

[54] **WALKING BEAM FURNACE**
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 [22] Filed: **Mar. 22, 1971**
 [21] Appl. No.: **126,648**

[30] **Foreign Application Priority Data**
 Mar. 21, 1970 Germany.....P 20 13 580.2

[52] U.S. Cl.....**263/219, 266/5 H**
 [51] Int. Cl.....**F27b 9/24**
 [58] Field of Search**266/24, 4 R, 4 A, 4 B, 4 E,**
266/5 R, 5 E, 5 H, 5 F, 6 R, 6 S, 6 PC; 263/6
A; 198/219

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[57] **ABSTRACT**

In a walking beam furnace there is provided at least one lower and at least one superposed upper walking beam support frame. These are mounted for relative vertical as well as longitudinal movement. Components having upwardly inclined surfaces are interposed between the frames with which they cooperate so as to effect relative vertical displacement of the upper frame with reference to the lower frame when the frames are moved longitudinally relative to one another. A rack is fast with the lower frame and a stationarily mounted gear cooperates with this rack to cause longitudinal displacement of the lower frame. Another rack is fast with the upper frame and an engaging arrangement is provided, including a stationary upright hollow guide member located beneath the upper frame, an upright support which is guided in the guide member for vertical movement, a gear wheel turnably carried by the upright support and camming with the rack on the upper frame, and a biasing arrangement such as a counterweight which permanently urges the gear wheel into engagement with the rack on the upper frame.

10 Claims, 13 Drawing Figures

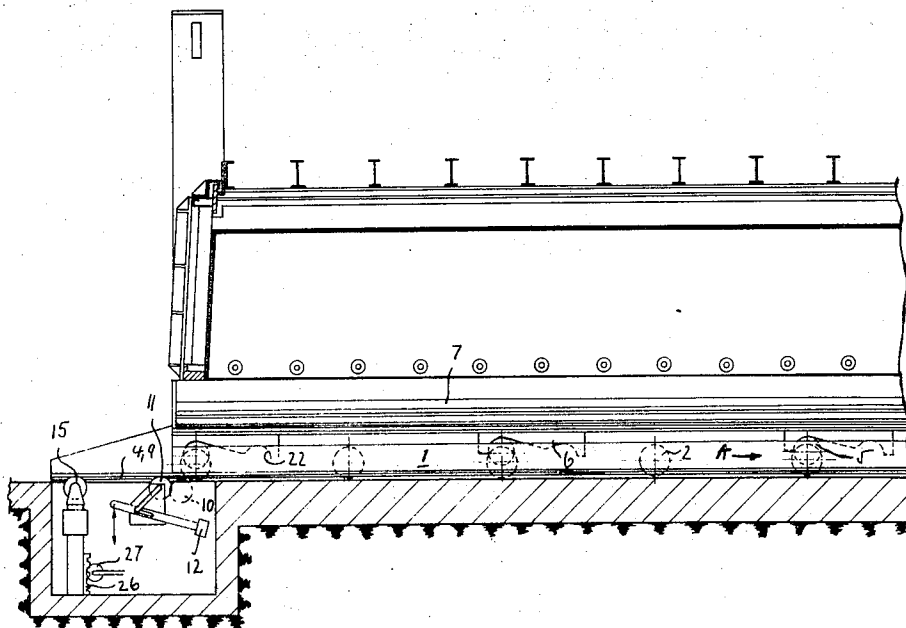


Fig.1

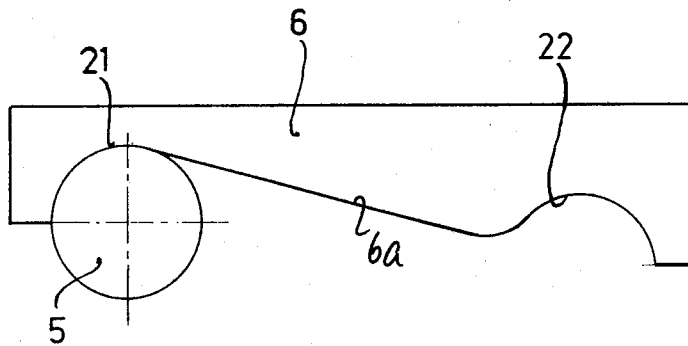
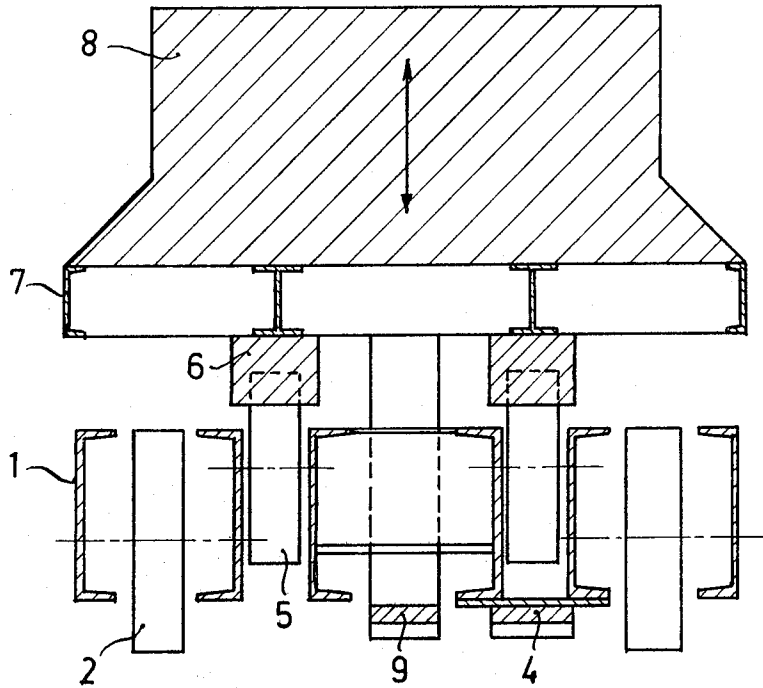


