BEARINGS FOR ROTARY CYLINDERS, DRUMS AND THE LIKE

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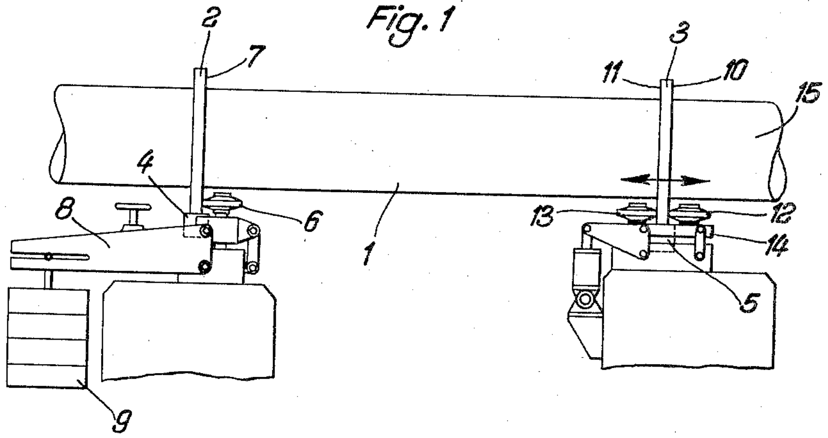

