

March 9, 1937.

G. E. SHAFER

2,073,185

CHANNEL STRUCTURE FOR METAL ARCHES

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2 Sheets-Sheet 1

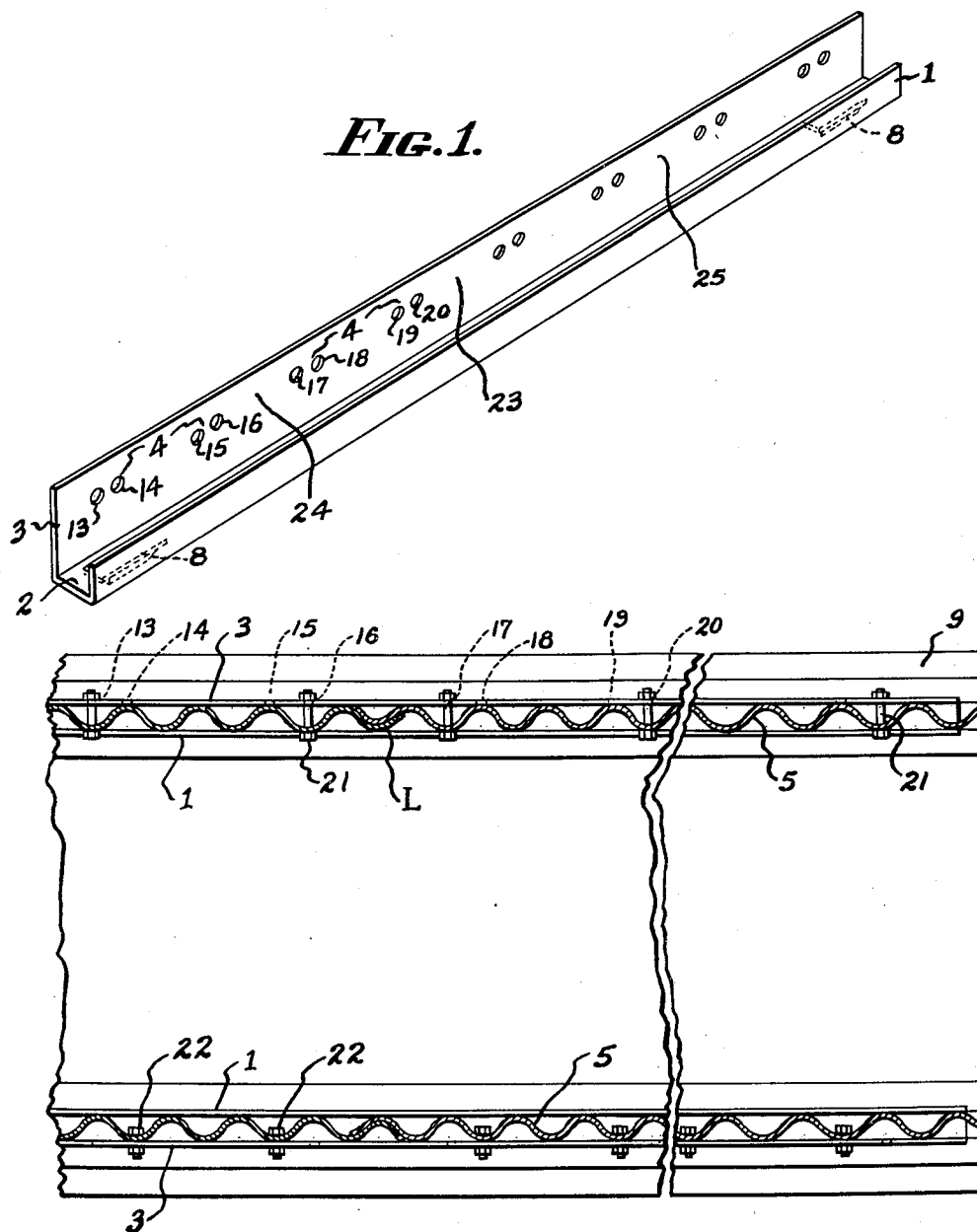


FIG. 2.

