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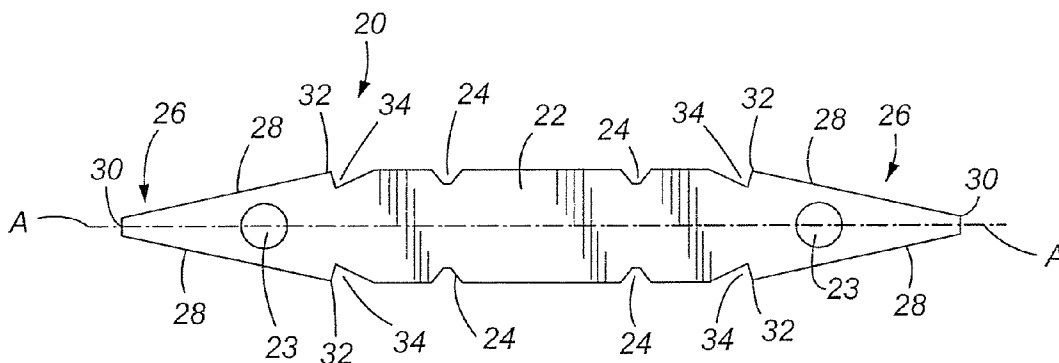
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(54) Title: CONCRETE TIE WITH REUSABLE WEDGE



(57) Abstract: An improved tie rod for use in concrete construction is provided. The tie rod has opposing ends, referred to as ears that may be used as wedges in a subsequent concrete construction operation. In a first wall form system, the ears of the tie rod are broken off when the forms are stripped from the cured concrete structure. The ears of the tie rod have tapered shapes enabling them to be used as wedges in a second or subsequent wall form system. The wedges are used with pins that secure abutting edges of adjacent wall form panels.

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CONCRETE TIE WITH REUSABLE WEDGE

FIELD OF THE INVENTION

The present invention relates to wall form systems used in poured concrete structures and connecting hardware used in the systems, and more particularly, to a concrete form tie rod having ends thereof that are especially adapted for subsequent use as components in connecting hardware of a concrete wall form system.

BACKGROUND OF THE INVENTION

Prefabricated wall forms are commonly used in forming concrete walls and other concrete structures. Such wall forms typically include prefabricated and reusable panel sections that are assembled to create the wall form arrangement for the concrete structure to be poured. Various pieces of hardware are used to interconnect abutting sections of the reusable panels.

Typically, each panel includes a facing surface that makes contact with the poured concrete, and a rear surface including a connecting flange. The flanges of the adjacent wall panels abut one another. Each flange has at least one hole that aligns with a hole of the abutting flange. Connecting hardware in the form of a pins or bolts are used to secure abutting flanges of adjacent panels. The pins are inserted through the aligned openings of the abutting flanges. Optionally, the pins may also pass through the ends of tie rods that are used to stabilize the spaced apart relationship of the wall forms. The tie rods are secured to the pins by wedges that are driven through slots formed in the shanks of the pins. As the wedges are driven in place, the abutting flanges of the adjacent panels are drawn together.

The pin and wedge combinations comprise a simple yet effective means for coupling the panel sections together. The pins and wedges can be removed from the panels during disassembly of the wall forms by forcing the wedges out from the slots and sliding the pins back out from their holes thereby releasing the adjacent panel units from one another. The tie rods remain embedded in the cured concrete.

There are a number of references that disclose various types of wall form systems used in concrete construction. There are also a number of references that disclose components of the wall form systems to include the specific hardware used in the systems.

Two references disclosing tie rods include the US Patents 4,239,173 and 4,433,826. Examples of references disclosing pins used in concrete wall form panels

include the US Patents 5,802,795 and 6,905,106. One example of a reference disclosing a particular wedge design is the US Patent 5,904,875.

Wall forms for concrete construction typically require a large amount of hardware to connect the numerous panels together. Multiple pin and wedge combinations typically connect each pair of adjacent panels. Particularly for large concrete forms, the force of the concrete being poured as well as the continued pressure exerted on the forms by the concrete during curing, requires the form constructions to be quite robust, thus requiring the large amount of connecting hardware.

One recurring cost that is incurred each time reusable concrete forms are used is the cost of the tie rods and wedges. The tie rods are consumed in each project, and the wedges oftentimes cannot be reused because they are damaged during placement and removal through the slots in the pins

Another problem associated with standard concrete tie rods is that once the concrete has cured, the ends of the tie rods must be broken off so there are no tie rod protrusions extending from the surfaces of the poured concrete. Both ends of the tie rods must be broken off. The broken off ends of the tie rods become scrap metal which should be disposed of. Because of the tight spaces in which many concrete forms are constructed, such as subsurface retaining walls or foundations, the broken off ends of the tie rods are oftentimes not picked up and disposed of, and continue to litter the construction site after the concrete construction operation has been completed.

Therefore, a need exists for reducing the amount of hardware required in assembly of concrete form systems. Additionally, there is a need to reduce the amount of scrap metal that is produced in concrete form assembly thereby providing a more environmentally friendly construction operation.

25

SUMMARY OF THE INVENTION

In accordance with the present invention, a tie rod is provided for use in concrete construction. The tie rod incorporates wedge shaped ends that may be used in a subsequent concrete construction operation. That is, the ends of the tie rod are broken off after the tie rod has been expended in the construction of a concrete structure, and the ends are then used as wedges in a subsequent concrete construction operation. In accordance with a preferred embodiment of the present invention, the ends of the tie rod each have the tapered configuration that is sized to match standard wedges used in the wedge and pin hardware combinations.

More specifically, the tie rod of the present invention is used in the conventional manner wherein the tie rod stabilizes spaced apart wall forms. After the concrete has cured and the wall forms are disassembled, the ends or ears of the tie rods are broken off, and the broken off ends are then used as wedges in a subsequent concrete construction operation.

