March 12, 1957 E. BERGDAL 2,784,476

JOINTED STRAP TIE FOR CONCRETE FORMS

Filed Feb. 2, 1953 2 Sheets-Sheet 1

Fig. 1

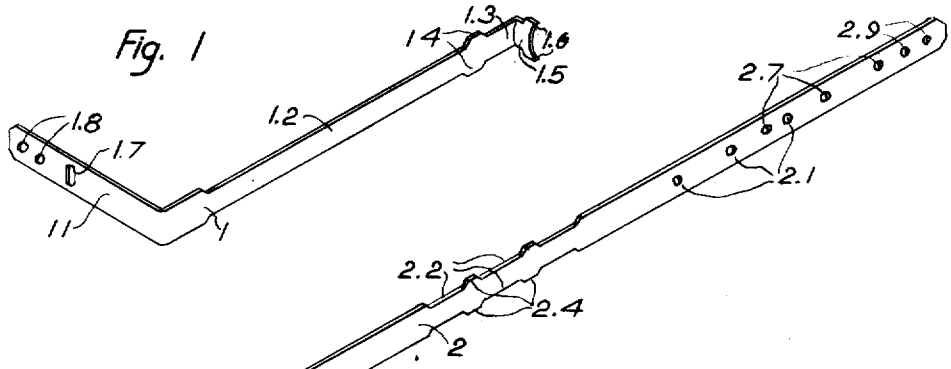


Fig. 2

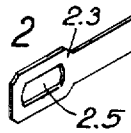


Fig. 3

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JOINTED STRAP TIE FOR CONCRETE FORMS

