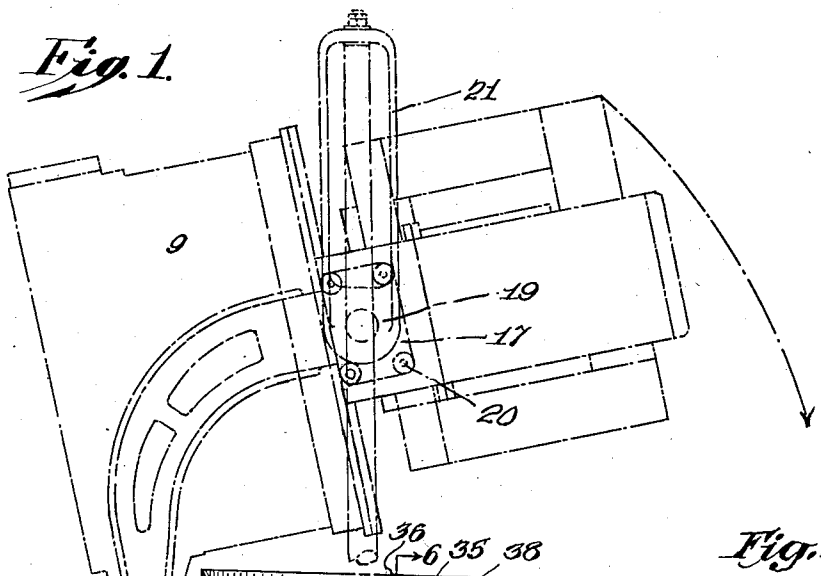
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TILTING DEVICE FOR FURNACES

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Fig. 1.



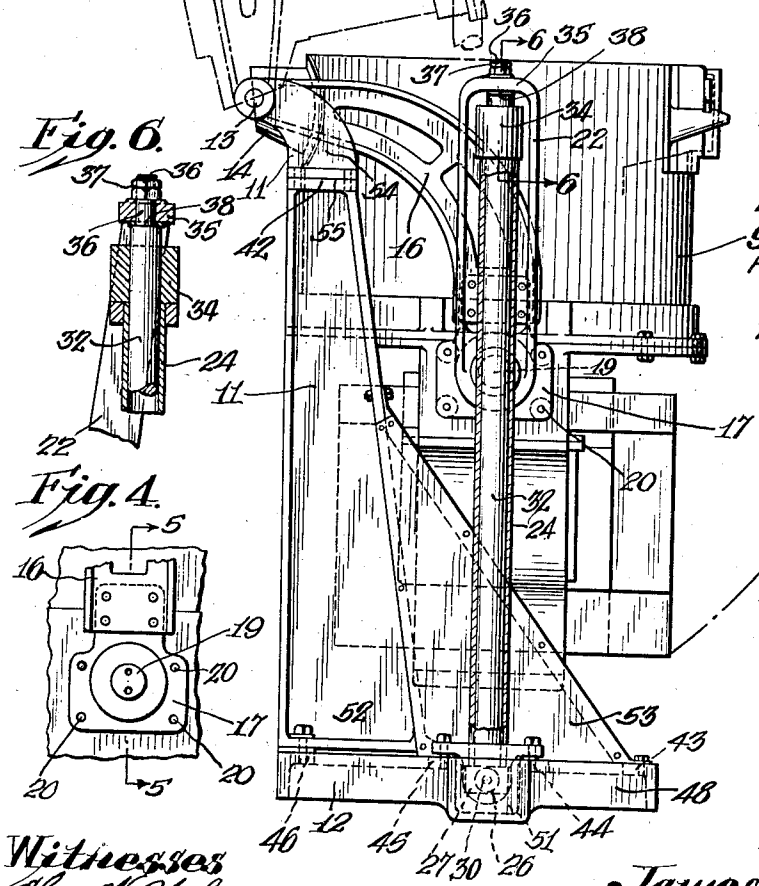


Fig. 3b.