In one aspect of the invention, it may be considered an improved tie rod wherein the ends of the tie rod are used as wedges in a subsequent concrete construction. In another aspect of the invention, it may be considered an improved concrete wall form system wherein the tie rods have a dual purpose. In yet another aspect of the present invention, it may be considered as a method of assembling a concrete wall form system wherein the tie rod ends are subsequently used as wedges in the pin and wedge hardware combinations.

As a result of the improved tie rod of the present invention, the requirement to use separate prefabricated wedges is eliminated, thus reducing the overall hardware requirement for a concrete forming operation. Furthermore, scrap metal is reduced because the broken off tie rod ends serve a specific purpose in a subsequent concrete forming operation. Additional motivation for recovering the broken off ends is provided since the ends have a specific utility as hardware. Accordingly, the tie rod of the present invention also provides an environmentally friendly solution to reducing non-recovered scrap at a construction site.

Other advantages and features of the present invention will become more readily apparent from a review of the following detailed description taken in conjunction with the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 is a plan view of a prior art concrete tie rod;

Fig. 2 is a plan view of the improved tie rod of the present invention;

Fig. 3 is another plan view of the tie rod of the present invention, showing one of the ears/ends broken away as would occur once the tie rod was embedded in cured concrete, and the concrete wall forms were being dismantled;

Fig. 4 is an enlarged plan view of a standard pin that receives a tie rod end/ear of the present invention thus comprising a pin and wedge hardware combination usable in a concrete wall form system;

Fig. 5 is a perspective view illustrating one example of a wall form for concrete

construction wherein the tie rod of the present invention is used, along with a tie rod ear of the present invention that has been broken off from its corresponding tie rod;

Fig. 6 is a plan view of the wall form of Fig. 5; and

Fig. 7 is a perspective view of a pair of tie rods in a second embodiment of the present invention showing how rebar supports may be secured to the tie rods.

Fig. 8 is a plan view of another embodiment of the present invention;

Fig. 9 is a cross-section taken along line 9-9 of Fig. 8;

Fig. 10 is a plan view of yet another embodiment of the present invention;

Fig. 11 is a perspective view of yet another example of a wall form for concrete construction wherein the tie rod of the present invention is used as a pass-through tie rod; and

Fig. 12 is a plan view of the wall form of Fig. 11.

DETAILED DESCRIPTION OF THE INVENTION

Fig. 1 illustrates a prior art tie rod 10. As shown, the tie rod 10 includes a body 12, a plurality of rebar channels 14, and respective ears/ends 16. Each of the ears 16 includes pin openings 18. The tie rod is typically constructed from a rectangular piece of metal sheet stock. As discussed above with respect to the prior art, separate wedge components are used with the pins for securing adjacent prefabricated wall panels.

Fig. 2 illustrates the improved tie rod 20 of the present invention. The tie rod 20 includes a body 22, a plurality of rebar channels 24, and respective ends/ears 26. Each of the ears 26 has tapered edges 28. The ends 26 terminate in blunt tips 30. A pair of opposing protrusions 32 defines opposite sides of the ears 26 at their largest width. Additionally, a pair of opposing slots 34 are formed directly adjacent the protrusions 32. Thus, there is a reduced width of the body 22 between the opposing slots 34. The ears 26 also each include respective pin openings 23 which are adapted to receive the concrete form pins.

Fig. 3 illustrates the tie rod of the present invention wherein one of the ears 26 has been broken off from the tie rod body 22 along an area between the pair of opposing slots 34. The broken off ear 26 may then be used in a subsequent concrete construction operation as a wedge in a pin and wedge hardware combination.

Fig. 4 illustrates the broken off ear 26 being used as a wedge in the wedge and pin combination. A standard design for a pin 40 is shown. The pin includes a head 42, a shank 44, and a tip 48. A transverse slot 46 is formed through the shank 44. The broken

off ear 26 is sized to fit in the slot 46 so that a distal portion of the broken off ear 26 can be inserted completely through the slot 46, while a proximal portion of the broken off ear 26 remains exteriorly of the slot 46. As necessary, a hammer contacts the exposed broken edge 36 of the ear 26 in order to tightly secure the ear 26 within the slot 46.

5 Fig. 5 illustrates one example of a wall form usable in a concrete construction operation incorporating the tie rod of the present invention. Specifically, Fig. 5 illustrates one portion of a concrete wall form system 50 comprising a pair of adjacent wall panels 52 and 54. The concrete wall form system 50 may further comprise one or more supports/reinforcements 60. The wall panels 52 and 54 each include respective flanges 56
10 and 58 that are placed in an abutting relationship so that the panels 52 and 54 form a continuous extended wall. The flanges 56 and 58 each include a plurality of aligned openings, and pins 40 are inserted through the aligned openings. In the example of Figure 5, one pin 40 is illustrated along with one tie rod 20. The tie rod 20 is secured to the pin 40 by inserting the shank 44 of the pin 40 through the pin opening 23 in the tie rod
15 ear 26. The pin and tie rod are then maintained in their secured position to the flanges by inserting a broken off ear 26 in the slot 46 of the pin. Thus, the broken off ear 26 serves as a wedge in the pin and wedge combination.

 Fig. 6 illustrates a plan view of the concrete wall form system 50. In this plan view, an opposing pair of wall form panels is shown. Thus, the concrete structure to be
20 poured is defined as the open area between the wall panels. The same reference numbers are used in this figure to designate like components in the wall form system. Figure 6 further illustrates two tie rods 20 and two rebar supports 62 that are shown resting on respective rebar channels 24 of the tie rods 20. Wire ties (not shown) can be wrapped around the tie rods and the rebar supports 62 at the locations of the channels 24 in order to
25 secure the rebar to the tie rods. The wire ties would be oriented substantially perpendicular to the longitudinal axis A-A of the tie rods.

