

Aug. 15, 1961

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2,995,871

BRACING FOR INDUSTRIAL FURNACES

Filed Nov. 5, 1957

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FIG. 1

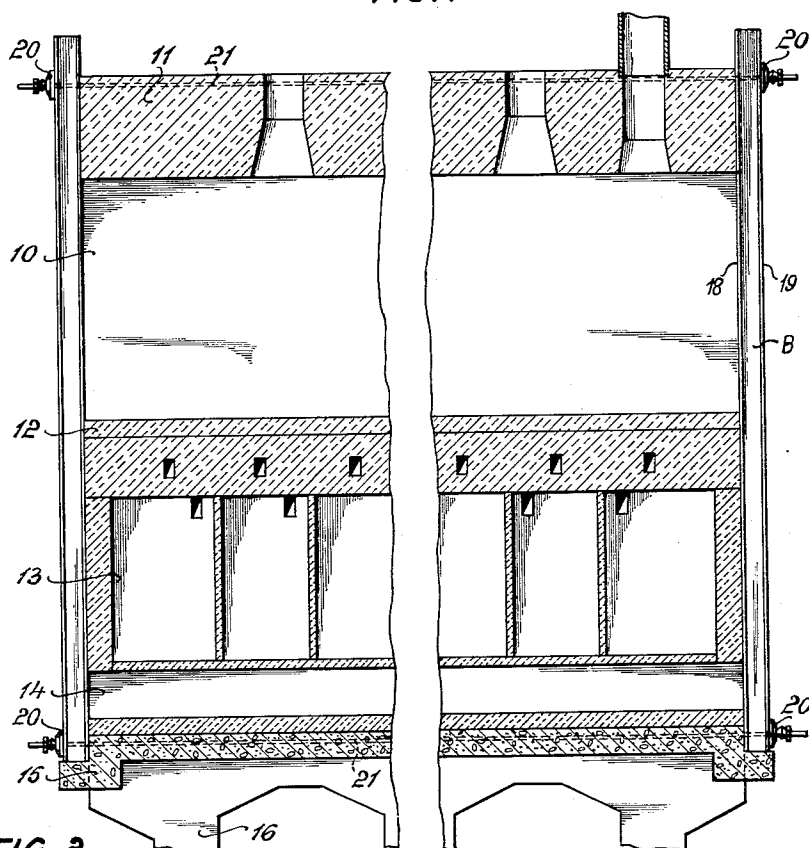
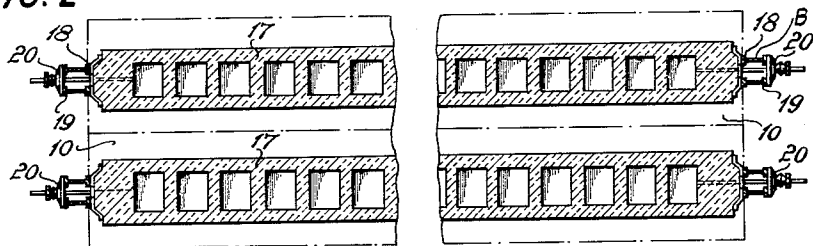


