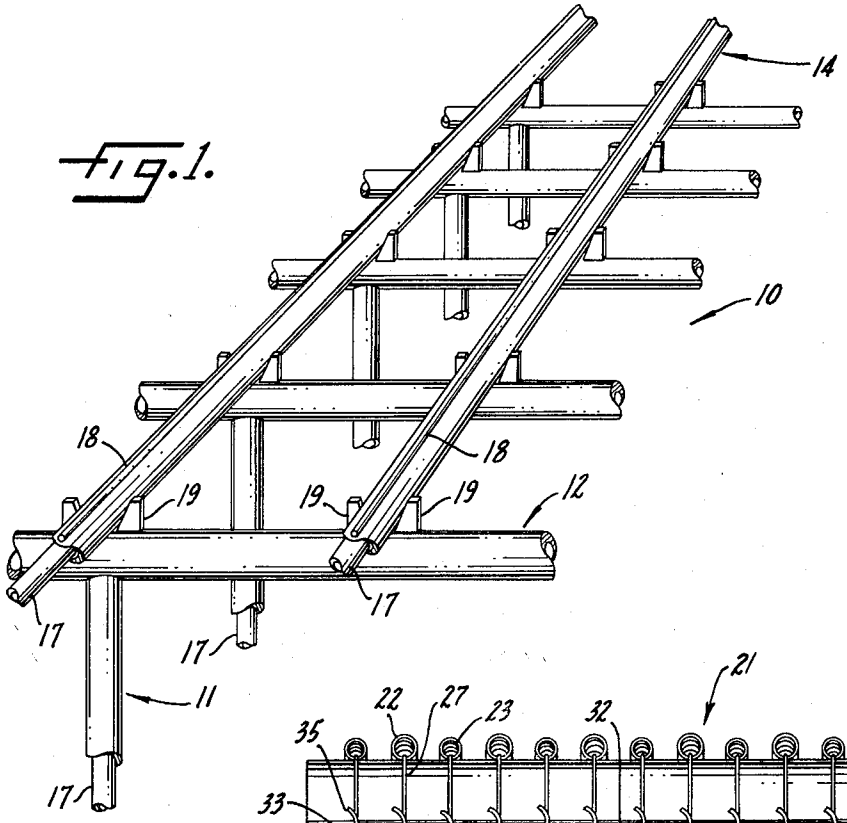
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FURNACE PIPE INSULATION

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Fig. 1.



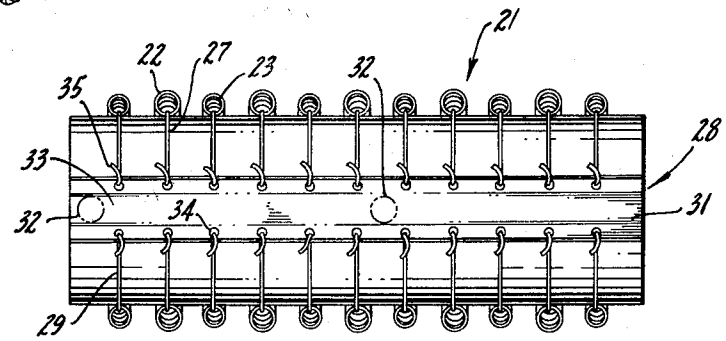


Fig. 2.

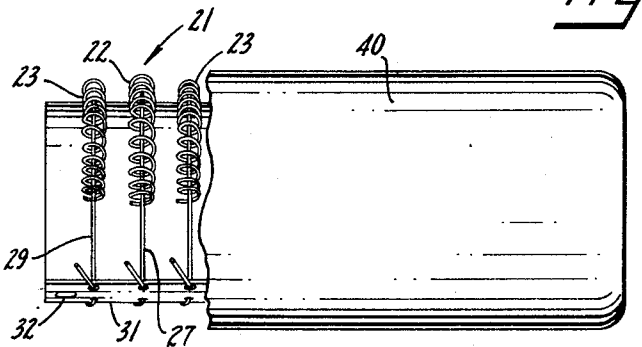


Fig. 3.