 Figure 7 illustrates a pair of tie rods 20' in a second embodiment of the present invention. The tie rods 20' are the same as the tie rods 20 with the exception that the tie rods 20' each include a pair of intermediate wire tie openings 35 which facilitate the use
30 of wire ties T for securing rebar supports R. The wire tie openings 35 are preferable positioned so that the most outer edges 37 of the openings 35 are spaced from the respective center lines of the channels 24. As shown, the wire ties T are routed through the openings 35 and then tied to the rebar supports. The rebar supports rest in the

channels 24. The rebar supports may be tied to the upper and/or lower pair of channels 24. The positioning of the openings 35 helps to prevent the rebar supports from being displaced from the channels 24. The wire ties are oriented so that they extend at an angle with respect to the longitudinal axis A-A, thus providing at least some component of retaining force directed along the longitudinal axis. Wire ties that are tied perpendicular to the longitudinal axis such as in the first embodiment may still provide adequate retaining force, but the angled orientation of the wire ties shown in Figure 7 have some advantage.

Figure 8 illustrates yet another embodiment of the present invention in the form of a tie rod 70. Figure 9 is a cross sectional view taken along line 9-9 of Figure 8. In this embodiment, the construction of the tie is the same as the embodiment as described above in Figure 7 with the exception that the embodiment of Figures 8 and 9 further includes a central raised portion that provides greater structural stability to the tie by stiffening the area around the raised portion. The same reference numbers used in this embodiment correspond to the same features described above with respect to the embodiment shown in Figure 7. The central raised portion 74 is shown as extending along a central area of the body 22 such that a longitudinal axis of the tie defined by line 9-9 bisects the raised portion 74. The raised portion 74 is defined by the area inside shoulder 76 and as shown in Figure 9, the raised portion is planer and extends parallel with the ears. The raised portion provides additional stiffening strength to the ties such that the body 22 of the tie has less of a tendency to bend. Also when the ears 26 are to be broken off, the raised portion 74 allows the ears to be broken off without unduly deforming the body 22.

Figure 10 illustrates yet another embodiment in the form of tie rod 80. The tie rod 80 has a body 82 which is similar to the body 22 shown in the embodiment of Figures 8 and 9; however, the ears 84 are inverted or are reversed shape. With respect to the body 82 of tie rod 80, a central raised portion 86 is provided in the same manner as the raised portion 74. Accordingly, the raised portion 86 is also defined by a shoulder 88 such that the raised portion 86 extends along the longitudinal axis of the tie and the raised portion 86 is substantially planer and extends in a parallel fashion with respect to the ears 84. A plurality of rebar channels 90 are disposed on the body 82. Wire tie openings 92 are located on the central raised portion 86. The tapered edges 94 of the ears 84 extend away from the body 82 such that the narrowest portion of the ears 84 is located at the point where the ears attach to the body 82. The ends 96 of the ears 84 extend substantially

perpendicular to the longitudinal axis of the tie. In the embodiment Figure 10, the area shown by dotted lines 98 is where the ears are broken off from the body 82. At this location, the tie is very narrow and therefore, less force is required to break off the ears 84 from the tie. The pin openings 100 allow the tie 80 to operate in the same manner such that form pins may be inserted through the openings 100.

Figures 11 and 12 illustrate a similar type of wall form as shown in Figures 5 and 6. Tie rod 70 in Figures 11 and 12 is shown as a pass-through tie meaning that in the event the wall forms are already in place prior to installation of the tie rod 70, the tie rod may simply be inserted between the abutting surfaces of the flanges 56 and 58. As shown in Figure 11, when the tie rod is used as a pass through tie, the only portion thereof that is exposed are the ears 70. While Figures 11 and 12 show the embodiment of Figure 8 as a pass through tie, it shall be understood that any of the embodiments of the present invention may be used as pass through ties in the manner that is illustrated in Figures 11 and 12.

In order to more easily confirm the installation of the ties in a wall form system, it is also contemplated that the ears of the tie may be painted a bright color to distinguish them from the surrounding wall form system.

Depending on the type of form pins 40 that are used, the shape and size of the ears may be changed so that the ears conveniently fit within the pin slots 46. For example, it may be necessary to adjust the particular angle of the tapered edges 28/94, and it may also be necessary to adjust the positions of the openings 23/100. Furthermore, the particular shapes and depths of the slots 34 may be adjusted to provide the necessary strength for the tie rod when used to support opposing wall panels.

Additionally, the tie rod of the present invention may be modified in terms of the number and spacing of rebar channels 24/90 to best match the type of wall form to be constructed. As can be appreciated, wall forms are assembled for pouring concrete walls of differing sizes, therefore necessitating the body of the tie rod to be longer or shorter, and to also have a desired number of rebar channels.

It is also contemplated within the present invention that the broken off ears 26/84 may be used as hardware components in other types of concrete wall form systems. For example, some wall form systems may not require pins, and may only require a single piece of hardware to secure abutting flanges of wall form panels. One or more slot shaped openings may be formed in the panel flanges, and the aligned slots receive a

single piece of hardware, such as a wedge shaped element to secure the abutting flanges. Accordingly, the tie rod of the present invention is also ideally suited for these types of concrete wall form systems.

While the tie rod of the present invention has been set forth in various preferred
5 embodiments, those skilled in the art may comprehend various other changes and
modifications to the invention, those changes and modifications which are intended to be
covered within the scope of the following claims and equivalents thereof.

What is claimed is:

1. A tie rod especially adapted for use in a wall form system for concrete construction, said tie rod comprising:
 - a body having opposing ends, each said end having a proximal portion and a distal tip;
 - a plurality of rebar channels formed on exterior surfaces of said body;
 - said opposing ends each having tapered edges transitioning from larger to smaller towards said distal tip;
 - a pin opening formed through each said end and positioned intermediate between said proximal portion and said distal tip;
 - a pair of opposing protrusions formed at each said proximal portion of said ends; and
 - a pair of opposing slots formed adjacent said pair of opposing protrusions, said pair of slots defining a narrowed area of a width of said body.
2. A tie rod, as claimed in Claim 1, wherein:
 - said pair of opposing protrusions are spaced from one another substantially a distance equaling said width of said body.
3. A tie rod, as claimed in Claim 1, wherein:
 - said pin openings of said ends are positioned approximately midway between said proximal portions and said distal tips.
4. A tie rod, as claimed in Claim 1, wherein:
 - said tie rod is symmetrical along a longitudinal axis thereof.
5. A tie rod, as claimed in Claim 1, further including:
 - at least one tie wire opening formed in said body between said pin openings.
6. A method of assembling a wall form, said method comprising the steps of:
 - providing a first wall form system wherein the first wall form system has been disassembled after a concrete structure has been poured;
 - breaking off an end of a first tie rod used in the first wall form system;
 - providing two wall form panels in a second wall form system, each panel having respective flanges extending substantially perpendicular to lengths of the panels;
 - positioning the panels end to end, and placing the flanges in an abutting relationship;
 - inserting at least one pin through aligned openings in said flanges;

