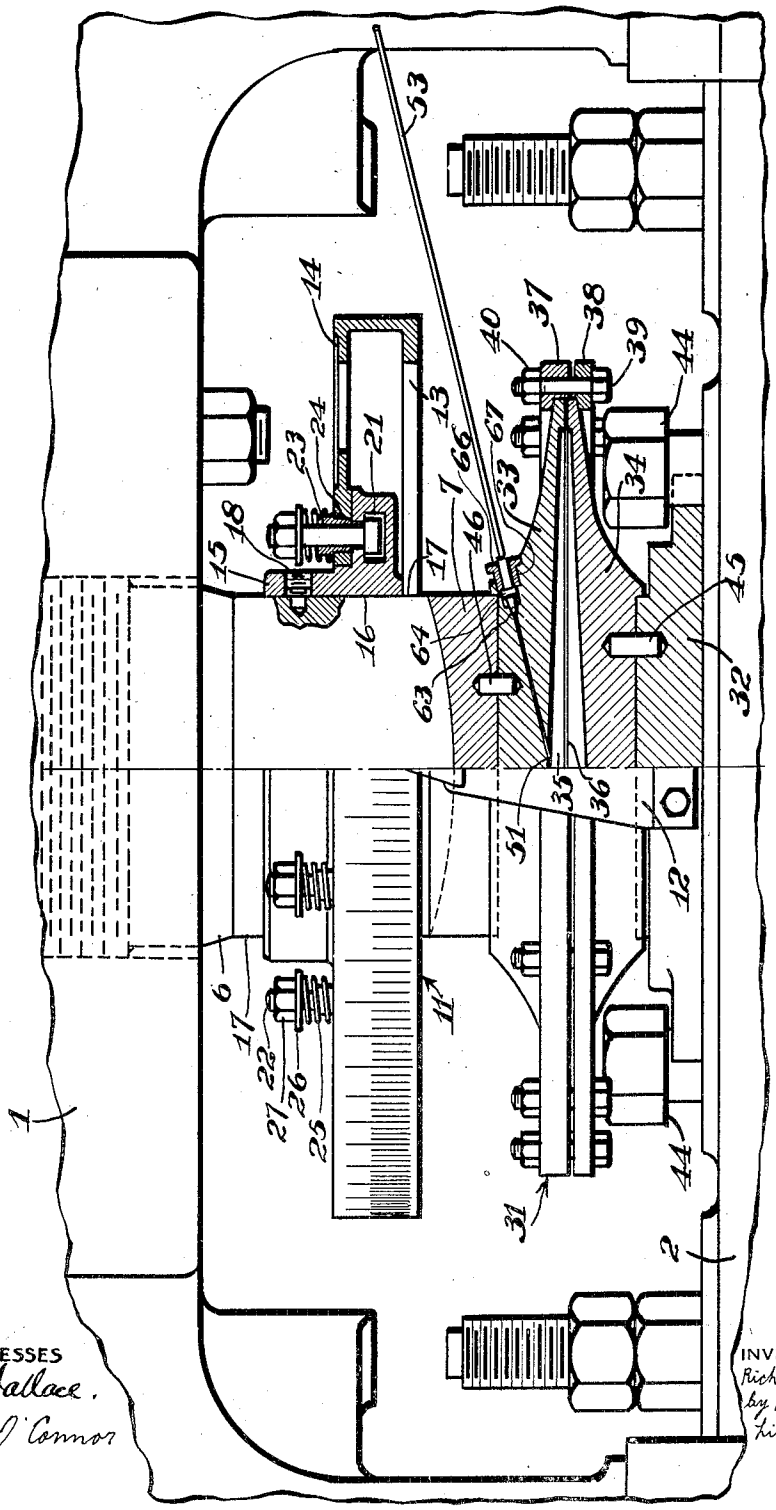


Fig. 1.

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Fig. 2.