Fig.2

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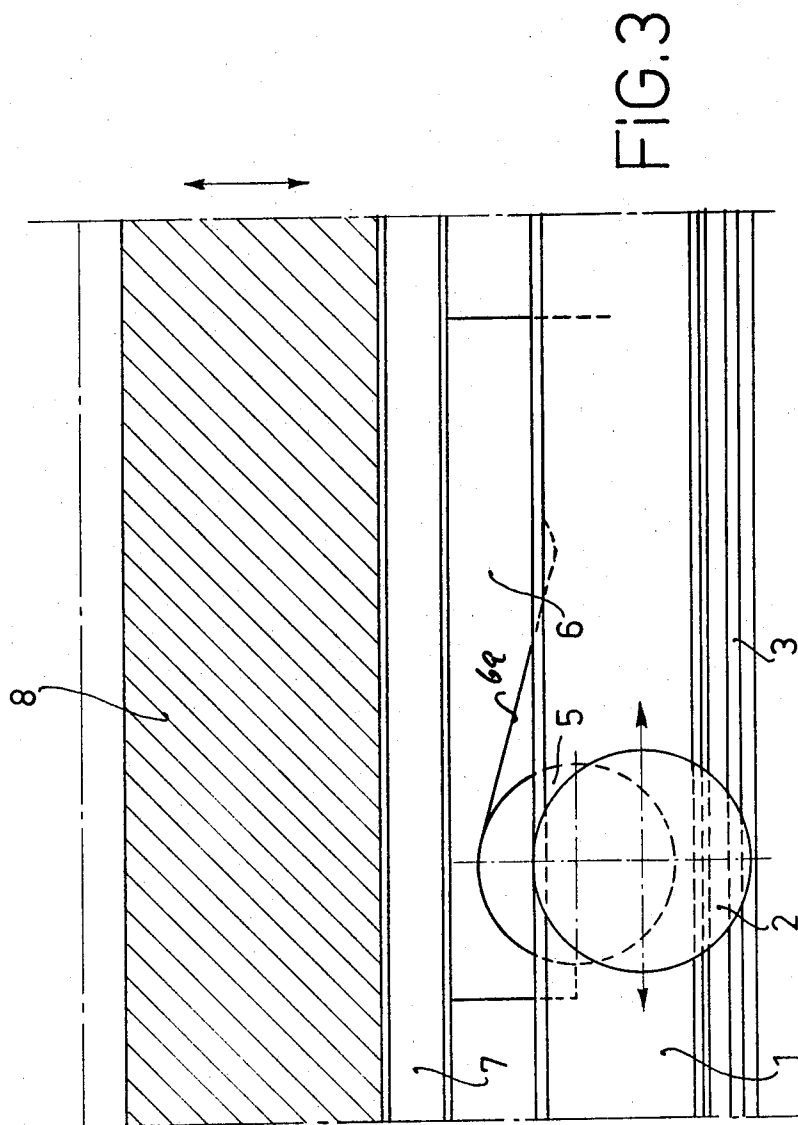


FIG. 3

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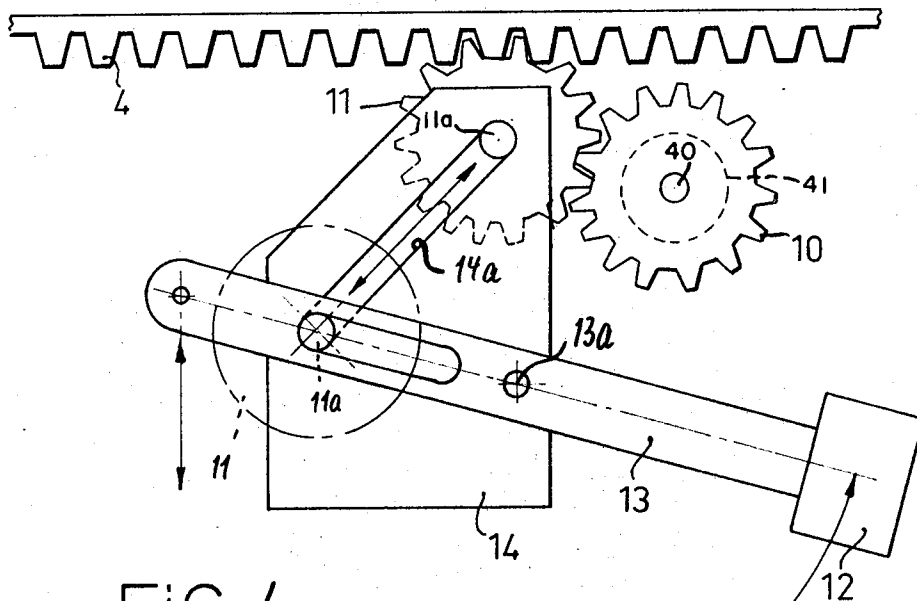


