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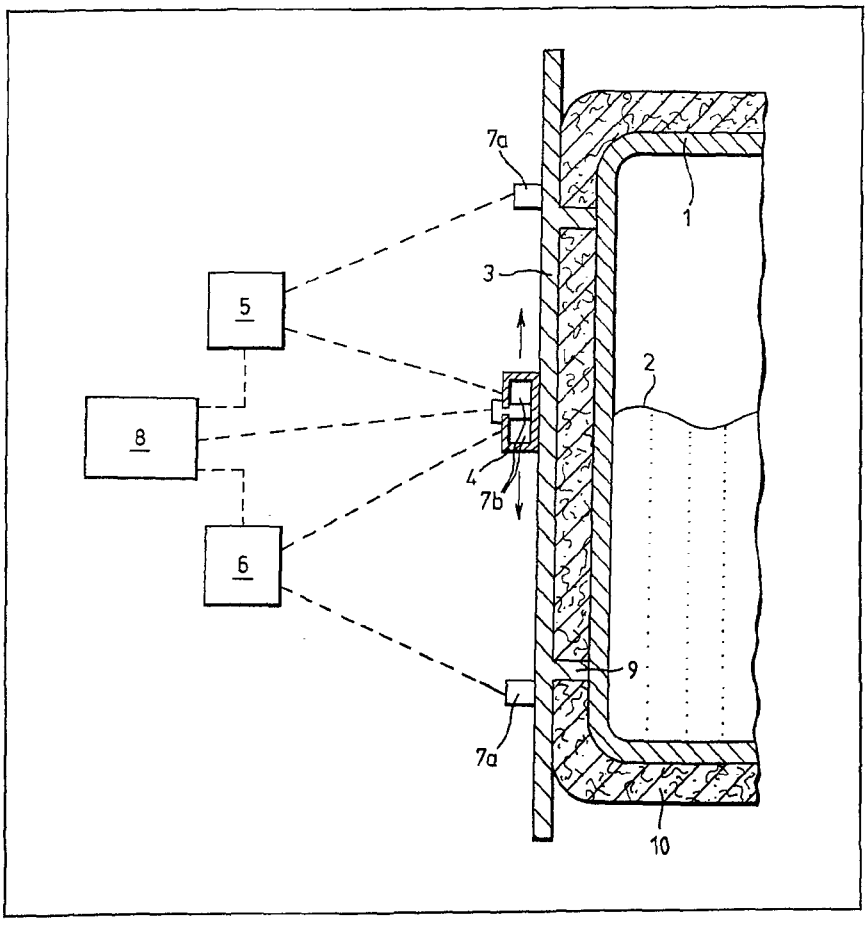
(54) **Liquid metal level measurement**

(57) In order to measure the level 2 of an electrically conductive liquid, such as molten sodium, contained in a tank 1 of non-magnetic material, such as stainless steel, a pair of induction elements 7a, are secured to the outside of the tank at its upper and lower extremities. Moveable carriage 4, fixed to a track 3, carries two more induction elements 7b which form complementary elements to elements 7a in two a.c. bridge networks 5,6. Whenever the level 2 alters so that it no longer lies between the positions of the elements 7b, causing one inductive path to comprise two media, the differential of the outputs of the two bridges causes a control means 8 to actuate a servomotor to move carriage 4 until each inductive path comprises only one medium again and the differential output is nulled. The liquid level can then be read off of a scale on the track, in addition to electronically.