Fig. 1

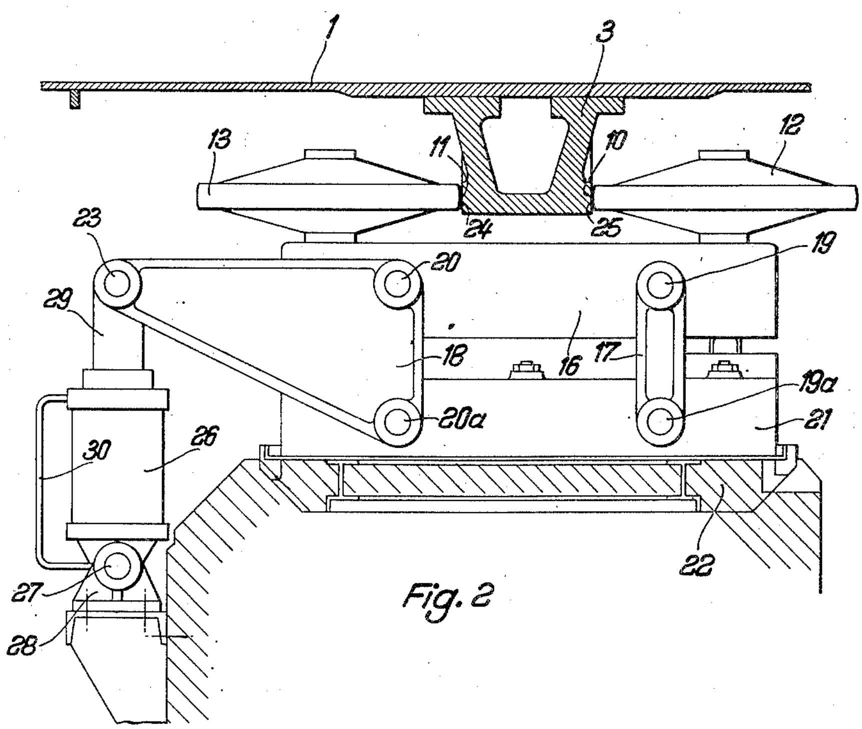

Fig. 2

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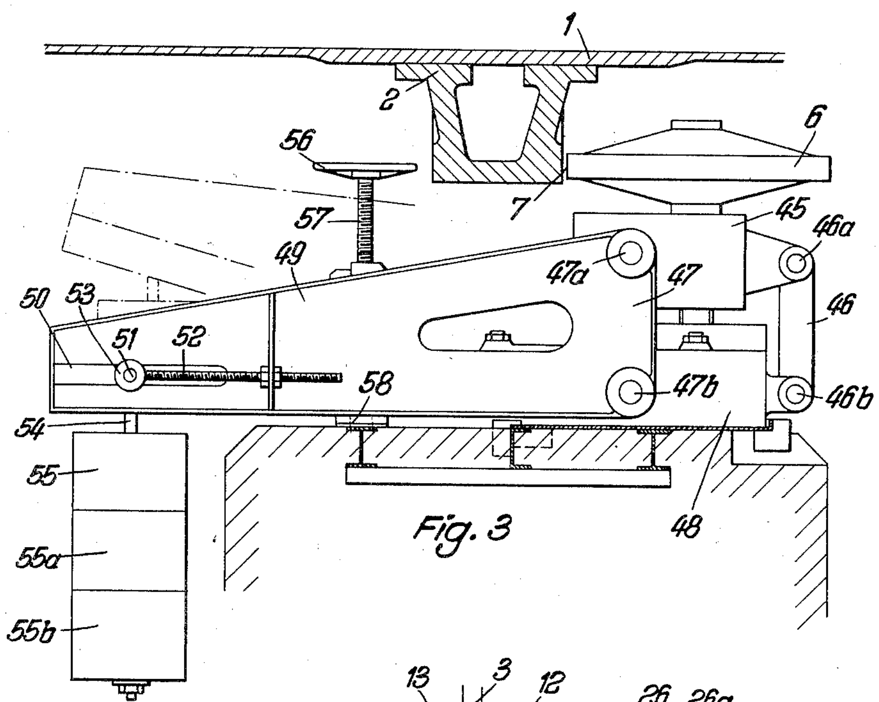

Fig. 3

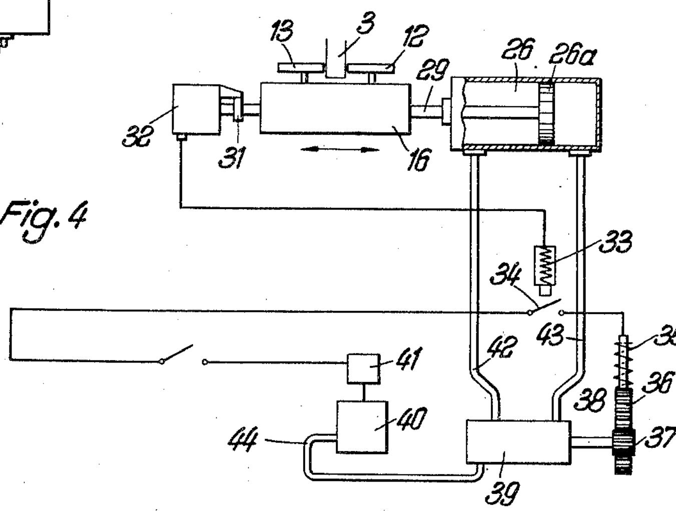

Fig. 4

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10 Claims. (Cl. 308—234)

This invention relates to improvements in rotary treatment cylinders, drums and the like, including rotary cylindrical or tubular furnaces, drying drums, mixing drums, pre-heating and cooling drums and so on. The cylindrical bodies of these machines are mounted on support rollers by means of racerings provided on such bodies. Rotary furnaces are generally arranged somewhat inclined relatively to the horizontal, and the position of a rotary furnace with its racerings is maintained on the associated support rollers by means of additional pressure rollers which bear against the appropriate side face of a racering.

The mechanical stresses to which the support rollers and the racerings are subjected is very considerable. In most cases no material is hard and homogeneous enough to be capable of withstanding without structural damage the high pressures which occur in non-stop day and night operation with approximately line contact between the rollers and associate surfaces. Thus scale peelings, grooving, fractures and deformations often occur at the surfaces of the support rollers and at the surfaces of the racerings.