FIG. 4

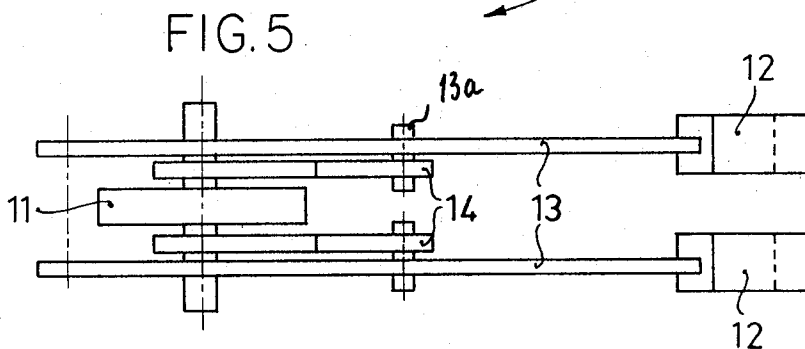


FIG. 5

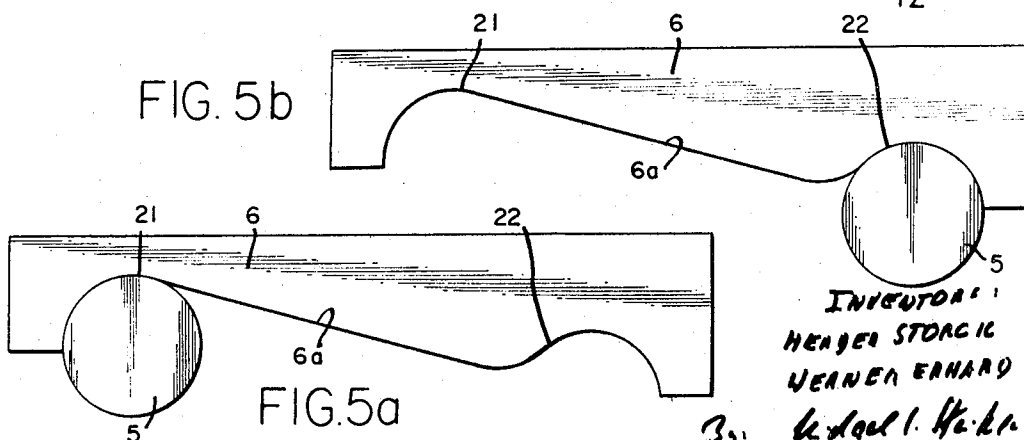


FIG. 5b

FIG. 5a

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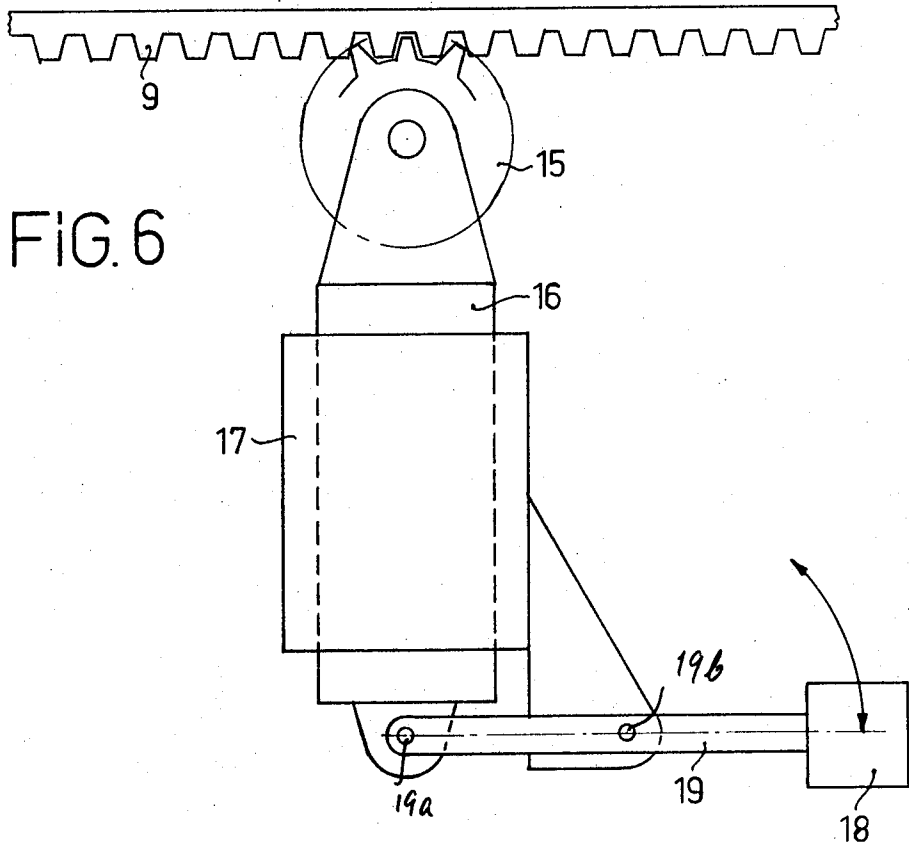