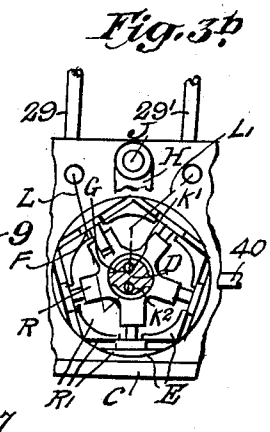
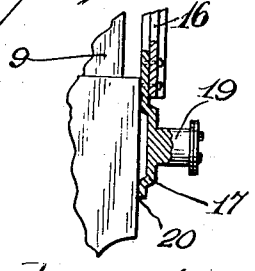


Fig. 6.

Fig. 4.

Fig. 5.



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TILTING DEVICE FOR FURNACES

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Fig. 2.

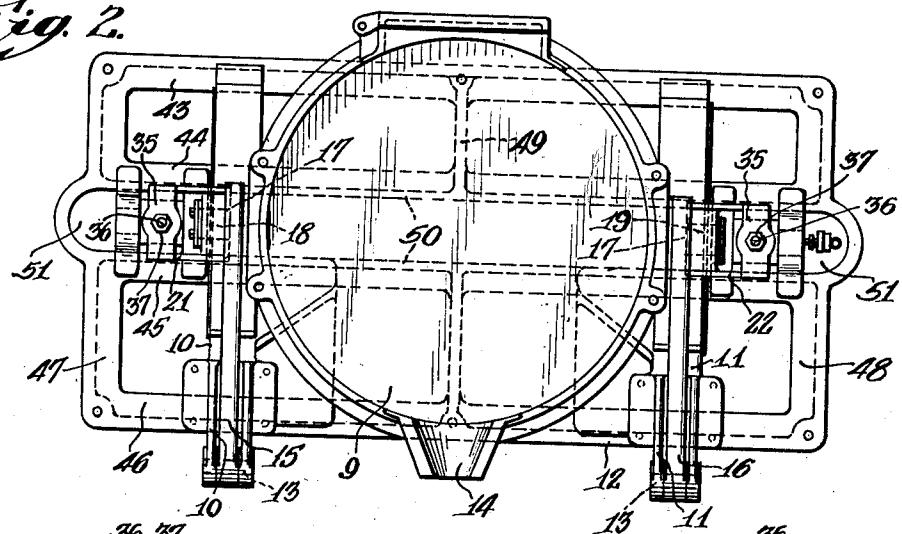


Fig. 5.