FIG. 2



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FIG. 3

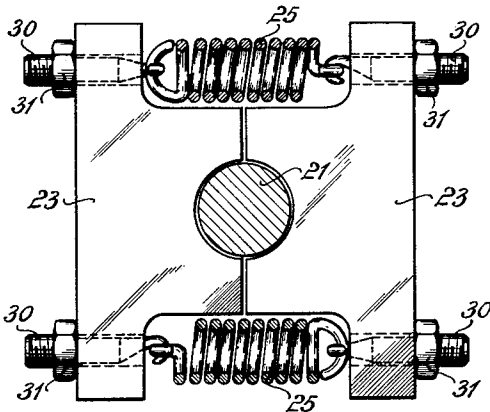
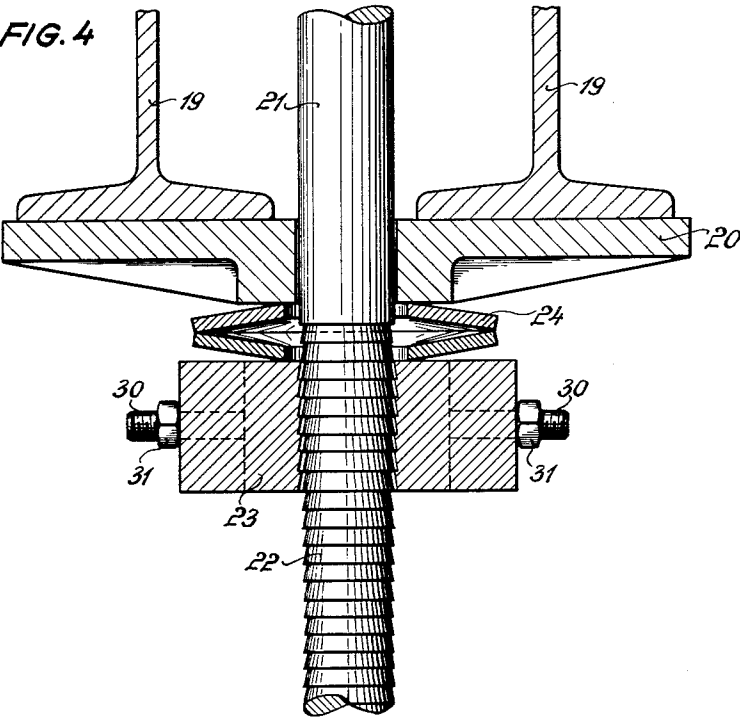


FIG. 4



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FIG. 5

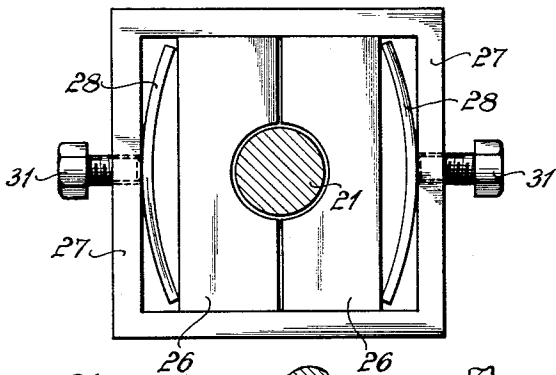
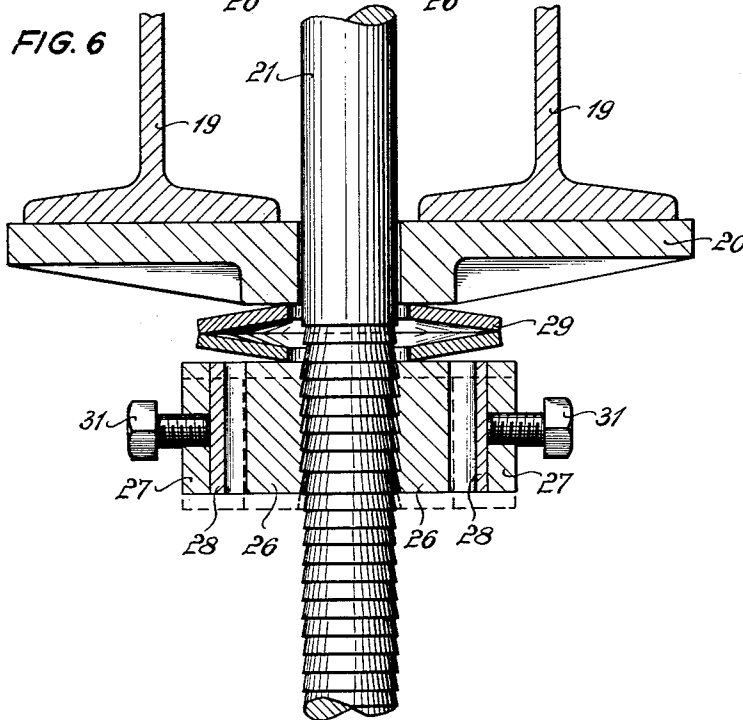