FIG. 6

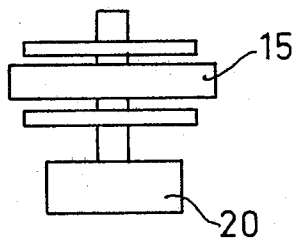


FIG. 7

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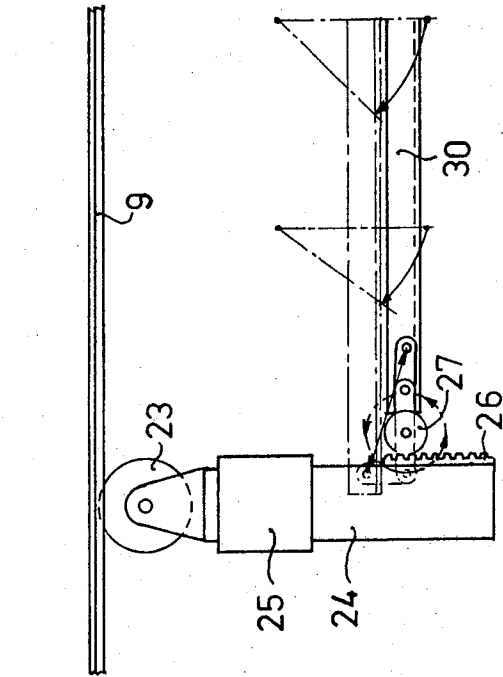