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FURNACE PIPE INSULATION

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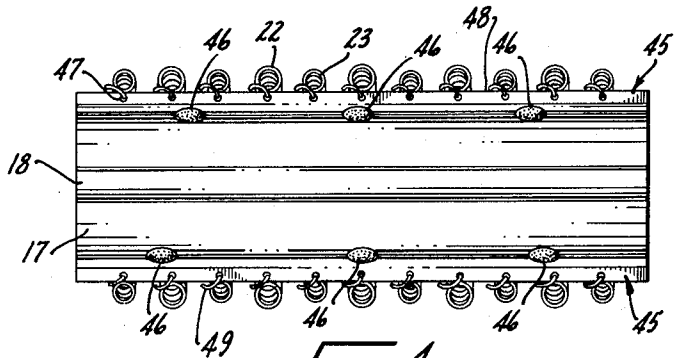


Fig. 4.

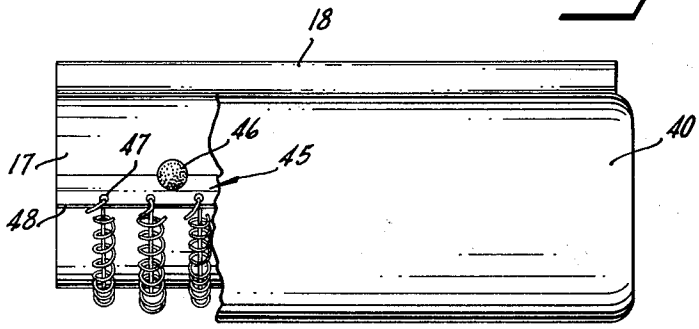


Fig. 5.

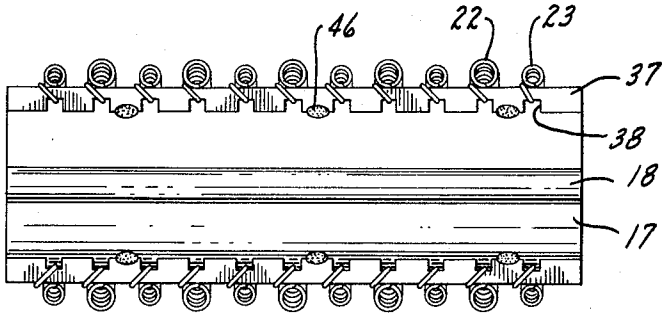


Fig. 6.

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FURNACE PIPE INSULATION

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5 Claims. (Cl. 263—6)

This invention relates in general to furnaces, and more particularly to an insulated pipe construction for use in high temperature furnaces. It deals specifically with an improved insulation construction for water cooled furnace pipes and is a variation on the constructions disclosed in the co-pending Brough application, Serial No. 121,427, entitled "Insulation," filed July 3, 1961 now abandoned and superseded by continuation-in-part application of Brough, Serial No. 193,575, filed May 2, 1962, entitled Furnace Pipe Insulation and Method, and assigned to the same assignee as the present invention.

It is a conventional practice in the iron and steel industry to provide reheating furnaces for bringing billets of steel up to required temperatures in preparation for rolling operations. One well-known type of furnace utilized is described as an underfired furnace. In the operation of such a furnace, fuel is burned in the lower regions of the furnace while billets of steel pass over the burning fuel and are heated thereby to a predetermined temperature. The fuel might be natural gas, coke oven gas, or oil or the like. It is not unusual for temperatures in the neighborhood of 2400° F. to be generated in such a furnace when a finished billet temperature in the neighborhood of 2100° F. is sought for a rolling operation, for example.

In passing through a furnace while undergoing reheating to a predetermined temperature, the billets are conventionally supported on a longitudinally extending skid means or tracks upon which the transversely extending billets slide. With billets of relatively small size, these tracks or skid means might be solid rails, but for heavier billets and, for that matter, for all high temperature end discharge furnaces, water cooled skid means in the form of skid pipes are standard.

These water cooled skid pipes normally have a wear strip welded on their upper surface and extend longitudinally of the pipes to support the billets in sliding relationship. In the underfired reheating furnace, for example, the longitudinally extending horizontal skid pipes are carried by transversely extending horizontal cross-over pipes, which in turn are supported by vertically extending support pipes. Water preferably courses through all the pipes in a well known manner to provide cooling thereof.