According to the present-day state of the rotary furnace art, precautions have been taken to allow the furnace drum with the associated racerings to be displaced longitudinally with respect to the support rollers. In fact it has been conventional practice for decades to position the support rollers with their axles slightly inclined with respect to the axis of the rotary furnace instead of straight. If the racerings of the rotary furnace press against the inclined support rollers under the influence of the considerable dead weight components due to the drum casing, furnace lining and fuel, the inclined furnace body is subjected to a kind of screw action tending to move it slowly in an upward direction. Depending on the size of the rotary furnace, a longitudinal distance of approximately 20 to 40 mm. will be chosen between the rigidly mounted upper and lower pressure rollers which are adapted to the furnace inclination. The operating personnel must pour a few drops of oil on to the support roller surfaces whenever the furnace drum presses with its racering flank against the upper pressure roller in the course of the movement which said drum is forced to perform by the helical force. With reduced surface friction, the furnace drum then slides slowly downwards. When it moves subsequently into the bottom position determined by the bottom pressure roller, a new upward movement is initiated when augmented frictional engagement occurs owing to the small quantities of oil on the roller surfaces drying out or deteriorating.

If the operators are careless, it can easily happen that the application of oil is overlooked. The dry support rollers would then cause the furnace drum to be moved by a helical force of extremely great force against the upper pressure roller. As persons skilled in the art will know, there would then be a great danger of breakage of the mounting of the upper pressure roller and also, of the furnace lining bricks. Consequently, the operating

efficiency of a rotary furnace installation according to the present state of the art is greatly dependent on the reliability of its attendants.

In order to obviate as much as possible the wear of the bearing surfaces between the racerings and the support rollers, it is also known to try to obtain a suspended condition, i. e. to achieve a balance between the tendency of the rotary furnace body to slide downwards and the ability of the inclined support rollers to exert a helical force. Owing to varying thermal expansion, in the longitudinal sense, of the rotary furnace body, a slight shifting of the rotary furnace body then occurs to a certain extent in the axial direction, which is desirable if strip damage is to be prevented. But these measures, which can only be regarded as measures of expediency, are quite unsatisfactory. It is very easy for bearings to be damaged owing to the inclined setting of the support rollers, and this would have a very detrimental effect on the expensive furnace lining and on the operating efficiency of the whole installation.

The object of the present invention is to obviate the aforesaid disadvantages.

The present invention is characterised in that two pressure rollers are provided one at each side of a racering, the lower ends of the axles of these pressure rollers being mounted in a cross-member to which a reciprocating movement substantially parallel to the longitudinal axis of the rotary cylindrical body, is imparted by automatically controlled driving means. The latter may be mechanical, electrical hydraulic, or hydroelectric. By this means it is ensured that the longitudinal movement of the rotary cylindrical body in the two opposite directions is effected positively and therefore uniformly at pre-determined intervals of time. In fact, the power means is double-acting in that it positively forces the cylindrical body up the inclination at which said body is set and then positively forces or controls said body downwards.

The cross-member carrying the pressure rollers can be mounted by an arrangement of parallel links on a base plate, and the drive for producing the reciprocating movement then acts either directly or through a leverage upon this cross-member. Less friction is thereby produced than would be the case with a slide guide arrangement for the cross-member—which is also possible. This is important since the great dead weight of, for example, a rotary furnace could result in considerable frictional forces. If it is a question of a particularly long rotary or so-called tubular furnace, it is expedient to arrange a twin pressure roller system of this kind not only at one racering but at two or more racerings, thereby correspondingly reducing the driving force required for operating a single twin pressure roller arrangement in the production of the reciprocating movement.

In a preferred embodiment, the parallel link arrangement may comprise a link in the form of a triangular lever. In this case the drive acts on an outwardly extending arm of the triangular lever.