Filed Feb. 2, 1953 2 Sheets-Sheet 2

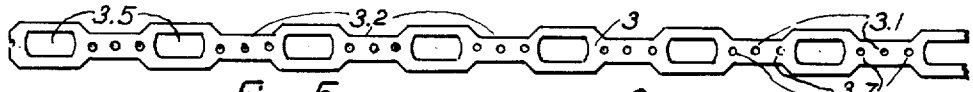


Fig. 5

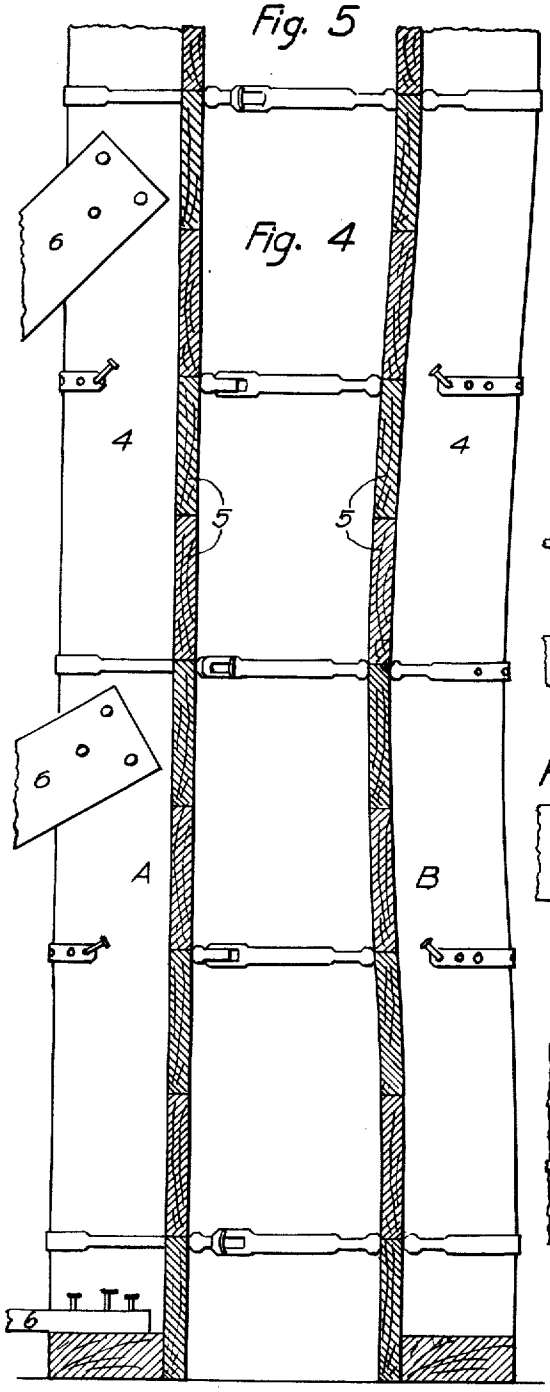


Fig. 4

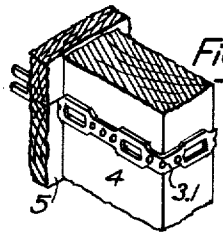


Fig. 6

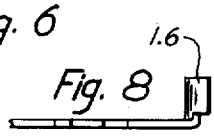


Fig. 8

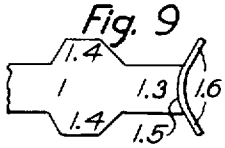


Fig. 9

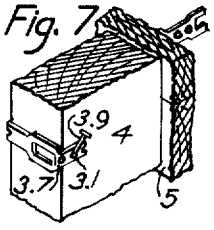


Fig. 7

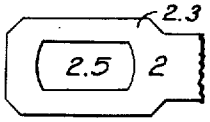


Fig. 10

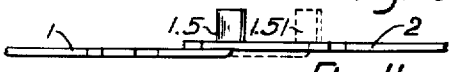


Fig. 11

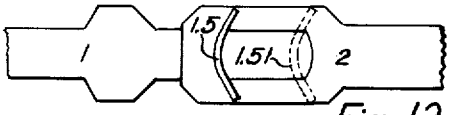


Fig. 12

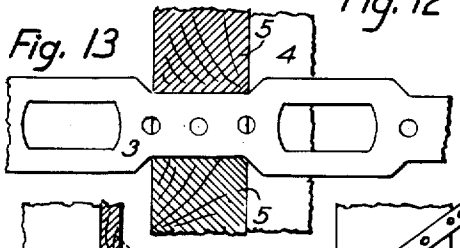


Fig. 13

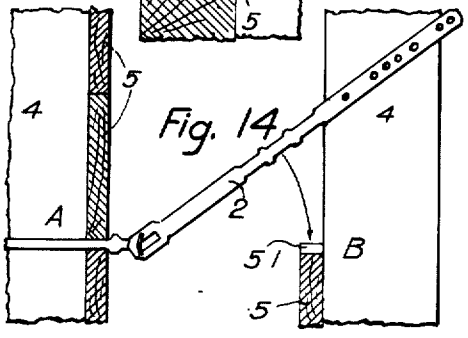


Fig. 14

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2,784,476

JOINTED STRAP TIE FOR CONCRETE FORMS

Ed Bergdal, Ellensburg, Wash.

Application February 2, 1953, Serial No. 334,699

4 Claims. (Cl. 25—131)

Brief summary of the invention

The invention is an improved form of strap tie for forms for concrete walls, or similar concrete structures, that is, an improvement in ties of the type consisting of straps or bands of metal extending through the concrete, the ends of the ties of such type being attached to the forms by bending or wrapping them around the back of the studs or other frame members and there securing them by nailing or equivalent means. A two-part tie as here understood is a tie having two principal parts connected in the space between the forms, regardless of whether or not minor auxiliary parts are used in addition to the two principal parts. Ties jointed between the forms have been used previously. The most important feature of the present invention is that it is strap tie so jointed, with a very practical joint.

The two-part tie herein described is very easily attached to the forms, not only because it has the favorable characteristics possessed by all strap ties, but also because of the fact that the use of two parts further facilitates the application of the tie to the forms. The attainment of this advantage is one of the objects of the invention, which is also true of the attainment of each of the other advantages hereinafter discussed.

One of the two parts of this tie is placed when the first of the two forms for the wall is erected. As this part projects from the face of such form for a distance of only an inch or two, it does not interfere with the placing of reinforcing steel or with the erection of the form for the other side of the wall. This feature is conducive to speed and convenience in the above work, and, because it obviates any need for bending projecting ties out of the way during the placing of reinforcing steel and during the erection of the second form, and later disentangling and straightening such ties, it avoids the deformation and weakening of the ties which such procedures involve. This constitutes a second advantage.

The second part of each tie is placed as the corresponding portion of the second form is being built. Because of the nature of the joint used in the tie, the two parts may be connected practically instantaneously, a third advantage. The joint can not be accidentally disconnected, a fourth advantage.

In the joint is provided a longitudinal clearance allowing a limited longitudinal movement of the two parts composing the tie, relative to each other, after they are connected, which further facilitates the placing of the second part of the tie, a fifth advantage.

The joint is of simple construction, a sixth advantage. The above construction is achieved with an economy of material, a seventh advantage. The joint is so sturdy that the strength of the tie is substantially the same as if it had been made in one piece, an eighth advantage.

The tie as a whole, as well as the joint, is of simple structure, and it may be manufactured at a cost low enough to make it economically practical as a tie to be used only once, a ninth advantage. The same economic practicality makes it feasible to use a fairly close spacing

of the ties, which in turn makes a light form-construction possible, a tenth advantage.

There is in this tie provided a spacing means whereby the desired spacing apart of the forms, which spacing determines the thickness of the wall, may be easily and accurately achieved, an eleventh advantage. The tie is adapted to be used in a combination in which a spacing notch in the edge of a strap tie interacts with a saw kerf cut into the edge of a sheathing board, whereby, when the function of spacing is separate from that of resisting the pressure of the concrete, one is enabled to obtain satisfactory spacing with very shallow spacing notches, thereby further achieving an economy of material in the manufacture of the tie, a twelfth advantage. Also, a given tie may be adapted to be used with various wall-thicknesses, a thirteenth advantage.