In recent years the use of insulation on such water cooled pipes has become popular because of the considerable heat losses suffered when non-insulated water cooled pipes are utilized. With non-insulated water cooled skid pipes in use in an underfired furnace it would not be unusual for up to 25 percent of the input of natural gas, for example, to be lost in heating the water rather than the steel billets. This, in turn, effects the furnace capacity in many cases since the furnace normally has a limited fan, stack or burner capacity and only so much fuel can be pumped through it. In addition, where the skid pipes are not insulated, uneven heating of the billets frequently results and, in some cases, it is serious enough to prevent rolling thereof.

A number of means for insulating water cooled high temperature furnace pipes have been utilized in the past. For example, the Schmidt Patent No. 2,482,878, entitled "Reinforced Refractory Pipe Insulation" discloses an insulation construction of the general type now in use in the iron and steel industry. Each has serious drawbacks, however.

It is an object of this invention to provide an improved insulated furnace pipe.

Another object is to provide an improved insulation construction for water cooled high temperature furnace pipes.

Still another object is to provide an improved insulation construction for water cooled skid pipes, cross-over pipes and vertical support pipes in underfired steel mill reheating furnaces.

A further object is to provide an insulation construction for water cooled high temperature furnace pipes which is highly durable.

Still another object is to provide an insulation construction for water cooled high temperature furnace pipes which is substantially easier to apply and less expensive than insulations heretofore utilized.

Yet another object is to provide a reinforced insulation construction for water cooled high temperature furnace pipes which requires a minimum of high cost, heat resisting reinforcing material.

Another object is to provide an insulation construction wherein the reinforcement means incorporated therein does not set up lines or planes of weakness in the insulation.

The above and other objects are realized in accordance with the present invention by providing a new and improved insulation construction for water cooled high temperature furnace pipes and a method for applying this insulation. Briefly, the invention contemplates encircling a conventional steel furnace pipe having a water carrying capacity with a plurality of circumferentially extending coils of high temperature heat resisting alloy wire and ordinary carbon steel wire and securing the coils to the pipes with tie wires of corresponding composition threaded through the coils. The high temperature heat resisting alloy wire coils and the ordinary carbon steel wire coils are arranged in such a manner that relatively increased support is afforded the refractory material when it is applied to the outer surface of the pipes in its plastic state. The arrangement of the wire coils is such that an irregular stress pattern is set up in the hardened refractory insulation material to virtually eliminate serious lines or planes of weakness in the insulation.

The invention, both as to its organization and method of operation, taken with further objects and advantages, will best be understood by reference to the following description taken in connection with the accompanying drawings, in which:

FIGURE 1 is a perspective view of conventionally arranged water cooled furnace pipes in an underfired steel mill reheating furnace;

FIGURE 2 is a bottom plan view of a support pipe or cross-over pipe showing the relationship of reinforced wire coils prior to the application of refractory material;

FIGURE 3 is a front elevational view of the arrangement shown in FIGURE 2, showing refractory insulating material applied to a portion of the pipe;

FIGURE 4 is a top plan view of the reinforcing wire coil arragement for a skid pipe, prior to the application of refractory material;

FIGURE 5 is a front elevational view of the pipe shown in FIGURE 4, showing refractory insulating material applied to a portion of the pipe; and

FIGURE 6 is a top plan view of an alternate form of the wire coil anchor construction.

Referring to the drawings, and particularly to FIGURE 1, a section of the billet supporting skid means which might be utilized in an underfired steel mill reheating fur-

nace, for example, is shown generally at 10. The description of the use of an insulation arrangement and method of constructing it, embodying the features of this invention, as applied to furnace pipes utilized in an underfired furnace is exemplary, as will readily be understood, and this construction might be utilized in various types of furnaces in the steel industry or otherwise. Of primary significance is the fact that furnaces of this type necessarily generate substantially high temperatures in operation; for example in the neighborhood of 2400° F. or higher.

The section 10 of the billet supporting skid means shown actually forms one set of skid means or tracks extending longitudinally through a furnace (not shown) along one side thereof, while a similar set or sets of tracks embodying substantially identical sectional constructions might extend longitudinally of the furnace along its opposite side and center, for example. In this way, transversely extending billets of substantial length are supported on each end and in the center by skid means as they slide through the furnace while being brought up to heat.