- 10 securing a second tie rod and inserting a shank of the pin through a pin opening
formed in an end of the second tie rod; and
 inserting the broken off end of the first tie rod in a slot of the pin.
7. A method, as claimed in Claim 6, wherein:
 said broken off end has a tapered shape.
8. A method, as claimed in Claim 6, wherein:
 said second tie rod has opposing ends with tapered shapes.
9. A method, as claimed in Claim 6, wherein:
at least one end of said opposing ends is broken off and used in another wall form system.
10. A tie rod especially adapted for use in a wall form system for concrete
construction, said tie rod comprising:
 a body having opposing ends, each said end having a proximal portion and a distal
tip, at least one end of said opposing ends having tapered edges transitioning from larger
5 to smaller towards said distal tip;
 a pin opening formed through each said end and positioned intermediate between
said proximal portion and said distal tip;
 a pair of opposing protrusions formed at said proximal portion of said at least one
end; and
10 a pair of opposing slots formed adjacent said pair of opposing protrusions, said
pair of slots defining a narrowed area of a width of said body.
11. A tie rod especially adapted for use in a wall form system for concrete
construction, said tie rod comprising:
 a body having opposing ends, each said end having a proximal portion and a distal
tip, at least one end of said opposing ends having tapered edges transitioning from larger
5 to smaller towards said distal tip;
 a plurality of rebar channels formed on exterior surfaces of said body; and
 a pin opening formed through each said end and positioned intermediate between
said proximal portion and said distal tip.
12. A tie rod especially adapted for use in a wall form system for concrete
construction, said tie rod comprising:
 a body having opposing ends, each said end having a proximal portion and a distal
tip;
5 a plurality of rebar channels formed on exterior surfaces of said body;

said opposing ends each having tapered edges transitioning from larger to smaller towards said distal tip;

a pin opening formed through each said end and positioned intermediate between said proximal portion and said distal tip; and

10 a raised central portion extending longitudinally along said body.

13. A tie rod, as claimed in Claim 12, wherein:

said raised central position is defined by a shoulder extending away from said body.

14. A tie rod, as claimed in Claim 12, wherein:

said pin openings of said ends are positioned approximately midway between said proximal portions and said distal tips.

15. A tie rod, as claimed in Claim 12, wherein:

said tie rod is symmetrical along a longitudinal axis thereof.

16. A tie rod, as claimed in Claim 12, further including:

at least one tie wire opening formed in said body and through said raised central position.

5 17. A tie rod especially adapted for use in a wall form system for concrete construction, said tie rod comprising:

a body having opposing ends, each said end having a proximal portion and a distal tip;

a plurality of the re-bar channels formed on exterior surfaces of said body;

10 said opposing ends each having tapered edges transitioning from smaller to larger towards said distal tip;

a pin opening form through each said end and positioned intermediate between said proximal portion and said distal tip; and

a raised central portion extending longitudinally along said body.

18. A tie rod, as claimed in claim 17, wherein:

said raised central portion is defined by a shoulder extending away from said body.

19. A tie rod, as claimed in claim 17, wherein:

said pin openings of said ends are positioned approximately midway between said proximal portions and said distal tips.

20. A tie rod, as claimed in claim 17, wherein:

said tie rod is symmetrical along a longitudinal axis thereof.

21. A tie rod especially adapted for use in a wall form system for concrete construction, said tie rod comprising:

a body having opposing ends, each said end having a proximal portion and a distal tip, at least one end of said opposing ends having tapered edges transitioning from larger
5 to smaller towards said distal tip;

a pin opening formed through each said end and positioned intermediate between said proximal portion and said distal tip; and