FIG. 6



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FIG. 7

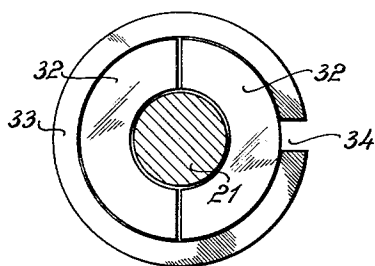
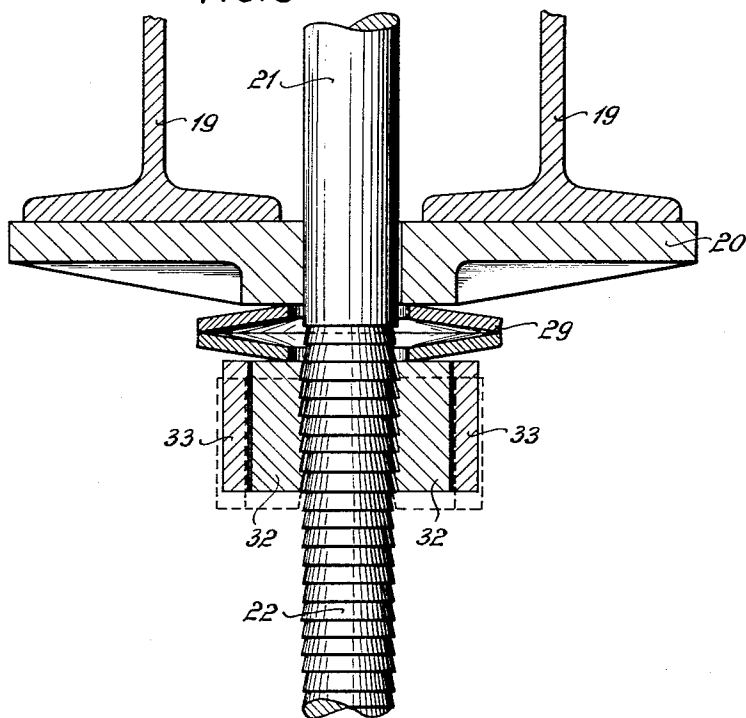


FIG. 8



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FIG. 9

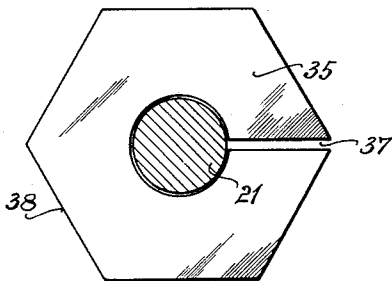
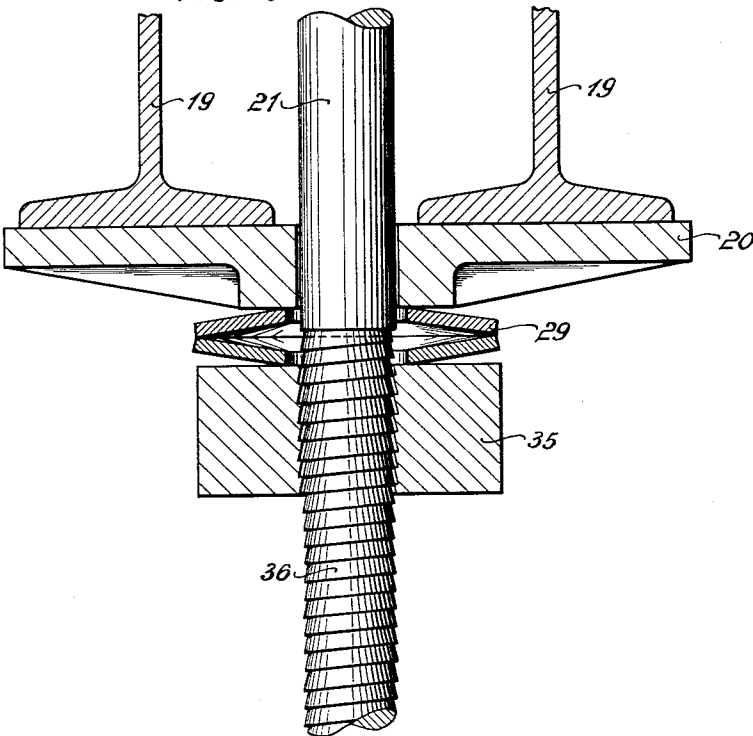


