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Diolot

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[54] **METHOD OF DETECTING AND COMPENSATING FOR DEFECTS ON ROLLING MILL ROLLS AND MEANS FOR APPLYING THIS METHOD**

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[52] **U.S. Cl.** **72/20,** 72/35, 72/245

[51] **Int. Cl.** **B21b 37/08**

[58] **Field of Search** 72/19, 20, 21, 35, 8, 9

[56] **References Cited**

UNITED STATES PATENTS

3,331,229	7/1967	Neumann et al.	72/8
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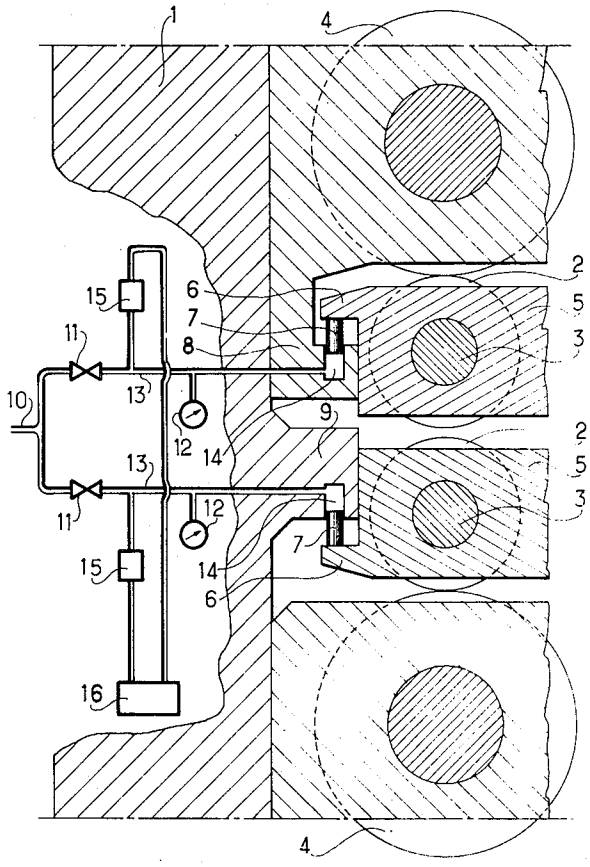
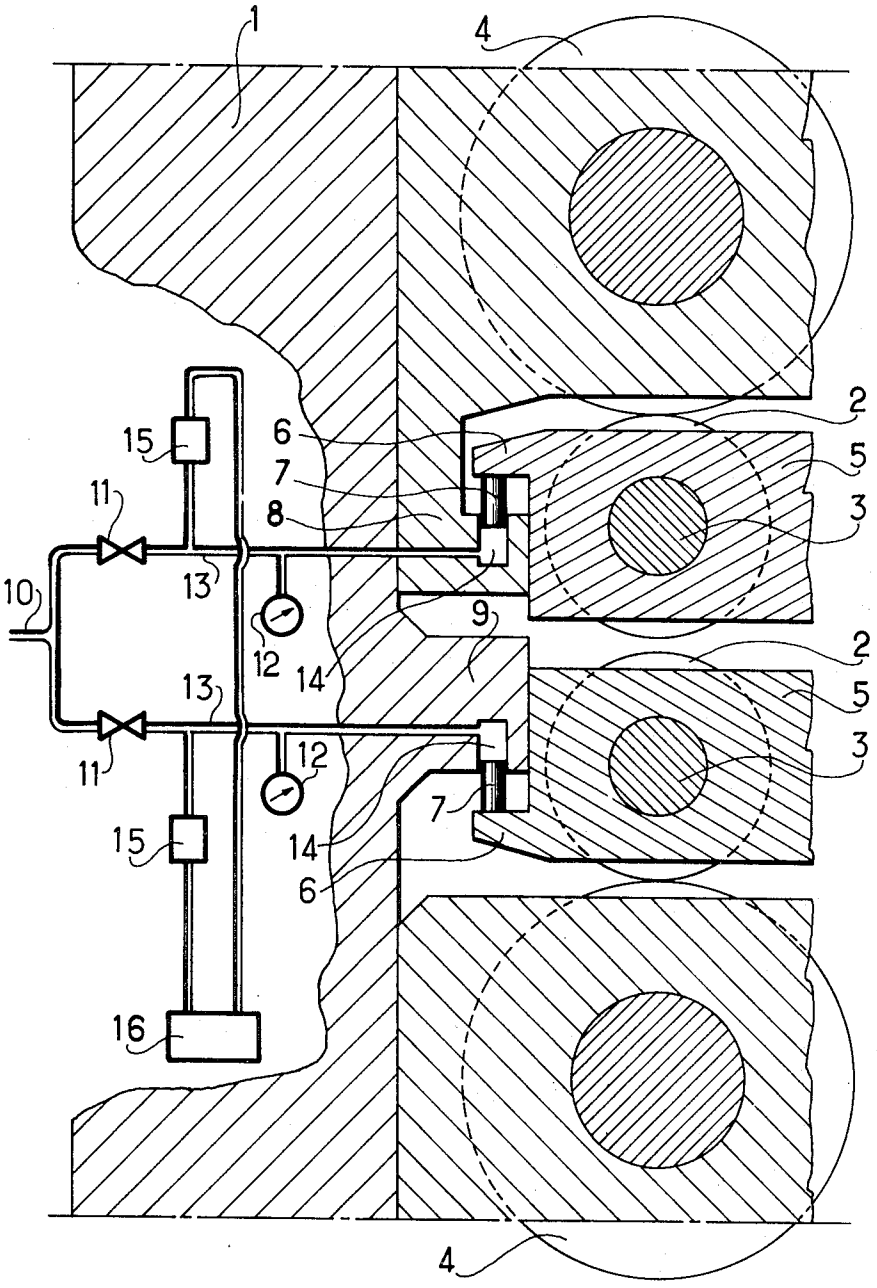
[57] **ABSTRACT**