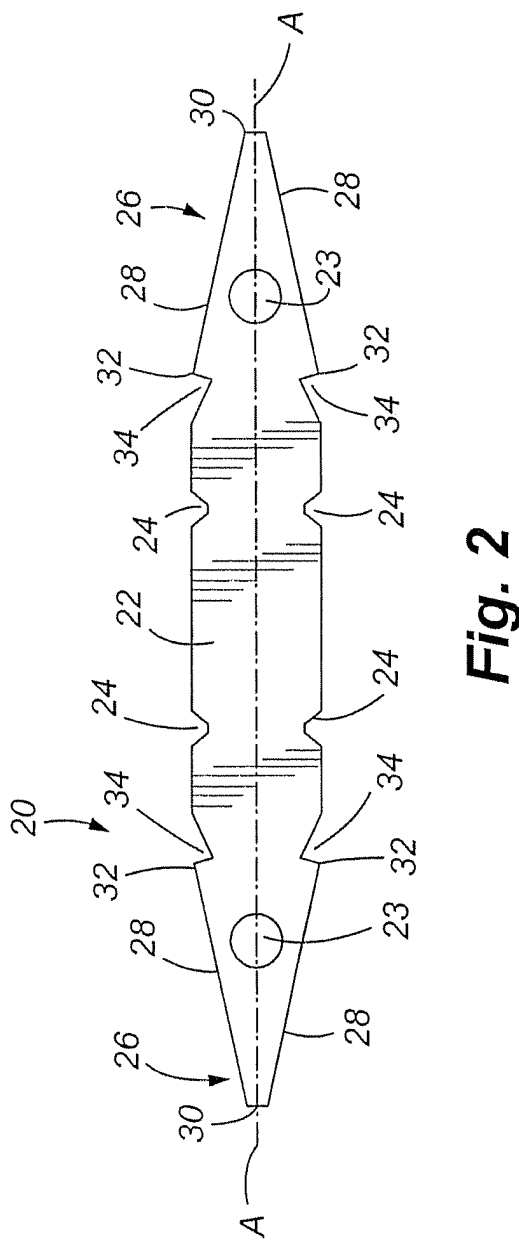
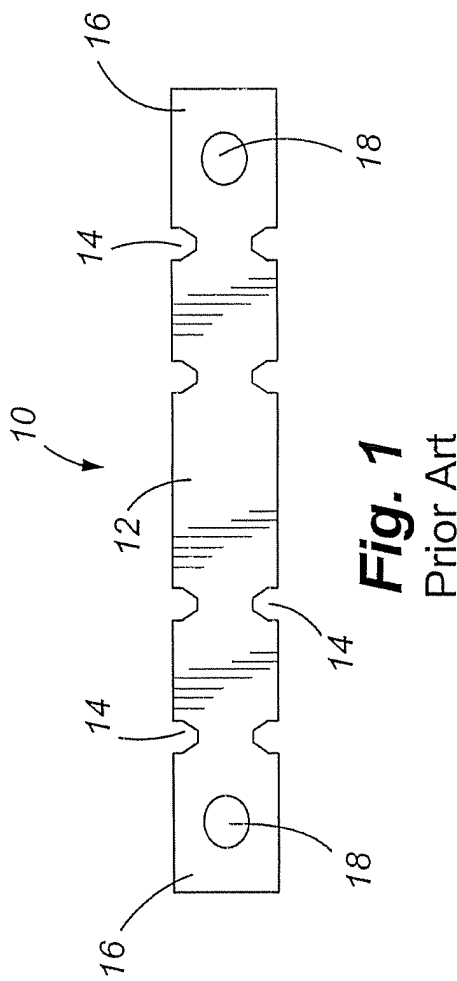
a raised central portion extending longitudinally along said body.

22. A tie rod especially adapted for use in wall form system for concrete construction, said tie rod comprising:

a body;

a raised central portion extending longitudinally along said body;

5 a pair of ears connected to opposite ends of said body, each said ear including a pin opening formed therethrough.