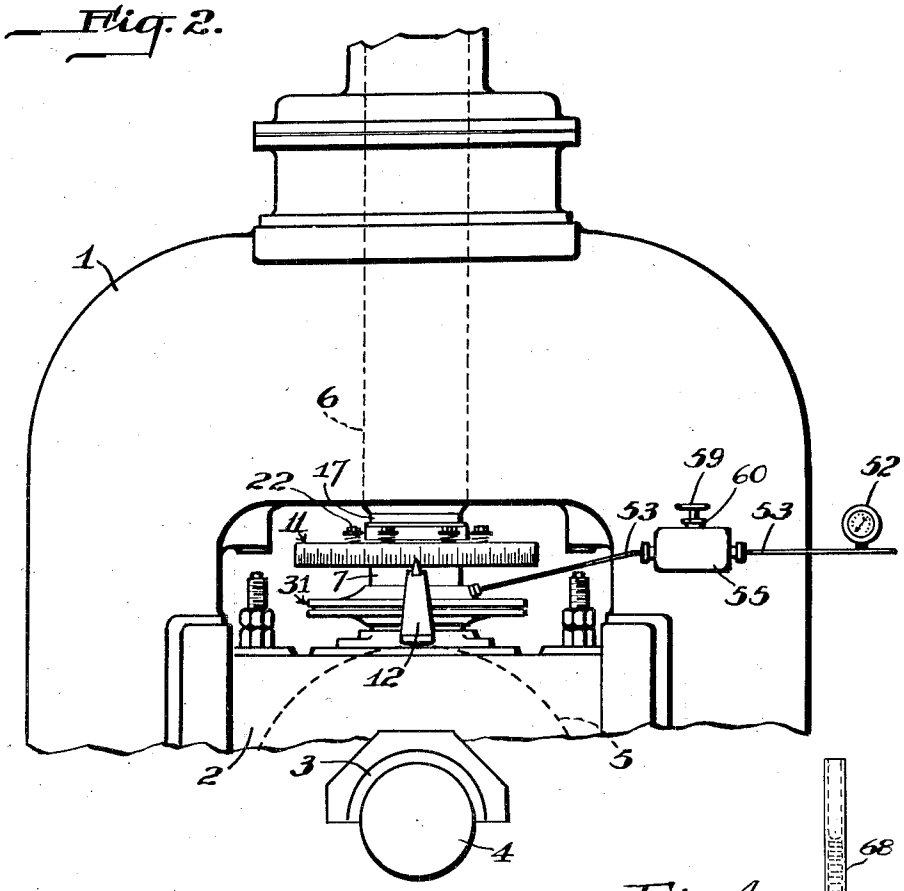
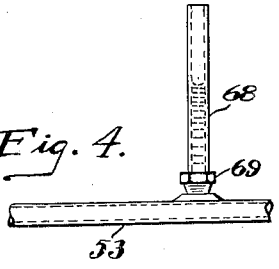


Fig. 4.



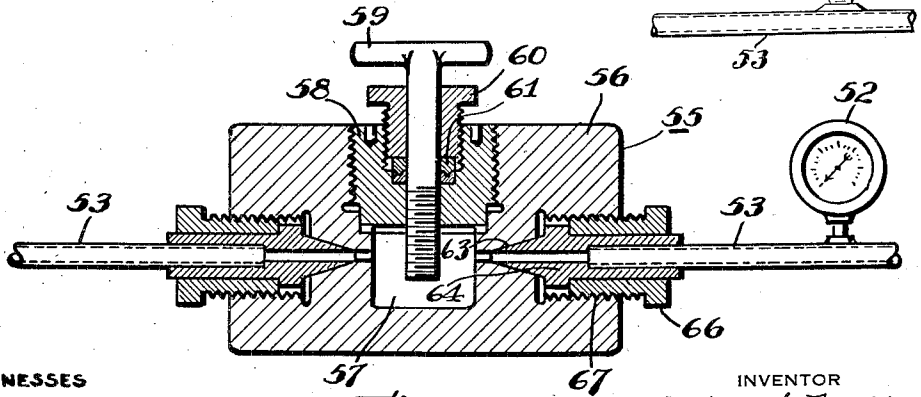


Fig. 3.