FIG. 8

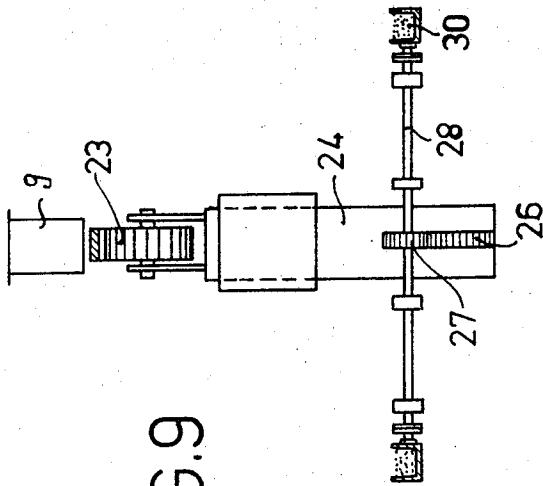


FIG. 9

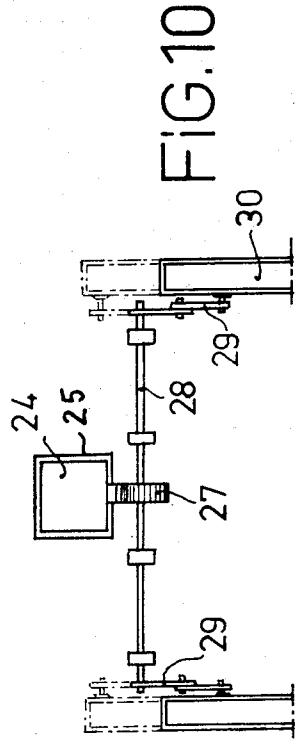


FIG. 10

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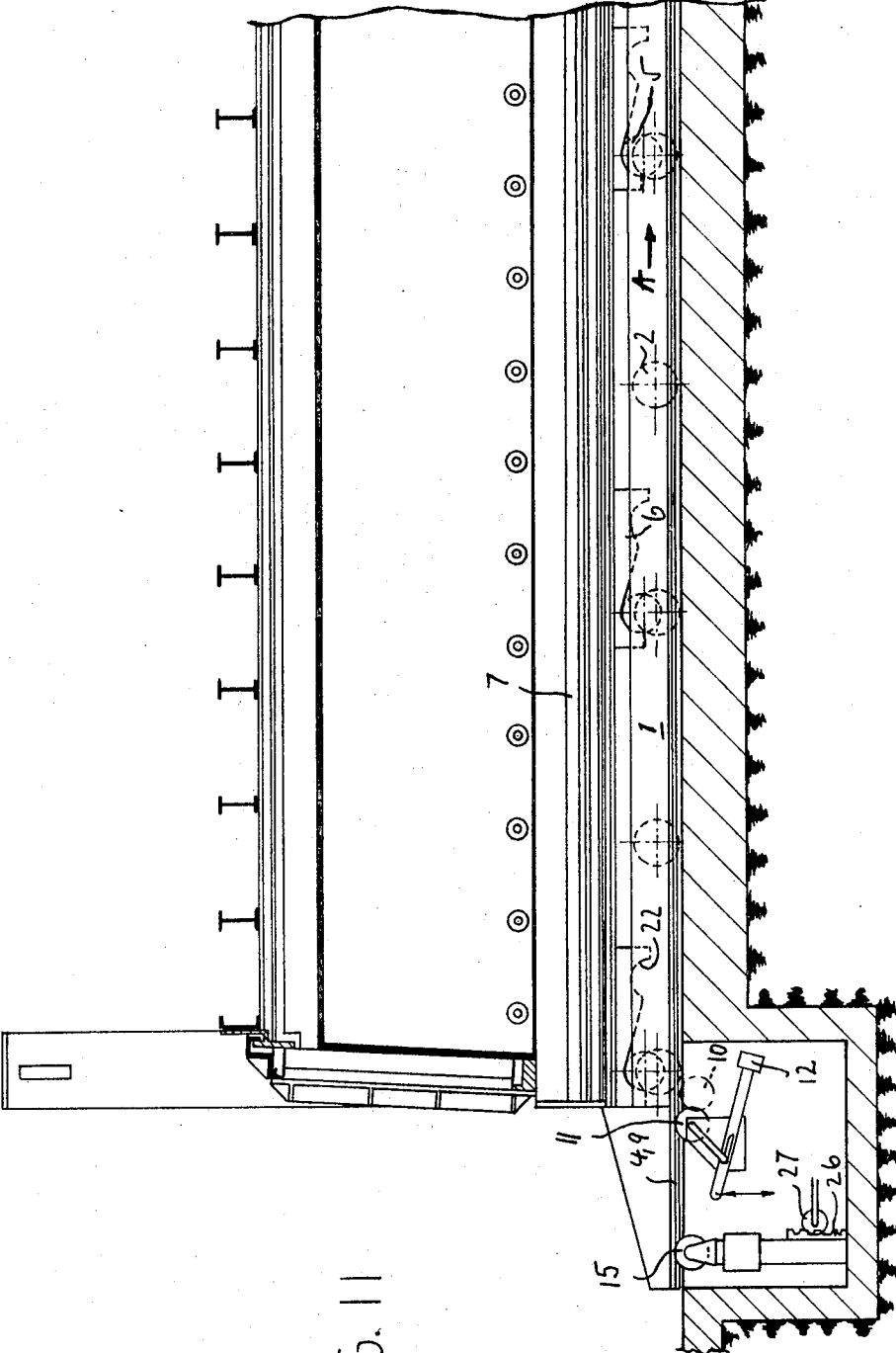


FIG. 11

WALKING BEAM FURNACE

BACKGROUND OF THE INVENTION

The present invention relates generally to furnaces, and more particularly to industrial furnaces. Still more specifically the present invention relates to a walking beam furnace and, in particular, to an improvement in a walking beam furnace for the heat treatment of metallic elements.

The construction and operation of walking beam furnaces is too well known to require detailed description. Generally speaking, however, it may be said that conventionally the hearth of such a walking beam furnace comprises one or several so-called walking beams as well as stationary beams which are adjacent to or located between the walking beams. The walking beams are operated in that they are lifted by cams or other suitable means located beneath them, and when they reach an upper position they are advanced longitudinally of the furnace in the direction in which workpieces to be treated are to be advanced through the furnace. Once they have reached the maximum longitudinal displacement of which they are capable, the walking beams are lowered again and in this lowered position are returned to their starting location. In other words, the walking beam or beams thus perform a periodically recurrent movement having the configuration of a rectangle or a parallelogram.

According to a prior-art construction of a walking beam furnace, the displacement of the walking beams is effected by means of two superposed walking beam support frames which can be displaced with reference to one another and to the floor of the furnace in the longitudinal direction of the furnace, and the upwards and downwards displacement of the frames takes place by the provision of inclined planes, that is members which have upwardly inclined surfaces and cooperate with the frames.

The problem with this latter type of construction is that it has not been entirely satisfactory, in that it does not permit longitudinal displacement of the walking beams over considerable distances, for instance over the entire length of the furnace without having to intermittently set the walking beams down and then to raise them again for the next advancing step.

SUMMARY OF THE INVENTION

It is, accordingly, a general object of the present invention to provide an improved walking beam furnace construction.

More particularly it is an object of the present invention to provide an improved walking beam furnace which affords the advantages discussed above as being desirable.

Still more specifically it is an object of the present invention to provide a walking beam furnace which makes it possible to advance the walking beams over considerable distances longitudinally of the furnace into or out of the same, without requiring intermediate shutting-down steps.

In pursuance of the above objects, and of others which will become apparent hereafter, one feature of the invention resides in the provision, in a walking beam furnace having a floor extending longitudinally of the furnace, of a combination which briefly stated com-

prises at least one lower and at least one superposed upper walking beam support frame. These frames are mounted for relative movement vertically as well as longitudinally with reference to the floor. Support means is interposed between the frames cooperating therewith and having inclined surfaces or planes which effect vertical relative displacement of the frames in response to longitudinal relative displacement thereof. A first rack is fast with the lower frame and a second rack is fast with the upper frame, and both racks extend longitudinally of the respective frame. Stationarily mounted guide means cooperates with the first rack effecting longitudinal displacement of the lower frame. Engaging means cooperates with the second rack and comprises a stationary upright hollow guide member beneath the upper frame, an upright support guided in the guide member for vertical movement, a gear wheel turnably carried by the upright support upwardly of the guide member, and biasing means which permanently urges the gear wheel into camming engagement with the second rack.