Method and device for detecting and compensating defects in rolling mill cylinders, characterized in that the fluctuations of the idle pressure of the fluid contained in the hydraulic jacks arranged between shoulders fast with the working chocks of the machine and the corresponding upright of the latter, are picked up, recorded and then restored during normal operation, with a view to controlling the compensation.

6 Claims, 1 Drawing Figure

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METHOD OF DETECTING AND COMPENSATING FOR DEFECTS ON ROLLING MILL ROLLS AND MEANS FOR APPLYING THIS METHOD

This is a Continuation, of application Ser. No. 152,722, filed June 14, 1971.

The present invention relates to a method of detecting and compensating for defects on rolling mill rolls, and also a means for applying this method.

It is already known, particularly from French Patent No. 1,541,086 of the applicants, to compensate for defects of this type, which defects may originate from uneven wear on the rolls, eccentricity of the latter, defective correcting operations to which they may have previously been subjected or any other accidental cause.

According to the aforesaid prior patent, the operation is started by detecting the variations being produced as regards the spacing between two rolls by means of appropriate pick-up devices disposed in contact with the working rolls, the rolling mill turning idly and at slow speed. These variations are recorded on a suitable support, the driving of which is synchronized with the operation of the rolls in question.

The recording thus obtained is utilized for piloting a compensating operation, aiming at progressively correcting the spacing between the working rolls which have served for the recording, the rolling mill this time operating under load and at its normal speed.

However, the method as thus described and its application have been designed as having to be carried out on rolling mills of a particular type, equipped with a main hydro-mechanical tightening (screwdown) system. This latter system has been particularly described in French Patent 1,213,820 of the applicants; the applicants have moreover described in U.S. Pat. No. 3,286,495 a method and a means for compensating for yielding of a rolling mill of the aforementioned type.

The feature common to all these means, which are proposed for compensating for defects of the rolls of a rolling mill, is that the basis is always the variations in the gap existing, throughout the operation of the machine, between the working rolls thereof. However, the influence on these variations of the defects and irregularities which the backing-up rolls of the rolling mill may have can only be sharply detected and consequently compensated for in the case where the said backing-up rolls are directly driven in rotation from outside; in fact, there are always differences, which are minimal but far from being negligible, between the diameters of the two backing-up rolls and, except in the aforesaid case, these differences are offset in phase from one cycle to the next, and this consequently results in any possible compensating action being made problematical.

The method and the means according to the invention are proposed for overcoming this disadvantage, while making the method as thus improved generally applicable to any rolling mill. The only condition set for this rolling mill is that it is equipped with a regulating system, having a sufficiently reduced response time, for being able faithfully to obey the compensating impulses originating from judiciously disposed pick-up devices.