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UNITED STATES PATENT OFFICE

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PRESSURE INDICATING MECHANISM FOR ROLLING MILLS

Application filed August 28, 1930. Serial No. 478,500.

My invention relates generally to rolling mills and more particularly to devices for indicating the pressures exerted by the rolling mills when in operation.

In rolling materials, and especially metals, it is desirable to know the pressure which is exerted upon the metal by the rolls of the rolling mill for several reasons. With metals which are difficult to work, such for instance as aluminum, it is of great advantage in controlling the treatment of the metal, during the fabricating period, to know the pressure to which it is subjected by the rolls of the mill. By a process of trial and error, the most suitable rolling pressure for a particular alloy or shape of finished product may be determined, and if a practical means for regulating the pressure exerted by the rolls is available, the most suitable pressure may be accurately applied to subsequent pieces which may be rolled.

Heretofore it has been the practice to regulate the rolling pressure by adjusting the pass opening or clearance space between the rolls in such manner that a predetermined reduction in the cross sectional area of the piece being rolled would be effected. However, this method of adjustment results at best in only an approximation of the desired rolling pressure inasmuch as a number of other factors, such as the temperature of the metal being rolled, its composition and dimensions, may greatly affect the pressure resulting from a predetermined change in the clearance between the rolls.

It is further desirable to know the pressure which is being exerted by the rolls at all times in order that excessive pressures may be avoided and the danger of damaging the rolling mill thereby reduced. Heretofore no practical means has been proposed for indicating the pressure exerted by the mill, and such damage to the mill as might occur from excessive pressures has been minimized by inserting special pieces known as breaker blocks between the movable roll bearing and the pressure exerting mechanism. These blocks are usually made of cast iron and are designed to break and relieve the excessive pressure before damage can occur to the larger and more expensive portions of the mill.

It is, therefore, an object of my invention to provide a practical device of simple and rugged construction which is suitable for indicating the pressure exerted by the rolls of a rolling mill on the work being rolled.

Another object of my invention is to provide a device for measuring large forces, which utilizes a flexible fluid container for resisting the force to be measured, and includes means responsive to the fluid displaced from the container when it is deflected to indicate the value of the force.

A further object of my invention is to provide means for readily and accurately adjusting a force-indicating device to measure a predetermined range of forces.

The structure for accomplishing these objects, and which embodies my invention, includes a suitable flexible element which may be disposed between the screw-down mechanism of a rolling mill and the movable roll bearing, together with fluid pressure means for accurately measuring the deflection of the flexible element when the rolling mill is in operation in order to indicate the pressure exerted by the roll upon the work being rolled.

The foregoing objects and others, which will become apparent upon reading the following specification, may be attained by the structure described therein and shown in the accompanying drawings, in which Fig. 1 is a view, partly in elevation and partly in section, of the pressure indicating device which embodies my invention, and a fragment of a rolling mill structure to which it is attached; Fig. 2 is a view, in end elevation, of a portion of a rolling mill and of the pressure indicating system embodying my invention, showing the manner in which the system may be applied in practice; and Fig. 3 is a view, in longitudinal section, of a volume regulating device that constitutes a part of my invention and which is utilized in the pressure indicating system shown in Fig. 2 or Fig. 4. Fig. 4 is another form of device for indicating the pressure from the fluid system.

As shown in the drawings, the pressure indicating device which embodies my invention

may be applied to a rolling mill of well known design, which comprises a frame member or housing 1 in which is slidingly mounted a cradle or casing 2 that carries a bearing 3 of bronze or of any other suitable material, or a roller bearing, for engaging the journal or roll neck 4 of an upper mill roll 5. For the sake of simplicity, only one bearing and one mill roll is shown in the drawings, but it will be readily understood that the other end of the mill roll 5 is also provided with a slidable bearing and that in the lower portion of the frame (which is not shown) one or more other mill rolls for cooperating with the upper roll 5 are mounted in either slidable or fixed bearings in a manner well known in the art.