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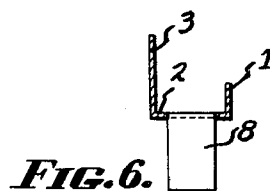
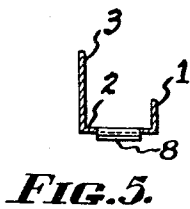
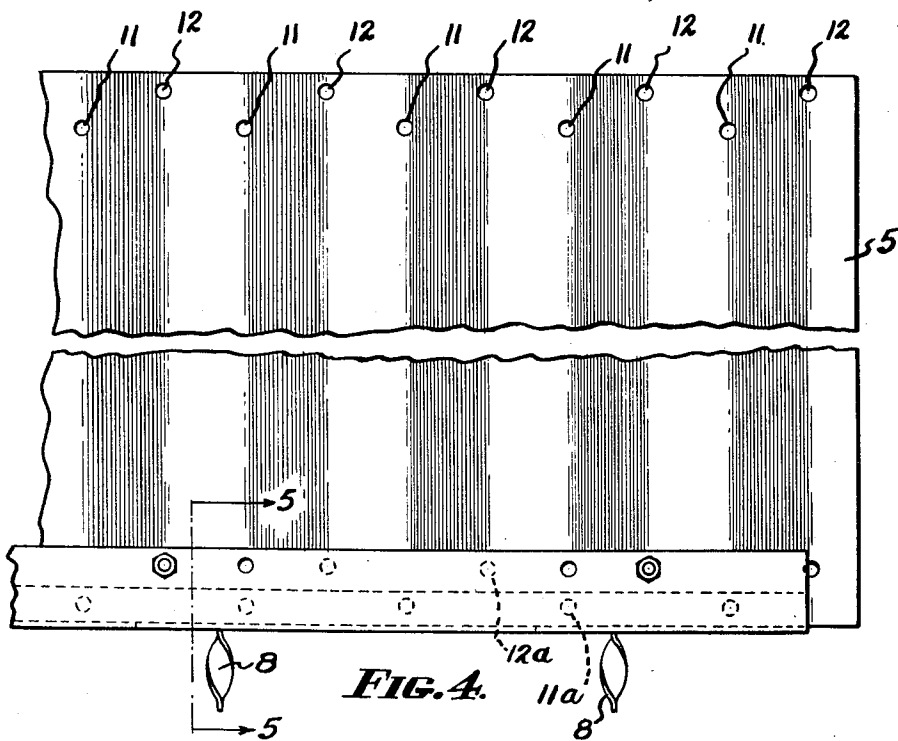
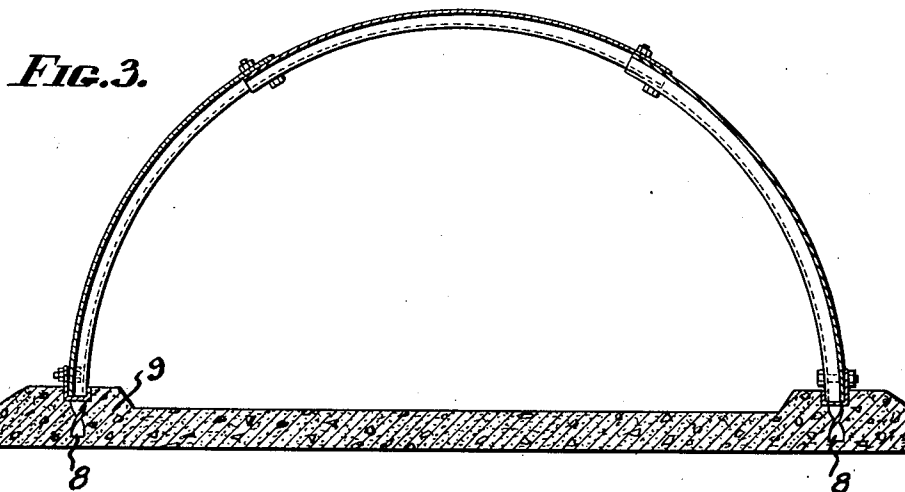
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CHANNEL STRUCTURE FOR METAL ARCHES

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9 Claims. (Cl. 138—71)

My invention has to do with the channel elements used as or in connection with footings for metal arches, especially such arches as are made from the heavy, corrugated, and curved plates of Patent No. 2,017,058, dated October 15th, 1935, of Jonathan R. Freeze.