A hydraulic ram is more particularly recommended for the automatic operation of the drive of the aforesaid cross-member. With such a drive the reciprocating cross-member may be arranged to actuate an electric switch which, by way of a lifting magnet arrangement, controls a valve, for example a rotary valve, in such manner as to produce the alternate to and fro movements of the ram in the working cylinder and thus the to and fro movements of the cross-member coupled thereto. In this case it is of advantage to employ a vertically working cylinder having its lower end pivotally mounted on the base plate, its associate ram or piston having the upper end of its rod pivotally connected to the arm of the triangular lever.

The requisite driving energy for the to and fro displacement of the twin pressure roller arrangement can be considerably reduced if the mounting of the pressure roller operative against the dead weight of the rotary furnace or the like is associated with a counter-balance arrangement. For example, one of two links supporting this pressure roller on the base plate may take the form of a lever presenting an arm for suspension of the counter-weight. The counter-weight itself can be varied, depending on the given circumstances, but it is also possible to shift the point of application of the counter-weight on the said lever arm.

This counterweight arrangement can be provided in association with the pressure roller of one racering, whilst the movable and positively reciprocated twin pressure roller arrangement is situated at a second racering. Alternatively, this counterweight arrangement can be associated with the movable and positively reciprocated twin pressure roller arrangement.

The bearing surfaces of the pressure rollers, and possibly also of the support rollers, are advantageously slightly rounded and although such rounded surfaces, when unloaded, make a point or line contact, on the other hand when pressure is exerted a rounded surface which originally was part circular will now be distorted so as to form part of a shallow ellipse. The result is that no edge contacts can occur between the rollers and the bearing surfaces of the racerings, a feature which not only contributes to further reducing the driving power necessary, but which strain-hardens the surface structure both of the rollers and also of the racerings and which, particularly with the use of grease or oil, conserves the said surfaces. Instead of scale peeling, grooving, fractures or deformations being brought about by particularly high pressures, as in the case of known rotary furnaces, the means according to the invention produce a completely uniform and controllable longitudinal movement in both directions of, for example, a rotary tube furnace, and the rounded construction of the bearing surfaces of the pressure rollers also results in a roll polishing effect, as it were, which imparts a particularly long life to the parts despite the positively effected reciprocatory movement. It is thus a decisive advantage, from the operational point of view, if the surfaces of all supporting rollers as well as pressure rollers themselves are provided with rounded surfaces.

In order to enable the invention to be readily understood, reference is made to the accompanying drawings illustrating embodiments of the invention, in which:

Figure 1 is a side view of a cylindrical rotary furnace with two racerings, one in association with counterbalance means and the other in association with driving means for positively reciprocating the furnace longitudinally.

Figure 2 is a view, partly in section and to a larger scale, of the means associated with the racering on the right-hand in Fig. 1.

Figure 3 is a view, partly in section and to a larger scale, of the counterbalance means associated with the racering on the left-hand in Fig. 1, and

Figure 4 is a diagram of an electrically controlled hydraulic drive for the automatic and positive production of the reciprocating movement.

According to Fig. 1, the tubular body **1** of a rotary furnace is mounted in the usual manner at a slight inclination of approximately 2° relatively to the horizontal by means of its racerings **2** and **3** bearing upon support rollers **4** and **5**. The inclination of the cylindrical rotary furnace is such that the racering **3** lies somewhat lower than the racering **2**. In order to take up the pressure load component caused by the dead weight of the furnace body, a pressure roller **6** which bears against one side face **7** of the racering **2** is mounted on a movable support. This support, as hereinafter explained, is carried upon two vertical parallel links, one of which is formed as a lever presenting an arm **8** on the end of which a counter weight **9** is suspended.

Pressure rollers **12** and **13** bear against respective side faces **10** and **11** of the racering **3**. The lower ends of the shafts of these pressure rollers are mounted in a guide member **14** and the latter is reciprocated by suitable driving means as indicated by the double arrow in the Figure 1, the path of such reciprocation being substantially parallel to the longitudinal axis **15** of the rotary furnace. The details of the twin pressure roller arrangement on the one hand and the pressure roller arrangement with counterweight compensation on the other hand will be explained with reference to Figs. 2 and 3.