In order that the distance or pass opening between the rolls may be regulated, and also for the purpose of exerting pressure upon the rolls, each end of frame 1 is provided with a screw-down mechanism comprising a spindle 6 that is disposed to exert a downward force upon the slidable bearing cradle 2 at each end of the roll 5. The screw-down spindles 6 are normally provided with heavy threads of the square or Acme type which engage complementary threads in the upper portion of frame 1. Suitable means, well known in the art, may be provided for turning the screw-down spindles either separately or simultaneously, and may be operated by hand wheels or motors (not shown).

That the screws may be free to turn about their axes without binding, means are provided for permitting each to align itself. As shown most distinctly in Fig. 1, the lower end of the spindle 6 has the shape of a portion of a sphere, and is disposed to engage a block or bearing shoe 7 of complementary shape which may be of bronze or other suitable bearing material and is carried by the slidable roll bearing 2. If desired, the bronze block 7 may be so designed as to also serve the purpose of a breaker block such as is ordinarily used in rolling mills and is normally made of cast iron or other inexpensive material. Heretofore, these cast iron breaker blocks have been relied upon entirely for the protection of the remainder of the mill from excessive pressures, they being the means which the mill operator possessed for limiting the pressure exerted by the rolling mill.

That the mill operator may know the amount which the roll 5 is moved by the screw-down mechanism when it is operated, the lower end of screw 6 is provided with a micrometer scale 11 disposed to cooperate with a pointer or indicator 12 carried by the roll bearing housing 2. It is desirable to be able to adjust the micrometer scale 11 angularly relative to spindle 6 to compensate for wear in the mill structure, or for the purpose of adapting the scale to rolls of different diameters. This adjustment may be readily accomplished by the structure in Fig. 1 in which the cross sectioned portion clearly shows that the micrometer scale 11 comprises an annular rim 13 of channel shaped cross section provided at one side with a web portion 14 which serves to support the rim. The inner edges of the web 14 rests upon a cast iron collar 15 having an internal bore 16 that engages a cylindrical surface 17 on the spindle 6. Suitable means, such as safety set screws 18, are provided for securely attaching the collar 15 to the spindle 6. As shown, the collar 15 is provided with a circular T-slot 21 disposed to receive the heads of a plurality of bolts 22 which serve to hold the rim 14 of the micrometer scale 11 in frictional engagement with the collar 15. Each bolt 22 is provided with a bushing 23 which engages a hole 24 in the web 14 of the micrometer scale 11, and which is provided with a shoulder or enlarged portion which rests upon the upper side of the web 14. That the proper degree of friction may be maintained between the web 14 of the micrometer scale and the collar 15, suitable springs are provided, such as coil springs 25, which encircle the shoulders 23 of the bushings 24, and are compressed by means of washers 26 at their upper ends which are held in place by nuts 27 threaded on the bolts 22. By turning the nuts 27, the degree of compression of the springs 25 may be so adjusted that any desired degree of frictional resistance may be set up between the collar 15 and the web 14 of the micrometer scale 11. In operation it may be desirable to normally maintain a high degree of friction and to loosen the nuts 27 in case it becomes desirable to move the scale 11 relative to the spindle 6.

By means of the micrometer scale 11 the mill operator is enabled to know at all times the width of the pass opening or the distance between the rolls of the rolling mill. This information is very desirable, but from it alone the operator cannot determine all of the conditions under which the mill is operating. In addition to knowing the width of the pass opening, it is highly desirable to also know the pressure which is being exerted by the rolls upon the metal being rolled. To accomplish this end, I have provided by my invention a practical device for measuring the pressure exerted by the rolls of a rolling mill.