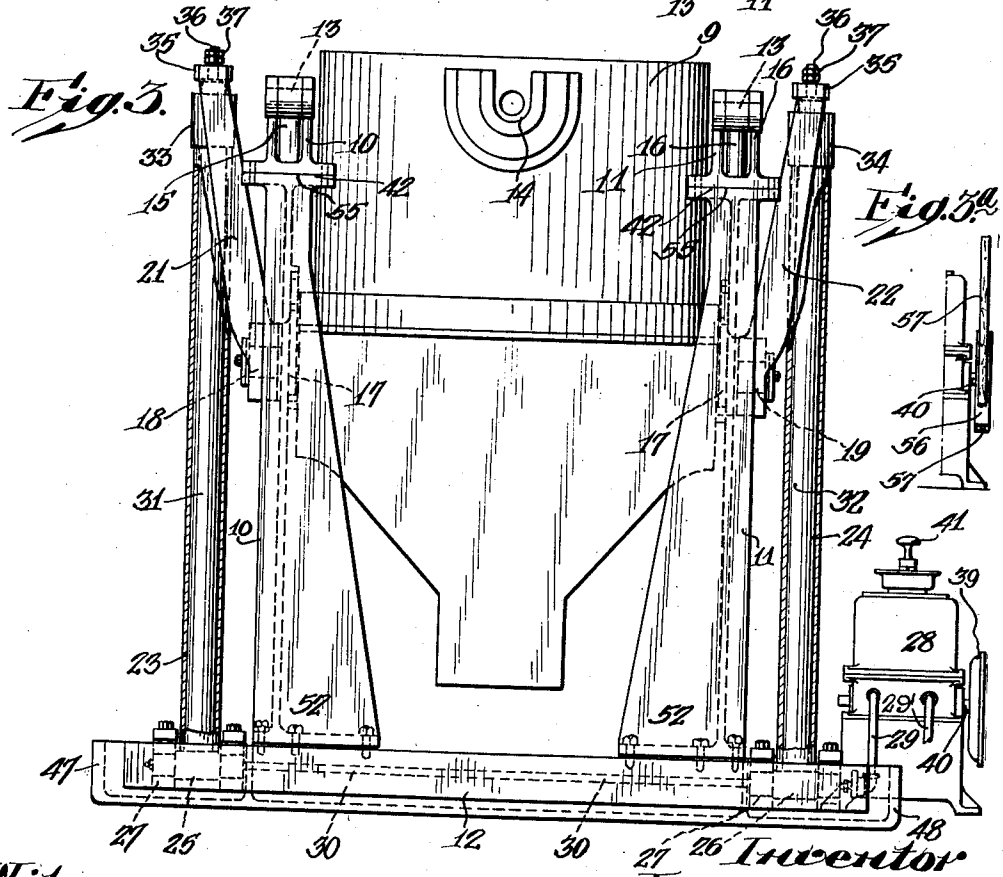


Fig. 5a.

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UNITED STATES PATENT OFFICE

2,014,349

TILTING DEVICE FOR FURNACES

James R. Wyatt, Camden, N. J., assignor to Ajax Electric Furnace Corporation, Philadelphia, Pa., a corporation of Pennsylvania

Application March 29, 1934, Serial No. 717,995

11 Claims. (Cl. 263—12)

The present invention relates to mechanism for supporting and tilting an electric furnace, and while being intended for any use to which it may be adapted, is believed to have perhaps its best and widest application with an induction electric furnace. It has therefore been illustrated and described herein as applied to one of the types of such furnaces.

A purpose of the invention is to provide supporting and tilting mechanism that will be easy and inexpensive to manufacture and well suited to the needs of service.

A further purpose is to control the tilt of a furnace by means of hydraulic rams on opposite sides of the furnace.

A further purpose is to support the main weight of a tiltable furnace upon hangers at opposite sides of the furnace, carrying the hangers at their upper ends upon the upper ends of the longitudinally movable members of rams and pivotally connecting the lower ends of the hangers to the furnace at points thereof between the rams and intermediate the lengths thereof. Preferably the furnace is tilted about an axis which passes approximately through the pouring spout of the furnace.

A further purpose is to provide novel structure for supporting and tilting a furnace and which can easily be adjusted to accommodate variation in the requirements of different furnaces with respect to furnace size and furnace dimensions.

Further purposes will appear in the specification and in the claims.

I have elected to show one only of the different forms of my invention, illustrating a form that is practical and efficient in operation but which has been selected primarily because it well illustrates the principles involved.

Figure 1 is a side elevation of structure embodying a desirable form of my invention in its application to an inductive electric furnace of the well known submerged V channel type, the furnace being shown full-line in normal heating position and in dot-and-dash line in its fully tilted position.

Figures 2 and 3 are respectively plan and front elevations of the full-line view in Figure 1.

Figure 3*a* is a fragmentary elevation of a part of Figure 3 but showing a pulley and belt drive.

Figure 3*b* is a somewhat diagrammatic sectional plan view of a detail of Figure 3, the view showing a conventional Hele-Shaw type pump.

Figures 4 and 5 are a fragmentary side elevation and section upon line 5—5 thereof showing the construction of the brackets, plates and trunnions at one side of the furnace.

Figure 6 is a fragmentary section upon line 6—6 of Figure 1.

Like numerals refer to like parts in all figures.