FIG. 10



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BRACING FOR INDUSTRIAL FURNACES

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6 Claims. (Cl. 50—128)

This invention relates to bracing for industrial furnaces, and particularly to means for automatically adjusting the tension in the tie rod connecting opposed buckstays in a coke oven battery.

The brickwork of industrial furnaces, which is heated to high temperatures (1,000° C. and more), experiences in this connection not only a considerable thermal expansion but also an irreversible expansion due to crystallographic transformations, particularly when the refractory bricks of the brickwork consist to a considerable extent of silica. It is customary to anchor or brace the brickwork by setting up buckstays in front of the outer longitudinal walls of the furnace and opposed buckstays are connected by tie rods; thrust blocks are provided on the tie rods and act on the buckstays.

In furnaces in which an extremely fine gas-tight seal between the individual furnace walls is required, as is the case, for instance, for the walls separating the heating flues and furnace chambers of coke oven batteries, adjustable thrust blocks are provided to help effect such a tight seal. These thrust blocks normally include threaded nuts positioned on the ends of the tie rods and compression springs acting between the nuts and the buckstays in the longitudinal direction of the tie rods.

It is of great importance that a given minimum pressure be exerted on the brickwork by the buckstays so that no gaps are produced during the expansion of the bricks. On the other hand, the pressure exerted on the brickwork must not exceed a given value at which the brick material is cracked or destroyed. With the arrangement described having adjustable thrust box blocks and compression springs, in order to keep the pressure exerted on the brickwork within the given limits it is customary to check the compression of the springs, for instance by continuously checking the length of the springs and thus determining the tension, for instance on basis of a calibration curve. If the tension exceeds a given value, the thrust block is shifted until the pressure value again lies within the given limits. With this type of supervision of the bracing system during the heating of the furnace, it is necessary to check all tie rods of a furnace block at least once and in many cases several times a day. In the case of a battery of 50 chambers, this constitutes a considerable amount of work; nor may it be omitted during the night hours. The damage resulting from a failure to check or carelessness in checking and readjusting the thrust blocks may lead to a complete shutdown of the furnace block or a substantial reduction in the usefulness of the furnace block.

One object of the present invention is to remedy the above discussed drawback by providing thrust blocks through which the tie rods act on the buckstays which are constructed so that they automatically change their position on the tie rods when the tension force acting on the tie rods and resulting from the expansion of the brickwork exceeds a predetermined value. However, this change will only be of such extent that sufficient tensile force is still present in the tie rods and the brickwork therefore is still under a given tension.

Another object of the present invention is to provide automatically yielding thrust blocks wherein the tie rods are formed as racks at their protruding parts.

The racks can in this connection be constructed of indi-

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vidual toothed rings, the oblique surfaces of which rise flatly in the direction of expansion and are cut vertically at the end of the rise. Such toothed rings, predominantly of the same shape, follow one after the other along the length of the end of the tie rod. It is essential that the inside of the thrust block, comprising movable jaws, is adapted to this outer surface of the toothed rings so that the outer surfaces of the tie rod and the inner surfaces of the thrust block can press firmly against each other with a considerable force per unit of area.

The end of the tie rod, instead of being constructed of such toothed rings, can also be provided in the form of a helix with a thread, in which connection the tie rod seen in axial section appears also provided with saw teeth. Naturally, in this case the thrust block must be provided with a corresponding inner surface. This also applies to the further developments of thrust blocks described below.