As shown in the drawings, my device comprises a load-measuring element or capsule 31 disposed beneath the bronze bearing shoe 7 and carried by a pressure block 32 mounted on the slidable bearing housing 2. In this position the device 31 is disposed to transmit all of the force exerted by the screw-down spindle 6 upon the slidable bearing housing 2.

The load-measuring device 31 comprises two flexible discs 33 and 34, of steel or other suitable material, which are similarly shaped

in the general form of a discus or saucer-like member. The adjacent faces of these discs are slightly concave throughout their central portions, and are provided at their edges with cooperating plane surfaces which enable them to be joined to constitute a closed chamber 35. So that high pressures may be developed within chamber 35 without danger of the contents thereof leaking out of the edges of the capsule 31, an annular gasket 36, preferably of soft metal such as aluminum, is provided between the plane edges of discs 33 and 34.

Positive sealing of the joint between discs 33 and 34 is effected by means of clamping rings 37 and 38 which are applied in a well known manner. To prevent the gasket 36 from being blown out from between the edges of the discs, upper clamping ring 37 is made in the shape of an annulus having an internal bore which closely engages the peripheries of both of the discs, thereby effectively confining the gasket. At its upper edge ring 37 is provided with an inwardly projecting flange which engages the external face of the disc 33. Similarly, the lower ring 38 is provided with a flange for engaging the lower surface of disc 34, and the rings may be drawn together in a well known manner by means of a plurality of bolts 39 disposed in aligned holes through the rings 37 and 38 and provided at their ends with nuts 40.

That all of the relative motion, which occurs between the spindle 6 and the bearing block 2 when the spindle is rotated, may take place between the spherical lower end of the spindle 6 and the bronze bearing block 7, the various parts which support bearing block 7 are secured against rotation relative to the bearing housing 2. As shown, the pressure block 32, which incidentally carries the pointer 12, is securely fastened to the bearing cradle 2 by means of bolts or cap screws 44. The upper portion of bearing block 32 is provided with a cylindrical shoulder which engages a complementary countersunk opening in the lower face of disc 34. Relative rotation between these members is prevented by means of suitable dowel pins 45. The upper disc 33 is likewise provided with a countersunk opening in its upper face which receives the lower end of the bronze shoe 7 which is held from rotating by means of dowel pins 46.

So that the pressure applied to the mill rolls by the screw-down spindle 6 may be indicated, the cavity 35 between the discs 33 and 34 is preferably completely filled with a suitable working fluid, such as oil, which may be displaced through an opening 51 in the upper disc 33 when the discs are deflected by the load imposed upon them. As shown in Fig. 2, the amount of fluid displaced from the cavity between the discs may be indicated by means of a gage 52, of any suitable type, connected to the opening 51 by a pipe 53. The type of coupling used to connect the opening 51 to the pipe 53 is similar to those shown in detail in Fig. 3 in which like numbers indicate like parts. The gage 52 is preferably of the type known as the Bourdon gage, which consists essentially of an elastic metal tube of oval cross section bent into an arc or a circle. Any increase of pressure in the fluid within the tube tends to force the oval sectioned tube into one of circular cross section and also to increase the radius of the arc of curvature, and in so doing the increased pressure operates the pointer or indicating needle of the gage which is suitably connected to the free end of the arc shaped tube. It is desirable that the gage be calibrated to read directly in pounds pressure applied to the mill rolls. Another suitable type of gauge such as is shown in Fig. 4 may be utilized when comparatively light pressures are encountered in the fluid system. This gauge consists essentially of a glass tube 68 attached in any suitable manner to a threaded bushing 69 adapted to be placed into threaded engagement with the tube 53. The pressure change in the fluid system is then indicated by the change in level of the fluid in the tube 68, which change may be measured either by means of graduations placed on the tube or any conventional measuring device, and may be calibrated to read directly in units of pressure or of linear measurement. If calibrated in the latter type of units, a conversion factor must be used to obtain a value of the pressure in pressure units. By the use of this type of gauge the pressure obtained in the operating fluid is very close to zero at all times and the force exerted by the screw-down spindle 6 would be carried entirely by the flexible discs 33 and 34.