In Fig. 2, the pressure rollers **12** and **13** bear against respective side faces **10** and **11** of the racering **3**, as in Figure 1. The shafts of these pressure rollers **12** and **13** are mounted in a guide-member marked **16** in Figure 2. This guide-member **16** is connected to a base plate **21** by means of parallel vertical links **17** and **18** and pivot pins **19**, **19*a*** and **20**, **20*a***. The base plate **21** is fixedly mounted on a pedestal **22**. The link **18** is of triangular shape presenting a laterally extending arm formed at its outer end with an eye **23**. A pivot pin inserted in the eye **23** is engaged by the driving means so as to swing the triangular link element **18** about the pivot pin **20*a*** to a certain extent, whereby the cross member **16** with the pressure rollers **12** and **13** carries out a reciprocating movement substantially parallel to the longitudinal axis of the furnace body. With this movement there also occurs a vertical displacement of the bearing surfaces of the pressure rollers **12** and **13** which are rounded as indicated by the reference numerals **24** and **25**, relatively to the flat side faces **10** and **11** of the racering **3**.

The driving up and down of the pin having a bearing in the eye **23** can be effected, for example, mechanically by an eccentric or cam drive, lever drive or the like. In the present example, however, a hydraulic drive is provided, a ram cylinder **26** having its lower end pivotally mounted in a bearing bracket **28** by means of the pin **27**. The upwardly extending piston rod or ram **29** is pivotally connected at its upper end with the eye **23** of the triangular link **18**. The reference numeral **30** designates a pipe line for oil under pressure. Thus, with this hydraulic driving apparatus, the reciprocation of the ram or piston in the cylinder **26** on the one hand causes the cylinder to pivot about the pin **27** and on the other hand causes the triangular link **18** to pivot about the bolt **20*a***.

The piston strokes in the cylinder **26** can be controlled by known means, many different kinds of which are known with hydraulic drives. One such control is illustrated in Fig. 4. The cross-member **16** with its two pressure rollers **12** and **13** is reciprocated in the manner aforesaid and as indicated by the double arrow in Fig. 4. In this diagram, however, the ram or piston rod **29** of the cylinder **26** is shown in a horizontal position acting directly upon the cross member **16** at one end of the latter. At the other end, a rod **31** acts upon a switching arrangement **32** which is adapted to switch on and off an auxiliary current for a relay-device **33** which acts upon a switch **34** which opens and closes the main circuit. When the main circuit is closed, a lifting magnet **35** is energised and operates a toothed rack **36**. This toothed rack **36** meshes wtih a pinion **37** which is mounted on the spindle **38** of a rotary valve **39**. The pressure fluid for the working cylinder **26** with its associate piston **26*a*** is delivered by a pump **40** driven from an electric motor **41** which is likewise connected in the main current line.

The actuation of the rotary valve **39** by way of the lifting magnet **35**, being controlled by the switching operations initiated by the switch **32**, causes the pressure fluid to flow via the rotary valve **39** either by way of the pipe line **42** or the pipe line **43**, to the one or the other side of the piston **26*a***. The rotary valve **39** is connected to the pump **40** by means of the pipe **44**.

This electrical and hydraulic control arrangement is only indicated in a purely schematic fashion in Fig. 4. As is customary with hydraulic drives, a return pipe for the pressure fluid, a venting arrangement, a pressure relief valve and the like would be provided in the piping system.