My invention relates to the base angle or channel in which the bottom portion or ends of the curved arch section rests. In culvert or arch construction, where the full round section is not desired, it has been the practice to employ an arch construction which may be a half round section or less, formed of heavy, corrugated metal plates, the ends of which rest in channel members in a suitable base or footing. Difficulty has hitherto been experienced in providing suitable channel members for this use, and in particular in providing channel members which are of standard construction, and may be used with arches of different section and different length.

One object of my invention is to provide a standard metal shape, so designed and so perforated that it is capable of use with arches of any span, or any rise, as well as any length. Another object of my invention is to provide a structural shape which is inexpensive to manufacture, and is not bulky to store or ship. The heavy metal corrugated and curved plates of which arches are formed, are not ordinarily carried in stock at various culvert manufacturing plants throughout the country, but on the contrary, have to be ordered directly from the mill. It, therefore, takes considerable time before the arch plates reach the job; and it is an object of my invention to provide a base member or channel which can be stocked at sales agencies or culvert companies throughout the country, and which can therefore be supplied well ahead of the arch plates, so that the concrete base for the arch can be poured between the placing of the order and the arrival of the arch proper at the place where it is to be erected.

It is an object of my invention to provide a channel to which individual plates may be bolted, and which will serve as an adequate support for the plates, without propping, during the erection of additional portions of the span of the arch.

It is another object of my invention to provide a metal arch base, so perforated that an arch of any desired length can be erected thereon by the use of one or more of the arch base sections, with or without cut portions of sections.

These and other objects of my invention which will be set forth hereinafter or will be apparent to one skilled in the art upon reading these

specifications, I accomplish by that certain construction and arrangement of parts of which I shall now describe a preferred embodiment. Reference is first made, however, to the drawings which form a part of these specifications, and in which:

Figure 1 is a perspective view of my channel section showing perforations as made at the factory.

Fig. 2 is a plan view, with the arch plates in section, showing an exemplary type of concrete footing with the channels cast therein and the plates bolted thereto.

Fig. 3 is a sectional view of an exemplary arch and footing showing the arch as comprising three plates in transverse section, with my channel cast into the concrete footing.

Fig. 4 is a partial side view showing an initial plate inserted in the channel and held thereby during erection of remaining portions of the span, and in part how the spacing of the perforations in the channel is related to the spacing of the perforations in the plates.

Fig. 5 is a sectional view taken along the lines 5, 5 of Fig. 4, showing my channel before the lip is turned down and twisted to make an anchoring structure.

Fig. 6 shows the lip bent down and ready for twisting to form the anchorage.

Briefly, in the practice of my invention, I provide a channel-shaped arch base, having a web and two legs. One of the legs is considerably shorter than the other, while providing sufficient depth of channel to accept the ends of the plates. This shorter leg also serves as a gauge to determine the depth to which the channel may be embedded in the concrete, and to insure that the upper portion of the longer leg projects sufficiently from the concrete to make it possible to bolt the arch plates thereto. This channel is perforated in a certain way for the purpose of bolting the arch plates thereto, as will hereinafter be more fully described. In the web portion of my channel, I make cut lips, i. e. elongated rectangular pieces severed from the main portion of the web at two sides and at one end. These lips are adapted to be turned down to form anchorage means, as will also hereinafter be more fully described.

In the drawings, my channel is shown with a shorter leg 1, a web 2, and a longer leg 3, a series of holes 4 being punched, or otherwise formed in the longer leg. Leg 3 is enough longer than the leg 2 to make the insertion of bolts therethrough possible without interference.

The web 2 of the channel has cut sections or lips designated at 8, which lips are ordinarily left as shown in Figs. 1 and 5 during the manufacture and storage of the article. When the article is received on the job, these lips are struck down as shown in Fig. 6, and then twisted, as more clearly shown in Figs. 3 and 4 to make anchorage means.