Accordingly to a first feature of the present invention, the value taken into consideration by each pick-up device is no longer a length, as was always the case previously, when the spacing between the working rolls was measured by means of the said pick-up devices; according to the invention, the value is a fluid pressure which undergoes fluctuations in response to the fluctuations in the spacing between the working rolls during operation, this arrangement enabling these last-named fluctuations to be interpreted more faithfully than by means of a direct measurement.

According to another feature of the invention, each pick-up device is associated with one of the working chocks of the rolling mill, and not directly with the corresponding roll, as was the case in the aforesaid French Patent No. 1,541,086 of the applicants. The displacements of each chock relatively to the housing of the rolling mill are thus permanently followed, these displacements representing the resultant of the cumulated influences of any type being exerted on this chock. It is then convenient to process and particularly to record separately the signals originating from each pick-up device, or even to totalize, before or after processing, the signals originating from two pick-up devices which are respectively associated with each of the chocks situated on the same side of the machine.

It is also possible according to the invention to proceed to the conversion, into analogue or digital signals, of the data originating from each pick-up device, the signals in question being totalized or not, depending on circumstances; these are preferably analogue or digital signals which are recorded with a view to subsequent compensation. This conversion offers particularly increased possibilities of using the method and the means according to the invention within the sphere of automation, which may be effected to a greater or lesser degree.

It is noted that, according to the present invention, the hydraulic circuits in which are included the pressure pick-up devices, are entirely independent of the main circuit for the hydro-mechanical screwdown of the machine, contrary to what has been set forth in one of the embodiments of French Patent No. 1,541,086 in the name of the applicants, in which embodiment use was made of the variations in the fluid pressure obtained in the main screwdown system, as a function of the fluctuations in the spacing between the working rolls. Furthermore, in the embodiment in question, the backing-up rolls were specifically assumed to be in the favorable case previously mentioned, being driven in rotation in a direct manner; now this is far from always being the case and the embodiment in question could not eliminate the essentially random influence of imperfections in the backing-up rolls.

According to the invention, each pick-up device is formed by a pressure detector which could in particular be a hydraulic jack, supplied by a fluid source and serving normally for the balancing of the working rolls.

An appropriate member, for example, a valve, permits each pick-up device to be isolated at will from the fluid supply source, thus capturing a constant quantity of fluid inside the jack, as well as in the pipe conduits and other apparatus which are downstream of the said member.

Among these apparatus, it is possible with advantage to use a visualization device, for example a pressure gauge, as well as signal converting and recording arrangements.

According to the invention, each pick-up device is arranged in such a way that its fixed or stationary part is made fast with the housing of the rolling mill and it is by its movable part that the said pick-up device bears on the chock with which it is associated.

One suitable means for making effective such a mounting is given in U.S. Pat. No. **3,498,098** of the applicants, in the form of blocks fixed against the uprights of the machine and inside the latter, in the immediate vicinity of its working chocks.

According to the invention, the jacks normally operated in the rolling mill and designed to ensure the balancing of the two working rolls of the machine, that is to say, to press each of them in suitable manner against the corresponding bearing cylinder, are preferably caused to serve as the pick-up devices. Only the arrangement of the pipelines for supplying fluid to the said jacks will be modified. In this manner, it is possible to avoid having the temporary installation on the machine of special pick-up devices designed for the recording operation, as was the case in the last-named U.S. patent.

For carrying out a preliminary recording operation, the following procedure is adopted: by acting on the main control system for the hydro-mechanical screw-down of the machine, the latter is first of all opened to a sufficient extent, until the upper and lower working rolls are no longer in contact with one another, while ensuring that each working roll nevertheless remains pressed against its respective backing-up roll, because of the balancing jacks of the rolling mill. By means of suitably placed and appropriate stop valves, each of the said balancing jacks is then separated from its supply pipe.

A pressure recording apparatus is connected to each of the said jacks and the signals thus obtained may be directed towards an adding system. It is then found in respect of each jack that there is a quantity of oil locked in a very reduced volume, under a suitably chosen initial pressure.

The rolling mill is then caused to turn idly and at slow speed, taking good care to follow the recording during the complete rotational cycle of one of the backing-up rolls, preferably that of which the diameter is throught to be the larger.

