



Europäisches Patentamt  
European Patent Office  
Office européen des brevets



(11) **EP 1 128 921 B1**

(12) **EUROPEAN PATENT SPECIFICATION**

(45) Date of publication and mention  
of the grant of the patent:  
**19.03.2003 Bulletin 2003/12**

(21) Application number: **99956161.6**

(22) Date of filing: **10.11.1999**

(51) Int Cl.7: **B22D 11/20**

(86) International application number:  
**PCT/GB99/03698**

(87) International publication number:  
**WO 00/027566 (18.05.2000 Gazette 2000/20)**

(54) **MEASURING MEANS FOR ROLLER GAPS IN CONTINUOUS CASTING APPARATUS**  
MESSEINRICHTUNG FÜR DIE ROLLENABSTÄNDE BEI EINER STRANGGUSSANLAGE  
MOYENS DE MESURE DES ECARTS ENTRE LES ROULEAUX D'UN APPAREIL DE COULEE  
CONTINUE

(84) Designated Contracting States:  
**AT BE CH CY DE DK ES FI FR GB GR IE IT LI LU  
MC NL PT SE**

(30) Priority: **10.11.1998 GB 9824531**

(43) Date of publication of application:  
**05.09.2001 Bulletin 2001/36**

(73) Proprietor: **Sarclad International Limited  
Chesterfield S41 9BW (GB)**

(72) Inventor: **STANLEY, Nicholas  
Chesterfield S41 9BW (GB)**

(74) Representative: **Fry, Alan Valentine et al  
FRY HEATH & SPENCE LLP  
The Gables  
Massetts Road  
Horley Surrey RH6 7DQ (GB)**

(56) References cited:  
**EP-B- 0 014 862 GB-A- 2 188 721  
US-A- 3 937 271**

**EP 1 128 921 B1**

Note: Within nine months from the publication of the mention of the grant of the European patent, any person may give notice to the European Patent Office of opposition to the European patent granted. Notice of opposition shall be filed in a written reasoned statement. It shall not be deemed to have been filed until the opposition fee has been paid. (Art. 99(1) European Patent Convention).

## Description

**[0001]** This invention relates to continuous casting apparatus and more especially to apparatus for monitoring and sensing the positions of rolls which provide a path of travel for a continuously cast strand of metal as it solidifies.

**[0002]** Conventional continuous casting machines comprise a water-cooled open-ended mould from which a partially solidified metal strand is withdrawn and moved along a curvilinear path defined between a plurality of spaced driven and/or idle rolls which engage opposite surfaces of the strand. The path of travel is generally vertical as the strand leaves the mould and generally horizontal as the solidified strand leaves the casting machine.

**[0003]** The strand is moved along the path defined between the rolls by a flexible dummy bar chain which is secured to the strand. This chain is typically several metres long, is made of mild steel and weighs around 10 tonnes.

**[0004]** With repeated use of the casting machine, the individual rolls can deviate from their original positions. For this reason it is important periodically to monitor the gap between the rolls to detect and correct any misalignment and to determine whether one or more of the rolls require replacement.

**[0005]** Dummy bar chains having integral sensors for monitoring the condition and spacings between pairs of rolls are known. Known monitors include units comprising sensors and instrumentation electronics which form integral parts of one or more links of the chain. In other known systems, chain links are replaced by customised links which contain the required sensors and associated instrumentation.

**[0006]** US-A-3937271 discloses apparatus for monitoring the positions of rolls of continuous casting machines which comprises a dummy bar chain having a block of integral position sensors. EP-B-0014862 discloses similar monitoring apparatus which comprises an integrated measuring device including sensors and a computer means with a store. Neither of these documents discloses roll position monitoring apparatus which comprises a dummy bar chain to which the monitoring apparatus is detachably secured. In both documents, the monitoring apparatus is exposed to hazards caused by the harsh environments of continuous casting even when no measurements of roll positions are required. In the present invention, the monitoring apparatus is removed from the dummy bar chain on occasions when measurements are not required.