The thrust block can be formed of two jaws on which springs having their axes transverse to the tie rods (transverse springs) act. When the pressure exerted by the brickwork on the buckstays reaches a given value, the pressure exerted by the transverse springs on the jaws is no longer sufficient to hold the jaws together; they are pressed from the outside against the tie rods and slide on the oblique surfaces of the teeth until pressure equalization is again restored. The arrangement preferably includes compression springs acting in the direction of the tie rod which have been known heretofore (tie-rod springs). These tie rod springs are compressed between the thrust block of the tie rod and the buckstays. In this connection, the transverse springs and tie rod springs are so arranged with respect to each other that when a given value of the tension taken up by the tie rod springs is exceeded, the transverse springs yield to an extent until, by displacement of the thrust block on the rack, the compression of the tie rod springs has again dropped below the given value.

The two jaws which form the thrust block can be held together by tension springs acting transverse to the longitudinal axis of the tie rod. The tension springs are preferably adjustable so as to provide a means for precisely setting the tension of the tie rod at which the thrust bearing formed by the jaws yields. This adjustability can be achieved, for instance, by supporting the tension springs on adjustable screws which pass through the jaws and which can be locked by nuts in their adjusted positions.

The jaws can also be inserted in a box-like housing through the center of which the tie rod passes and the transverse springs are formed as compression springs arranged between the inner wall of the housing and the jaws, the transverse springs pressing the jaws with the necessary pressure against the tie rod.

A particularly simple embodiment of the present invention is obtained by forming the jaws out of the two halves of a cylinder which is cut in an axial plane. An open ring spring surrounding the two semi-cylinders presses the jaws against the tie rod. Although the embodiment with two mirror image semi-cylinders is the most obvious, a division of the cylinder lying within the ring springs into more than two sectors is also readily possible.

Finally, the jaws serving as thrust blocks and the ring spring pressing the jaws firmly against the armature can also be combined into a single part, an open ring spring surrounding the tie rod and resting with corresponding inner surfaces against same by itself may form the thrust block. The periphery of this ring spring can be in the form of a polygon, particularly a hexagon or square, as seen in section at right angles to the axis of the tie rod. In this case, when the tie rod is provided with

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sawtooth-like thread, it is possible, by means of a wrench placed on the hexagon, square or the like, to screw the ring spring serving as thrust block to such an extent onto the tie rod that the tie rod spring is imparted the necessary tension. In order to make possible such handling of the ring spring which forms the thrust block, it is sufficient if the ring spring is provided with a portion or extension with a polygonal periphery, for instance in the form of a hexagon, square or the like.

By the use of the present invention, the tiresome work of readjusting the bracing members is dispensed with. In this way, there are also excluded the errors which arise in case of an inaccurate or careless performance of this work.

The use of the new bracing is shown in the attached drawings as applied to a coke oven battery.

In the drawings:

FIGURE 1 is a vertical sectional view through a coke oven in a coke oven battery;

FIGURE 2 is a fragmentary horizontal sectional view showing the coke oven illustrated in FIGURE 1 flanked by its adjacent heating walls;

FIGURE 3 is a view, partly in elevation and partly in vertical section, showing one form of thrust member embodying the present invention;

FIGURE 4 is a horizontal view, partly in section and partly in plan, showing the thrust member illustrated in FIGURE 3 at the end of a tie rod;

FIGURE 5 is a view similar to FIGURE 3 showing another embodiment of the present invention;

FIGURE 6 is a view similar to FIGURE 4 but further illustrating the form of the invention shown in FIGURE 5;

FIGURE 7 is a view similar to FIGURES 3 and 5 illustrating still another form of the present invention;

FIGURE 8 is a view similar to FIGURES 4 and 6 further illustrating the form of the invention shown in FIGURE 7;

FIGURE 9 is a view similar to FIGURES 3, 5 and 7 illustrating yet another embodiment of the present invention; and

FIGURE 10 is a view similar to FIGURES 4, 6 and 8 further illustrating the form of the invention shown in FIGURE 9.