According to a further concept of the invention the support means provided with the inclined surfaces or planes for raising or lowering of the upper frame with reference to the lower frame and to the floor of the furnace, is provided on the underside of the upper frame and has detent or arresting means for arresting the rollers—which are mounted on the lower frame and over which the frame advances longitudinally by rolling engagement of the rollers with the inclined surfaces—so as to prevent further rolling movement of the rollers on these inclined surfaces when the upper frame reaches its lowest or highest position, respectively.

Another suitable arresting device, for instance a magnetic braking device, may be provided according to a further concept of the invention for preventing the gear wheel from turning when desired, so that the gear wheel and thereby the upper frame can be arrested at will against movement. When this is done, and if now the lower frame is moved longitudinally in one or the opposite direction, then a vertical upward or downward displacement of the upper frame will follow. This will take place irrespective of the particular position at which the walking beam is located, and will depend only on the length of the racks.

If several walking beams are arranged next to each other, and if they are to be displaced individually or jointly, then the drive means—usually gears—which drive the various lower frames required for such a construction can all be mounted on a common shaft. A pivotably mounted pinion, which preferably is raised or lowered by suitable motor means, can move the respective gears into or out of camming engagement with the first racks provided on the respective lower frames which are to be advanced longitudinally.

It is conventional to provide a water-seal or a sand-seal between the walking beam and the stationary beam in walking beam furnaces. Usually these seals, whose construction is well known in the art and which are generally of trough-shaped configuration, are provided on and extend longitudinally of the walking beams with which they are advanced. However, in the present invention the walking beam is to be capable both in raised and in lowered position of displacement through considerable distances, possibly even though a distance

corresponding to the entire length of the furnace in one or an opposite direction, this prior-art arrangement cannot be used. It is therefore a further embodiment of the invention which provides that there will be mounted—preferably outside the furnace—an upright support component in which an upright support element is vertically displaceable carrying at its upper end an additional gear which cams with the second rack of the upper support frame. This additional gear is also maintained in camming engagement with the second rack by suitable biasing means, such as a counterweight, springs or the like, and a portion of the upright support component which extends outwardly of the upright tubular support element is provided with a third rack which also extends in upright direction. A pinion cams with this third rack and is connected via a shaft and a lever arrangement with the sand seal construction which is also vertically displaceable. The sand seal construction is in raised position when the walking beam and the stationary beam are located at identical height, that is when the walking beam is stationary in the furnace. However, because longitudinal displacement of the walking beam is always preceded by either a raising or lowering of the latter, the sand seal construction will be lowered in each and every instance because the gear requires a full rotation for a complete upward or downward movement. With this construction it is assured that no portions of the upper support frame will extend into and drag along the sand seal construction during the displacement in longitudinal direction of the upper support frame, so that the expulsion of sand from the sand seal construction during such movement is reliably avoided.

The novel features which are considered as characteristic for the invention are set forth in particular in the appended claims. The invention itself, however, both as to its construction and its method of operation, together with additional objects and advantages thereof, will be best understood from the following description of specific embodiments when read in connection with the accompanying drawing.

BRIEF DESCRIPTION OF THE DRAWING

FIG. 1 is a somewhat diagrammatic transverse section through the upper and lower walking beam support frames according to one embodiment of the invention;

FIG. 2 is a diagrammatic side view illustrating the inclined planes of the support means cooperating with the upper and lower support frames;

FIG. 3 is a fragmentary longitudinal side-elevational section through the arrangement in FIG. 1;

FIG. 4 is a diagrammatic detail view illustrating the drive means for the lower support frame;

FIG. 5 is a top-plan view of FIG. 4;

FIG. 5a and 5b are analogous to FIG. 2, but showing the support means in the first position and in a moved second position respectively;

FIG. 6 is a view similar to FIG. 4 but illustrating the drive means for the upper support frame;

FIG. 7 is a top-plan view of the drive means shown in FIG. 6, with the upper support frame omitted;

FIG. 8 is a side-elevational diagrammatic view showing in detail an arrangement for raising and lowering a sand seal construction;

FIG. 9 is an end view of FIG. 8;

FIG. 10 is a top-plan view of FIG. 9 with certain components omitted for the sake of clarity; and

FIG. 11 is a side-elevational section of a portion of a furnace incorporating the present invention.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Discussing now the drawing in detail, and firstly FIGS. 1-3, it will be seen that reference numeral 1 identifies a lower walking beam support frame which has connected thereto rollers or wheels 2 by means of which it can advance longitudinally on non-illustrated rails 3 (compare FIG. 3) through the non-illustrated furnace chamber. A rack 4 is fast with the lower frame 1, here with the underside thereof, and extends longitudinally of the lower frame 1, that is in the direction of displacement of the same, over substantially or entirely the length thereof.

As the drawing also shows, there are further journaled for rotation about horizontal axes additional wheels 5 mounted on the lower frame 1, but these wheels 5 do not engage the rails 3 or the bottom wall of the furnace chamber. Instead, the upper walking beam support frame 7 is supported on these wheels 5 via the intermediary of support means 6. The support means 6 is shown more clearly in FIG. 2 and will be seen to have downwardly directed surfaces which are inclined in upward direction, that is which constitute inclined planes. They will be described in more detail subsequently with respect to FIG. 2.