**[0007]** The environment within a continuous casting machine is particularly harsh. During casting relatively high temperatures are reached and water sprays are used to cool the strand. The resulting steam combines with the air, water mist sprays and running water to create an environment not conducive to longevity.

**[0008]** Because of the systems' repeated exposure to

the casting environment, maintenance of these systems is required frequently. Also, poor accessibility means that maintenance can be difficult and sometimes dangerous to undertake. Compounds used during casting, such as casting powders and steel chills, present hazards to the monitoring instruments; systems are also susceptible to high levels of mechanical shock during normal operations.

**[0009]** In one aspect, the present invention sets out to provide apparatus for monitoring and sensing the positions, conditions and alignment of rolls and related equipment of continuous casting machines which do not suffer from, or at least alleviate, many of the disadvantages discussed above.

**[0010]** According to the present invention in one aspect there is provided apparatus for monitoring the positions of rolls of a continuous casting machine, the apparatus comprising a dummy bar chain to which is detachably secured monitoring apparatus which includes one or more sensors and associated electronic circuitry to monitor and sense the positions of rolls of a continuous casting machine, the apparatus being characterised in that the monitoring apparatus is attached to the dummy bar chain when the positions of the rolls are to be monitored and is detached therefrom when these positions are not to be monitored, the apparatus comprising a beam from the upper surface of which the sensors protrude and to the undersurface of which is secured a housing for the electronic circuitry, the beam being dimensioned to locate within indents formed in the upper surface of the links of the dummy bar chain with the housing positioned between opposed inner faces of these links.

**[0011]** The dummy bar chain preferably includes a pair of side-by-side links shaped to receive the monitoring apparatus with the apparatus generally aligned both longitudinally and laterally with the dummy bar chain.

**[0012]** Means may be provided for limited vertical movement of the monitoring apparatus relative to the dummy bar chain when the former is secured to the latter. This means may comprise one or more pivotably mounted links.

**[0013]** The invention will now be described by way of example only with reference to the accompanying diagrammatic drawings, in which:-

Figure 1 is a perspective view of monitoring apparatus in accordance with the invention prior to assembly on a dummy bar chain of a continuous casting machine;

Figure 2 shows the monitoring apparatus of Figure 1 when assembled onto a dummy bar chain;

Figures 3a and 3b are side views of the assembly illustrated in Figure 2;

Figures 4a and 4b are side views of an alternative

assembly in accordance with the invention;

Figure 5 is a view from above of further monitoring apparatus in accordance with the invention; and

Figure 6 is a section taken along line VI-VI of Figure 5.

**[0014]** The apparatus illustrated in Figure 1 of the drawings comprises monitoring apparatus 1 in accordance with the invention positioned above support links 2, 3 of a dummy bar chain 4. The monitoring apparatus 1 is a double or articulated unit which can readily be assembled onto or removed from the support links 2, 3 of the dummy bar chain. Monitoring apparatus 1 carries all necessary electronics and sensors to perform the required measurements. The apparatus 1 includes a beam 5 from the upper surface of which protrude sensors 6 (which may be spring loaded) and from the under surface of which is secured a housing 7 containing the required electronics. Monitors 8 are suspended from the beam ends and are selectively detachable therefrom.

**[0015]** The chain links 2, 3 are shaped and dimensioned to receive the monitoring apparatus. Thus, when assembled the electronics housing 7 locates between the opposed inner faces 9 of the chain links 2, 3 and the beam is positioned within indents 10 formed in the upper surface of each support link. When fitted, the monitors 8 extend into side channels 11 of the support links. Figure 2 illustrates the apparatus when assembled on the dummy bar chain. It will be seen that, when assembled, the support links define a carriage for the monitoring apparatus.

**[0016]** As will be seen from Figures 3a and 3b, the monitoring apparatus is able to float vertically to a limited extent relative to the support links of the dummy bar chain whereby either the upper or lower margin of the apparatus stands proud of the support links. The ability to float is in a single axis and ensures *inter alia* smooth transition to and from the dummy bar carriage. It also ensures that the monitoring apparatus is held onto the outer face of the casting rolls under inspection regardless of the amount of tension within the dummy bar chain. Springs may be provided for this purpose.