While my invention is not limited to the use of the integral anchoring means just described, yet I prefer to use such means not only because they are simple, inexpensive and strong, but also because they leave the interior of the channel free. Thus there are no bolt heads or the like projecting upwardly on the web to interfere with the insertion of the arch plate edges into the channel; and there is also nothing to interfere with the free movement of an arch or arch plates longitudinally in the channel, as is sometimes necessary in erection work, before they are bolted thereto.

In Fig. 3, I have shown my channel structures embodied in a concrete footing 9. The form of this footing is not a limitation upon my invention. The form of arch shown is a half round arch, the channels being used in upright position. If the arch were to be a broad, flat arch, i. e. an arch less than half round in cross section, it would be advisable to tilt the channels to the desired angular position, being that angle to the horizontal at which the arch plates meet the channel. In practice, one or more of my channel sections are suitably supported, as by being nailed to a 2x6, or other wooden beam, located inside the channel, and are positioned in the mould, so that the level of the concrete will come up substantially to the top of the shorter leg. The anchorage members 8 will thus extend well down into the concrete. When the footing has set it is a preferable method of procedure to fasten an arch plate directly to the longer leg of my channel. The channel is made of sufficiently heavy metal to hold the arch plate when so bolted, in proper position without propping or external support. As a consequence the work of erecting the arch would proceed simultaneously from both sides of the structure. In an arch, the span of which comprises three plates transversely, a plate will be attached by workmen to the channel on each side, whereupon the crew will then attach the intermediate plate to the two plates previously installed, which plates will be held by my channel in the proper position for such work. I have found that in most cases my channel will adequately support in this way as many as two plates, one being bolted to the longer leg of the channel and the other being bolted to the first. In arches therefore having more than five plates constituting the span, it may be necessary to employ props; but the labor of this is greatly facilitated because of the fact that my channels not only help to support the plates but also locate the plates in the proper position.

The perforation of the longer leg of my channel is done in a special way. A number of factors have to do with this and will now be briefly discussed. In the first place, standard arch plates are perforated along each edge, both at the crests of the corrugations and in the valleys thereof; but the two sets of perforations are staggered and one set is located closer to the edge of the plate than the other as will be clearly seen in Fig. 4. For example, at the upper edge of the plate, there will be a series of holes 12, lo-

cated in the valleys of the corrugations and located at a certain distance from the edge. There will also be a series of holes 11 located at the crests of the corrugations and spaced a greater distance from the edge. Since the plates are lapped in the direction of the span of the arch, it will be understood that it is necessary to reverse the order of the holes on the opposite edge of the sheet. Thus as shown in Fig. 4, the valley perforations 12a of the plate are those located furthest from the edge, while the crest perforations 11a are located closest to the edge of what is shown as the bottom of the plate in this figure. Now it is not necessary for purposes of strength, that the arch plates should be bolted to the channel by as many bolts as those which are used to fasten the arch plates one to the other. This would be impossible in any event by reason of the fact that my channel is partially embedded in the concrete of the footing 9, so that it is possible only to bolt the plate to the longer leg of the channel by means of bolts or other fastening members passing through that series of holes located furthest from the edge of the plate. Moreover, it is desirable that surface water passing through the earth above the arch, where the arch is used in earth construction, should be permitted to drain into the culvert along the channel line at the top of the footing. The omission of bolts or other fastening means through certain of the perforations in the plate is desirable for this reason also. By my invention I provide a standard channel section which is intended for use indiscriminately on either side of the arch. Assuming therefore, that the same type of channel is used on both sides, and that at the end of an arch construction, from which the work is started, the arch plates are coterminous with the ends of the channel, it follows that the holes through the longer leg of my channel upon one side of the arch must be interspaced from the end of the channel by a distance different from the interspacing of the holes to be used in the longer leg of my channel on the opposite side of the arch. Therefore at the start of any series of perforations in my channel there must be two holes interspaced by half the pitch of a corrugation, i. e., half the distance between crests of corrugations in the plate, in order to make it immaterial which side of an arch plate is brought against my channel, so far as the fastening of that arch plate to the channel is concerned.