The driving mechanism of the arrangement for recording the fluctuations experienced by each of the working chocks is synchronized, mechanically or electrically, with the rotational movement of the corresponding bearing roll. In this way, it is certain that the fluctuations in the position of the chock, caused by the variations in the radius of the corresponding backing-up roll, are directly picked up, while the fluctuations caused by the variations in the radius of the working roll are then of second order and consequently can be ignored. By preliminary measurements, there is established once and for all the scale according to which the recordings thus obtained will have to be interpreted.

From then on, it is easy to reproduce in the most adequate manner the fluctuations thus recorded, so as to inject the corresponding compensating impulses into the general regulating system of the machine, and this at the desired moment, taking into account in known manner the delays which may intervene in the transmission of the signals, staggering the corresponding compensating impulses accordingly at the time of restitution; it goes without saying that once the preliminary recording is completed, it is necessary to reestablish the initial connections of the machine, in particular enabling the balancing jacks of the latter to re-assume their original purpose.

It is thus seen that it is no longer necessary to be occupied in detail with the different causes capable of causing fluctuations in the spacing between working rolls, since the pick-up devices provide all the desired indications, and this in respect of each end of each chock.

Other features and advantages will become apparent from the following description and from reference to the accompanying drawing, the said description and drawing relating to one preferred embodiment of the invention, which is given purely by way of illustration and has no limiting character.

To be seen in the Figure at **1** is the central part of one of the uprights of a rolling mill, and also the working rolls **2**, their journals **3** and the backing-up rolls **4**, it being assumed that a four-high rolling mill is involved.

Each of the working chocks **5** comprises a shoulder **6** facing each of the uprights, which shoulder is designed to cooperate with the balancing jacks **7**. In the case shown in the Figure, it is assumed that, for the pair of upper rolls, it is by interaction between the respective working and support chocks that the working roll **2** is pressed against the backing-up roll **4**.

To this end, the balancing jack **7** is received in the upper support chock **8** and, by bearing against this latter, it is able to act on the shoulder **6** associated therewith.

On the other hand, it has been assumed that, as regards the lower pair of rolls, the corresponding balancing jack **7** is bearing against a boss **9** provided for this purpose on the upright **1** of the housing, facing the lower working chock, this latter being at the same time guided laterally by the said boss **9** and a member (not shown) symmetrical therewith. The balancing jack **7** is thus received in the said boss **9**, this enabling it, because of the shoulder **6**, to press the lower working roll **2** against the backing-up roll associated therewith.

The hydraulic supply circuit for the two jacks **7** which are shown can with advantage be formed by a common fluid supply **10**, an individual valve **11** for each of the jacks, a visualization apparatus, for example a pressure gauge **12**, branched off from each of the individual supply conduits **13**.

It is seen in particular that the constant quantity of the locked-in fluid contained downstream of the closed valves **11**, that is to say, in the pipes **13**, and their branches, as well as in the compression chambers **14** of the two jacks, is subjected to the fluctuations of the position of the corresponding chock **5**.

In addition, the pressure pick-up devices are to be seen at **15**, each of which emit signals in the direction of an adding apparatus **16**. The pressure pickup device may be a Model GW–13 or EGW–13 device marketed by SFIM, 13 Avenue M. Ramolfo-Garnier, 91 Massy, France. The adding apparatus **16**, in turn, may be a Model A 1597 differential amplifier manufactured by the Rochar Electronic Division of the Schlumberger Corporation, A U. S. firm.

The systems which may possibly serve for the conversion of the signals emitted by the pick-up devices into analogue or digital signals have not been represented, nor has the manner in which the recordings obtained in the manner as just explained are used for the purposes of compensation; this has been described in the aforementioned French Patent No. 1,541,086.

It is obvious that the foregoing description has only been given as a non-limiting example and that other

modifications can also be developed without thereby departing from or exceeding the scope of the invention.

What is claimed is:

1. In an apparatus for detecting defects in the rolls of a rolling mill, said rolling mill being of the known type that has (a) a stand, (b) backing-up rolls, (c) first chocks supporting said backing-up rolls and movably held in said stand, (d) working rolls one associated with each backing-up roll, (e) second chocks supporting said working rolls and movably held with respect to said first chocks, and a regulating system, the improvement comrising,

A. means associated with each working roll and defining a closed space containing locked-in hydraulic fluid,

B. hydraulic jack means in engagement with said second chocks and communicating with said means defining a closed space, said hydraulic jack means having

1. a movable part,

2. a stationary part integral with one of said first chocks and

C. sensing means connected to said means defining a closed space; said sensing means responding to pressure fluctuations in said hydraulic fluid caused by a fluctuating motion of said second chocks and storing same for later use by the regulating system.