In this two-part tie one part may have such a form that a section of any desired length cut from a band or strip prepared for this purpose may be used for said part without any additional preparation of such section, a fourteenth advantage.

The tie has such a small thickness that it will retain only insignificant quantities of fresh concrete dropping on its edge, a fifteenth advantage. The tie may be used with various types of sheathing boards, irrespective of the nature of the edges of such boards, a sixteenth advantage.

The spacing notches used in this tie have sloping shoulders, this feature facilitating the removal of the sheathing boards from the set concrete, a seventeenth advantage.

Brief description of the views of the drawings

In the accompanying drawings Figure 1 is an isometric view of one of the two parts of the tie herein discussed and claimed, which part is in the various views identified by the reference numeral **1** whenever such identification is needed. Figure 2 is a similar view of the corresponding second part, which is identified by the reference numeral **2**. Figure 3 is an isometric view of a portion of a set of concrete forms in which the tie is used. Figure 4 is a vertical transverse view of a portion of a similar set of concrete forms; this view shows particularly how the tie functions when a stud in the forms is somewhat crooked.

Figure 5 is a side view of a special form of the second part of the tie, which special form is designated by the reference numeral **3**. Figures 6 and 7 are isometric views showing how such special second part is secured to a stud.

Figure 8 is a top view of the inner, or joint, end of part **1**, which part, as noted, is shown complete in Figure 1; Figure 9 is a corresponding side view. Figure 10 is a side view of the joint end of part **2**, which part is shown complete in Figure 2. Figure 11 is a top view of the joint ends of parts **1** and **2** connected; Figure 12 is a corresponding side view. Figure 13 is a vertical section showing the relationship between the sheathing and the member **3**, shown in Figure 5, when the latter is used as the second part of the tie. Figure 14 is a vertical sectional view indicating how part **2** is placed.

The various partial views of concrete forms, while they represent the same general type of forms, are not to be regarded as merely different views of the same forms, and any given sectional view does not necessarily represent a definite plane in some other view.

Detailed description of invention

The form tie herein described and illustrated in the accompanying drawings is, as noted, composed of two separate but connectable parts. For the purpose of readily distinguishing these parts, one shown by itself in Figure 1 and the other similarly shown in Figure 2, they will in

this description be called the anchor and the yoke, respectively.

The anchor, designated by the numeral **1**, is best shown in Figure 1. It is stamped out of sheet steel or hoop steel. It has at one end a portion **1.1** bent at a right angle to the main portion. The latter has for most of its length material cut away from its two edges, leaving a relatively narrow stem **1.2**. A shorter stem **1.3**, similarly produced, is separated from stem **1.2** by projections **1.4**. A portion **1.5** of the anchor, consisting of a small portion of the stem **1.3** and the anchor beyond stem **1.3** is bent at a right angle in the direction opposite to that of portion **1.1**. The extreme end of portion **1.5** has a pair of wings **1.6** extending in opposite directions. Portion **1.5** is curved in such a manner that the wings **1.6** project away from the rest of the anchor, the portion **1.5** being convex on the side toward the other end of the anchor and concave on the opposite side. This curvature is best shown in Figures 8 and 9. The portion **1.1** of the anchor has an elongated hole **1.7** to facilitate the making of another right-angle bend at the back of a stud, and has nailing holes **1.8**, used in securing the outer end of the anchor to a stud.

The yoke, designated by the numeral **2**, is best shown in Figure 2. It is made from the same kind of material as the anchor, though the gage of the material may be slightly different. At one end the yoke has a wide portion **2.3** in which is an elongated hole **2.5**. The hole **2.5** is of such a size and shape that the portion **1.5** of the anchor may be inserted therein. The hole has curved ends, the curvature being such that when the connected tie is under tension, or otherwise fully extended, that part of the convex surface of portion **1.5** which lies within the hole when the two parts are connected will fit into one of the concave ends of the hole, that is, into that end of the hole which is nearest the inner end of the yoke.

As seen in Figure 2, the yoke has three pairs of relatively wide and shallow notches **2.2** in the edges. These notches are separated by the projections **2.4**. The notches determine the spacing-apart of the forms, and they may therefore be called spacing notches. A plurality of pairs of spacing notches makes it possible to use the yoke for a corresponding number of different wall-thicknesses. Any convenient number of notches may be used. A yoke designed for one wall-thickness needs only one pair of notches; in fact, a single notch in the lower edge of the yoke would serve, but the notch in the upper edge has some utility, particularly as a visual guide. The spacing notches have sloping shoulders.

The holes **2.1** and **2.7** in the yoke, as shown in Figure 2, facilitate the bending of the yoke around the back of a stud. Only one hole **2.1** and one hole **2.7** would be used in any yoke placed in a form; which of the available holes to be used would depend on the wall-thickness. The holes **2.9** are nailing holes, used in securing the outer end of the yoke to a stud.