Each seciton 10 of the skid means preferably includes vertically extending insulated support pipes 11, carrying horizontally and transversely extending insulated cross-over pipes 12. The vertical support pipes 11 and cross-over pipes 12 perform no other function than to support insulated longitudinally extending skid pipes 14.

Each of the insulated furnace pipes 11, 12 and 14 includes a conventional steel pipe 17, whilch might be comprised of one-half inch plate. The bare pipes might be anywhere from two to eight inches in diameter. These dimensions, of course, are merely exemplary and it will be understood that they could vary substantially within limits. The steel pipes 17 which form the backbone of the skid pipes 14 have wear strips 18 secured to their upper surfaces by welding, for example. The longitudinally extending skid pipes 14 might be positioned on the transversely extending cross-over pipes 12 by U-shaped brackets 19 of any well known construction, welded to the upper surface of the steel pipes 17 incorporated in the insulated cross-over pipes 12.

With regard to their insulation construction, the vertically extending support pipes 11 and the horizontal, transversely extending cross-over pipes 12 are substantially identical in construction. Consequently, only the cross-over pipes 12 will be described in detail, since the make-up of the insulation construction inherent therein is common to each.

Referring now to FIGURES 2 and 3, the construction of an insulated cross-over pipe 12 is shown in detail. Specifically, in FIGURE 2, the pipe 17 is shown to have a plurality of coils 21 encircling it at generally regularly spaced intervals along its length. These coils include a plurality of ordinary carbon steel wire coils 22 and another plurality of high temperature heat resisting alloy wire coils 23. The high temperature heat resisting alloy is preferably stainless steel, even though it is conceivable that many other alloys might be utilized. Consequently, the succeeding description of this invention will be couched in terms of stainless steel wire coils though the coils could be formed of other metals.

Threaded through each carbon steel coil 22 is a carbon steel tie wire 27, which has its opposite ends secured to an anchoring member, seen generally at 28. In turn, each stainless steel wire coil 23 has a corresponding stainless steel tie wire 29 threaded therethrough and tied at its opposite ends to the anchor member 28.

The anchor member 28 is a slightly troughed metal strip 31. The strip 31 might be spot welded, as at 32, to the outer surface of the pipe 17 in longitudinally extending relationship, as seen best in FIGURE 2, or it might be secured by other conventional means to the pipe.

Arranged along each of the slightly upturned, longitudinally extending edges 33 of the strip 31 are a plurality of generally regularly spaced apertures 34, which act as anchoring holes for the ends of corresponding tie wires 27 and 29. The tie wires 27 and 29 are passed through corresponding apertures 34 and bent back, as at 35, to hold the tie wires and coils in place.

As will readily be seen, the coils 21 are arranged on the pipe 17 such that a stainless steel wire coil 23 alternates with a carbon steel wire coil 22. This sequence is repeated along the length of the pipe. This sequence, however, is merely exemplary of the arrangements which might be used. In practice, for example, pairs of carbon steel wire coils alternating with single stainless steel wire coils might also be utilized.

It will also be seen that the stainless steel wire coils 23 have a substantially smaller diameter than do the carbon steel wire coils 22. This relationship is especially significant, as will be pointed out in detail in the succeeding discussion of the invention.

It will be understood, of course, that alternate forms of the wire coil anchors 28 might be utilized. For example, referring to FIGURE 6, solid metal bars 37 having notches 38 machined therein are preferable in many instances. In such case, the bars 37 are welded to the pipe 17 with the notches 38 facing the pipe.

Referring again to FIGURE 3, it will be seen that a layer 40 of refractory cement has been partially applied to the pipe 17. When applied, this refractory material is in a plasticized state. It might be any well known type of high temperature refractory material, such as Chromite, for example, as has been pointed out. The refractory material is packed in and around the wire coils 22 and 23 in its plastic state by hand or by any other well known means. It virtually encompasses and surrounds the generally cylindrical spirals of each coil and comes into intimate contact with both the wires and the surface of the pipe 17. After a pipe is completely covered with the plasticized refractory material 40 in this manner it is set aside and the refractory is permitted to harden.