**[0017]** As will be seen in Figures 4a and 4b, the monitoring apparatus 1, may be connected to the chain links by one or more pivotably mounted links 14. These links operate to connect the monitoring apparatus to the support links which enable floating of the apparatus relative to the dummy bar chain.

**[0018]** As will be seen from Figures 5 and 6, a multiplicity of measuring heads may be carried by the monitoring apparatus. These heads may include roll rotation units 15, bend sensors 16 and inclinometers 17. Measurements taken by the monitoring apparatus include the gaps between roll pairs of a continuous casting machine, tangential measurements of neighbouring rolls to provide measurements of roll alignment, roll rotation

measurements, analyses of the water spray pattern within a casting machine and measurements of eccentricity of the centre of a roll when the roll is supported at and rotated about its bearings. Spring anvils 18 may also be provided to ensure contact of the measuring devices with the respective rolls.

**[0019]** An important advantage of the apparatus described is the facility to load the monitoring apparatus to the support links only when measurements are required.

It is estimated that this will normally be one or two times per week for most applications, whereas normal dummy bar inserts could frequent around 35 times per week. Clearly, this will provide significant savings on the wear and tear normally associated with in-chain measuring devices.

**[0020]** Also, the loading/unloading procedure of the monitoring apparatus to/from the dummy bar chain has been designed to be a quick and simple procedure.

**[0021]** Furthermore, maintenance and serviceability of the system is relatively easy because the measuring unit would normally be stored in a maintenance area with easy access away from the dummy bar chain. Normal dummy bar chain operations will be possible with or without the in-chain measuring device.

**[0022]** It will be appreciated that the foregoing is merely exemplary of monitoring apparatus in accordance with the invention and that various modifications can readily be made thereto without departing from the true scope of the invention.

## Claims

1. Apparatus for monitoring the positions of rolls of a continuous casting machine, the apparatus comprising a dummy bar chain (4) to which is detachably secured monitoring apparatus (1) which includes one or more sensors (6) and associated electronic circuitry to monitor and sense the positions of rolls of a continuous casting machine, the apparatus being **characterised in that** the monitoring apparatus (1) is attached to the dummy bar chain (4) when the positions of the rolls are to be monitored and is detached therefrom when these positions are not to be monitored, the apparatus comprising a beam (5) from the upper surface of which the sensors (6) protrude and to the undersurface of which is secured a housing (7) for the electronic circuitry, the beam (5) being dimensioned to locate within indents (10) formed in the upper surface of the links (2, 3) of the dummy bar chain (4) with the housing (7) positioned between opposed inner faces of these links (2, 3).
2. Apparatus as claimed in claim 1 wherein means are provided for limited vertical movement of the monitoring apparatus relative to the dummy bar chain when the former is attached to the latter.

3. Apparatus as claimed in claim 2 wherein the movement limiting means comprises one or more pivotably mounted links (14).
4. Apparatus as claimed in any one of the preceding claims wherein the monitoring apparatus comprises an articulated unit capable of being assembled onto or removed from support links of the dummy bar chain.
5. Apparatus as claimed in claim 4 wherein the protruding sensors are spring loaded.