Describing in illustration and not in limitation and referring to the drawings:—

Any furnace 9 here shown in a submerged channel induction electric furnace is located between spaced supports 10 and 11 resting upon frame 12. The supports provide or cooperate with bearings for tilting the furnace upon or about coaxial pins 13. The axis shown passes through approximately the outlet of the pouring spout 14.

Though the furnace is largely supported otherwise, during its pouring movement it is guided and in part supported through the pins 13 which form bearings for or are carried by brackets 15, 16, one on each side. It makes no difference whether the pins turn within the supports or within the brackets.

The brackets 15, 16 are rigidly secured at their inner ends to plates 17 which carry trunnions 18 and 19. The plates are, in turn, rigidly connected with the furnace frame at 20.

A convenient construction for the rigid connection of the brackets with the furnace frame appears in the figures where the parts are riveted together. The two-part construction above reduces the need of large castings. The plates 17 as shown fit under the brackets and between inner bracket flanges.

The main weight of the furnace rests through the trunnions 18, 19 in bearings within the lower parts of hangers 21 and 22 and the height of the trunnions is varied during tilting of the furnace by hydraulic mechanism engaging the upper ends of these hangers to lift them or to permit them to lower.

The hydraulic mechanism as illustrated comprises cylinder and piston or plunger pairs at opposite sides of the furnace, one part—cylinder or piston—pivoted at the lower end of each pair in the frame and the other parts connected rigidly one to each of the hangers at the upper ends of the hangers so that the pair can swing about the bottom pivots and the hangers maintain substantial parallelism with the pairs.

It is much more convenient to pivot the cylinders rather than the pistons at the bottom and this has been done. In the illustration cylinders 23 and 24 are rigidly secured to bearing sleeves 25 and 26 which fit within bearings 27 at opposite sides of the frame. This construction

swingingly supports, stiffens and guides the swinging movements of the cylinders. The hollows of the bearing sleeves give fluid access to the interiors of the cylinders, whereby oil under hydraulic pressure from pump 28 through pipe 29 passes through the sleeve 26 (Figure 3) into cylinder 24. At the same time oil from the pump passes through sleeve 26 and pipe 30 into sleeve 25 and into cylinder 23. The cylinders are thus connected in parallel and at whatever height the pistons 31 and 32 may be lifted they are raised concurrently and are held up at equal pressures in each of the two cylinders.

At the tops of the cylinders are located stuffing boxes 33, 34 within which the pistons (or their rods if the rods be smaller than the pistons) slide and which perform the usual functions of stuffing boxes. Obviously any form of stuffing box can be used.

The pistons (or their rods) are connected to the loops 35 of the respective hangers by reduced threaded projections 36 from the pistons or rods upon which the loops are fastened by nuts and lock nuts shown at 37. The lower face of each loop rests upon the shoulder 38 formed by the reduction of the piston or rod.

The pump 29 by which oil is forced into the cylinder is driven by electric motor 39 through shaft 40. The pump is conventionally shown only for the reason that there are many pumps available for the purpose, its requirement being that it shall be capable of pumping in either direction at a great variety of speeds, including very low speeds of fluid flow, and shall afford a definite check or stop in any pumping position against regurgitation of the oil; so that the pump may be operated in one direction to lift the furnace toward or to the position shown in dotted lines in Figure 1 to hold the furnace in any position to which it has been lifted, and to allow the furnace to lower with reversal of the direction of fluid flow.

What is known generally as a Hele-Shaw type well fulfils these requirements.

Various forms of the Hele-Shaw motor appear in patents and in manufacture, in which a shaft rotating in the same direction operates a ring of cylinders or pistons as the case may be cooperating with pistons or cylinders about the ring and in which the stroke of each piston in turn during the rotation of the shaft is determined by the eccentricity of the axis of the ring with respect to the axis of the shaft. Characteristically, reversal of the position of the axis of the ring with respect to the axis of the shaft may be made to alter the direction of pumping. Such pumps have been put on the market and are now on the market put out by Oil Gear Company of Milwaukee, Wisconsin. The mode of operation above is contemplated in patents owned by this company identified as Ferris, Nos. 1,558,002; 1,558,003 and 1,592,864 and Magee and Ferris Nos. 1,485,986 and 1,502,310. Though these patents contain reference to a fluid-operated motor also this does not interfere with the disclosure of Hele-Shaw type construction capable of serving my purpose. See also patents to Wilsey No. 1,633,720 and Valentine No. 1,902,345.