That gage 52 may be conveniently adjusted to indicate zero pressure when no load is applied to the mill rolls, a suitable volume-regulating device 55 is provided in pipe 53. As shown in detail in Fig. 3, such device comprises a block or body portion 56, preferably of steel, and provided with a centrally disposed cavity, 57, closed by a plug 58 in which is threaded a regulating or adjusting screw 59. As shown, leakage past the adjusting screw 59 is prevented by means of a suitable gland nut 60 and packing 61. By turning the operating handle of the adjusting screw 59 to move it into or out of the cavity 57, the volume of the fluid pressure system may be adjusted in such manner that gage 52 will indicate zero pressure when no load is applied, and consequently will accurately indicate the true pressure exerted by the rolls when the mill is in operation. In the event that there is a slight leakage of liquid from the system, it will be found necessary to turn down the regulating screw 59 at intervals in order that the volume of the system may be

made equal to the volume of the liquid remaining in it at zero pressure.

That leakage from the pressure system may be reduced to a minimum, the connections with the pipe 53 have been made as nearly pressure-proof as possible. As shown in detail in Fig. 3, each joint between the elements of the system and the pipe 53 is made by forming a conical bore 63 in the element to which the connection is to be made and which is adapted to receive the point of a cone-shaped bronze block 64. The bronze block 64 is provided with a central bore or passageway for the liquid and, at its inner end, its edges are sharpened to constitute what is known as a feather edge for closely engaging the tapered bore 63. At its external end block 64 is provided with an enlarged bore for receiving the end of the pipe 53 which may be secured therein by means of any well known sweating or soldering process. Each of the blocks 64 is held securely in contact with its cooperating conical bore 63 by means of a threaded gland nut 66 engaging internal threads 67 in the member to which the connection is made.

Although only one mill housing and slidable bearing cradle has been shown and described as being provided with my pressure indicating device, it will be readily understood that a similar pressure measuring mechanism is normally installed between the screw-down mechanism and slidable bearing at the other end of the mill roll. It is also clear that the other pressure measuring device may be provided with a separate gage, or the pressure measuring device at each end of the roll may be connected to the same gage, preferably of the displacement type, in such manner that the total pressure exerted by the roll may be indicated on one dial.

From the foregoing description and explanation of the operation of my device it is apparent that my invention provides a satisfactory device for measuring the pressures exerted by the rolls of a rolling mill, and that this device enables mill operators to regulate the process of rolling metal in a more precise manner than they have heretofore been able to do.

Although I have described and shown only one embodiment of my invention, it will be obvious to others skilled in the art to which this device relates that various changes may be made in the proportions and in the general arrangement of the elements of the device, and that gages of types other than the type shown may be utilized, without departing from the spirit and scope of my invention as defined in the appended claims.

I claim:

1. In a rolling mill, in combination, a housing, a slidable roll-neck bearing carried by the housing, a screw-down mechanism mounted on the housing and operative to exert pressure upon the slidable bearing, a collar secured to the screw-down mechanism and having an annular groove of T-shaped cross section, a dial carried by the collar, a plurality of bolts and springs mounted in the T slot for holding the dial in frictional engagement with the collar whereby it may be turned relative thereto to effect an adjustment, and a pointer disposed to cooperate with the dial to indicate the position of the slidable bearing.

2. A pressure-measuring device, comprising a pair of flexible disc members having concave faces disposed in superimposed relation to constitute a closed chamber, a gasket disposed between the engaging edges of the discs, a clamping ring having an internal bore disposed to engage the peripheries of the discs for retaining said gasket and having a shoulder for engaging the external face of one disc near the edge, a second clamping ring for engaging the edge of the other disc, means for holding the clamping rings to compress the edges of the discs into close engagement with the gasket, and pressure indicating means connected to the closed chamber for measuring the pressure to which the external surfaces of the discs may be subjected.

In testimony whereof, I sign my name.

RICHARD L. TEMPLIN.