#### Patentansprüche

1. Vorrichtung zur Überwachung der Positionen von Rollen einer Stranggußmaschine, welche Vorrichtung eine Hilfsstrangkette (4) aufweist, an der abnehmbar eine Überwachungsvorrichtung (1) festlegbar ist, die einen oder mehrere Sensoren (6) aufweist und der eine elektronische Schaltung zugeordnet ist, um die Positionen der Rollen einer Stranggußmaschine zu überwachen und abzutasten, **dadurch gekennzeichnet, daß** die Überwachungsvorrichtung (1) an der Hilfsstrangkette (4) befestigt ist, wenn die Positionen der Rollen überwacht werden sollen und die von der Hilfsstrangkette abgenommen wird, wenn diese Positionen nicht überwacht werden sollen, und daß die Vorrichtung einen Träger (5) aufweist, aus dessen oberer Oberfläche Sensoren (6) vorstehen und dessen Unterseite mit einem Gehäuse (7) für die elektronische Schaltung verbunden ist, und daß der Träger (5) so dimensioniert ist, daß er in Vertiefungen (10) einpaßt, die in der oberen Oberfläche der Kettenglieder (2, 3) der Hilfsstrangkette (4) angeordnet sind, wobei das Gehäuse (7) zwischen den gegenüberliegenden inneren Oberflächen dieser Glieder (2, 3) zu liegen kommt.
2. Vorrichtung nach Anspruch 1, bei welcher Mittel vorgesehen sind, um eine begrenzte Vertikalbewegung der Überwachungsvorrichtung relativ zu der Hilfsstrangkette durchzuführen, wenn die Überwachungsvorrichtung an der Hilfsstrangkette befestigt ist.
3. Vorrichtung nach Anspruch 2, bei welcher die die Bewegung begrenzenden Mittel aus einem schwenkbar gelagerten Lenker (14) oder mehreren schwenkbar gelagerten Lenkern (14) bestehen.
4. Vorrichtung nach einem der vorhergehenden Ansprüche, bei welcher die Überwachungsvorrichtung eine schwenkbar angelenkte Einheit ist, die auf den Traggliedern der Hilfsstrangkette aufgesetzt bzw. entnommen werden kann.

5. Vorrichtung nach Anspruch 4, bei welcher die vorstehenden Sensoren federbelastet sind.

#### 5 Revendications

1. Appareil pour surveiller les positions de cylindres d'une machine de coulée continue, l'appareil comprenant une chaîne de mannequin (4) à laquelle est fixé de manière amovible un appareil de surveillance (1) qui englobe un ou plusieurs capteurs (6) et des composants de circuits électroniques associés pour surveiller et détecter les positions des cylindres d'une machine de coulée continue, l'appareil étant **caractérisé en ce que** l'appareil de surveillance (1) est fixé à la chaîne de mannequin (4) lorsque les positions des cylindres doivent être surveillées et est détaché de ladite chaîne lorsque ces positions ne doivent pas être surveillées, l'appareil comprenant une poutre (5) par rapport à la surface supérieure de laquelle font saillie les capteurs (6) et à la surface inférieure de laquelle est fixé un boîtier (7) pour les composants de circuits électroniques, la poutre (5) étant dimensionnée pour venir se disposer dans des renforcements (10) formés dans la surface supérieure des articulations (2, 3) de la chaîne de mannequin (4), le boîtier (7) venant se disposer entre les faces internes opposées de ces articulations (2, 3).
2. Appareil selon la revendication 1, dans lequel on prévoit des moyens pour un mouvement vertical limité de l'appareil de surveillance par rapport à la chaîne de mannequin lorsque le premier cité est fixé à la dernière citée.
3. Appareil selon la revendication 2, dans lequel le moyen de limitation du mouvement comprend une ou plusieurs articulations (14) montées en pivotement.
4. Appareil selon l'une quelconque des revendications précédentes, dans lequel l'appareil de surveillance comprend une unité articulée capable d'être montée sur ou d'être retirée des articulations de support de la chaîne de mannequin.
5. Appareil selon la revendication 4, dans lequel les capteurs faisant saillie sont chargés par ressorts.