Referring now to FIGURES 1 to 4 in detail, the furnace chambers 10 which are arranged in a side-by-side row are flanked on both sides by heating walls 17, within which the heating flues are located. The top of the oven is formed by the furnace ceiling 11 and the bottom by the chamber floor 12. Regenerator chambers provided with checkerwork are generally designated by the reference numeral 13, and the sole channels are designated by the reference numeral 14. The baseplate 15 of the furnace is located above the under-cellaring 16. On both sides of the heating walls 17 there are located the buckstays B developed as wide flanged beams, the inner flanges 18 of which rest against the ends of the heating walls 17. In front of the outer flanges 19 of buckstays B, there are located pressure plates 20 through which the upper and the lower tie rods 21 are passed. The outer ends of the tie rods 21 are developed as racks with teeth 22. The cross section of this part of the tie rod is preferably circular. In vertical axial section, there is obtained a sawtooth profile. The sides of the teeth rise very gradually towards the outside surfaces thereof and then are substantially at right angles to the axis of the tie rod. Instead of a circular cross section, the outer ends of the tie rod can, if desired, be of polygonal cross section.

The inner sides of the two jaws 23 have a surface which is complementary to the sawtooth shape of the ends of the tie rod. The two jaws 23 are firmly pressed against the outer end of the tie rod by the tension springs 25. The tension springs 25 act on the bolts 30 which have nuts 31 threadedly secured to their ends. By changing the

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position of the nuts 31 relative to bolts 30, the tension of the springs 25 can be regulated.

The jaws 23 form the thrust member for the tie rod spring 24 herein shown as a cup spring. The pressure of the brickwork acting on the buckstays is transmitted by the flanges 19 via the pressure plate 20 to the cup spring 24. The latter acts on the jaws 23 forming the thrust member and endeavors to push them outward of the tie rods 21. However, this tendency is limited to the extent that the jaws 23 are capable of moving away from each other only against the action of the transverse springs 25. By suitable dimensioning of the cup springs 24 and of the transverse springs 25, the stress of the brickwork will at all times remain within given limits.

In the arrangement shown in FIGURES 5 and 6, the thrust member is formed by two pressure jaws 26 which are clamped in a frame-like housing 27, by means of the plate springs 28. The tie rod springs are in this case also formed by cup springs 29. By adjustable set screws 31 which pass through the housing 27, the compression of the plate springs 28 can be regulated. The development of the outer end of the tie rod is the same as in the case of the embodiment shown in FIGURE 4. The inner surface of the pressure plates 26 is complementary to the periphery of the tie ends. It will be obvious to anyone skilled in the art that the operation of the embodiment shown in FIGURES 5 and 6 is the same as that shown in FIGURES 1 to 4. Therefore, a detailed description of the operation is deemed unnecessary.

Referring now to FIGURES 7 and 8, the arrangement of pressure plate 20, tie rod 21 and cup spring 29 remain the same. The pressure jaws 32 are developed as semi-cylinders. Their inner surface is again adapted to the shape of the surface of the tie rod end. A ring spring 33 provided with a slit 34 presses the two semi-cylinders 32 against the tie rod and prevents the thrust member from moving outward as long as the pressure of spring 29 is not greater than a predetermined value.

While the position of the pressure jaws 32 and of the ring spring 33 is indicated in FIGURE 8 in solid line in a position in which the projections of the inner surfaces of the two pressure jaws extend into the roots of the teeth 22, there is shown in FIGURE 8 in dotted line a position of the pressure jaws in which they are seated only on the outermost tooth sides so that upon further displacement towards the outside snapping into the next tooth gap takes place.