It is desirable for my purpose that the variation of speed of pumping from a maximum to zero and from zero to a maximum in the opposite direction shall be accomplished without altering the direction of rotation of the impelling shaft; and it is quite convenient as in the patents above that the rotation of the shaft may continue notwithstanding that the zero setting of the axis of the ring may result in there being no fluid flow in the system; however, it is not necessary that the position of the axis of the ring be reversed with respect to the axis of the impelling shaft to cause reversal of pumping direction of flow as the shifting of the axis may be used to vary the extent of pumping from zero to a maximum while a control valve is used to vary the direction in which this pumping is effected as in the case of patents owned by the company: Ferris Nos. 1,647,690 and 1,753,562 and Ferris & Ferris No. 1,798,198.

The structures of all of the above patents have the characteristic utilized here of being controlled by some such lever, or arm as 41 (in most of them a single arm, in some two arms) to alter displacement of the pump and/or valve position so as at will to vary the direction of fluid (including stoppage of flow altogether at the zero point between displacements in opposite directions) and to vary the rate of pumping by variation of the extent of the reciprocations within the cylinder bores to any extent between zero flow and the maximum for which the pump is designed. The reversal of direction of pumping and variation in the extent of pumping take place while the electric motor is rotating and moreover while it is rotating in the same direction. Such a pump therefore offers means for varying the direction and extent of hydraulic flow and the fluid pumped may be held at any point by shifting the pump axis to the neutral axis if the motor is to continue to operate or to an eccentricity at which the pressure tending to reverse the flow will be insufficient, for any given weight of furnace and content, to reverse the operation of the pump and make it a fluid motor if the electric motor driving the pump is to be stopped. The construction indicated above permits use of a constant speed electric motor or belt drive or other source of power with control of speed of fluid flow wholly by the eccentricity of the pump axis with respect to the driving axis.

It will be evident that, when the Hele-Shaw type pump stops in any position, leakage through the pump is prevented, and the plungers remain in a position corresponding to the pump position.

The brackets 15, 16 are preferably removably fastened at 42 to the tops of standards or supports 10, 11.

The bed or frame 12 carries the weight of the entire structure at the bearings for the lower ends of the ram casings or cylinders. Part of my invention resides in novel features of the bed adapting the same bed to accommodate standards or supports, cylinders etc. for furnaces of different sizes.

The frame or bed, preferably an integral casting and usually for permanent installation in concrete, presents in effect laterally spaced upwardly directed rail surfaces 43, 44, 45 and 46 that are parallel to one another and to the tilting axis of the furnace, permitting the supports or standards 10, 11 and the sleeve bearings to be mounted equally well at different positions along the length of the bed. The parallel bed rails are cross-connected and stiffened at the ends at 47 and 48 and at the middle at 49.

The main weight is carried upon the central rails 43 and 44 and intermediate these rails at 50 I form the bed into a trough 51, preferring to make the trough deeper and showing it as longer than the remaining portion of the bed.

This trough structure secures a considerable body and depth of metal and rib stiffening at all those points of the bed that may have to receive the main weight of the furnace, provides ample room for the cylinder bearings and for piping at the axis of these bearings and also provides for excellent vertical and longitudinal interlocking with the concrete.

The supports or standards are made in two parts so that the lower portion may be used generally with furnaces of different sizes and so that for the different heights and lateral projections of furnace pouring spout required with differing capacities of furnace, corresponding upper standard portions may be provided specially suited to the particular furnace installed. The lower parts **52** of the standards or supports are upwardly tapered and of general T cross-section with bottom flanges suitable for fastening to the rails **44** and **46**. They are additionally stiffened by stays **53** secured to the rail **45** by plates between the stays and standards or supports.