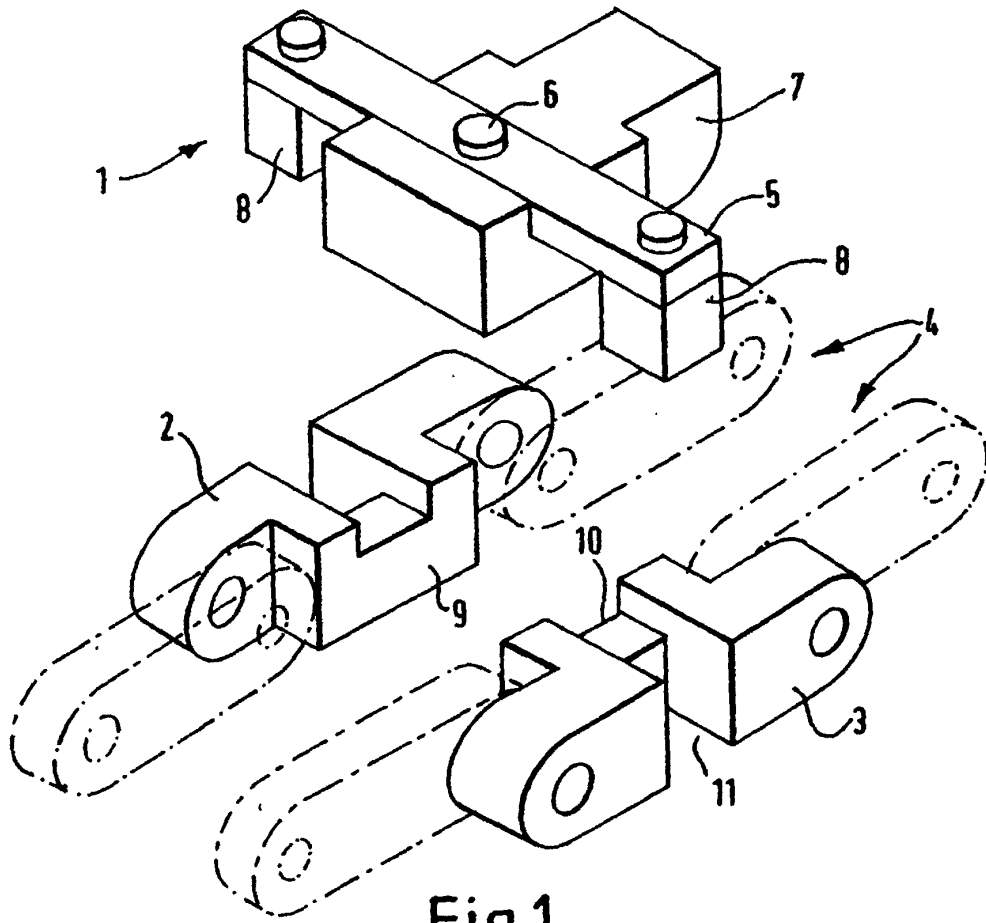


Fig.1.

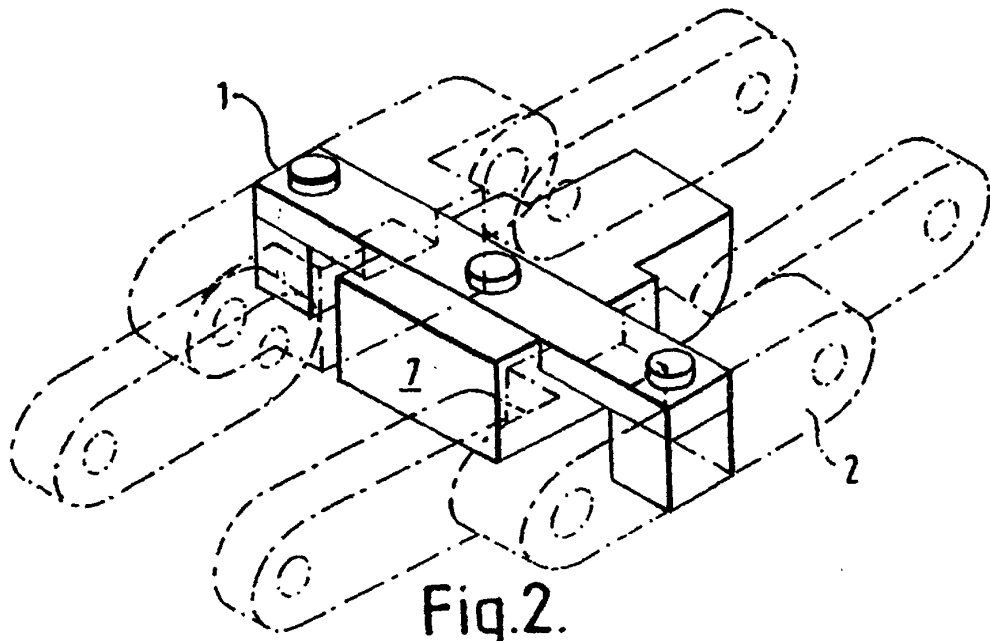


Fig.2.