In Figure 5 is shown a special form of the yoke, which form is designated by the reference numeral **3**. It is particularly useful in the case of walls for which no ready-made yokes of the right lengths are available. Yokes of this type may be cut on the job to any desired length, from strips of metal prepared as indicated in Figure 5. Such strips may be made in lengths up to several hundred feet, and may be reeled up into coils for convenience in handling. As we may see in Figure 5, yoke **3** has wide portions, each having a hole **3.5**, alternating with portions having spacing notches **3.2** and bending holes **3.1** and **3.7**, which bending holes also serve as nailing holes. Such alternating portions occur at uniform intervals throughout the whole length of the strip. Such intervals represent a lineal base unit of the thickness of the wall. With a stock of such yoke material on hand, in addition to a supply of anchors, one may obtain ties for any wall-thickness in multiples of a selected base unit. Since concrete walls generally are constructed in thicknesses which are multiples of two inches, this distance would be a suitable base unit.

Application procedure

The tie is placed in the forms as follows: As the first of the two forms for a wall is being erected a saw kerf equal in depth to the width of stem **1.2**, Figure 1, of the anchor is cut into the sheathing in line with one side of a stud, as shown at **5.1** in Figure 3, where the various saw kerfs shown are occupied by anchors in place, except the one opposite the top of the stud on the left, which is shown unoccupied, as is also the one at the right in Figure 14. The anchor is then placed in such position that the stem **1.2** lies against the stud, with the inner end of said stem lying in the saw kerf, the lower of the two projections **1.4** being hooked inside of the sheathing, and the bend at the outer end engaging the nearest of the two back corners of the stud. The elongated hole **1.7** is thereby brought opposite the second back corner of the stud and the projecting end of the anchor is with a blow or two of a hammer readily bent against the adjoining side of the stud, where it is secured with a nail driven through one of the nail holes.

Because of the snubbing effected by the two right-angle bends there is very little stress on the nail, and to make this easy to pull when stripping the forms, it may be driven in only part way and then bent over, as shown at **1.9**, Figure 3, and at various other places in the drawings. The primary snubbing effect achieved by the first right-angle bend at the back of the stud, where the anchor is pre-bent, overcomes most of the stress to which the anchor is subjected, and therefore the secondary snubbing at the second back corner, where the anchor is bent as it is being placed, needs only to take up a relatively slight stress; for this reason a relatively large portion of the cross-section of the anchor may safely be cut away at this point, making it possible to use a slot or an elongated hole, so as to effect the bending with a minimum of effort, since in the case of the anchor, the bending always takes place at the same point.

As the second form is being constructed the inner ends of the yokes are connected to the projecting ends of the corresponding anchors attached to the first form, and the outer ends of the yokes are attached to the second form. A yoke is normally connected to an anchor by holding the yoke in a position somewhat approaching the vertical, with the joint end down, and slipping the end portion **2.3**, with the hole **2.5**, over the wings **1.6** of the anchor, and then rotating the yoke in a vertical plane until a selected spacing notch is seated in a saw kerf in the sheathing of the second form. The saw kerfs in the second form are similar to those in the first form, and both are in the drawings designated by the numeral **5.1**. A yoke in the process of being placed is shown in Figure 14. Some modifications of the above procedure may at times be required where special conditions prevail.

After the appropriate spacing notch is seated in the saw kerf, the yoke is bent with two right-angle bends around the back of the adjacent stud, the first bend being made at one of the holes **2.1** and the second bend at one of the holes **2.7**. The set of holes **2.1** and the set **2.7**, best shown in Figure 2, are arranged so that whenever a particular spacing notch is used, a corresponding hole **2.1** and a corresponding hole **2.7** are brought opposite the respective back corners of the stud. The outer end of the yoke is secured with a bent-over nail in one of the nail holes **2.9**. As indicated in Figures 3 and 4, the ties on any one stud are placed alternatingly on one side and on the other side of the stud, to neutralize any tendency of the stud to twist.

The anchor as shown in the various views is the same for all wall-thicknesses, though this is not an essential feature; obviously an adjustment of the extent to which it projects beyond the face of the form may be provided for in the same manner as that by which the yoke is ad-

justable for different wall-thicknesses, if such an adjustment should be needed. Likewise, various non-adjustable anchors having interior projections of different longitudinal extent may be provided.

In yokes of type **2** one may conveniently center the spacing notches one inch apart. However, if, as sometimes happens, we have a wall-thickness involving a fraction of an inch, or in the case of yokes of type **3** we have a wall-thickness involving a whole number of inches not there provided for in the spacing notches, such yokes may still be used, though not so conveniently, since the spacing must then be established by means other than spacing notches.