There is a further consideration bearing on the spacing of the holes which has to do with the provision of standard channel constructions which may be cut apart as desired, to accommodate arches of different length. The effective length of the standard arch plate is ten feet. As a consequence, and because it is not ordinarily convenient to handle channels much greater than ten feet in length, I make my channels also ten feet in length. Where the term "special length" is used in the art of arch construction, it does not ordinarily imply dimensions to within an inch or so. On the contrary, arches are ordinarily constructed to comprise either a standard length of arch plate or some multiple thereof; and where a departure from these standard lengths is necessary, the departure is arranged to comprise as an addition to a standard plate or multiple thereof, either a half plate or quarter plate. However, it will be remembered that in arch construction where plates are fastened together side by side to form a span of

the arch transverse to the axis of the arch, it is highly advisable to break joints in the courses. Thus, if a ten foot arch begins on one side with one arch plate, the next transverse course in the span of the arch will comprise two half plates joined together in the center of the span. Likewise, if the first course comprises a plate and a half plate, the next course will also comprise a plate and a half plate, but the order of the parts will be reversed. If any plate or portion thereof were to be bolted to my channel, at each crest or at each valley of the corrugations, it would be necessary to perforate the longer leg of my channel at each crest and at each valley of the corrugations in order to make it immaterial upon which side my channel were located in the arch. It has been shown above however, that it is not advisable to do this but that it is preferable to fasten the arch plate to the channel only at intervals so that perforations will be left through the arch plate for the drainage of water. Moreover if my channel were perforated at each valley and at each crest of the corrugations of the arch plate, it would be necessary in cutting my channel into half or quarter length to cut through perforations therein, which is undesirable. Since my channels will have to be cut only into quarter and half lengths, it is advisable to provide such a spacing of the holes that unperforated portions are left at the one-quarter, one-half and three-quarter length portions of the channel. Since the channel length is based upon the length of the standard arch plate, it is possible to express the interspacing of the holes therein in terms of channel length, and this has been done in Figure 1. It will be noted in this figure that the series of perforations start with perforation 13, preferably located at a distance from the end of the channel corresponding to the pitch of the corrugations in the arch plate. There is an adjacent perforation 14 located a distance from the perforation 13 equivalent to half of the pitch of the corrugation. The next perforation 15 is interspaced from the perforation 14 by an even multiple of the pitch of the corrugations. The next perforation 16 is interspaced from 15 by half the pitch of a corrugation. The same interspacing is maintained throughout the remainder of the channel, and it will be noted from Figure 2 that the outer ones of the first two pairs of perforations, viz., the perforations 13 and 16, are those which coincide with perforations in the crests of the corrugations of the plate P, whereas the perforations 16 and 17, being the adjacent perforations of the second and third pairs of perforations also fall adjacent perforations in crests of the corrugations in the plates. Thus in attaching the plate P and adjacent plates to the channel 5 in Fig. 2, one employs holes 13, 16, 17 and 20. If the channel 5 were located on the opposite side of the arch in Fig. 2, so that the opposite side of the plate were presented thereto, one would employ perforations numbered 14, 15, 18 and 19.

It will be clear that in my spacing on one side of the arch long bolts 21 are used to fasten the crests of corrugations to the leg of my channel by being passed through alternate pairs of holes, and on the other side of the channel short bolts 22 are used to fasten valleys of the corrugations to my channel, again being used through alternate but different pairs of holes. The structure therefore does not permit of the plates being incorrectly attached to the channel while permitting the channels or portions thereof, to be

used indiscriminately on either side of the arch. The lapping of plates as at L in Fig. 2, does not disturb the fastening of plates to the channels inasmuch as the lapping as shown, comprises a length equivalent to the pitch of one corrugation, whereas the plates are perforated at the crests and at the valleys of each perforation. It will also be noted that the center point 23, as well as the one-quarter and three-quarter points 24 and 25 of the channel, are left free of perforations.

Modifications may be made in my invention without departing from the spirit thereof.

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

1. A channel member for the purpose described, comprising a web and two legs of uniform length throughout, one of said legs being of a height sufficient to gauge a satisfactory depth to which the said channel may be embedded in concrete, the other of said legs being sufficiently longer to permit the bolting of plates thereto, without interference either from said first mentioned leg, or from said concrete.