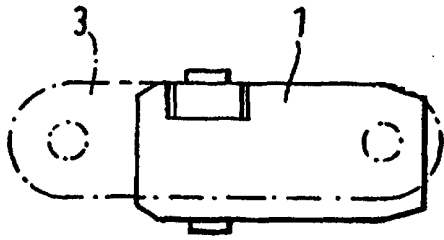


Fig.3a.

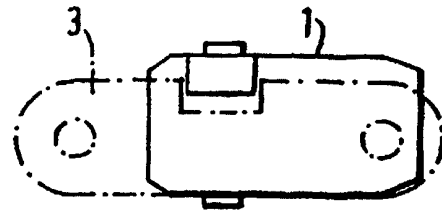


Fig.3b.

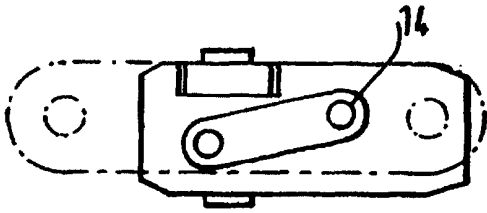


Fig.4a.

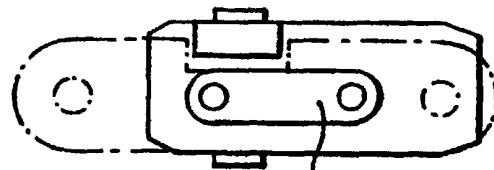


Fig.4b.

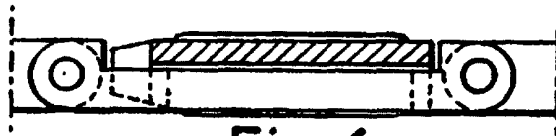


Fig.6.

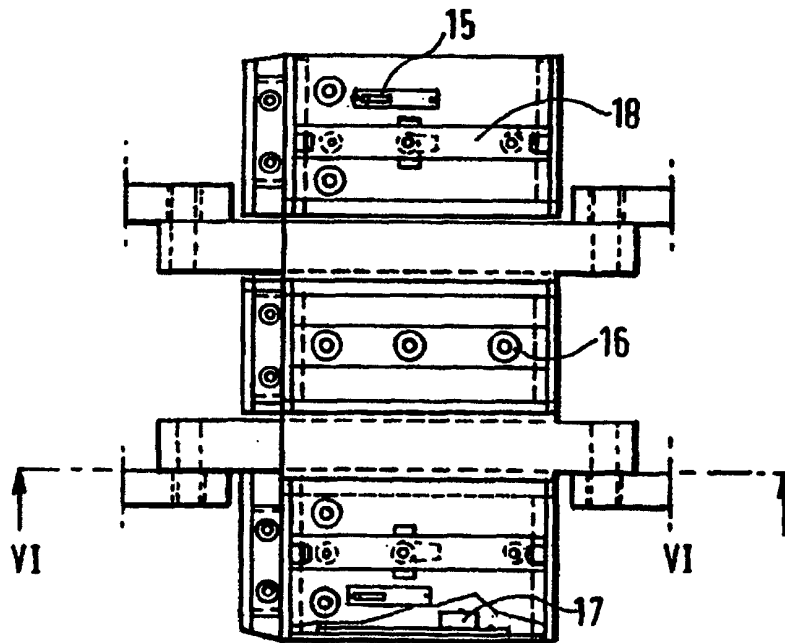


Fig.5.