In Figures 6 and 7 is shown how holes **3.1** and **3.7** in yoke **3** correspond to holes **2.1** and **2.7** in yoke **2**, as shown in Figure 2, such holes in both cases being used in bending the yoke around the back of the stud. No special nailing holes are needed in yoke **3**, however, since nailing may be done in any of the holes **3.1** or **3.7** available. In Figure 7 a nail **3.9** is shown driven through one of the holes **3.1**.

Recount of beneficial effects

The advantageous results obtainable by the use of this invention have already been listed, and we shall now give these a somewhat detailed examination. Of the various concrete-form ties used, a strap tie, that is, a tie consisting of a metal strap or band, is one of the most easily attached to the forms, if we consider the actual work of attaching it only. Such a tie is bent or wrapped around the back of studs or other frame members of the forms. This gives a snubbing effect, with which only a light nailing or other fastening is needed. Sheet-metal ties which do not function as described above are herein excluded from the designation "strap tie." However, such strap ties as have heretofore been used have disadvantages which partly or wholly outweigh the above advantage. As we shall see, the present tie avoids these disadvantages while retaining the said advantage.

In the construction of forms for a concrete wall or a similar concrete structure it is in all cases highly desirable, and in most cases absolutely essential, that the two forms for the respective sides of the wall be constructed separately and successively and not simultaneously. The usual procedure is as follows: As the first form is being erected, one end of each form tie is attached to this form. In the case of strap ties, such as heretofore generally used, the ties are one-part ties, and this is true also of most other commonly-used ties. By the term "one-part tie" is here meant any tie which has a principal part extending across the space to be occupied by the concrete, regardless of the existence or non-existence of auxiliary parts. The ties thus attached at one end to the first form extend across the space between the forms, and in the case of strap ties and most other ties, also across the space to be occupied by the second form. Such projecting ties seriously interfere with the placing of reinforcing steel and other imbedded installations, if any, and even to a greater extent interferes with the placing of materials, particularly the sheathing boards, in the erection of the second form. This not only greatly hampers the work but is also likely to cause damage to the tie. The present tie avoids these troubles, because the anchor projects only an inch or two from the face of the first form, and the yoke is placed at any point only after the rest of the work there has been completed.

Some of the ties which have previously been used have a joint, or a plurality of joints, in the space between the forms, but none of these apparently, has a joint close to the face of the first form which may be quickly connected after the first form is completed; in fact, apparently none of them has any reliable joint anywhere in the space between the forms which may be quickly connected. Reliable joints, having strength commensurate with the breaking strength of the separate parts of the tie, such as various screw joints, particularly such as must be adjusted to establish the spacing of the forms, require from ten to fifty times as long time to connect as the joint in the new tie herein described, which may be connected practically instantaneously.

All previous ties, apparently, which have dependable interior joints, are made relatively expensive by their complex structure, and though this is in part compensated for by the fact that some of the parts may be used repeatedly, it is still found necessary to make such ties relatively heavy, so that they may be spaced relatively far apart, thereby using fewer of them. But the advantage thus gained is largely futile. The fact that parts may be used repeatedly is hardly an adequate compensation for the large initial investment in those parts and in parts which can not be re-used. Also, the work, when stripping the forms from the set concrete, of salvaging the parts to be re-used, the work of keeping them in repair and storing them, the unavoidable losses of relative expensive parts during this handling, and the risk incurred in using parts which because of their having been previously used one or more times may have become more or less worn or otherwise damaged, involve other disadvantages. Furthemore, a far-apart spacing of the ties makes it necessary to use forms of heavier construction than would otherwise be required, which involve additional expense for material and labor.

The present tie is of such simple construction and affords such an economy of material that a close spacing may be used without involving any undue expense, and there is no need to provide for salvaging any parts for re-use, since the cost of salvaging such parts as could be re-used would be greater than the cost of buying such small and simple parts new. Hence, the use of the present tie affords us the advantage of using forms of light construction, thereby saving labor and material, and the advantage of always working with new tie material.

We may also note that even some of the light-weight ties at present quite commonly used, which may not be spaced far apart, are of such nature that they require a great deal of material in the forms; such additional material is not needed to strengthen the forms; it is needed merely as a means to enable the ties to function. With such ties the forms must have a double line of wales, sometimes called "strongbacks," that is, horizontal frame members extending across the back of the studs, for every row of ties and on both sides of the wall. The quantity of lumber required for such wales may amount to as much as, or even more than, all the rest of the lumber in the forms. With the present tie a single line of wales for every other row of ties on one side of the wall is sufficient. Thus is achieved a saving of seven-eighths of the waling material, which means a saving of something like forty percent or more of the total amount of lumber needed in forms using the above ties.

While the present tie may of course be made so as to be suitable for attachment to wales, there does not seem to be much need for such an arrangement. When ties are fastened to studs, the wales have no direct function in connection with the ties. The wales in such a case do not resist the thrust of the concrete; they merely serve to help hold the forms straight, and therefore they need not, when the present tie is used, be fastened strongly to the forms; lightly nailing them to the back of the studs of the form first erected is sufficient.