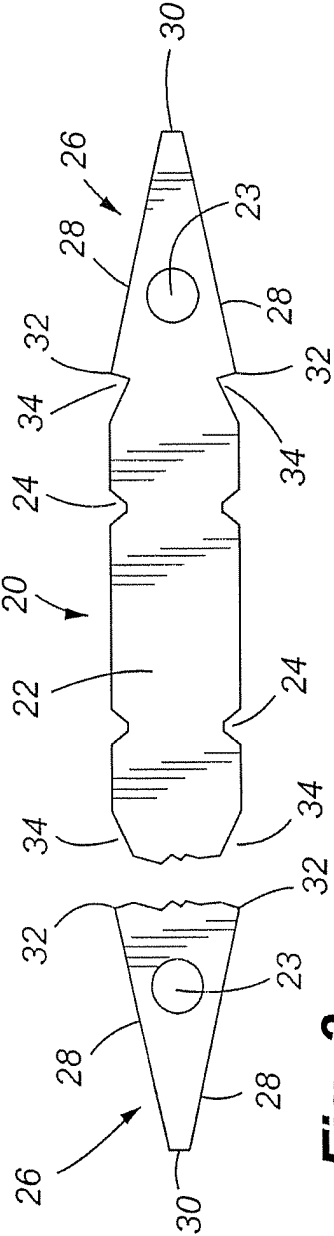


Fig. 3

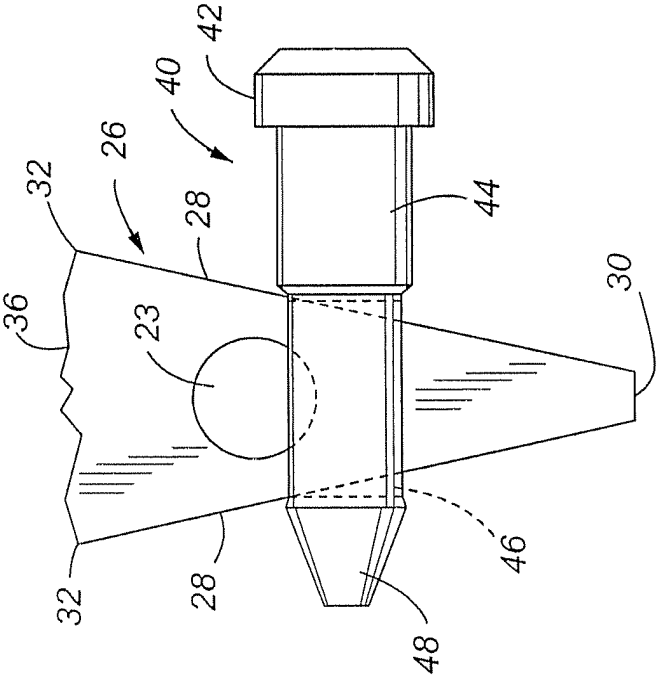


Fig. 4

Fig. 5

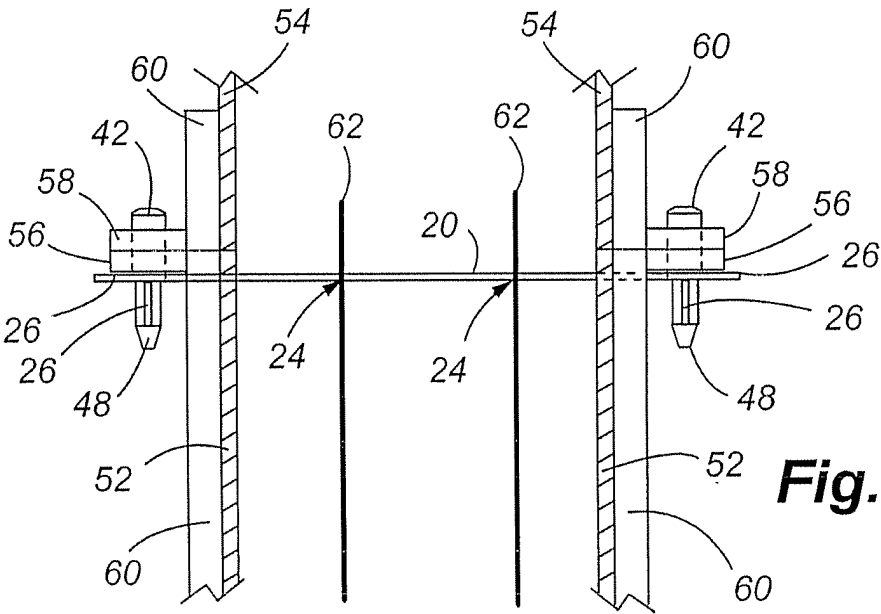
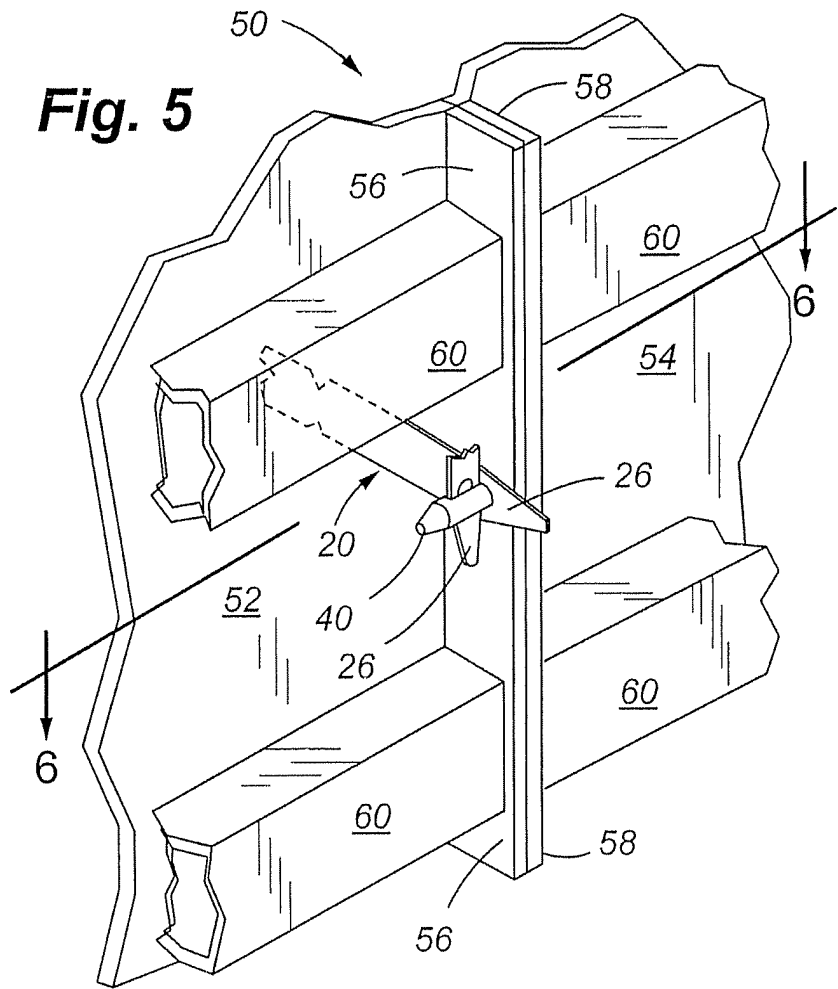