2. A channel member for the purpose described, comprising a web and two legs, one of said legs being of a height sufficient to gauge a satisfactory depth to which the said channel may be embedded in concrete, the other of said legs being sufficiently longer to permit the bolting of plates thereto, without interference either from said first mentioned leg, or from said concrete, said web having anchoring means integral therewith.

3. A channel member for the purpose described, comprising a web and two legs, one of said legs being of a height sufficient to gauge a satisfactory depth to which the said channel may be embedded in concrete, the other of said legs being sufficiently longer to permit the bolting of plates thereto, without interference either from said first mentioned leg, or from said concrete, said web having anchoring means attached thereto, said anchoring means comprising lips formed by cutting said web along two sides and one end, said lips capable of being turned down substantially at right angles to said web and twisted to form anchoring means, said channel being free of inward projections.

4. A channel member for the purpose described, comprising a web and two legs, one of said legs being of a height sufficient to gauge a satisfactory depth to which the said channel may be embedded in concrete, the other of said legs being sufficiently longer to permit the bolting of plates thereto, without interference either from said first mentioned leg, or from said concrete, said web having anchoring means attached thereto, said anchoring means comprising lips formed by cutting said web along two sides and one end, said lips capable of being turned down substantially at right angles to said web and twisted to form anchoring means, said channel having a length which is the effective length of standard plates.

5. A channel member for the purpose described, comprising a web and two legs, one of said legs being of a height sufficient to gauge a satisfactory depth to which the said channel may be embedded in concrete, the other of said legs being sufficiently longer to permit the bolting of arch plates thereto, without interference either from said first mentioned leg, or from said concrete, said longer leg being perforated at intervals, said intervals being so spaced as to permit the attachment of either edge of said arch plate to said

leg, when the end of said arch plate is coterminous with the end of said channel.

6. A channel member for the purpose described, comprising a web and two legs, one of said legs being of a height sufficient to gauge a satisfactory depth to which the said channel may be embedded in concrete, the other of said legs being sufficiently longer to permit the bolting of arch plates thereto, without interference either from said first mentioned leg, or from said concrete, said longer leg being perforated at intervals, said intervals being so spaced as to permit the attachment of either edge of said arch plate to said leg, when the end of said arch plate is coterminous with the end of said channel, said anchoring means comprising lips formed by cutting said web along two sides and one end, said lips capable of being turned down substantially at right angles to said web and twisted to form anchoring means.

7. In a base channel for arch construction, a web, a shorter leg gauging the height to which said channel may be embedded in a footing, a longer leg extending sufficiently beyond the shorter leg to provide for bolting arch plates thereto, integral anchoring means attached to said web and extending therebelow, said longer leg being perforated by interspaced pairs of holes, each hole constituting a pair being spaced from the other hole of said pair by a distance of half the pitch of a corrugation and adjacent holes of adjacent pairs being interspaced by a distance which is an even multiple of the pitch of the corrugations in an arch plate.

8. In a base channel for arch construction comprising a leg to which arch plates are to be attached, said leg having perforations therein for the passage of fastening members, an inter-

spacing of said perforations as follows:—the first perforation being interspaced from the end of said channel the distance of the pitch of a corrugation, the next perforation being interspaced from the first by half the pitch of a corrugation, the third perforation being interspaced from the second by the distance of an even multiple of the pitch of a corrugation, the fourth perforation being interspaced from the third by a distance of half the pitch of a corrugation, and so on.

9. In a base channel for arch construction comprising a leg to which arch plates are to be attached, said leg having perforations therein for the passage of fastening members, an interspacing of said perforations as follows:—the first perforation being interspaced from the end of said channel the distance of the pitch of a corrugation, the next perforation being interspaced from the first by half the pitch of a corrugation, the third perforation being interspaced from the second by the distance of an even multiple of the pitch of a corrugation, the fourth perforation being interspaced from the third by a distance of half the pitch of a corrugation and so on, whereby said leg is perforated with interspaced pairs of perforations, the distance between pairs being greater than the distance between individual perforations in the pair, and said pairs of perforations being so interspaced that the quarter, half and three-quarter points of said channel are left free of perforations, so that said channel may be cut to provide quarter, half or three-quarter portions, each end of any such portion being symmetrical, and such portions being interchangeable.

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