Before a strap tie may be attached at both ends to the forms one must first have provided a means for establishing the spacing-apart of the two forms forming the two sides of the wall. Such spacing is normally done after the first form has been erected, with one end of the ties attached thereto. With ties heretofore used one method of procedure is to insert a temporary strut, called a spreader, between the forms, and while maintaining the spreader in position, and in some way applying tension to the tie, secure the free end of the tie to the second form. The necessity for using a spreader, and the difficulty of applying a sufficient and uniform tension

to a strap tie renders this procedure inconvenient and unduly time-consuming. Another method is to provide the tie with spacing marks of some kind, so that the placing of certain points on the tie opposite certain points on the forms gives a desired spacing. This, however, also requires the bringing of the two forms into the final and correct spacing relationship with each other before the tie can be secured at both ends; since this generally requires the springing of the second form inward or outward to some extent each time a tie is to be fastened to said form, it slows up to a considerable extent the work of said attaching the ties.

These difficulties may be largely or wholly avoided by the use of the present tie. The placing of the anchor is facilitated by the fact that the anchor has only a small longitudinal dimension, so that, as noted, it does not project far enough from the face of the form to get in the way of the operator, who almost always has to work from the face side of the form when erecting the first form. In fact, the anchor may be placed in a few seconds. The placing of the yoke, which may be practically instantaneously connected to the anchor, is greatly facilitated by the fact that it is not necessary to bring the two forms into an exact spacing relationship with each other before fastening the yoke. As may be noted in the drawings, the tie has a longitudinal clearance in the joint, permitting a limited longitudinal movement of the anchor and the yoke relative to each other. This is best illustrated in Figures 11 and 12, where a top view and a side view, respectively, of the joint are given. The reference numeral **1.5** indicates the inner end portion of the anchor when the tie is under tension or otherwise fully extended. The outline of this portion in dotted lines is shown at the right in both figures, identified by the reference numeral **1.51**, indicating the position occupied when the anchor and the yoke are displaced toward each other to the extreme extent of the possible movement.

The ideal position from the standpoint of ease in attaching the yoke to the form is an intermediate position, since then there is neither tension nor compression in the tie to hinder the rapid seating of the desired spacing notch in the saw kerf in the sheathing. Such intermediate positioning of the two parts of the tie relative to each other during the erection of the forms may generally be effected more or less automatically by simply refraining from placing spreaders between the forms except at a very few points, and these to be placed only after the ties near those points have been placed.

The fact that the lumber in the forms is seldom straight is what makes the longitudinal play in the joint particularly useful. When, for instance, one has to spring a crooked stud into place while attaching a tie, the work in question and the time required are considerably augmented, in fact, may be multiplied several times. Figure 4 shows how this longitudinal play functions in the case of a crooked stud, and is otherwise informative about a practical application of the tie in question.

The figure is a sectional view of a set of forms, showing a pair of studs **4**, sheathing boards **5**, and braces **6**. The stud and the sheathing shown on the left belong to the form first erected, designated by the letter A. The stud and sheathing on the right are part of the second form, designated by the letter B. These forms are shown connected by five ties at different levels. Form A has been brought into its final position, and is held in alignment by the braces **6**. Form B is not braced; it is held by the ties only, and because of the play in the joints of the ties, the crooked stud, shown as part of this form, is free to retain its curvature for the time being. We may note that the top and bottom ties are in the fully extended position; in the middle tie the joint is as indicated by the dotted lines in Figures 11 and 12; the tie which is second from the bottom and the one which is second from the top in this figure are in intermediate positions. When the space between the forms is filled with concrete, the

hydrostatic pressure of the latter will automatically bring all the ties into the fully extended position, and the face of the form B into a plane parallel with the aligned and braced form A.

There are times when it is necessary or desirable, during the construction of such concrete forms, to spread these apart to some extent in order to facilitate the placing of additional ties in cases where the forms have been excessively crowded together, or to the full extent of the desired spacing in cases where the forms for the wall in question are to be connected to forms for a transverse wall or similar structure; this can be done by inserting one or more spreaders after the near-by ties have been placed, refraining from placing spreaders where ties are yet to be placed. Likewise, there are times when it is necessary to spring into place a stud which is curving outward. However, with these ties the necessary springing is not confined to that relative short portion of the stud which extends between one tie and the next tie below; with the sliding connection provided in these ties the springing will ordinarily extend over several times that distance, and will therefore be quite easily affected.

The curvature of the stud shown in form B, Figure 4, is somewhat exaggerated for the sake of clearness; a stud as crooked as that would not in practice be used as a concrete form. Hence, in a practical application of these ties, most of them may be placed without any tensile or compressive stress in them, and where a stress does occur it needs to be only of an insignificant magnitude, except in a case where a buck frame for a door or window opening, or something equivalent, is to be placed between the forms; in the later case the sliding connection has neither an advantage nor a disadvantage; but relatively few ties need to be placed adjacent to such frames.