2. In an apparatus for detecting defects in the rolls of a rolling mill, said rolling mill being of the known type that has (a) a stand, (b) backing-up rolls, (c) first chocks supporting said backing-up rolls and movably held in said stand, (d) working rolls one associated with each backing-up roll, (e) second chocks supporting said working rolls and movably held with respect to said first chocks, and a regulating system, the improvement comprising,

A. means associated with each working roll and defining a closed space containing locked-up hydraulic fluid,

B. hydraulic jack means in engagement with said second chocks and communicating with said means defining a closed space, said hydraulic jack means having

1. a movable part,

2. a stationary part integral with said stand, and

C. sensing means connected to said means defining a closed space; said sensing means responding to pressure fluctuations in said hydraulic fluid caused by a fluctuating motion of said second chocks and storing same for later use by the regulating system.

3. In an apparatus for detecting defects in the rolls of a rolling mill, said rolling mill being of the known type that has (a) a stand, (b) backing-up rolls, (c) first chocks supporting said backing-up rolls and movably held in said stand, (d) working rolls one associated with each backing-up roll, (e) second chocks supporting said working rolls and movably held with respect to said first chocks and a regulating system, the improvement comprising,

A. means associated with each working roll and defining a closed space containing locked-in hydraulic fluid,

B. hydraulic jack means in engagement with said second chocks and communicating with said means defining a closed space, said hydraulic jack means including a piston,

C. an integral shoulder forming part of at least one of said second chocks, said integral shoulder cooperating with said piston and

D. sensing means connected to said means defining a closed space; said sensing means responding to pressure fluctuations in said hydraulic fluid caused by fluctuating motion of said second chocks and storing same for later use by the regulating system.

4. A method of detecting and compensating defects in the rolls of a rolling mill having working rolls, working roll-supporting chocks, backing-up rolls, backing-up roll supporting chocks, a hydraulic pressure circuit for detecting fluctating motions of the working roll-supporting chocks and a regulating system connected with the working roll-supporting chocks comprising the following steps:

A. causing said rolls to rotate in an idle run, whereby fluctuating motions of the working roll-supporting chocks occur in response to said defects in said rolls,

B. maintaining a clearance between the cooperating working rolls of the rolling mill for the duration of said idle run,

C. transmitting said fluctuating motions of each working roll-supporting chock to a separate enclosed volume of fluid to vary the pressure thereof in response to said fluctuating motions,

D. maintaining at least one working roll in engagement with its associated backing-up roll for the duration of each idle run, whereby the fluctuating motions of a supporting chock of the working roll engaged by its associated backing-up roll are transmitted to said fluid,

E. sensing the pressure variations of said liquid and

F. transforming said pressure variations into useful signals to be used by the regulating system.

5. In an apparatus for detecting and compensating defects in the rolls of a rolling mill, said rolling mill being of the known type that has (a) a stand, (b) backing-up rolls, (c) first chocks supporting said backing-up rolls and movably held in said stand, (d) working rolls, one associated with each backing-up roll, (e) second chocks supporting said working rolls and movably held with respect to said first chocks, (f) a regulating system, (g) hydraulic pressure means operatively connected to said second chocks, said hydraulic pressure means including jacks, one in engagement with each second chock, hydraulic compression chambers, each accommodating a separate jack and a hydraulic circuit for supplying hydraulic liquid to said hydraulic compression chambers, the position of each jack in its associated hydraulic compression chamber and the pressure in the latter being interdependent values, the improvement comprising

A. means for converting at will said hydraulic circuit into separate closed spaces each containing locked-in hydraulic fluid and each including one of said hydraulic compression chambers and

B. sensing means communicating with each said closed space, said sensing means responding to pressure fluctuations in said locked-in hydraulic fluid caused by a fluctuating motion of said second chocks and storing same for later use by the regulating system, whereby defects in said rolls are sensed during idle test runs of said rolling mill.

6. An improvement as defined in claim **5**, wherein said jacks constitute balancing jacks for said second chocks during normal rolling operation of said rolling mill.

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