It is during the period when the refractory material is in its plastic state that the ordinary carbon steel wire coils 22 are especially significant. This is true throughout the period during which the refractory cement is hardening. The ordinary carbon steel wire coils 22 have substantially large diameters and extend from the surface of the pipe 17 virtually to the surface of the refractory cement layer 40. In this manner, they provide complete reinforcement throughout the extent of the hardening layer 40 of refractory cement.

On the other hand, the coils of stainless steel wire 23 are substantially smaller in diameter and consequently their outermost extremities are relatively further from the surface of the layer 40. Although they provide a substantial amount of reinforcement to the refractory cement in its plastic state, their primary purpose is to provide lifelong reinforcement of the hardened refractory material when the pipe is in operation in a high temperature furnace, for example.

In operative relationship then, under temperatures in the neighborhood of and exceeding even 2400° F. for example, the refractory material is amply supported and reinforced by the stainless steel wire coils 23. Since the outermost extremities of the coils 23 are somewhat removed from the surface of the refractory layer 40, the coils are substantially protected from damagingly extreme temperatures, and consequently are additionally long-lived and durable reinforcement for the refractory. On the other hand, the ordinary carbon steel wire coils 22, their primary purpose having been served in supporting the refractory cement in its plastic state, are more susceptible to high temperature deterioration. They do, however, provide a certain amount of reinforcement and support for the layer 35 of refractory material throughout the service life of the insulated pipes.

In operation, the refractory cement layer 40 might fre-

quently be damaged by pieces of slag falling from the billets above and, consequently, a continuous deterioration or chipping process is taking place at the surface of the refractory. In some instances this might expose portions of the carbon steel wire coils **22** and cause partial breakdown thereof, but since the refractory is amply supported by the stainless steel wire coils **23** no lessening of the reinforcement of the refractory construction is experienced to any noticeable degree.

The difference in diameter between the coils of stainless steel wire and ordinary carbon steel wire has other ramifications also. Since a somewhat undulated surface is defined by the outermost extremities of the coils along the length of the pipe **17**, no significant lines or planes of weakness are set up in the hardened refractory and the danger of cracking, and consequently serious deterioration of the insulation, is considerably lessened.

Since stainless steel wire coils **23** are utilized as only one-half or less than one-half of the total number of coils required and additionally have lesser diameters than the carbon steel coils, the resultant insulation construction and process for applying it is substantially less expensive than generally similar insulations and methods heretofore and presently utilized. In known constructions, for example, it has been common practice to use unitary reinforcing means which are primarily composed of high temperature heat resisting alloys due to their unitary nature in order to insure the requisite high temperature reinforcing characteristics necessary to sustain reasonably long life operation of the insulated pipes. The concept embodied in this invention provides optimum reinforcement of the refractory material in its plastic state immediately after application, during the hardening stages of the refractory cement, and after the insulated pipe is in operation, all at a relatively low cost.

It will be seen that a considerably lesser amount of stainless steel is utilized than would be required if all the coils were made of such material and, of course, each of the stainless steel wire coils is of a lesser diameter than a corresponding ordinary carbon steel wire coil, and consequently contains less wire. As has been pointed out, substantial savings in the expense of insulating furnace pipes of this nature are realized. Nevertheless, due to the specific utilization of the coils in this construction, an insulation is provided which is superior to similar known insulations.

Referring now to FIGURES 4 and 5, an insulation construction and method of insulating skid pipes **14** is shown in detail. In essence, since a wear strip **18** is welded to the upper surface of the steel pipe **17**, forming the backbone of skid pipe **14** to provide a sliding surface for the billets of steel, the coils **21** are anchored to the pipe on opposite sides of the wear strip.

Referring specifically to FIGURE 4, it will be seen that a pair of longitudinally extending steel strips **45** bracket the wear strip **18** and are welded to the surface of the steel pipe **17** at intervals along their length, such as at **46**. The strips **45** are troughed slightly and provide means for anchoring the opposite ends of the stainless steel tie wires **29** extending through the coils **23** of stainless steel wire and the carbon steel tie wires **27** extending through the coils **22** of carbon steel wire. The opposite ends of the tie wires **27** and **29** extend through apertures **47** provided in the opposite edges **48** of each of the strips **45** in generally regularly spaced relationship. The tie wires might be passed through the apertures and bent back, as at **49**, to secure the tie wires and coils in place.