Fig. 6

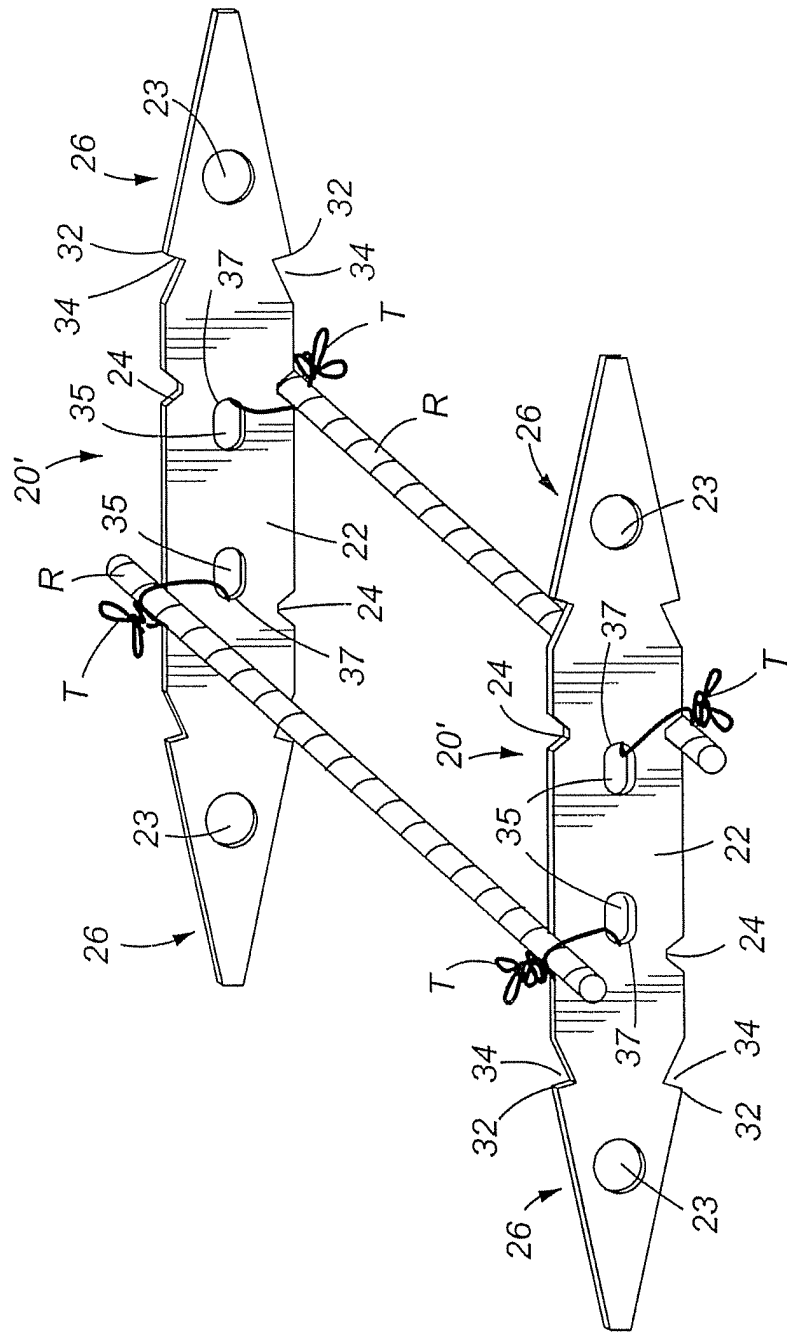


Fig. 7

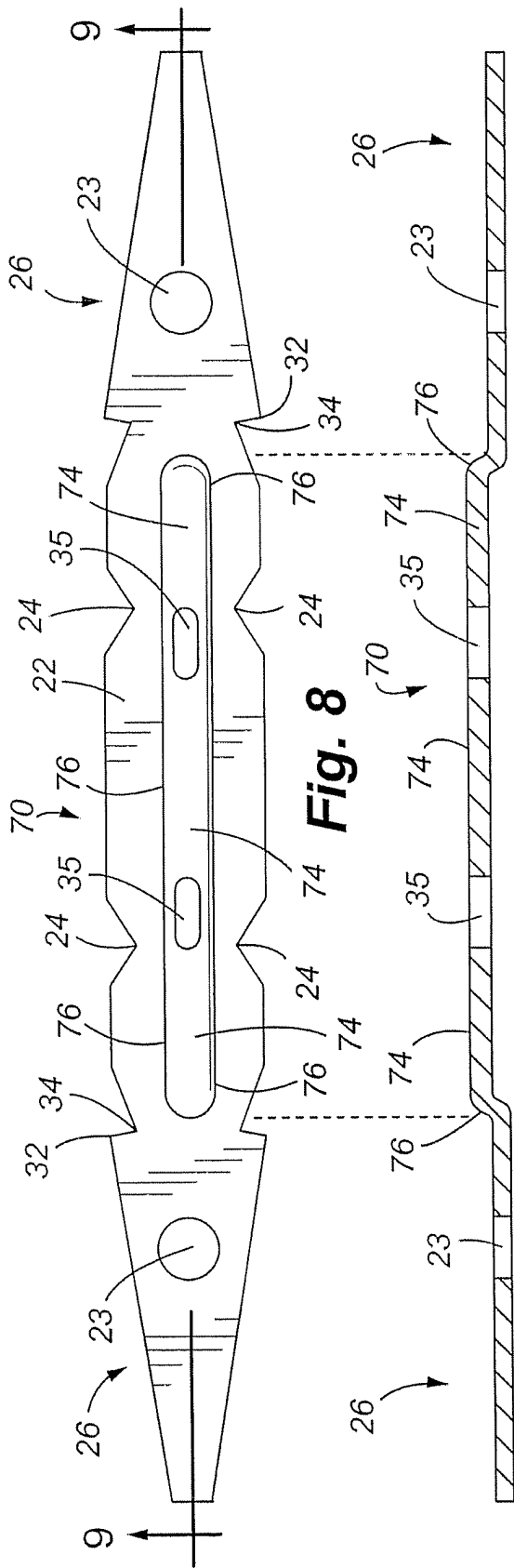


Fig. 9

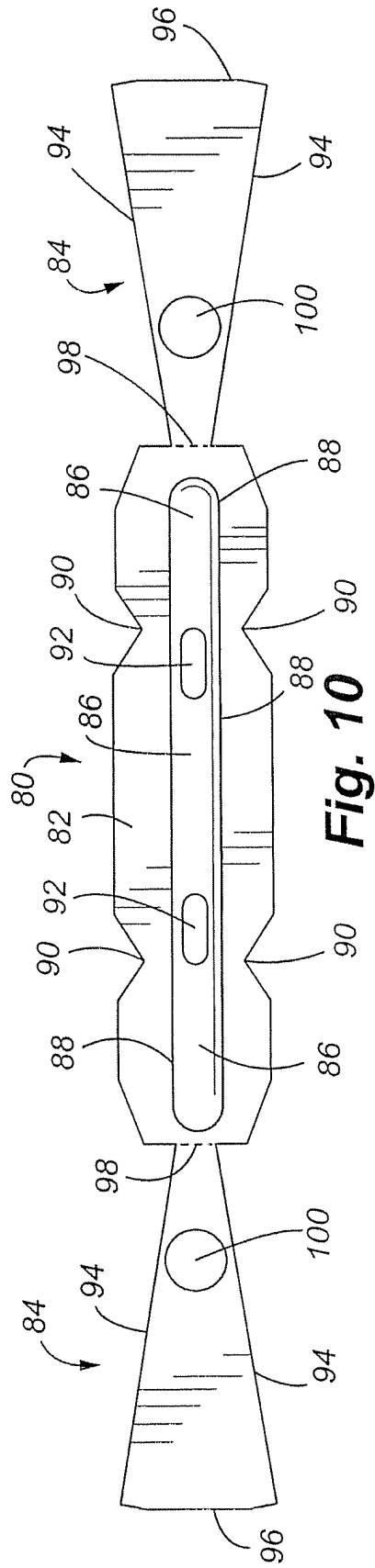