FIGS. 1 and 3 also show that the upper walking beam support frame 7 carries a thick layer of fire-resistant or fireproof material 8 on which the workpieces to be heat treated are to be supported. A further rack 9, extending also over the entire or substantially the entire length of the upper support frame 7, is secured on the latter fast with it; in the present embodiment the rack 9 is located in the same transverse plane as the rack 4 but the arrangement could be different.

FIGS. 4 and 5 show the drive means for advancing the lower frame 1 in longitudinal direction along the rails 3. For this purpose there is provided a turnably mounted gear 10 which is rotatable about a stationary axis. As FIG. 4 shows particularly clearly, the gear 10 itself does not cam with the rack 4. Instead, there are provided two transversely spaced parallel arms 13 which are mounted at 13a for pivotal movement in a stationary support 14. The free ends of the arms 13 carry counterweights 12 so that they will perform the movements indicated by the curved double-headed arrow in FIG. 4. A pinion 11 is journaled on a shaft 11a which can slide in the upwardly inclined slots 14a of the support 14, between a lower position shown in broken lines and the upper position shown in full lines in which it cams with the driven gear 10 as well as with the rack 4, in dependence upon the pivoting movement of the arms 13. The counterweights 12 will normally maintain the pinion 11 in camming engagement with the gear 10 and with the rack 4 so that motion can be transmitted to the latter and thereby the lower frame 1 from the gear 10 via the pinion 11.

The drive for the upper frame 7 is illustrated in FIGS. 6 and 7. As shown in these Figures, a gear wheel 15 is provided which cams with the rack 9 on the upper frame 7 (which is omitted for clarity in FIGS. 6 and 7). The gear wheel 15 is mounted on an upright support

element 16 for turning movement, and the element 16 is mounted for vertical displacement in a hollow tubular upright guide member 17 which is stationarily mounted. An arm 19 is pivoted to the lower end of the element 16 at 19a, and it is again pivoted at 19b to a stationary element, for instance a projecting of the element 17. Thus, a counterweight mounted on the free end of the arm 19 will normally tend to displace the same in the direction of the double-headed arrow in FIG. 6 about the pivot 19b in downward direction, raising the element 16 and maintaining the gear wheel 15 in camming engagement with the rack 9 as illustrated in FIG. 6.

As shown in FIG. 7, a suitable arresting device—here illustrated as a magnetic braking device 20 of known and conventional construction—is associated with the gear wheel 15 and can be operated in a sense preventing the gear wheel 15 from rotation when desired. When the device 20 is operated and the gear wheel 15 can no longer turn about its axis, longitudinal displacement of the lower frame 1 along the rails 3 will not result in corresponding longitudinal advancement of the upper frame 7. Instead, the rollers 5 on the lower support frame 1 will roll only on the inclined planes or surfaces 6a of the support means 6 shown in FIG. 2, and this will impose upon the upper frame 7 a vertical movement in upward or downward direction, depending upon the direction in which the lower support frame 1 moves in longitudinal direction. The wheels or rollers 5 will reach either a detent or recess 21 as shown in FIG. 5a or a detent or recess 22 as shown in FIG. 5b, these recesses being located at the opposite longitudinal ends of the inclined surfaces 6a shown in FIG. 2, and having the purpose of preventing further displacement of the rollers 5 when the upper support frame (which is not illustrated in FIG. 2) has reached its highest or lowest position, respectively.

Coming to FIGS. 8-10 it will be seen that there we have illustrated an arrangement for acting upon the sand seal construction which is to be associated with the novel combination disclosed herein. There is provided according to the embodiment of FIGS. 8-10 an additional gear 23 which also cams with the rack 9 of the upper support frame 7, preferably but not necessarily located outside the confines of the furnace chamber. The gear 23 is also mounted for turning movement on an upright support component 24 which is journaled for vertical displacement in a stationary mounted tubular guide element 25. Again, a suitable biasing means, such as a counterweight, spring or the like, is provided (not illustrated) for permanently tending to bias the wheel 23 into camming engagement with the rack 9.

A portion of the component 24 which projects downwardly out of the tubular guide element 25 is provided with still a third rack 26 which extends longitudinally of the component 24 and with which a pinion 27 cams. This pinion 27 is mounted on a shaft 28 which is connected with beel crank lever arrangements 29 acting upon the respectively associated elongated trough-shaped sand seal constructions 30 which are upwardly open and which contain sand as shown in FIG. 9. Any vertical displacement of the component 24 resulting from vertical rising or descending of the upper support frame 7 on which the rack 9 is provided, is transmitted

via the pinion 27, the shaft 28 and the levers 29 to the sand seal devices 30 which are then correspondingly raised or lowered as indicated by the arrows in FIG. 8 and in broken lines in FIG. 10.

It will be appreciated that the purposes of the present invention are achieved with the disclosed construction and that this makes possible a greatly facilitated heat treatment of workpieces in a walking beam furnace constructed in accordance with the present invention.

In FIG. 11 we have shown a portion of a walking beam furnace provided with the arrangement of the present invention, to illustrate their cooperation and to show the operation of the arrangement. The inclined planes 6 on frame 7 engage and are supported on the wheels 5 which in turn are journaled on frame 1. When it is desired to lift frame 7 out of the position shown in FIG. 11, frame 1 is shifted in direction of the arrow A by driving the pinion 11 via gear 10; the pinion cams with rack 4 and thus moves frame 1.