The arrangement shown in FIGURES 9 and 10 differs from the previously described arrangements in several respects. The end of the tie rod 21 in the embodiment shown in FIGURES 9 and 10 does not consist of toothed rings parallel to each other but is provided with a saw tooth thread 36. The inner surface of the thrust member which is formed in this case solely by a ring spring 35 which has an opening slit 37 is formed complementary to this thread. The outer periphery 38 of this ring spring is developed as a hexagon. The placing on of the ring spring 35 can be effected in a simple manner by placing a wrench on the hexagon 38 and turning the ring spring 35 until the cup spring 29 has reached the required stress. Thereafter, the operation will be the same as previously described.

It will be understood that the thrust members shown in FIGURES 3, 5 and 7 can be modified to have either a polygonal periphery or to be provided with a polygonal portion and may be made to cooperate with a tie rod having a sawtooth thread similar to thread 36 shown in FIGURE 10. With such an arrangement, the forms of the invention shown in FIGURES 3, 5 and 7 can be adapted to easy threaded positioning on the tie rod as described above with regard to the embodiment shown in FIGURES 9 and 10.

While I have herein shown and described several forms of the present invention and have suggested various changes and modifications therein, other changes and

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modifications may be made therein within the scope of the appended claims without departing from the spirit and scope of this invention.

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

1. Means for bracing a substantially parallel pair of walls of a furnace, comprising a pair of buckstays, one in operative engagement with one of said walls and the other in operative engagement with the other of said walls, a tie rod extending between said two buckstays, a pair of thrust members, one adjacent each end of said tie rod, mounted on said tie rod and operatively engaging the buckstay adjacent thereto for exerting a force thereon in the direction of the other buckstay, the surface of the end portions of said tie rod being provided with sawtooth portions in the form of a helical thread, said thrust members being provided with complementary sawtooth portions in the form of a helical thread and interengaging said sawtooth portions on said tie rod for permitting movement of said thrust members outwardly of said tie rod and for preventing movement of said thrust member inwardly of said tie rod, means for biasing said sawtooth portions of said thrust members into engagement with said sawtooth portions of said tie rod for yieldably holding said thrust members fixed relative to said tie rod when force exerted by said thrust members against their associated buckstays is less than a predetermined value and for permitting movement of said thrust members outwardly relative to said tie rod when said force exceeds said predetermined value, whereby to reduce said force to below said predetermined value.

2. Means for bracing a substantially parallel pair of walls of a furnace, comprising a pair of buckstays, one in operative engagement with one of said walls and the other in operative engagement with the other of said walls, a tie rod extending between said two buckstays, a pair of thrust members, one adjacent each end of said tie rod, mounted on said tie rod and operatively engaging the buckstay adjacent thereto for exerting a force thereon in the direction of the other buckstay, the surface of the end portions of said tie rod being provided with sawtooth portions in the form of a helical thread, said thrust members being provided with complementary sawtooth portions in the form of a helical thread and interengaging said sawtooth portions on said tie rod for permitting movement of said thrust members outwardly of said tie rod and for preventing movement of said thrust member inwardly of said tie rod, means for biasing said sawtooth portions of said thrust members into engagement with said sawtooth portions of said tie rod for yieldably holding said thrust members fixed relative to said tie rod when the force exerted by said thrust members against their associated buckstays is less than a predetermined value and for permitting movement of said thrust members outwardly relative to said tie rod when said force exceeds said predetermined value, whereby to reduce said force to below said predetermined value, said thrust members having non-circular peripheral portions adapted to be gripped by a wrench for turning said thrust members to thereby adjust their positions relative to said tie rod.