The upper parts **54** curve upwardly and outwardly from the lower parts as shown—but may extend upwardly more or less and outwardly to different extents for different furnaces—and are secured to the lower parts through meeting flanges **55**.

It will be seen that the same bed, plunger or ram structure and supports or standards may be used with different furnaces of quite widely variant dimensions, with of course proper adjustments of the position of the parts along the bed and possibly substitution of different upper standard sections.

With furnaces of widely different dimensions it will usually be necessary however to select suitable hangers and brackets of suitable dimensions even if the same cylinders and rams, pistons or plungers be used.

The fact that the motor driving the pump may be of any suitable character has been indicated by illustration of a different drive for shaft **40**, selecting as conventional a form as possible in the pulley **56** and belt **57**.

In operation with the crucible in the full line position shown in Figure 1 the motor **29** is started and the axis about which the pump elements are placed is shifted to pump through the pipe into the cylinders in parallel, causing oil flow and consequently lifting of plungers **31**, **32** at a rate dependent upon the eccentricity of the pump axis. The furnace is thus lifted at any speed desired to any point along the arc of movement indicated by the dash and dot line and may be held at any point desired. If it is to be held merely the pump control preferably is thrown to the zero position where lifting will wholly stop though the electric motor continues to operate. The pump then is not reversible by reverse pressure (to force the oil back through the pump and thus make it a fluid motor).

So long as the eccentricity of the pump axis is kept below that at which (with the pressure exerted) the pump will not become an hydraulic motor the lifting can be stopped and the furnace can be held at any position by merely stopping the driving electric motor, belt or other drive.

Where it is not desired to cut off the flow wholly the flow may be reduced sufficiently for the purpose and lifting may be continued at reduced or progressively reduced rates to taper off the pouring stream. When the oil flow is to be cut off entirely the pump control preferably is thrown to zero position.

When pouring has ceased whether at the dash and dot line position of Figure 1 or at any intermediate point the furnace may be dropped slowly or quickly by reversing the pump (by valve or by reversal of eccentricities) and setting the pump at a small or large eccentricity of pump throw as desired to pump the oil out of the cylinders into the storage tank within the pump casing.

In view of my invention and disclosure variations and modifications to meet individual whim or particular need will doubtless become evident to others skilled in the art to obtain all or part of the benefits of my invention without copying the structure shown, and I, therefore, claim all such in so far as they fall within the reasonable spirit and scope of my invention.

Having thus described my invention what I claim as new and desire to secure by Letters Patent is:—

1. An electric furnace having a pouring spout, trunnion plates and trunnions upon which the furnace is supported, brackets rigid with the trunnion plates and terminating on opposite sides substantially in line with the furnace pouring spout, bearings about which the brackets are guided to swing the furnace about the pouring spout, supports for the bearings, hangers engaging the trunnions at their lower ends, hydraulic cylinders, plungers rigid with the hangers, bearings for the cylinders and hydraulic connections in parallel for supplying their discharging liquid to the cylinders for tilting operation.

2. In an electric furnace, a furnace body having a pouring spout and including side trunnions and plates rigid with the body upon which the trunnions are carried, brackets secured to the trunnion plates and curved into line on opposite sides of the furnace with the furnace pouring spout, bearings for the brackets causing tilting of the furnace about the pouring spout, supports for the bearings, hydraulic cylinder and piston lifting and lowering mechanisms for the trunnions, hangers rigidly connecting the pistons with the trunnions, and pumping means adapted to pump to and from the cylinders to lift and lower the pistons and furnace and to hold them by the pump position in intermediate positions.