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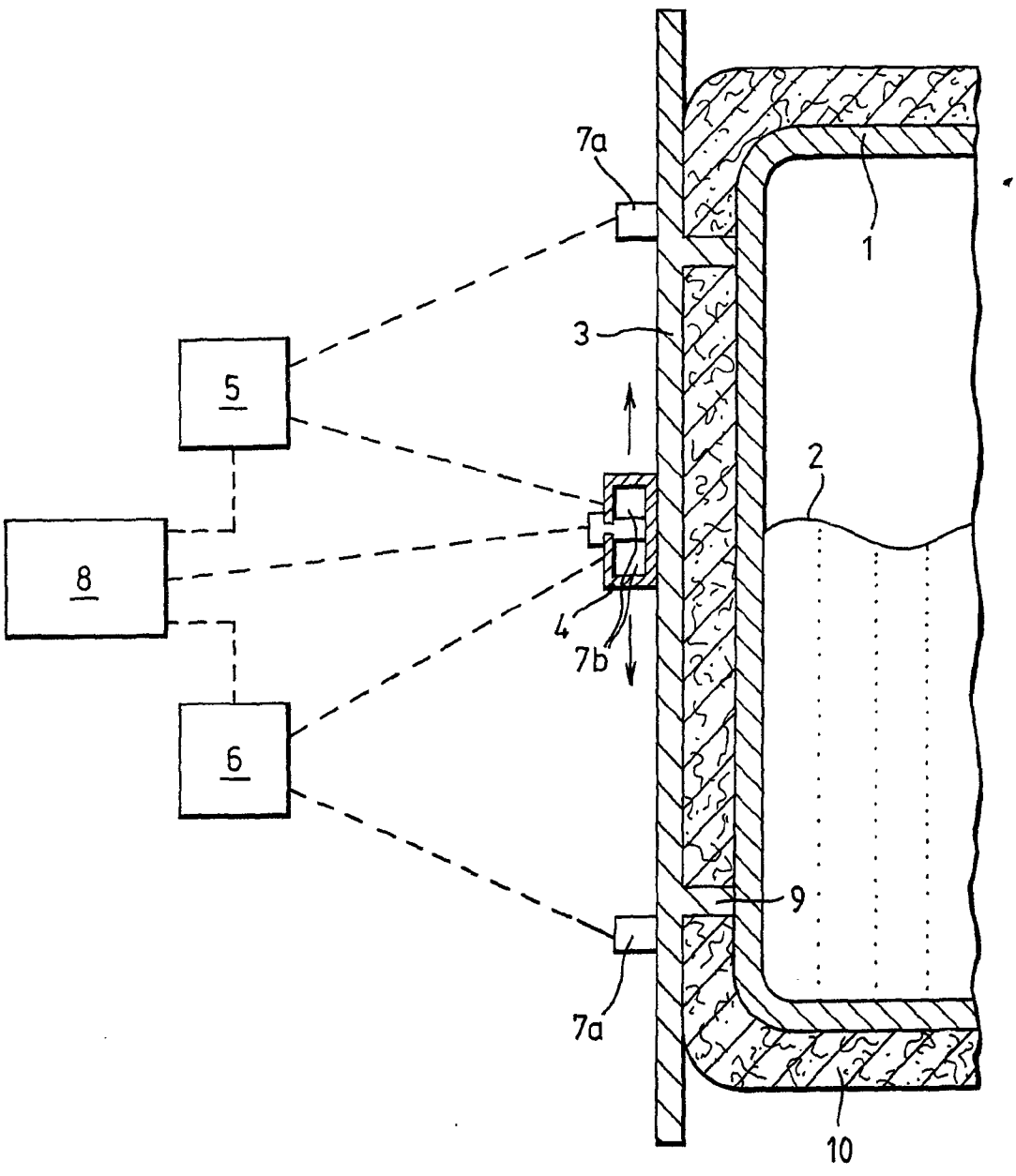
7a
1
3
5
2
8
4
7b
6
9
7a
10

SPECIFICATION

Liquid level measuring instrumentation

This invention relates to liquid level measuring instrumentation and is primarily directed to the measurement of the level of liquid alkali metal contained in stainless steel tanks.

Liquid alkali metals such as sodium and potassium are used in the nuclear reactor art as coolants for nuclear reactor fuel assemblies, for example, those used in fast breeder nuclear reactors. It is required to be able to measure the depth of the liquid alkali metal in its containment tank and to detect change of level. Measurements have been made using intank instrumentation, for example, instrumentation incorporating induction coils. The coils are normally housed in thimble tubes set into the tank and they detect level change by variation of the inductive coupling between a pair of vertically mounted windings of the coil. Unfortunately the overall range of the level indication is limited to the useful lengths of the coils and the position of the thimble tube.

An object of the invention is to provide instrumentation which will give a reading over substantially the full depth of the tank and which will indicate the sense of change of level.