Fig. 10

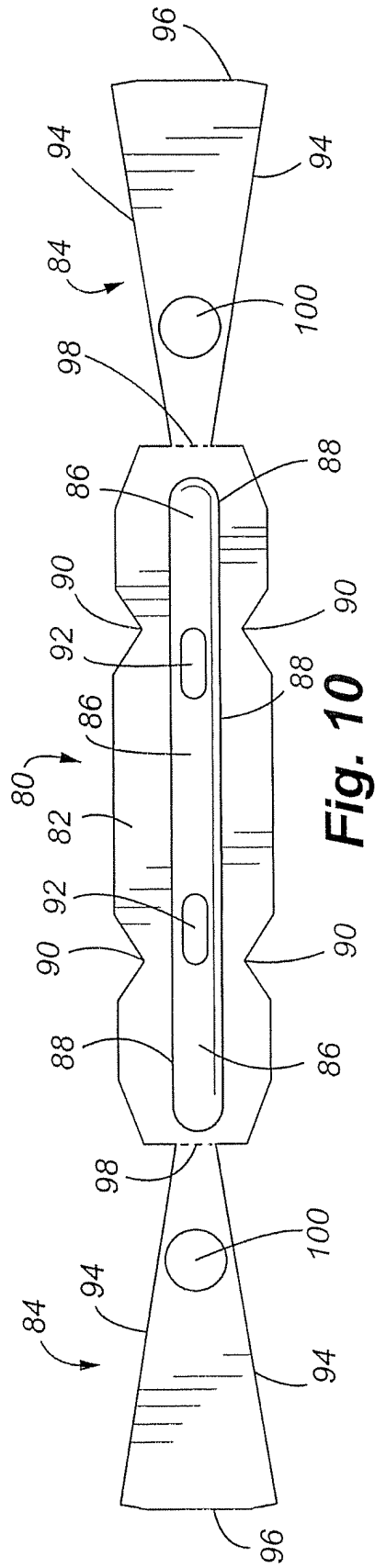


Fig. 11

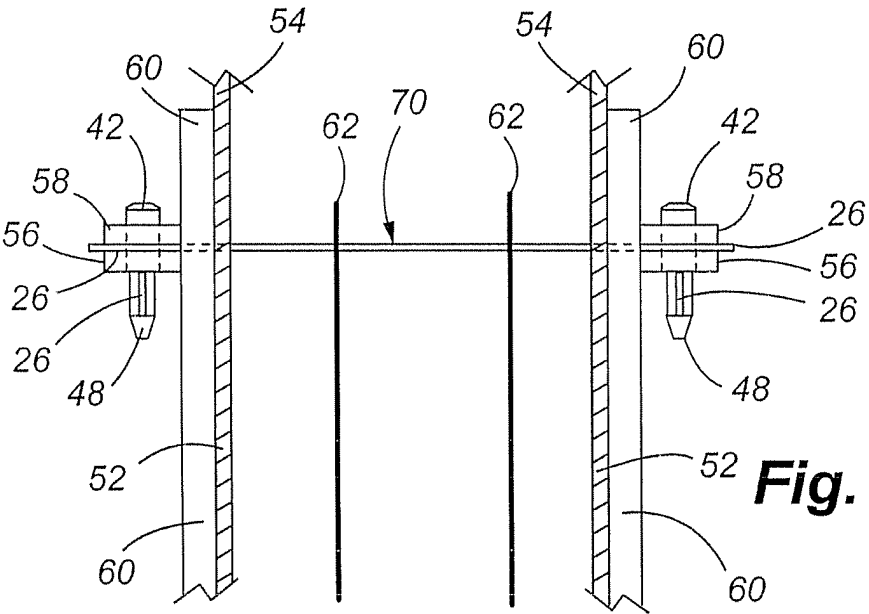
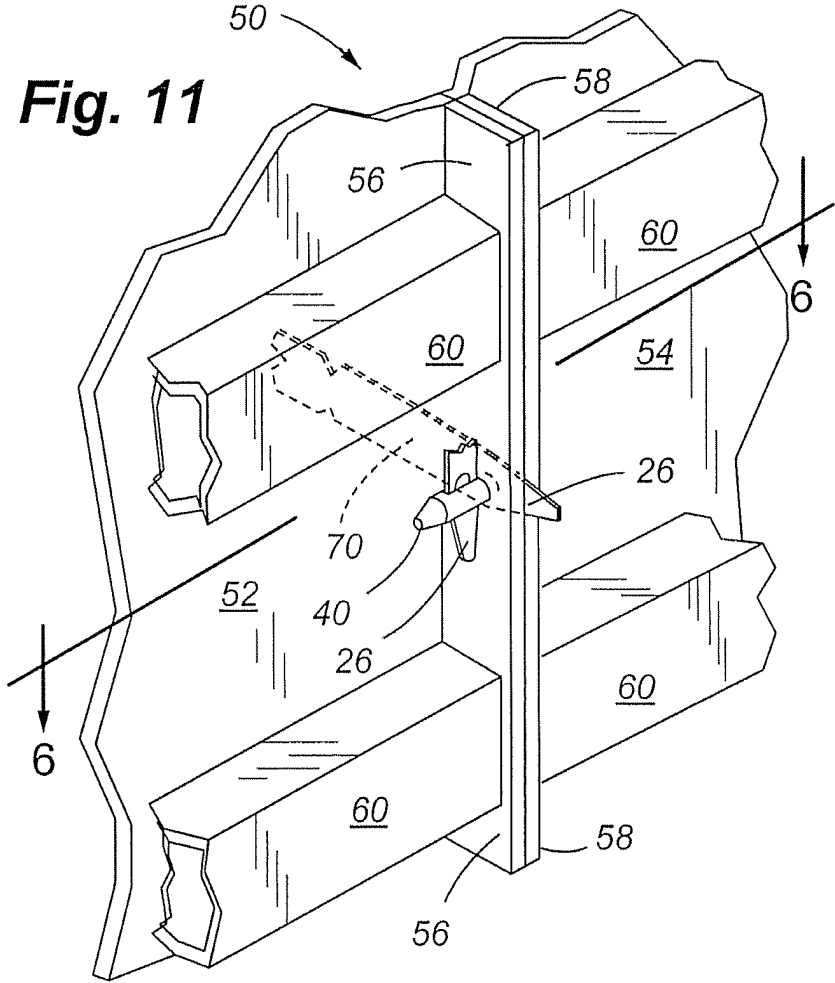


Fig. 12