The joint in the present tie has several other advantageous features. Thus, after a tie has been placed in the forms, the joint can not be accidentally disconnected by jars, jerks, longitudinal compression, lateral buckling, or anything else short of actual fracture of the tie. It is of simple construction and may be produced by simple stamping operations. A two-part tie with such a joint, when the regular yoke, yoke **2**, is used, requires very little more material than an equivalent one-part strap tie. However, the most important feature of the joint is the construction by which the joint is rendered so sturdy that the tie is of practically the same strength as a one-part strap tie of the same weight.

The construction by which this is achieved has already been described, and we may now consider the functions of the elements of this construction. The curved engagement area between the convex side of portion **1.5** of the anchor and the concave inner end of hole **2.5** of the yoke—see Figures 8 to 12—we may here designate as merely the "engagement area"; this term therefore does not, as here used, include the engagement of the edges of the wings **1.6** of the anchor with the portion **2.3** of the yoke. The fact that the engagement area has this curvature, combined with the buttressing effect of the back-swept wings **1.6**, brings about a situation in which when the tie is in tension the shear stress in the engagement area is distributed throughout that area, which is conducive to maximum strength for any given weight of material in the tie.

The inventor's experiments have shown that, in the case of such light materials as would otherwise be strong enough for these ties, when the ends of the connection hole are straight and the inner end of the anchor is shaped accordingly, the shear is to a considerable extent concentrated at the ends of the engagement area; hence, the material opposite these points, either in the anchor or in the yoke, will relatively readily begin to fail, and a complete failure of the tie rapidly follows. Also, when the wings of the anchor extend directly crosswise to the tie, instead of being bent or curved away from the end of the anchor, like wings **1.6**, indicated particularly in

Figures 1, 8, and 9, there is no buttressing effect, and the right-angle bend at the inner end of the anchor tends to straighten out when the joint is subjected to a tensile stress; this tends further to concentrate the shear at the ends of the engagement area, making it necessary to use somewhat heavy material in order to obtain a tie of satisfactory strength. The use of heavier material not only increases the cost of the tie, but also renders it less easily placed in the forms. The construction used in the present tie achieves the object of overcoming these difficulties.

We may note that both ends of the connection hole **2.5** are curved lines. The curvature in the end nearest the outer end of the yoke is conducive to maximum strength with a given amount of material in the wide portion **2.3** of the yoke, and it also gives yokes of type **3** an end-for-end reversibility.

The yokes as shown in the drawings have spacing notches in pairs, one in the lower edge and a corresponding one in the upper edge. Only the former is essential, but having them arranged in pairs makes the yoke reversible, and the one which happens to come at the top is also of some utility, though its function is primarily that of a visual guide. For reasons of economy of material, the spacing notches are not made deep enough to maintain the spacing by themselves alone, but by placing the yoke in a saw kerf, where it is gripped somewhat firmly, the spacing is maintained while the yoke is being bent around the stud and fastened. The saw kerf also helps to keep the yoke in its proper place up to the time the concrete is poured, which is also true in the case of the anchor.

Because the spacing notches are seated in saw kerfs, and because they have no function in respect to resisting the pressure of the concrete, they may have a depth of as little as one-sixteenth of an inch, though a notch that shallow may not necessarily be an ideal one. The above reasons also make it practicable to use notches with sloping sides, which facilitates the stripping of the sheathing boards from the wall after the concrete is set, thus avoiding a handicap inherent in all ties having spacing notches with square shoulders; such handicap being the fact that square shoulders will grip the sheathing boards so firmly that the boards can not be released without considerable effort and not generally without some damage to the boards. The above-discussed spacing notches are obviously quite different both in form and in function from the deep square-edged notches found in various other ties, in which the shoulders formed by the sides or edges of the notches are primarily intended to resist the pressure of the concrete. In the latter ties the material must be cut away across the major portion of the width of the tie in order to form these deep notches, which necessitates the use of an amount of material for the ties which is disproportionally great for the strength of the ties.

The saw kerfs also have two other advantageous effects. One of these is that the saw kerfs firmly establish the flat sides of the tie in a vertical position, which prevents any appreciable quantity of fresh concrete from being retained on ties in the upper portions of the forms while lower portions are being filled with concrete; because it begins to set before it can be properly consolidated, such retained concrete forms weak and porous spots in the wall. The other advantageous effect is that the saw kerfs obviate the necessity for using square-edged sheathing boards which are required with strap ties which lie flat and pass through the cracks between the boards. For tight forms one needs shiplap, tongue-and-groove, or exceptionally straight square-edged material. With strap ties set in saw kerfs one may use any of these, including two-foot-wide plywood boards.