As also seen in FIGURE 5, the layer **40** of refractory cement in its plastic state is applied to the surface of the pipe **17** such that it encompasses and surrounds the wire coils **22** and **23** and the steel strips **45**. In this relationship it is in intimate contact with the surface of the pipe **17**, each of the wire coils **22** and **23**, and the tie wires **27** and **29** and hardens in this relationship. During the hardening process, the refractory material is supported to a great extent by the larger diameter carbon steel wire coils **22**. Considerable support is also offered, as will easily be understood, by the alloy steel wire coils **23** which are of somewhat smaller diameter and consequently do not extend as close to the surface of the layer **40** of refractory cement as do the carbon steel wire coils **22**.

After the refractory cement is hardened, the skid pipes might be set in place in wedging relationship within the brackets **19**. At intervals along the length of the skid pipes **14**, the steel pipe **17** forming the backbone of the skid pipes might be left bare of insulation to afford a spot for contact by the brackets **19** in supporting relationship. This feature, however, forms no part of the invention and it is not thought necessary that it be shown in detail.

Of course, the advantages inherent in the insulation construction of the skid pipes **14** are substantially identical to those inherent in the insulation construction of the crossover pipes **12** hereinbefore described. As has been pointed out, a substantial saving in cost is realized by virtue of the fact that the amount of high temperature heat resisting alloy wire required to secure durable insulation constructions is considerably less than in known similar insulation constructions.

The specific arrangement of the alternating coils of varying diameter carbon steel and stainless steel are such that the stainless steel coils are substantially protected from the maximum temperatures generated in the furnace while the ordinary carbon steel coils extended, at their outer extremities, close to the surface of the refractory to insure satisfactory reinforcement during its hardening period. In conjunction with this, of course, the outermost extremities of the alternating coils define a somewhat undulating surface which does not set up lines or planes of weakness in the hardened refractory. The insulation construction which results is less expensive, more durable and easier to construct than similar known constructions.

While several embodiments described herein are at present considered to be preferred, it is understood that various modifications and improvements might be made therein, and it is intended to cover in the appended claims all such modifications and improvements as fall within the true spirit and scope of the invention.

What is described to be claimed and secured by Letters Patent of the United States is:

1. In a furnace pipe, a reinforced insulation construction including a plurality of coils of wire extending circumferentially of the pipe and tie wires extending through the coils so that opposite free ends of the tie wires protrude from the coils, the improvement comprising; anchor means for securing the free ends of the tie wires to the pipe so as to anchor corresponding coils to the pipe, said anchor means including metal strip means welded to the outer surface of the pipe and extending longitudinally thereof, said metal strip means having portions thereof extending generally radially of the pipe, and spaced apertures formed in said portions for receiving the free ends of the tie wires.

2. The improvement in reinforced insulation construction of claim 1 further characterized in that said metal strip means comprises a relatively wide strip of sheet metal welded to the pipe, said radially extending portions being flanges formed at the longitudinally extending edges of said sheet metal strip, said apertures being formed in each of said flanges.

3. The improvement in reinforced insulation construction of claim 1 further characterized in that said metal strip means comprise a pair of longitudinally extending strips of sheet metal radially spaced on said pipe, said radially extending portions being flanges formed at the oppositely disposed outer edges of said strips, said apertures being formed in each of said flanges.

4. The improvement in reinforced insulation construction of claim 1 further characterized in that said metal

strip means comprises a pair of metal bars extending longitudinally of the pipe and spaced circumferentially thereon, notches formed in said bars at spaced intervals to define said apertures.

5. In a furnace pipe, a reinforced insulation construction comprising; a plurality of coils of wire extending circumferentially of said pipe, tie wires extending through said coils and having their opposite free ends protruding from said coils, anchor means for securing the free ends of said tie wires to said pipe so as to anchor corresponding coils to said pipe, said anchor means including metal strip means welded to the outer surface of said pipe and extending longitudinally thereof, said metal strip means having portions thereof extending generally radially of said pipe, and spaced apertures in said portions for receiving and anchoring said free ends of said tie wires.

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