In Figure 3 the pressure roller **6** bears against a side face **7** of the racering **2**, as in Figure 1. The pressure roller **6** is mounted in a guide-member **45** which is supported on a base plate **48** by vertical parallel links **46** and **47**. The link pair **46** has connecting pivots **46***a* and **46***b*, and the link pair **47** has pivots **47***a* and **47***b*. The links of the pair **47** are fashioned as lever arms **49** extending laterally for a suitable length. The outer end of each of these lever arms **49** is formed with a slot **50** into which is mounted a suspension pin **51** which can be adjusted along the slots by means of a threaded rod **52** which comprises suitable eyes **53** engaging the pin **51**. A rod **54** suspended from the pin **51** carries counter weights **55**, **55***a*, **55***b*. Therefore, by means of these counterweights **55**, **55***a* and **55***b* acting by way of the lever arms of the links **47**, the pressure roller **6** is additionally pressed against the bearing surface **7** of the racering **2**. The dimensions of the lever on the one hand and the value of the counterweights on the other hand are so calculated that this counter-pressure of the pressure roller **6** can substantially compensate the components of the load produced by the deadweight of the furnace and constantly tending to move the latter in a downward direction. This pressure compensation can also be effected by arranging a plurality of such systems according to Fig. 3 at different racerings on the cylindrical rotary furnace.

The position of the lever **49** shown in Fig. 3 is that in which this lever settles when the furnace is in the hot operating condition, when the said furnace is in its highest position. When the furnace movement in one direction away from this highest position amounts to approximately 40 mm. and the furnace has moved from its highest position into the lowest position, the lever **49** then rises into the position shown in chain lines in Figure 3.

According to Fig. 3 the lever **49** is also provided with a hand-wheel **56** and spindle **57**. One purpose of this hand wheel-spindle arrangement is, when necessary, to swing the lever **49** relatively to the base plate **58** in such a manner that the pressure roller **6** no longer bears against the running surface **7** of the racering **2**. Another purpose of this hand-wheel adjustment arrangement **56**, **57** is to regulate exactly the appropriate application of the pressure roller **6** against the bearing surface **7** of the racering **2**.

I claim:

1. Rotary treatment cylinder fitted with race-rings running on support rollers for radial support and operatively engaged by cooperating pressure rollers bearing laterally against said rings for the axial support of said rotary cylinder, wherein two pressure rollers are provided one at each side of a racering each mounted for rotation on a shaft or the like, the lower end of said shafts of said pressure rollers being supported on a guide-member mounted for reciprocating movement substantially parallel to the longitudinal axis of said rotary cylinder and automatically controlled driving means operative to impart reciprocating movement to said guide member, whereby said rotary cylinder is positively forced and controlled in both axial directions.

2. Rotary treatment cylinder according to claim 1, wherein said guide-member carrying said pressure rollers is supported on a base plate by a parallel link arrangement, and said driven means for producing the reciprocation of said cylinder is operatively connected to said guide-member.

3. Rotary treatment cylinder according to claim 2, wherein one member of the parallel link arrangement is defined by a triangular lever pivotally mounted on said base plate and presenting a laterally extending arm operatively engaged by said driving means.

4. Rotary treatment cylinder according to claim 1, wherein said guide-member carrying said pressure rollers is driven by hydraulic means including a piston, and said guide member is fitted with means for actuating switch contacts for the electrical control of a distributor valve controlling the alternate to and fro movement of said piston operative upon said guide-member.

5. Rotary treatment cylinder according to claim 4, wherein the lower end of the working cylinder for said piston is pivotally mounted on a base plate, and said piston is pivotally connected at its upper end with means actuating said guide member.

6. Rotary treatment cylinder according to claim 1, wherein a pressure roller which takes the load resulting from the dead weight component of said cylinder is mounted on a movable base provided with a counter-balance arrangement adapted for compensating said load.

7. Rotary treatment cylinder according to claim 6, wherein said movable base is supported by a link presenting a lever arm adapted for the suspension of a counterweight.

8. Rotary treatment cylinder according to claim 6, in which said counter-balance arrangement is provided at the pressure roller of one racering while said cooperating pressure rollers are situated at a second racering.

9. Rotary treatment cylinder according to claim 1, wherein the bearing surfaces of said pressure rollers are rounded.

10. Rotary treatment cylinder in accordance with claim 9 wherein the bearing surfaces of said support rollers for said racering are rounded.

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