According to the invention a tank of non-magnetic material for containing electrically conductive liquid has instrumentation for indicating the level of the liquid therein, the instrumentation comprising a pair of ac bridge networks arranged so that an induction element of each network is fixedly secured relative to the tank, the elements being disposed in proximity one with each of upper and lower extremities of the tank, and complementary induction elements of the networks which are mutually displaceable between the upper and lower extremities, there being means for feeding the differential of the output signals of the two bridge networks to control means for mutually displacing the complementary elements between the fixed elements. The level indicating instrumentation is based on the eddy current induction effect. The out of balance of each bridge network will depend on the presence or absence of liquid in proximity with the displaceable elements, thus when the displaceable elements are disposed one on each side of the liquid level each of the networks will be substantially in balance so that the differential of the bridge outputs will be substantially zero. If the level changes, then one of the bridge networks will produce an out of balance signal and a corresponding differential signal from the bridge networks, the differential signal then being used to indicate the change of level and to effect automatic displacement of the two displaceable coils in the direction of the change until the networks regain their balance.

The invention will also reside in a stainless steel tank containing liquid alkali metal having instrumentation for indicating the level of the liquid alkali metal therein, the means comprising a pair of ac bridge networks arranged so that an induction element of each network is fixedly secured relative to the tank, the elements being disposed in proximity one with each of upper and lower extremities of the tank, and complimentary induction elements of the networks which are mutually displaceable between the upper and lower extremities, there being means for feeding the differential of the output signals of the two bridge networks to control means for mutually displacing the complementary elements between the fixed elements.

An embodiment of the invention is described by way of example with reference to the accompanying diagramatic drawing which is a side view of a tank containing liquid alkali metal.

The tank designated 1 in the drawing contains molten sodium, the level being designated 2. A vertically extending track 3 guiding a carriage 4 is attached to the outside of the tank, the track extending over the full depth of the tank. There is a pair of ac bridge networks 5, 6 each having a pair of induction elements designated 7a, 7b. The induction element 7a of each network is fixedly secured relative to the tank. The elements are disposed in proximity one with each of upper and lower extremities of the tank. The complementary induction elements designated 7b of each of the bridge networks are mutually displaceable along the track on the carriage 4 between the upper and lower extremities. A differential signal from each bridge network 5, 6 is fed to null point detection and carriage control equipment 8.

The sodium containing tank is lagged the track 3 being disposed within an aluminium boundary frame 9 within which the lagging 10 of slag wool is laid to an even depth and plastered to form a regular outer surface. The lagging is laid without wire reinforcement and trace heating elements thereby to avoid electrical interference to the induction elements.

When the level 2 of the sodium in the tank is disposed between the two induction elements 7b the bridge networks will be in balance, but when the sodium level is displaced to the upper side of both induction elements 7b the upper bridge network 5 will become out of balance thereby initiating a differential of the bridge networks. The out of balance is caused by the change in magnetic field in the upper induction element 7b brought about by eddy currents induced in the sodium. The differential signal effects displacement of the carriage upwardly until, after hunting for the null, the liquid level is again disposed between the two induction elements 7b. The sodium level is then read off a calibrated scale on the track or, alternatively, can be taken from a digital read-out.

CLAIMS

1. A tank of non-magnetic material for containing electrically conductive liquid, the tank having instrumentation for indicating the level of liquid therein, the instrumentation comprising a pair of ac bridge networks arranged so that an induction element of each network is fixedly secured relative to the tank, the elements being disposed in proximity one with each of upper and lower extremities of the tank, and complementary induction elements of

the networks which are mutually displaceable between the upper and lower extremities, there being means for feeding the differential of the output signals of the two bridge networks to control means for mutually displacing the complementary elements between the fixed elements.

2. A stainless steel tank containing liquid alkali metal and having instrumentation for indicating the level of the liquid alkali metal therein, the instrumentation comprising a pair of ac bridge networks arranged so that an induction element of each network is fixedly secured relative to the tank, the elements being disposed in proximity one with each of upper and lower extremities of the tank, and complementary induction elements of the networks which are mutually displaceable between the upper and lower extremities, there being means for feeding the differential of the output signals of the two bridge networks to control means for mutually displacing the complementary elements between the fixed elements.

3. A tank having instrumentation for indicating the level of liquid therein substantially as herein before described with reference to the accompanying drawings.

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