Slots in the sheathing somewhat similar to the saw kerfs used in connection with the present tie have been used before; ties having notches engaging some part of the forms have also been used. In the present tie and the forms to which it is applied, modified forms of the above elements are combined, and thereby is achieved a new result which is not merely the sum of the results obtainable with these features separately, even when such modified forms are used. The use of a saw kerf by itself does not effect any spacing. The use of a form-gripping notch in a tie effects a spacing by itself only if the notch has a depth of approximately one-half inch or more, and has square shoulders at the sides. The combination makes it possible to use notches in the tie as shallow as one-sixteenth of an inch, involving a saving in such a case of some two-thirds of the material, and makes it possible to use notches with sloping shoulders, the advantage of which has already been explained.

Such form-gripping notches as discussed above are of course something entirely different from notches, slots, holes, etc., used to facilitate the bending of a tie at a particular point.

While a plurality of square-shouldered form-gripping notches have been used non-exclusively for spacing in various ties, it does not appear that anyone has been able to adapt spacing notches, either with square or sloping shoulders, to ties involving the use of continuous-strip material. This, however, is accomplished in yoke **3**, shown in Figures 5, 6, 7, and 13. Spacing means in a series, in order to be practical, must be separated by whole units of distance, such as inches, or by multiples of such units. But the material in the forms is practically never in thicknesses constituting whole inches or other units, and therefore the width of any spacing notches used must ordinarily involve fractional inches. It is evident that if a ¾" spacing notch in a one-part tie grips a ¾" sheathing board in one form, and a similar notch grips a similar sheathing board in the other form, the distance between the face surfaces of the two forms can not constitute whole inches if these notches are spaced apart a whole number of inches from center to center. Hence, with such or similar spacing means in a one-part tie one could not obtain a wall-thickness in whole inches.

In the present invention, by adapting a continuous-strip member for use in a jointed tie, the above difficulty is avoided. It is then possible to use a yoke cut from a continuous strip which has spacing notches alternating in position with connection holes at regular intervals throughout the whole length of the strip, since we can provide an anchor in which the interior projection is of such longitudinal magnitude as to leave a space between the forms which is mensurable in whole inches.

Claims

In the claims the following definitions apply: "Inner," "outer"; by the inner end and the outer end of a part of the tie is meant the end which extends into the space between the forms and the end which is attached to the forms, respectively; when these terms are applied to particular portions of the two parts of the tie, they are to be interpreted in conformity with the above. "Plane"; as a strap tie has a relatively small thickness, the portion of it extending between the forms and any straight continuations thereof may for convenience in description be said to occupy a plane, and the latter word is used in conformity with this conception in the claims. "Shoulders"; the shoulders of a spacing notch are the portions of material forming the short mutually opposite sides of such a notch. "Connection hole"; a connection hole is one of such holes as are identified in the drawings by the reference numeral **2.5**, as in Figure 2, and the equivalent holes identified by the reference numeral **3.5**, as in Figure 5, which holes are elsewhere in the specification also designated as connection holes. "Connection hook"; this term designates the inner end of the anchor, comprising the stem **1.3** and the portion **1.5**, including the wings **1.6**, as in Figure 1, fully described in the specification. The claims are:

1. A two-part strap tie for concrete forms: a first part

having on its inner end two projections extending in opposite directions from the edges of said part, the inner end of said part, including said projections, extending at a right angle to the plane of the tie; the said inner end, including said projections, being curved so as to present a convex surface toward the outer end of the said part, the plane of symmetry of the said convex surface being perpendicular to the plane of the tie; a second part having in its inner end an oblong hole with concave ends, the major axis of the said hole being lengthwise to the said second part, the said inner end of the first part extending through the said hole in the second part; the middle portion of the said convex surface conforming to the concave inner end of the said hole; one edge of each of said projections engaging the material forming the sides of the said hole.

2. A two-part strap tie for concrete forms: a first part having on its inner end two projections extending in opposite directions from the edges of said part, the inner end of said part, including said projections, extending at a right angle to the plane of the tie; the said projections being bent obliquely away from the outer end of said part; a second part having in its inner end an oblong hole, the major axis of the said hole being lengthwise to the said second part, the said inner end of the first part extending through the said hole in the second part; one edge of each of said projections engaging the material forming the sides of the said hole.

3. A two-part strap tie for concrete forms: a first part having on its inner end two projections extending in opposite directions from the edges of said part, the inner end of said part, including said projections, extending at a right angle to the plane of the tie; a second part having in its inner end an oblong hole, the major axis of the said hole being lengthwise to the said second part, the said inner end of the first part extending through the said hole in the second part; one edge of each of said projections engaging the material forming the sides of the said hole.

4. A two-part strap tie for concrete forms as defined in claim 3, which tie has a limited variability in length after the connectable parts have been joined, the means for such variability being a longitudinal clearance in the connection, permitting a sliding longitudinal displacement of the two parts with respect to each other.

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