3. Means for bracing a substantially parallel pair of walls of a furnace, comprising a pair of buckstays, one in operative engagement with one of said walls and the other in operative engagement with the other of said walls, a tie rod extending between said two buckstays, a pair of thrust members, one adjacent each end of said tie rod, mounted on said tie rod and operatively engaging the buckstay adjacent thereto for exerting a force thereon in the direction of the other buckstay, the surface of the end portions of said tie rod being provided with sawtooth portions in the form of a helical thread, said thrust members being provided with complementary sawtooth portions in the form of a helical thread and interengaging said sawtooth portions on said tie rod for permitting movement of said thrust members outwardly of said tie

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rod and for preventing movement of said thrust member inwardly of said tie rod, means for biasing said sawtooth portions of said thrust members into engagement with said sawtooth portions of said tie rod for yieldably holding said thrust members fixed relative to said tie rod when the force exerted by said thrust members against their associated buckstays is less than a predetermined value and for permitting movement of said thrust members outwardly relative to said tie rod when said force exceeds said predetermined value, whereby to reduce said force to below said predetermined value, said thrust members having polygonal peripheral portions adapted to be gripped by a wrench for turning said thrust members to adjust their positions relative to said tie rod.

4. Means for bracing a substantially parallel pair of walls of a furnace, comprising a pair of buckstays, one in operative engagement with one of said walls and the other in operative engagement with the other of said walls, a tie rod extending between said two buckstays, a pair of thrust members, one adjacent each end of said tie rod, each of said thrust members comprising a pair of relatively movable confronting jaws having their confronting surfaces shaped to define a passage therein through which the adjacent end portion of said thrust rod extends, the surface of the end portions of said tie rod being provided with a plurality of sawtooth portions, the surface defining said passage in each of said thrust members being provided with complementary sawtooth portions interengaging said sawtooth portions on said tie rod for permitting movement of said thrust members outwardly of said tie rod and for preventing movement of said thrust member inwardly of said tie rod, a ring spring substantially surrounding said jaws and biasing them toward each other for biasing said sawtooth portions of said thrust members into engagement with said sawtooth portions of said tie rod for yieldably holding said thrust members fixed relative to said tie rod when the force exerted by said thrust members on their associated buckstays is less than a predetermined value and for permitting movement of said jaws away from one another to permit movement of said thrust members outward relative to said tie rod when said force exceeds said predetermined value, whereby to reduce said force to below said predetermined value.

5. Means for bracing a substantially parallel pair of walls of a furnace, comprising a pair of buckstays, one in operative engagement with one of said walls and the other in operative engagement with the other of said walls, a tie rod extending between said two buckstays, means for connecting said tie rod to said buckstays, at least one of said connecting means including a thrust member mounted on an end portion of said tie rod and operatively engaging the buckstay adjacent thereto for exerting a force thereon in the direction of the other buckstay, the surface of said end portion of said tie rod being provided with a sawtooth portion, said thrust member being provided with a complementary sawtooth portion interengaging said sawtooth portion on said tie rod for permitting movement of said thrust member outwardly of said tie rod and for preventing movement of said thrust member inwardly of said tie rod, means for biasing said sawtooth portion of said thrust member into engagement with said sawtooth portion of said tie rod for yieldably holding said thrust member fixed relative to said tie rod when the force exerted by said thrust member against its associated buckstay is less than a predetermined value and for permitting movement of said thrust member outwardly relative to said tie rod when said force exceeds said predetermined value, whereby to reduce said force to said predetermined value.

6. Means for bracing a substantially parallel pair of walls of a furnace, comprising a pair of buckstays, one in operative engagement with one of said walls and the other in operative engagement with the other of said walls, a tie rod extending between said two buckstays, a pair of

thrust members, one adjacent each end of said tie rod, mounted on said tie rod and operatively engaging the buckstay adjacent thereto for exerting a force thereon in the direction of the other buckstay, the surface of the end portions of said tie rod being provided with sawtooth portions, said thrust members being provided with complementary sawtooth portions interengaging said sawtooth portions on said tie rod for permitting movement of said thrust members outwardly of said tie rod and for preventing movement of said thrust member inwardly of said tie rod, means for biasing said sawtooth portions of said thrust members into engagement with said sawtooth portions of said tie rod for yieldably holding said thrust members fixed relative to said tie rod when the force exerted by said thrust members against their associated buckstays is less than a predetermined

value and for permitting movement of said thrust members outwardly relative to said tie rod when said force exceeds said predetermined value, whereby to reduce said force to below said predetermined value.

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