The upper frame 7 is prevented from participating in such movement of the frame 1 by the gear 15 which meshes with rack 9 and is blocked by operation of the magnetic brake 20. As a result, the wheels roll on the respectively associated inclined planes 6 and, because vertical movement of the upper frame 7 is not blocked, the same will move upwardly away from frame 1. Movement of the frame 1 in direction of the arrow A is terminated when the wheels 5 reach the recesses 22. At this time, the bodies to be treated are out of engagement with the stationary supports of the furnace.

To obtain transportation of these bodies through the furnace, i.e., "walking" of the frame 7, the magnetic brake 20 is released and the frame 1 is thereupon advanced further in the direction of arrow A; this time, however, the frame 7 is not blocked by the gear 15 and brake 20 and thus participates in the horizontal movement of frame 1. Subsequently, frame 7 is lowered by moving the frame 1 counter to the direction indicated by arrow A while blocking frame 7 from participating in this movement via gear 15 and brake 20.

It is clear that movement of the frame 1, as well as of frame 7 (both vertical and horizontal in the case of the latter) is effected via the driven gear 10. Gear 15, on the other hand, is not driven; it is associated with the brake 20 which can prevent it from turning. When the brake 20 is not operated, gear 15 turns in response to movement of the rack 9 with which it cams at all times, due to the urging of counterweight 18.

It will be understood that each of the elements described above, or two or more together, may also find a useful application in other types of constructions differing from the types described above.

While the invention has been illustrated and described as embodied in a walking beam furnace construction, it is not intended to be limited to the details shown, since various modifications and structural changes may be made without departing in any way from the spirit of the present invention.

Without further analysis, the foregoing will so fully reveal the gist of the present invention that others can be applying current knowledge readily adapt it for various applications without omitting features that, from the standpoint of prior art, fairly constitute essential characteristics of the generic or specific aspects of this invention and, therefore, such adaptations should and

are intended to be comprehended within the meaning and range of equivalence of the following claims.

What is claimed as new and desired to be protected by Letters Patent is set forth in the appended

1. In a walking beam furnace having a floor extending longitudinally of the furnace, in combination, at least one lower and at least one superposed upper walking beam support frame, mounted for relative movement vertically as well as longitudinally with reference to said floor; support means interposed between said frames cooperating therewith and having inclined surfaces which effect vertical relative displacement of said frames in response to relative longitudinal displacement thereof; a first rack fast with said lower frame and a second rack fast with said upper frame, each extending longitudinally of the respective frame; stationarily mounted drive means cooperating with said first rack for effecting longitudinal displacement of said lower frame; and engaging means cooperating with said second rack and comprising a stationary upright hollow guide member beneath said upper frame, an upright support guided in said guide member for vertical movement, a gear wheel turnably carried by said support upwardly of said guide member, and biasing means permanently urging said gear wheel into engagement with said second rack.

2. In a walking beam furnace as defined in claim 1, wherein said biasing means comprises weight means connected with said support.

3. In a walking beam furnace as defined in claim 1; and further comprising arresting means operable for arresting said gear wheel against turning movement when it is desired to prevent longitudinal displacement of said upper frame.

4. In a walking beam furnace as defined in claim 3, wherein said arresting means is a magnetic braking device.

5. In a walking beam furnace as defined in claim 1, said support means being mounted on and located underneath said upper frame and said inclined surfaces being downwardly directed; further comprising a plurality of rollers each mounted on said lower frame for turning movement about a substantially horizontal axis which is stationary with reference to said lower frame;

and detent means on said inclined surfaces for detaining said rollers against further rolling movement upon said upper frame reaching a highest and a lowest position, respectively.

6. In a walking beam furnace as defined in claim 1; further comprising at least one additional lower frame and at least one additional upper frame, additional support means, additional first and second racks, additional stationarily mounted drive means and additional engaging means; and further comprising operating means for operating said drive means and said additional drive means severally or in unison, as desired.

7. In a walking beam furnace as defined in claim 6, wherein said drive means and said additional drive means each comprise a gear camming with said first rack and said additional first rack, respectively.

8. In a walking beam furnace as defined in claim 7, said operating means comprising a shaft mounting both of said gears for turning movement, and pivotable means for selectively moving the respective gears into and out of mesh with the associated rack.

9. In a walking beam furnace as defined in claim 1; further comprising an upright tubular guide element mounted stationarily below said upper frame, an upright member guided for vertical displacement in said guide element, a gear element carried by said upright member above said guide element and camming with said second rack, and a biasing element acting upon said upright member in a sense tending to maintain said gear element in camming engagement with said second rack.

10. In a walking beam furnace as defined in claim 9, said upright member being elongated in upright direction and having at least a portion located exteriorly of said upright guide element; further comprising a third rack provided on said portion and extending in direction of elongation of said upright member; sand seal means extending longitudinally of said frames and being vertically movable with reference thereto; a pinion camming with said third rack; and linkage means connecting said pinion with said sand seal means in a sense effecting vertical displacement of the same in response to relative displacement of said frames.

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