3. In an electric furnace, a furnace body having a pouring spout and including side trunnions and plates rigid with the body upon which the trunnions are carried, brackets secured to the trunnion plates and curved into line on opposite sides of the furnace with the furnace pouring spout, bearings for the brackets guiding tilting of the furnace about the pouring spout, supports for the bearings, hydraulic cylinder and piston lifting and lowering mechanism for the trunions, hangers connecting the lifting and lowering mechanisms with the trunnions, rigidly connected with the pistons and reversely operative pumping means for the cylinders connected to them in parallel to lift and lower the pistons and furnaces and to hold them in intermediate positions, comprising a Hele-Shaw type pump, means for varying and reversing the eccentricity of the axis of the pump mechanism and driving means for the pump adapted to operate in the same direction with either direction of pumping action by the pumps.

4. A furnace adapted to be tilted about a pivot point and having trunnions at a second point, supports and bearings determining the first pivot point, rigid connecting brackets whereby the

trunnion axis and bearings are maintained in uniform spacing, hydraulic cylinders on opposite sides of the furnace pivoted at their lower ends, connections through the cylinders for supplying hydraulic pressure in parallel to the cylinders, hydraulic plungers for the cylinders, hangers rigidly connecting the plungers with bearings for the trunnions, a pump connected with the cylinders adapted to pump in reverse directions, and by pump action holding the plungers in any set positions against reversal of fluid flow and driving means for the pump rotating in the same direction.

5. An electric furnace having a casing, a pouring spout and a fixed pivotal support about which the furnace is to be turned in pouring, hydraulic rams laterally offset from the pivotal axis on opposite sides of the furnace, hangers from the rams and by which the furnace is supported, operating connections between the rams and furnace casing back of the fixed pivot adapting the rams to effect the turning of the furnace and means including a pump operating upon a liquid for holding the furnace in any raised position by resistance of the pump to regurgitation.

6. An electric furnace having a pouring spout, a stationary pivotal support axially across the spout, hangers having lower end supporting engagements with the furnace at opposite sides thereof located inwardly and downwardly of the pivotal axis, upwardly and downwardly extending plungers and cylinders, the plungers telescoping into the cylinders and at their upper ends carrying the upper ends of the hangers, and the cylinders having pivotal support at their lower ends located downwardly of the furnace and toward their upper ends vertically overlapping a portion of the hangers when the furnace is in upright position.

7. A bed, cylinders extending generally upwardly and downwardly and having at their lower ends pivot supports on the bed adapting the cylinders to angular movements directionally transverse to the bed length, plungers telescoping downwardly into the cylinders, hangers depending downwardly and inwardly from the upper ends of the plungers downwardly overlapping the cylinders and at their lower ends lying inwardly of the cylinders, an electric furnace intermediate the hangers and pivotally supported thereon at the lower ends thereof, spaced standards on the bed and alined pouring pivot connections between the standards and furnace.

8. Structure in accord with claim 7 and in which the bed includes upwardly presented parallel longitudinal rails and cross connections therebetween, the inner rails carrying the cylinder pivots at points of the rails longitudinally selective to suit furnace dimensions and the standards being carried on an outer rail and one of the inner rails at points thereof longitudinally selective to suit furnace dimensions.

9. Structure in accord with claim 7 and in which the bed includes upwardly presented parallel longitudinal rails, transverse connections between the rails and a trough for the cylinder pivots extending the length of the bed between the inner rails.

10. Structure in accord with claim 7 and in which the pivotal support on the hangers and the pouring pivot connections are on the inner and outer ends respectively of two opposite counterpart brackets fastened to the furnace on opposite sides thereof at the inner ends of the brackets, each bracket including a base plate at its inner end fastened to the furnace and presenting an outward trunnion to one of the hangers and at the outer end of each bracket presenting a journal for hinge connection to the top of one of the standards.

11. Structure in accord with claim 7 and in which the pivotal support on the hangers and the pouring pivot connections are on the inner and outer ends of two opposite counterpart brackets and are fastened to the furnace on opposite sides thereof at the inner ends of the brackets and the standards each include main and top members, of which the top members pivotally support the outer ends of the brackets and removably fasten to the upper ends of the main members for interchange with top members of different dimensions to accommodate different furnace dimensions.

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